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8138-03
July 5, 2013

Stanford S. Carr, President
Stanford Carr Development, LLC
Alakea Corporate Tower
1100 Alakea Street, 27th Floor
Honolulu, HI 96813

Subject: Kunia Road 3rd Northbound Lane,
Royal Kunia Phase II

Dear Mr. Carr:

As requested, we evaluated the regional roadway needs based on a report titled *Traffic Impact Study for Royal Kunia Phase II*, dated April 15, 2013, prepared by KOA Corporation, herein referred to as the traffic study. Specifically, we evaluated the roadway infrastructure needs relative to a 3rd northbound lane along Kunia Road between the Kunia Interchange and Anonui Street as identified in the traffic study. Currently, Kunia Road generally has two northbound lanes.

Background

The traffic study assessed the Royal Kunia Phase II traffic impacts on Kunia Road as well as future traffic operations and associated roadway deficiencies without the development of the Royal Kunia Phase II project. The traffic study is based on the following development absorption schedule for the project:

Phase 1A – 417 residential dwelling units with completion in Year 2018.
Phase 1B – 537 residential dwelling units, an elementary school with an enrollment of 500 students. Completion in Year 2020.
Phase 2A – 561 residential units with completion in Year 2023.
Phase 2B – 492 residential units, 261,360 SF commercial use, and 682,150 SF light industrial use. Completion in Year 2025.

In coordination with the Department of Transportation, ambient traffic growth projections in the vicinity of Kunia Road were incorporated in the traffic study as a result of other proposed developments in the region. These proposed developments are listed in Table 1. To identify the traffic impacts associated with the proposed Royal Kunia Phase II project, the traffic study evaluated each development phase as noted above under conditions *with* and *without* the project's anticipated traffic generation to measure the direct impacts of the Royal Kunia Phase II project.

EXHIBIT "6"

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TABLE 1

2035 Traffic Model Growth From 2007 3/28/2013

	Project	TAZ	Population		Housing Unit		Total Employment		Public School Enrollment	
			Growth	% Growth	Growth	% Growth	Growth	% Growth	Growth	% Growth
1	DHHL	546, 599	7,233	12690%	2,500	13158%	1,346	178%	1,761	176124%
2	Gentry	554, 555, 566	2,268	29%	898	32%	1,132	97%	2,460	246000%
3	Harborside	578	784	700%	278	732%	4,286	597%	-	0%
4	Ho'opili	547, 549, 600, 764	33,942	4747%	11,750	6057%	10,397	1309%	2,710	271038%
5	Kalaeloa Development	571, 572, 573, 574	18,243	1424%	6,500	1009%	8,398	1637%	4,282	428189%
6	Kapolei West	581, 584, 585	6,239	758%	2,400	599%	445	190%	-	0%
7	Makaiwa Hills	611, 612, 613, 615, 616	12,861	14133%	4,280	14759%	2,481	1216%	1,830	183013%
8	Monsanto	539, 618	-39	-6%	-	0%	304	28%	-	0%
9	Ocean Point	564, 565	14,522	291%	5,591	307%	2,059	5	4,845	484535%
10	Regional [1] Comm Center	598	113	11300%	39	3900%	1,711	171100%	-	0%
11	Robinson	540	-	0%	-	-	47	36%	-	-
12	UHWO [2]	604, 763	11,691	69%	4,041	19243%	3,887	210%	2,987	298739%
13	Kapolei Business Park	580	184	184%	66	194%	683	74%	-	-
14	Makakilo D2	609	531	15%	256	20%	138	39%	210	31%
	2035 Total Growth		108,573	528%	38,599	515%	37,314	386%	21,086	1726%
	2007 Grand Total		*20,556*		*7,489*		*9,666*		*1,222*	

NOTE: [1] Incorporates 1.5M SF GLA Commercial Use
[2] Incorporates 7,600 FTE College Students

Findings

The traffic study for the Royal Kunia Phase II project prepared by KOA Corporation identifies poor traffic operating conditions on Kunia Road at the Kunia Interchange during both the AM and PM peak hours of traffic under Year 2025 conditions *without* the Royal Kunia Phase II project. Specifically, the northbound approach of Kunia Road at the Kunia Interchange is expected to operate at Levels of Service "F" during both the AM and PM peak hours of traffic *without* the project as a result of projected ambient traffic growth in the region. Such a condition represents over-capacity roadway conditions and would require additional roadway capacity or laneage to carry and service the anticipated increase in traffic demands. Therefore, an additional 3rd northbound lane on Kunia Road would be needed to support the increase regional traffic demands in Year 2025 even without the development of the Royal Kunia Phase II project.

Should you have any questions or require additional information, please do not hesitate to contact me at 946-2277.

Sincerely:

Pete G. Pascua, P.E., VP
Director of Traffic Engineering

PP/jm

Traffic Impact Study for Royal Kunia Phase II Project in Honolulu, Hawaii

Prepared For:

Wilson Okamoto Corporation
1907 South Beretania Street, Suite 400
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Prepared by:

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April 15, 2013

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1. Introduction

The purpose of this report is to assess the traffic impact of the proposed Royal Kunia Phase II project on the existing and future roadway network in vicinity of the project site. This report documents the existing (2013) and future years (2018, 2020, 2023 and 2025) roadway conditions and operation performance, forecast traffic volumes, methodologies used in roadway segment and intersection Level of Service (LOS) analysis, and recommendations for roadway improvement.

1.1 Project Description

The project site is located east of Kunia Road and north of Anonui Street in Honolulu, Hawaii. The project vicinity map is shown in Figure 1.

The proposed Royal Kunia Phase II project is a mixed-use development consists of different types of land uses. Conceptual land use plan is shown in Figure 2. The proposed mixed-use project includes the following land uses:

- Single-Family Detached Housing
- Low-Rise Condo/Townhouse
- Low-Rise Apartment
- Elementary School
- Commercial Retail
- Light industrial

1.2 Project Phasing

The project is expected to be developed in 4 phases. The study horizon years assessed for each phase are as follows:

- Phase 1A – 2018
- Phase 1B – 2020
- Phase 2A – 2023
- Phase 2B – 2025

The proposed project land use assumptions are listed below in Table 2:

Table 1 – Project Land Use Assumptions

Project Phasing	Housing Unit (DU)	School (STU)	Retail (TSF)	Light Industrial (TSF)
Phase 1A	417 DU	0	0	0
Phase 1B	537 DU	500 STU	0	0
Phase 2A	561 DU	0	0	0
Phase 2B	492 DU	0	261.36 TSF	682.15 TSF
Total	**2,007 DU**	**500 STU**	**261.36 TSF**	**682.15 TSF**

Note: DU = Dwelling Unit; STU = Students; TSF = Thousand Square Feet

LEGEND

- Project Site
- # Study Intersection (Existing)
- # Study Intersection (Future)

N

Not to Scale

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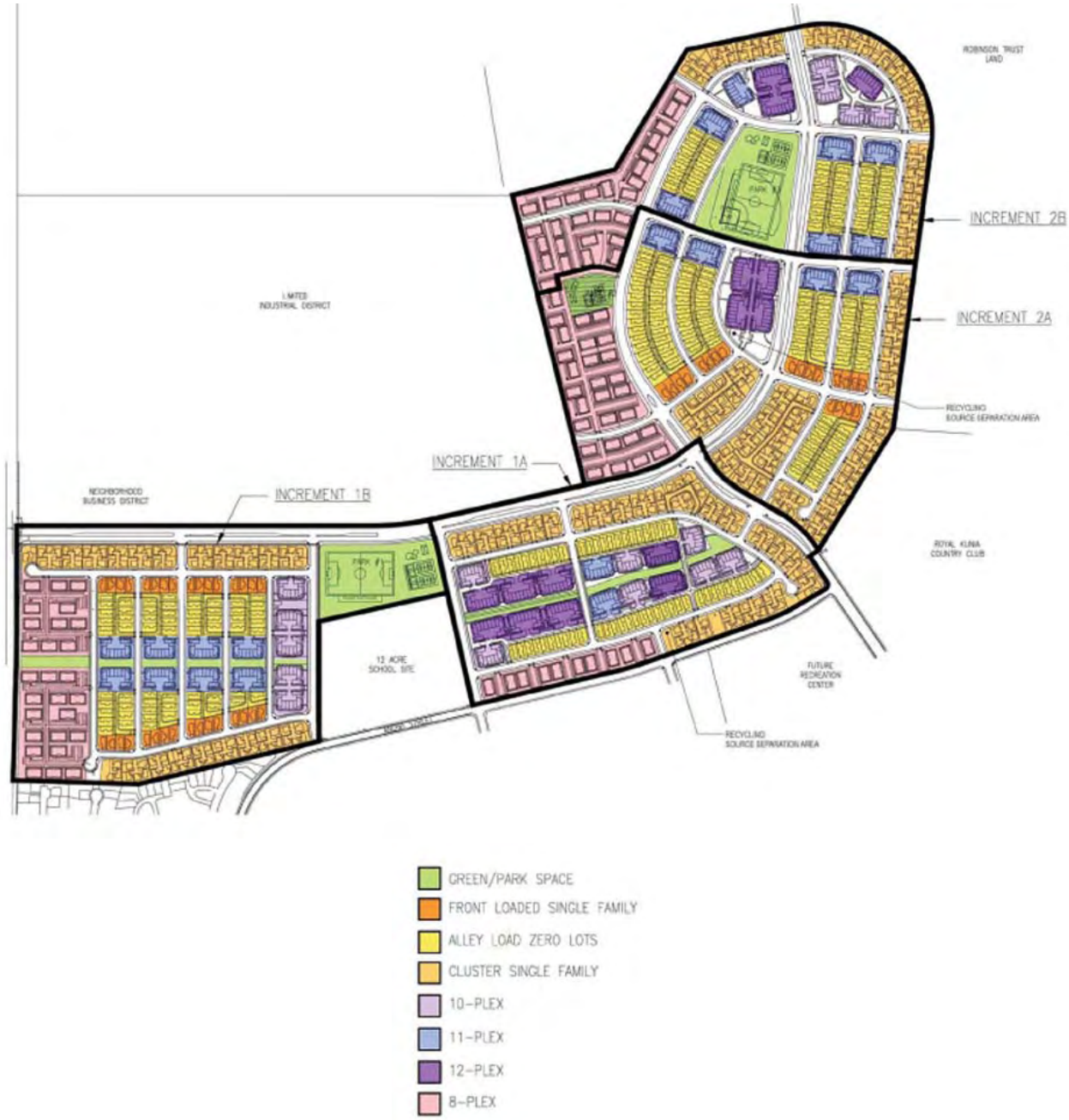
Royal Kunia Phase II Traffic Impact Study — Figure 1

Honolulu, Hawaii — Project Vicinity Map

FIGURE 2 – CONCEPTUAL LAND USE PLAN



2. Traffic Operations Analysis Methodology

This section documents the methodologies and assumptions used to conduct the traffic operations analysis for the project site. The following background information is included:

- Study scenarios
- Study area description
- Capacity analysis methodologies

2.1 Study Scenarios

This report presents an analysis of the intersection operating conditions during the AM and PM peak hours for the following anticipated timeframes:

- Existing 2013 Condition
- 2018 without Project Condition
- 2020 without Project Condition
- 2023 without Project Condition
- 2023 without Project Condition
- 2018 with Project Phase 1A Condition
- 2020 with Project Phase 2B Condition
- 2023 with Project Phase 2A Condition
- 2025 with Project Phase 2B Condition

2.2 Project Study Area

The study area consists of the following eight surface-street intersections:

- Kunia Road at the Agricultural Access – Future
- Kunia Road at the Industrial Access – Future
- Kunia Road at Royal Kunia Access – Future
- Kunia Road at Anonui Street – Existing
- Kunia Road at Upper Kupuna Loop – Existing
- Kunia Road at Lower Kupuna Loop – Existing
- Kunia Road at H-1 Westbound Ramps – Existing
- Kunia Road at H-1 Eastbound Ramps – Existing

The study area consists of the following freeway mainline segments:

- H-1 Westbound Mainline, east of the Kunia Road Westbound Slip Off-Ramp
- H-1 Westbound Mainline, between the Kunia Road Westbound Slip Off-Ramp and Westbound Loop Off-Ramp
- H-1 Westbound Mainline, between the Kunia Road Westbound Loop Off-Ramp and Westbound On-Ramp
- H-1 Westbound Mainline, west of the Kunia Road Westbound On-Ramp
- H-1 Eastbound Mainline, west of the Kunia Road Eastbound Off-Ramp
- H-1 Eastbound Mainline, between the Kunia Road Eastbound Off-Ramp and On-Ramp
- H-1 Eastbound Mainline, east of the Kunia Road Eastbound On-Ramp

The study area consists of the following freeway ramp locations:

- H-1 Westbound Slip Off-Ramp at Kunia Road (Diverge)
- H-1 Westbound Loop Off-Ramp at Kunia Road (Diverge)
- H-1 Westbound On-Ramp at Kunia Road (Merge)
- H-1 Eastbound Off-Ramp at Kunia Road (Diverge)
- H-1 Eastbound On-Ramp at Kunia Road (Merge)

2.3 Intersection Analysis Methodologies

Street system operating conditions are typically described in terms of level of service (LOS). Level of service is a report-card scale used to indicate the quality of traffic flow on roadway segments and at intersections. Levels of service range from Level A (free flow, little congestion) to Level F (forced flow, extreme congestion).

Intersection level of service analysis was conducted using Synchro software which applies the principles or the specific analysis methods contained in the *Highway Capacity Manual*, 2000 Edition (*HCM*), a publication of the Transportation Research Board, a research agency affiliated with the Federal Government. Chapter 9 of the *HCM* is devoted to analysis of signalized intersections and Chapter 10 is devoted to the analysis of unsignalized intersections. The methodology in the *HCM* for signalized intersections is based upon measurements or forecasts of control delay for traffic utilizing all approaches to the intersection. Intersection average delay and poorest movement delay are reported for all unsignalized intersections. Table 2 defines the level of service and control delay ranges for signalized and unsignalized intersections.

Table 2 – Levels of Service for Intersections

Level of Service	Signalized Intersection Control Delay (seconds/vehicle)	Unsignalized Intersection Control Delay (seconds/vehicle)
A	0 ~ 10	0 ~ 10
B	10.1 ~ 20	10 ~ 15
C	20.1 ~ 35	15 ~ 25
D	35.1 ~ 55	25 ~ 35
E	55.1 ~ 80	35 ~ 50
F	More than 80	More than 50

Source: Highway Capacity Manual, 2000.

A lane capacity of 1,900 vehicles per hour per lane and a 2 second loss time per phase were used for this study. Unsignalized intersections were analyzed using the *HCM 2000* method for unsignalized intersections.

2.4 Freeway Analysis Methodologies

The freeway analysis is conducted based upon the Highway Capacity Manual (HCM) methodology. The ramps are assessed using the HCM Merge and Diverge analysis methods. The freeway mainline segments are assessed using the HCM Basic Freeway Segment analysis method. The freeway analysis is performed using the Highway Capacity Software (HCS) computer software program. The results will be calculated based on the existing number of ramp lanes and freeway mainline travel lanes. HCM-based traffic density criteria for freeway mainline and ramp Levels of Service are presented below:

Table 3 – Levels of Service for Freeway Facilities

Level of Service	Operations Density (passenger car/mile/lane)	
	Freeway Mainline	Ramp Merge/Diverge
A	0 ~ 11	0 ~ 10
B	11 ~ 18	10 ~ 20
C	18 ~ 26	20 ~ 28
D	26 ~ 35	28 ~ 35
E	35 ~ 45	More than 35
F	More than 45	Demand Exceeds Capacity

3. Future Traffic Forecast Methodology

This section documents the methodologies and assumptions used to forecast the future traffic volumes for the project vicinity. The following background information is included:

- Existing traffic count data
- Trip generation rates
- Pass-by trip reduction
- Internal trip capture
- Transit trip discount
- Project traffic generation
- Project trip distribution patterns
- Other cumulative development traffic
- Ambient background growth

It should be noted that the overall future traffic forecast is a worst-case scenario because this analysis utilized a conservative approach in the overall traffic projection. The project trip reduction adjustments, such as pass-by trips and transit discounts that are used in this analysis are conservatively low. In addition to accounting for cumulative development traffic in the vicinity of the project site, a conservatively-high ambient background growth factor is also used to assess other unidentified projects and general population growth traffic that may contribute to overall traffic growth.

3.1 Existing Traffic Count Data

Wilson Okamoto Corporation conducted traffic counts at existing study area intersections on Tuesday, April 20, and Thursday, August 26, 2010. The AM and PM peak hour counts were conducted from 5:00 AM to 8:00 AM and from 3:00 PM to 6:00 PM, respectively. Traffic count data sheets are included in Appendix A of this report. The 2010 counts have been adjusted to reflect 2013 conditions based on ambient growth rate. 2013 traffic volumes are summarized in Table 4.

Table 4 - Existing 2013 Conditions Peak Hour Intersection Volumes

Int.	Intersection Name	Peak Hr.	Northbound			Southbound			Eastbound			Westbound			Total
			NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	
1	Kunia Rd at Agricultural Access	AM	0	1,588	0	0	348	0	0	0	0	0	0	0	1,936
		PM	0	408	0	0	1,317	0	0	0	0	0	0	0	1,725
2	Kunia Rd at Industrial Access	AM	0	1,588	0	0	348	0	0	0	0	0	0	0	1,936
		PM	0	408	0	0	1,317	0	0	0	0	0	0	0	1,725
3	Kunia Rd at Royal Kunia Access	AM	0	1,588	0	0	348	0	0	0	0	0	0	0	1,936
		PM	0	408	0	0	1,317	0	0	0	0	0	0	0	1,725
4	Kunia Rd at Anonui St	AM	0	1,140	157	44	305	0	0	0	0	455	0	449	2,550
		PM	0	342	401	213	1,103	0	0	0	0	186	0	67	2,312
5	Kunia Rd at Upper Kupuna Loop	AM	4	1,304	238	35	710	0	0	0	0	315	2	66	2,674
		PM	0	712	542	91	1,173	0	0	0	6	508	0	40	3,072
6	Kunia Rd at Lower Kupuna Loop	AM	0	1,500	355	0	1,037	0	0	0	0	526	0	23	3,441
		PM	0	1,229	975	0	1,677	0	0	0	0	414	0	22	4,317
7	Kunia Rd at H-1 WB Ramps	AM	141	1,355	0	0	1,172	289	0	0	1,403	0	0	490	4,850
		PM	263	1,019	0	0	1,556	535	0	0	2,478	0	0	1,201	7,052
8	Kunia Rd at H-1 EB Ramps	AM	0	1,164	3,317	877	1,698	0	332	0	278	0	0	0	7,666
		PM	0	928	2,745	372	3,663	0	353	0	296	0	0	0	8,357

3.2 Trip Generation Rates

This study used the nationally recognized trip rates, published by the Institute of Transportation Engineers (ITE), 8th Edition, to determine the site-only traffic volumes generated by the proposed Royal Kunia Phase II project. Based on the proposed land use plan, the following ITE trip rates are used for the project land uses as listed in Table 5:

- Single-Family Detached Housing (ITE Code 210)
- Low-Rise Condo/Townhouse (ITE Code 231)
- Low-Rise Apartment (ITE Code 221)
- Elementary School (ITE Code 520)
- Shopping Center/Commercial Reatil (ITE Code 820)
- Light industrial (ITE Code 110)

Trip reduction adjustment has been made to the overall project traffic generation to account for pass-by trips, internal capture and transit trip discount. The reduction percentage assumption has been based on past experience for this type of development and the reference information obtained from other studies in the area.

3.3 Pass-By Trip Reduction

Pass-by trip is a portion of traffic generated by retail uses already on the road stopping at a secondary destination on its way to an ultimate destination. For instance, a driver that got off from work at an off-site location on his way home may stop by a retail center along his travel route to do some shopping, and his shopping trip is considered a pass-by trip already on the road because it is not a new trip generated by the retail center impacting the external roadway network. As recommended by ITE Trip Generation Handbook, the study assumed 30 percent of the trips to and from retail land uses are pass-by trips. Pass-by trips are trips already on the road within and to the south of the project site.

Table 5 – Trip Generation Rates

ITE Code	Project Description	Quantity	Daily	AM Peak Hour			PM Peak Hour		
				Total	In	Out	Total	In	Out
210	Single-Family Detached Housing	DU	9.57	0.75	0.19	0.56	1.01	0.64	0.37
231	Low-Rise Condo/Townhouse	DU	8.72	0.67	0.17	0.50	0.78	0.45	0.33
221	Low-Rise* Apartment	DU	6.59	0.46	0.10	0.36	0.58	0.38	0.20
520	Elementary School	STU	1.29	0.45	0.25	0.20	0.15	0.07	0.08
820	Retail	TSF	42.94	1.00	0.61	0.39	3.73	1.83	1.90
110	Light Industrial	TSF	6.97	0.92	0.81	0.11	0.97	0.12	0.85

Note: * ITE Code 231 has no daily trip rate. The daily rate is estimated based on the same PM to Daily ratio for ITE Code 230.

3.4 Internal Trip Capture

Internal capture is a portion of traffic that visits multiple uses within the project boundary on a single trip. An example may be a customer that visits a restaurant and then goes shopping afterwards at an adjacent retail store without driving out of the project boundary. His shopping trip would be considered an internal trip already accounted for by his original trip. Internal capture trip discount factors have been estimated based on the Multi-Use Development trip generation methodology stated in the ITE Trip Generation Handbook. Since Phase 2B of the project is a mixed-use development, the study has applied ITE procedure to calculate the internal trips among three types of land uses (residential, light industrial, and retail). The detailed ITE internal capture calculation worksheets are be included in Appendix B of this report.

3.5 Transit Trip Discount

Transit trip is a portion of traffic that utilizes public transportation or vanpool opportunities instead of driving alone in personal vehicles to their destinations. For instance, a driver may drive from his residence to a near-by park-and-ride facility to ride a vanpool to go to work at a further destination. Transit discount factor is assessed based on the available transit-oriented development and opportunities in the surrounding community. The existing Royal Kunia Park and Ride facility and future Hub and Spoke Transit Route will provides transit service to communities of Royal Kunia. Based on a review of the available transit opportunities for the project site, this study has included a 8% transit trip discount factor to account for traffic utilizing transit-oriented opportunities.

3.6 Project Traffic Generation

Table 6 summarizes the project traffic generation for the proposed Royal Kunia Phase II project. As shown in Table 6, the proposed project is anticipated to generate 23,916 daily trips with 2,030 AM peak hour trips and 2,457 PM peak hour trips, with pass-by, internal capture and transit trip discount adjustments.

3.7 Project Trip Distribution Patterns

Trip distribution is the process of identifying the probable destination, direction or traffic routes that will be utilized by project traffic. The potential interaction between the proposed land use and surrounding regional access routes are considered when identifying the route where the project traffic will distribute. The project's trip distribution patterns are presented in the following figures for the four major types of land uses:

- Figure 3 – Residential
- Figure 4 – Elementary School
- Figure 5 – Commercial Retail
- Figure 6 – Light Industrial

Table 6 – Project Traffic Generation Summary

Phase	ITE Code	Project Description	Quantity*	Daily	AM Peak Hour			PM Peak Hour		
					Total	In	Out	Total	In	Out
1A 2018	210	Single-Family Detached Housing	149 DU	1,426	111	28	83	150	95	55
	231	Low-Rise Condo/Townhouse	188 DU	1,639	126	32	94	147	85	62
	221	Low-Rise Apartment	80 DU	527	37	8	29	46	30	16
	TOTAL - Phase 1A		***417 DU***	***3,592***	***274***	***68***	***206***	***343***	***210***	***133***
1B 2020	210	Single-Family Detached Housing	183 DU	1,751	137	35	102	185	117	68
	231	Low-Rise Condo/Townhouse	138 DU	1,203	92	23	69	108	62	46
	221	Low-Rise Apartment	216 DU	1,423	100	22	78	125	82	43
	SUBTOTAL - Phase 1B Residential		**537 DU**	**4,377**	**329**	**80**	**249**	**418**	**261**	**157**
	520	Elementary School	500 STU	645	225	125	100	75	35	40
	TOTAL - Phases 1A~1B			***8,614***	***828***	***273***	***555***	***836***	***506***	***330***
2A 2023	210	Single-Family Detached Housing	245 DU	2,345	184	47	137	248	157	91
	231	Low-Rise Condo/Townhouse	92 DU	802	62	16	46	71	41	30
	221	Low-Rise Apartment	224 DU	1,476	103	22	81	130	85	45
	SUBTOTAL - Phase 2A Residential		**561 DU**	**4,623**	**349**	**85**	**264**	**449**	**283**	**166**
	TOTAL - Phases 1A~2A			***13,237***	***1,177***	***358***	***819***	***1,285***	***789***	***496***
2B 2025	210	Single-Family Detached Housing	123 DU	1,177	92	23	69	125	79	46
	231	Low-Rise Condo/Townhouse	153 DU	1,334	103	26	77	119	69	50
	221	Low-Rise Apartment	216 DU	1,423	100	22	78	125	82	43
	SUBTOTAL - Phase 2B Residential		**492 DU**	**3,934**	**295**	**71**	**224**	**369**	**230**	**139**
	TOTAL - Phases 1A~2B Residential		**2,007 DU**	**16,526**	**1,247**	**304**	**943**	**1,579**	**984**	**595**
	Transit Reduction[1]		8%	-1,322	-99	-24	-75	-127	-79	-48
	SUBTOTAL - Phases 1A~2B Residential			***15,204***	***1,148***	***280***	***868***	***1,452***	***905***	***547***
	820	Retail	261.36 TSF	11,223	261	159	102	975	478	497
	Internal Trip Reduction[2]		Attachment 3	-3,028	-48	-24	-24	-256	-128	-128
	Pass-By Trip Reduction[3]		30%	-3,367	-79	-48	-31	-292	-143	-149
	Transit Reduction[1]		8%	-898	-21	-13	-8	-78	-38	-40
	SUBTOTAL - Phase 2B Retail			***3,930***	***113***	***74***	***39***	***349***	***169***	***180***
	110	Light Industrial	682.15 TSF	4,755	628	553	75	662	82	580
	Internal Trip Reduction[2]		Attachment 3	-238	-34	-17	-17	-28	-14	-14
	Transit Reduction[1]		8%	-380	-50	-44	-6	-53	-7	-46
	SUBTOTAL - Phase 2B Industrial			***4,137***	***544***	***492***	***52***	***581***	***61***	***520***
	SUBTOTAL - Elementary School			***645***	***225***	***125***	***100***	***75***	***35***	***40***
	TOTAL - Phases 1A~2B			***23,916***	***2,030***	***971***	***1,059***	***2,457***	***1,170***	***1,287***

Note:

* DU = Dwelling Units; STU = Students; TSF = Thousand Square Feet

[1] 8% of Transit Reduction is assumed based upon existing and future transit routes

[2] See ITE Internal Capture calculation worksheets in Attachment 3

[3] 30% Pass-By Trip Reduction is recommended by ITE Trip Generation Handbook

LEGEND

- Project Site
- Study Intersection (Existing)
- Study Intersection (Future)
- XX% Trip Distribution Percentage

N

Not to Scale

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Royal Kunia Phase II Traffic Impact Study — Figure 3

Honolulu, Hawaii — Project Trip Distribution for Residential

LEGEND

- Project Site
- Study Intersection (Existing)
- Study Intersection (Future)
- XX% Trip Distribution Percentage

N

Not to Scale

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Royal Kunia Phase II Traffic Impact Study — Figure 4

Honolulu, Hawaii — Project Trip Distribution for Elementary School

LEGEND

- Project Site
- Study Intersection (Existing)
- Study Intersection (Future)
- XX% Trip Distribution Percentage

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Not to Scale

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Royal Kunia Phase II Traffic Impact Study — Figure 5

Honolulu, Hawaii — Project Trip Distribution for Retail

LEGEND

- Project Site
- Study Intersection (Existing)
- Study Intersection (Future)
- XX% Trip Distribution Percentage

N

Not to Scale

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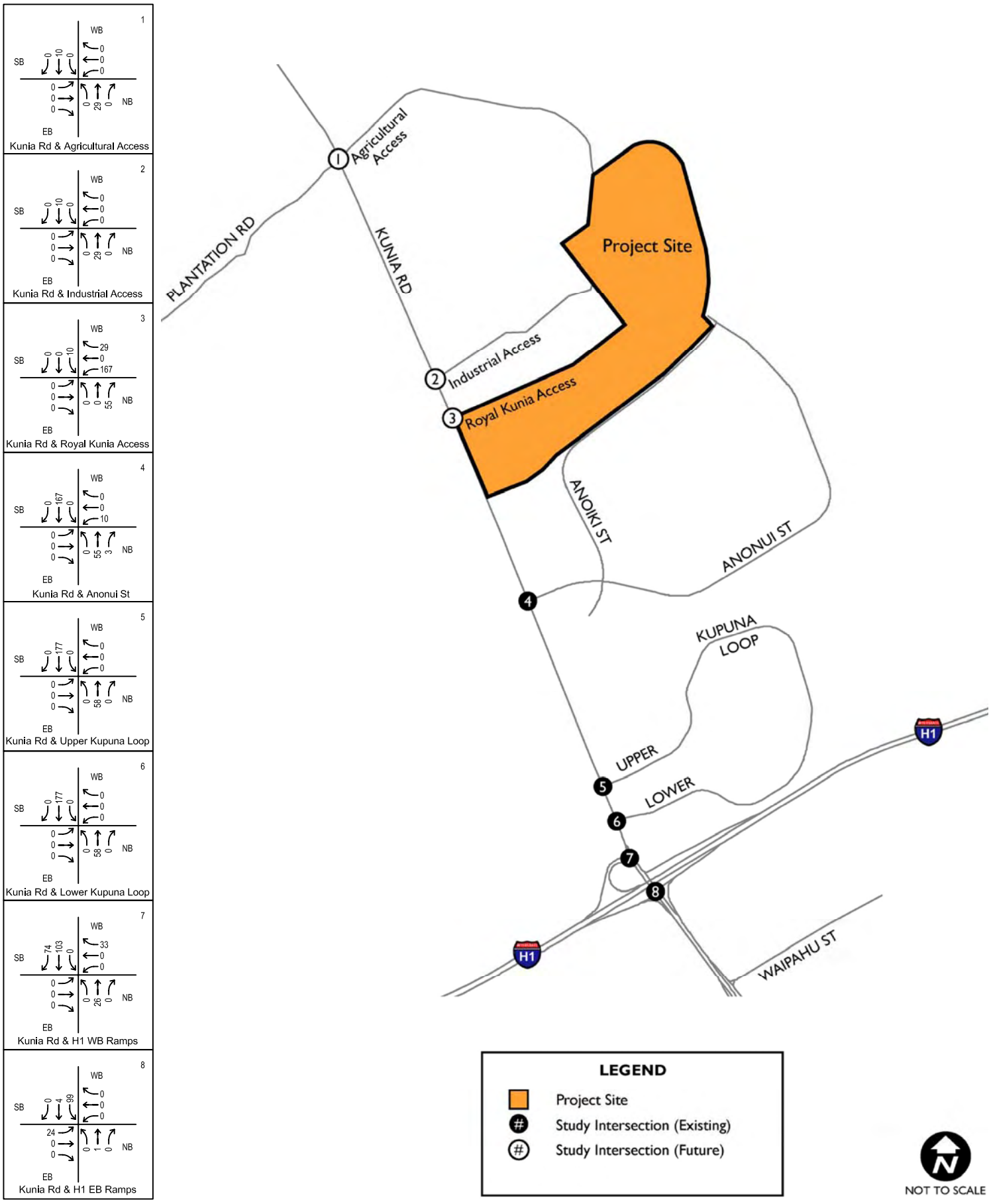
Royal Kunia Phase II Traffic Impact Study — Figure 6

Honolulu, Hawaii — Project Trip Distribution for Light Industrial

Table 7 - Phase 1A Project-Only Conditions Peak Hour Intersection Volumes

Int.	Intersection Name	Peak Hr.	Northbound			Southbound			Eastbound			Westbound			Total
			NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	
1	Kunia Rd at Agricultural Access	AM	0	29	0	0	10	0	0	0	0	0	0	0	39
		PM	0	19	0	0	29	0	0	0	0	0	0	0	48
2	Kunia Rd at Industrial Access	AM	0	29	0	0	10	0	0	0	0	0	0	0	39
		PM	0	19	0	0	29	0	0	0	0	0	0	0	48
3	Kunia Rd at Royal Kunia Access	AM	0	0	55	10	0	0	0	0	0	167	0	29	261
		PM	0	0	170	29	0	0	0	0	0	108	0	19	326
4	Kunia Rd at Anonui St	AM	0	55	3	0	167	0	0	0	0	10	0	0	235
		PM	0	170	11	0	108	0	0	0	0	7	0	0	296
5	Kunia Rd at Upper Kupuna Loop	AM	0	58	0	0	177	0	0	0	0	0	0	0	235
		PM	0	181	0	0	114	0	0	0	0	0	0	0	295
6	Kunia Rd at Lower Kupuna Loop	AM	0	58	0	0	177	0	0	0	0	0	0	0	235
		PM	0	181	0	0	114	0	0	0	0	0	0	0	295
7	Kunia Rd at H-1 WB Ramps	AM	0	26	0	0	103	74	0	0	0	0	0	33	236
		PM	0	80	0	0	67	48	0	0	0	0	0	101	296
8	Kunia Rd at H-1 EB Ramps	AM	0	1	0	99	4	0	24	0	0	0	0	0	128
		PM	0	4	0	64	3	0	76	0	0	0	0	0	147



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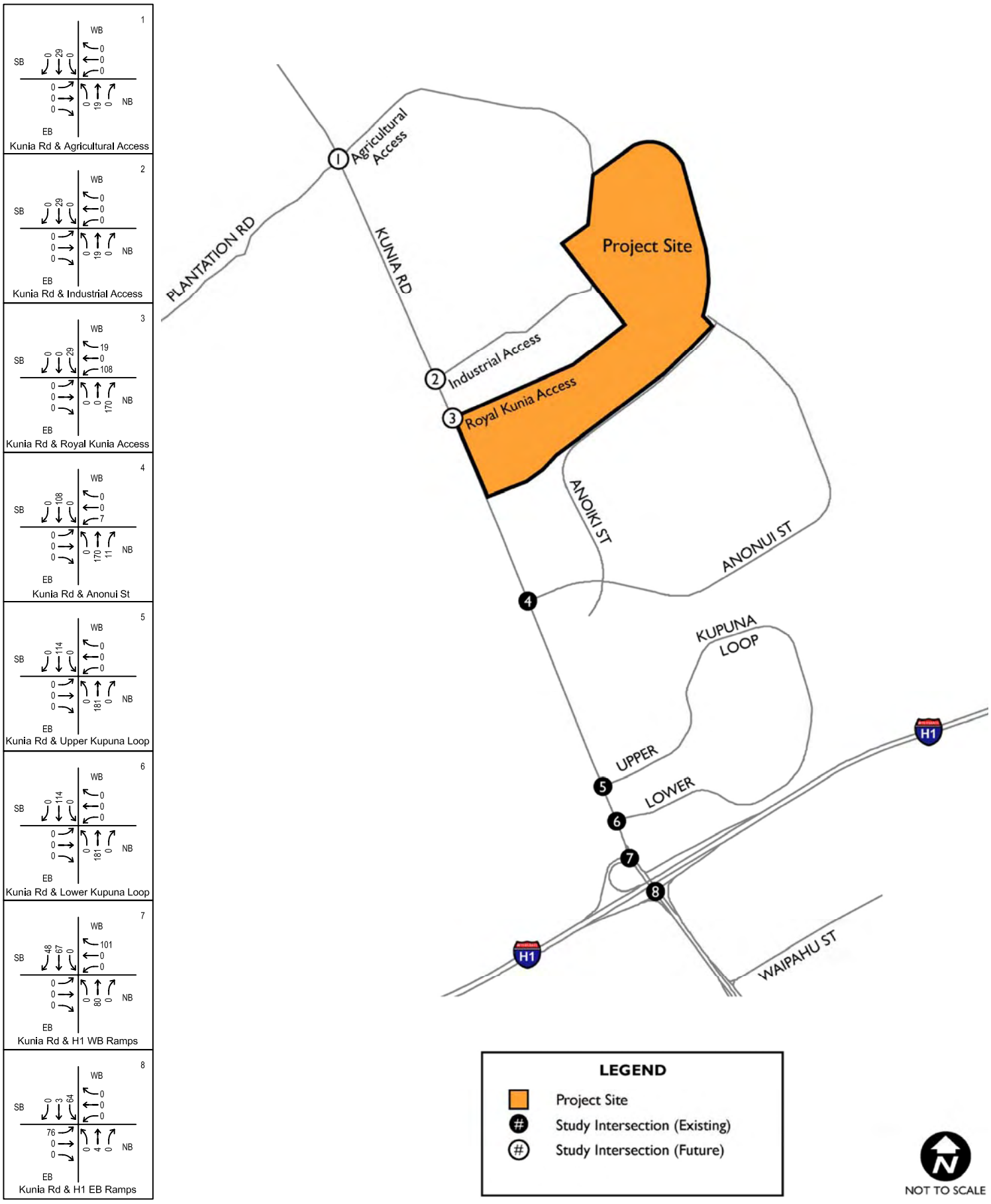
Royal Kunia Phase II Traffic Impact Study — Figure 7

Honolulu, Hawaii — Phase 1A Project-Only AM Peak Hour Intersection Movement Volumes



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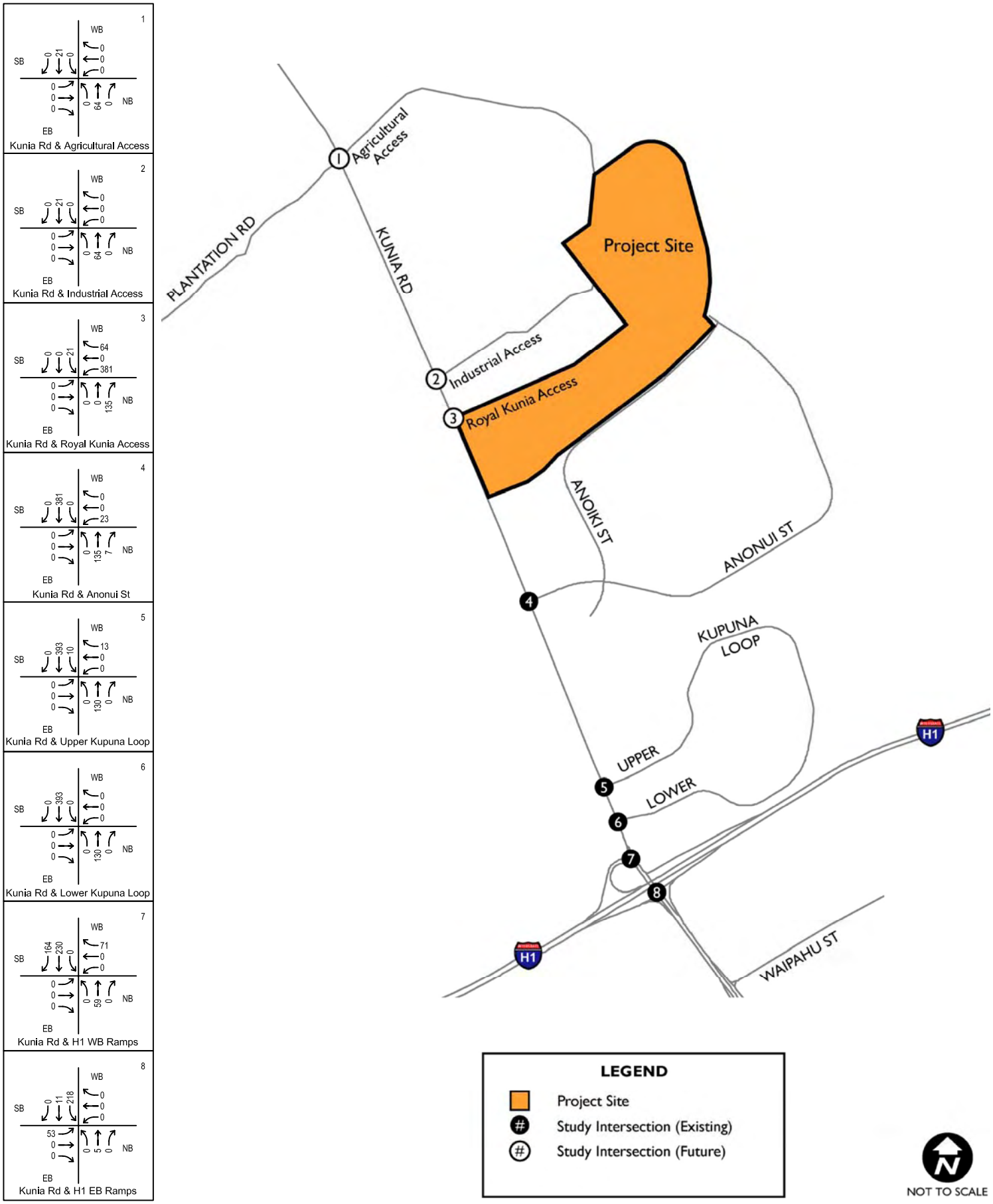
Royal Kunia Phase II Traffic Impact Study — Figure 8

Honolulu, Hawaii — Phase 1A Project-Only PM Peak Hour Intersection Movement Volumes

Table 8 - Phase 1B Project-Only Conditions Peak Hour Intersection Volumes

Int.	Intersection Name	Peak Hr.	Northbound			Southbound			Eastbound			Westbound			Total
			NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	
1	Kunia Rd at Agricultural Access	AM	0	64	0	0	21	0	0	0	0	0	0	0	85
		PM	0	41	0	0	66	0	0	0	0	0	0	0	107
2	Kunia Rd at Industrial Access	AM	0	64	0	0	21	0	0	0	0	0	0	0	85
		PM	0	41	0	0	66	0	0	0	0	0	0	0	107
3	Kunia Rd at Royal Kunia Access	AM	0	0	135	21	0	0	0	0	0	381	0	64	601
		PM	0	0	386	66	0	0	0	0	0	240	0	41	733
4	Kunia Rd at Anonui St	AM	0	135	7	0	381	0	0	0	0	23	0	0	546
		PM	0	386	24	0	240	0	0	0	0	15	0	0	665
5	Kunia Rd at Upper Kupuna Loop	AM	0	130	0	10	393	0	0	0	0	0	0	13	546
		PM	0	406	0	4	250	0	0	0	0	0	0	4	664
6	Kunia Rd at Lower Kupuna Loop	AM	0	130	0	0	393	0	0	0	0	0	0	0	523
		PM	0	406	0	0	250	0	0	0	0	0	0	0	656
7	Kunia Rd at H-1 WB Ramps	AM	0	59	0	0	230	164	0	0	0	0	0	71	524
		PM	0	180	0	0	146	104	0	0	0	0	0	226	656
8	Kunia Rd at H-1 EB Ramps	AM	0	5	0	218	11	0	53	0	0	0	0	0	287
		PM	0	10	0	139	7	0	170	0	0	0	0	0	326



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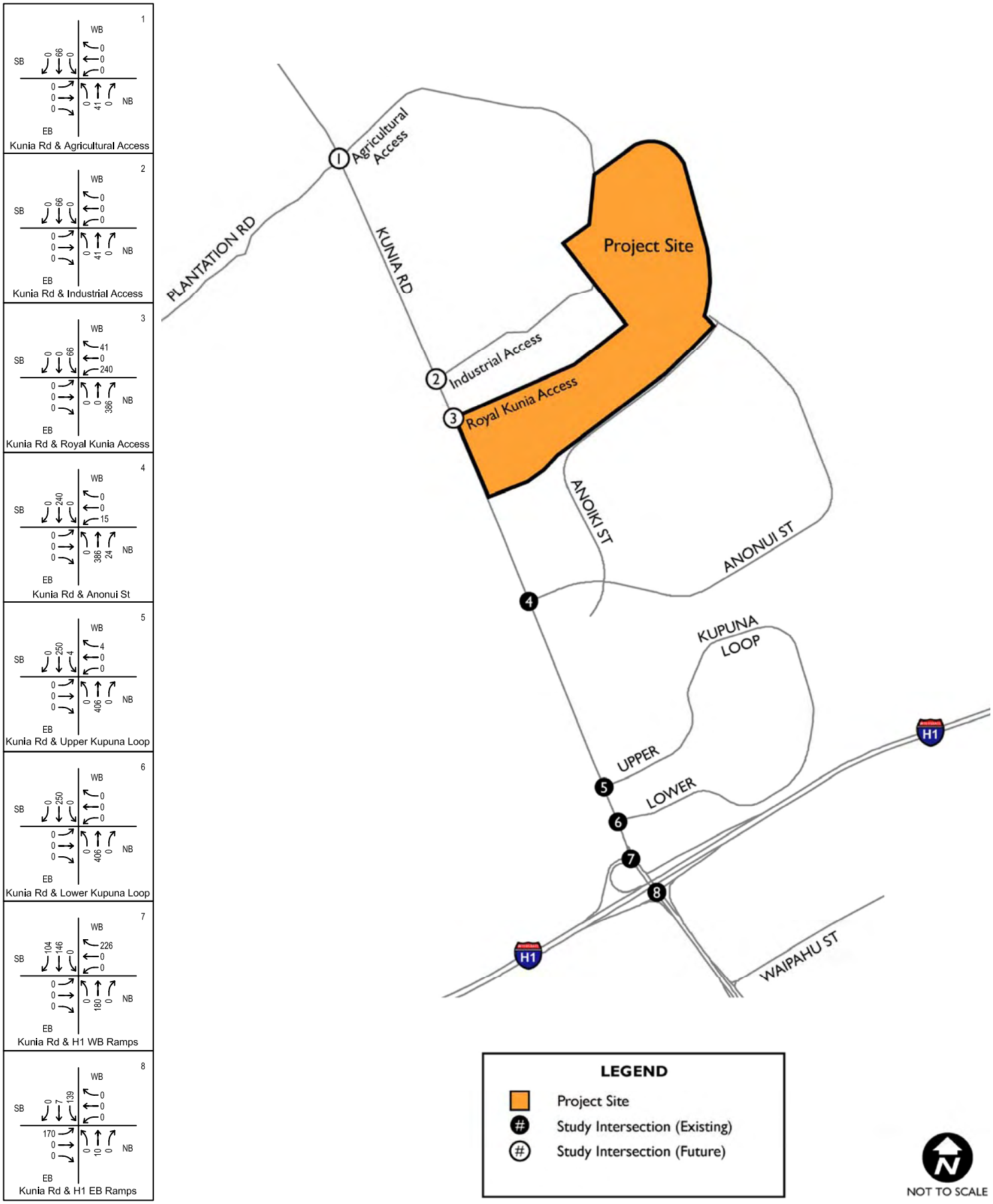
Royal Kunia Phase II Traffic Impact Study — Figure 9

Honolulu, Hawaii — Phase 1B Project-Only AM Peak Hour Intersection Movement Volumes



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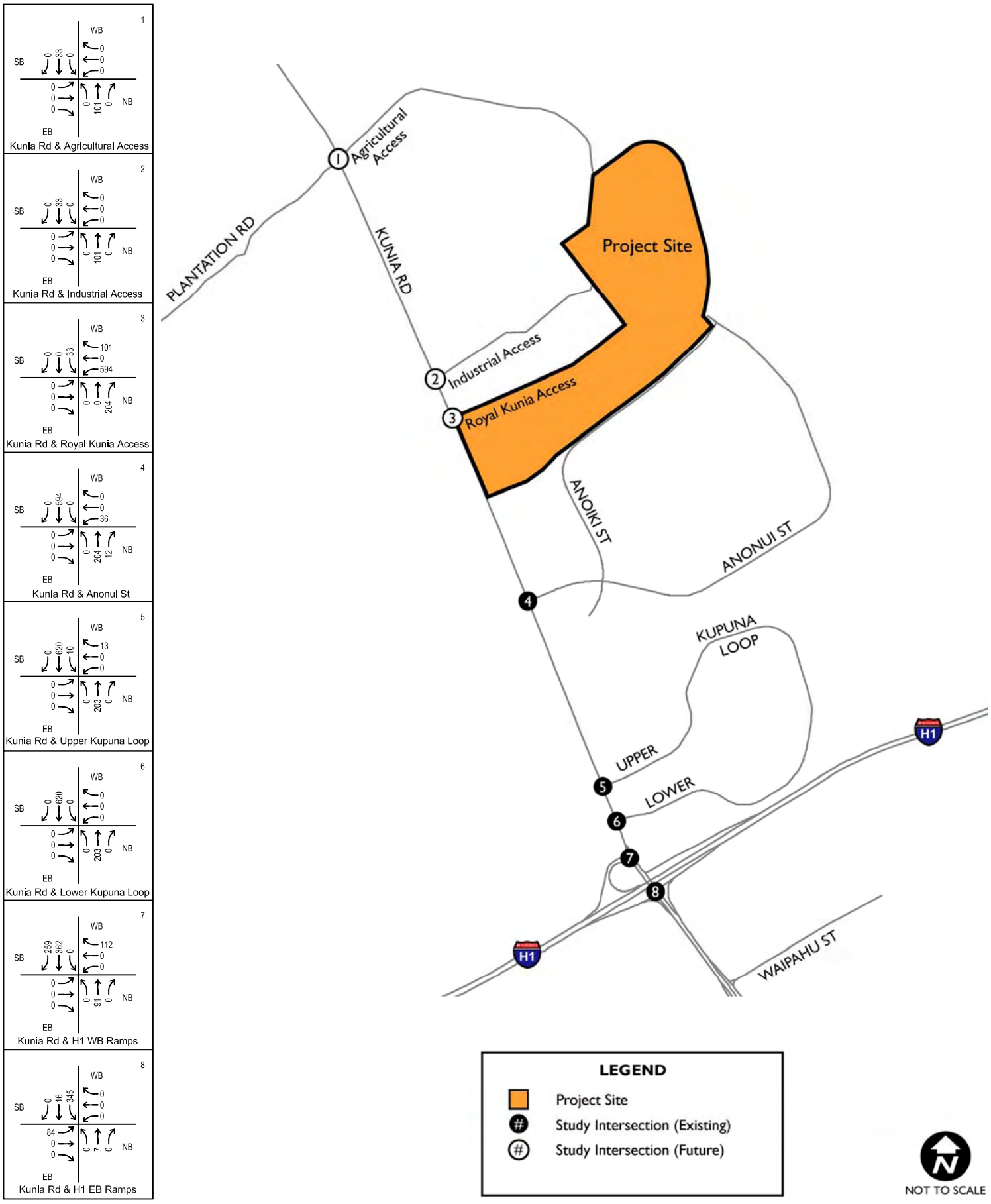
Royal Kunia Phase II Traffic Impact Study — Figure 10

Honolulu, Hawaii — Phase 1B Project-Only PM Peak Hour Intersection Movement Volumes

Table 9 - Phase 2A Project-Only Conditions Peak Hour Intersection Volumes

Int.	Intersection Name	Peak Hr.	Northbound			Southbound			Eastbound			Westbound			Total
			NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	
1	Kunia Rd at Agricultural Access	AM	0	101	0	0	33	0	0	0	0	0	0	0	134
		PM	0	64	0	0	106	0	0	0	0	0	0	0	170
2	Kunia Rd at Industrial Access	AM	0	101	0	0	33	0	0	0	0	0	0	0	134
		PM	0	64	0	0	106	0	0	0	0	0	0	0	170
3	Kunia Rd at Royal Kunia Access	AM	0	0	204	33	0	0	0	0	0	594	0	101	932
		PM	0	0	615	106	0	0	0	0	0	374	0	64	1,159
4	Kunia Rd at Anonui St	AM	0	204	12	0	594	0	0	0	0	36	0	0	846
		PM	0	615	38	0	374	0	0	0	0	23	0	0	1,050
5	Kunia Rd at Upper Kupuna Loop	AM	0	203	0	10	620	0	0	0	0	0	0	13	846
		PM	0	649	0	4	393	0	0	0	0	0	0	4	1,050
6	Kunia Rd at Lower Kupuna Loop	AM	0	203	0	0	620	0	0	0	0	0	0	0	823
		PM	0	649	0	0	393	0	0	0	0	0	0	0	1,042
7	Kunia Rd at H-1 WB Ramps	AM	0	91	0	0	362	259	0	0	0	0	0	112	824
		PM	0	287	0	0	229	164	0	0	0	0	0	362	1,042
8	Kunia Rd at H-1 EB Ramps	AM	0	7	0	345	16	0	84	0	0	0	0	0	452
		PM	0	16	0	219	10	0	271	0	0	0	0	0	516



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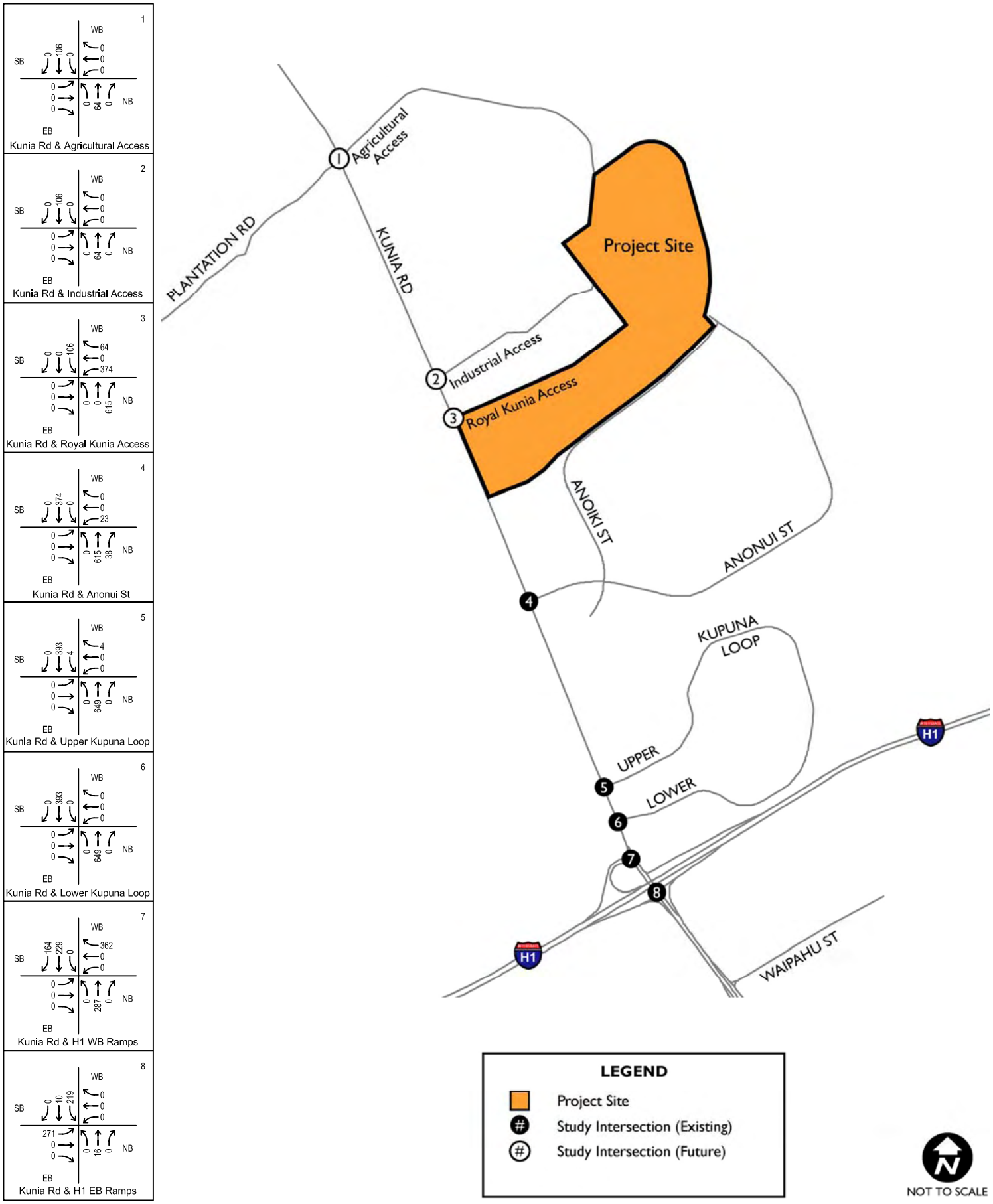
Royal Kunia Phase II Traffic Impact Study — Figure 11

Honolulu, Hawaii — Phase 2A Project-Only AM Peak Hour Intersection Movement Volumes



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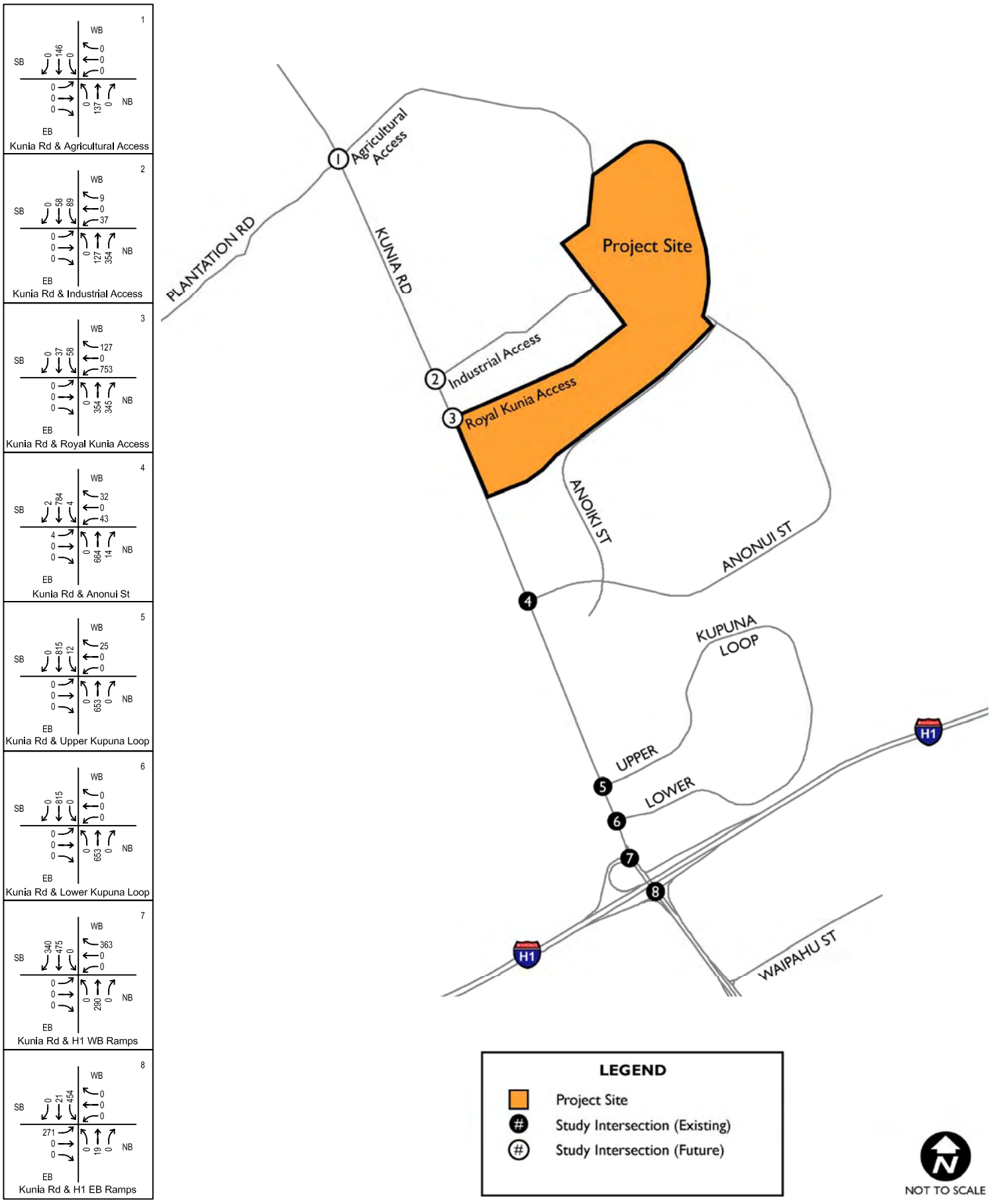
Royal Kunia Phase II Traffic Impact Study — Figure 12

Honolulu, Hawaii — Phase 2A Project-Only PM Peak Hour Intersection Movement Volumes

Table 10 - Phase 2B Project-Only Conditions Peak Hour Intersection Volumes

Int.	Intersection Name	Peak Hr.	Northbound			Southbound			Eastbound			Westbound			Total
			NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	
1	Kunia Rd at Agricultural Access	AM	0	137	0	0	146	0	0	0	0	0	0	0	283
		PM	0	202	0	0	159	0	0	0	0	0	0	0	361
2	Kunia Rd at Industrial Access	AM	0	127	354	89	58	0	0	0	0	37	0	9	674
		PM	0	109	44	11	148	0	0	0	0	374	0	94	780
3	Kunia Rd at Royal Kunia Access	AM	0	354	345	58	37	0	0	0	0	753	0	127	1,674
		PM	0	44	887	148	374	0	0	0	0	644	0	109	2,206
4	Kunia Rd at Anonui St	AM	0	664	14	4	784	2	4	0	0	43	0	32	1,547
		PM	0	914	45	37	973	9	8	0	0	27	0	9	2,022
5	Kunia Rd at Upper Kupuna Loop	AM	0	653	0	12	815	0	0	0	0	0	0	25	1,505
		PM	0	950	0	20	981	0	0	0	0	0	0	10	1,961
6	Kunia Rd at Lower Kupuna Loop	AM	0	653	0	0	815	0	0	0	0	0	0	0	1,468
		PM	0	950	0	0	981	0	0	0	0	0	0	0	1,931
7	Kunia Rd at H-1 WB Ramps	AM	0	290	0	0	475	340	0	0	0	0	0	363	1,468
		PM	0	418	0	0	574	407	0	0	0	0	0	531	1,930
8	Kunia Rd at H-1 EB Ramps	AM	0	19	0	454	21	0	271	0	0	0	0	0	765
		PM	0	23	0	548	26	0	395	0	0	0	0	0	992



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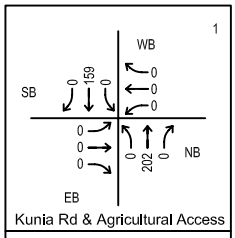
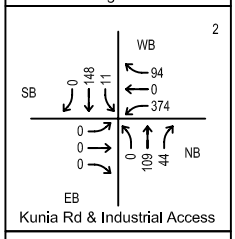
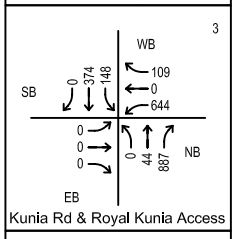
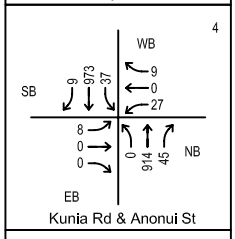
Royal Kunia Phase II Traffic Impact Study — Figure 13

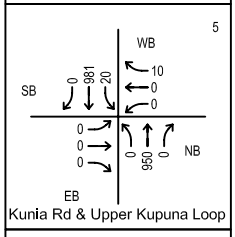
Honolulu, Hawaii — Phase 2B Project-Only AM Peak Hour Intersection Movement Volumes

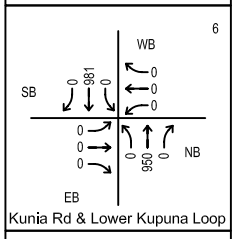


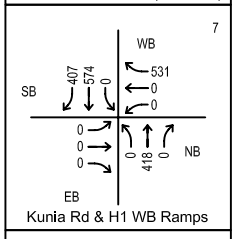


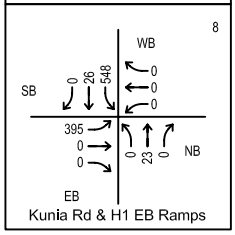












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Royal Kunia Phase II Traffic Impact Study — Figure 14

Honolulu, Hawaii — Phase 2B Project-Only PM Peak Hour Intersection Movement Volumes

3.8 Project Trip Assignment

Based on the traffic generation and trip distribution patterns presented above, project-only traffic volumes are shown in the following tables and figures for the 4 project phases:

- Table 7, and Figures 7 and 8: Total Project Phase 1A Traffic
- Table 8, and Figures 9 and 10: Total Project Phase 1B Traffic
- Table 9, and Figures 11 and 12: Total Project Phase 2A Traffic
- Table 10, and Figures 13 and 14: Total Project Phase 2B Traffic

3.9 Other Cumulative Development Traffic

Future traffic increases consider additional traffic that are generated by other cumulative developments that either are under construction, approved, planned, or proposed for development near the study area based on the available information obtained by the project team.

Thirteen (13) potential cumulative developments in the study area have been identified as shown in Appendix C of this report. The table in Appendix C summarizes the model growth for the socioeconomic data (population, housing unit, total employment and public school enrollment) within the traffic analysis zones (TAZ) of the OahuMPO model corresponding to the 13 potential cumulative developments. As shown in the table in Appendix C, most of the TAZ's have very high overall growth from 2007 to 2035 conditions, which indicates that the development potential within the TAZ's is already incorporated in the traffic model and accounted for by the ambient growth. Therefore, the ambient growth will account for the new traffic from the 13 cumulative developments except for the following two projects where the model TAZ's have nominal growth:

- Robinson development
- Monsanto Kunia Master Plan

The Robinson development includes a 150-acre farm lot and 30 homes to be developed by the Department of Agriculture which are located north of the project site. It is assumed that these nominal non-commute cumulative trips are captured in the background growth.

The trip generation for the Monsanto Kunia Master Plan is summarized below in Table 11:

Table 11 – Cumulative Development Trip Generation

Cumulative Dvelopment	AM Peak Hour			PM Peak Hour		
	Total	In	Out	Total	In	Out
Monsanto Kunia Master Plan	200	172	28	202	200	182

The trip distribution patterns for the Monsanto Kunia Master Plan are included in Appendix C of this report. The trip distribution is a 50-50 split in the northbound and southbound directions on Kunia Road, based upon information in the the Monsanto Kunia Master Plan Traffic Access Analysis Report.

3.10 Ambient Background Growth

In addition to cumulative development traffic, other unidentified projects and general population growth will contribute to ambient background traffic growth. Ambient growth is an annual growth percentage increase from existing traffic volume counts.

OahuMPO Year 2035 model was re-run with the latest land use changes as illustrated in Appendix D. A screenline analysis was then conducted to calculate the ambient growth of traffic volume between the base year (2007) and the long-range year (2035) conditions. Based on the screenline analysis, the average annual growth rate in the study area is approximately 2.0% per year. By using the traffic count data collected in 2010, the following total ambient growth factors will be applied for the study scenarios:

- Existing (Year 2013) – 6.1%
- Phase 1A (Year 2018) – 17.2%
- Phase 1B (Year 2020) – 21.9%
- Phase 2A (Year 2023) – 29.4%
- Phase 2B (Year 2025) – 34.6%

3.11 Future Traffic Volumes

Based on the traffic forecast methodologies mentioned above, the future traffic volumes for the study area intersections and analysis years assessed in this traffic study are shown in the following tables:

- Table 12 – 2018 Without Project Traffic
- Table 13 – 2018 With Project Phase 1A Traffic
- Table 14 – 2020 Without Project Traffic
- Table 15 – 2020 With Project Phase 1B Traffic
- Table 16 – 2023 Without Project Traffic
- Table 17 – 2023 With Project Phase 2A Traffic
- Table 18 – 2025 Without Project Traffic
- Table 19 – 2025 With Project Phase 2B Traffic

Table 12 - 2018 Without Project Conditions Peak Hour Intersection Volumes

Int.	Intersection Name	Peak Hr.	Northbound			Southbound			Eastbound			Westbound			Total
			NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	
1	Kunia Rd at Agricultural Access	AM	0	1,768	3	3	470	0	0	0	0	9	0	9	2,262
		PM	0	542	10	10	1,554	0	0	0	0	6	0	6	2,128
2	Kunia Rd at Industrial Access	AM	0	1,768	0	0	470	0	0	0	0	0	0	0	2,238
		PM	0	542	0	0	1,554	0	0	0	0	0	0	0	2,096
3	Kunia Rd at Royal Kunia Access	AM	0	1,768	0	0	470	0	0	0	0	0	0	0	2,238
		PM	0	542	0	0	1,554	0	0	0	0	0	0	0	2,096
4	Kunia Rd at Anonui St	AM	86	1,259	173	48	336	86	14	0	14	503	0	496	3,015
		PM	100	377	443	236	1,219	100	91	0	91	205	0	74	2,936
5	Kunia Rd at Upper Kupuna Loop	AM	5	1,526	263	39	798	0	0	0	0	348	2	73	3,054
		PM	0	886	599	101	1,387	0	0	0	7	561	0	45	3,586
6	Kunia Rd at Lower Kupuna Loop	AM	0	1,743	393	0	1,159	0	0	0	0	581	0	26	3,902
		PM	0	1,457	1,077	0	1,944	0	0	0	0	457	0	25	4,960
7	Kunia Rd at H-1 WB Ramps	AM	156	1,535	0	0	1,303	325	0	0	1,549	0	0	589	5,457
		PM	291	1,169	0	0	1,774	627	0	0	2,738	0	0	1,383	7,982
8	Kunia Rd at H-1 EB Ramps	AM	0	1,289	3,664	977	1,876	0	401	0	307	0	0	0	8,514
		PM	0	1,030	3,032	462	4,050	0	430	0	327	0	0	0	9,331

Table 13 - 2018 With Project Phase 1A Conditions Peak Hour Intersection Volumes

Int.	Intersection Name	Peak Hr.	Northbound			Southbound			Eastbound			Westbound			Total
			NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	
1	Kunia Rd at Agricultural Access	AM	0	1,797	3	3	480	0	0	0	0	9	0	9	2,301
		PM	0	561	10	10	1,583	0	0	0	0	6	0	6	2,176
2	Kunia Rd at Industrial Access	AM	0	1,797	0	0	480	0	0	0	0	0	0	0	2,277
		PM	0	561	0	0	1,583	0	0	0	0	0	0	0	2,144
3	Kunia Rd at Royal Kunia Access	AM	0	1,768	55	10	470	0	0	0	0	167	0	29	2,499
		PM	0	542	170	29	1,554	0	0	0	0	108	0	19	2,422
4	Kunia Rd at Anonui St	AM	86	1,314	176	48	503	86	14	0	14	513	0	496	3,250
		PM	100	547	454	236	1,327	100	91	0	91	212	0	74	3,232
5	Kunia Rd at Upper Kupuna Loop	AM	5	1,584	263	39	975	0	0	0	0	348	2	73	3,289
		PM	0	1,067	599	101	1,501	0	0	0	7	561	0	45	3,881
6	Kunia Rd at Lower Kupuna Loop	AM	0	1,801	393	0	1,336	0	0	0	0	581	0	26	4,137
		PM	0	1,638	1,077	0	2,058	0	0	0	0	457	0	25	5,255
7	Kunia Rd at H-1 WB Ramps	AM	156	1,561	0	0	1,406	399	0	0	1,549	0	0	622	5,693
		PM	291	1,249	0	0	1,840	675	0	0	2,738	0	0	1,484	8,277
8	Kunia Rd at H-1 EB Ramps	AM	0	1,291	3,664	1,076	1,880	0	426	0	307	0	0	0	8,644
		PM	0	1,034	3,032	526	4,052	0	506	0	327	0	0	0	9,477

Table 14 - 2020 Without Project Conditions Peak Hour Intersection Volumes

Int.	Intersection Name	Peak Hr.	Northbound			Southbound			Eastbound			Westbound			Total
			NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	
1	Kunia Rd at Agricultural Access	AM	0	1,839	3	3	486	0	0	0	0	9	0	9	2,349
		PM	0	560	10	10	1,613	0	0	0	0	6	0	6	2,205
2	Kunia Rd at Industrial Access	AM	0	1,839	0	0	486	0	0	0	0	0	0	0	2,325
		PM	0	560	0	0	1,613	0	0	0	0	0	0	0	2,173
3	Kunia Rd at Royal Kunia Access	AM	0	1,839	0	0	486	0	0	0	0	0	0	0	2,325
		PM	0	560	0	0	1,613	0	0	0	0	0	0	0	2,173
4	Kunia Rd at Anonui St	AM	86	1,309	180	50	350	86	14	0	14	523	0	516	3,128
		PM	100	393	461	245	1,268	100	91	0	91	213	0	77	3,039
5	Kunia Rd at Upper Kupuna Loop	AM	5	1,584	273	40	830	0	0	0	0	362	2	76	3,172
		PM	0	918	623	105	1,439	0	0	0	7	584	0	46	3,722
6	Kunia Rd at Lower Kupuna Loop	AM	0	1,810	408	0	1,205	0	0	0	0	605	0	27	4,055
		PM	0	1,512	1,120	0	2,018	0	0	0	0	475	0	26	5,151
7	Kunia Rd at H-1 WB Ramps	AM	162	1,595	0	0	1,355	338	0	0	1,612	0	0	611	5,673
		PM	302	1,214	0	0	1,843	650	0	0	2,848	0	0	1,436	8,293
8	Kunia Rd at H-1 EB Ramps	AM	0	1,340	3,811	1,016	1,951	0	416	0	319	0	0	0	8,853
		PM	0	1,071	3,154	479	4,212	0	446	0	340	0	0	0	9,702

Table 15 - 2020 With Project Phase 1B Conditions Peak Hour Intersection Volumes

Int.	Intersection Name	Peak Hr.	Northbound			Southbound			Eastbound			Westbound			Total
			NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	
1	Kunia Rd at Agricultural Access	AM	0	1,903	3	3	507	0	0	0	0	9	0	9	2,434
		PM	0	601	10	10	1,679	0	0	0	0	6	0	6	2,312
2	Kunia Rd at Industrial Access	AM	0	1,903	0	0	507	0	0	0	0	0	0	0	2,410
		PM	0	601	0	0	1,679	0	0	0	0	0	0	0	2,280
3	Kunia Rd at Royal Kunia Access	AM	0	1,839	135	21	486	0	0	0	0	381	0	64	2,926
		PM	0	560	386	66	1,613	0	0	0	0	240	0	41	2,906
4	Kunia Rd at Anonui St	AM	86	1,444	187	50	731	86	14	0	14	546	0	516	3,674
		PM	100	779	485	245	1,508	100	91	0	91	228	0	77	3,704
5	Kunia Rd at Upper Kupuna Loop	AM	5	1,714	273	50	1,223	0	0	0	0	362	2	89	3,718
		PM	0	1,324	623	109	1,689	0	0	0	7	584	0	50	4,386
6	Kunia Rd at Lower Kupuna Loop	AM	0	1,940	408	0	1,598	0	0	0	0	605	0	27	4,578
		PM	0	1,918	1,120	0	2,268	0	0	0	0	475	0	26	5,807
7	Kunia Rd at H-1 WB Ramps	AM	162	1,654	0	0	1,585	501	0	0	1,612	0	0	682	6,196
		PM	302	1,394	0	0	1,988	755	0	0	2,848	0	0	1,662	8,949
8	Kunia Rd at H-1 EB Ramps	AM	0	1,346	3,811	1,234	1,962	0	470	0	319	0	0	0	9,142
		PM	0	1,081	3,154	618	4,218	0	616	0	340	0	0	0	10,027

Table 16 - 2023 Without Project Conditions Peak Hour Intersection Volumes

Int.	Intersection Name	Peak Hr.	Northbound			Southbound			Eastbound			Westbound			Total
			NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	
1	Kunia Rd at Agricultural Access	AM	0	1,951	3	3	510	0	0	0	0	9	0	9	2,485
		PM	0	589	10	10	1,706	0	0	0	0	6	0	6	2,327
2	Kunia Rd at Industrial Access	AM	0	1,951	0	0	510	0	0	0	0	0	0	0	2,461
		PM	0	589	0	0	1,706	0	0	0	0	0	0	0	2,295
3	Kunia Rd at Royal Kunia Access	AM	0	1,951	0	0	510	0	0	0	0	0	0	0	2,461
		PM	0	589	0	0	1,706	0	0	0	0	0	0	0	2,295
4	Kunia Rd at Anonui St	AM	86	1,390	192	53	371	86	14	0	14	555	0	547	3,308
		PM	100	417	489	260	1,346	100	91	0	91	226	0	82	3,202
5	Kunia Rd at Upper Kupuna Loop	AM	5	1,676	290	43	880	0	0	0	0	384	3	80	3,361
		PM	0	968	661	111	1,522	0	0	0	8	620	0	49	3,939
6	Kunia Rd at Lower Kupuna Loop	AM	0	1,916	433	0	1,278	0	0	0	0	642	0	28	4,297
		PM	0	1,598	1,189	0	2,137	0	0	0	0	505	0	27	5,456
7	Kunia Rd at H-1 WB Ramps	AM	172	1,690	0	0	1,438	358	0	0	1,711	0	0	646	6,015
		PM	321	1,286	0	0	1,953	688	0	0	3,023	0	0	1,521	8,792
8	Kunia Rd at H-1 EB Ramps	AM	0	1,423	4,045	1,078	2,071	0	439	0	339	0	0	0	9,395
		PM	0	1,136	3,348	505	4,471	0	471	0	361	0	0	0	10,292

Table 17 - 2023 With Project Phase 2A Conditions Peak Hour Intersection Volumes

Int.	Intersection Name	Peak Hr.	Northbound			Southbound			Eastbound			Westbound			Total
			NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	
1	Kunia Rd at Agricultural Access	AM	0	2,052	3	3	543	0	0	0	0	9	0	9	2,619
		PM	0	653	10	10	1,812	0	0	0	0	6	0	6	2,497
2	Kunia Rd at Industrial Access	AM	0	2,052	0	0	543	0	0	0	0	0	0	0	2,595
		PM	0	653	0	0	1,812	0	0	0	0	0	0	0	2,465
3	Kunia Rd at Royal Kunia Access	AM	0	1,951	204	33	510	0	0	0	0	594	0	101	3,393
		PM	0	589	615	106	1,706	0	0	0	0	374	0	64	3,454
4	Kunia Rd at Anonui St	AM	86	1,594	204	53	965	86	14	0	14	591	0	547	4,154
		PM	100	1,032	527	260	1,720	100	91	0	91	249	0	82	4,252
5	Kunia Rd at Upper Kupuna Loop	AM	5	1,879	290	53	1,500	0	0	0	0	384	3	93	4,207
		PM	0	1,617	661	115	1,915	0	0	0	8	620	0	53	4,989
6	Kunia Rd at Lower Kupuna Loop	AM	0	2,119	433	0	1,898	0	0	0	0	642	0	28	5,120
		PM	0	2,247	1,189	0	2,530	0	0	0	0	505	0	27	6,498
7	Kunia Rd at H-1 WB Ramps	AM	172	1,781	0	0	1,800	616	0	0	1,711	0	0	758	6,838
		PM	321	1,573	0	0	2,181	853	0	0	3,023	0	0	1,883	9,834
8	Kunia Rd at H-1 EB Ramps	AM	0	1,431	4,045	1,423	2,087	0	523	0	339	0	0	0	9,848
		PM	0	1,152	3,348	724	4,481	0	742	0	361	0	0	0	10,808

Table 18 - 2025 Without Project Conditions Peak Hour Intersection Volumes

Int.	Intersection Name	Peak Hr.	Northbound			Southbound			Eastbound			Westbound			Total
			NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	
1	Kunia Rd at Agricultural Access	AM	0	2,029	3	3	527	0	0	0	0	9	0	9	2,580
		PM	0	609	10	10	1,770	0	0	0	0	6	0	6	2,411
2	Kunia Rd at Industrial Access	AM	0	2,029	0	0	527	0	0	0	0	0	0	0	2,556
		PM	0	609	0	0	1,770	0	0	0	0	0	0	0	2,379
3	Kunia Rd at Royal Kunia Access	AM	0	2,029	0	0	527	0	0	0	0	0	0	0	2,556
		PM	0	609	0	0	1,770	0	0	0	0	0	0	0	2,379
4	Kunia Rd at Anonui St	AM	86	1,446	199	55	386	86	14	0	14	577	0	569	3,432
		PM	100	433	509	271	1,400	100	91	0	91	236	0	85	3,316
5	Kunia Rd at Upper Kupuna Loop	AM	5	1,740	302	44	914	0	0	0	0	400	3	83	3,491
		PM	0	1,003	688	116	1,580	0	0	0	8	645	0	51	4,091
6	Kunia Rd at Lower Kupuna Loop	AM	0	1,989	451	0	1,329	0	0	0	0	668	0	30	4,467
		PM	0	1,659	1,237	0	2,219	0	0	0	0	525	0	28	5,668
7	Kunia Rd at H-1 WB Ramps	AM	179	1,757	0	0	1,495	372	0	0	1,779	0	0	670	6,252
		PM	334	1,336	0	0	2,030	714	0	0	3,144	0	0	1,580	9,138
8	Kunia Rd at H-1 EB Ramps	AM	0	1,480	4,208	1,121	2,155	0	455	0	353	0	0	0	9,772
		PM	0	1,182	3,482	523	4,650	0	488	0	376	0	0	0	10,701

Table 19 - 2025 With Project Phase 2B Conditions Peak Hour Intersection Volumes

Int.	Intersection Name	Peak Hr.	Northbound			Southbound			Eastbound			Westbound			Total
			NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	
1	Kunia Rd at Agricultural Access	AM	0	2,166	3	3	673	0	0	0	0	9	0	9	2,863
		PM	0	811	10	10	1,929	0	0	0	0	6	0	6	2,772
2	Kunia Rd at Industrial Access	AM	0	2,156	354	89	585	0	0	0	0	37	0	9	3,230
		PM	0	718	44	11	1,918	0	0	0	0	374	0	94	3,159
3	Kunia Rd at Royal Kunia Access	AM	0	2,341	387	64	558	0	0	0	0	757	0	154	4,261
		PM	0	527	1,013	165	2,127	0	0	0	0	662	0	240	4,734
4	Kunia Rd at Anonui St	AM	86	2,110	213	59	1,170	88	18	0	14	620	0	601	4,979
		PM	100	1,347	554	308	2,373	109	99	0	91	263	0	94	5,338
5	Kunia Rd at Upper Kupuna Loop	AM	5	2,393	302	56	1,729	0	0	0	0	400	3	108	4,996
		PM	0	1,953	688	136	2,561	0	0	0	8	645	0	61	6,052
6	Kunia Rd at Lower Kupuna Loop	AM	0	2,642	451	0	2,144	0	0	0	0	668	0	30	5,935
		PM	0	2,609	1,237	0	3,200	0	0	0	0	525	0	28	7,599
7	Kunia Rd at H-1 WB Ramps	AM	179	2,047	0	0	1,971	711	0	0	1,779	0	0	1,033	7,720
		PM	334	1,754	0	0	2,603	1,121	0	0	3,144	0	0	2,111	11,067
8	Kunia Rd at H-1 EB Ramps	AM	0	1,500	4,208	1,575	2,176	0	726	0	353	0	0	0	10,538
		PM	0	1,205	3,482	1,071	4,675	0	883	0	376	0	0	0	11,692

4. Existing 2013 Conditions

This section documents existing conditions in the study area at the time when the traffic counts were taken in 2010. The topics of discussion include local land uses, roadway characteristics, and intersection operation performance. The discussion presented here is limited to specific roadways and study area intersections in the project vicinity.

4.1 Existing Land Use

The project site is currently vacant. The surrounding area is also mostly vacant. There are residential developments south of the project site and east of Kunia Road. North of the project site is a vacant land owned by HRT Ltd., which is expected to be fully developed to a limited industrial district and a neighborhood business district. Monsanto Company proposes to construct its agricultural research facilities west of Kunia Road and north of Anonui Street, which is expected to be constructed before the Royal Kunia Phase II project.

4.2 Existing Roadway Network

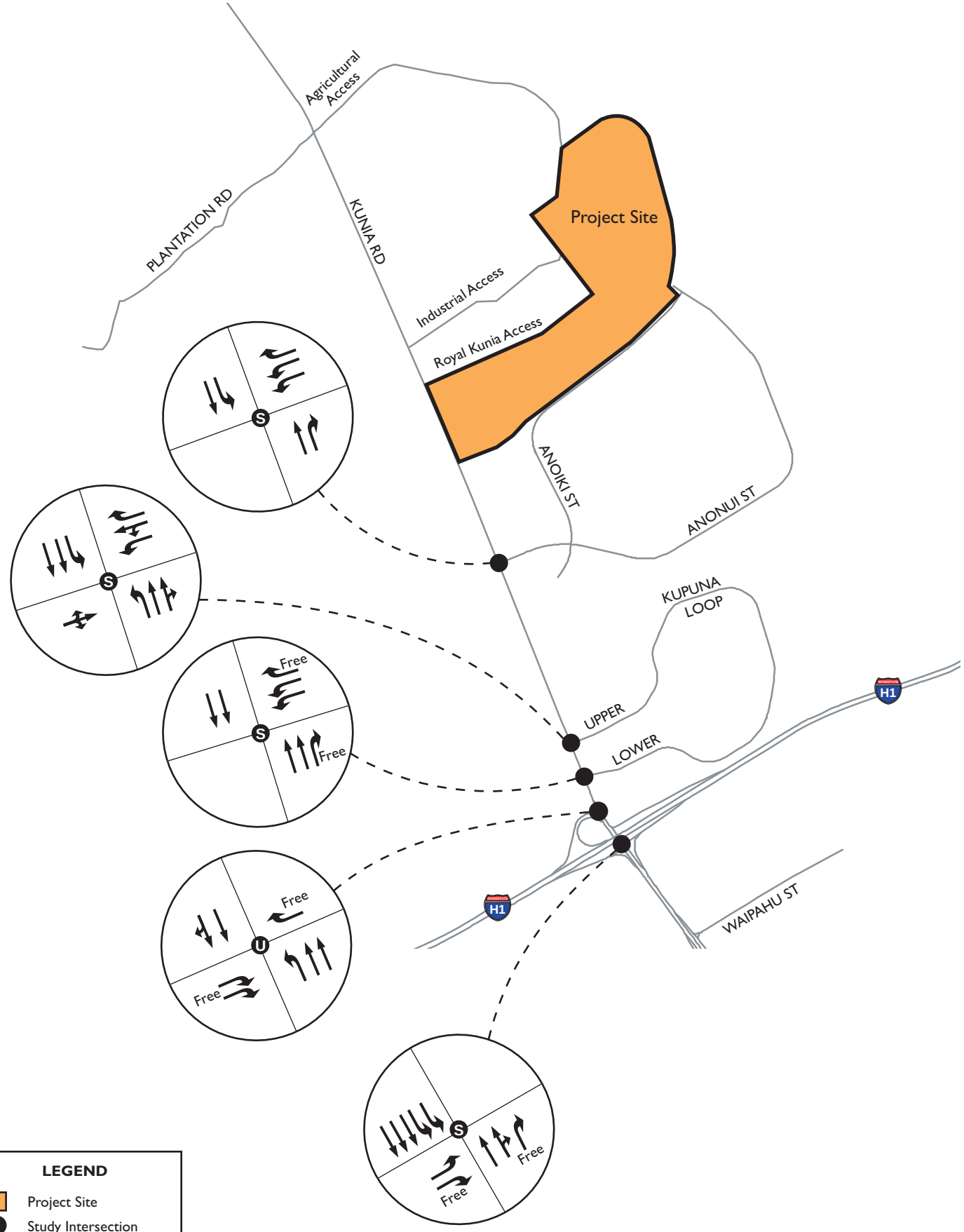
The H-1 Freeway currently provides regional access to the project site, and it runs in an east-west direction. Kunia Road is a major State Highway facility providing access for the Royal Kunia Phase II project. It extends towards Schofield Barracks and Wahiawa to the north and towards the H-1 Freeway to the south. Kunia Road is a two-lane Minor Arterial from Wilikina Drive to Anonui Street, a four-lane Principle Arterial from Anonui Street to the H-1 Freeway, and a six-lane Principle Arterial from the H-1 Freeway to Farrington Highway. Currently, heavy northbound through volumes are observed during the AM peak hour, while the PM southbound through volume almost mirrors the northbound AM traffic. The posted speed on Kunia Road is 45 miles per hour north of Anonui Street, and 35 miles per hour from Anonui Street to Farrington Highway. Figure 15 presents the existing intersection configurations in the vicinity of the study roadway network.

4.3 Traffic Count Data

Figures 16 and 17 show the 2013 AM and PM peak hour traffic volumes for the study intersections. The 2010 AM and PM peak hour counts were conducted on Tuesday, September 21, and Wednesday, September 22 in Year 2010. The 2010 counts have been adjusted to reflect 2013 conditions based on ambient growth rate. Traffic count data sheets are included in Appendix A of this report. The AM and PM peak periods for the count data are from 5:00 AM to 8:00 AM and from 3:00 PM to 6:00 PM, respectively.

4.5 Existing Transit Service

The existing Royal Kunia Park and Ride facility and future Hub and Spoke Transit Route will provides transit service to communities of Royal Kunia.



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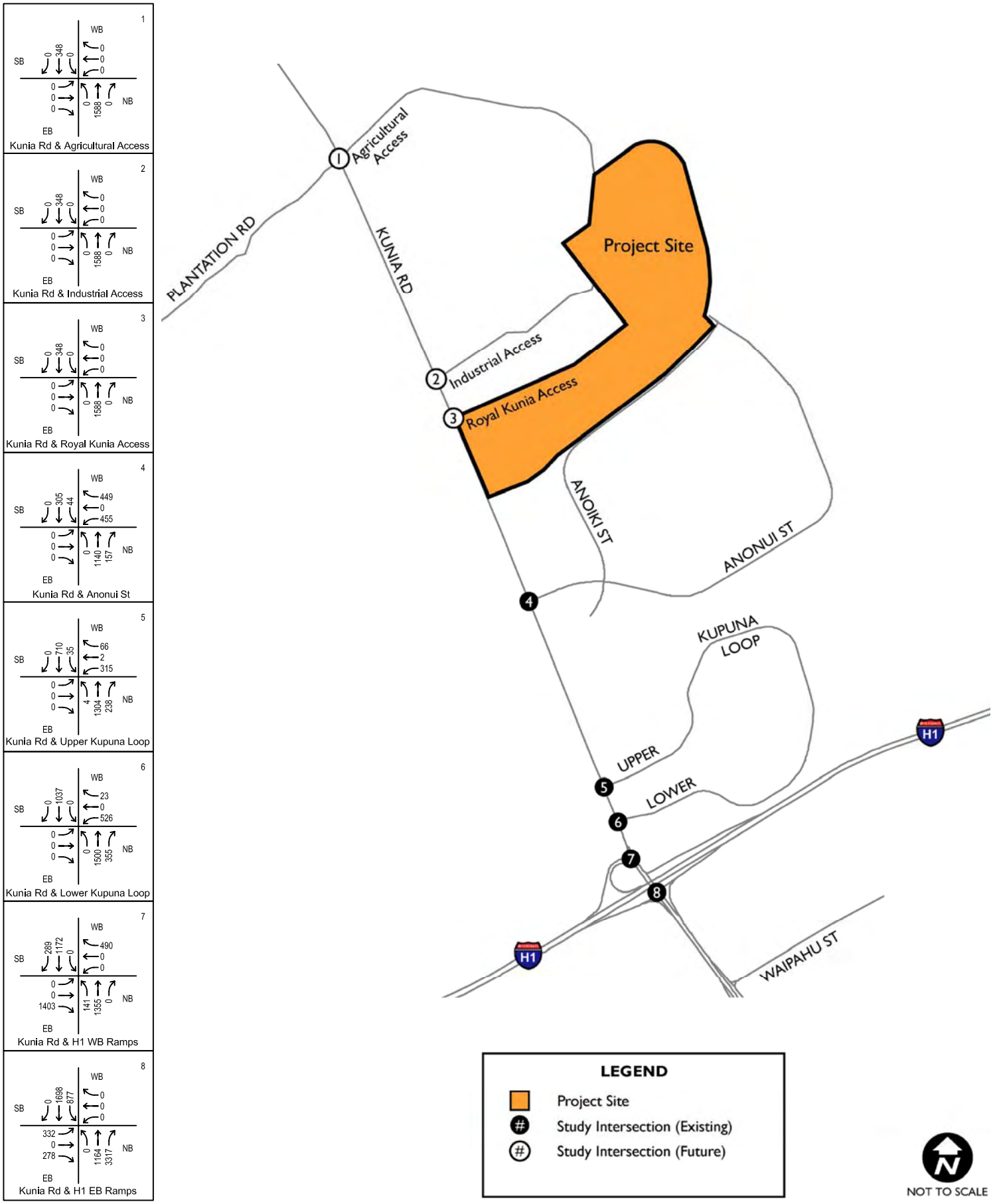
Royal Kunia Phase II Traffic Impact Study — Figure 15

Honolulu, Hawaii — Existing Intersection Lane Geometry



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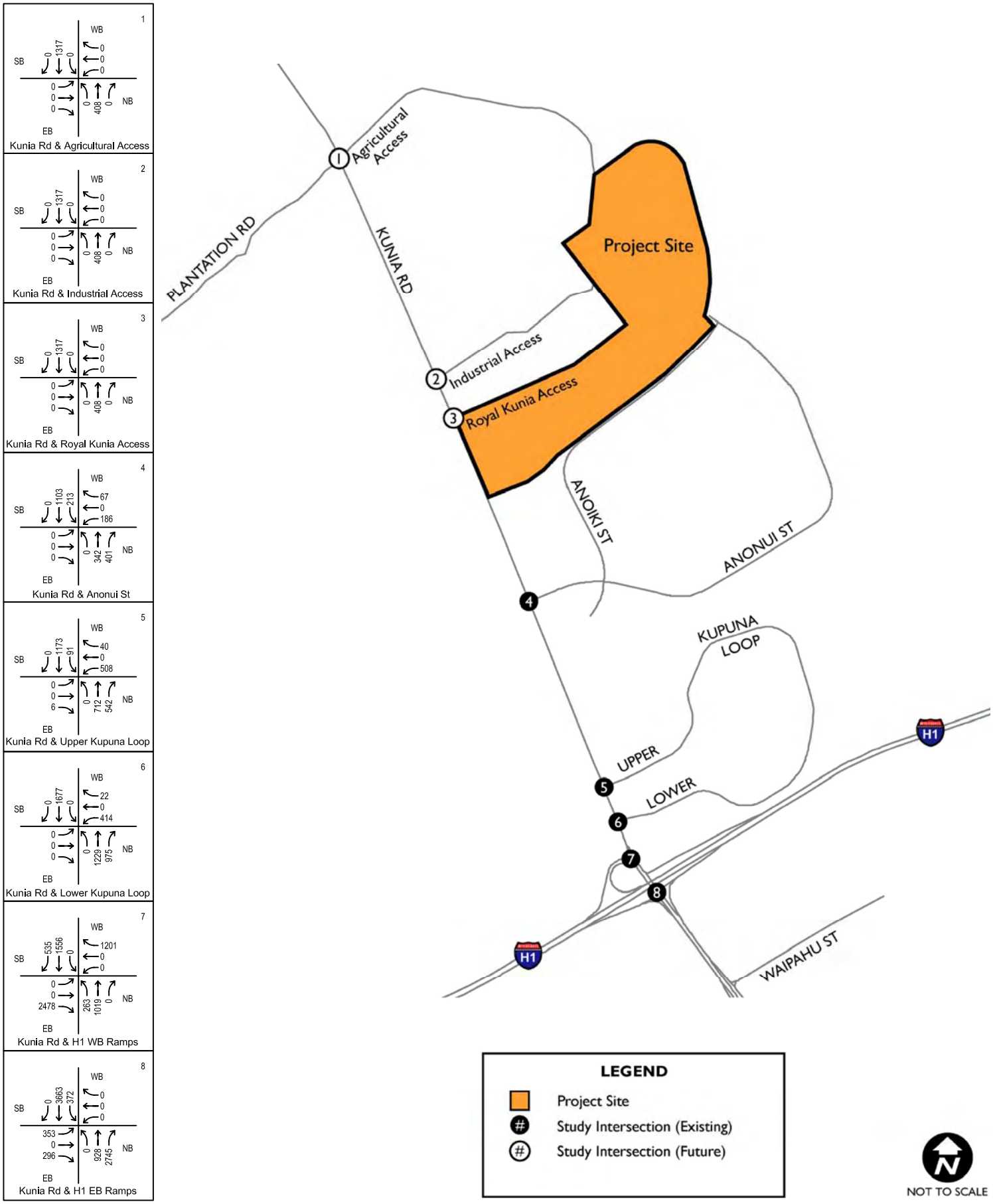
Royal Kunia Phase II Traffic Impact Study — Figure 16

Honolulu, Hawaii — Existing 2013 AM Peak Hour Intersection Movement Volumes



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Royal Kunia Phase II Traffic Impact Study — Figure 17

Honolulu, Hawaii — Existing 2013 PM Peak Hour Intersection Movement Volumes

4.6 Intersection Operations Analysis for Existing 2013 Conditions

Intersection Level of Service (LOS) analysis was conducted using Synchro software based on the analysis methodologies mentioned in Section 2 on this report. Table 20 below shows the existing 2013 intersection LOS for both AM and PM peak hours. Appendix E contains the Synchro level of service analysis worksheets for the Existing 2013 Conditions. As shown in Table 20, the following study area intersections are projected to operate at Level of Service "E" or worse for Existing 2012 Conditions during the peak hours, with existing lane geometry:

- Kunia Road at Anonui Street (#4)
- Kunia Road at H-1 Eastbound Ramps (#8)

4.7 Freeway Analysis for Existing 2013 Conditions

Freeway analysis was conducted using Highway Capacity Software (HCS) based on the analysis methodologies mentioned in Section 2 on this report. Table 21 below shows the freeway analysis results for Existing 2013 conditions. Appendix F contains the HCS freeway analysis worksheets for Existing 2013 Condition. As shown in Table 21, the eastbound direction on the H-1 Freeway is currently experiencing Level of Service E during the AM Peak hour.

Table 20 - Existing 2012 Conditions
Intersection Operations Analysis Summary

Intersection			AM Peak Hour				PM Peak Hour			
			Queue[1] (ft)		Delay[2]		Queue[1] (ft)		Delay[2]	
No.	Name	Approach	Movement	Length	(sec/veh)	LOS[3]	Movement	Length	(sec/veh)	LOS[3]
4	Kunia Rd at Anonui St	**Average**	--	--	**58.5**	**E**	--	--	**9.9**	**A**
5	Kunia Rd at Upper Kupuna Loop	**Average**	--	--	**12.2**	**B**	--	--	**14.1**	**B**
6	Kunia Rd at Lower Kupuna Loop	**Average**	--	--	**8.6**	**A**	--	--	**8.0**	**A**
7	Kunia Rd at H-1 WB Ramps	NB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		SB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		EB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		WB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Average	--	--	**n/a**	**n/a**	--	--	**n/a**	**n/a**
8	Kunia Rd at H-1 EB Ramps	NB	Thru	503	85.4	F	Thru	306	9.0	A
		SB	Left	359	18.9	B	Left	143	65.3	E
		EB	Left	267	33.6	C	Left	288	35.8	D
		WB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Average	--	--	**59.0**	**E**	--	--	**38.3**	**D**

Note:

[1] 95th percentile queue length; Highlighted values show the volume exceeds capacity and queue may be longer.

[2] HCM average control delay; Approach or intersection average delay.

[3] HCM Level of Service

Table 21 - Existing 2013 Conditions
Freeway Analysis Summary

Freeway Facility				Number of Lanes		AM Peak Hour				PM Peak Hour			
						Traffic		Density[1]		Traffic		Density[1]	
Dir.	No.	Type	Location	Mainline	Ramp	Mainline	Ramp	(pc/mi/ln)	LOS[1]	Mainline	Ramp	(pc/mi/ln)	LOS[1]
H-1 Westbound	1	Mainline	e/o Kunia Slip Off-Ramp	4	--	4,641	--	18.4	C	4,941	--	19.6	C
	2	Off-Ramp	Kunia Slip Off-Ramp	4	1	4,641	490	23.1	C	4,941	1,201	28.0	C
	3	Mainline	btw Kunia Slip Off-Ramp & Kunia Loop Off-Ramp	4	--	4,151	--	16.5	B	3,740	--	14.8	B
	4	Off-Ramp	Kunia Loop Off-Ramp	3	2	4,151	1,403	1.4	A	3,740	2,478	5.1	A
	5	Mainline	btw Kunia Loop Off-Ramp & Kunia On-Ramp	3	--	2,748	--	14.9	B	1,262	--	6.8	A
	6	On-Ramp	Kunia On-Ramp	3	1	2,748	430	15.5	B	1,262	798	10.9	B
	7	Mainline	w/o Kunia On-Ramp	3	--	3,178	--	17.2	B	2,060	--	11.2	B
H-1 Eastbound	8	Mainline	w/o Kunia Off-Ramp	3	--	6,476	--	42.2	E	4,879	--	26.7	D
	9	Off-Ramp	Kunia Off-Ramp	3	1	6,476	610	36.7	E	4,879	649	30.3	D
	10	Mainline	btw Kunia Off-Ramp & Kunia On-Ramp	3	--	5,866	--	34.5	D	4,230	--	22.9	C
	11	On-Ramp	Kunia On-Ramp	3	1[2]+2	5,866	877	37.0	F	4,230	372	24.9	C
	12	Mainline	e/o Kunia On-Ramp	4+1[3]	--	10,060	--	35.4	E	7,347	--	30.7	D

Note:

[1] Density (passenger car per mile per lane) and Level of Service based on Highway Capacity Manual (HCM) methodologies.

[2] Ramp merging traffic is the volume on the left lane of the 3-lane H-1 Eastbound On-Ramp.

[3] Shoulder lane on the right side may be utilize during congested conditions.

5. 2018 WITHOUT PROJECT TRAFFIC CONDITIONS

5.1 Future Traffic Volumes for 2018 Without Project Conditions

Future AM and PM peak hour intersection traffic volumes for 2018 Without Project Conditions are shown in Figures 18 and 19. The future traffic forecast is estimated based on the methodologies are presented in Section 3.

5.2 Future Planned Improvements

By 2018, there are planned improvements to the study area intersections that will be implemented by other surrounding developments to accommodate the overall traffic growth due to background ambient growth and new cumulative developments. The following planned intersection improvements are anticipated:

Kunia Road at Agricultural Access (#1)

- Install Westbound Stop Sign
- Add a Westbound All-Way Lane
- Add a Southbound Left-Turn Lane

Kunia Road at Anonui Street (#4)

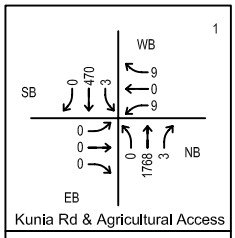
- Add a Northbound Left-Turn Lane
- Add a Eastbound Left Lane
- Add a Eastbound Through-Right Lane

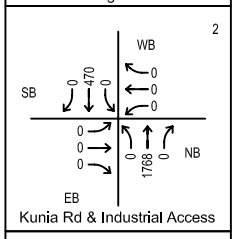
5.3 Intersection Operations Analysis for 2018 Without Project Conditions

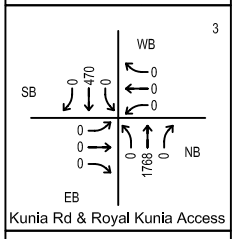
Synchro software was used to conduct intersection operations analysis. Table 22 summarizes the results for the 2018 Without Project Conditions intersection operations analysis, with existing geometry and planned improvements. As shown in Table 22, the following study area intersections are projected to operate at Level of Service "E" or worse for 2018 Without Project Conditions during the peak hours, with existing lane geometry and planned improvements:

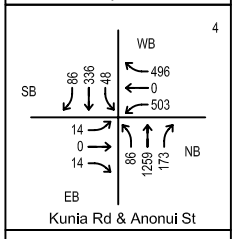
- Kunia Road at Anonui Street (#4)
- Kunia Road at H-1 Eastbound Ramps (#8)

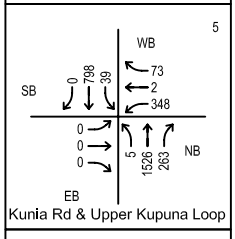
Appendix G contains the analysis worksheets for 2018 Without Project Conditions, with existing geometry and planned improvements.

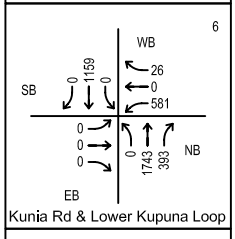


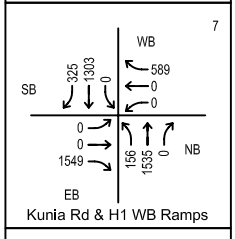


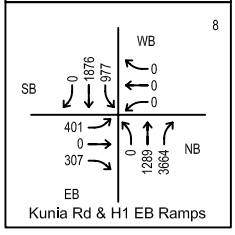












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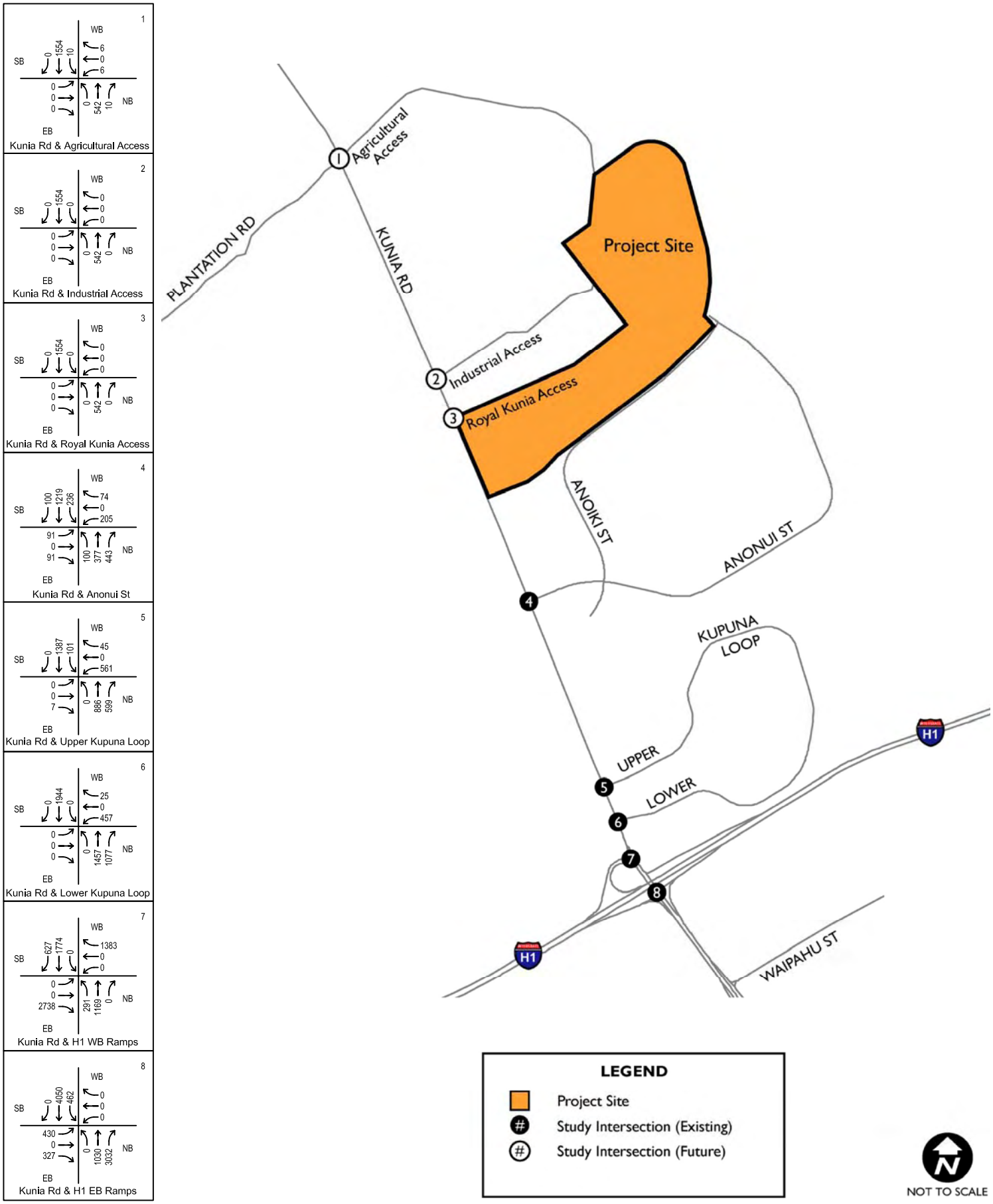
Royal Kunia Phase II Traffic Impact Study — Figure 18

Honolulu, Hawaii — 2018 Without Project AM Peak Hour Intersection Movement Volumes



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Royal Kunia Phase II Traffic Impact Study — Figure 19

Honolulu, Hawaii — 2018 Without Project PM Peak Hour Intersection Movement Volumes

Table 22 - 2018 Without Project Conditions
Intersection Operations Analysis Summary,
With Existing Geometry

Intersection			AM Peak Hour				PM Peak Hour			
			Queue[1] (ft)		Delay[2]		Queue[1] (ft)		Delay[2]	
No.	Name	Approach	Movement	Length	(sec/veh)	LOS[3]	Movement	Length	(sec/veh)	LOS[3]
1	Kunia Rd at Agricultural Access	**Average**	--	--	**1.4**	**A**	--	--	**2.1**	**A**
4	Kunia Rd at Anonui St	**Average**	--	--	**49.6**	**D**	--	--	**67.9**	**E**
5	Kunia Rd at Upper Kupuna Loop	**Average**	--	--	**10.7**	**B**	--	--	**17.7**	**B**
6	Kunia Rd at Lower Kupuna Loop	**Average**	--	--	**9.3**	**A**	--	--	**9.4**	**A**
7	Kunia Rd at H-1 WB Ramps	NB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		SB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		EB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		WB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Average	--	--	**n/a**	**n/a**	--	--	**n/a**	**n/a**
8	Kunia Rd at H-1 EB Ramps	NB	Thru	615	132.1	F	Thru	362	68.5	E
		SB	Left	442	28.3	C	Left	250	74.8	E
		EB	Left	432	49.5	D	Left	637	116.7	F
		WB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Average	--	--	**90.5**	**F**	--	--	**75.4**	**E**

Note:

[1] 95th percentile queue length; Highlighted values show the volume exceeds capacity and queue may be longer.

[2] HCM average control delay; Approach or intersection average delay.

[3] HCM Level of Service

5.4 Recommended Improvements for 2018 Without Project Conditions

Figure 20 shows the recommended roadway network and intersection lane geometry for 2018 Without Project Conditions to mitigate the traffic impact. In addition to the planned improvements that are mentioned in Section 5.2, the following additional improvements are recommended to accommodate 2018 Without Project Conditions:

Kunia Road at Anonui Street (#4)

- Add a Second Southbound Through Lane

Kunia Road at H-1 Westbound Ramps (#7)

- Install a partial signal for the northbound Left-Turn and southbound through movements
- Add a Southbound Free-Right Turn Lane

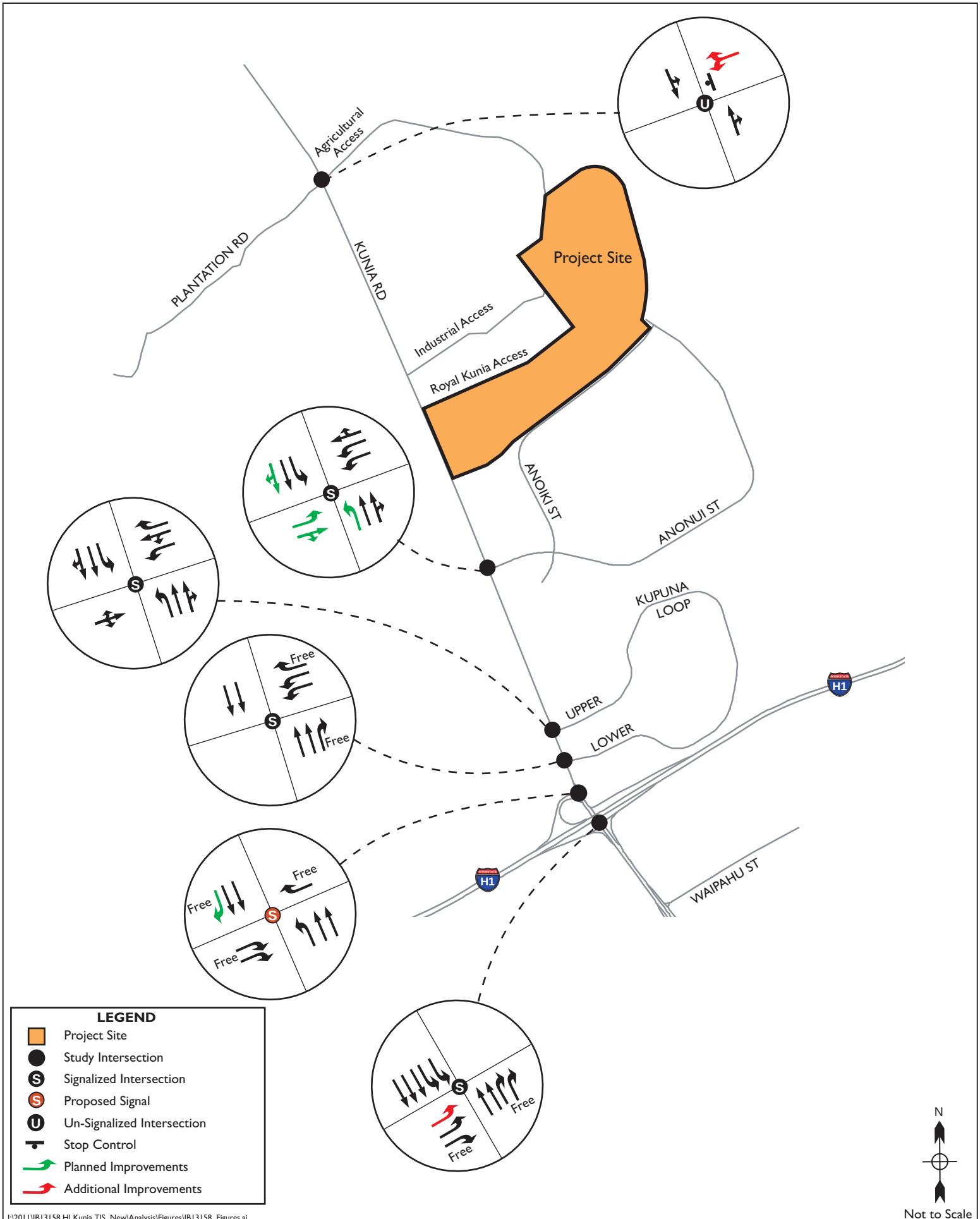
Kunia Road at H-1 Eastbound Ramps (#8)

- Add a Second Eastbound Left-Turn Lane

Table 23 shows the intersection operations analysis results for 2018 Without Project conditions, with recommended mitigations. With recommended 2018 Without Project intersection lane improvements, the study area intersections are projected to be mitigated to Level of Service "D" or better during the peak hours. The intersection operations analysis worksheets for 2018 Without Project Conditions, with recommended mitigation measures, are included in Appendix H of this report.

5.5 Freeway Analysis for 2018 Without Project Conditions

Freeway analysis was conducted using Highway Capacity Software (HCS) based on the analysis methodologies mentioned in Section 2 on this report. Table 24 below shows the freeway analysis results for 2018 Without Project conditions. Appendix I contains the HCS freeway analysis worksheets for 2018 Without Project Conditions. As shown in Table 24, the eastbound direction on the H-1 Freeway are projected to experience Level of Service F during the AM Peak hour and Los of Service E during the PM peak hour.



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Royal Kunia Phase II Traffic Impact Study — Figure 20

Honolulu, Hawaii — Recommended Improvements for 2018 Without Project Conditions

Table 23 - 2018 Without Project Conditions
Intersection Operations Analysis Summary.
With Recommended Mitigations

Intersection			AM Peak Hour				PM Peak Hour			
			Queue[1] (ft)		Delay[2]		Queue[1] (ft)		Delay[2]	
No.	Name	Approach	Movement	Length	(sec/veh)	LOS[3]	Movement	Length	(sec/veh)	LOS[3]
1	Kunia Rd at Agricultural Access	**Average**	--	--	**0.9**	A	--	--	**2.1**	A
4	Kunia Rd at Anonui St	**Average**	--	--	**25.1**	C	--	--	**22.9**	C
5	Kunia Rd at Upper Kupuna Loop	**Average**	--	--	**17.6**	B	--	--	**18.2**	B
6	Kunia Rd at Lower Kupuna Loop	**Average**	--	--	**10.5**	B	--	--	**10.4**	B
7	Kunia Rd at H-1 WB Ramps	NB	Left	70	1.3	A	Left	325	12.9	B
		SB	Thru	194	5.2	A	Thru	888	18.8	B
		EB	Right	0	0.9	A	Right	210	71.6	E
		WB	Right	0	0.7	A	Right	68	8.7	A
		Average	--	--	**2.3**	A	--	--	**34.1**	C
8	Kunia Rd at H-1 EB Ramps	NB	Thru	464	29.3	C	Thru	263	11.2	B
		SB	Left	361	13.6	B	Left	221	25.7	C
		EB	Left	165	21.2	C	Left	280	57.4	E
		WB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Average	--	--	**18.9**	B	--	--	**27.1**	C

Note:

[1] 95th percentile queue length; Highlighted values show the volume exceeds capacity and queue may be longer.

[2] HCM average control delay; Approach or intersection average delay.

[3] HCM Level of Service

Table 24 - 2018 Without Project Conditions
Freeway Analysis Summary

Freeway Facility				Number of Lanes		AM Peak Hour				PM Peak Hour			
						Traffic		Density[1]		Traffic		Density[1]	
Dir.	No.	Type	Location	Mainline	Ramp	Mainline	Ramp	(pc/mi/ln)	LOS[1]	Mainline	Ramp	(pc/mi/ln)	LOS[1]
H-1 Westbound	1	Mainline	e/o Kunia Slip Off-Ramp	4	--	5,172	--	20.5	C	5,512	--	21.9	C
	2	Off-Ramp	Kunia Slip Off-Ramp	4	1	5,172	589	25.8	C	5,512	1,383	31.2	D
	3	Mainline	btw Kunia Slip Off-Ramp & Kunia Loop Off-Ramp	4	--	4,583	--	18.2	C	4,129	--	16.4	B
	4	Off-Ramp	Kunia Loop Off-Ramp	3	2	4,583	1,549	3.9	A	4,129	2,738	8.0	A
	5	Mainline	btw Kunia Loop Off-Ramp & Kunia On-Ramp	3	--	3,034	--	16.4	B	1,391	--	7.5	A
	6	On-Ramp	Kunia On-Ramp	3	1	3,034	481	17.4	B	1,391	918	12.5	B
	7	Mainline	w/o Kunia On-Ramp	3	--	3,515	--	19.0	C	2,309	--	12.5	B
H-1 Eastbound	8	Mainline	w/o Kunia Off-Ramp	3	--	7,184	--	n/a	F	5,427	--	30.6	D
	9	Off-Ramp	Kunia Off-Ramp	3	1	7,184	708	39.3	F	5,427	757	32.8	D
	10	Mainline	btw Kunia Off-Ramp & Kunia On-Ramp	3	--	6,476	--	42.2	E	4,670	--	25.4	C
	11	On-Ramp	Kunia On-Ramp	3	1[2]+2	6,476	977	40.8	F	4,670	462	27.8	C
	12	Mainline	e/o Kunia On-Ramp	4+1[3]	--	11,117	--	44.3	E	8,164	--	36.7	E

Note:

[1] Density (passenger car per mile per lane) and Level of Service based on Highway Capacity Manual (HCM) methodologies.

[2] Ramp merging traffic is the volume on the left lane of the 3-lane H-1 Eastbound On-Ramp.

[3] Shoulder lane on the right side may be utilize during congested conditions.

6. 2020 WITHOUT PROJECT TRAFFIC CONDITIONS

6.1 Future Traffic Volumes for 2020 Without Project Conditions

Future AM and PM peak hour intersection traffic volumes for 2020 Without Project Conditions are shown in Figures 21 and 22. The future traffic forecast is estimated based on the methodologies are presented in Section 3.

6.2 Future Planned Improvements

It should be noted that the 2020 Without Project Conditions have the same planned improvements as the 2018 Without Project Conditions which were listed in previous Section 5.2 of this report.

6.3 Intersection Operations Analysis for 2020 Without Project Conditions

Table 25 summarizes the results for the 2020 Without Project Conditions intersection level of service analysis, with existing geometry and planned improvements. As shown in Table 25, the following study area intersections are projected to operate at Level of Service "E" or worse for 2020 Without Project Conditions during the peak hours, with existing lane geometry and planned improvements:

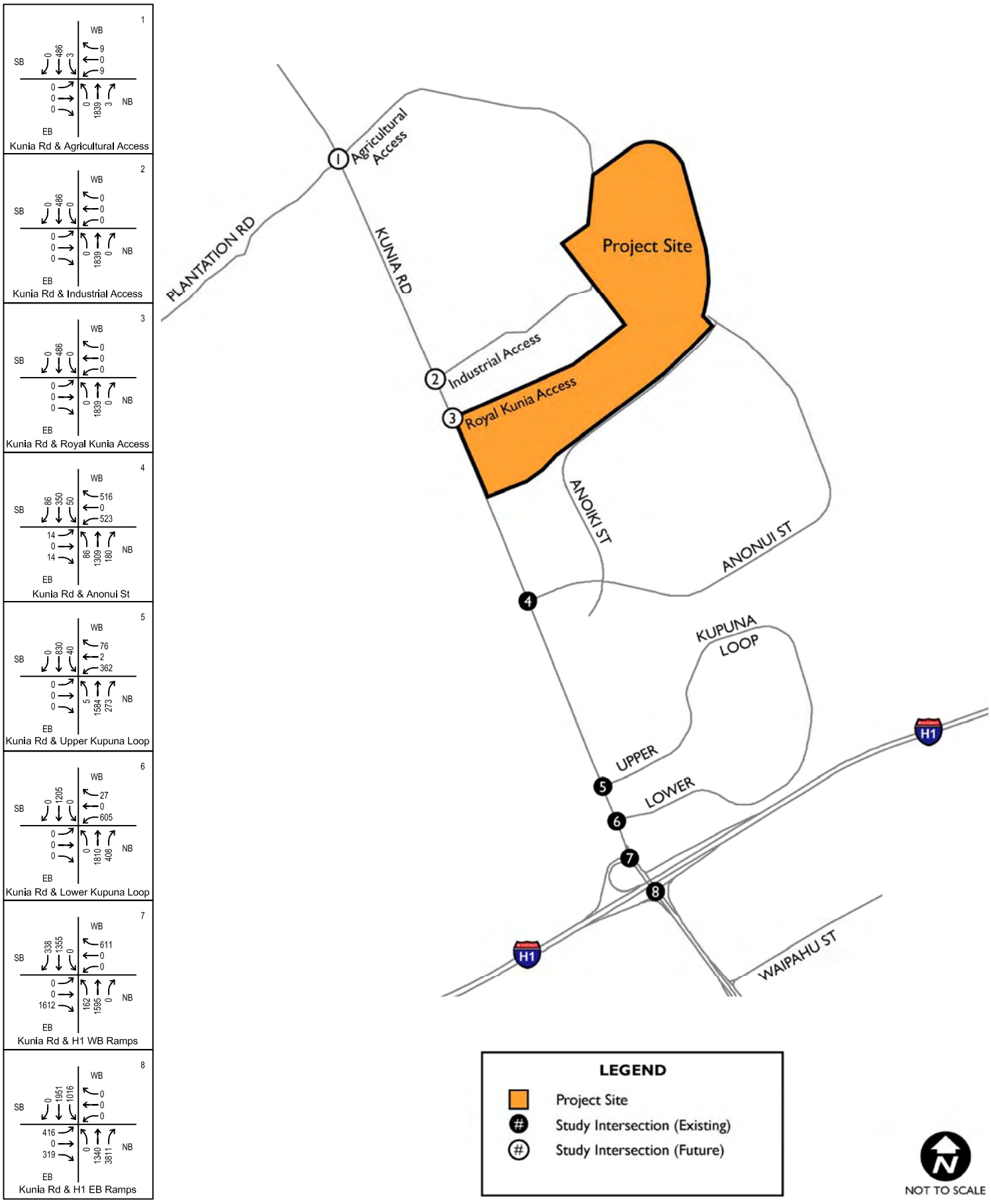
- Kunia Road at Anonui Street (#4)
- Kunia Road at H-1 Eastbound Ramps (#8)

Appendix J contains the analysis worksheets for 2020 Without Project Conditions, with existing geometry and planned improvements.

6.4 Recommended Improvements for Year 2020 Without Project Conditions

Figure 23 shows the recommended roadway network and intersection lane geometry for 2020 Without Project Conditions to mitigate the traffic impact. The recommended lane improvements for 2020 Without Project Conditions are same as the ones previously listed in Section 5.4 and shown in Figure 20 for 2018 Without Project Conditions.

Table 26 shows the intersection operations analysis results for 2020 Without Project conditions, with recommended mitigations. With recommended 2020 Without Project intersection lane improvements, the study area intersections are projected to be mitigated to Level of Service "D" or better during the peak hours. The intersection operations analysis worksheets for 2020 Without Project Conditions, with recommended mitigation measures, are included in Appendix K of this report.



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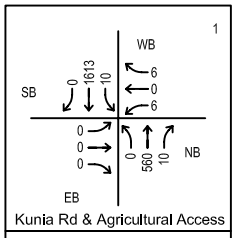
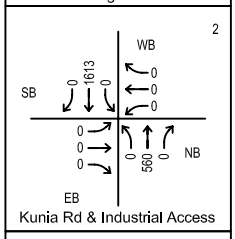
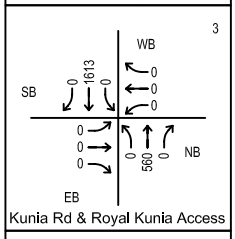
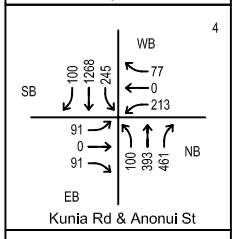
Royal Kunia Phase II Traffic Impact Study — Figure 21

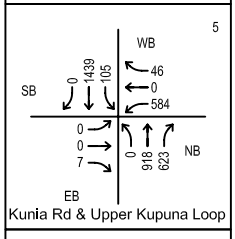
Honolulu, Hawaii — 2020 Without Project AM Peak Hour Intersection Movement Volumes

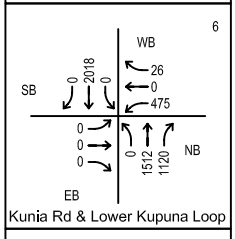


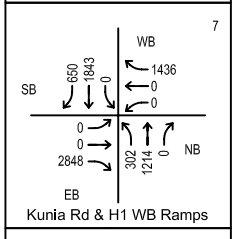


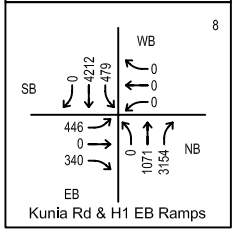












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Royal Kunia Phase II Traffic Impact Study — Figure 22

Honolulu, Hawaii — 2020 Without Project PM Peak Hour Intersection Movement Volumes

Table 25 - 2020 Without Project Conditions
Intersection Operations Analysis Summary,
With Existing Geometry

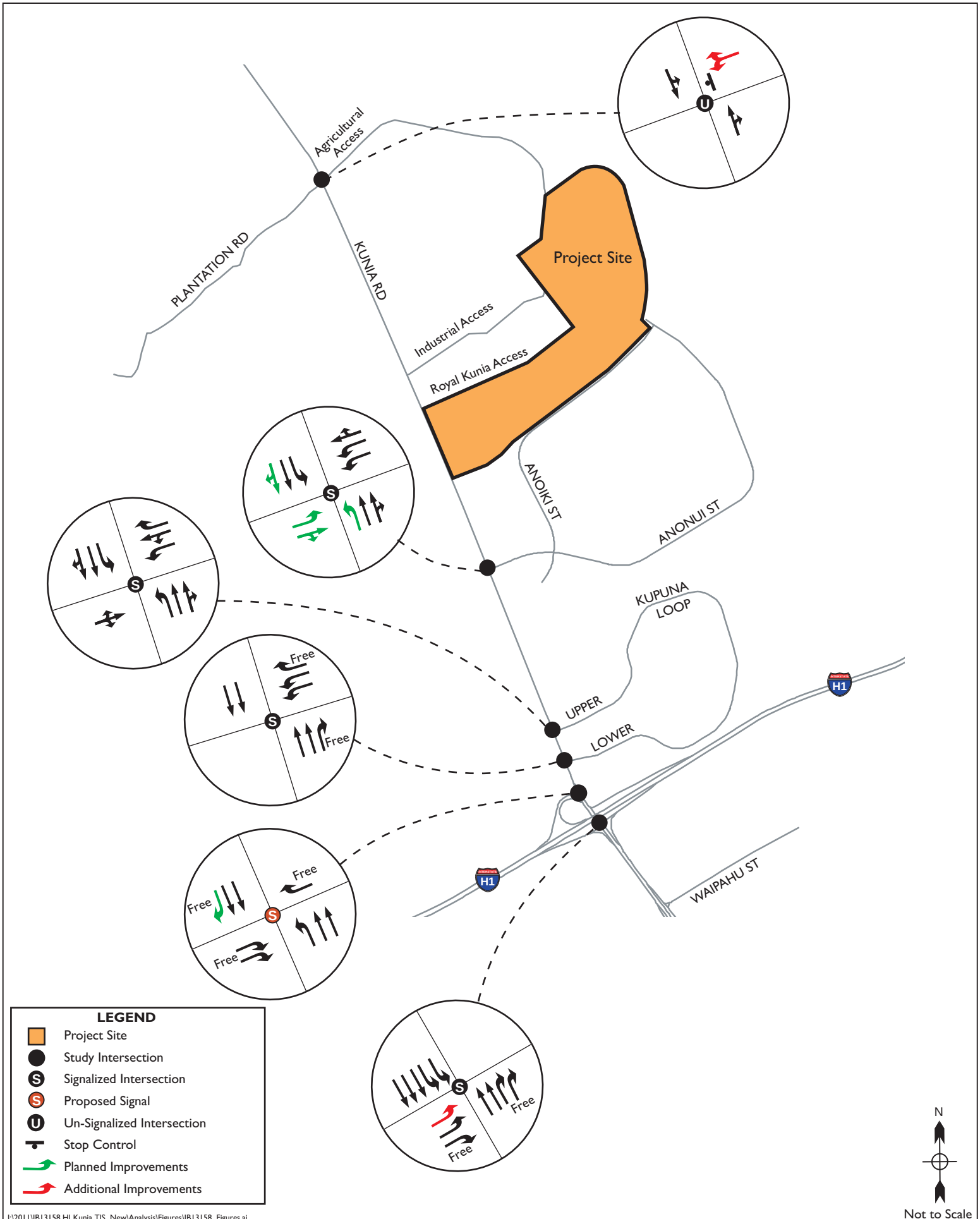
Intersection			AM Peak Hour				PM Peak Hour			
			Queue[1] (ft)		Delay[2]		Queue[1] (ft)		Delay[2]	
No.	Name	Approach	Movement	Length	(sec/veh)	LOS[3]	Movement	Length	(sec/veh)	LOS[3]
1	Kunia Rd at Agricultural Access	**Average**	--	--	**1.7**	**A**	--	--	**2.2**	**A**
4	Kunia Rd at Anonui St	**Average**	--	--	**60.1**	**E**	--	--	**77.2**	**E**
5	Kunia Rd at Upper Kupuna Loop	**Average**	--	--	**11.6**	**B**	--	--	**19.1**	**B**
6	Kunia Rd at Lower Kupuna Loop	**Average**	--	--	**9.8**	**A**	--	--	**10.2**	**B**
7	Kunia Rd at H-1 WB Ramps	NB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		SB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		EB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		WB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Average	--	--	**n/a**	**n/a**	--	--	**n/a**	**n/a**
8	Kunia Rd at H-1 EB Ramps	NB	Thru	654	152.1	F	Thru	382	79.3	E
		SB	Left	472	33.0	C	Left	260	92.4	F
		EB	Left	456	51.9	D	Left	665	130.1	F
		WB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Average	--	--	**103.9**	**F**	--	--	**89.8**	**F**

Note:

[1] 95th percentile queue length; Highlighted values show the volume exceeds capacity and queue may be longer.

[2] HCM average control delay; Approach or intersection average delay.

[3] HCM Level of Service



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Royal Kunia Phase II Traffic Impact Study — Figure 23

Honolulu, Hawaii — Recommended Improvements for 2020 Without Project Conditions

Table 26 - 2020 Without Project Conditions
Intersection Operations Analysis Summary.
With Recommended Mitigations

Intersection			AM Peak Hour				PM Peak Hour			
			Queue[1] (ft)		Delay[2]		Queue[1] (ft)		Delay[2]	
No.	Name	Approach	Movement	Length	(sec/veh)	LOS[3]	Movement	Length	(sec/veh)	LOS[3]
1	Kunia Rd at Agricultural Access	**Average**	--	--	**1.0**	A	--	--	**1.2**	A
4	Kunia Rd at Anonui St	**Average**	--	--	**27.3**	C	--	--	**23.7**	C
5	Kunia Rd at Upper Kupuna Loop	**Average**	--	--	**19.2**	B	--	--	**19.6**	B
6	Kunia Rd at Lower Kupuna Loop	**Average**	--	--	**11.3**	B	--	--	**11.6**	B
7	Kunia Rd at H-1 WB Ramps	NB	Left	73	1.3	A	Left	195	4.8	A
		SB	Right	19	3.8	A	Right	123	7.6	A
		EB	Right	0	1.0	A	Right	228	68.2	E
		WB	Right	0	0.7	A	Right	153	11.9	B
		Average	--	--	**1.9**	A	--	--	**28.6**	C
8	Kunia Rd at H-1 EB Ramps	NB	Thru	495	33.4	C	Thru	277	11.7	B
		SB	Left	385	14.9	B	Left	229	36.7	D
		EB	Left	175	22.3	C	Left	294	63.6	E
		WB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Average	--	--	**20.9**	C	--	--	**35.9**	D

Note:

[1] 95th percentile queue length; Highlighted values show the volume exceeds capacity and queue may be longer.

[2] HCM average control delay; Approach or intersection average delay.

[3] HCM Level of Service

6.5 Freeway Analysis for 2020 Without Project Conditions

Freeway analysis was conducted using Highway Capacity Software (HCS) based on the analysis methodologies mentioned in Section 2 on this report. Table 27 below shows the freeway analysis results for 2020 Without Project conditions. Appendix L contains the HCS freeway analysis worksheets for 2020 Without Project Conditions. As shown in Table 27, the eastbound direction on the H-1 Freeway are projected to experience Level of Service F during the AM Peak hour and Level of Service E during the PM peak hour.

Table 27 - 2020 Without Project Conditions
Freeway Analysis Summary

Freeway Facility				Number of Lanes		AM Peak Hour				PM Peak Hour			
						Traffic		Density[1]		Traffic		Density[1]	
Dir.	No.	Type	Location	Mainline	Ramp	Mainline	Ramp	(pc/mi/ln)	LOS[1]	Mainline	Ramp	(pc/mi/ln)	LOS[1]
H-1 Westbound	1	Mainline	e/o Kunia Slip Off-Ramp	4	--	5,379	--	21.4	C	5,732	--	22.8	C
	2	Off-Ramp	Kunia Slip Off-Ramp	4	1	5,379	611	26.7	C	5,732	1,436	32.3	D
	3	Mainline	btw Kunia Slip Off-Ramp & Kunia Loop Off-Ramp	4	--	4,768	--	18.9	C	4,296	--	17.1	B
	4	Off-Ramp	Kunia Loop Off-Ramp	3	2	4,768	1,612	5.0	A	4,296	2,848	9.3	A
	5	Mainline	btw Kunia Loop Off-Ramp & Kunia On-Ramp	3	--	3,156	--	17.1	B	1,448	--	7.8	A
	6	On-Ramp	Kunia On-Ramp	3	1	3,156	500	18.1	B	1,448	952	13.0	B
	7	Mainline	w/o Kunia On-Ramp	3	--	3,656	--	19.8	C	2,400	--	13.0	B
H-1 Eastbound	8	Mainline	w/o Kunia Off-Ramp	3	--	7,473	--	n/a	F	5,645	--	32.4	D
	9	Off-Ramp	Kunia Off-Ramp	3	1	7,473	735	40.3	F	5,645	786	33.8	D
	10	Mainline	btw Kunia Off-Ramp & Kunia On-Ramp	3	--	6,738	--	n/a	F	4,859	--	26.6	D
	11	On-Ramp	Kunia On-Ramp	3	1[2]+2	6,738	1,016	42.4	F	4,859	479	28.9	D
	12	Mainline	e/o Kunia On-Ramp	4+1[3]	--	11,565	--	n/a	F	8,492	--	39.9	E

Note:

[1] Density (passenger car per mile per lane) and Level of Service based on Highway Capacity Manual (HCM) methodologies.

[2] Ramp merging traffic is the volume on the left lane of the 3-lane H-1 Eastbound On-Ramp.

[3] Shoulder lane on the right side may be utilize during congested conditions.

7. 2023 WITHOUT PROJECT TRAFFIC CONDITIONS

7.1 Future Traffic Volumes for 2023 Without Project Conditions

Future AM and PM peak hour intersection traffic volumes for 2023 Without Project Conditions are shown in Figures 24 and 25. The future traffic forecast is estimated based on the methodologies are presented in Section 3.

7.2 Future Planned Improvements

It should be noted that the 2023 Without Project Conditions have the same planned improvements as the 2018 Without Project Conditions which were listed in previous Section 5.2 of this report.

7.3 Intersection Operations Analysis for 2023 Without Project Conditions

Table 28 summarizes the results for the 2023 Without Project Conditions intersection level of service analysis, with existing geometry and planned improvements. As shown in Table 28, the following study area intersections are projected to operate at Level of Service "E" or worse for 2023 Without Project Conditions during the peak hours, with existing lane geometry and planned improvements:

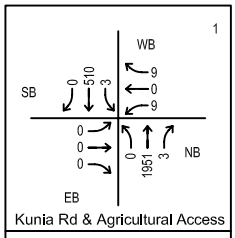
- Kunia Road at Anonui Street (#4)
- Kunia Road at H-1 Eastbound Ramps (#8)

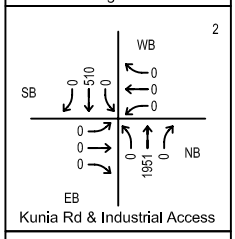
Appendix M contains the analysis worksheets for 2023 Without Project Conditions, with existing geometry and planned improvements.

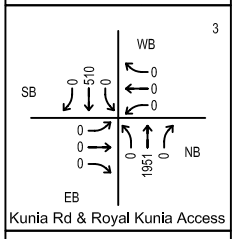
7.4 Recommended Improvements for Year 2023 Without Project Conditions

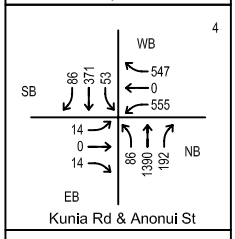
Figure 26 shows the recommended roadway network and intersection lane geometry for 2023 Without Project Conditions to mitigate the traffic impact. The recommended lane improvements for 2023 Without Project Conditions are same as the ones previously listed in Sections 5.4 and shown in Figure 20 for 2018 Without Project Conditions.

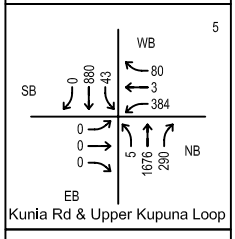
Table 29 shows the intersection operations analysis results for 2023 Without Project conditions, with recommended mitigations. With recommended 2023 Without Project intersection lane improvements, the study area intersections are projected to be mitigated to Level of Service "D" or better during the peak hours. The intersection operations analysis worksheets for 2023 Without Project Conditions, with recommended mitigation measures, are included in Appendix N of this report.

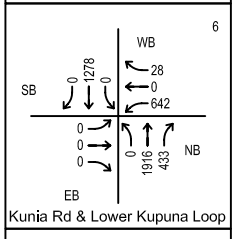


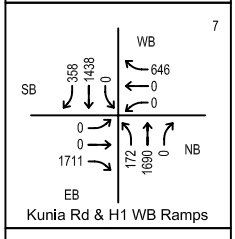


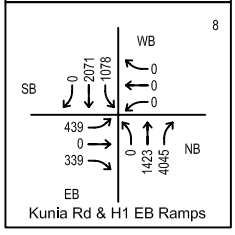












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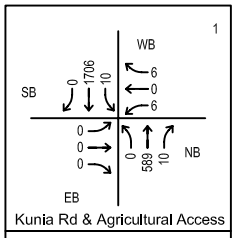
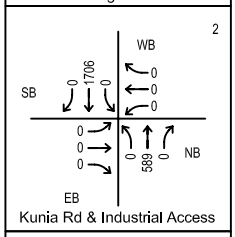
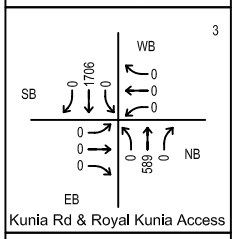
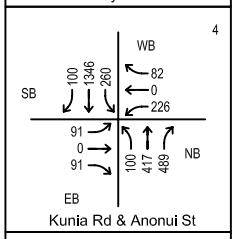
Royal Kunia Phase II Traffic Impact Study — Figure 24

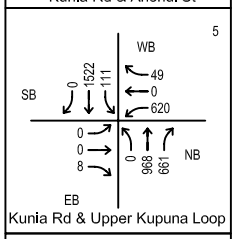
Honolulu, Hawaii — 2023 Without Project AM Peak Hour Intersection Movement Volumes

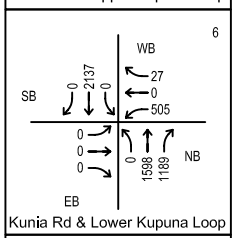


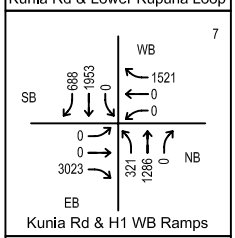


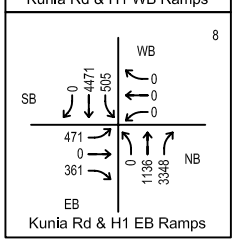












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Royal Kunia Phase II Traffic Impact Study — Figure 25

Honolulu, Hawaii — 2023 Without Project PM Peak Hour Intersection Movement Volumes

Table 28 - 2023 Without Project Conditions
Intersection Operations Analysis Summary,
With Existing Geometry

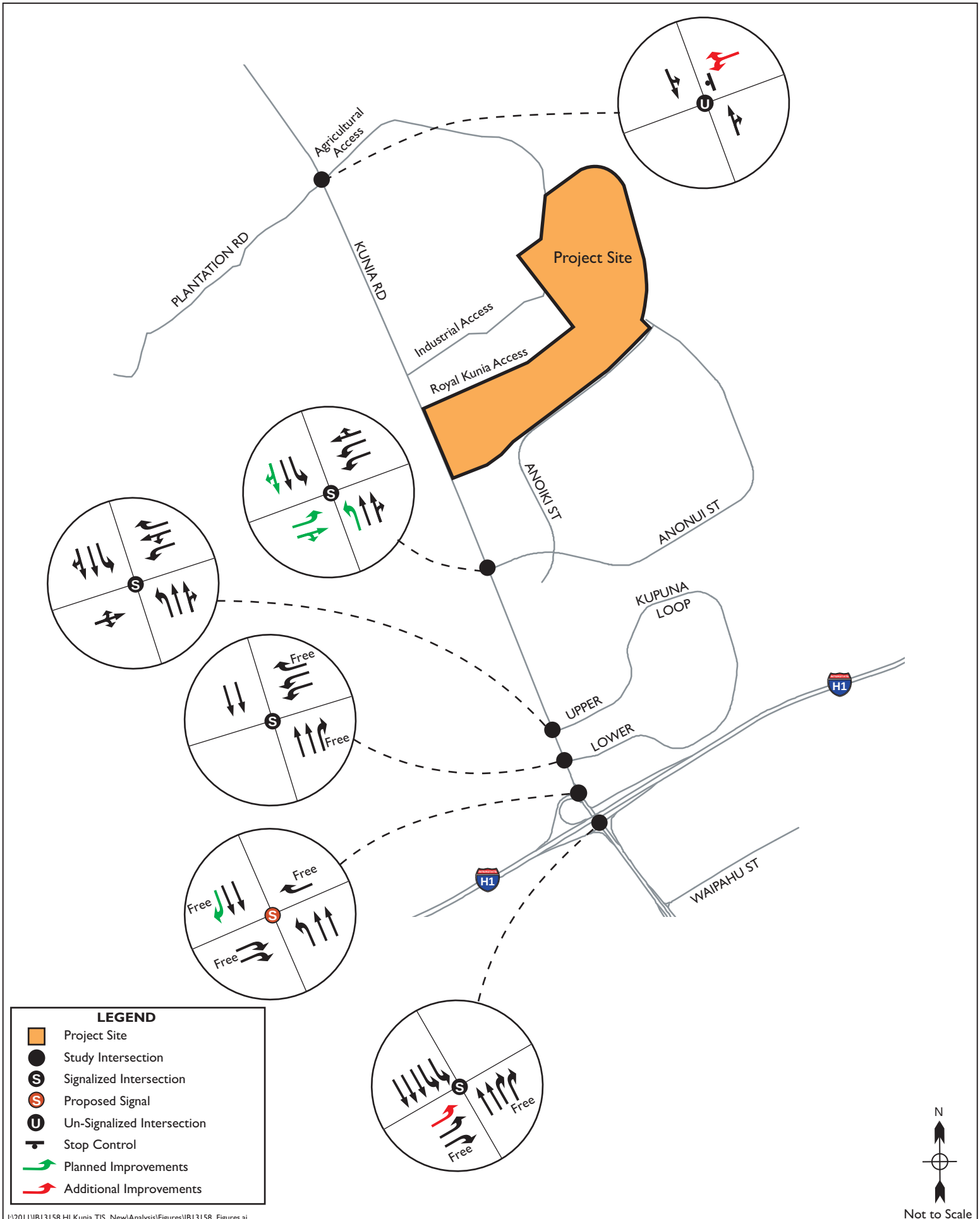
Intersection			AM Peak Hour				PM Peak Hour			
			Queue[1] (ft)		Delay[2]		Queue[1] (ft)		Delay[2]	
No.	Name	Approach	Movement	Length	(sec/veh)	LOS[3]	Movement	Length	(sec/veh)	LOS[3]
1	Kunia Rd at Agricultural Access	**Average**	--	--	**2.2**	**A**	--	--	**3.0**	**A**
4	Kunia Rd at Anonui St	**Average**	--	--	**80.2**	**F**	--	--	**91.0**	**F**
5	Kunia Rd at Upper Kupuna Loop	**Average**	--	--	**13.6**	**B**	--	--	**21.2**	**C**
6	Kunia Rd at Lower Kupuna Loop	**Average**	--	--	**10.3**	**B**	--	--	**11.9**	**B**
7	Kunia Rd at H-1 WB Ramps	NB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		SB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		EB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		WB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Average	--	--	**n/a**	**n/a**	--	--	**n/a**	**n/a**
8	Kunia Rd at H-1 EB Ramps	NB	Thru	715	184.9	F	Thru	415	99.4	F
		SB	Left	517	42.2	D	Left	275	121.0	F
		EB	Left	491	58.3	E	Left	716	153.1	F
		WB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Average	--	--	**126.6**	**F**	--	--	**114.2**	**F**

Note:

[1] 95th percentile queue length; Highlighted values show the volume exceeds capacity and queue may be longer.

[2] HCM average control delay; Approach or intersection average delay.

[3] HCM Level of Service



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Royal Kunia Phase II Traffic Impact Study — Figure 26

Honolulu, Hawaii — Recommended Improvements for 2023 Without Project Conditions

Table 29 - 2023 Without Project Conditions
Intersection Operations Analysis Summary.
With Recommended Mitigations

Intersection			AM Peak Hour				PM Peak Hour			
			Queue[1] (ft)		Delay[2]		Queue[1] (ft)		Delay[2]	
No.	Name	Approach	Movement	Length	(sec/veh)	LOS[3]	Movement	Length	(sec/veh)	LOS[3]
1	Kunia Rd at Agricultural Access	**Average**	--	--	**1.3**	A	--	--	**0.4**	A
4	Kunia Rd at Anonui St	**Average**	--	--	**32.8**	C	--	--	**24.8**	C
5	Kunia Rd at Upper Kupuna Loop	**Average**	--	--	**22.3**	C	--	--	**22.8**	C
6	Kunia Rd at Lower Kupuna Loop	**Average**	--	--	**12.9**	B	--	--	**13.7**	B
7	Kunia Rd at H-1 WB Ramps	NB	Left	76	1.4	A	Left	229	5.9	A
		SB	Right	20	4.0	A	Right	159	8.8	A
		EB	Right	0	1.2	A	Right	320	98.1	F
		WB	Right	0	0.8	A	Right	225	21.0	C
		Average	--	--	**2.0**	A	--	--	**41.1**	D
8	Kunia Rd at H-1 EB Ramps	NB	Thru	569	32.9	C	Thru	330	12.9	B
		SB	Left	471	20.6	C	Left	260	57.8	E
		EB	Left	227	35.4	D	Left	342	82.8	F
		WB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Average	--	--	**26.0**	C	--	--	**53.4**	D

Note:

[1] 95th percentile queue length; Highlighted values show the volume exceeds capacity and queue may be longer.

[2] HCM average control delay; Approach or intersection average delay.

[3] HCM Level of Service

7.5 Freeway Analysis for 2023 Without Project Conditions

Freeway analysis was conducted using Highway Capacity Software (HCS) based on the analysis methodologies mentioned in Section 2 on this report. Table 30 below shows the freeway analysis results for 2023 Without Project conditions. Appendix O contains the HCS freeway analysis worksheets for 2023 Without Project Conditions. As shown in Table 30, the eastbound direction on the H-1 Freeway are projected to experience Level of Service F during the AM Peak hour and Level of Service E during the PM peak hour.

Table 30 - 2023 Without Project Conditions
Freeway Analysis Summary

Freeway Facility				Number of Lanes		AM Peak Hour				PM Peak Hour			
						Traffic		Density[1]		Traffic		Density[1]	
Dir.	No.	Type	Location	Mainline	Ramp	Mainline	Ramp	(pc/mi/ln)	LOS[1]	Mainline	Ramp	(pc/mi/ln)	LOS[1]
H-1 Westbound	1	Mainline	e/o Kunia Slip Off-Ramp	4	--	5,706	--	22.7	C	6,080	--	24.2	C
	2	Off-Ramp	Kunia Slip Off-Ramp	4	1	5,706	646	28.2	D	6,080	1,521	34.2	D
	3	Mainline	btw Kunia Slip Off-Ramp & Kunia Loop Off-Ramp	4	--	5,060	--	20.1	C	4,559	--	18.1	C
	4	Off-Ramp	Kunia Loop Off-Ramp	3	2	5,060	1,711	6.7	A	4,559	3,023	11.2	B
	5	Mainline	btw Kunia Loop Off-Ramp & Kunia On-Ramp	3	--	3,349	--	18.1	C	1,536	--	8.3	A
	6	On-Ramp	Kunia On-Ramp	3	1	3,349	530	19.3	B	1,536	1,009	13.9	B
	7	Mainline	w/o Kunia On-Ramp	3	--	3,879	--	21.0	C	2,545	--	13.8	B
H-1 Eastbound	8	Mainline	w/o Kunia Off-Ramp	3	--	7,928	--	n/a	F	5,989	--	35.8	E
	9	Off-Ramp	Kunia Off-Ramp	3	1	7,928	778	41.7	F	5,989	832	35.2	E
	10	Mainline	btw Kunia Off-Ramp & Kunia On-Ramp	3	--	7,150	--	n/a	F	5,157	--	28.6	D
	11	On-Ramp	Kunia On-Ramp	3	1[2]+2	7,150	1,078	44.9	F	5,157	505	30.6	D
	12	Mainline	e/o Kunia On-Ramp	4+1[3]	--	12,273	--	n/a	F	9,010	--	29.6	D

Note:

[1] Density (passenger car per mile per lane) and Level of Service based on Highway Capacity Manual (HCM) methodologies.

[2] Ramp merging traffic is the volume on the left lane of the 3-lane H-1 Eastbound On-Ramp.

[3] Shoulder lane on the right side may be utilize during congested conditions.

8. 2025 WITHOUT PROJECT TRAFFIC CONDITIONS

8.1 Future Traffic Volumes for 2025 Without Project Conditions

Future AM and PM peak hour intersection traffic volumes for 2025 Without Project Conditions are shown in Figures 27 and 28. The future traffic forecast is estimated based on the methodologies are presented in Section 3.

8.2 Future Planned Improvements

It should be noted that the 2025 Without Project Conditions have the same planned improvements as the 2018 Without Project Conditions which were listed in previous Section 5.2 of this report.

8.3 Intersection Operations Analysis for 2025 Without Project Conditions

Table 31 summarizes the results for the 2025 Without Project Conditions intersection level of service analysis, with existing geometry and planned improvements. As shown in Table 31, the following study area intersections are projected to operate at Level of Service "E" or worse for 2025 Without Project Conditions during the peak hours, with existing lane geometry and planned improvements:

- Kunia Road at Anonui Street (#4)
- Kunia Road at H-1 Eastbound Ramps (#8)

Appendix P contains the analysis worksheets for 2025 Without Project Conditions, with existing geometry and planned improvements.

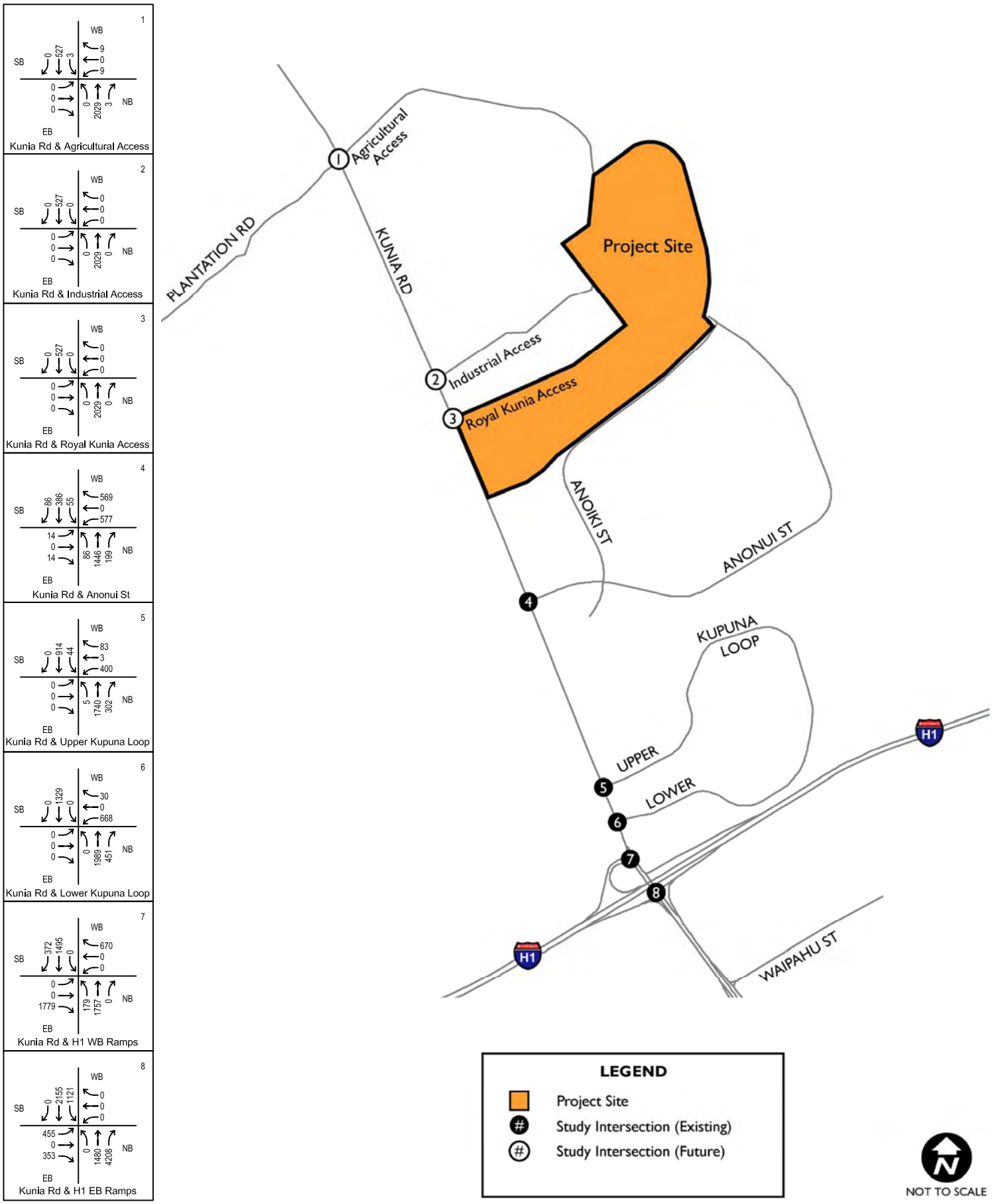
8.4 Recommended Improvements for Year 2025 Without Project Conditions

Figure 29 shows the recommended roadway network and intersection lane geometry for 2025 Without Project Conditions to mitigate the traffic impact. In addition to the recommended 2018 Without Project improvements previously listed in Section 5.4, the following additional improvement is recommended to accommodate 2025 Without Project Conditions:

Kunia Road at H-1 Eastbound Ramps (#8)

- Add a Fourth Southbound Through Lane

Table 32 shows the intersection operations analysis results for 2025 Without Project conditions, with recommended mitigations. With recommended 2025 Without Project intersection lane improvements, the study area intersections are projected to be mitigated to Level of Service "D" or better during the peak hours. The intersection operations analysis worksheets for 2025 Without Project Conditions, with recommended mitigation measures, are included in Appendix Q of this report.



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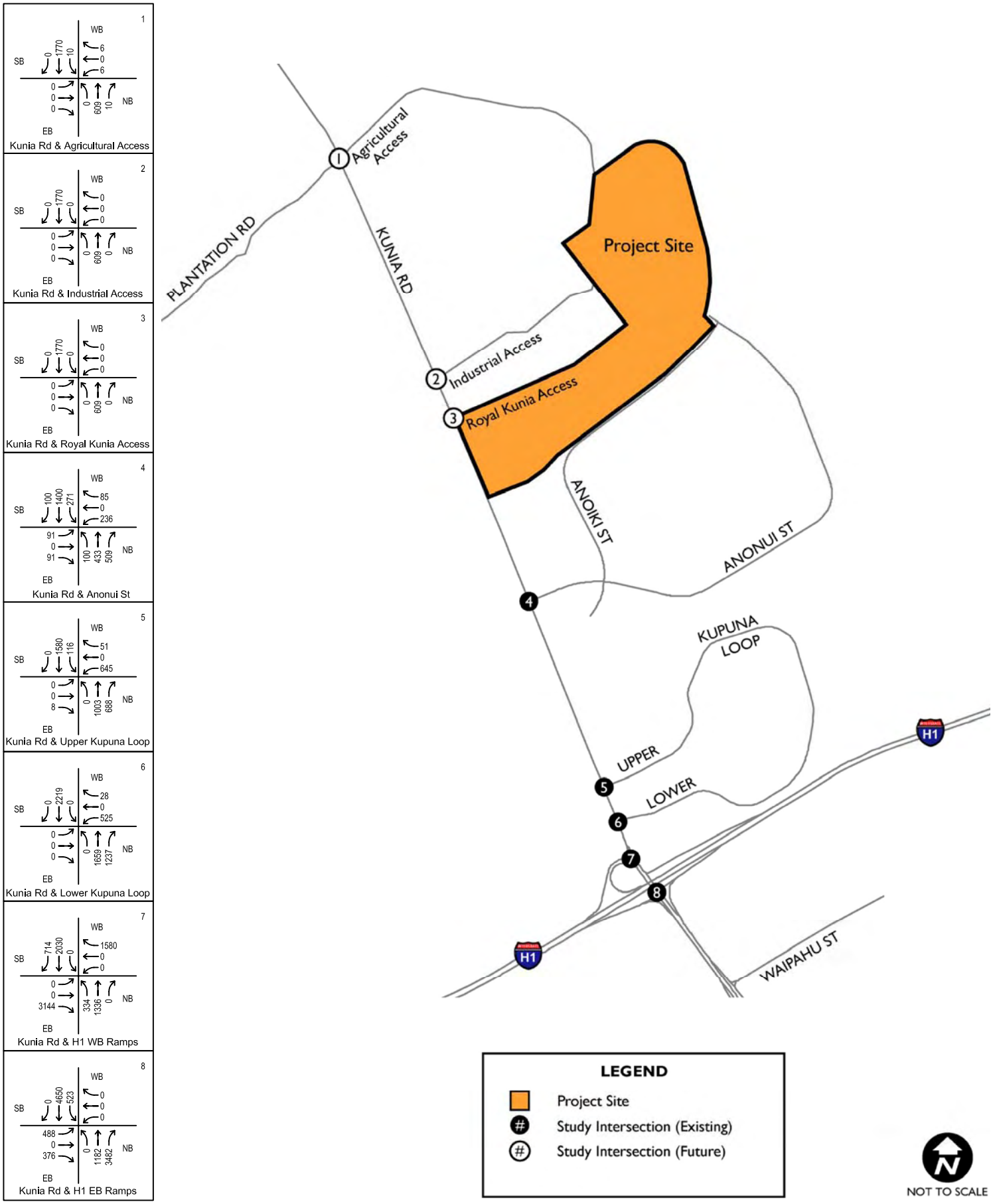
Royal Kunia Phase II Traffic Impact Study — Figure 27

Honolulu, Hawaii — 2025 Without Project AM Peak Hour Intersection Movement Volumes



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Royal Kunia Phase II Traffic Impact Study — Figure 28

Honolulu, Hawaii — 2025 Without Project PM Peak Hour Intersection Movement Volumes

Table 31 - 2025 Without Project Conditions
Intersection Operations Analysis Summary,
With Existing Geometry

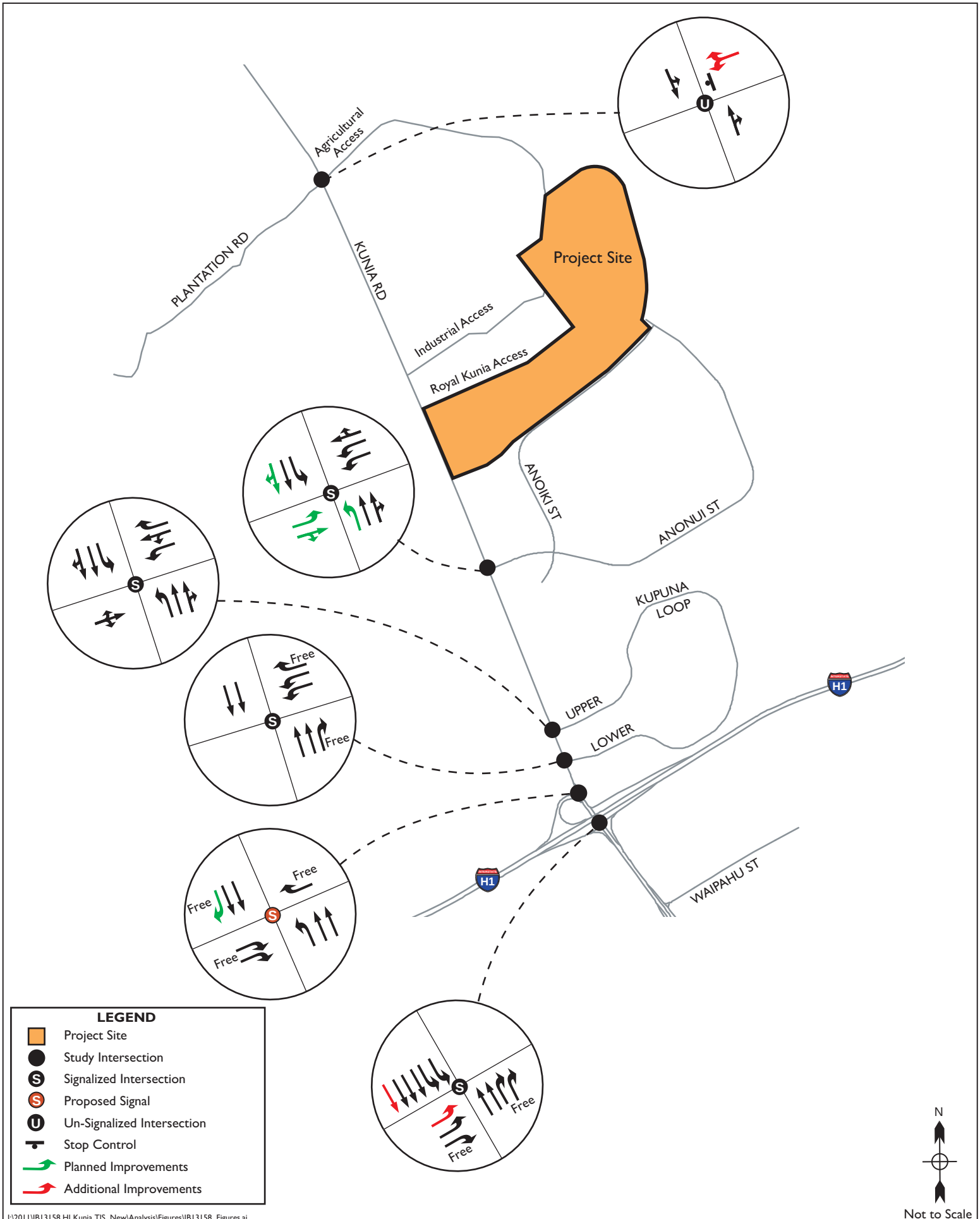
Intersection			AM Peak Hour				PM Peak Hour			
			Queue[1] (ft)		Delay[2]		Queue[1] (ft)		Delay[2]	
No.	Name	Approach	Movement	Length	(sec/veh)	LOS[3]	Movement	Length	(sec/veh)	LOS[3]
1	Kunia Rd at Agricultural Access	**Average**	--	--	**2.7**	**A**	--	--	**4.0**	**A**
4	Kunia Rd at Anonui St	**Average**	--	--	**97.9**	**F**	--	--	**101.2**	**F**
5	Kunia Rd at Upper Kupuna Loop	**Average**	--	--	**17.6**	**B**	--	--	**23.5**	**C**
6	Kunia Rd at Lower Kupuna Loop	**Average**	--	--	**10.8**	**B**	--	--	**13.5**	**B**
7	Kunia Rd at H-1 WB Ramps	NB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		SB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		EB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		WB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Average	--	--	**n/a**	**n/a**	--	--	**n/a**	**n/a**
8	Kunia Rd at H-1 EB Ramps	NB	Thru	758	207.7	F	Thru	440	114.1	F
		SB	Left	548	48.7	D	Left	302	141.2	F
		EB	Left	516	65.7	E	Left	748	170.1	F
		WB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Average	--	--	**142.7**	**F**	--	--	**131.7**	**F**

Note:

[1] 95th percentile queue length; Highlighted values show the volume exceeds capacity and queue may be longer.

[2] HCM average control delay; Approach or intersection average delay.

[3] HCM Level of Service



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Royal Kunia Phase II Traffic Impact Study — Figure 29

Honolulu, Hawaii — Recommended Improvements for 2025 Without Project Conditions

Table 32 - 2025 Without Project Conditions
Intersection Operations Analysis Summary.
With Recommended Mitigations

Intersection			AM Peak Hour				PM Peak Hour			
			Queue[1] (ft)		Delay[2]		Queue[1] (ft)		Delay[2]	
No.	Name	Approach	Movement	Length	(sec/veh)	LOS[3]	Movement	Length	(sec/veh)	LOS[3]
1	Kunia Rd at Agricultural Access	**Average**	--	--	**1.5**	A	--	--	**0.5**	A
4	Kunia Rd at Anonui St	**Average**	--	--	**38.8**	D	--	--	**25.9**	C
5	Kunia Rd at Upper Kupuna Loop	**Average**	--	--	**27.9**	C	--	--	**26.2**	C
6	Kunia Rd at Lower Kupuna Loop	**Average**	--	--	**14.8**	B	--	--	**16.2**	B
7	Kunia Rd at H-1 WB Ramps	NB	Left	79.0	2.1	A	Left	207	5.1	A
		SB	Right	20	3.2	A	Right	159	11.3	B
		EB	Right	0	1.3	A	Right	332	113.1	F
		WB	Right	0	0.9	A	Right	255	56.1	E
		Average	--	--	**2.0**	A	--	--	**52.9**	D
8	Kunia Rd at H-1 EB Ramps	NB	Thru	620	45.2	D	Thru	294	13.9	B
		SB	Left	487	20.5	C	Left	182	16.6	B
		EB	Left	239	39.4	D	Left	222	30.5	C
		WB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Average	--	--	**29.8**	C	--	--	**17.8**	B

Note:

[1] 95th percentile queue length; Highlighted values show the volume exceeds capacity and queue may be longer.

[2] HCM average control delay; Approach or intersection average delay.

[3] HCM Level of Service

8.5 Freeway Analysis for 2025 Without Project Conditions

Freeway analysis was conducted using Highway Capacity Software (HCS) based on the analysis methodologies mentioned in Section 2 on this report. Table 33 below shows the freeway analysis results for 2025 Without Project conditions. Appendix R contains the HCS freeway analysis worksheets for 2025 Without Project Conditions. As shown in Table 33, the eastbound direction on the H-1 Freeway are projected to experience Level of Service F during the AM Peak hour and Level of Service E during the PM peak hour.

Table 33 - 2025 Without Project Conditions
Freeway Analysis Summary

Freeway Facility				Number of Lanes		AM Peak Hour				PM Peak Hour			
						Traffic		Density[1]		Traffic		Density[1]	
Dir.	No.	Type	Location	Mainline	Ramp	Mainline	Ramp	(pc/mi/ln)	LOS[1]	Mainline	Ramp	(pc/mi/ln)	LOS[1]
H-1 Westbound	1	Mainline	e/o Kunia Slip Off-Ramp	4	--	5,935	--	23.6	C	6,323	--	25.3	C
	2	Off-Ramp	Kunia Slip Off-Ramp	4	1	5,935	670	29.2	D	6,323	1,580	35.4	E
	3	Mainline	btw Kunia Slip Off-Ramp & Kunia Loop Off-Ramp	4	--	5,265	--	20.9	C	4,743	--	18.8	C
	4	Off-Ramp	Kunia Loop Off-Ramp	3	2	5,265	1,779	7.9	A	4,743	3,144	12.6	B
	5	Mainline	btw Kunia Loop Off-Ramp & Kunia On-Ramp	3	--	3,486	--	18.9	C	1,599	--	8.7	A
	6	On-Ramp	Kunia On-Ramp	3	1	3,486	551	20.2	C	1,599	1,048	14.5	B
	7	Mainline	w/o Kunia On-Ramp	3	--	4,037	--	21.9	C	2,647	--	14.3	B
H-1 Eastbound	8	Mainline	w/o Kunia Off-Ramp	3	--	8,247	--	n/a	F	6,229	--	38.6	E
	9	Off-Ramp	Kunia Off-Ramp	3	1	8,247	808	42.7	F	6,229	864	36.2	E
	10	Mainline	btw Kunia Off-Ramp & Kunia On-Ramp	3	--	7,439	--	n/a	F	5,365	--	30.1	D
	11	On-Ramp	Kunia On-Ramp	3	1[2]+2	7,439	1,121	46.7	F	5,365	523	31.7	D
	12	Mainline	e/o Kunia On-Ramp	4+1[3]	--	12,765	--	n/a	F	9,370	--	31.3	D

Note:

[1] Density (passenger car per mile per lane) and Level of Service based on Highway Capacity Manual (HCM) methodologies.

[2] Ramp merging traffic is the volume on the left lane of the 3-lane H-1 Eastbound On-Ramp.

[3] Shoulder lane on the right side may be utilize during congested conditions.

9. 2018 WITH PROJECT PHASE 1A TRAFFIC CONDITIONS

9.1 Future Traffic Volumes for 2018 With Project Phase 1A Conditions

Future AM and PM peak hour intersection traffic volumes for 2018 With Project Phase 1A Conditions are shown in Figures 30 and 31. The future traffic forecast is estimated based on the methodologies are presented in Section 3. It should be noted that in addition to the project-only traffic, the 2018 With Project Phase 1A Conditions also includes cumulative development traffic in the vicinity of the project site as well as ambient background growth to account for other unidentified projects and general population growth. The project is only one of the many contributors to the overall traffic growth.

9.2 Future Planned Improvements

It should be noted that the 2018 With Project Phase 1A Conditions have the same planned improvements as the 2018 Without Project Conditions which were listed in previous Section 5.2 of this report.

9.3 Intersection Operations Analysis for 2018 With Project Phase 1A Conditions

Table 30 summarizes the results for the 2018 With Project Phase 1A Conditions intersection level of service analysis, with existing geometry and planned improvements. As shown in Table 30, the following study area intersections are projected to operate at Level of Service "E" or worse for 2018 With Project Phase 1A Conditions during the peak hours, with existing lane geometry and planned improvements:

- Kunia Road at Royal Kunia Access (#3)
- Kunia Road at Anonui Street (#4)
- Kunia Road at H-1 Eastbound Ramps (#8)

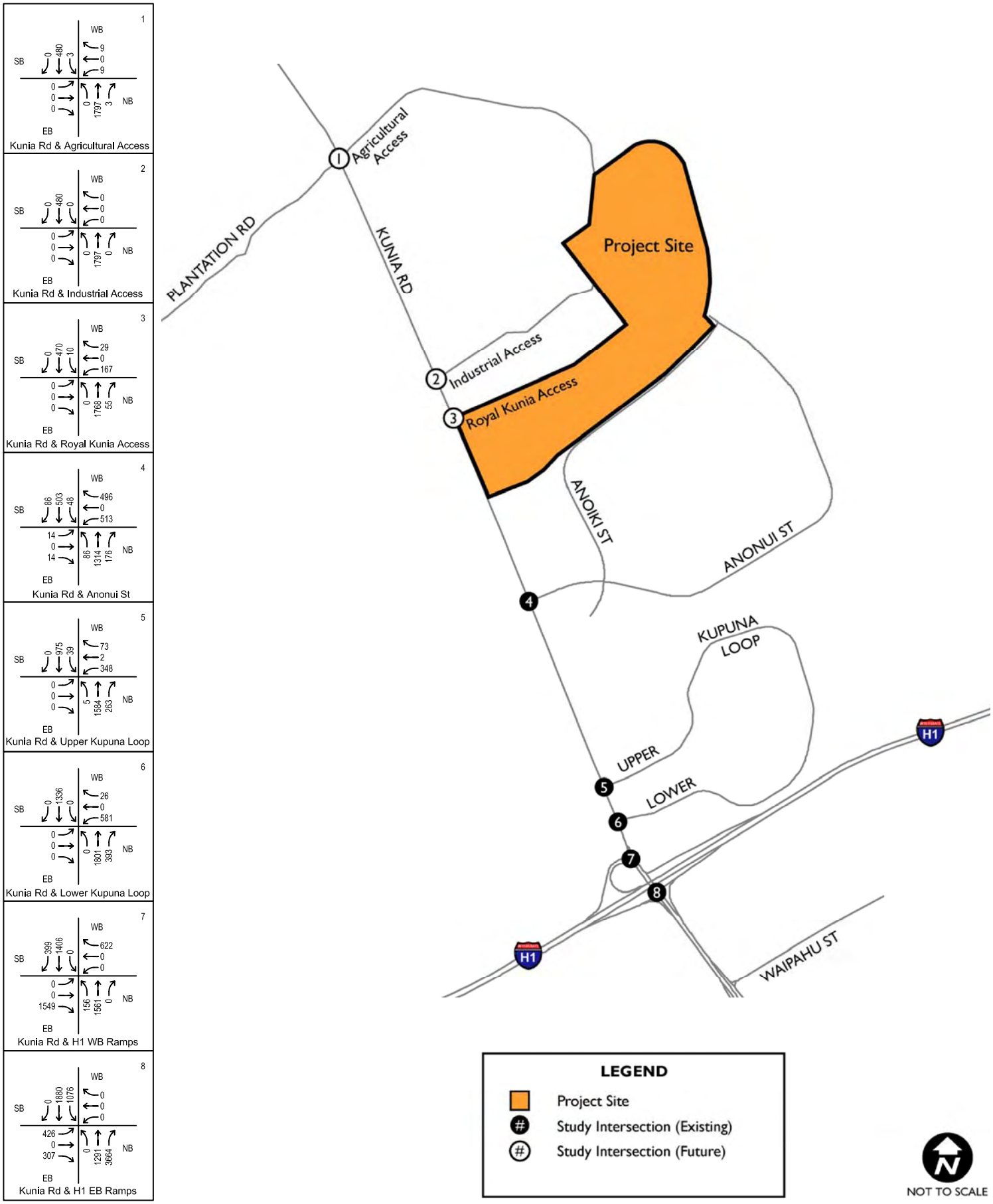
Appendix S contains the analysis worksheets for 2018 With Project Phase 1A Conditions, with existing lane geometry and planned improvements.

9.4 Recommended Improvements for Year 2018 With Project Phase 1A Conditions

Figure 42 shows the recommended roadway network and intersection lane geometry for 2018 With Project Phase 1A Conditions to mitigate the traffic impact. In addition to the recommended 2018 Without Project improvements previously listed in Section 5.4, the following additional improvement is recommended to accommodate 2018 With Project Phase 1A Conditions:

Kunia Road at Royal Kunia Access (#3)

- Install a Traffic Signal
- Add a Second Northbound Through Lane



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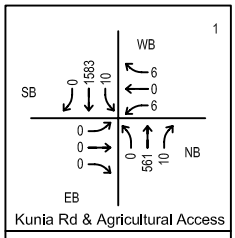
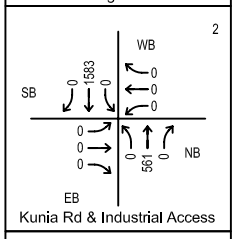
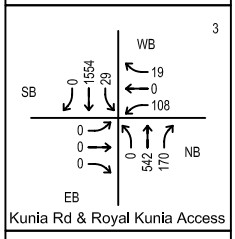
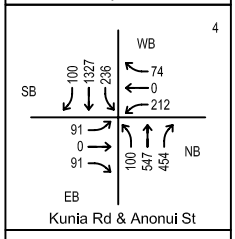
Royal Kunia Phase II Traffic Impact Study — Figure 30

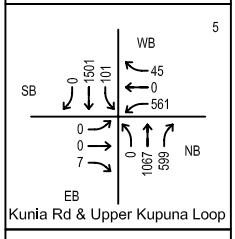
Honolulu, Hawaii — 2018 With Project AM Peak Hour Intersection Movement Volumes

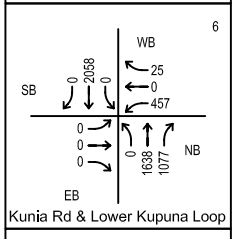


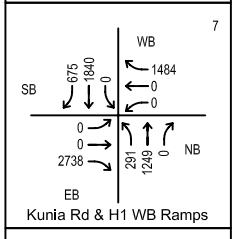


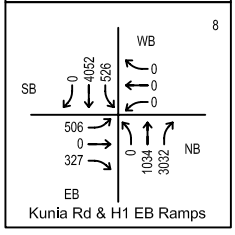












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Royal Kunia Phase II Traffic Impact Study — Figure 31

Honolulu, Hawaii — 2018 With Project PM Peak Hour Intersection Movement Volumes

Table 34 - 2018 With Project Phase 1A Conditions
Intersection Operations Analysis Summary,
With Existing Geometry

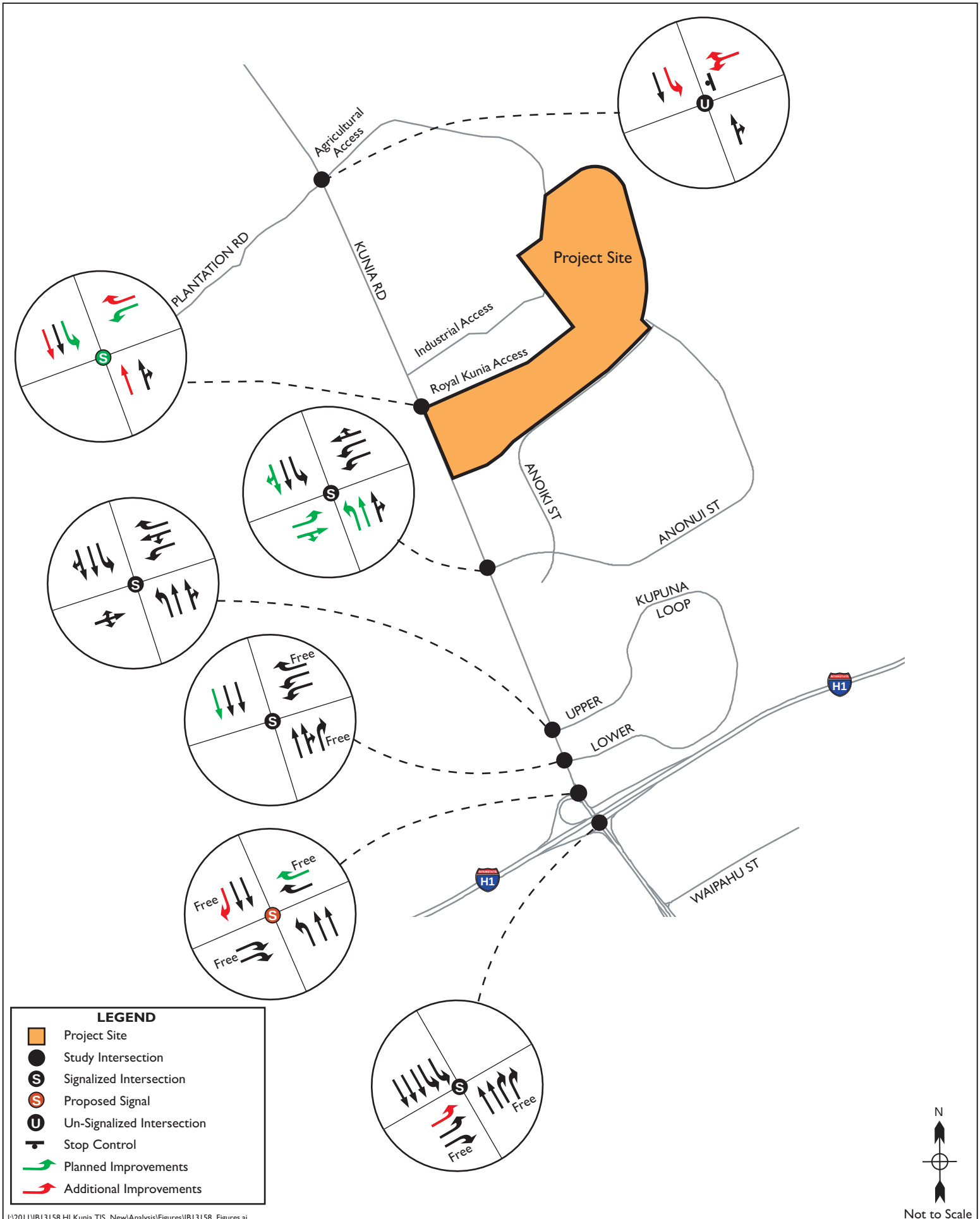
Intersection			AM Peak Hour				PM Peak Hour			
			Queue[1] (ft)		Delay[2]		Queue[1] (ft)		Delay[2]	
No.	Name	Approach	Movement	Length	(sec/veh)	LOS[3]	Movement	Length	(sec/veh)	LOS[3]
1	Kunia Rd at Agricultural Access	**Average**	--	--	**1.5**	**A**	--	--	**3.8**	**A**
3	Kunia Rd at Royal Kunia Access	**Average**	--	--	**>200**	**F**	--	--	**>200**	**F**
4	Kunia Rd at Anonui St	**Average**	--	--	**58.2**	**E**	--	--	**84.9**	**F**
5	Kunia Rd at Upper Kupuna Loop	**Average**	--	--	**11.1**	**B**	--	--	**19.2**	**B**
6	Kunia Rd at Lower Kupuna Loop	**Average**	--	--	**9.4**	**A**	--	--	**9.9**	**A**
7	Kunia Rd at H-1 WB Ramps	NB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		SB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		EB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		WB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Average	--	--	**n/a**	**n/a**	--	--	**n/a**	**n/a**
8	Kunia Rd at H-1 EB Ramps	NB	Thru	616	133.5	F	Thru	363	68.6	E
		SB	Left	514	43.8	D	Left	308	75.3	E
		EB	Left	470	52.1	D	Left	781	168.0	F
		WB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Average	--	--	**96.0**	**F**	--	--	**80.6**	**F**

Note:

[1] 95th percentile queue length; Highlighted values show the volume exceeds capacity and queue may be longer

[2] HCM average control delay; Approach or intersection average delay.

[3] HCM Level of Service



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Royal Kunia Phase II Traffic Impact Study — Figure 32

Honolulu, Hawaii — Recommended Improvements for 2018 With Project Phase 1A Conditions

- Add a Southbound Left-Turn Lane
- Add a Second Southbound Through Lane
- Add a Westbound Left-Turn Lane
- Add a Eastbound Left-Turn Lane

Kunia Road at Lower Kupuna Loop (#6)

- Add a Third Southbound Through Lane

Kunia Road at H-1 Westbound Ramps (#7)

- Add a Second Westbound Free-Right Turn Lane

Table 35 shows the intersection operations analysis results for 2018 With Project Phase 1A conditions, with recommended mitigations. With recommended 2018 With Project Phase 1A intersection lane improvements, the study area intersections are projected to be mitigated to Level of Service "D" or better during the peak hours. The intersection operations analysis worksheets for 2018 With Project Phase 1A Conditions, with recommended mitigation measures, are included in Appendix T of this report.

9.5 Freeway Analysis for 2018 With Project Phase 1A Conditions

Freeway analysis was conducted using Highway Capacity Software (HCS) based on the analysis methodologies mentioned in Section 2 on this report. Table 31 below shows the freeway analysis results for 2018 With Project Phase 1A conditions. Appendix U contains the HCS freeway analysis worksheets for 2018 With Project Phase 1A Conditions. As shown in Table 31, the eastbound direction on the H-1 Freeway are projected to experience Level of Service F during the AM Peak hour and Level of Service E during the PM peak hour.

Table 35 - 2018 With Project Phase 1A Conditions
Intersection Operations Analysis Summary.
With Recommended Mitigations

Intersection			AM Peak Hour				PM Peak Hour			
			Queue[1] (ft)		Delay[2]		Queue[1] (ft)		Delay[2]	
No.	Name	Approach	Movement	Length	(sec/veh)	LOS[3]	Movement	Length	(sec/veh)	LOS[3]
1	Kunia Rd at Agricultural Access	**Average**	--	--	**0.9**	A	--	--	**0.4**	A
3	Kunia Rd at Royal Kunia Access	**Average**	--	--	**8.2**	A	--	--	**5.3**	A
4	Kunia Rd at Anonui St	**Average**	--	--	**25.8**	C	--	--	**24.3**	C
5	Kunia Rd at Upper Kupuna Loop	**Average**	--	--	**9.9**	A	--	--	**17.7**	B
6	Kunia Rd at Lower Kupuna Loop	**Average**	--	--	**8.7**	A	--	--	**12.4**	B
7	Kunia Rd at H-1 WB Ramps	NB	Left	128	4.4	A	Left	299	10.5	B
		SB	Right	26	3.4	A	Right	75	5.9	A
		EB	Right	0	0.9	A	Right	215	76.6	E
		WB	Right	0	0.6	A	Right	0.0	6.8	A
		Average	--	--	**2.7**	A	--	--	**30.3**	C
8	Kunia Rd at H-1 EB Ramps	NB	Thru	532	34.8	C	Thru	255	14.6	B
		SB	Left	402	14.1	B	Left	332	11.0	B
		EB	Left	229	32.7	C	Left	277	48.9	D
		WB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Average	--	--	**22.2**	C	--	--	**27.6**	C

Note:

[1] 95th percentile queue length; Highlighted values show the volume exceeds capacity and queue may be longer.

[2] HCM average control delay; Approach or intersection average delay.

[3] HCM Level of Service

Table 36 - 2018 With Project Phase 1A Conditions
Freeway Analysis Summary

Freeway Facility				Number of Lanes		AM Peak Hour				PM Peak Hour			
						Traffic		Density[1]		Traffic		Density[1]	
Dir.	No.	Type	Location	Mainline	Ramp	Mainline	Ramp	(pc/mi/ln)	LOS[1]	Mainline	Ramp	(pc/mi/ln)	LOS[1]
H-1 Westbound	1	Mainline	e/o Kunia Slip Off-Ramp	4	--	5,205	--	20.7	C	5,613	--	22.3	C
	2	Off-Ramp	Kunia Slip Off-Ramp	4	1	5,205	622	26.1	C	5,613	1,484	32.1	D
	3	Mainline	btw Kunia Slip Off-Ramp & Kunia Loop Off-Ramp	4	--	4,583	--	18.2	C	4,129	--	16.4	B
	4	Off-Ramp	Kunia Loop Off-Ramp	3	2	4,583	1,549	3.9	A	4,129	2,738	8.0	A
	5	Mainline	btw Kunia Loop Off-Ramp & Kunia On-Ramp	3	--	3,034	--	16.4	B	1,391	--	7.5	A
	6	On-Ramp	Kunia On-Ramp	3	1	3,034	555	17.9	B	1,391	966	12.8	B
	7	Mainline	w/o Kunia On-Ramp	3	--	3,589	--	19.4	C	2,357	--	12.8	B
H-1 Eastbound	8	Mainline	w/o Kunia Off-Ramp	3	--	7,209	--	n/a	F	5,503	--	31.2	D
	9	Off-Ramp	Kunia Off-Ramp	3	1	7,209	733	39.4	F	5,503	833	33.3	D
	10	Mainline	btw Kunia Off-Ramp & Kunia On-Ramp	3	--	6,476	--	42.2	E	4,670	--	25.4	C
	11	On-Ramp	Kunia On-Ramp	3	1[2]+2	6,476	1,076	41.5	F	4,670	526	28.3	D
	12	Mainline	e/o Kunia On-Ramp	4+1[3]	--	11,216	--	n/a	F	8,228	--	37.3	E

Note:

[1] Density (passenger car per mile per lane) and Level of Service based on Highway Capacity Manual (HCM) methodologies.

[2] Ramp merging traffic is the volume on the left lane of the 3-lane H-1 Eastbound On-Ramp.

[3] Shoulder lane on the right side may be utilize during congested conditions.

10. 2020 With Project Phase 1B Traffic Conditions

10.1 Future Traffic Volumes for 2020 With Project Phase 1B Conditions

Future AM and PM peak hour intersection traffic volumes for 2020 With Project Phase 1B Conditions are shown in Figures 33 and 34. The future traffic forecast is estimated based on the methodologies are presented in Section 3. It should be noted that in addition to the project-only traffic, the 2020 With Project Phase 1B Conditions also includes cumulative development traffic in the vicinity of the project site as well as ambient background growth to account for other unidentified projects and general population growth. The project is only one of the many contributors to the overall traffic growth.

10.2 Future Planned Improvements

It should be noted that the 2020 With Project Phase 1B Conditions have the same planned improvements as the 2018 Without Project Conditions which were listed in previous Section 5.2 of this report.

10.3 Intersection Operations Analysis for 2020 With Project Phase 1B Conditions

Table 37 summarizes the results for the 2020 With Project Phase 1B Conditions intersection level of service analysis, with existing geometry and planned improvements. As shown in Table 37, the following study area intersections are projected to operate at Level of Service "E" or worse for 2020 With Project Phase 1B Conditions during the peak hours, with existing lane geometry and planned improvements:

- Kunia Road at Royal Kunia Access (#3)
- Kunia Road at Anonui Street (#4)
- Kunia Road at H-1 Eastbound Ramps (#8)

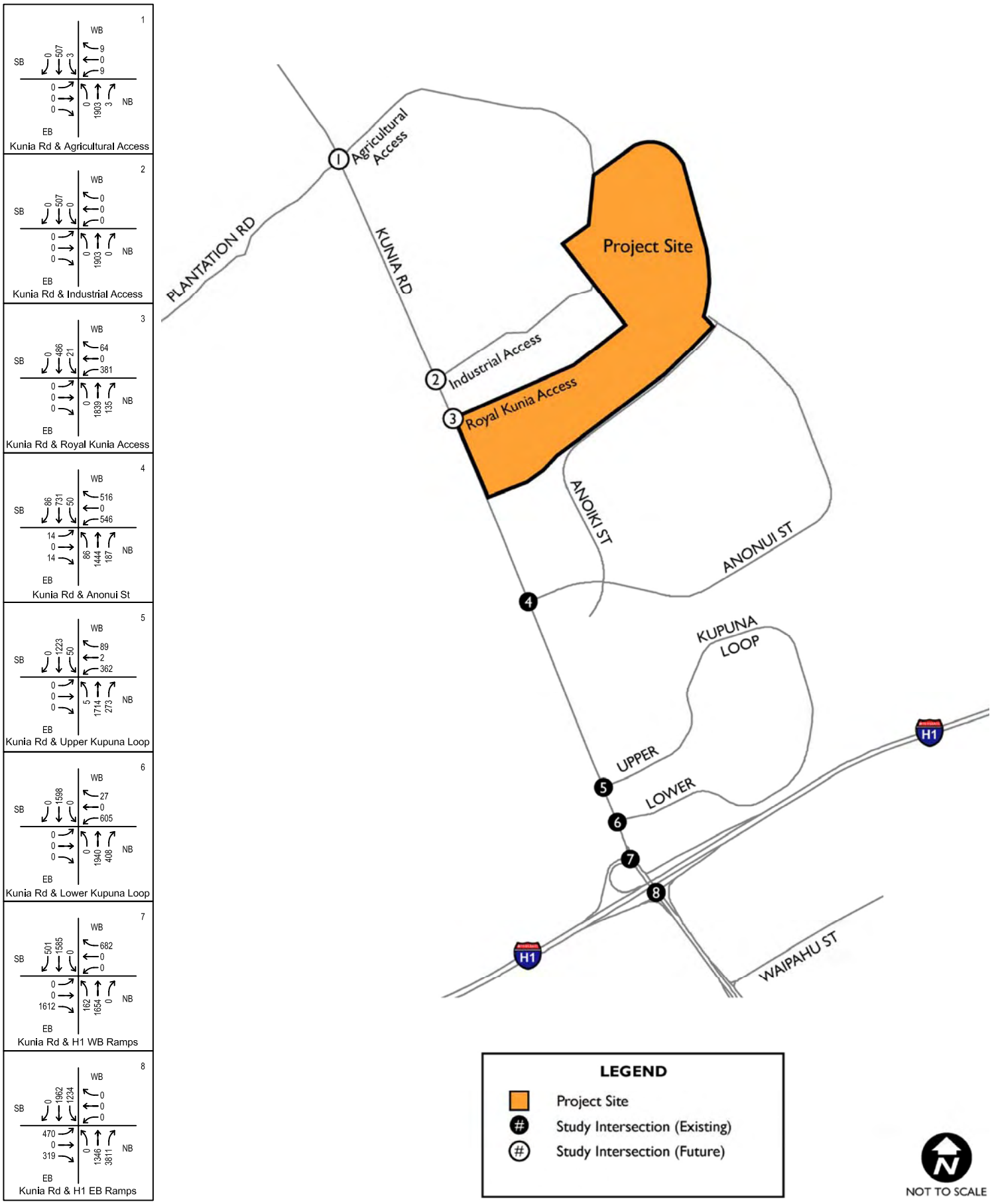
Appendix V contains the analysis worksheets for 2020 With Project Phase 1B Conditions, with existing lane geometry and planned improvements.

10.4 Recommended Improvements for Year 2020 With Project Phase 1B Conditions

Figure 35 shows the recommended roadway network and intersection lane geometry for 2020 With Project Phase 1B Conditions to mitigate the traffic impact. In addition to the recommended 2018 With Project Phase 1A improvements previously listed in Section 9.4, the following additional improvements are recommended to accommodate 2020 With Project Phase 1B Conditions:

Kunia Road at Upper Kupuna Loop (#5)

- Add a Northbound Right-Turn Lane



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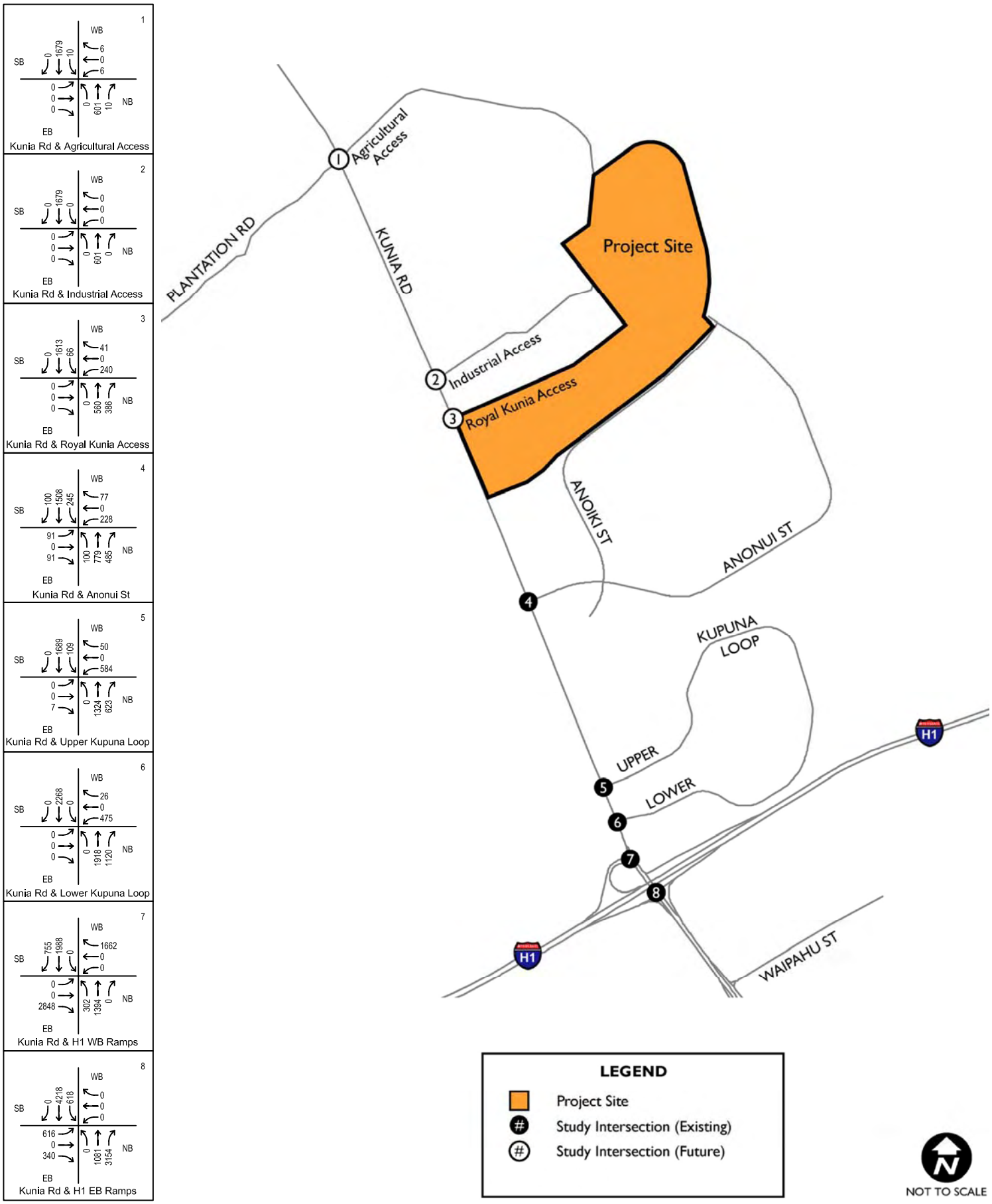
Royal Kunia Phase II Traffic Impact Study — Figure 33

Honolulu, Hawaii — 2020 With Project AM Peak Hour Intersection Movement Volumes



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Royal Kunia Phase II Traffic Impact Study — Figure 34

Honolulu, Hawaii — 2020 With Project PM Peak Hour Intersection Movement Volumes

Table 37 - 2020 With Project Phase 1B Conditions
Intersection Operations Analysis Summary,
With Existing Geometry

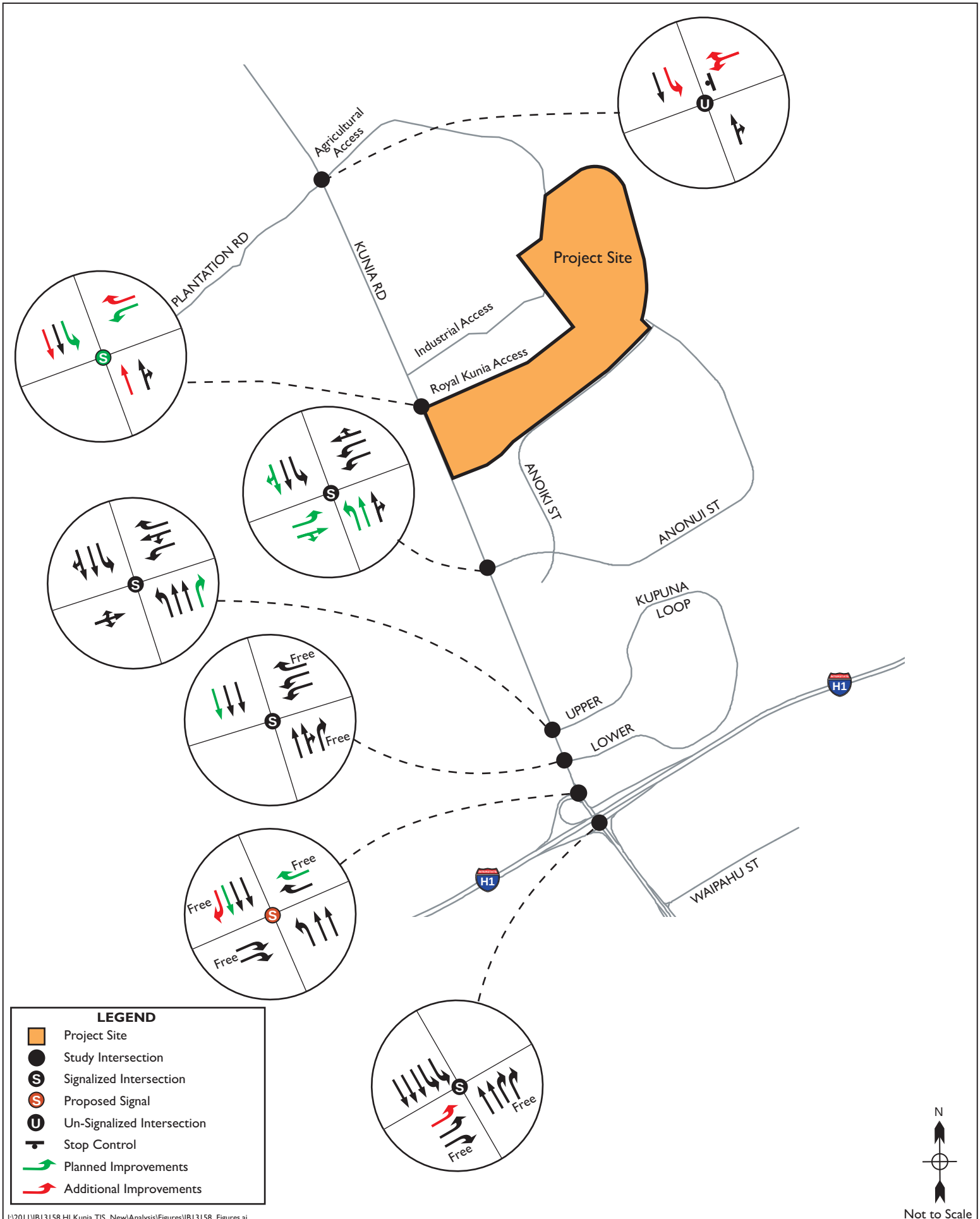
Intersection			AM Peak Hour				PM Peak Hour			
			Queue[1] (ft)		Delay[2]		Queue[1] (ft)		Delay[2]	
No.	Name	Approach	Movement	Length	(sec/veh)	LOS[3]	Movement	Length	(sec/veh)	LOS[3]
1	Kunia Rd at Agricultural Access	**Average**	--	--	**2.0**	**A**	--	--	**3.9**	**A**
3	Kunia Rd at Royal Kunia Access	**Average**	--	--	**>200**	**F**	--	--	**>200**	**F**
4	Kunia Rd at Anonui St	**Average**	--	--	**81.6**	**F**	--	--	**119.4**	**F**
5	Kunia Rd at Upper Kupuna Loop	**Average**	--	--	**16.5**	**B**	--	--	**39.8**	**D**
6	Kunia Rd at Lower Kupuna Loop	**Average**	--	--	**10.2**	**B**	--	--	**12.1**	**B**
7	Kunia Rd at H-1 WB Ramps	NB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		SB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		EB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		WB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Average	--	--	**n/a**	**n/a**	--	--	**n/a**	**n/a**
8	Kunia Rd at H-1 EB Ramps	NB	Thru	658	153.1	F	Thru	386	79.4	E
		SB	Left	629	73.4	E	Left	395	95.3	F
		EB	Left	540	68.5	E	Left	988	>200	F
		WB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Average	--	--	**117.9**	**F**	--	--	**104.1**	**F**

Note:

[1] 95th percentile queue length; Highlighted values show the volume exceeds capacity and queue may be longer

[2] HCM average control delay; Approach or intersection average delay.

[3] HCM Level of Service



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Royal Kunia Phase II Traffic Impact Study — Figure 35

Honolulu, Hawaii — Recommended Improvements for 2020 With Project Phase 1B Conditions

Kunia Road at H-1 Westbound Ramps (#7)

- Add a Third Southbound Through Lane

Table 38 shows the intersection operations analysis results for 2020 With Project Phase 1B conditions, with recommended mitigations. With recommended 2020 With Project Phase 1B intersection lane improvements, the study area intersections are projected to be mitigated to Level of Service "D" or better during the peak hours. The intersection operations analysis worksheets for 2020 With Project Phase 1B Conditions, with recommended mitigation measures, are included in Appendix W of this report.

10.5 Freeway Analysis for 2020 With Project Phase 1B Conditions

Freeway analysis was conducted using Highway Capacity Software (HCS) based on the analysis methodologies mentioned in Section 2 on this report. Table 39 below shows the freeway analysis results for 2020 With Project Phase 1B conditions. Appendix X contains the HCS freeway analysis worksheets for 2020 With Project Phase 1B Conditions. As shown in Table 39, the eastbound direction on the H-1 Freeway are projected to experience Level of Service F during the AM Peak hour.

Table 38 - 2020 With Project Phase 1B Conditions
Intersection Operations Analysis Summary.
With Recommended Mitigations

Intersection			AM Peak Hour				PM Peak Hour			
			Queue[1] (ft)		Delay[2]		Queue[1] (ft)		Delay[2]	
No.	Name	Approach	Movement	Length	(sec/veh)	LOS[3]	Movement	Length	(sec/veh)	LOS[3]
1	Kunia Rd at Agricultural Access	**Average**	--	--	**1.1**	A	--	--	**0.4**	A
3	Kunia Rd at Royal Kunia Access	**Average**	--	--	**20.9**	C	--	--	**8.3**	A
4	Kunia Rd at Anonui St	**Average**	--	--	**32.0**	C	--	--	**28.0**	C
5	Kunia Rd at Upper Kupuna Loop	**Average**	--	--	**9.8**	A	--	--	**17.0**	B
6	Kunia Rd at Lower Kupuna Loop	**Average**	--	--	**9.1**	A	--	--	**16.0**	B
7	Kunia Rd at H-1 WB Ramps	NB	Left	59	1.5	A	Left	309	9.7	A
		SB	Right	35	4.7	A	Right	159	5.4	A
		EB	Right	0	1.0	A	Right	301	91.6	F
		WB	Right	0	0.7	A	Right	235	18.8	B
		Average	--	--	**2.3**	A	--	--	**36.1**	D
8	Kunia Rd at H-1 EB Ramps	NB	Thru	621	47.7	D	Thru	340	20.2	C
		SB	Left	519	20.3	C	Left	253	52.6	D
		EB	Left	265	43.0	D	Left	355	72.6	E
		WB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Average	--	--	**30.6**	C	--	--	**50.3**	D

Note:

[1] 95th percentile queue length; Highlighted values show the volume exceeds capacity and queue may be longer.

[2] HCM average control delay; Approach or intersection average delay.

[3] HCM Level of Service

Table 39 - 2020 With Project Phase 1B Conditions
Freeway Analysis Summary

Freeway Facility				Number of Lanes		AM Peak Hour				PM Peak Hour			
						Traffic		Density[1]		Traffic		Density[1]	
Dir.	No.	Type	Location	Mainline	Ramp	Mainline	Ramp	(pc/mi/ln)	LOS[1]	Mainline	Ramp	(pc/mi/ln)	LOS[1]
H-1 Westbound	1	Mainline	e/o Kunia Slip Off-Ramp	4	--	5,450	--	21.6	C	5,958	--	23.7	C
	2	Off-Ramp	Kunia Slip Off-Ramp	4	1	5,450	682	27.3	C	5,958	1,662	34.4	D
	3	Mainline	btw Kunia Slip Off-Ramp & Kunia Loop Off-Ramp	4	--	4,768	--	18.9	C	4,296	--	17.1	B
	4	Off-Ramp	Kunia Loop Off-Ramp	3	2	4,768	1,612	5.0	A	4,296	2,848	9.3	A
	5	Mainline	btw Kunia Loop Off-Ramp & Kunia On-Ramp	3	--	3,156	--	17.1	B	1,448	--	7.8	A
	6	On-Ramp	Kunia On-Ramp	3	1	3,156	663	19.4	B	1,448	1,057	13.8	B
	7	Mainline	w/o Kunia On-Ramp	3	--	3,819	--	20.7	C	2,505	--	13.6	B
H-1 Eastbound	8	Mainline	w/o Kunia Off-Ramp	3	--	7,527	--	n/a	F	5,815	--	34.0	D
	9	Off-Ramp	Kunia Off-Ramp	3	1	7,527	789	40.5	F	5,815	956	34.7	D
	10	Mainline	btw Kunia Off-Ramp & Kunia On-Ramp	3	--	6,738	--	n/a	F	4,859	--	26.6	D
	11	On-Ramp	Kunia On-Ramp	3	1[2]+2	6,738	1,234	44.1	F	4,859	618	30.0	D
	12	Mainline	e/o Kunia On-Ramp	4+1[3]	--	11,783	--	n/a	F	8,631	--	27.9	D

Note:

[1] Density (passenger car per mile per lane) and Level of Service based on Highway Capacity Manual (HCM) methodologies.

[2] Ramp merging traffic is the volume on the left lane of the 3-lane H-1 Eastbound On-Ramp.

[3] Shoulder lane on the right side may be utilize during congested conditions.

11. 2023 With Project Phase 2A Traffic Conditions

11.1 Future Traffic Volumes for 2023 With Project Phase 2A Conditions

Future AM and PM peak hour intersection traffic volumes for 2023 With Project Phase 2A Conditions are shown in Figures 36 and 37. The future traffic forecast is estimated based on the methodologies are presented in Section 3. It should be noted that in addition to the project-only traffic, the 2023 With Project Phase 2A Conditions also includes cumulative development traffic in the vicinity of the project site as well as ambient background growth to account for other unidentified projects and general population growth. The project is only one of the many contributors to the overall traffic growth.

11.2 Future Planned Improvements

It should be noted that the 2023 With Project Phase 2A Conditions have the same planned improvements as the 2018 Without Project Conditions which were listed in previous Section 5.2 of this report.

11.3 Intersection Operations Analysis for 2023 With Project Phase 2A Conditions

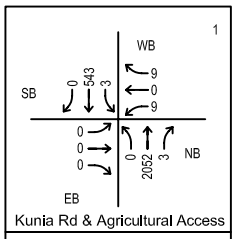
Table 40 summarizes the results for the 2023 With Project Phase 2A Conditions intersection level of service analysis, with existing geometry and planned improvements. As shown in Table 40, the following study area intersections are projected to operate at Level of Service "E" or worse for 2023 With Project Phase 2A Conditions during the peak hours, with existing lane geometry and planned improvements:

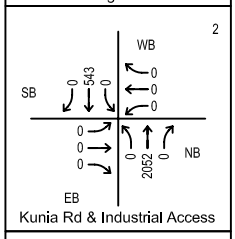
- Kunia Road at Royal Kunia Access (#3)
- Kunia Road at Anonui Street (#4)
- Kunia Road at Upper Kupuna Loop (#5)
- Kunia Road at H-1 Eastbound Ramps (#8)

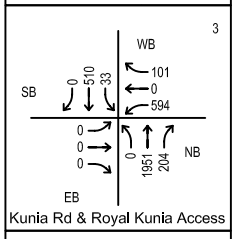
Appendix Y contains the analysis worksheets for 2023 With Project Phase 2A Conditions, with existing lane geometry and planned improvements.

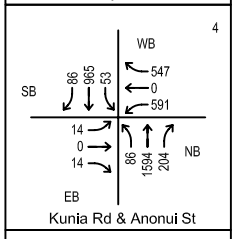
11.4 Recommended Improvements for Year 2023 With Project Phase 2A Conditions

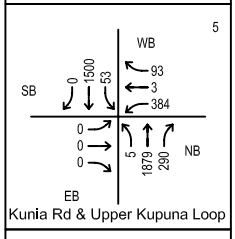
Figure 38 shows the recommended roadway network and intersection lane geometry for 2023 With Project Phase 2A Conditions to mitigate the traffic impact. In addition to the recommended 2020 With Project Phase 1B improvements previously listed in Section 10.4, the following additional improvements are recommended to accommodate 2023 With Project Phase 2A Conditions:

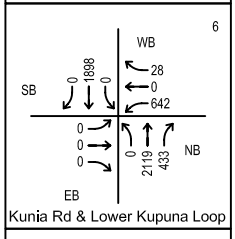


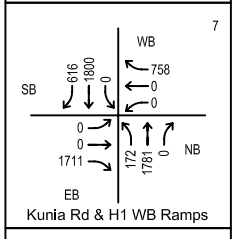


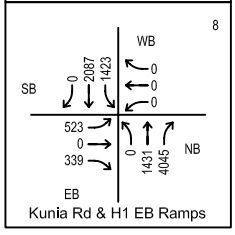












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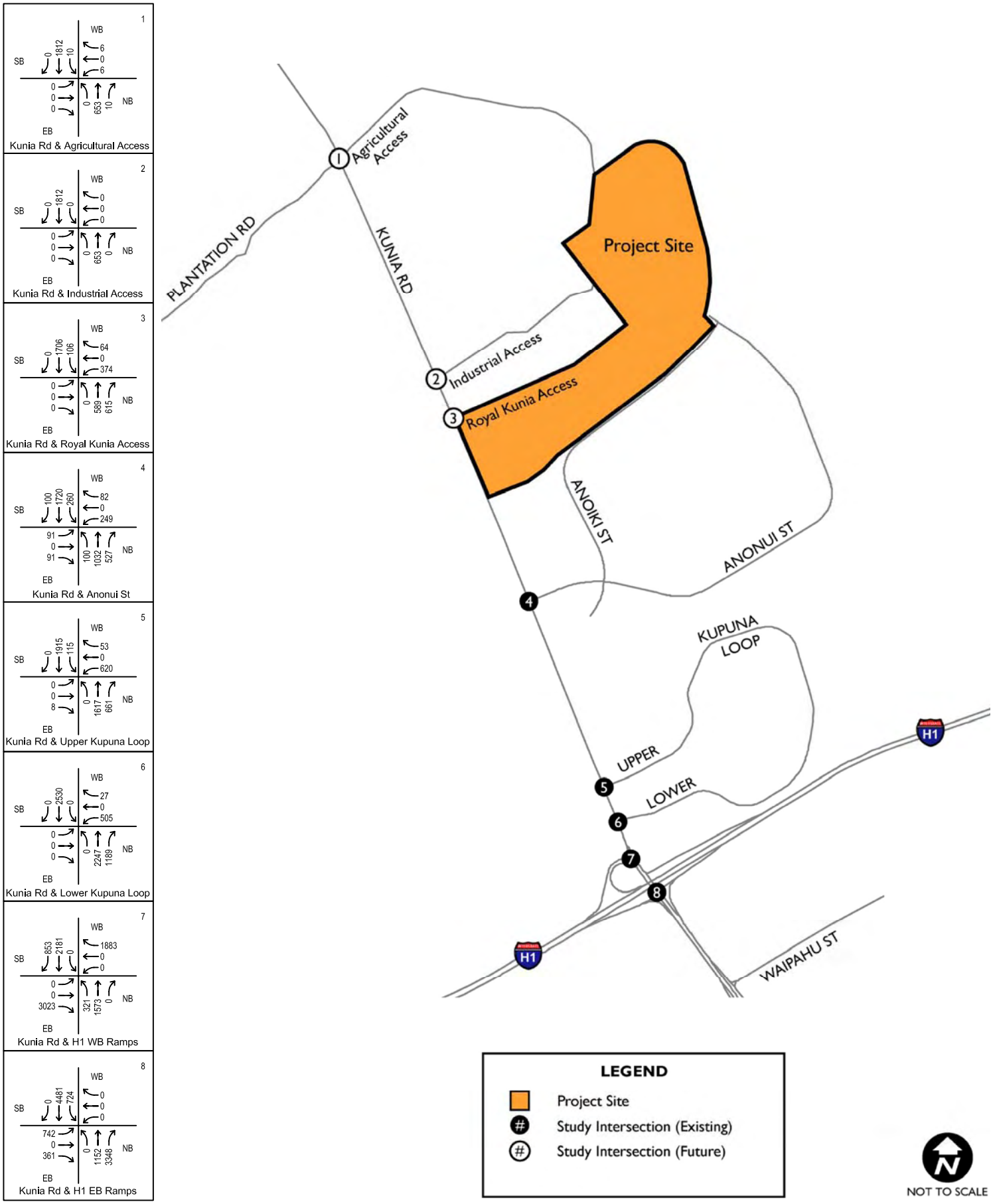
Royal Kunia Phase II Traffic Impact Study — Figure 36

Honolulu, Hawaii — 2023 With Project AM Peak Hour Intersection Movement Volumes



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Royal Kunia Phase II Traffic Impact Study — Figure 37

Honolulu, Hawaii — 2023 With Project PM Peak Hour Intersection Movement Volumes

Table 40 - 2023 With Project Phase 2A Conditions
Intersection Operations Analysis Summary,
With Existing Geometry

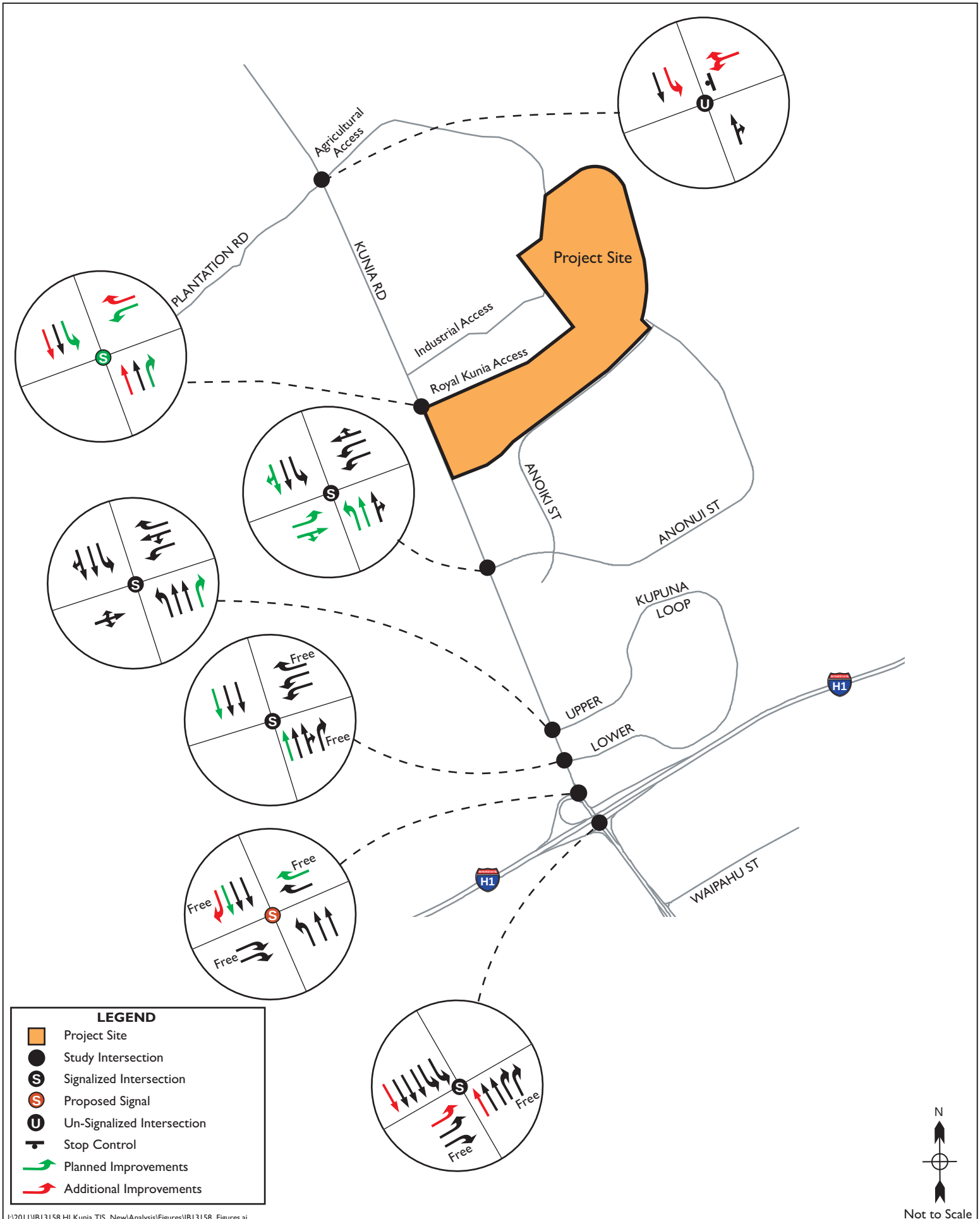
Intersection			AM Peak Hour				PM Peak Hour			
			Queue[1] (ft)		Delay[2]		Queue[1] (ft)		Delay[2]	
No.	Name	Approach	Movement	Length	(sec/veh)	LOS[3]	Movement	Length	(sec/veh)	LOS[3]
1	Kunia Rd at Agricultural Access	**Average**	--	--	**2.9**	**A**	--	--	**4.3**	**A**
3	Kunia Rd at Royal Kunia Access	**Average**	--	--	**>200**	**F**	--	--	**>200**	**F**
4	Kunia Rd at Anonui St	**Average**	--	--	**124.1**	**F**	--	--	**>200**	**F**
5	Kunia Rd at Upper Kupuna Loop	**Average**	--	--	**37.1**	**D**	--	--	**81.9**	**F**
6	Kunia Rd at Lower Kupuna Loop	**Average**	--	--	**12.3**	**B**	--	--	**21.6**	**C**
7	Kunia Rd at H-1 WB Ramps	NB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		SB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		EB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		WB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Average	--	--	**n/a**	**n/a**	--	--	**n/a**	**n/a**
8	Kunia Rd at H-1 EB Ramps	NB	Thru	721	185.4	F	Thru	424	99.3	E
		SB	Left	765	112.9	F	Left	496	130.5	F
		EB	Left	622	94.8	F	Left	1,222	>200	F
		WB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Average	--	--	**151.6**	**F**	--	--	**142.1**	**F**

Note:

[1] 95th percentile queue length; Highlighted values show the volume exceeds capacity and queue may be longer

[2] HCM average control delay; Approach or intersection average delay.

[3] HCM Level of Service



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Royal Kunia Phase II Traffic Impact Study — Figure 38

Honolulu, Hawaii — Recommended Improvements for 2023 With Project Phase 2A Conditions

Kunia Road at Royal Kunia Access (#3)

- Add a Northbound Right-Turn Lane

Kunia Road at Lower Kupuna Loop (#6)

- Add a Third Northbound Through Lane

Kunia Road at H-1 Eastbound Ramps (#8)

- Add a Third Northbound Through Lane
- Add a Fourth Southbound Through Lane

Table 41 shows the intersection operations analysis results for 2023 With Project Phase 2A conditions, with recommended mitigations. With recommended 2023 With Project Phase 2A intersection lane improvements, the study area intersections are projected to be mitigated to Level of Service "D" or better during the peak hours. The intersection operations analysis worksheets for 2023 With Project Phase 2A Conditions, with recommended mitigation measures, are included in Appendix Z of this report.

11.5 Freeway Analysis for 2023 With Project Phase 2A Conditions

Freeway analysis was conducted using Highway Capacity Software (HCS) based on the analysis methodologies mentioned in Section 2 on this report. Table 42 below shows the freeway analysis results for 2023 With Project Phase 2A conditions. Appendix AA contains the HCS freeway analysis worksheets for 2023 With Project Phase 2A Conditions. As shown in Table 42, the eastbound direction on the H-1 Freeway are projected to experience Level of Service F during the AM Peak hour and Level of Service E during the PM peak hour.

Table 41 - 2023 With Project Phase 2A Conditions
Intersection Operations Analysis Summary.
With Recommended Mitigations

Intersection			AM Peak Hour				PM Peak Hour			
			Queue[1] (ft)		Delay[2]		Queue[1] (ft)		Delay[2]	
No.	Name	Approach	Movement	Length	(sec/veh)	LOS[3]	Movement	Length	(sec/veh)	LOS[3]
1	Kunia Rd at Agricultural Access	**Average**	--	--	**1.5**	A	--	--	**0.5**	A
3	Kunia Rd at Royal Kunia Access	**Average**	--	--	**40.6**	D	--	--	**13.7**	B
4	Kunia Rd at Anonui St	**Average**	--	--	**38.3**	D	--	--	**37.4**	D
5	Kunia Rd at Upper Kupuna Loop	**Average**	--	--	**11.6**	B	--	--	**20.7**	C
6	Kunia Rd at Lower Kupuna Loop	**Average**	--	--	**8.2**	A	--	--	**11.4**	B
7	Kunia Rd at H-1 WB Ramps	NB	Left	0	0.8	A	Left	259	9.3	A
		SB	Right	27	5.9	A	Right	536	11.7	B
		EB	Right	0	1.2	A	Right	438	118.6	F
		WB	Right	0	0.3	A	Right	0.0	1.0	A
		Average	--	--	**2.7**	A	--	--	**42.0**	D
8	Kunia Rd at H-1 EB Ramps	NB	Thru	432	43.3	D	Thru	256	23.2	C
		SB	Left	570	13.9	B	Left	231	14.2	B
		EB	Left	284	39.5	D	Left	394	54.5	D
		WB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Average	--	--	**25.0**	C	--	--	**21.6**	C

Note:

[1] 95th percentile queue length; Highlighted values show the volume exceeds capacity and queue may be longer.

[2] HCM average control delay; Approach or intersection average delay.

[3] HCM Level of Service

Table 42 - 2023 With Project Phase 2A Conditions
Freeway Analysis Summary

Freeway Facility				Number of Lanes		AM Peak Hour				PM Peak Hour			
						Traffic		Density[1]		Traffic		Density[1]	
Dir.	No.	Type	Location	Mainline	Ramp	Mainline	Ramp	(pc/mi/ln)	LOS[1]	Mainline	Ramp	(pc/mi/ln)	LOS[1]
H-1 Westbound	1	Mainline	e/o Kunia Slip Off-Ramp	4	--	5,818	--	23.1	C	6,442	--	25.9	C
	2	Off-Ramp	Kunia Slip Off-Ramp	4	1	5,818	758	29.2	D	6,442	1,883	37.5	F
	3	Mainline	btw Kunia Slip Off-Ramp & Kunia Loop Off-Ramp	4	--	5,060	--	20.1	C	4,559	--	18.1	C
	4	Off-Ramp	Kunia Loop Off-Ramp	3	2	5,060	1,711	6.7	A	4,559	3,023	11.2	B
	5	Mainline	btw Kunia Loop Off-Ramp & Kunia On-Ramp	3	--	3,349	--	18.1	C	1,536	--	8.3	A
	6	On-Ramp	Kunia On-Ramp	3	1	3,349	788	21.3	C	1,536	1,174	15.2	B
	7	Mainline	w/o Kunia On-Ramp	3	--	4,137	--	22.4	C	2,710	--	14.7	B
H-1 Eastbound	8	Mainline	w/o Kunia Off-Ramp	3	--	8,012	--	n/a	F	6,260	--	39.0	E
	9	Off-Ramp	Kunia Off-Ramp	3	1	8,012	862	42.1	F	6,260	1,103	36.7	E
	10	Mainline	btw Kunia Off-Ramp & Kunia On-Ramp	3	--	7,150	--	n/a	F	5,157	--	28.6	D
	11	On-Ramp	Kunia On-Ramp	3	1[2]+2	7,150	1,423	47.6	F	5,157	724	32.3	D
	12	Mainline	e/o Kunia On-Ramp	4+1[3]	--	12,618	--	n/a	F	9,229	--	30.6	D

Note:

[1] Density (passenger car per mile per lane) and Level of Service based on Highway Capacity Manual (HCM) methodologies.

[2] Ramp merging traffic is the volume on the left lane of the 3-lane H-1 Eastbound On-Ramp.

[3] Shoulder lane on the right side may be utilize during congested conditions.

12. 2025 With Project Phase 2B Traffic Conditions

12.1 Future Traffic Volumes for 2025 With Project Phase 2B Conditions

Future AM and PM peak hour intersection traffic volumes for 2025 With Project Phase 2B Conditions are shown in Figures 39 and 40. The future traffic forecast is estimated based on the methodologies are presented in Section 3. It should be noted that in addition to the project-only traffic, the 2025 With Project Phase 2B Conditions also includes cumulative development traffic in the vicinity of the project site as well as ambient background growth to account for other unidentified projects and general population growth. The project is only one of the many contributors to the overall traffic growth.

12.2 Future Planned Improvements

It should be noted that the 2025 With Project Phase 2B Conditions have the same planned improvements as the 2018 Without Project Conditions which were listed in previous Section 5.2 of this report.

12.3 Intersection Operations Analysis for 2025 With Project Phase 2B Conditions

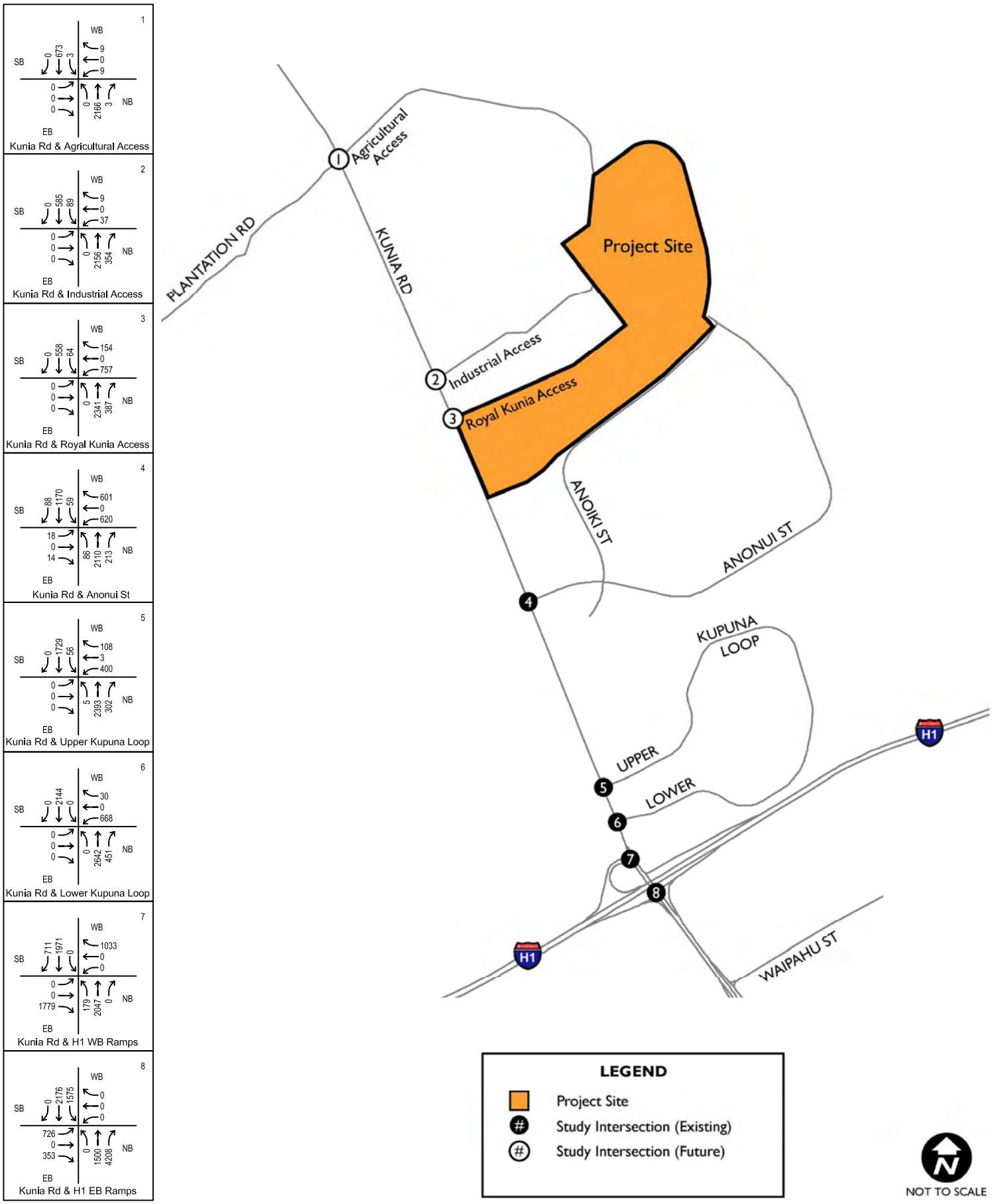
Table 41 summarizes the results for the 2025 With Project Phase 2B Conditions intersection level of service analysis, with existing geometry and planned improvements. As shown in Table 41, the following study area intersections are projected to operate at Level of Service "E" or worse for 2025 With Project Phase 2B Conditions during the peak hours, with existing lane geometry and planned improvements:

- Kunia Road at Industrial Access (#2)
- Kunia Road at Royal Kunia Access (#3)
- Kunia Road at Anonui Street (#4)
- Kunia Road at Upper Kupuna Loop (#5)
- Kunia Road at Lower Kupuna Loop (#6)
- Kunia Road at H-1 Eastbound Ramps (#8)

Appendix BB contains the analysis worksheets for 2025 With Project Phase 2B Conditions, with existing lane geometry and planned improvements.

12.4 Recommended Improvements for Year 2025 With Project Phase 2B Conditions

Figure 41 shows the recommended roadway network and intersection lane geometry for 2025 With Project Phase 2B Conditions to mitigate the traffic impact. In addition to the recommended 2023 With Project Phase 2A improvements previously listed in Section 11.4, the following additional improvements are recommended to accommodate 2025 With Project Phase 2B Conditions:



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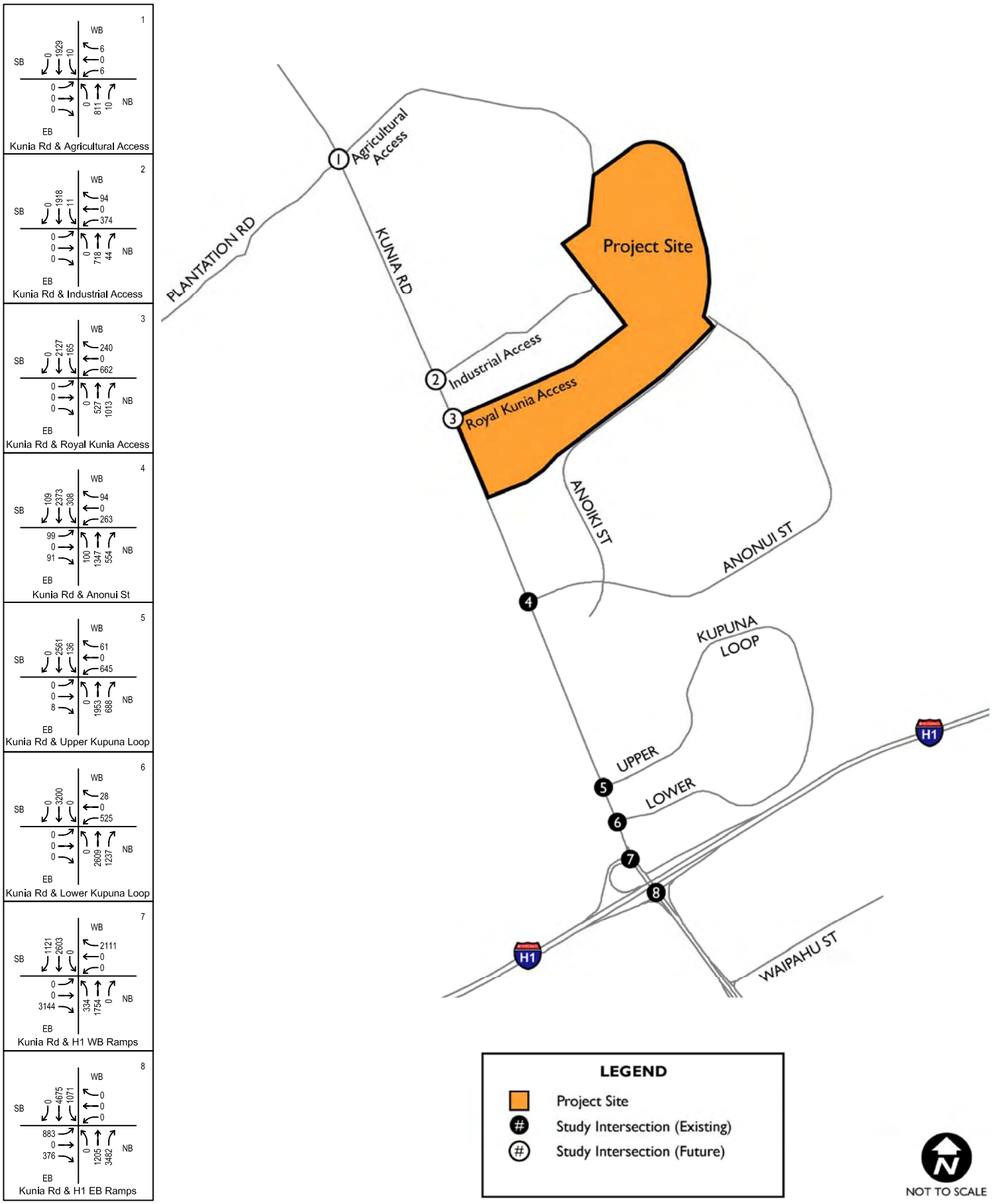
Royal Kunia Phase II Traffic Impact Study — Figure 39

Honolulu, Hawaii — 2025 With Project AM Peak Hour Intersection Movement Volumes



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Royal Kunia Phase II Traffic Impact Study — Figure 40

Honolulu, Hawaii — 2025 With Project PM Peak Hour Intersection Movement Volumes

Table 43 - 2025 With Project Phase 2B Conditions
Intersection Operations Analysis Summary,
With Existing Geometry

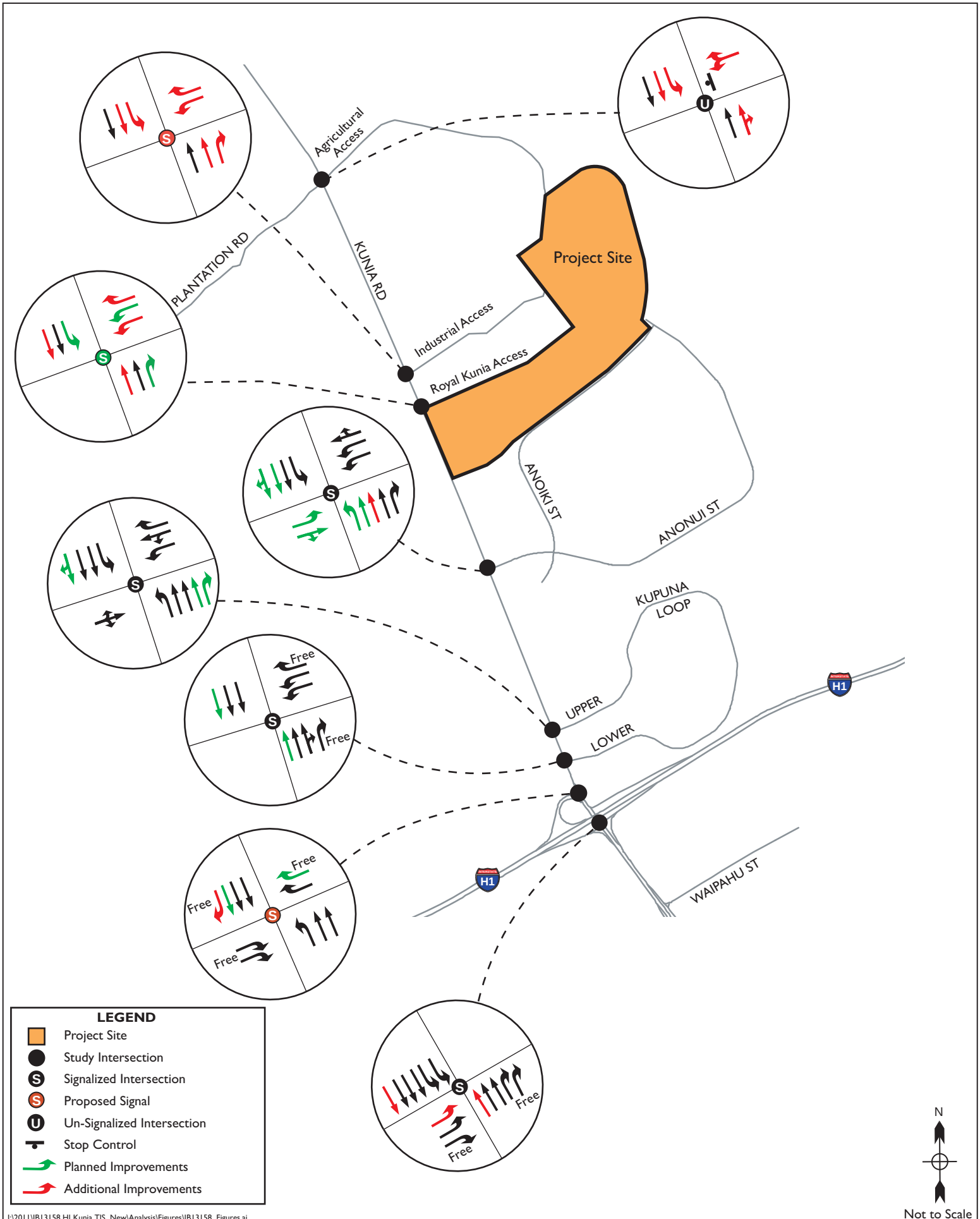
Intersection			AM Peak Hour				PM Peak Hour			
			Queue[1] (ft)		Delay[2]		Queue[1] (ft)		Delay[2]	
No.	Name	Approach	Movement	Length	(sec/veh)	LOS[3]	Movement	Length	(sec/veh)	LOS[3]
1	Kunia Rd at Agricultural Access	**Average**	--	--	**4.7**	**A**	--	--	**4.6**	**A**
2	Kunia Rd at Industrial Access	**Average**	--	--	**153.1**	**F**	--	--	**>200**	**F**
3	Kunia Rd at Royal Kunia Access	**Average**	--	--	**>200**	**F**	--	--	**>200**	**F**
4	Kunia Rd at Anonui St	**Average**	--	--	**>200**	**F**	--	--	**>200**	**F**
5	Kunia Rd at Upper Kupuna Loop	**Average**	--	--	**109.3**	**F**	--	--	**151.8**	**F**
6	Kunia Rd at Lower Kupuna Loop	**Average**	--	--	**43.9**	**D**	--	--	**83.4**	**F**
7	Kunia Rd at H-1 WB Ramps	NB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		SB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		EB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		WB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Average	--	--	**n/a**	**n/a**	--	--	**n/a**	**n/a**
8	Kunia Rd at H-1 EB Ramps	NB	Thru	773	>200	F	Thru	453	113.8	F
		SB	Left	836	147.4	F	Left	822	195.0	F
		EB	Left	926	>200	F	Left	1,479	>200	F
		WB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Average	--	--	**189.1**	**F**	--	--	**195.6**	**F**

Note:

[1] 95th percentile queue length; Highlighted values show the volume exceeds capacity and queue may be longer; OC = Over-Capacity

[2] HCM average control delay; Approach or intersection average delay.

[3] HCM Level of Service



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Royal Kunia Phase II Traffic Impact Study — Figure 41

Honolulu, Hawaii — Recommended Improvements for 2025 With Project Phase 2B Conditions

Kunia Road at Agricultural Access (#1)

- Add a Second Northbound Through Lane
- Add a Second Southbound Through Lane

Kunia Road at Industrial Access (#2)

- Install a Traffic Signal
- Add a Second Northbound Through Lane
- Add a Northbound Right-Turn Lane
- Add a Southbound Left-Turn Lane
- Add a Second Southbound Through Lane
- Add a Westbound Left-Turn Lane
- Add a Westbound Right-Turn Lnae

Kunia Road at Anonui Street (#4)

- Add a Third Northbound Through Lane

Kunia Road at Upper Kupuna Loop (#5)

- Add a Third Northbound Through Lane
- Add a Third Southbound Through Lane

Table 44 shows the intersection operations analysis results for 2025 With Project Phase 2A conditions, with recommended mitigations With recommended 2025 With Project Phase 2B intersection lane improvements, the study area intersections are projected to be mitigated to Level of Service "D" or better during the peak hours. The intersection operations analysis worksheets for 2025 With Project Phase 2B Conditions, with recommended mitigation measures, are included in Appendix CC of this report.

12.5 Freeway Analysis for 2025 With Project Phase 2B Conditions

Freeway analysis was conducted using Highway Capacity Software (HCS) based on the analysis methodologies mentioned in Section 2 on this report. Table 45 below shows the freeway analysis results for 2023 With Project Phase 2B conditions. Appendix DD contains the HCS freeway analysis worksheets for 2023 With Project Phase 2A Conditions. As shown in Table 45, the eastbound direction on the H-1 Freeway are projected to experience Level of Service F during the AM Peak hour and Level of Service E during the PM peak hour.

Table 44 - 2025 With Project Phase 2B Conditions
Intersection Operations Analysis Summary.
With Recommended Mitigations

Intersection			AM Peak Hour				PM Peak Hour			
			Queue[1] (ft)		Delay[2]		Queue[1] (ft)		Delay[2]	
No.	Name	Approach	Movement	Length	(sec/veh)	LOS[3]	Movement	Length	(sec/veh)	LOS[3]
1	Kunia Rd at Agricultural Access	**Average**	--	--	**1.3**	A	--	--	**0.2**	A
2	Kunia Rd at Industrial Access	**Average**	--	--	**6.7**	A	--	--	**18.2**	B
3	Kunia Rd at Royal Kunia Access	**Average**	--	--	**36.9**	D	--	--	**21.3**	C
4	Kunia Rd at Anonui St	**Average**	--	--	**30.5**	C	--	--	**27.6**	C
5	Kunia Rd at Upper Kupuna Loop	**Average**	--	--	**10.5**	B	--	--	**18.5**	B
6	Kunia Rd at Lower Kupuna Loop	**Average**	--	--	**9.1**	A	--	--	**16.9**	B
7	Kunia Rd at H-1 WB Ramps	NB	Left	0	0.1	A	Left	312	12.3	B
		SB	Right	42	9.9	A	Right	982	14.3	B
		EB	Right	0	1.3	A	Right	532	138.2	F
		WB	Right	0	0.4	A	Right	0.0	2.5	A
		Average	--	--	**3.8**	A	--	--	**46.8**	D
8	Kunia Rd at H-1 EB Ramps	NB	Thru	506	80.3	F	Thru	322	34.6	C
		SB	Left	680	29.0	C	Left	410	43.3	D
		EB	Left	393	60.6	E	Left	465	65.4	E
		WB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Average	--	--	**46.5**	D	--	--	**45.4**	D

Note:

[1] 95th percentile queue length; Highlighted values show the volume exceeds capacity and queue may be longer.

[2] HCM average control delay; Approach or intersection average delay.

[3] HCM Level of Service

Table 45 - 2025 With Project Phase 2B Conditions
Freeway Analysis Summary

Freeway Facility				Number of Lanes		AM Peak Hour				PM Peak Hour			
						Traffic		Density[1]		Traffic		Density[1]	
Dir.	No.	Type	Location	Mainline	Ramp	Mainline	Ramp	(pc/mi/ln)	LOS[1]	Mainline	Ramp	(pc/mi/ln)	LOS[1]
H-1 Westbound	1	Mainline	e/o Kunia Slip Off-Ramp	4	--	6,298	--	25.2	C	6,854	--	27.9	D
	2	Off-Ramp	Kunia Slip Off-Ramp	4	1	6,298	1,033	32.5	D	6,854	2,111	40.3	F
	3	Mainline	btw Kunia Slip Off-Ramp & Kunia Loop Off-Ramp	4	--	5,265	--	20.9	C	4,743	--	18.8	C
	4	Off-Ramp	Kunia Loop Off-Ramp	3	2	5,265	1,779	7.9	A	4,743	3,144	12.6	B
	5	Mainline	btw Kunia Loop Off-Ramp & Kunia On-Ramp	3	--	3,486	--	18.9	C	1,599	--	8.7	A
	6	On-Ramp	Kunia On-Ramp	3	1	3,486	890	22.8	C	1,599	1,455	17.7	B
	7	Mainline	w/o Kunia On-Ramp	3	--	4,376	--	23.7	C	3,054	--	16.5	B
H-1 Eastbound	8	Mainline	w/o Kunia Off-Ramp	3	--	8,518	--	n/a	F	6,624	--	44.6	E
	9	Off-Ramp	Kunia Off-Ramp	3	1	8,518	1,079	43.8	F	6,624	1,259	38.3	E
	10	Mainline	btw Kunia Off-Ramp & Kunia On-Ramp	3	--	7,439	--	n/a	F	5,365	--	30.1	D
	11	On-Ramp	Kunia On-Ramp	3	1[2]+2	7,439	1,575	50.2	F	5,365	1,071	36.0	E
	12	Mainline	e/o Kunia On-Ramp	4+1[3]	--	13,222	--	n/a	F	9,918	--	34.5	D

Note:

[1] Density (passenger car per mile per lane) and Level of Service based on Highway Capacity Manual (HCM) methodologies.

[2] Ramp merging traffic is the volume on the left lane of the 3-lane H-1 Eastbound On-Ramp.

[3] Shoulder lane on the right side may be utilize during congested conditions.

13. RECOMMENDED IMPROVEMENTS

Under future traffic scenarios, the study area intersections are expected to have poor levels of service. Improvement measures have been evaluated for all future with project scenarios. The purpose of the recommended improvements is to improve traffic operations for the study area intersections. It should be noted that the recommended improvements for each horizon year are needed to serve overall traffic growth which includes the project-only traffic and cumulative development traffic as well as ambient background traffic growth. This accounts for other unidentified projects and general population growth. The project is only one of the many contributors to the overall traffic growth.

It is recommended that the traffic study be updated periodically every 5 years to monitor the actual traffic growth and provide appropriate mitigation measures.

Recommended improvement measures and intersection operation performance improvements are reported in this section. Figures 20, 23, 26, 29, 32, 35, 38 and 41 summarize the recommended intersection lane geometry to mitigate the traffic impact for the following analysis conditions:

- 2018 Without Project conditions, with existing lane geometry and planned improvements
- 2020 Without Project conditions, with existing lane geometry and planned improvements
- 2023 Without Project conditions, with existing lane geometry and planned improvements
- 2025 Without Project conditions, with existing lane geometry and planned improvements
- 2018 With Project Phase 1A conditions, with recommended intersection improvements
- 2020 With Project Phase 1B conditions, with recommended intersection improvements
- 2023 With Project Phase 2A conditions, with recommended intersection improvements
- 2025 With Project Phase 2B conditions, with recommended intersection improvements

Table 46 summarizes the recommended intersection improvements for the various analysis scenarios in a tabular format.

13.1 Year 2018, 2020, 2023 Without Project Improvements

It should be noted that the three "Without Project" scenarios for 2018, 2020 and 2023 conditions have the same recommended improvements.

For 2018, 2020 and 2023 Without Project Conditions, the list of recommended improvements includes planned improvements that are anticipated to be completed by agencies and other cumulative developments. Figures 20, 23 and 26 illustrate the recommended roadway network and intersection lane geometry for the 2018, 2020 and 2023 Without Project Conditions. The following planned intersection improvements are anticipated:

Table 46 (1 of 2) - Intersection Mitigation Summary

Intersection	Recommended Intersection Improvements					
	2018, 2020, 2023 Without Project	**2025 Without Project**	**2018 With Project Phase 1A**	**2020 With Project Phase 1B**	**2023 With Project Phase 2A**	**Year 2025 Project Phase 2B**
1 Kunia Rd at Agricultural Access	• Install WB Stop Sign • Add a WB All-Way Lane • Add a SB Left-Turn Lane	• No additional improvements	• No additional improvements	• No additional improvements	• No additional improvements	• Add a 2nd NB Thru Lane • Add a 2nd SB Thru Lane
2 Kunia Rd at Industrial Access	• None	• None	• No additional improvements	• No additional improvements	• No additional improvements	• Install a Traffic Signal • Add a 2nd NB Thru Lane • Add a NB Right-Turn Lane • Add a SB Left-Turn Lane • Add a 2nd SB Thru Lane • Add a WB Left-Turn Lane • Ad a WB Right-Turn Lane
3 Kunia Rd at Royal Kunia Access	• None	• None	• Install a Traffic Signal • Add a 2nd NB Thru Lane • Add a SB Left-Turn Lane • Add a 2nd SB Thru Lane • Add a WB Left-Turn Lane • A a EB Left-Turn Lane	• No additional improvements	• Add a NB Right-Turn Lane	• No additional improvements

Table 46 (2 of 2) - Intersection Mitigation Summary

Intersection	Recommended Intersection Improvements					
	2018, 2020, 2023 Without Project	**2025 Without Project**	**2018 With Project Phase 1A**	**2020 With Project Phase 1B**	**2023 With Project Phase 2A**	**Year 2025 Project Phase 2B**
4 Kunia Rd at Anonui St	• Add a NB Left-Turn Lane • Add a EB Left-Turn Lane • Add a EB Thru-Right Lane • Add a 2nd SB Thru Lane	• No additional improvements	• No additional improvements	• No additional improvements	• No additional improvements	• Add a 3rd NB Thru Lane
5 Kunia Rd at Upper Kupuna Loop	• None	• None	• No additional improvements	• Add a NB Right-Turn Lane	• No additional improvements	• Add a 3rd NB Thru Lane • Add a 3rd SB Thru Lane
6 Kunia Rd at Lower Kupuna Loop	• None	• None	• Add a 3rd SB Thru Lane	• No additional improvements	• Add a 3rd NB Thru Lane	• No additional improvements
7 Kunia Rd at H-1 WB Ramps	• Install a Partial Signal for NB Left-Turn and SB Thru movements • Add a SB Free-Right Turn Lane	• No additional improvements	• Add a 2nd WB Free-Right Turn Lane	• Add a 3rd SB Thru Lane	• No additional improvements	• No additional improvements
8 Kunia Rd at H-1 EB Ramps	• Add a 2nd EB Left-Turn Lane	• Add a 4th SB Thru Lane	• No additional improvements	• No additional improvements	• Add a 3rd NB Thru Lane • Add a 4th SB Thru Lane	• No additional improvements

Kunia Road at Agricultural Access (#1)

- Install Westbound Stop Sign
- Add a Westbound All-Way Lane
- Add a Southbound Left-Turn Lane

Kunia Road at Anonui Street (#4)

- Add a Northbound Left-Turn Lane
- Add a Eastbound Left-Turn Lane
- Add a Eastbound Through-Right Lane

In addition to the planned improvements that are listed above, the following additional improvements are recommended to accommodate 2018, 2020 and 2023 Without Project Conditions:

Kunia Road at Anonui Street (#4)

- Add a Second Southbound Through Lane

Kunia Road at H-1 Westbound Ramps (#7)

- Install a partial signal for the northbound Left-Turn and southbound through movements
- Add a Southbound Free-Right Turn Lane

Kunia Road at H-1 Eastbound Ramps (#8)

- Add a Second Eastbound Left-Turn Lane

13.2 Year 2025 Without Project Improvements

Figure 29 illustrates the recommended roadway network and intersection lane geometry for 2025 Without Project Condition. In addition to the 2018, 2020 and 2023 Without Project improvements listed above, the following additional improvement is recommended to accommodate 2025 Without Project Condition:

Kunia Road at H-1 Eastbound Ramps (#8)

- Add a Fourth Southbound Through Lane

13.3 Year 2018 With Project Phase 1A Improvements

Three study area intersections require improvements due to significant traffic impacts from the Royal Kunia project in Year 2018. These intersections are expected to have poor levels of service due to the combination of background traffic growth and traffic generated by the project. The following intersections are expected to be impacted by the project. Recommended mitigation measures are described for each intersection. Figure 32 illustrates the recommended roadway network and

intersection lane geometry for the 2018 With Project Phase 1A Conditions, showing the recommended improvement measures designed to mitigate the traffic impacts at the study intersections.

13.3.1 Kunia Road at Royal Kunia Access (#3)

The intersection of Kunia Road at Royal Kunia Access is the main access for the project site. A traffic signal is warranted at this intersection based on future traffic volumes. Adjacent to the project site, Kunia Road needs to be widened to a four-lane roadway to accommodate future traffic due to ambient background growth and additional project traffic. The following additional improvements are recommended at the intersection of Kunia Road and Royal Kunia Access:

Kunia Road at Royal Kunia Access (#3)

- Install a Traffic Signal
- Add a Second Northbound Through Lane
- Add a Southbound Left-Turn Lane
- Add a Second Southbound Through Lane
- Add a Westbound Left-Turn Lane
- Add a Eastbound Left-Turn Lane

13.3.2 Kunia Road at Lower Kupuna Loop (#6)

The southbound through traffic at the intersection of Kunia Road and Kupuna Loop will experience high growth due to the proposed project and ambient background growth. The PM peak hour southbound through traffic is 1,958 vehicles, and much of the traffic is accessing the H-1 Freeway. Additional through lane capacity on Kunia Road is recommended at this location. The following additional improvement is recommended at the intersection of Kunia Road and Lower Kupuna Loop:

Kunia Road at Lower Kupuna Loop (#6)

- Add a Third Southbound Through Lane

13.3.3 Kunia Road at H-1 Westbound Ramps (#7)

The westbound right turn movement that exits the H-1 Westbound Off-Ramp will exceed the theoretical capacity of a single free-right turn lane with a PM peak hour traffic volumes of 1,412 vehicles. Additional right turn lane capacity at the H-1 Westbound Off-Ramp is recommended at this location. The following additional improvement is recommended at the intersection of Kunia Road and H-1 Westbound Ramps:

Kunia Road at H-1 Westbound Ramps (#7)

- Add a Second Westbound Free-Right Turn Lane

13.4 Year 2020 With Project Phase 1B Improvements

Four study area intersections are expected to experience significant traffic impacts from the Royal Kunia project in Year 2020. These intersections are expected to have poor levels of service due to the combination of traffic generated by the proposed project and area background traffic growth. Recommended mitigation measures for two additional intersections are described below in addition to improvements for previous phase of the project. Figure 35 shows the recommended roadway network and intersection lane geometry for the 2020 With Project Phase 1B Conditions to mitigate the traffic impact at the study intersections.

13.4.1 Kunia Road at Upper Kupuna Loop (#5)

The intersection of Kunia Road at Kupuna Loop is expected to have moderate increases in traffic from the proposed project and from background traffic in 2020, particularly for the northbound and southbound through movements. By providing a dedicated northbound right turn lane to accommodate the high PM peak hour right turn traffic of 605 vehicles, the northbound through capacity on Kunia Road will also be improved. The following improvement measure for this intersection is therefore recommended to mitigate the Project Phase 1B impacts in 2020:

Kunia Road at Upper Kupuna Loop (#5)

- Add a Northbound Right-Turn Lane

13.4.2 Kunia Road at H-1 Westbound Ramps (#7)

The intersection of Kunia Road at H-1 Westbound Ramps will experience a significant increase in north-south through traffic by 2020. Additional southbound through capacity is recommended on Kunia Road. It is recommended that the project traffic impact be mitigated by the following improvements:

Kunia Road at H-1 Westbound Ramps (#7)

- Add a Third Southbound Through Lane

13.5 Year 2023 With Project Phase 2A Improvements

Three study area intersections are expected to require additional improvements by 2023 to accommodate the combination of traffic generated by the proposed Project Phase 2A and background traffic growth. The following traffic mitigation measures are required for these intersections to accommodate these traffic increases. Figure 38 shows the recommended roadway network and intersection lane geometry for the 2023 With Project Phase 2A Conditions to mitigate the traffic impact within the study area.

13.5.1 Kunia Road at Royal Kunia Access (#3)

By 2023 during Phase 2A of the project, the northbound right turn volumes at the project access is expected to increase to 615 vehicles during the PM peak hour. It is recommended a dedicated

northbound right turn lane be provided to accommodate the project traffic. The following improvement measures are recommended to accommodate project traffic growth at this intersection:

Kunia Road at Royal Kunia Access (#3)

- Add a Northbound Right-Turn Lane

13.5.2 Kunia Road at Lower Kupuna Loop (#6)

Phase 2A of the project will require lane improvements at this intersection. Project traffic increases will be primarily to north-south through traffic. The Project Phase 2A impact at this intersection can be mitigated by increasing northbound through capacity with the following recommended improvements:

Kunia Road at Lower Kupuna Loop (#6)

- Add a Third Northbound Through Lane

13.5.3 Kunia Road at H-1 Eastbound Ramps (#8)

The intersection of Kunia Road at H-1 Eastbound Ramps is expected to have significant increases in traffic from the proposed project and from background traffic by 2023. These increases will be for all approaches. The following improvement measures are recommended to accommodate project traffic growth at this intersection:

Kunia Road at H-1 Eastbound Ramps (#8)

- Add a Third Northbound Through Lane
- Add a Fourth Southbound Through Lane

The additional southbound through lane may begin after the H-1 Freeway bridge. The improvements recommended in this traffic study do not require the widening of bridge for the H-1 Freeway.

13.6 Year 2025 With Project Phase 2B Improvements

Four study area intersections are expected to require additional improvements by 2025 to accommodate the traffic generated by the proposed Project Phase 2B. The following traffic mitigation measures are required for these intersections to accommodate these traffic increases. Figure 41 shows the recommended roadway network and intersection lane geometry for the 2025 With Project Phase 2B Conditions to mitigate the traffic impact within the study area.

13.6.1 Kunia Road at Agricultural Access (#1)

By 2025, Kunia Road will need to be widened to a four-lane roadway north of the project site up to the Agricultural Access. The Project Phase 2B impact at this intersection can be mitigated by increasing northbound and southbound through capacity with the following recommended improvements:

Kunia Road at Agricultural Access (#1)

- Add a Second Northbound Through Lane
- Add a Second Southbound Through Lane

13.6.2 Kunia Road at Industrial Access (#2)

This intersection is the main access for the industrial portion of the project which will be built during Phase 2B of the project in 2025. The following improvement measures are recommended to accommodate project traffic at this intersection:

Kunia Road at Industrial Access (#2)

- Install a Traffic Signal
- Add a Second Northbound Through Lane
- Add a Northbound Right-Turn Lane
- Add a Southbound Left-Turn Lane
- Add a Second Southbound Through Lane
- Add a Westbound Left-Turn Lane
- Add a Westbound Right-Turn Lnae

13.6.3 Kunia Road at Upper Kupuna Loop (#5)

Phase 2B of the project will require lane improvements at this intersection. Project traffic increases will be primarily to north-south through traffic. The Project Phase 2B impact at this intersection can be mitigated by increasing northbound through capacity with the following recommended improvements:

Kunia Road at Upper Kupuna Loop (#5)

- Add a Third Northbound Through Lane
- Add a Third Southbound Through Lane

14. Conclusions

The purpose of this study is to assess the overall traffic impact of the proposed Royal Kunia project, which will be developed in 4 phases, for 2018, 2020, 2023 and 2025 conditions.

This study used the existing traffic volumes and the surrounding land use and geographic conditions to determine the project trip distribution patterns. ITE trip rates are used to estimate the site-only project traffic volumes, and trip reduction adjustments have been made to the overall project traffic generation to account for pass-by trips, internal trip capture and transit trip discount. The reduction percentage assumptions have been based on past experience for this type of development and other reference information.

Future traffic increases also consider additional traffic that are generated by other cumulative developments that either are under construction, approved, planned, or proposed for development near the study area based on the available information obtained by the project team. In addition to cumulative development traffic, other unidentified projects and general population growth contribute to ambient background traffic growth. Ambient growth for the study is 2.0% per year, which is calculated based on the screenline analysis using the OahuMPO model data.

Synchro models were developed to conduct intersection level of service analyses. Analysis methodologies and parameters are presented in Section 2 of this report. Table 47 summarizes the intersection level of service analysis results with existing lane geometry and planned improvements. Table 48 summarizes the expected levels of service for the study area intersections with additional mitigation measures in place.

The document presents the recommended mitigation improvements to the study area intersections. The recommended intersection improvements are described in previous Section 13 of this report. Table 46 summarizes the recommended intersection improvements for the various analysis scenarios in a tabular format.

It is recommended that the traffic study be updated periodically every 5 years to monitor the actual traffic growth and provide appropriate mitigation.

Table 47 - Intersection Operations Analysis Summary, With Existing Geometry

Intersection			2018 Without Project				2020 Without Project				2023 Without Project				2025 Without Project				2018 With Project Phase 1A				2020 With Project Phase 1B				2023 With Project Phase 2A				2025 With Project Phase 2B			
			AM		PM		AM		PM		AM		PM		AM		PM		AM		PM		AM		PM		AM		PM		AM		PM	
No.	Name	Approach	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
1	Kunia Rd at Agricultural Access	**Average**	**1.4**	**A**	**2.1**	**A**	**1.7**	**A**	**2.2**	**A**	**2.2**	**A**	**3.0**	**A**	**2.7**	**A**	**4.0**	**A**	**1.5**	**A**	**3.8**	**A**	**2.0**	**A**	**3.9**	**A**	**2.9**	**A**	**4.3**	**A**	**4.7**	**A**	**4.6**	**A**
2	Kunia Rd at Industrial Access	**Average**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**153.1**	**F**	**>200**	**F**
3	Kunia Rd at Royal Kunia Access	**Average**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**>200**	**F**	**>200**	**F**	**>200**	**F**	**>200**	**F**	**>200**	**F**	**>200**	**F**	**>200**	**F**	**>200**	**F**
4	Kunia Rd at Anonui St	**Average**	**49.6**	**D**	**67.9**	**E**	**60.1**	**E**	**77.2**	**E**	**80.2**	**F**	**91.0**	**F**	**97.9**	**F**	**101.2**	**F**	**58.2**	**E**	**84.9**	**F**	**81.6**	**F**	**119.4**	**F**	**124.1**	**F**	**>200**	**F**	**>200**	**F**	**>200**	**F**
5	Kunia Rd at Upper Kupuna Loop	**Average**	**10.7**	**B**	**17.7**	**B**	**11.6**	**B**	**19.1**	**B**	**13.6**	**B**	**21.2**	**C**	**17.6**	**B**	**23.5**	**C**	**11.1**	**B**	**19.2**	**B**	**16.5**	**B**	**39.8**	**D**	**37.1**	**D**	**81.9**	**F**	**109.3**	**F**	**151.8**	**F**
6	Kunia Rd at Lower Kupuna Loop	**Average**	**9.3**	**A**	**9.4**	**A**	**9.8**	**A**	**10.2**	**B**	**10.3**	**B**	**11.9**	**B**	**10.8**	**B**	**13.5**	**B**	**9.4**	**A**	**9.9**	**A**	**10.2**	**B**	**12.1**	**B**	**12.3**	**B**	**21.6**	**C**	**43.9**	**D**	**83.4**	**F**
7	Kunia Rd at H-1 WB Ramps	NB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		SB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		EB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		WB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Average	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**
8	Kunia Rd at H-1 EB Ramps	NB	132.1	F	68.5	E	152.1	F	79.3	E	184.9	F	99.4	F	207.7	F	114.1	F	133.5	F	68.6	E	153.1	F	79.4	E	185.4	F	99.3	E	>200	F	113.8	F
		SB	28.3	C	74.8	E	33.0	C	92.4	F	42.2	D	121.0	F	48.7	D	141.2	F	43.8	D	75.3	E	73.4	E	95.3	F	112.9	F	130.5	F	147.4	F	195.0	F
		EB	49.5	D	116.7	F	51.9	D	130.1	F	58.3	E	153.1	F	65.7	E	170.1	F	52.1	D	168.0	F	68.5	E	>200	F	94.8	F	>200	F	>200	F	>200	F
		WB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Average	**90.5**	**F**	**75.4**	**E**	**103.9**	**F**	**89.8**	**F**	**126.6**	**F**	**114.2**	**F**	**142.7**	**F**	**131.7**	**F**	**96.0**	**F**	**80.6**	**F**	**117.9**	**F**	**104.1**	**F**	**151.6**	**F**	**142.1**	**F**	**189.1**	**F**	**195.6**	**F**

Table 48 - Intersection Operations Analysis Summary, With Recommended Mitigations

Intersection			2018 Without Project				2020 Without Project				2023 Without Project				2025 Without Project				2018 With Project Phase 1A				2020 With Project Phase 1B				2023 With Project Phase 2A				2025 With Project Phase 2B			
			AM		PM		AM		PM		AM		PM		AM		PM		AM		PM		AM		PM		AM		PM		AM		PM	
No.	Name	Approach	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
1	Kunia Rd at Agricultural Access	**Average**	**0.9**	**A**	**2.1**	**A**	**1.0**	**A**	**1.2**	**A**	**1.3**	**A**	**0.4**	**A**	**1.5**	**A**	**0.5**	**A**	**0.9**	**A**	**0.4**	**A**	**1.1**	**A**	**0.4**	**A**	**1.5**	**A**	**0.5**	**A**	**1.3**	**A**	**0.2**	**A**
2	Kunia Rd at Industrial Access	**Average**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**6.7**	**A**	**18.2**	**B**
3	Kunia Rd at Royal Kunia Access	**Average**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**8.2**	**A**	**5.3**	**A**	**20.9**	**C**	**8.3**	**A**	**40.6**	**D**	**13.7**	**B**	**36.9**	**D**	**21.3**	**C**
4	Kunia Rd at Anonui St	**Average**	**25.1**	**C**	**22.9**	**C**	**27.3**	**C**	**23.7**	**C**	**32.8**	**C**	**24.8**	**C**	**38.8**	**D**	**25.9**	**C**	**25.8**	**C**	**24.3**	**C**	**32.0**	**C**	**28.0**	**C**	**38.3**	**D**	**37.4**	**D**	**30.5**	**C**	**27.6**	**C**
5	Kunia Rd at Upper Kupuna Loop	**Average**	**17.6**	**B**	**18.2**	**B**	**19.2**	**B**	**19.6**	**B**	**22.3**	**C**	**22.8**	**C**	**27.9**	**C**	**26.2**	**C**	**9.9**	**A**	**17.7**	**B**	**9.8**	**A**	**17.0**	**B**	**11.6**	**B**	**20.7**	**C**	**10.5**	**B**	**18.5**	**B**
6	Kunia Rd at Lower Kupuna Loop	**Average**	**10.5**	**B**	**10.4**	**B**	**11.3**	**B**	**11.6**	**B**	**12.9**	**B**	**13.7**	**B**	**14.8**	**B**	**16.2**	**B**	**8.7**	**A**	**12.4**	**B**	**9.1**	**A**	**16.0**	**B**	**8.2**	**A**	**11.4**	**B**	**9.1**	**A**	**16.9**	**B**
7	Kunia Rd at H-1 WB Ramps	NB	1.3	A	12.9	B	1.3	A	4.8	A	1.4	A	5.9	A	2.1	A	5.1	A	4.4	A	10.5	B	1.5	A	9.7	A	0.8	A	9.3	A	0.1	A	12.3	B
		SB	5.2	A	18.8	B	3.8	A	7.6	A	4.0	A	8.8	A	3.2	A	11.3	B	3.4	A	5.9	A	4.7	A	5.4	A	5.9	A	11.7	B	9.9	A	14.3	B
		EB	0.9	A	71.6	E	1.0	A	68.2	E	1.2	A	98.1	F	1.3	A	113.1	F	0.9	A	76.6	E	1.0	A	91.6	F	1.2	A	118.6	F	1.3	A	138.2	F
		WB	0.7	A	8.7	A	0.7	A	11.9	B	0.8	A	21.0	C	0.9	A	56.1	E	0.6	A	6.8	A	0.7	A	18.8	B	0.3	A	1.0	A	0.4	A	2.5	A
		Average	**2.3**	**A**	**34.1**	**C**	**1.9**	**A**	**28.6**	**C**	**2.0**	**A**	**41.1**	**D**	**2.0**	**A**	**52.9**	**D**	**2.7**	**A**	**30.3**	**C**	**2.3**	**A**	**36.1**	**D**	**2.7**	**A**	**42.0**	**D**	**3.8**	**A**	**46.8**	**D**
8	Kunia Rd at H-1 EB Ramps	NB	29.3	C	11.2	B	33.4	C	11.7	B	32.9	C	12.9	B	45.2	D	13.9	B	34.8	C	14.6	B	47.7	D	20.2	C	43.3	D	23.2	C	80.3	F	34.6	C
		SB	13.6	B	25.7	C	14.9	B	36.7	D	20.6	C	57.8	E	20.5	C	16.6	B	14.1	B	11.0	B	20.3	C	52.6	D	13.9	B	14.2	B	29.0	C	43.3	D
		EB	21.2	C	57.4	E	22.3	C	63.6	E	35.4	D	82.8	F	39.4	D	30.5	C	32.7	C	48.9	D	43.0	D	72.6	E	39.5	D	54.5	D	60.6	E	65.4	E
		WB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Average	**18.9**	**B**	**27.1**	**C**	**20.9**	**C**	**35.9**	**D**	**26.0**	**C**	**53.4**	**D**	**29.8**	**C**	**17.8**	**B**	**22.2**	**C**	**27.6**	**C**	**30.6**	**C**	**50.3**	**D**	**25.0**	**C**	**21.6**	**C**	**46.5**	**D**	**45.4**	**D**