NATURAL ENERGY LABORATORY OF HAWAII AUTHORITY

An Authority of the State of Hawaii attached to the Department of Business, Economic Development & Tourism

March 25, 2014

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Ms. Jessica Wooley, Acting Director
Office of Environmental Quality Control
235 South Beretania Street, Suite 702
Honolulu, HI 96813

Dear Ms. Wooley:

I am transmitting herewith a Draft Environmental Assessment and Anticipated Finding of No Significant Impact (DEA- AFONSI) for the proposed NELHA roadway connections to Queen Ka'ahumanu Highway and Kona International Airport situated in Kailua-Kona on the Island of Hawaii. I am requesting that this be published in the next available edition of your bulletin The Environmental Notice.

I have enclosed a completed OEQC Publication Form, one copy of the DEA-AFONSI, an Adobe Acrobat PDF file of the same, and an electronic copy of the publication form in MS Word.

If there are any questions, please feel free to contact me at (808) 327-9585 ext. 225 or gb@nelha.org.

Very truly yours,

Gregory P. Barbour

cc: Jim Hayes, Parsons Brinkerhoff

Enclosures

73-4460 Queen Kaahumanu Hwy., #101, Kailua-Kona, Hawaii USA 96740-2637
Phone: (808) 327-9585 Fax: (808) 327-9586 Email: nelha@nelha.org Website: http://www.nelha.org

AGENCY ACTIONS
SECTION 343-5(B), HRS
PUBLICATION FORM (JULY 2012 REVISION)

Project Name: Natural Energy Laboratory of Hawai'i Authority, Connections to Queen Ka'ahumanu Highway and Kona International Airport at Keahole

Island: Hawai'i

District: North Kona

TMK: Highway right-of-way, 7-3-043:072, and 7-3-043:073

Permits: None specific to the proposed project; necessary permits will be obtained by associated projects

Proposing/ Determination Agency:
Natural Energy Laboratory of Hawai'i Authority
73-4460 Queen Ka'ahumanu Highway, #101
Kailua-Kona, HI 96740-2637
Contact: Mr. Greg Barbour
Phone: (808) 327-9585

Consultant:
Parsons Brinckerhoff
1001 Bishop St., American Savings Bank Tower, Suite 2400
Honolulu, Hawai'i 96813
Contact: Mr. James Hayes
Phone: (808) 566-2239

Status (check one only):

X	DEA-AFNSI	Submit the proposing agency notice of determination/transmittal on agency letterhead, a hard copy of DEA, a completed OEQC publication form, along with an electronic word processing summary and a PDF copy (you may send both summary and PDF to oeqchawaii@doh.hawaii.gov); a 30-day comment period ensues upon publication in the periodic bulletin.
	FEA-FONSI	Submit the proposing agency notice of determination/transmittal on agency letterhead, a hard copy of the FEA, an OEQC publication form, along with an electronic word processing summary and a PDF copy (send both summary and PDF to oeqchawaii@doh.hawaii.gov); no comment period ensues upon publication in the periodic bulletin.
	FEA-EISPN	Submit the proposing agency notice of determination/transmittal on agency letterhead, a hard copy of the FEA, an OEQC publication form, along with an electronic word processing summary and PDF copy (you may send both summary and PDF to oeqchawaii@doh.hawaii.gov); a 30-day consultation period ensues upon publication in the periodic bulletin.

Act 172-12 EISPN	Submit the proposing agency notice of determination on agency letterhead, an OEQC publication form, and an electronic word processing summary (you may send the summary to oeqchawaii@doh.hawaii.gov). NO environmental assessment is required and a 30-day consultation period upon publication in the periodic bulletin.
DEIS	The proposing agency simultaneously transmits to both the OEQC and the accepting authority, a hard copy of the DEIS, a completed OEQC publication form, a distribution list, along with an electronic word processing summary and PDF copy of the DEIS (you may send both the summary and PDF to oeqchawaii@doh.hawaii.gov); a 45-day comment period ensues upon publication in the periodic bulletin.
FEIS	The proposing agency simultaneously transmits to both the OEQC and the accepting authority, a hard copy of the FEIS, a completed OEQC publication form, a distribution list, along with an electronic word processing summary and PDF copy of the FEIS (you may send both the summary and PDF to oeqchawaii@doh.hawaii.gov); no comment period ensues upon publication in the periodic bulletin.
Section 11-200-23 Determination	The accepting authority simultaneously transmits its determination of acceptance or nonacceptance (pursuant to Section 11-200-23, HAR) of the FEIS to both OEQC and the proposing agency. No comment period ensues upon publication in the periodic bulletin.
Section 11-200-27 Determination	The accepting authority simultaneously transmits its notice to both the proposing agency and the OEQC that it has reviewed (pursuant to Section 11-200-27, HAR) the previously accepted FEIS and determines that a supplemental EIS is not required. No EA is required and no comment period ensues upon publication in the periodic bulletin.
Withdrawal (explain)	

Summary (Provide proposed action and purpose/need in less than 200 words. Please keep the summary brief and on this one page):

The Natural Energy Laboratory of Hawai'i Authority (NELHA) is a quasi-public agency of the State of Hawai'i and administers the Hawai'i Ocean Science and Technology Park (HOST Park) at Keāhole Point, Kailua-Kona. The purpose of the proposed project is to maintain and create connectivity between NELHA and HOST Park and regional transportation facilities. NELHA and the State of Hawai'i Department of Transportation (HDOT) are proposing to provide connections between NELHA's HOST Park roads and (a) HDOT's Queen Ka'ahumanu Highway, and (b) roadways within the Kona International Airport at Keahole (KOA). Land use plans and traffic modeling indicate that as the overall region grows, and transportation demand grows, more roadway network interconnectivity will be required to avoid delays and maintain public safety. The first phase of the proposed project would be in the next ten years and Phase 2 of the proposed project would occur when NELHA, HOST Park, and surrounding developments, such as KOA expansion and nearby proposed or envisioned residential developments in long-range plans, approach full build-out. Phase 2 is not projected to occur until roughly 2035.

DRAFT ENVIRONMENTAL ASSESSMENT

NATURAL ENERGY LABORATORY OF HAWAIʻI AUTHORITY, CONNECTIONS TO QUEEN KAʻAHUMANU HIGHWAY AND KONA INTERNATIONAL AIRPORT AT KEĀHOLE

KEĀHOLE, ISLAND OF HAWAIʻI, HAWAIʻI

April 8, 2014

DRAFT ENVIRONMENTAL ASSESSMENT

Natural Energy Laboratory of Hawai‘i Authority, Connections to Queen Ka‘ahumanu Highway and Kona International Airport at Keāhole

Keāhole, Island of Hawai‘i, Hawai‘i

Submitted Pursuant to the

Hawai‘i Environmental Policy Act,
Chapter 343, Hawai‘i Revised Statutes, and
Title 11, Chapter 200, Hawai‘i Department of Health Administrative Rules

by the

Natural Energy Laboratory of Hawai‘i Authority
State of Hawai‘i

The following person may be contacted for additional information concerning this document:

Mr. Greg Barbour
Natural Energy Laboratory of Hawai‘i Authority
73-4460 Queen Ka‘ahumanu Highway, #101
Kailua-Kona, HI 96740-2637
Phone: (808) 327-9585 x237

This Draft Environmental Assessment documents a provisional finding that there would be no significant environmental impacts if the proposed project proceeds. The proposed project would improve access from the Natural Energy Laboratory of Hawai‘i Authority (NELHA) to Queen Ka‘ahumanu Highway and the Kona International Airport at Keāhole.

Comments on this Draft Environmental Assessment (EA) are due by May 8, 2014, and should be sent to the Natural Energy Laboratory of Hawai‘i Authority at the address above with copies to the Office of Environmental Quality Control, 235 South Beretania Street, Suite 702, Honolulu, Hawai‘i 96813 and Jim Hayes, Parsons Brinckerhoff, Inc., 1001 Bishop Street, Suite 2400, Honolulu, Hawai‘i 96813.

April 8, 2014

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1.0 DESCRIPTION OF THE PROPOSED ACTION

1.1 Introduction

The Natural Energy Laboratory of Hawai‘i Authority (NELHA) is a quasi-public agency of the State of Hawai‘i and administers the Hawai‘i Ocean Science and Technology Park (HOST Park) at Keāhole Point, Kailua-Kona, on the Big Island of Hawai‘i. HOST Park is comprised of 870 acres and is a master-permitted ocean science and technology park that stimulates economic development and diversification. HOST Park is the only ocean science facility in the world which continually brings ashore high quality, pristine supplies of both warm surface and cold deep seawater 24 hours a day, 365 days a year.

HOST Park has a unique combination of natural resources, subtropical environment, and community infrastructure that makes it a desirable location for new business enterprises. HOST Park currently has over 40 business and organizations involved in a variety of leading edge research, education, sustainable living, nutraceutical, water bottling, and energy technologies. These enterprises generate almost $90 million per year in total economic impact and 600 jobs statewide.

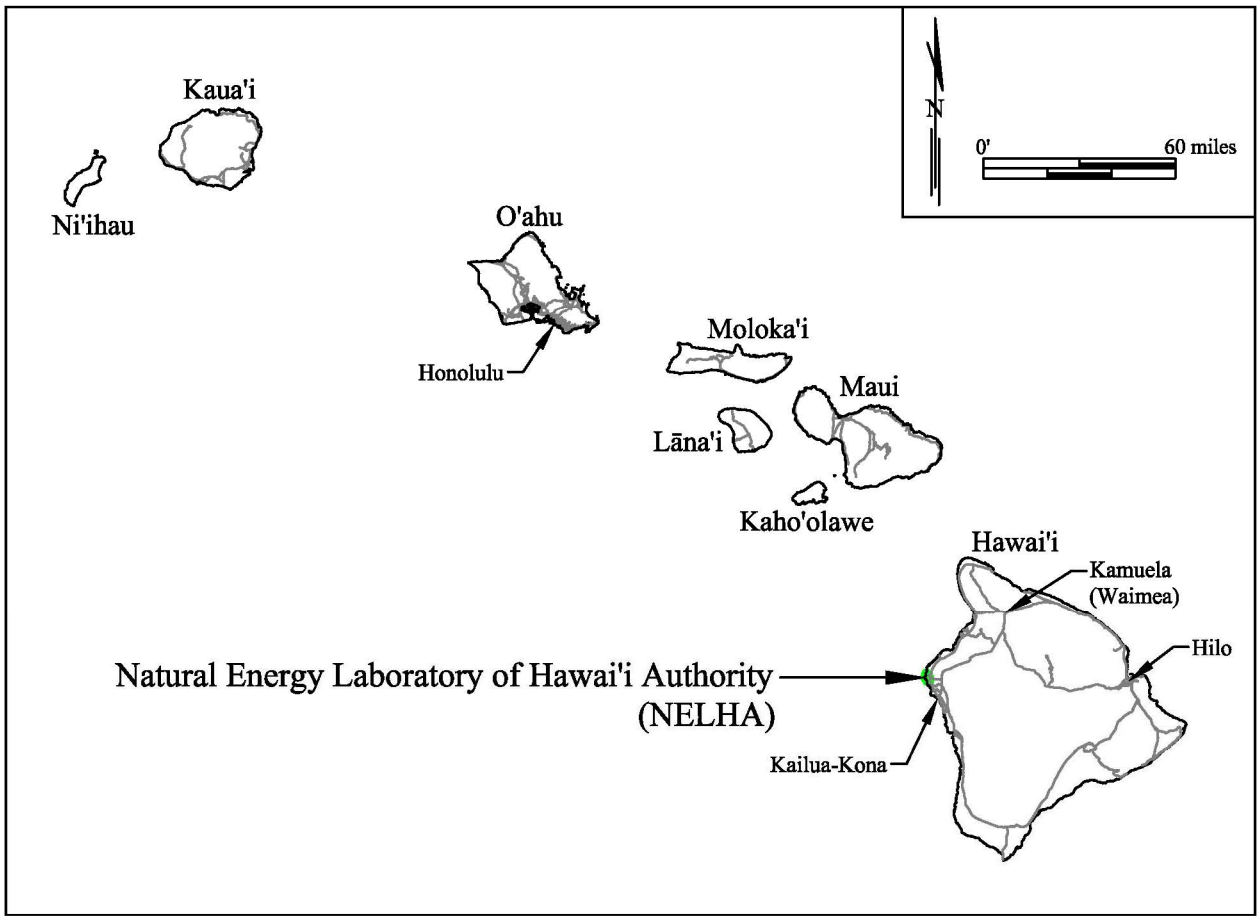

Figure 1-1: Proposed Project Location

NELHA's mission statement reads, "To develop and diversify the Hawai‘i economy by providing resources and facilities for energy and ocean-related research, education, and commercial activities in an environmentally sound and culturally sensitive manner." Towards that end, NELHA intends to further develop its lands through "cohesion in the built environment" and by "foster[ing] collaboration among tenants" through the construction of six zones of use:

1. Applied Renewable Energy Zone
2. Economic Driver – NELHA-related products and services
3. Applied Technology Laboratories and Containerized Technology Research Center
4. Science and Technology Cultural Center
5. Ocean, Air, Energy, and Biology Research Laboratories
6. Ocean Village

NELHA and the State of Hawai‘i Department of Transportation (HDOT) are proposing to provide connections between NELHA's HOST Park roadway facilities and HDOT's Queen Ka‘ahumanu Highway and roadways within the Kona International Airport at Keāhole (KOA) on the island of Hawai‘i. Figure 1-2 illustrates the general location of the proposed connections.

1.1.1 Purpose of this Document

The proposed project requires environmental review in accordance with Hawai‘i Revised Statutes (HRS) Chapter 343 due to the use of State funds and land. Therefore, the environmental review must comply with Hawai‘i Administrative Rules (HAR) Title 11, Chapter 200.

This Draft EA discloses the foreseeable environmental impacts that could result from the proposed project's implementation and commits to the employment of specific measures to avoid, minimize, or mitigate adverse impacts to the environment. Additionally, this Draft EA contains a record of consultation activities that have been conducted to date as part of project planning.

NELHA anticipates that the proposed project would not have a "significant" impact in accordance with HRS Chapter 343 regulations and HAR Title 11, Chapter 200 rules. Therefore, NELHA anticipates a "Finding of No Significant Impact" (FONSI) will be issued with the Final Environmental Assessment (Final EA) to be prepared after collecting and considering comments on this Draft EA. If, during the consideration of comments received on this Draft EA, it is determined that a "significant" impact would occur, NELHA would either revise the proposed project to avoid causing a significant impact or issue a Final EA / Environmental Impact Statement Preparation Notice (FEA-EISPN).

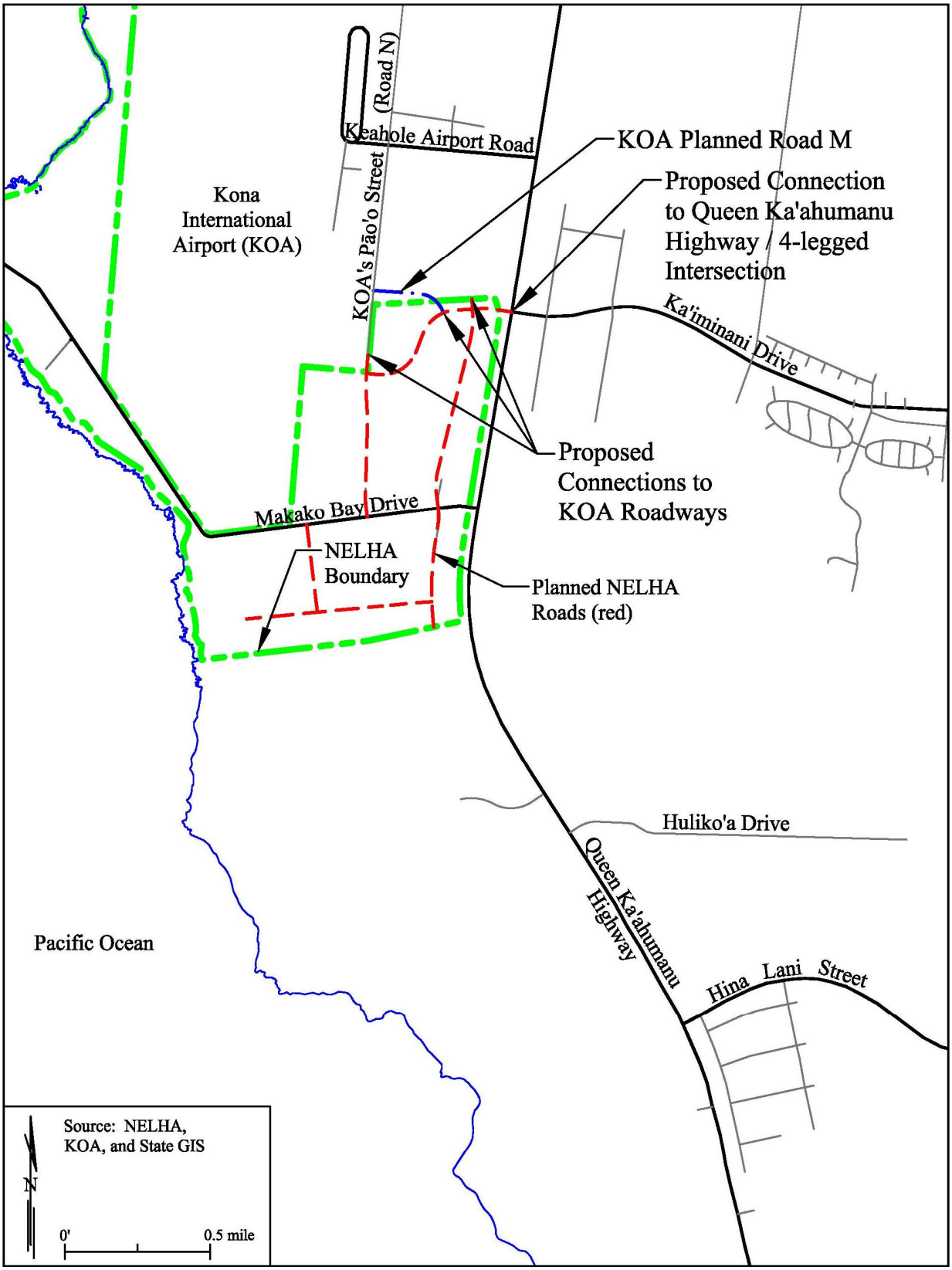

Figure 1-2: Project Area

1.1.2 Organization of this Document

Section 1.0 discusses the purpose and need for the proposed project. It introduces the alternatives that were considered and the proposed project's anticipated schedule and cost. It also lists permits and approvals that may be required. Section 2.0 describes existing environmental conditions, potential environmental impacts, and the mitigation measures that are proposed to reduce the level of adverse impact. Section 3.0 documents agency and public coordination conducted to date related to the proposed project. Section 4.0 provides the Anticipated Finding of No Significant Impact (FONSI) statement, pursuant to HRS Chapter 343. Section 5.0 consists of a list of references used in the preparation of this Draft EA. Appendix A contains records of coordination conducted for the proposed project, Appendix B is a traffic impact analysis that supports the proposed project, and Appendix C is an archeological study for portions of the HOST Park near certain proposed connections.

1.2 Background

1.2.1 NELHA's HOST Park Expansion

NELHA has prepared a number of disclosure documents regarding their plans to develop their holdings. These documents have included plans to develop the Hawai‘i Ocean Science and Technology (HOST) Park area (Figure 1-3), which is where the proposed project is located. The HOST Park area is the mauka portion of NELHA's holdings. These documents have illustrated various, but similar roadway and lot plans for the HOST Park. The plans have all called for the complete development of the HOST Park area; therefore, the exact alignment of the internal roadways and lots is not particularly important. Furthermore, the plans have always called for the HOST Park lots to be accessed from NELHA's internal roads, none of the lots would be directly accessed from Queen Ka‘ahumanu Highway.

Figure 1-3 illustrates the current conceptual NELHA internal roadway and lot configuration; the final roadway and lot configuration may change based on a number of factors, including environmental constraints, roadway geometry, or market demand.

NELHA's disclosure documents have included:

- Final Environmental Impact Statement, Development Plan for the Hawai‘i Ocean Science and Technology Park and Expansion of the Natural Energy Laboratory of Hawai‘i, Keāhole, North Kona, Hawai‘i (NELHA, 1985).
- Final Supplemental Environmental Impact Statement, Development of Land Exchange Parcel, State of Hawai‘i, The Natural Energy Laboratory of Hawai‘i Authority, Keāhole, North Kona, Hawai‘i (NELHA, 1992).
- Master Plan for Natural Energy Laboratory of Hawai‘i Authority (NELHA, 2011).

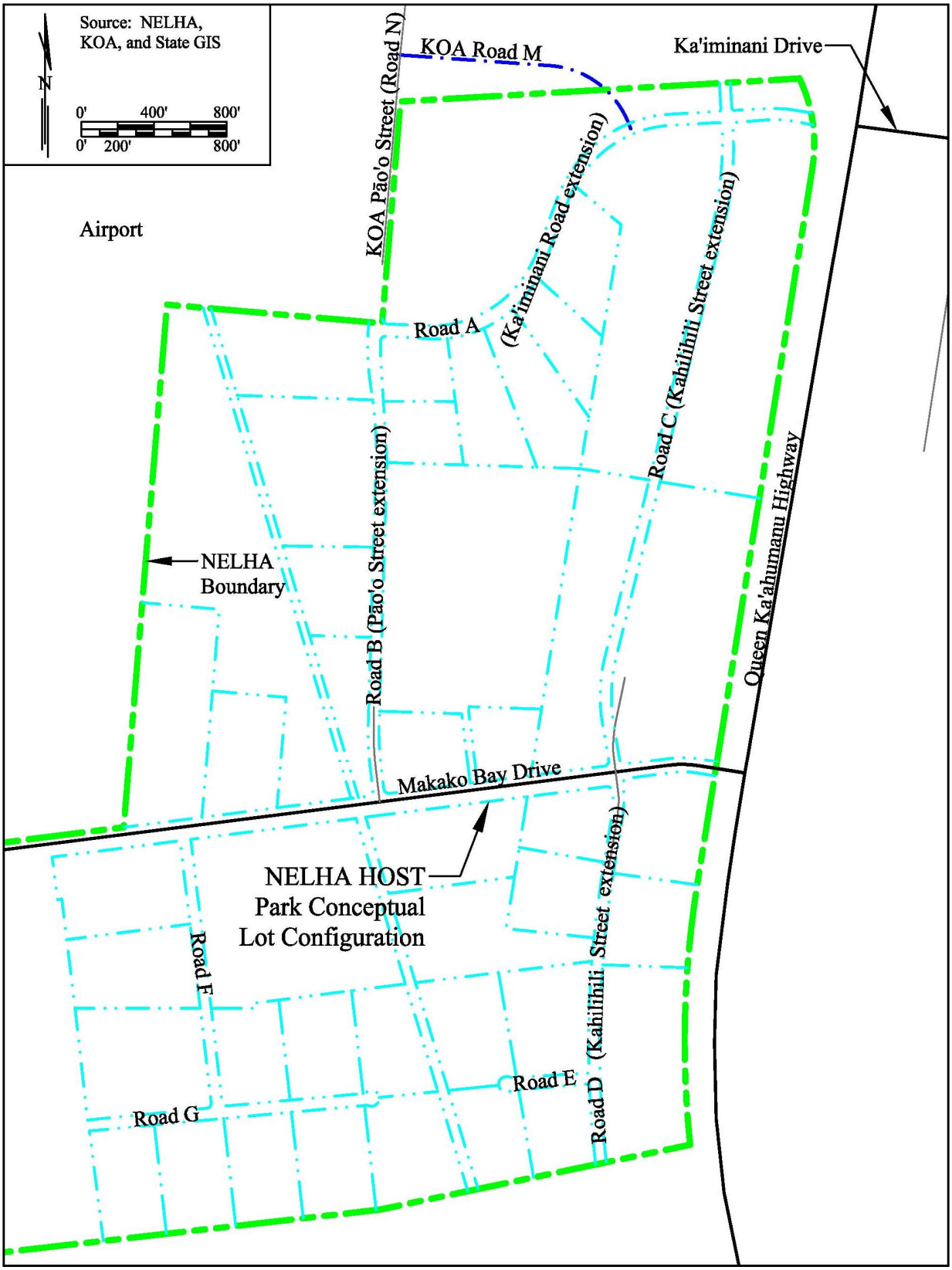

Figure 1-3: HOST Park Area

1.2.2 HDOT’s Queen Ka‘ahumanu Highway Widening

HDOT has been planning the widening of Queen Ka‘ahumanu Highway for a number of years. Queen Ka‘ahumanu Highway is the primary arterial highway in the region, providing connectivity between destinations in North Kona, including Kailua-Kona village, KOA, and the resorts to the north, and access to other island-wide destinations.

In 1996, HDOT released the Final Environmental Assessment for Queen Ka‘ahumanu Highway Widening, Kailua to Keāhole, County of Hawai‘i (HDOT, 1996). Since that time HDOT has been preparing to implement the improvements disclosed in that document. In general, those improvements include widening Queen Ka‘ahumanu Highway to two lanes in each direction with a landscaped median and auxiliary turn lanes at intersections. Portions of Queen Ka‘ahumanu Highway to the south of Kealakehe Parkway have already been widened. The HDOT will continue that widening to a point just north of KOA.

Table 1-1 summarizes planned intersection configurations along Queen Ka‘ahumanu Highway according the Final EA (HDOT, 1996).

Table 1-1: Planned Queen Ka‘ahumanu Highway Intersection Configuration

Intersection/Location	Intersection Type/Description
Henry Street	Signalized 4-legged channelized intersection.
Palani Road	Signalized 4-legged channelized intersection.
Kaiwi Street	Limited Access*; channelized right-turn in and right-turn out only.
Makala Boulevard	Signalized 4-legged intersection.
Kealakehe Parkway	Signalized 4-legged channelized intersection.
Honokōhau Street	Right-turn in, right-turn out with single left toward Kailua.
Kaloko-Honokōhau National Park	Channelized right and left turns. The need for signalization to be determined.
Hina Lani Drive	Signalized 3-legged channelized intersection
Huliko‘a Drive	Limited Access*; channelized right-turn in and right-turn out only.
Makako Bay Drive	Limited Access*; channelized right-turn in and right-turn out only.
Ka‘iminani Drive	3-legged channelized intersection with signals
Keāhole Airport Road	Signalized 3-legged channelized intersection
Hawai‘i Electric	Limited Access*; channelized right-turn in and right-turn out only.

* Limited Access –No break in the Median to allow left turns

1.2.3 KOA’s Facility Improvements

KOA provides a vital air link in Hawai‘i’s regional transportation system. It serves the entire western portion of Hawai‘i Island. The region is forecast to continue to grow and air traffic is anticipated to continue to increase. As such, HDOT is planning improvements to KOA to keep up with demand. In 2013, HDOT Airports Division released the Final Environmental Assessment, Airfield, Terminal, and Facility Improvements for the Kona International Airport at Keāhole (HDOT, 2013. That EA outlines a number of proposed improvements, including:

- Expansion of the General Aviation (GA) facilities (#1 on Figure 1-4).
- Construction of a new road, Road M (Phase I) (#4 on Figure 1-4).
- Construction of a Seawater Air Conditioning System (SWAC) (#5 on Figure 1-4).

- Construction of the Terminal Modernization (Phase I) (#7 on Figure 1-4).

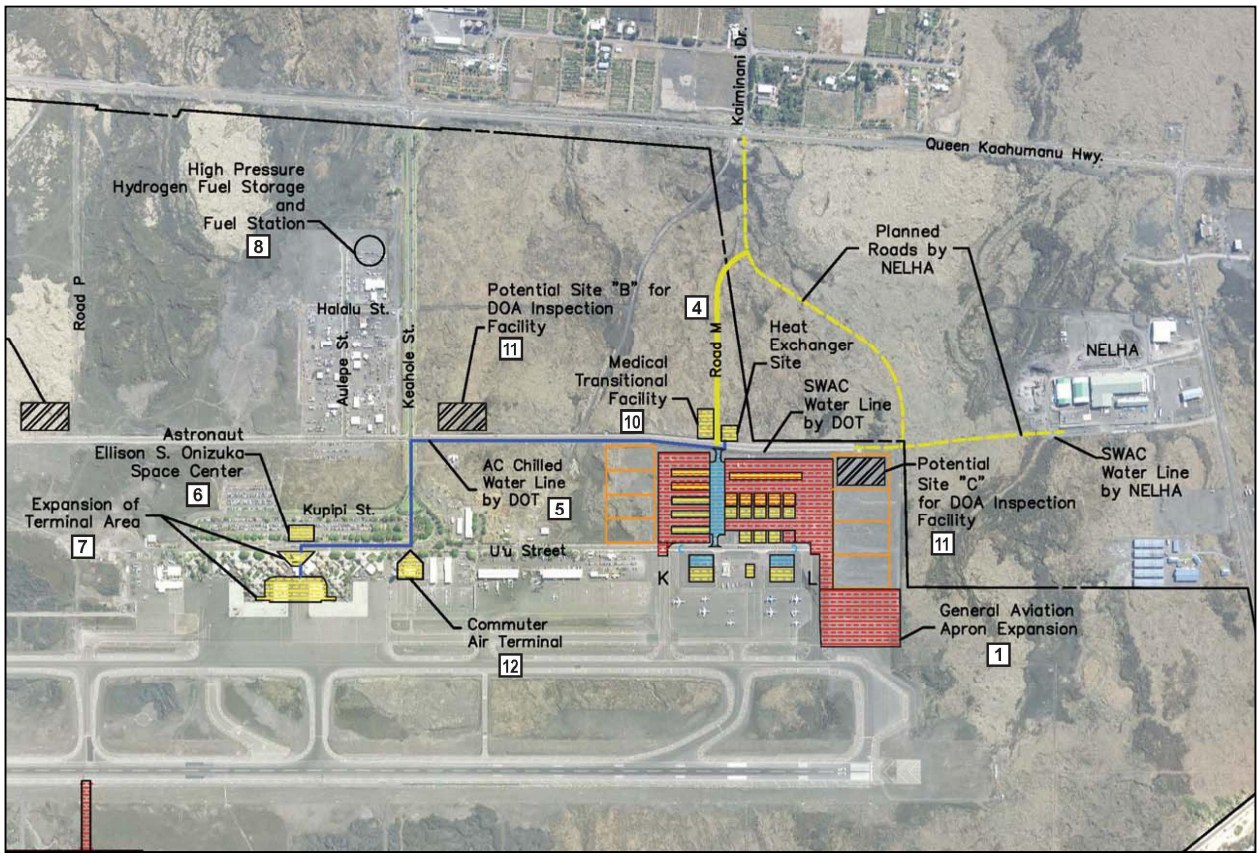

Figure 1-4: Portion of KOA Project Site Plan (portion of Figure 2-1 of KOA's EA)

Potential areas for partnership between KOA and NELHA include supplying renewable energy and cool deep seawater for KOA's proposed SWAC, renewable fuel vehicle transport for arriving passengers, synergy between tenants along the Queen Ka‘ahumanu Highway corridor through interconnectivity and a second access utilizing KOA Road M and the 4-legged intersection at Ka‘iminani Road, and sanitary sewer facilities.

1.3 Project Purpose and Need

The purpose of the proposed project is to maintain and create connectivity between NELHA/HOST Park and regional transportation facilities. A major purposes is to mitigate the impacts of the planned Queen Ka‘ahumanu Highway widening project on NELHA/HOST Park. That project will convert the Queen Ka‘ahumanu Highway – Makako Bay Drive intersection into a right-turn in and out only intersection, severely limiting access to HOST Park and NELHA in general unless the improvements to the regional transportation system are made.

Land use plans and traffic modeling indicate that as the overall region grows, and transportation demand grows, more interconnectivity within the roadway network will be required. The Traffic Impact Analysis prepared for NELHA (Appendix B), and other regional studies (County of Hawai‘i, 2008) have identified this need. As development increases the level of connectivity

will need to increase in order to spread the travel demand among a greater number of routes and connections.

1.3.1 Connections to Queen Ka‘ahumanu Highway

Currently Makako Bay Drive provides the only access to NELHA and HOST Park (Figure 1-2). Makako Bay Drive intersects Queen Ka‘ahumanu Highway and although the intersection is not signalized, it provides full access: vehicles travelling north on Queen Ka‘ahumanu Highway can turn left into HOST Park, vehicles travelling south on Queen Ka‘ahumanu Highway can turn right into HOST Park, and vehicles exiting HOST Park can turn left or right onto Queen Ka‘ahumanu Highway.

Current HDOT plans call for the conversion of the Makako Bay Drive – Queen Ka‘ahumanu Highway intersection from a full access intersection to a right-turn-in/right-turn-out only intersection when Queen Ka‘ahumanu Highway is widened (HDOT, 1996). If the Makako Bay Drive intersection with access to South-bound lanes only remained NELHA’s and HOST Park’s only access to Queen Ka‘ahumanu Highway, this condition would require north-bound vehicles exiting HOST Park to turn right/south and make a “U” turn at Huliko‘a Drive or Hina Lani Street (Figure 1-2). In addition, north-bound vehicles on Queen Ka‘ahumanu Highway whose destination is NELHA or HOST Park would have to make a “U” turn at Keâhole Airport Road (Figure 1-2), backtrack, and then enter HOST Park. This situation would (a) have a significantly negative economic impact on NELHA and HOST Park tenants, (b) hinder marketing efforts to attract new tenants to HOST Park, (c) promote congestion and reduce safety at the intersections where “U” turns are made, and (d) inconvenience motorists utilizing Makako Bay Drive.

Of particular concern is heavy vehicle traffic (trucks and buses) coming and going from NELHA/HOST Park. In 2010 the daily volume of heavy vehicles coming and going from NELHA/HOST Park via Makako Bay Drive on one day was 68. With the intersection reduced to a right-turn-in, right-turn-out intersection at least half of those heavy vehicles would need to make “U” turns north or south of Makako Bay Drive. As NELHA/HOST Park develops the number of heavy vehicles will increase, escalating the problems associated with the right-turn-in/right-turn-out situation.

In addition, as NELHA develops HOST Park the resulting travel demand will exceed the capacity of the current, unsignalized Makako Bay Drive – Queen Ka‘ahumanu Highway intersection. Furthermore, as the overall area and NELHA’s HOST Park approach complete build out, the travel demand is projected to exceed the capacity provided by a single, signalized Makako Bay Drive – Queen Ka‘ahumanu Highway intersection (Appendix B).

1.3.2 Connections to KOA Roadways

Pāo‘o Street

The construction of NELHA’s planned Road B (Pāo'o Road extension) toward KOA and its connection with KOA’s Pāo'o Road (Road N) has long been planned (NELHA, 1985). The purpose of the connection is to provide access between the two State-owned facilities – NELHA, HOST Park, and KOA and eliminate the need for NELHA and HOST Park tenants to use Queen Ka‘ahumanu Highway to reach facilities within KOA.

KOA Road M

KOA recently proposed the construction of Road M within KOA and connecting it to NELHA's planned Road A (Ka‘iminani Road extension) (HDOT, 2012) (Figure 1-2). In KOA's Draft EA (HDOT, 2012) it is stated that "Road M is planned to be a two-lane, two-way road that will eventually provide public access from Queen Ka‘ahumanu Highway to the airport's south ramp area. It currently intersects existing and planned north-south roads within and extending beyond the airport. In the future, it will intersect with additional planned north-south roads. The proposed initial construction of Road M will extend eastward, approximately 850-feet from its intersection with Pâo'o Street (Road N). … Its eastern end will eventually connect with a roadway that the neighboring Natural Energy Laboratory of Hawai‘i Authority (NELHA) plans to build on its property."

KOA's goal of Road M providing access from Queen Ka‘ahumanu Highway to KOA's south ramp area can only be achieved if (a) it connects with NELHA's planned Road A (Ka‘iminani Road extension), and (b) an improvement connection between NELHA's internal roadways and Queen Ka‘ahumanu Highway is made, as discussed in Section 1.3.1.

Queen Ka‘ahumanu Highway Frontage Road

Regional plans (County of Hawai‘i, 2008) call for the development of a Queen Ka‘ahumanu Highway frontage road (Kahilihili Street) on the makai side of Queen Ka‘ahumanu Highway from roughly KOA in the north to Konokôhau Harbor in the south. The County envisions this frontage road to serve as a secondary transit route to "enable the consolidation of Queen Ka‘ahumanu Highway vehicular access points for the developments makai of Queen Ka‘ahumanu Highway" (County of Hawai‘i, 2008). One purpose of the proposed project is to provide for this need identified by the County of Hawai‘i.

The Queen Ka‘ahumanu Highway frontage road, once completed as envisioned, would provide a makai route parallel to Queen Ka‘ahumanu Highway and would facilitate HDOT's goal to maintain Queen Ka‘ahumanu Highway as a limited access highway in a highly developed area.

Completing the frontage road as envisioned would require NELHA's planned Road C (Kahilihili Street extension) to connect with a future frontage road on KOA to the north and a future frontage road to the south.

1.4 Alternatives Addressed in this EA

Two alternatives are analyzed in this EA, the No Build and the Build Alternative. The proposed project is the Build Alternative.

1.4.1 No Build Alternative

The No Build Alternative assumes:

- HDOT would widen Queen Ka‘ahumanu Highway as planned. This would result in the following conditions in the vicinity of NELHA and HOST Park:
    - The Queen Ka‘ahumanu Highway – Makako Bay Drive intersection would be converted to a right-turn-in/right-turn-out only intersection (Figure 1-5); and

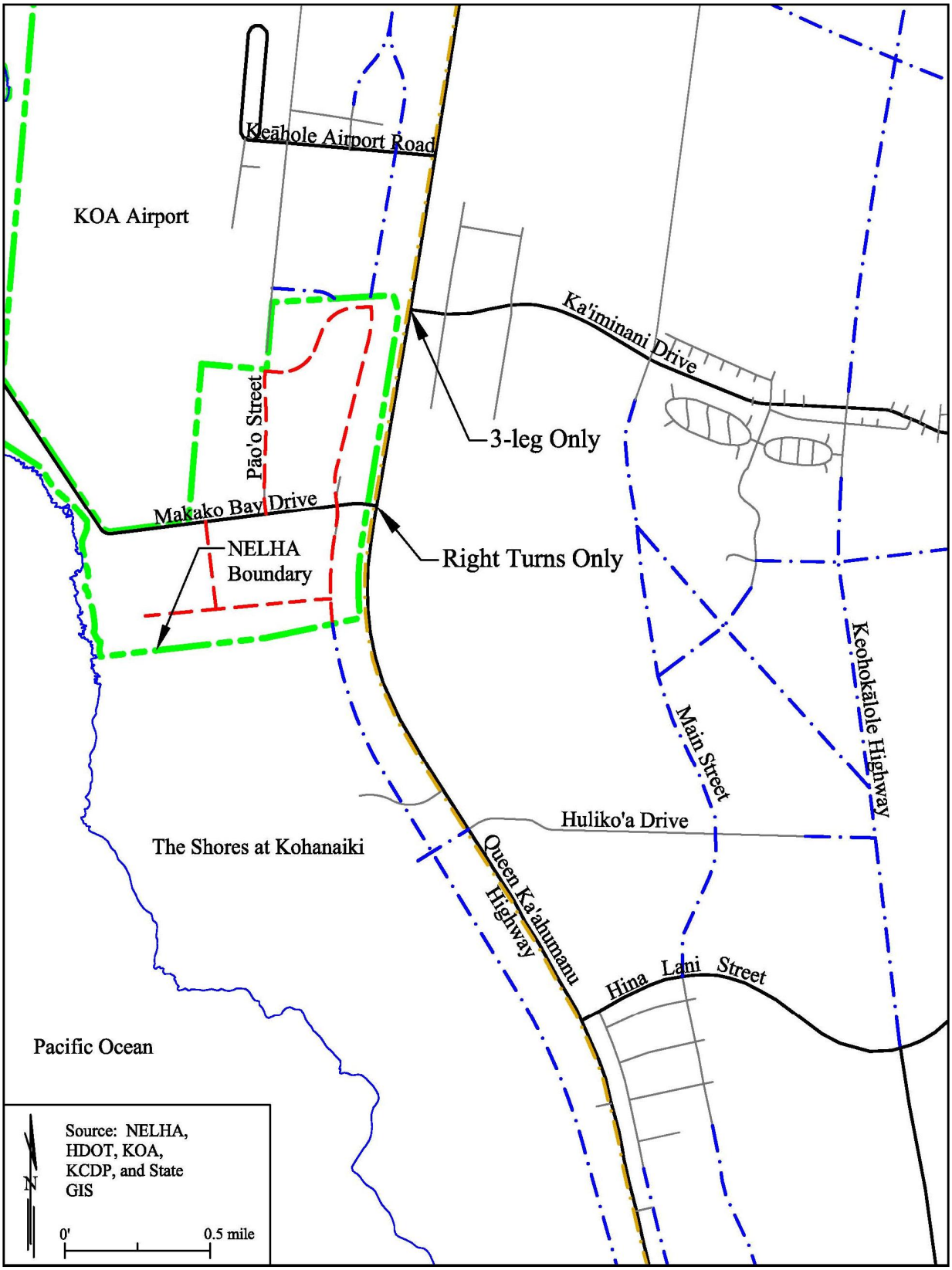

Figure 1-5: No Build Alternative Regional Transportation Network

  - The Queen Ka‘ahumanu Highway – Ka‘iminani Road intersection would remain a signalized three-leg intersection (Figure 1-5).

- NELHA would develop their internal roadways as planned (Figure 1-5; NELHA, 1985; NELHA, 1992; and NELHA, 2011), including:
  - Road A (Ka‘iminani Road extension) with no connection to Queen Ka‘ahumanu Highway
  - Road B (Pāo‘o Street extension) with no connection to KOA’s Pāo'o Road (Road N)
  - Road C (Kahilihili Street extension/Queen Ka‘ahumanu Highway frontage road north of Makako Bay Drive).
  - Road D (Kahilihili Street extension/Queen Ka‘ahumanu Highway frontage road south of Makako Bay Drive)
- KOA would develop their internal roadways as proposed, including at least a portion of Road M extending toward NELHA’s planned Road A (Figure 1-5). KOA’s Road M will not extend to Road A unless both NELHA and HDOT agree to have the roads connect.
- HDOT and the County of Hawai‘i would develop other regional roadways, including those illustrated on Figure 1-5, as the region continues to develop. This could include the Queen Ka‘ahumanu Highway frontage road within KOA.

The roadways listed above would be developed by the various agencies/owners responsible for the surrounding lands (KOA and NELHA for example) under the No Build Alternative; however, as illustrated in Figure 1-5, there would be gaps in the roadways.

1.4.2 Build Alternative

Under the Build Alternative, all the developments outlined in the No Build Alternative would occur, plus roadways would be completed to provide a more connected regional roadway network (Figure 1-6).

The various components of the proposed project would be built in conjunction with other improvements in the area. Therefore, the timing of the various components of the proposed project would be dependent on other actions in the area. In this Draft EA, the proposed project is divided into Phase 1 and 2. Phase 1 components are likely to be implemented soon, because related components are in the planning phase now. Phase 2 components are not likely to be needed until regional development has increased substantially.

Phase 1

Phase 1 of the proposed project would likely occur over the next ten years following the construction of NELHA planned roads A, B, and/or C and KOA road M. Phase 1 would include:

- Making the Queen Ka‘ahumanu – Ka‘iminani Street intersection a four-leg intersection and completing NELHA’s planned Road A (Ka‘iminani Road extension) to be the fourth, western (makai) leg. The intersection would be signalized and allow straight-through, right-turn, and left-turn movements in all directions.

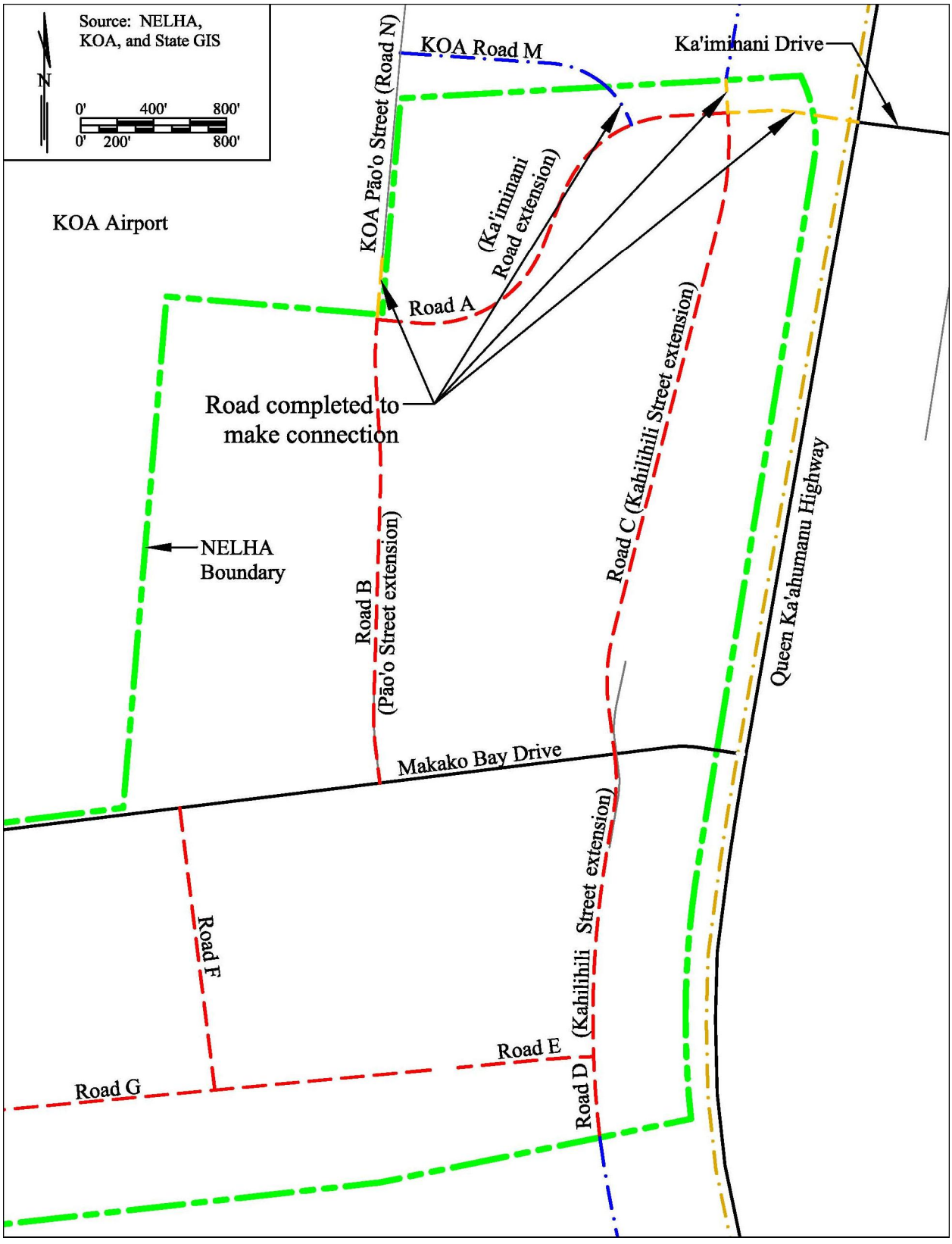

Figure 1-6: Build Alternative

- Making the following connection between NELHA's planned roadways and KOA's existing or planned roadways:
    - NELHA's Road A (Ka‘iminani Road extension) and KOA's proposed Road M.
    - NELHA's Road B (Pāo‘o Street extension) and KOA's Pāo‘o Street (Road N).

Figure 1-6 illustrates the location of these roads and intersections and Figure 1-7 illustrates the proposed lane configuration after Phase 1 implementation. The final lane configuration would depend on the outcome of detailed transportation demand analysis performed by the final designer of the proposed intersections.

The following sections describe Phase 1 of the Build Alternative in more detail. The information provided is based on preliminary engineering work. As NELHA and HDOT consult with project stakeholders and advance the design, modifications or additions to the Build Alternative are possible.

Queen Ka‘ahumanu Highway – Ka‘iminani Road Intersection

NELHA's planned Road A (Ka‘iminani Road extension) would be completed the roughly 600 feet from Road C (Kahilihili Street extension) toward Queen Ka‘ahumanu Highway and form the fourth leg of the Queen Ka‘ahumanu Highway – Ka‘iminani intersection. The intersection would be signalized, providing for straight-through, right-turn, and left-turn movements in all directions.

NELHA's Road B (Pāo‘o Street extension) and KOA's Pāo‘o Street (Road N)

NELHA would complete Road B (Pāo‘o Street extension) all the way to the existing end of KOA's Pāo‘o Street (Road N) (Figure 1-7). This was originally envisioned in NELHA's EIS in 1985 (NELHA, 1985). Vehicles would be allowed to freely travel between NELHA and KOA 24-hours a day. However, weight restrictions may be imposed on Pāo‘o Street, requiring that all heavy vehicles use alternative routes (i.e. planned Road A (Ka‘iminani Road extension) and Queen Ka‘ahumanu Highway), to reach their destination.

KOA's Proposed Road M – NELHA's Planned Road A (Ka‘iminani Road extension) Intersection

KOA's proposed Road M would be completed across NELHA's property and form a three-leg intersection with NELHA's planned Road A (Ka‘iminani Road extension) during Phase 1 (Figure 1-7). Vehicles would be allowed to freely travel between NELHA and KOA 24-hours a day. However, weight restrictions may be imposed on Road M, requiring that all heavy vehicles use alternative routes (i.e. planned Road A (Ka‘iminani Road extension) and Queen Ka‘ahumanu Highway), to reach their destination.

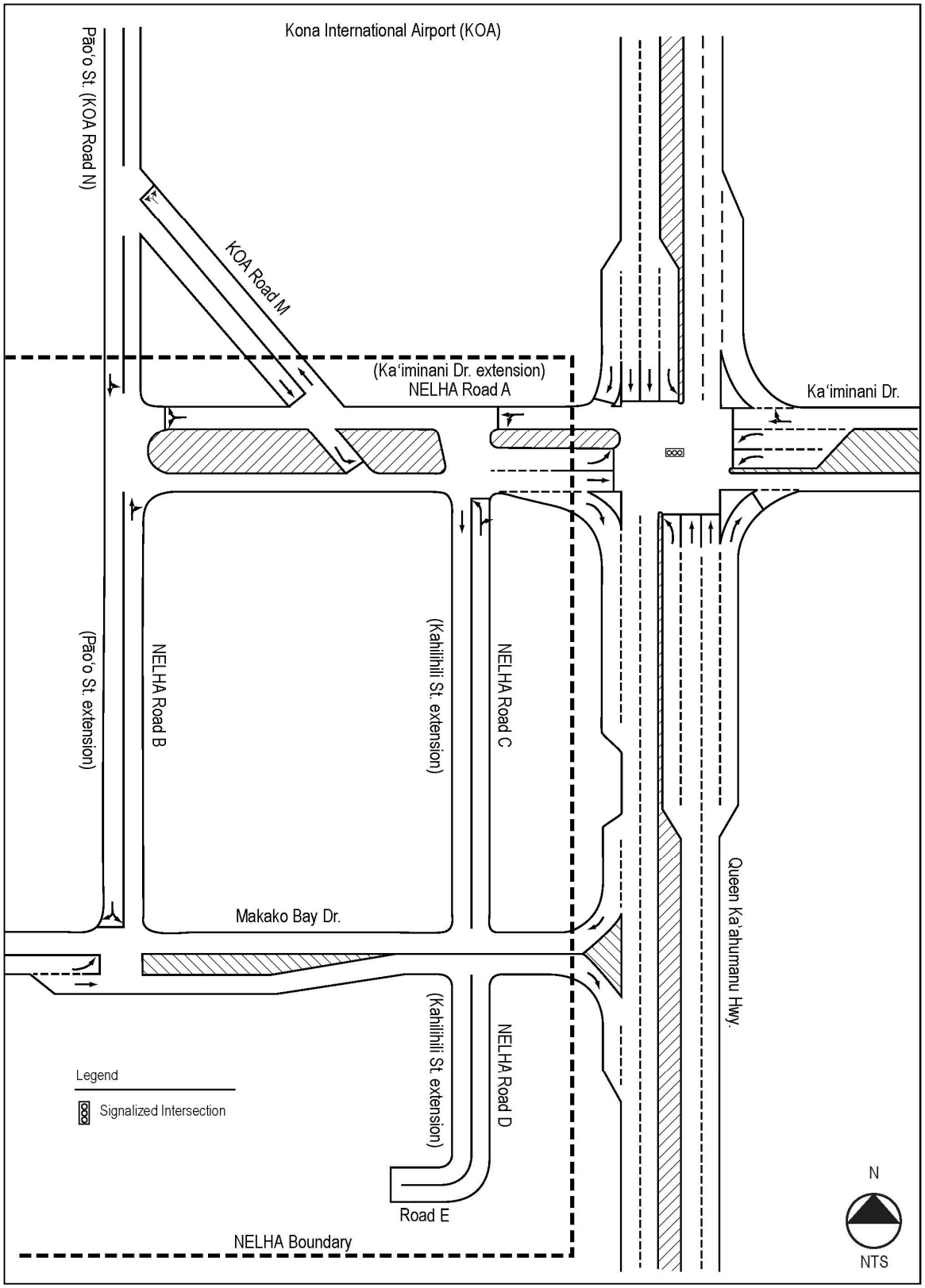

Figure 1-7: Recommended Phase 1 Lane Configuration

Phase 2

Phase 2 of the proposed project would occur when NELHA, HOST Park, and surrounding developments, such as KOA and nearby residential developments, approach full build-out. This is not projected to occur until roughly 2035. Phase 2 would include:

- Making the connection between NELHA's planned Road C (Kahilihili Street extension/Queen Ka‘ahumanu Highway frontage road) and KOA's future Queen Ka‘ahumanu Highway frontage road.
- Signalizing the Queen Ka‘ahumanu Highway – Makako Bay Drive intersection as a three-leg intersection with left-turn movements allowed into and out of Makako Bay Drive.

Figure 1-6 illustrates the location of these roads and intersections and Figure 1-8 illustrates the proposed lane configuration after implementation of Phase 2.

The following sections describe Phase 2 of the Build Alternative in more detail. The information provided is based on preliminary engineering work. As NELHA and HDOT consult with project stakeholders and advance the design, modifications or additions to the Build Alternative are possible.

NELHA's Planned Road C (Kahilihili Street extension) – KOA Future Frontage Road

NELHA would build Road C (Kahilihili Street extension) as planned in Phase 1 – a stub-out on the northern side of the intersection with Road A (Ka‘iminani Road extension). In Phase 2 it would be completed to connect to KOA's frontage road if and when KOA builds a frontage road.

Queen Ka‘ahumanu Highway – Makako Bay Drive Intersection

As part of Phase 2, the Queen Ka‘ahumanu Highway – Makako Bay Drive intersection would be converted from a right-turn-in/right-turn-out unsignalized intersection to a signalized three-leg intersection (Figure 1-8) that allows left turns into and out of Makako Bay Drive.

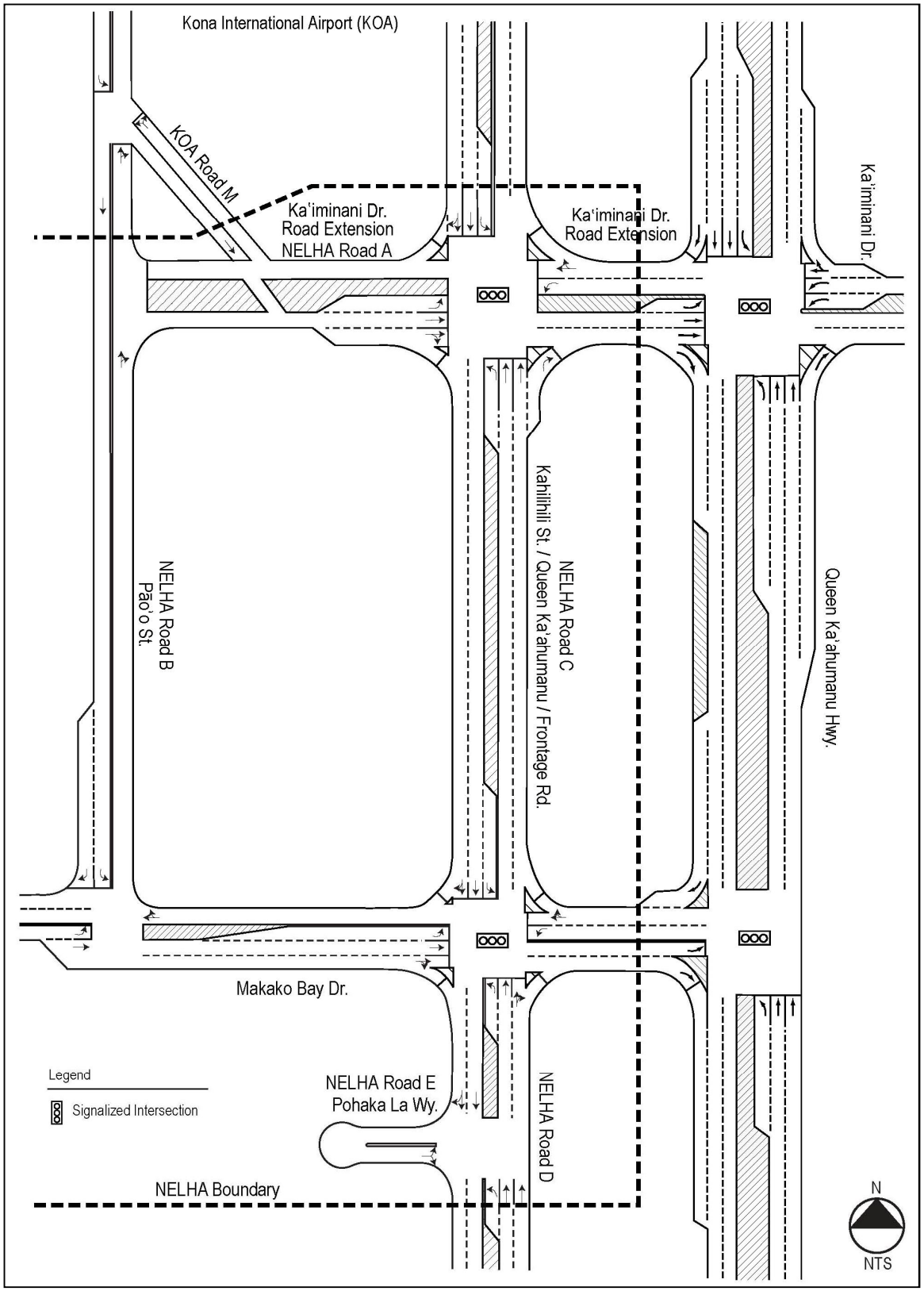

Figure 1-8: Recommended Phase 2 Lane Configurations

1.5 Schedule

The implementation of the proposed project is contingent on the construction of other improvements in the area. Generally, Phase 1 would be implemented as possible over the next ten years or so as follows: (a) to mitigate HDOT plans to widen Queen Ka‘ahumanu Highway in the vicinity of Makako Bay Drive and Ka‘iminani Drive, (b) to connect to KOA’s Pāo‘o Road when NELHA completes their planned Road B, and (c) to connect KOA’s proposed Road M to NELHA’s planned Road A when they are both completed.

Phase 2 of the proposed project would be implemented as warranted when NELHA, HOST Park, and the surrounding area, including KOA becomes more developed.

1.6 Permits and Approvals

Other than this Environmental Assessment, no project-specific permits or approvals are believed to be necessary prior to implementing the proposed project. Making the connections discussed in Section 1.4.2 would be made as part of one or more larger projects, including: (a) HDOT’s Queen Ka‘ahumanu Highway widening project, (b) NELHA’s HOST Park internal road construction projects, and (c) KOA’s facilities expansion projects. The construction of the proposed project would be covered by permits obtained for one or more of these larger projects because the connections could not be built until one or more of those larger projects are built.

In 1986, after NELHA’s initial planning for an internal road network in HOST Park, NELHA obtained a change of zoning for the area and Special Management Area (SMA) Permit No. 239 covering the planned development. Since that time, NELHA has consulted with the County of Hawai‘i Planning Department regarding the need for a new SMA permit (Appendix A). The Planning Department determined that “SMA Permit No. 239 did not set restrictions on the location of roads within the NELHA property so long as the main access road to Queen Ka‘ahumanu Highway is the only direct highway access. Therefore, the revised plan is consistent with the permit and does not require further review against the SMA rules.” (PD, May 11, 2009).

The Planning Department also found that “The future four-legged intersection at Ka‘iminani Drive … was not anticipated at the time of the rezone. However, we believe the revised road circulation plan is consistent with Ordinance No. 86-093 [SMA Permit No. 239], because the plan does not propose any direct access to the highway from lots fronting the highway. Instead all lots within the HOST Park property will continue to be accessed by internal roadways, and the internal roadways will connect to the highway at the main access road intersection (right turn in/right turn out movements only) and the future Ka‘iminani Drive four-legged intersection.” (PD, May 19, 2009).

2.0 AFFECTED ENVIRONMENT, POTENTIAL IMPACTS, AND PROPOSED MITIGATION

This section describes existing conditions in the area potentially affected by the project. It also describes immediate and long-term environmental impacts of the proposed action, including construction-phase impacts. Where an impact is considered adverse, measures proposed to avoid, minimize, or mitigate the impact are specified.

2.1 Roadways and Traffic

The Island of Hawai‘i is served by a network of 1,393 miles of public roads. This includes 394 miles of state highways. The backbone of the system is the Hawai‘i Belt Road which circles the island. The Belt Road is comprised of State Route 11 to the south and State Route 19 to the north. Queen Ka‘ahumanu Highway (State Route 19) provides access to NELHA and is part of the Hawai‘i Belt Road.

2.1.1 Existing Conditions

Roadways in the project area are illustrated on Figure 2-1. Queen Ka‘ahumanu Highway is located along the east (mauka) side of NELHA and KOA. Queen Ka‘ahumanu Highway is a two-lane (north of Kealakehe Parkway), Class I State Highway with limited access and a posted speed limit of 45 miles per hour near the project location. South of Kealakehe Parkway, the highway has been widened to four lanes to Henry Street.

Although access to Queen Ka‘ahumanu Highway is limited, the following roads provide access in the project area:

- **Makako Bay Drive**, three-legged, unsignalized intersection. Makako Bay Drive (sometimes referred to as the NELHA Access Road or the OTEC Road) is a 24-foot wide asphalt concrete pavement road. The road provides access to NELHA and tenant facilities, shoreline, “Pine Trees” beach, and Wawaloli Beach Park. It is a two-lane, undivided, public roadway. The right-of-way varies between 80 feet and 110 feet. There is an access gate near Makako Bay Drive’s intersection with Queen Ka‘ahumanu Highway; this gate is closed between 8 p.m. and 6 a.m. The posted speed limit is 25 mph.
- **Ka‘iminani Drive**, three-legged, signalized intersection. Ka‘iminani Drive is located roughly 3,500 feet (2/3rds of a mile) north of Makako Bay Drive. It is a collector road that extends east from Queen Ka‘ahumanu Highway to Māmalahoa Highway (State Route 190). The posted speed limit just mauka of Queen Ka‘ahumanu Highway is 35 mph.
- **Keāhole Airport Road**, three-legged, signalized intersection. Keāhole Airport Road is roughly 2,800 feet (0.5 mile) north of Ka‘iminani Drive and provides primary airport access from the highway to the passenger terminal as well as other airport facilities. Keāhole Airport Road is a two-lane, undivided roadway. The posted speed limit on Keāhole Airport Road is 25 mph.

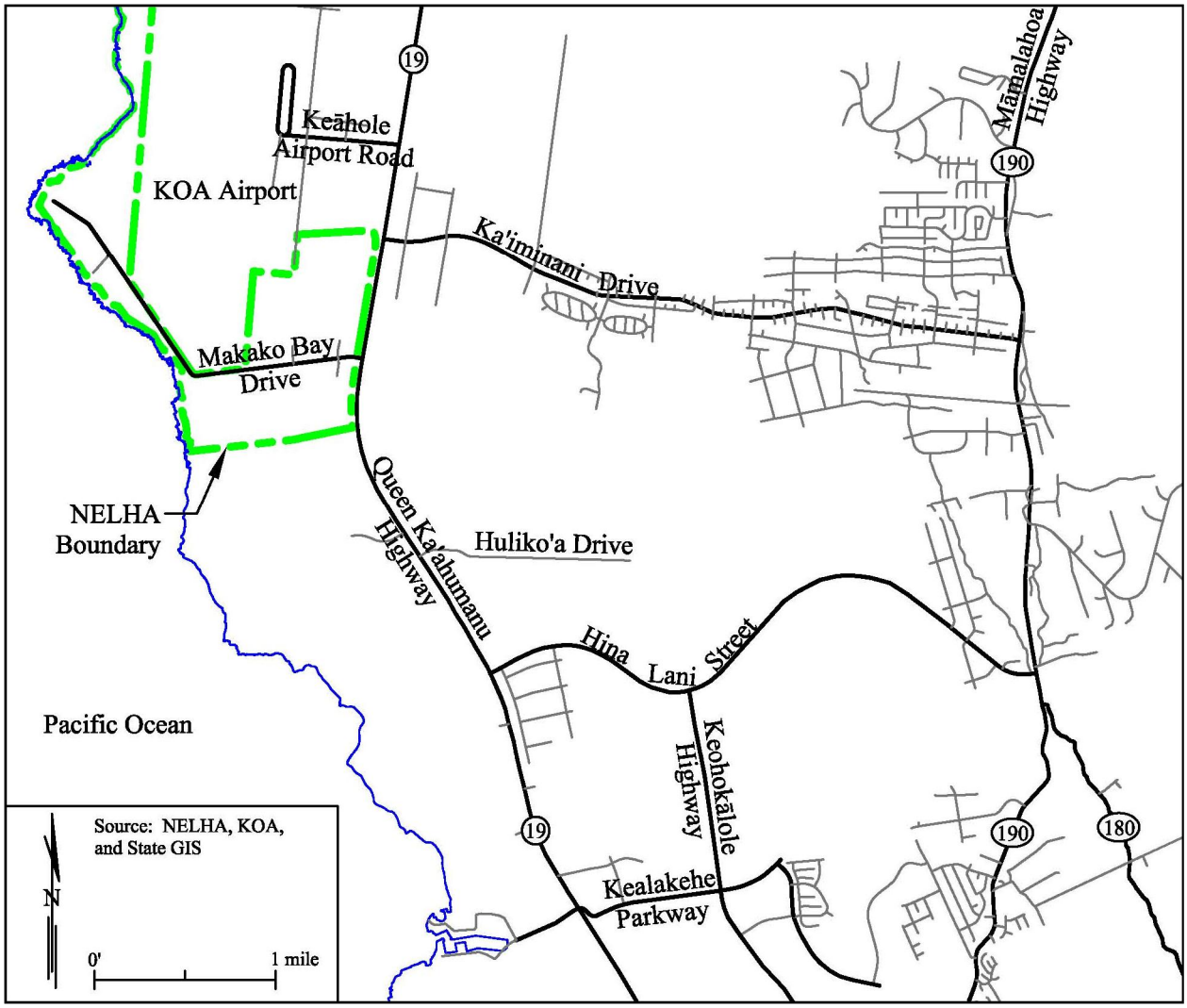

Figure 2-1: Existing Highways and Roads in Region

- **Huliko‘a Drive**, three-legged, unsignalized intersection. Huliko‘a Drive is located roughly 1.2 miles south of Makako Bay Drive and provides access to Kohanaiki industrial area. Huliko‘a Drive is a two-lane, undivided roadway; the posted speed limit is 30 mph.
- **Hina Lani Street**, three-legged, signalized intersection. Hina Lani Street is located roughly 4,000 feet (0.75 mile) south of Huliko‘a Drive and provides access to the Kaloko industrial area and extends east to Māmalahoa Highway (State Route 190). Hina Lani Street is a two-lane, undivided roadway; the posted speed limit is 30 mph.

The Hawai‘i County Mass Transit Agency provides public transportation around the island on the Hele-On bus system. Service is provided to the major urban centers on the island via the main roadways. There is also shuttle service available in the Hilo and the Kona Districts. The Hele-On service uses a fleet of buses with a capacity of 33 to 45 passengers. The bus service stops twice Monday through Saturday (once northbound and once southbound) at the Keāhole Airport terminal and two additional routes pass by the project area on Queen Ka‘ahumanu

Highway twice in the northbound direction and three times in the southbound direction Monday through Saturday. On Sundays, one route passes the project area (once northbound and once southbound).

Traffic Volumes

Traffic volumes on Queen Ka‘ahumanu Highway, Keāhole Airport Road, and Makako Bay Road are summarized in the following tables and figures. The tables summarize the peak or average traffic volumes and the figures show a graph of the traffic volume over a 24-hour period.

Table 2-1: 2008 Peak Hour Traffic Volumes on Queen Ka‘ahumanu Highway between Makako Bay Drive and Keāhole Airport Road

Direction	AM Peak Traffic Volume (vehicles/hour)	AM Peak Time	PM Peak Traffic Volume (vehicles/hour)	PM Peak Time
North bound	831	6:15 – 7:15	832	3:15 – 4:15
South bound	870	7:00 – 8:00	880	3:30 – 4:30

Notes: AM = morning; PM = afternoon
Traffic counts from Tuesday, September 16, 2008.

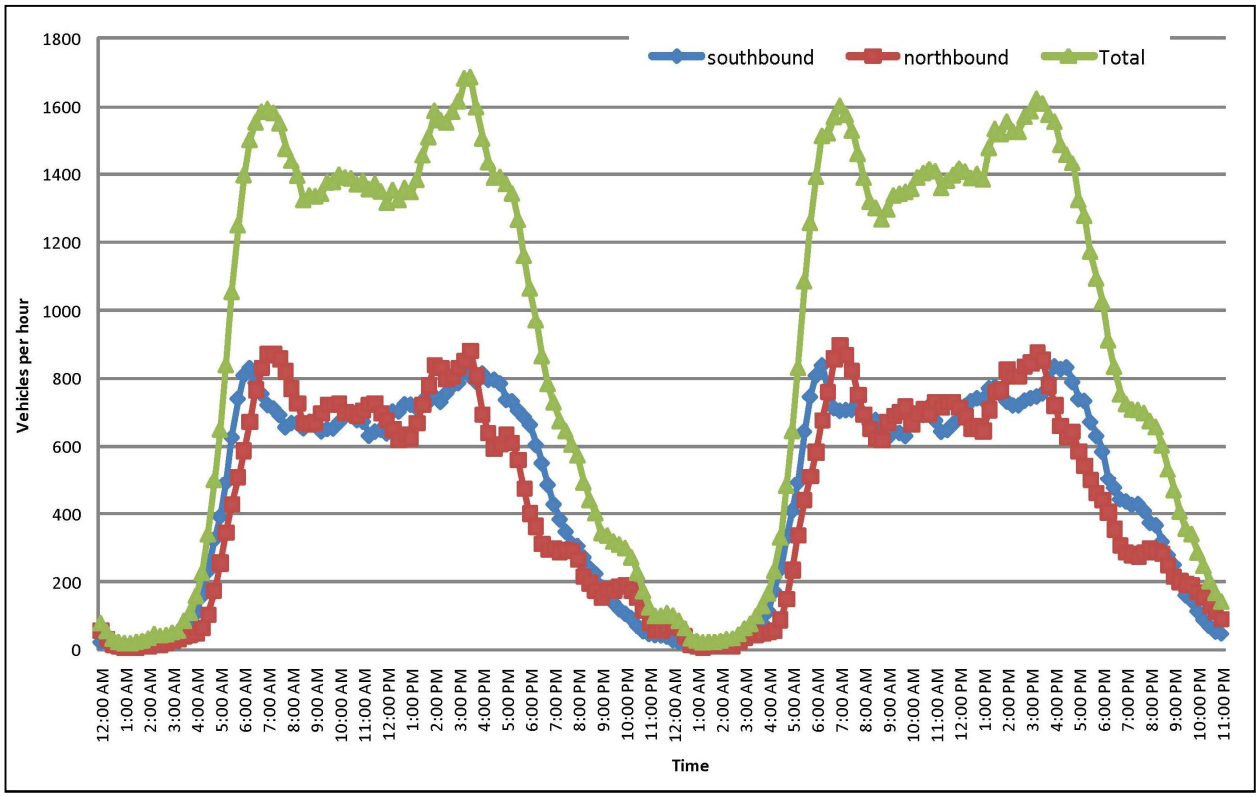

Figure 2-2: 2008 Queen Ka‘ahumanu Highway 24-Hour Traffic Volumes

Table 2-2: 2010 Peak Hour and Average Traffic Volumes on Keāhole Airport Road west (makai) of Pāo'o Street

Direction	Peak Traffic Volume (vehicles/hour)	Peak Time	Daytime Average (vehicles/hour)	Time of Average
East (mauka) bound	315	10:45 – 11:45 a.m.	247	8:00 a.m. – 8:00 p.m.
West (makai) bound	336	11:00 a.m. – noon	231	8:00 a.m. – 8:00 p.m.

Notes: a.m. = morning; p.m. = afternoon
Traffic counts from Tuesday, September 14, 2010.

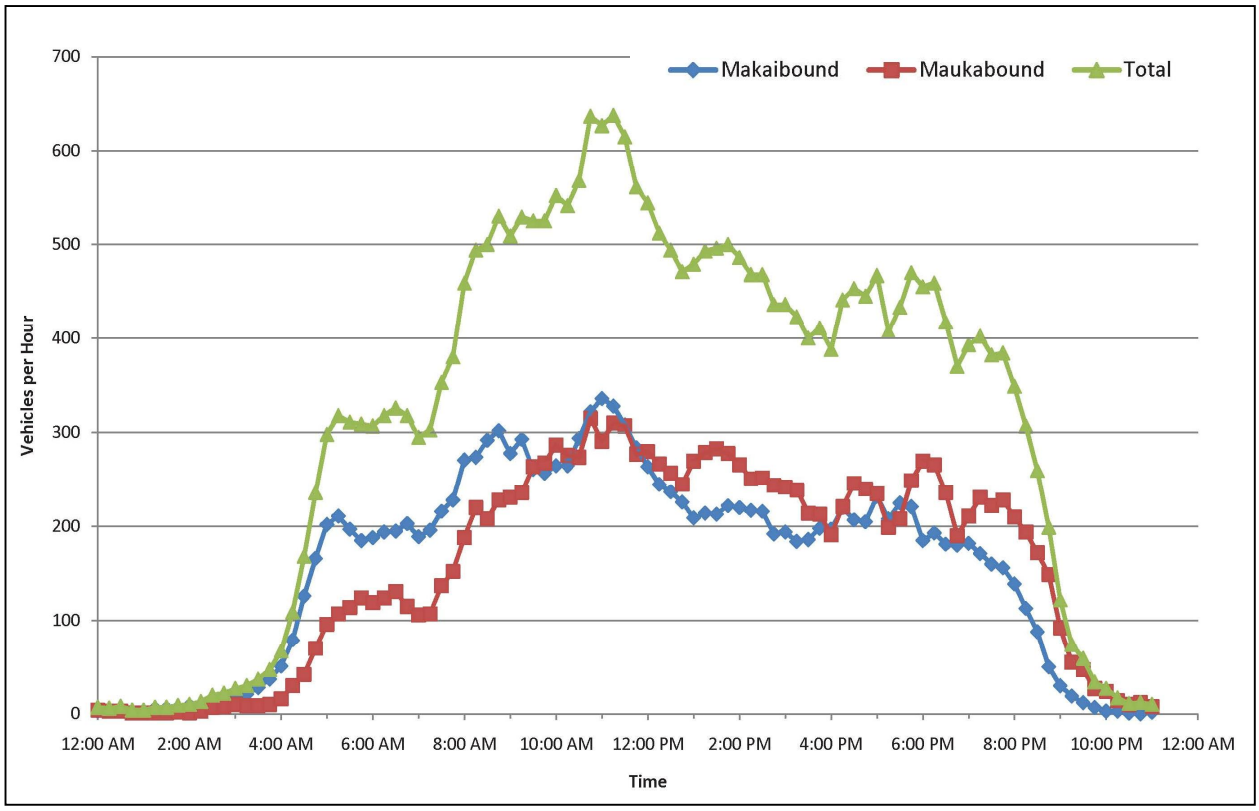

Figure 2-3: 2010 Keāhole Airport Road 24-Hour Traffic Volumes

Table 2-3: 2010 Peak Hour Traffic Volumes on Makako Bay Drive west (makai) of Queen Ka'ahumanu Highway

Direction	AM Peak Traffic Volume (vehicles/ hour)	AM Peak Time	Mid-day Peak Traffic Volume (vehicles/ hour)	Mid-day Peak Time	PM Peak Traffic Volume (vehicles/ hour)	PM Peak Time
East (mauka) bound	108	8:15 – 9:15	139	11:30 – 12:30	157	2:00 – 3:00
West (makai) bound	172	8:00 – 9:00	132	11:30 – 12:30	114	1:45 – 2:45

Notes: AM = morning; PM = afternoon
Traffic counts from Tuesday, September 14, 2010.

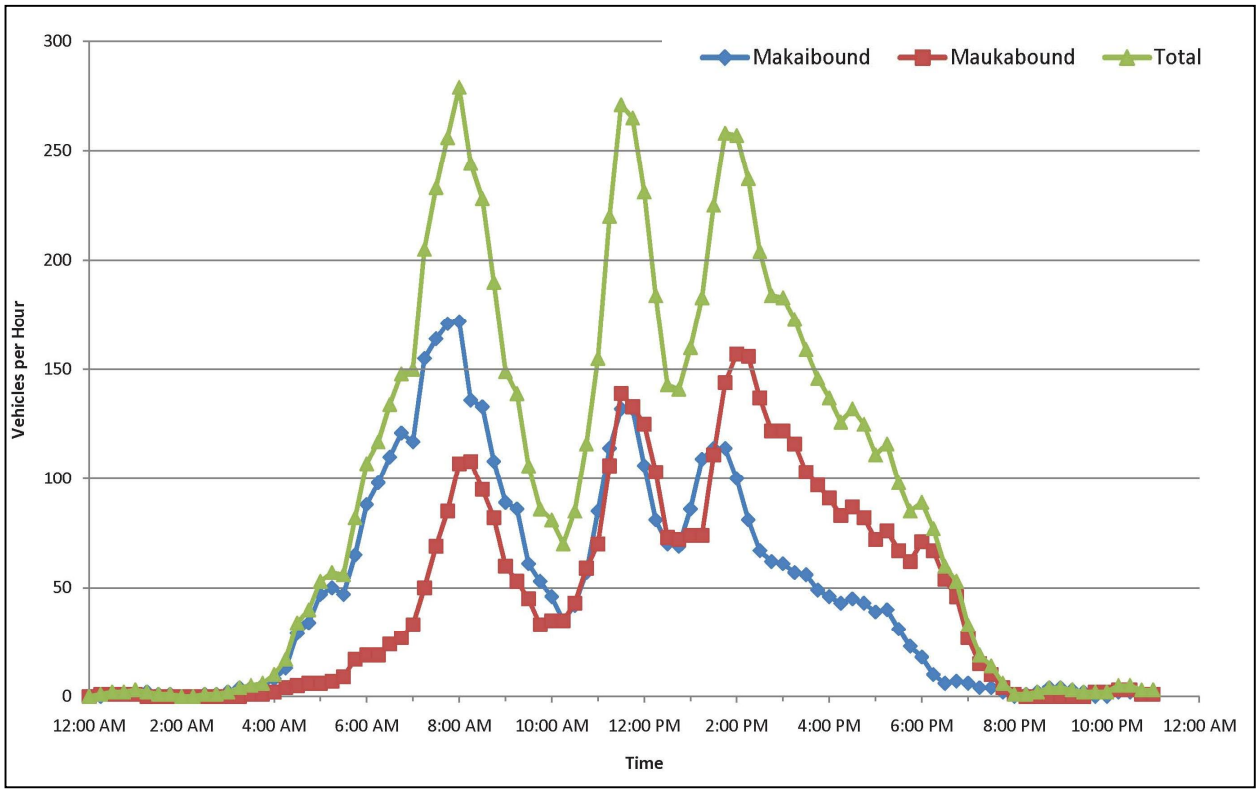

Figure 2-4: 2010 Makako Bay Drive 24-Hour Traffic Volumes

Of the 2,171 total vehicles utilizing Makako Bay Drive, 68 of them were classified as heavy vehicles. Many of those heavy vehicles move materials and product from NELHA/HOST Park to and from Kawaihae Harbor to the north. Therefore, many of them make left turns from Makako Bay Drive onto Queen Ka'ahumanu Highway.

Turning Movement Counts

Turning movement counts were recorded at the following intersections on September 14 and 15, 2010:

- Queen Ka‘ahumanu Highway – Hina Lani Street
- Queen Ka‘ahumanu Highway – Makako Bay Drive
- Queen Ka‘ahumanu Highway – Ka‘iminani Drive
- Queen Ka‘ahumanu Highway – Keāhole Airport Road
- Keāhole Airport Road – Halulu Street
- Keāhole Airport Road – Pāo'o Street

Figure 2-5 shows the existing peak hour traffic volumes at the recorded intersection locations. Based upon historical peak hour data and KOA flight schedules, counts were performed at the following intervals at all intersections except Queen Ka‘ahumanu Highway – Makako Bay Drive:

- Morning peak: between 7 a.m. to 9 a.m.
- Mid-day peak: 10 a.m. to noon
- Afternoon peak: and from 2:30 p.m. to 4:30 p.m.

Due to the specific traffic patterns at the Queen Ka‘ahumanu Highway – Makako Bay Drive intersection, this intersection’s turning movements were recorded from 6:30 a.m. to 9 a.m., 10 a.m. to noon, and 1:30 p.m. to 4:30 p.m.

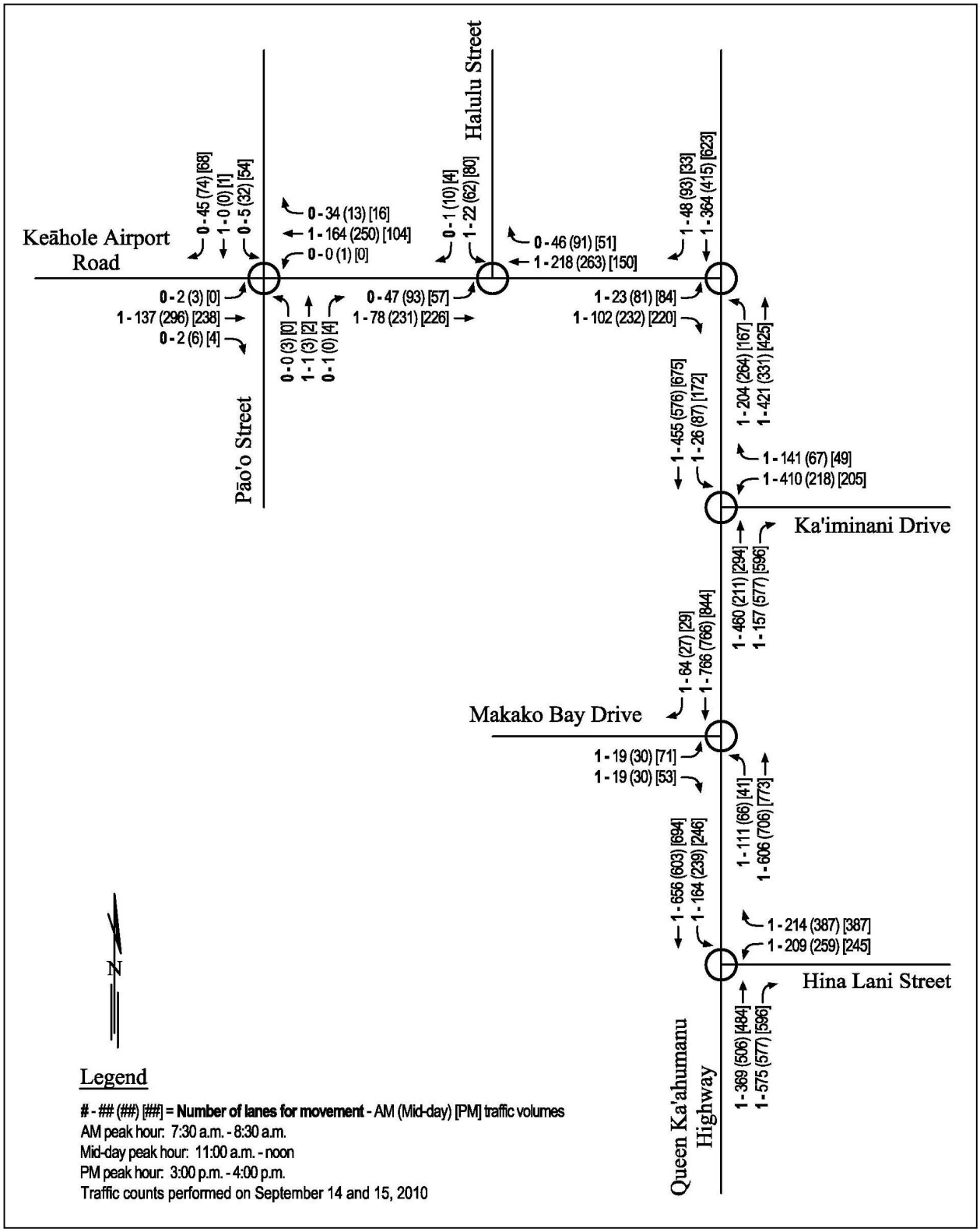

Figure 2-5: Existing Turning Movement Volumes

Traffic Operations

The existing intersections where turning movements counts were collected on September 14 and 15, 2010, were analyzed using the methodologies documented in the *2000 Highway Capacity Manual (HCM)*.

Table 2-5 summarizes the existing Level-of-Service (LOS) conditions at these six intersections.

LOS grades range from a best of "A" to a worst of "F". The LOS grades are defined in Table 2-4.

Table 2-4: Level of Service Descriptions

LOS	Signalized Intersections	Unsignalized Intersections
A	Control delay up to 10 second/vehicle. Many vehicles do not stop at all.	Control delay up to 10 seconds/vehicle.
B	Control delay greater than 10 and up to 20 second/vehicle. Some vehicles do not stop at all.	Control delay greater than 10 and up to 15 seconds/vehicle.
C	Control delay greater than 20 and up to 35 seconds/vehicle. Few vehicles do not stop at all. Individual cycle failures may occur.	Control delay greater than 15 and up to 25 seconds/vehicle.
D	Control delay greater than 35 and up to 55 seconds/vehicle. Individual cycle failures are noticeable. Most vehicles stop.	Control delay greater than 25 and up to 35 seconds/vehicle.
E	Control delay greater than 55 and up to 80 seconds/vehicle. Individual cycle failures are frequent and nearly all vehicles stop.	Control delay greater than 35 and up to 50 seconds/vehicle.
F	Control delay in excess of 80 seconds/vehicle. The capacity of intersection is exceeded and many individual cycle failures occur.	Control delay greater than 50 seconds/vehicle.

Table 2-5: Existing Level of Service Summary

Existing LOS	AM		Mid-day		PM	
	LOS	Delay	LOS	Delay	LOS	Delay
Queen Ka'ahumanu Hwy – Hina Lani St	B	12.5	B	19.4	B	13.8
Hina Lina WB Left-Right	C	22.3	C	29.9	C	26.2
Queen Ka'ahumanu NB Through	B	15.7	C	23.5	B	17.0
Queen Ka'ahumanu NB Right	A	9.9	B	15.6	B	11.3
Queen Ka'ahumanu SB Left	A	7.4	B	14.9	A	9.8
Queen Ka'ahumanu SB Through	A	6.0	A	9.0	A	6.0
Queen Ka'ahumanu Hwy – Makako Bay Dr	Unsignalized		Unsignalized		Unsignalized	
Makako Bay Dr EB Left	E	35.8	E	48.6	F	134.5
Queen Ka'ahumanu NB Left	B	10.3	A	9.9	B	10.1
Queen Ka'ahumanu Hwy – Ka'iminani Dr	C	26.5	B	13.8	B	14.1
Ka'iminani WB Left-Right	D	54.8	B	19.6	B	19.9
Queen Ka'ahumanu NB Through	B	16.5	B	18.3	B	20.0
Queen Ka'ahumanu NB Right	B	10.1	B	10.8	B	12.4
Queen Ka'ahumanu SB Left	A	7.9	A	8.4	A	8.8
Queen Ka'ahumanu SB Through	A	9.0	A	8.8	A	9.7
Queen Ka'ahumanu Hwy – Keāhole Airport Rd	A	7.0	B	13.0	B	17.4
Keāhole EB Left-Right	B	16.7	C	21.2	C	28.2
Queen Ka'ahumanu NB Left	A	3.4	A	6.1	A	9.1
Queen Ka'ahumanu NB Through	A	2.9	A	5.0	A	4.5
Queen Ka'ahumanu SB Through	B	10.5	B	18.3	C	23.4
Queen Ka'ahumanu SB Right	A	7.7	B	11.6	B	10.3
Keāhole Airport Rd – Halulu St	Unsignalized		Unsignalized		Unsignalized	
Keāhole EB Left-Through	A	3.2	A	3.0	A	1.9
Keāhole WB Through-Right	A	3.2	A	3.0	A	1.9
Halulu SB Left-Right	B	11.8	C	18.0	B	14.3
Keāhole Airport Rd – Pāo'o St	Unsignalized		Unsignalized		Unsignalized	
Keāhole EB Left-Through-Right	A	0.1	A	0.1	A	0.0
Keāhole WB Left-Through-Right	A	0.0	A	0.0	A	0.0
Pāo'o NB Left-Through-Right	B	10.2	C	15.3	B	10.3
Pāo'o SB Left	B	11.1	B	14.8	B	12.1
Pāo'o SB Through-Right	A	9.5	B	10.3	A	9.3

Notes: EB = east (mauka)-bound; NB = north-bound; WB = west (makai)-bound; SB = south-bound
Delay in seconds/vehicle
AM = Morning peak: between 7 a.m. to 9 a.m.; except Makako Bay Dr: 6:30 a.m. to 9 a.m.
Mid-day peak: 10 a.m. to noon
PM = Afternoon peak: and from 2:30 p.m. to 4:30 p.m.; except Makako Bay Dr: 1:30 p.m. to 4:30 p.m.

2.1.2 Potential Impacts

No Build Alternative

Under the No Build alternative a number of roads would be built in the region by the County and State (including HDOT Highways, HDOT Airports, and NELHA), including those illustrated on

Figure 1-5. However, no connections between NELHA/HOST Park roadways and Queen Ka‘ahumanu Highway and Kona International Airport roadways would be made and the Makako Bay Drive and Queen Ka‘ahumanu Highway intersection will become a right-turn-in/right-turn-out only intersection (HDOT, 1996).

Under the No Build alternative, vehicles exiting NELHA and HOST Park seeking to go north-bound would have to turn right/south from Makako Bay Drive onto Queen Ka‘ahumanu Highway and then make a “U” turn at Huliko‘a Drive or Hina Lani Street (Figure 1-2). In addition, north-bound vehicles on Queen Ka‘ahumanu Highway whose destination is NELHA or HOST Park would have to make a “U” turn at either Ka‘iminani Drive or Keāhole Airport Road (Figure 1-2), backtrack, and then enter HOST Park. This situation would (a) have a negative economic impact on NELHA and HOST Park tenants, (b) hinder marketing efforts to attract new tenants to HOST Park, (c) promote congestion at the intersections where “U” turns are made, and (d) inconvenience motorists utilizing Makako Bay Drive.

The No Build Alternative has negative consequences on NELHA and HOST Park traffic. Although the LOS for the Queen Ka‘ahumanu Highway – Makako Bay Drive intersection will be good, that is due to the elimination of the left turns. Forcing the large trucks, school buses, tour buses, and other NELHA/HOST Park traffic to make U-turns at other Queen Ka‘ahumanu Highway intersections will negatively affect the LOS at those intersections. Furthermore, the level of safety at the intersections where U-turns would be made would be compromised by those U-turn movements.

Nevertheless, keeping the Ka‘iminani Road – Queen Ka‘ahumanu Highway intersection three legged would result in better intersection LOS at that intersection than a four-legged intersection (the Build Alternative). This is primarily because (a) no U-turn movements would be made at this intersection, and (b) makai-bound left turns would not have to compete for green time with mauka-bound straight traffic.

Build Alternative

The only differences between the No Build Alternative and Phase 1 of the Build Alternative are (a) the completion of NELHA’s planned Road A to become the fourth leg of a signalized Queen Ka‘ahumanu Highway – Ka‘iminani Road intersection, and (b) allowing multiple roadway connections (Road A and B) between HOST Park and Kona International Airport (KOA) (Figure 2-6). This would allow additional exits from the NELHA/HOST Park facility and improve regional roadway connectivity.

Phase 1 of the proposed project, as described in Section, 1.4.2, was analyzed for traffic impacts with a forecasted completion date of 2015. Table 2-6 summarizes the LOS for the intersections in the area under the Build Alternative in the year 2015 (Phase I implemented). Delays in several projects, in particular the widening of Queen Ka‘ahumanu Highway, have occurred; that is why the forecast year is so close to the current year. All intersections associated with the proposed project are projected to operate at LOS D, or better during the forecasted 2015 time frame. However, some left turning movements are projected to operate at LOS E or F during peak periods.

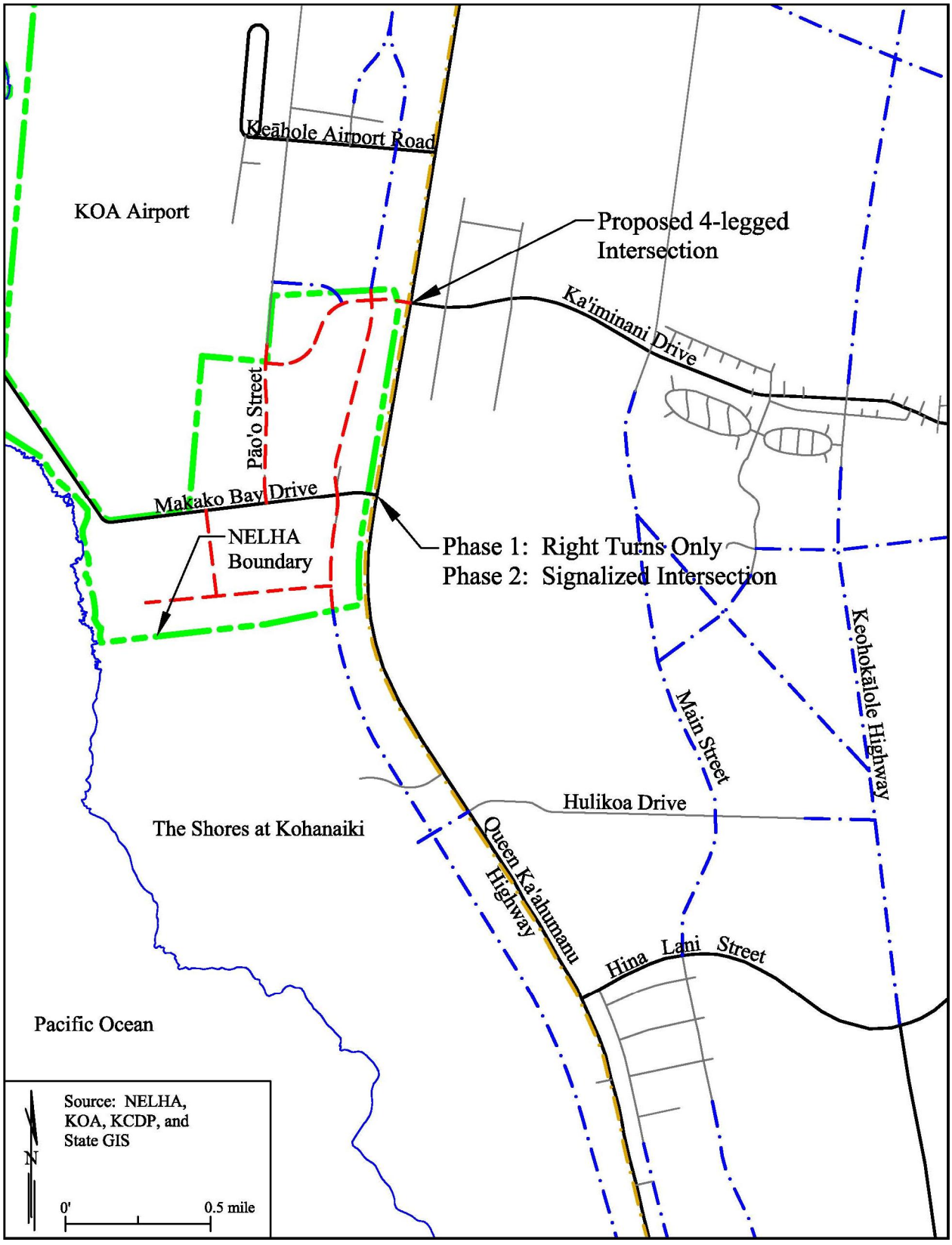

Figure 2-6: Build Alternative Regional Transportation Network

Table 2-6: Year 2015 Level-of-Service Summary

2015	AM		PM	
	LOS	Delay	LOS	Delay
Queen Ka'ahumanu Hwy and Makako Bay Dr*	Unsignalized		Unsignalized	
Queen Ka'ahumanu Hwy and Ka'iminani Dr/Road "A"	D	40.9	C	34.4
Road A EB Left	E	67.3	E	57.1
Road A EB Through-Right	D	50.1	D	44.1
Ka'iminani WB Left	D	52.1	D	45.0
Ka'iminani WB Through-Right	C	21.8	C	31.5
Queen Ka'ahumanu NB Left	E	58.5	E	55.2
Queen Ka'ahumanu NB Through	C	31.3	C	34.7
Queen Ka'ahumanu NB Right	C	26.7	C	29.3
Queen Ka'ahumanu SB Left	F	81.7	D	46.4
Queen Ka'ahumanu SB Through	D	44.6	C	26.9
Queen Ka'ahumanu SB Right	C	34.7	B	18.7
Makako Bay Drive and Road B	Unsignalized		Unsignalized	
Makako Bay Drive EB Left-Through	A	3.0	A	4.0
Road B SB Left-Right	A	9.6	A	9.3
Road B and Road A	Unsignalized		Unsignalized	
Road A WB Left-Right	A	9.7	A	9.3
Road B SB Left-Through	A	3.7	A	3.7

Notes: * = According to Highway Capacity Manual 2010, the right turn in and right turn out will not have any delay at the intersection therefore no LOS is calculated

The Phase 1 connections of the Build alternative are also considered beneficial to KOA's operations and were included in KOA's recent Environmental Assessment for airport improvements (HDOT, 2013). According to FAA AC 150/5360-13, *Design Guidelines for Airport Terminal Facilities*, and KOAs 2010 Master Plan, additional capacity for airport access needs to be considered. A secondary access road to separate general aviation traffic from commercial service traffic entering the airport would assist in relieving capacity and enhancing safety. Generally, traffic operations at KOA would improve under the Build Alternative due to the increased connectivity in the immediate area and connectivity to Queen Ka'ahumanu Highway. It would also provide potential benefits to KOA in that (a) non-passenger traffic could be separated from passenger traffic (non-passenger traffic could use Ka'iminani Road); and (b) there would be additional emergency vehicle access so that if Keāhole Airport Road was for any reason inaccessible, access would still be swift.

Traffic operations were analyzed for Year 2035, the forecasted time frame for completion of the entire NELHA development and the Phase 2 transportation system improvements of the Build Alternative. As shown in Table 2-7, most intersections are projected to operate at LOS D, however:

1. The Queen Ka'ahumanu Highway and Ka'iminani Drive/Road A intersection is projected to operate at LOS E in both the AM (60.6 sec/veh) and PM (56.4 sec/veh) peak hours. Only the northbound through and right turn movements and southbound right turn movement are projected to operate at LOS D, or better, at this intersection during either peak hour.

2. Left-turning movements at the intersection of Queen Ka'ahumanu Highway and Makako Bay Drive will experience LOS E in the eastbound direction during the AM peak hour and LOS F in the eastbound direction in the PM peak hour. In the northbound direction, the left-turning movement is projected to experience LOS F during both peak hours.
3. A number of individual turning movements will experience excessive delay at the internal signalized intersections.

Table 2-7: Year 2035 Level-of-Service Summary

Year 2035 with NELHA LOS	AM		PM	
	LOS	Delay	LOS	Delay
Makako Bay Drive and Queen Ka'ahumanu Highway	C	26.2	D	41.7
Makako Bay Dr EB Left	E	60.8	F	136.1
Makako Bay Dr EB Right	E	59.0	A	0.7
Queen Ka'ahumanu Hwy NB Left	F	80.2	F	141.5
Queen Ka'ahumanu Hwy NB Through	A	5.1	B	12.1
Queen Ka'ahumanu Hwy SB Through	D	37.1	E	62.9
Queen Ka'ahumanu Hwy SB Right	B	15.9	B	13.0
Ka'iminani Drive and Queen Ka'ahumanu Highway	E	61.0	E	59.6
Road A EB Left	E	74.1	F	108.4
Road A EB Through	E	58.1	F	104.6
Ka'iminani Dr WB Left	F	115.0	E	75.7
Ka'iminani Dr WB Through-Right	F	128.3	F	87.5
Queen Ka'ahumanu Hwy NB Left	F	120.0	F	178.4
Queen Ka'ahumanu Hwy NB Through	C	31.3	D	47.6
Queen Ka'ahumanu Hwy NB Right	B	17.5	C	23.5
Queen Ka'ahumanu Hwy SB Left	E	78.0	F	162.2
Queen Ka'ahumanu Hwy SB Through	E	62.7	D	53.7
Queen Ka'ahumanu Hwy SB Right	B	17.5	B	15.5
Makako Bay Dr and Road B	Unsignalized		Unsignalized	
Makako Bay Dr EB Left	A	9.0	A	8.2
Road B SB Left	B	13.9	F	104.7
Road B SB Right	B	10.5	A	9.3
Makako Bay Dr and Road C	D	49.8	D	46.0
Makako Bay Dr EB Left	F	83.2	F	132.5
Makako Bay Dr EB Through	D	48.0	E	58.9
Makako Bay Dr WB Left	E	72.9	F	81.1
Makako Bay Dr WB Through-Right	D	52.3	E	50.0
Road C NB Left	E	73.7	F	80.1
Road C NB Through-Right	C	28.5	D	40.3
Road C SB Left	E	72.6	F	81.4
Road C SB Through-Right	C	31.8	C	26.3
Road G and Road F	Unsignalized		Unsignalized	
Road G EB Left-Through	A	6.4	A	7.6
Road F SB Left-Right	A	10.2	B	12.5

Year 2035 with NELHA LOS	AM		PM	
	LOS	Delay	LOS	Delay
Road E and Road D	Unsignalized		Unsignalized	
Road E EB Left-Right	B	12.8	F	97.5
Road D NB Left	A	8.6	B	10.6
Road D NB Through	A	0.0	A	0.0
Road D SB Through-Right	A	0.0	A	0.0
Road A and Road B	Unsignalized		Unsignalized	
Road A WB Left	B	11.2	B	13.7
Road B SB Left	A	7.4	A	8.6
Road A and Road C	B	17.7	C	29.3
Road A EB Left	D	36.6	D	41.3
Road A EB Through-Right	B	18.7	C	34.8
Road A WB Left	C	22.7	D	41.4
Road A WB Through-Right	B	15.3	D	39.3
Road C NB Left	C	30.7	E	56.6
Road C NB Through	B	17.5	C	26.0
Road C NB Right	B	16.6	C	24.2
Road C SB Left	C	31.1	D	54.3
Road C SB Through-Right	B	14.9	C	21.9
Makako Bay Dr and Road F	Unsignalized		Unsignalized	
Makako Bay Dr WB Left	A	8.0	A	7.7
Road F NB Left-Right	A	9.9	B	11.7

2.1.3 Mitigation Measures

The proposed project is itself a mitigation measure for NELHA access and transportation efficiency regionally. Because the impacts are anticipated to be beneficial in nature, no mitigation is necessary.

2.2 Alternative Modes of Transportation

HDOT and County of Hawai‘i plans, such as the KCDP and Bike Plan Hawai‘i, outline pedestrian, bicycle, and transit facilities for the region. The proposed project would be designed so as to allow for those planned facilities and immediately match the facilities for these alternatives modes of transportation up-stream and down-stream from them. For example, NELHA Road C (Kahilihili Street extension and Queen Ka‘ahumanu Highway frontage road) will have bike lanes and shoulders to connect with bike lanes on KOA’s future Queen Ka‘ahumanu Highway frontage road.

2.3 Emergency Response and Hazards

The additional access and regional connectivity provided by the proposed project would improve emergency response times at NELHA and the southern portion of KOA. This is true for NELHA because in the No Build scenario any emergency responders coming from the south would have to pass NELHA and then make a U-turn, extending the response time. KOA would have

additional emergency vehicle access so that if Keāhole Airport Road was for any reason blocked or inaccessible, response time would still be swift.

The project is outside the Flood Hazard Zone and the Tsunami Evacuation Zone.

2.4 Land Use

2.4.1 Existing Conditions

The proposed project is located in the North Kona District and is north of Kailua-Kona, West Hawai‘i’s primary and largest urban area. The NELHA and Host Park area is adjacent to KOA, the airport which serves the west side of the Island of Hawai‘i.

The project area is part of NELHA and its HOST Park and has been designated for improvement in the Master Plan. Currently, the land is vacant.

2.4.2 Land Use Development Trends

The North Kona and South Kohala districts continue to grow and contain the primary drivers of the region’s economy, which include visitor, construction, and related service industries.

As described in the Master Plan, NELHA intends to develop further to play a more significant role in Hawai‘i’s growth in renewable energy technologies and sustainable development. NELHA intends to further develop its lands through “cohesion in the built environment” and by “foster[ing] collaboration among tenants” through the construction of six zones of use:

1. Applied Renewable Energy Zone
2. Economic Driver – NELHA-related products and services
3. Applied Technology Laboratories and Containerized Technology Research Center
4. Science and Technology Cultural Center
5. Ocean, Air, Energy, and Biology Research Laboratories
6. Ocean Research Village and Zone.

NELHA’s closest neighbor, KOA, also plans to expand its facilities. The airport currently has an 11,000 foot long runway, but plans to build additional runways makai of the existing runway. Additional conceptual plans for the airport include developing the frontage along Queen Ka‘ahumanu Highway with operations that complement airport and surrounding development, including a hotel/conference center and a cultural education center.

On the vacant land south of NELHA, O‘oma Beachside Village had been envisioned as a master-planned, mixed-use development. The State Land Use Commission (LUC) denied the necessary zoning request in November 2010. In early 2014 the County of Hawai‘i purchased the makai portion of the property. It is currently considered publicly-accessible open space and the County is working on a management plan for the area. The mauka portion of the property remains undeveloped but was not acquired by the County.

2.4.3 Potential Impacts

No Build Alternative

Without direct, all-way access to Queen Ka‘ahumanu Highway, development within NELHA would potentially be less attractive when compared to other options in the region where easier access to the primary transportation facilities exist. Therefore, although development within portions of NELHA has been approved (i.e. zoning change complete), there may be pressure to first develop other industrial lots in the region that have better access to Queen Ka‘ahumanu Highway.

Build Alternative

The Build Alternative provides NELHA with sufficient access to Queen Ka‘ahumanu Highway and KOA to enable development to occur within NELHA as planned and foreseen when the area was rezoned.

2.4.4 Mitigation Measures

No mitigation measures are necessary because no adverse effects would occur.

2.5 Consistency with Government Plans, Policies, and Controls

This section discusses whether the No-Build and Build Alternatives are consistent with existing government plans, policies, and controls.

2.5.1 State of Hawai‘i Plans and Controls

Hawai‘i 2050 Sustainability Plan

The Hawai‘i 2050 Sustainability Plan, January 2008 (State Plan), serves as a guide for the future long-range development of the State. The State Plan promotes the growth and diversification of the State’s economy, the protection of the physical environment, the provision of public facilities, and the promotion of and assistance to socio-cultural advancement.

The No Build alternative is in conflict with the State Plan and would hinder current plans for economic diversification and sociocultural advancement. However, the eventual development of the region around the Kona International Airport for commercial and industrial purposes, whether by the proposed project or a future project, would be consistent with several goals and strategic actions outlined in the State Plan.

The proposed project, in that it furthers NELHA’s mission, is consistent with several of the State Plan’s Goals and Strategic actions, including the following:

- Goal 2, The Economy:
    - Strategic Action 1 “Develop a more diverse and resilient economy.”
    - Strategic Action 2 “Support the building blocks for economic stability and sustainability.”

- Goal 3, Environmental and Natural Resources:
    - Strategic Action 1 “Reduce reliance on fossil (carbon-based) fuels.”

Bike Plan Hawai‘i

Bike Plan Hawai‘i (August 2003) was prepared with broad public input and includes a wide range of recommendations that support the Plan's vision of an island community where bicycling is a safe, viable and popular travel choice for residents and visitors of all ages. The plan outlines how the state intends to accommodate and promote bicycling.

The No Build alternative does not support the bike plan because gaps would continue to exist in the transportation network for bicycles.

The proposed project would provide continuity to existing bicycle facilities. A bike path will be included along NELHA Road C (Kahilihili Street extension and Queen Ka‘ahumanu Highway Frontage Road).

Complete Streets

The Statewide Complete Streets Policy (Act 54) was enacted in 2009 and requires HDOT and county transportation departments to adopt a Complete Streets Policy. Complete Streets is a comprehensive design approach to planning, design, and construction of transportation systems that accommodate all users of the road regardless of their age, ability, or preferred mode of transportation.

The No Build alternative would not result in the construction of any streets; therefore, the complete streets policy is not applicable.

The proposed project would provide continuity to bicycle and pedestrian facilities on contiguous streets.

Hawai‘i State Land Use Controls

The State Land Use Commission (SLUC), under the authority granted in HRS Chapter 205, regulates land use through classification of State lands into four districts: Urban, Agriculture, Conservation, and Rural. The intent of the land classification is to accommodate growth and development while retaining the natural and agricultural resources of the State. Each district has specific land use objectives and development constraints.

Both the No Build and Build alternatives would not change any existing State land use zoning. The proposed project conforms to the State land use “Urban” designation of the HOST Park.

2.5.2 Coastal Zone Management

The entire State of Hawai‘i is within the Coastal Zone Management (CZM) area. The objectives and policies of the Hawai‘i CZM Program as described in HRS Section 205A-2 are to protect and manage Hawai‘i’s coastal resources. Federally-assisted activities within Hawai‘i’s coastal zone, including the project site, must be consistent with CZM objectives and policies.

The No Build Alternative considered in this document does not require CZM review because there would be no Federal action or assistance. The individual developments that are planned and will occur whether the proposed project proceeds or not (such as HDOT's Queen Ka‘ahumanu Highway widening project), have or will comply with CZM policies during the planning of those projects.

Although the Build Alternative does not trigger a CZM review because it is not a Federal action, the Build Alternative is believed to be consistent with CZM policies. The following sections provide a brief overview of the information provided in the consistency assessment.

Recreation Resources

The Keāhole Point region provides a valuable ocean recreation resource. NELHA maintains, at its own expense, Wawaloli Beach Park with parking, restrooms and showers and administers a fishing permit system. The proposed project site is inland of this coastal area. The proposed roadway and intersection improvements will help provide access to the coastal recreation resources.

Historic Resources

The project has coordinated with and will continue to coordinate with the State Historic Preservation Division (SHPD). SHPD has reviewed and approved an Archaeological Inventory Survey related to NELHA Roads C, D, and E that included a portion of Road A, the extension of Ka‘iminani Road from NELHA Road C to Queen Ka‘ahumanu Highway (see Section 2.7). Complying with the policies outlined in that report will limit the effect of NELHA connecting to Queen Ka‘ahumanu Highway at Ka‘iminani Road. The other aspects of Phase 1 and 2 of the proposed project are minor in nature (not the construction of roads but the connection of planned roads); therefore, no effects to historic resources would occur. Proposed Phase 2 improvements are far in the future and additional historic resources may be present at that time; therefore, they will be further assessed at that time, if deemed necessary.

Scenic and Open Space Resources

No significant landforms or landmarks will be affected by development of the Project. The proposed roads are connected to existing roads. Since the Project would be at a lower elevation than Queen Ka‘ahumanu Highway, the line of sight from Queen Ka‘ahumanu Highway toward the ocean would not be affected. Furthermore, other facilities are already present between Queen Ka‘ahumanu Highway and the shoreline, including airport facilities and existing NELHA facilities.

Coastal Ecosystems

The proposed project area is barren lava, very dry and largely devoid of vegetation. Roads and utilities would require earthwork due to the uneven existing lava surface. An NPDES for construction stormwater would be obtained in conjunction with other roadway projects in the area.

Consultation with the U.S. Fish and Wildlife Service (USFWS) was initiated. In a letter dated September 8, 2010, the USFWS stated that their records indicated no known federally-listed species or designated critical habitat for protected species within the project footprint. In a later

letter, dated April 22, 2013, the USFWS noted that the Blackburn's sphinx moth may breed and feed within the proposed project area. A survey will be performed prior to the publication of the Final EA for the proposed project. Habitat for endangered plants, birds, turtles, and seals, is nearby, especially along the coastline, but will not be impacted by the project.

The USFWS noted that although the current project is not likely to result in further degradation to these sensitive habitats, there are anchialine pools located near the project area. Two clusters of ponds have been identified on or near NELHA property approximately 3/4 and 1-1/4 miles from the proposed project. A northern complex of approximately three pools is situated north of the NELHA complex, and another group of small ponds lies near the most southerly bend in Makako Bay Drive mauka of Wawaloli Beach. The water quality of these pools is regularly monitored as part of NELHA's Comprehensive Environmental Monitoring Plan which includes samples from over 120 sites every 90 days. In addition, NELHA conducts a Biota survey offshore on an annual basis. Over the past 19 years, the sampling and surveys have not shown any negative impact on the groundwater or ocean-water off of NELHA (HOST Park Environmental Monitoring, 2014). More numerous anchialine pools are located within the Kaloko-Honokohau National Historical Park, roughly 5 miles to the south of the proposed project. Studies have shown that resort development may have a negative impact on anchialine pools when in close proximity to the development; the impact is typically related to damage during construction and increasing nutrient concentrations in anchialine ponds (County of Hawai‘i, 2006). The proposed project is not a resort development and is not near the pools; therefore, no impact to the ponds in NELHA's coastal area are anticipated. Furthermore, there is no reason to expect the proposed project to have an adverse effect on groundwater resources or coastal ecosystems, including the anchialine pools at the Kaloko-Honokohau National Historical Park.

While there are several on the island of Hawai‘i, no Natural Area Reserves are in the vicinity of the proposed project. The Old Kona Airport Marine Life Conservation District is located several miles south of the project area closer to Kailua-Kona.

Economic Uses

NELHA is at the forefront of economic development for ocean-related research, clean energy, and aquaculture. It is dependent on access to pristine ocean water, high solar insolation and stable climatic conditions and its location in an Enterprise and Foreign Trade Zone next to the airport.

The U.S. Department of Agriculture Soil Conservation Service Soil Survey report for the area designates soil types as ‘a‘ā (rLV) and pāhoehoe (rLW) lava flows. According to the Land Study Bureau's Detailed Land Classification report for the Island of Hawai‘i, the area is designated as class "E'' lands. Class "E" lands are very poor or the least suited for agricultural uses.

Coastal Hazards

The project site is not on or abutting a sandy beach. The rocky coastline adjacent to the NELHA contains intermittent coral sand and black sand and boulder beaches including Wawaloli Beach Park. The area is not known for significant shoreline erosion.

The proposed project area is outside the Tsunami Evacuation Zone and Flood Hazard Zone. Other portions of NELHA makai of the northwestern bend of the NELHA Access Road fall into the Tsunami Evacuation Zone and Flood Hazard Zone so a well designed roadway network is important for evacuation purposes.

Managing Development

The project conforms with the land use designations for the site and is consistent with government plans, policies, and controls.

The project will be coordinated with other projects that will obtain a National Pollution Discharge Elimination System (NPDES) permit, Noise Permit, and Grading permits. A Special Management Area (SMA) permit was obtained for the project in 1986 and the County of Hawai'i has indicated that permit allows for the proposed project.

Public Participation

No public participation specifically related to coastal management or processes is planned. As an agency, NELHA has actively engaged all the stakeholders in the development of its Master Plan which includes the proposed project. Agencies, non-governmental groups, businesses, and the public have been central to the planning process for the NELHA facility. More details on NELHAs interaction with the public can be found in the Master Plan. The Draft EA will be available to the public for comment.

Beach Protection

The project does not involve construction of erosion-protection structures seaward of the shoreline, any buildings or structures in the shoreline setback area, or loss of open space areas along the shoreline.

Marine Resources

The project does not involve any marine or coastal construction or other aspects that relate to the State's ocean resources management plan. The project will not have an impact on marine resources.

2.5.3 County of Hawai'i Plans and Controls

Mapping Kona's Future, Kona Community Development Plan (September, 2008)

The No Build alternative does not directly contradict or support the Kona Community Development Plan (KCDP). However, the KCDP foresees the expansion of NELHA through the proposed project or similar future project.

The proposed new roads and connections are necessary for the continued growth of NELHA. The facility is central to the initiatives of the KCDP in the area of Economic Development:

- "(a) Energy Industry. With NELHA as a catalyst, the Plan [the KCDP] encourages the development of renewable and distributed energy endeavors."

- “(d) Food Industry. Policies recognize the benefits of increasing locally produced food for the local market by reducing the current dependence on imported food to the island. NELHA’s aquaculture incubation is leading the way for new food production.”
- “(f) Workforce Development and Innovation. The synergistic relationship of a university or community college at West Hawai‘i with the NELHA will provide opportunities for the West Hawai‘i residents to obtain the necessary education and training to fill jobs in the skill areas of energy, aquaculture and the other emerging industries developing at NELHA.”

The KCDP recognizes NELHA as a strategic public facility and business opportunity for economic simulation in Policy ECON–1.3:

> “NELHA as Stimulus for Energy and Research Industry:
>
> > “NELHA has paradoxical missions: is it a research institution that requires State subsidy or a self-sustaining commercial operation. Are the diverse uses of the cold, pristine, deep ocean water its focus or is the innovative energy research that may use the deep ocean water or other ocean resources as well as non-ocean energy research its focus. The Kona CDP encourages the State and NELHA’s board of directors to balance NELHA’s complex mission in order to make it a worldclass renewable energy research center with close ties to the proposed West Hawai‘i University. To offset research subsidies, the plan supports commercial development of the mauka NELHA area by businesses incubated at the NELHA’s research area. The proposed frontage road would provide convenient access by residents and visitors to this proposed commercial area.”

The Kona Community Development Plan and the County of Hawai‘i General Land Use Pattern Allocation Guide Map include the NELHA site within their designated urban area. The proposed improvements are in areas zoned for industrial use.

2.6 Biological Resources

2.6.1 Existing Conditions

The Master Plan gives a full description of the flora and fauna of the facility, which is summarized below.

Plants growing on the lava flows are fountain grass (*Pennisetum setaceum*) with an occasional ‘ilima (*Sida fallax*), noni (*Morinda citrifolia*), Christmas-berry (*Schinus terebithifolius*), and maiapilo (*Capparis sandwichiana*). Those are primarily in disturbed areas; undisturbed areas are largely devoid of vegetation.

Indigenous birds commonly observed at NELHA/HOST Park include the golden plover, wandering tattler, stilts, and ruddy turnstone. Introduced species known to be present include the Indian grey francolin, barred dove, common mynah, Japanese white-eye, house finch, house sparrow, cardinal and Brazilian cardinal, among other species. The Indian mongoose, the

common home mouse, roof rat, the Polynesian rat, goats, and feral cats are known to inhabit the undeveloped portions of the NELHA site.

In their letter of April 22, 2013, the U.S. Fish and Wildlife Service describes the Blackburn's sphinx moth (*Manduca blackburni*), a species protected by the Endangered Species Act (ESA), and indicated it may occur in the project area. Adult moths feed on nectar from native plants, including beach morning glory (*Ipomoea pes-caprae*), iliee (*Plumbago zeylanica*), and maiapilo (*Capparis sandwichiana*). Larvae feed upon non-native tree tobacco (*Nicotiana glauca*) and native aiea (*Nothocestrum latifolium*). Blackburn's sphinx moth pupae may occupy the soil within 250 feet of larval host plants for a year or longer. A survey for the moth and related plants will be completed prior to the publication of the Final EA. This will allow for the survey to occur roughly 6 weeks after significant rains, as suggested by the USFWS.

The USFWS also describes anchialine pools near the project area; however, the majority of the pools are located in the Kaloko-Honokohau National Historical Park, roughly 5 miles to the south. Two small clusters of ponds have been identified on or near NELHA property. A northern complex of approximately three pools is situated north of the NELHA complex, and another group of small ponds lies near the most southerly bend in Makako Bay Drive mauka of Wawaloli Beach. These ponds are ¾ to 1 ¼ miles from the proposed project.

2.6.2 Potential Impacts

No Build Alternative

The No Build Alternative would not result in any direct impacts to biological resources.

Build Alternative

The proposed project is unlikely to impact the Blackburn's sphinx moth. The project area is approximately a mile inland of the coast, at a low elevation, consists of a lava flow with little to no soil developed, and there is little rain (roughly 10 inches per year). Neither tree tobacco nor aiea grow there. Furthermore, the scant soil is unlikely to support the pupae stage of their growth cycle. A survey will be performed prior to publication of the Final EA for the proposed project to confirm this.

Anchialine pools will be unaffected by the proposed project. No groundwater wells are planned to support the proposed project, in fact no water use will be required as part of the proposed project.

No threatened or endangered species or otherwise rare species would be impacted by the proposed project. The flora and fauna present in the area to be disturbed are common introduced species.

2.6.3 Mitigation Measures

No mitigation measures are necessary.

2.7 Historic and Archaeological Resources

HRS Chapter 6E, as described in regulations provided in Title 13, Chapter 275 of the Hawai‘i Administrative Rules (HAR), provide the framework for the identification and assessment of historic and archaeological resources in Hawai‘i.

2.7.1 Existing Conditions

Background

The South Kohala/North Kona region is known for archeological and historical resources. A number of surveys documenting trails, historic boundary walls, cairns, habitation areas and other resources have been conducted on the land NELHA occupies. The first of those surveys was performed in the 1930s and surveys of select areas were performed as recently as 2012. The project involves the ‘O‘oma 1st and 2nd and Kalaoa 5th Ahupua‘as, the traditional land divisions of Native Hawaiians (Figure 2-7).

In 1985, a reconnaissance survey identified 45 sites in a 450-acre area which includes the project area (Barrera, 1985). In 2012, Rechtman Consulting, LLC resurveyed approximately 30 acres adjacent to NELHA Roads C, D and E within the larger area that was previously investigated by Barrera. Rechtman Consulting, LLC completed an intensive resurvey and, identified one known site (recorded before the Barrera study), and found three additional sites that had not been previously recorded (Appendix C).

Historic Properties in Project Area

There have been no historic properties recorded at the connection points between HOST Park and neighboring HDOT facilities that are part of the proposed project. Rechtman describes 3 sites along Road C: two trails (Sites 29272 and 29273) and two similarly constructed rock cairns (Site 29274), but they are not in the proposed project area. Those resources will be addressed through the HRS Chapter 6E process for the NELHA Road C project.

Additional archaeological surveys, unrelated to the proposed project, will be performed on the sites that are made accessible to development by NELHA’s internal roadway network.

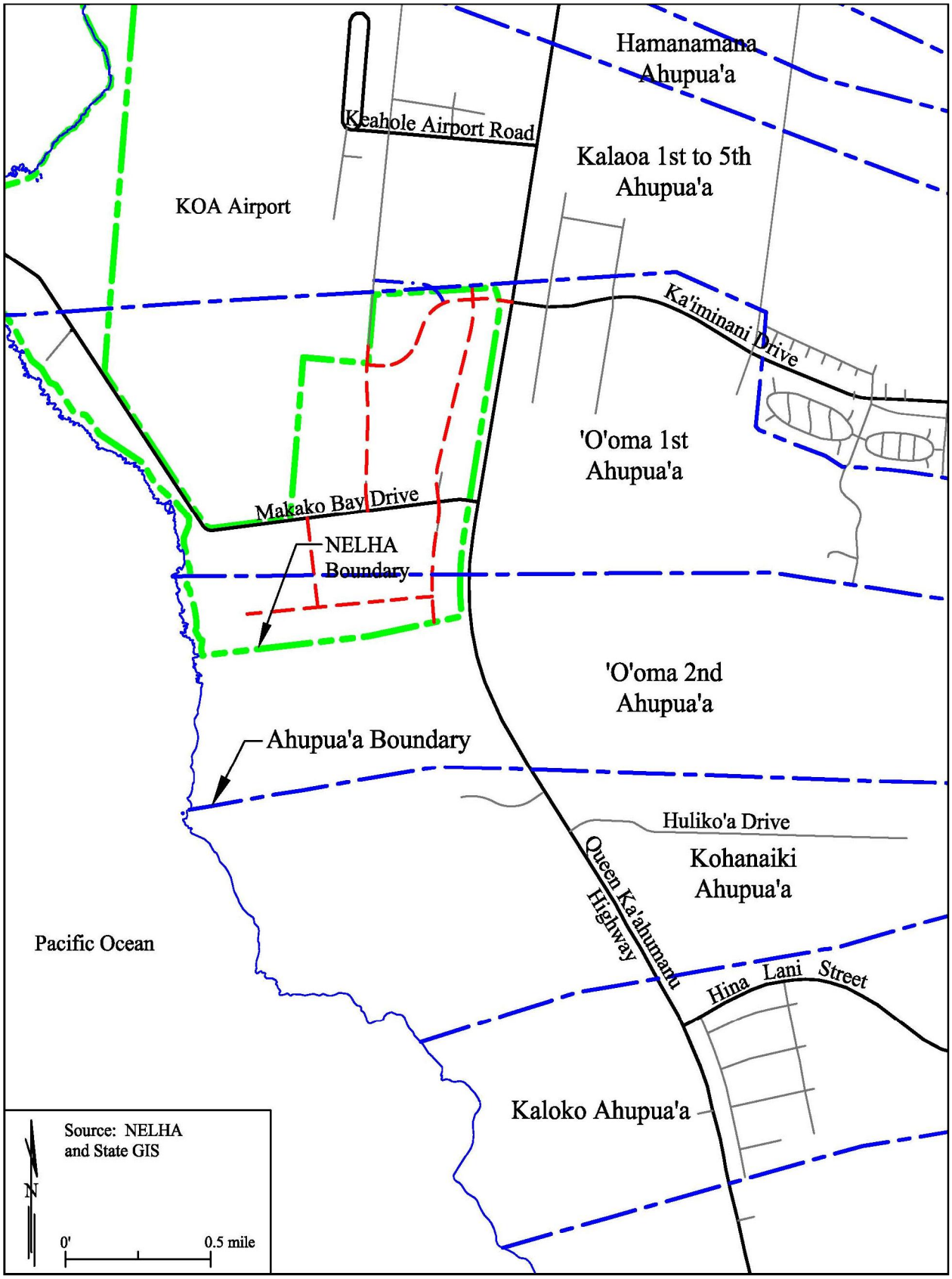

Figure 2-7: Ahupua‘a in Project Area

2.7.2 Potential Impacts

No Build Alternative

Under the No-Build Alternative, no direct development-related impacts to historic properties would occur. However, the HOST Park would still ultimately be developed, including the internal roads and parcels, but perhaps at a slower pace. As it is developed, archaeological surveys would be performed. Archaeological impacts and preservation within the HOST Park would be similar regardless of if the proposed connects are made or not. The impacts and mitigation measures associated with NELHA internal roads C, D, and E are documented in the attached report (Appendix C). Similar reports (documenting archaeological resources, project impacts, and mitigation measures) will be performed for other developments within HOST Park as necessary.

Build Alternative

There are no archaeological resources in the immediate area of the proposed connections; therefore, there will be no direct impact to archaeological or historic resources.

2.7.3 Mitigation Measures

A qualified archaeological monitor will be present during ground-disturbing activities associated with development of the proposed roadways and intersections associated with the proposed connections. A monitoring plan compliant with HAR §13-279 will be prepared prior to construction. If undocumented burial and archaeological sites are uncovered during construction, work would stop and the appropriate authorities, including SHPD and the police, would immediately be notified. Construction in the area of the find would resume upon approval of the appropriate authorities.

2.8 Section 4(f) Evaluation

Section 4(f) of the Department of Transportation Act, 49 U.S.C. 303 and 23 U.S.C. 138 (referred to hereafter as "Section 4(f)"), permits the use of land for a transportation project from a significant publicly-owned public park, recreation area, wildlife and waterfowl refuge, or a historic site only when the FHWA has determined that:

- There is no feasible and prudent alternative to such use; and
- The project includes all possible planning to minimize harm to the property resulting from such use.

The purpose of Section 4(f) is to preserve significant parkland, recreation areas, refuges, and historic/archaeological sites by limiting the circumstances under which such land can be used for transportation projects. The word "use" in this case means:

- Land is permanently incorporated into a transportation facility;
- There is a temporary occupancy of land that is adverse in terms of preservation of the resource; or

- The project’s proximity to the site substantially impairs those functions that qualify the site as a Section 4(f) resource even though no land is permanently or temporarily acquired. This is called “constructive use.”

Under the No Build alternative there would be no use of a Section 4(f) resource.

Under the Build alternative, there are no park resources or archaeological resources in the immediate area of the proposed connections; therefore, there will be no effect on a Section 4(f) resource.

2.9 Construction Impacts and Mitigation

2.9.1 Maintenance of Traffic

To minimize traffic and access problems on Queen Ka‘ahumanu Highway and adjacent side streets, construction phasing and traffic control plans would be developed and implemented. A maintenance of traffic (MOT) plan would be developed during final project design and implemented by the selected contractor. The MOT plan will provide the contractor with details regarding lane closures and other details necessary to maintain traffic movement through the area.

2.9.2 Air Quality

Air quality impacts during construction generally consist of fugitive dust and mobile source emissions from construction equipment.

Fugitive dust is airborne particulate matter, of usually large particle size, generated by construction vehicles operating around construction sites and from material blown from uncovered haul trucks, stockpiles, and exposed areas. The emission rate for fugitive dust emissions from construction activities is difficult to estimate accurately because its generation varies greatly depending upon the type of soil, the amount and type of dirt-disturbing activity, the moisture content of exposed soil, and wind speed.

Frequent watering will control fugitive dust at the construction site. In addition, the construction plan will limit the areas of disturbance at any given time. To prevent haul trucks from tracking dirt onto paved streets, tire washing or road cleaning may be appropriate; however, given the rocky nature of the project site, this will probably be unnecessary. State regulations further stipulate that open-bodied trucks be covered at all times when in motion if they are transporting wind-erodible materials.

Construction vehicles and equipment will emit engine exhaust. The largest of this equipment is usually diesel-powered, which emit relatively high levels of nitrous oxides (NOx) in comparison to gasoline-powered equipment. However, standards for such pollutants are set on an annual basis and will therefore not likely be violated by short-term construction equipment emissions.

2.9.3 Noise

Construction would involve the use of heavy machinery that may cause temporary noise impacts. There are no adjacent noise sensitive land uses; airport noise already dominates the area. Table 2-8 presents a range of noise levels for various construction equipment anticipated to be used

during construction of the proposed project. Equipment noise levels vary depending on the make and model of the equipment, the operation being performed, the condition of the equipment, and other variables. The noise levels listed are based on published measurement taken at a distance of 50 feet from the equipment.

Table 2-8: Construction Equipment Noise Levels

Equipment	Decibels	Equipment	Decibels
Standard Construction Equipment		Light Impact Equipment	
Truck	75 - 90	Jack Hammer	81 - 98
Saw	72 - 81	Jumping Jack	81 - 97
Cold Planer	79 - 88		
Paving Machine	86 - 88	Heavy Impact Equipment	
Roller	63 - 70	Hoe rams	95 - 106
Striping machine	75 - 86		
Concrete Truck	75 - 88		
Backhoe/Loader	72 - 83		
Compressor	74 - 87		
Generator	71 - 82		
Crane	75 - 87		

Since HDOH maintains community noise control standards (HAR Section 11-46) that apply to construction noise, these specifications would be followed. In conjunction with other area roadway projects, a noise permit would be obtained for construction activities performed during standard work hours (Monday through Friday 7:00 a.m. through 6:00 p.m. and Saturday 9:00 a.m. through 6:00 p.m.).

2.9.4 Water Resources

As there are no streams or other surface waters in the project area, potential construction-related impacts to the quality of surface and coastal waters are negligible. Construction activities will involve land-disturbing activities, such as grading and excavation that may result in some soil erosion. Various measures will be incorporated into the project's construction plan to minimize soil disturbances and potential short-term erosion impacts during construction activities. Mitigation measures will be instituted in accordance with site-specific assessments, incorporating appropriate structural and/or non-structural BMPs such as minimizing time of exposure between construction and landscaping. Following the associated construction activity, the excavated areas will be paved over or backfilled to its graded contours or re-vegetated to control erosion.

The anchialine pools noted by the USFWS are located 5 miles south and makai of the project area and, as discussed in Sections 2.6 and 2.10, will be unaffected by the proposed project.

2.9.5 Biological Resources

Except for the non-native plants in the project footprint, there would be no impact to the biological resources in the project area.

A biological survey for the Blackburn sphinx moth or the plants important to its life cycle will be conducted prior to construction to ensure the moth is not adversely impacted.

2.9.6 Solid Waste Management and Hazardous Waste

Good housekeeping BMPs will be required of the contractor, such as ensuring that:

- All waste materials be collected and stored in securely lidded dumpsters that are emptied before becoming overly full and not buried on site;
- Materials stored on-site be stored in a neat, orderly manner in appropriate containers (i.e., per manufacturers recommendations);
- All on-site vehicles be monitored for leaks and receive regular preventive maintenance to reduce the chance of leakage;
- A spill cleanup kit be located on-site where petroleum products, paints, or other hazardous materials are stored; and
- All sanitary waste generated during the construction phase will be collected from portable units as required and directed to a HDOH-permitted treatment facility.

Most of the project area consists of land that has not previously been disturbed, so hazardous materials contamination is not likely to be uncovered during construction. If contamination were identified during construction, the contractor would report it immediately to NELHA. Handling of hazardous materials and possible site remediation would be required in accordance with applicable State and federal laws, specifying the handling, treatment, and disposal of contaminated materials.

2.9.7 Historic and Archaeological Resources

Construction activities have the potential to encounter undocumented burial and archaeological sites. As detailed in Section 2.7.3, if such a site were uncovered during construction, work would stop and the appropriate authorities, including SHPD and the police, would immediately be notified. Construction in the area of the find would resume only upon approval of the appropriate authorities.

2.9.8 Relationship of Short-Term Uses and Long-Term Productivity

Construction of the proposed project would have short-term effects on the environment as described in this section. These effects would end with the completion of construction. The proposed project would provide improvements to the transportation system as described in Section 1.2.

The long-term benefit that would be provided by the proposed project would be greater than the short-term adverse effects on the human environment. The proposed project does not exclude future opinions, narrow the range of beneficial uses of the environment, or pose long-term risks to health and safety.

2.10 Secondary and Cumulative Impacts

2.10.1 Potential Secondary Impacts

Secondary, or indirect, impacts are defined by Council on Environmental Quality (CEQ) as “effects which are caused by the [proposed] action and are later in time or further removed in distance, but are still reasonably foreseeable. Indirect effect may include growth-inducing effects and other effects related to changes in the pattern of land use, population density, or growth rate…”

No significant secondary impacts are anticipated should the proposed project proceed. Urban development will proceed in North Kona regardless of the proposed project. While the proposed project would help improve the regional roadway network, factors affecting development such as demand, property prices, and disposable income levels are likely to have a far greater effect on development pressures. Given the factors above and the coverage of the existing roadway network, the proposed project is not constraining proposed development, and proceeding with the project would have only a minor effect on overall development trends in North Kona. Therefore, the proposed project would not induce secondary land uses.

2.10.2 Potential Cumulative Impacts

Cumulative impacts are defined by CEQ as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time.” Cumulative impacts include the direct and indirect impacts of a project together with the reasonably foreseeable future actions of others.

Past Actions

Directly offshore of Keāhole Point in North Kona, Hawai‘i, the ocean bottom gradient drops steeply, making deep cold ocean water accessible relatively near shore. Recognizing the site’s potential for ocean related research, renewable thermal energy conversion demonstration, and aquaculture, the State of Hawai‘i established the Natural Energy Laboratory of Hawai‘i (NELH) at Keähole in 1974. In 1986, ground was broken on adjacent lands for the first increment of the State’s Hawai‘i Ocean Science and Technology (HOST) Park, a development which was intended to provide sites for the commercialization of research activities initiated at NELH.

Until 1990, NELH and HOST Park were separately administered, although their missions were complementary. The 1990 State Legislature (Chapter 227D, HRS) consolidated management of NELH and HOST Park’s 870 acres of lands and facilities under a single administrative state agency, NELHA.

A major natural asset of the site is the access to pristine deep, cold ocean water ideal for aquaculture and natural cooling. There are presently three pipeline systems pumping deep and surface seawater including an intake at 3,000 feet deep, making it the world’s largest diameter, and deepest oceanic pipeline. Other key assets at Keähole Point include high solar insolation (intensity), stable climactic conditions and location in an Enterprise and Foreign Trade Zone next

to the airport. Existing activities on the sites include more than forty tenants engaged in aquaculture, water bottling, renewable energy projects, research, and education.

Present and Reasonably Foreseeable Actions

Present and reasonable foreseeable actions in the immediate vicinity of the proposed project include:

- HDOT widening of Queen Ka‘ahumanu Highway.
- NELHA/HOST Park development.
- Continued development and increase in air traffic at KOA.

The proposed project would not change the effects of development in the vicinity of the proposed project. The proposed project is not a pre-requisite for any of the foreseeable actions; planned development is occurring and will continue to occur independent of the proposed project. Consequently, the proposed project would not cumulatively affect the resources discussed below beyond what will occur due to these planned and reasonably foreseeable developments.

Groundwater and Biological Resources

The USFWS has expressed concern that future development of NELHA/HOST Park lots might draw down groundwater and cause increased salinity in the existing anchialine pools leading to changes in the species composition.

Under both the No Build Alternative and the Build Alternative, development is likely to occur at NELHA/HOST Park; therefore, the USFWS' concern is not directly tied to the proposed project. Industrial development and growth in general is forecast to occur in the Kona District in the coming years. The proposed project was developed to address the traffic impacts of that growth in the vicinity of NELHA/HOST Park. The County of Hawai‘i Department of Water Supply, the State of Hawai‘i Commission on Water Resource Management (CWRM), and other stakeholders are assessing how to sustainably provide water to accommodate the forecast growth. The outcome of that assessment is unknown at this time; however, strategies and technologies exist to supply water to support the forecast growth without negatively affecting the anchialine pools at the Kaloko-Honokōhau National Historical Park.

Historic Resources

In the past, NELHA has complied with historic preservation regulations prior to development. This has resulted in the preservation of archaeological resources, including the preparation of "A Preservation Plan for a Section of the Māmalahoa Trail (SIHP Site 50-10-27-2), TMK:3-7-3-9:24,34)". NELHA has coordinated with and will continue to coordinate with the State Historic Preservation Division (SHPD) regarding the development of its HOST Park internal roadway network and on development on its lots. Last year SHPD reviewed and approved an Archaeological Inventory Survey related to NELHA Roads C, D, and E that included a portion of Road A, the extension of Ka‘iminani Road from NELHA Road C to Queen Ka‘ahumanu Highway (see Section 2.7). Complying with the policies outlined in that report will limit the effect of those roadways.

In the near future NELHA will be conducting additional archaeological studies and surveys in the HOST Park area. Those surveys will address other internal roadways and undeveloped lots in the HOST Park area, including those internal roadways associated with some aspects of Phase 1 and 2 of the proposed project. Through the regulatory processes associated with historic resources, NELHA will consider and address (avoid, minimize, and/or mitigate) potential impacts to historic resources by future development at HOST Park.

Land Use

The project does not require any changes to land use designations and will not cumulatively affect land use because it is already consistent with community plans.

Cumulative Summary

This project will not result in commitments to implement other projects or result in significant change to how the surrounding area beyond NELHA will develop. The proposed project will not result in cumulative effects on the environment. NELHA is an existing facility and its development has been previously addressed in numerous environmental documents and anticipated by the community.

2.11 Irreversible and Irretrievable Commitments of Resources

A commitment of resources is irreversible when primary or secondary impacts limit the future options for a resource; an irretrievable commitment refers to the use or consumption of resources that are neither renewable nor recoverable for future use.

All the land to be used by the proposed project is within NELHA and KOA and, therefore, has either been cleared for, or is anticipated to become commercial in nature or used for regional transportation. No new land would be irreversibly and irretrievably committed as a result of the proposed project.

The proposed project would require the commitment of natural, physical, and human resources to plan, design, and construct. Diesel fuel to power equipment would be used during proposed project construction and building materials, such as concrete and asphalt, would be consumed. Some of those materials could ultimately be recycled for reuse, those that are not would be expended.

2.12 Unavoidable Adverse Impacts

Probable unavoidable adverse impacts related to the proposed project are all considered less than significant and include minor impacts on certain turning movements at the Queen Ka‘ahumanu Highway – Ka‘iminani Road intersection.

2.13 Unresolved Issues

Unresolved issues include:

- Timing and coordination of the improvements has not been determined. This is primarily due to the unknown timing of improvements to Queen Ka‘ahumanu Highway in the area.

- The presence of and effects on the Blackburn sphinx moth or the plants important to its life cycle. A survey for the moth the associated plants will be conducted prior to construction to ensure the moth is not adversely impacted.

3.0 COMMENTS AND COORDINATION

3.1 Agency and Stakeholder Consultation

3.1.1 Pre-Assessment Consultation

The agencies and organizations listed in Table 3-1 were contacted by letter (see Appendix A) and asked if they were aware of any environmental or social issue associated with the proposed project, or if they had any such concerns. Copies of the responses are provided in Appendix A. Section 3.1.2 provides a brief summary of the comments received.

Table 3-1: Pre-Assessment Consultation List

Agency/Organization	Date of Response	Follow-up Consultations
Federal Agencies		
U.S. Army Corps of Engineers, Regulatory Branch	04/02/2013	
U.S. Department of Agriculture, National Resources Conservation Service (NRCS)		
U.S. Department of Commerce, National Oceanographic and Atmospheric Administration (NOAA)	03/28/2013	
U.S. Department of Homeland Security, Federal Emergency Management Agency (FEMA)	04/09/2013	
U.S. Department of Interior, Fish and Wildlife Service	04/22/2013	
U.S. Department of Interior, United States Geological Survey	04/05/2013	
U.S. Department of Transportation, Federal Aviation Administration (FAA)	04/02/2013	
U.S. Department of Transportation, Federal Highways Administration (FHWA)		
U.S. Environmental Protection Agency, Region 9		
U.S. Environmental Protection Agency, PICO		

Agency/Organization	Date of Response	Follow-up Consultations
State Agencies		
Department of Accounting and General Services (DAGS)		
Department of Agriculture		
Department of Budget and Finance		
Department of Business, Economic Development & Tourism (DBEDT)		
Director		
Office of Planning	04/10/2013	
Department of Defense (DoD)		
Department of Education (DOE)		
Department of Health (HDOH)		
Director		
Clean Water Branch (CWB)		
Environmental Planning Office	03/27/2013	
Hazard Evaluation and Emergency Response (HEER) Office		
Indoor and Radiological Health (IRH)	04/04/2013	
Office of Environmental Quality Control (OEQC)	04/16/2013	
Solid and Hazardous Waste Section (SHWB)		
Wastewater Branch		
Department of Hawaiian Homelands (DHHL)		
Department of Labor and Industrial Relations	04/18/2013	
Department of Land and Natural Resources (DLNR)		
Chairperson		
Commission on Water Resource Management (CWRM)		
Division of Forestry and Wildlife (DOFAW)		
Office of Conservation and Coastal Lands (OCCL)	04/10/2013	
Land Division	05/22/2013	
State Historic Preservation Divison	O5/09/2013	Yes
Department of Transportation	04/23/2013	Yes
University of Hawai'i		
Environmental Center		
Water Resources Research Center		
County Agencies		
Civil Defense		
Department of Environmental Management	03/28/2013	
Department of Finance - Property Management Division		
Department of Finance - Public Access, Open Space, & Natural Resources Preservation Commission		
Department of Parks and Recreation		
Planning Department	04/10/2013	
Department of Public Works	04/12/2013	
Department of Research and Development		
Department of Water Supply	05/20/2013	
Fire Department	04/04/2013	
Police Department	03/22/2013	

Agency/Organization	Date of Response	Follow-up Consultations
Organizations/Businesses		
Hawaiian Electric and Light Company (HELCO)		
Conservation Council for Hawai'i		
Hawai'i Audubon Society		
Kohala Center		
Life of the Land		
Nature Conservancy of Hawai'i		
Sierra Club		
Bishop Museum		
Hawaiian Civic Club of Kona - Kuakini		
Hawai'i Island Chamber of Commerce		
Kona-Kohala Chamber of Commerce		
Elected Officials		
Mr. Neil Abecrombie, Governor		
Mr. William Kenoi, Mayor	03/27/2013	
Ms. Maize Hirono, U.S. Senator		
Mr. Brian Schatz, U.S. Senator		
Ms. Colleen Hanabusa, U.S. Congressperson		
Ms. Tulsi Gabbard, U.S. Congressperson		
Mr. Josh Green, State Senator		
Ms. Nicole E. Lowen, State Representative	03/28/13	
Mr. J. Yoshimoto, Chair County Council		
Ms. Karen Eoff, County Council Member		

Additional consultation efforts, particularly those concerning regulatory matters, are described in Section 3.2.

3.1.2 Summary of Agency and Public Comments

In response to NELHA's request for comment on the proposed project, the following comments were received:

- In their April 2, 2013, letter the ACOE confirmed that the project would not require a permit from the agency.
- NOAA, in a March 28, 2013, email commented that the project may indirectly impact water quality off Keāhole Point and recommended implementing Low Impact Development (LID) principles in the project.
- FEMA's April 9, 2013, letter advised reviewing the current effective countywide Flood Insurance Rate Maps and summarized the National Flood Insurance Program's floodplain management building requirements.
- The USFWS noted in their letter of April 22, 2013, that the Blackburn's sphinx moth, an endangered species, may breed and feed within the proposed project area. They also noted that future development in the area may threaten anchialine pools.

- The FAA in an April 2, 2013, email provided the requirements and notification conditions from 14 CFR Part 77, Safe, Efficient Use, and Preservation of the Navigable Airspace.
- DBEDT's Office of Planning indicated in an April 10, 2013, letter that the Draft EA should include a discussion of the proposed project's consistency with the objectives and policies of CZM Program. The proposed project may also have nonpoint pollution impacts on coastal waters and suggested reviewing the Hawai‘i Watershed Guidance. Finally, as the project is within the SMA, the Draft EA should discuss the project's consistency with SMA guidelines and regulations set forth in HRS 205A-26.
- On March 27, 2013, HDOH's EPO sent suggestions about the sustainable design of communities and encouraged conducting a Health Impact Assessment. They advised that the project is required to adhere to all the Standard Comments.
- HDOH's IRH commented in an April 4, 2013, letter that Project activities shall comply with Hawai‘i Administrative Rules for the Department of Health, Chapter 11-46, Community Noise Control.
- OEQC noted that there are projects in the planning stages at the Kona Airport and advises coordination with the HDOT. Their April 16, 2012 (sic), letter also advises to check with the County Planning Department for local requirements and approvals. Finally, the letter states that the EA should include all the content requirements as indentified in HRS 11-200-10 and list all the permits and approvals required for the project.
- DLNR's Office of Conservation and Coastal Lands (OCCL) notes in their April 10, 2013, letter that part of Phase II of the project may be in the Conservation District General Subzone and suggests that they be contacted when plans are developed for advice on permitting requirements.
- DLNR's Historic Preservation Division sent a memorandum to the Land Division on May 9, 2013, to comment on Chapter 6E-8 Historic Preservation Review requirements for the project. DLNR's Land Division forwarded the comments from the Historic Preservation Division on May 20, 2013. The memorandum stated that previous archeological work was inadequate and that an archeological inventory survey (AIS) should be conducted on all of the proposed roadways.
- HDOT noted in their April 23, 2013, letter that the Highways and Airports Divisions have concerns about the project including impacts on two DOT bike path projects and construction impacts. The letter also clarified the content and coordination needs of the project's Traffic Impact Report.
- The County Planning Department described in an April 10, 2013, letter the area's zoning, noted the location in the SMA and requested that the EA include a discussion of the project's relevance to the implementation of the Kona Community Development Plan's objectives and policies.
- The County's Department of Public Works described some of the traffic volume forecasts and other design data and recommendations which must be included in the

project assessment. Their April 12, 2013, letter also notes that public parking may not be accommodated on streets to be dedicated to the County.

- The Department of Water Supply in their letter of May 20, 2013, states that the existing water system is served by a 6-inch master meter and that the Department cannot provide any additional water at this time for any type of development requiring water within NELHA.
- In their letter of April 4, 2013, the County Fire Department recommended that hydrant spacing shall comply with the Department of Water Supply standards.
- State Representative Nicole Lowen called on March 28, 2013, to clarify the status of ‘O‘oma Beachside development. Ms. Lowen indicated that the project is generally opposed by the community because (a) it is close to the airport and residents there would be impacted by noise, and (b) the area is heavily used for camping and beach access. In addition, the community wants the area to remain open space and she believes that the community development plan indicates it will remain open space. Finally, she shared that the Land Board denied their application for rezoning.
- Sydney Kraul, who works at Pacific Planktonics, a precommerical tenant of NELHA, commented in a March 26, 2013, email on the difficulty of turning left onto the Queen Ka‘ahumanu Highway out of the NELHA facility and expressed interest in being able to turn at Ka‘iminani Road’s stop-lighted intersection.
- Bob Ward in a March 25, 2013, email asked for assurance that the proposed project conforms with the Complete Streets law, the Kona Community Development Plan, and the Bike Plan Hawai‘i.

3.2 Regulatory Coordination

Since the project would require compliance with specific environmental laws and regulations, additional coordination and consultation was conducted as described below. Appendix A contains copies of relevant correspondence.

3.2.1 Hawai‘i Revised Statutes Chapter 6E-8

Correspondence with the SHPD was initiated September, 2010, with a letter from Parsons Brinckerhoff describing the project.

On March 16, 2011 SHPD responded and indicated, *“we have been requesting update surveys for proposed project areas in the NELHA and Keāhole Airport areas, due to the fact that the surveys conducted in the 1980s were based on reconnaissance level field work, and a number of previously unidentified sites have been found in the more recent studies. We therefore recommend that once you have identified the APE for these two roads, a systematic (inventory survey level) field inspection be conducted to verify that no historic properties are present. Should historic properties be identified, we will request that an inventory survey report be completed and submitted to our office for review and approval.”*

On March 25, 2011, PB proposed to SHPD that the APE be 150’ feet wide, 75 feet on either side of the road centerlines. Rechtman Consulting then proceeded with an archaeological survey of

the area and prepared an Archaeological Inventory Survey (AIS) report in compliance with HRS Chapter 6E. The AIS for Roads C, D, and E (which included the portion of Road A (Ka‘iminani Road Extension) from Road C to Queen Ka‘ahumanu Highway) was submitted to SHPD on August 24, 2012, and was accepted as final by SHPD on May 13, 2013. That AIS is provided in Appendix C.

NELHA is currently undergoing a process to conduct an archaeological inventory survey of the remainder of the HOST Park area. NELHA will work closely with SHPD and other stakeholders to complete that effort.

3.2.2 Section 7 of the Endangered Species Act and Chapter 195D of the Hawai‘i Revised Statutes

In their letter of April 22, 2013, the U.S. Fish and Wildlife Service describes the Blackburn’s sphinx moth (*Manduca blackburni*), a species protected by the Endangered Species Act. Adult moths feed on nectar from native plants, including beach morning glory (*Ipomoea pes-caprae*), iliee (*Plumbago zeylanica*) and maiapilo (*Capparis sandwichiana*). Larvae feed upon non-native tree tobacco (*Nicotiana glauca*) and native aiea (*Nothocestrum latifolium*). Blackburn’s sphinx moth pupae may occupy the soil within 250 feet of larval host plants for a year or longer.

A survey for the moth and related plants will be completed prior to the publication of the Final EA. This will allow for the survey to occur roughly 6 weeks after significant rains, as suggested by the USFWS. The results of the survey will be provided to the USFWS as soon as they are available.

The USFWS also describes anchialine pools makai of the project area. They expressed concern that the proposed project will help provide access to additional leasable parcels and as these parcels are developed, they may need to use groundwater. Groundwater wells might increase the salinity of the anchialine pools as ocean water seeps inland. A change in salinity in these pools may alter their species composition. Many of the species that are unique to anchialine pools are declining and may be considered for federal listing as threatened or endangered within the next several years.

A discussion of the issues regarding the anchialine pools is provided in Sections 2.6 and 2.10. As discussed in those sections, the proposed project would not have a direct affect on the pools and development of water supplies to support future development can be achieved without significant impacts to the pools.

4.0 ANTICIPATED FINDING OF NO SIGNIFICANT IMPACT

As the proposing agency, NELHA anticipates rendering a Finding of No Significant Impact (FONSI) for the proposed project in accordance with HRS Chapter 343 and Hawai‘i Administrative Rules (HAR), Sections 11-200-9 and 11-200-11.2. This assessment is based on an evaluation of project impacts in relation to the "Significance Criteria" specified in HAR 11-200-12(b). The Significance Criteria appear below in italics, followed by a discussion of the project in relation to the specific criterion. The nature of the project's potential impacts is discussed in detail in Section 2.0.

1. *Involves an irrevocable commitment to loss or destruction of any natural or cultural resource* – The proposed project would cause minor loss or destruction of a natural or cultural resource. The area that would be directly affected does not contain important plants or animals, as confirmed though coordination with the responsible agencies. The proposed project would only affect plants and animals that are common and found throughout the region, island, and State.
2. *Curtails the beneficial uses of the environment* – The proposed project would not curtail beneficial uses of the environment because NELHA is an existing facility and its development has been planned and anticipated by the community. NELHA takes advantage of the abundant natural environmental assets such as deep-sea water and high solar insolation available at this location.
3. *Conflicts with the State's long-term environmental policies or goals and guidelines expressed in Chapter 344, HRS, and any revisions thereof and amendments thereto, court decisions, or executive orders* – The proposed project is consistent with the environmental goals and objectives of the State of Hawai‘i, as demonstrated in this section and in Section 2.5.
4. *Substantially affects the economic or social welfare of the community or State* – The proposed project would enhance the island's economy by supporting NELHA's mission. NELHA administers the world's premier energy and ocean technology park offering research support facilities for the development of clean energy and other demonstration projects that utilize the unique resources found at the park. It is the largest diversified economic development project in the State and is largely focused on green economic development projects.
5. *Substantially affects public health* – The proposed project would not adversely affect public health.
6. *Involves substantial secondary impacts* – The proposed project does not constrain proposed development, and proceeding with the project would not impact overall development trends in North Kona. Therefore, the proposed project would not induce secondary land uses, nor would it result in related secondary impacts that would otherwise not occur.
7. *Involves substantial degradation of environmental quality* – The proposed project would not result in a substantial degradation of environmental quality. The project would not result in adverse environmental conditions, as demonstrated in Section 2.0.

The few and minor potential adverse effects of the proposed project are summarized in Section 2.12.

8. *Substantially affects a rare, threatened, or endangered species or its habitat* – Coordination and consultation with resource agencies, including an informal consultation with the USFWS in accordance with Section 7 of the Endangered Species Act, indicates that interactions with protected species are unlikely. The only endangered species that might live in the project area is the Blackburn's sphinx moth. A survey will be performed for the moth and the plants integral to its lifecycle prior to the publication of the Final EA for the proposed project. Though no designated critical habitats exist in the project area, the FWS notes that there are anchialine ponds in the vicinity. Two small clusters of ponds are on or near NELHA property near the coast, located between ¾ and 1 ¼ miles from the proposed project. Numerous anchialine ponds are located 5 miles south of NELHA at Kaloko-Honokōhau National Historical Park as described in Section 2.6. The anchialine ponds would be unaffected by the proposed project.
9. *Is individually limited but cumulatively has considerable effect upon the environment or involves a commitment for larger actions* – The proposed project would not create a commitment for other actions by NELHA, another government agency, or other party. The proposed project is a complete, independent project, with logical termini, and would not result in commitments for other roadway projects, nor result in cumulative, considerable effects on the environment.
10. *Detrimentally affects air or water quality or ambient noise levels* – The proposed project would not detrimentally affect air or water quality or noise levels. The project would comply with State of Hawai‘i and federal environmental regulations and standards. The project would cause no violations of State or National Ambient Air Quality Standards. BMPs would be implemented during project construction in order to minimize water quality impacts from construction site runoff. No adverse noise impacts are anticipated.
11. *Affects or is likely to suffer damage by being located in an environmentally sensitive area such as a floodplain, tsunami zone, beach, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters* – The proposed project is not located in an environmentally sensitive area.
12. *Substantially affects scenic vistas and viewplanes identified in county or state plans or studies* – It is anticipated that the proposed project would not significantly affect any existing scenic views, nor obstruct such views, because it is at ground level and occurs adjacent to existing roads.
13. *Requires substantial energy consumption* – The proposed project would not result in substantial energy consumption; the project has a small footprint and short duration.

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APPENDIX A CORRESPONDENCE

Comments and Coordination

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, HONOLULU DISTRICT
FORT SHAFTER, HAWAII 96858-5440

REPLY TO
ATTENTION OF:

April 2, 2013

Regulatory Branch

POH-2013-00071

Parsons Brinckerhoff
Attn: James Hayes, Senior Supervising Planner
1001 Bishop St, Suite 2400
Honolulu, HI 96813

NO PERMIT REQUIRED

Dear Mr. Hayes:

This is in response to your March 23, 2013 request for the Department of the Army to review and comment on the proposed Natural Energy Laboratory of Hawai'i Authority and Hawai'i Ocean Science and Technology Park Connections to the Queen Ka'ahumanu Highway and Kona International Airport near Keāhole, Kona, Island of Hawai'i, Hawai'i. We have assigned the project the reference number **POH-2013-00071**. Please cite this reference number in any correspondence with us concerning this project. We have completed our review of the submitted document and have the following comments:

Section 10 of the Rivers and Harbors Act of 1899 (Section 10) requires that a Department of the Army (DA) permit be obtained from the U.S. Army Corps of Engineers (Corps) prior to undertaking any construction, dredging, and other activities occurring in, over, or under navigable waters of the U.S. Section 404 of the Clean Water Act (Section 404) of 1972 (33 U.S.C. 1344) requires that a DA permit be obtained for the discharge, or placement, of dredge and/or fill material into waters of the U.S., including wetlands.

Based on our review of the submitted document, it appears that the project location consists entirely of uplands and no navigable waters of the U.S. are present. As such, authorization under Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act do not appear to be required for the proposed project.

If the project design should change and work is to be proposed in wetlands, streams, drainage ditches, the Pacific Ocean, or other aquatic resource, (whether or not water is present in that resource during project construction) please contact our office to request a jurisdictional determination. We can then determine if any regulatory requirements apply to work that may impact those resources.

Thank you for contacting us regarding this project. We look forward to working with you on this project as well as any future projects. Should you have any questions, please contact Kaitlyn Seberger, at (808) 835-4300 or via email at Kaitlyn.R.Seberger@usace.army.mil.

Sincerely,

George P. Young, P. E.
Chief, Regulatory

From: Danielle Jayewardene- NOAA Affiliate [danielle.jayewardene@noaa.gov]
Sent: Thursday, March 28, 2013 1:17 PM
To: Hayes, James (Honolulu)
Subject: NELHA and HOST connections to Queen Kaahumanu Highway and Kona International Airport, Keahole, Kona

Aloha James,

I have just reviewed the Preparation Notice for the subject mentioned project on behalf of the Habitat Conservation Division of NOAA
Fisheries, Pacific Islands Regional Office. We appreciate the
opportunity to provide the following informal comments.

While this project does not appear to involve any in-water work, hence will have no direct impact to our trust resources (Essential Fish Habitat and coral reef resources) present in the marine environment, the project may indirectly impact water quality off Keahole Point. In preparing the EA for this project, we recomemnd fully exploring alternatives which include Low Impact Development. These would include limiting the use of impervious surfaces, and implementation of innovative measures that control pollutant discharge to the marine environment via storm-water run-off both during construction, also importantly post-construction.

Thanks again for the opportunity to comment, don't hesitate to get in touch with any questions.
Danielle

--
Danielle Jayewardene Ph.D.
Coral Reef Ecologist/EFH coordinator
NOAA PIRO Habitat Conservation Division
1601 Kapiolani Blvd, Suite 1110
Honolulu, HI 96814
Ph 808-944 2162

U.S. Department of Homeland Security
FEMA Region IX
1111 Broadway, Suite 1200
Oakland, CA. 94607-4052

FEMA

April 9, 2013

James Hayes, Senior Supervising Planner
Parsons Brinckerhoff
1001 Bishop Street, Suite 2400
Honolulu, Hawaii 96813

Dear Mr. Hayes:

This is in response to your request for comments on Notice of Preparation of Environmental Assessment – Natural Energy Laboratory Hawaii Authority and Hawaii Ocean Science and Technology Park Connections to Queen Ka'ahumanu Highway and Kona International Airport.

Please review the current effective countywide Flood Insurance Rate Maps (FIRMs) for the County of Hawaii (Community Number 155166), Maps revised April 2, 2004. Please note that the County of Hawaii, State of Hawaii is a participant in the National Flood Insurance Program (NFIP). The minimum, basic NFIP floodplain management building requirements are described in Vol. 44 Code of Federal Regulations (44 CFR), Sections 59 through 65.

A summary of these NFIP floodplain management building requirements are as follows:

- All buildings constructed within a riverine floodplain, (i.e., Flood Zones A, AO, AH, AE, and A1 through A30 as delineated on the FIRM), must be elevated so that the lowest floor is at or above the Base Flood Elevation level in accordance with the effective Flood Insurance Rate Map.

- If the area of construction is located within a Regulatory Floodway as delineated on the FIRM, any ***development*** must not increase base flood elevation levels. **The term *development* means any man-made change to improved or unimproved real estate, including but not limited to buildings, other structures, mining, dredging, filling, grading, paving, excavation or drilling operations, and storage of equipment or materials.** A hydrologic and hydraulic analysis must be performed *prior* to the start of development, and must demonstrate that the development would not cause any rise in base flood levels. No rise is permitted within regulatory floodways.

- All buildings constructed within a coastal high hazard area, (any of the "V" Flood Zones as delineated on the FIRM), must be elevated on pilings and columns, so that the lowest horizontal structural member, (excluding the pilings and columns), is elevated to or above the base flood elevation level. In addition, the posts and pilings foundation and the structure attached thereto, is anchored to resist flotation, collapse and lateral movement due to the effects of wind and water loads acting simultaneously on all building components.

- Upon completion of any development that changes existing Special Flood Hazard Areas, the NFIP directs all participating communities to submit the appropriate hydrologic and hydraulic data to FEMA for a FIRM revision. In accordance with 44 CFR, Section 65.3, as soon as practicable, but not later than six months after such data becomes available, a community shall notify FEMA of the changes by submitting technical data for a flood map revision. To obtain copies of FEMA's Flood Map Revision Application Packages, please refer to the FEMA website at http://www.fema.gov/business/nfip/forms.shtm.

Please Note:

Many NFIP participating communities have adopted floodplain management building requirements which are more restrictive than the minimum federal standards described in 44 CFR. Please contact the local community's floodplain manager for more information on local floodplain management building requirements. The Hawaii County floodplain manager can be reached by calling Carter Romero, Director, Department of Public Works, at (808) 961-8943.

If you have any questions or concerns, please do not hesitate to call Sarah Owen of the Mitigation staff at (510) 627-7050.

Sincerely,

Gregor Blackburn, CFM, Branch Chief
Floodplain Management and Insurance Branch

cc:
Carter Romero, Director, Department of Public Works, Hawaii County
Carol Tyau-Beam, NFIP State Coordinator, Hawaii Department of Land & Natural Resources
Sarah Owen, NFIP Planner, DHS/FEMA Region IX
Alessandro Amaglio, Environmental Officer, DHS/FEMA Region IX

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawaii 96850

In Reply Refer To:
2013-SL-0204

APR 22 2013

James Hayes
Parsons Brinckerhoff
1001 Bishop Street, Suite 2400
Honolulu, Hawaii 96813

Subject: Species List for Preparation of an Environmental Assessment by the Natural Energy Laboratory of Hawaii Authority, Hawaii

Dear Mr. Hayes:

The U.S. Fish and Wildlife Service (Service) received your correspondence on March 21, 2013, requesting comments on the development of an Environmental Assessment by the Natural Energy Laboratory of Hawaii Authority (NELHA), Hawaii. NELHA is planning to enhance surface transportation connections between regional transportation facilities and the Hawaii Ocean Science and Technology Park, which NELHA administers. Parsons Brinckerhoff is assisting NELHA with the preparation of an Environmental Assessment in compliance with Hawaii Revised Statutes Chapter 343. The second phase of this proposed project is not projected to occur until roughly 2035.

Based on information you provided and pertinent information in our files, including data compiled by the Hawaii Biodiversity and Mapping Program, one species protected by the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*), could be impacted by the proposed project. To assist you with minimization and avoidance of impacts to this species, the Service offers the following recommendations:

- The Blackburn's sphinx moth (*Manduca blackburni*) may breed and feed within the proposed project area. Adult moths feed on nectar from native plants, including beach morning glory (*Ipomoea pes-caprae*), iliee (*Plumbago zeylanica*), and maiapilo (*Capparis sandwichiana*); larvae feed upon non-native tree tobacco (*Nicotiana glauca*) and native aiea (*Nothocestrum latifolium*). Blackburn's sphinx moth pupae may occupy the soil within 250 feet of larval host plants for a year or longer. The Service recommends that a qualified biologist survey all project areas, and areas adjacent to the project, for the presence of native and non-native Blackburn's sphinx moth host plants. The Service recommends these surveys be conducted during the wettest portion of the year (usually November-April), approximately four to eight weeks following a significant rainfall event. Surveys should include looking for eggs, larvae, and signs of pupating

larvae (frass, chewed leaves and stems, or other characteristic signs of larval browsing). If presence of the Blackburn's sphinx moth is confirmed, the Service should be contacted for further coordination.

Though no designated critical habitat occurs within the vicinity of the proposed action area, there are several anchialine pools located within the project area. More than 90 percent of the anchialine pools in Hawaii have already been lost to development. Although the current project is not likely to result in any further degradation of these sensitive habitats, future development may because future development projects planned for the leasable lots may draw water from the site (i.e., drawing down groundwater). This may cause increased salinity of existing pools as ocean water seeps into the ground. A change in the salinity of these pools may alter their species composition. Many of the species that are unique to anchialine pools are declining and may be considered for federal listing as threatened or endangered within the next several years. As a result, we recommend minimizing and avoiding impacts to anchialine pools when planning future development projects at this site.

We appreciate your efforts to conserve listed species. Please contact Fish and Wildlife Biologist Dr. Tim Langer (808-792-9462) if you have any questions or for further guidance.

Sincerely,

for Loyal Mehrhoff
Field Supervisor

cc: Lasha-Lynn H. Salbosa, Division of Forestry and Wildlife

United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Pacific Islands Water Science Center
677 Ala Moana Blvd., Suite 415
Honolulu, Hawaii 96813
Phone: (808) 587-2400/Fax: (808) 587-2401

April 5, 2013

Mr. James Hayes
Parsons Brinckerhoff
1001 Bishop Street, Suite 2400
Honolulu, Hawaii 96813

Dear Mr. Hayes:

Subject: Preparation of an Environmental Assessment, Natural Energy Laboratory of Hawai'i Authority and Hawai'i Ocean Science and Technology Park Connections to Queen Ka'ahumanu Highway and Kona International Airport, Keāhole, Kona, Hawai'i

Thank you for forwarding the subject letter for review and comment by the staff of the U.S. Geological Survey Pacific Islands Water Science Center. We have reviewed the document and have no comments to offer on the proposed project.

We appreciate the opportunity to participate in the review process.

Sincerely,

Stephen S. Anthony
Center Director

From: Gordon.Wong@faa.gov
Sent: Tuesday, April 02, 2013 11:21 AM
To: Hayes, James (Honolulu)
Cc: kimberly.k.evans@hawaii.gov; lynn.becones@hawaii.gov; Kandyce.Watanabe@faa.gov; Steve.Wong@faa.gov
Subject: Preparation of EA - NELHA Roadway Connections

Reference your letter of March 23, 2013, informing us of the preparation of an Environmental Assessment for enhanced surface transportation connections (Roads A, B, and C) between regional transportation facilities near the Natural Energy Laboratory of Hawaii Authority (NELHA) and Hawaii Ocean Science and Technology (HOST) Park, including the Kona International Airport at Keahole.

Cognizant of 14 CFR Part 77, Safe, Efficient Use, and Preservation of the Navigable Airspace, certain proposed construction on or near an airport is required to notify the FAA to determine the effect on the safe and efficient use of navigable airspace, air navigation facilities or equipment. Notification to the FAA is done through submittal of FAA Form 7460-1, Notice of Proposed Construction or Alteration and uploaded to FAA's Obstruction Evaluation/Airport Airspace Analysis (OE/AAA) website:
https://oeaaa.faa.gov/oeaaa/external/portal.jsp

Notification to FAA is required under the following conditions:

(a) Any construction or alteration that is more than 200 ft. AGL at its site.

(b) Any construction or alteration that exceeds an imaginary surface extending outward and upward at any of the following slopes:

(1) 100 to 1 for a horizontal distance of 20,000 ft. from the nearest point of the nearest runway of each airport described in paragraph (d) of this section with its longest runway more than 3,200 ft. in actual length, excluding heliports.

(2) 50 to 1 for a horizontal distance of 10,000 ft. from the nearest point of the nearest runway of each airport described in paragraph (d) of this section with its longest runway no more than 3,200 ft. in actual length, excluding heliports.

(3) 25 to 1 for a horizontal distance of 5,000 ft. from the nearest point of the nearest landing and takeoff area of each heliport described in paragraph (d) of this section.

(c) Any highway, railroad, or other traverse way for mobile objects, of a height which, if adjusted upward 17 feet for an Interstate Highway that is part of the National System of Military and Interstate Highways where overcrossings are designed for a minimum of 17 feet vertical distance, 15 feet for any other public roadway, 10 feet or the height of the highest

mobile object that would normally traverse the road, whichever is greater, for a private road, 23 feet for a railroad, and for a waterway or any other traverse way not previously mentioned, an amount equal to the height of the highest mobile object that would normally traverse it, would exceed a standard of paragraph (a) or (b) of this section.

(d) Any construction or alteration on any of the following airports and heliports:

(1) A public use airport listed in the Airport/Facility Directory, Alaska Supplement, or Pacific Chart Supplement of the U.S. Government Flight Information Publications;

(2) A military airport under construction, or an airport under construction that will be available for public use;

(3) An airport operated by a Federal agency or the DOD.

(4) An airport or heliport with at least one FAA-approved instrument approach procedure.

(e) You do not need to file notice for construction or alteration of:

(1) Any object that will be shielded by existing structures of a permanent and substantial nature or by natural terrain or topographic features of equal or greater height, and will be located in the congested area of a city, town, or settlement where the shielded structure will not adversely affect safety in air navigation;

(2) Any air navigation facility, airport visual approach or landing aid, aircraft arresting device, or meteorological device meeting FAA-approved siting criteria or an appropriate military service siting criteria on military airports, the location and height of which are fixed by its functional purpose;

(3) Any construction or alteration for which notice is required by any other FAA regulation.

(4) Any antenna structure of 20 feet or less in height, except one that would increase the height of another antenna structure

The notification to the FAA should also include proposed street lights (if any).

We recommend you also coordinate this proposal with the State of Hawaii, Department of Transportation, Airports Division to determine it's effects on airport plans.

Gordon Wong
FAA Honolulu Airports District Office
T: 808-541-3565
F: 808-541-3566
E: gordon.wong@faa.gov

OFFICE OF PLANNING
STATE OF HAWAII

NEIL ABERCROMBIE
GOVERNOR

JESSE K. SOUKI
DIRECTOR
OFFICE OF PLANNING

235 South Beretania Street, 6th Floor, Honolulu, Hawaii 96813
Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804

Telephone: (808) 587-2846
Fax: (808) 587-2824
Web: http://hawaii.gov/dbedt/op/

Ref. No. P-13943

April 10, 2013

Mr. James Hayes
Parsons Brinckerhoff
1001 Bishop Street, Suite 2400
Honolulu, Hawaii 96813

Dear Mr. Hayes:

Subject: Environmental Assessment Preparation Notice, Natural Energy Laboratory of Hawaii Authority and Hawaii Ocean Science and Technology Park Connections to Queen Kaahumanu Highway and Kona International Airport, Keahole, Kona, Hawaii

Thank you for the opportunity to provide comments on your Environmental Assessment (EA) preparation notice for the Natural Energy Laboratory of Hawaii Authority and Hawaii Ocean Science and Technology Park Connections to Queen Kaahumanu Highway and Kona International Airport.

The Office of Planning has reviewed the documents you provided in a letter dated March 23, 2013, and has the following comments to offer:

1. The entire state is defined to be within the Coastal Zone Management Area (Hawaii Revised Statutes (HRS) §205A-1 - definition of "coastal zone management area"). The Draft Environmental Assessment (Draft EA) should include a discussion of the proposed project's consistency with the objectives and policies set forth in HRS §205A-2.

2. The construction project may have nonpoint pollution impacts on coastal waters. We invite the applicant to review the Hawaii Watershed Guidance, which provides a summary of, and links to, management measures that may be implemented to minimize coastal nonpoint pollution impact. The Hawaii Watershed Guidance document can be found on-line at http://hawaii.gov/dbedt/czm/initiative/nonpoint/HI Watershed Guidance Final.pdf.

3. The Draft EA should include the Coastal Zone Management Act, HRS Chapter 205A, in the list of "Relationship to Land Use Plans, Policies, and Controls."

4. The proposed project is within the Special Management Area (SMA) delineated by the County of Hawaii. The Draft EA should include a discussion of the proposed project's consistency with SMA guidelines and regulations set forth in HRS §205A-26.

If you have any questions regarding this comment letter, please contact Leo Asuncion, Coastal Zone Management Program Manager, at 587-2875.

Sincerely,

Jesse K. Souki
Director

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

LORETTA J. FUDDY, A.C.S.W., M.P.H.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HI 96801-3378

In reply, please refer to:
File:
13-067
NELHA

March 27, 2013

Mr. James Hayes
Parsons Brinckerhoff
1001 Bishop Street, Suite 2400
Honolulu, Hawaii 96813

Dear Mr. Hayes:

SUBJECT: Preparation of an Environmental Assessment, Natural Energy Laboratory of Hawaii Authority and Hawaii Ocean Science and Technology Park Connections to Queen Kaahumanu Highway and Kona International Airport, Keahole, Kona, Hawaii

The Department of Health (DOH), Environmental Planning Office (EPO), acknowledges receipt of your letter dated March 23, 2013. Thank you for allowing us to review and comment on the subject letter. The letter was routed to the Clean Water Branch in the Department of Health. They will provide specific comments to you if necessary. EPO recommends that you review the Standard Comments (www.hawaii.gov/health/epo under the land use tab). You are required to adhere to all Standard Comments specifically applicable to this application.

EPO suggests that you examine the many sources available on strategies to support the sustainable design of communities, including the:
U.S. Environmental Protection Agency's sustainability programs: www.epa.gov/sustainability
U.S. Green Building Council's LEED program: www.new.usgbc.org/leed

The DOH encourages everyone to apply these sustainability strategies and principles early in the planning and review of projects. We also request that for future projects you consider conducting a Health Impact Assessment (HIA). More information is available at www.cdc.gov/healthyplaces/hia.htm. We request you share all of this information with others to increase community awareness on sustainable, innovative, inspirational, and healthy community design.

We request a written response confirming receipt of this letter and any other letters you receive from DOH in regards to this submission. You may mail your response to 919 Ala Moana Blvd., Ste. 312, Honolulu, Hawaii 96814. However, we would prefer an email submission to epo@doh.hawaii.gov. We anticipate that our letter(s) and your response(s) will be included in the final document. If you have any questions, please contact me at (808) 586-4337.

Mahalo,

Laura Leialoha Phillips McIntyre, AICP
Manager, Environmental Planning Office

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

LORETTA J. FUDDY, A.C.S.W., M.P.H.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HI 96801-3378

In reply, please refer to:
File:

April 4, 2013

Mr. James Hayes
Parsons Brinckerhoff
1001 Bishop Street, Suite 2400
Honolulu, HI 96813

Dear Mr. Hayes:

This correspondence is in response to your request for comments Preparation of an Environmental Assessment for the Natural Energy Laboratory of Hawaii Authority and Hawaii Ocean Science and Technology Park Connections to Queen Ka'ahumanu Highway and Kona International Airport, Keahole, Kona, Hawaii.

Project activities shall comply with the following Administrative Rules of the Department of Health:

- Chapter 11-46 Community Noise Control

Should you have any questions, please contact me at (808) 586-4701.

Sincerely,

Jeffrey M. Eckerd
Program Manager
Indoor and Radiological Health Branch

NEIL ABERCROMBIE
GOVERNOR

GARY L. GILL
ACTING DIRECTOR

STATE OF HAWAI'I
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
Department of Health
235 South Beretania Street, Suite 702
Honolulu, Hawai'i 96813
Telephone (808) 586-4185
Facsimile (808) 586-4186
Email: oeqchawaii@doh.hawaii.gov

April 16, 2012

James Hayes, Senior Supervising Planner
Parsons Brinckerhoff
1001 Bishop Street, Suite 2400
Honolulu, Hawai'i 96813

SUBJECT: Preparation of an Environmental Assessment, Natural Energy Laboratory of Hawai'i Authority and Hawai'i Ocean Science and Technology Park connections to Queen Ka'ahumanu Highway and Kona International Airport, Keāhole, Kona, Hawai'i

Dear Mr. Hayes,

The Office of Environmental Quality Control has reviewed the proposed activities described in your letter of March 23, 2013, and offers these comments:

1. The Hawai'i State Department of Transportation (DOT), Airports Division, has improvement projects in the planning stages for Kona Airport. We advise that you coordinate with the Hawai'i State DOT to ensure that your proposed road improvements are compatible and aligned with DOT highways and airport improvement projects.
2. Check with the County of Hawai'i Planning Department for local requirements and approvals.
3. Please list all the necessary permits and approvals required for the project.
4. Make sure that the environmental assessment includes the content requirements identified in §11-200-10, Hawai'i Administrative Rules, and list all the necessary permits the project will apply for.

Thank you for the opportunity to provide comments about the subject project. Feel free to contact me at (808) 586-4184, if you have further questions.

HERMAN TUIOLOSEGA
Senior Planner

NEIL ABERCROMBIE
GOVERNOR

DWIGHT TAKAMINE
DIRECTOR

AUDREY HIDANO
DEPUTY DIRECTOR

STATE OF HAWAII
DEPARTMENT OF LABOR AND INDUSTRIAL RELATIONS
830 PUNCHBOWL STREET, ROOM 321
HONOLULU, HAWAII 96813
www.hawaii.gov/labor
Phone: (808) 586-8844/Fax: (808) 586-9099

April 18, 2013

Mr. James Hayes
Parsons Brinckerhoff
1001 Bishop Street, Suite 2400
Honolulu, HI 96813

Dear Mr. Hayes:

This is in response to your request for comments dated March 23, 2013 on the preparation of an Environmental Assessment for the Natural Energy Laboratory of Hawaii Authority and Hawaii Ocean Science and Technology Park Connections to Queen Ka'ahumanu Highway and Kona International Airport project located in Keahole, island of Hawaii.

The Department of Labor and Industrial Relations has no comments, and we foresee no impact on our existing or proposed programs.

Should you have any questions, please call me at 586-8844.

Sincerely,

DWIGHT TAKAMINE
Director

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ESTHER KIA'AINA
FIRST DEPUTY

WILLIAM M. TAM
DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
OFFICE OF CONSERVATION AND COASTAL LANDS
POST OFFICE BOX 621
HONOLULU, HAWAII 96809

REF: OCCL: AJR

COR: HA-13-128

APR 10 2013

James Hayes
c/o Parsons Brickerhoff
1001 Bishop St., Ste. 2400
Honolulu, HI 96813

RE: Proposed Roadway Improvements for the Natural Energy Laboratory of Hawaii Authority (NELHA) at Kona International Airport; Pre-Environmental Assessment
North Kona District, Island of Hawaii
TMK's: (3) 7-3-043: XXX

Dear Mr. Hayes,

The Office of Conservation and Coastal Lands (OCCL) is in receipt of your letter, dated *March 21, 2013*, requesting a pre-assessment of the proposed project for the preparation of an Environmental Assessment (EA) for roadway repairs and construction on the NELHA Facility and Kona International Airport Property.

According to your letter the applicant (NELHA) is proposing a two (2) phase project of road repair, road construction and associated vehicular intersection improvements. While the information provided did not list any tax map keys for the proposed project sites, the OCCL believes that the work proposed for *Phase I* does not appear to include any land uses in the Conservation District.

The proposed *Phase II* portion of the project may require a review by the OCCL as the work appears to be located within the Conservation District General Subzone. This office understands that the *Phase II* portion of the proposed project will not be instituted until approximately 2035; therefore we request that, when ready, the applicant contact the OCCL to determine permitting requirements for the *Phase II* portion.

Should you have any questions concerning this correspondence please feel free to contact Alex J. Roy, M.Sc. of our Office of Conservation and Coastal Lands staff at 808-587-0316 or via email at alex.j.roy@hawaii.gov

Sincerely,

Samuel J. Lemmo, Administrator
Office of Conservation and Coastal Lands

CC: Chairperson
HDLO
County of Hawaii – Dept. of Planning

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

April 22, 2013

Parsons Brinkerhoff
Attention: Mr. James Hayes
1001 Bishop Street, Suite 2400
Honolulu, Hawaii 96813

via email: hayesja@pbworld.com

Dear Mr. Hayes:

SUBJECT: Preparation of an Environmental Assessment, Natural Energy Laboratory of Hawaii and Hawaii Ocean Science and Technology Park Connections to Queen Kaahumanu Highway and Kona International Airport, Parsons Brinkerhoff for the Natural Energy Laboratory of Hawaii Authority, North Kona, Hawaii

Thank you for the opportunity to review and comment on the subject matter. The Department of Land and Natural Resources' (DLNR) Land Division distributed or made available a copy of your report pertaining to the subject matter to DLNR Divisions for their review and comments.

At this time, the DLNR has no comments to offer on the subject matter. Should you have any questions, please feel free to call Kevin Moore at (808) 587-0426. Thank you.

Sincerely,

Russell Y. Tsuji
Land Administrator

Enclosure(s)

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

May 20, 2013

Parsons Brinkerhoff
Attention: Mr. James Hayes
1001 Bishop Street, Suite 2400
Honolulu, Hawaii 96813

via email: hayesja@pbworld.com

Dear Mr. Hayes:

SUBJECT: Preparation of an Environmental Assessment, Natural Energy Laboratory of Hawaii and Hawaii Ocean Science and Technology Park Connections to Queen Kaahumanu Highway and Kona International Airport, Parsons Brinkerhoff for the Natural Energy Laboratory of Hawaii Authority, North Kona, Hawaii

Thank you for the opportunity to review and comment on the subject matter. In addition to the comments previously sent under cover of our letter dated April 22, 2013, enclosed are comments from the State Historic Preservation Division on the subject matter. Should you have any questions, please feel free to call Kevin Moore at 587-0426.

Sincerely,

Russell Y. Tsuji
Land Administrator

Enclosure(s)

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
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BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

HISTORIC PRESERVATION DIVISION
DEPARTMENT OF LAND AND NATURAL RESOURCES
601 Kamokila Boulevard, Suite 555
Kapolei, HI 96806

May 9, 2013

MEMORANDUM

To: Russell Tsuji
Land Division
PO Box 621
Honolulu, HI 96809

LOG NO: 20123.2561
DOC NO: 1304MV30
Archaeology

FROM: Theresa Donham, Archaeology Branch Chief

SUBJECT: **Chapter 6E-8 Historic Preservation Review –**
Natural Energy Laboratory of Hawaii Authority (NELHA)
Pre-EA for Connector Roads and Other Roads in HOST Park (HAD-HI)
Kalaoa Ahupua'a, North Kona District, Island of Hawai'i
TMK: (3) 7-3-43 Multiple Parcels

Thank you for the opportunity to review this project that was received by our office on April 2, 2013. We recognize that the due date for comments has elapsed. However, please keep in mind that Hawaii Administrative Rules (HAR) 13-275-5(a) provides SHPD with a 30 day review period for projects such as this. According to the Environmental Assessment (EA) preparation notice, the purpose of this project is to enhance transportation connections between regional transportation facilities and the NELHA Hawaii Ocean Science and Technology (HOST) Park. This includes roads A, B, C, D, E, F, and G as identified in Figure 1. A review of our records indicates that this project area was subject to an archeological reconnaissance survey by Bishop Museum archaeologists in 1984 (SHPD Rpt. H-00816). However, a recent AIS of roads C, D, and E within NELHA recorded multiple previously unidentified historic properties (Rechtman and Clark, 2012). This is new information that demonstrates the inadequacy of the prior survey in this location. We believe it is very likely that additional historic properties exist in the alignments of roadways A, B, F and G.

In a recent Section 106 review of a federal undertaking to improve connector roads within the HOST park, SHPD requested the opportunity to review an archaeological inventory survey (AIS) of this project area (Log 2012.1809, Doc 1211MV07). We believe that an **AIS should be conducted** on all of the proposed roadways in order to adequately identify any historic properties and, if necessary, determine an appropriate course of mitigation. In addition, we believe that the construction of the roadways will open up previously undeveloped areas within the HOST park to development. Because the previous archaeological inventory survey (SHPD Rpt. H-00816) is considered inadequate, we recommend that an AIS be conducted of the areas serviced by the new roads, in order to consider the potential cumulative impacts of this development on the historic sites in this area. We look forward to the opportunity to review an AIS report that meets the standards of Hawaii Administrative Rule 13-276.

Please contact Mike Vitousek at (808) 652-1510 or Michael.Vitousek@Hawaii.gov if you have any questions of concerns regarding this letter.

NEIL ABERCROMBIE
GOVERNOR

GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
JADE T. BUTAY
FORD N. FUCHIGAMI
RANDY GRUNE
JADINE URASAKI

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

IN REPLY REFER TO:
STP 8.1186

April 23, 2013

Mr. James Hayes
Senior Supervising Planner
Parsons Brinckerhoff
1001 Bishop Street, Suite 2400
American Savings Bank Tower
Honolulu, Hawaii 96813

Dear Mr. Hayes:

Subject: Natural Energy Laboratory of Hawaii Authority (NELHA) and Hawaii Ocean Science and Technology (HOST) Park Connections To Queen Kaahumanu Highway and Kona International Airport Pre-Consultation for Environmental Assessment

Thank you for requesting the State Department of Transportation's (DOT) review of the subject project. DOT understands the NELHA is planning to enhance surface transportation connections between the HOST Park and the Queen Kaahumanu Highway and the Kona International Airport.

Given the location nature of the subject project, DOT Highways and Airports Divisions have concerns regarding highway access. DOT comments are as follows:

DOT-Airports

The DOT Airports Division is aware of the proposed roadway projects, as they have coordinated with NELHA during the master planning process for the Kona International Airport's Master Plan. While the DOT Airport Division has no objection to the projects they request continued consultation during the environmental review process.

DOT Highways

1. The Draft Environmental Assessment (DEA) should address:

   a. The subject project's impact to two DOT proposed bike-path projects in the area:

      1) Old Airport coastal bike-path; and

      2) The bike-path along Queen Kaahumanu Highway situated within and beyond the subject project.

b. Short term traffic generated by the project and impacts during construction.

c. Inconvenience to the motoring public, bicyclists, joggers etc., during construction.

d. Dust, odor and noise pollution.

2. Prior to the development of the proposed project, NELHA shall provide for our review and acceptance a Traffic Impact Report (TIR) that evaluates/addresses project impacts on our State highway facilities.

3. The TIR should be coordinated with DOT's Queen Kaahumanu Highway widening project.

4. The TIR should include discussion/evaluation and mitigation of project impacts to the DOT's two proposed bike-path projects (referenced above).

DOT appreciates the opportunity to provide comments. Should you have any questions, including the need to meet with DOT Airports Division or Highways Division staff, please contact Mr. Garrett Smith of the DOT Statewide Transportation Planning Office at telephone number (808) 831-7976.

Very truly yours,

GLENN M. OKIMOTO, Ph.D.
Director of Transportation

From: Henry, Sharron [shenry@co.hawaii.hi.us]
Sent: Thursday, March 28, 2013 9:11 AM
To: Hayes, James (Honolulu)
Subject: NELHA EA

SUBJECT: Preparation of an Environmental Assessment
NELHA and Hawai`i Ocean Science and Technology Park Connections to Queen Ka'ahumanu Highway and Kona Intl. Airport
Keāhole, Kona, Hawai`i

The Department of Environmental Management has no comments on the subject Project.

Thank you for allowing us to offer our comments on this project.

Sharron Henry
Secretary to the Director
County of Hawai`i
Department of Environmental Management
Mailing Address: 25 Aupuni Street
Physical Address: Puainako Town Center,
2100 Kanoelehua
Hilo, HI 96720
Phone: 808.961.8083 or 808.981.8398
Fax: 808.961.8086 or 808.981.2092
Email: schenry@co.hawaii.hi.us
cohdem@co.hawaii.hi.us
http://www.hawaiicounty.gov/environmental-management

William P. Kenoi
Mayor

BJ Leithead Todd
Director

Margaret K. Masunaga
Deputy

West Hawai'i Office
74-5044 Ane Keohokalole Hwy
Kailua-Kona, Hawai'i 96740
Phone (808) 323-4770
Fax (808) 327-3563

County of Hawai'i
PLANNING DEPARTMENT

East Hawai'i Office
101 Pauahi Street, Suite 3
Hilo, Hawai'i 96720
Phone (808) 961-8288
Fax (808) 961-8742

April 10, 2013

Mr. James Hayes
Parsons Brinkerhoff
1001 Bishop Street, Suite 2400
American Savings Bank Tower
Honolulu, Hawai'i 96813

Dear Mr. Hayes:

SUBJECT: Pre-Consultation for Draft Environmental Assessment
Project: Natural Energy Laboratory of Hawai'i Authority (NELHA) Connection Roads
TMK: (3) 7-3-043:073; Keāhole, North Kona, Hawai'i

This is to acknowledge receipt on March 21, 2013 of the letter requesting comments from this office regarding the preparation of a Draft Environmental Assessment (DEA) for the subject project.

NELHA is planning to enhance surface transportation connections between regional transportation facilities and the Hawaii Ocean Science and Technology (HOST) Park.

The subject property consists of 189.712 acres and is zoned MG-3a (General Industrial) by the County of Hawai'i and designated Urban by the State Land Use Commission. The Hawai'i County General Plan Land Use Pattern Allocation Guide (LUPAG) Map designates the parcels as Industrial. In addition, the entire property is located within the Special Management Area (SMA) and subject to review against SMA rules and regulations.

The Kona Community Development Plan (KCDP), effective as of September 25, 2008, identifies Action TRAN-1.5a, to *design and construct a Frontage Road makai of Queen Kaahumanu Highway, or if permitted by Department of Transportation, within the 300-foot wide Queen Kaahumanu Highway right-of-way between the airport and Honokohau Harbor to serve as a Secondary Transit Route.*

The proposed Road C appears to be the location of the proposed Queen Ka'ahumanu Frontage Road as established in the KCDP. Please include discussion as to the project's relevance to the implementation of the KCDP objectives and policies.

If you have questions or require further information, please feel free to contact Bethany Morrison of this office at 961-8138.

Sincerely,

BJ LEITHEAD TODD
Planning Director

BJM:cs
P:\wpwin60\Bethany\EA-EIS Review\preconsultdraftea NELHA roads.doc

cc: Planning Department- Kona

William P. Kenoi
Mayor

Walter K. M. Lau
Managing Director

Warren H. W. Lee
Director

Brandon A. K. Gonzalez
Deputy Director

County of Hawai'i
DEPARTMENT OF PUBLIC WORKS
Aupuni Center
101 Pauahi Street, Suite 7 · Hilo, Hawai'i 96720-4224
(808) 961-8321 · Fax (808) 961-8630
www.co.hawaii.hi.us

April 12, 2012

James Hayes, Senior Supervising Planner
Parsons Brinckerhoff
1001 Bishop Street, Suite 2400
Honolulu, HI, 96813

Subject: Environmental Assessment Preparation Notice
NELHA and HOST Park Roads
Keahole , Kona Hawaii

Aloha James,

To date we have had communications with Jeff Nichols of NELHA and Randall Urasaki of your company regarding the subject roads. Preliminary engineering documents were reviewed and comments returned by email to Randall. We recently responded by email to a revised cross section design proposal for Road C (Frontage Road) following NELHA negotiations with the Planning Department. Road C is proposed to be dedicated to the County. Please include the following in the assessment:

- recommendations with supporting volume data and warrants for intersection auxiliary lanes, including storage lengths, and traffic controls.
- forecast ADT volumes with % of trucks for pavement design purposes.
- demand for and recommendations to accommodate bicycle and pedestrian traffic with connectivity to existing streets.

Public parking may not be accommodated on County dedicable street(s). Planning of any adjacent development should provide for adequate off-street parking.

We appreciate our inclusion in your list of agencies consulted. If you have any questions, please feel fee to contact Kiran Emler of our Kona office at 323-4851.

Warren H. W. Lee
Director, Department of Public Works

KE

Copy: Planning Director
DPW ENG—Hilo/Kona

DEPARTMENT OF WATER SUPPLY • COUNTY OF HAWAI'I
345 KEKŪANAŌ'A STREET, SUITE 20 • HILO, HAWAI'I 96720
TELEPHONE (808) 961-8050 • FAX (808) 961-8657

May 20, 2013

James Hayes
Parsons Brinckerhoff
1001 Bishop Street, Suite 2400
Honolulu, HI 96813

PRE-ENVIRONMENTAL ASSESSMENT CONSULTATION
NELHA / HOST PARK CONNECTIONS TO QUEEN KA'AHUMANU HIGHWAY AND KONA INTERNATIONAL AIRPORT
TAX MAP KEY 7-3-043:VARIOUS PARCELS

This is in response to your Pre-Environmental Assessment Consultation request dated March 23, 2013.

Please be informed that the existing water system along the Natural Energy Laboratory Hawaii Authority (NELHA) Access Road from the Queen Ka'ahumanu Highway intersection to the subject properties is privately owned and operated. The existing water system is served by a 6-inch master meter.

The Department will note that there was no mention of water within your request. However, the Department cannot provide any additional water at this time for subdivision or any other type of development requiring water within NELHA. Extensive improvements and additions, which may include, but not limited to source, storage, booster pumps, transmission, and distribution facilities, would be required.

Should there be any questions, please contact Mr. Ryan Quitoriano of our Water Resources and Planning Branch at 961-8070, extension 256.

Sincerely yours,

Quirino Antonio, Jr., P.E.
Manager-Chief Engineer

RQ:dfg

William P. Kenoi
Mayor

Darren J. Rosario
Fire Chief

Renwick J. Victorino
Deputy Fire Chief

County of Hawai'i
HAWAI'I FIRE DEPARTMENT
25 Aupuni Street • Room 2501 • Hilo, Hawai'i 96720
(808) 932-2900 • Fax (808) 932-2928

April 4, 2013

Mr. James Hayes
Parsons Brinckerhoff
1001 Bishop Street, Suite 2400
Honolulu, Hawai'i 96813

Dear Mr. Hayes,

SUBJECT: ENVIRONMENTAL ASSESSMENT FORNATURAL ENERGY LABORATORY OF HAWAI'I AUTHORITY AND HAWAI'I OCEAN SCIENCE AND TECHNOLOGY PARK CONNECTIONS TO QUEEN KAAHUMANU HIGHWAY AND KONA INTERNATIONAL AIRPORT KEAHOLE, KONA, HAWAII

Upon review of the documentation received for the above referenced project, the Hawai'i Fire Department recommends that the hydrant spacing shall comply with the Department of Water Supply standards.

Thank you for the opportunity to comment.

Sincerely,

DARREN J. ROSARIO
Fire Chief

KT/lpc

William P. Kenoi
Mayor

Harry S. Kubojiri
Police Chief

Paul K. Ferreira
Deputy Police Chief

County of Hawai'i

POLICE DEPARTMENT
349 Kapi'olani Street • Hilo, Hawai'i 96720-3998
(808) 935-3311 • Fax (808) 961-2389

March 22, 2013

Mr. James Hayes
Senior Supervising Planner
Parsons Brinckerhoff
1001 Bishop Street, Suite 2400
American Savings Bank Tower
Honolulu, Hawai'i 96813

Dear Mr. Hayes:

SUBJECT: Preparation of an Environmental Assessment
Natural Energy Laboratory of Hawai'i Authority and Hawai'i Ocean Science and Technology Park Connections to Queen Kaahumanu Highway and Kona International Airport
Keahole, Kona, Hawai'i

This responds to your request for comments in reference to the above-noted project. We have reviewed the environmental assessment and have no comments or objections to offer at this time.

Should there be any questions, please contact Captain Richard Sherlock, Commander of the Kona District, at (808)326-4646, ext. 299.

Sincerely,

HARRY S. KUBOJIRI
POLICE CHIEF

PAUL H. KEALOHA JR.
ASSISTANT CHIEF
AREA II OPERATIONS

RS:dmv
RS130201

William P. Kenoi
Mayor

Walter K.M. Lau
Managing Director

Randall M. Kurohara
Deputy Managing Director

County of Hawai'i

Office of the Mayor

25 Aupuni Street, Suite 2603 • Hilo, Hawai'i 96720 • (808) 961-8211 • Fax (808) 961-6553
KONA: 74-5044 Ane Keohokalole Hwy., Bldg. C • Kailua-Kona, Hawai'i 96740
(808) 323-4444 • Fax (808) 323-4440

March 27, 2013

Mr. James Hayes
Parsons Brickerhoff
1001 Bishop Street, Suite 2400
Honolulu, HI 96813

RE: Preparation of an Environmental Assessment
Natural Energy Laboratory of Hawai'i Authority and Hawai'i Ocean Science and Technology Park Connections to Queen Ka'ahumanu Highway and Kona International Airport, Keahole, Kona, Hawai'i

Aloha James,

As the Mayor of the County of Hawai'i is a voting member of the Board of Directors of the Natural Energy Laboratory of Hawai'i Authority, we will defer any comment to Departments of Public Works and Planning Departments.

We trust all appropriate county agencies will also be consulted during the actual assembly of the environmental assessment.

Mahalo,

Billy Kenoi
MAYOR

cc: Warren Lee, Director, Dept. of Public Works
Bobby Jean Leithead-Todd, Director, Planning Dept.

PARSONS BRINCKERHOFF

1001 Bishop Street, Suite 2400
American Savings Bank Tower
Honolulu, Hawaii 96813
Main: 808-531-7094
Fax: 808-528-2368

www.pbworld.com

Telephone Conversation Memorandum

Project:	NELHA	**Job #:**	16511A	**Date:**	Mar 28, 2013
Talked to:	Nicole Lowen	**From:**	State Representative	**#:**	586-8400

Items Discussed: ‘O‘oma Beachside proposed development

Information Shared/Obtained:

Nicole Lowen called and asked why we had included the ‘O‘oma Beachside development in our assessment to date. I indicated that they had done an EIS and back when we started doing this project there was no decision regarding the project.

Ms. Lowen indicated the following:

- The project is generally opposed by the community because (a) it is close to the airport and residents there would impacted by noise, and (b) the area is heavily used for camping and beach access.
- The community wants the area to remain open space and she believes that the community development plan indicates it will remain open space.
- The Land Board denied their application for rezoning.

I asked her if this is the fact for both the mauka and makai parcels (both are makai of Queen Ka‘ahumanu Highway, the mauka parcel is mauka of the Kings trail). Ms. Lowen indicated she felt this is true for both parcels.

She indicated that the way Kohanaiki developed (further south from ‘O‘oma) cased changes to the coastal uses and the community wants to avoid that in other areas.

Action Required:

Address this in the Draft EA.

Research indicates that the ‘O‘oma parcel is currently for sale and that the Land Board did not approve the rezoning request (conservation to urban).

Distribution: | | | | | | By: JTH

From: Syd [syd@pacificplanktonics.com]
Sent: Tuesday, March 26, 2013 10:27 AM
To: Hayes, James (Honolulu)
Subject: NELHA roads

Follow Up Flag: Follow up
Flag Status: Flagged

Hi James -
I am very worried about some of the plans for revised NELHA roads. I work at Pacific Planktonics, a pre-commercial tenant of NELHA, and normally turn left (north) when exiting the current (Makako Bay Dr.) NELHA road onto Queen Kaahumanu Hwy. I have heard one of the (county?) road chiefs say there isnt enough traffic at that intersection to justify a traffic light. He may be right, but there is so much traffic going south on Queen K late afternoon that we sometimes have to wait a very long time for a chance to shoot across into the north bound center "suicide lane." Compounding this, northbound traffic is waiting to enter NELHA and they have right of way for their left turn. People like me have to look back and forth quickly be very careful timing our exit and I have almost been hit a couple times. Northbound traffic turning left at NELHA approach quickly and change quickly from the northbound lane into their left turn lane. That's the current situation.
I hear that the highway expansion planners have now recognized that 40 foot trailers going north from NELHA will contribute to road hazards if they have to make a U turn 1 mile south of NELHA, so we might get a left turn exit.
Strictly from a safety point of view (ie, my life and health), I hope the highway expansion will include a required access road within NELHA to get to Kaiminani Rd's stoplight intersection. Even if there is no highway expansion, I would sure feel safer having access to that light, rather than risking suicide at the current intersection.
Thank you for including my opinion,
Sydney A Kraul, Jr
73-998 Ahikawa St
Kailua-Kona, HI 96740
Tel 808 326-1180 (daytime)
email syd@pacificplanktonics.com

address at NELHA:
73-951 Makako Bay Dr.
Kailua-Kona, HI 96740

From: Bob Ward [rgward007@hawaii.rr.com]
Sent: Monday, March 25, 2013 2:03 PM
To: Hayes, James (Honolulu)
Subject: NELHA

Follow Up Flag: Follow up
Flag Status: Flagged

Aloha,

I've noticed that you will be studying roadways at NELHA. What are the boundaries, proposed corridors, and typical cross-sections?

I would like to be assured that on-site and connecting roadways conform to the Complete Streets law, Kona Community Development Plan, and Bike Plan Hawai`i.

Please send me .pdf files on background material.

Thanks,

Bob Ward

Regulatory Coordination

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
601 KAMOKILA BOULEVARD, ROOM 555
KAPOLEI, HAWAII 96707

March 16, 2011

Jan Reichelderfer, Environmental Planner
Parsons Brinkerhoff
1001 Bishop Street, Suite 2400
Honolulu, Hawai‘i 96813
(reichelderfer@pbworld.com)

LOG NO: 2010.3201
DOC NO: 1103TD18
Archaeology

Dear Ms. Reichelderfer:

SUBJECT: National Historic Preservation Act Section 106 Review –
Airport Connector Roadway and Kaiminani Drive Extension, NELHA
‘O‘oma 1st Ahupua‘a, North Kona District, Island of Hawai‘i
TMK: (3) 7-3-043: 073

Thank you for requesting our review of the proposed project, described in your letter dated September 8, 2010. We apologize for the delay in responding. As indicated in your letter, the State of Hawai‘i Department of Transportation (HDOT) is planning to build several new connector roads to access new lease areas within the Natural Energy Laboratory Hawaii Authority (NELHA) property. Your letter addresses two of the proposed roads, identified as Roads B and C that will be built using Federal funds. Proposed Road C intersects with Ka‘ahumanu Highway at Kaiminani Drive and proceeds west into NELHA property approximately 2,900 feet, where it intersects with proposed Road B, which will proceed approximately 2,600 feet south to connect with an existing roadway. No information regarding the proposed width of these roadways is provided, and the lengths were obtained from a small-scaled map attached to your letter. We are therefore not able to comment on the area of potential effect (APE) for these two roadways at this time.

Attached to your letter is a summary of previous archaeological work conducted within the NELHA area, taken from the updated Master Plan. Nine items are listed, seven of which pre-date 1990. The only post-1990 study noted here is a preservation plan for sites in the ‘O‘oma archaeological preserve area. We wish to inform you that there have been additional studies in the area since this time. In addition, we have been requesting update surveys for proposed project areas in the NELHA and Keahole Airport areas, due to the fact that the surveys conducted in the 1980s were based on reconnaissance level field work, and a number of previously unidentified sites have been found in the more recent studies. We therefore recommend that once you have identified the APE for these two roads, a systematic (inventory survey level) field inspection be conducted to verify that no historic properties are present. Should historic properties be identified, we will request that an inventory survey report be completed and submitted to our office for review and approval.

Please contact me at Theresa.K.Donham@hawaii.gov, or at (808) 933-7653 if you have any questions regarding this letter.

Aloha,

Theresa K. Donham, Acting Archaeology Branch Chief
Deputy State Historic Preservation Officer
Historic Preservation Division

Date: August 24, 2012

Submittal Sheet for Historic Preservation Review Filing Fees

State Historic Preservation Division
601 Kamokila Blvd., #555, Kapolei, Hawai`i 96707

Agency/Firm (Requesting Review): Rechtman Consulting, LLC

Contact: Bob Rechtman
Phone: 808-969-6066 Fax: 808-443-0065 E-Mail: bob@rechtmanconsulting.com
Address: 507 A E. Lanikaula Street Hilo HI 96720

Title of Report/Plan: Archaeological Inventory Survey Update for the Proposed NELHA Roads C,D, and E

RC-0732

Island: Hawaii District: North Kona Ahupua`a: Ooma 1/2 and Kalaoa 5
TMK [(1) 1-1-001:001]: (3) 7-3-043: pors. 073, 080, 083, 089, and 091

Submitted Plan/Report Fee & Type: (All reports or plans submitted to the SHPD for review shall be accompanied by the appropriate fee in accordance with HAR §13-275-4 and §284-4).

		Indicate here (X) if report is a re-submittal (no fee charged)
	$50	Archaeological Assessment
	$150	Archaeological Inventory Survey Plan
X	$450	Archaeological, Architectural or Ethnographic Survey Report
	$150	Preservation Plan
	$25	Monitoring Plan
	$150	Archaeological Data Recovery Plan
	$250	Burial Treatment Plan
	$100	Archaeological Monitoring Report, if resources reported
	$450	Archaeological Data Recovery Report
	$450	Ethnographic Documentation Report
	$25	Burial Disinterment Report
	$50	Osteological Analysis Report

Fee Total: $ 450

Make check payable to "Hawai`i Historic Preservation Special Fund." A service charge of $15 will be assessed on all dishonored checks pursuant to HRS §40-35.5" A copy of this form will be mailed or faxed back to you and will serve as your receipt.

For Office Use Only:

Date Received:	Receipt No.:
	Payment Method: Cash $ Check: Check No.:
Log. No.:	Receipt Issued by: Treasury Deposit Receipt No:

HISTORIC PRESERVATION DIVISION
DEPARTMENT OF LAND AND NATURAL RESOURCES

601 Kamokila Boulevard, Suite 555
Kapolei, HI 96806

March 27, 2013

Robert B. Rechtman, Ph. D.
Rechtman Consulting, LLC
507-A East Lanikaula Street
Hilo, Hawai`i 96720
(bob@rechtmanconsulting.com)

LOG NO: 2012.2625
DOC NO: 1303MV18

Dear Dr. Rechtman:

SUBJECT: **Chapter 6E-42 Historic Preservation Review –**
An Archaeological Inventory Survey Report for the Proposed Roads C, D, and E
At the Natural Energy Laboratory Hawaii (NELHA)
O'oma and Kalaoa Ahupua'a, North Kona District, Island of Hawai'i
TMK: (3) 7-3-043:073, :080, :083, :089, and :091 (portions)

Thank you for submitting the draft report titled *Archaeological Inventory Survey Update for the Proposed NELHA Roads C, D, and E TMK 3) 7-3-043:073, :080, :083, :089, and :091, O'oma 1st and 2nd and Kalaoa 5th Ahupua'a, North Kona District, Island of Hawaii (*R. Rechtman and M. Clark July, 2012). This document was received on August 27, 2012. We apologize for the extremely delayed review and thank you for your patience. The survey area described in the report consists of a 200 ft. wide corridor that extents for roughly 6,000 ft. and covers approximately 30 acres. The fieldwork portion of this survey included a 100% pedestrian survey that utilized 15 meter transects. During the course of this survey one previously identified site, the Kalaoa-O'oma Boundary wall (SIHP 50-10-27-06432), and 3 newly recorded archaeological sites were identified and recorded. The newly recorded sites include a trail (SIHP Site 50-10-27-29272), a steppingstone trail segment (Site 29273), and a marker (Site 29274). All four sites are assessed as significant under Hawaii Administrative Rule (HAR) 13-284-6 Criterion "d" and recommended for no further work.

We believe that this survey adequately covered the project area; and we believe that the historic properties were adequately documented to the standards of HAR 13-276-5. In addition, we agree with the treatment recommendations and significance assessments for SIHP 50-10-27-29274. However, based on the results of the recent AIS (Monahan et al. 2012) and Section 106 historic preservation review performed on the Ka'ahumanu Highway widening undertaking, we have some concerns that relate to the significance assessments for the other three sites presented in this report. Please consider the comments found in the attachment as potential revisions for this report:

We agree with your recommendation that SIHP Sites 29272 and 29273 be preserved, and we look forward to the opportunity to review a preservation plan that meets the standards of HAR 13-277. We also request that where possible, large portions of Site 6432 be preserved and included in the preservation plan. Please consider these recommendations, and revise or address our concerns accordingly. We look forward to receiving a revised draft of this report. To aid in a review of the subsequent submittal, please submit a cover letter that specifies the changes made to this document and their page numbers. Please contact Mike Vitousek at (808) 652-1510 or Michael.Vitousek@Hawaii.gov if you have any questions or concerns regarding this letter.

Aloha,

Theresa K. Donham
Archaeology Branch Chief

ATTACHMENT

Comments and Questions: *Archaeological Inventory Survey Update for the Proposed NELHA Roads C, D, and E TMK 3) 7-3-043:073, :080, :083, :089, and :091, O'oma 1st and 2nd and Kalaoa 5th Ahupua'a, North Kona District, Island of Hawaii* (R. Rechtman and M. Clark July, 2012)

1. Page 15, correct typo: "catchin eels"

2. SIHP Site 6432 was recently re-evaluated as significant under Criteria "d" and "e" (Monahan et al. 2012). In addition, SIHP Site 29272 was evaluated as significant under Criteria "c", "d", and "e". SHPD concurred with the significance assessments for these sites (Log 2012.1443, Doc. 1208MV01). We believe that these significance assessments should be consistently applied to the same historic properties in the NELHA project area (Page 77).

3. We believe that SIHP Site 29273 should be assessed as significant under Criterion "c" as well as "d", because it embodies the distinctive characteristics of the stepping stone trail site type as well as displaying distinctive methods of construction (Page 77).

4. Given the possibility of subsurface lava tubes in this area, we recommend that a qualified archaeological monitor be onsite during ground disturbing activities. Please include this in the recommendations portions of the report, and we look forward to the opportunity to review an archaeological monitoring plan that meets the standards of HAR 13-279-4 prior to the commencement of project activities.

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ESTHER KIA'AINA
FIRST DEPUTY

WILLIAM M. TAM
DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

HISTORIC PRESERVATION DIVISION
DEPARTMENT OF LAND AND NATURAL RESOURCES

601 Kamokila Boulevard, Suite 555
Kapolei, HI 96806

May 13, 2013

Robert B. Rechtman, Ph. D.
Rechtman Consulting, LLC
507-A East Lanikaula Street
Hilo, Hawai`i 96720
(bob@rechtmanconsulting.com)

LOG NO: 2013.2046
DOC NO: 1304MV25

Dear Dr. Rechtman:

SUBJECT: **Chapter 6E-8 Historic Preservation Review –**
Revised Archaeological Inventory Survey Report for Proposed Roads C, D, and E
At the Natural Energy Laboratory Hawaii (NELHA)
O'oma and Kalaoa Ahupua'a, North Kona District, Island of Hawai'i
TMK: (3) 7-3-043:073, :080, :083, :089, and :091 (portions)

Thank you for submitting the revised draft report titled *Archaeological Inventory Survey Update for the Proposed NELHA Roads C, D, and E TMK 3) 7-3-043:073, :080, :083, :089, and :091, O'oma 1st and 2nd and Kalaoa 5th Ahupua'a, North Kona District, Island of Hawaii (*R. Rechtman and M. Clark August, 2013). This document was received on April 18, 2013. The survey area described in the report consists of a 200 ft. wide corridor that extents for roughly 6,000 ft. and covers approximately 30 acres. The fieldwork portion of this survey included a 100% pedestrian survey that utilized 15 meter transects. During the course of this survey one previously identified site, the Kalaoa-O'oma Boundary wall (SIHP 50-10-27-06432), and three newly recorded archaeological sites were identified and recorded. The newly recorded sites include a trail (SIHP Site 50-10-27-29272), a steppingstone trail segment (Site 29273), and a marker (Site 29274).

The revisions to this document are in response to our review of a previous draft of this report, (LOG NO: 2012.2625, DOC NO: 1303MV18). Our previous concerns have been addressed. All four sites were initially assessed as significant under Hawaii Administrative Rule (HAR) 13-284-6 Criterion "d" only and recommended for no further work. Site 6432 was recently re-evaluated as significant under Criteria "d" and "e," Site 29273 is evaluated as significant under Criteria "c" and "d" and Site 29272 is evaluated as significant under Criteria "c", "d", and "e". We concur with these revised significance assessments.

Sites 6432, 29272 and 29273 are recommended for limited preservation for the portions of the sites that will not be impacted by roadway development. Site 29274 is still assessed as significant under criterion "d" only, and recommended for no further work. In addition, this report recommends that an archaeological monitor be present during ground disturbing activities. We concur with the treatment recommendations for all four sites, and with the recommendation that archaeological monitoring occur during ground alteration. This report meets the requirements of Hawaii Administrative Rule (HAR) 13-276 and is accepted by SHPD. Please send one hardcopy of the document, clearly marked **FINAL**, along with a copy of this review letter and a text-searchable PDF version on CD to the Kapolei SHPD office, attention SHPD Library. We look forward to the opportunity to review and accept a preservation plan that meets the standards of HAR 13-277 and an archaeological monitoring plan pursuant to HAR 13-279 prior to the issuance of any permits that may lead to ground disturbing activities. If you have any questions or concerns please contact Mike Vitousek at (808) 652-1510 or Michael.Vitousek@Hawaii.gov.

Aloha,

Theresa K. Donham
Archaeology Branch Chief

Parsons
Brinckerhoff

American Savings Bank Tower
1001 Bishop Street, Suite 2400
Honolulu, HI 96813
808-531-7094
Fax: 808-528-2368

September 8, 2010

Mr. Patrick Leonard
Field Supervisor
U.S. Fish and Wildlife Office
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122, Box 50088
Honolulu, Hawai'i 96850

Subject: **Section 7 Informal Consultation**
Airport Connector Roadway and Kaiminani Drive Extension
Natural Energy Laboratory Hawaii Authority
Island of Hawai'i, Hawai'i

Dear Mr. Leonard:

The State of Hawai'i Department of Transportation (HDOT) is planning to build new connector roads at the Natural Energy Laboratory Hawaii Authority (NELHA). Parsons Brinckerhoff (PB) has been contracted by HDOT to manage permit activities.

Several new interior roads will be built to provide access to new leasable lots. Our letter concerns the proposed roadways shown in BLUE on the attached map (Roads B and C). These roads will be built using Federal Funds and may be eligible for a Federal Categorical Exclusion.

In an effort to initiate the permitting process for building the roads, PB has prepared this letter summarizing the existing condition and project activities. The Master Plan for NELHA is currently being updated and we have attached relevant sections for your review. We request that your office review the findings and proposed improvements and provide your determination regarding the project's effect on listed species or critical habitat.

PB believes that the project will have no effect on threatened or endangered species and critical habitat. Available records do not indicate any species of concern or critical habitat in the area.

Please contact me at 566-2204 or reichelderfer@pbworld.com if you have questions or comments related to this plan.

Sincerely,

PARSONS BRINCKERHOFF

Jan Reichelderfer

Environmental Planner

Attachments

- Figure 1 – Location Map
- Figure 2 –Proposed NELHA Roadways
- Excerpt from the Master Plan for Natural Energy Laboratory of Hawaii Authority

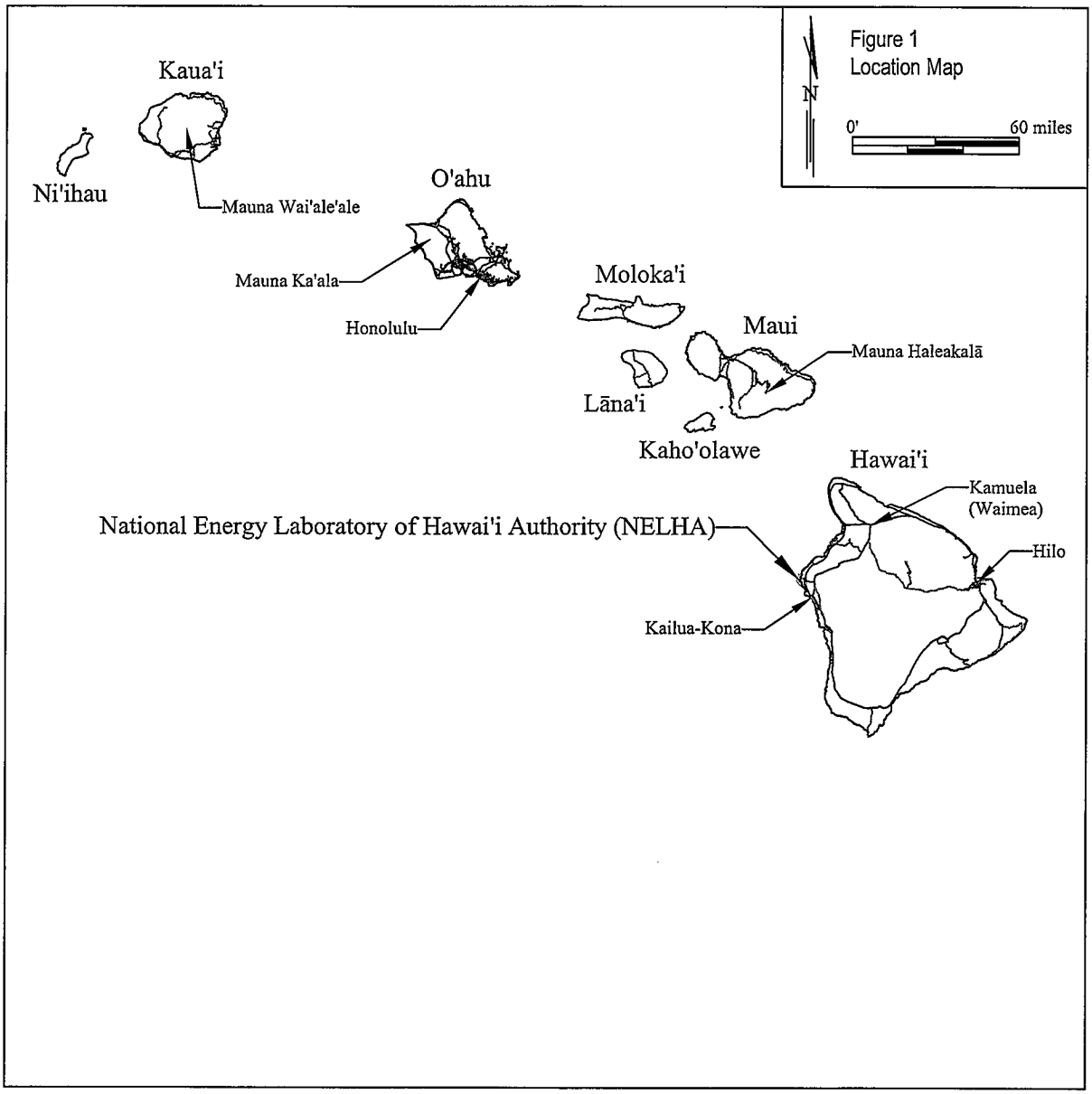


Figure 1
Location Map
N
0'
60 miles
Kaua'i
Ni'ihau
Mauna Wai'ale'ale
O'ahu
Mauna Ka'ala
Honolulu
Moloka'i
Maui
Mauna Haleakalā
Lāna'i
Kaho'olawe
Hawai'i
Kamuela
(Waimea)
Hilo
National Energy Laboratory of Hawai'i Authority (NELHA)
Kailua-Kona

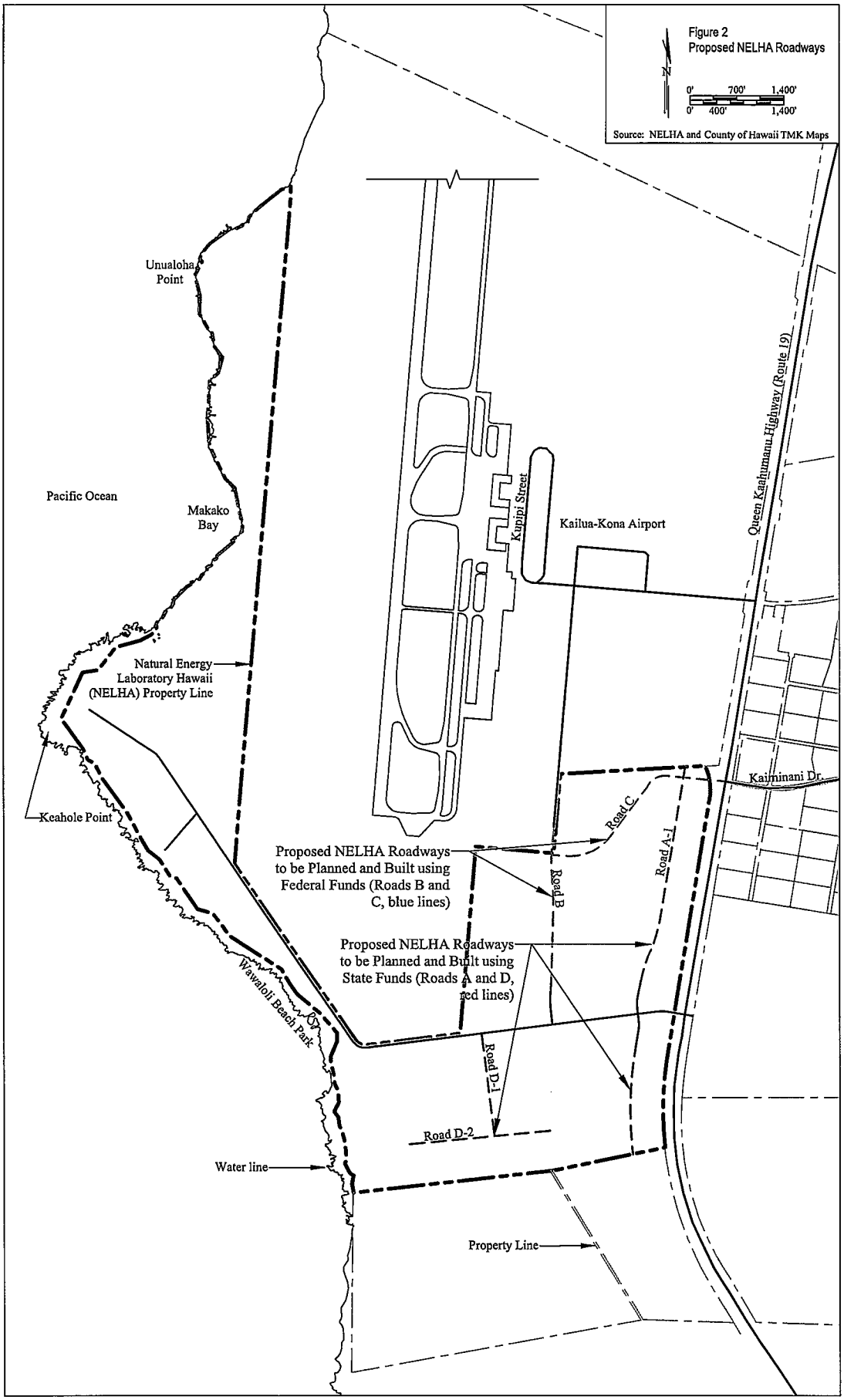


Figure 2
Proposed NELHA Roadways
N
0' 700' 1,400'
0' 400' 1,400'
Source: NELHA and County of Hawaii TMK Maps
Unualoha Point
Pacific Ocean
Makako Bay
Natural Energy Laboratory Hawaii (NELHA) Property Line
Keahole Point
Kupipi Street
Kailua-Kona Airport
Queen Kaahumanu Highway (Route 19)
Kaiminani Dr.
Road C
Road A-1
Road B
Proposed NELHA Roadways to be Planned and Built using Federal Funds (Roads B and C, blue lines)
Proposed NELHA Roadways to be Planned and Built using State Funds (Roads A and D, red lines)
Wawaloli Beach Park
Road D-1
Road D-2
Water line
Property Line

from these other mountains, or about 5 percent since 1800, and less than 15 percent within the last 750 years. Keāhole Point has also been identified as at risk from particle-and-gas clouds emanating from a Hualālai eruption. Hualālai's last errupion in 1801 covered the entire Keāhole Point area.

2.9.2 Seismic Activity

All of the island of Hawai'i is located in Earthquake Zone 3 (on a scale of 0-4 of increasing seismic occurrence and danger). The nearest rift zone to NELHA is at least five miles to the north. Earthquakes are frequent in the Kona area; a quake of magnitude 5 was recorded west of Kona in 1972 and another magnitude 6.7 in 2006.

2.9.3 Tsunami Hazards

Keāhole Point is sheltered from the major tsunami generation centers for the Pacific (the Aleutians and Chile); however, the effects of local quakes such as the one occurring in Ka'u in 1868, reported to have been between 7.5 and 8.2 on the Richter scale and to have generated a wave as high as 45 feet, are more severe. *Figure 2.8* illustrates the Tsunami Evacuation and Flood Hazard Zones at NELHA. All areas ma kai of the northwestern bend of the NELHA Access Road are in the Tsunami Evacuation Zone.

Examination of the Federal Emergency Management Agency's Digital Flood Insurance Rate Map (DFIRM), indicates that most coastal areas of NELHA are located within the A Zone, or the 100 year flood plain. The rest of NELHA is in Zone X, which includes areas outside the 500-year floodplain, areas within the 500-year floodplain, areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees.

2.10 FLORA AND FAUNA

2.10.1 Flora

Coastal vegetation at Keāhole Point includes tree heliotrope (*Messerschmidia argentea*) naupaka (*Scaevola sericea*), Christmas-berry (*Schinus terebithifolius*), beach morning glory (*Ipomea pescaprae*), 'ilima (*Sida fallax*), and noni (*Morinda citrifolia*). A band of vegetation composed primarily of beach naupaka (*Scaevola taccada*), one to two meters tall, is found along the edge of the beach areas. Among the herbaceous species are nohu (*Tribulus cistoides*), pōhuehue or beach morning glory (*Ipommoea brasiliensis*), Bermuda grass (*Cynodon dactylon*), alena (*Boerhavia diffusa*), and the native poppy (*Argemone glauca*).

Fountain grass (*Pennisetum setaceum*) is the dominant plant on the pāhoehoe landscape closest to the shore. Further inland, however, large areas may be dominated by the native piligrass (*Heteropogon contortus*) or by a Natal redtop (*Rhynchelytrum repens*) and 'uhaloa (*Waltheria indica var. Americana*) association. Shrubs of 'ilima (*Sida fallax*) and indigo (*Indigofera suffruticosa*) may be locally common, especially in depressions in the pahoehoe flows.

Widely scattered throughout the ma uka areas of NELHA are taller plants of kiawe (*Prosopis pallida*), Christmas-berry, 'a'ali'i (*Dodonaea viscosa*), maiapilo (*Capparis sandwichiana var. zohari*), and noni.

In some of the collapsed lava tubes which are frequently encountered on the site, ferns such as ki'iāu pueo (*Pteris vittata*), 'iwa'iwa (*Doryopteris decora*), and swordfern or kupukupu (*Nephrolepis multiflora*) may be found, although rarely.

The rough 'a'ā flows support only a few plants, usually fountain grass, coat buttons (*Tridax procumbens*), or 'uhaloa.

2.10.2 Fauna

There are low concentrations of birds in the predominant habitat of scattered fountain grass on pāhoehoe lava with occasional shrubs. Most birds in these areas at NELHA have been observed to be passing through on their way to more preferred habitats that provided more food, water, and cover.

The Grey Francolin bird has been observed on a more regular basis and presumably is able to utilize the available food sources more effectively than most of the birds found there. Its habitat usually extends to within 30 meters or so of the shoreline, where it is replaced by coastal birds, which are much more abundant, though also transitory. Many species feed along the coast during daytime hours, but roost elsewhere at night.

Beaches and sections of rocky coastline on the seaward edge of the strand vegetation comprise an important habitat for migratory shorebirds.

Indigenous birds commonly observed at NELHA include the golden plover, wandering tattler and ruddy turnstone. Introduced species known to be present include the Indian grey francolin, barred dove, common mynah, Japanese white-eye, house finch, house sparrow, cardinal and Brazilian cardinal, among other species.

The Indian mongoose, the common home mouse, roof rat, the Polynesian rat, and feral cats are known to inhabit the undeveloped portions of the NELHA site.

In their pristine state, anchialine ponds harbor a distinctive assemblage of organisms. Certain of these organisms, primarily decapod crustaceans, move between the open waters of the ponds and the interconnected water table below. Many of the existing ponds at NELHA have been degraded by the introduction of exotic fish which prey on the natural fauna. Typical populations in NELHA anchialine ponds include an assemblage of opae'ula (*Halocaridina rubra*) and small unidentified red amphipods. At times, opae'o'haa (*Macrobrachium grandimanus*) are also present.

2.11 NOISE

A major source of man-made noise affecting NELHA originates from air traffic operations at the Kona International Airport. Otherwise, most of the site is exposed to relatively low ambient noise levels, with wind, surf and occasional traffic being the only noticeable sounds.

In measuring the impacts of noise, it is important to note that although people respond to the noise of single events, the long-range effects of prolonged exposure to noise appear to correlate best with cumulative metrics, which is the Federal Aviation Administration's (FAA) standard metric. Aircraft noise exposure maps with continuous noise contour levels were prepared as part of the Kona Airport's Master Plan Update to be completed in 2009. The Constraints Map (*Figure 2.9)* includes significant effect long range noise contours affecting NELHA from those maps developed by the Department of Transportation Airports Division.

2.12 LIGHT

Light is a potential pollutant resulting from development. With the level of development anticipated along the Kona coast, light pollution has the potential to be an increasing issue of concern. Light is known to affect the biology of marine organisms, and a reduction or

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moan Boulevard, Room 3-122, Box 50088
Honolulu, Hawaii 96850

In Reply Refer To:
2010-TA-0494

Ms. Jan Reichelderfer
Parsons Brinckerhoff
1001 Bishop Street, Suite 2400
Honolulu, Hawaii 96813

Subject: Technical Assistance for Proposed Roadway Expansion, National Energy Laboratory Hawaii Authority, Hawaii

Dear Ms. Reichelderfer:

The U.S. Fish and Wildlife Service (Service) is in receipt of your letter, dated September 8, 2010, in which your requested our review of the proposed project to construct new connector roads at the National Energy Laboratory Hawaii Authority (NELHA) on the island of Hawaii. You requested our determination on whether the proposed project would have an effect on any federally proposed or listed species, or on any proposed or designated critical habitat within the project footprint. You stated in your letter that you determined there will be no effect due to the fact that available records indicate that there are no federally protected species or critical habitat in the area. This response is in accordance with section 7 of the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 *et seq.*).

You requested our determination on whether the proposed action will have no effect on listed species or designated critical habitat. Pursuant to section 7 of the Endangered Species Act (ESA), it is the responsibility of the Federal action agency to determine if a project "may affect" listed species or designated critical habitat. Implementing regulations for the ESA (50 CFR 402) and Service policy does not specifically provide for our concurrence with an action agencies' determination that its proposed action will not affect listed species. However, to assist you with your request, and based on the information you have provided to us, we agree with your determination that the action, as proposed and analyzed, will have no effect on listed species or critical habitat. Unless the project description changes, or new information reveals that the proposed project may affect listed species in a manner or to an extent not considered, or a new species or critical habitat is designated that may be affected by the proposed action, no further action pursuant to section 7 of the ESA is necessary.

We note that the portion of the Master Plan that you provided us identifies that there are several anchialine pools located within the project area. More than 90 percent of the anchialine pools in Hawaii have been lost to development. Although the current project is not likely to result in any further degradation of these sensitive habitats, future development may. Future development

projects planned for the leasable lots may draw water from the site (i.e., drawing down groundwater). This may cause increased salinity of existing pools as ocean water seeps into the ground. A change in the salinity of these pools may alter their species composition. Many of the species that are unique to anchialine pools are likely to be federally listed within the next several years. We recommend minimization or avoidance of impacts to anchialine pools when planning future development projects on this site.

We appreciate your efforts to conserve listed species. If you have questions about our comments, please contact Michelle Bogardus or Dr. Jeff Zimpfer, Consultation and Habitat Conservation Planning Program (phone: 808-792-9400, fax: 808-792-9581).

Sincerely,

for Loyal Mehrhoff
Field Supervisor

U.S. Department of Transportation
Federal Highway Administration

Hawaii Federal-Aid Division

May 1, 2013

300 Ala Moana Blvd, Rm 3-306
Box 50206
Honolulu, Hawaii 96850
Phone: (808) 541-2700
Fax: (808) 541-2704

In Reply Refer To:
HDA-HI

Loyal Mehrhoff, Field Supervisor
U.S. Department of the Interior
U.S. Fish and Wildlife Service, Pacific Islands
300 Ala Moana Blvd., Room 3-122
Honolulu, HI 96850

Subject: Section 7 Informal Consultation
Natural Energy Laboratory of Hawai'i Authority's Hawai'i Ocean Science and Technology Park Internal Roadways and Connections to Queen Ka'ahumanu Highway and Kona International Airport
Keāhole, North Kona, Island of Hawai'i
Federal-aid Project No. DEM-0100(71)

Dear Dr. Mehrhoff:

The Natural Energy Laboratory of Hawai'i Authority (NELHA) is planning to enhance surface transportation connections between regional transportation facilities and the Hawai'i Ocean Science and Technology (HOST) Park, which NELHA administers. The Federal Highway Administration (FHWA) intends to fund improvements to certain HOST Park internal roadways and connections between the HOST Park and Queen Ka'ahumanu Highway and HOST Park and Kona International Airport (KOA) roadways.

The NELHA and the Hawaii Department of Transportation (HDOT) are working with the FHWA to comply with other federal requirements for the proposed project. At this time, FHWA anticipates issuing a Categorical Exclusion to comply with the National Environmental Policy Act (NEPA).

Parsons Brinckerhoff (PB), the NELHA's consultant for the proposed project, previously coordinated with you via a letter dated September 8, 2010, and you responded with letter 2010-TA-0494, dated September 30, 2010. Since that time the proposed project has been modified slightly. Given the modifications to the proposed project and the elapsed time since our previous coordination activities, we would like to have your input on the proposed project again.

Project Overview

The proposed project is located in the North Kona area of the Island of Hawai'i (see enclosed Figure 1). The project now involves:

- NELHA Road A (Ka'iminani Road extension).
- NELHA Road B (Pāo'o Road extension).
- Modification of the Queen Ka'ahumanu Highway – Ka'iminani Road intersection from a 3-leg intersection to a 4-leg intersection with NELHA Road A (Ka'iminani Road extension) being extended to form the fourth, west (makai) leg.
- Connect NELHA Road B (Pāo'o Road extension) to KOA's Pāo'o Road (Road N).

The modification of the Queen Ka'ahumanu Highway – Ka'iminani Road intersection was not part of the proposed project when PB coordinated with your office in 2010. The project area is shown in the enclosed Figure 2. All the work will be done within the NELHA, KOA, or HDOT's current land holdings.

Species and Habitat Information Request

We request that your office provide any pertinent information concerning threatened and endangered species and/or designated critical habitat in the project area. We also request that your office share with us any specific or general concerns you may have regarding the project.

Please feel free to contact the HDOT's Project Manager, Robert Sun by phone at (808) 692-7578, or by email at robert.sun@hawaii.gov , if you have any questions. If you wish to contact me directly, you can reach me by phone at (808) 541-2314 or by email at roy.siegel@dot.gov . We look forward to working with you on these needed improvements.

Sincerely yours,

Roy Siegel, P.E.
Transportation Engineer

Enclosures (2)

cc: Jim Hayes (PB)
Jeff Nichols (NELHA)
Robert Sun (HDOT)

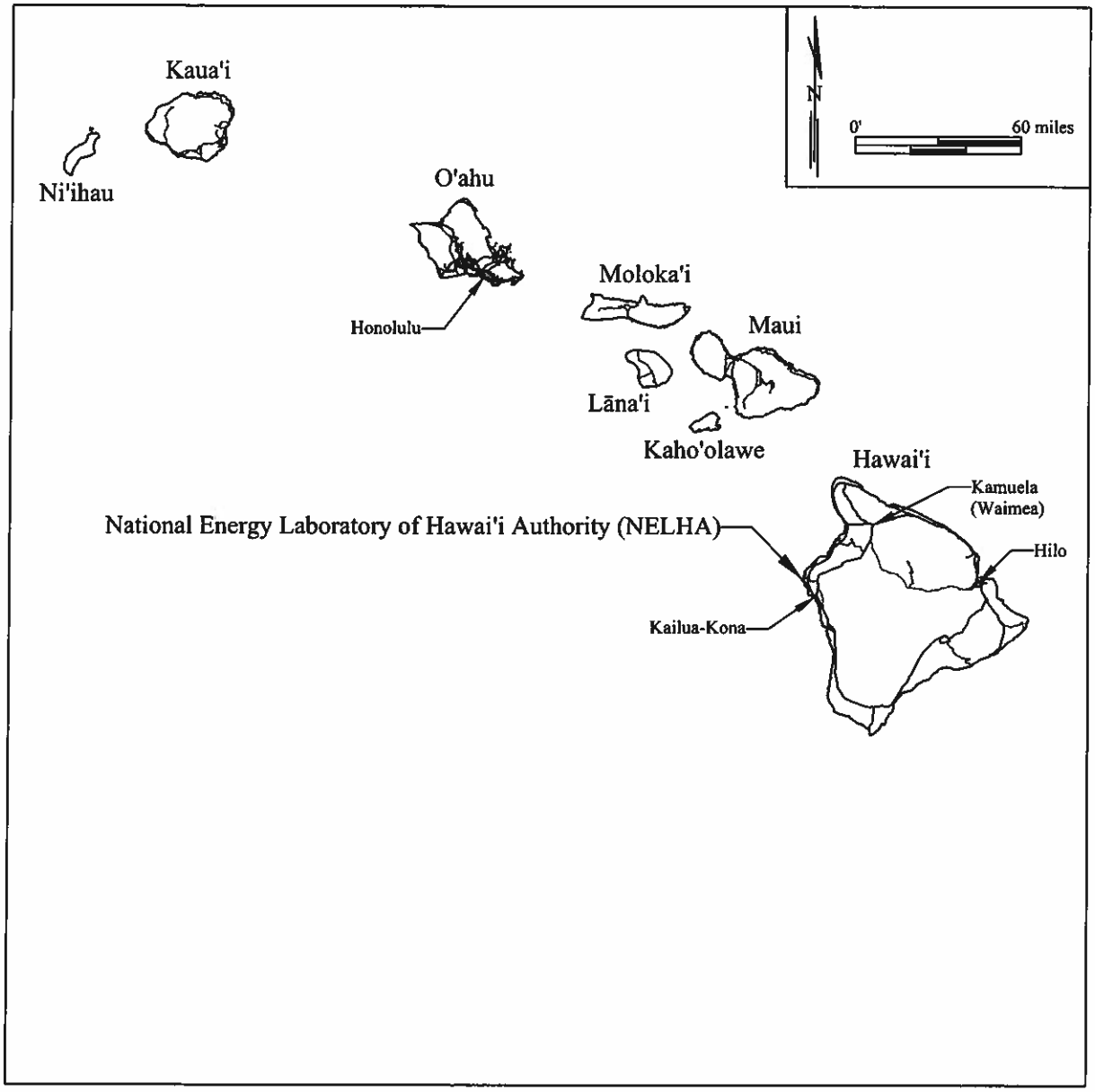


Figure 1: Project Location

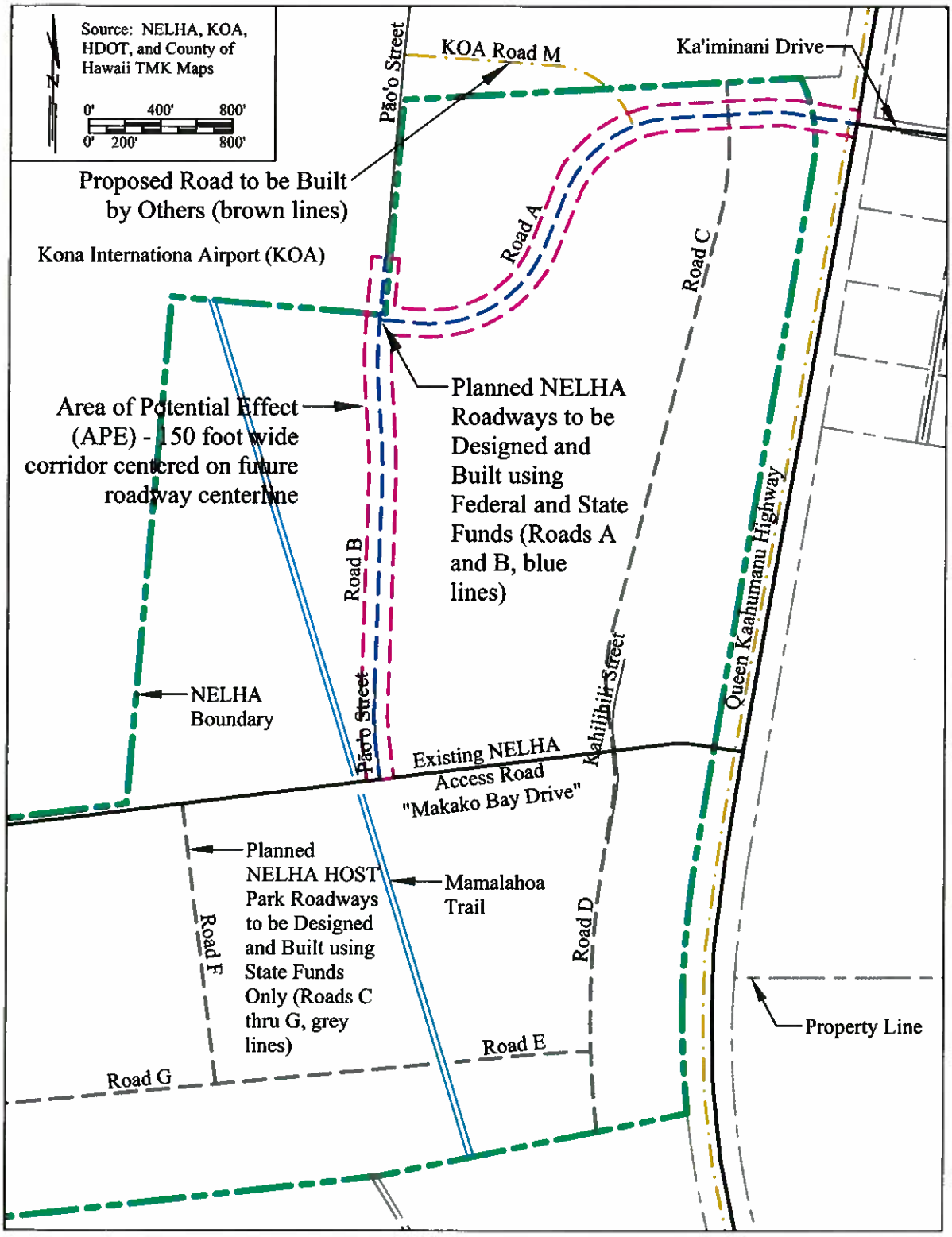


Figure 2: Area of Potential Effect

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawaii 96850

In Reply Refer To:
2013-SL-0204

APR 22 2013

James Hayes
Parsons Brinckerhoff
1001 Bishop Street, Suite 2400
Honolulu, Hawaii 96813

Subject: Species List for Preparation of an Environmental Assessment by the Natural Energy Laboratory of Hawaii Authority, Hawaii

Dear Mr. Hayes:

The U.S. Fish and Wildlife Service (Service) received your correspondence on March 21, 2013, requesting comments on the development of an Environmental Assessment by the Natural Energy Laboratory of Hawaii Authority (NELHA), Hawaii. NELHA is planning to enhance surface transportation connections between regional transportation facilities and the Hawaii Ocean Science and Technology Park, which NELHA administers. Parsons Brinckerhoff is assisting NELHA with the preparation of an Environmental Assessment in compliance with Hawaii Revised Statutes Chapter 343. The second phase of this proposed project is not projected to occur until roughly 2035.

Based on information you provided and pertinent information in our files, including data compiled by the Hawaii Biodiversity and Mapping Program, one species protected by the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*), could be impacted by the proposed project. To assist you with minimization and avoidance of impacts to this species, the Service offers the following recommendations:

- The Blackburn's sphinx moth (*Manduca blackburni*) may breed and feed within the proposed project area. Adult moths feed on nectar from native plants, including beach morning glory (*Ipomoea pes-caprae*), iliee (*Plumbago zeylanica*), and maiapilo (*Capparis sandwichiana*); larvae feed upon non-native tree tobacco (*Nicotiana glauca*) and native aiea (*Nothocestrum latifolium*). Blackburn's sphinx moth pupae may occupy the soil within 250 feet of larval host plants for a year or longer. The Service recommends that a qualified biologist survey all project areas, and areas adjacent to the project, for the presence of native and non-native Blackburn's sphinx moth host plants. The Service recommends these surveys be conducted during the wettest portion of the year (usually November-April), approximately four to eight weeks following a significant rainfall event. Surveys should include looking for eggs, larvae, and signs of pupating

larvae (frass, chewed leaves and stems, or other characteristic signs of larval browsing). If presence of the Blackburn's sphinx moth is confirmed, the Service should be contacted for further coordination.

Though no designated critical habitat occurs within the vicinity of the proposed action area, there are several anchialine pools located within the project area. More than 90 percent of the anchialine pools in Hawaii have already been lost to development. Although the current project is not likely to result in any further degradation of these sensitive habitats, future development may because future development projects planned for the leasable lots may draw water from the site (i.e., drawing down groundwater). This may cause increased salinity of existing pools as ocean water seeps into the ground. A change in the salinity of these pools may alter their species composition. Many of the species that are unique to anchialine pools are declining and may be considered for federal listing as threatened or endangered within the next several years. As a result, we recommend minimizing and avoiding impacts to anchialine pools when planning future development projects at this site.

We appreciate your efforts to conserve listed species. Please contact Fish and Wildlife Biologist Dr. Tim Langer (808-792-9462) if you have any questions or for further guidance.

Sincerely,

for Loyal Mehrhoff
Field Supervisor

cc: Lasha-Lynn H. Salbosa, Division of Forestry and Wildlife

APPENDIX B TRAFFIC IMPACT ANALYSIS

TRAFFIC STUDY

Natural Energy Laboratory of Hawaii Authority

KAILUA-KONA, HAWAII

April 2011

Over a Century of Engineering Excellence

TRAFFIC STUDY

Natural Energy Laboratory of Hawaii Authority

Kailua-Kona, Hawaii

April 2011

Prepared For:

Natural Energy Laboratory of Hawaii Authority
73-4460 Queen Kaahumanu Hwy., #101
Kailua-Kona, HI 96740

Prepared By:

PB Americas, Inc.
American Savings Bank Tower – Suite 2400
1001 Bishop Street
Honolulu, Hawaii 96813
(808) 531-7094

PB Reference Number:

16511A

TABLE OF CONTENTS

APPENDICES

FIGURES

TABLES

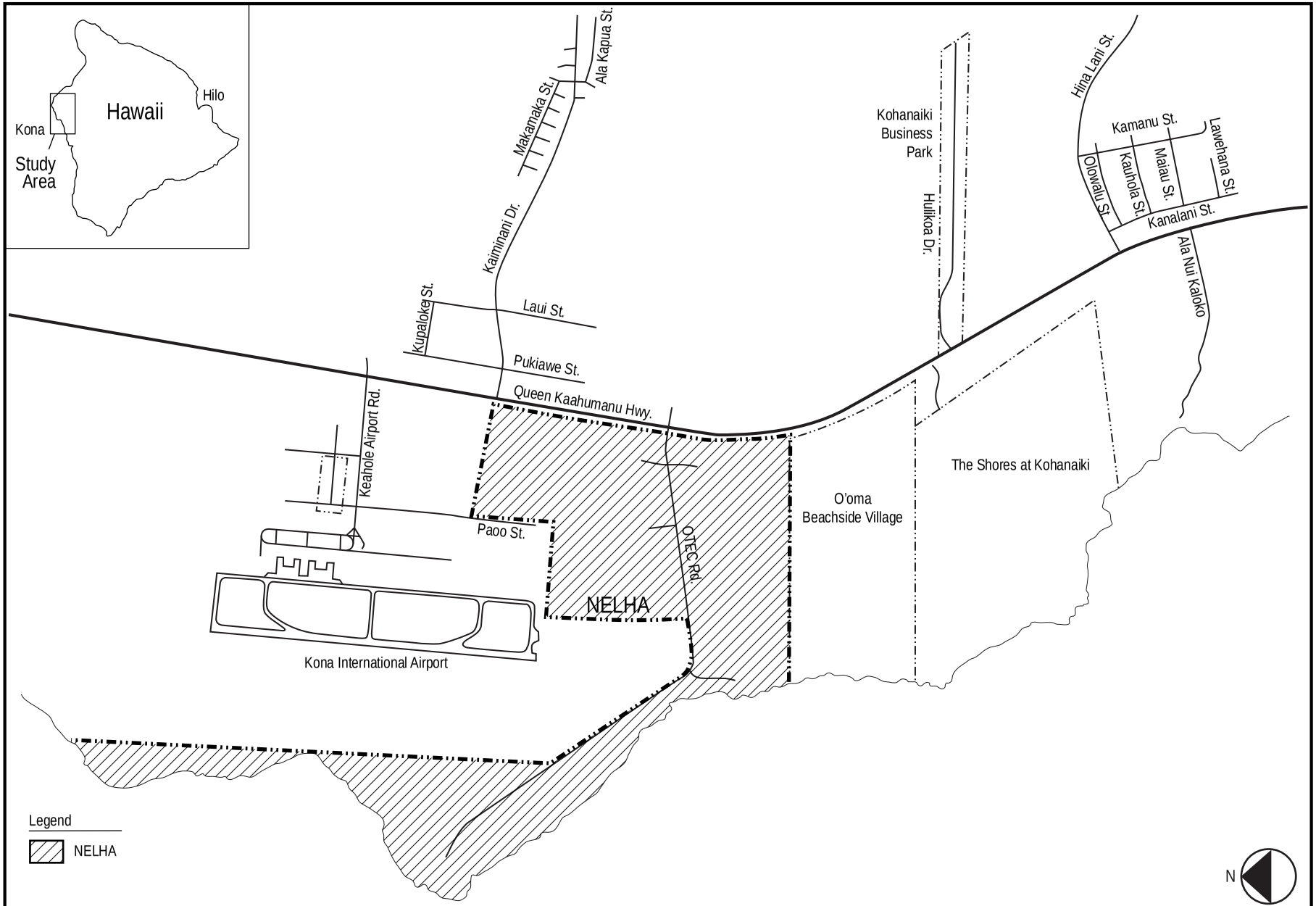
I. INTRODUCTION

The Natural Energy Laboratory of Hawaii Authority (NELHA) began as the Natural Energy Laboratory of Hawaii (NELH) in 1974 when the Hawaii State Legislature created NELH on 322 acres of land at Keahole Point, Hawaii. After merging in 1990 with the Hawaii Ocean Science and Technology (HOST) Park which owned 548 adjacent acres at Keahole, NELHA transformed its function from a research support facility for ocean thermal energy conversion (OTEC) process to a facilitator of new industry development with far-reaching economic benefits to the rest of the state and beyond. Today, NELHA is "landlord" to many thriving enterprises which generate about $30-40 million per year in total economic impact including tax revenues, over 200 jobs, construction activity and high value product exports. Existing activities on the sites include more than 40 tenants engaged in aquaculture, water bottling, energy projects, research, and education.

Figure 1 illustrates the NELHA site. NELHA is located at Keahole Point, North Kona, Hawaii, makai of Queen Kaahumanu Highway, and adjacent to the western and southern boundaries of the Kona International Airport at Keahole. Keahole Point lies within the Ooma 2nd District ahupuaa, North Kona Moku (District) on the Island of Hawaii. A lighthouse operated by the U.S. Coast Guard occupies the tip of Keahole Point. To the south of the NELHA property is the proposed Ooma master planned development.

NELHA's mission statement reads, "To develop and diversify the Hawaii economy by providing resources and facilities for energy and ocean-related research, education, and commercial activities in an environmentally sound and culturally sensitive manner." Towards that end, NELHA intends to further develop its lands through "cohesion in the built environment" and by "foster[ing] collaboration among tenants" through the construction of six zones of use:

1. Applied Renewable Energy Zone
2. Economic Driver – NELHA-related products and services
3. Applied Technology Laboratories and Containerized Technology Research Center
4. Science and Technology Cultural Center
5. Ocean, Air, Energy, and Biology Research Laboratories
6. Ocean Village



Vicinity Map

Figure 1

In 2009, a draft master plan supporting NELHA's mission statement was completed. Out of the total 870 acres land at Keahole Point facility, approximately 200 acres will remain in other lands such as conservation, roads, utility corridors and pipeline easement, and NELHA support services. There is about 452 acres currently available at NELHA that has not been designated or leased. The current tenants' terms of lease will generally expire by year 2038. There will be 500 acres available for development, or redevelopment by 2015, an additional 165 acres by year 2038.

To the north, the Keahole International Airport Master Plan was prepared in 2009. The master plan provides systematic guidelines for the airport's overall development, maintenance, and operation. The proposed roadway improvements will dramatically change the traffic circulations in Keahole that we see today.

In light of the recommendations in the Keahole International Airport Master Plan, this report summarizes the results of a traffic analysis for the NELHA development plan as documented in NELHA's master plan. It provides analysis for the construction of NELHA's airport connector roadways, NELHA's accesses to Queen Kaahumanu Highway, and its internal roadways. The objectives of the report were to determine the future traffic demands and growth projections for the area and to identify the short-term (year 2015) and long-term (year 2035) geometric configurations for the roadways that would accommodate these future volumes.

II. EXISTING CONDITIONS

A. Existing Land Use

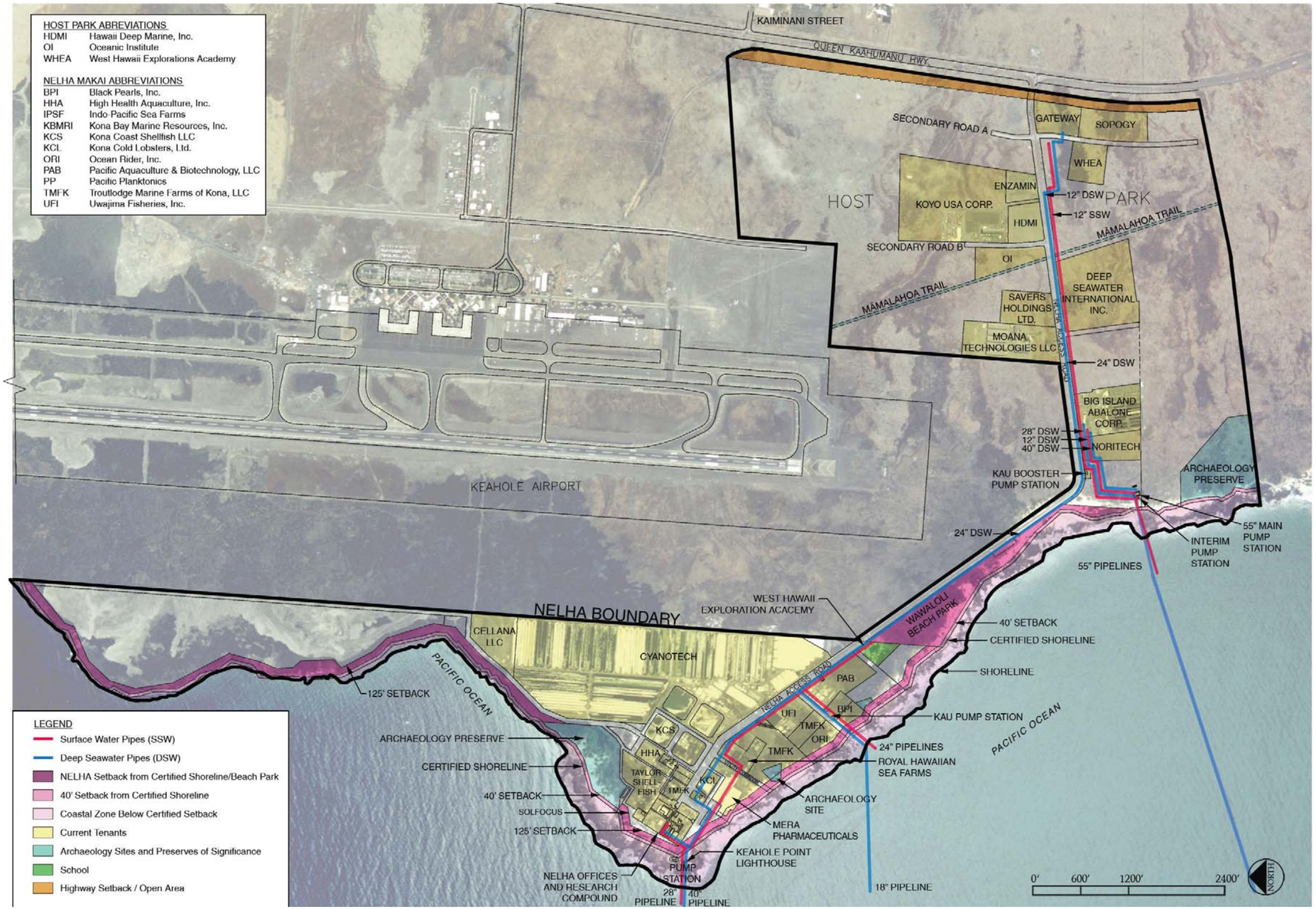
Figure 2 illustrates the existing NELHA land use. The majority of the NELHA lands are in the State Urban district which offers no constraints to development. Three sections are located in the State Conservation District which restricts many of the proposed or potential activities identified in the master plan. The three areas that comprise the Conservation District include: the tip at Keahole Point including the lighthouse site, a triangular section north of Wawaloli Beach and makai of the OTEC Road; the end of the airport runway buffer, a larger piece mauka of one of the deep ocean cold water pump stations; and an archaeological site adjacent to Ooma.

The County General Plan and the Kona Community Development Plan include the NELHA site within their designated urban area. The County Land Use Pattern Allocation Guide (LUPAG) also identifies the shoreline area as an open district. There are restrictions on development in the open district usually limited to open space, recreational uses, single family homes, and accessory recreational facilities.

Kona International Airport occupies the land just north of NELHA. Two of NELHA's new roadways will connect with two airport roadways (thus the name "airport connector roadways"). Kona International Airport is classified as a primary commercial service small-hub airport, reporting 1,519,345 total passenger enplanements (boardings) for 2007. This equates to approximately 0.20 percent of the total annual enplanements in the United States. In 2007, Kona International Airport ranked 76th out of 575 commercial service airports, and ninth of 73 small-hub airports in enplanements. For comparison, Honolulu International Airport ranked 25th for commercial service airports by reporting 10,279,791 total passenger enplanements in 2007.

Kona International Airport is situated on approximately 3,450 acres within the City of Kailua/Kona corporate limits, approximately nine miles northwest of the central business district.

The airport currently has an 11,000 foot runway, but plans to build additional runways makai of the existing runway, which will impact NELHA's operations. Additional conceptual



Source: Master Plan for Natural Energy Laboratory of Hawaii Authority, c. 2008.

Existing Land Use

Figure 2

plans for the airport include developing the frontage along Queen Kaahumanu Highway with operations that complement the airport and surrounding development, including a hotel/conference center and a cultural education center. Potential areas for partnership between the airport and NELHA include supplying renewable energy and deep seawater cooling for airport developments, renewable fuel vehicle transport for arriving passengers, and synergy between tenants along the Queen Kaahumanu corridor.

Kohanaiki Business Park is a 52-parcel development that can currently only be accessed by Hulikoa Drive on the mauka side of Queen Kaahumanu Highway in North Kona. Forty-one of its 52 parcels are presently occupied, and the remaining 11 parcels are expected to be developed in the next few years.

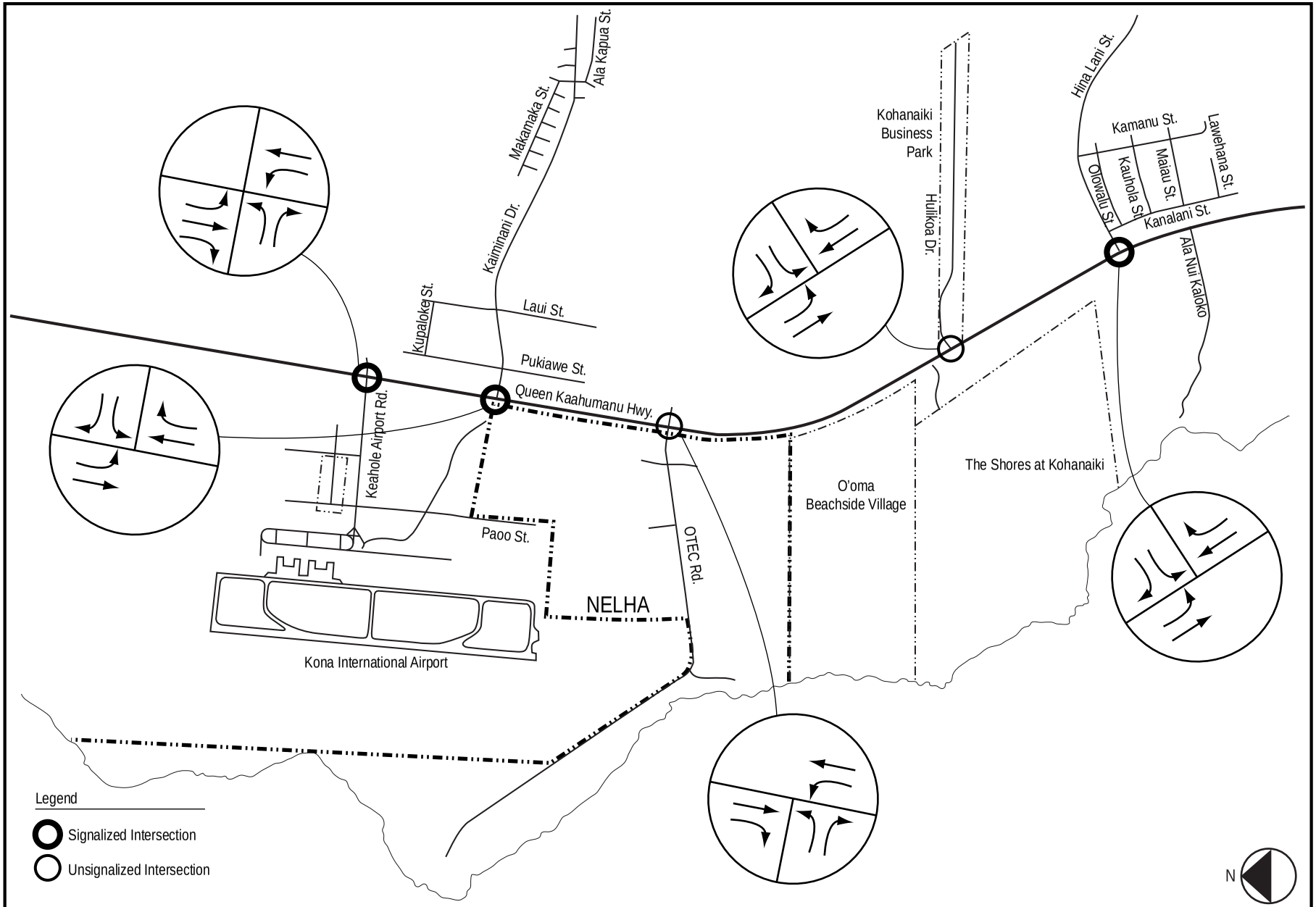
Two new proposed developments on the makai side of the highway, The Shores at Kohanaiki and Ooma Beachside Village, have proposed accesses to Queen Kaahumanu Highway from the same access point. The Shores would consist of 500 residential units, an 18-hole golf course, and 120 public beach parking spaces, with expected project completion in 2015. Ooma would include 1,190 residential units, commercial uses, a school and beach access in phased construction between 2015 and 2029.

B. Existing Roadway Network

The island of Hawaii is served by a network of 1,393 miles of public roads. This includes 394 miles of state highways. The backbone of the system is the Hawaii Belt Road which circles the island. The Belt Road is comprised of State Highway (State Route 11) to the south and State Highway (State Route 19) to the north. Queen Kaahumanu Highway (State Route 19) provides access to NELHA and is part of the Hawaii Belt Road.

1. Queen Kaahumanu Highway

As shown in Figure 3, Queen Kaahumanu Highway is located along the mauka side of NELHA, the airport, Ooma, and The Shores at Kohanaiki proposed developments. Queen Kaahumanu Highway is a two-lane (north of Kealakehe Parkway), Class I State Highway with limited access and a posted speed limit of 45 miles per hour near the project location. South of Kealakehe Parkway, the highway was recently widened to four lanes to Henry Street. It is a link in the principal highway system that circles the island.



Existing Roadway Network

Figure 3

The Hawaii Department of Transportation (HDOT) is currently widening Queen Kaahumanu Highway from two to four lanes from Kealakehe Parkway to the airport, north of the study area. The southern portion of the widening project is near completion. The portion that would affect the NELHA development has not begun, but a design-build contractor has been selected and will soon be under contract to commence the last leg of the widening project.

2. Keahole Airport Road

Keahole Airport Road provides primary airport access from the highway to the passenger terminal as well as other airport facilities. Keahole Airport Road is a two-lane, undivided roadway. The posted speed limit on Keahole Airport Road is 25 mph.

3. Kaiminani Drive

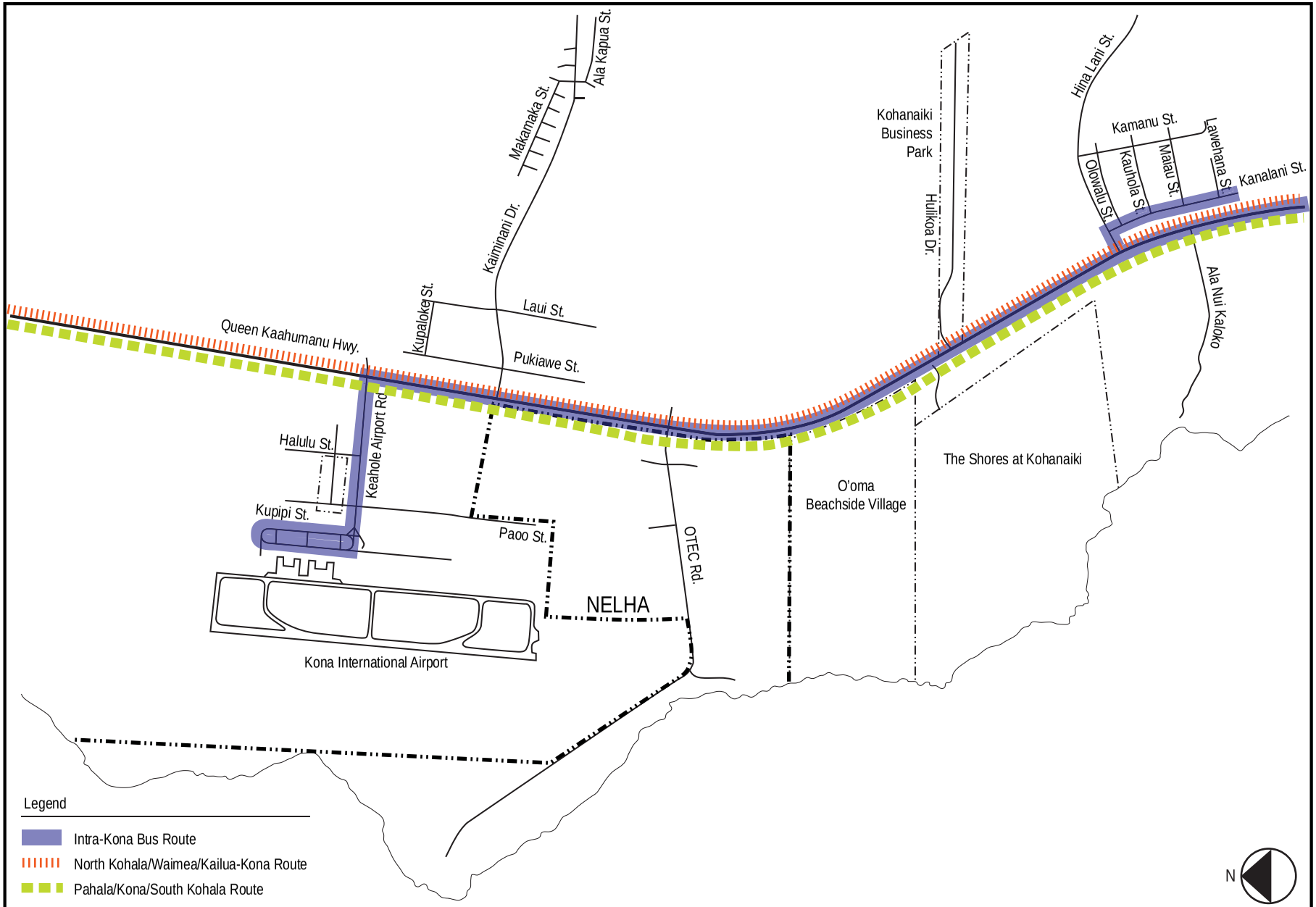
Kaiminani Drive is a collector road that extends east from Queen Kaahumanu Highway to Mamalahoa Highway. Just mauka of Queen Kaahumanu Highway, Kaiminani Drive is a two-lane, undivided roadway. It provides an inbound left-turn lane and right-turn storage lane at its signalized intersection with Queen Kaahumanu Highway. The posted speed limit just mauka of Queen Kaahumanu Highway is 35 mph.

4. OTEC Road

OTEC Road provides access between NELHA and Queen Kaahumanu Highway via a 24-foot wide asphalt concrete pavement road. It is a two-lane, undivided roadway. The right-of-ways vary between 80 feet and 110 feet. The wider 110-foot section begins just after the first interior intersection and ends near the main roadway bend near the booster pump station site. The Access Road is approximately 11,600 feet in length and is a public roadway. The road provides access to NELHA and tenant facilities, shoreline, “Pine Trees” beach and Wawaloli Beach Park. There is an access gate near OTEC Road’s intersection with Queen Kaahumanu Highway. This gate is closed between 8 p.m. and 6 a.m. The posted speed limit is 25 mph.

C. Existing Transit Service

Figure 4 shows the Hawaii County Hele-On transit routes in the region. The Hawaii County Mass Transit Agency provides public transportation around the island on the Hele-On bus system. Service is provided to the major urban centers on the island via the main roadways. There is also shuttle service available in the Hilo and the Kona Districts. The Hele-On service uses a fleet of buses with a capacity of 33 to 45 passengers. The bus service stops twice Monday through Saturday (once northbound and once southbound) at the Keahole Airport terminal and two additional routes pass by the project area on Queen Kaahumanu Highway twice in the northbound direction and three times in the southbound direction Monday through Saturday. On Sundays, one route passes the project area (once northbound and once southbound).



Existing Public Transit Routes

Figure 4

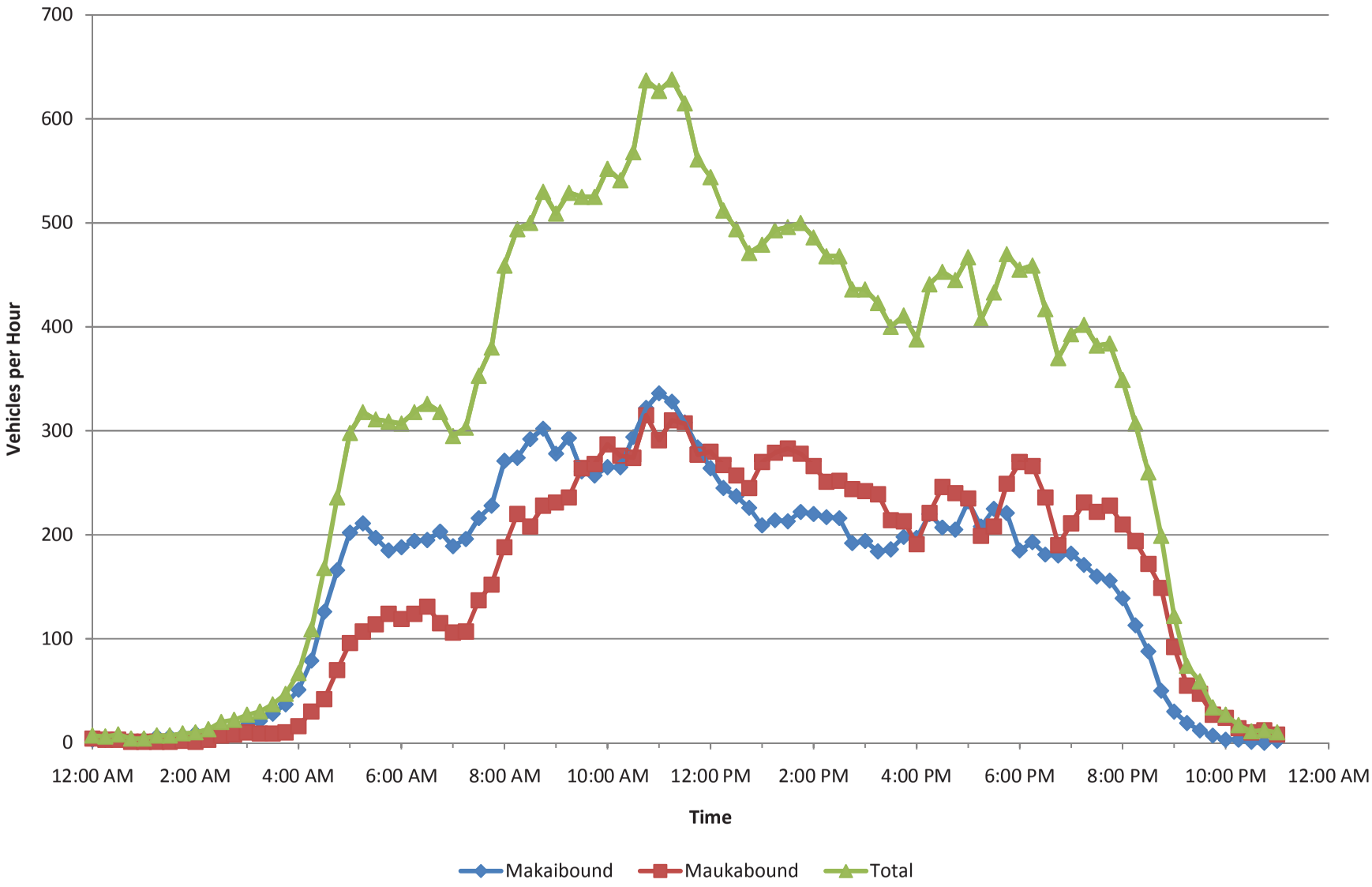
D. Existing Traffic Volumes

1. 24-Hour Volumes

Figures 5, 6, and 7 show 24-hour traffic volume plots along Keahole Airport Road, OTEC Road, and Queen Kaahumanu Highway just north of OTEC Road. Automatic traffic recorders (ATRs) were placed along Keahole Airport Road (near its intersection with Paoo Street) and OTEC Road (just mauka of its first internal intersection) on Tuesday, September 14, 2010 and Wednesday, September 15, 2010. The Queen Kaahumanu Highway data was taken from HDOT counts at station T8M on Tuesday, September 16 and Wednesday, September 17, 2008 (the most recent year available). The 2010 24-hour volume counts were compared with HDOT 24-hour counts to ensure that the collected data was reasonable. Figure 5 shows that Keahole Airport Road experienced the busiest hour during mid-day period from 10 am to 12 pm. The 24-hour plot on OTEC Road indicated three peak hours during the day that are associated with work and school related trips during morning peak hours, lunch break related trips during the mid-day period, and home and school related trips during afternoon peak hours.

2. Turning Movement Counts

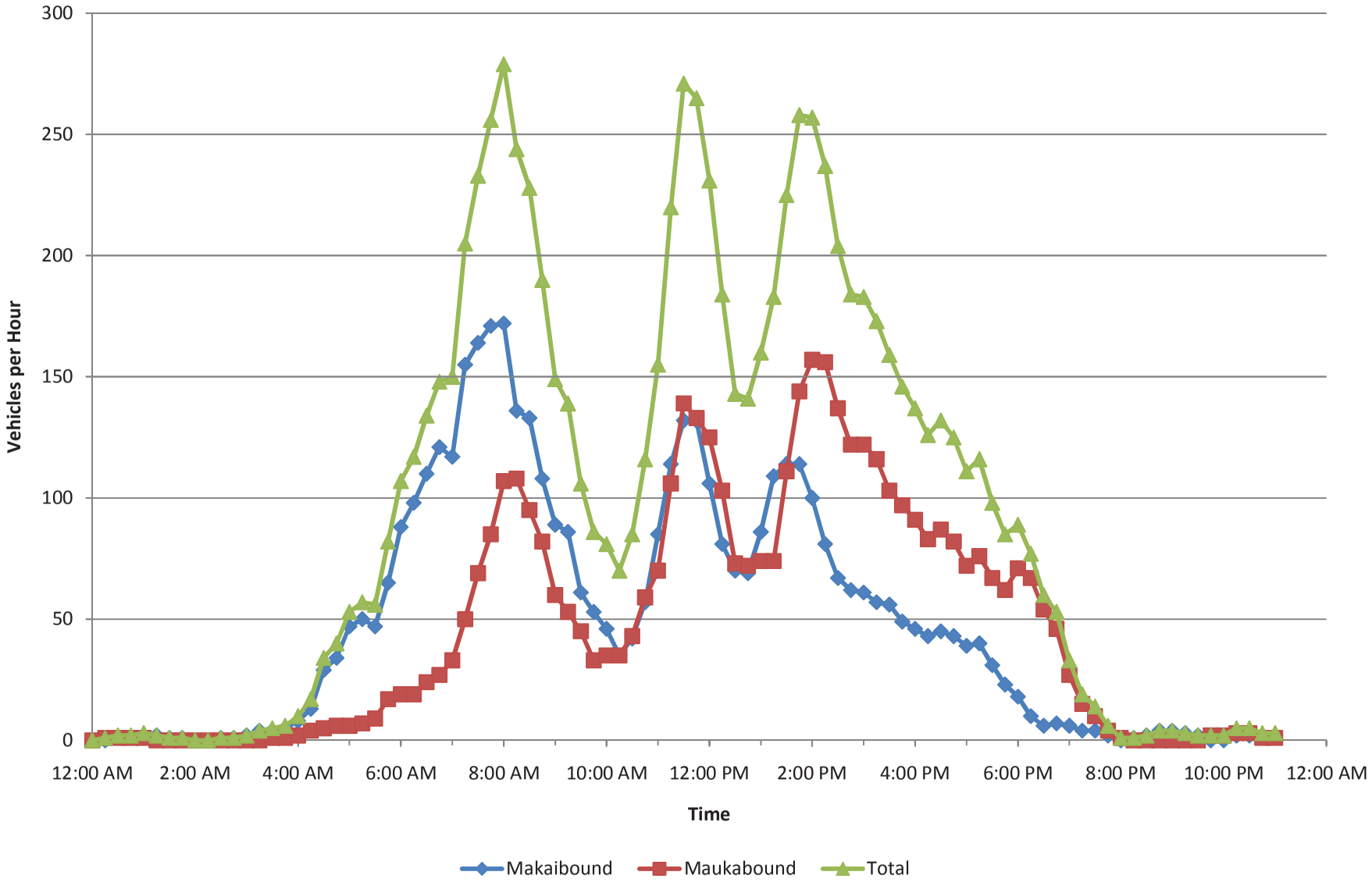
In addition, turning movement counts were recorded via traffic counting personnel at the intersections of Queen Kaahumanu Highway and Hina Lani Street, Queen Kaahumanu Highway and OTEC Road, Queen Kaahumanu Highway and Kaiminani Drive, Queen Kaahumanu Highway and Keahole Airport Road, Keahole Airport Road and Halulu Street, and Keahole Airport Road and Paoo Street. Figure 8 shows the existing peak hour traffic volumes at the recorded intersection locations. Based upon historical peak hour data and KOA flight schedules, counts were performed between 7am to 9am, 10am to noon, and from 2:30pm to 4:30pm, respectively. Due to the specific traffic patterns at Queen Kaahumanu Highway and OTEC Road, this intersection's turning movements were recorded from 6:30am to 9am, 10am to noon, and 1:30pm to 4:30pm. Additional existing traffic count data can be found in Appendix A.



Counts Taken: Tuesday, September 14-Wednesday, September 15, 2010

Existing Keahole Airport Road 24-Hour Traffic Volumes

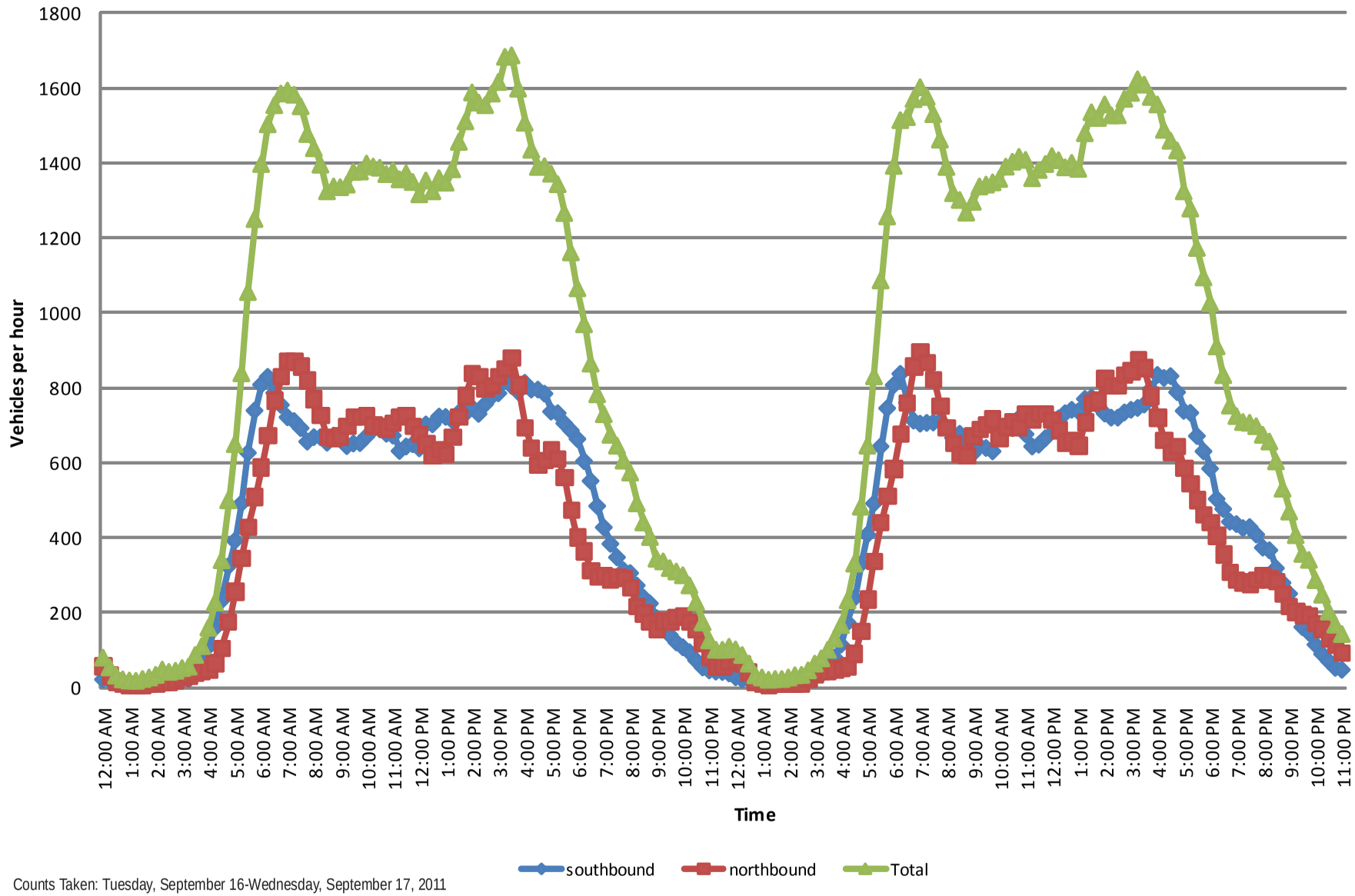
Figure 5



Counts Taken: Tuesday, September 14-Wednesday, September 15, 2010

Existing OTEC Road 24-Hour Traffic Volumes

Figure 6



Counts Taken: Tuesday, September 16-Wednesday, September 17, 2011

Queen Kaahumanu Highway North of OTEC Road
24-Hour Traffic Volumes

Figure 7

Existing Peak Hour Traffic Volumes

Figure 8

E. Existing Traffic Operations

The existing intersections in the study area (along Queen Kaahumanu Highway and Keahole Airport Road) were analyzed using the methodologies documented in the *2000 Highway Capacity Manual (HCM).*

Table 1 summarizes the existing Level-of-Service (LOS) conditions for these intersections. For detailed analysis information, Appendix C includes capacity analysis worksheets.

Table 1 Existing Level-of-Service Summary

Existing	AM		Midday		PM	
	LOS	Delay	LOS	Delay	LOS	Delay
OTEC Road and Queen Kaahumanu Highway	**Unsignalized**		**Unsignalized**		**Unsignalized**	
OTEC Road EB Left	E	35.8	E	48.6	F	134.5
Queen Kaahumanu NB Left	B	10.3	A	9.9	B	10.1
Kaiminani Drive and Queen Kaahumanu Highway	**C**	**26.5**	**B**	**13.8**	**B**	**14.1**
Kaiminani WB Left-Right	D	54.8	B	19.6	B	19.9
Queen Kaahumanu NB Through	B	16.5	B	18.3	B	20.0
Queen Kaahumanu NB Right	B	10.1	B	10.8	B	12.4
Queen Kaahumanu SB Left	A	7.9	A	8.4	A	8.8
Queen Kaahumanu SB Through	A	9.0	A	8.8	A	9.7
Hina Lina Street and Queen Kaahumanu Highway	**B**	**12.5**	**B**	**19.4**	**B**	**13.8**
Hina Lina WB Left-Right	C	22.3	C	29.9	C	26.2
Queen Kaahumanu NB Through	B	15.7	C	23.5	B	17.0
Queen Kaahumanu NB Right	A	9.9	B	15.6	B	11.3
Queen Kaahumanu SB Left	A	7.4	B	14.9	A	9.8
Queen Kaahumanu SB Through	A	6.0	A	9.0	A	6.0
Keahole Airport Road and Queen Kaahumanu Highway	**A**	**7.0**	**B**	**13.0**	**B**	**17.4**
Keahole EB Left-Right	B	16.7	C	21.2	C	28.2
Queen Kaahumanu NB Left	A	3.4	A	6.1	A	9.1
Queen Kaahumanu NB Through	A	2.9	A	5.0	A	4.5
Queen Kaahumanu SB Through	B	10.5	B	18.3	C	23.4
Queen Kaahumanu SB Right	A	7.7	B	11.6	B	10.3
Keahole Airport Road and Paoo Street	**Unsignalized**		**Unsignalized**		**Unsignalized**	
Keahole EB Left-Through-Right	A	0.1	A	0.1	A	0.0
Keahole WB Left-Through-Right	A	0.0	A	0.0	A	0.0
Paoo NB Left-Through-Right	B	10.2	C	15.3	B	10.3
Paoo SB Left	B	11.1	B	14.8	B	12.1
Paoo SB Through-Right	A	9.5	B	10.3	A	9.3
Keahole Airport Road and Halulu Street	**Unsignalized**		**Unsignalized**		**Unsignalized**	
Keahole EB Left-Through	A	3.2	A	3.0	A	1.9
Paoo SB Left-Right	B	11.8	C	18.0	B	14.3

*Delay in seconds/vehicle.

Although the three signalized intersections near the study area all operate at acceptable LOS, significant queuing was observed along Queen Kaahumanu Highway during the PM peak hour. The LOS methodology in HCM does not address queuing well. The queuing that occurs along Queen Kaahumanu Highway will be addressed by HDOT's widening project.

The left movement outbound from OTEC Road operates at LOS E in the AM and mid-day peak hours and LOS F in the PM peak hour. The eastbound right turn is channelized and has a lengthy acceleration lane on Queen Kaahumanu Highway. The left turn movement experienced difficulty finding sufficient gaps in mainline traffic.

III. YEAR 2015 TRAFFIC EVALUATION

The Year 2015 time frame will result in the completion of Phase 1 according to the Master Plan for Natural Energy Laboratory of Hawaii Authority, 2008.

This section of the report contains a traffic evaluation of the five-year master plan conditions. This section of the report helps to identify roadway elements that need to be in place to accommodate the projected demand.

A. Year 2015 Conceptual Development Plan for NELHA

Figure 9 illustrates the year 2015 five-year master planned condition. Phase 1 of the master plan includes the construction of the stub-out roads north of OTEC Road in the "Applied Technology" area, the construction of Roads A and B (shown in Figure 9), the completion of a full-access, signalized Queen Kaahumanu Highway at Kaiminani Drive intersection, and the development and leasing of the lots surrounding Roads A and B.

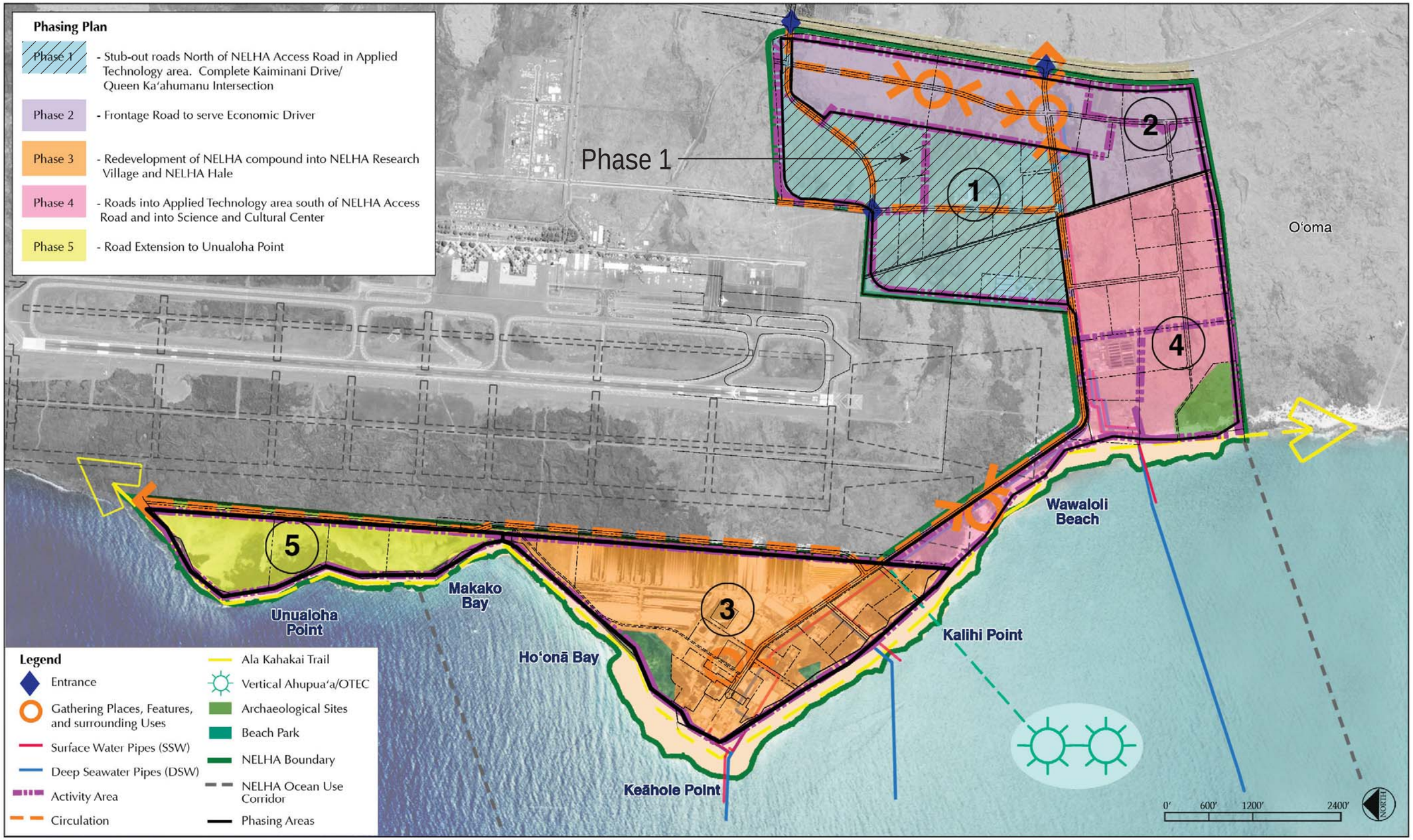
B. Year 2015 Roadway Network

The most significant assumed changes to the existing roadway by the end of 2015 are the widening of the existing Queen Kaahumanu Highway from two to four lanes and the construction related to Phase 1 of the NELHA master plan, as detailed above. The following describes the future roadway network assumptions. Figure 10 illustrates the internal and surrounding roadway network projected for year 2015.

1. Queen Kaahumanu Highway

Queen Kaahumanu Highway is undergoing a two-phase construction project to widen the highway from the existing two lanes to four between Henry Street in Kailua-Kona to Keahole Airport Road. Phase I of this project widened the highway from Henry Street to Kealakehe Parkway. Phase II of this project will widen the highway the remainder of the distance (between Kealakehe Parkway to Keahole Airport Road).

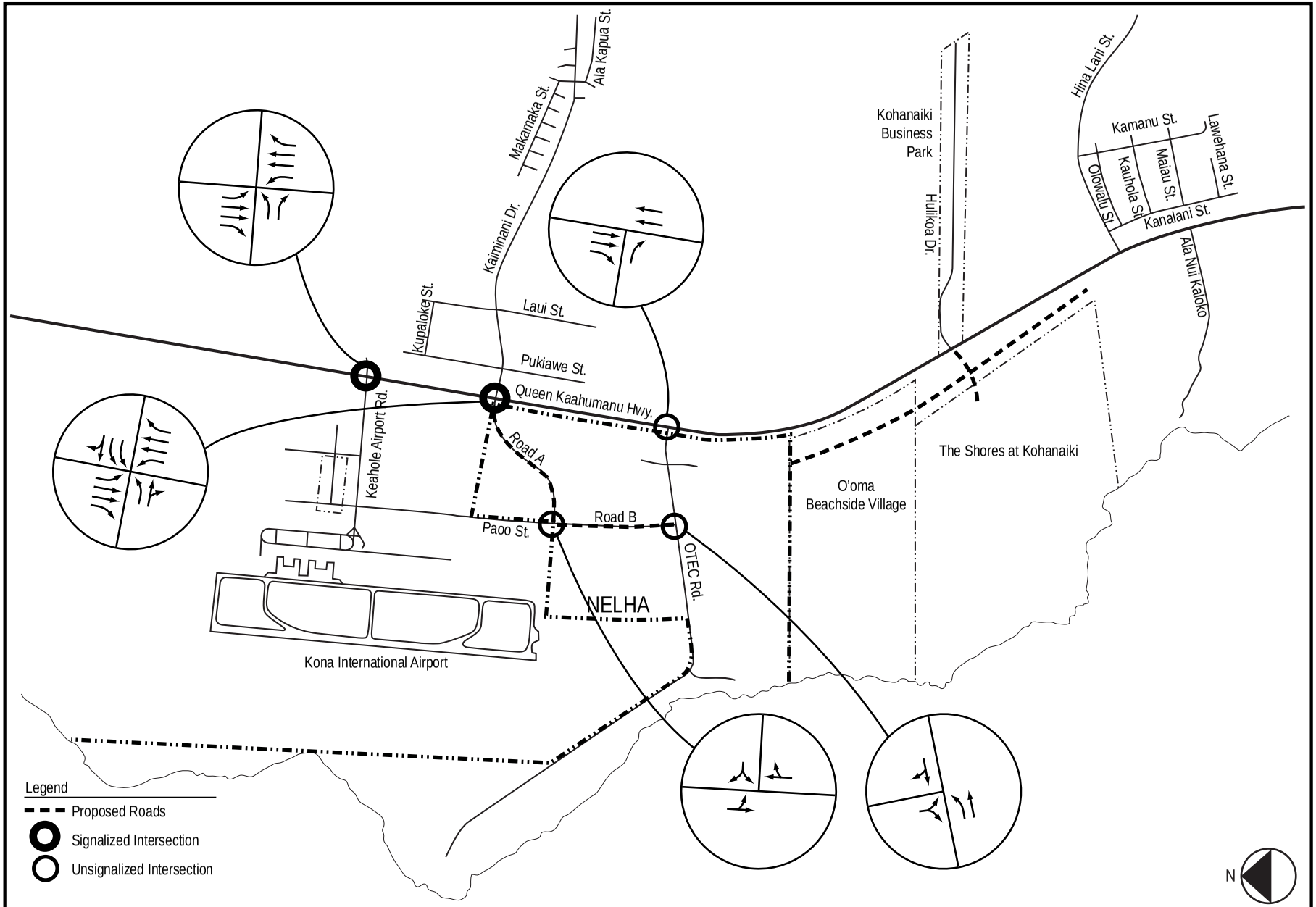
The Queen Kaahumanu Highway and Kaiminani Drive will be analyzed as a signalized four-leg intersection. The Queen Kaahumanu Highway and OTEC Road intersection is anticipated to be restricted to Right In/Right Out movements only by the year 2015. This will shift all northbound inbound and outbound traffic to the Queen Kaahumanu Highway and Kaiminani Drive intersection.



Source: Master Plan for Natural Energy Laboratory of Hawaii Authority, c. 2008.

Year 2015 Conceptual Development Plan

Figure 9



Year 2015 Roadway Network

Figure 10

2. Internal Roadways

Paoo Street is currently closed off south of Keahole Airport Road. It is expected that this road will be open upon the construction of NELHA's Roads A and B. This connection is intended to be the makai-most of the two airport connector roads.

Road A is planned to be constructed during Phase 1. It is proposed as the primary access to the NELHA commercial developments and a major collector roadway for the project. It will have a 60-foot right-of-way, two 12-foot lanes, and eight-foot shoulders. The speed limit will be 25 mph.

Road B is planned to be constructed during Phase 1. During this time frame, it will provide access to the "Applied Technology" and "Energy Zone" portions of the project. It will have a 60-foot right-of-way, two 12-foot lanes, and eight-foot shoulders. The speed limit will be 25 mph.

C. Year 2015 Transit Service

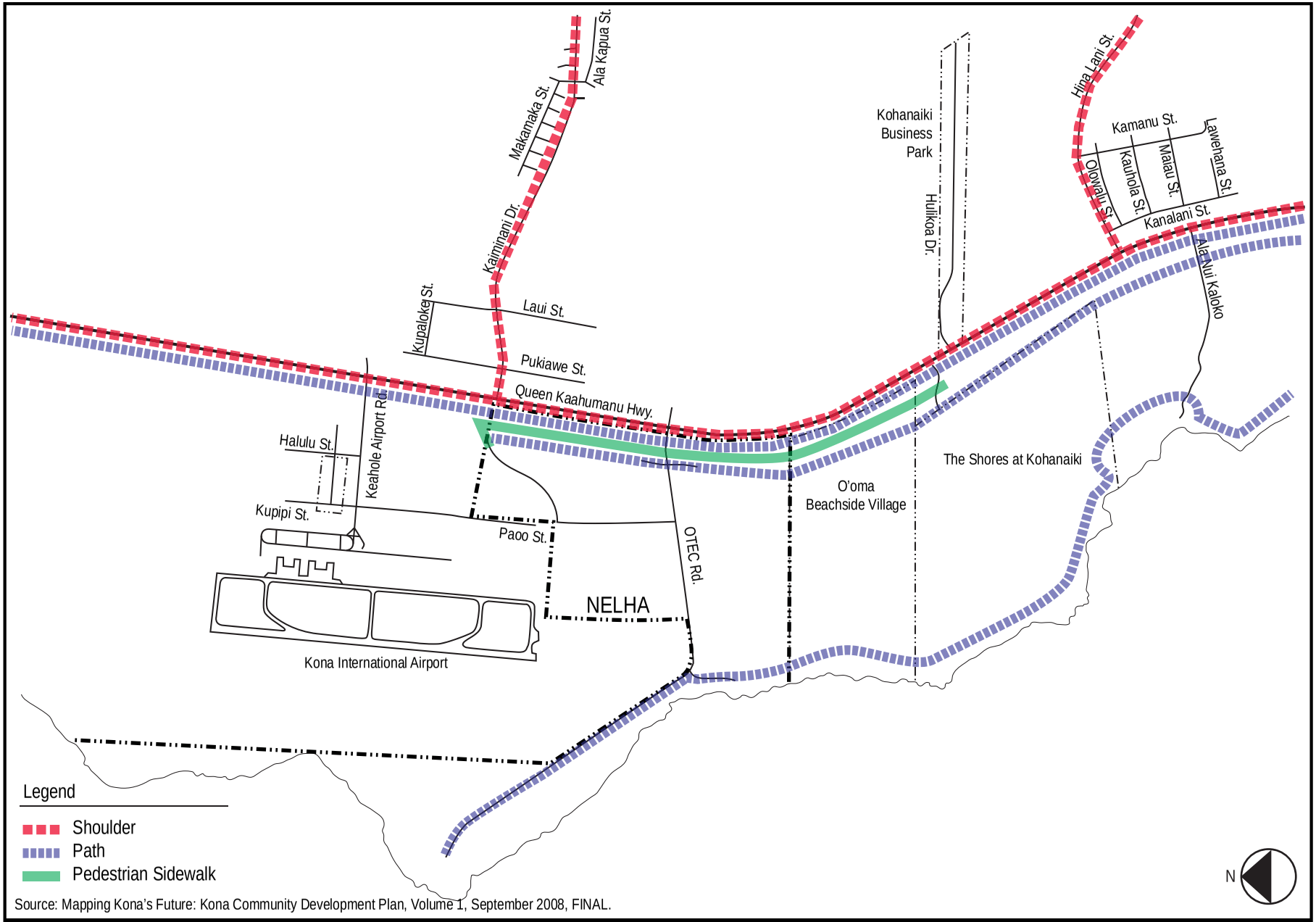
The Year 2015 transit service is assumed to be similar to the existing service. The Hawaii County Mass Transit Agency is anticipated to continue to provide public transportation around the island on the Hele-On bus system. Service is anticipated to be provided to the major urban centers on the island via the main roadways. There will also be shuttle service available in Hilo and the Kona Districts.

D. Year 2015 Pedestrian and Bike Network

The pedestrian and bike network in year 2015 will be greatly influenced by the adjacent Kona International Airport, Ooma, and The Shores at Kohanaiki developments. However, the following elements are expected to be in place within this time frame:

- Wide shoulders on Queen Kaahumanu Highway, Kaiminani Drive, and Hina Lani Street;
- Bike path on Queen Kaahumanu Highway in the vicinity of the project;
- Bike path on the frontage road makai of Queen Kaahumanu Highway that is to continue through the Ooma and The Shores at Kohanaiki developments;
- Sidewalks along the frontage road makai of Queen Kaahumanu Highway that is to be constructed within the Ooma and The Shores at Kohanaiki developments.

Together, these regional pedestrian/bike facilities, as shown in Figure 11, will enable bicyclists and pedestrians to access pedestrian/bike facilities in a manner consistent with the recommendations of the Kona Community Development Plan completed by the County of Hawaii in 2008, though no timeline was given.



Source: Mapping Kona's Future: Kona Community Development Plan, Volume 1, September 2008, FINAL.

Future Kailua-Kona Regional Public Transit Routes

Figure 11

E. Projected Year 2015 Travel Demand

1. Trip Generation

The methodology used in the *Institute of Transportation Engineers (ITE), Trip Generation, 8th edition (2003)* was reviewed for application on this project. It was noted that the trip rates used in ITE *Trip Generation* were developed based on the samples of light industrial warehouses and employee-intensive manufacturers, which do not represent NELHA's planned land use. For example, according to the data collected in 2009 and 2010, the entering trips to NELHA in the AM peak hour were in the range of 175 to 186, According to ITE *Trip Generation* utilizing the Light Industrial ITE Code, NELHA would generate 1,479 entering trips. ITE *Trip Generation* methodology is clearly not representative of the local existing land use conditions and an alternative must be sought.

The traffic counts conducted in 2010 by PB revealed a more reasonable correlation between the NELHA's land use and the trips it generated. Furthermore, NELHA's master plan indicated that at least a portion of the planned future developments will share similar characteristics with the existing developments (e.g., aquaculture). Similar types of tenants are anticipated by the Year 2015. It stands to reason that the projected trips generated by these new tenants should generate roughly the same rate as the current tenants. Therefore, for the Applied Technology and Research Zone land uses, the trip generation rate developed based on the current land use and traffic counts was applied to the future Year 2015 land uses as opposed to the ITE methodology.

Table 2 summarizes the total trips generated by the NELHA Phase 1 development by Year 2015.

Table 2

Year 2015 NELHA Trip Generation Summary

		AM Peak Hour of Traffic		PM Peak Hour of Traffic	
Land Use Designation	**No. of Units**	**Enter (vph)**	**Exit (vph)**	**Enter (vph)**	**Exit (vph)**
Light Industrial (KSF)	4,601	89	40	60	106
Subtotal		89	40	60	106
Total Net Trips (external)		89	40	60	106

*KSF = 1,000 square feet

2. Trip Distribution and Assignment

The traffic generated for Year 2015 of the NELHA Phase 1 development was distributed and assigned to the network based on the regional travel patterns, or trend analysis, observed from the existing turning movement counts data. It is reflected in the project generated traffic turning volumes.

3. Background Traffic Volumes

Background traffic volumes are volumes not directly associated with the development proposed for the NELHA Phase 1 site. These volumes are comprised of regional volumes using Queen Kaahumanu Highway to travel north and southbound past the NELHA Phase 1 development as well as the existing NELHA traffic. The existing NELHA traffic that utilizes OTEC Road as a full access intersection (i.e., uses the inbound Queen Kaahumanu Highway northbound left turn and the outbound OTEC Road eastbound left turn) was redistributed in the Year 2015 background traffic scenario to take into account the anticipated limited access of the Queen Kaahumanu Highway and OTEC Road intersection once Queen Kaahumanu Highway is widened to four lanes.

Embedded in the regional background traffic volumes are those trips generated by the expansion of the Kona International Airport. The airport's passenger traffic has risen and is projected to rise at a steady rate. According to the "Kona International Airport at Keahole Draft Airport Master Plan, January 2009", total airport passenger traffic is anticipated to rise at the steady rate of approximately 1.8% between 2005 and 2030. Historically, this rate has coincided and is anticipated to continue to coincide with the 3.7% annualized traffic growth along Queen Kaahumanu Highway in the vicinity of OTEC Road. HDOT counts at the

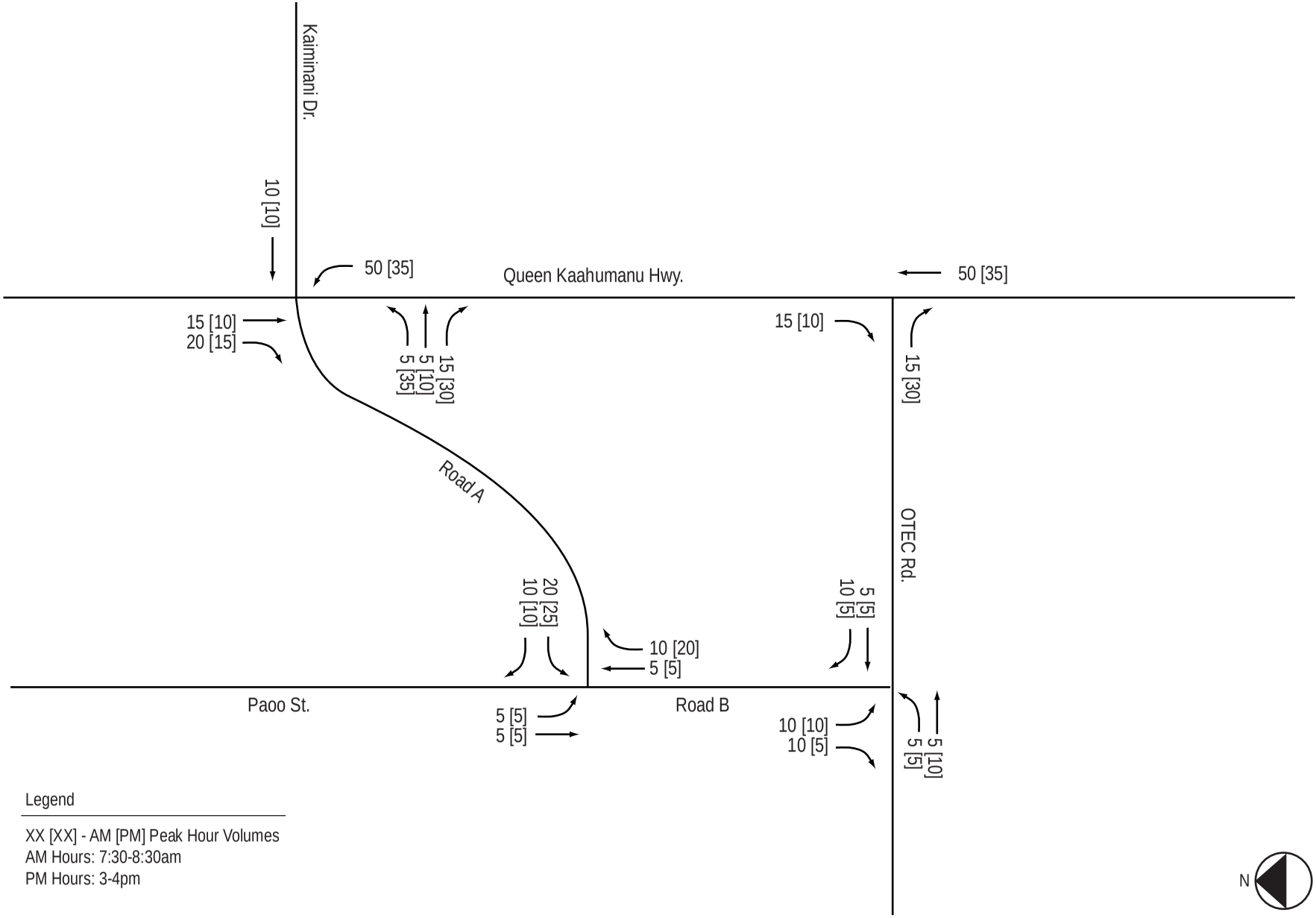
Queen Kaahumanu Highway location just north of OTEC Road show this consistent traffic growth of 3.7% between 2002 and 2007. In 2008 (the most recent year available), the traffic volumes recorded by HDOT along Queen Kaahumanu Highway decreased. However, according to the National Bureau of Economic Research, the U.S. was in a "Great Recession" (December 2007 to June 2009) during this time, and therefore the HDOT counts during this time were not considered for the annual traffic growth estimation as they were recorded during the recession and are not consistent with the overall, historical picture of the region.

The trips associated with the full build out of The Shores at Kohanaiki, the Phase I development of Ooma, and the fully leased-out Kohanaiki Business Park were generated and added to the 3.7% annualized increasing traffic growth on Queen Kaahumanu Highway.

These components were assigned to the future roadway system to estimate Year 2015 background traffic volumes.

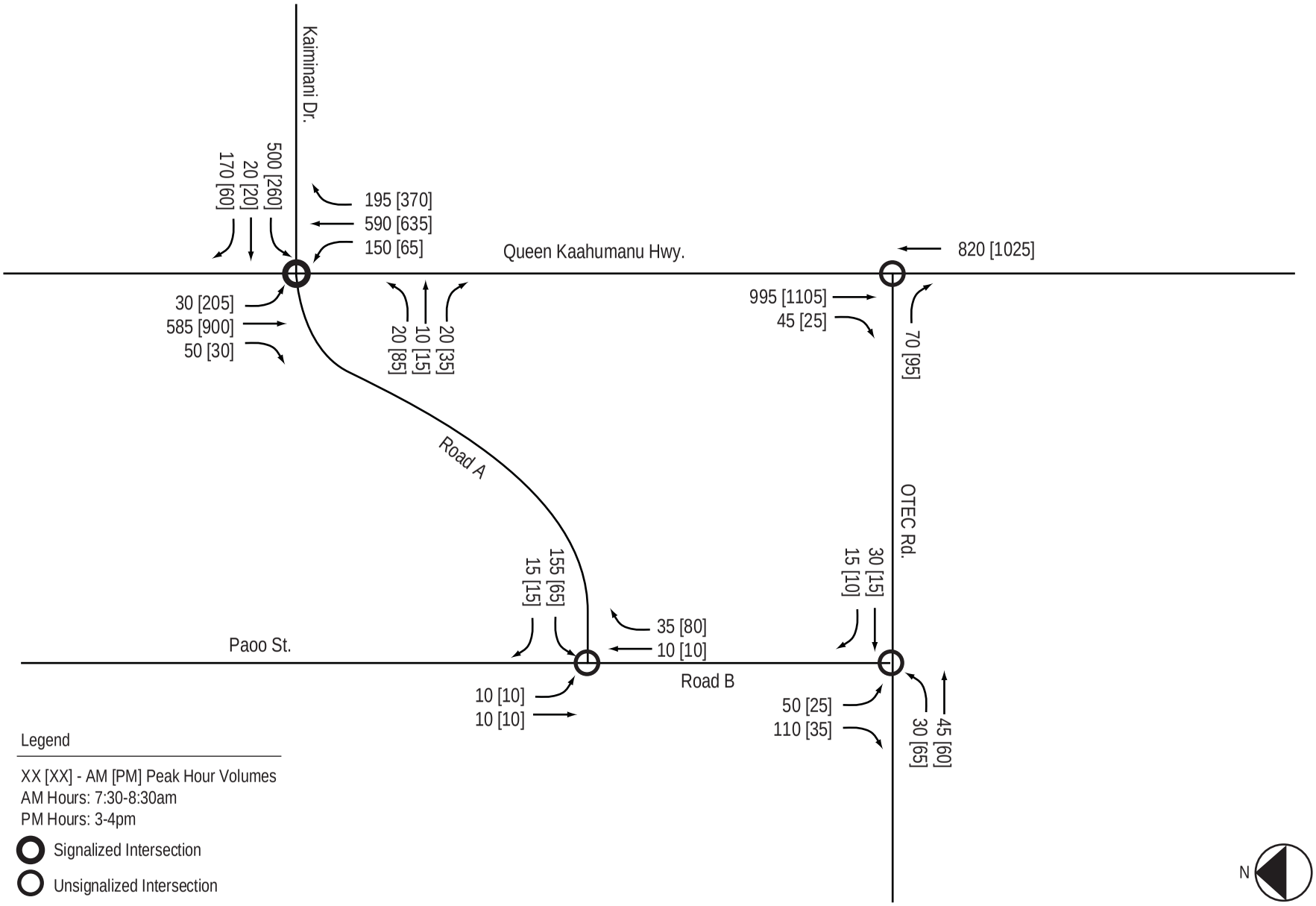
4. Total Traffic Volumes

The traffic generated by the NELHA Phase 1 development by Year 2015 (shown in Figure 12) was combined with the background traffic. This sum represents the total Year 2015 traffic volumes with the NELHA Phase 1 development and is shown in Figure 13.



Year 2015 Project Generated Peak Hour Traffic Volumes

Figure 12



Year 2015 Total Peak Hour Traffic Volumes with NELHA

Figure 13

F. Projected Year 2015 Traffic Operations

Table 3 summarizes the projected Year 2015 peak hour intersection level-of-service with the NELHA Airport Connector Roadways development. Based on the projected Year 2015 peak hour traffic volumes and construction schedule, the Queen Kaahumanu Highway at Kaiminani Drive intersection is expected to operate as a signalized cross intersection and is analyzed as such. Direct access between NELHA and the airport's Paoo Street was assumed. The Road A and Road B intersection is recommended to be stop-controlled on the Road A approach. The OTEC Road and Road B intersection is recommended to be stop-controlled on the Road B approach. Appendix C includes intersection capacity worksheets.

As shown in Table 3, the development levels assumed for the 5-year master plan time frame can be accommodated by the roadway network.

Table 3
Year 2015
Level-of-Service Summary

2015	AM		PM	
	LOS	Delay	LOS	Delay
Queen Kaahumanu Hwy and OTEC Rd	**Unsignalized**		**Unsignalized**	
Queen Kaahumanu Hwy and Kaiminani Dr/Road "A"	**D**	**40.9**	**C**	**34.4**
Road A EB Left	E	67.3	E	57.1
Road A EB Through-Right	D	50.1	D	44.1
Kaiminani WB Left	D	52.1	D	45.0
Kaiminani WB Through-Right	C	21.8	C	31.5
Queen Kaahumanu NB Left	E	58.5	E	55.2
Queen Kaahumanu NB Through	C	31.3	C	34.7
Queen Kaahumanu NB Right	C	26.7	C	29.3
Queen Kaahumanu SB Left	F	81.7	D	46.4
Queen Kaahumanu SB Through	D	44.6	C	26.9
Queen Kaahumanu SB Right	C	34.7	B	18.7
OTEC Road and Road B	**Unsignalized**		**Unsignalized**	
OTEC Road EB Left-Through	A	3.0	A	4.0
Road B SB Left-Right	A	9.6	A	9.3
Road B and Road A	**Unsignalized**		**Unsignalized**	
Road A WB Left-Right	A	9.7	A	9.3
Road B SB Left-Through	A	3.7	A	3.7

G. Summary of Results

All intersections associated with the NELHA Phase 1 development are projected to operate at LOS D, or better during the 2015 time frame. At the Queen Kaahumanu Highway and Kaiminani Drive/Road A intersection, the Road A eastbound left turns and Queen Kaahumanu Highway northbound left turns are projected to individually operate at LOS E during both peak periods. In addition, the Queen Kaahumanu Highway southbound left turn is projected to operate at LOS F in the AM peak hour.

The Queen Kaahumanu Highway and OTEC Road intersection's operation could not be quantified since the HCM methodology cannot calculate LOS for a Right In/Right Out only intersection. The two movements at this intersection (the inbound southbound right and the outbound eastbound right) are both virtually free movements as they are both channelized and have a deceleration lane and acceleration lane, respectively.

IV. YEAR 2015 RECOMMENDATIONS

This section of the report serves to verify that the assumed future roadway system will adequately handle the traffic demand placed on it at Year 2015 of the NELHA Phase 1 development. The recommended lane configurations in Year 2015 are shown in Figure 14.

Queen Kaahumanu Highway

By Year 2015, Queen Kaahumanu Highway is anticipated to be built out to a four-lane highway. The intersection of Queen Kaahumanu Highway and Kaiminani Drive/Road A should be constructed as a signalized cross intersection. It will feature one exclusive left-turn lane for both directions on Queen Kaahumanu Highway. The deceleration right turning lane to Kaiminani Drive should remain and the deceleration right turning lane to Road A should be built. The existing left turns on Kaiminani Drive approach have already warranted double left turning lanes. It should be widened to contain double left turning lanes and a shared through and right turning lane. The Road A approach should have an exclusive left turning lane and a shared through lane/right turning lane. The right turn should be channelized and have an acceleration lane.

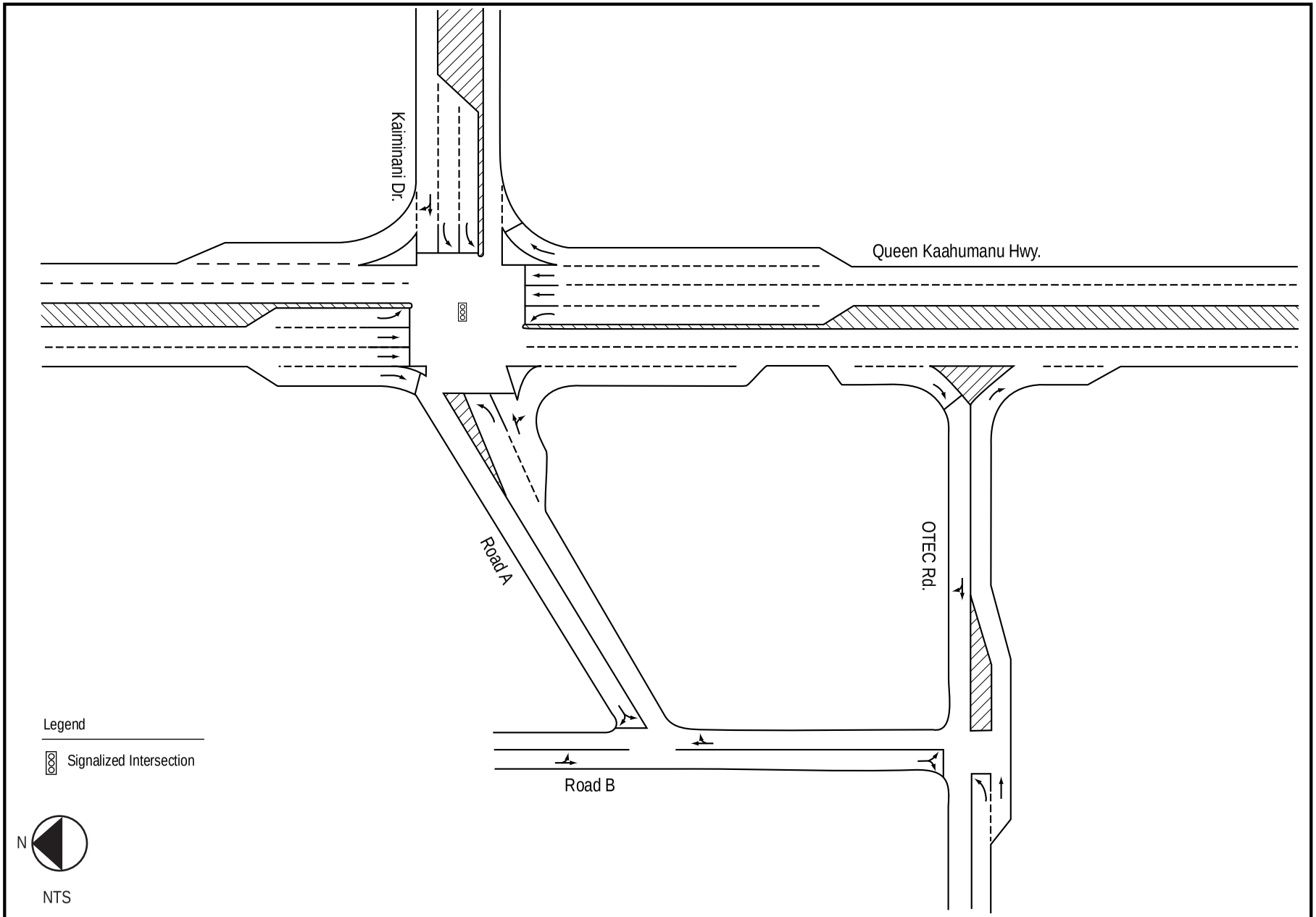
At the intersection of Queen Kaahumanu Highway and OTEC Road, the right turn in and right turn out configuration is used to be consistent with HDOT's Queen Kaahumanu Widening design. The deceleration right turning lane from Queen Kaahumanu Highway to OTEC Road and the acceleration lane from OTEC Road to Queen Kaahumanu Highway will have to remain.

Road A

Road A will function as a collector with the posted speed limit of 25 mph. By Year 2015, the volumes at the Road A and Road B intersection are not projected to warrant signalization. The intersection should be stop-controlled with the stop sign on Road A. All approaches are recommended to have one lane. These lane configurations will be able to process the expected demand through the intersection.

Road B

Road B will function as a collector with the posted speed limit of 25 mph. The OTEC Road and Road B intersection should be stop-controlled with the stop sign on Road B. The Road B approach will have a shared left turn/right turn lane at OTEC Road. The eastbound OTEC Road approach will be widened to have an exclusive left turning lane and a through lane.



Recommended Year 2015 Lane Configurations

Figure 14

V. YEAR 2035 ULTIMATE BUILD OUT TRAFFIC EVALUATION

Year 2035 is the forecasted time frame for completion of the entire NELHA development. Figure 15 illustrates the Year 2035 conceptual development plan and Figure 16 illustrates the Year 2035 roadway network. This includes all five phases.

A. Year 2035 Conceptual Development Plan

Phase 1 includes: the construction of the stub-out roads north of OTEC Road in the "Applied Technology" area, the construction of Roads A and B, the completion of a full-access, signalized Queen Kaahumanu Highway at Kaiminani Drive/Road A intersection, and the development and leasing of the lots surrounding Roads A and B.

Phase 2 includes: the construction of the frontage road (Road C/Road D), construction of Road E and complete build out of the commercial properties just makai of Queen Kaahumanu Highway and the light industrial properties makai of Queen Kaahumanu Highway and south of OTEC Road.

Phase 3 includes: the construction of the North NELHA Access Road from OTEC Road to Makako Bay and the construction of a 40-unit residential facility.

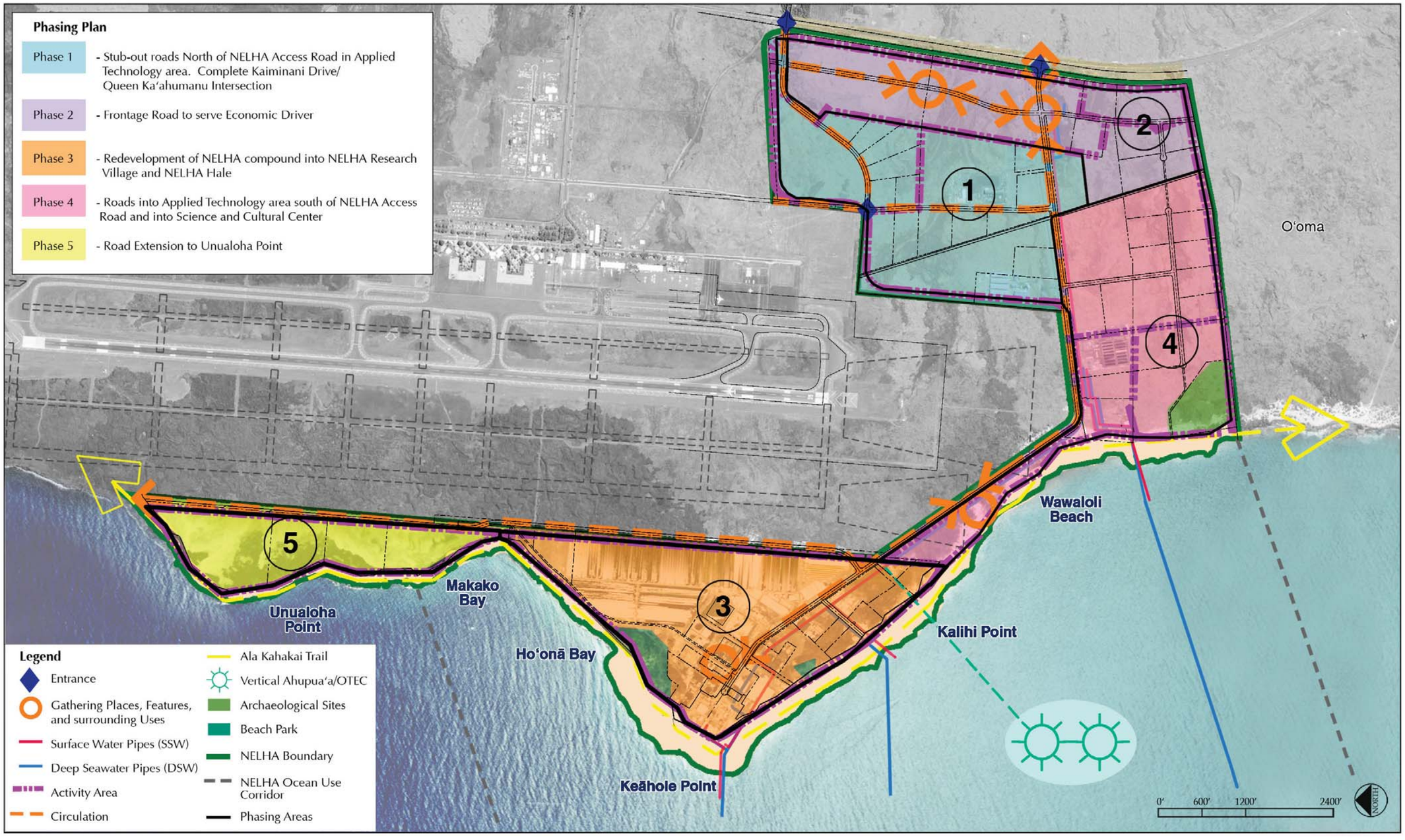
Phase 4 includes: the completion of the light industrial parcels, Roads F and G, and construction of the Science and Cultural Center.

Phase 5 includes: the extension of the North NELHA Access Road to Unualoha Point and construction of the Research facilities makai of the airport.

Year 2035 forecasted traffic volumes were used to analyze the completed NELHA master-planned development.

Other developments assumed to be completed by Year 2035:

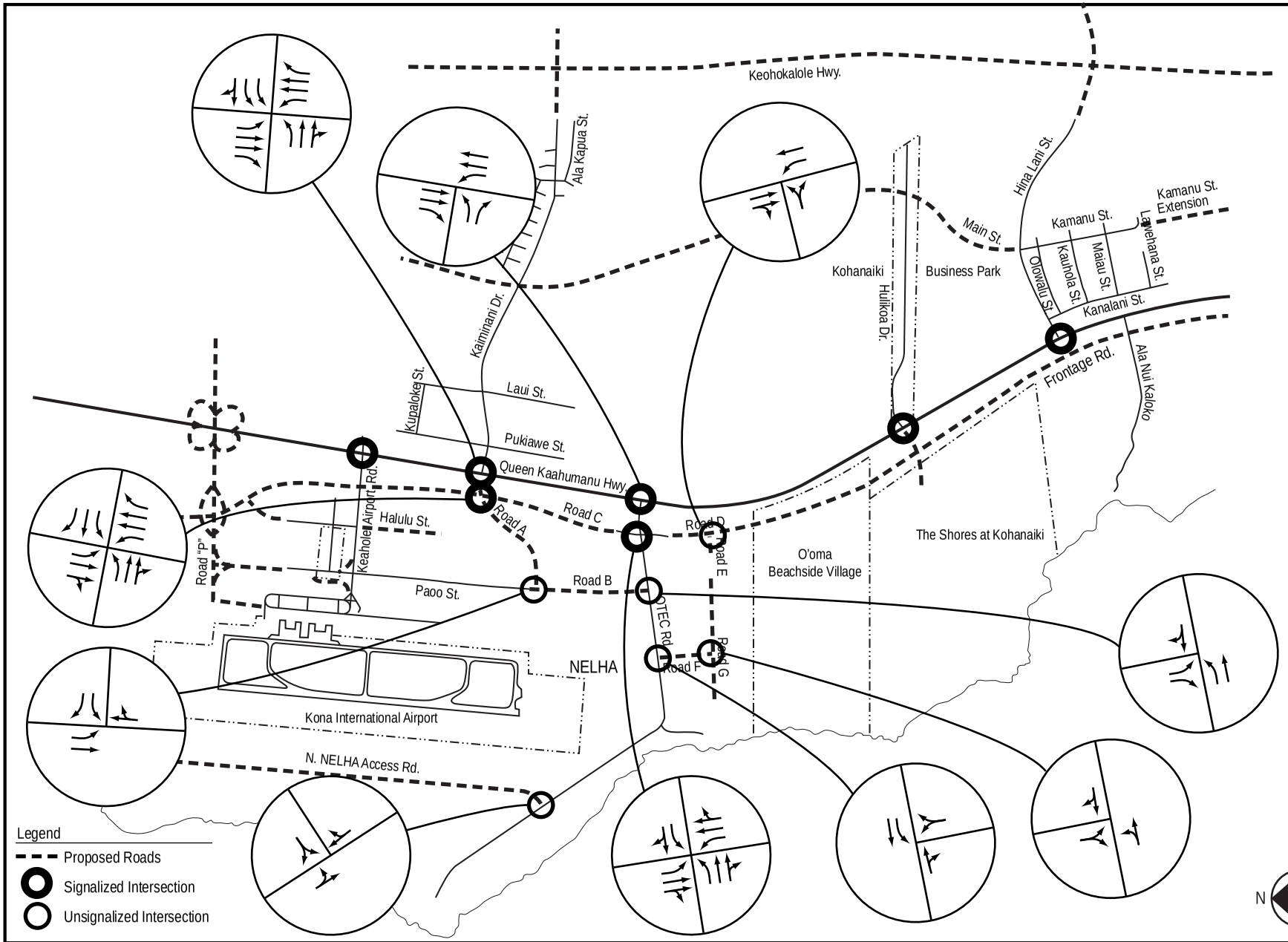
- Ooma Beachside Village
- The Shores at Kohanaiki
- Kohanaiki Business Park
- Kona International Airport long-term master-planned development



Source: Master Plan for Natural Energy Laboratory of Hawaii Authority, c. 2008.

Year 2035 Conceptual Development Plan

Figure 15



Year 2035 Roadway Network

Figure 16

B. Year 2035 Roadway Network

Significant changes are expected for the roadway network in the vicinity of the NELHA site and in the Kailua-Kona region by the year 2035.

1. Queen Kaahumanu Highway

Queen Kaahumanu Highway is assumed to be a four-lane highway. The lane configuration at the intersection of Queen Kaahumanu Highway and Kaiminani Drive/Road A will remain the same as in the Year 2015 except that the Road A eastbound approach will have a left-turn lane, a through lane, and a shared through-right turn lane. The intersection of OTEC Road and Queen Kaahumanu Highway is expected to allow all movements and be signalized.

2. Makai Frontage Road (connection to Roads C and D)

A frontage road makai of Queen Kaahumanu Highway that crosses Hulikoa Drive and connects to NELHA's Road D is anticipated to be built out. This frontage road is anticipated to connect from Kailua-Kona to the airport's future Road P (read below).

3. Kona International Airport

Road improvements at Kona International Airport anticipated by Year 2035 include: the creation of a Road P which will provide a grade-separated interchange at its intersection with Queen Kaahumanu Highway at some location north of the Keahole Airport Road intersection. An airport collector roadway is also anticipated to be constructed that will connect Road P with NELHA's Road C, acting as the fourth leg at NELHA's Road A and Road C intersection.

4. Regional Improvements

Regionally, the "Kona Community Development Plan, September 2008" anticipates that two major north-south arterials will be constructed mauka of Queen Kaahumanu Highway. A mid-level arterial will connect the Kamanu Street Extension with Kamanu Street and intersect Hulikoa Drive and Kaiminani Drive. The mauka-most arterial, to be named Keohokalole Highway will run makai of Mamalahoa Highway and intersect Hina Lani Street and Kaiminani Drive in the project's vicinity. Both north-south collectors are anticipated to reduce regional traffic along Queen Kaahumanu Highway by the Year 2035.

5. Internal Roadways

Road A is proposed as the main access to the NELHA development, forming the makai leg of the Queen Kaahumanu Highway at Kaiminani Drive intersection. Two westbound receiving lanes are required to accommodate Queen Kaahumanu Highway's northbound double left-turn storage lanes. The section of Road A that is in-between Queen Kaahumanu Highway and Road C is projected to require an 80-foot right-of-way.

A few hundred feet west of the Road A and Road C intersection, Road A can be tapered down to a two-lane, bi-directional street with a 60-foot right-of-way. The speed limit on Road A will be 25 mph.

Road B is proposed as the southern connection to the airport's Paoo Street. Road B will form a T-intersection with Road A. Road B will require a 60-foot right-of-way cross section. The speed limit on Road B will be 25 mph.

Road C is proposed to be an arterial, the primary road through the commercial phase of the project extending from Road A to OTEC Road. The Airport is anticipated to build out the north leg of this intersection. Road C is projected to require an 80-foot right-of-way. The speed limit on Road C will be 35 mph.

Road D is proposed as an arterial, the southern extension of Road C, picking up from the end of the roadway that runs adjacent to the current visitor's center (OTEC Road) to NELHA's boundary with Ooma (in the south). This extension is anticipated to be connected with the makai frontage road that Ooma builds. Road D is projected to require an 80-foot right-of-way and the speed limit will be 35 mph.

Road E is proposed as a two-lane roadway that intersects Road D as a T-intersection. Road E will run in a mauka-makai direction, but will end in a cul-de-sac just mauka of the Mamalahoa Trail. It will have a 60-foot right-of-way and a speed limit of 25 mph.

Road F is proposed as a two-lane roadway that intersects OTEC Road makai of the Mamalahoa Trail. Road F will form a T-intersection with OTEC Road. It will run southbound and provide access to the light industrial area south of OTEC Road, terminating at its T-intersection with Road G. Road F will have a 60-foot right-of-way and a speed limit of 25 mph.

Road G is proposed as a two-lane roadway that intersects Road F, forming a T-intersection. Road G will run in a mauka-makai direction and end at each of its termini in a cul-de-sac. In the

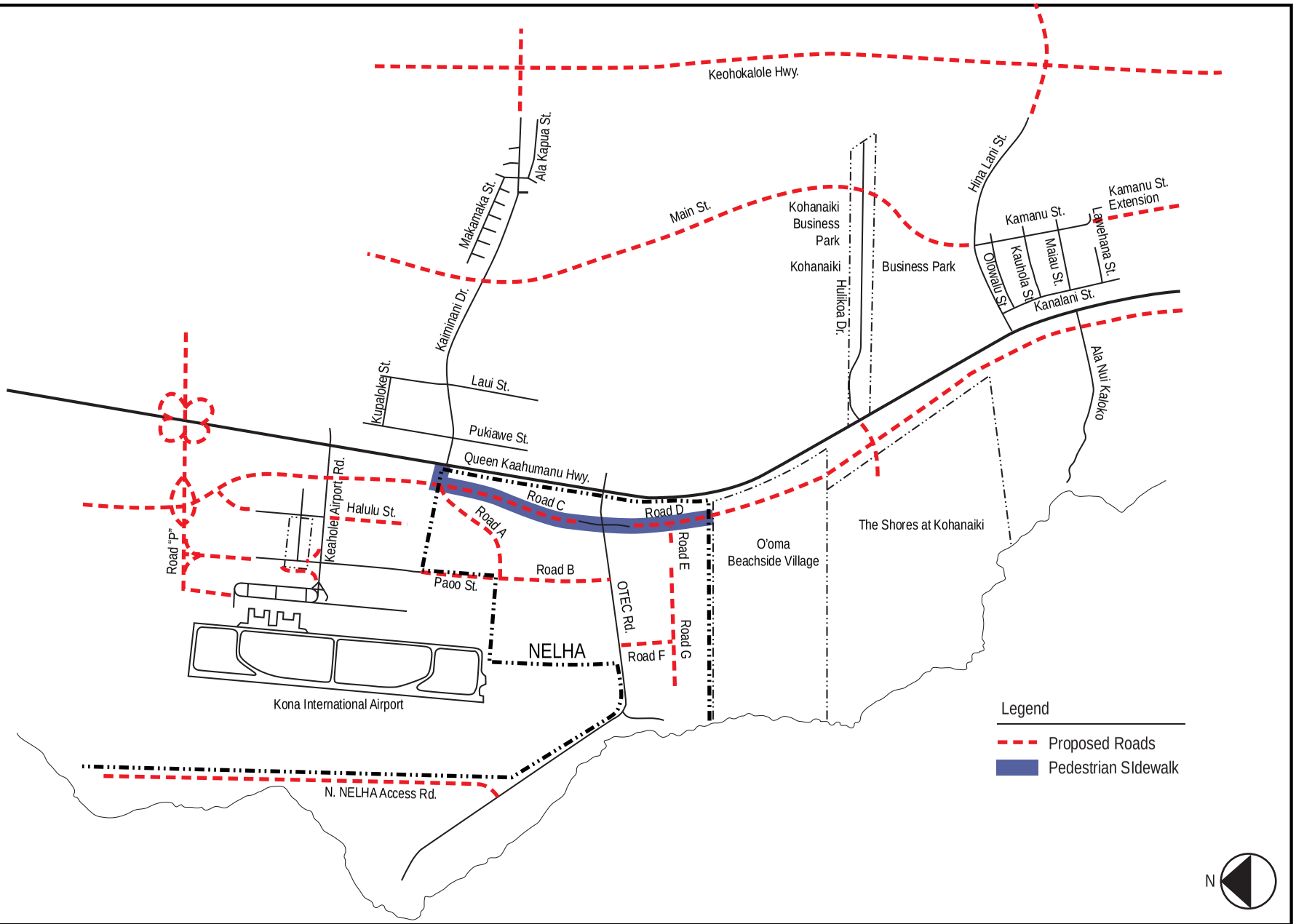
maukabound direction it will stop short of the Mamalahoa Trail. It will have a 60-foot right-of-way and a speed limit of 25 mph.

North NELHA Access Road is currently a dirt roadway that provides access to the NELHA areas makai of the airport. This two-lane, bi-directional roadway will be extended north to Unualoha Point, providing access to the future research facilities makai of the airport. It will have a speed limit of 25 mph.

OTEC Road will remain a two-lane, bi-directional, industrial roadway makai of its intersection with Road F. Between the Road F and Road B intersections, OTEC Road is proposed to have left-turn lanes at both intersection approaches. Between the Road B and Road C/Road D intersections, OTEC Road is proposed to have one westbound lane and two eastbound lanes (and an eastbound left-turn lane at the Road C approach). Between the Road C/Road D and Queen Kaahumanu Highway intersections, OTEC Road is proposed to have a four-lane cross section. The speed limit will remain 25 mph.

C. Year 2035 Transit Service and Pedestrian and Bike Network

The Year 2035 transit service and pedestrian and bike networks are assumed to be similar to the Year 2015 transit service and pedestrian and bike networks. Figure 17 shows the Year 2035 pedestrian, bike, and bus circulation networks.



Future Pedestrian, Bike, and Bus Networks

Figure 17

D. Year 2035 Travel Demand

1. Trip Generation

NELHA's year 2035 developments generally fall into four land use designations: Light Industrial, Commercial, Research and Development, and Cultural/Education. Discussions with NELHA indicated that they expect roughly half of the future Light Industrial tenants to be more traditional Light Industrial use tenants, similar to those characterized in the ITE Trip Generation Handbook. The other half are expected to be similar to the current tenants (e.g., aquaculture businesses) using the land. To represent the current tenant-type trip generation, we developed our own trip generation rates based on current rates in and out of NELHA. For the other half of the Light Industrial and Research and Development land uses, and for the Commercial and Cultural/Education land uses, the standard ITE trip generation rates were used.

a) Trips Internal to the NELHA Site Area

The vehicular trip generation was modified in order to account for the internal trips to the NELHA site area.

Within the build out time frame, a small number of residential uses are projected to exist within the NELHA development site. Proposing multi-use development is a conscious effort on the part of NELHA to enable and encourage trip making internal to the NELHA development site. As a result, trips from commercial uses would interact with the residential uses on the NELHA development site. The residential trips were reduced to avoid double counting the commercial trips assigned to the residential areas. Table 4 summarizes the total trips generated by the NELHA development, including the reductions described above.

Table 4
Year 2035 NELHA Trip Generation Summary

		AM Peak Hour of Traffic		PM Peak Hour of Traffic	
Land Use Designation	**No. of Units**	**Enter (vph)**	**Exit (vph)**	**Enter (vph)**	**Exit (vph)**
Light Industrial (KSF)	8,653	1,103	178	253	1,292
Commercial (KSF)	3,417	371	237	1,482	1,543
Research and Development (KSF)	3,079	9	4	6	10
Cultural/Education (Acres)	39.60	7	7	13	13
Subtotal		1,490	426	1,754	2,858
Apartment (units) - internal capture*	40	(4)	(21)	(19)	(9)
Total Net Trips (external)		1,486	405	1,735	2,849

* Residential trips adjusted to account for retail-residential interaction
* KSF = 1,000 SF

2. Trip Distribution and Assignment

The traffic generated by the proposed NELHA Development for Year 2035 was directionally distributed and assigned to the future roadway network.

The regional travel patterns entering and exiting from Queen Kaahumanu Highway were analyzed after review of the County of Hawaii 2020 Travel Demand Forecasting Model. Because this model did not account for the NELHA, Ooma, and The Shores development roadway networks, trend analysis was utilized. This trend analysis was based on the historical trip distribution recorded at the Queen Kaahumanu Highway at OTEC Road intersection. Table 5 summarizes the distribution patterns of the generated volumes entering and exiting the NELHA development.

Table 5
Year 2035 Trip Distribution

	Distribution Percentage	
Origin/Destination	AM	PM
From Kailua-Kona	63%	59%
From Keahole/Kohala	37%	41%
Kailua-Konabound	76%	57%
Keaholebound/Kohalabound	24%	43%

Traffic generated from the NELHA area was distributed and assigned to the road network and is reflected in the project generated peak hour traffic volumes.

These distributions were applied to the ultimate build out trips generated, and the resulting project-generated trip assignment is shown in Figure 18.

3. Background Traffic Volumes

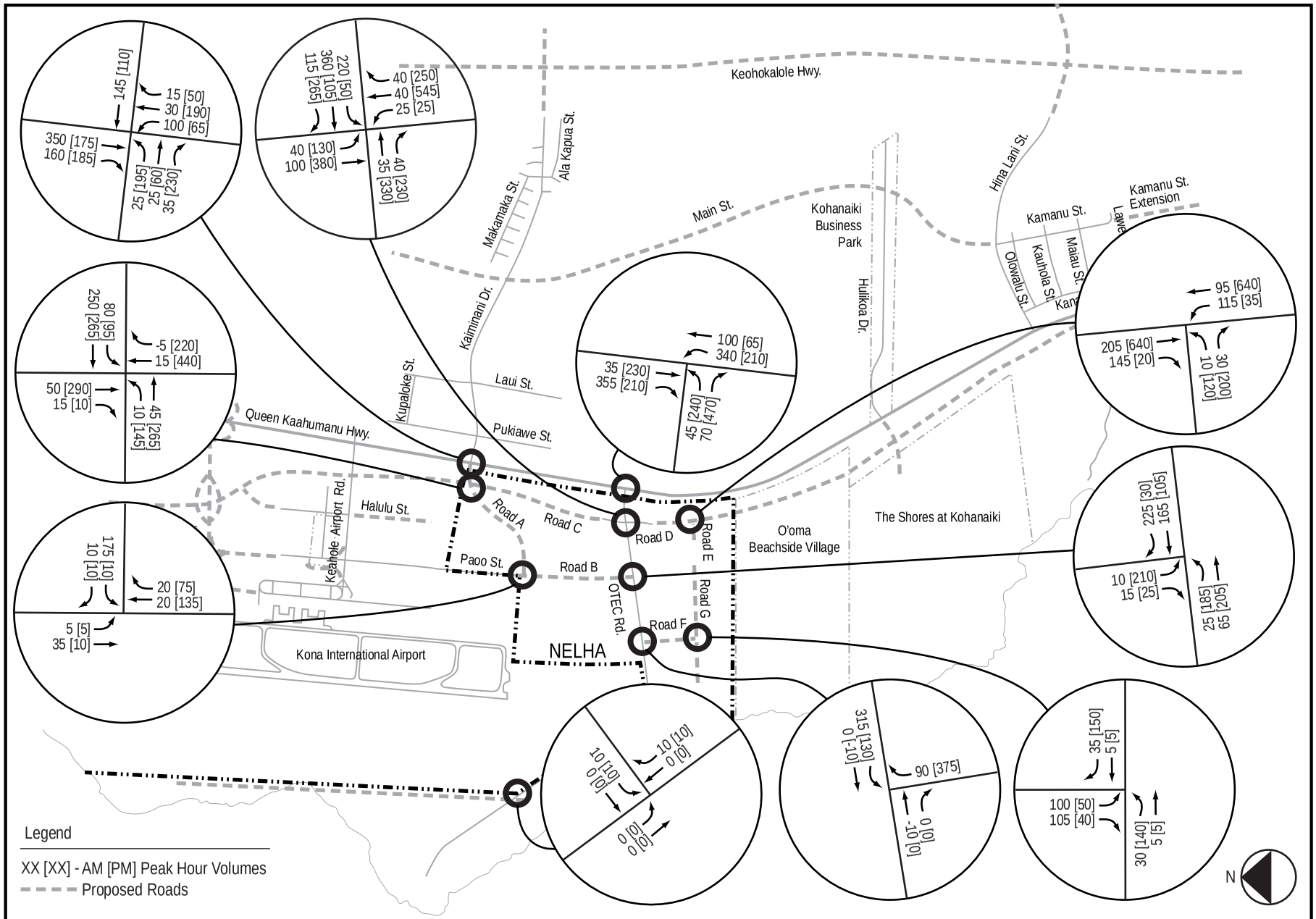
Background traffic for Year 2035 was assumed to include build out of the Ooma Beachside Village, The Shores at Kohanaiki, and a fully-occupied Kohanaiki Business Park.

In addition, the historic passenger counts and future passenger forecasts for Kona International Airport were considered along with the historical HDOT traffic counts along Queen Kaahumanu Highway just north of OTEC Road.

According to the "Kona International Airport at Keahole Draft Airport Master Plan, January 2009", total airport passenger traffic is anticipated to rise at the steady rate of approximately 1.8% between 2005 and 2030. This has also been the historical rate of growth between 1995 and 2006.

HDOT counts at the Queen Kaahumanu Highway location just north of OTEC Road show a consistent traffic growth of 3.7% between 2002 and 2007. It is believed that the passenger growth at the airport has been and will be accounted for in the traffic growth on Queen Kaahumanu Highway and therefore the airport passenger growth is built into the background traffic growth on Queen Kaahumanu Highway, being 3.7%.

These components were assigned to the future roadway system to estimate Year 2035 background traffic volumes.

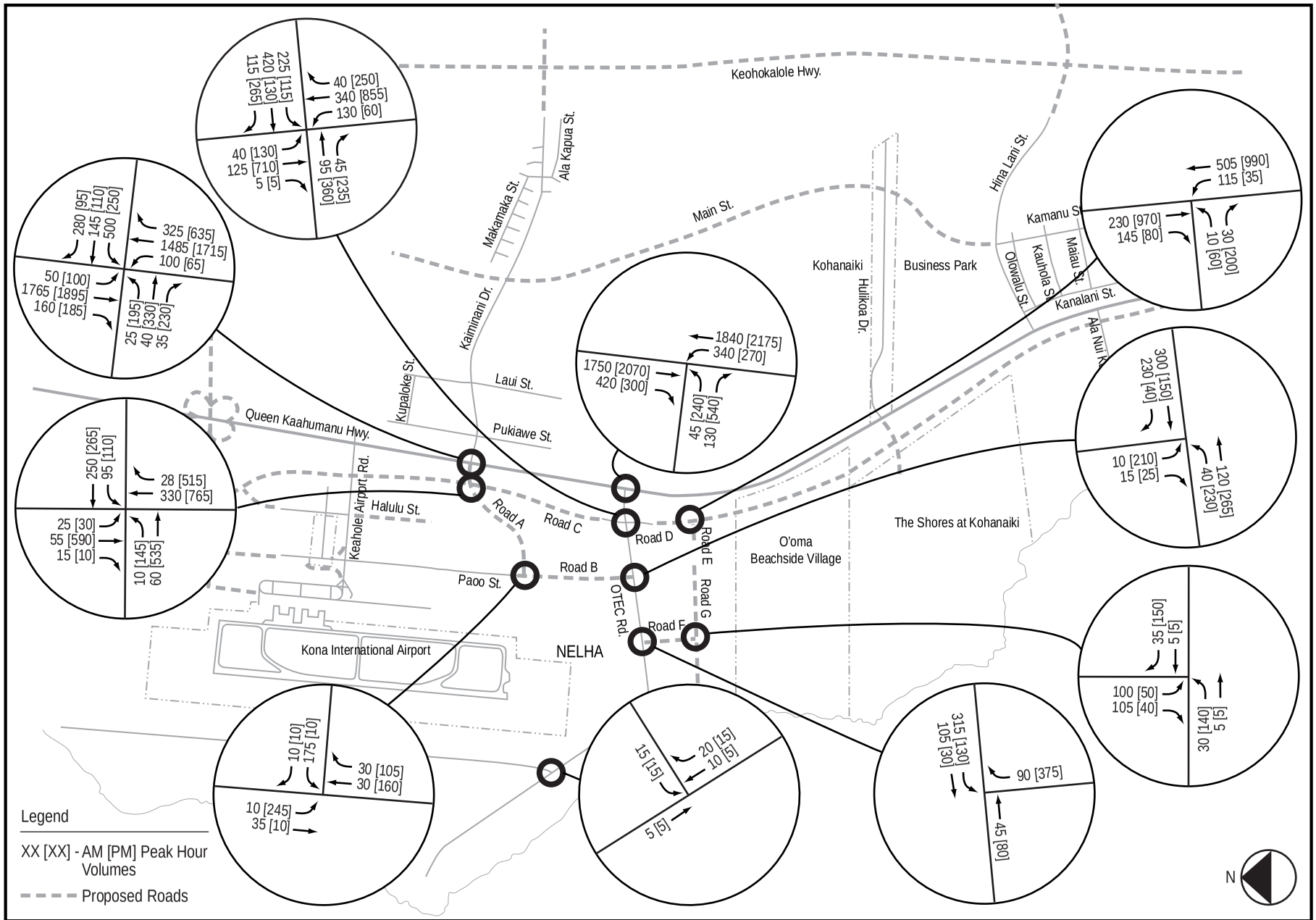


Year 2035 Project Generated Peak Hour Traffic Volumes

Figure 18

4. Total Traffic Volumes

Total Year 2035 traffic volumes were calculated from Year 2035 background volumes and Year 2035 NELHA project generated volumes, and are summarized in Figure 19. It was assumed that from 2010 to 2035, the growth occurring within the corridor was due to increased traffic demand from the Ooma, The Shores, and Kohanaiki Business Park developments as well as a 3.7% growth factor (which includes the passenger growth at the airport built-in) for traffic flowing through the study area. As part of this summation, background traffic was re-assigned to take advantage of the new roadway network connections provided by regional and local improvements. Regionally, Kamanu Street Extension/Main Street and Keohokalole Highway will provide mauka diversions from Queen Kaahumanu Highway. A traffic study for the Keahuolu Affordable Housing Master Plan, North Kona, Island of Hawaii, Hawaii (Fehr & Peers, January 2008) projected that 20% of the future traffic on Queen Kaahumanu Highway would be diverted to other north-south roadways in the area. Assuming that each of the roadway improvements described above are completed, a similar diversion can be expected on this portion of Queen Kaahumanu Highway by 2030. In addition, an iterative process, similar to a Capacity Restraint process, was utilized to further balance volumes on the various north/southbound arterials in order to arrive at equitable travel times for motorists within the roadway network.



Year 2035 Peak Hour Total Traffic Volumes with NELHA

Figure 19

E. Projected Year 2035 Traffic Operations

These intersections were analyzed using the methodologies for unsignalized and signalized intersections outlined in the 2000 Highway Capacity Manual (HCM). Operating conditions at an intersection are expressed as qualitative measures known as Level of Service (LOS) ranging from A to F. LOS A represents free-flow operations with low delay, while LOS F represents conditions with relatively high delay. The approach LOS is a weighted average of the LOS of individual traffic movement groups. Appendix B has more detailed definitions of intersection LOS. By the Year 2035 time frame, all of the future roadway network in the vicinity of the proposed NELHA development is assumed to be in place including Ooma and The Shores proposed makai frontage road. The Kona International Airport's long term roadway network, including a grade-separated interchange with Queen Kaahumanu Highway, Road P, and the makai frontage road that extends to NELHA's Road C are assumed to be completed. Two NELHA internal intersections are expected to warrant signalization by Year 2035: the Road A and Road C intersection and the OTEC Road and Road C/Road D intersection. Appendix D provides traffic signal warrant analysis.

Table 6 summarizes the projected Year 2035 peak hour intersection level-of-service with the NELHA development.

Table 6
Year 2035 Level-of-Service Summary

Year 2035 with NELHA LOS	AM		PM	
	LOS	Delay	LOS	Delay
OTEC Road and Queen Kaahumanu Highway	**C**	**26.2**	**D**	**41.7**
OTEC Rd EB Left	E	60.8	F	136.1
OTEC Rd EB Right	E	59.0	A	0.7
Queen Kaahumanu Hwy NB Left	F	80.2	F	141.5
Queen Kaahumanu Hwy NB Through	A	5.1	B	12.1
Queen Kaahumanu Hwy SB Through	D	37.1	E	62.9
Queen Kaahumanu Hwy SB Right	B	15.9	B	13.0
Kaiminani Drive and Queen Kaahumanu Highway	**E**	**61.0**	**E**	**59.6**
Road A EB Left	E	74.1	F	108.4
Road A EB Through	E	58.1	F	104.6
Kaiminani Dr WB Left	F	115.0	E	75.7
Kaiminani Dr WB Through-Right	F	128.3	F	87.5
Queen Kaahumanu Hwy NB Left	F	120.0	F	178.4
Queen Kaahumanu Hwy NB Through	C	31.3	D	47.6
Queen Kaahumanu Hwy NB Right	B	17.5	C	23.5
Queen Kaahumanu Hwy SB Left	E	78.0	F	162.2
Queen Kaahumanu Hwy SB Through	E	62.7	D	53.7
Queen Kaahumanu Hwy SB Right	B	17.5	B	15.5
OTEC Rd and Road B	**Unsignalized**		**Unsignalized**	
OTEC Rd EB Left	A	9.0	A	8.2
Road B SB Left	B	13.9	F	104.7
Road B SB Right	B	10.5	A	9.3
OTEC Rd and Road C	**D**	**49.8**	**D**	**46.0**
OTEC Rd EB Left	F	83.2	F	132.5
OTEC Rd EB Through	D	48.0	E	58.9
OTEC Rd WB Left	E	72.9	F	81.1
OTEC Rd WB Through-Right	D	52.3	E	50.0
Road C NB Left	E	73.7	F	80.1
Road C NB Through-Right	C	28.5	D	40.3
Road C SB Left	E	72.6	F	81.4
Road C SB Through-Right	C	31.8	C	26.3

Table 6 (Continued)

Year 2035 with NELHA LOS Cont.	AM		PM	
	LOS	Delay	LOS	Delay
Road G and Road F	**Unsignalized**		**Unsignalized**	
Road G EB Left-Through	A	6.4	A	7.6
Road F SB Left-Right	A	10.2	B	12.5
Road E and Road D	**Unsignalized**		**Unsignalized**	
Road E EB Left-Right	B	12.8	F	97.5
Road D NB Left	A	8.6	B	10.6
Road D NB Through	A	0.0	A	0.0
Road D SB Through-Right	A	0.0	A	0.0
Road A and Road B	**Unsignalized**		**Unsignalized**	
Road A WB Left	B	11.2	B	13.7
Road B SB Left	A	7.4	A	8.6
Road A and Road C	**B**	**17.7**	**C**	**29.3**
Road A EB Left	D	36.6	D	41.3
Road A EB Through-Right	B	18.7	C	34.8
Road A WB Left	C	22.7	D	41.4
Road A WB Through-Right	B	15.3	D	39.3
Road C NB Left	C	30.7	E	56.6
Road C NB Through	B	17.5	C	26.0
Road C NB Right	B	16.6	C	24.2
Road C SB Left	C	31.1	D	54.3
Road C SB Through-Right	B	14.9	C	21.9
OTEC Rd and Road F	**Unsignalized**		**Unsignalized**	
OTEC Rd WB Left	A	8.0	A	7.7
Road F NB Left-Right	A	9.9	B	11.7
OTEC Rd and NELHA Access Road	**Unsignalized**		**Unsignalized**	
OTEC Rd SB Left-Through	A	3.7	A	3.6
NELHA Access Rd WB Left-Right	A	8.9	A	8.7

F. Summary of Results

Overall, most intersections are projected to operate at LOS D, however:

1. The Queen Kaahumanu Highway and Kaiminani Drive/Road A intersection is projected to operate at LOS E in both the AM (60.6 sec/veh) and PM (56.4 sec/veh) peak hours. Only the northbound through and right turn movements and southbound right turn movement are projected to operate at LOS D, or better, at this intersection during either peak hour.
2. Left-turning movements at the intersection of Queen Kaahumanu Highway and OTEC Road will experience LOS E in the eastbound direction during the AM peak hour and LOS F in the eastbound direction in the PM peak hour. In the northbound direction, the left-turning movement is projected to experience LOS F during both peak hours.
3. A number of individual turning movements will experience excessive delay at the internal signalized intersections.

VI. YEAR 2035 RECOMMENDATIONS

The future roadway system recommendations are separated into regional and internal roadway components.

A. Regional Roadway Improvements

1. Queen Kaahumanu Highway

a) Queen Kaahumanu Highway and Kaiminani Drive intersection

Queen Kaahumanu Highway is assumed to remain a four-lane roadway by the year 2035 time frame. The currently planned ultimate signalized configuration for the Queen Kaahumanu Highway and Kaiminani Drive/Road A intersection would provide exclusive right-turn lanes at all approaches except for the Road A eastbound approach, single left-turn lanes for the Queen Kaahumanu Highway northbound and southbound approaches, and Road A eastbound approach and double left-turn lanes for the Kaiminani Drive westbound approach. Acceleration lanes for the eastbound and westbound right-turning movements are proposed, and deceleration lengths for the highway approaches and the Kaiminani Drive approach are proposed.

b) Queen Kaahumanu Highway at OTEC Road

The intersection of Queen Kaahumanu Highway at OTEC Road is projected to operate as a full-access, signalized intersection within the year 2035 time. This intersection is expected to be fully channelized with exclusive right-turn, a single left-turn lane from Queen Kaahumanu Highway to OTEC Road, and deceleration and acceleration lanes on its southbound and eastbound approaches, respectively.

B. Internal Roadway Improvements

The internal roadways were evaluated with regard to amount of traffic carried. The roadway cross-sections as proposed in the section below were found to adequately handle the traffic demand projected at build out of the NELHA development.

Figures 20 and 21 summarize the proposed cross-sections for the internal roadways. Figure 22 shows the Year 2035 lane configurations. The internal intersections that were studied include: Road A and Road C, Road A and Road B, OTEC Road and Road C/Road D, Road D and Road E, OTEC Road and Road B, OTEC Road and Road F, Road F and Road G, and OTEC Road and North NELHA Access Road.

1. NELHA Internal Intersections

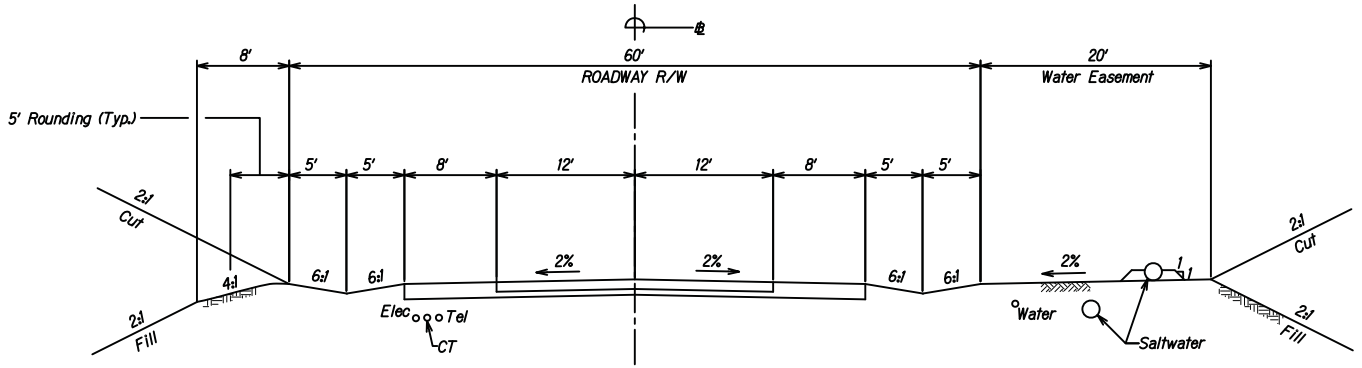
Road A and Road C is proposed to be a signalized, four leg intersection with exclusive left turn lanes at all approaches, through and shared through/right-turn lanes on the southbound Road C and eastbound Road A approaches, and an exclusive right-turn lane on the northbound Road C approach.

Road A and Road B is proposed to be an unsignalized T-intersection with a left and right-turn lane in the westbound approach, a left-turn lane and through lane for the southbound approach, and a shared through/right-turn lane for the northbound approach.

At the OTEC Road and Road C/Road D intersection, the eastbound OTEC Road approach is recommended to carry one through lane, a shared through/right-turn lane and left-turn lane. The westbound OTEC Road approach is recommended to carry one shared through-right turn lane and one left-turn lane. The southbound Road C and northbound Road D approaches are recommended to have one through lane, one shared through/right-turn lane and a dedicated left-turn lane. This intersection is proposed to be signalized.

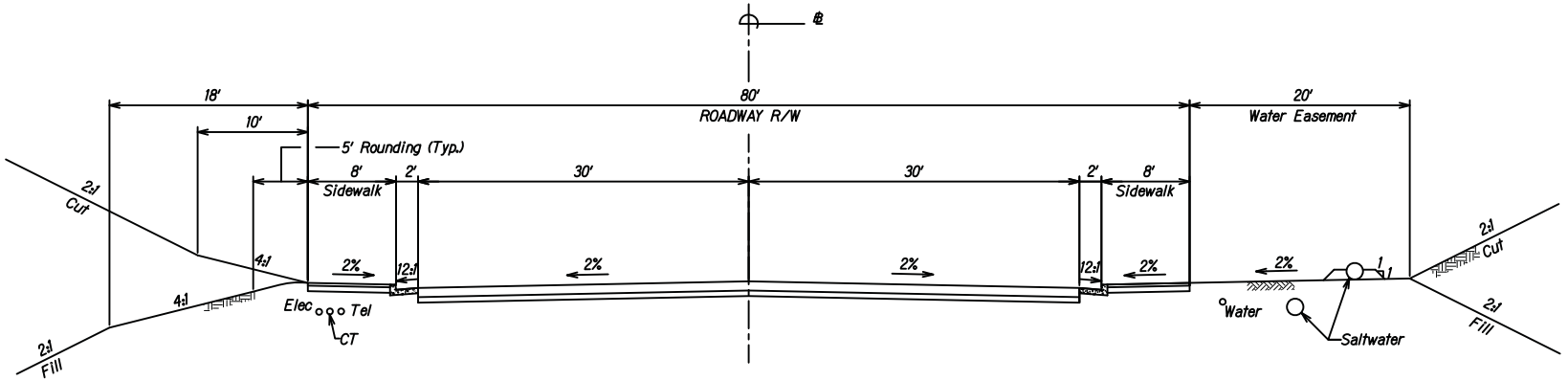
The Road D and Road E intersection is proposed be unsignalized and to have two through lanes and a left-turn lane in the northbound approach and one through lane and a shared through/right-turn lane in the southbound approach. The eastbound approach is proposed to carry one lane.

The OTEC Road and Road B intersection is proposed to remain unsignalized. The Road B southbound approach is projected to require one left-turn and one right-turn lane, the OTEC Road eastbound approach is projected to require one left turn lane and one through lane, and the OTEC Road westbound approach requires a shared through/right turn lane.



TYPICAL SECTIONS
Scale: 1" =5'

BUSINESS & INDUSTRIAL STREET
(FOR ROAD A & B)



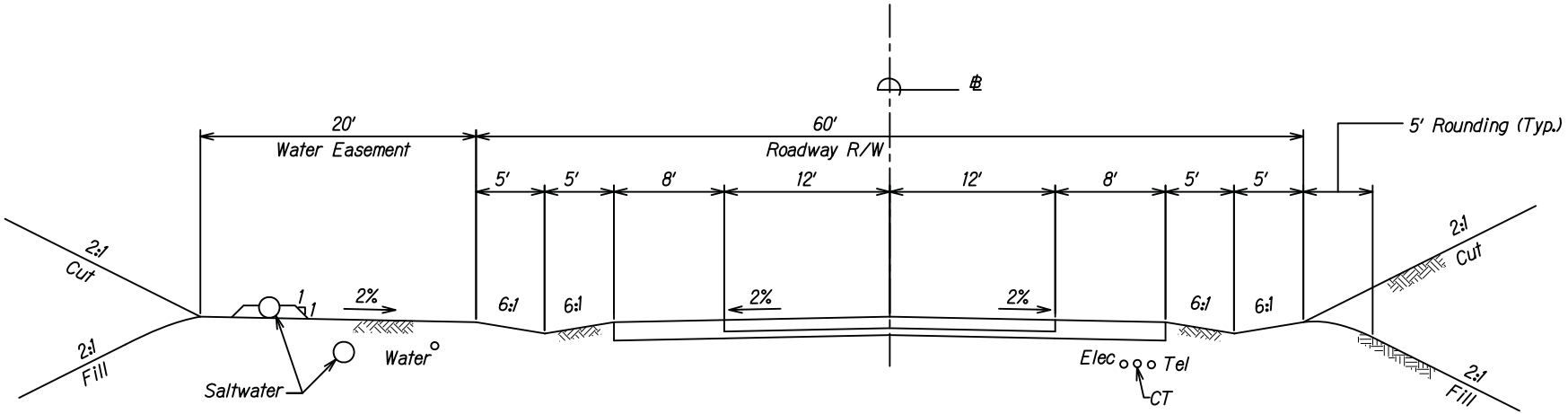
TYPICAL SECTIONS
Scale: 1" =5'

SECONDARY ARTERIALS
(FOR ROAD C & D)

5' 2.5' 0 5' 10'

Roads A, B, C, and D Typical Cross-section

Figure
20



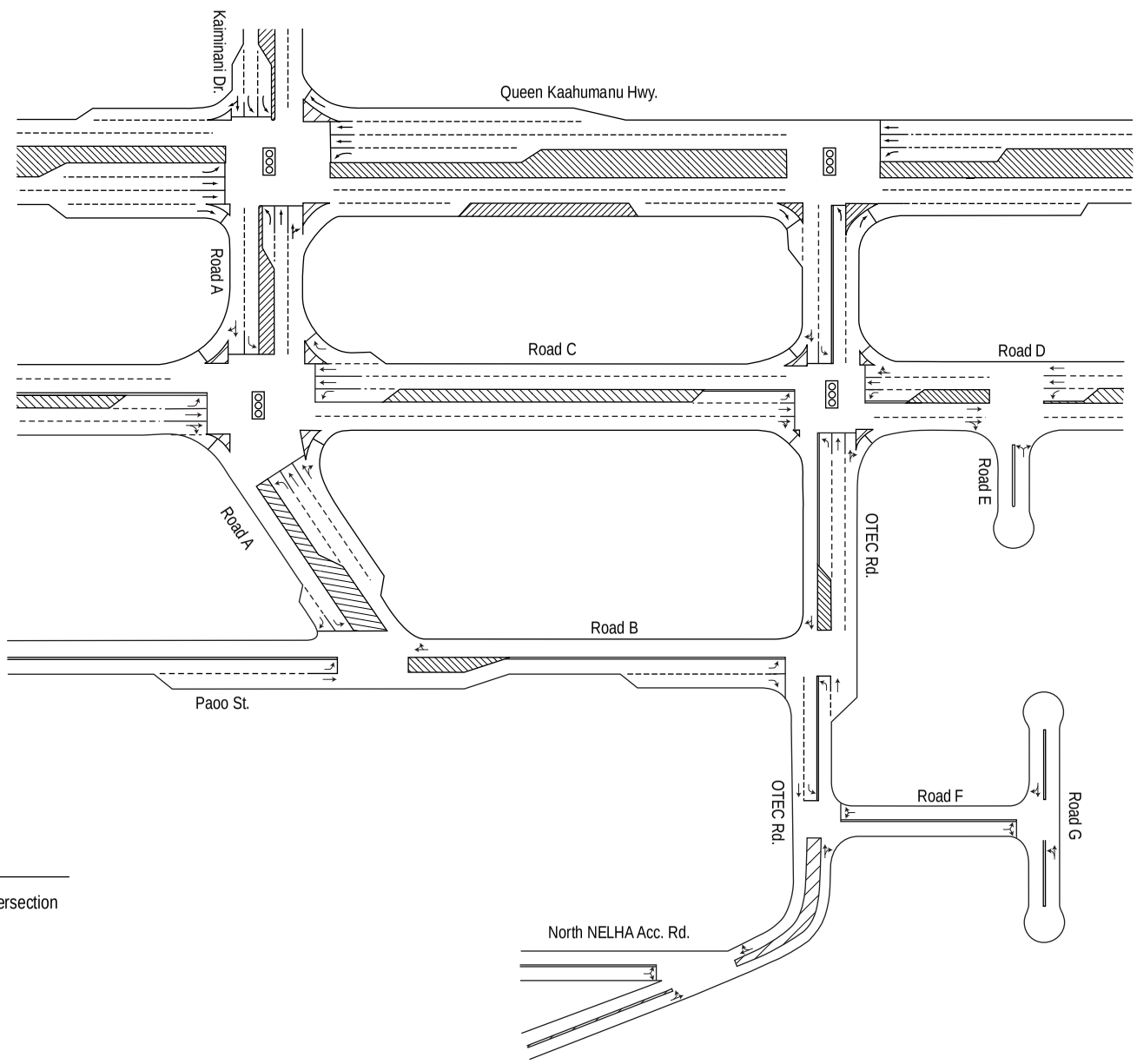
TYPICAL SECTIONS

BUSINESS ⊄ INDUSTRIAL STREET
(FOR ROAD E, F ⊄ G)

5' 2.5' 0 5' 10'

Roads E, F, and G Typical Cross-section

Figure
21



Recommended Year 2035 Lane Configurations

Figure 22

OTEC Road and Road F intersection is proposed to be unsignalized and carry a through lane and left-turn lane in the westbound OTEC Road approach and one lane each at the eastbound OTEC Road and northbound Road F approaches.

The Road F and Road G intersection and OTEC Road and North NELHA Access Road intersection are both proposed to be T-intersections with stop control on the minor side street/s and one lane for each approach.

These lane configurations should be able to process the anticipated demand through the intersection.

VII. SUMMARY AND CONCLUSION

The regional growth in West Hawaii, the proposed expansion of the Keahole International Airport and developments at NELHA, Ooma Beachside Village, the Shores at Kohanaiki, and the Kohanaiki Business Park, all contribute to traffic increases along this portion of Queen Kaahumanu Highway. However, the planned two mauka arterials and one makai arterial roadways are expected to divert traffic away from Queen Kaahumanu Highway. The roadway improvements proposed for Keahole International Airport will also improve the regional traffic circulation and alleviate a significant portion of traffic.

The need for continuing improvement to the transportation system to address this growth has been recognized by the County of Hawaii. A number of major roadway improvements that should have a significant effect on future traffic on Queen Kaahumanu Highway and other existing roadways are planned for the area. The following improvements are assumed to be operational by year 2035, within the timeframe of the NELHA development's long-term analysis:

1. North-south direction Keohokalole Highway,
2. North-south direction Kamanu Street extension/Main Street,
3. North-south direction Makai Frontage Road,
4. Mauka-makai direction Kaiminani Drive/Road A,
5. Road P as planned in Keahole International Airport Master Plan.

These improvements will expand the system-wide capacity and have the additional effect of relieving some of the pressure on existing roadways. They are prerequisites for the Queen Kaahumanu Highway and Kaiminani Drive intersection and Queen Kaahumanu Highway and OTEC Road intersection to operate at acceptable level of services. Without these regional improvements, the traffic operations at Queen Kaahumanu Highway and Kaiminani Drive intersection and Queen Kaahumanu Highway and OTEC Road intersection will deteriorate significantly.

The construction of the NELHA internal roadway system is important in not only allowing for the ease of movement and access to the various phases of development, but also in providing alternatives to drivers as they enter and exit the development. The recommendations include:

Queen Kaahumanu Highway

Queen Kaahumanu Highway will remain as a four-lane roadway by the year 2035 time frame as it will be in year 2015. The Queen Kaahumanu Highway and Kaiminani Drive/Road A intersection is proposed to provide exclusive right-turn lanes at all approaches except for the Road A eastbound approach, single left-turn lanes for the Queen Kaahumanu Highway northbound and southbound approaches, and Road A eastbound approach and double left-turn lanes for the Kaiminani Drive westbound approach.

The volumes of the Kaiminani Drive westbound left turns will not increase because the Keoholalole Highway and Kamanu Street extension will open by the Year 2035 and are projected to intercept many regional southbound trips.

The intersection of Queen Kaahumanu Highway at OTEC Road is expected to be signalized by the year 2035. A single northbound left-turn lane from Queen Kaahumanu Highway to OTEC Road should be built.

Road A

Road A will function as a collector with the posted speed limit of 25 mph. Between Queen Kaahumanu Highway and Road C, it should be widened from its year 2015 cross section to a two westbound lane and three eastbound lane cross section by the year 2035 in order to accommodate the projected traffic volumes.

A few hundred feet west of Road C, Road A becomes two lanes with the turning lanes at the intersection with Road B. The intersection of Road A at Road B is proposed to be a stop-controlled T-intersection with an stop sign on Road A.

Road B

Road B will function as a minor collector with the posted speed limit of 25 mph. It will be two lanes between Road A and OTEC Road with a right-turn lane on its southbound approach to OTEC Road. The lane configuration at this intersection will remain as in year 2015.

Road C and Road D

Road C and Road D will be the segments of the planned Makai Frontage Road within NELHA properties. Road C and Road D will function as an arterial with the posted speed limit of 35 mph. It will be four lanes within NELHA's property. The intersection of Road C and OTEC Road will be signalized.

The Road D at Road E intersection is also proposed to be unsignalized.

Roads E, F, G, and North NELHA Access Road

Roads F, G, and North NELHA Road will function as local roads with posted speed limits of 25 mph. The intersections on these roads will be stop-controlled. With the exception of OTEC Road's westbound approach to Road F, they will not warrant exclusive turning lanes.

The future driveways for the planned developments have not been laid out at this stage. When the land uses of the parcels start to take shape, the sizes, the spacing, and the locations of the future driveways should be carefully planned. It is recommended wherever possible, the driveways should align to avoid too many T-intersections that are placed too closely.

The signal warrants (Appendix D) and the turning lane warrants documented in this report were based on the projected peak hour volumes. Once the intersections are open, their operations should be monitored closely and the signal warrants and the turning warrants should be conducted periodically to ensure the necessary improvements will be initiated when warranted.

Based on the analysis of the proposed NELHA development in the context of the projected growth for the Kailua-Kona region, it is concluded that the NELHA development along with its internal roadway and regional network improvements are an integral part of the regional circulation in Keahole. The NELHA and adjacent developments will place demands on the surrounding transportation system, but with the transportation improvements identified in this report, these demands can be accommodated by the proposed roadway network.

APPENDICES

APPENDIX A

TRAFFIC COUNT DATA

Parsons Brinckerhoff
1001 Bishop Street #2400
Honolulu, HI 96813

File Name : Hina Lani_MERGED_2010_09_21_PA
Site Code : 00000006
Start Date : 9/14/2010
Page No : 1

Groups Printed- Unshifted

	Queen Kaahumanu Southbound					Hina Lani Westbound					Queen Kaahumanu Northbound					Hina Lani Eastbound					
Start Time	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Int. Total
07:30	0	43	165	0	208	0	45	0	42	87	0	0	142	82	224	0	0	0	0	0	519
07:45	0	42	189	0	231	0	52	0	50	102	0	0	130	83	213	0	0	0	0	0	546
Total	0	85	354	0	439	0	97	0	92	189	0	0	272	165	437	0	0	0	0	0	1065
08:00	0	39	151	0	190	0	58	0	65	123	0	0	155	101	256	0	0	0	0	0	569
08:15	0	40	151	0	191	0	59	0	52	111	0	0	148	103	251	0	0	0	0	0	553
Grand Total	0	164	656	0	820	0	214	0	209	423	0	0	575	369	944	0	0	0	0	0	2187
Apprch %	0	20	80	0		0	50.6	0	49.4		0	0	60.9	39.1		0	0	0	0		
Total %	0	7.5	30	0	37.5	0	9.8	0	9.6	19.3	0	0	26.3	16.9	43.2	0	0	0	0	0	

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File Name : Hina Lani_MERGED_2010_09_21_PA
Site Code : 00000006
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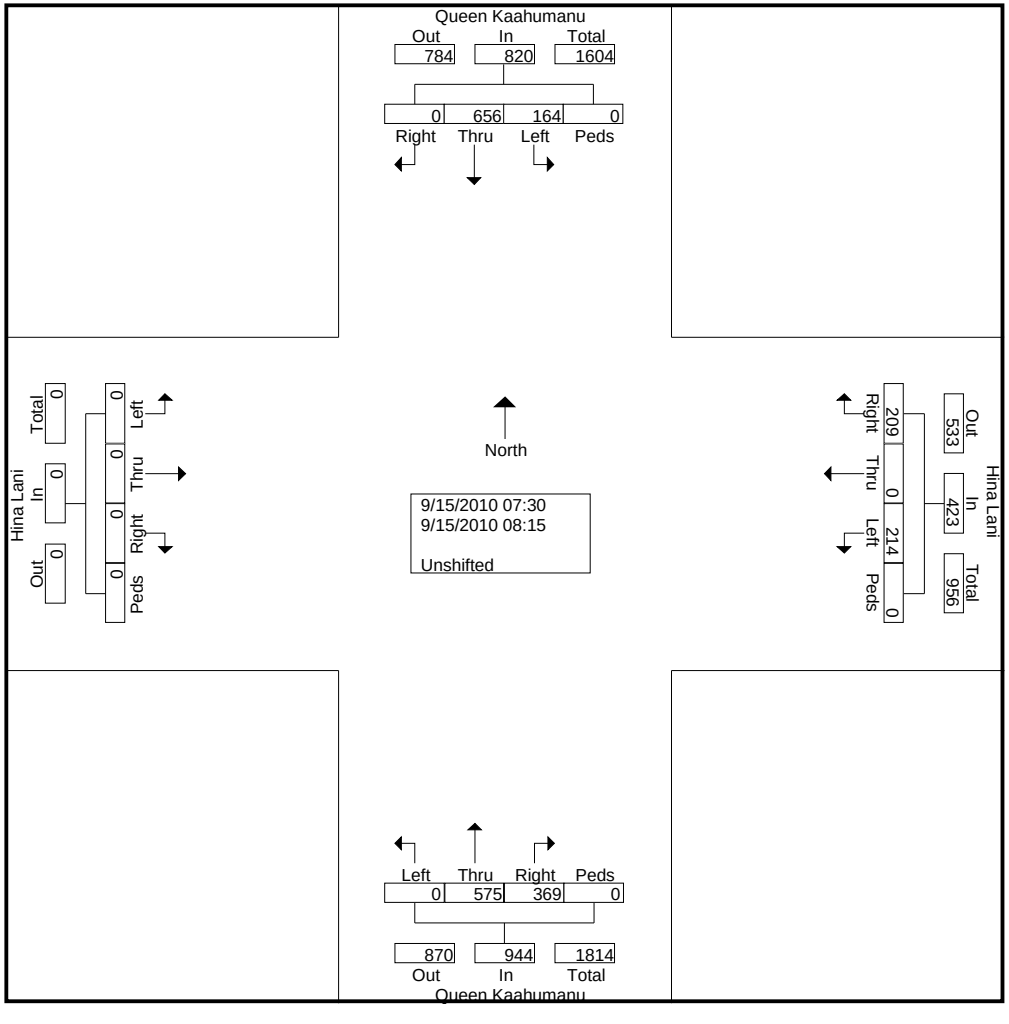

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File Name : Hina Lani_MERGED_2010_09_21_PA
Site Code : 00000006
Start Date : 9/14/2010
Page No : 1

Groups Printed- Unshifted

	Queen Kaahumanu Southbound					Hina Lani Westbound					Queen Kaahumanu Northbound					Hina Lani Eastbound					
Start Time	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Int. Total
11:00	0	61	143	0	204	0	82	0	52	134	0	0	133	126	259	0	0	0	0	0	597
11:15	0	52	141	0	193	0	111	0	66	177	0	0	126	132	258	0	0	0	0	0	628
11:30	0	70	151	0	221	0	91	0	74	165	0	0	145	114	259	0	0	0	0	0	645
11:45	0	56	168	0	224	0	103	0	67	170	0	0	173	134	307	0	0	0	0	0	701
Total	0	239	603	0	842	0	387	0	259	646	0	0	577	506	1083	0	0	0	0	0	2571
Grand Total	0	239	603	0	842	0	387	0	259	646	0	0	577	506	1083	0	0	0	0	0	2571
Apprch %	0	28.4	71.6	0		0	59.9	0	40.1		0	0	53.3	46.7		0	0	0	0		
Total %	0	9.3	23.5	0	32.7	0	15.1	0	10.1	25.1	0	0	22.4	19.7	42.1	0	0	0	0	0	

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File Name : Hina Lani_MERGED_2010_09_21_PA
Site Code : 00000006
Start Date : 9/14/2010
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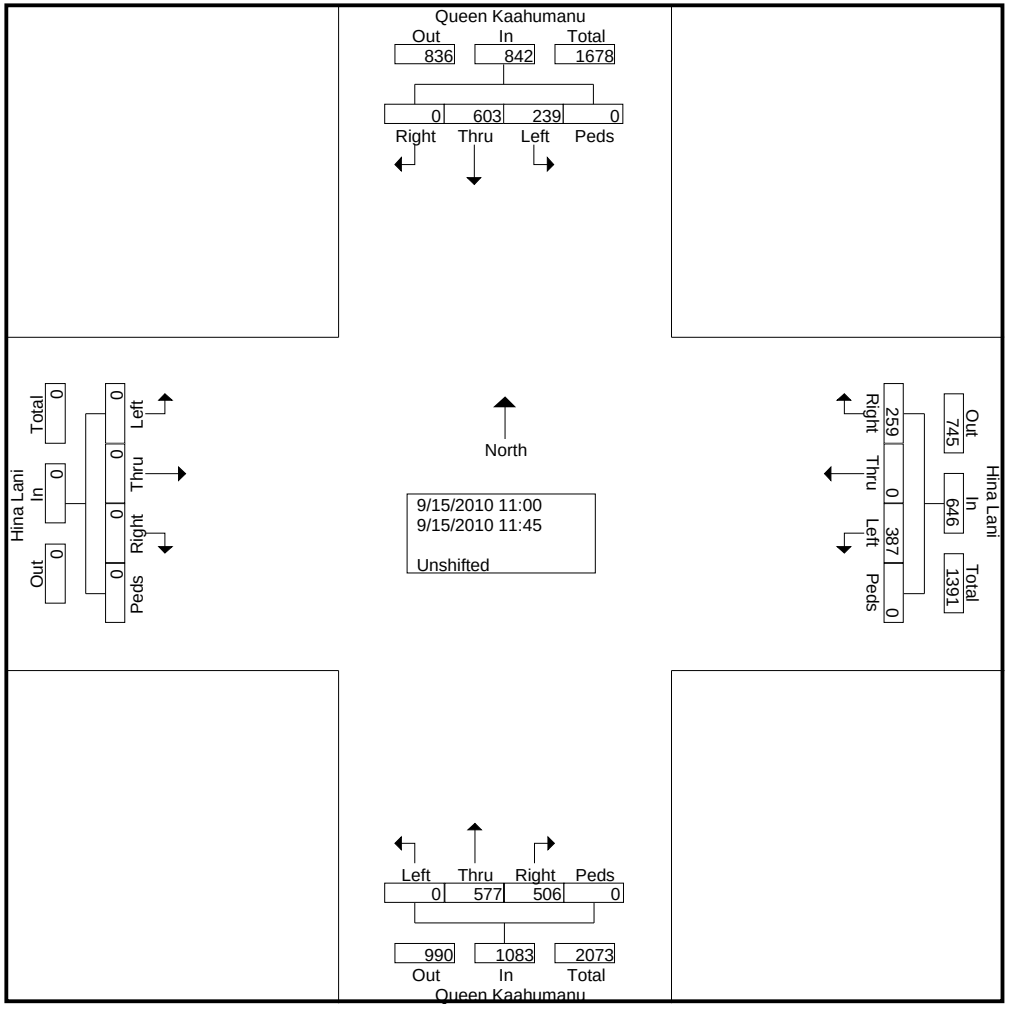

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File Name : Hina Lani_MERGED_2010_09_21_PA
Site Code : 00000006
Start Date : 9/14/2010
Page No : 1

Groups Printed- Unshifted

	Queen Kaahumanu Southbound					Hina Lani Westbound					Queen Kaahumanu Northbound					Hina Lani Eastbound					
Start Time	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Int. Total
15:00	0	63	150	0	213	0	89	0	65	154	0	0	167	105	272	0	0	0	0	0	639
15:15	0	55	181	0	236	0	100	0	59	159	0	0	134	105	239	0	0	0	0	0	634
15:30	0	59	175	0	234	0	101	0	66	167	0	0	139	137	276	0	0	0	0	0	677
15:45	0	69	188	0	257	0	97	0	55	152	0	0	156	137	293	0	0	0	0	0	702
Total	0	246	694	0	940	0	387	0	245	632	0	0	596	484	1080	0	0	0	0	0	2652
Grand Total	0	246	694	0	940	0	387	0	245	632	0	0	596	484	1080	0	0	0	0	0	2652
Apprch %	0	26.2	73.8	0		0	61.2	0	38.8		0	0	55.2	44.8		0	0	0	0		
Total %	0	9.3	26.2	0	35.4	0	14.6	0	9.2	23.8	0	0	22.5	18.3	40.7	0	0	0	0	0	

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File Name : Hina Lani_MERGED_2010_09_21_PA
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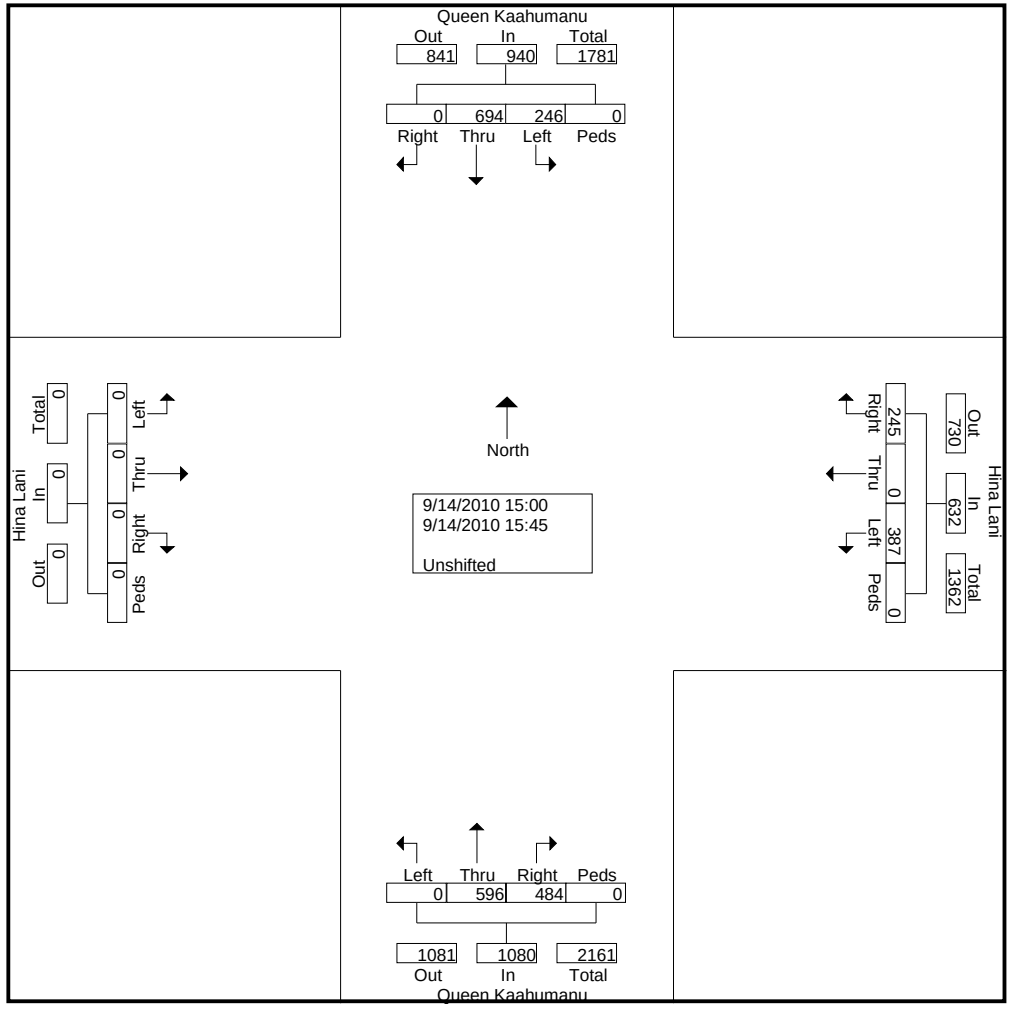

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File Name : Kaiminani St_MERGED_2010_09_21_PA
Site Code : 00000004
Start Date : 9/14/2010
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Groups Printed- Unshifted - Bank 1

	Queen Kaahumanu Southbound					Kaiminani Westbound					Queen Kaahumanu Northbound					Eastbound					
Start Time	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Int. Total
07:30	0	4	108	0	112	0	137	0	36	173	0	1	110	33	144	0	0	0	0	0	429
07:45	0	5	103	0	108	0	116	0	42	158	0	0	94	31	125	0	0	0	0	0	391
Total	0	9	211	0	220	0	253	0	78	331	0	1	204	64	269	0	0	0	0	0	820
08:00	0	7	114	0	121	0	70	0	38	108	0	0	129	49	178	0	0	0	0	0	407
08:15	0	10	130	0	140	0	87	0	25	112	0	0	127	44	171	0	0	0	0	0	423
Grand Total	0	26	455	0	481	0	410	0	141	551	0	1	460	157	618	0	0	0	0	0	1650
Apprch %	0	5.4	94.6	0		0	74.4	0	25.6		0	0.2	74.4	25.4		0	0	0	0		
Total %	0	1.6	27.6	0	29.2	0	24.8	0	8.5	33.4	0	0.1	27.9	9.5	37.5	0	0	0	0	0	
Unshifted	0	26	455	0	481	0	410	0	141	551	0	1	460	157	618	0	0	0	0	0	1650
% Unshifted	0	100	100	0	100	0	100	0	100	100	0	100	100	100	100	0	0	0	0	0	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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File Name : Kaiminani St_MERGED_2010_09_21_PA
Site Code : 00000004
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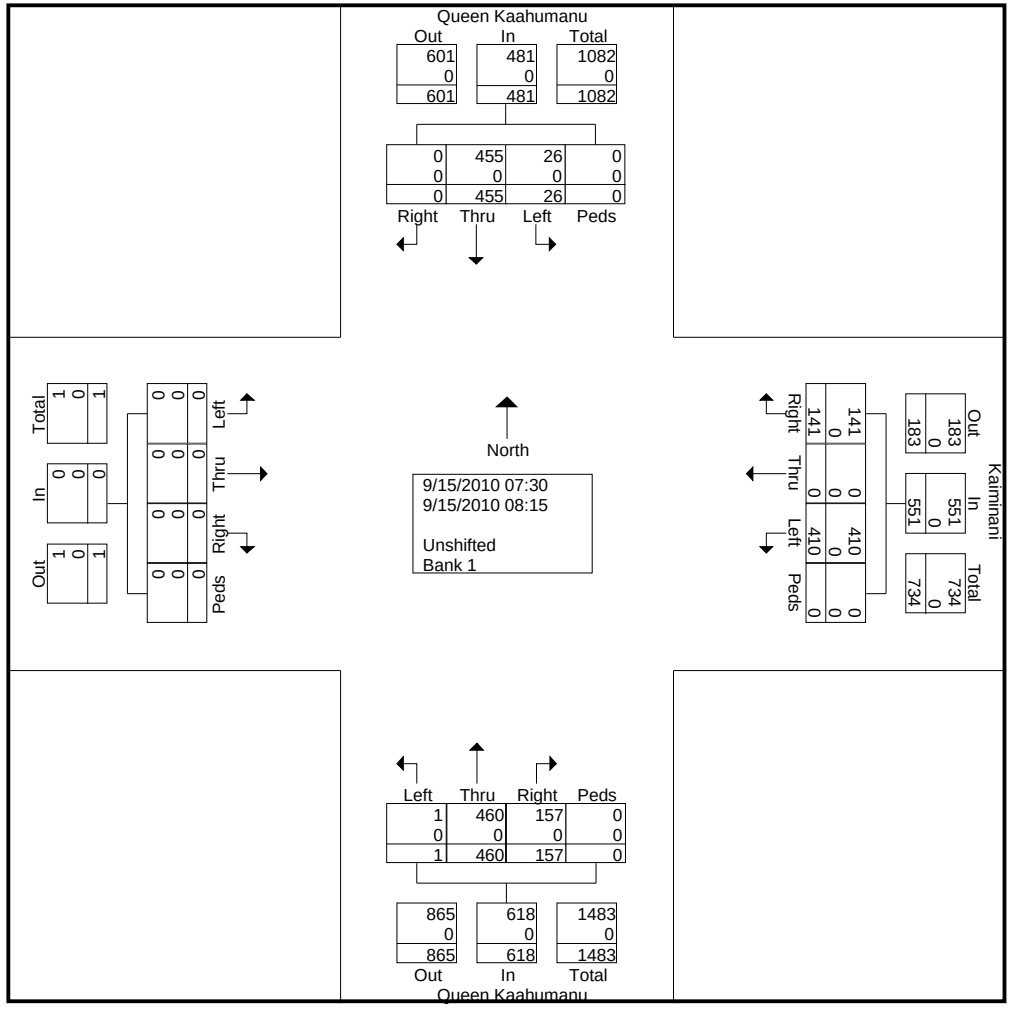

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File Name : Kaiminani St_MERGED_2010_09_21_PA
Site Code : 00000004
Start Date : 9/14/2010
Page No : 1

Groups Printed- Unshifted - Bank 1

	Queen Kaahumanu Southbound					Kaiminani Westbound					Queen Kaahumanu Northbound					Eastbound					
Start Time	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Int. Total
11:00	0	20	130	0	150	0	58	0	9	67	0	0	118	46	164	0	0	0	0	0	381
11:15	0	19	141	0	160	0	51	0	18	69	0	0	134	40	174	0	0	0	0	0	403
11:30	0	20	144	0	164	0	55	0	20	75	0	0	137	41	178	0	0	0	0	0	417
11:45	0	28	161	0	189	0	54	0	20	74	0	0	129	84	213	0	0	0	0	0	476
Total	0	87	576	0	663	0	218	0	67	285	0	0	518	211	729	0	0	0	0	0	1677
Grand Total	0	87	576	0	663	0	218	0	67	285	0	0	518	211	729	0	0	0	0	0	1677
Apprch %	0	13.1	86.9	0		0	76.5	0	23.5		0	0	71.1	28.9		0	0	0	0		
Total %	0	5.2	34.3	0	39.5	0	13	0	4	17	0	0	30.9	12.6	43.5	0	0	0	0	0	
Unshifted	0	87	576	0	663	0	218	0	67	285	0	0	518	211	729	0	0	0	0	0	1677
% Unshifted	0	100	100	0	100	0	100	0	100	100	0	0	100	100	100	0	0	0	0	0	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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File Name : Kaiminani St_MERGED_2010_09_21_PA
Site Code : 00000004
Start Date : 9/14/2010
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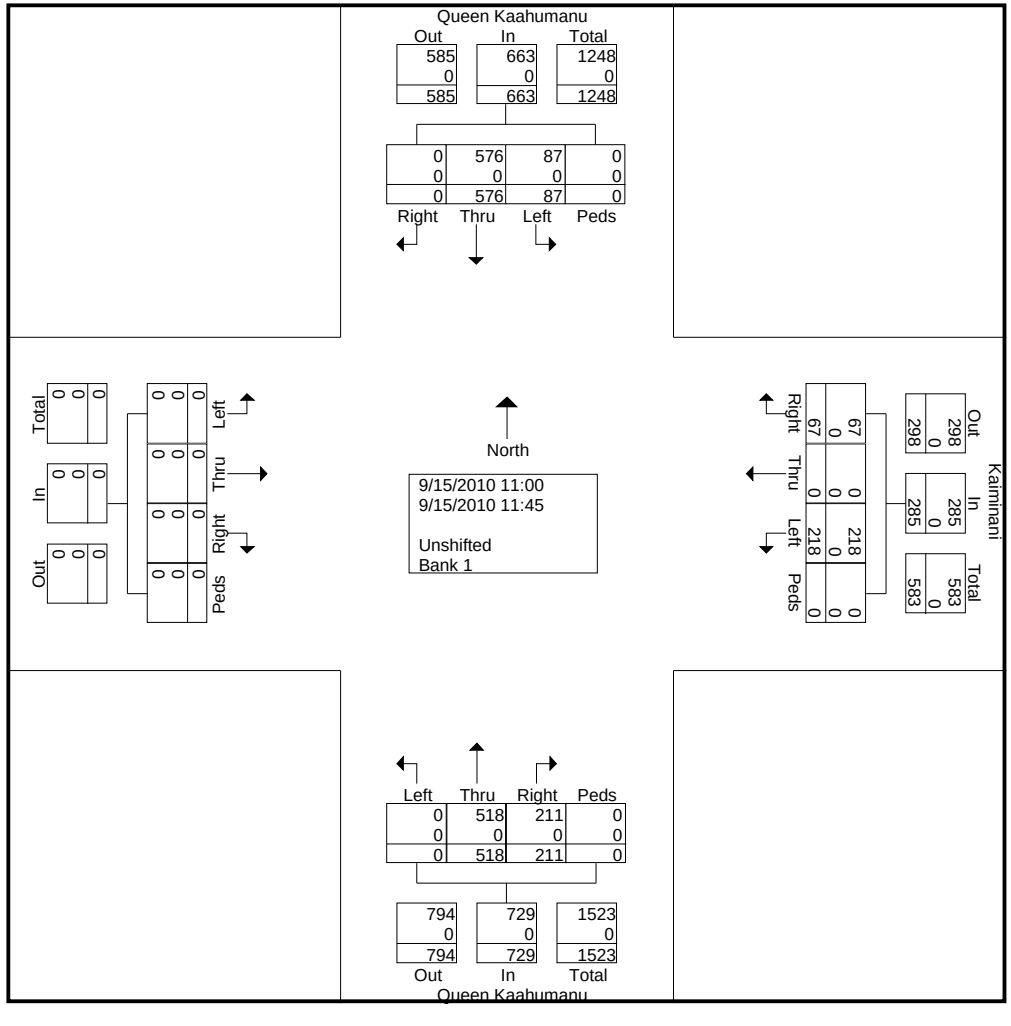

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File Name : Kaiminani St_MERGED_2010_09_21_PA
Site Code : 00000004
Start Date : 9/14/2010
Page No : 1

Groups Printed- Unshifted - Bank 1

	Queen Kaahumanu Southbound					Kaiminani Westbound					Queen Kaahumanu Northbound					Eastbound					
Start Time	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Int. Total
15:00	0	34	155	0	189	0	57	0	12	69	0	0	145	76	221	0	0	0	0	0	479
15:15	0	41	156	0	197	0	41	0	15	56	0	0	104	60	164	0	0	0	0	0	417
15:30	0	45	168	0	213	1	59	0	14	74	0	0	120	74	194	0	0	0	0	0	481
15:45	0	52	196	0	248	0	48	0	8	56	0	0	117	84	201	0	0	0	0	0	505
Total	0	172	675	0	847	1	205	0	49	255	0	0	486	294	780	0	0	0	0	0	1882
Grand Total	0	172	675	0	847	1	205	0	49	255	0	0	486	294	780	0	0	0	0	0	1882
Apprch %	0	20.3	79.7	0		0.4	80.4	0	19.2		0	0	62.3	37.7		0	0	0	0		
Total %	0	9.1	35.9	0	45	0.1	10.9	0	2.6	13.5	0	0	25.8	15.6	41.4	0	0	0	0	0	
Unshifted	0	172	675	0	847	1	205	0	49	255	0	0	486	294	780	0	0	0	0	0	1882
% Unshifted	0	100	100	0	100	100	100	0	100	100	0	0	100	100	100	0	0	0	0	0	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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File Name : Kaiminani St_MERGED_2010_09_21_PA
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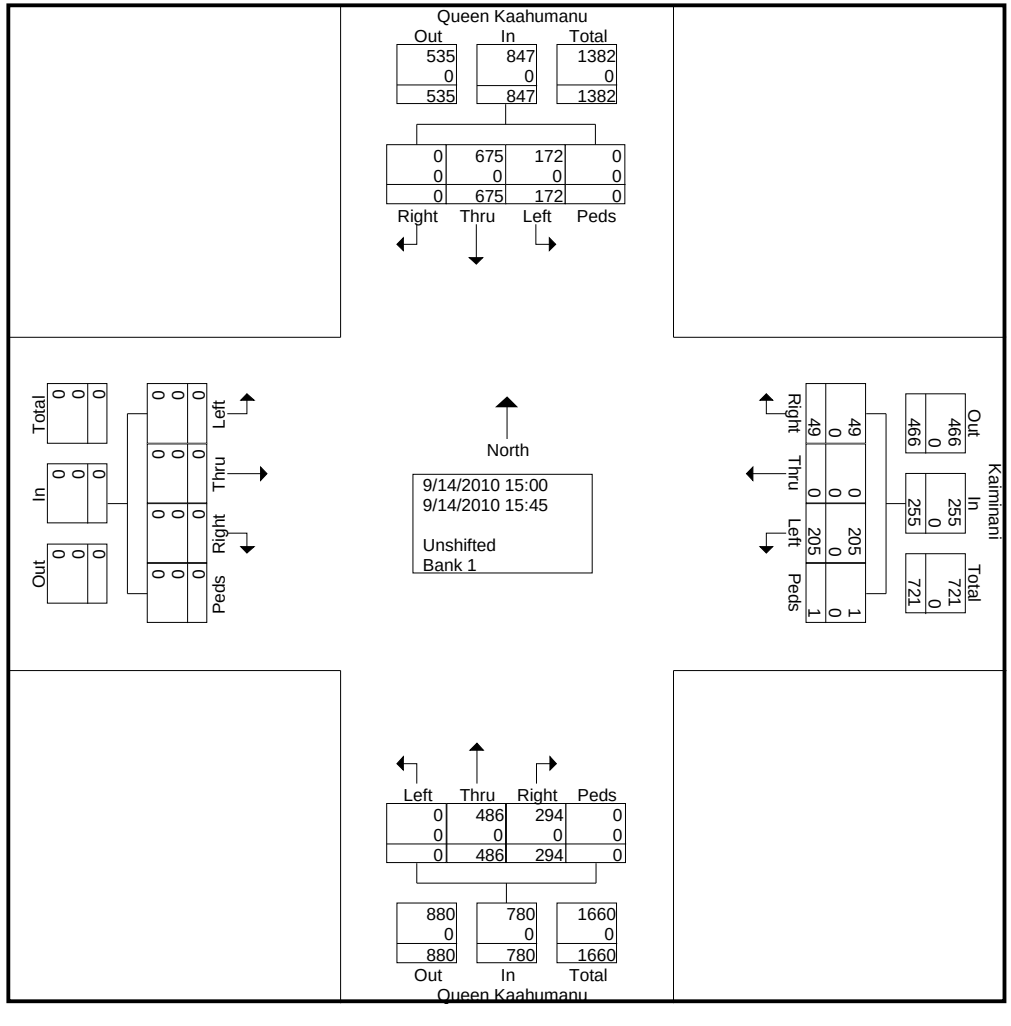

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File Name : Keahole Airport Rd_MERGED_2010_09_21_PA
Site Code : 00000003
Start Date : 9/14/2010
Page No : 1

Groups Printed- Unshifted - Bank 1

	Queen Kaahumanu Southbound					Keahole Airport Westbound					Queen Kaahumanu Northbound					Keahole Airport Eastbound					
Start Time	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Int. Total
07:30	0	0	97	9	106	0	0	0	0	0	0	33	101	0	134	0	3	0	15	18	258
07:45	0	0	98	13	111	0	0	0	0	0	0	41	120	0	161	0	3	0	13	16	288
Total	0	0	195	22	217	0	0	0	0	0	0	74	221	0	295	0	6	0	28	34	546
08:00	0	0	90	14	104	0	0	0	0	0	0	58	97	0	155	0	3	0	23	26	285
08:15	0	0	79	12	91	0	0	0	0	0	0	72	103	0	175	0	14	0	51	65	331
Grand Total	0	0	364	48	412	0	0	0	0	0	0	204	421	0	625	0	23	0	102	125	1162
Apprch %	0	0	88.3	11.7		0	0	0	0		0	32.6	67.4	0		0	18.4	0	81.6		
Total %	0	0	31.3	4.1	35.5	0	0	0	0	0	0	17.6	36.2	0	53.8	0	2	0	8.8	10.8	
Unshifted	0	0	364	48	412	0	0	0	0	0	0	204	421	0	625	0	23	0	102	125	1162
% Unshifted	0	0	100	100	100	0	0	0	0	0	0	100	100	0	100	0	100	0	100	100	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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File Name : Keahole Airport Rd_MERGED_2010_09_21_PA
Site Code : 00000003
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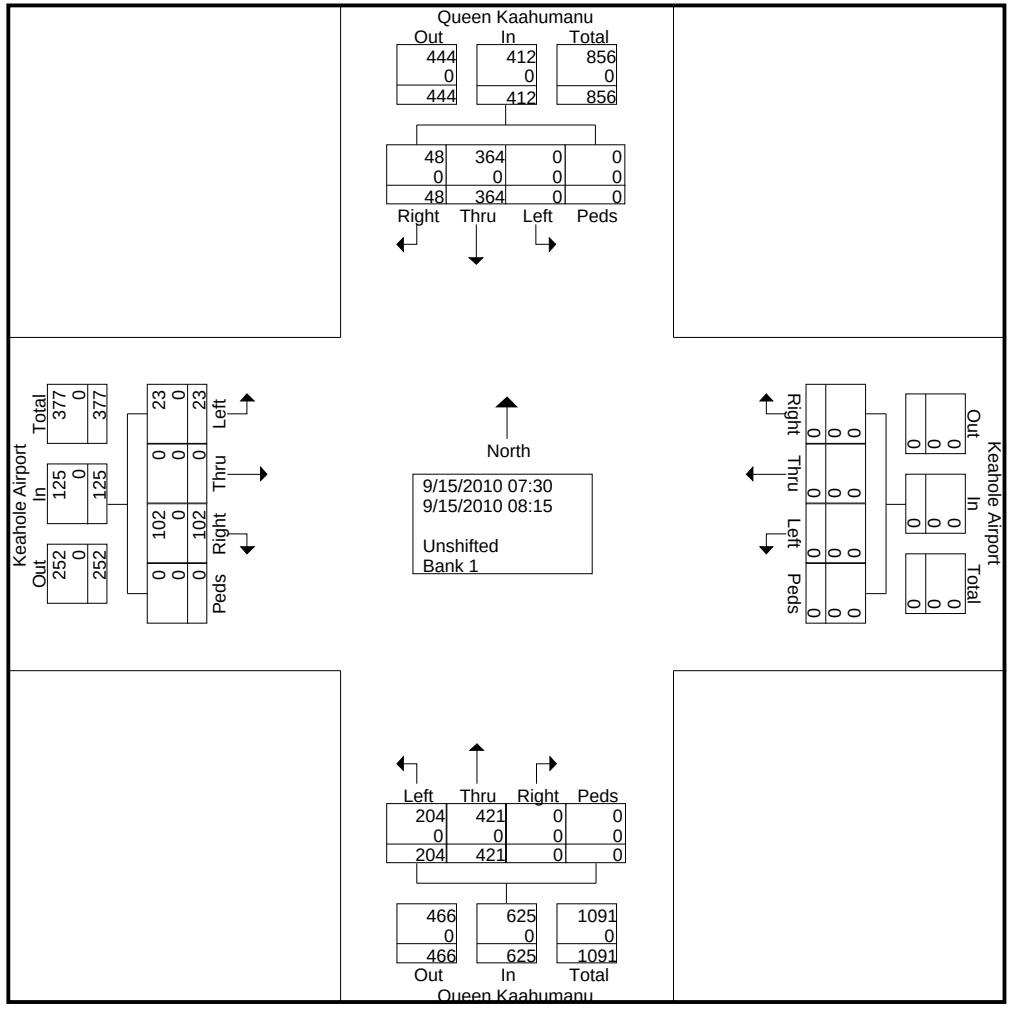

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File Name : Keahole Airport Rd_MERGED_2010_09_21_PA
Site Code : 00000003
Start Date : 9/14/2010
Page No : 1

Groups Printed- Unshifted - Bank 1

	Queen Kaahumanu Southbound					Keahole Airport Westbound					Queen Kaahumanu Northbound					Keahole Airport Eastbound					
Start Time	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Int. Total
11:00	0	0	99	28	127	0	0	0	0	0	0	51	84	0	135	0	18	0	51	69	331
11:15	0	0	93	20	113	0	0	0	0	0	0	70	85	0	155	0	11	0	55	66	334
11:30	0	0	112	23	135	0	0	0	0	0	0	67	90	0	157	0	32	0	50	82	374
11:45	0	0	111	22	133	0	0	0	0	0	0	76	72	0	148	0	20	0	76	96	377
Total	0	0	415	93	508	0	0	0	0	0	0	264	331	0	595	0	81	0	232	313	1416
Grand Total	0	0	415	93	508	0	0	0	0	0	0	264	331	0	595	0	81	0	232	313	1416
Apprch %	0	0	81.7	18.3		0	0	0	0		0	44.4	55.6	0		0	25.9	0	74.1		
Total %	0	0	29.3	6.6	35.9	0	0	0	0	0	0	18.6	23.4	0	42	0	5.7	0	16.4	22.1	
Unshifted	0	0	415	93	508	0	0	0	0	0	0	264	331	0	595	0	81	0	232	313	1416
% Unshifted	0	0	100	100	100	0	0	0	0	0	0	100	100	0	100	0	100	0	100	100	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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File Name : Keahole Airport Rd_MERGED_2010_09_21_PA
Site Code : 00000003
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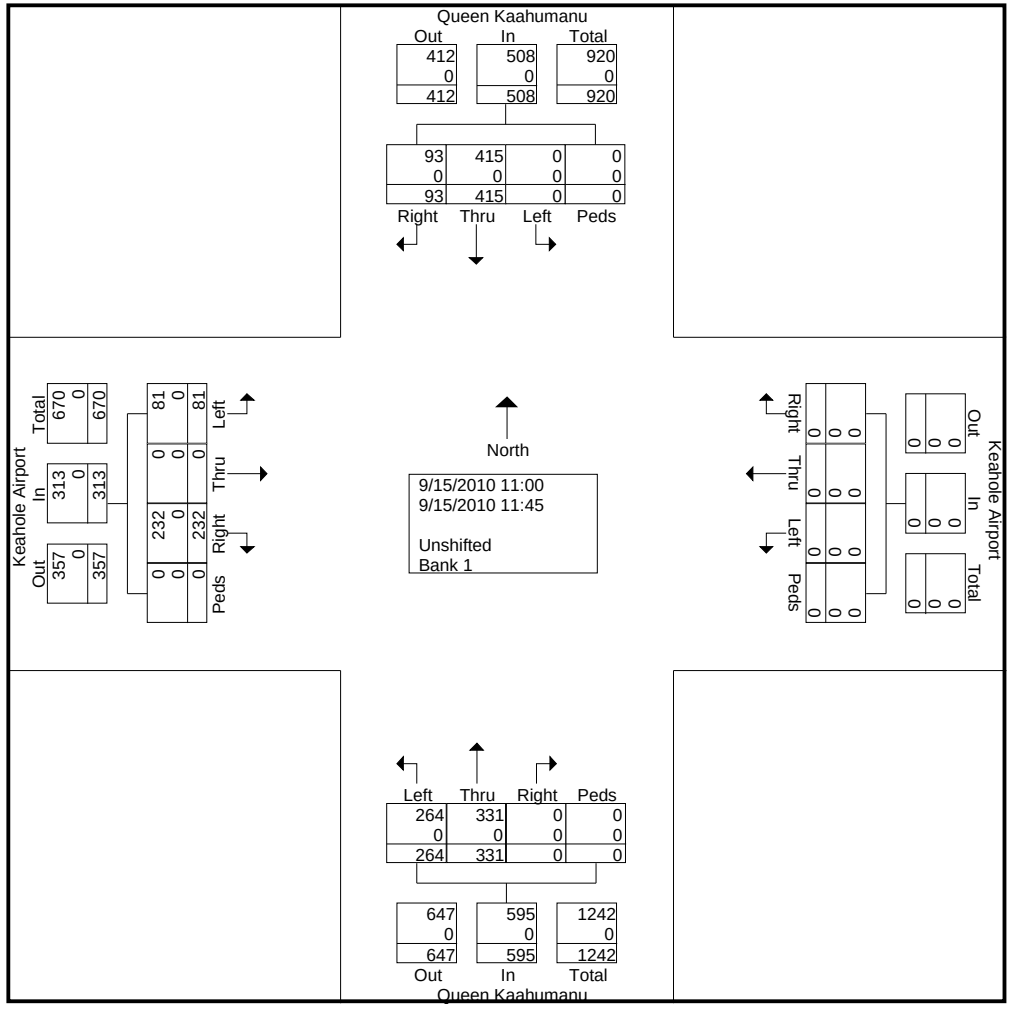

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File Name : Keahole Airport Rd_MERGED_2010_09_21_PA
Site Code : 00000003
Start Date : 9/14/2010
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Groups Printed- Unshifted - Bank 1

	Queen Kaahumanu Southbound					Keahole Airport Westbound					Queen Kaahumanu Northbound					Keahole Airport Eastbound					
Start Time	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Int. Total
15:00	0	0	137	9	146	0	0	0	0	0	0	32	127	0	159	0	21	0	47	68	373
15:15	0	0	148	6	154	0	0	0	0	0	0	54	89	0	143	0	26	0	64	90	387
15:30	0	0	151	12	163	0	0	0	0	0	0	42	107	0	149	0	19	0	57	76	388
15:45	0	0	187	6	193	0	0	0	0	0	0	39	102	0	141	0	18	0	52	70	404
Total	0	0	623	33	656	0	0	0	0	0	0	167	425	0	592	0	84	0	220	304	1552
Grand Total	0	0	623	33	656	0	0	0	0	0	0	167	425	0	592	0	84	0	220	304	1552
Apprch %	0	0	95	5		0	0	0	0		0	28.2	71.8	0		0	27.6	0	72.4		
Total %	0	0	40.1	2.1	42.3	0	0	0	0	0	0	10.8	27.4	0	38.1	0	5.4	0	14.2	19.6	
Unshifted	0	0	623	33	656	0	0	0	0	0	0	167	425	0	592	0	84	0	220	304	1552
% Unshifted	0	0	100	100	100	0	0	0	0	0	0	100	100	0	100	0	100	0	100	100	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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File Name : Keahole Airport Rd_MERGED_2010_09_21_PA
Site Code : 00000003
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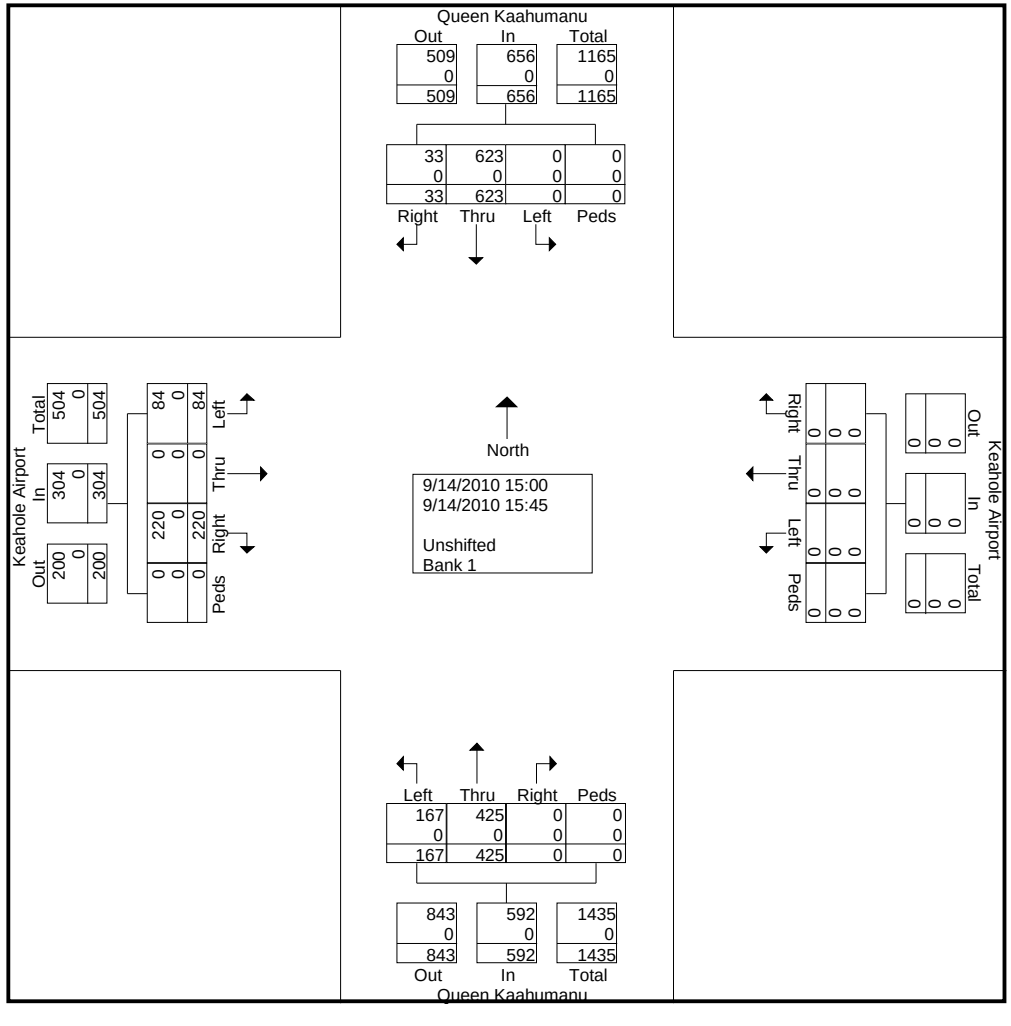

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File Name : OTEC Rd_MERGED_2010_09_21_PA
Site Code : 00000005
Start Date : 9/14/2010
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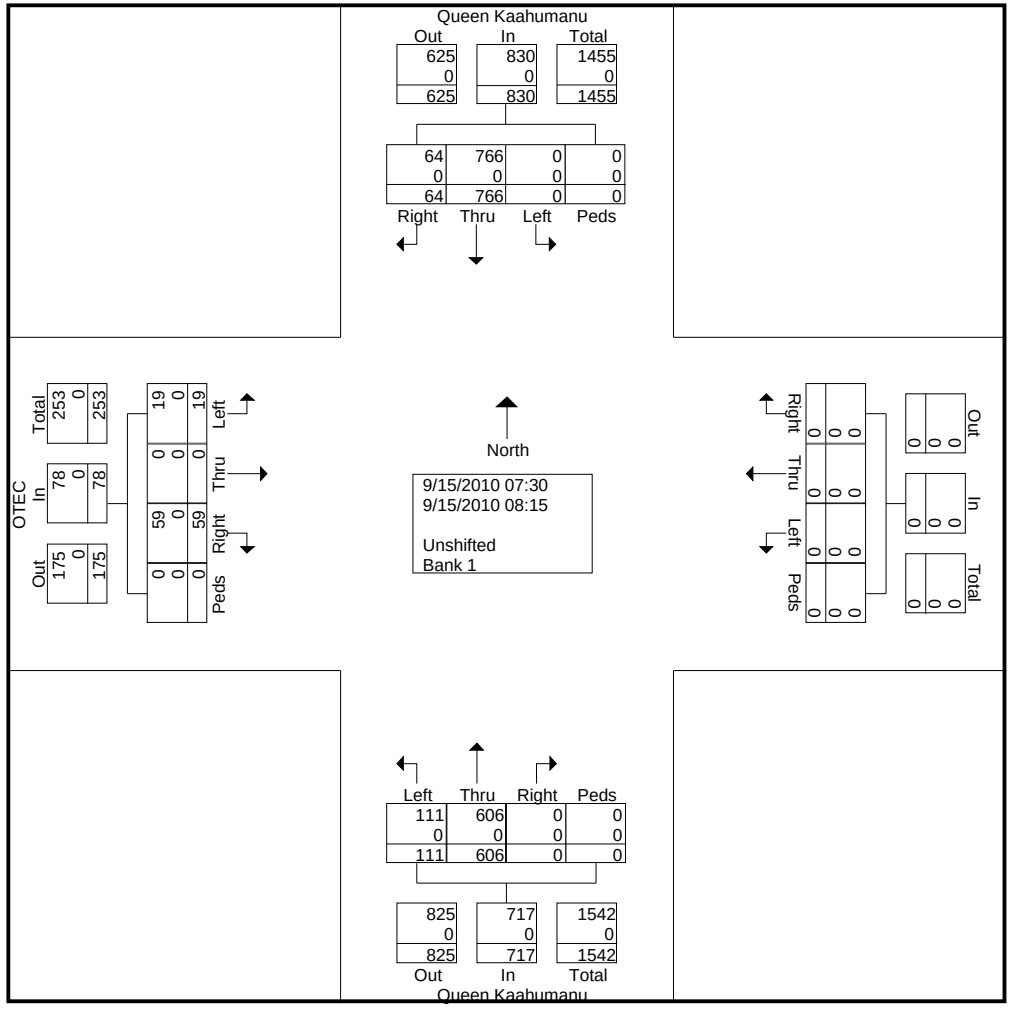
Groups Printed- Unshifted - Bank 1

	Queen Kaahumanu Southbound					Westbound					Queen Kaahumanu Northbound					OTEC Eastbound					
Start Time	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Int. Total
07:30	0	0	226	16	242	0	0	0	0	0	0	23	130	0	153	0	3	0	13	16	411
07:45	0	0	202	15	217	0	0	0	0	0	0	26	130	0	156	0	4	0	7	11	384
Total	0	0	428	31	459	0	0	0	0	0	0	49	260	0	309	0	7	0	20	27	795
08:00	0	0	159	18	177	0	0	0	0	0	0	38	160	0	198	0	6	0	16	22	397
08:15	0	0	179	15	194	0	0	0	0	0	0	24	186	0	210	0	6	0	23	29	433
Grand Total	0	0	766	64	830	0	0	0	0	0	0	111	606	0	717	0	19	0	59	78	1625
Apprch %	0	0	92.3	7.7		0	0	0	0		0	15.5	84.5	0		0	24.4	0	75.6		
Total %	0	0	47.1	3.9	51.1	0	0	0	0	0	0	6.8	37.3	0	44.1	0	1.2	0	3.6	4.8	
Unshifted	0	0	766	64	830	0	0	0	0	0	0	111	606	0	717	0	19	0	59	78	1625
% Unshifted	0	0	100	100	100	0	0	0	0	0	0	100	100	0	100	0	100	0	100	100	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Parsons Brinckerhoff
1001 Bishop Street #2400
Honolulu, HI 96813

File Name : OTEC Rd_MERGED_2010_09_21_PA
Site Code : 00000005
Start Date : 9/14/2010
Page No : 2



Parsons Brinckerhoff
1001 Bishop Street #2400
Honolulu, HI 96813

File Name : OTEC Rd_MERGED_2010_09_21_PA
Site Code : 00000005
Start Date : 9/14/2010
Page No : 1

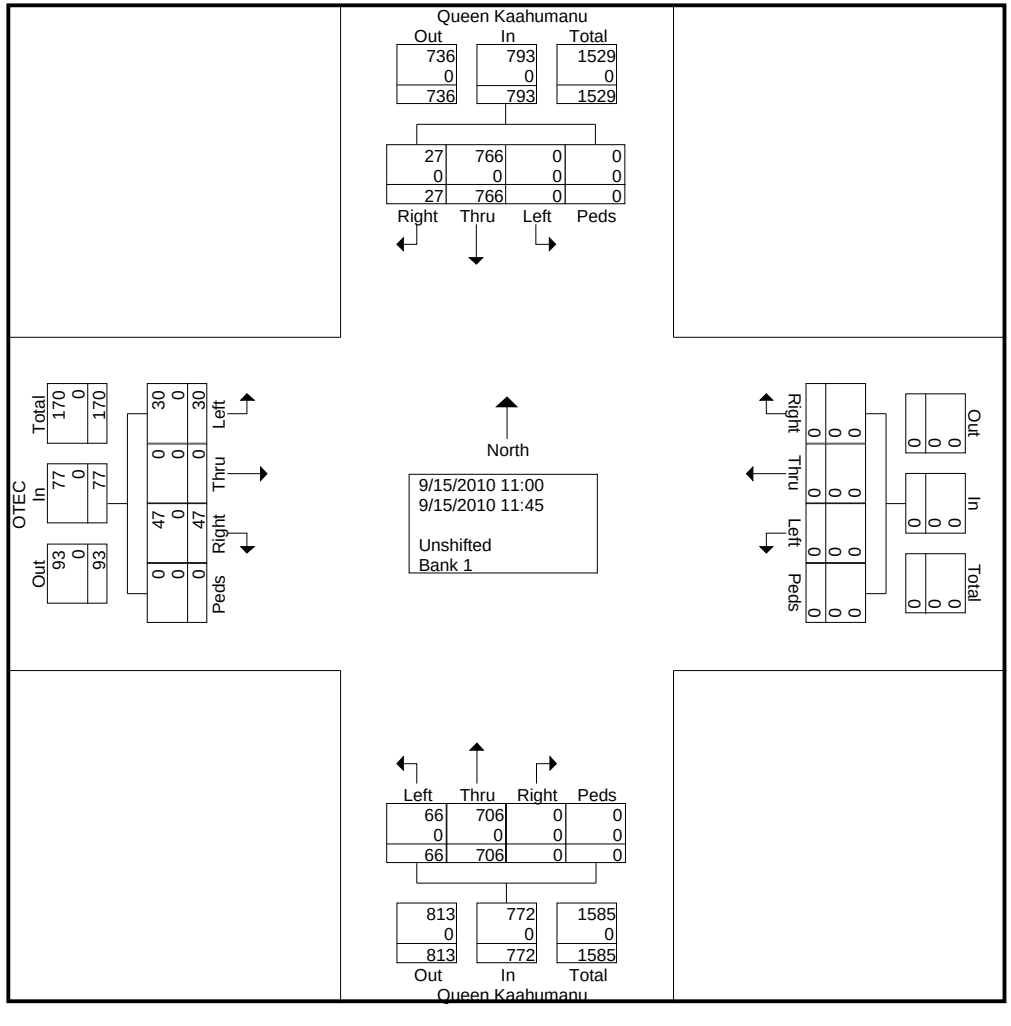
Groups Printed- Unshifted - Bank 1

	Queen Kaahumanu Southbound					Westbound					Queen Kaahumanu Northbound					OTEC Eastbound					
Start Time	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Int. Total
11:00	0	0	196	5	201	0	0	0	0	0	0	5	153	0	158	0	3	0	14	17	376
11:15	0	0	176	6	182	0	0	0	0	0	0	13	171	0	184	0	10	0	8	18	384
11:30	0	0	187	7	194	0	0	0	0	0	0	20	176	0	196	0	7	0	13	20	410
11:45	0	0	207	9	216	0	0	0	0	0	0	28	206	0	234	0	10	0	12	22	472
Total	0	0	766	27	793	0	0	0	0	0	0	66	706	0	772	0	30	0	47	77	1642
Grand Total	0	0	766	27	793	0	0	0	0	0	0	66	706	0	772	0	30	0	47	77	1642
Apprch %	0	0	96.6	3.4		0	0	0	0		0	8.5	91.5	0		0	39	0	61		
Total %	0	0	46.7	1.6	48.3	0	0	0	0	0	0	4	43	0	47	0	1.8	0	2.9	4.7	
Unshifted	0	0	766	27	793	0	0	0	0	0	0	66	706	0	772	0	30	0	47	77	1642
% Unshifted	0	0	100	100	100	0	0	0	0	0	0	100	100	0	100	0	100	0	100	100	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Parsons Brinckerhoff

1001 Bishop Street #2400
Honolulu, HI 96813

File Name : OTEC Rd_MERGED_2010_09_21_PA
Site Code : 00000005
Start Date : 9/14/2010
Page No : 2



Parsons Brinckerhoff
1001 Bishop Street #2400
Honolulu, HI 96813

File Name : OTEC Rd_MERGED_2010_09_21_PA
Site Code : 00000005
Start Date : 9/14/2010
Page No : 1

Groups Printed- Unshifted - Bank 1

	Queen Kaahumanu Southbound					Westbound					Queen Kaahumanu Northbound					OTEC Eastbound					
Start Time	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Peds	Left	Thru	Right	App. Total	Int. Total
15:00	0	0	192	5	197	0	0	0	0	0	0	13	199	0	212	0	9	0	17	26	435
15:15	0	0	208	6	214	0	0	0	0	0	0	10	182	0	192	0	21	0	14	35	441
15:30	0	0	216	10	226	0	0	0	0	0	0	10	191	0	201	0	10	0	21	31	458
15:45	0	0	228	8	236	0	0	0	0	0	0	8	201	0	209	0	13	0	19	32	477
Total	0	0	844	29	873	0	0	0	0	0	0	41	773	0	814	0	53	0	71	124	1811
Grand Total	0	0	844	29	873	0	0	0	0	0	0	41	773	0	814	0	53	0	71	124	1811
Apprch %	0	0	96.7	3.3		0	0	0	0		0	5	95	0		0	42.7	0	57.3		
Total %	0	0	46.6	1.6	48.2	0	0	0	0	0	0	2.3	42.7	0	44.9	0	2.9	0	3.9	6.8	
Unshifted	0	0	844	29	873	0	0	0	0	0	0	41	773	0	814	0	53	0	71	124	1811
% Unshifted	0	0	100	100	100	0	0	0	0	0	0	100	100	0	100	0	100	0	100	100	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Parsons Brinckerhoff

1001 Bishop Street #2400
Honolulu, HI 96813

File Name : OTEC Rd_MERGED_2010_09_21_PA
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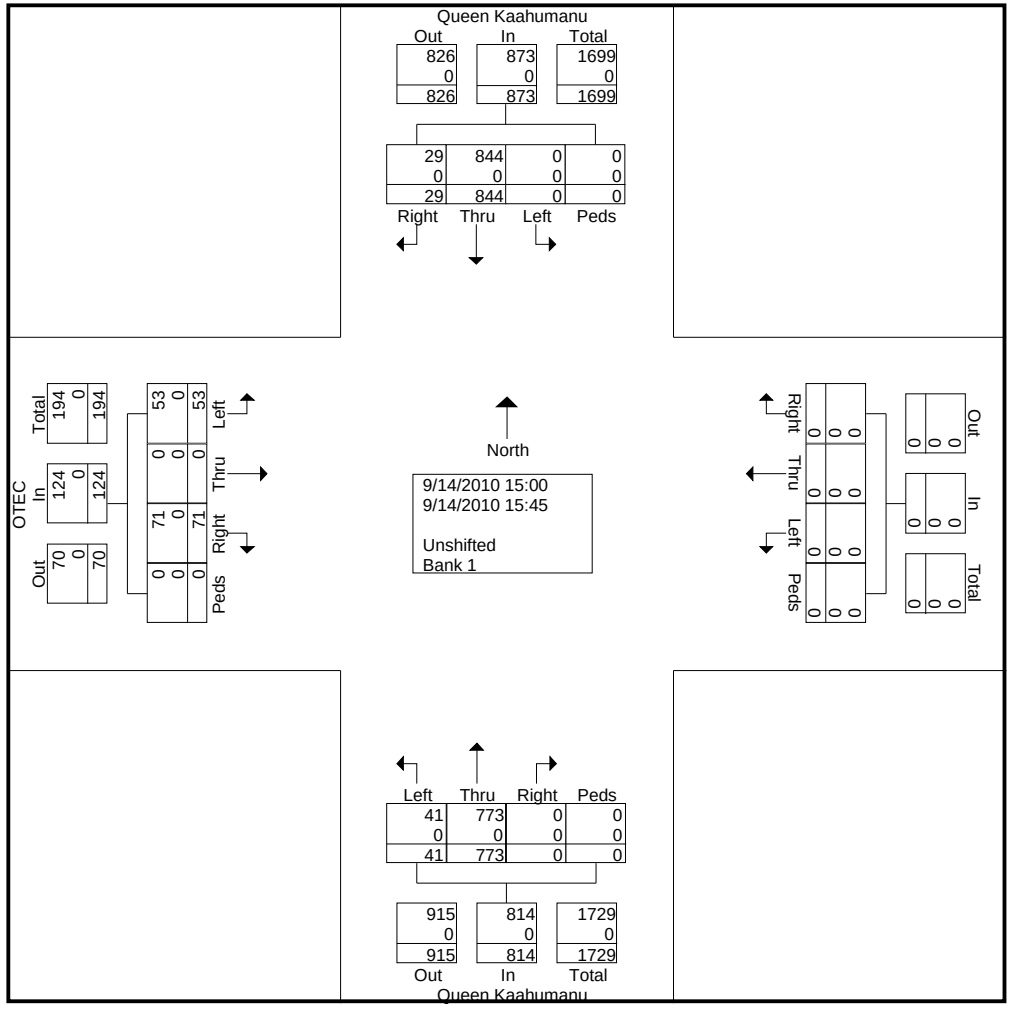
Page No : 2



Data Collection Worksheet

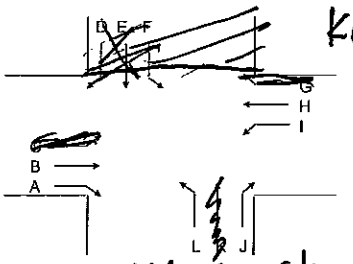
Intersection: KEAHOLE st. & HALAU

Date: 9/15/2010

By: shenghong Li

Weather: Sunny

8-Digit ID Code: 2

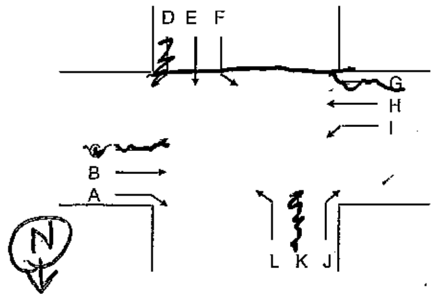


AM Peak Count

TIME	A	B	C	D	E	F	G	H	I	J	K	L
6:30 - 6:45	12	43						30	16	3		7
6:45 - 7:00	15	53						23	8	1		10
7:00 ~ 7:15	10	48						23	9	1		6
7:15 - 7:30	11	55						23	10	1		6
7:30 ~ 7:45	7	38						16	8			3
7:45 ~ 8:00	8	40						9	9			1
8:00 - 8:15	15	66										
8:15 - 8:30		74								1		
	16							32	12	1		14

Data Collection Worksheet

Intersection: Kealahole Airport Rd / Holulu
Date: 9/15/10
By: SL
Weather:



Street:

Street:

Mid-day Peak Count

TIME	A	B	C	D	E	F	G	H	I	J	K	L
10:00 ~10:15	15		49				59				18	
10:15	20		43				55			1		10
10:30	27		45									
10:45												
11:00												
11:15-												
11:30												
11:45-												

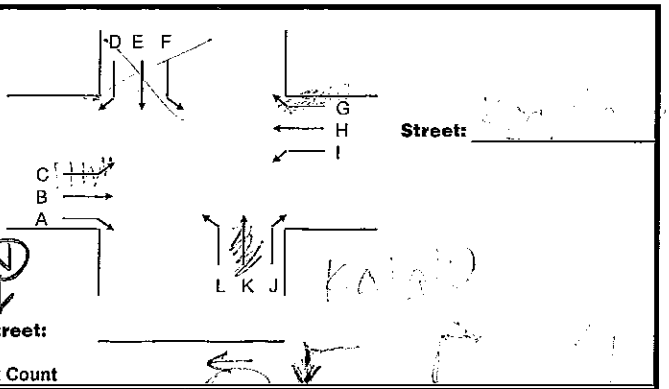
Data Collection Worksheet

Intersection: Kenhole Airport Rd / Halulu

Date: 9/14/2010

By: Shenghong Li

Weather: Sunny



PM Peak Count

TIME	A	B	C	D	E	F	G	H	I	J	K	L
2:30 - 2:45	15											
			46				55		20			
2:45 - 3:00			30									
	30								22			
3:00 - 3:15												
							51					
3:15 - 3:30												
			43								25	
3:30 - 3:45												
							55		15		20	
3:45 - 4:00												
			51			53			9			
4:00 - 4:15									14		11	
	53		20			56						
4:15 - 4:30						43					16	
20			42						25			

Data Collection Worksheet

Rental Car

Intersection: Paoo & Keahole

Date: 6/15/10

By: DM

Weather: Nice

8-Digit ID Code: 1

Airport

Street: Keahole

Mailbox

Street: Paoo

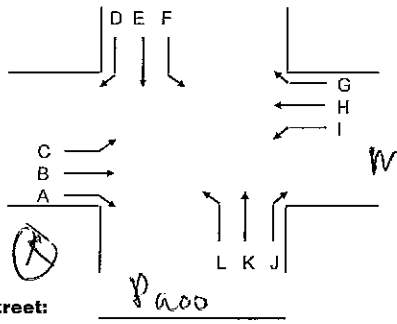
AM Peak Count

TIME	A	B	C	D	E	F	G	H	I	J	K	L
630-645	0	41	0	7	0	3	14	32	0	0	0	0
645-700	0	30	0	10	0	2	9	48	0	0	0	0
700-715	1	29	0	10	1	3	5	42	0	1	0	0
715-730	0	26	0	9	0	2	11	33	1	0	0	1
730-745	1	26	0	7	0	1	2	39	0	0	1	0
745-800	0	23	1	12	0	0	10	36	0	1	0	0
800-815	0	30	0	8	0	1	13	40	0	0	0	0
815-830	1	58	1	18	0	3	9	49	0	0	0	0

Data Collection Worksheet

Rental Car

Intersection: Paoo / Kealoha
Date: 9/15/2010
By: DM
Weather: Sunny



Mid-day Peak Count

TIME	A	B	C	D	E	F	G	H	I	J	K	L
1000–1015	11		1							11		
	2		66 Ø	19	Ø	5	6		54 Ø	2	Ø	Ø
1015–1030					1	1	11			1		
	Ø		74 Ø	15	2	6	2	1 36	Ø	1	Ø	Ø
1030–1045			11									
	Ø		62 Ø	21	Ø	10	4	45	Ø	Ø	Ø	Ø
1045–1100												
	D		65	25	Ø	10	5		59 Ø	Ø	Ø	Ø
1100–1115	1111		1			111	1				111	1
	4		53 1	16	Ø	3	1		144 Ø	Ø	3	1
1115–1130	1											1
	1		71 Ø	17	Ø	6	3		83 Ø	Ø	Ø	1
1130–1145	111					11	11					
	Ø 88		1	20	Ø	7	2	11	77 Ø	Ø	Ø	Ø
1145–1200	1					111	111		1	1		1

2214 6280 - Honolulu

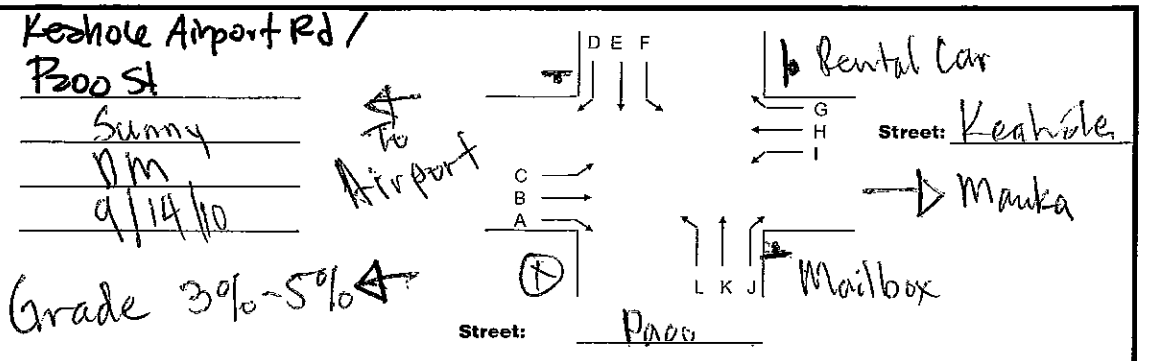
Data Collection Worksheet

Intersection: Keahole Airport Rd / Paoo St

Date: Sunny

By: DM

Weather: 9/14/10



PM Peak Count

TIME	A	B	C	D	E	F	G	H	I	J	K	L
1:30 - 1:45	0	57	0	20	1	12	4	55	1	0	0	2
1:45 - 2:00	0	69	0	16	0	8	4	30	0	0	0	0
3:00 - 3:15	3	53	0	20	0	11	3	29		2	1	0
3:15 - 3:30	1	68	0	17	0	15	5	32	0	1	0	0
3:30 - 3:45	0	49	0	15	1	15	9	32	0	1	0	0
3:45 - 4:00	0	66	0	16	0	13	0	31	0	0	1	0
4:00 - 4:15	1	57	0	15	1	19	3	25	0	0	1	1
4:15 - 4:30												

APPENDIX B

INTERSECTION LEVEL OF SERVICE DEFINITIONS

The *Highway Capacity Manual* defines six Intersection Levels of Service (LOS), labeled A through F, from free flow to congested conditions.

Levels of Service for signalized intersections is defined in terms of control delay, which is a measure of driver discomfort, frustration, fuel consumption, and increased travel time. The delay experienced by a motorist is made up of a number of factors that relate to control, geometrics, traffic, and incidents. Total delay is the difference between the travel time actually experienced and the reference travel time that would result during base conditions: in the absence of traffic control, geometric delay, any incidents, and any other vehicles. Specifically, LOS criteria for traffic signals are stated in terms of the average control delay per vehicle, typically for a 15-minute analysis period. Delay is a complex measure and depends on a number of variables, including the quality of progression, the cycle length, the green ratio, and the v/c ratio for the lane group.

LEVEL-OF-SERVICE A: Low control delay, up to 10 s/veh. This LOS occurs when progression is extremely favorable and most vehicles arrive during the green phase. Many vehicles do not stop at all. Short cycle lengths may tend to contribute to low delay values.

LEVEL-OF-SERVICE B: Control delay greater than 10 and up to 20 s/veh. This level generally occurs with good progression, short cycle lengths, or both. More vehicles stop than with LOS A, causing higher levels of delay.

LEVEL-OF-SERVICE C: Control delay greater than 20 and up to 35 s/veh. These higher delays may result from only fair progression, longer cycle lengths, or both. Individual cycle failures may begin to appear at this level. Cycle failure occurs when a given green phase does not serve queued vehicles, and overflows occur. The number of vehicles stopping is significant at this level, though many still pass through the intersection without stopping.

LEVEL-OF-SERVICE D: Control delay greater than 35 and up to 55 s/veh. At LOS D, the influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavorable progression, long cycle lengths, and high v/c ratios.

Many vehicles stop, and the proportion of vehicles not stopping declines. Individual cycle failures are noticeable.

LEVEL-OF-SERVICE E: Control delay greater than 55 and up to 80 s/veh. These high delay values generally indicate poor progression, long cycle lengths, and high v/c ratios. Individual cycle failures are frequent.

LEVEL-OF-SERVICE F: Control delay in excess of 80 s/veh. This level, considered unacceptable to most drivers, often occurs with oversaturation, that is when arrival flow rates exceed the capacity of lane groups. It may also occur at high v/c ratios with many individual cycle failures. Poor progression and long cycle lengths may also contribute significantly to high delay levels.

For unsignalized intersections, the *Highway Capacity Manual* evaluates gaps in the major street traffic flow and calculates available gaps for left-turns across oncoming traffic and for the left and right-turns onto the major roadway from the minor street. Average control delay, based on these factors, is still used to define the levels of service.

LEVEL-OF-SERVICE A: Low control delay, up to 10 s/veh.

LEVEL-OF-SERVICE B: Control delay greater than 10 and up to 15 s/veh.

LEVEL-OF-SERVICE C: Control delay greater than 15 and up to 25 s/veh.

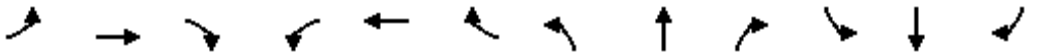
LEVEL-OF-SERVICE D: Control delay greater than 25 and up to 35 s/veh.

LEVEL-OF-SERVICE E: Control delay greater than 35 and up to 50 s/veh.

LEVEL-OF-SERVICE F: Control delay in excess of 50 s/veh.

APPENDIX C

INTERSECTION CAPACITY ANALYSIS WORKSHEETS



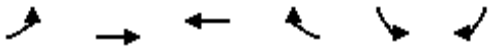
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	20	10	20	500	20	170	150	590	195	30	585	50
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.90		1.00	0.87		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1676		1770	1613		1770	3539	1583	1770	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	1676		1770	1613		1770	3539	1583	1770	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	22	11	22	543	22	185	163	641	212	33	636	54
RTOR Reduction (vph)	0	20	0	0	106	0	0	0	136	0	0	40
Lane Group Flow (vph)	22	13	0	543	101	0	163	641	76	33	636	14
Turn Type	Prot			Prot			Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	3.1	12.7		42.7	52.3		16.6	44.1	44.1	3.6	31.1	31.1
Effective Green, g (s)	3.1	12.7		42.7	52.3		16.6	44.1	44.1	3.6	31.1	31.1
Actuated g/C Ratio	0.03	0.10		0.35	0.42		0.13	0.36	0.36	0.03	0.25	0.25
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	45	173		614	685		239	1268	567	52	894	400
v/s Ratio Prot	0.01	0.01		c0.31	c0.06		c0.09	0.18		0.02	c0.18	
v/s Ratio Perm									0.05			0.01
v/c Ratio	0.49	0.08		0.88	0.15		0.68	0.51	0.13	0.63	0.71	0.03
Uniform Delay, d1	59.2	49.9		37.9	21.7		50.7	31.0	26.6	59.1	41.9	34.7
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	8.1	0.2		14.2	0.1		7.8	0.3	0.1	22.6	2.7	0.0
Delay (s)	67.3	50.1		52.1	21.8		58.5	31.3	26.7	81.7	44.6	34.7
Level of Service	E	D		D	C		E	C	C	F	D	C
Approach Delay (s)		57.0			43.7			34.7			45.6	
Approach LOS		E			D			C			D	

Intersection Summary			
HCM Average Control Delay	40.9	HCM Level of Service	D
HCM Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	123.1	Sum of lost time (s)	15.0
Intersection Capacity Utilization	71.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	155	15	10	35	10	10
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	168	16	11	38	11	11
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	62	30			49	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	62	30			49	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	82	98			99	
cM capacity (veh/h)	937	1045			1558	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	185	49	22
Volume Left	168	0	11
Volume Right	16	38	0
cSH	946	1700	1558
Volume to Capacity	0.20	0.03	0.01
Queue Length 95th (ft)	18	0	1
Control Delay (s)	9.7	0.0	3.7
Lane LOS	A		A
Approach Delay (s)	9.7	0.0	3.7
Approach LOS	A		

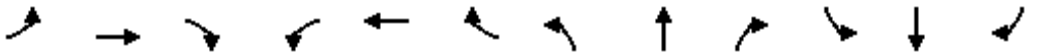
Intersection Summary			
Average Delay	7.4		
Intersection Capacity Utilization	23.9%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	30	45	30	15	50	110
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	33	49	33	16	54	120
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)			1256			
pX, platoon unblocked						
vC, conflicting volume	49				155	41
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	49				155	41
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	98				93	88
cM capacity (veh/h)	1558				819	1030

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	82	49	174
Volume Left	33	0	54
Volume Right	0	16	120
cSH	1558	1700	953
Volume to Capacity	0.02	0.03	0.18
Queue Length 95th (ft)	2	0	17
Control Delay (s)	3.0	0.0	9.6
Lane LOS	A		A
Approach Delay (s)	3.0	0.0	9.6
Approach LOS			A

Intersection Summary			
Average Delay		6.3	
Intersection Capacity Utilization		26.9%	ICU Level of Service A
Analysis Period (min)		15	



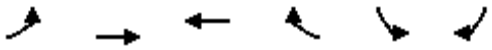
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	85	15	35	260	20	60	65	635	370	205	900	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.89		1.00	0.89		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1666		1770	1654		1770	3539	1583	1770	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	1666		1770	1654		1770	3539	1583	1770	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	92	16	38	283	22	65	71	690	402	223	978	27
RTOR Reduction (vph)	0	34	0	0	49	0	0	0	282	0	0	16
Lane Group Flow (vph)	92	20	0	283	38	0	71	690	120	223	978	11
Turn Type	Prot			Prot			Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	8.9	11.7		24.3	27.1		7.6	32.4	32.4	20.3	45.1	45.1
Effective Green, g (s)	8.9	11.7		24.3	27.1		7.6	32.4	32.4	20.3	45.1	45.1
Actuated g/C Ratio	0.08	0.11		0.22	0.25		0.07	0.30	0.30	0.19	0.41	0.41
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	145	179		396	412		124	1055	472	331	1468	657
v/s Ratio Prot	0.05	0.01		c0.16	c0.02		0.04	0.19		c0.13	c0.28	
v/s Ratio Perm									0.08			0.01
v/c Ratio	0.63	0.11		0.71	0.09		0.57	0.65	0.25	0.67	0.67	0.02
Uniform Delay, d1	48.3	43.8		39.0	31.4		49.0	33.3	29.0	41.1	25.7	18.7
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	8.8	0.3		6.0	0.1		6.3	1.5	0.3	5.3	1.2	0.0
Delay (s)	57.1	44.1		45.0	31.5		55.2	34.7	29.3	46.4	26.9	18.7
Level of Service	E	D		D	C		E	C	C	D	C	B
Approach Delay (s)		52.3			41.8			34.1			30.2	
Approach LOS		D			D			C			C	

Intersection Summary			
HCM Average Control Delay	34.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	108.7	Sum of lost time (s)	10.0
Intersection Capacity Utilization	62.5%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	65	15	10	80	10	10
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	71	16	11	87	11	11
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	87	54			98	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	87	54			98	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	92	98			99	
cM capacity (veh/h)	907	1013			1495	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	87	98	22
Volume Left	71	0	11
Volume Right	16	87	0
cSH	925	1700	1495
Volume to Capacity	0.09	0.06	0.01
Queue Length 95th (ft)	8	0	1
Control Delay (s)	9.3	0.0	3.7
Lane LOS	A		A
Approach Delay (s)	9.3	0.0	3.7
Approach LOS	A		

Intersection Summary			
Average Delay	4.3		
Intersection Capacity Utilization	18.9%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	65	60	10	10	25	35
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	71	65	11	11	27	38
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)			1256			
pX, platoon unblocked						
vC, conflicting volume	22				223	16
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	22				223	16
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	96				96	96
cM capacity (veh/h)	1594				731	1063

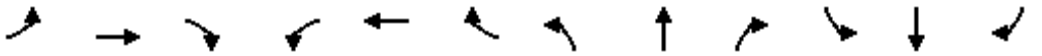
Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	136	22	65
Volume Left	71	0	27
Volume Right	0	11	38
cSH	1594	1700	894
Volume to Capacity	0.04	0.01	0.07
Queue Length 95th (ft)	3	0	6
Control Delay (s)	4.0	0.0	9.3
Lane LOS	A		A
Approach Delay (s)	4.0	0.0	9.3
Approach LOS			A

Intersection Summary			
Average Delay		5.2	
Intersection Capacity Utilization		23.6%	ICU Level of Service A
Analysis Period (min)		15	

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	45	130	340	1840	1750	420
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frpb, ped/bikes	1.00	0.96	1.00	1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1528	1770	3539	3539	1528
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1528	1770	3539	3539	1528
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	49	141	370	2000	1902	457
RTOR Reduction (vph)	0	128	0	0	0	193
Lane Group Flow (vph)	49	13	370	2000	1902	264
Confl. Peds. (#/hr)	10	10	10			10
Turn Type		Perm	Prot			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Actuated Green, G (s)	13.5	13.5	32.2	118.6	81.4	81.4
Effective Green, g (s)	13.5	13.5	32.2	118.6	81.4	81.4
Actuated g/C Ratio	0.10	0.10	0.23	0.83	0.57	0.57
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	168	145	401	2954	2027	875
v/s Ratio Prot	c0.03		c0.21	0.57	c0.54	
v/s Ratio Perm		0.01				0.17
v/c Ratio	0.29	0.09	0.92	0.68	0.94	0.30
Uniform Delay, d1	59.8	58.7	53.7	4.5	28.0	15.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.0	0.3	26.5	0.6	9.0	0.2
Delay (s)	60.8	59.0	80.2	5.1	37.1	15.9
Level of Service	E	E	F	A	D	B
Approach Delay (s)	59.5			16.8	33.0	
Approach LOS	E			B	C	

Intersection Summary			
HCM Average Control Delay	26.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	142.1	Sum of lost time (s)	15.0
Intersection Capacity Utilization	88.1%	ICU Level of Service	E
Analysis Period (min)	15		

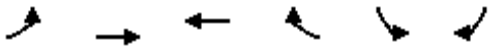
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	25	40	35	500	145	280	100	1485	325	50	1765	160
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	1.00	0.95		0.97	1.00		1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes	1.00	0.98		1.00	0.98		1.00	1.00	0.96	1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.93		1.00	0.90		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3235		3433	1639		1770	3539	1526	1770	3539	1526
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	3235		3433	1639		1770	3539	1526	1770	3539	1526
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	27	43	38	543	158	304	109	1614	353	54	1918	174
RTOR Reduction (vph)	0	34	0	0	46	0	0	0	161	0	0	82
Lane Group Flow (vph)	27	47	0	543	416	0	109	1614	192	54	1918	92
Confl. Peds. (#/hr)	10		10	10		10	10		10	10		10
Turn Type	Prot			Prot			Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	5.1	17.1		22.1	34.1		10.0	79.8	79.8	7.5	77.3	77.3
Effective Green, g (s)	5.1	17.1		22.1	34.1		10.0	79.8	79.8	7.5	77.3	77.3
Actuated g/C Ratio	0.03	0.12		0.15	0.23		0.07	0.54	0.54	0.05	0.53	0.53
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	62	378		518	382		121	1928	831	91	1867	805
v/s Ratio Prot	0.02	0.01		c0.16	c0.25		c0.06	0.46		0.03	c0.54	
v/s Ratio Perm									0.13			0.06
v/c Ratio	0.44	0.13		1.05	1.09		0.90	0.84	0.23	0.59	1.03	0.11
Uniform Delay, d1	69.3	58.0		62.2	56.2		67.8	27.9	17.4	68.0	34.6	17.4
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.8	0.2		52.8	72.1		52.3	3.3	0.1	10.0	28.1	0.1
Delay (s)	74.1	58.1		115.0	128.3		120.0	31.3	17.5	78.0	62.7	17.5
Level of Service	E	E		F	F		F	C	B	E	E	B
Approach Delay (s)		62.1			121.1			33.6			59.4	
Approach LOS		E			F			C			E	

Intersection Summary			
HCM Average Control Delay	61.0	HCM Level of Service	E
HCM Volume to Capacity ratio	1.06		
Actuated Cycle Length (s)	146.5	Sum of lost time (s)	20.0
Intersection Capacity Utilization	92.6%	ICU Level of Service	F
Analysis Period (min)	15		

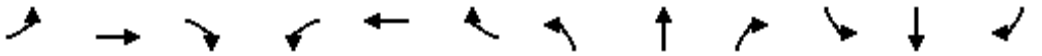
c Critical Lane Group



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	40	120	300	230	10	15
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	43	130	326	250	11	16
Pedestrians		10	10		10	
Lane Width (ft)		12.0	12.0		12.0	
Walking Speed (ft/s)		3.5	3.5		3.5	
Percent Blockage		1	1		1	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)			1256			
pX, platoon unblocked	0.76				0.76	0.76
vC, conflicting volume	586				688	471
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	291				426	139
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	95				97	98
cM capacity (veh/h)	951				414	674

Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2
Volume Total	43	130	576	11	16
Volume Left	43	0	0	11	0
Volume Right	0	0	250	0	16
cSH	951	1700	1700	414	674
Volume to Capacity	0.05	0.08	0.34	0.03	0.02
Queue Length 95th (ft)	4	0	0	2	2
Control Delay (s)	9.0	0.0	0.0	13.9	10.5
Lane LOS	A			B	B
Approach Delay (s)	2.2		0.0	11.9	
Approach LOS				B	

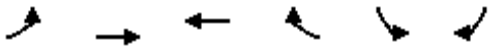
Intersection Summary			
Average Delay	0.9		
Intersection Capacity Utilization	46.1%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	5	95	45	225	420	115	130	340	40	40	125	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	0.95		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.95		1.00	0.97		1.00	0.98		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3328		1770	1789		1770	3471		1770	3513	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3328		1770	1789		1770	3471		1770	3513	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	5	103	49	245	457	125	141	370	43	43	136	5
RTOR Reduction (vph)	0	38	0	0	8	0	0	5	0	0	1	0
Lane Group Flow (vph)	5	114	0	245	574	0	141	408	0	43	140	0
Confl. Peds. (#/hr)	10		10	10		10	10		10	10		10
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	1.4	32.2		26.0	56.8		17.2	63.9		7.9	54.6	
Effective Green, g (s)	1.4	32.2		26.0	56.8		17.2	63.9		7.9	54.6	
Actuated g/C Ratio	0.01	0.21		0.17	0.38		0.11	0.43		0.05	0.36	
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	17	714		307	677		203	1479		93	1279	
v/s Ratio Prot	0.00	0.03		c0.14	c0.32		c0.08	c0.12		0.02	0.04	
v/s Ratio Perm												
v/c Ratio	0.29	0.16		0.80	0.85		0.69	0.28		0.46	0.11	
Uniform Delay, d1	73.8	47.9		59.5	42.6		63.9	28.0		69.0	31.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	9.4	0.1		13.4	9.7		9.9	0.5		3.6	0.2	
Delay (s)	83.2	48.0		72.9	52.3		73.7	28.5		72.6	31.8	
Level of Service	F	D		E	D		E	C		E	C	
Approach Delay (s)		49.1			58.4			40.0			41.3	
Approach LOS		D			E			D			D	

Intersection Summary			
HCM Average Control Delay	49.8	HCM Level of Service	D
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	74.0%	ICU Level of Service	D
Analysis Period (min)	15		

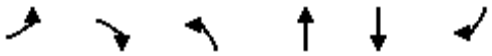
c Critical Lane Group



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	30	5	5	35	100	105
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	33	5	5	38	109	114
Pedestrians		10	10		10	
Lane Width (ft)		12.0	12.0		12.0	
Walking Speed (ft/s)		3.5	3.5		3.5	
Percent Blockage		1	1		1	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	53				115	44
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	53				115	44
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	98				87	89
cM capacity (veh/h)	1537				846	1006

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	38	43	223
Volume Left	33	0	109
Volume Right	0	38	114
cSH	1537	1700	921
Volume to Capacity	0.02	0.03	0.24
Queue Length 95th (ft)	2	0	24
Control Delay (s)	6.4	0.0	10.2
Lane LOS	A		B
Approach Delay (s)	6.4	0.0	10.2
Approach LOS			B

Intersection Summary			
Average Delay	8.2		
Intersection Capacity Utilization	28.0%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	10	30	115	505	230	145
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	33	125	549	250	158
Pedestrians	10			10	10	
Lane Width (ft)	12.0			12.0	12.0	
Walking Speed (ft/s)	3.5			3.5	3.5	
Percent Blockage	1			1	1	
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)					1063	
pX, platoon unblocked						
vC, conflicting volume	873	224	418			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	873	224	418			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	96	96	89			
cM capacity (veh/h)	252	765	1127			

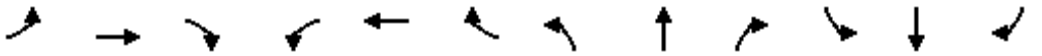
Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	43	125	274	274	167	241
Volume Left	11	125	0	0	0	0
Volume Right	33	0	0	0	0	158
cSH	507	1127	1700	1700	1700	1700
Volume to Capacity	0.09	0.11	0.16	0.16	0.10	0.14
Queue Length 95th (ft)	7	9	0	0	0	0
Control Delay (s)	12.8	8.6	0.0	0.0	0.0	0.0
Lane LOS	B	A				
Approach Delay (s)	12.8	1.6			0.0	
Approach LOS	B					

Intersection Summary				
Average Delay	1.4			
Intersection Capacity Utilization	34.5%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	250	10	30	30	10	35
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	272	11	33	33	11	38
Pedestrians	10		10			10
Lane Width (ft)	12.0		12.0			12.0
Walking Speed (ft/s)	3.5		3.5			3.5
Percent Blockage	1		1			1
Right turn flare (veh)		4				
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	129	69			75	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	129	69			75	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	68	99			99	
cM capacity (veh/h)	843	975			1509	

Direction, Lane #	WB 1	NB 1	SB 1	SB 2
Volume Total	283	65	11	38
Volume Left	272	0	11	0
Volume Right	11	33	0	0
cSH	877	1700	1509	1700
Volume to Capacity	0.32	0.04	0.01	0.02
Queue Length 95th (ft)	35	0	1	0
Control Delay (s)	11.2	0.0	7.4	0.0
Lane LOS	B		A	
Approach Delay (s)	11.2	0.0	1.6	
Approach LOS	B			

Intersection Summary			
Average Delay	8.2		
Intersection Capacity Utilization	27.7%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	10	60	5	95	250	5	5	330	280	25	55	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	
Lane Util. Factor	1.00	0.95		1.00	1.00		1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	0.98	1.00	0.99	
Flpb, ped/bikes	0.99	1.00		1.00	1.00		0.99	1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00		1.00	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1759	3496		1770	1857		1746	3539	1550	1770	3402	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1759	3496		1770	1857		1746	3539	1550	1770	3402	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	11	65	5	103	272	5	5	359	304	27	60	16
RTOR Reduction (vph)	0	4	0	0	1	0	0	0	224	0	11	0
Lane Group Flow (vph)	11	66	0	103	276	0	5	359	80	27	65	0
Confl. Peds. (#/hr)	10		10	10		10	10		10	10		10
Turn Type	Prot			Prot			Prot		Perm	Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases									2			
Actuated Green, G (s)	0.9	11.3		8.6	19.0		0.9	14.9	14.9	2.1	16.1	
Effective Green, g (s)	0.9	11.3		8.6	19.0		0.9	14.9	14.9	2.1	16.1	
Actuated g/C Ratio	0.02	0.20		0.15	0.33		0.02	0.26	0.26	0.04	0.28	
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	28	694		268	620		28	927	406	65	963	
v/s Ratio Prot	0.01	0.02		c0.06	c0.15		0.00	c0.10		c0.02	0.02	
v/s Ratio Perm									0.05			
v/c Ratio	0.39	0.10		0.38	0.45		0.18	0.39	0.20	0.42	0.07	
Uniform Delay, d1	27.7	18.6		21.8	14.8		27.6	17.3	16.3	26.8	14.9	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	8.9	0.1		0.9	0.5		3.0	0.3	0.2	4.3	0.0	
Delay (s)	36.6	18.7		22.7	15.3		30.7	17.5	16.6	31.1	14.9	
Level of Service	D	B		C	B		C	B	B	C	B	
Approach Delay (s)		21.1			17.3			17.2			19.2	
Approach LOS		C			B			B			B	

Intersection Summary			
HCM Average Control Delay	17.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.44		
Actuated Cycle Length (s)	56.9	Sum of lost time (s)	20.0
Intersection Capacity Utilization	45.1%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	45	5	315	105	5	90
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	49	5	342	114	5	98
Pedestrians	10			10	10	
Lane Width (ft)	12.0			12.0	12.0	
Walking Speed (ft/s)	3.5			3.5	3.5	
Percent Blockage	1			1	1	
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			64		871	72
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			64		871	72
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			78		98	90
cM capacity (veh/h)			1523		245	972

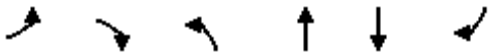
Direction, Lane #	EB 1	WB 1	WB 2	NB 1
Volume Total	54	342	114	103
Volume Left	0	342	0	5
Volume Right	5	0	0	98
cSH	1700	1523	1700	840
Volume to Capacity	0.03	0.22	0.07	0.12
Queue Length 95th (ft)	0	22	0	10
Control Delay (s)	0.0	8.0	0.0	9.9
Lane LOS		A		A
Approach Delay (s)	0.0	6.0		9.9
Approach LOS				A

Intersection Summary			
Average Delay	6.1		
Intersection Capacity Utilization	39.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	NBT	NBR	SBL	SBT	SWL	SWR
Lane Configurations						
Volume (veh/h)	10	20	5	5	15	5
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	22	5	5	16	5
Pedestrians	10			10	10	
Lane Width (ft)	12.0			12.0	12.0	
Walking Speed (ft/s)	3.5			3.5	3.5	
Percent Blockage	1			1	1	
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			43		58	42
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			43		58	42
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		98	99
cM capacity (veh/h)			1551		928	1010

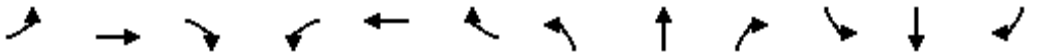
Direction, Lane #	NB 1	SB 1	SW 1
Volume Total	33	11	22
Volume Left	0	5	16
Volume Right	22	0	5
cSH	1700	1551	947
Volume to Capacity	0.02	0.00	0.02
Queue Length 95th (ft)	0	0	2
Control Delay (s)	0.0	3.7	8.9
Lane LOS		A	A
Approach Delay (s)	0.0	3.7	8.9
Approach LOS			A

Intersection Summary			
Average Delay	3.6		
Intersection Capacity Utilization	19.0%	ICU Level of Service	A
Analysis Period (min)	15		



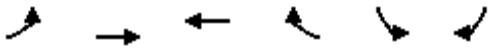
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	240	540	270	2175	2070	240
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	4.0	5.0	5.0	5.0	5.0
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	3539	3539	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	3539	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	261	587	293	2364	2250	261
RTOR Reduction (vph)	0	0	0	0	0	103
Lane Group Flow (vph)	261	587	293	2364	2250	158
Turn Type		Free	Prot			Perm
Protected Phases	4		5	2	6	
Permitted Phases		Free				6
Actuated Green, G (s)	21.0	150.0	23.0	119.0	91.0	91.0
Effective Green, g (s)	21.0	150.0	23.0	119.0	91.0	91.0
Actuated g/C Ratio	0.14	1.00	0.15	0.79	0.61	0.61
Clearance Time (s)	5.0		5.0	5.0	5.0	5.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	248	1583	271	2808	2147	960
v/s Ratio Prot	c0.15		c0.17	0.67	c0.64	
v/s Ratio Perm		0.37				0.10
v/c Ratio	1.05	0.37	1.08	0.84	1.05	0.16
Uniform Delay, d1	64.5	0.0	63.5	9.6	29.5	12.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	71.6	0.7	78.0	2.5	33.4	0.1
Delay (s)	136.1	0.7	141.5	12.1	62.9	13.0
Level of Service	F	A	F	B	E	B
Approach Delay (s)	42.4			26.4	57.7	
Approach LOS	D			C	E	

Intersection Summary			
HCM Average Control Delay	41.7	HCM Level of Service	D
HCM Volume to Capacity ratio	1.05		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	98.0%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	195	330	230	250	110	95	65	1715	635	100	1835	185
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	1.00	0.95		0.97	1.00		1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.94		1.00	0.93		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3321		3433	1734		1770	3539	1583	1770	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	3321		3433	1734		1770	3539	1583	1770	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	212	359	250	272	120	103	71	1864	690	109	1995	201
RTOR Reduction (vph)	0	63	0	0	21	0	0	0	204	0	0	88
Lane Group Flow (vph)	212	546	0	272	202	0	71	1864	486	109	1995	113
Turn Type	Prot			Prot			Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	19.0	24.2		15.2	20.4		6.0	80.8	80.8	9.0	83.8	83.8
Effective Green, g (s)	19.0	24.2		15.2	20.4		6.0	80.8	80.8	9.0	83.8	83.8
Actuated g/C Ratio	0.13	0.16		0.10	0.14		0.04	0.54	0.54	0.06	0.56	0.56
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	225	539		350	237		71	1917	857	107	1988	889
v/s Ratio Prot	c0.12	c0.16		0.08	0.12		0.04	0.53		c0.06	c0.56	
v/s Ratio Perm									0.31			0.07
v/c Ratio	0.94	1.01		0.78	0.85		1.00	0.97	0.57	1.02	1.00	0.13
Uniform Delay, d1	64.6	62.5		65.3	62.9		71.6	33.1	22.6	70.1	32.7	15.4
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	43.9	42.1		10.4	24.5		106.8	14.5	0.9	92.1	21.0	0.1
Delay (s)	108.4	104.6		75.7	87.5		178.4	47.6	23.5	162.2	53.7	15.5
Level of Service	F	F		E	F		F	D	C	F	D	B
Approach Delay (s)		105.6			81.0			44.8			55.5	
Approach LOS		F			F			D			E	

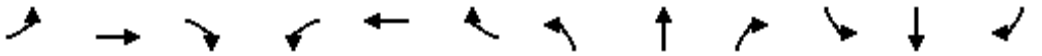
Intersection Summary			
HCM Average Control Delay	59.6	HCM Level of Service	E
HCM Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	149.2	Sum of lost time (s)	20.0
Intersection Capacity Utilization	94.6%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	230	265	150	40	210	25
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	250	288	163	43	228	27
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)			1256			
pX, platoon unblocked						
vC, conflicting volume	207				973	185
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	207				973	185
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	82				0	97
cM capacity (veh/h)	1365				228	857

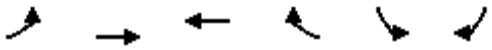
Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2
Volume Total	250	288	207	228	27
Volume Left	250	0	0	228	0
Volume Right	0	0	43	0	27
cSH	1365	1700	1700	228	857
Volume to Capacity	0.18	0.17	0.12	1.00	0.03
Queue Length 95th (ft)	17	0	0	231	2
Control Delay (s)	8.2	0.0	0.0	104.7	9.3
Lane LOS	A			F	A
Approach Delay (s)	3.8		0.0	94.5	
Approach LOS				F	

Intersection Summary			
Average Delay	26.2		
Intersection Capacity Utilization	44.7%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	5	360	235	115	130	265	60	855	250	130	710	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	0.95		1.00	1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.94		1.00	0.90		1.00	0.97		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3330		1770	1675		1770	3419		1770	3536	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3330		1770	1675		1770	3419		1770	3536	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	5	391	255	125	141	288	65	929	272	141	772	5
RTOR Reduction (vph)	0	71	0	0	48	0	0	17	0	0	1	0
Lane Group Flow (vph)	5	575	0	125	381	0	65	1184	0	141	776	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	0.8	33.9		14.4	47.5		8.8	65.9		15.8	72.9	
Effective Green, g (s)	0.8	33.9		14.4	47.5		8.8	65.9		15.8	72.9	
Actuated g/C Ratio	0.01	0.23		0.10	0.32		0.06	0.44		0.11	0.49	
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	9	753		170	530		104	1502		186	1718	
v/s Ratio Prot	0.00	0.17		c0.07	c0.23		0.04	c0.35		c0.08	0.22	
v/s Ratio Perm												
v/c Ratio	0.56	0.76		0.74	0.72		0.62	0.79		0.76	0.45	
Uniform Delay, d1	74.4	54.3		65.9	45.3		69.0	36.1		65.2	25.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	58.1	4.6		15.2	4.6		11.1	4.3		16.1	0.9	
Delay (s)	132.5	58.9		81.1	50.0		80.1	40.3		81.4	26.3	
Level of Service	F	E		F	D		F	D		F	C	
Approach Delay (s)		59.5			57.0			42.4			34.7	
Approach LOS		E			E			D			C	

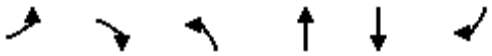
Intersection Summary			
HCM Average Control Delay	46.0	HCM Level of Service	D
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	81.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	140	5	5	150	100	105
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	152	5	5	163	109	114
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	168				397	87
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	168				397	87
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	89				80	88
cM capacity (veh/h)	1409				543	972

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	158	168	223
Volume Left	152	0	109
Volume Right	0	163	114
cSH	1409	1700	701
Volume to Capacity	0.11	0.10	0.32
Queue Length 95th (ft)	9	0	34
Control Delay (s)	7.6	0.0	12.5
Lane LOS	A		B
Approach Delay (s)	7.6	0.0	12.5
Approach LOS			B

Intersection Summary			
Average Delay	7.3		
Intersection Capacity Utilization	39.5%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	60	200	35	990	970	80
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	65	217	38	1076	1054	87
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)					1063	
pX, platoon unblocked	0.86	0.86	0.86			
vC, conflicting volume	1712	571	1141			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1500	170	835			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	29	70	94			
cM capacity (veh/h)	91	725	682			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	283	38	538	538	703	438
Volume Left	65	38	0	0	0	0
Volume Right	217	0	0	0	0	87
cSH	279	682	1700	1700	1700	1700
Volume to Capacity	1.01	0.06	0.32	0.32	0.41	0.26
Queue Length 95th (ft)	263	4	0	0	0	0
Control Delay (s)	97.5	10.6	0.0	0.0	0.0	0.0
Lane LOS	F	B				
Approach Delay (s)	97.5	0.4			0.0	
Approach LOS	F					

Intersection Summary				
Average Delay	11.0			
Intersection Capacity Utilization	51.7%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	10	10	160	105	245	10
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	11	174	114	266	11
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		4				
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	774	231			288	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	774	231			288	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	96	99			79	
cM capacity (veh/h)	290	808			1274	

Direction, Lane #	WB 1	NB 1	SB 1	SB 2
Volume Total	22	288	266	11
Volume Left	11	0	266	0
Volume Right	11	114	0	0
cSH	580	1700	1274	1700
Volume to Capacity	0.04	0.17	0.21	0.01
Queue Length 95th (ft)	3	0	20	0
Control Delay (s)	13.7	0.0	8.6	0.0
Lane LOS	B		A	
Approach Delay (s)	13.7	0.0	8.2	
Approach LOS	B			

Intersection Summary			
Average Delay	4.4		
Intersection Capacity Utilization	41.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	145	535	5	110	265	5	5	765	515	30	590	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	
Lane Util. Factor	1.00	0.95		1.00	1.00		1.00	0.95	1.00	1.00	0.95	
Frt	1.00	1.00		1.00	1.00		1.00	1.00	0.85	1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	3535		1770	1858		1770	3539	1583	1770	3530	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	3535		1770	1858		1770	3539	1583	1770	3530	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	158	582	5	120	288	5	5	832	560	33	641	11
RTOR Reduction (vph)	0	1	0	0	1	0	0	0	267	0	1	0
Lane Group Flow (vph)	158	586	0	120	292	0	5	832	293	33	651	0
Turn Type	Prot			Prot			Prot		Perm	Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases									2			
Actuated Green, G (s)	15.4	24.8		13.1	22.5		1.0	37.0	37.0	3.5	39.5	
Effective Green, g (s)	15.4	24.8		13.1	22.5		1.0	37.0	37.0	3.5	39.5	
Actuated g/C Ratio	0.16	0.25		0.13	0.23		0.01	0.38	0.38	0.04	0.40	
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	277	891		236	425		18	1331	595	63	1417	
v/s Ratio Prot	c0.09	c0.17		0.07	0.16		0.00	c0.24		c0.02	0.18	
v/s Ratio Perm									0.19			
v/c Ratio	0.57	0.66		0.51	0.69		0.28	0.63	0.49	0.52	0.46	
Uniform Delay, d1	38.4	33.0		39.7	34.7		48.3	25.0	23.5	46.6	21.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	2.8	1.8		1.7	4.6		8.3	0.9	0.6	7.6	0.2	
Delay (s)	41.3	34.8		41.4	39.3		56.6	26.0	24.2	54.3	21.9	
Level of Service	D	C		D	D		E	C	C	D	C	
Approach Delay (s)		36.1			39.9			25.3			23.4	
Approach LOS		D			D			C			C	

Intersection Summary			
HCM Average Control Delay	29.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	98.4	Sum of lost time (s)	15.0
Intersection Capacity Utilization	62.7%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	80	5	130	30	5	375
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	87	5	141	33	5	408
Pedestrians					5	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					3.5	
Percent Blockage					0	
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			97		410	95
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			97		410	95
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			91		99	57
cM capacity (veh/h)			1489		539	957

Direction, Lane #	EB 1	WB 1	WB 2	NB 1
Volume Total	92	141	33	413
Volume Left	0	141	0	5
Volume Right	5	0	0	408
cSH	1700	1489	1700	948
Volume to Capacity	0.05	0.09	0.02	0.44
Queue Length 95th (ft)	0	8	0	56
Control Delay (s)	0.0	7.7	0.0	11.7
Lane LOS		A		B
Approach Delay (s)	0.0	6.2		11.7
Approach LOS				B

Intersection Summary			
Average Delay	8.7		
Intersection Capacity Utilization	44.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	NBT	NBR	SBL	SBT	SWL	SWR
Lane Configurations						
Volume (veh/h)	5	15	5	5	15	5
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	16	5	5	16	5
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			22		30	14
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			22		30	14
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		98	99
cM capacity (veh/h)			1594		981	1066

Direction, Lane #	NB 1	SB 1	SW 1
Volume Total	22	11	22
Volume Left	0	5	16
Volume Right	16	0	5
cSH	1700	1594	1001
Volume to Capacity	0.01	0.00	0.02
Queue Length 95th (ft)	0	0	2
Control Delay (s)	0.0	3.6	8.7
Lane LOS		A	A
Approach Delay (s)	0.0	3.6	8.7
Approach LOS			A

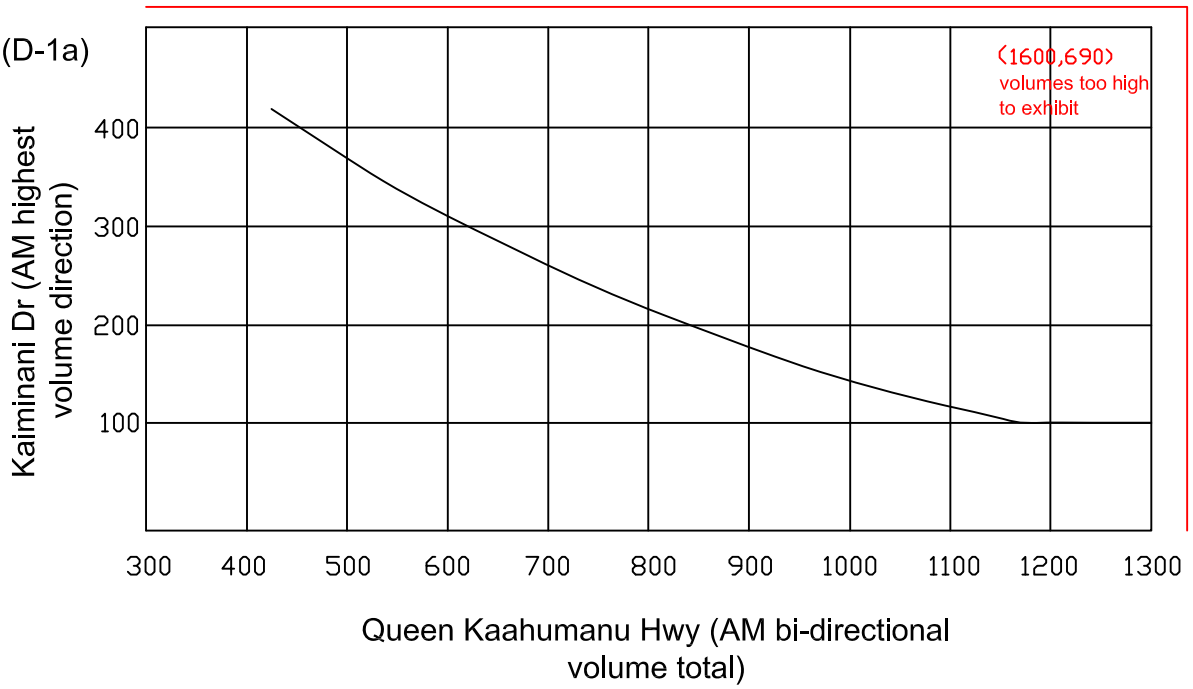
Intersection Summary			
Average Delay		4.2	
Intersection Capacity Utilization		14.7%	ICU Level of Service A
Analysis Period (min)		15	

APPENDIX D

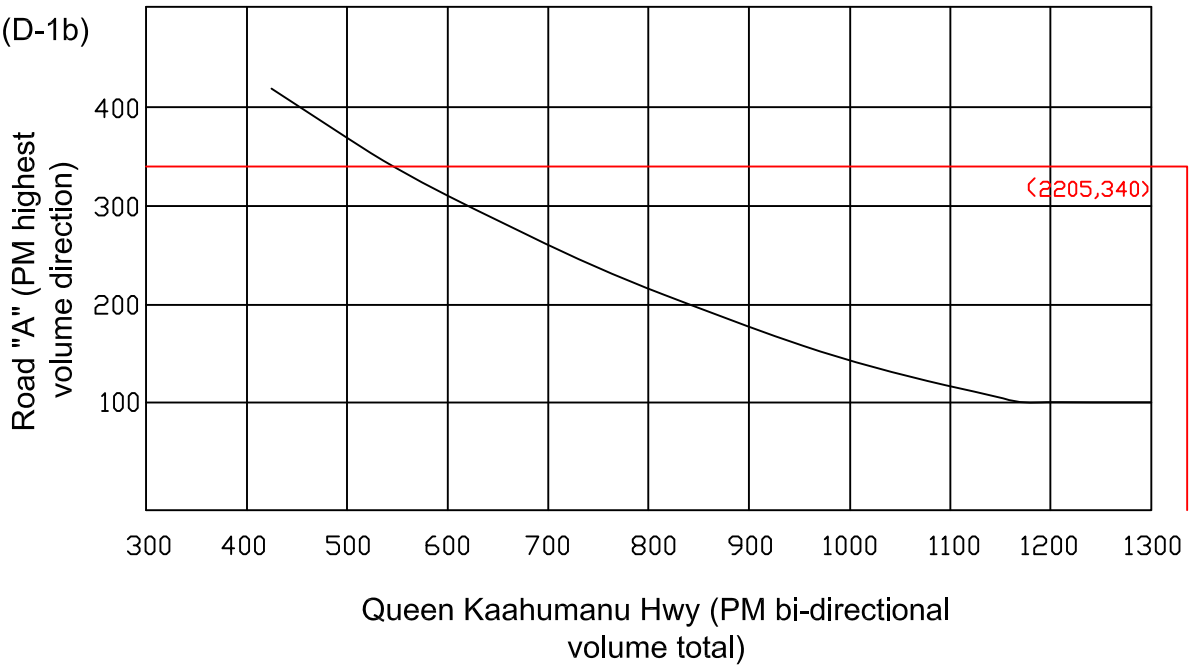
TRAFFIC SIGNAL WARRANT STUDY

Appendix D-1: Queen Kaahumanu Hwy & Kaiminani Dr/Road "A" Year 2015 Signal Warrant by Peak Period

(D-1a)

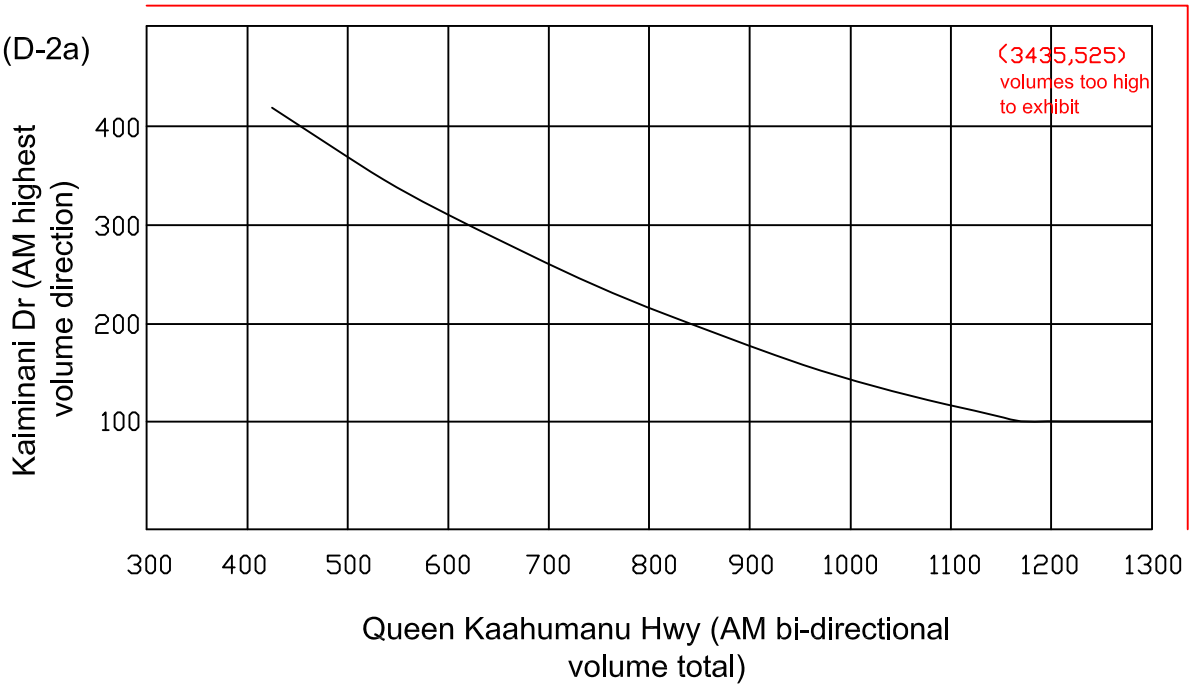


(D-1b)

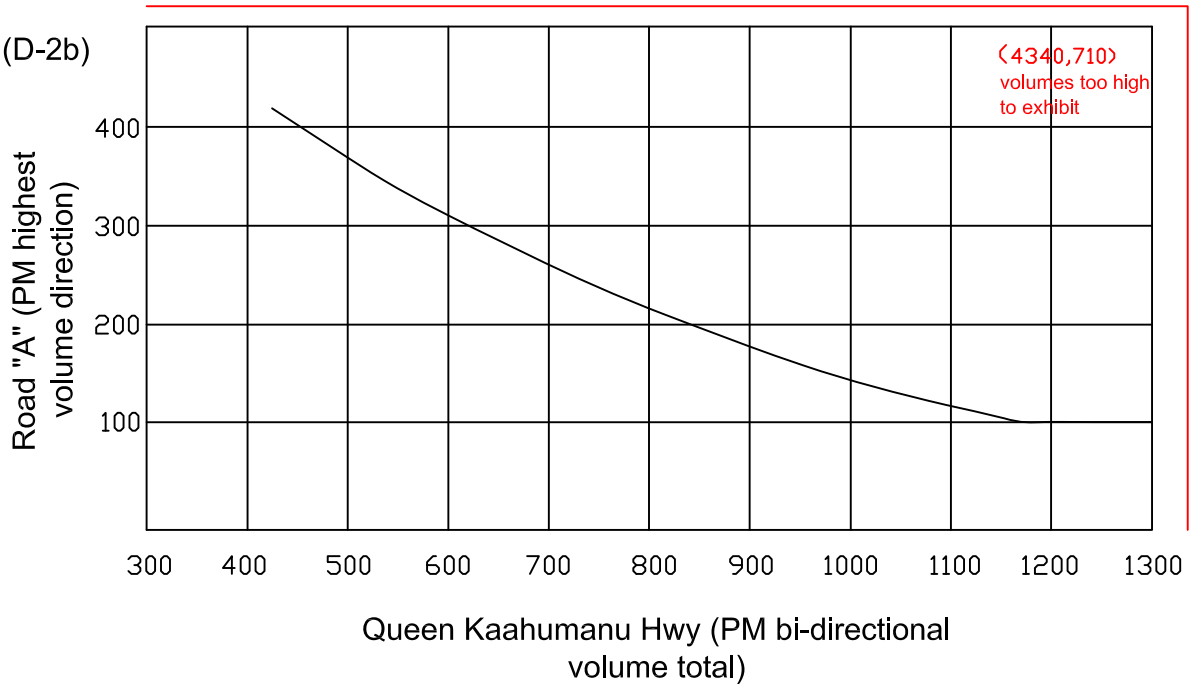


Appendix D-2: Queen Kaahumanu Hwy & Kaiminani Dr/Road "A" Year 2035 Signal Warrant by Peak Period

(D-2a)

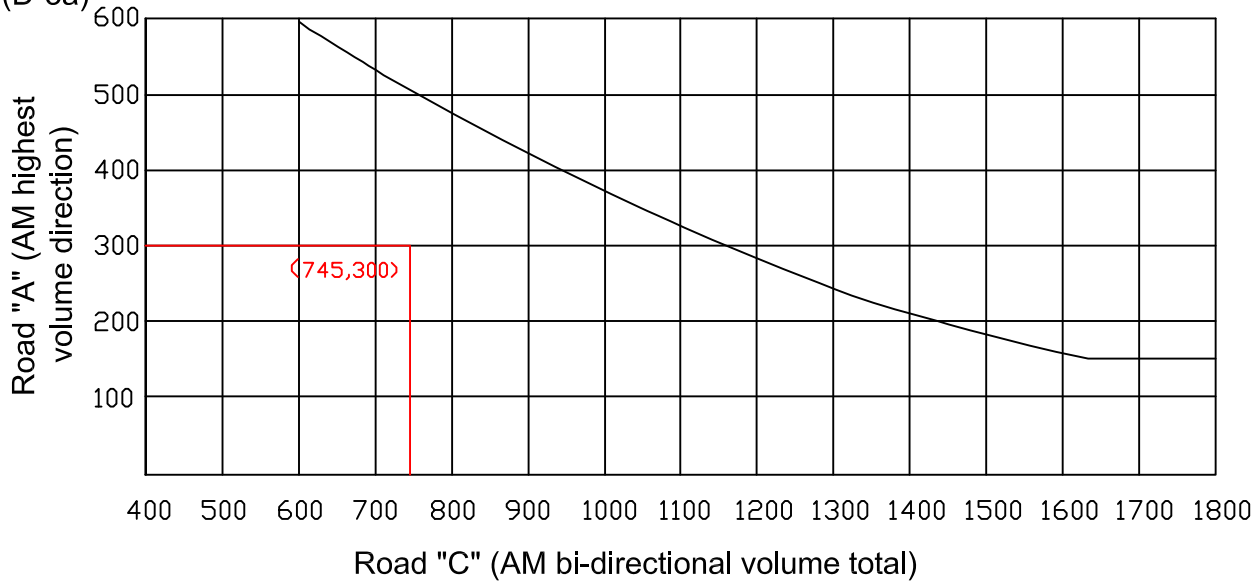


(D-2b)

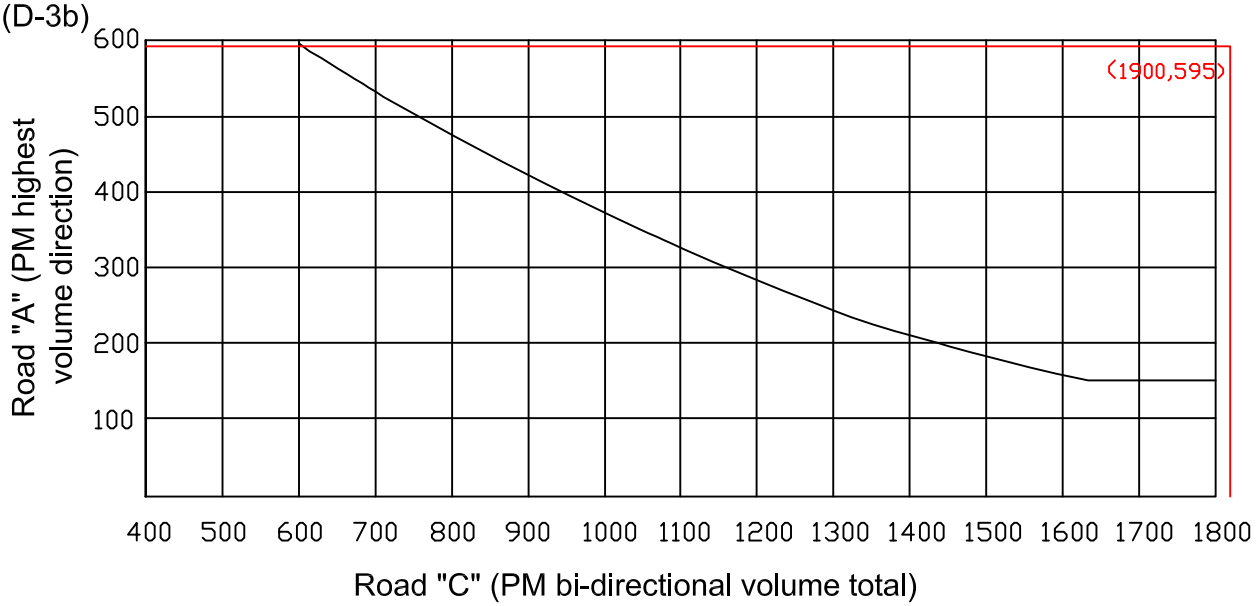


Appendix D-3: Road "A" & Road "C" Year 2035 Signal Warrant by Peak Period

(D-3a)

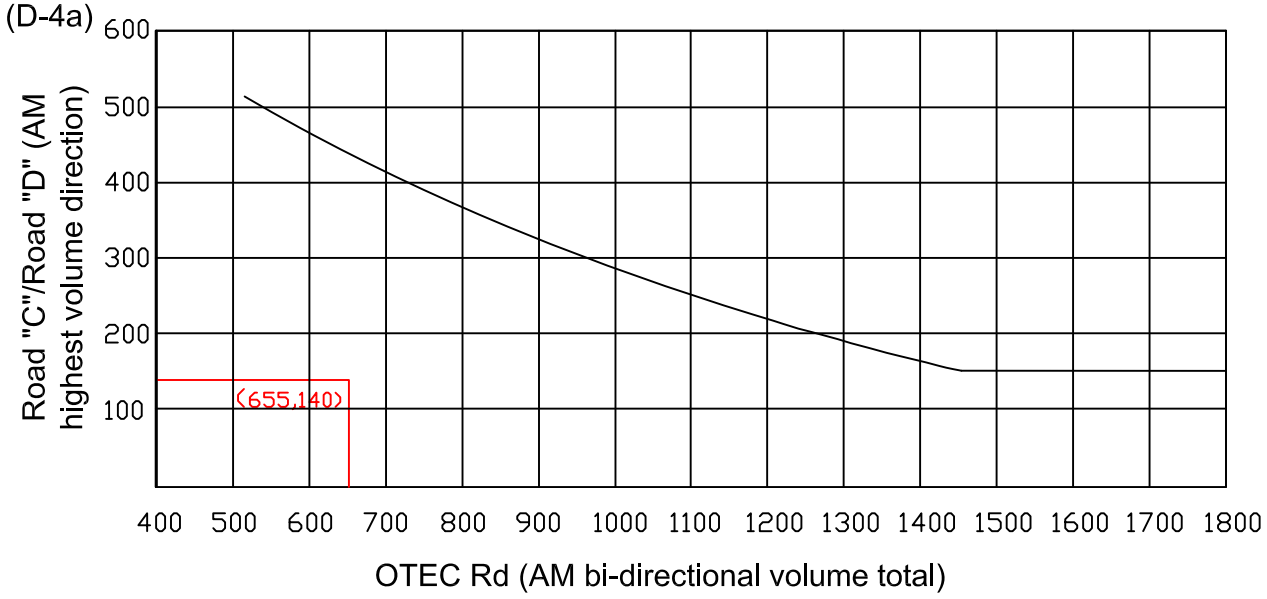


(D-3b)

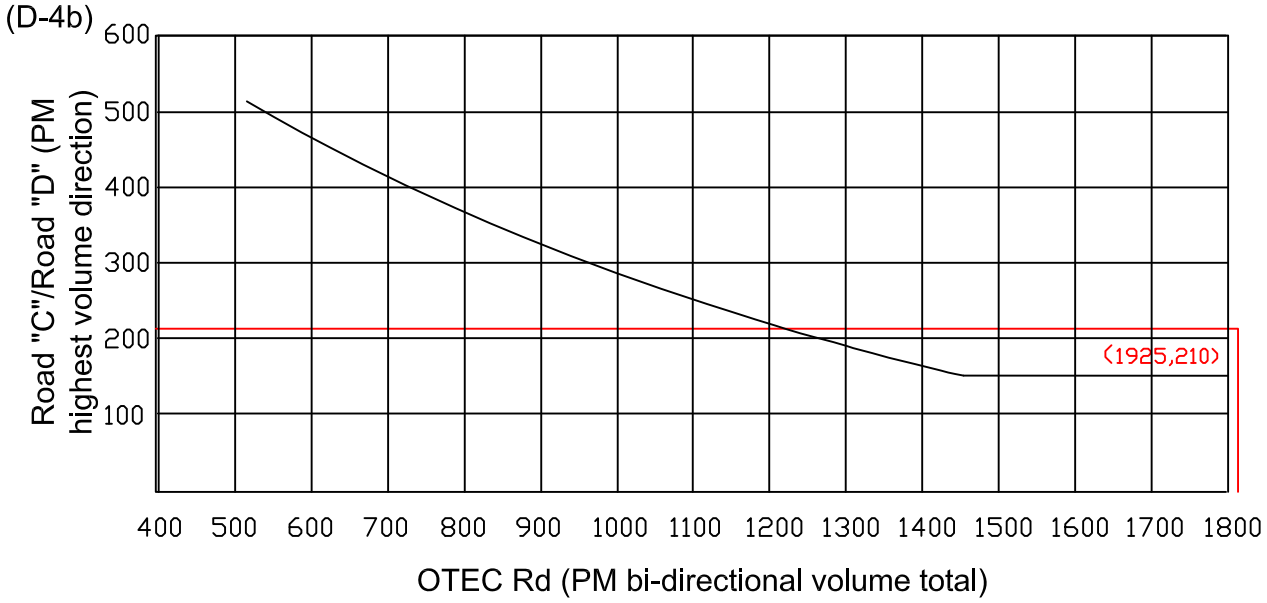


Appendix D-4: Road "C"/Road "D" & OTEC Rd Year 2035 Signal Warrant by Peak Period

(D-4a)



(D-4b)



APPENDIX E
REFERENCES

1. "Master Plan for Natural Energy Laboratory of Hawaii Authority", Group 70 International, 2009.
2. "Master Plan for Natural Energy Laboratory of Hawaii Authority, Appendix C. Engineering Reports: Traffic Studies and Site Infrastructure", Austin, Tsutsumi & Associates, Inc., revised April 28, 2009.
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6. "Traffic Engineering Study for the Intersection of Queen Kaahumanu Highway & Hulikoa Road", Fehr & Peers, October 2008.
7. "Traffic Impact Analysis Report, Kohanaiki Business Park, Kailua-Kona, Hawaii", Lyon Associates, April 2006.

APPENDIX C ARCHEOLOGICAL SURVEY FOR NELHA ROADS C, D, AND E

RC-0732

Archaeological Inventory Survey Update for the Proposed NELHA Roads C, D, and E

(TMKs: 3-7-3-43:portions 073, 080, 083, 089, and 091)

‘O‘oma 1st and 2nd and Kalaoa 5th *ahupua‘a*
North Kona District
Island of Hawai‘i

FINAL VERSION

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ARCHAEOLOGICAL, CULTURAL, AND HISTORICAL STUDIES

RC-0732

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(TMK: 3-7-3-43:portions 073, 080, 083, 089, and 091)

‘O‘oma 1st and 2nd and Kalaoa 5th *ahupua‘a*
North Kona District
Island of Hawai‘i

RECHTMAN CONSULTING

EXECUTIVE SUMMARY

At the request of Parsons Brinckerhoff, Inc., on behalf of Natural Energy Laboratory Hawai'i Authority, Rechtman Consulting, LLC has prepared this update to earlier DLNR-SHPD approved archaeological survey work. The current study area is a 200 foot wide corridor extending for roughly 6000 feet (approximately 30 acres) within a larger area that was investigated by Barrera (1985a) in 'O'oma 1st and 2nd and Kalaoa 5th *ahupua'a*, North Kona District, Island of Hawai'i (portions of TMKs: 3-7-3-43:073 080, 083, 089.and 091). Barrera's earlier work included a survey of a 450-acre portion of the NELHA host park that included the entire current project area (Barrera 1985a). Barrera identified 45 sites, none of which fall within the current study area. Rechtman Consulting, LLC completed an intensive resurvey for the current study area, identified one known site (SIHP Site 6432; recorded before the Barrera study), and found three additional sites (SIHP Sites 29272, 29273, and 29274) that had not been previously recorded.

The significance and treatment of SIHP Site 6432 has already been determined as a result of previous studies. This site was determined to be significant under Criterion d for recovered archaeological and historical information with an approved treatment of no further historic preservation work required. The three newly recorded sites (SIHP Sites 29272, 29273, and 29274) are also considered significant under Criterion d for information they have yielded relative to the Precontact and Historic period use of the study area. The documentation and interpretive explanation offered in this report concerning Site 29274 is considered sufficient to mitigate any impacts to this site from the proposed road construction project, therefore no further historic preservation work is required for this site. For Site 29273, it is recommended that the more intact eastern portion of the site that falls on the *mauka* edge and outside of the study corridor be preserved. Both temporary protection and long term preservation measures will need to be developed. With respect to SIHP Site 29272, it is recommended that NELHA work with the road design engineers to avoid as much of this site as is feasible and then develop a preservation plan for the portions of this site that will remain outside of the roadway corridor after the proposed road construction has been completed.

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INTRODUCTION

At the request of Parsons Brinckerhoff, Inc., on behalf of Natural Energy Laboratory Hawai'i Authority (NELHA), Rechtman Consulting, LLC has prepared this update to earlier DLNR-SHPD approved archaeological survey work. The current study area is a 200 foot wide corridor extending for roughly 6000 feet (approximately 30 acres) within a larger area that was investigated by Barrera (1985a) in 'O'oma 1st and 2nd and Kalaoa 5th *ahupua'a*, North Kona District, Island of Hawai'i (portions of TMKs: 3-7-3-43:073 080, 083, 089.and 091) (Figures 1 and 2). Barrera's earlier work included a survey of a 450-acre portion of the NELHA host park that included the entire current project area (Barrera 1985a). Barrera indentified 45 sites, none of which fall within the current study area. Rechtman Consulting, LLC completed an intensive resurvey for the current study area, identified one known site (recorded before the Barrera study), and found three additional sites that had not been previously recorded.

The current report documents the findings of the resurvey of the study area and has been prepared in compliance with Chapter 343 HRS, as well as fulfilling the requirements of the County of Hawai'i Planning Department and the Department of Land and Natural Resources (DLNR) with respect to permit approvals for land-altering and development activities.

This report begins with a description of the general project area and the proposed development activities. This is followed by a presentation of the archaeological background for the specific study area. A discussion of the cultural and historical background for the 'O'oma and Kalaoa *ahupua'a* and the Kekaha region is then presented that was derivied from detailed archival research (Rechtman and Maly 2003). It is a comprehension of this background information that facilitates a more complete understanding of the significance of the resources that exist within the study area. Lastly, site descriptions are presented and significance evaluations offered along with treatment recommendations.

PROJECT AREA DESCRIPTION AND PROPOSED DEVELOPMENT ACTIVITIES

The current study area is a 200 foot wide corridor extending for roughly 6,000 feet (roughly 30 acres) *makai* of the Queen Ka'ahumanu Highway right-of-way in 'O'oma 1st and 2nd and Kalaoa 5th *ahupua'a*, North Kona District, Island of Hawai'i that spans four current Tax Map parcels (TMK: 3-7-3-43:073 080, 083, 089.and 091; see Figure 2). In the north, the study corridor extends *makai* from where Kaiminani Drive intersects Queen Ka'ahumanu Highway, then turns southward paralleling the Highway and crossing the exisiting NELHA access road, then turns *makai* again and extends to the preservation buffer of the Māmalahoa Trail (Figure 3). At both the north and south ends the study corridor extends to the respective parcel boundaries (see Figures 2 and 3). Elevation across the project area ranges from 75 to 140 feet above sea level, and the terrain (Figure 4) is characterized by weathered *pāhoehoe* and *'a'ā* flows that emanated from Hualālai between 3,000 and 5,000 years ago (Wolfe and Morris 1996). Situated within the Kekaha region, the principle environmental features are a hot, dry climate, and extensive lava fields with little to no soil accumulation. This region receives roughly 10 inches of rain per year and has a mean annual temperature of 70 to 76 degrees Fahrenheit (Donham 1987). The dominant vegetation (Figure 5) is fountain grass (*Pennisetum setaceum*) with an occasional *'ilima* (*Sida fallax*), *noni* (*Morinda citrifolia*), Christmas-berry (*Schinus terebithifolius*), and *maiapilo* (*Capparis sandwichiana*).

NELHA plans to construct a new access road that will create a four way intersection at Kaiminani Drive and Queen Ka'ahumanu Highway. This will allow for both right and left turns at a signalized intersection; the current access road will then be converted to a right in and right out road only. The new road will parallel the Highway and bring vehicular traffic south to the current access road, then either down to the main facility or continue south on the new road to present and future tenant facilities (see Figure 3).

Figure 1. Project area location.

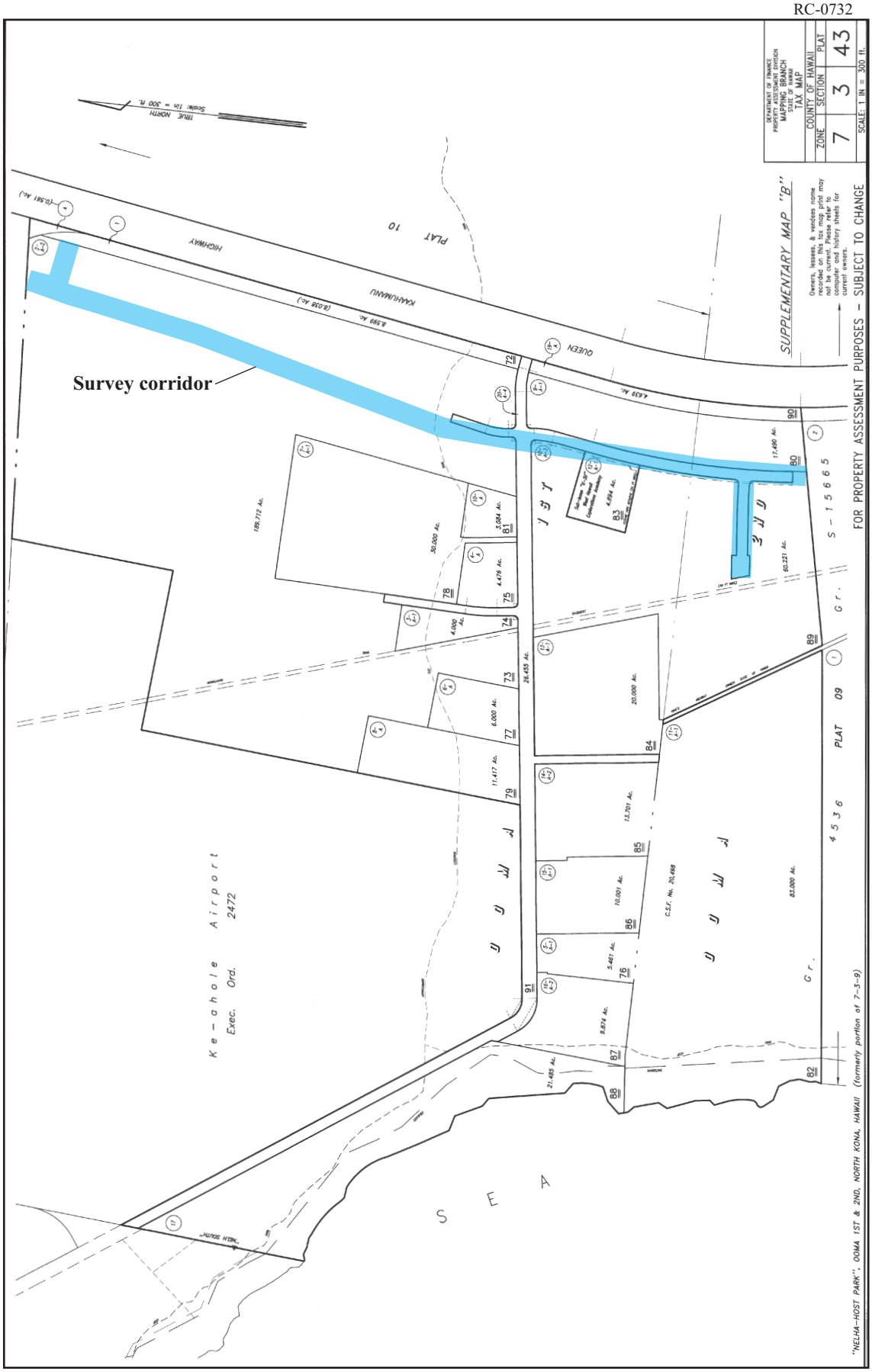

Figure 2. Tax Map Key (TMK): 3-7-3-43 showing the current survey corridor.

Figure 3. Aerial view showing the current survey corridor (from Google Earth).

Figures 4. Typical terrain and vegetation in the southern portion of the study corridor.

Figure 5. Typical terrain and vegetation in the northern portion of the study corridor.

ARCHAEOLOGICAL BACKGROUND

The lands encompassed by the NELHA Host park were previously the subject of DLNR-SHPD approved archaeological surveys conducted by Barrera (1985a) and Donham (1987) (Figure 6). Some sites within these survey areas have undergone archaeological data recovery investigation (Barrera 1989; Corbin 2000), while at others, archaeological site preservation planning has been implemented (Rechtman and Clark 2004, 2006). The Barrera (1985a) survey included all the lands encompassed by the current survey corridor. More recent studies conducted within and adjacent to the NELHA host park, in areas that were previously surveyed, have shown that while no additional sites are present in some areas (Rechtman 2010a, 2010b) they are present in others (Rechtman 2007). The following archaeological background summarizes the findings of studies previously conducted in the coastal portions of ʻOʻoma 1st and 2nd and Kalaoa 5th *ahupuaʻa*, North Kona District, Island of Hawaiʻi.

In 1929-1930, the Bishop Museum contracted John Reinecke to conduct a survey of Hawaiian sites in West Hawaiʻi, including coastal portions of the ʻOʻoma and the Kalaoa *ahupuaʻa* (Reinecke n.d.). A portion of Reinecke's survey fieldwork extended north from Kailua as far as Kalāhuipuaʻa. His work being the first attempt at a survey of sites of varying function, ranging from ceremonial to residency and resource collection.

During his study, Reinecke traveled along the shore, documenting near-shore sites. Where he could, he spoke with the few native residents he encountered. Among his general descriptions of the region, Reinecke observed:

> This coast formerly was the seat of a large population. Only a few years ago Keawaiki, now the permanent residence of one couple, was inhabited by about thirty-five Hawaiians. Kawaihae and Puako were the seat of several thousands, and smaller places numbered their inhabitants by the hundreds. Now there are perhaps fifty permanent inhabitants between Kailua and Kawaihae–certainly not over seventy-five.
>
> When the economy of Hawaii was based on fishing this was a fairly desirable coast; the fishing is good; there is a fairly abundant water supply of brackish water, some of it nearly fresh and very pleasant to the taste; and while there was no opportunity for agriculture on the beach, the more energetic Hawaiians could do some cultivation at a considerable distance *mauka*.
>
> The scarcity of remains is therefore disappointing. This I attribute to four reasons: (1) those simply over looked, especially those a short distance mauka, must have been numerous; (2) a number must have been destroyed, as everywhere, by man and by cattle grazing; (3) the coast is for the most part low and storm-swept, so that the most desirable building locations, on the coral beaches, have been repeatedly swept over and covered with loose coral and lava fragments, which have obscured hundreds of platforms and no doubt destroyed hundreds more; (4) many of the dwellings must have been built directly on the sand, as are those of the family at Kaupulehu, and when the posts have been pulled up, leave no trace after a very few years.
>
> The remains on this strip of coast have some special characteristics differentiating them from the rest in Kona. First, there is an unusual number of petroglyphs and papamu, especially about Kailua and at Kapalaoa. Second, probably because of the strong winds, there are many walled sites, both of houses and especially of temporary shelters… (Reinecke n.d.:1-2)

The following site descriptions are quoted from Reinecke's manuscript of fieldwork conducted between Pūhili Point on the Kohanaiki-ʻOʻoma 2nd boundary, and into Kalaoa 5th (Figure 7). In the site descriptions below, Reinecke references the occurrence of at least six house sites; seven enclosures and pens (one of which is an "old cattle pen"); eleven terraces and platforms (one of which he felt was a "*heiau*"); two caves; two *ahu*; a stepping stone trail; three waterholes and a well; and eleven rock shelters. Apparently, no one was residing in the area at the time of his field survey.

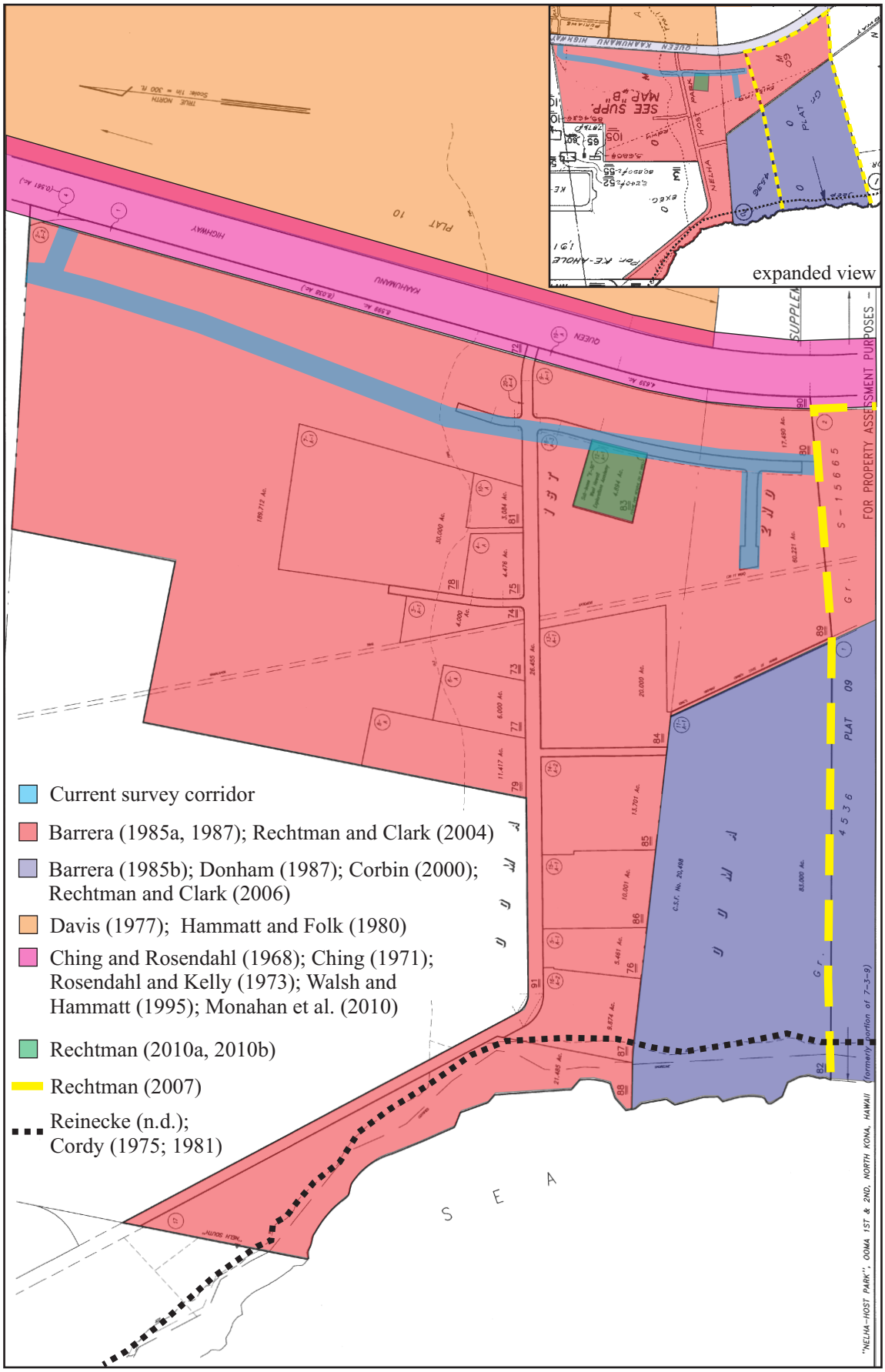

Figure 6. Previous archaeological studies conducted in the vicinity of the current survey corridor.

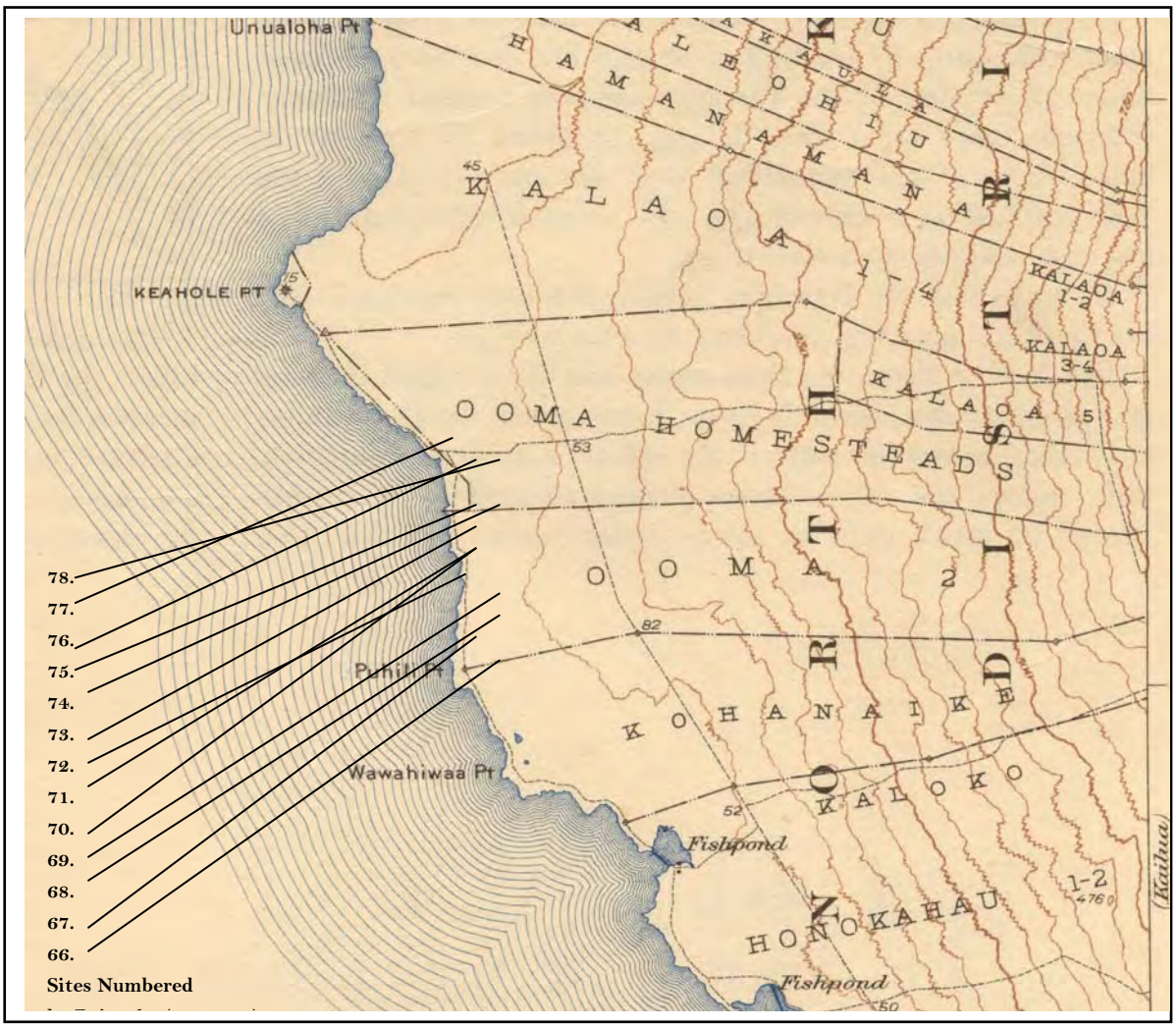

Figure 7. Approximate locations of sites described by Reinecke (n.d.:37) projected on USGS Keahole Quad, 1928.

Reinecke's site descriptions, south to north, across 'O'oma 2nd and 'O'oma 1st included:

> Site 66. Very doubtful dwelling site. Then a row of sand-covered platforms at the border of the sand and the beach lava, enough for 6-10 homes. Remains of an old, large pen.
>
> Site 67. Dry well on the crest of the beach.
>
> Site 68. Water hole, two small platforms, four or more shelters, pens with very small platform.
>
> Site 69. Large cattle pen. Doubtful old, rough platform at its north end. Remains of two old platforms by an ahu to the north.
>
> Site 70. Walled platform, S.E. corner terraced, badly broken down. Platform mauka. The walls of this and of Site 73 are built of thin pieces of pahoehoe surface lava, rather unusual in appearance. [Reinecke n.d.:15]
>
> Site 71. A knob partly walled on its slopes, with house site. Adjoining it on the south is a rough platform with three smooth boulders – heiau and kuula? Back of this a house platform and a platform about a fine shelter cave. Another platform and wall are about a slight natural depression filled with bones, including those of a whale.
>
> Site 72. Ruins of a pen.
>
> Site 73. Apparently a modern dwelling site of unusual construction; two terraces of pebbles, the upper 29x25x2 in front and 4-5' high elsewhere; the lower 19x10x25x3, with a three-sided pen at N.E.; surrounded by a carefully laid wall.
>
> Site 74. A shelter about a shallow cave; remains of another shelter; an ahu.

> Site 75. Trace of site; house platform; enclosure on shore. There are many faint traces of sites on this strip of coast. Toward the north is an unmistakable small site.
>
> Site 76. Modern shelter pen; house or shelter site; shelter mauka by kiawe tree.
>
> Site 77. Platform; tiny pen; sites of some kind marked by stones in lines on the pahoehoe flow.
>
> Site 78. Slightly brackish springs and pools; house site, shelters, stepping stone path leading to the walled house site… [Reinecke n.d.:16]

Reinecke's description of the features, albeit limited, contains valuable information about site condition and provides a 70 plus year perspective on natural degradation along this coastline (c.f., Donham 1987:7). In 1971-72, DLNR started an inventory of known archaeological sites and visited the sites Reinecke recorded along the ʻOʻoma coastline. These sites were assigned State Inventory of Historic Places (SIHP) site numbers, site forms were completed, and sketch maps were made. Reinecke's sites were assigned SIHP Sites 1911–1919.

In 1975, Ross Cordy carried out an intensive survey and subsurface testing program along this portion of the coast. He assigned Bishop Museum site numbers to the sites recorded by Reinecke, and synthesized the data he generated with those from seven other North Kona *ahupuaʻa* as part of his doctoral dissertation (Cordy 1981). Cordy (1985) further documented his work in an overview summary report for the ʻOʻoma and Kalaoa areas.

Davis (1977) conducted an archaeological survey of a proposed agricultural park in ʻOʻoma 1st and Kalaoa 5th *ahupuaʻa* located *mauka* of Queen Kaʻahumanu Highway (see Figure 6). Davis recorded a number of archaeological sites including surface complexes of habitation features, lava tubes used for habitation and refuge, a wall, several cairns, and two trails. Four of the lava tubes were the subject of an archaeological data recovery project reported on by Hammatt and Folk (1980). The wall (Site 6432), recorded along the boundary between ʻOʻoma 1st and 2nd *ahupuaʻa*, extends into the current study area following that boundary.

In 1985, Barrera began a series of studies, survey and data recovery, in Kalaoa 5th, ʻOʻoma 1st and 2nd *ahupuaʻa* (1985a, 1985b, 1989, 1992), two of which (Barrera 1985a, 1989) are the subject of this update survey. Barrera's work began with a reconnaissance of a 450-acre portion of the NELHA host park that included the entire current project area (Barrera 1985a; see Figure 6). Barrera conducted pedestrian sweeps across the project area at intervals of 100-feet looking for evidence of past use. He identified 45 sites (Figure 8) including the Māmalahoa Trail (SIHP Site 2) and four other sites previously assigned the SIHP designations (Sites 1917, 1919, 5603, and 5604), and 40 sites not previously assigned SIHP designations (Sites 10151-10190). The sites identified by Barrera (1985a) were not recorded in detail, but were briefly described, plotted on a scaled map of the project area, and photographed. Barrera summarizes his findings as follows:

> The sites located during this reconnaissance indicate a light, probably temporary utilization of the inland area and primary concentration of settlement at the coast. Such inland features as were found are small, scattered mounds and crude shelters with little or no midden deposits. The coastal sites, on the whole, can be characterized as large, well built structures of a more permanent nature, as evidenced by the presence of considerably greater amounts of midden materials and artifacts. (1985a:48)

Specifically the sites recorded by Barrera (1985a) include fourteen habitation shelters or shelter complexes (Sites 1917, 1919, 5603, 5604, 10154, 10166, 10168, 10170, 10171, 10175, 10177, 10179, 10180, and 10182), two midden scatters (Sites 10151 and 10185), twelve isolated stone mounds (Sites 10152, 10153, 10156, 10157, 10160, 10162, 10167, 10169, 10174, 10176, 10186, and 10189), four mound complexes (Sites 10161, 10181, 10187, and 10188), a habitation cave (Site 10155), three *pāhoehoe* excavations (Sites 10158, 10164, and 10184), six C-shaped enclosures (Sites 10159, 10163, 10165, 10172, 10173, and 10190), and two "petroglyphs" (Site 10178) interpreted as Historic boundary markers. None of the recorded sites fall within the current study area. Figure 8 shows the relationship of the current survey corridor to these previously recorded sites. A recent archaeological field inspection of five acres (TMK:3-7-3-43:83) within the Barrera (1985a) project area adjacent to the current survey corridor reported no additional findings, nor the presence of archaeological resources of any kind (Rechtman 2010a, 2010b). A preservation plan has already been implemented for the portion of the Māmalahoa Trail (SIHP Site 2) that crosses the NELHA property (Rechtman and Clark 2004).

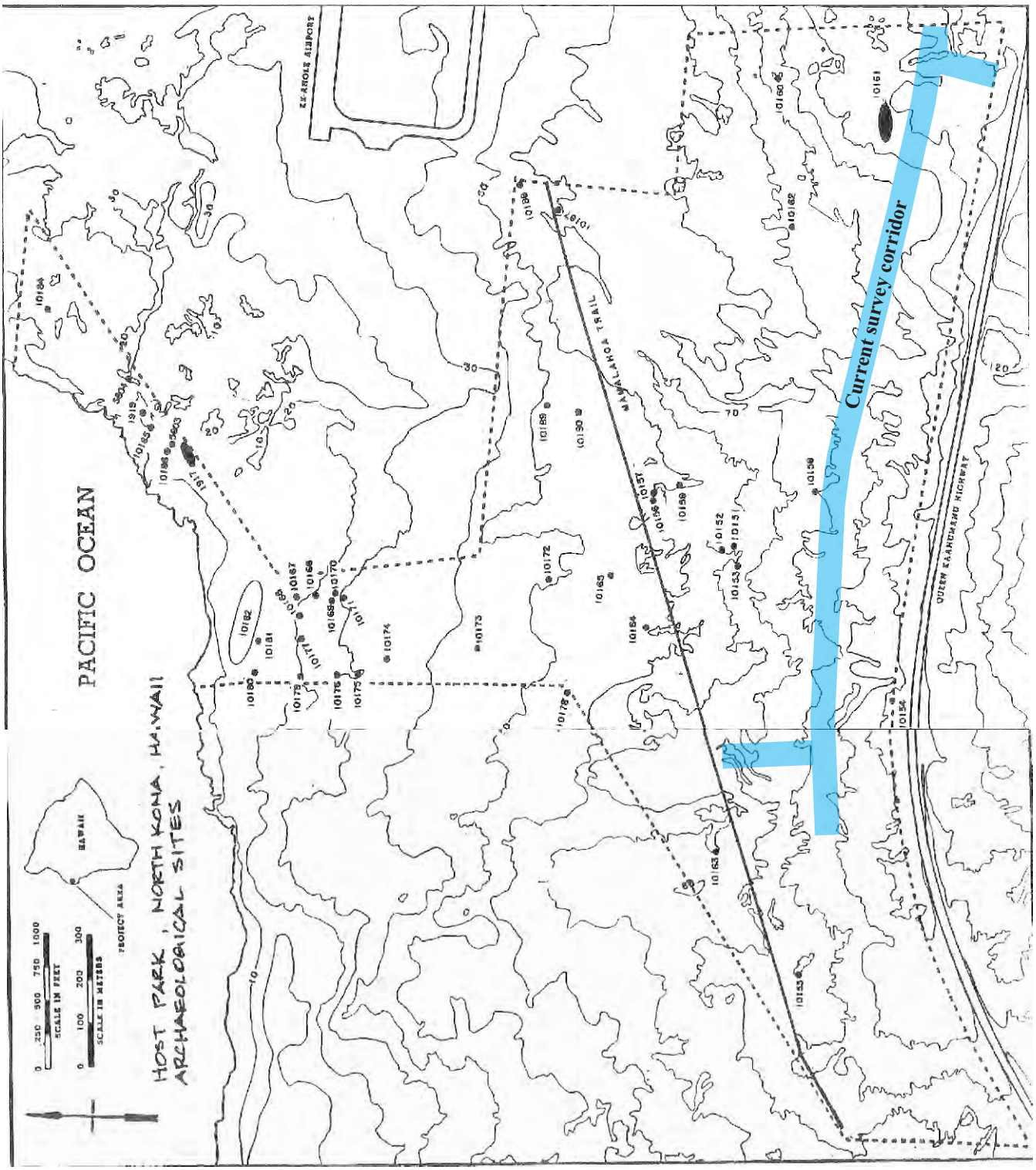

Figure 8. Barrera's (1985a) site location map showing the current survey corridor.

Barrera (1985b) then conducted an archaeological reconnaissance of a 350-acre parcel located in O‘oma 2nd Ahupua‘a between the coastal jeep road and the NELHA host park boundary (see Figure 6), recording 29 new sites and 12 sites previously documented by Cordy (1975, 1985). A later DLNR-SHPD field check of the area (Cordy 1986) concluded, however, that while the inland portion of the Barrera (1985b) project area had been adequately surveyed, the coastal portion had not. Cordy (1986:5) found the survey to be deficient because it did not include the coastal portion of the parcel between the Jeep road and the coast, and it failed to record numerous small coastal sites that were noted, but not reported on. Cordy (1986) actually identified six new sites during the field check. The Barrera (1985b) survey area would later be re-examined by Donham (1987).

Following the completion of the Barrera (1985a, 1985b) reconnaissance, but prior to the Donham (1987) survey, a mitigation program entitled “Hawaii Ocean Science and Technology Park Work Program for Archaeological Data Recovery” was generated by DLNR-SHPD for the Barrera (1985a) project area. Three levels of further work were called for in the plan including additional recording only (Sites 10154, 10159, 10161, 10163, 10165, 10170, 10172, 10173, 10179, 10180, 10187, 10188, and 10190), further recording and excavation (Sites 10166, 10171, 10175, and 10182), and excavation only (Sites 1917, 1919, and 10185). The data recovery program was implemented by Barrera (1987). Figure 8 shows the relationship of the “data recovered” sites to current survey corridor. As a result of the additional study Barrera (1987) found that the earliest occupation of the project area was around the middle of the sixteenth century, with occupation continuing and increasing throughout the seventeenth and early eighteenth centuries, but that by the end of the eighteenth century most of the sites had been abandoned. The archaeological evidence overwhelmingly indicated that the exploitation of marine resources was the primary occupation of residents at the coastal structures in O‘oma and Kalaoa.

Donham (1987) conducted archaeological survey and testing at a 314-acre coastal parcel in ‘O‘oma 2nd Ahupua‘a located *makai* of the current project area (see Figure 6). That study, which re-inventoried the sites previously identified by Barrera (1985b), was a comprehensive inventory of sites for an Environmental Impact Statement prepared in 1991. Including the sites that had been previously documented by Cordy (1975, 1985, 1986) and Barrera (1985a), Donham (1987) recorded a total of 74 sites containing 279 features. The recorded sites included numerous formal feature types that were interpreted as having been used for temporary and permanent habitation, ceremonial, burial, transportation, quarry, and indeterminate purposes. These findings indicated that the earlier Barrera (1985b) study had indeed been inadequate, especially in the coastal portions of the project area. Two of the sites reported on by Donham (1987) were later the subject of an archaeological data recovery report prepared by Corbin (2000). Sites 1916 and 18028, both habitation complexes located in the coastal potion of ‘O‘oma 2nd Ahupua‘a, were extensively excavated in 1999. Radiocarbon dates indicated that both of the complexes were established around A.D. 1600 to 1650, and that the exploitation of marine resources, based on the artifact assemblage, was the primary activity of residents of there.

More recently, a preservation plan (Rechtman and Clark 2006) was implemented for seven of the sites that fall within the NELHA portion of the Donham (1987) survey area (Sites 1913, 1914, 1915, 16132, 18025, 18026, and 18027). Also, an update inventory survey of the southern portions of the combined Donham (1987) and Barrera (1985a, 1985b) project areas (see Figure 6) was conducted (Rechtman 2007). This update inventory survey revealed the presence of two additional sites (Site 25932 and 26678) within the Donham (1987) survey area. Both sites were lava tubes containing human skeletal remains located approximately 200 meters *makai* of the Māmalahoa Trail (Site 2).

The Queen Ka‘ahumanu Highway right-of-way at the *mauka* termination of the current survey corridor has been the subject of several archaeological studies (see Figure 6). Prior to its construction, the right-of way was surveyed for archaeological sites by Ching and Rosendahl (1968). Additional reporting on sites within the highway alignment was provided by Ching (1971), and salvage work at selected sites was reported by Rosendahl and Kelly (1973). No archaeological sites were reported in the immediate vicinity of the current project area during this initial highway work. More recent archaeological survey for the proposed widening of the Queen Ka‘ahumanu Highway by Cultural Surveys Hawai‘i, Inc. (Walsh and Hammatt 1995; Monahan et al. 2012), however, has identified several archaeological sites within ‘O‘oma 1st and 2nd and Kalaoa 5th *ahupua‘a* along the *makai* edge of the current highway alignment. While Walsh and Hammatt (1995) identified only Site 6432 (the core-filled wall along the boundary between ‘O‘oma 1st and 2nd *ahupua‘a*), on-going work reported on by Monahan et al. (2012) has identified at least six additional sites in this area. The additional sites include a grouping of cairns, 2 *pāhoehoe* excavations, a small lava tube, a possible filled crevice, and a modified lava blister.

CULTURE-HISTORICAL BACKGROUND

One of the potential shortcomings of the earlier studies, given current regulatory standards and practices, was in not providing sufficiently detailed cultural and historical contexts. While the physical study area is limited to a narrow corridor the stretches across portions of ʻOʻoma 1st and 2nd and Kalaoa 5th *ahupuaʻa* identified as TMK:3-7-3-43: portions 073, 080, 083, 089, and 091, in an effort to provide a comprehensive and holistic understanding of the current project area, this section of the report examines the entire area and its relationship to neighboring lands within the larger Kekaha region. Rechtman Consulting, LLC has previously prepared a Cultural Impact Assessment for this general area (Rechtman and Maly 2003). Extensive research for that study was conducted by Kepā Maly of Kumu Pono Associates, and it included a review of archival-historical literature from both Hawaiian and English language sources, including an examination of Hawaiian Land Commission Award records from the *Māhele ʻĀina* (Land Division) of 1848; survey records of the Kingdom and Territory of Hawaiʻi; and historical texts authored or compiled by Malo (1951), Iʻi (1959), Kamakau (1961, 1964, 1976, and 1991), Ellis (1963), Fornander (1916-1919 and 1996), Thrum (1908), Stokes and Dye (1991), Beckwith (1970), Reinecke (n.d.); and Handy and Handy with Pukui (1972). That study also included several native accounts from Hawaiian language newspapers (compiled and translated from Hawaiian to English, by Kepā Maly), and historical narratives authored by eighteenth and nineteenth century visitors to the region. The information was presented within thematic categories and ordered chronologically by the date of publication.

The archival-historical resources were located in the collections of the Hawaiʻi State Archives (HSA), State Land Division (LD), State Survey Division (SD), and State Bureau of Conveyances (BoC); the Bishop Museum Archives (BPBM); Hawaiian Historical Society (HHS); University of Hawaiʻi-Hilo Moʻokini Library; private family collections; and in the collection of Kumu Pono Associates.

Over the last ten years, Kepā Maly of Kumu Pono Associates has researched and prepared several detailed studies—in the form of review and translation of accounts from Hawaiian language newspapers, historical accounts recorded by Hawaiian and non-Hawaiian residents, and government land use records—for lands in the Kekaha region of which ʻOʻoma and Kalaoa are a part. Kepā Maly has also conducted a number of detailed oral history interviews with elder *kamaʻāina* documenting their knowledge of the Kekaha region, and he undertook new interviews and further consultation as a part of the 2003 study.

As the information collected and presented by Rechtman and Maly (2003) is comprehensive, this report presents only a slightly modified version of the cultural and historical background for the Kekaha region that was already generated. It is a comprehension of this background information that facilitates a more complete understanding of the potential significance of the resources that exist within the current study area.

Natural and Cultural Resources in a Hawaiian Context

In Hawaiian society, natural and cultural resources are one and the same. Native traditions describe the formation (the literal birth) of the Hawaiian Islands and the presence of life on and around them in the context of genealogical accounts. All forms in the natural environment, from the skies and mountain peaks, to the watered valleys and lava plains, and to the shoreline and ocean depths were believed to be embodiments of Hawaiian deities. One Hawaiian genealogical account, records that Wākea (the expanse of the sky–father) and Papa-hānau-moku (Papa—Earth-mother who gave birth to the islands)—also called Haumea-nui-hānau-wā-wā (Great Haumea—Woman-earth born time and time again)—and various gods and creative forces of nature, gave birth to the islands. Hawaiʻi, the largest of the islands, was the first-born of these island children. As the Hawaiian genealogical account continues, we find that these same god-beings, or creative forces of nature who gave birth to the islands, were also the parents of the first man (Hāloa), and from this ancestor, all Hawaiian people are descended (cf. Beckwith 1970; Malo 1951:3; Pukui and Korn 1973). It was in this context of kinship, that the ancient Hawaiians addressed their environment and it is the basis of the Hawaiian system of land use.

An Overview of Hawaiian Settlement

Archaeologists and historians describe the inhabiting of these islands in the context of settlement that resulted from voyages taken across the open ocean. For many years, researchers have proposed that early Polynesian settlement voyages between Kahiki (the ancestral homelands of the Hawaiian gods and people) and Hawai'i were underway by A.D. 300, with long distance voyages occurring fairly regularly through at least the thirteenth century. It has been generally reported that the sources of the early Hawaiian population—the Hawaiian Kahiki—were the Marquesas and Society Islands (Cordy 2000; Emory in Tatar 1982:16-18). More recently, Kirch (2011) has suggested that initial settlement of Hawaii may not have occurred until about A.D. 1000.

For generations following initial settlement, communities were clustered along the watered, windward (*ko'olau*) shores of the Hawaiian Islands. Along the *ko'olau* shores, streams flowed and rainfall was abundant, and agricultural production became established. The *ko'olau* region also offered sheltered bays from which deep sea fisheries could be easily accessed, and near shore fisheries, enriched by nutrients carried in the fresh water, could be maintained in fishponds and coastal waters. It was around these bays that clusters of houses where families lived could be found (McEldowney 1979:15). In these early times, Hawai'i's inhabitants were primarily engaged in subsistence level agriculture and fishing (Handy et al. 1972:287).

Following the initial settlement period, areas with the richest natural resources became populated and perhaps crowded, and by about A.D. 1200, the population began expanding to the *kona* (leeward side) and more remote regions of the island (Cordy 2000:130). In Kona, communities were initially established along sheltered bays with access to fresh water and rich marine resources. The primary "chiefly" centers were established at several locations—the Kailua (Kaiakeakua) vicinity, Kahalu'u-Keauhou, Ka'awaloa-Kealakekua, and Hōnaunau. The communities shared extended familial relations, and there was an occupational focus on the collection of marine resources. By the fourteenth century, inland elevations to around the 3,000-foot level were being turned into a complex and rich system of dryland agricultural fields (today referred to as the Kona Field System). By the fifteenth century, residency in the uplands was becoming permanent, and there was an increasing separation of the chiefly class from the common people. In the sixteenth century the population stabilized and the *ahupua'a* land management system was established as a socioeconomic unit (see Ellis 1963; Handy et al. 1972; Kamakau 1961; Kelly 1983; and Tomonari-Tuggle 1985).

In Kona, where there were no regularly flowing streams to the coast, access to potable water (*wai*), was of great importance and played a role in determining the areas of settlement. The waters of Kona were found in springs and caves (found from shore to the mountain lands), or procured from rain catchments and dewfall. Traditional and historic narratives abound with descriptions and names of water sources, and also record that the forests were more extensive and extended much further seaward than they do today. These forests not only attracted rains from the clouds and provided shelter for cultivated crops, but also in dry times drew the *kēhau* and *kēwai* (mists and dew) from the upper mountain slopes to the low lands (see also traditional-historical narratives and oral history interviews in this study).

In the 1920s-1930s, Handy et al. (1972) conducted extensive research and field interviews with elder native Hawaiians. In lands of North and South Kona, they recorded native traditions describing agricultural practices and rituals associated with rains and water collection. Primary in these rituals and practices was the lore of Lono—a god of agriculture, fertility, and the rituals for inducing rainfall. Handy et al., observed:

> The sweet potato and gourd were suitable for cultivation in the drier areas of the islands. The cult of Lono was important in those areas, particularly in Kona on Hawai'i . . . there were temples dedicated to Lono. The sweet potato was particularly the food of the common people. The festival in honor of Lono, preceding and during the rainy season, was essentially a festival for the whole people, in contrast to the war rite in honor of Ku which was a ritual identified with Ku as god of battle. (Handy et al. 1972:14)

Handy et al. (1972) noted that the worship of Lono was centered in Kona. Indeed, it was while Lono was dwelling at Keauhou, that he is said to have introduced taro, sweet potatoes, yams, sugarcane, bananas, and *ʻawa* to Hawaiian farmers (Handy et al. 1972:14). The rituals of Lono "The father of waters" and the annual *Makahiki* festival, which honored Lono and which began before the coming of the *kona* (southerly) storms and lasted through the rainy season (the summer months), were of great importance to the native residents of this region (Handy et al. 1972: 523). The significance of rituals and ceremonial observances in cultivation and indeed in all aspects of life was of great importance to the well being of the ancient Hawaiians, and cannot be overemphasized, or overlooked when viewing traditional sites of the cultural landscape.

Hawaiian Land Use and Resource Management Practices

Over the generations, the ancient Hawaiians developed a sophisticated system of land and resources management. By the time ʻUmi-a-Līloa rose to rule the island of Hawaiʻi in ca. 1525, the island (*moku-puni*) was divided into six districts or *moku-o-loko* (cf. Fornander 1973–Vol. II:100-102). On Hawaiʻi, the district of Kona is one of six major *moku-o-loko* within the island. The district of Kona itself, extends from the shore across the entire volcanic mountain of Hualālai, and continues to the summit of Mauna Loa, where Kona is joined by the districts of Kaʻū, Hilo, and Hāmākua. One traditional reference to the northern and southern-most coastal boundaries of Kona tells us of the district's extent:

> *Mai Ke-ahu-a-Lono i ke ʻā o Kani-kū, a hōʻea i ka ʻūlei kolo o Manukā i Kaulanamauna e pili aku i Kaʻū!*—From Keahualono [the Kona-Kohala boundary] on the rocky flats of Kanikū, to Kaulanamauna next to the crawling (tangled growth of) ʻūlei bushes at Manukā, where Kona clings to Kaʻū! (*Kaʻao Hoʻoniua Puʻuwai no Ka-Miki in Ka Hōkū o Hawaiʻi*, September 13, 1917; Translated by Kepā Maly)

Kona, like other large districts on Hawaiʻi, was further divided into ʻokana or kalana (regions of land smaller than the *moku-o-loko*, yet comprising a number of smaller units of land). In the region now known as Kona ʻakau (North Kona), there are several ancient regions (*kalana*) as well. The southern portion of North Kona was known as "Kona kai ʻōpua" (interpretively translated as: Kona of the distant horizon clouds above the ocean), and included the area extending from Lanihau (the present-day vicinity of Kailua Town) to Puʻuohau (now known as Red Hill). The northern-most portion of North Kona was called "Kekaha" (descriptive of an arid coastal place). Native residents of the region affectionately referred to their home as *Kekaha-wai-ʻole o nā Kona* (Waterless Kekaha of the Kona District), or simply as the *āina kaha*. It is within this region of Kekaha, that the lands of ʻOʻoma and Kalaoa are found.

The *ahupuaʻa* were also divided into smaller individual parcels of land (such as the *ʻili, kōʻele, māla*, and *kīhāpai*, etc.), generally oriented in a *mauka-makai* direction, and often marked by stone alignments (*kuaiwi*). In these smaller land parcels the native tenants tended fields and cultivated crops necessary to sustain their families, and the chiefly communities with which they were associated. As long as sufficient tribute was offered and *kapu* (restrictions) were observed, the common people, who lived in a given *ahupuaʻa* had access to most of the resources from mountain slopes to the ocean. These access rights were almost uniformly tied to residency on a particular land, and earned as a result of taking responsibility for stewardship of the natural environment, and supplying the needs of the *aliʻi* (see Kamakau 1961:372-377 and Malo 1951:63-67).

Entire *ahupuaʻa*, or portions of the land were generally under the jurisdiction of appointed *konohiki* or lesser chief-landlords, who answered to an *aliʻi-ʻai-ahupuaʻa* (chief who controlled the *ahupuaʻa* resources). The *aliʻi-ʻai-ahupuaʻa* in turn answered to an *aliʻi ʻai moku* (chief who claimed the abundance of the entire district). Thus, *ahupuaʻa* resources supported not only the *makaʻāinana* and *ʻohana* who lived on the land, but also contributed to the support of the royal community of regional and/or island kingdoms. This form of district subdividing was integral to Hawaiian life and was the product of strictly adhered to resources management planning. In this system, the land provided fruits and vegetables and some meat in the diet, and the ocean provided a wealth of protein resources. Also, in communities with long-term royal residents, divisions of labor (with specialists in various occupations on land and in procurement of marine resources) came to be strictly adhered to. It is in this cultural setting that we find the present study area.

The *ahupuaʻa* of ʻOʻoma (historically, ʻOʻoma 1st and 2nd) and Kalaoa (historically, Kalaoa 1st – 5th) are two of some twenty ancient *ahupuaʻa* within the *ʻokana* of Kekaha-wai-ʻole. The place name ʻOʻoma can be literally translated as concave. The place name Kalaoa can be literally translated as "the choker (as a stick for

catching eels)" (Pukui et al. 1974:75). To date, no tradition explaining the source of the place names has been located. A few place names within ʻOʻoma were discussed in traditional accounts, thus we have some indication of the histories associated with that land.

While there are only limited native accounts that have been recorded about ʻOʻoma, we do know that the land was so esteemed, that during the youth of Kauikeaouli (later known as Kamehameha III), the young prince—son of Kamehameha I and his sacred wife Keōpūolani—was taken to be raised near the shore of ʻOʻoma under the care of his stewards from infancy until he was five years old (Kamakau 1961:263-264). Again, this is a significant part of the history of this land, as great consideration went into all aspects of the young king's upbringing (see Iʻi 1959 and Kamakau 1961).

The Environmental Setting of ʻOʻoma and Kalaoa

The *ahupuaʻa* of ʻOʻoma and Kalaoa cross several environmental zones that are generally called *wao* in the Hawaiian language. These environmental zones include the near-shore fisheries and shoreline strand (*kahakai*) and the *kula kai/kula uka* (shoreward/inland plains). These regional zones were greatly desired as places of residence by the natives of the land.

While the *kula* region is now likened to a volcanic desert, native and historic accounts describe or reference groves of native hardwood shrubs and trees such as *ʻūlei* (*Osteomeles anthyllidifolia*), *ēlama* (*Diospyros ferrea*), *uhiuhi* (*Caesalpina kavaiensis*), and *ohe* (*Reynoldsia sandwicensis*) extending across the land and growing some distance shoreward. The few rare and endangered plants found in the region, along with small remnant communities of native dryland forest (Char 1991) give an indication that there was a significant diversity of plants growing upon the *kula* lands prior to the introduction of ungulates.

The lower *kula* lands receive only about 20 inches of rainfall annually, and it is because of their dryness, the larger region of which ʻOʻoma and Kalaoa are a part, is known as "Keka ha." While on the surface, there appears to be little or no potable water to be found, the very lava flows which cover the land contain many underground streams that are channeled through subterranean lava tubes which feed the springs, fishponds and anchialine ponds on the *kula kai* (coastal flats). Also in this region, on the flat lands, about a half-mile from the shore, is the famed *Alanui Aupuni* (Government Trail), built in 1847, at the order of Kamehameha III. This trail or government roadway, was built to meet the needs of changing transportation in the Hawaiian Kingdom, and in many places it overlays the older near shore *ala loa* (ancient foot trail that encircled the island).

Continuing into the *kula uka* (inland slopes), the environment changes as elevation increases. This zone is called the *wao kanaka* (region of man) and *wao nahele* (forest region). Rainfall increases to 30 or 40 inches annually, and taller forest growth occurred. This region provided native residents with shelter for residential and agricultural uses, and a wide range of natural resources that were of importance for religious, domestic, and economic purposes. In ʻOʻoma and Kalaoa, this region is generally between the 1,200 to 2,200 foot elevation, and is crossed by the present-day Māmalahoa Highway. The highway is situated not far below the ancient *ala loa*, or foot trail, also known as Ke-alaʻehu, and was part of a regional trail system passing through Kona from Kaʻū and Kohala.

The ancient Hawaiians saw (as do many Hawaiians today) all things within their environment as being interrelated. That which was in the uplands shared a relationship with that which was in the lowlands, coastal region, and even in the sea. This relationship and identity with place worked in reverse as well, and the *ahupuaʻa* as a land unit was the thread that bound all things together in Hawaiian life. In an early account written by Kihe (in *Ka Hōkū o Hawaiʻi*, 1914-1917), with contributions by John Wise and Steven Desha Sr., the significance of the dry season in Kekaha and the custom of the people departing from the uplands for the coastal region is further described:

> *…ʻOia ka wā e neʻe ana ka lā iā Kona, hele a maloʻo ka ʻāina i ka ʻai kupakupa ʻia e ka lā, a o nā kānaka, nā liʻi o Kona, pūheʻe aku la a noho i kahakai kāhi o ka wai e ola ai nā kānaka* – It was during the season, when the sun moved over Kona, drying and devouring the land, that the chiefs and people fled from the uplands to dwell along the shore where water could be found to give life to the people. (*Ka Hōkū o Hawaiʻi*, April 5, 1917 translated by Kepā Maly)

It appears that the practice of traveling between upland and coastal communities in the ʻOʻoma and Kalaoa *ahupuaʻa* greatly decreased by the middle nineteenth century. Indeed, the only claimant for *kuleana* land in ʻOʻoma, during the *Māhele ʻĀina* of 1848—when native tenants were allowed to lay claim to lands on which they lived and cultivated—noted that he was the only resident in ʻOʻoma at the time (see *Helu* 9162 to Kahelekahi, in this study). This is perhaps explained by the fact that at time of the *Māhele* there was a significant decline in the Hawaiian population, and changes in Hawaiian land tenure led to the relocation of many individuals from various lands.

Native Traditions and Historical Accounts of ʻOʻoma, Kalaoa and the Kekaha Region

This section of the study presents *moʻolelo*—native traditions and historical accounts (some translated from the original Hawaiian by Kepā Maly)—of the Kekaha region that span several centuries. There are very few accounts that have been found to date, that specifically mention ʻOʻoma and Kalaoa. Thus, narratives that describe neighboring lands within the Kekaha region help provide an understanding of the history of these *ahupuaʻa*, describing features and the use of resources that were encountered on the land.

It may be, that the reason there are so few accounts for ʻOʻoma, and Kalaoa is that thay may have been considered marginal settlement areas, occupied only after the better situated lands of Kekaha—those lands with the sheltered bays, and where fresh water could be easily obtained—were populated. As the island population grew, so too did the need to expand to more remote or marginal lands. This thought is found in some of the native traditions and early historic accounts below. However, as people populated the Kekaha lands, they came to value its fisheries—those of the deep sea, near shore, and inland fishponds.

The native account of Punia (also written Puniaiki – cf. Kamakau 1964), is perhaps among the earliest accounts of the Kekaha area, and in it is found a native explanation for the late settlement of Kekaha. The following narratives are paraphrased from Fornander's *Hawaiian Antiquities and Folklore* (Fornander 1959):

Punia: A Tale of Sharks and Ghosts of Kekaha

Punia was born in the district of Kohala, and was one of the children of Hina. One day, Punia desired to get lobster for his mother to eat, but she warned him of Kaiʻaleʻale and his hoards of sharks who guarded the caves in which lobster were found. These sharks were greatly feared by all who lived along, and fished the shores of Kohala for many people had been killed by the sharks. Heeding his mother's warning, Punia observed the habits of the sharks and devised a plan by which to kill each of the sharks. Setting his plan in motion, Punia brought about the deaths of all the subordinate sharks, leaving only Kaiʻaleʻale behind. Punia tricked Kaiʻaleʻale into swallowing him whole. Once inside Kaiʻaleʻale, Punia rubbed two sticks together to make a fire to cook the sweet potatoes he had brought with him. He also scraped the insides of Kaiʻaleʻale, causing great pain to the shark. In his weakened state, Kaiʻaleʻale swam along the coast of Kekaha, and finally beached himself at Alula, near the point of Maliu in the land of Kealakehe. The people of Alula, cut open the shark and Punia was released.

At that time Alula was the only place in all of Kekaha where people could live, for all the rest of the area was inhabited by ghosts. When Punia was released from the shark, he began walking along the trail, to return to Kohala. While on this walk, he saw several ghosts with nets all busy tying stones for sinkers to the bottom of the nets, and Punia called out in a chant trying to deceive the ghosts and save himself:

Auwe no hoi kuu makuakane o keia kaha e! *Alas, O my father of these coasts!*
Elua wale no maua lawaia o keia wahi. *We were the only two fishermen of this place (Kaha).*
Owau no o koʻu makuakane, *Myself and my father,*
E hoowili aku ai maua i ka ia o ianei, *Where we used to twist the fish up in the nets,*
O kala, o ka uhu, o ka palani, *The kala, the uhu, the palani,*

O ka ia ku o ua wahi nei la, *The transient fish of this place.*
Ua hele wale ia no e maua keia kai la! *We have traveled over all these seas,*
Pau na kuuna, na lua, na puka ia. *All the different place, the holes, the runs.*
Make koʻu makuakane, koe au. *Since you are dead, father, I am the only one left.*

> Hearing Punia's wailing, the ghosts said among themselves, "Our nets will be of some use now, since here comes a man who is acquainted with this place and we will not be letting down our nets in the wrong place." They then called out to Punia, "Come here." When Punia went to the ghosts, he explained to them, the reason for his lamenting; "I am crying because of my father, this is the place where we used to fish. When I saw the lava rocks, I thought of him." Thinking to trick Punia and learn where all the kuʻuna (net fishing grounds) were, the ghosts told Punia that they would work under him. Punia went into the ocean, and one-by-one and two-by-two, he called the ghosts into the water with him, instructing them to dive below the surface. As each ghost dove into the water, Punia twisted the net entangling the ghosts. This was done until all but one of the ghosts had been killed. That ghost fled and Kekaha became safe for human habitation (Fornander 1959:9-17).

One of the earliest datable accounts that describes the importance of the Kekaha region fisheries comes from the mid-sixteenth century, following ʻUmi-a-Līloa's unification of the island of Hawaiʻi under his rule. Writing in the 1860s, native historian, Samuel Mānaiakalani Kamakau (1961) told readers about the reign of ʻUmi, and his visits to Kekaha:

> ʻUmi-a-Liloa did two things with his own hands, farming and fishing...and farming was done on all the lands. Much of this was done in Kona. He was noted for his skill in fishing and was called Puʻipuʻi a ka lawaiʻa (a stalwart fisherman). Aku fishing was his favorite occupation, and it often took him to the beaches (Ke-kaha) from Kalahuipuaʻa to Makaula[1]. He also fished for ʻahi and kala. He was accompanied by famed fishermen such as Pae, Kahuna, and all of the chiefs of his kingdom. He set apart fishing, farming and other practices… (Kamakau 1961:19-20)

In his accounts of events at the end of ʻUmi's life, Kamakau (1961) references Kekaha once again. He records that Koʻi, one of the faithful supporters and a foster son of ʻUmi, sailed to Kekaha, where he killed a man who resembled ʻUmi. Koʻi then took the body and sailed to Makaʻeo in the *ahupuaʻa* of Keahuolu. Landing at Makaʻeo in the night, Koʻi took the body to the cave where ʻUmi's body lay. Replacing ʻUmi's body with that of the other man, Koʻi then crossed the lava beds, returning to his canoe at Makaʻeo. From there, ʻUmi's body was taken to its' final resting place… (Kamakau 1961:32-33).

As a child in ca. 1812, Hawaiian historian John Papa Iʻi passed along the shores of Kekaha in a sailing ship, as a part of the procession by which Kamehameha I returned to Kailua-Kona from his residency on Oʻahu. In his narratives, Iʻi described the shiny lava flows and fishing canoe fleets of the "Kaha" (Kekaha) lands:

> The ship arrived outside of Kaelehuluhulu, where the fleet for aku fishing had been since the early morning hours. The sustenance of those lands was fish.
>
> When the sun was rather high, the boy [Iʻi] exclaimed, "How beautiful that flowing water is!" Those who recognized it, however, said, "That is not water, but pahoehoe. When the sun strikes it, it glistens, and you mistake it for water…"
>
> Soon the fishing canoes from Kawaihae, the Kaha lands, and Ooma drew close to the ship to trade for the paʻiʻai (hard poi) carried on board, and shortly a great quantity of aku lay silvery-hued on the deck. The fishes were cut into pieces and mashed; and all those aboard fell to and ate, the women by themselves.

[1] Kalāhuipuaʻa is situated in the district of Kohala, bounding the northern side of Puʻuanahulu in Kekaha. Makaʻula is situated a few *ahupuaʻa* north of ʻOʻoma.

> The gentle Eka sea breeze of the land was blowing when the ship sailed past the lands of the Mahaiulas, Awalua, Haleohiu, Kalaoas, Hoona, on to Oomas, Kohanaiki, Kaloko, Honokohaus, and Kealakehe, then around the cape of Hiiakanoholae… (I'i 1959:109-110)

Ka-Lani-Kau-i-ke-Aouli (Kamehameha III)

In ca. 1813, Ka-lani Kau-i-ke-aouli, who grew up to become Kamehameha III, was born. S.M. Kamakau (1961) tells us that the baby appeared to be still-born, but that shortly after birth, he was revived. Upon the revival of the baby, he was given to the care of Ka-iki-o-'ewa, who with Keawe-a-mahi and family, raised the child in seclusion at 'O'oma for the first five years of the young king's life. Kauikeaouli apparently held some interest in the land of 'O'oma 2nd through the *Māhele 'Āina*, as he originally claimed 'O'oma 2nd as his personal property. Though he subsequently gave it up to the Kingdom (Government) later during the Division (see records of *Māhele 'Āina* in this study).

Kamakau provides us with the following description of Kauikeaouli's birth and early life at 'O'oma:

> Ka-lani-kau-i-ke-aouli was the second son of Ke-opu-o-lani by Kamehameha, and she called him Kiwala'o after her own father. She was the daughter of Kiwala'o and Ke-ku'i-apo-iwa Liliha, both children of Ka-Iola Pupuka-o-Hono-ka-wai-lani, and hence she [Ke-opu-o- lani] was a ni'aupi'o and a naha chiefess, and the ni'aupi'o rank descended to her children and could not be lost by them. While she was carrying the child [Kau-i-ke-aouli] several of the chiefs begged to have the bringing up of the child, but she refused until her kahu, Ka-lua-i-konahale, known as Kua-kini, came with the same request. She bade him be at her side when the child was born lest some one else get possession of it. He was living this side of Keauhou in North Kona, and Ke-opu-o-lani lived on the opposite side.
>
> On the night of the birth the chiefs gathered about the mother. Early in the morning the child was born but as it appeared to be stillborn Kua-kini did not want to take it. Then came Ka-iki-o-'ewa from some miles away, close to Kuamo'o, and brought with him his prophet who said, "The child will not die, he will live." This man, Ka-malo-'ihi or Ka-pihe by name, came from the Napua line of kahunas descended from Makua-kau-mana whose god was Ka-'onohi-o-ka-la (similar to the child of God). The child was well cleaned and laid upon a consecrated place and the seer (kaula) took a fan (pe'ahi), fanned the child, prayed, and sprinkled it with water, at the same time reciting a prayer addressed to the child of God, something like that used by the Roman Catholics—
>
> "He is standing up, he is taking a step, he walks" (*Kulia-la, ka'ina-la, hele ia la*).
>
> Or another—
>
> *Huila ka lani i ke Akua,* / *The heavens lighten with the god,*
> *Lapalapa ka honua i ke keiki* / *The earth burns with the child,*
> *E ke keiki e, hooua i ka punohu lani,* / *O son, pour down the rain that brings the rainbow,*
> *Aia i ka lani ka Haku e,* / *There in heaven is the Lord.*
> *O ku'u 'uhane e kahe mau,* / *Life flows through my spirit,*
> *I la'a i kou kanawai.* / *Dedicated to your law.*
>
> The child began to move, then to make sounds, and at last it came to life. The seer gave the boy the name of "The red trail" (Ke-aweawe-'ula) signifying the roadway by which the god descends from the heavens.
>
> Ka-iki-o-'ewa became the boy's guardian and took him to rear in an out-of-the-way place at 'O'oma, Kekaha. Here Keawe-a-mahi, the lesser chiefs, the younger brothers and sisters of Ka-iki-o-'ewa, and their friends were permitted to carry the child about and hold him on their laps (uha). Ka-pololu was the chief who attended him; Ko'i-pepeleleu and Ulu-nui's mother [were] the nurses who suckled him. Later Ka-'ai-kane gave him her breast after she

> had given birth to Ke-kahu-pu‘u. Here at ‘O‘oma he was brought up until his fifth year, chiefly occupied with his toy boats rigged like warships and with little brass cannon loaded with real powder mounted on [their] decks. The firing off of these cannon amused him immensely. He excelled in foot races. On one occasion when the bigger boys had joined in the sport, a [rascal] boy named Ka-hoa thought to play a practical joke by smearing with mud the stake set up to be grasped by the one who first reached the goal. He expected one of the larger boys to be the winner, but it was the little prince who first caught the stick and had his hands smeared. “You will be burnt alive for dirtying up the prince. We are going to tell Ka-pololu on you!” the boys threatened; but the prince objected, saying, “Anyone who tells on him shall never eat with me again or play with me and I will never give him anything again.” Kau-i-ke-aouli was a splendid little fellow. He loved his playmates and never once did them any hurt, and he was kind and obedient to his teachers… [Kamakau 1961:264]

It is not until the early twentieth century, that we find a few detailed native accounts which tell of traditional features and residents of ‘O‘oma, Kalaoa, and vicinity. The writings of John Whalley Hermosa Isaac Kihe, a native son of Kekaha, in Hawaiian language newspapers (recently translated by Kepā Maly from the original Hawaiian texts), share the history of the land and sense the depth of attachment that native residents felt for ‘O‘oma, Kalaoa, and the larger Kekaha-wai-‘ole-o-nā-Kona.

> Kihe (who also wrote under the name of Ka-‘ohu-ha‘aheo-i-nā-kuahiwi-‘ekolu) was born in 1853, his parents were native residents of Honokōhau and Kaloko (his grandfather, Kuapāhoa, was a famed kahuna of the Kekaha lands). During his life, Kihe taught at various schools in the Kekaha region; served as legal counsel to native residents applying for homestead lands in ‘O‘oma and vicinity; worked as a translator on the Hawaiian Antiquities collections of A. Fornander; and was a prolific writer himself. In the later years of his life, Kihe lived at Pu‘u Anahulu and Kalaoa, and he is fondly remembered by elder kama‘āina of the Kekaha region. Kihe, who died in 1929, was also one of the primary informants to Eliza Maguire, who translated some of the writings of Kihe, publishing them in abbreviated form in her book “Kona Legends” (1926).

Writers today have varying opinions and theories pertaining to the history of Kekaha, residency patterns, and practices of the people who called Kekaha-wai-‘ole-o-nā-Kona home. For the most part, our interpretations are limited by the fragmented nature of the physical remains and historical records, and by a lack of familiarity with the diverse qualities of the land. As a result, most of us only see the shadows of what once was, and it is difficult at times, to comprehend how anyone could have carried out a satisfactory existence in such a rugged land.

Kihe and his co-authors provide readers with several references to places and events in the history of ‘O‘oma, Kalaoa, and neighboring lands. Through the narratives, we learn of place name origins, areas of ceremonial significance, how resources were managed and accessed, and the practices of those native families who made this area their home.

One example of the rich materials recorded by native writers, is found in “*Ka‘ao Ho‘oniua Pu‘uwai no Ka-Miki*” (The Heart Stirring Story of Ka-Miki). This tradition is a long and complex account, that was published over a period of four years (1914-1917) in the weekly Hawaiian-language newspaper *Ka Hōkū o Hawai‘i*. The narratives were primarily recorded for the paper by Hawaiian historians John Wise and J.W.H.I. Kihe.

While “*Ka-Miki*” is not an ancient account, the authors used a mixture of local stories, tales, and family traditions in association with place names to tie together fragments of site-specific histories that had been handed down over the generations. Also, while the personification of individuals and their associated place names may not be entirely “ancient,” such place name-person accounts are common throughout Hawaiian (and Polynesian) traditions. The English translations below are a synopsis of the Hawaiian texts, with emphasis upon the main events and areas being discussed. Diacritical marks and hyphenation have been placed to help with pronunciation of certain words.

“Kaao Hooniua Puuwai no Ka-Miki” (The Heart stirring Story of Ka-Miki)

This *moʻolelo* (tradition) is set in the 1300s (by association with the chief Pili-a-Kaʻaiaea), and is an account of two supernatural brothers, Ka-Miki (The quick, or adept, one) and Ma-Kaʻiole (Rat [squinting] eyes). The narratives describe the birth of the brothers, their upbringing, and their journey around the island of Hawaiʻi along the ancient *ala loa* and *ala hele* (trails and paths) that encircled the island. During their journey, the brothers competed alongside the trails they traveled, and in famed *kahua* (contest fields) and royal courts, against *ʻōlohe* (experts skilled in fighting or in other competitions, such as running, fishing, debating, or solving riddles, that were practiced by the ancient Hawaiians). They also challenged priests whose dishonorable conduct offended the gods of ancient Hawaiʻi. Ka-Miki and Ma-Kaʻiole were empowered by their ancestress Ka-uluhe-nui-hihi-kolo-i-uka (The great entangled growth of uluhe fern which spreads across the uplands), who was one of the myriad of body forms of the goddess Haumea, the earth-mother, creative force of nature who was also called Papa or Hina. Among her many nature-form attributes were manifestations that caused her to be called upon as a goddess of priests and competitors (people, places named for them, and other place names are marked below with underlining):

> …Kūmua was the husband of Ka-uluhe-nui-hihi-kolo-i-uka. The place that is named for Kūmua is in the uplands of Kohanaiki, an elevated rise from where one can look towards the lowlands. The shore and deep sea are all clearly visible from this place. The reason that Kūmua dwelt there was so that he could see the children and grandchildren of he and his wife.
>
> Wailoa, a daughter, was the mother of Kapaʻihilani, also called Kapaʻihi. There is a place in the uplands of Kohanaiki, below Kūmua, to the northwest, a hidden water hole, that is called Kapaʻihi. Wailoa is a pond there on the shore of Kohanaiki. Because Wailoa married Kahunakalehu, a native of the area, she lived and worked there. Thus the name of that pond is Wailoa, and it remains so to this day.
>
> Pipipiʻapoʻo was another daughter of Kūmua and Ka-uluhe-nui-hihi-kolo-i-uka. She married Haleolono, one who cultivated sweet potatoes upon the ʻilima covered flat lands of Nānāwale, also called Nāhiʻahu (Nāwahʻiahu), as it has been called from before and up to the present time. Cultivating the land was the skill of this youth Haleolono, and because he was so good at it, he was able to marry the beauty, Pipipiʻapoʻo.
>
> Pipipiʻapoʻo’s skill was that of weaving pandanus mats, and there are growing many pandanus trees there, even now. The grove of pandanus trees and a nearby cave, is called Pipipiʻapoʻo to this day, and you may ask the natives of Kohanaiki to point it out to you.
>
> Kapukalua was a son of Kūmua and Kaʻuluhe. He was an expert at aku lure fishing, and all other methods of fishing of those days gone by. He married Kauhiʻonohua a beauty with skin as soft as the blossoms of the hīnano, found in the pandanus grove of ʻOʻoma. This girl was pleasingly beautiful, and because of her fame, Kapukalua, the exceptionally skilled son of the sea spray of ʻApoʻula, secured her as his wife. Here, we shall stop speaking of the elders of Ka-Miki… [January 8, 1914]

The tradition continues, recounting the training of the brothers, and preparations of their *hālau aliʻi* (royal compound) at Kohanaiki. At the dedication ceremonies it was revealed that one of the *kahuna* of the Kaha lands, had taken up the habit of killing people, and that he had also thought to take the lives of Ka-Miki and Ma-Kaʻiole. We revisit the story here, and learn the name of a priest of ʻOʻoma and Kohanaiki—

> …The sun broke forth and the voices of the roosters and the ʻelepaio of the forests were heard resonating and rising upon the mountain slopes. The day became clear, with no clouds to be seen, it was calm. So too, the ocean was calm and the shore of Laʻi a ʻEhu (Kona) was calm. The flowers of the upland forest reddened and unfolded, and nodded gently in the kēhau breezes.

> The priests gathered together to discuss these events and prepared to apologize to the children of the chief, asking for their forgiveness. They selected ʻElepaio, Pūhili, Kaluaʻōlapa, and Kalua-ʻōlapa-uwila to go before the brothers for this purpose.
>
> ʻElepaio was the high priest of Honokōhau. The place where he dwelt bears the name ʻElepaio [an ʻili on the boundary of Honokōhau nui & iki]. It is in the great grove of *ʻulu (kaulu ʻulu)* on the boundary between Honokōhau-nui and Honokōhau-iki… [April 23, 1914]
>
> Pūhili was the high priest of ʻOʻoma and Kohanaiki, the place where he lived is on the plain of Kohanaiki, at the shore, and bears his name to this day. It is on the boundary between Kohanaiki and ʻOʻoma.
>
> Kaluaʻōlapa was the high priest of Haleʻōhiʻu and Kamāhoe, that is the waterless land of Kalaoa (Kalaoa wai ʻole). The place where he lived was in the uplands of Maulukua on the plain covered with *ʻilima* growth. This place bears his name to this day.
> Kalua-ʻōlapa-uwila was the high priest of Kealakehe and Keʻohuʻolu (Keahuolu), and it was he who built the *heiau* named Kalua-ʻōlapa-uwila, which is there along the shore of Kealakehe, next to the road that goes to Kailua. The nature of this priest was that of a shark and a man. The shark form was named Kaiwi, and there is a stone form of the shark that can be seen near the *heiau* to this day.
>
> These priests all went to the door of the house and presented the offerings of the black pig, the red fish, the black *ʻawa*, the white rooster, the *malo* (loin clothes), and all things that had been required of their class of priests. They also offered their prayers and asked forgiveness for their misspoken words. They then called for their prayers to be freed and the *kapu* ended… [April 30, 1914]

Through the 1920s, up to the time of his death in 1929, J.W.H.I. Kihe continued to submit traditional accounts and commentary on the changing times to the paper, *Ka Hōkū o Hawaiʻi*. In 1923, Kihe penned a series of articles, some of which formed the basis of Eliza Maguire's *Kona Legends* (1926). One of the accounts, "*Ka Punawai o Wawaloli*" (The Pond of Wawaloli), describes that the pond of Wawaloli, on the shore of ʻOʻoma, was named for a supernatural ocean being, who could take the form of the *loli* (sea cucumber) and of a handsome young man. Through this account it is learned that people regularly traveled between the uplands and shore of ʻOʻoma; the *kula* lands were covered with *ʻilima* growth; and that a variety of fish, seaweeds, and shellfish were harvested along the shore. Also, the main figures in the tradition are memorialized as places on the lands of ʻOʻoma, Kalaoa, and neighboring *ahupuaʻa*. These individuals and places include Kaluaʻōlapa (a hill on the boundary of Hāmanamana and Haleohiʻu), Wawaloli (a bay between ʻOʻoma and Kalaoa), Hoʻohila (on the boundary of Kaū and Puʻukala), Pāpaʻapoʻo (a cave site in Hāmanamana), Kamakaoiki and Malumaluiki (locations unknown). The following narratives were translated by Kepā Maly from the original Hawaiian texts published in *Ka Hōkū o Hawaiʻi* (September 23rd, October 4th & 11th, 1923):

Ka Punawai o Wawaloli (The Pond of Wawaloli)

> The place of this pond (Wawaloli) is set there on the shore of ʻOʻoma near Kalaoa. It is a little pond, and is there to this day. It is very close to the sandy shore, and further towards the shore there is also a pond in which one can swim. There is a tradition of this pond, that is held dearly in the hearts of the elders of this community.
>
> Wawaloli is the name of a loli (sea cucumber) that possessed dual body forms (kino pāpālua), that of a loli, and that of a man!
>
> Above there on the ʻilima covered flat lands, there lived a man by the name of Kaluaʻōlapa and his wife, Kamakaoiki, and their beautiful daughter, Malumaluiki.
>
> One day the young maiden told her mother that she was going down to the shore to gather limu (seaweeds), ʻōpihi (limpets), and pupu (shellfish). Her mother consented, and so the

maiden traveled to the shore. Upon reaching the shore, Malumaluiki desired to drink some water, so she visited the pond and while she was drinking she saw a reflection in the rippling of the water, standing over her. She turned around and saw that there was a handsome young man there, with a smile upon his face. He said… [September 27, 1923] "…Pardon me for startling you here as we meet at this pond, in the afternoon heat which glistens off of the pāhoehoe."

She responded, "What is the mistake of our meeting, you are a stranger, and I am a stranger, and so we have met at this pond." The youth, filled with desire for the beautiful young maiden, answered "I am not a stranger here along this shore, indeed, I am very familiar with this place for this is my home. And when I saw you coming here, I came to meet you."

These two strangers, having thus met, then began to lay out their nets to catch kala, uhu, and pālani, the native fish of this land. And in this way, the beauty of the plains of Kalaoa was caught in the net of the young man who dwelt in the sea spray of ʻOʻoma.

These two strangers of the long day also fished for hīnālea, and then for kawele'ā. It was during this time, that their lines became entangled like those of the fishermen of Wailua (a poetic reference to those who become entangled in a love affair).

The desire for the limu, ʻōpihi, and pūpū was completely forgotten, and the fishing poles bent as the lines were pulled back in the sea spray. The handsome youth was moistened in the rains that fell, striking the land and the beloved shore of the land. The sun drew near, entering the edge of the sea and was taken by Lehua Island. Only then did these two fishers of the long day take up their nets.

Before the young maiden began her return to the uplands, she told the youth, "Tell me your name." He answered her, "The name by which I am known is Wawa. But my name, when I go and dwell in the pond here, is Loli. And when you return, you may call to me with the chant:

E Loli nui kīkewekewe[2]	*Oh great Loli moving back and forth*
I ka hana ana kīkewekewe	*Doing your work moving back and forth*
I kuʻu piko kīkewekewe	*You are in my mind moving back and forth*
A ka makua kīkewekewe	*The parents moving back and forth*
I hana ai kīkewekewe	*Are at their work moving back and forth*
E piʻi mai ʻoe kīkewekewe	*Won't you arise moving back and forth*
Ka kaua puni kīkewekewe	*To that which we two desire moving back and forth*
Puni kauoha kīkewekewe	*Your command is desired moving back and forth*

Having finished their conversation, the maiden then went to the uplands. It was dark, and the kukui lamps had been lit in the house. Malumaluiki's parents asked her, "Where are your limu, ʻōpihi and pūpū?" She replied, "It is proper that you have asked me, for when I went to the shore it was filled with people who took all there was? Thus I was left with nothing, not even a fragment of limu or anything else. So I have returned up here."

Well, the family meal had been made ready, so they all sat to eat together. But after a short while the maiden stood up. Her parents inquired of this, and she said she was no longer hungry, and that her feet were sore from traveling the long path. So the maiden went to sleep. She did not sleep well though, and felt a heat in her bosom, as she was filled with desire, thus she had no sleep that night.

With the arrival of the first light of day, the Malumaluiki went once again down to the shore.

[2] "Kīkewekewe" is translated by Eliza Maguire (1926) as "charmer." Kepā Maly was unfamiliar with this meaning of the word. It is most commonly used in the refrain of a song, and is here translated as "moving back and forth," as the word is used in the spoken language. Kewe also means concave, similar to the place name ʻOʻoma.

Upon arriving at the place of the pond, she entered the water and called out as described above. Then, a loli appeared and turned into the handsome young man. They two then returned to their fishing for the kala, uhu and pālani, the native fish the land.

So it was that at the two lovers met regularly there on the shore of ʻOʻoma. Now Malumaluiki's parents became suspicious because of the actions of the daughter, and her regular trips to the shore. So they determined that they should secretly follow her and spy on her.

One day, the father followed her to the shore, where he saw his daughter sit down by the side of the pond. He then heard her call out —

E Loli nui kīkewekewe	*Oh great Loli moving back and forth*
I ka hana ana kīkewekewe	*Doing your work moving back and forth*
I kuʻu piko kīkewekewe	*You are the center of my life moving back and forth*
Piko maikaʻi kīkewekewe	*It is good moving back and forth*
A ka makua kīkewekewe	*The parents moving back and forth*
I hana ai kīkewekewe	*Are at their work moving back and forth*
E piʻi mai ʻoe kīkewekewe	*Won't you arise moving back and forth*
Ka kaua puni kīkewekewe	To that which we two desire *moving back and forth*
Puni kauoha kīkewekewe	*Your command is desired moving back and forth*
[October 4, 1923]	

"O Loli, here is your desire, the one you command, Malumaluiki, who's eyes see nothing else."

Her father then saw a loli coming up from the pond, and when it was up, it turned into the youth. He watched the two for a while, unknown to them, and saw that his daughter and the youth of the two body forms (kino pāpālua), took their pleasure in one another.

The father returned to the uplands and told all of this to her mother, who upon hearing it, was filled with great anger, because of the deceitfulness of her daughter. But then she learned that the man with whom her daughter slept was of dual body forms. Kamakaoiki then told Kaluaʻōlapa that he should "Go down and capture the loli, and beat it to death," to which he agreed.

One day, Kaluaʻōlapa went down early, and hid, unseen by the two lovers. Malumaluiki arrived at the pond and called out, and he then memorized the lines spoken by his daughter. When she left, returning to the uplands, he then went to the pond and looked closely at it. He then saw a small circular opening near the top of the water in the pond. He then understood that that was where the loli came up from. He then slept that night and in the early morning, he went to the pond and set his net in the water. He then began to call out as his daughter had done with the above words.

When he finished the chant, the loli began to rise up through the hole, and was ensnared in the net. Kaluaʻōlapa then carried him up onto the kula, walking to the uplands. On his way, he saw his daughter coming down, and he hid until she passed him by.

When the daughter arrived at the pond, she called out in the chant as she always did. She called and called until the sun was overhead, but the loli did not appear in the pond, nor did he come forward in his human form. Thus, she thought that he had perhaps died, and she began to wail and mourn for the loss of her lover. Finally as evening came, the beautiful maiden stood, and ascended the kula to her home.

Now, let us look back to the Kaluaʻōlapa. He went up to his house and showed the loli to his wife. Seeing the loli, she told her husband, "Take it to the kahuna, Pāpaʻapoʻo who lives on the kula of Hoʻohila." So he went to the kahuna and explained everything that had occurred

to him, and showed him the loli in his net. Seeing this and hearing of all that had happened, Pāpa‘apo‘o told the father to build an imu in which to kālua the great loli that moves back and forth (loli kīkewekewe). He said, “When the loli is killed, then your daughter will be well, so too will be the other daughters of the families of the land.” Thus, the imu was lit and the supernatural loli cooked.

When the daughter returned to her home, her eyes were all swollen from crying. Her mother asked her, “What is this, that your eyes are puffy from crying, my daughter?” She didn’t answer, she just kneeled down, giving no response. At that time, her father returned to the house and saw his daughter kneeling down, and he said “Your man, with whom you have been making love at the beach has been taken by the kahuna Pāpa‘apo‘o. He has been cooked in the imu that you may live, that all of the girls who this loli has loved may live.”

That pond is still there on the shore, and the place with the small round opening is still on the side of that pond to this day. It is something to remember those things of days gone by, something that should not be forgotten by those of today and in time to come. [October 11, 1923]

Ka Loko o Paaiea (The fishpond of Pā‘aiea)

The tradition of *Ka loko o Paaiea* (The fishpond of Pā‘aiea) was written by J.W.H.I. Kihe, and printed in *Ka Hōkū o Hawai‘i* in 1914 and 1924. The narratives describe traditional life and practices in various *ahupua‘a* of Kekaha, and specifically describes the ancient fishpond Pā‘aiea. The following excerpts from Kihe’s *mo‘olelo*, include references to Wawaloli, on the shore of ‘O‘oma and Kalaoa. Pā‘aiea, was destroyed by the Hualālai lava flows of 1801, reportedly as a result of the pond overseer’s refusal to give the goddess Pele—traveling in human form—any fish from the pond:

Pā‘aiea was a great fishpond, something like the ponds of Wainānāli‘i and Kīholo, in ancient times. At that time the high chiefs lived on the land, and these ponds were filled with fat awa, ‘anae, āhole, and all kinds of fish that swam inside. It is this pond that was filled by the lava flows and turned into pāhoehoe, that is written of here. At that time, at Ho‘onā, there was a Konohiki (overseer), Kepa‘alani, who was in charge of the houses (hale papa‘a) in which the valuables of the King [Kamehameha I] were kept. He was in charge of the King’s food supplies, the fish, the hālau (long houses) in which the fishing canoes were kept, the fishing nets and all things. It was from there that the King’s fishermen and the retainers were provisioned. The houses of the pond guardians and Konohiki were situated at Ka‘elehuluhulu and Ho‘onā.

In the correct and true story of this pond, we see that its boundaries extended from Ka‘elehuluhulu on the north, and on the south, to the place called Wawaloli (between ‘O‘oma and Kalaoa). The pond was more than three miles long and one and a half miles wide, and today, within these boundaries, one can still see many water holes.

While traveling in the form of an old woman, Pele visited the Kekaha region of Kona, bedecked in garlands of the *ko‘oko‘olau* (*Bidens* spp.). Upon reaching Pā‘aiea at Ho‘onā, Pele inquired if she might perhaps have an *‘ama‘ama*, young *āholehole*, or a few *‘ōpae* (shrimp) to take home with her. Kepa‘alani, refused, “they are *kapu*, for the King.” Pele then stood and walked along the *kuapā* (ocean side wall) of Pā’aiea till she reached Ka‘elehuluhulu. There, some fishermen had returned from aku fishing, and were carrying their canoes up onto the shore…

…Now because Kepa‘alani was stingy with the fishes of the pond Pā‘aiea, and refused to give any fish to Pele, the fishpond Pā‘aiea and the houses of the King were all destroyed by the lava flow. In ancient times, the canoe fleets would enter the pond and travel from Ka‘elehuluhulu to Ho‘onā, at Ua‘u‘ālohi, and then return to the sea and go to Kailua and the other places of Kona. Those who traveled in this manner would sail gently across the pond pushed forward by the ‘*Eka* wind, and thus avoid the strong currents which pushed out from the point of Keāhole

> It was at H oʻonā that Kepaʻalani dwelt, th at is wh ere the houses in which the chiefs valuables (*hale papaʻa*) were kept. It was also one of the canoe landings of the place. Today, it is where the light house of America is situated. Pelekāne (in Puʻukala) is where the houses of Kamehameha were located, near a stone mound that is partially covered by the *pāhoehoe* of Pele. If this fishpond had not been covered by the lava flows, it would surely be a thing of great wealth to the government today… [J.W.H.I. Kihe in *Ka Hoku o Hawaii*; compiled and translated by Kepā Maly, fro m the narratives written February 5-26, 1914 and May 1-15, 1924].

Na Hoʻomanao o ka Manawa (The Recollections of a Native Son)

Later in 1924, Kihe, described the changes which had occurred in the Kekaha region since his youth. In the following article, titled *Na Hoʻomanao o ka Manawa* (in *Ka Hōkū o Hawaiʻi* June 5th & 12th 1924), Kihe wrote about the villages that were once inhabited throughout Kekaha, identifying families, practices, and schools of the historic period (ca. 1860-1924). In the two part series (translated by Kepā Maly), he also shared his personal feelings about the changes that had occurred, including the demise of the families and the abandonment of the coastal lands of Kekaha.

> There has arisen in the mind of the author, some questions and thoughts about the nature, condition, living, traveling, and various things that bring pleasure and joy. Thinking about the various families and the many homes with their children, going to play and strengthening their bodies.
>
> In the year 1870, when I was a young man at the age of 17 years old, I went to serve as the substitute teacher at the school of Honokōhau. I was teaching under William G. Kanakaʻole who had suffered an illness (maʻi-lolo, a stroke).
>
> In those days at the Hawaiian Government Schools, the teachers we re all Hawaiian and taught in the Hawaiian language. In those days, the students were all Hawaiian as well, and the books were in Hawaiian. The students were all Hawaiian… There were many, many Hawaiian students in the schools, no Japanese, Portuguese, or people of other nationalities. Everyone was Hawaiian or part Hawaiian, and there were only a few part Hawaiians.
>
> The schools included the school house at Kīholo where Joseph W. Keala taught, and la ter J.K. Kaʻailuwale taught there. At the school of Makalawena, J. Kaʻelemakule Sr., who now resides in Kailua, was the teacher. At the Kalaoa School, J.U. Keaweʻake was the teacher. There were also others here, including myself for four years, J. Kainuku, and J.H. Olohia who was the last one to teach in the Hawaiian langua ge. At Kaloko, Miss Kaʻaimahuʻi was the last teacher before the Ka loko school was combined as one with the Honokōhau school where W.G. Kanakaʻole was the teacher. I ta ught there for two years as well... [Ki he includes additional descriptions on the schools of Kona]
>
> It was whe n they stoppe d teaching in Hawaiian, and began instructing in E nglish, that significant changes took place among our children. Some of them became puffed up and stopped listening to their parents. The children spoke gibberish (English) and the parents couldn't understand (*nā keiki namu*). Before that time, the Hawaiians weren't marrying too many people of other races. The children and their parents dwelt together in peace with the children and parents speaking together… [June 5, 1924]
>
> …Now perhaps there are some wh o will not agree with what I am saying, but these are my true thoughts. Things which I have seen with my own eyes, and know to be true…In the year 1870 when I was substitute teaching at Honokōhau for W.G. Kanakaʻole, I taught more than 80 students. There were both boys and girls, and this school had the highest enrollment of students studying in Hawaiian at that time [in Kekaha]. And the students then were all knowledgeable, all knew how to read and write.

Now the majority of those people are all dead. Of those things remembered and thought of by the people who yet remain from that time in 1870; those who are here 53 years later, we cannot forget the many families who lived in the various (*ʻāpana*) land sections of Kekaha.

From the lands of Honokōhau, Kaloko, Kohanaiki, the lands of ʻOʻoma, Kalaoa, Haleʻohiʻu, Makaʻula, Kaū, Puʻukala-ʻŌhiki, Awalua, the lands of Kaulana, Mahaiʻula, Makalawena, Awakeʻe, the lands of Kūkiʻo, Kaʻūpūlehu, Kīholo, Keawaiki, Kapalaoa, Puʻuanahulu, and Puʻuwaʻawaʻa. These many lands were filled with people in those days.

There were men, women, and children, the houses were filled with large families. Truly there were many people [in Kekaha]. I would travel around with the young men and women in those days, and we would stay together, travel together, eat together, and spend the nights in homes filled with aloha.

The lands of Honokōhau were filled with people in those days, there were many women and children with whom I traveled with joy in the days of my youth. Those families are all gone, and the land is quiet. There are no people, only the rocks remain, and a few scattered trees growing, and only occasionally does one meet with a man today [1924]. One man and his children are all that remain.

Kaloko was the same in those days, but now, it is a land without people. The men, the women, and the children are all gone, they have passed away. Only one man, J.W. Haʻau, remains. He is the only native child (keiki kupa) besides this author, who remains.

At Kohanaiki, there were many people on this land between 1870 and 1878. These were happy years with the families there. In those years Kaiakoili was the haku ʻāina (land overseer)...

Now the land is desolate, there are no people, the houses are quiet. Only the houses remain standing, places simply to be counted. I dwelt here with the families of these homes. Indeed it was here that I dwelt with my kahu hānai (guardian), the one who raised me. All these families were closely related to me by blood. On my fathers' side, I was tied to the families of Kaloko [J.W.H.I. Kihe's father was Kihe, his grandfather was Kuapāhoa, a noted kahuna of Kaloko]. I am a native of these lands.

The lands of ʻOʻoma, and Kalaoa, and all the way to Kaulana and Mahaiʻula were also places of many people in those days, but today there are no people. At Mahaiʻula is where the great fishermen of that day dwelt. Among the fishermen were Poʻokoʻai mā, Pāʻaoʻao senior, Kaʻao mā, Kaiʻa mā, Kaʻāʻīkaula mā, Pāhia mā, and John Kaʻelemakule Sr., who now dwells at Kailua.

Kaʻelemakule moved from this place [Ma haiʻula] to Kailua where he prospered, but his family is buried there along that beloved shore (kapakai aloha). He is the only one who remains alive today… At Makalawena, there were many people, men, women, and their children. It was here that some of the great fishermen of those days lived as well. There were many people, and now, they are all gone, lost for all time.

Those who have passed away are Kahaʻialiʻi mā, Mamaʻe mā, Kapehe mā, Kauaionuʻuanu mā, Hopulāʻau mā, Kaihemakawalu mā, Kaomi, Keoni Aihaole mā, and Pahukula mā. They are all gone, there only remains the son-in-law of Kauaionuʻuanu, J.H. Mahikō, and Jack Punihaole, along with their children, living in the place where Kauaionuʻuanu and Ahu once lived.

At Kūkiʻo, not one person remains alive on that land, all are gone, only the ʻaʻā remains. It is the same at Kaʻūpūlehu, the old people are all gone, and it is all quiet… [June 12, 1924]

Ko Keoni Kaelemakule Moolelo Ponoi – Kakau ponoi ia mai no e ia (The True Story of John Ka‘elemakule – Actually written by him[3])

In the period between 1928 and 1930, John Ka‘elemakule Sr., who was a native of Kekaha, living at Mahai‘ula, Kaulana and Kohanaiki, wrote a series of articles that were published in serial form in *Ka Hōkū o Hawai‘i*. The story is a rich account of life in Kekaha between 1854 and 1900. Ka‘elemakule’s texts introduce us to the native residents of Kekaha, and include descriptions of the practices and customs of the families who resided there. In the following excerpts from Ka‘elemakule’s narratives (translated by Kepā Maly), we find reference once again to ‘O‘oma, Kalaoa, and neighboring lands, and the practices associated with procuring water in this region:

> *“Kekaha Wai Ole o na Kona”* (Waterless Kekaha of Kona)
>
> …We have seen the name “Kekaha wai ole o nā Kona” since the early part of my story in *Ka Hōkū o Hawai‘i*, and we have also seen it in the beautiful tradition of Mākālei. An account of the boy who dwelt in the uplands of Kekaha wai ‘ole, that was told by Ka-‘ohu-ha‘aheo-i-nā-kuahiwi-‘ekolu [the penname used by J.W.H.I. Kihe]. I think that certain people may want to know the reason and meaning of this name. So it is perhaps a good thing for me to explain how it came about. The source of it is that in this land of Kekaha even in the uplands, between Kaulana in the north and ‘O‘oma in the south, there was no water found even in the ancient times. For a little while, I lived in the uplands of Kaulana, and I saw that this land of Kekaha was indeed waterless.
>
> The water for bathing, washing one’s hands or feet, was the water of the banana stump (*wai pūma‘ia*). The *pūmai‘a* was grated and squeezed into balls to get the juice. The problem with this water is that it makes one itchy, and one does not really get clean. There were not many water holes, and the water that accumulated from rain dried up quickly. Also there would be weeks in which no rain fell… The water which the people who lived in the uplands of Kekaha drank, was found in caves. There are many caves from which the people of the uplands got water… [September 17, 1929:3]
>
> …The *kūpuna* had very strict *kapu* (restrictions) on these water caves. A woman who had her menstrual cycle could not enter the caves. The ancient people kept this as a sacred *kapu* from past generations. If a woman did not know that her time was coming and she entered the water cave, the water would die, that is, it would dry up. The water would stop dripping. This was a sign that the *kapu* of Kāne-of-the-water-of-life (Kaneikawaiola) had been desecrated. Through this, we learn that the ancient people of Kekaha believed that Kāne was the one who made the water drip from within the earth, even the water that entered the sea from the caves. This is what the ancient people of Kekaha wai ‘ole believed, and there were people who were *kia‘i* (guardians) who watched over and cleaned the caves, the house of Kāne… [September 24, 1929:3]
>
> When the *kapu* of the water cave had been broken, the priest was called to perform a ceremony and make offerings. The offerings were a small black pig; a white fish, and *āholehole*; young taro leaves; and *awa*. When the offering was prepared, the priest would chant to Kane:

[3] This account was published in serial form in the Hawaiian newspaper *Ka Hōkū o Hawai‘i*, from May 29, 1928 to March 18, 1930. The translated excerpts in this section include narratives that describe Mahai‘ula and nearby lands in Kekaha with references to families, customs, practices, ceremonial observances, and sites identified in text. The larger narratives also include further detailed accounts of Ka‘elemakule’s life, and business ventures. A portion of the narratives pertaining to fishing customs (November 13, 1928 to March 12, 1929), and canoeing practices (March 19 to May 21, 1929) were translated by M. Kawena Pukui, and may be viewed in the Bishop Museum-Hawaiian Ethnological Notes (BPBM Archives).

E Kane i uka, e Kane i kai,	*O Kane in the uplands, O Kāne at the shore,*
E Kane i ka wai, eia ka puaa,	*O Kane in the water, here is the pig,*
Eia ka awa, eia ka luau,	*Here is the ʻawa, here are the taro greens,*
Eia ka ia kea.	*Here is the white fish.*

Then all those people of the uplands and coast joined together in this offering, saying:

He mohai noi keia ia oe e Kane,	*This is a request offering to you o Kāne,*
E kala i ka hewa o ke kanaka i hana ai,	*Forgive the transgression done by man,*
A e hoomaemae i ka hale wai,	*Clean the water house (source),*
A e hoonui mai i ka wai o ka hale,	*Cause the water to increase in the house,*
I ola na kanaka,	*That the people may live,*
Na ohua o keia aina wai ole.	*Those who are dependent on this waterless land.*
Amama.	*It is finished…*

[October 1, 1929:3; Kepā Maly, translator]

It is not surprising today, when we hear of caves in which cultural materials are found. Along trails, near residences, and in once remote areas, a wide range of uses occurred. Caves in the Kekaha lands were used to store items, keep planting shoots cool and fresh for the next season, to hide or take shelter in, to catch water, and as burial sites.

Land Tenure in ʻOʻoma, Kalaoa, and Vicinity

Through the traditions and early historical accounts cited above, we see that there are descriptions of early residences and practices of the native families on the lands of ʻOʻoma, Kalaoa, and within greater Kekaha. Importantly, we find chiefly associations with the land of ʻOʻoma 2nd, as documented by the residency of the chiefs Kaikioʻewa, Keaweamahi, their families and retainers, while they were serving as the guardians of the young king, Kauikeaouli (Kamehameha III in ca. 1813-1818; Kamakau 1961 and Gov. Kapeau, 1847 in this study). Among the earliest government records documenting residency are those of the *Māhele ʻĀina* (Land Division), Interior and Taxation Departments, Roads and Public Works, and the Government Survey Division.

This section of the study describes land tenure (residency and land use) and identifies families associated with ʻOʻoma, Kalaoa, and it's neighboring lands. The documentation is presented chronologically within the following subsections, The *Māhele ʻĀina* (1848): Disposition of ʻOʻoma and Kalaoa, Land Grants in ʻOʻoma, Kalaoa, and Vicinity (1855-1864), The Government Homesteading Program in Kekaha, Field Surveys of J.S. Emerson (1882-1889), and Trails and Roads of Kekaha (Governmental Communications).

A review of the records below reveals that none of the claims by native tenants made during the *Māhele*, or any of the applications for Royal Patent Grants, included lands that are a part of the current development area.

The *Māhele ʻĀina* (1848): Disposition of ʻOʻoma and Kalaoa

In Precontact Hawaiʻi, all land, ocean, and natural resources were held in trust by the high chiefs (*aliʻi ʻai ahupuaʻa* or *aliʻi ʻai moku*). The use of land, fisheries and other resources were given to the *hoaʻāina* (native tenants) at the prerogative of the *aliʻi* and their representatives or land agents (*konohiki*), who were considered lesser chiefs. By 1845, the Hawaiian system of land tenure was being radically altered, and the foundation for implementing the *Māhele ʻĀina* was set in place, system of fee-simple right of ownership.

As the *Māhele* evolved, it defined the land interests of Kauikeaouli (King Kamehameha III), some 252 high-ranking *Aliʻi* and *Konohiki*, and the Government. As a result of the *Māhele*, all land in the Kingdom of Hawaiʻi came to be placed in one of three categories: (1) Crown Lands (for the occupant of the throne); (2) Government Lands; and (3) *Konohiki* Lands (cf. Indices of Awards 1929). The "Enabling" or "*Kuleana Act*" of the *Māhele* (December 21, 1849) further defined the frame work by which *hoaʻāina* (native tenants) could apply for, and be granted fee-simple interest in "*Kuleana*" lands (cf. Kamakau in *Ke Au Okoa* July 8 & 15, 1869; 1961:403-403). The *Kuleana Act* also reconfirmed the rights of *hoaʻāina* to access, subsistence and

collection of resources necessary to their life upon the land in their given *ahupua'a* ("Enabling Act"[4], August 6, 1850 – HSA DLNR 2-4).

In the *Buke Kakau Paa no ka Mahele Aina* (Land Division Book), between Kamehameha III and his supporters, we learn that by the time of the *Māhele 'Āina*, 'O'oma was divided into two *ahupua'a*, 'O'oma 1st and 2nd; and Kalaoa into five *ahupua'a*, Kalaoa 1st through 5th. 'O'oma 1st was claimed by Moses Kekūāiwa (brother of Kamehameha IV and V, and Victoria Kamāmalu), one of the children of Kīna'u and M. Kekūanao'a, thus, a grandson of Kamehameha I. 'O'oma 2nd was held by Kamehameha III (*Buke Māhele*, January 27, 1848:13-14). On March 8, 1848, Kamehameha III assigned his interest in 'O'oma 2nd to the Government land inventory (*Buke Māhele*, 1848:183). Moses Kekūāiwa died on November 24, 1848, and his father, Mataio Kekūanao'a, administrator of the estate, relinquished in commutation, his rights to 'O'oma 1st, giving the land over to the Government land inventory (Foreign Testimony Volume 3:408). Thus, both 'O'oma 1st and 2nd were assigned to the Government Land inventory (Government Lands - Indices of Awards 1929:10). All five of the Kalaoa *ahupua'a* were retained as Governement lands.

In 2000, Kumu Pono Associates digitized the entire collection of handwritten records from the *Māhele 'Āina*. Most of the records are in the Hawaiian language. An extensive review of all the records identifies only one native tenant who filed a claim of residency and land use in 'O'oma during the *Māhele*. The claim—*Helu* 9162, by Kahelekahi—was not awarded, and except for an entry in Native Register Volume 8 (Figure 9), there is no further record of the claim. Below, is a copy of the original Hawaiian text from the Native Register. The account is of particular interest as Kahelekahi reported that in 1848, he was the only resident in 'O'oma:

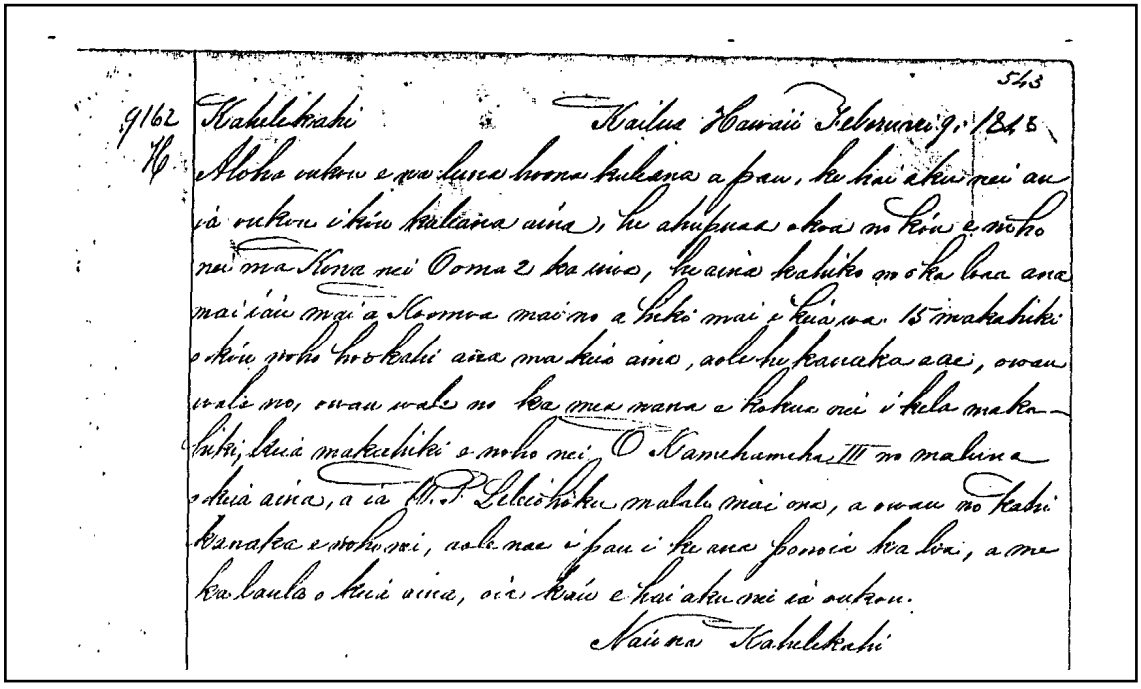

Figure 9. Copy of Native Register Vol. 8:543 Helu 9162, claim of Kahelekahi for *kuleana* at 'O'oma.

Kahelekahi – Helu 9162
Kailua, Hawaii February 9, 1848

Greetings to all of you commissioner who quiet land titles, I hereby tell you of my claim for land. I have an entire ahupuaa situated there in Kona, it's name is Ooma 2. It is an old land gotten by me from Koomoa, and held to this time. For 15 years, I have been the only one residing on this land, there are no other people, only me. I am the only one, there is no one living here to help from one year to the next year. Kamehameha III is the one above, who has this land, and W.P. Leleiohoku is below him, and I am the one man dwelling there. The

[4] See also *"Kanawai Hoopai Karaima no ko Hawaii Pae Aina"* (Penal Code) 1850.

survey of the length and width of this land is not accurately completed. That is what I have to tell you.

Done by me, Kahelekahi
[Native Register Vol. 8:543; translated by Kepā Maly]

In Kalaoa 5th only two *kuleana* claims were awarded (a third was claimed but not awarded), both of which were located *mauka* in the vicinity of the Hawai'i Belt Road.

Kupuoe (Kupuae) – Helu 7899
Kailua, Hawaii Jan. 2, 1849
Kanahele sworn [the whole ili cla im is an error] He has seen the house lot and the place Kupuoe had cultivated. There are 12 partially cultivated kihapais in Kaweo ili of Kalaoa 5 ahupuaa. It has not been enclosed completely, one house is for Kupuoe. In Kalaoa 4, 8 kihapais have been cultivated. Kupuoe's land is from Kaainoa in 1843, no one has objected to him. Kukaanio sworn they [Kanahele and Kukaanio] both have known in the same way. [Native Testimony 4:540; translated by Kepā Maly]

Kukaaui (Kukaani/Kukaanio) – Helu 7937
Greetings to all of you Land Commissioners: I hereby petition for my ili in the ahupua'a [possessed by] Leleiohoku, in Kailua, Hawaii, which is as follows: it is an entire ill in the comer of Kalaoa 5 - its name is Kahuku. It is bounded on the north by Kahuku, on the east by Kapulehu [Ka'ūpūlehu], on the south by Kawao, on the west by Kihalau. That is it, for your information, the commissioners to quiet land titles. [sign ed] KUKAAUI [Native Register 8:453-454; translated by Kepā Maly]

Kanahele sworn He has seen the place Kukaani had cultivated. It is an error that he had included the whole ili in his claim. The Kahuku ili of Kalaoa 5 ahupuaa, 9 Kihapais are at Kolaoa [Kalaoa] 4, 8 have been partially cultivated. He does not know the boundaries and is expecting the surveyor to establish boundaries upon his arrival.

Land is from Kaluaonaona [Kalimaonaona] in 1848, no one has objected to Kukaani. Kupuoe sworn they both have known alike in the things mentioned about this land. [Native Testimony 4:539-540; translated by Kepā Maly]

In 1849, S. Haanio, Tax Assessor of North Kona, submitted a report to the Board of Education regarding those individuals who were subject to the Tuesday Tax Laws (*Poalua*), to be worked as a part of the School Tax requirements of the time. At the time of Haanio's report, three individual families were identified as residents of 'O'oma and sixteen collectively in the Kalaoa *ahupua'a*. Residents in the neighboring land of Kohanaiki were also listed, they were:

Kalaoa: 1. Kila, 2. Piena, 3. Nakuala, 4. Kupono, 5. Loa, 6. Kaeha, 7. Keliipuipui, 8. Kapuolokai, 9. Kaainoa, 10. Paina, 11. Kalimaonaona, 12. Kaikeleaukai, 13. Kanahele, 14. Kukaani, 15. Kupuai, and 16. Helekahi[5]

Ooma: 1. Kalua, 2. Kamaka and 3. Mamali

Kohanaiki: 1. Hulikoa, 2. Kaoeno, 3. Honolii and 4. Awa [HSA – Series 262, Hawaii 1849].

Unfortunately, there is no indication of where people were living at the time. Based on traditional patterns of residency in the region, it is likely that they had primary residences in the uplands, near sheltered *māla 'ai* (agricultural fields), and kept near shore residences for seasonal fishing, collection of salt, and other resources of the coastal zone. Of the names given for 'O'oma and Kalaoa, descendants of some of these family lines are known to still be residing in the Kekaha region.

[5] Helekahi or Kahelekahi – the one who made a claim for a *kuleana* in 'O'oma during the Māhele (Helu 9162).

Land Grants in ʻOʻoma, Kalaoa 5th, and Vicinity (1855-1864)

In conjunction with the *Māhele*, the King also authorized the issuance of Royal Patent Grants to applicants for tracts of land, larger than those generally available through the Land Commission. The process for applications was set forth by the "Enabling Act" of August 6, 1850, which set aside portions of government lands for grants.

> Section 4. Resolved that a certain portion of the Government lands in each Island shall be set apart, and placed in the hands of special agents to be disposed of in lots of from one to fifty acres in fee simple to such natives as may not be otherwise furnished with sufficient lands at a minimum price of fifty cents per acre. [HSA – "Enabling Act" Series DLNR 2-4]

The Kingdoms' policy of providing land grants to native tenants was further clarified in a communication from Interior Department Clerk, A. G. Thurston, on behalf of Keoni Ana (John Young), Minister of the Interior; to J. Fuller, Government Land Agent-Kona:

> *February 23, 1852*
> …His Highness the Minister of the Interior instructs me to inform you that he has and does hereby appoint you to be Land Agent for the District of Kona, Hawaii. You will entertain no application for the purchase of any lands, without first receiving some part, say a fourth or fifth of the price; then the terms of sale being agreed upon between yourself and the applicant you will survey the land, and send the survey, with your report upon the same to this office, for the Approval of the Board of Finance, when your sales have been approved you will collect the balance due of the price; upon the receipt of which at this office, the Patent will be forwarded to you.
>
> Natives who have no claims before the Land Commission have no Legal rights in the soil.
>
> They are therefore to be allowed the first chance to purchase their homesteads. Those who neglect or refuse to do this, must remain dependant upon the mercy of whoever purchases the land: as those natives now are who having no kuleanas are living on lands already Patented, or belonging to Konohikis.
>
> Where lands have been granted, but not yet Patented, the natives living on the land are to have the option of buying their homesteads, and then the grant be located, provided this can be done so as not to interfere with them.
>
> No Fish Ponds are to be sold, neither any landing places.
>
> As a general thing you will charge the natives but 50 cents pr. acre, not exceeding 50 acres to any one individual.
>
> Whenever about to survey land adjoining that of private individuals, notice must be given them or their agents to be present and point out their boundaries… [Interior Department Letter Book 3:210-211]

Between 1855 and 1864, at least six applications were made for land in the *ahupuaʻa* of ʻOʻoma and Kalaoa 5th, and four of them were patented. The applications were made by:

Grant	Applicant	Land	Acreage	Book and Year
1590	Kauhini	Hamanamana, Kalaoa and Ooma 1	1,816	8:1855 (canceled)
1599	J. Hall	Ooma 2	101.33	8:1855 (canceled)
1600	Kaakau	Ooma 2	58.5	8:1855
1609	Kama	Kalaoa 5	45	8:1855

2027	Kameheu	Ooma 2	101.33	11:1856 (same area as Grant 1599)
2031	Koanui	Ooma 1	24.5	11:1856
2972	Kaakau & Kama	Kalaoa 5 & Ooma 1	515	14:1864

["Index of all Grants Issued…Previous to March 31, 1886;" 1887]

The grants to Ka'akau and Kameheu were patented by 1859, as recorded in the following letter:

April 8, 1859
S. Spencer, Interior Department Clerk;
to Lot Kamehameha, Minister of the Interior;
Lands in Puaa and Ooma 2 in Kona, Hawaii which were sold by the Government Agent:

Royal Patent 1600, Kaakau 58 50/100 acres in Ooma	$29.25
Royal Patent 2027, Kameheu, 101 33/100 acres in Ooma	$38.00

[HSA – Interior Department, Lands]

In the years following issuance of the first Royal Patents, native tenants and others continued to express interest in the lands of 'O'oma and Kalaoa *ahupua'a*. Applications were made to either lease or purchase portions of the remaining government lands. In 1865, Government Surveyor and Land Agent, S.C. Wiltse, wrote to the Minister of the Interior, describing the condition and status of the lands remaining to the government.

September 5, 1865
S.C. Wiltse, Government Surveyor and Land Agent;
to F.W. Hutchinson, Minister of the Interior.
Kona Hawaii. Government Lands in this District not Sold;
also those Sold and Not Patented:

…"Kalaoa 5th"
Not in the Mahele book but believed to be Gov't. land. This land above the Govt. Road has been sold and Patented. Below the road I have surveyed 515 acres which was sold by Sheldon to "Kaakau" & "Kama" who payed him $165.00. As no valuation was made of this land per acre by Sheldon I afterwards valued it myself as follows, 300 Ac. at 50 cts. per acre, 215 at 25 cts. per Ac. The balance due according to this valuation including Patent was $42.75 which was payed to me in March 1864 and forwarded by me to your office. The survey of this land is in your office. If the payments made are satisfactory, these men would be very glad to get their Patent.

This is a piece of 3rd rate land, used only as goat pasture, no improvements on it. Makai of this survey is about 400 Ac. remaining to the Govt., but of very little value.

"Ooma 1st & 2nd"
The best part of these lands have been sold, there remains to the Govt. the forest part, 2 or 300 Ac., and the makai part some 1500 Ac., about 500 of which is 3rd rate land, the balance rocks.

"Kohanaiki"
The forest part of this land is all that remains to the Gov't., this is extensive, extending to the mauka side of the forest. It may contain 1500 to 2000 Ac.

The makai part of this land containing 220 Ac. has been sold both by Sheldon and myself. In April 1863 I was surveying in Kona when "Nahuina" (who lives on the adjoining land of "Kaloko") applied to me to survey the makai part of the Gov't. land Kohanaiki which he wished to purchase. I inquired whether he had applied to Sheldon for this lands (Sheldon was then in Honolulu) he told me that he had not, but would do so immediately, if it was

> necessary he would go to Honolulu for that purpose. I told him that I was then writing to Sheldon and I would make the application for him which I did, but never got an answer. I wrote several times to him about that time, for information about Gov't. lands, but he declined to answer my letters.
>
> On the 30th of May following, I surveyed said piece of land for "Nahuina." When I was making this survey "Kapena" (who bought this land from Sheldon) was present, and afterwards went to Honolulu and payed Sheldon for this land.
>
> "Nahuina" had the money then to pay for this land, and I told him to keep it until he knew who he was paying it to. I was perfectly satisfied then that Sheldon's transaction as Gov't. land Agt. was not honest. Mr. Sheldon had then been away from Kona nearly three months, he had previous to this resigned his office as Judge and taken up his residence permanently in Honolulu. Afterwards when requested by Mr. S. Spencer to act as land Agt. for Kona, "Nahuina" payed me for this land at 25 cents per Acre. Its only value is for a place for a residence on the beach.
>
> I have been thus particular in giving you the history of this affair, so that you might be able to decide which of the parties were intitled to said land… [HSA – Interior Department, Lands]

Historical records document that the primary use of the *kula* – lowlands in the Kekaha region, was for goat ranching, with limited cattle ranching. Throughout the 1800s, most of the cattle ranching occurred on the *mauka* slopes nearer the old upper government road.

Summary of Land Tenure Described in Grant Records

Grant No.'s 1600 (for Kaakau) and 2031 (for Koanui) are situated on the *mauka* side of the Alanui Aupuni (the Upper Government Road, near present-day Māmalahoa Highway) in ʻOʻoma 2nd and 1st.

Grant No. 1599 (surveyed for Kauhini), was situated across the *kula* lands from Oʻoma 1st in the south, to Hāmanamana, in the north. Communications from the 1880s, indicate that the parcel was never patented, though Kauhini had lived in ʻOʻoma 1st, through the time of his death (before 1888). J.S. Emerson's Register Map No. 1449, identifies a Triangulation Station in ʻOʻoma 1st as "Kauhini." At almost the same time that Kauhini's grant was surveyed, other grants in Kalaoa and ʻOʻoma covering a portion of the area described under Kauhini's grant were patented to Kakau and Kama (Royal Patent Grant No. 2972). In 1888, this confusing situation was brought to the government's attention in a letter from more than 70 native residents of ʻOʻoma and the larger Kekaha region, when the Minister of the Interior was developing homestead lots for applicants (see communications below).

Grant No. 2027 (for Kameheu), situated in ʻOʻoma 2nd, extends from the *makai* edge of the Upper Government Road, to a short distance below the historic Homestead Road between Kaloko and Kalaoa, at about 900 feet above sea level (see Register Map No. 1449).

ʻOʻoma grantee Kaakau (Grant No. 1600), also held an interest in Grant No. 2972 in the land of Kalaoa 5th and ʻOʻoma 1st, which he shared with his relative, Kama. Historic survey records (in Register Maps and Survey Field Books) do identify "Kama's house" near the Wawaloli pond (Register Map No. 1449) in ʻOʻoma 1st. The same house is later identified as "Keoki Mao's House" (Register Map No. 1280). Kama also received Grant 1609 in Kalaoa 5.

In 1888, government surveyor J.S. Emerson identified Kama as a resident in ʻOʻoma, near the *mauka* government road (see communication below). This Kama is identified in oral history interviews as being an elder of the Kamaka line, from whom the often-mentioned Palakiko Kamaka and others descend. A temporary beach shelter—in the vicinity of "Kama's House" marked near the shore of ʻOʻoma 1st on Register Maps 1449 and 1280—remained in use by family members at least until the outbreak of World War II.

While no formal awards or grants of land appear to have been made for the near shore *kula* or beach lands, it is logical to assume that families living in the uplands of the ʻOʻoma, Kalaoa, and Kohanaiki *ahupuaʻa*, made regular visits to the near shore lands. The practice of continued travel between upland residences and near-shore shelters, is also described by *kūpuna* Peter K. Park, and Elizabeth Lee, who was born and raised in the *mauka* section of ʻOʻoma, and by other *kupuna* from neighboring lands (Rechtman and Maly 2003).

No records indicating that the above Royal Patent Grantees had applied for coastal parcels as a part of their original claims were found while conducting the present research. A further review of the *Māhele* records was also made to determine if any of the grant applicants had been *Māhele* claimants (as is sometimes the case). Their names did not appear in the Register or Testimony volumes for the area.

Ka ʻĀina Kaha–(A Native's Perspective)

In 1875, J.P Puuokupa, a native resident of Kalaoa wrote a letter to the editor of the Hawaiian newspaper, *Ku Okoa*, responding to a letter which had been previously published in the paper (written by a visitor to Kona). The first account apparently described the Kekaha region as a hard land that presented many difficulties to the residents. It was also reported that a drought on Hawaiʻi had significantly impacted crop production, and that a "famine" was occurring. Puuokupa, responded to the account and described the situation as he knew it, from living upon the land. His letter is important as it provides us with an explanation as to why people of the region—including ʻOʻoma and Kalaoa—lived mostly in the uplands, for it was there that the rich soils enabled residents to cultivate the land and sustain themselves.

> *Mai Kailua a hiki i Kiholo*–(From Kailua to Kiholo)
> …The people who live in the area around Kailua are not bothered by the famine. They all have food. There are sweet potatoes and taro. These are the foods of these lands. There are at this time, breadfruit bearing fruit at Honokohau on the side of Kailua, and at Kaloko, Kohanaiki, Ooma and the Kalaoas where lives J.P. [the author]. All of these lands are cultivated. There is land on which coffee is cultivated, where taro and sweet potatoes are cultivated, and land livestock is raised. All of us living from Kailua to Kalaoa are not in a famine, there is nothing we lack for the well being of our bodies.
>
> Mokuola[6] is seen clearly upon the ocean, like the featherless back of the *ʻukeke* (shore bird). So it is in the uplands where one may wander gathering what is needed, as far as Kiholo which opens like the mouth of a long house into the wind. It is there that the bow of the boats may safely land upon the shore. The livelihood of the people there is fishing and the raising of livestock. The people in the uplands of Napuu are farmers, and as is the custom of those people of the backlands, they all eat in the morning and then go to work. So it is with all of the native people of these lands, they are a people that are well off.
>
> …As was said earlier, coffee is the plant of value on these lands, and so, is the raising of livestock. From the payments for those products, the people are well off, and they have built wooden houses. If you come here you shall see that it is true. Fish are also something which benefits the people. The people who make the *pai ai* on Maui bring it to Kona and trade it. Some people also trade their *poi* for the coffee of the natives here… (J.P. Puuokupa, in *Ku Okoa* November 27, 1875; translated by Kepā Maly)

The Government Homesteading Program in Kekaha

Following the *Māhele* and Grant programs of the middle 1800s, it was found that many native tenants still remained on lands for which they had no title. In 1884, the Hawaiian Kingdom initiated a program to create Homestead lots on Government lands—a primary goal being to get more Hawaiian tenants in possession of fee-simple property (Homestead Act of 1884). The Homestead Act allowed applicants to apply for lots of up to 20 acres in size, and required that they own no other land.

[6] *Moku-ola* — literally: Island of life — is a poetic reference to a small island in Hilo Bay which was known as a place of sanctuary, healing, and life. By poetic inference, the Kekaha region was described as a place of life and well-being.

On Hawai‘i, several lands in the Kekaha region of North Kona, were selected and a surveying program was authorized to subdivide the lands. Initially, those lands extended from Kohanaiki to Kūki‘o. Because it was the intent of the Homestead Act to provide residents with land upon which they could cultivate crops or graze animals, most of the lots were situated near the *mauka* road (near the present-day Māmalahoa Highway) that ran between Kailua and ‘Akāhipu‘u.

Early in the process, native residents of Kekaha soon began writing letters to the Minister of the Interior, observing that 20 acre parcels were insufficient "to live on in every respect." They noted that because of the rocky nature of the land, goats were the only animals that they could raise, and thus, try to make their living (cf. State Archives–Land File, December 26, 1888, and Land Matters Document No. 255; and communications below).

During the first years of the Homestead Program, all of the remaining government lands in the Kekaha region, from Kohanaiki to Kūki‘o 2nd, had been leased to King David Kalākaua for grazing purposes. The following lease was issued, with the notation that should portions of the land be desired for Homesteading purposes, the King would relinquish his lease:

> *August 2nd 1886*
> *General Lease 364*
> *Between His Majesty Kalakaua;*
> *and Walter M. Gibson, Minister of the Interior*
> [Lease of unencumbered government lands between Kealakehe to Kukio 2nd]:
>
> …Oma [Ooma] No. 1 & 2 – yearly rent Ten dollars…
> Each and every of the above mentioned lands are let subject to the express condition that at any time during the term of this lease, the Minister of the Interior may at his discretion peaceably enter upon, take possession, and dispose of such piece or pieces of land included in the lands hereby demised, as may be required for the purposes of carrying out the terms and intent of the Homestead Laws now in force, or that may be hereafter be enacted during the term of this lease… [State Land Division Lease Files]

By 1889, the demand for homestead lots in the Kekaha lands was so great that King Kalākaua gave up his interest in the lands:

> *January 22, 1889*
> *J.W. Robertson, Acting Chamberlain;*
> *to J.A. Hassinger, Chief Clerk, Interior Department*
> [Regarding termination of Lease No. 364 for lands from Kukio to Kohanaiki]:
>
> …I have the honor to acknowledge the receipt of your communication, of the 17th, instant, informing me that you are directed, by His Excellency the Minister of the Interior, to say, that he desires to take possession of the lands, described in Government Lease No. 364, for Homestead purposes, and requests the surrender of the lease.
>
> His Majesty the King, is willing, for the purpose of assisting in carrying out the Homestead Act, to accede to the terms of the lease, so far as to give up only such portions of the lands, as are suitable to be apportioned off for Homestead purposes.
>
> It has come to the knowledge of His Majesty, that several of the applicants for portions of the above lands, are already in possession of lands elsewhere, and living in comfortable homes. They are not poor people, nor are they entitled to the privilege of obtaining lands under the Homestead Act, but are desirous of obtaining more of such property, for the purpose of selling or leasing to the Chinese, which class is beginning to outnumber the natives in nearly every district…

His Majesty is desirous of retaining the balance of lands, that may be left after the apportionment has been completed; and also desires to lease remnants of other Government lands in that section of the Island…

Reply attached – Dated January 22, 1889:
The lands of Kohanaiki and Kalaoa and Makaula have been divided up into Homestead lots, and taken up.

Lands marked * are in Emerson's List of lands to be sold. Emerson's List attached.

His Majesty has paid rent to Aug. 22, 1889. Another rent is due in adv. from this date…

* Kukio 2	* Maniniowali
* Mahaiula	* Kaulana
* Awalua	Puukala
+ Makaula	+ Kalaoa 1, 2, 3, 4 & 5
* Ooma 1 & 2	+ Kohanaiki

Lease cancelled by order – Minister of Int. August 2, 1889 [HSA – Interior Department, Lands]

One of the significant issues that arose with the development of homesteads in the Kekaha region, involved the lands of ʻOʻoma, Kalaoa, and Hāmanamana, which had been surveyed for Kauhini in 1855, under Grant No. 1590. The grant was apparently never patented, and questions regarding the government's authority to divide portions of the ʻOʻoma-Kalaoa-Hāmanamana lands into Homestead lots were raised. Adding to the confusion, in 1888, John A. Maguire was also making his move from Kohala to Kona, and in the process of establishing his Huehue Ranch. One of the lands he reportedly purchased was covered under the unperfected Grant No. 1590. Thus, homestead applicants and program managers met with a wide range of challenges during the program's history.

Homestead Communications

There are a number of letters between native residents (applicants for Homestead lands) and government agents, documenting the development of the homesteading program and residency in Kekaha. Tracts of land in Kohanaiki, ʻOʻoma, Kalaoa and neighboring *ahupuaʻa* were let out to native residents, and eventually to non-native residents as well. Those lands which were not sold to native tenants were sold or leased to ranching interests—most of which came under John A. Maguire of Huehue Ranch.

One requirement of the Homestead Program was that lots which were to be sold as homesteads to the applicants, needed to be surveyed. J.S. Emerson, one of the most knowledgeable and best-informed surveyors to work in Kona, began surveying the Kekaha region homestead lots in 1888. Emerson's letters to Surveyor General, W. D. Alexander, provide valuable historical documentation about the community and land. Writing from ʻOʻoma in April 1888, Emerson spoke highly of the Hawaiian families living on the land; he also described land conditions and weather at the time. In the letter, we find that questions regarding the status of several lands in Kona had arisen, and that John A. Maguire was planning to "settle" in Kona (see communications in Part 4 of this section of the study). Emerson's letters along with those below from the native tenants of the land, provide first hand accounts of the land development of the communities in Kekaha. The following communications are among those found in the collection of the Hawaiʻi State Archives (HSA).

May 1888
J.W.H. Isaac Kihe, Jr., et al.; to L.A. Thurston, Minister of the Interior
[Petition with 71 signatures, regarding discrepancy in land grant to Kauhini in Kalaoa and Ooma; and desires that said land be divided into Homestead Lots for applicants]:

…We, the undersigned, subjects residing within the boundaries of Kekaha, from Kohanaiki to Makalawena, and Whereas, the land said to belong to Kauhini is within the boundaries

above set forth; Whereas, some doubt and hesitancy has come into our minds concerning the things relating to said land of Kauhini, and that it is proper that a very careful investigation be made, because, we have never known said Kauhini to have lands in the Kalaoas and Ooma 1, and because of such doubt, the Government sold some pieces in said land of 687 acres to Kama, Kaakau and Hueu, and they have been living with all the rights for 20 years and over, on pieces that were acquired by them. Therefore, we leave this request before your Excellency, the honorable one, with the grounds of this request:

First: The said land of Kauhini is not a land that is clear in every way, so that it can be shown truthfully and clearly that it belongs to Kauhini and his heirs – said kuleana.

Second: The land said to belong to Kauhini was only surveyed, but the money was not paid, that is the price for the land, only the payment for the survey was paid. We are ready with witnesses to prove this ground, as well as other grounds.

Third: Because of Kama and Kaakau and Hueu's knowing that Kauhini had no true interest in the land, therefore, they bought from the Government some acres of in the piece which Kauhini had surveyed, and the Government readily agreed to sell to them. This is real proof that said land was not conveyed to Kauhini, and the second is that Kauhini was living right there and he made no protest against the sale by the Government of those 687 acres to Kama (k), Kaakau (k) and Hueu (k), up to the time of his death, and only now has the question been raised through the plat of the survey, and thereby basing the claim that Kauhini had some land.

…We ask your honor that this matter be traced in the Government Departments, so as to find out the truth, there is much trouble and uncertainty about this land.
And our inquiry to be based upon these great questions. Does the land belong to Kauhini? Or to the Government?… [HSA – Interior Department, Lands]

May 16, 1888
Interior Department Clerk; to J.W.H. Isaac Kihe, Jr.:
…I have been directed by the Honorable Minister of the Interior, to say, that your request asking that Kauhini's interest in the lands of Kalaoa & Ooma 1 be investigated, and to let you know the you are wanted to send, or to bring here to Honolulu, 2 or 3 good witnesses, and all the papers found by you or them, concerning this land of Kauhini… [HSA Interior Department Lands]

May 16, 1888
J.F. Brown, Government Surveyor; to L.A. Thurston, Minister of the Interior
[Regarding disposition of Grant No. 1590, to Kauhini for Lands in Hamanamana, Kalaoa, and Ooma; Figure 10]:

…With reference to the letter of inquiry of numerous natives in N. Kona, Hawaii, I beg to report:

That as regards the land belonging to Kauhini, I find that Grant 1590 on record and signed in due form, assigned to Kauhini something over 1800 acres shown in sketch by yellow tinted boundary line. At the bottom of the page however and in different handwriting is the following remark "Memo – this to be cancelled" S.S. (Stephen Spencer)?

Later the grants shown in sketch by blue lines were issued to the parties indicated in the sketch, and this fact together with the memo attached to the Grant, and the statements and beliefs of the natives leads me to think that the Grant to Kauhini was actually cancelled, but of this I have not yet obtained further proof than I have here given… [HSA – Interior Department, Lands]

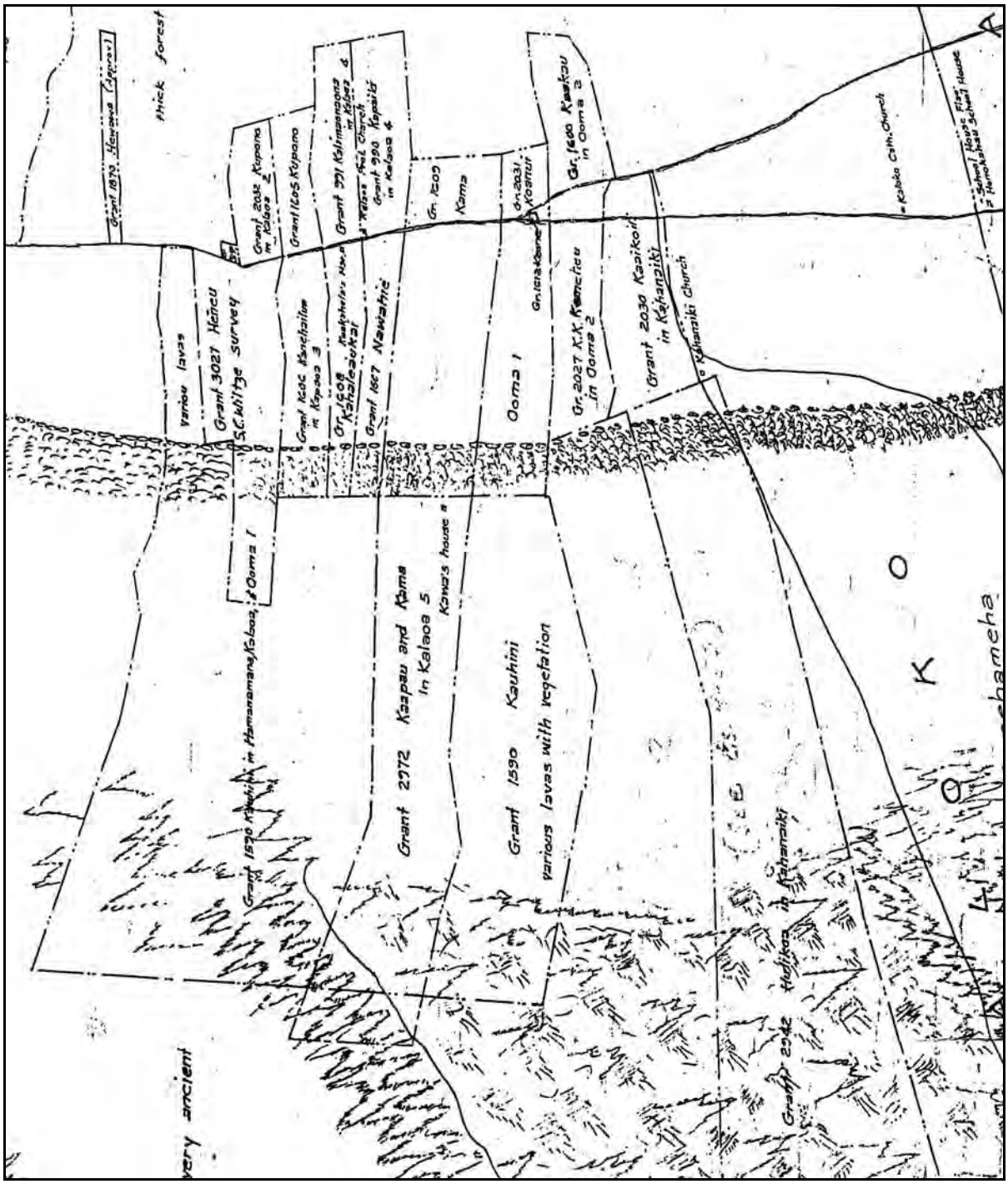

Figure 10. Portion of 1882 Register Map No. 1280 showing original boundaries of Grant No. 1590, to Kauhini.

May 1888 - J.W.H.I. Kihe, Jr.; to L.A. Thurston, Minister of the Interior:
…Oh honorable one, I am ready with the right witnesses to come when I receive the order, and if you agree, oh honorable one, to help with the fares for us on the vessel, and for our support while staying there and coming back.

Proofs are ample to prove that the land belongs to the Government, when I arrive with the witnesses, according to what you wish to be done… [HSA – Interior Department, Lands]

[Applying to purchase remnant lands from Makaula to Ooma 2nd, as a native Hui; and that land not be sold to outsiders.]

…We the undersigned, kamaaina (old residents) who reside from "Makaula" to "Ooma 2," joining "Kohanaiki," hereby petition and we also file this petition with you, and for you to consider and conferring with the Minister of the Interior, whether to consent or refuse the petition which we humbly file, and at the same time setting forth the nature of the land and the boundaries desired.

We ask that all be sold to us as a Hui, that the remnants of all the Government lands from "Hamanamana" to "Ooma 2 (two)," that is from the Government remnant of "Hamanamana, Kalaoa 1, 2, 3, 4, 5, Ooma 1 & 2" running until it meets the sea. Being the remnants remaining from the "Homesteads" lately, and remaining after the sale of the lands formerly sold by the Government, these are the remnants which we wish to buy as a "HUI." If you consent, and also the "Minister of the Interior," for these reasons:

1. The "remnants of Government lands" aforesaid, join our land kuleanas and were lately surveyed, and for that reason we believe it proper that they be sold to us.

2. The "kuleanas" that were surveyed for us are not sufficient to live on in every respect, they are too small, and are not in accordance with the law, that is one hundred acres, (Laws 1888).

3. Because of our belonging to, and being old residents of said places, is why we ask that consent be granted us for the sale to us and not to any one from other places, or we may be put to trouble in the future.

With these reasons, we leave this with you, and for you to approve, and we also adhere to our first offer per acre, and the explanations in regards to said offer.

FIRST: The price per acre to be 10 cents per acre.

SECOND: The nature of the land is rocky and lava stones in all from one and to the other, and there is only one kind of animal which can roam thereon, and it is goats, and that is the only thing to make anything out of, and to benefit us if we acquire it.

THIRD: If this land is acquired by others, they will probably cause us trouble, because the kuleanas which we have got are very small and not enough, not 20 acres of the land were acquired by us; very few of the lots reach 20 acres or more.

And because of these reasons and the explanations herein, we leave before your Excellency for the granting of the consent or not… [HSA – Interior Department, Lands]

ca. February 1889
Petition of J.W.H. Isaac Kihe, Jr. and 21 others;
to L.A. Thurston, Minister of the Interior
[Transmitting first payment for Homestead Land from Makaula to Kohanaiki]:

…We, the ones whose names are below, persons who but for the pieces of "Homestead" lands from Makaula to Kohanaiki, present to you documents of proof and money as first payment of ten ($10.00) dollars in the hands of J. Kaelemakule, the Agent appointed for the "Homestead" lands in North Kona, Hawaii.

We ask that the Agreements be sent up, with the Government for five years to J. Kaelemakule, the Agent here, in number the same as there are names below…

1. J.W.H. Isaac Kihe, Jr.	9. P. Nahulanui	17. Keawehawaii
2. S. Mahauluae	10. Kaukaliinea	18. D. Kaninau
3. D.P. Manuia	11. Kamahiai (w)	19. Mokuaikai
4. S.M. Kaawa	12. C.K. Kapa	20. Nuuanau
5. H.P. Ku	13. P.K. Kanuha	21. S. Kaimuloa
6. W.N. Kailiino	14. J. Haau	22. J. Kaloa
7. Z. Kawainui	15. G. Mao	
8. Kikane	16. J. Pule	

[HSA – Interior Department Document No. 227]

February 18, 1889
J. Kaelemakule, Land Agent; to L.A. Thurston, Minister of the Interior:
I am sending the correct report of the applicants for homestead lands here in North Kona, and their respective names, and the amount they have paid for their initial deposits in order that the agreements will be made correctly…

Pule $10.	Keoki Mao $10.	Mahuluae $10.	Haau $10.
Nuuanu $10.	Manuia $10.	Kaukaliinea $10.	Kamahiai (w) $10.
Kaawa $10.	Kaninau $10.	J. Kaelemakule $10.	Kawainui $10.
Mokuaikai $10.	Keawehawaii $10.	Nahulanui $10.	Kaloa $10.
Haiha $10.	Kapa $10.	Kaumuloa $10.	Isaac Kihe $10.
Kailiino $10.	Kanuha $10.	Ku $10.	Kikane $10.

[HSA – Interior Department, Lands]

October 7, 1889
J. Kaelemakule, Land Agent; to L.A. Thurston, Minister of the Interior:
…The applications of Kahinu and Lilinoe which were sent down during the month of August, please have the lots changed, because the map of Ooma has arrived with new numbers, as follows: Kahinu, Lot 51; Lilinoe, Lot 49, in Ooma 1st … [HSA – Interior Department, Lands]

October 10, 1889
J.W.H. Isaac Kihe, Secretary; to L.A. Thurston, Minister of the Interior:
…I leave some more names who make applications for homestead lands here in North Kona… The places wanted by those named are:

Pika Kaninau at Ooma 1
Kahinu at Ooma 2
Keaweiwi at Ooma 2… [HSA – Interior Department, Lands]

October 28, 1889
J. Kaelemakule, Land Agent; to L.A. Thurston, Minister of the Interior:
…The eight lots in Ooma have all been taken, none are left… These lots have been very quickly taken by the bidders, before the issuance of the notice from the Minister… Bear in mind the agreements for Kahinu and Lilinoe… [HSA – Interior Department, Lands]

December 31, 1890
J.W.H.I. Kihe, Jr.; to C.N. Spencer, Minister of the Interior:
We, the undersigned, who are without homes, and are destitute and have no place to live on, and whereas, the government has permitted all the people who have no lands, and that they receive homesteads, and for that reason, your humble servants make application that our

application may be speedily granted which we now place before Your Excellency, that the Government land which was divided and surveyed by Joseph S. Emerson, be immediately sub-divided , the same being portions of Kalaoa 5 and Ooma, on the mauka side of Kama (k), Koanui (k), to the junction with Ooma of Kaakau (k), containing an area of one hundred and fifteen acres (115), and it is those acres which your applicants are applying for before Your Excellency, and where as your applicants are native Hawaiians by birth, residing at Kalaoa, North Kona, Island of Hawaii. And the minds of your servants hope and desire to have a place to live on in the future, and to have a home for all time, and Your Excellency, your servants humbly place their petition with the hope that you will grant this application...

M.E. Kuluwaimaka (k)
H. Hanawahine (k)
D.W. Kanui (k)
Mr. Kahumoku (k)
[HSA – Interior Department, Lands]

July 30, 1890
Petition of Kaihemakawalu and 63 native residents of Kekaha;
to C.N. Spencer, Minister of the Interior
[Requesting that lands available for Homesteading be sub-divided and granted to applicants]:

…We, the undersigned, old-timers living from Kealakehe to Kapalaoa, who are subject to taxes, and who have the right to vote in the District of Kona, Hawaii, and ones who are really without lands, and who wish to place this application before Your Excellency, that all of these Government lands here in North Kona, be given to the native Hawaiians who are destitute and poor, being the lots which were sub-divided by the Government which are lying idle and for which no Agreements have been given out, and also the lots which were granted Agreements and issued in the time when Lorrin A. Thurston was Minister of the Interior, and also the lots which still remain undivided. All of these Government lands are what we are now again asking that the dividing and sub-dividing be continued in these remnants of Government lands, until all of the poor and needy ones are provided for.

Your Excellency, we ask that no consent whatever be given to permitting lands to be acquired by the rich through sale at auction, or by lease, and if there is to be any lease, then to be leased to the poor ones, if they are supplied with homes.

Your Excellency, we ask that you immediately send copies of all agreements of the Government lands which were cut up and sub-divided, which are remaining and have no documents for those lots. And we also ask that a surveyor be sent now to again survey and sub-divide the remaining Government lands, being the Government lands of Kaulana, Mahaiula, Kukio 1 & 2, mauka of the Government Road, and Kalaoa 5 & Ooma 1, mauka of the Government Road, joining Kama's and Koanui's.

And now, Your Excellency, we also ask that all of the pieces of Government land lying idle outside of these lands which have been sub-divided, and lands which are to be sub-divided, applied for above, to be allowed to be leased to use for five cents per acre, because, they are rocky and pahoehoe lands only left, and the number of acres being about three thousand and over, thereby giving the Government some income from these which have been lying idle and without any value… [HSA – Interior Department, Lands]

June 22, 1893
J. Kaelemakule, Land Agent; to J.A. King, Minister of the Interior:
…I am forwarding you with this, the copy of the agreement of Wm. Harbottle, and some applications as herein below set forth (Figure 11):

107, Kalua (w), for Lot # 59, Map 6, Ooma;
108, G.M. Paiwa, for Lot # 56, Map 6, Ooma;
109, Namakaokalani, for Lot # 58, Map 6, Ooma;
110, Pika Kaninau, for Lot # 57, Map 6, Ooma.

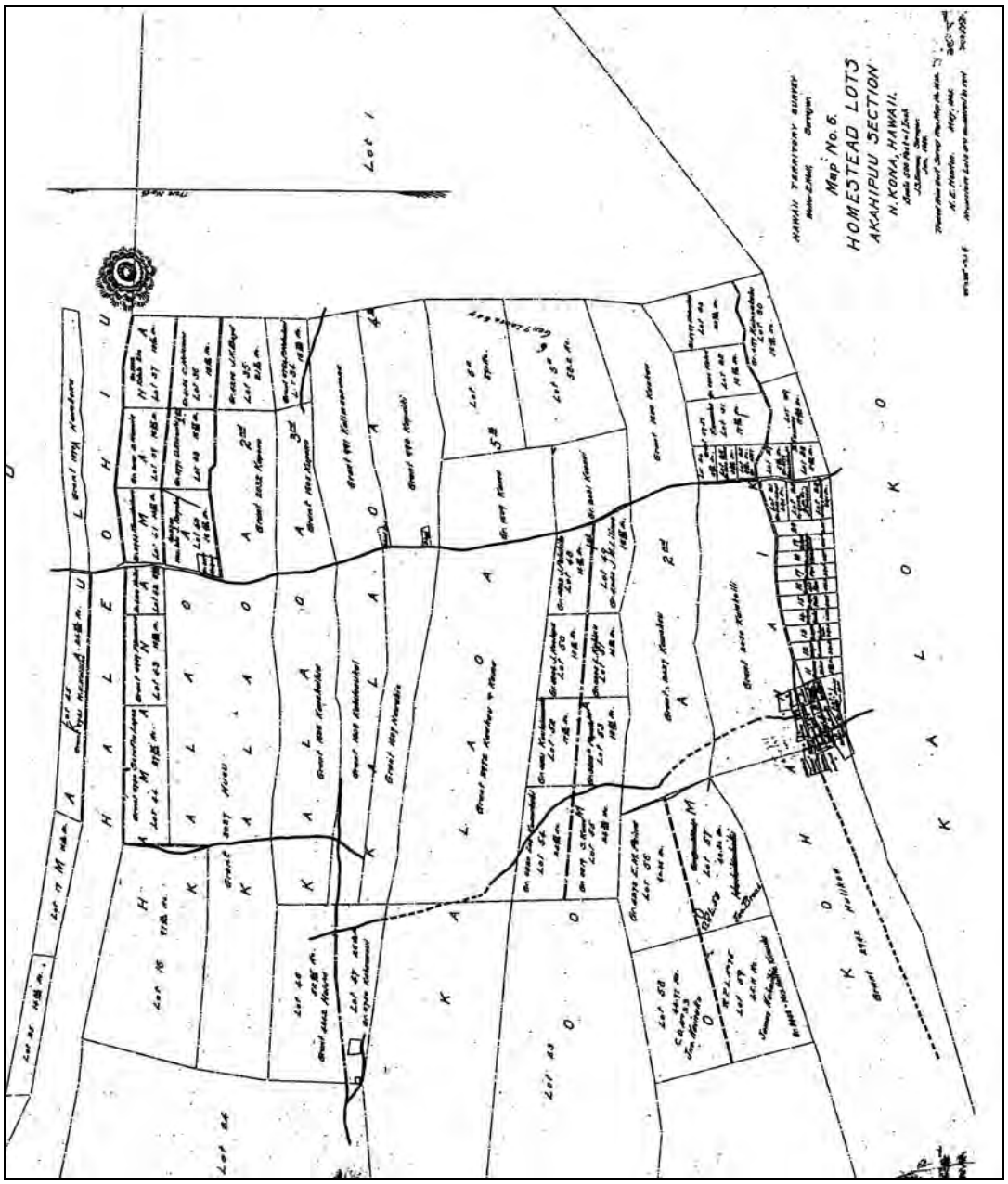

Figure 11. 1902 Homestead Map No. 6 showing Ooma-Kalaoa Homestead Lots (State Survey Division).

Lot # 57 above set forth, was formerly agreed with D. Kealoha Hoopii, but this applicant left altogether and lived a long time in Kohala, and has done nothing towards the land, and has never signed the agreement to this day. As two years have gone by, I thought it would be better to give the lands to the new applicant… [HSA – Interior Department, Lands]

August 31, 1898
Statement of Leases of Public Lands
Under Control of the Commissioner of Public Lands…

…Ooma (mauka) 1160 acres – Coffee, wood lands & grazing
Lease No. 432 – Annual rent $60. – Expires August 1st, 1906…
Reservation in lease by which the Gov't. may take up portions suited to settlement. [HSA – F.O. & Ex, 1898 – Public Lands]

In May 1902, the Territorial Survey Office issued Register Map No. 2123 (Figure 12), depicting a portion of the Kalaoa-Ooma Homesteads. ʻOʻoma 1st had been divided into 25 lots extending from near the shore (excluding the shore line) to the upper limits of the ahupuaʻa; also excluding the early Royal Patent Grant parcels previously sold to native tenants.

Applicants for land in ʻOʻoma 1st (from *makai* to *mauka*) included:

- Kanealii – Right of Purchase Lease # 30; Lot 4-B (cancelled);

Kanealii's parcel was just mauka of the shore line exclusion.

- Wm. Keanaaina – Right of Purchase Lease #33; Lot 13

(Patented by Grant No. 5472);
The makai end of Wm. Nuuanu Keanaaina's Grant 5472, is situated at approximately 325 feet above sea level.

- J. Maiola – Right of Purchase Lease # 28; Lot 14 (cancelled);

J. Maiola's parcel was situated about 525 feet above sea level.

- K. Kama Jr. – Right of Purchase Lease #27; Lot 15

(Patented by Grant No. 5046).
The makai end of K. Kama's Grant No. 5046, is situated at approximately 725 feet above sea level.

Territorial Survey Map No. 6 (Homestead Lots, Akahipuu Section), surveyed by J.S. Emerson in 1889, depicts the eight original homestead lots sold to applicants. The lots are in the area extending from 1,022 feet above sea level to the old Māmalahoa Highway. The lots contained approximately 15 to 25 acres each, and were (*makai* to mauka) sold to:

- S. Kane – Grant No. 3819, Lot 55;
- Loe Kumukahi – Grant No. 3820, Lot 54;
- Papala (w) – Grant No. 3820 B, Lot 53;
- Kaulainamoku – Grant No. 3821, Lot 52
- L. Kahinu – Grant No. 3805, Lot 51
- J. Hoolapa – Grant No. 3804, Lot 50
- J.M. Lilinoe – Grant No. 4343, Lot 49
- J. Palakiko – Grant No. 3822, Lot 48

Except for the Homestead parcels and the two lots patented to Keanaaina and Kama (totaling ten parcels of the available 25 parcels), no other land in ʻOʻoma 1st was sold during this time. The land was retained by the government and portions leased out for grazing (see General Lease No.'s 590 and 604).

ʻOʻoma 2nd was also divided into homestead parcels, but only six lots were made in the subdivision (see Register Map No. 2123). The two *makai* lots consisted of approximately 1,333 acres—the first lot from above the shore to the 1847 *Alanui Aupuni*, containing approximately 302 acres, and the other lot running *mauka* from the same *Alanui Aupuni*, to about the 800 foot elevation (containing approximately 1,031 acres). In 1899, John A. Maguire, founder of Huehue Ranch applied for a Patent Grant on both of the *makai* lots, but he only secured Grant No. 4536, for the lower parcel of 302 acres, in ʻOʻoma 2nd. Maguire's Huehue Ranch did hold General Lease No.'s 1001 and 590 for grazing purposes on the remaining government lands—both below and above the *mauka* highway—in ʻOʻoma 2nd.

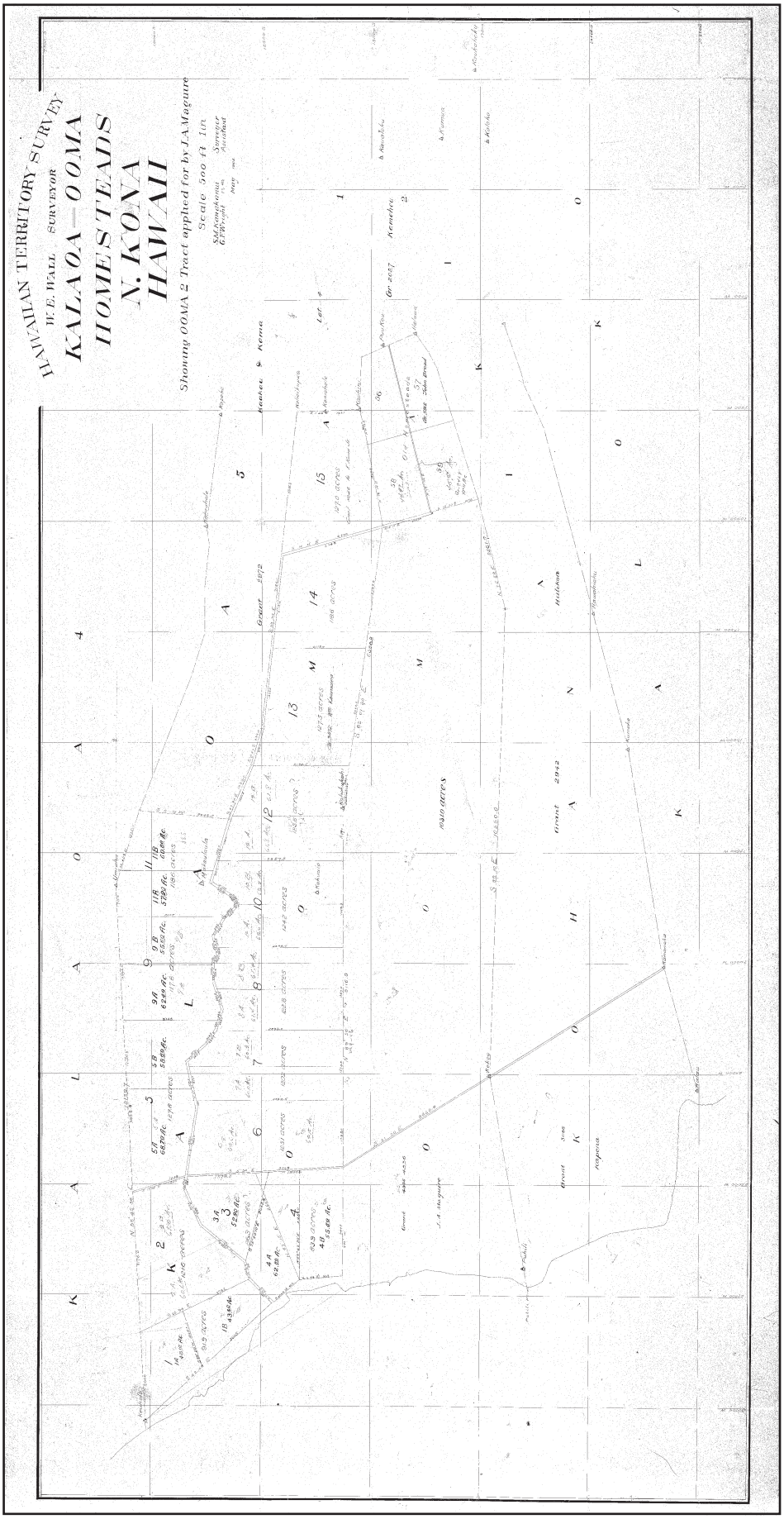

Figure 12. Hawai'i Register Map No. 2123, May 1902, Kalaoa-'O'oma Homesteads, N. Kona, Hawai'i.

Between 700 and 1,100 feet elevation, four Homestead lots were subdivided, containing 40.50 to 45 acres each. Applicants for the lots (*makai* to *mauka*) were:

- James Kuhaiki – Right of Purchase Lease # 75, Lot 59
  (Patented to Mrs. Hattie Kinoulu);
- Jno. Kainuku – C.O. No. 33, Lot 58 (not granted by 1902);
- Holokahiki – C.O. No. 11, Lot 57
  (cancelled; R.P.L. # 59 to Jno. Broad); and
- E.M. Paiwa – Grant No. 4273, Lot 56.

The notes of survey from Maguire's Grant No. 4536 describes the near shore parcel in 'O'oma 2nd. Of particular interest, it also references one of the prominent cultural-historical features on the boundary between 'O'oma 2nd and Kohanaiki, an "old 'Kahua hale' on white sand…" The "kahua hale" being an old house site. The notes of survey read (Figure 13):

> Grant No. 4536
> To J.A. Maguire
> Purchase Price $351.00
> A Portion of Ooma 2nd, N. Kona, Hawaii Applied for by J.C. Lenhart, June 8, 1899.
> Beginning at Puhili Gov't. trig. St. on the boundary between Kohanaiki and Ooma marked by a drill hole in stone 9 feet South of the South corner of an old "Kahua hale" on white sand at a point from which
> Akahipuu Gov't. trig. Sta. is N 55º 27' 39" E true 32634.7 feet
> Keahole Gov't. Trig. Sta. is N 21º 52' 36" W true 9310.5 ft.
> Keahuolu Gov't Trig. Sta. is S 22º 24' 36" E true 20,141.8 ft., and running —
> 1. S. 79º 26' W. true 298.0 feet along Gr. 3086 Kapena, to a large [mark] on solid pahoehoe by the sea at Puhili Point, thence continuing the same line to the sea shore and along the sea shore to a point whose direct bearing and distance is:
> 2. N. 4º 54' W. true 4192.0 feet;
> 3. Due east true 2920.0 feet along Ooma 1st;
> 4. S. 31º 30' E. true 3920.0 feet along reservation for Gov't. Road 30 feet wide;
> 5. S 790º 45' W. true 4387.0 feet along Grant 3086 Kapena, to initial point and including an area of 302 acres.
>
> J.S. Emerson, Surveyor
> Oct. 10, 1901.

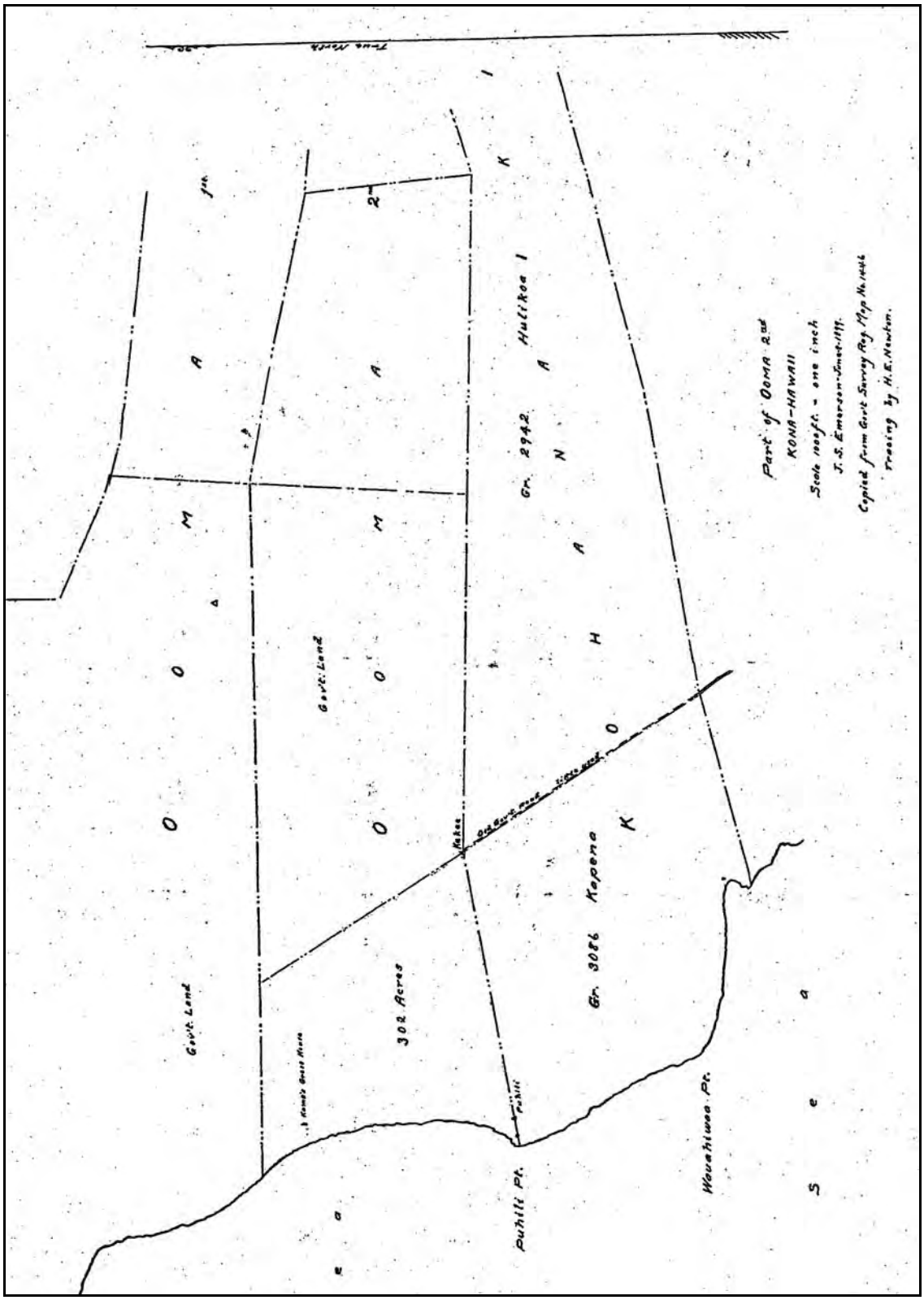

Figure 13. 1899 Grant Map No. 4536 showing *makai* portion of ʻOʻoma 2nd to John A. Maguire.

Field Surveys of J.S. Emerson (1882-1889)

Among the most interesting historic Government records of the study area—in the later nineteenth century—are the communications and field notebooks of Kingdom Surveyor, Joseph S. Emerson. Born on O'ahu, J.S. Emerson (like his brother, Nathaniel Emerson, a compiler of Hawaiian history) had the ability to converse in Hawaiian, and he was greatly interested in Hawaiian beliefs, traditions, and customs. As a result of this interest, his letters and field notebooks record more than coordinates for developing maps. While in the field, Emerson also sought out knowledgeable native residents of the lands he surveyed, as guides. Thus, while he was in the field he also recorded their traditions of place names, residences, trails, and various features of the cultural and natural landscape (including the extent of the forest and areas impacted by grazing). Among the lands that Emerson worked in was the greater Kekaha region of North Kona, including the lands of 'O'oma and vicinity.

One of the unique facets of the Emerson field notebooks is that his assistant J. Perryman, was also a sketch artist. While in the field, Perryman prepared detailed sketches that help to bring the landscape of the period to life. In a letter to W.D. Alexander, Surveyor General, Emerson described his methods and wrote that he took readings off of:

> …every visible hill, cape, bay, or point of interest in the district, recording its local name, and the name of the *Ahupuaa* in which it is situated. Every item of local historical, mythological or geological interest has been carefully sought & noted. Perryman has embellished the pages of the field book with twenty four neatly executed views & sketches from the various trig stations we have occupied… [Emerson to Alexander, May 21, 1882; HSA – DAGS 6, Box 1]

Discussing the field books, Emerson also wrote to Alexander, reporting "I must compliment my comrade, Perryman, for his very artistic sketches in the field book of the grand mountain scenery…" (HSA – HGS DAGS 6, Box 1; Apr. 5, 1882). Later he noted, "Perryman is just laying himself out in the matter of topography. His sketches deserve the highest praise…" (ibid. May 5, 1882). Field book sketches and the Register Maps that resulted from the fieldwork provide a glimpse of the country side of more than 100 years ago.

Field Notebooks and Correspondence from the Kekaha Region

The following documentation is excerpted from the field notebooks and field communications of J. S. Emerson. Emerson undertook his original surveys of lands in the Kekaha region in 1882-1883 (producing Register Maps No. 1278 and 1280). Subsequently, in 1888-1889, Emerson returned to Kekaha to survey out the lots to be developed into Homesteads for native residents of 'O'oma, Kalaoa and vicinity (see above, The Government Homesteading Program in Kekaha). Through Emerson's letters and notes taken while surveying, we learn about the people who lived on the land—some of them identified in preceding parts of the study—and about places on the landscape. The numbered sites and place names cited from the field books coincide with sketches prepared by Perryman, which are shown as figures in the current study.

> *J.S. Emerson Field Notebook Vol. 111 Reg. No. 253*
> *West Hawaii Primary Triangulation, Kona District*
> *Akahipuu; May 27, 1882*
> (Figures 14 and 15)
>
> *Site # and Comment:*
> …6 – Koanui's frame house. E.G. In Honokohau – nui.
> 7 – Aimakapaa Cape. Extremity. In Honokohau-nui.
> 11 – Beniamina's house (frame). N.G. In Aiopio. In Honokohau-nui.
> 12 – Beniamina's house No. 2. E.G. In Honokohau-nui.
> 18 – Lae o Palaha. Between Kaloko and Honokohau-nui.
> 19 – Awanuka Bay (Haven of rest) Retreat during storms in this dist.
> 20 – Kealiihelepo's (frame house). N.G. In Kaloko.

21 – Lae Maneo. From the "Maneo" fish in Kaloko.

22 – Kohanaiki Bay. By sea wall of fish pond.

23 – Kaloko-nui fish pond. Tang. S. end by Nuuanu's grass house.

24 – Wall between fish pond of Kaloko nui and iki.

25 – Kaloko iki fish pond. Tang. N. extremity.

Kaloko nui was originally a bay, shut off from the sea by a wall by Kamehameha 1st order.

26 – Kawaimaka's frame house. In Kohanaiki.

27 – Lae o Wawahiwaa. Rock cape. In Kohanaiki.

28 – Keoki Mao's grass house. In Ooma.

29 – Pahoehoe hill. Between Ooma and Kalaoa 5.

30 – Lae o Keahole. Extremity. In Kalaoa 5.

31 – Lae o Kukaenui. Resting place for boats.

32 – Makolea Bay.

33 – Lae o Unualoha.

34 – Pohaku Pelekane.

35 – Lae o Kahekaiao. Kahe-ka-iao – place of the "iao" which abound there. [Notebook 253:33,35]

…Keahole Bay.

Lae o Kalihi in Kalaoa 5.

Wawaloli Bay in Kalaoa 5.

Lae o Kekaaiki.

Limu Koko in Ooma 1.

Lae o Puhili in Kohanaiki.

Lae o Kealakehe in Kealakehe.

Hueu's frame house in Kalaoa 4, makai side of Gov't. Road.

Kuakahela's frame house in Kalaoa 5.

Protestant Church Steeple in Kalaoa 5.

Kama's frame house, N. gable in Ooma 1.

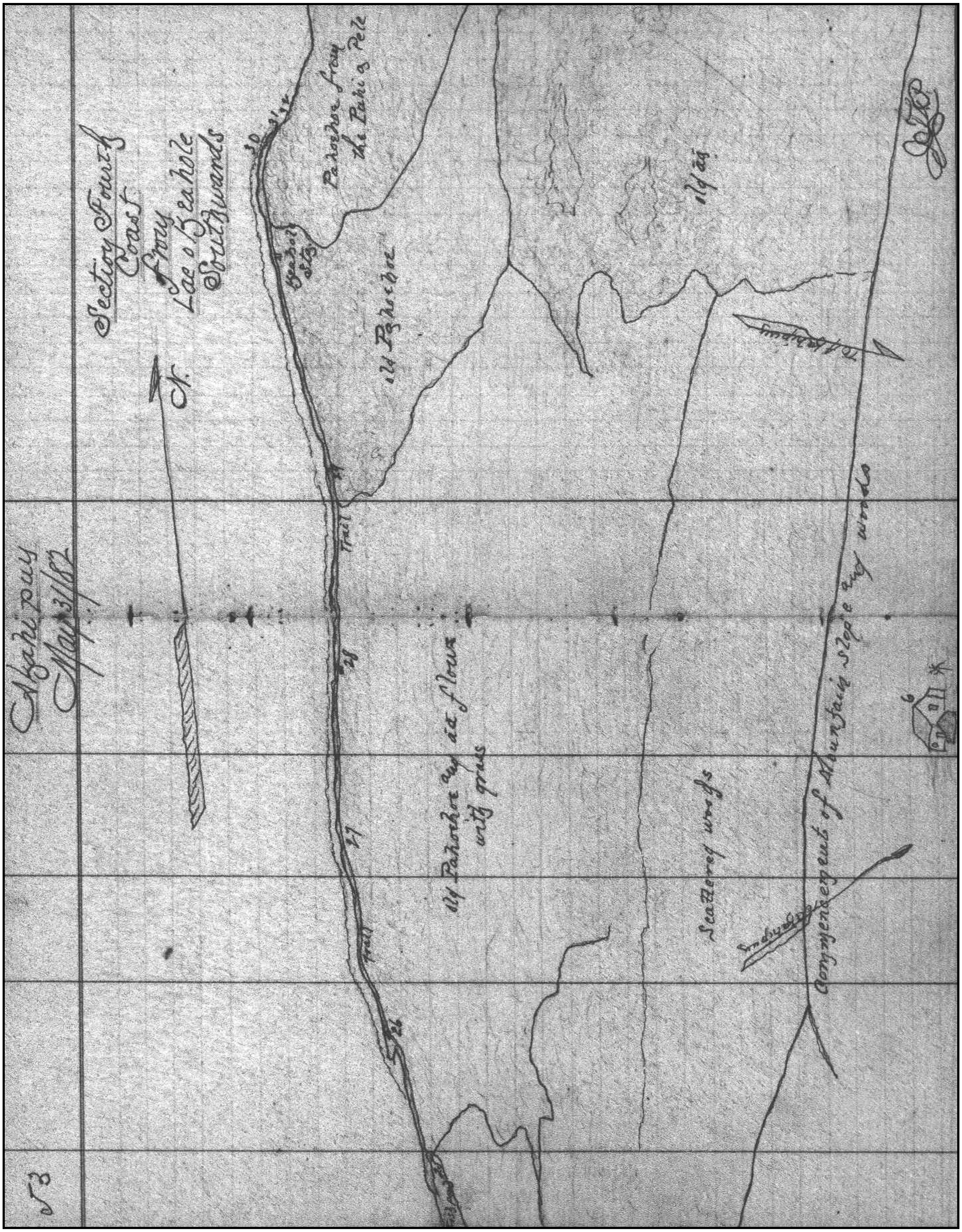

Figure 14. J. S. Emerson, field notebook map, Book 253:53 (State Survey Division).

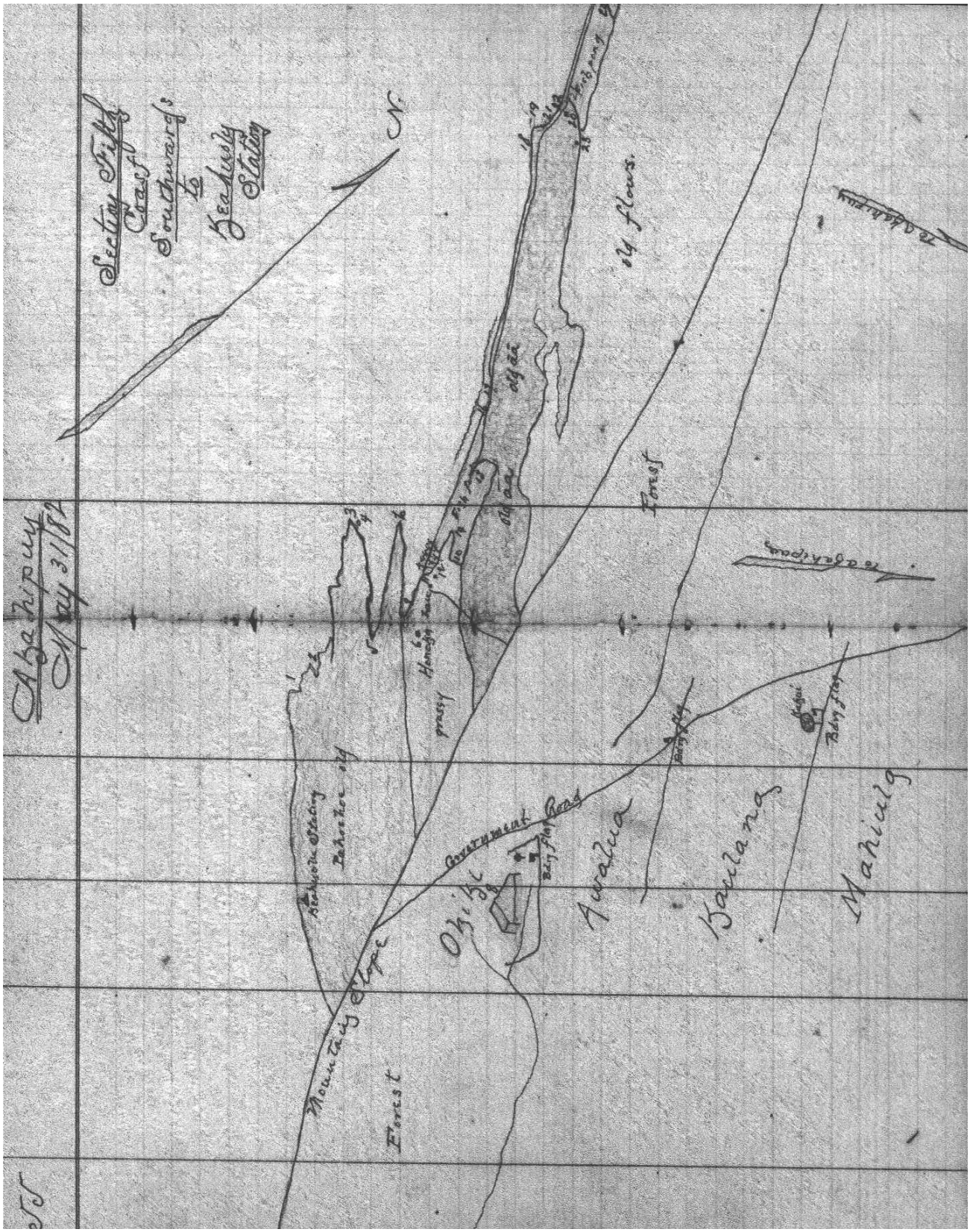

Figure 15. J. S. Emerson, field notebook map, Book 253:55 (State Survey Division).

While taking sightings from Keāhole, Perryman prepared additional sketches of the landscape. One sketch on page 69 of the field book (Figure 16) depicts the view up the slope of Hualālai. Dated June 4, 1882, the sketch is of importance as it also depicts Kalaoa Village and church; the upper Government road; Kohanaiki Village; and two trails to the coast, one trail to Honokōhau, and the other near the Kaloko-Kohanaiki boundary. Use of these trails continued through the 1950s.

The other sketch on page 73 of the field book (dated June 8, 1882) depicts the coastline south from Keāhole, to an area beyond Keauhou (Figure 17). Of interest, we see only the near-shore "Trail" in the foreground, with no trail on the *kula* lands. Then a short distance south, a house is depicted on the shore, in the ʻOʻoma vicinity (identified as the house of Kama or Keoki Mao on Emerson's Register Maps). And a little further beyond (south) the house, two trails are indicated—presumably the *Alanui Aupuni* on the *kula* lands to ʻOʻoma, and the near shore trail, seen coming in from Honokōhau.

While surveying the uplands on Hualālai in August 1882, Perryman drew a sketch of the Keāhole-Honokōhauiki coastal lands. This sketch (Figure 18) from field Book No. 254 shows the reverse view of Figure 12. Noting again, that the only trail given at that time, was the near shore trail, running out of Honokōhau-Kaloko, Kohanaiki, ʻOʻoma and on to Keāhole.

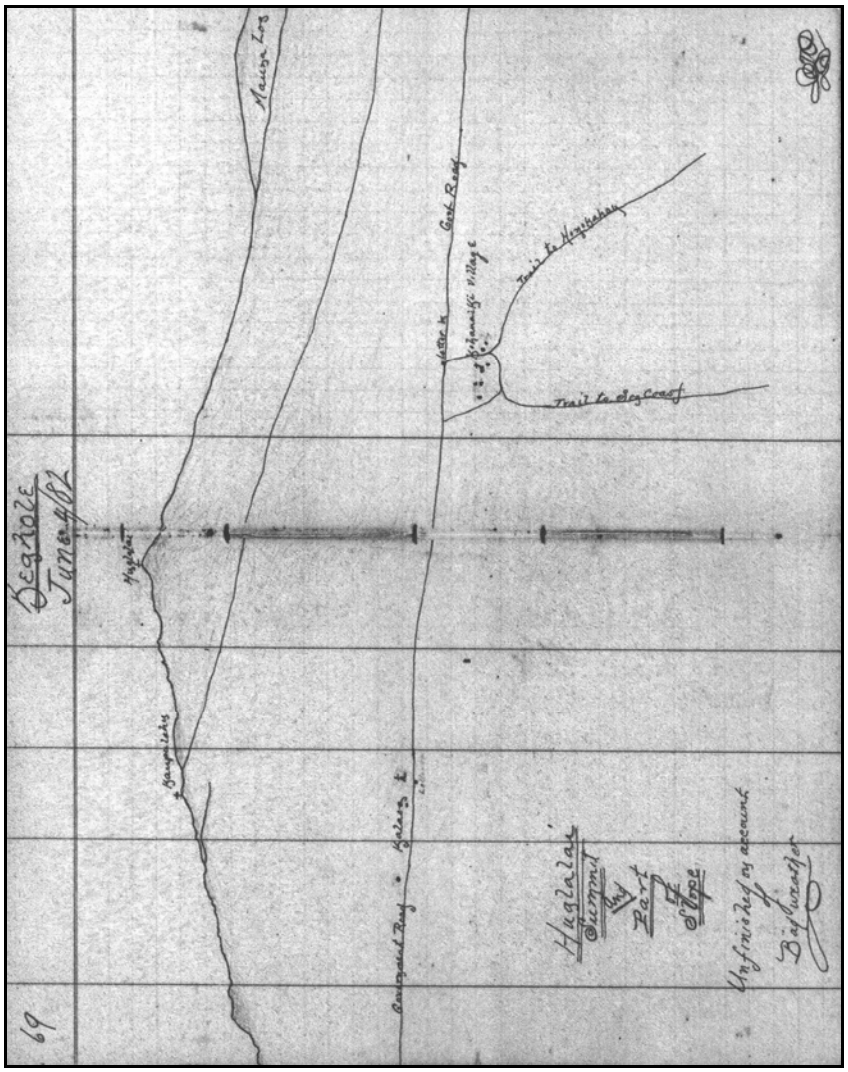

Figure 16. J. S. Emerson, field notebook map, Book 253:69 (State Survey Division).

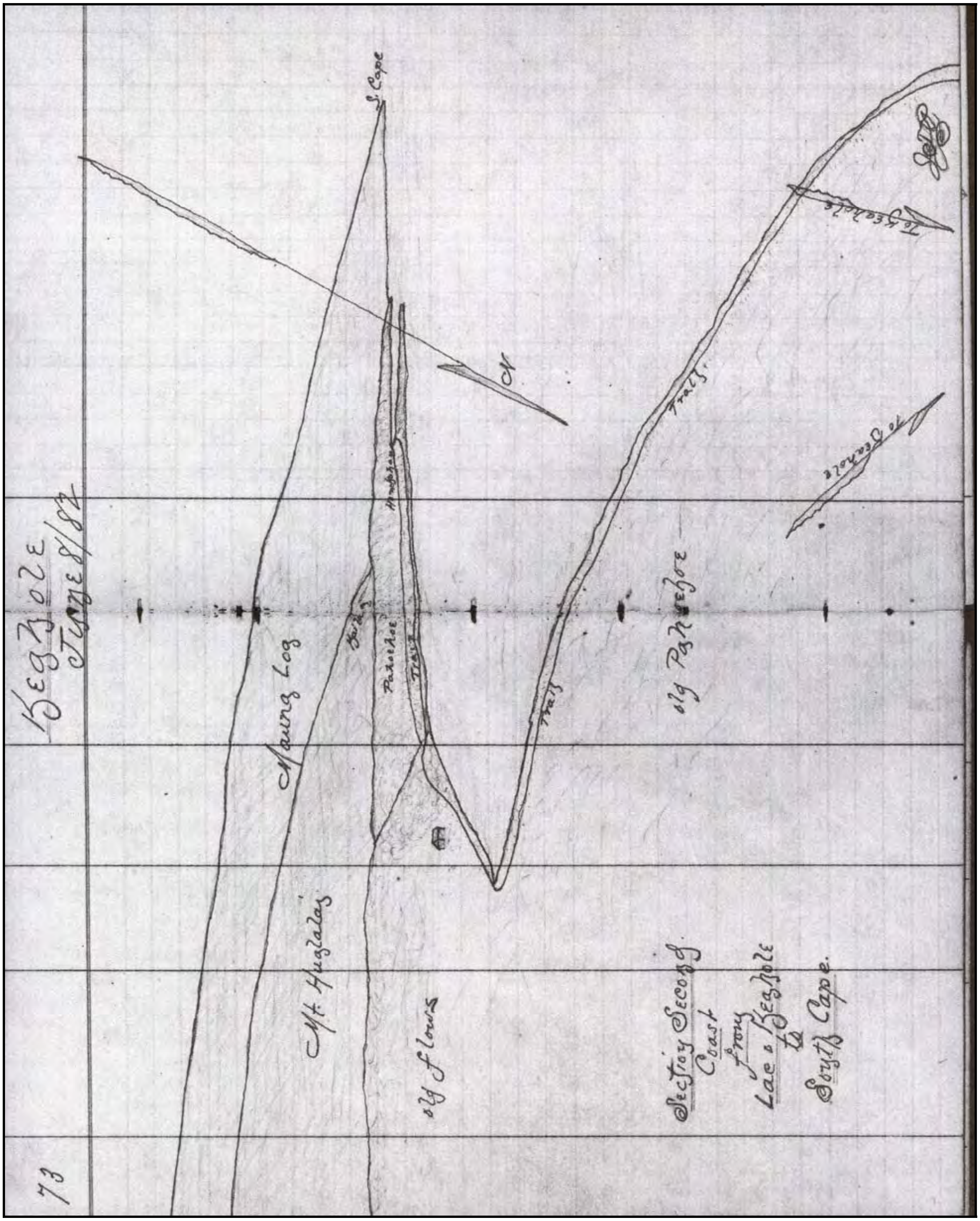

Figure 17. J. S. Emerson, field notebook map, Book 253:73 (State Survey Division).

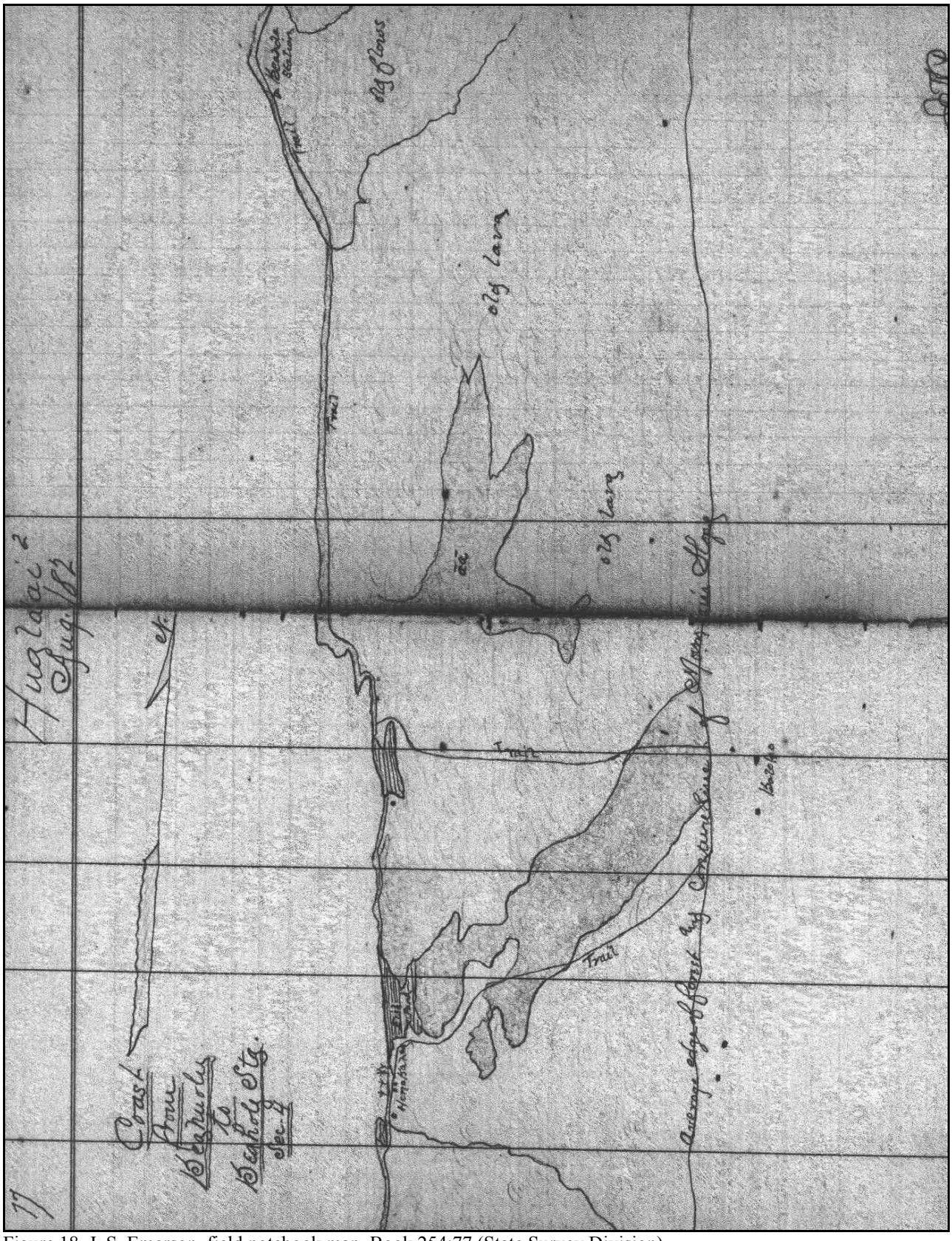

Figure 18. J. S. Emerson, field notebook map, Book 254:77 (State Survey Division).

While surveying the ‘O‘oma and Kalaoa homestead lots in 1888-1889, Emerson camped near Kama’s house in ‘O‘oma 1st. The following communications were sent by Emerson to W.D. Alexander, and tell us more about the people of the land, their beliefs, and commentary on then current events in the Kingdom. Of interest, we also find that J.W.H. Isaac Kihe, whose writing of traditions, and as a representative of the native families in the land application process—which have been cited extensively in this study—is also mentioned in Emerson’s narratives.

(Underlining, italics and brackets are inserted to draw attention to certain passages.)

> *April 8, 1888*
> …Our tent is pitched in Ooma on the *mauka* Govt. road at a convenient distance from Kama’s fine cistern which supplies us with the water we need. The pasturage is excellent and fire wood abundant. As I write 4:45 P.M. the thermometer is 71º, barometer 28.78. The entire sky is overcast with black storm clouds over the mountains. The rainy season comes late to Kona this year and has apparently just begun. We have had about three soaking rains with a good deal of cloud & drizzle. We are now having a gentle rain which gladdens the residents with water for their cisterns… We have set a large number of survey signals and identified many important corners of Gov’t. lands etc. from Puhiapele on the boundary of Kaupulehu to the boundary line of Kaloko. The natives welcome us and do a great deal to help the work along. Tomorrow I expect to go to Kuili station with a transit and make a few observations & reset the old signal... The Kamaainas tell me that Awakee belongs to the Gov’t. though I see it put down as LCA 10474 Namauu no Kekuanaoa.
>
> They also tell me that the heirs of Kanaina estate still receive rent for the Ahupuaa of Kaulana, though I have recorded as follows in my book, Kaulana ½ Gov’t. per civil Code 379, ½ J. Malo per Mahele Bk. Title not perfected; all Gov’t. Please examine into the facts about Kaulana and instruct me as to what I shall do about it. Kealoha Hopulaau rents it and if it is Gov’t. land the Gov’t. should receive the rent or sell it off as homesteads. It is a desirable piece of land, a part of it at least… [HSA – HGS DAGS 6, Box 2]
>
> *April 17, 1888*
> ...The work is being pushed rapidly and steadily forward. The natives render me most valuable assistance and find all the important corners for me as fast as I can locate them. It is hard getting around on account of the rocks & stones, to say nothing of trees etc., but there is a great deal of really fine land belonging to the Government, admirably adapted to coffee etc. The more I see of it the better it appears.
>
> As to Kaulana, if I hear nothing to the contrary from you, I will leave it all as Gov’t. land.
>
> Mr. McGuire [sic] of Kohala, the representative for that district, proposes to settle in Kona. He has bought Grant 1590, Kauhine, in Ooma, Kalaoa etc. and wants the Gov’t. to make good to him the amount taken from him by Grants 2972, Kaakau & Kama, and 3027, Hueu, which occupy portions of the same land granted to Kauhine. If his title is good, would it not be just to leave Kaakau & Kama as well as Hueu in possession of their lots where they have lived for over 20 years, and give McGuire an area in adjoining lands equal to that taken from him by these two grants.
>
> It is said that Chas. Achi has written to the natives that Grant 1590, Kauhine, has been cancelled. Will you learn the true state of the case and be so kind as to inform me… [HSA – HGS DAGS 6, box 2 Jan.-Apr. 1888]

In his field book notes, on May 1st, 1888, Emerson noted that he had placed the “Pulehu” station on the “ground by ahu, about 4 feet makai of Kama’s goat pen, on the iwi aina between Kalaoa 5 and Ooma 1…” (J.S. Emerson Field Book 291:83).

In the same field book on May 19th, 1888, while surveying the area near the boundary of ʻOʻoma 1st and 2nd, at the 325 foot elevation, Emerson cited off of a station named "Kahokukahi." The point is "on the entrance of the cave, Kahokukahi… The above is the vertical entrance of a famous *ana kaua*, which extends for a long distance to the E. and to the W…" (J.S. Emerson Field Book 291:137). An "ana kaua" would be a place, where during times of war, people could hide and fortify themselves. Emerson's description indicates that the cave runs some distance *mauka* and *makai* of "Kahokukahi."

On May 23 , 1888, Emerson surveyed Pūhili, the boundary between Kohanaiki and ʻOʻoma 2nd. He observed, "Large [mark] on solid pahoehoe, on bound. bet. Kohanaiki & Ooma, by the sea, near the end of a cape… Station mark, drill hole in stone, 9 ft. S. of the S. corner of an old "kahua hale" on white sand…" (J.S. Emerson Field Book 291:151).

Returning to his "old camp Ooma," in August 1888, Emerson submitted the following letter to Alexander:

> *August 25th, 1888*
> …I have to report that the very intricate and irregular remainder of Gov't. land situated in Kealakehe is cut up into homesteads, ready for the committee to estimate its values. The job has been made unusually long & tedious by the absurd arrangement of the old kuleanas scattered around at random. I have also run out the boundaries of Papaakoko, ready for fencing. Thursday P.M. I made my way through a heavy rain to this place and set up tent in the storm. It rained a good deal every day since and is raining now. In spite of the weather the work of cutting up Ooma 1st goes bravely on. I have a huge umbrella to camp under while it rains. I propose to finish up Ooma 1st & return to Honolulu by the next trip of the *Hall*.
>
> Kailua beach is the great rendezvous for men & asses from all parts of the country when the steamer arrives from Honolulu. It has in consequence become the natural place to tell and hear gossip & news. Here, the sand-lot orator, mounted on a packing box, can address the largest crowd. T.N. Simeona, who stole the church money, keeps the pound and takes care of the court house wanting to make a speech, repaired to the beach last Wednesday morning and is reported to have made a windy harangue to the effect that the King was hewa and that the Ministers were pono! Up to that time he had always been the contemptible too of the King's party and was loud in his denunciation of the Government. I explain this change in his talk by his wish to retain his Gov't. billets & his desire to avoid arrest as a rebel.
>
> A native man told me the other day (Wednesday) that the Cabinet was hewa in two things viz.
>
> 1st They taxed chickens, banana trees and many other things that had not been heretofore taxed.
>
> 2nd They arrested and sent to Molokai many who were not lepers. For these reasons many justified Wilcox for trying to out the ministers.
>
> There is a sturdy old native living at Kaloko named Kealiihelepo, whom I greatly respect. Said he to me "When King Kalakaua returned from his foreign trip he made a speech at Kailua and said that 'in foreign lands the foreign God was losing his power. His former worshippers were deserting him. That the old Hawaiian Gods were still mana and them he would worship.'" But said Kealiihelepo "The King was mistaken. Our old Gods were once mighty, but the coming of the foreigner with his Gods has robbed them of their strength. Therefore the King has made the mistake to oppose the God who is now in power, and Jehovah is opposing him. Hence the King's pilikia."
>
> You are entirely justified in calling Kona "that heathen district." [HSA – HGS DAGS 6, box 2 Jan.-Apr. 1888]

On October 14th 1888, Emerson wrote to Alexander, briefing him on conversations he was having with J.W.H. Isaac Kihe, his "encyclopedia," "the son of a famous sorcerer." Later, Emerson used many of the notes taken during his conversations with Kihe, to develop his paper on Hawaiian religion (Emerson 1892). J.W.H. Isaac Kihe, was the son of Kihe, who was the son of Kuapahoa, of Kaloko (notes of J.S. Emerson, September 25, 1915; in collection of the Hawaiian Historical Society). While at 'O'oma, Kihe described the various nature forms taken by the deceased, and their role in the spiritual practices. On October 14th Kihe named for him some of the gods called upon by those who practiced the Kahuna Kuni sorcery.

> *Ooma*
> *October 14, 1888*
> *J.S. Emerson; to W.D. Alexander:*
> …I have just been having a chat with a son of a famous sorcerer, with the following for a summary of what he said.
>
> There are four gods worshipped by murders and sorcerers viz:
>
> (1). Kui-a-Lua, the god of the Lua, Mokomoko, Haihai and other forms of violence.
>
> (2). Uli, the god of the Anaana, Kuni, Hoopiopio and Lawe Maunu.
>
> (3). Kalaipahoa, god of the Hoounauna, Hookomokomo and Hooleilei.
>
> (4). Hiiaka-i-ka-poli-o-Pele, the goddess of the Poi uhane, Apo leo, Pahiuhiu and Hoonoho uhane… [J.S. Emerson, in collection of the Hawaiian Historical Society]

Trails and Roads of Kekaha

Alahele (trails and byways) and *alaloa* (regional thoroughfares) are an integral part of the cultural landscape of Hawai'i. The *alahele* provided access for local and regional travel, subsistence activities, cultural and religious purposes, and for communication between extended families and communities. Trails were, and still remain important features of the cultural landscape.

Traditional and historical accounts (cited in this study) describe at least two traditional trails that were of regional importance which pass through the lands of 'O'oma and Kalaoa. One trail is the *alaloa*—parts of which were modified in the 1840s and later, into what is now called the *Alanui Aupuni* (Government Road) or Māmalahoa Trail or King's Highway—that crosses the *makai* (near shore) lands, linking royal centers, coastal communities, and resources together. The other major thoroughfare of this region is "*Kealaehu*" (The path of Ehu), which passes through the uplands, generally a little above the *mauka* Government Road or old Māmalahoa Highway, out to the 'Akāhipu'u vicinity, and then cuts down to Kīholo in Pu'u Wa'awa'a. From Kīholo, the *makai alaloa* and Kealaehu join together as the *Alanui Aupuni,* and into Kohala, passing through Kawaihae and beyond. The *mauka* route provided travelers with a zone for cooler traveling, and access to inland communities and resources. It also allowed for more direct travel between the extremities of North and South Kona (cf. Malo 1951; I'i 1959; Kamakau 1961; Ellis 1963; and *Māhele* and Boundary Commission Testimonies).

In addition to the *alahele* and *alaloa*, running laterally with the shore, there are another set of trails that run from the shore to the uplands. By nature of traditional land use and residency practices, every *ahupua'a* also included one or more *mauka-makai* trail. In native terminology, these trails were generally known as—*ala pi'i uka* or *ala pi'i mauna* (trails that ascend to the uplands or mountain). Some of these trails are described in native accounts and oral history interviews (Rechtman and Maly 2003).

Along the trails of the Kekaha region are found a wide variety of cultural resources, including, but not limited to residences (both permanent and temporary), enclosures and exclosures, wall alignments, agricultural complexes, resting places, resource collection sites, ceremonial features, *ilina* (burial sites), petroglyphs, subsidiary trails, and other sites of significance to the families who once lived in the vicinity of the trails. The

trails themselves also exhibit a variety of construction methods, generally determined by the environmental zone and natural topography of the land. "Ancient" trail construction methods included the making of worn paths on *pāhoehoe* or *ʻaʻā* lava surfaces, curbstone and coral-cobble lined trails, or cobble stepping stone pavements, and trails across sandy shores and dry rocky soils.

Following the early nineteenth century, western contact brought about changes in the methods of travel (horses and other hoofed animals were introduced). By the mid-nineteenth century, wheeled carts were also being used on some of the trails. In the Kona region portions of both near shore and upland *ala hele-ala loa* were realigned (straightened out), widened, and smoothed over, while other sections were simply abandoned for newer more direct routes. In establishing modified trail—and early road-systems—portions of the routes were moved far enough inland so as to make a straight route, thus, taking travel away from the shoreline.

It was not until 1847, that detailed communications regarding road construction on Hawaiʻi began to be written and preserved. It was also at that time that the ancient trail system began to be modified and the alignments became a part of a system of "roads" called the " *Alanui Aupuni*" or Government Roads. Work on the roads was funded in part by government appropriations, and through the labor or financial contributions of area residents and prisoners working off penalties (see communications below). Where the *Alanui Aupuni* crosses the lands of ʻOʻoma and Kalaoa, the alignment includes several construction methods, such as being lined with curbstones; elevated; and with stone filled "bridges" in areas that level out the contour of the roadway.

The following letters provide readers with a historical overview of the *Alanui Aupuni*, and travel through the Kekaha region. Of particular interest, are those communications addressing the lower Government Road.

(Underlining, italics, and square brackets have been added.)

> *June 26, 1847*
> *George L. Kapeau to Keoni Ana*
> I have received your instructions, that I should explain to you about the *alaloa* (roadways), *alahaka* (bridges), lighthouses, markets, and animal pounds. I have not yet done all of these things. I have thought about where the *alanui heleloa* (highways) should be made, from Kailua to Kaawaloa and <u>from Kailua to Ooma, where our King was cared for [7]</u>, and then afterwards around the island. It will be a thing of great value, for the roads to be completed. Please instruct me which is the proper thing for me to do about the *alaloa*, *alahaka*, and the laying out of the *alaloa*… [HSA – Interior Department Misc., Box 142; Kepā Maly, translator)
>
> *August 13, 1847*
> *Governor of Hawaii, George L. Kapeau; to*
> *Premier and Minister of Interior, Keoni Ana*
> *Aloha oe e ka mea Hanohano –*
> I have a few questions which I wish to ask you. Will the police officers be required to pay, when they do not attend the Tuesday (*Poalua*) labor days? How about parents who have several children? What about school teachers and school agents? Are they not required to work like all other people when there is Government work on the roads and highways?
>
> I believe that school agents, school teachers and parents who have several children, should only go and work on the weeks of the public, and not on the *konohiki* days…
>
> …<u>The roads from Kailua and down the pali of Kealakekua, and from Kailua to Honokohau, Kaloko, Ooma, at the places that were told our King, and from thence to Kaelehuluhulu [at</u>

[7] For the first five years of his life (until ca. 1818), Kauikeaouli was raised at ʻOʻoma, by Ka-iki-o-ʻewa and Keawe-a-mahi *mā* (see Kamakau 1960; and this study).

Kaulana in Kekaha], are now being surveyed. When I find a suitable day, I will go to Napoopoo immediately, to confer with the old timers of that place, in order to decide upon the proper place to build the highway from Napoopoo to Honaunau, and Kauhako, and thence continue on to meet the road from Kau. The road is close to the shore of Kapalilua…

The width of the highways around Hawaii, is only one fathom, but, where it is suitable to widen where there is plenty of dirt, two fathoms and over would be all right… If the roads are put into proper condition, there are a lot of places for the strangers to visit when they come here. The Kilauea volcano, and the mountains of Maunaloa, Maunakea, Hualalai.

There is only one trouble to prevent the building of a highway all around, it is the steep gulches at Waipio and Pololu, but this place can be left to the very last… [HSA – Roads, Hawaii]

March 29, 1848
Governor Kapeau; to Minister of the Interior, Keoni Ana:
[Acknowledging receipt of communication and answering questions regarding construction methods used in building the roads.]

…I do not know just what amount of work has been done, but, I can only let you know what has come under my notice.

The highway has been laid from Kailua to Kaloko, and running to the North West, about four miles long, but it is not completely finished with dirt. The place laid with dirt and in good condition is only 310 fathoms.

The highway from Kealakekua to Honaunau has been laid, but is not all finished, and are only small sections… [HSA – Roads, Hawaii]

July 9, 1873
R.A. Lyman; to
E.O. Hall, Minister of the Interior.
Notifies Minister that *the road from Kiholo to Kailua needs repairing*. [HSA – Interior Department – Land Files]

August 14, 1873
R.A. Lyman; to
E.O. Hall, Minister of the Interior:
I have just reached here [Kawaihae] from Kona. I have seen most of the roads in N. Kona, and they are being improved near where the people live. If there is any money to be expended on the roads in N. Kona, I would say that the place where it is most needed is from Kiholo to Makalawena, or the Notch on Hualalai.

This is the main road around the island and is in very bad condition. Hardly anyone lives there, and there are several miles of road across the lava there, that can only be worked by hiring men to do it. There is also a road across a strip of Aa a mile & a half or 2 in length in the south end of S. Kohala next to the boundary of N. Kona, that needs working, and then the road from here [Kawaihae] to Kona will be quite passable… [HSA – Roads, Hawaii]

November 4, 1880
J.W. Smith, Road Supervisor, North Kona; to
A.P. Carter, Minister of the Interior:
…Heretofore I have been paying one dollar per day, but few natives will work for that, they want $1.50 per day. Thus far I have refused to pay more than $1.00 and have been getting men for that sum.

The most urgent repairs are needed on the main road from Kaupulehu to Kiholo, and north of Kiholo to the Kohala boundary, a distance of about 20 miles… [HSA – Roads, Hawaii]

Kailua Nov. 19th, 1880
Geo. McDougall; to
A.P. Carter, Minister of the Interior —
…I noticed among the appropriation passed by the last Legislature, an item of $5000 for Roads in North Kona Hawaii — as I am very much interested about roads in this neighbourhood, I take the liberty to express my opinions what is wanted to put the roads in good repair and give the most satisfaction to all concerned.

The Road from Kailua going north for about eight miles to where it joins the upper Road, has never been made, it is only a mule track winding through the lava. It could cost to make it a good cart road, fully two thousand dollars. And from Kailua to where it joins the South Kona road, about 12 miles was made by Gov. Adams, and is in pretty much the same state as he left it, only a little worse of the ware of 20 years or more, it could cost to make it in good repair about 15 hundred dollars. Then we could have 20 miles of good road… [HSA – Interior Department Letters]

March 21st, 1885
C.N. Arnold, Road Superintendent-in-Chief, Hawaii; to
Charles Gulick, Minister of Interior:
…In accordance with your instructions I beg to hand you the following list of names as being those I would select for Supervisors in the different Road Districts under my charge:

… Judge J.K. Hoapili, North Kona District…

Hoping these parties may meet with your approval… [HSA – Roads, Hawaii]

March 1886
Petition to Charles Gulick, Minister of the Interior:
[Signed by 53 residents of North Kona, asking that the appropriated funds be expended for the Kailua-Kohanaiki Road]:

We the people whose names are below, subjects of the King, residing in North Kona, Island of Hawaii:

The funds have been appropriated by the Legislature for the opening of the road from Kailua to Kohanaiki, therefore, we humbly request that the road be made there. The length of this road being thought of is about five miles more or less. The road that is there at the present time is not fit for either man nor beast.

Your people have confidence that as so explained, you will kindly grant our request, and end this trouble in our District…

[those signing included names of individuals known to have ties to the ʻOʻoma vicinity]: …J. Kamaka, Kuakahela, Kahulanui, & Palakiko… [HSA – Roads Hawaii; Maly, translator]

March 9th, 1887
C.N. Arnold, Road Superintendent-in-Chief, Hawaii; to
Chas. Gulick, Minister of the Interior:

[Arnold provides documentation of the early native trail from Kailua to the upper Kohanaiki region, and its' ongoing use at the time. He also notes that McDougall (resident at Honokōhau) and others are presently in the business of dairy ranching]:

…The enclosed petition [cited above] has just come to hand from North Kona. The petitioners are mistaken when they say that any special appropriation has been made for this road as there has never been a Government road in this part of the District. There is however an old native trail which has always been used as a short cut, from the lower part of the district between Keahou [sic] and Kailua, by persons who were traveling to Kawaihae and Waimea. The opening of a good road here would be a great convenience to the traveling public and also a great accommodation to a great many people who live on, or nearly on the line of it. I may mention among the number, Messrs. McDougall and Clark who are engaged in dairy ranching near the head of the proposed line. I may also mention that I, with Mr. Smith, made a preliminary survey of it, at the request of His Majesty the King, who is also interested in the opening of this road, as itopens up all of His Kailua lands for settlement. I regard the road as necessary for the above reasons.

From the preliminary survey made, I estimate that a wagon road 12 feet wide will cost from Kailua to the *mauka* Govt. road at Kohanaiki $6000. The length of the road is 5 ¾ miles. The elevation of highest point (*mauka* Road) is 1600 feet above tide at Kailua. Mr. Smith Supt. of Public Works has all the notes of the survey, and can give you full information in regard to this matter… [HSA – Roads, Hawaii]

July 14th, 1887
C.N. Arnold, Road Superintendent-in-Chief, Hawaii; to
L.A. Thurston, Minister of the Interior:
…In obedience to your request I beg to hand you the following list of the District Supervisors under my jurisdiction:

…North Kona – Hon. J.K. Nahale; Native… [HSA – Roads Hawaii]

March 8, 1888
J. Kaelemkule; Supervisor, North Kona Road Board; to
L.A. Thurston, Minister of the Interior.
[Ka'elemakule provides Thurston with an overview of work on the roads of North Kona, and describes the Government roads (*Ala nui Aupuni* or *Ala loa*) which pass through the Kekaha region]:

The road that runs from Kailua to Kohanaiki, on the north of Kailua, perhaps 6 miles. It is covered with aa stone, and is perhaps one of the worst roads here. The Road Board of North Kona has appropriated $200 for work in the worst areas, and that work has been undertaken and the road improved. The work continues at this time. This is one of the important roads of this district, and it is one of the first roads that should be worked on.

The government road or ala loa from upland Kainaliu (that is the boundary between this district of South Kona) [Kealaehu], runs straight down to Kiholo and reaches the boundary of the district adjoining South Kohala, its length is 20 and 30 miles. With a troubled heart I explain to your Excellency that from the place called Kapalaoa next to South Kohala until Kiholo – this is a very bad section of about 8 miles; This place is always damaged by the animals of the people who travel along this road. The pahoehoe to the north of Kiholo called Ke A. hou, is a place that it is justified to work quickly without waiting. Schedule A, attached, will tell you what is proposed to care for these bad places…

Schedule A: [Appropriations needed]
The road from Kailua to Kohanaiki, and then joining with the inland Government Road – $500.

The upland Road from Kainaliu to the boundary adjoining S. Kohala – $1,500.00. [HSA – Roads Hawaii; Kepā Maly, translator]

September 30, 1889
Thos. Aiu, Secretary, North Kona Road Board (for J. Kaelemakule); to
L.A. Thurston, Minister of the Interior.
[Provides Thurston with an overview of work on the roads of North Kona, and identifies individuals who are responsible for road maintenance (cantoniers) in various portions of the district; several of the individuals named were also old residents and applicants for Homestead lots. Of interest, Kaelemakule's report indicates that maintenance of the Alanui Aupuni which crossed into the kula lands of ʻOʻoma, had not been assigned to anyone. (see report of Dec. 22, 1890)]:

1. In that section of the road which proceeds from Kailua near the shore to Kohanaiki, Mano is the cantonier.
2. That section of the road from Kukuiooohiwai to Keahuolono, Paiwa is the cantonier…
3. That section of road from Kailua to the shore of Honokohau, Keaweiwi is the cantonier …
4. That section of road from Kukuioohiwai to Lanihau along the upland road, Isaac Kihe is the caretaker…

The work done along these sections is the cutting of brush – guava, lantana and such – which trouble the road, and the removal of bothersome stones… [HSA – Roads Hawaii; Kepā Maly, translator]

December 22, 1890
J. Kaelemkule; Supervisor, North Kona Road Board; to
C.N. Spencer, Minister of the Interior
[Reports on the cantoniers assigned to road work in various sections of North Kona. As in 1889, apparently no one was assigned to the lower Alanui Aupuni through the ʻOʻoma kula lands. Though Kaelemakule did include the road section on the land, extending through Kalaoa, on his attached diagram]:

…I forward to you the list of names of the cantoniers who have been hired to work on the roads of this district, totaling 15 sections; showing the alignment of the road and the length of each of the sections. The monthly pay is $4.00 per month, at one day of work each week. The board wanted to increase it to two days a week, but if that was done, there would not have been enough money as our road tax is only $700.00 for this district… You will receive here the diagram of the roads of North Kona. [HSA – Roads Hawaii; Kepā Maly, translator] (Figure 19)

Twentieth Century Travel in ʻOʻoma, Kalaoa, and Neighboring lands of Kekaha

Kamaʻāina who have participated in oral history interviews (Rechtman and Maly 2003), describe on-going travel between the uplands and coastal lands of ʻOʻoma, Kalaoa and other *ahupuaʻa* in Kekaha. The primary method of travel between 1900 and 1947, was by foot or on horse or donkey, and those who traveled the land, were generally residents of the ʻOʻoma, Kalaoa, Kohanaiki Homesteads and other lands in the immediate vicinity. After World War II, retired military vehicles became available to the public, after that time, the *Alanui Aupuni* (Figure 20) and some of the smaller trails along the shore were modified for vehicular traffic.

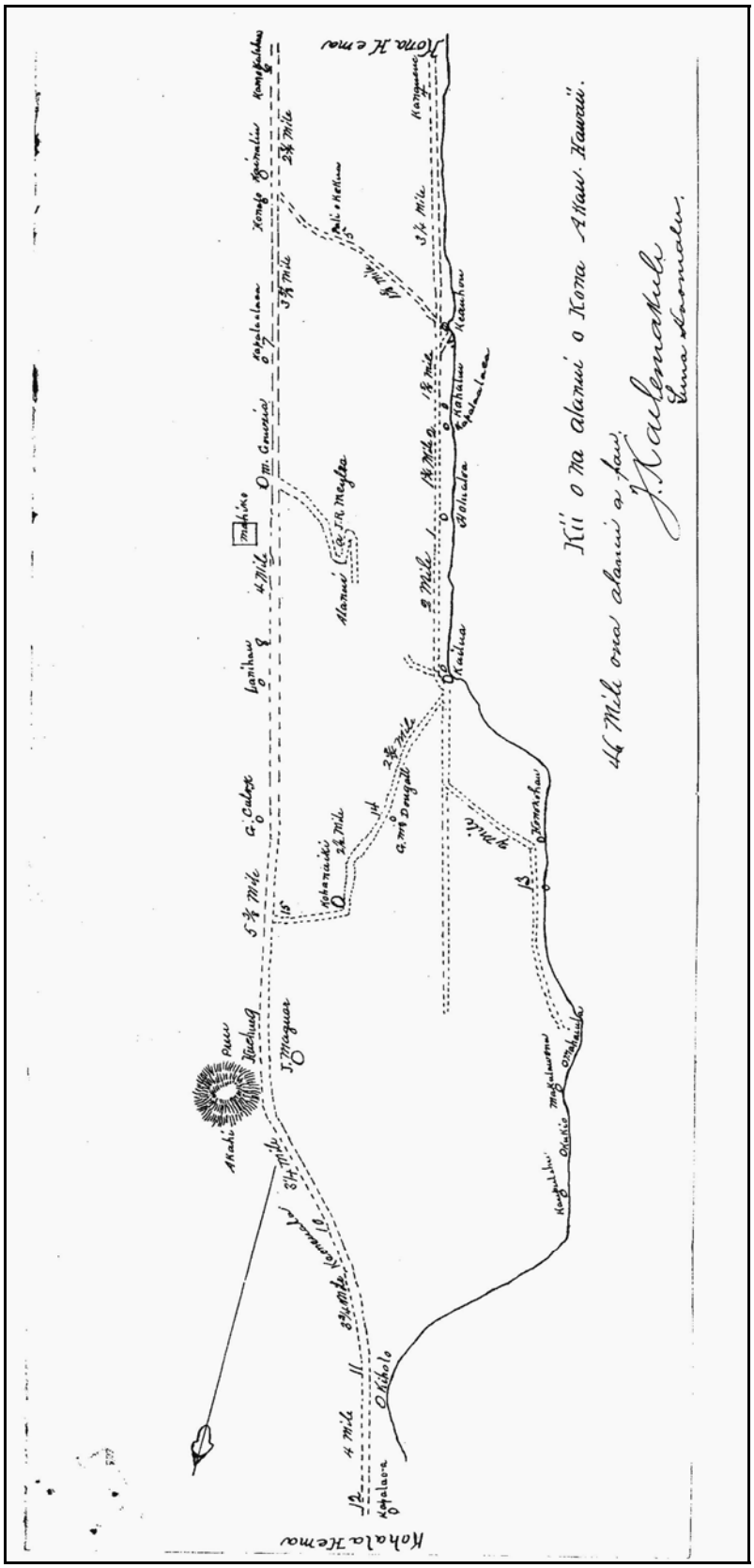

Figure 19. *Kii o na alanui o Kona Akau* (diagram of the roads of North Kona); J. Kaelemakule Sr., Road Supervisor (HSA – Roads, Hawaii; December 22, 1890).

Figure 20. Portion of the *Alanui Aupuni* crossing the *kula kai* lands of ʻOʻoma 2nd; view to south.

The primary routes of travel through the 1960s, descended from upland Kohanaiki and Kaloko, or came out of Kailua. In the 1950s, Huʻehuʻe Ranch bulldozed a Jeep road to the shore at Kaloko. The ranch, and some individuals who went to the shore either as a part of their ranch duties, or for leisure fishing along the coast, used this Jeep road. The *Alanui Aupuni* was modified from Kailua, to at least as far as Honokōhau and Kaloko, and remained in use through the 1970s. It was not until the Queen Kaʻahumanu Highway was opened (ca. 1973) that travel across the *kula kai* (shoreward plains) was once again made possible for the general public.

ARCHAEOLOGICAL FIELDWORK

Fieldwork for the current project was conducted on February 9 and 10, 2012 and March 8, 2012 by Robert B. Rechtman, Ph.D., Matthew R. Clark, B.A., Ashton Dircks-Ah Sam, B.A., and Lauryl Sumner, B. A. The entire study corridor was subject to transect survey with fieldworkers spaced at 15-meter intervals. When archaeological resources were encountered, they were compared to existing site location maps to determine if they had been previously recorded. All site encountered were assigned temporary and plotted on a map (Figure 21) of the study parcel using Garmin Vista HCx handheld GPS technology (with sub five-meter accuracy), and then mapped in detail using tape and compass, photographed, tagged with temporary site numbers, and described using standardized site record forms. One previously identified site (SIHP Site 6432) was found and three newly discovered sites (SIHP Sites 29272, 29273, and 29274) were recorded (Table 1).

Table 1. Sites recorded within the current study corridor.

*SIHP No.**	*Formal Type*	*Functional Type*	*Age*
6432	Core-filled rock wall	Boundary wall	Historic
29272	Trail/Roadway	Transportation	Precontact/Historic
29273	Stepping-stone trail	Transportation	Precontact
29274	Cairns	Survey marker	Historic

*SIHP Site numbers are preceded by 50-10-27-.

SIHP Site 6432

Site 6432 was originally described by Davis (1977) as a historic boundary wall. This site is a core-filled rock wall that is coincident with the ‘O‘oma 1/2 boundary, and extends across the entire width of the 200 foot study corridor (see Figure 21). Within the study corridor, Site 6432 ranges between 70 and 80 centimeters wide (Figure 22) and stands between 60 and 130 centimeters tall (Figure 23). The rocks used in its construction are locally derived medium to large size disaggregated and fragmented *pāhoehohe* cobble and boulders, with smaller *pāhoehoe* cobble fill. The wall is generally in a good state of repair with only minimal collapse noted. Site 6432 was described again as a result of the archaeological inventory survey for the Queen Ka‘ahumanu Highway right-of-way study area as “a free-standing stone wall that forms the boundary between Kalaoa-O‘oma and O‘oma 2 . . . The wall has been breached in the construction of the present highway, but continues both *mauka* and *makai* for more than several hundred feet . . .” (Walsh and Hammatt 1995:37). As a result of these prior studies, the site was assessed as significant under Criterion d and a determination of no further work was approved by DLNR-SHPD.

Based on a review of historical maps and records (see Background section of this report), it is likely that this wall was constructed to define property interests and contain the movement of cattle during the Maguire period of ownership of coastal ‘O‘oma 2 Ahupua‘a, and was not likely constructed until after 1901 as this wall was not mentioned by J .S. Emerson in his survey of that year of the government grant parcels.

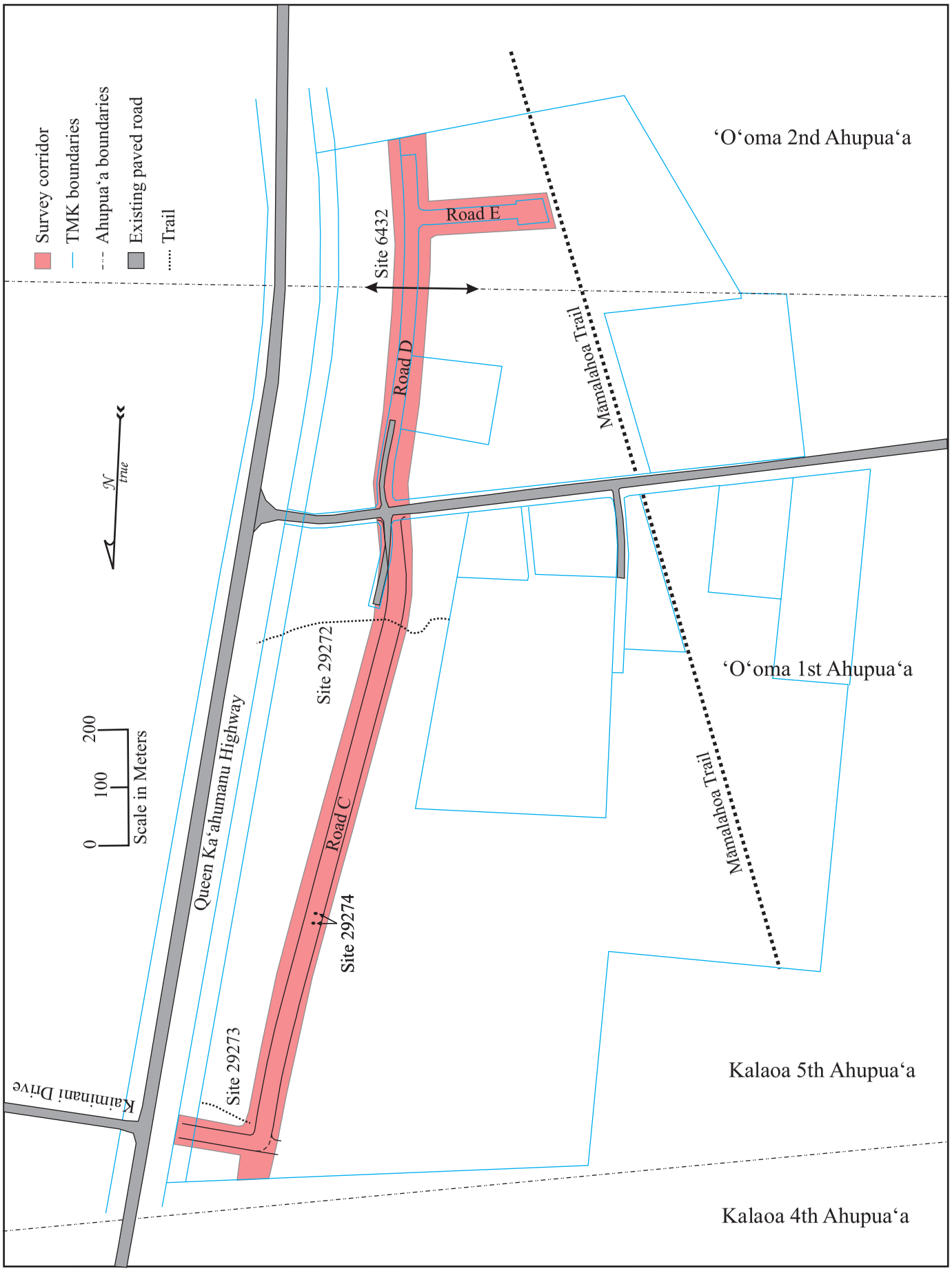

Figure 21. Project area plan view.

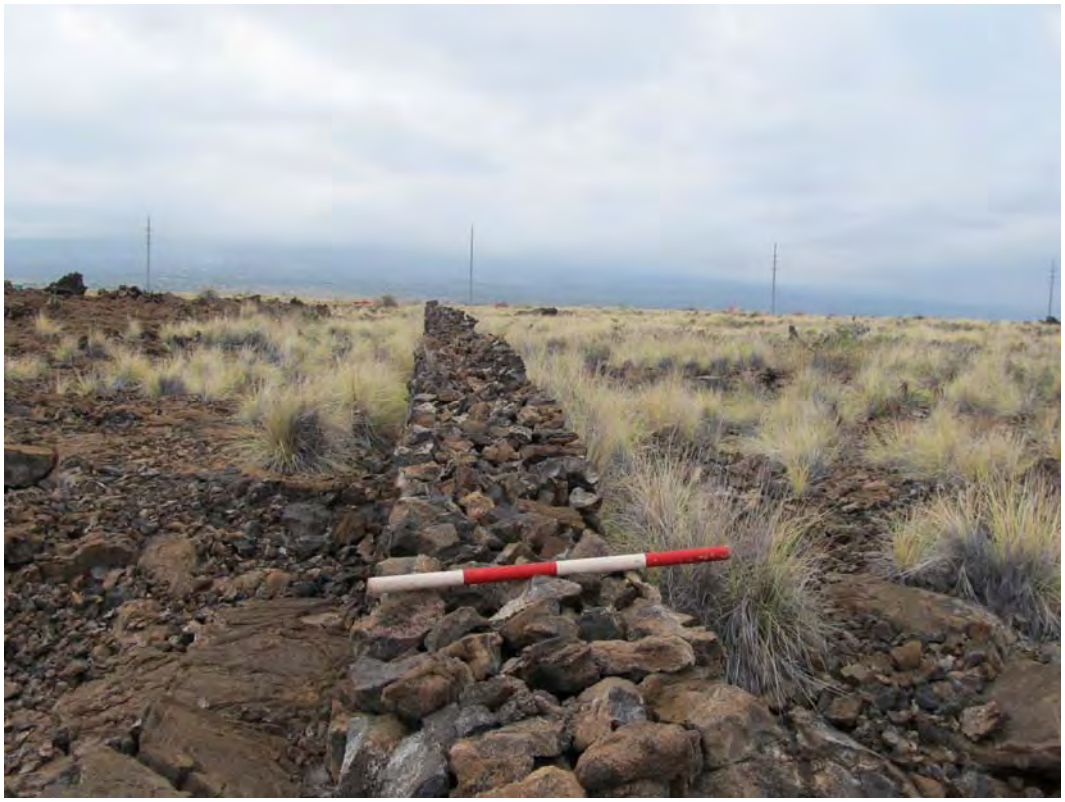

Figure 22. SIHP Site 6432 view to the east.

Figure 23. SIHP Site 6432 view to the south.

SIHP Site 29272

Located in the central portion of the study corridor roughly 20 meters north of the existing end of pavement of Kahilihili Street, Site 2 9272 is a trail th at traverses the entire width of th e study corridor in a *mauka/makai* direction (see Figure 21). This site continues *makai* of the study corridor and was terminated by the construction of the Koyo facility (Figure 24). The trail can also be followed (albeit difficult to discern) *mauka* of the study corridor all the way to the Queen Ka‘ahumanu Highway corridor (Figure 25). A plan view was prepared for the section of the site within the study corridor (Figure 26). This portion of trail has several defining characteristics: a narrow (roughly 50 centimeter wide) worn pathway at its center with a linear growth of fountain grass (Figure 27); a cleared, widened (up to 3.7 meters), and in places cobble paved thoroughfare (Figure 28); low kerbing in spots (Figure 29); and a constructed (10.3 meters long x 3.7 meters wide) bridge (Figure 30). The trail has been impacted by bulldozer activity (Figure 31) in the vicinity of a con structed bridge just *makai* of t he study corridor centerline (see Fig ure 26). Cultural material observed at th is site includes glass bottle fragments and water worn coral cobbles.

Given the amount of effort (paving, bridging, etc.) put into its construction, coupled with its depiction on the 1928 USGS Keāhole Quadrangle (see Fig ure 7), th is trail a ppears to have been a primary transportation route during early Historic times (perhaps even used as a Jeep trail beginning in the 1940s) providing access to the O‘oma-Kalaoa shoreline areas from points *mauka*. And, given the heavily worn central footpath it is also likely that this trail has Precontact origins.

Figure 24. SIHP Site 29272, view to the west.

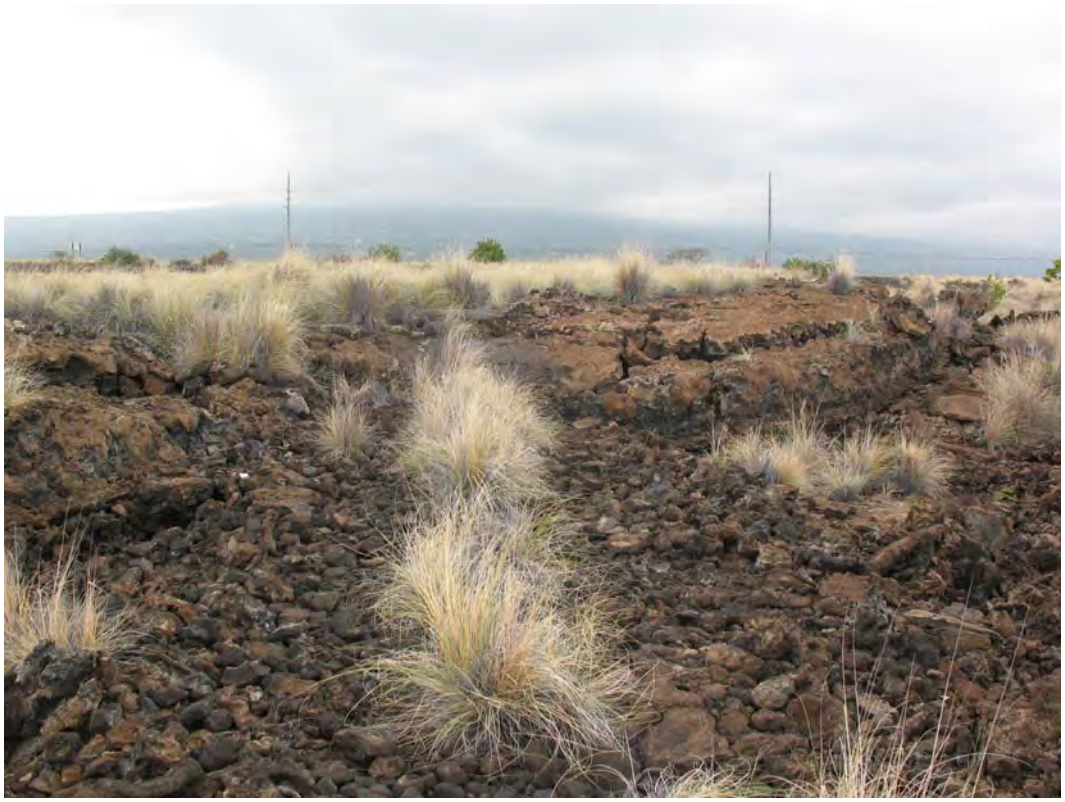

Figure 25. SIHP Site 29272, view to the east.

Figure 27. SIHP Site 29272 worn alignment.

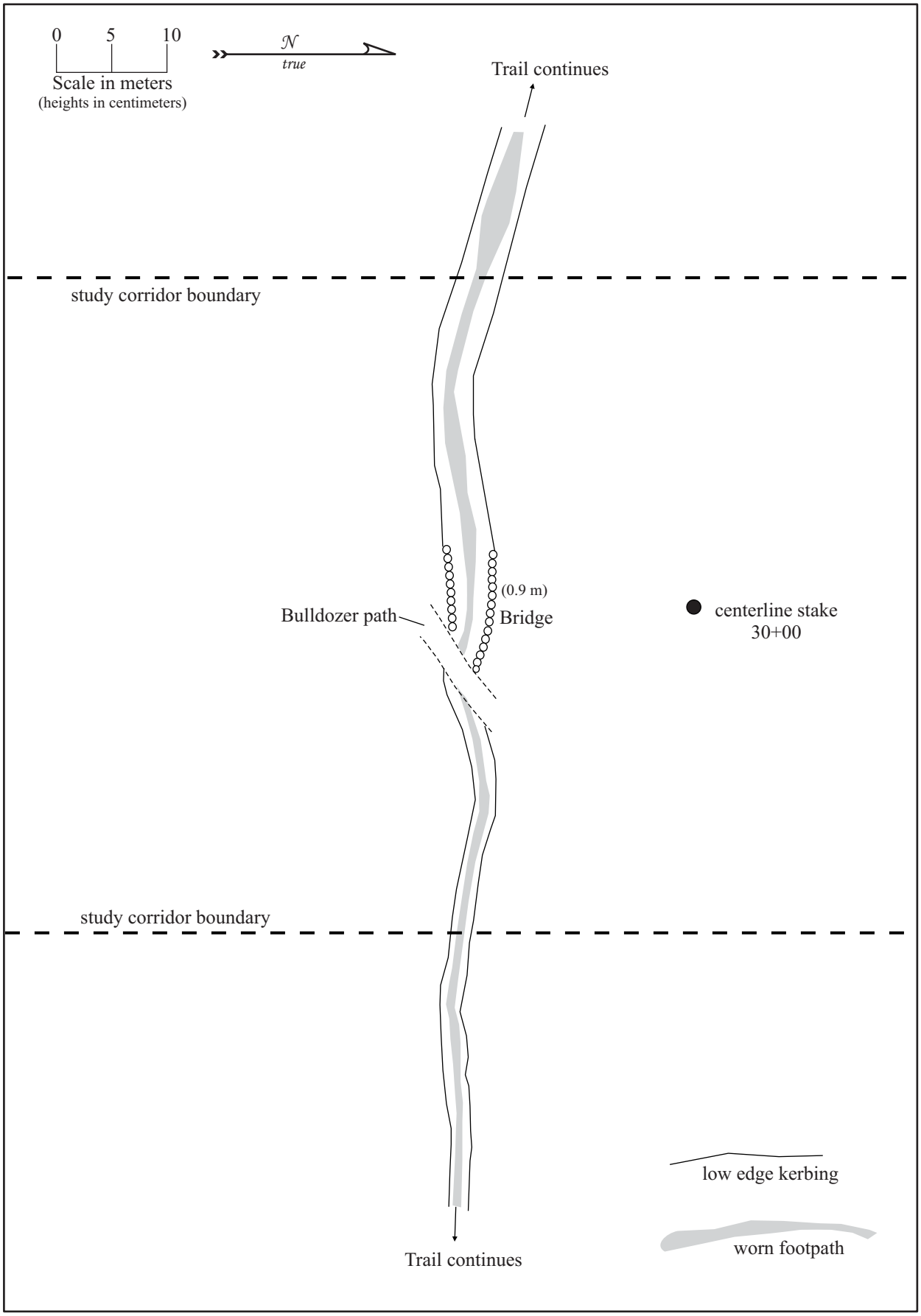

Figure 26. SIHP Site 29272 plan view.

Figure 28. SIHP Site 29272 cobble pavement.

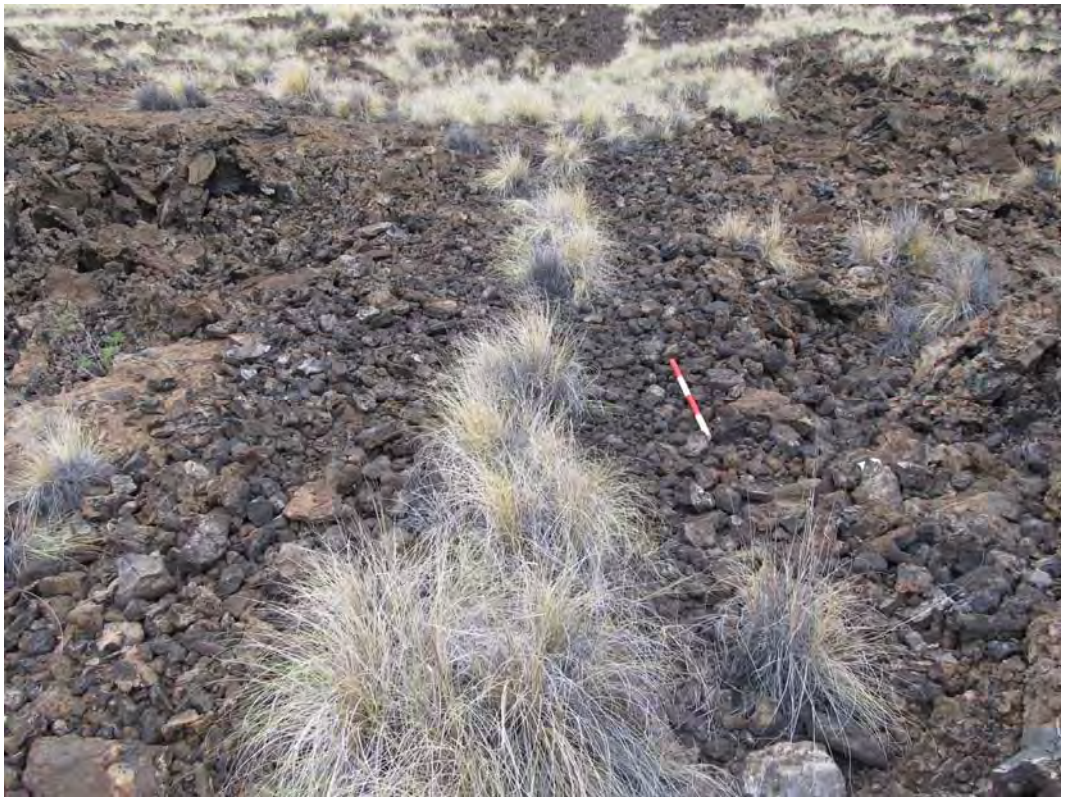

Figure 29. SIHP Site 29272, low kerbing.

Figure 30. SIHP Site 29272, bulldozed area.

SIHP Site 29273

Site 29273 is a *mauka/makai* trail segment that skirts an elevated outcrop of rough lava (Figure 31) located in the northern portion of the current study corridor (see Figure 21). This trail consists of a single row of *pāhoehoe* slabs set in an *ʻaʻā* and disaggregated *pāhoehoe* substrate to facilitate ease of walking. There are two relatively intact stepping stone alignments separated by a 25 meter gap where the ground surface is relatively smooth *pāhoehoe* (Figure 32). In the eastern alignment, which extends for 20 meters, the slabs are tightly spaced (Figure 33); and in the 37 meter long western alignment the slabs are further apart (Figure 34). In both directions beyond the recorded alignments the trail could not be discerned on the relatively smooth *pāhoehoe* ground surface. No additional cultural material was observed at this site. Given the lack of historic (or modern) debris, it appears as though this trail segment has a Precontact origin. This trail does no appear to have been a "major" transportation route, but rather may have been part of a localized trail network connecting sites in the shoreward and lower *kula* portions of the Kalaoa-ʻOʻoma area.

Figure 31. Elevated outcrop at northern end of study corridor.

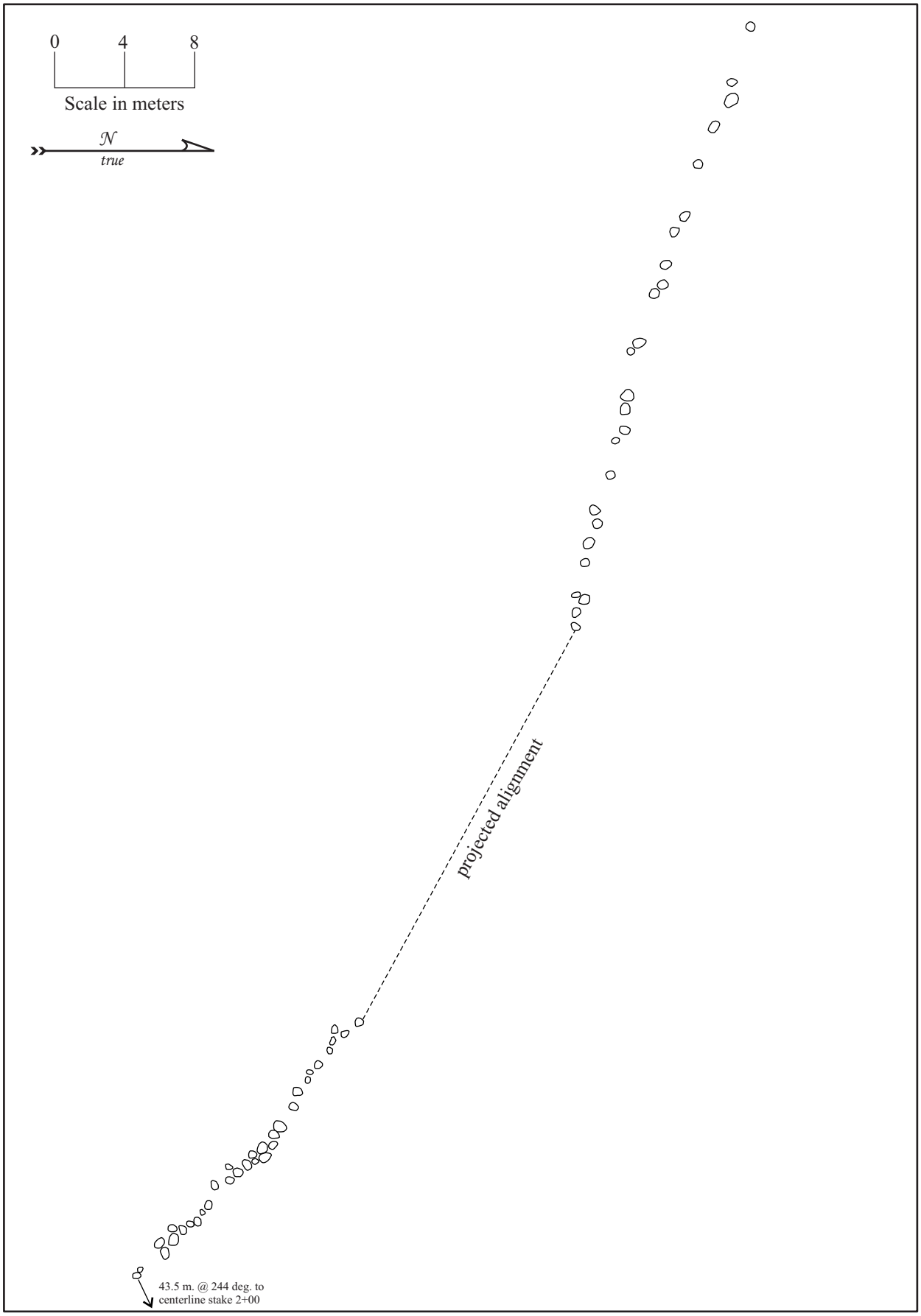

Figure 32. SIHP Site 27293 plan view.

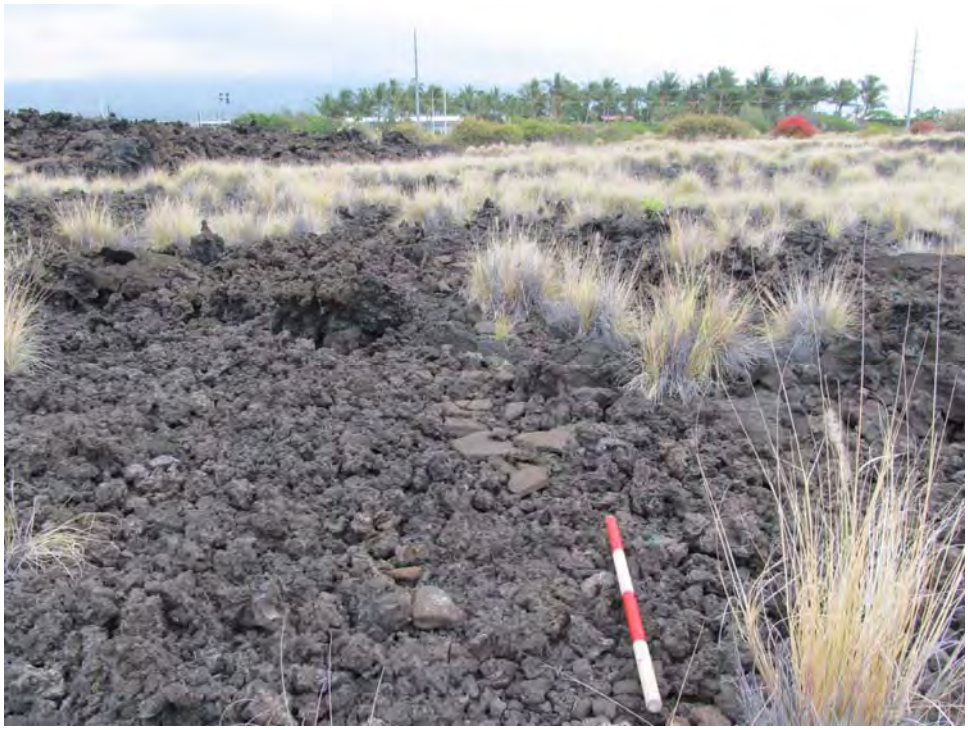

Figure 33. SIHP Site 29273 eastern stepping-stone alignment.

Figure 34. SIHP Site 29273 western stepping-stone alignment.

SIHP Site 29274

Site 29274 consists of two similarly constructed rock cairns (Features A and B) located on level *pāhoehoe* bedrock (Figure 35) near the centerline of the study corridor close to the 13+00 stake (see Figure 21). Measured from center of cairn to center of cairn, Features A and B are 15 meters apart. Feature A (Figure 36) consists of about 50 small to medium sized angular *pāhoehoe* cobbles, measures 90 centimeters x 75 centimeters in outline, and rises 50 centimeters above the ground surface. Feature B (Figure 37), situated to the southwest of Feature A, is 135 centimeters x 90 centimeters in outline and 58 centimeters tall. It is made up of roughly 60 small to medium sized angular *pāhoehoe* cobbles. When comparing the location of these rock piles to the alignment of a proposed but never constructed grant increment road shown on Hawai‘i Register Map 2123 dated May 1902, the two cairns fall almost exactly on both sides of the road right at a surveyed change in direction (Figure 38). It seems an appropriate interpretation that these cairns represent survey markers placed during the 1902 Hawai‘i Territory Survey fieldwork for the proposed Kalaoa-‘O‘oma Homesteads to mark a change in direction of a proposed but never constructed roadway.

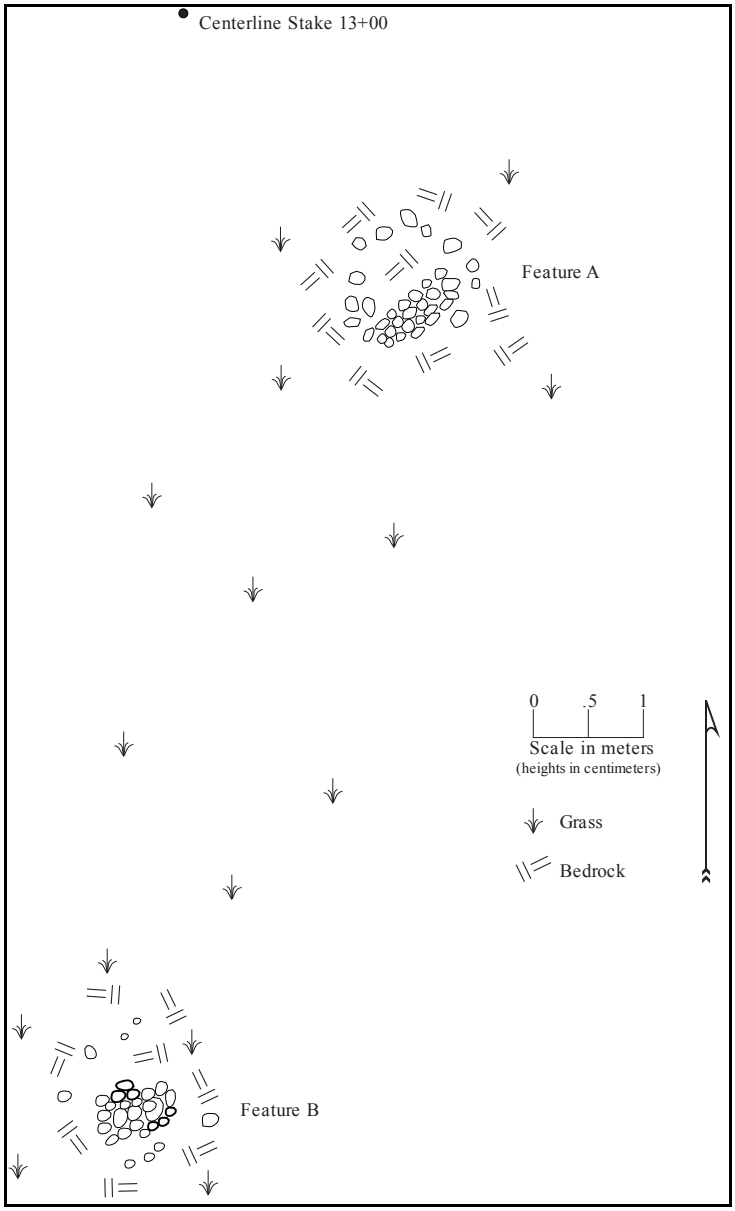

Figure 35. SIHP Site 29274 plan view.

Figure 36. SIHP Site 29274 Feature A, view to the southeast.

Figure 37. SIHP Site 29274 Feature B, view to the southeast.

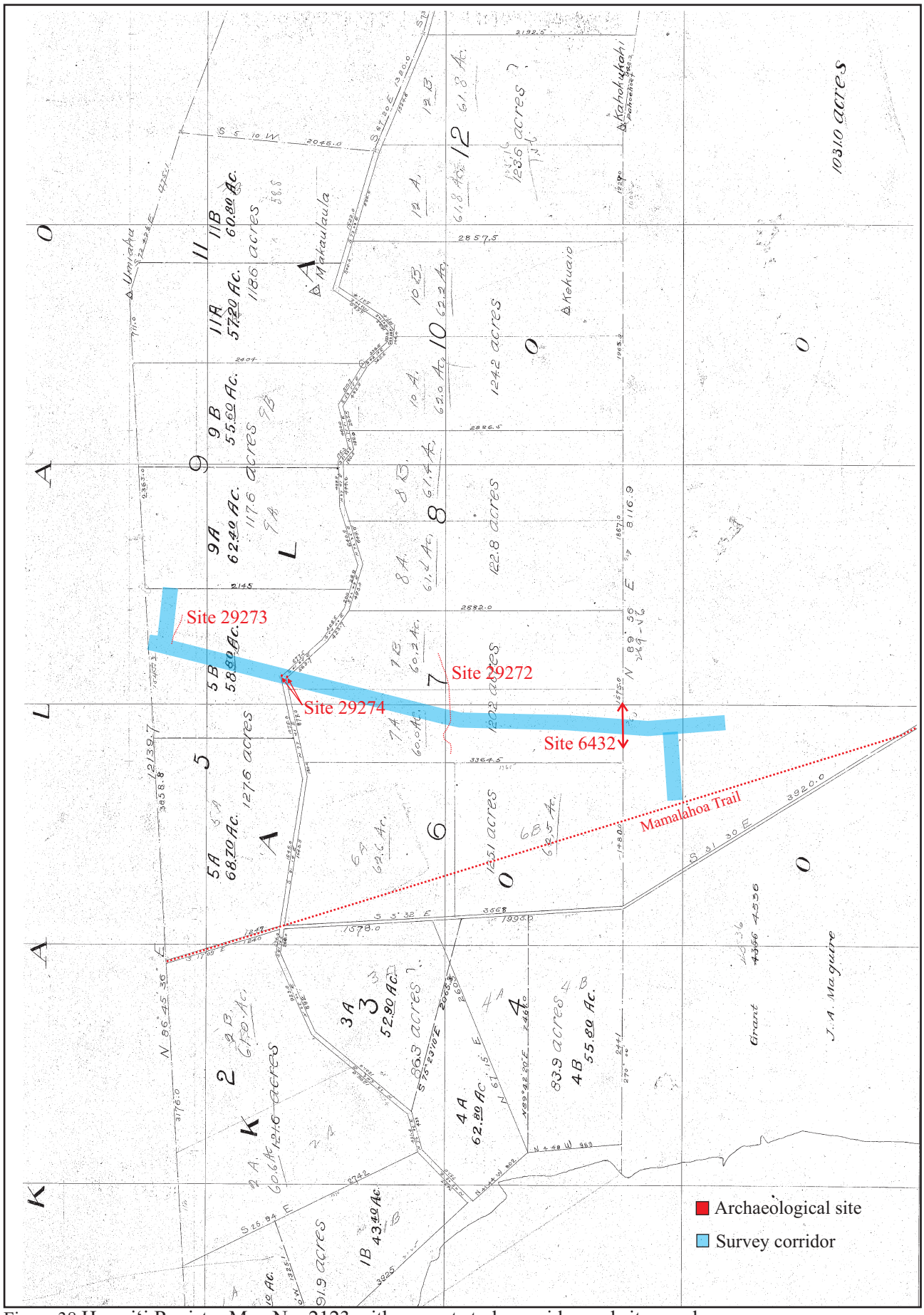

Figure 38.Hawai‘i Register Map No. 2123 with current study corridor and site overlay.

SIGNIFICANCE EVALUATION AND TREATMENT RECOMMENDATION

The above-described archaeological resources are assessed for their significance based on criteria established and promoted by the DLNR-SHPD and contained in the Hawai'i Administrative Rules 13§13-284-6. The significance evaluation should be considered as preliminary until DLNR-SHPD provides concurrence. For resources to be significant they must possess integrity of location, design, setting, materials, workmanship, feeling, and association and meet one or more of the following criteria:

A Be associated with events that have made an important contribution to the broad patterns of our history;

B Be associated with the lives of persons important in our past;

C Embody the distinctive characteristics of a type, period, or method of construction; represent the work of a master; or possess high artistic value;

D Have yielded, or is likely to yield, information important for research on prehistory or history;

E Have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts—these associations being important to the group's history and cultural identity.

Table 2 presents a summary of the significance and treatment for all four sites.

Table 2. Significance evaluation and treatment recommendations.

SIHP No.	*Function*	*Age*	*Significance*	*Treatment*
6432	Boundary wall	Historic	D, E*	Limited preservation
29272	Trail/Road	Precontact/Historic	C, D, E*	Limited preservation
29273	Trail	Precontact	C, D**	Limited preservation
29274	Survey marker	Historic	D	No further work

*previously determined by DLNR-SHPD; **in compliance with DLNR-SHPD recommendation.

The significance of SIHP Sites 6432 and 29272 has recently been reevaluated (Monahan et al. 2012) and DLNR-SHPD has approved those evaluations. Site 6432 was determined to be significant under Criterion D and Criterion E; earlier DLNR-SHPD had determined the site significant under Criterion D only and approved a no further work recommendation. The current position of DLNR-SHPD is that they would like to see, where possible portions of this wall preserved. To that end, NELHA will make an effort to preserve sections of this wall where it does not interfere with the current planned development activities or with the future use of tenant leased parcels. In their review of an earlier version of this report DLNR-SHPD recommended that SIHP Site 29273 "be assessed significant under Criterion c as well as d, because it embodies the distinctive characteristics of the stepping stone trail site type as well as displaying distinctive methods of construction" (DOC NO: 1303MV18). SIHP Site 29274 is considered significant under Criterion D for information it has yielded relative to the Historic Period use of the study area. The documentation and interpretive explanation offered in this report concerning Site 29274 is considered sufficient to mitigate any impacts to this site from the proposed road construction project, therefore no further historic preservation work is required for this site. For Site 29273, it is recommended that the more intact eastern portion of the site that falls on the *mauka* edge and outside of the study corridor be preserved. Both temporary protection and long term preservation measures will need to be developed. With respect to SIHP Sites 6432 and 29272, it is recommended that NELHA work with the road design engineers to avoid as much of this site as is feasible and then develop a preservation plan for the portions of these sites that will remain outside the roadway corridor after the proposed road construction has been completed. A preservation plan addressing Sites 6432, 29272, and 29273 should be prepared in accordance with HAR §13-277 and submitted to DLNR-SHPD for review and approval.

It is the further recommendation of this study that a qualified archaeological monitor be present during ground-disturbing activities associated with development of the proposed roadways and that a monitoring plan compliant with HAR §13-279 be prepared prior to the commencement of such activities.

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