Draft Supplemental Environmental Impact Statement
(DSEIS)

for

UNIVERSITY OF HAWAIʻI CENTER – WEST HAWAIʻI LONG RANGE DEVELOPMENT PLAN 2009 REVISION AND UPDATE

Kalaoa, Hawaiʻi, Hawaiʻi
Tax Map Key: (3)7-3-010:042

Proposing Agency:

University of Hawaiʻi
Office of Capital Improvements
1960 East West Road
Biomedical Sciences, B102
Honolulu, Hi 96822

This document is prepared pursuant to Hawaiʻi Revised Statutes Chapter 343, Environmental Impact Statement Law and Hawaiʻi Administrative Rules Chapter 200 of Title 11 Department of Health, Environmental Impact Statement Rules.

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This document and all other ancillary documents were prepared under the signatory's direction.

By: ______________________ Date: 2/3/10

Brian Minaai
Associate Vice President for Capital Improvements, University of Hawaiʻi

January 2010

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1998 Ed Specs	*University of Hawai‘i Center at West Hawai‘i: Educational Specifications*
1998 LRDP	*University of Hawai‘i Center at West Hawai‘i Long Range Development Plan*
2008 Ed Specs	*1998 Update Educational Specifications, Final Report*
2009 LRDP	*University of Hawai‘i Center – West Hawai‘i Long Range Development Plan 2009 Revision and Update*
°F	degrees Fahrenheit
AAQS	Ambient Air Quality Standards
ADA	American with Disabilities Act
ALISH	Agricultural Lands of Importance in the State of Hawai‘i
A.M.	ante meridiem
AQIR	air quality impact report
ASHRAE	American Society of Heating, Refrigeration, and Air-Conditioning Engineers
BAS	building automation system
BMP	best management practices
BOR	University of Hawai‘i Board of Regents
BTP	Burial Treatment Plan
CATV	cable television
CO	carbon monoxide
CO_2	carbon dioxide
DAGS	State of Hawai‘i, Department of Accounting and General Services
dB	decibels
DBEDT	State of Hawai‘i, Department of Business, Economic Development and Tourism
DLNR	State of Hawai‘i, Department of Land and Natural Resources
DNL	day-night average sound level
DOH	State of Hawai‘i, Department of Health
DOT	State of Hawai‘i, Department of Transportation
DWS	County of Hawai‘i, Department of Water Supply
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FTES	Full-time Equivalent Students
GHG	greenhouse gas
gpd	gallons per day
GPS	global positioning system
GSF	gross square feet

HAR	Hawaiʻi Administrative Rules
HawCC	University of Hawaiʻi, Hawaiʻi Community College at Hilo
HITS	Hawaiʻi Interactive Television System
HELCO	Hawaiʻi Electric Light Company
HOST	Hawaiʻi Ocean Science Technology
HPP	*Conceptual Historic Preservation Plan for the Proposed University Center at West Hawaiʻi, North Kona, Hawaiʻi Island*
HRS	Hawaiʻi Revised Statutes
HVAC	heating, ventilation, and air-conditioning
IAQ	Indoor Air Quality
KCDP	*Mapping Kona's Future, Kona Community Development Plan*
K to K Plan	*Keohole to Kailua Development Plan*
kV	kilovolt
kVA	kilovolt amps
LEED	Leadership in Energy and Environmental Design
LOS	level-of-service
LRDP	Long Range Development Plan
LUC	State of Hawaiʻi, Land Use Commission
LUPAG	Land Use Pattern Allocation Guide Map
mgd	million gallons per day
MOU	Memorandum of Understanding
msl	mean sea level
NELHA	Natural Energy Laboratory of Hawaiʻi
O & M	Operations & Maintenance
OCI	University of Hawaiʻi, Office of Capital Improvements
OHA	Office of Hawaiian Affairs
OSP	Office of State Planning
P.M.	post meridiem
SEIS	Supplemental Environmental Impact Statement
SEISPN	Supplemental Environmental Impact Statement Preparation Notice
SF	square feet
SHPD	State of Hawaiʻi, Department of Land and Natural Resources, Historic Preservation Division
SO_2	sulphur dioxide
SRI	solar reflectance index
TIAR	Traffic Impact Analysis Report
TMK	Tax Map Key
TOD	transit-oriented development

UIC	Underground Injection Control
UH	University of Hawai‘i
UHCWH	University of Hawai‘i Center – West Hawai‘i
U.S.	United States
USFWS	United States Fish and Wildlife Service
USGBC	United States Green Building Council
v/c	volume to capacity ratio
WWTP	wastewater treatment plant

1.0 INTRODUCTION AND SUMMARY

1.1 NEED FOR A SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

The Proposed Action or subject of this Draft Supplemental Environmental Impact Statement Statement (SEIS) is the updated and revised plan for a permanent higher education facility for the West Hawaiʻi region of the island of Hawaiʻi. The proposed facility is the University of Hawaiʻi Center – West Hawaiʻi (UHCWH), also known as the Hawaiʻi Community College Campus at Palamanui. In this document the UHCWH also may be referred to as the University Center or Center.

The University of Hawaiʻi (UH), Office of Capital Improvements (OCI) has determined that a SEIS needs to be prepared to address revisions to the *UHCWH Long Range Development Plan* (LRDP). The existing LRDP was prepared in 1998 and associated Environmental Impact Statement (EIS) in 2000. Changes to the long-term vision for the UHCWH, as well as changes in the West Hawaiʻi community and the progression of nearby development projects have necessitated an update and revision of the 1998 LRDP. These changes are discussed further in Section 1.4 (*Background)* of the SEIS.

There are two major changes from the 1998 LRDP and the *University of Hawaiʻi – West Hawaiʻi Long Range Development Plan 2009 Revision and Update*, hereafter referred to as the 2009 LRDP. First and foremost is the change in location of the campus core from the southwestern portion of the 500-acre state-owned parcel that was designated for University use, to the northwestern corner (refer to Figure 5 in Chapter 2). The second major change in the LRDP is the expanded educational requirements and inclusion of additional instructional programs. The 2009 LRDP documents the steps taken and the information compiled throughout the update and revision process.

1.1.1 Alternatives Considered

As this Draft EIS is a supplement to the original EIS approved in 2000, only the revised Proposed Action and No Action will be evaluated in depth in this document.

1.1.2 2000 Environmental Impact Statement

The action analyzed in the 2000 EIS was the development of the UHCWH campus core on an approximately 33-acre site in the southwestern portion of the 500-acre state-owned parcel in Kalaoa. The 33-acre site was chosen because of its proximity to Kaiminani Drive, the only existing access road to the proposed Center. The ability to tie into the utility corridor in Kaiminani Drive would reduce infrastructure development costs for the UHCWH. The second reason for choosing this location was the relative flatness of the terrain, which would reduce the cost of grading and site work.

The 2000 EIS was built upon two analytical studies that were conducted previous to the EIS. The first was the *University of Hawaiʻi at Hilo, West Hawaiʻi Campus: Site Assessment Study* (DPD, c. 1992), which evaluated alternative West Hawaiʻi locations for the new campus. Out of seven candidate sites, three sites emerged as more preferable—Kalaoa, Kaulana (abutting the private Kau development north of Kailua-Kona), and Awakee (abutting the proposed urban development area of Kaupulehu). The 500-acre Kalaoa site (currently referred to as the University site or University parcel) was selected by the University's Board of Regents (BOR) because of its potential for expansion; its proximity to water supply, roadway, and other established infrastructure elements; and it was the preferred site as expressed by the local community. The second study on which the 2000 EIS was built was the 1998 LRDP. The LRDP evaluated alternative siting and layout configurations within the 500-acre Kalaoa site. The 33-acre area located in the southwestern portion of the 500 acres was eventually settled upon as the preferred site.

In addition to No Action and the preferred alternative, the 2000 EIS looked specifically at alternative actions to service the new campus. The following three alternatives actions were considered: 1) Alternative A - revised access road, 2) Alternative B - water system option, and 3) Alternative C - wastewater system options.

The 2000 EIS concluded that several beneficial impacts would result from implementing project actions. These beneficial impacts included the incorporation of selected historic and cultural resources into the campus as educational and interpretive venues; enhancing opportunities for higher education in the West Hawaiʻi; and fulfilling the goals, objectives and policies represented in state and county planning documents, which are supportive of urban growth in the Kalaoa area and the creation of a permanent higher education facility in West Hawaiʻi. Project actions would also have short- and long-term beneficial economic impacts in the form of increased employment, earnings, and tax revenues.

The 2000 EIS also identified potential adverse impacts associated with project actions, for which mitigation measures would be required. Most notable are the potential impacts to fauna and cultural resources. With avoidance and the application of appropriate mitigation measures, these impacts were not expected to be significant.

Several unresolved issues were identified in the 2000 EIS. These issues pertained to cultural resources, ceded lands, and traffic.

1.2 Scope and Authority

This SEIS is prepared pursuant to Chapter 343, Hawaiʻi Revised Statutes (HRS)—the State EIS law—and associated State of Hawaiʻi, Department of Health Hawaiʻi Administrative Rules (HAR), Title 11, Chapter 200. The use of state or county lands or government funds triggers the EIS law for the Proposed Action. The purpose of the Draft SEIS is to inform interested parties of the proposed changes to the LRDP and to seek comments and public input on the project.

1.3 PROJECT INFORMATION

General project information is listed below.

PROJECT NAME:	University of Hawai‘i Center - West Hawai‘i Long Range Development Plan 2009 Revision and Update
APPLICANT:	University of Hawai‘i Office of Capital Improvements 1960 East West Road Biomedical Sciences, B102 Honolulu, Hawai‘i 96822 Contact: Brian Minaai, Associate Vice President for Capital Improvements (808) 956-7935, FAX (808) 956-3175 Email: bminaai@hawaii.edu
SEIS PREPARER:	Wil Chee - Planning, Inc. 1018 Palm Drive Honolulu, Hawai‘i 96814 Contact: Celia Shen, Project Manager (808) 596-4688, FAX (808) 597- 1851 Email: cshen@wcphawaii.com
UHCWH ADMINISTRATION:	University of Hawai‘i Center - West Hawai‘i 81-964 Haleki‘i Street Kealakekua, Hawai‘i 96750 Contact: Beth Sanders, Interim Director (808) 322-4850, FAX: (808) 956-3175
LOCATION:	North Kona, Island of Hawai‘i
TAX MAP KEY (TMK):	(3)7-3-010:042
RECORDED FEE OWNER:	State of Hawai‘i
LOT AREA:	500 acres (approximately 73 acres will be subdivided from the 500 acres for development of the UHCWH campus)
EXISTING USE:	Vacant, undeveloped
PROPOSED ACTION:	Development of the University of Hawai‘i Center - West Hawai‘i on the 500-acre state-owned parcel in Kalaoa
STATE LAND USE CLASSIFICATION:	Urban

COUNTY GENERAL PLAN (LUPAG):	University Use
COUNTY ZONING:	A-5a (Agriculture) and Open
SPECIAL MANAGEMENT AREA:	Not within the Special Management Area
SPECIAL DISTRICT:	Not within a Special District
ACCEPTING AUTHORITY:	University of Hawaiʻi Office of Capital Improvements 1960 East West Road Biomedical Sciences, Room B102 Honolulu, Hawaiʻi 96822

1.4 AGENCIES, ORGANIZATIONS AND INDIVIDUALS CONSULTED

As part of the 2009 LRDP revision and update process, discussions have been initiated with the County of Hawaiʻi Planning Department, the County of Hawaiʻi Department of Water Supply, the Hawaiʻi Island Burial Council, and the UH West Hawaiʻi Advisory Council.[1] Consultation with these agencies and organizations are on-going, as well as with the following agencies and organizations in regards to the SEIS process.

Federal
- Department of the Interior, U.S. Fish and Wildlife Service (USFWS)

State of Hawaiʻi
- Department of Business Economic Development and Tourism (DBEDT)
- Department of Land and Natural Resources (DLNR)
- Department of Land and Natural Resources, Historic Preservation Division (SHPD)
- Department of Hawaiian Home Lands
- Department of Health (DOH)
- Department of Health, Office of Environmental Quality Control
- Department of Transportation (DOT)
- Office of Hawaiian Affairs (OHA)
- University of Hawaiʻi Center – West Hawaiʻi (UHCWH)
- University of Hawaiʻi, Hawaii Community College (HawCC)
- University of Hawaiʻi, Environmental Center

County of Hawaiʻi
- Hawaiʻi County Mayor's Office
- Department of Public Works
- Planning Department

[1] The UH West Hawaii Advisory Council is a four-member panel convened by the Chancellor of Hawaiʻi Community College. The Council consists of community representatives that provide input and feedback on the current UHCWH planning effort.

Department of Water Supply (DWS)
Civil Defense Agency
Fire Department
Police Department

Elected Officials
Congresswoman Mazie Hirono, Second U.S. Congressional District
Senator Josh Green M.D., State Senatorial District 3
Representative Robert Herkes, State House District 5
Representative Denny Coffman, State House District 6
Representative Cindy Evans, State House District 7
Council Member Brenda Cook, Hawai‘i County Council District 7
Council Member Kelly Greenwell, Hawai‘i County Council District 8
Council Member Peter Hoffman, Hawai‘i County Council District 9

Other
Hawai‘i Island Burial Council
Hawai‘i Electric Light Company (HELCO)
Hawaiian Telcom
Oceanic Time Warner Cable
Kona Palisades Estate Community
Hawai‘i Tribune Herald
West Hawai‘i Today

1.5 LIST OF ANTICIPATED PERMITS OR APPROVALS

The following is a list of anticipated permits or approvals needed to implement the Proposed Action.

Permit or Approval	Administering Agency
Burial Treatment Plan	Hawai‘i Island Burial Council State of Hawai‘i, Department of Land & Natural Resources, Historic Preservation Division
Use Permit	Hawai‘i County Planning Commission
Water Supply System	County of Hawai‘i, Department of Water Supply
Wastewater System	State of Hawai‘i, Department of Health
Underground Injection Permit	State of Hawai‘i, Department of Health
Construction Permits (building, grading)	County of Hawai‘i, Department of Public Works
NPDES Permit	State of Hawai‘i, Department of Health
Approvals relating to road improvements, driveways, intersections and landscaping	County of Hawai‘i, Department of Public Works

1.6 SUMMARY OF ANTICIPATED IMPACTS

The Proposed Action would produce several beneficial impacts for the natural environment, as well as the surrounding community, most significant are the following:

- Social Factors: The new UHCWH would fill a large void in the higher-educational needs for West Hawaiʻi residents. No permanent public facility for higher education currently exists in West Hawaiʻi. The new UHCWH at Kalaoa would bolster opportunities for higher education, and provide West Hawaiʻi residents with a physical symbol and focal point for their educational aspirations, including job training and continuing education. The Kalaoa campus, being more centrally located, would save many West Hawaiʻi students valuable time and traveling expenses.
- Economic Factors: Both short-term and long-term economic benefits would result from the Proposed Action and include direct, indirect and induced benefits. In the short-term, development of the new UHCWH campus would boost the regional economy by providing added employment for construction workers, fees for design and engineering professionals, and earnings for construction companies and building material suppliers. In the long-term, the Proposed Action would provide additional employment opportunities, additional economic output, earnings, and tax revenue. More importantly, the Proposed Action would provide expanded opportunities for post-secondary education and workforce development, which would enhance future employment opportunities, thereby supporting and helping to diversify the region's and the state's economy in general.
- Land Use: Completion of the UHCWH campus would fulfill the goals, objectives, and policies stated in the Hawaiʻi County General Plan, as well as the Kona Community Development Plan; both of which are supportive of urban growth in Kalaoa and the creation of a permanent facility for higher education. Developing the campus in the northwest corner of the project area also facilitates connectivity between the campus and the future Palamanui Village Town Center, thus promoting a synergistic relationship between the two developments that encourages pedestrian-oriented style of development. This supports goals within master planning documents for the county, as well as the State of Hawaiʻi.
- Environmental Sustainability: The University's BOR approved the UHCWH 2009 LRDP in November 2009 and its goal of achieving a Leadership in Energy and Environmental Design (LEED) Platinum certification for Phases 1 and 2 of the project. Wherever plausible, state-of-the-art technologies and design strategies will be incorporated into the development of campus facilities to reduce the carbon footprint of the campus—thereby reducing greenhouse gas emissions, consumption of utilities that cause secondary sources of pollution, amount of waste generated, and impacts on other environmental factors that contribute to large-scale adverse environmental consequences. It is intended that the new UHCWH would become a model of sustainability, thus encouraging students, faculty, and staff to make more environmentally responsible choices in their personal lives and becoming an education tool for the public at large.

Potential adverse impacts that require mitigation measures are summarized below:

- Archaeological, Historic, and Cultural Resources: There are two archaeological sites and one archaeological preserve that potentially could be impacted by the Proposed Action. The location of these resources was a critical factor in the UHCWH's site planning efforts, and their consideration is reflected in the 2009 LRDP. In the 2009 LRDP, these resources have been incorporated into the campus plan as passive landscaping elements. However, construction activities undertaken within areas known to contain archaeological, historic, or cultural resources could potentially cause irreparable damage to these resources, as well as those resources not previously identified.
- Fauna: There is no federally designated critical habitat in the vicinity of the Proposed Action. As well, previous surveys have not identified any endangered faunal species within the proposed site, such as the Hawaiian Hoary bat and the Hawaiian hawk. However, these species, as well as endangered seabirds and shorebirds potentially could occur in the vicinity of the Proposed Action. Development of the Proposed Action could attract flying insects, which in turn could attract bats. Exterior lighting could increase the potential to disorient seabirds and shorebirds, thereby making collisions with powerlines, buildings, as well as the light fixtures themselves, more likely to occur.

  Known lava tubes within the proposed site have been explored to the extent possible and no invertebrates or habitat indicative of their presence have been found. However, it is possible that unidentified lava tubes could be found that support significant biota. Construction activities could potentially cause damage to unidentified cave habitats and any possible unique arthropods that may be harbored in those habitats.
- Natural Hazards: The Proposed Action is located in lava flow hazard zone 4, which encompasses all areas surrounding Mt. Hualālai. It is also located in an area prone to earthquake hazards; however, this risk comprises the entire island of Hawaiʻi. Another risk associated with the project site is from lava tube roof collapse, as several lava tubes have been identified in the vicinity of the Proposed Action.

The following short-term, temporary impacts are anticipated as a result of implementing the Proposed Action. Employing construction site BMPs and adherence to applicable regulations would minimize these short-term impacts.

- Air Quality: In the short-term, construction site work and ground disturbing activities may generate fugitive dust and particulate emissions that would be controlled with standard dust control measures, such as the implementation of a watering program and use of dust screens. Non-stationary sources of both short- and long-term air pollutants include construction vehicles and personal automobiles. At completion, the UHCWH would have preferential parking for low-emission and fuel efficient vehicles, and parking loading provisions for shuttles and vans to encourage carpooling. Ultimately it would be the responsibility of students, faculty, and staff to utilize carpools, public transportation, low-emission fuel-efficient vehicles, and other more environmentally friendly modes of transportation.

- Noise: In the short-term, construction activities would generate unavoidable noise impacts that would be minimized by the use of properly muffled construction equipment, the implementation of curfew periods, and adherence to construction noise control regulations established the DOH. However, area residents may still experience noise impacts to a degree consistent with each individual's tolerance to noise stimuli.

1.7 SUMMARY OF PROPOSED MITIGATION MEASURES

Mitigation measures that address potential adverse impacts are summarized below:

- Historic, Archaeological, and Cultural Resources: A Burial Treatment Plan (BTP) currently is being prepared to address long-term preservation and management of Preserve 2. Adherence to the approved BTP should provide sufficient protection of the preserve and the resources it contains.

  To address construction-related impacts, an interim preservation buffer of 50 feet is being proposed in the BTP to protect Preserve 2. Other construction-related protection measures shall be implemented to ensure awareness and adherence to the preservation buffer. There would be on-site archaeological monitoring during all ground-disturbing activities and appropriate procedures shall be defined and followed for any inadvertent find.

  In the future, should the UHCWH wish to develop a trail system with educational and interpretive venues for the other proposed preserves within the larger 500-acre University site, the 2000 Conceptual Historic Preservation Plan would be updated, finalized, and submitted to SHPD for approval.

- Fauna: Exterior lighting would be properly shielded to minimize potential impacts to seabirds and shorebirds. Potential impacts to the Hawaiian hoary bat and the Hawaiian hawk can be minimized by not scheduling vegetation clearing during their breeding, birthing, and/or pup rearing seasons. If vegetation clearing during these seasons cannot be avoided, site specific surveys prior to initiating work should be conducted to determine their presence within the development area. Efforts to minimize the destruction of caves habitat during grading should be undertaken during the construction period.

- Natural Hazards: There currently are no effective mitigation measures for volcanic eruptions, other than maintaining an evacuation plan for the campus. Campus facilities would be designed and constructed in accordance with all applicable building codes for Seismic Zone 3, which contain structural design standards for earthquake resistance. To address the risk of potential lava tube collapse, a geotechnical investigation should be conducted for construction areas and appropriate measures employed to address site specific conditions. Such measures may include backfilling the lava tube; spanning the lava tube with girders or other means of support to minimize the stress on the cave roof; or modifying the facility layout to avoid the lava tube altogether.

1.8 SUMMARY OF UNRESOLVED ISSUES

There are three unresolved issues pertaining to the Proposed Action. The first is the long-term treatment of the various archaeological, historic, and cultural resources within the 500-acre University site and particularly within the 73-acre proposed site. The second issue to be resolved is to determine compensation for the use of ceded lands. The third issue is the undetermined nature of any future expansion of the UHCWH campus, beyond the 1,500 FTES campus encompassed by the 2009 LRDP update.

1.9 COMPATIBILITY WITH LAND USE PLANS AND POLICIES

Implementation of the Proposed Action would be consistent with existing state policy documents (i.e., the Hawaii State Plan and Functional Plans) as evidenced by supporting statements encouraging the creation of opportunities for higher education and job training, especially with the integration of information technology in education. Statements that encourage the development of projects that preserve natural, historic and scenic resources of the physical environment further emphasize compatibility with state policy documents.

Compatibility with various land use plans, such as the State Land Use Law, West Hawai‘i Regional Plan, Hawai‘i County General Plan, and the KCDP is evidenced by the mention and/or depiction of the University Center in Kalaoa in these policy statements and plans. Development of the UHCWH is consistent with the land use entitlements, plans, and policies for the project area.

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2.0 PURPOSE OF AND NEED FOR ACTION

2.1 PROPOSED ACTION

The Proposed Action is to develop the new UHCWH campus in the extreme northwest corner of the 500-acre parcel that was set aside in 1991 for the University's future use (refer to Figure 5). A detailed description of the Proposed Action is provided in Chapter 3 of this SEIS. **Hereafter, in this document the usage of the term "project area" is used interchangeably with 500-acre University site or University parcel and the term "proposed site" refers to the 73-acre subdivision in the northwest corner of the project area that is being proposed as the new location for the UHCWH campus core**.

2.2 PURPOSE OF THE PROPOSED ACTION

The purpose of the Proposed Action is to develop a permanent facility for the UHCWH. West Hawai'i is the only remaining major geographic area and population center in the State of Hawai'i that does not have a permanent facility for higher education. The nearest UH campus is in Hilo, over 100 miles from the center of the West Hawai'i region. The University of Hawai'i has responded by making the planning, design and construction of the new University Center a priority. UHCWH provides access to lower division undergraduate courses and programs, which include specialized occupational and technical fields; support for baccalaureate and graduate instruction; classroom and laboratory spaces; telecommunication and computer resources; library services; academic support services; and administrative support services. UHCWH differs from other campuses in the UH system, in that it serves as a vehicle for providing services and programs from all parts of the University system. Degrees are conferred by other campuses (UH Hilo, HawCC, UH Mānoa, etc.) that provide educational programs and courses to the Center. This multi-program approach from distant sources is made possible by the use of technology such as the internet, video conferencing, or the Hawai'i Interactive Television System (HITS). Distance technology can also make programs and courses from the mainland United States (U.S.) and foreign locations possible. The UHCWH allows residents to continue to live and work in West Hawai'i, while having the benefit of educational opportunities that would have required them to attend classes in Hilo or on other islands. UHCWH is a commuter school and will not provide dormitories, faculty housing, or athletic facilities.

2.3 NEED FOR THE PROPOSED ACTION

The Proposed Action is needed because existing facilities are inadequate to serve the educational programs currently offered by the UHCWH, much less any planned program expansion. UHCWH's existing facilities, which are located in portions of a commerical center/business complex—the Kealakekua Business Plaza—have been described as hot, cramped, and noisy. The current location poses difficulties in providing sufficient classroom, office, general study and service space (HawCC, 2006b). Further, the tenant mix at the Kealakekua Business Plaza, which includes various state and federal offices, real estate offices, doctor's offices, the County Prosecutor's offices, and a bar and grill, is not conducive to a proper academic environment.

Other constraints include the Center's location in Kealakekua, which is at least a 40 minute drive for more than half of the population in the West Hawaiʻi region, with limited accessibility via public transportation. "Distance to the site" was cited by 65 percent of survey respondents as the greatest barrier to their enrollment (SSRI, 1988, as cited in HawCC, 1997). The Hawaiʻi County Mass Transit Agency now provides public transportation around the island through the Hele-On bus. To promote public transportation, the County now offers this bus service for free. However, frequency is limited. Moreover, access to the current UHCWH's facilities by private vehicle is becoming increasingly inconvenient due in large part to the growing traffic congestion in the area (HawCC, 2006b).

Other needs identified in the *University of Hawaiʻi Center: West Hawaiʻi Development Plan, 1998-2007* (HawCC, 1997) are described in the following paragraphs.

- <u>Need Based on Demographic Factors</u>. The total population of the West Hawaiʻi region—this includes the districts of North Kohala, South Kohala, North Kona, South Kona, and the Western portion of Kaʻu—is expected to grow to almost 100,000 persons by the year 2010 (p. 10). This is sufficient population to justify the construction of a higher education center serving 1,200 to 1,600 students by year 2010 (p. 10).

  The West Hawaiʻi population includes more persons in the 25 to 39 age group than either Honolulu or Kauaʻi (p. 10). Course offerings, programs and delivery strategies must be developed to meet the needs of working adults in this age group.

  The West Hawaiʻi population, in general, has a higher rate of high school graduation and a larger percentage of persons who have some college as compared to the populations in either Honolulu or Kauaʻi (p. 10). Many individuals who have completed either an associate or baccalaureate degree are professionals working in the region who desire further education to maintain or upgrade existing job skills (p. 10).

  Two factors may be contributing to the low (2 percent) rate of enrollment in postsecondary education by persons in West Hawaiʻi who are 18 years of age or older as compared to other reporting areas having a sizeable University of Hawaiʻi presence: the location and size of education facilities at Kealakekua, and the limited range of courses and programs offered at this time (pp. 10-11).

  Despite the relatively close proximity between Konawaena High School and postsecondary facilities in Kealakekua, there is a low (22 percent) participation rate of students continuing from that high school to the University of Hawaiʻi (UH) (including its community colleges) as compared to other neighbor island high schools located near a UH campus (p. 11).

- <u>Need Based on Employment Trends</u>. Employment trends in the West Hawaiʻi region are of great importance in the planning of the UHCWH because of two factors: most students cite preparation for employment as their primary reason for pursuing postsecondary education; and access to appropriately focused education and training programs can be a tremendous boost to the economic development of a community (p. 11).

  Service and sales positions account for 40 percent of the currently available jobs in West Hawaiʻi (p. 11). In the West Hawaiʻi region, there is also a prevalence of executive/managerial and professional occupations that require extensive postsecondary education for entry to these fields (p. 11). In the future, more scientific enterprises related to astronomy and ocean engineering may increase the need for professional and graduate education in West Hawaiʻi (p. 11).

- <u>Need for a More Central Location within West Hawaiʻi</u>. The existing location of the UHCWH is considerably south of the population center of the region. This fact, coupled with the lack of adequate facilities and necessary infrastructure will continue to interfere with the delivery of quality programs at the UHCWH (p. 15).

- Need to Meet Community Expectations. The community of West Hawai'i has advocated strongly for increased postsecondary educational opportunities over the past twenty years (p. 12).

Despite being published over 10 years ago, the needs expressed in the *University of Hawai'i Center: West Hawai'i Development Plan, 1998-2007* still persist as demonstrated by current data.

The West Hawai'i region (the districts of North Kohala, South Kohala, North Kona and South Kona) accounted for approximately 40 percent of the Hawai'i island population in 2008; however, the Fall 2008 enrollment at the current UHCWH facility in Kealakekua was 231 full-time equivalent students (FTES), only 12.8 percent of HawCC's total FTES enrollment of 1,807 (Lucas, 2009). The fact that UHCWH did not get its fare share of enrollment indicates that the limited space at the current facility could not meet the education and training needs of the community. The situation will be exacerbated in the future if the status quo remains, considering that the region's population continues to grow.

Another indicator of the unmet need is the region's low "going rate," which measures how many high school graduates continue their post-secondary education without a break. Fall 2007 data indicate that West Hawai'i only had a 7.9 percent going rate compared to 24.1 percent for East Hawai'i schools, 28.3 percent for East O'ahu, 19.1 percent for Central O'ahu, and 16.5 percent for Windward O'ahu (Lucas, 2009).

Additionally, growth in HawCC's enrollment will increasingly come from people already in workforce (Lucas, 2009). It is also confirmed by the UHCWH staff that their students are older than those at the HawCC main campus in Hilo and are more likely to be part-time students.

Tourism is and will remain the single largest industry in Hawai'i County for the foreseeable future. The West Hawai'i region contains about 85 percent of the county's total hotel room inventory; most of which is clustered in South Kohala and North Kona (DBEDT, 2008). A new UHCWH campus in Kalaoa would be more accessible to tourism industry employees, given its more centralized location within the West Hawai'i region. Besides tourism, other important industries in the West Hawai'i region, including diversified agriculture, health care, education, and research, such as astronomy, would benefit from the new facility (Lucas, 2009).

In two recent Hawai'i Community College documents, the development of a new and relocated facility for UHCWH is identified as a priority. The *Hawai'i Community College UH Center – West Hawai'i Unit Review Report* (HawCC, 2006b) states that a permanent facility still is considered a critical need and remains a major focus for the University Center. The *Institutional Self-Study in Support of Reaffirmation of Accreditation* (HawCC, 2006a) states that "The college is greatly in need of improving sufficiency and capacity of its facilities in West Hawai'i. This community is one of the fastest growing areas in Hawai'i County, and the need for a new location to support Hawai'i Community College's programs and services has long been recognized. It is the college's hope that the significant progress made in the 2005 legislative session will provide the impetus to build a new campus in West Hawaiʻi in the near future…The college will strive to continue in its significant progress towards the development and construction of new campuses in East and West Hawaiʻi" (p. 232).

At the 500-acre University site, the UHCWH has the opportunity to develop appropriate and adequate permanent facilities for students who are unable to travel to a specific UH campus. The proposed new UHCWH in Kalaoa would address these long-standing needs and allow students to continue to enroll in courses or credential programs offered by one or more of the accredited institutions of the University of Hawaiʻi. The project is in keeping with the stated mission, objectives and goals of the UHCWH.

2.4 PROJECT BACKGROUND

In 1971, UH, through the University of Hawaiʻi at Hilo (UH Hilo) Center for Continuing Education and Community Services, began offering courses in West Hawaiʻi relying on hotels and public schools for classroom space. In 1981, Hawaiʻi Community College (HawCC) also began offering courses in West Hawaiʻi. Administrative, instructional, and support service functions for these UH courses were consolidated and centralized at the Kealakekua Business Plaza in the fall of 1987. In the summer of 1990, the BOR commissioned the *University of Hawaii at Hilo, West Hawaii Campus Site Assessment Study* (DPD Associates, 1992). Based on this study's findings and on unanimous testimony by the affected community, the BOR in July 1991 selected the 500-acre Kalaoa site as the location for West Hawaii's future center for higher education (refer to Figures 1 through 3). This site, hereafter referred to as the University site or University parcel, was the preferred choice for the majority of West Hawaiʻi residents because of its central location between the urban center of Kailua-Kona and the resort nodes of South Kohala and North Kona, and its proximity to the airport and high tech facilities (Natural Energy Laboratory of Hawaiʻi [NELHA] and the Hawaiian Ocean Science and Technology [HOST] Park) (refer to Figure 4). The region's rapid growth and increasing demand for higher education resulted in the 1996 establishment of the UHCWH by BOR action. Since July 1, 1998, UHCWH has become the administrative responsibility of HawCC and continues to be housed at the Kealakekua Business Plaza. Among other drawbacks, the UHCWH's present location allows no room for growth, which provides further incentive to relocate and construct a permanent facility at Kalaoa for the UHCWH.

In February 1996, the *University of Hawaiʻi Center at West Hawaiʻi Long Range Development Plan* was submitted to the BOR. With the absence of an Academic Development Plan, which was unavailable when the 1996 LRDP was being prepared, the 1996 LRDP focused on the physical and tangible aspects of the UHCWH that were considered to be constant and timeless elements. The 1996 LRDP was updated in October 1998 when *the University of Hawaiʻi Center at West Hawaiʻi: Educational Specifications* (1998 Ed Specs) became available. The 1998 LRDP translated the program needs formulated by the 1998 Ed Specs into physical space, equipment, and utility requirements for each functional area and sub-area. The UHCWH's 2000 EIS addressed the 1998 LRDP.

A Project Development Report for Phase I of the UHCWH at Kalaoa was completed in 2000. Subsequently, the Department of Accounting and General Services (DAGS) contracted out the design work for Phase I. Design work was partially completed in March 2002 when work was halted pending UH Administration decisions on relocating the UHCWH.

After completion of the 1998 LRDP and 2000 EIS, planning commenced for the 725-acre parcel of land owned by Hiluhilu Development, LLC (Hiluhilu), located immediately north of the Project Area (refer to Figure 3). On November 21, 2002, with the BOR's approval, UH entered into a Memorandum of Understanding (MOU) with Hiluhilu. Hiluhilu is developing Palamanui, a master-planned community to include single- and multi-family residential, health facilities, mixed-commercial development, a small hotel, passive and active parks, and a dry forest preserve, among other things. Hiluhilu expressed its willingness to coordinate its development with the University for the West Hawai'i campus. By the MOU, UH agreed to consult and discuss joint development opportunities for the two adjacent properties, with Hiluhilu providing critical infrastructure for the UHCWH's development. On April 16, 2004, the BOR approved an amended MOU, which incorporated understandings that had been reached as a result of discussions since November 2002. This MOU discussed potable water, roadway, wastewater treatment and similar infrastructure issues.

The MOU also addressed discussions about the concept of a university-centered village that Hiluhilu wanted to develop. The university-centered village would be a residential/commercial community with a town center (the Palamanui Village Town Center) spanning its land and the University site. This town center was envisioned as a pedestrian-oriented village that would link the UHCWH with compatible commercial, recreational and cultural facilities. In the initial MOU discussions, the plan was for UHCWH to relocate from Kealakekua and lease space in the Palamanui Village Town Center until the University was ready to build a campus on its own property.

Recognizing that state funds for this and other large capital projects were not abundant and may take a long time to materialize, the University included the development of the UHCWH as part of a larger effort aimed at improving community college facilities on the island of Hawai'i. The project became one of five that the University intended to develop as public-private ventures. In pursuit of the project, the University issued in 2005 a RFP (Request for Proposal) and awarded a "Real Estate Development Services Agreement" in 2006 to Hawaii Campus Developers to update the 1998 LRDP and prepare the associated SEIS.

While the University's public-private effort was underway, Hiluhilu's circumstances changed. In 2006, the County of Hawai'i placed conditions on Hiluhilu in exchange for approving the reclassification of their 725 acres from Agriculture (A-3a) and Open to Project District; it is common for the county to place conditions on developers during reclassification. These conditions, such as building parks and roadways, are intended as a means for developers to contribute to the community in return for the right to develop large tracts of land. Conditions placed on Hiluhilu relative to the relocation of the UHCWH, as excerpted from Section EE of Ordinance 06-105 amending Chapter 25 of the Hawai'i County Code (Zoning Code), are as follows:

1. Applicant shall allow the University of Hawaiʻi to connect with its wastewater and water supply systems. Applicant shall also allow the University of Hawaiʻi to connect electrical and telecommunication systems to facilities installed within the project. These connectivity sites shall be to the University's satisfaction and located along its northern boundary on Road "1" [the future University Drive].

2. Build Applicant's wastewater treatment system to handle the wastewater from the initial University of Hawaiʻi building and design the wastewater treatment system to accommodate future expansion for wastewater from future expansion of the University of Hawaiʻi operations.

3. Design and construct an initial classroom and administration building of 20,000 square feet, with associated parking, at Applicant's expense.…Applicant shall be responsible for the first $5,000,000 and the University shall be responsible for the balance. Construction on the building shall commence as soon as the University has required the necessary consents and approvals. If the necessary consents and approvals cannot be obtained by the State, the University shall have the right to lease from Applicant appropriate space to house University of Hawaii at West Hawaiʻi until the necessary consents and approvals are obtained at comparable lease rates now being paid by the University of Hawaii until the 20,000 square foot building can be constructed on the State land at Applicant's expense. Applicant shall commence construction of the building, or assure its construction by a bond or other security accepted by the Planning Director and the Chancellor of Hawaiʻi Community College, before the issuance of a certificate of occupancy for any building, other than the DOE [state Department of Education] building, or final subdivision approval for any subdivision creating single-family residential lots.…The location and design of the building (interior and exterior) and related improvements will be on terms determined by the University of Hawaiʻi. The University of Hawaiʻi shall consult on design of said building with Applicant.

Another condition placed on Hiluhilu that impacts the UHCWH includes the requirement to construct the mauka half of a 120-foot right-of-way to county-dedicable standards as a collector road (Main Street Road). They must also construct Main Street Road's intersection with Kaiminani Drive that meets the approval of the Department of Public Works. Intersection improvements shall include a left-turn lane on Kaiminani Drive.

Currently, the UHCWH and its public-private venture partner Hawaii Campus Developers, with assistance from Palamanui, LLC (Hiluhilu, LLC is now known as Palamanui, LLC), is working to create a campus that brings together the University's educational resources with the financial resources of the private sector. Palamanui will assist in building the initial complex of classrooms, offices, and support spaces at the Kalaoa.

The new UHCWH campus will serve the needs of West Hawaiʻi residents who wish to pursue lifelong learning programs. The connection between Palamanui and UHCWH is a mutually beneficial public-private sector partnership that will improve the educational opportunities that will broaden and enhance the lives of West Hawaiʻi residents.

2.5 PROJECT OBJECTIVES

The objectives of the project, development of a new UHCWH campus in Kalaoa, as embodied by the 2009 LRDP are as follows:

- Provided for the relocation of functions and programs from existing leased facilities in the commercial mall complex in Kealakekua to State-owned facilities specifically built to accommodate existing and future UHCWH functions;
- Reorganize facilities and functions into a cohesive campus that elevates the image of the UHCWH within the West Hawaiʻi region and fosters a nurturing learning environment;
- Extend higher education services to residents who live and work in the West Hawaiʻi region—the only major geographic population center in the Hawaiian Islands that does not have a permanent facility for higher education—and especially to those who cannot afford to pursue their educational needs at other University of Hawaiʻi campuses in Hilo or on other islands;
- Provide for the expansion of functions and programs to accommodate a future FTES enrollment of 1,500 students; and
- Reflect the cultural legacy and volcanic origin of the West Hawaiʻi region at the Kalaoa site in the layout of the University Center and the use of landscaping, lava materials and other architectural elements to create a Hawaiian sense of place.

2.6 PROJECT SCOPE

The SEIS addresses development as represented in the 2009 LRDP. In the future, separate SEISs or Environmental Assessments may be prepared, as warranted, to address any development that deviates substantially from the LRDP or future phases of development that are not fully defined and cannot be covered adequately by this SEIS.

The SEIS incorporates by reference the following studies and plans that contribute to the proposed development of the UHCWH within the 73-acre subdivision located in the northwest corner of the 500-acre University parcel.

- *University of Hawaiʻi at Hilo, West Hawaiʻi Campus: Site Assessment Study* (1992)
  Candidate sites for a higher education center in West Hawaiʻi were evaluated in this document prepared by DPD Associates, Inc. Selection criteria focused on the site assessment of public parcels (state-owned) of at least 500 acres that were reasonable in shape and topography for ease of design and construction. Upon completion of the study, the University's BOR selected a parcel in Kalaoa, approximately eight miles north of Kailua-Kona. The site assessment study noted that the citizens of Kailua-Kona advocated the Kalaoa site as their preferred choice for the location of the Center.

- *University of Hawaiʻi Center at West Hawaiʻi: Long Range Development Plan* (1998)
  The 1998 LRDP resulted from and documents the planning process undertaken to plan the new University Center. The preferred site for the new campus was a 33 acre plot of land located in the southwest portion of the 500-acre state-owned parcel in Kalaoa that was previously set aside for University use. The University Center is depicted in a basic site plan and the various ultimate plans for grading and drainage, water and wastewater system, landscaping, power, lighting, telecommunications/building automation system, and

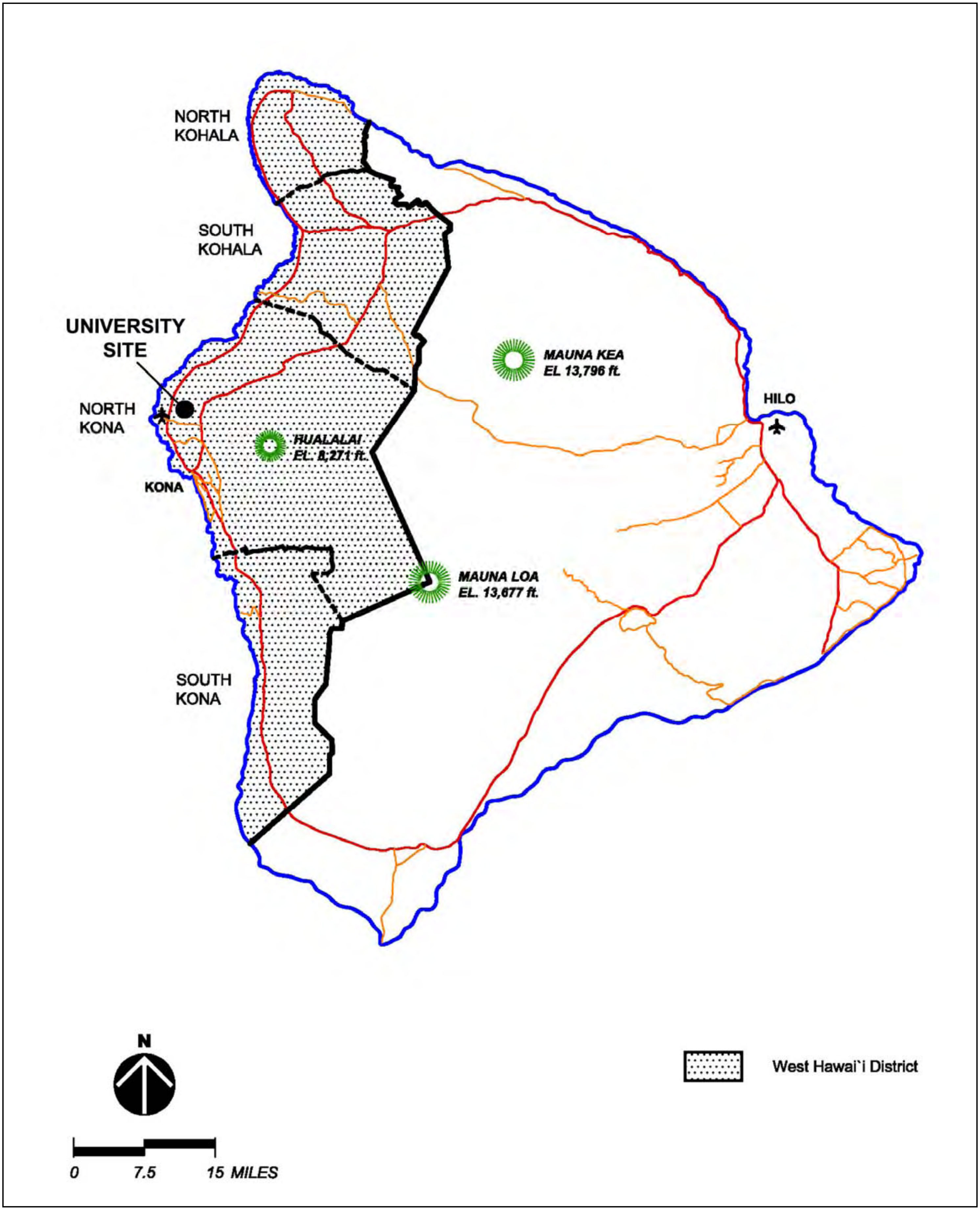
mechanical system. A phasing plan; estimated costs for implementation; and design considerations and guidelines for architecture, landscaping and other project components also were provided.

- *Final Environmental Impact Statement for University of Hawaiʻi Center at West Hawaiʻi* (2000)
  The EIS prepared in 2000 addressed the development of the UHCWH as represented in the 1998 LRDP. At that time, the new UHCWH was to provide space to transition the existing programs currently operating in leased facilities at Kealakekua. At full build out, the new UHCWH would accommodate a head count enrollment of 1,500 students. The 2000 EIS looked at several development alternatives including options for water and wastewater systems and access roads. Refer to Section 1.1.2 for additional information on the 2000 EIS.

- *Update 1998 Educational Specifications, Final Report* (2008)
  The purpose of the *Update 1998 Educational Specifications, Final Report*, hereafter referred to as the 2008 Ed Specs, was to recommend updates or changes to the 1998 Educational Specifications. The 2008 Ed Specs provide space and general design requirements and define the functional relationships that are used as the basis for physical planning and incremental development strategies. For 750 FTES the UHCWH will require roughly 98,000 gross square feet (GSF) and for 1,500 FTES, approximately 166,000 GSF will be needed to accommodate the five major components of the UHCWH—Instruction, Academic Support, Student Services, Continuing Education and Training, and Institutional Support. The 2008 Ed Specs also provide the basis from which to update the 1998 LRDP.

- *University of Hawaiʻi – West Hawaiʻi Long Range Development Plan 2009 Revision and Update* (2009)
  In the years since the 1998 LRDP was completed, changing circumstances and expanded educational requirements have necessitated an update of this document. In 2008, the University embarked on the update process, which has culminated in *The University of Hawaiʻi – West Hawaiʻi Long Range Development Plan 2009 Revision and Update*. There are two major changes from the 1998 LRDP and the 2009 LRDP. First is the change in the campus core's location from the southwestern portion of the 500-acre University site to the northwest corner (refer to Figure 5). The second major change is the inclusion of additional instructional programs.

  The intent of the 2009 LRDP is to guide initial and future development of the UHCWH, beginning with the transition from their existing facilities at Kealakekua to full development of the 1,500 FTES campus at Kalaoa. The LRDP documents the design and decision-making process and presents the overall site plan; development phases; design considerations and guidelines; and schematic plans for grading and drainage, water and wastewater, landscaping, electrical, lighting, telecommunication and building automation systems.



Location Map – Island of Hawai'i Figure 1

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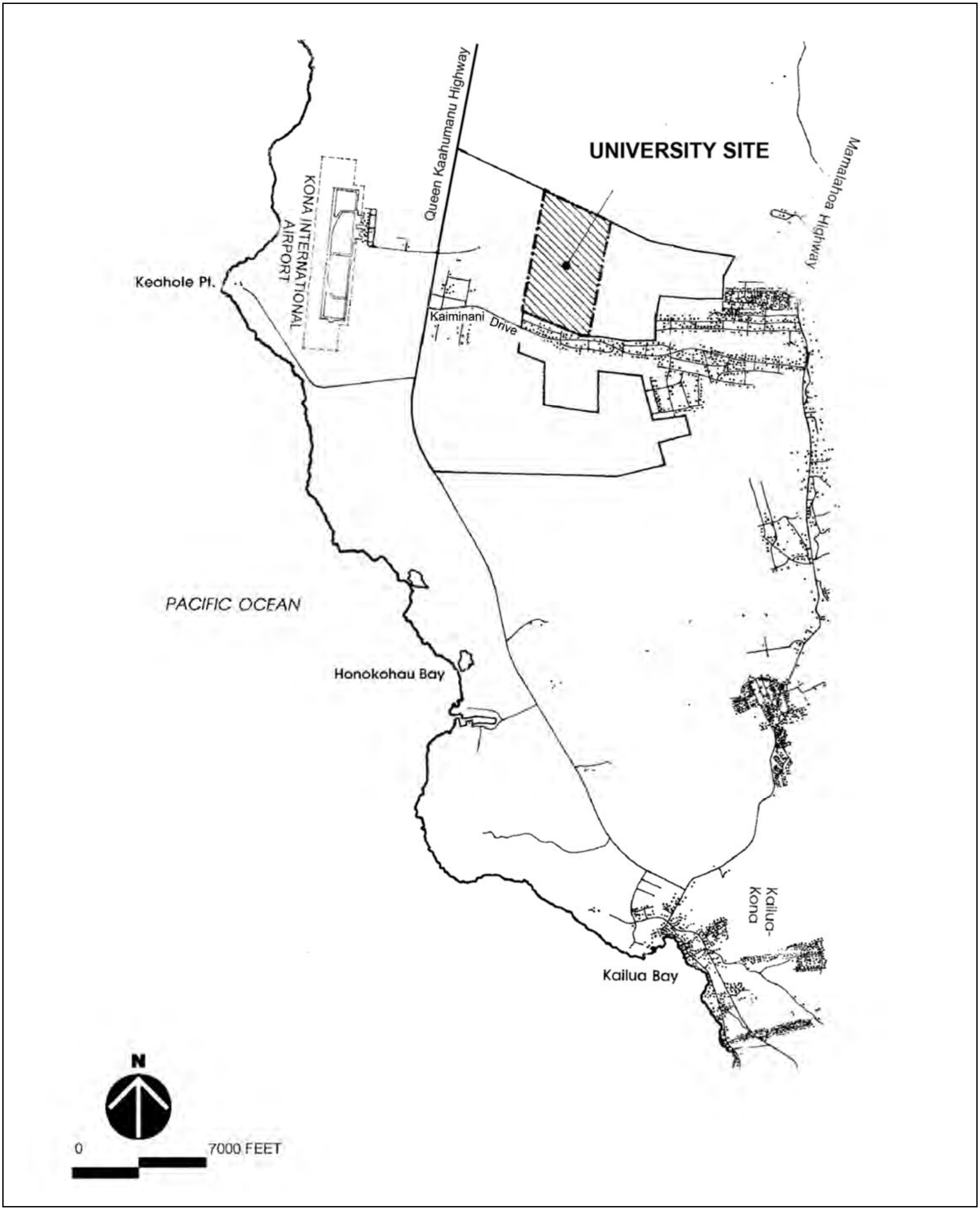

Location Map – North Kona

Figure 2

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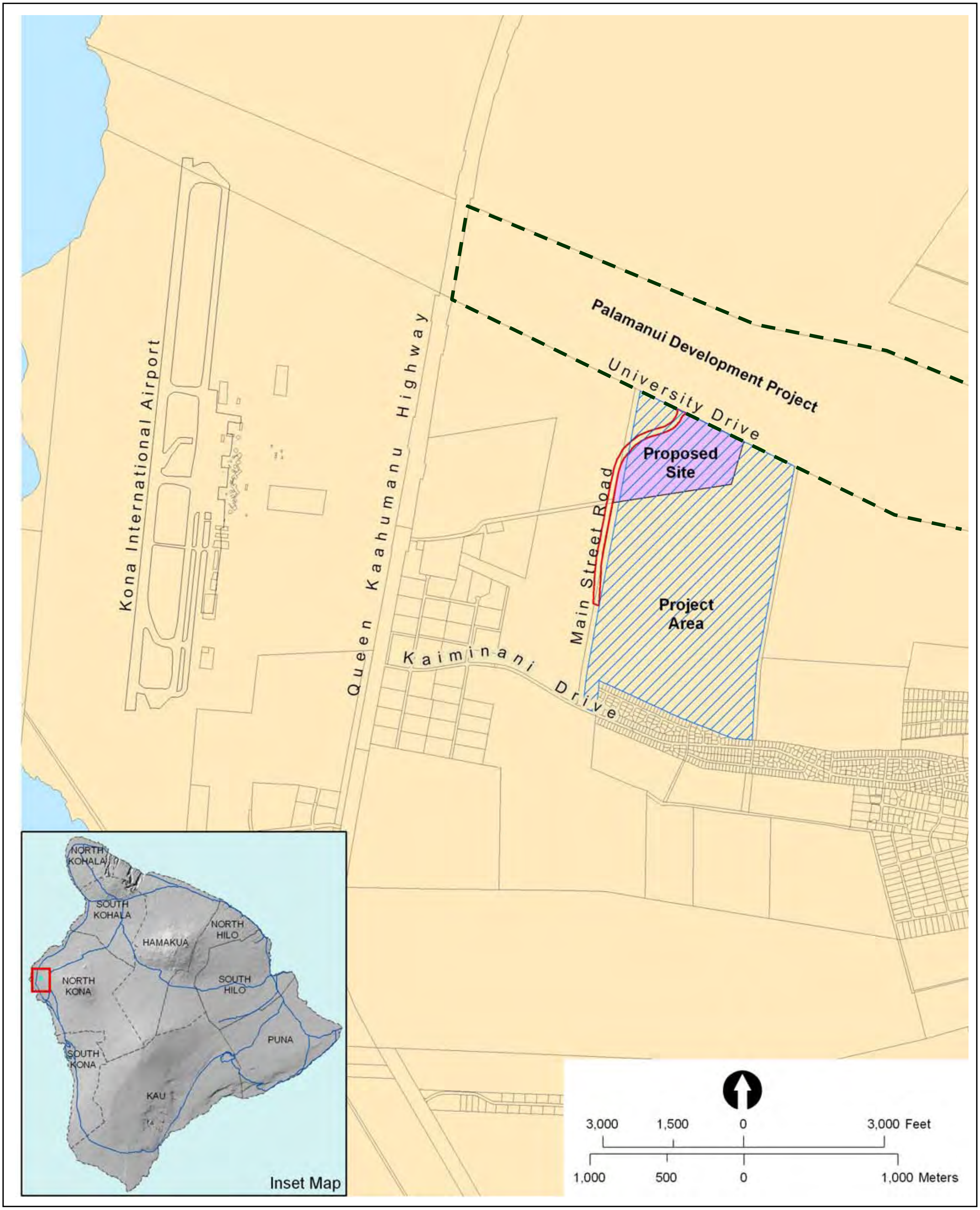

Location Map – University Site

Figure 3

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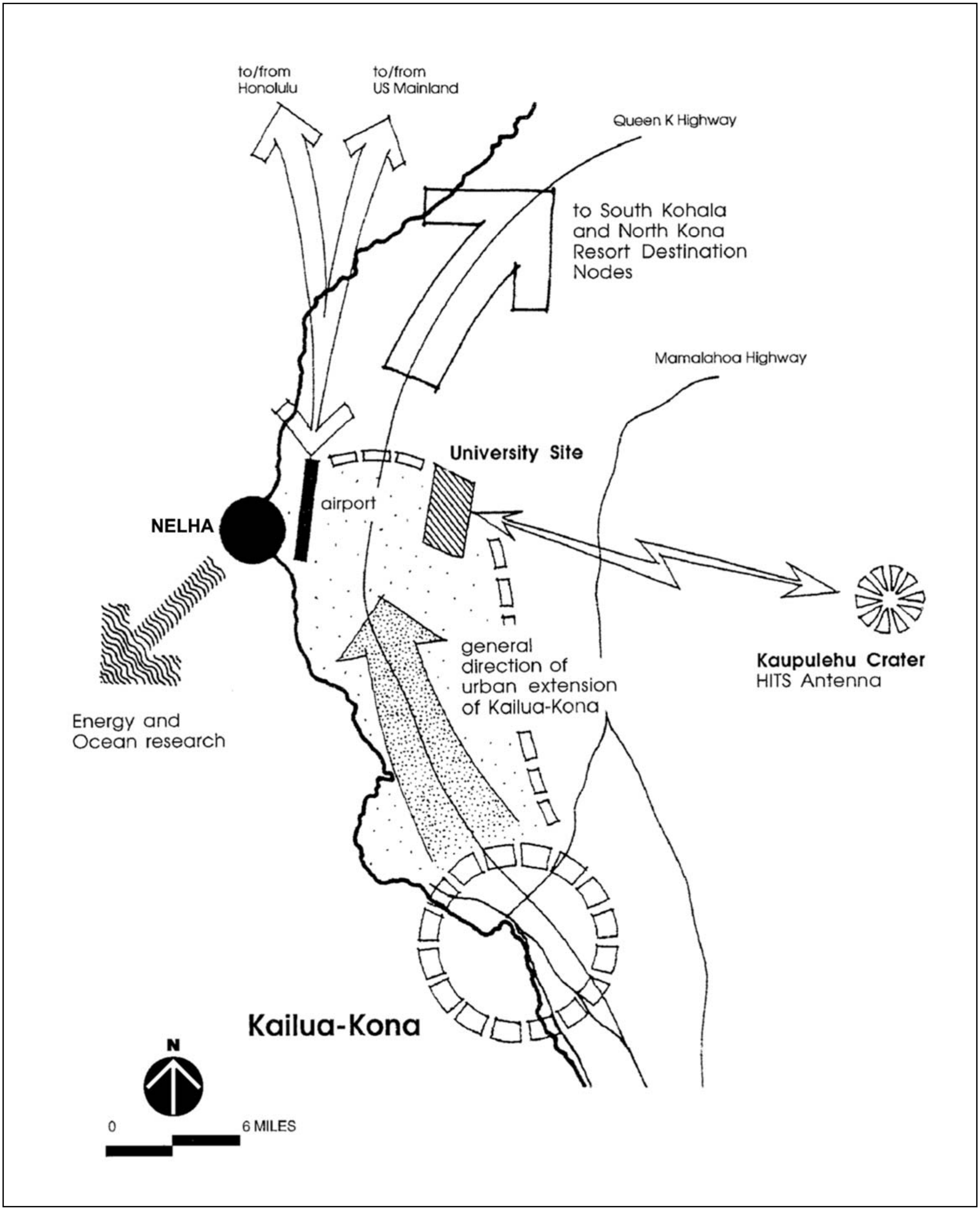

Regional Significance Figure 4

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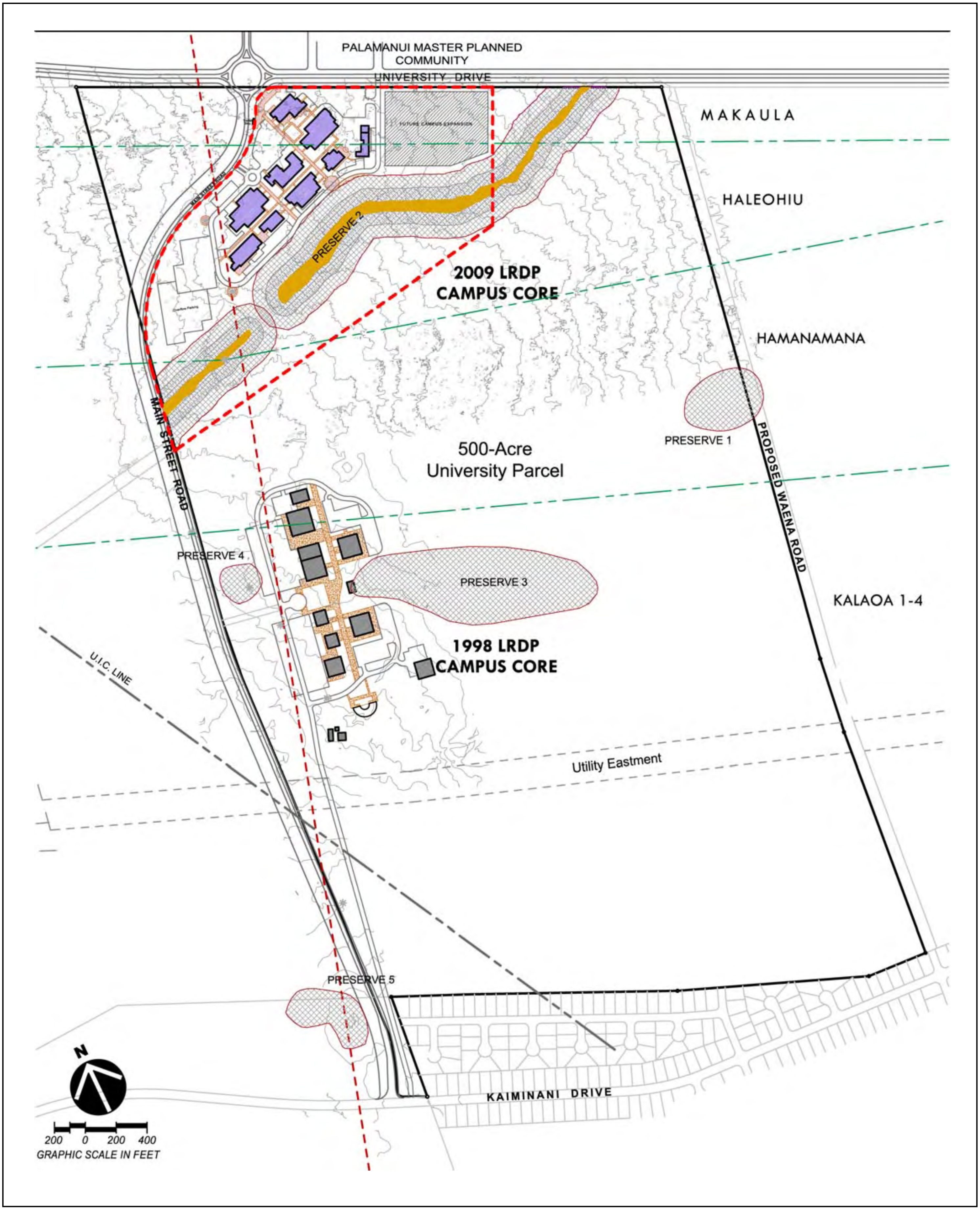

Location of the Campus Core

Figure 5

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3.0 DESCRIPTION OF THE PROPOSED ACTION

University of Hawai‘i BOR action in 1990 began the search for alternative sites for the UHCWH. A site assessment study applied the following criteria to candidate sites: the site must comprise public land with a minimum size of 500 acres and be reasonable in shape and topography for ease of design and construction. The 500-acre University parcel in Kalaoa was selected from a total of seven candidate sites in the West Hawai‘i region, and was approved by the BOR in 1991. The Proposed Action is to address the planned development of the UHCWH campus core in the northwestern corner of 500-acre University parcel, proximal to the Palamanui Village Town Center. This planned development is the Ultimate Campus Site Plan and associated ultimate plans as represented in the 2009 LRDP.

As stated previously in Section 1.1, the proposal to situate the campus core in the northwest corner represents the major change from the 1998 LRDP that necessitates preparation of the SEIS. The natural environment for both locations is similar, mainly the result of ancient lava flows from the nearby volcano, Mt. Hualālai. These flows have hardened into large expanses of *‘a‘ā* and *pāhoehoe* lava rock which is the dominant physical characteristic of the area.

3.1 PROJECT LOCATION

The 500-acre University parcel, identified as TMK (3)7-3-010:042 (refer to Figure 6) is located along the southwestern slopes of Mt. Hualālai in North Kona on the western coast of the island of Hawai‘i (refer to Figure 1). The project area comprises a portion of the 2,640-acre state-owned parcel that is located approximately 4,500 feet mauka or landward of the Queen Ka‘ahumanu Highway. While it is understood that the entire 500-acre parcel is set aside for University use; at present, the University does not control the property, which remains under the jurisdiction of the State of Hawai‘i DLNR.

The UHCWH campus core is to be located in the northwestern corner of the 500-acre University parcel. A subdivision of 73 acres was assigned to UHCWH by the Department of Land and Natural Resources, Land Division in 2008. The campus core covers approximately 23 acres of the subdivision. Another roughly seven acres on the eastern side of the campus core are set aside for future expansion, in which possible uses include student/transient housing and recreational facilities.

After careful analysis of infrastructure needs and development cost factors, the campus core was placed as close as possible to the adjacent Palamanui Master Planned Community. This location minimizes infrastructure costs because the length of utility lines (i.e., water, sewer, electrical, and telecommunications) needed to connect with Palamanui’s utility systems would be reduced. It also provides students and staff ease of access to the commercial and community facilities available in the Palamanui Village Town Center. The maximum dimensions of the UHCWH campus core are 1,650 feet from north to south and 1,450 feet from east to west.

3.2 Description of the Project Area and Proposed Site

The 500-acre University parcel generally is trapezoidal in shape. The mauka or eastern boundary of the project area is determined by the Urban Land Use Petition boundary for the 2,640-acre state-owned parcel and is delineated by the proposed Waena Drive road alignment. The makai or western boundary is delineated by the former alignment of the Mid-Level Road.[2] The Palamanui development abuts the project area along its northern boundary and is delineated by the proposed University Drive, which will link Palamanui and the UHCWH with Queen Ka'ahumanu Highway. The Kona Palisades Subdivision lies to the immediate south of the project area. The proposed site, where the UHCWH campus core is to be located, is in the northwestern corner of the project area. The project area is located on lava lands covered in fountain grass, small trees and shrubs. Although there is some evidence of agricultural use by ancient Hawaiians, the site has never been developed for modern use.

The proposed site has two major site constraints, the archaeological preserve surrounding the lava tube (containing human burials), which takes up more than half of the total land area, and the 11-acre "Open Zone" on the western end of the subdivision. After deducting the "Open Zone" and archaeological preserve, only 37 acres of developable land remains. For planning purposes, a 164-foot buffer (50-meter) was used to protect Preserve;[3] however, a 50-foot buffer area is being proposed in the BTP, currently being prepared. Due to the 164-foot archaeological buffer, the 8.5 acres below Preserve 2 are inaccessible. Unless access can be gained to the 8.5, the developable land area is effectively reduced to 28.5 acres (see Figure 7 Site Constraints).

No improved vehicular access to the proposed site is available at this time. The nearest existing road is Kaiminani Drive, a mauka-makai improved County roadway roughly one mile south of the proposed site, near the southern boundary of the project area. Two roads are being constructed by Palamanui that will connect the proposed site to existing roadways. Main Street Road (previously known as the Mid-Level Road) will start from the existing Kaiminani Drive and extend north to the future University Drive. Main Street Road represents Phase IV of the proposed Keohokalole Highway, which will function as a trunk transit route connecting Kailua Village with the airport. The second roadway, University Drive will extend eastward from Queen Ka'ahumanu Highway and will form the project area's northern boundary. Refer to Figure 24 in Chapter 4 for a diagram of the regional roadways including Main Street Road and University Drive.

[2] The original alignment of the Mid-Level Road, now known as Main Street Road, ran north-south, parallel to Queen Ka'ahumanu Highway. The road was realigned in 2005 to avoid archaeological sites in the straight-line right-of-way and again in 2007 by Palamanui LLC to facilitate the connection between Main Street Road and Palamanui's road network.

[3] The 164-feet (50-meter) buffer was preliminarily suggested in the 2000 HPP, which also recommended that guidance should be sought from the Hawai'i Island Burial Council to determine the appropriate buffer size. Through the BTP, which currently is in the draft stage, the UHCWH is proposing a buffer size of 50 feet (15 meters). The BTP must be reviewed and approved by both the Hawai'i Island Burial Council and SHPD.

3.3 DESCRIPTION OF THE PROPOSED ACTION

The Proposed Action is the development of the new UHCWH in Kalaoa, North Kona, Hawai'i. The UHCWH would be constructed within a 73-acre subdivision that is located within a larger 500-acre parcel that was set aside by the state in 1991 for future University use.

3.4 FEATURES OF THE PROPOSED ACTION

As a UH Center, the new UHCWH would not be a stand-alone and separately accredited campus in the UH system. As a consequence, the UHCWH will continue to draw significant administrative and academic support from other locations in the UH system. The UHCWH is and will, for the foreseeable future, continue to be a commuter school and will not provide dormitories, faculty housing, or athletic facilities. In addition to the two instructional programs (General Instruction and Culinary Arts) included in the 1998 Ed Specs, the 2008 Ed Specs recommends adding Business Education, Health Science, Public Services, Hawaiian Lifestyles, and Technology to UHCWH's instructional programs. The Technology program, which is recommended for phasing-in with the 1,500 FTES, would include three subprograms – 1) Architecture, Engineering and CAD (computer-aided drafting) Technology, 2) Electrical Installation and Maintenance Technology, and 3) Carpentry. In addition to instructional programs, academic, student and institutional support needs to be provided. These have been identified in the 2008 Ed Specs as the Library and Learning Resources, Student Services, Continuing Education and Institutional Support.

3.4.1 Technical Characteristics

The Ultimate Campus Site Plan represents the synthesis of all of the UHCWH's educational needs translated into physical terms. It is a culmination of the LRDP planning process including site considerations, program planning, planning criteria, site utilization and site plan alternatives. The Ultimate Campus Site Plan and associated ultimate technical plans establish a framework and guidelines for the physical development of the UHCWH.

It should be noted that normally an LRDP provides guidelines rather than specifying a specific building design concept. Typically, the LRDP would be passed on to an architectural design consultant to prepare schematic design studies, design development, and construction drawings. Each of these activities would be separate and sequential. This current UHCWH effort is unusual in that the LRDP update and schematic building design/design development were conducted concurrently to expedite the process. The University is making every effort to accommodate Palamanui's construction and development schedule, which includes constructing the first campus building (Culinary Arts).

Following is a summary of the technical elements of the Proposed Action as represented in the 2009 LRDP. These element s are shown on the Ultimate Campus Site Plan (Figure 8):

<u>Vehicular Circulation</u>

The Ultimate Campus Site Plan has two vehicular accesses. Primary access to the UHCWH would be from Main Street Road, close to Palamanui's roundabout. It is a 48-foot wide driveway with an 8-foot wide island defined by a line of tall palm trees. A 55-foot radius roundabout is placed at this main entrance to facilitate traffic flow within the campus core and enhance its grand entry. The secondary or service access would be via University Drive. It is a 30-foot wide driveway that is aligned with one of Palamanui's access roads. The physical limits of the UHCWH campus core and the vehicular circulation systems are circumscribed by a U-shaped roadway. This U-shaped roadway promotes the pedestrian connection between the campus core and the adjacent Palamanui community. The roadway runs counter-clockwise from the primary vehicular access and the campus's roundabout, to the parking area located on the western end, to the southern portion of the campus core (paralleling Archaeological Preserve 2), and then to the eastern end of the campus core.

Buildings

At full build-out there would be a total of nine buildings on the UHCWH campus, which are to be constructed in four phases. Phase 1 would encompass construction of the Culinary Arts building and part of the Health Science/Student Services building. This first phase would accommodate all of the educational programs and administrative activities currently housed at Kealakekua. Phase 2 would entail completion of the Health Science/Student Services building. Phase 3 would add the Administration & Academic Support, General Education I and Operations & Maintenance (O & M) buildings. These three buildings will complete the 750 FTES campus. Phase 4 would add the General Education II, Vocational Technology I, Vocational Technology II, and Hawaiian Studies buildings and will bring the campus up to the 1,500 FTES level. See Section 3.5 of this document for a more detailed discussion of phasing.

The building design concept proposed in the 2009 LRDP is based on the creation of long linear building modules called "bars" that are arranged on the site to fulfill the functional and square footage requirements set forth in the 2008 Ed Specs. Spaces between the bars become pedestrian ways, which can be covered with roofing or trellises. Building placement maximizes northern and southern exposures, which optimize opportunities for natural daylighting. South facing roofs at the appropriate pitch would maximize photovoltaic panel efficiency. Minimizing eastern and western exposures would reduce cooling costs as it is difficult to shade from the sun.

Typical building width would be 30 to 40 feet to maximize the efficiency of natural daylighting and ventilation. All buildings would be single story, as one-story buildings are the most efficient for natural daylighting and ventilation. The buildings are being designed so that spaces can be air conditioned during hot weather, but can also take advantage of natural ventilation in cooler weather. Wide roof overhangs would be used to provide shading from direct solar gain. Roofs with photovoltaic collectors will be oriented and angled for optimum performance resulting in visual interest from the varied roof forms.

Parking

Parking and access for the physically disabled would be provided near all buildings for the convenience of students and staff. This is in contrast to many campuses where there is a single large parking lot that requires long walks to buildings on the opposite end of the school grounds. Several medium and small parking areas at the UHCWH campus would be served by the U-shaped roadway that affords easy access to any part of the campus, while leaving the central mall and connected interior walkways for use by pedestrians. The number of marked parking stalls and loading spaces is derived by using the Hawaiʻi County Code parking requirements. For an ultimate enrollment of 1,500 FTES, 463 standard stalls, 17 accessible stalls, and 17 loading spaces would be provided. Parking would be sheltered by medium canopy trees at regular intervals. To satisfy the UH parking standard (1 stall for every 2 students), 750 parking stalls are required to serve the 1,500 FTES campus. Therefore, landscaped overflow parking would be added to the southwestern corner of the site to provide an additional 290 parking spaces.

Pedestrian Entry Plaza

To facilitate the pedestrian connection between the UHCWH and the adjacent Palamanui community, a 5,000-square-foot pedestrian entry plaza would be located on the northwestern corner of proposed site, adjacent to Palamanui's roundabout. This plaza functions as the entrance to the campus for those who walk from the Palamanui community and as a proposed transit stop on Main Street Road. Stairways and ramps would be provided for pedestrians.

Pedestrian Malls and Central Open Space

One of the underlying site planning concepts from the 2009 LRDP is to promote safe and pedestrian-friendly circulation within the campus core. The UHCWH campus core is defined by the perpendicular axis of two 20-foot wide north-south pedestrian malls and a 50- to 75-foot wide mauka-makai (or east-west) open space. The first mall starts at the pedestrian entry and continues south to the cultural plaza, while the second one extends from the campus's roundabout to the campus roadway running along the archaeological preserve. Both pedestrian malls also function as an accessway for maintenance and emergency vehicles. Running east to west and perpendicular to the pedestrian malls is a central open space. The width of the open space varies depending on the space between buildings, but a 15-foot wide paved pedestrian pathway would run the entire length of the central open space.

Marae/Piko

A large open space or clearing of approximately 10,000 square feet between the Culinary Arts building and the Health Science/Student Services building would be allocated for a marae/piko.[4] This outdoor gathering and reception space will serve the campus's ceremonial activities. The area between the first two buildings is selected as the location of marae/piko because it is the central and most prominent location within the UHCWH campus core and can be provided during the first phase of construction.

Cultural Plaza

A 7,000-square-foot circular cultural plaza would be located at the southern end of the pedestrian mall. Approximately one-third of the plaza is shared with the campus roadway. This plaza serves as another gathering space for students as well as a link between the campus core and Preserve 2. The Hawaiian Studies building would be located adjacent to the plaza so that it can be used for instructional purposes and ceremonies related to Hawaiian history and culture.

[4] The Maori word "marae" refers to a sacred gathering place that serves both religious and social purposes; its use was common throughout Polynesia. The Hawaiian form of marae is ma laʻe, while the term "piko" means the navel or center of a place.

Outdoor Amphitheater

A 4,000-square-foot outdoor amphitheater would be located in the area adjacent to the eastern side of the Hawaiian Studies building. It would be used for student performances, such as hula. The orientation of seating is designed to take advantage of the existing site topography.

Cultivation Area

An open area of approximately 6,000 square feet between the Health Science/Student Services building and the O & M building would be allocated for instructional cultivation purposes, such as growing herbs and greens for the culinary program.

Landscaping

Landscaping is planned throughout the UHCWH campus and would be in harmony with the natural lava strewn surroundings. Native Hawaiian and Polynesian-introduced species common to the area, especially those that are wind and drought tolerant, and well-suited to the site's natural environment, would be used as much as possible. To the extent practicable, the existing grassland and lava fields would be incorporated into the campus landscaping. Large expanses of grassed lawns typical of college campuses would not be provided because they require extensive maintenance and watering. Natural lava rock available at the site would be crushed and used as the main materials for pavement and other landscape elements such as walls, site furniture, and artwork. Natural lava outcrops could be preserved and incorporated as part of the campus' open space system. Use of lava material would project a unique Hawaiian sense of place that fosters connection with the land and its volcanic origins.

Hawaiian Sense of Place

The UHCWH site is on lava lands that have never been developed for modern use. This provides an opportunity to create a unique spirit and Hawaiian sense of place. The existence of numerous cultural resources at Kalaoa provides the backdrop and inspiration for this quality. The goal is to create a balance between the modern needs of education and the traditional elements of Hawaiian culture and teaching.

The 73-acre project site has three known archaeological elements: Archaeological Preserve 2 and two archaeological sites north of Preserve 2. Archaeological Preserve 2 encompasses a lava tube containing human burials and possible ceremonial areas. Located north of Preserve 2 is Site 15304, a single petroglyph, and Site 15262, a roughly 13-foot by 10-foot stone terrace and three adjacent stone mounds or *ahu*.

The connection between the UHCWH campus and these distinctive archaeological resources would be emphasized by using several site planning components. Two north-south pedestrian malls function as visual corridors linking the campus core and Preserve 2. The cultural plaza would serve as a visual link between the campus core and Preserve 2 by providing a viewing area of the preserve and the lava fields beyond. A terrace could be constructed on the slip of land between the roadway and the 164-foot buffer boundary (refer to Figure 8, *Ultimate Campus Site Plan*). The terrace would extend eastward from the cultural plaza, along the edge of the archaeological buffer. Interpretive signage could be emplaced within the terrace to convey the history and significance of the preserve and the Kalaoa area. Likewise, the two archaeological sites located north of Preserve 2 could be incorporated into the campus through the landscape design. Ultimately, these two sites would be preserved; however, the exact nature of their treatment would be determined at a later date when Phase 4 of the UHCWH is planned in more detail. Refer to Section 3.5 for a detailed discussion on project phasing.

3.4.2 Economic Characteristics

The UHCWH would generate both short-term and long-term economic benefits for the island of Hawai'i and the state, in the form of additional jobs, economic output, employment earnings and tax revenues. The short-term benefits are related to construction of the new Center, while the long-time benefits refer to those accrued from operating the Center.

For the purposes of assessing the Proposed Action's economic characteristics, project development was defined by two increments—Increment 1 encompasses construction of the 750 FTES campus and Increment 2 comprises build out of the 1,500 FTES campus. Each increment is assumed to occur over a 36-month period. Based on 2009 dollars, total investment is expected to be $44.3 million for the Increment 1 and $31.7 million for the Increment 2. In total, $76.0 million would be invested to construct the entire 1,500 FTES campus. According to the *Economic Impact Study for University of Hawaii Center West Hawaii* (Lucas, 2009), the Increment 1 initial capital investment of $44.3 million would create 263 direct annual jobs in the construction industry over the 36-month construction period, and generate $14.4 million in earnings for employees working directly on the campus construction. The Increment 2 initial investment of $31.7 million would result in 181 direct annual jobs and $10.2 million in direct earnings.

Economic benefits go beyond the direct impacts when considering the multiplier effects of consequent rounds of spending by suppliers and households, which would further stimulate the economy. The indirect and induced impacts are calculated by using the state input-output model. Additional output impact of constructing Phase 1 would be $43.9 million in spending by suppliers and households, 347 indirect annual jobs in other industries, and $13.4 million in earnings accrued mostly to island of Hawai'i employees and the self-employed. For Increment 2, additional output would include $31.2 million in spending by suppliers and households, 247 indirect annual jobs, and $9.5 million in earnings. In addition, $4.5 million in state tax revenue is projected to be collected from the Increment 1 construction and $3.4 million from the Increment 2 construction. Refer to Table 1 below for a summary of construction-related economic impacts.

When the UHCWH is in operation, direct long-term benefits would occur in terms of employment, economic output, earnings, and state tax revenues. Using Fall 2008 data from the UHCWH's operations in Kealakekua as a baseline measure, the following long-term benefits of a relocated and expanded UHCWH campus in Kalaoa were estimated. Direct impacts of operating the new 750 FTES campus include 77 new jobs on campus, $10.6 million in increased operating expenditures, and $6.1 million in additional earnings for faculty and staff. Full operation of the 1,500 FTES campus is projected to include, beyond 2008 levels, 178 additional jobs on campus, $21.4 million in increased operating expenditures, and $12.6 million in additional earnings.

The UHCWH is also expected to result in long-term indirect and induced economic benefits. For the 750 FTES campus, 48 additional jobs, $12.6 million in output, and $4.0 million extra earnings in other industries are projected. Cumulatively, 111 new jobs, $25.5 million in output and $8.3 million in earnings in other industries are projected for the 1,500 FTES campus. Furthermore, operating expenditures will generate considerable state tax revenues, $1.4 million and $2.8 million annually for the 750 FTES and the 1,500 FTES student campuses, respectively. Refer to Table 2 below for a summary of long-term economic impacts resulting from implementing the Proposed Action.

Most jobs, output, and earnings generated through the project would remain on the island of Hawai'i, benefiting local businesses and households. Although a large amount of tax revenues will end up going to state, some of it would return to Hawai'i County to fund state departments and agencies located on the island, which includes the UHCWH.

Table 1. Construction-related Economic Impacts

Category		*Direct Impact*	*Indirect & Induced Impact*	*Total Impact*
Increment 1 Construction (750 FTES campus)	Jobs	263.0	347.0	610.0
	Output ($M)	44.3	43.9	88.2
	Earnings ($M)	14.4	13.4	27.8
	State Tax ($M)	--	--	4.5
Increment 2 Construction (1,500 FTES campus)	Jobs	181.0	247.0	428.0
	Output ($M)	31.7	31.2	62.9
	Earnings ($M)	10.2	9.5	19.7
	State Tax ($M)	--	--	3.4
Cumulative (Increments 1 and 2)	Jobs	444.0	594.0	1038.0
	Output ($M)	76.0	75.1	151.1
	Earnings ($M)	24.6	22.9	47.5
	State Tax ($M)	--	--	7.9

Source: Lucas, R., 2009. Economic Impact Study for University of Hawaii Center West Hawaii.

Table 2. Long-term Economic Impacts

Category		*Direct Impact*	*Indirect & Induced Impact*	*Total Impact*
750 FTES Campus Operation	Jobs	77.0	48.0	125.0
	Output ($M)	10.6	12.6	23.2
	Earnings ($M)	6.1	4.0	10.1
	State Tax ($M)	--	--	1.4
1,500 FTES Campus Operation	Jobs	178.0	111.0	289
	Output ($M)	21.4	25.5	46.9
	Earnings ($M)	12.6	8.3	20.9
	State Tax ($M)	--	--	2.8

Source: Lucas, R., 2009. Economic Impact Study for University of Hawaii Center West Hawaii.

The new UHCWH would also provide a much needed boost in post-secondary education and training capacity for the West Hawai'i region, thereby facilitating attainment of planned social and economic goals set forth in the *Mapping Kona's Future, Kona Community Development Plan* (Wilson Okamoto, 2008) (KCDP) and other relevant state and county development plans. The greater education and planning capacity of the new UHCWH would also enable vitally important further diversification of the regional and county economy, bringing a wider range of vocational choice and increased stability to the economy.

3.4.3 Social Characteristics

The Proposed Action is in keeping with the provisions of the most current land use planning document for the West Hawai'i region, the KCDP. One of the guiding principles of the KCDP is to direct future growth patterns toward compact villages preserving Kona's rural, diverse, and historical character. The KCDP designates a series of ten villages between Keauhou and Keahole. The University Village is the northernmost of these ten villages. Four of the ten villages, one of which is the University Village, are considered regional centers.

A regional center, as opposed to a neighborhood village, is intended for mixed-use and higher-density residential, retail, commercial, and employment facilities. A regional center also contains a major civic, medical, education or entertainment facility. For the University Village this major facility is the UHCWH. Regional centers are designed around a commercial center, which encourages pedestrian activity. In this case, the commercial center is the Palamanui Village Town Center directly adjacent to the UHCWH. Thus, the Proposed Action would have the social characteristics of a small compact village served by public transit (Hele-On Bus) rather than the characteristics of a high-density urban community or a sprawling suburb that is dependent on the individual automobile.

The UHCWH would provide a myriad of social benefits to the West Hawai'i region through the development of a permanent facility for higher education. West Hawai'i is currently the only area of the state that does not have a permanent venue for higher education. The development of a new, strategically located, and permanent facility for higher education in West Hawai'i would provide area residents with the opportunity to achieve personal goals for economic benefits. The more centralized location would lower the commute time for many area residents. The development of a new campus in West Hawai'i also fits into projections for future county economic growth, with tourism, research, and educational opportunities comprising a significant sector of the economy.

Several beneficial impacts to the social environment would result from the Proposed Action; however, two stand out as most prominent. The first impact is that the Proposed Action expands educational opportunities, and thus economic opportunities, for a significant portion of the area's population, and thereby the county as a whole. During times of economic downturn, the long-term opportunities that higher education can provide frequently act as a significant pull factor; attracting a wider portion of the population to enroll in educational institutions. The provision of adequate and well-designed facilities to meet current enrollment demands, as well as projected future demand, in an area that currently is underserved is a major long-term, positive social impact.

The second significant positive impact is the provision of additional educational programs to a larger portion of the population closer to home. Shorter commute times and increased program availability creates the possibility of a higher quality of life for individuals who choose to attend the UHCWH. The 2009 LRDP and campus design address key push factors that may prevent individuals from enrolling in an institution of higher education, such as lack of availability of desired programs and long commute times between home and campus. These push factors are mitigated by a centrally located campus, the addition of several educational programs, and an academic plan that includes projections for future needs. The campus is planned for the social needs of the community in the present, as well as the projected needs of future generations.

The University Center is not planned as a residential campus. As a commuter school, the social characteristics of the UHCWH are different than if it were a residential campus with dormitories and athletic facilities. Nevertheless, the proximity to the Palamanui Village Town Center would offer commercial and social opportunities to students, faculty and staff that would not otherwise be available on a campus isolated from a village core. Likewise, the Palamanui community would benefit from having the UHCWH as an integral part of the village fabric. The school would be an attraction to potential residents of Palamanui, as well as a symbol of the potential for advancement in life that a university affords the community.

3.4.4 Environmental Characteristics

The 2009 LRDP offers as a goal for the development the new UHCWH, LEED Platinum certification for Phases 1 and 2, with movement toward achieving net zero energy consumption for the new campus. To achieve these goals, significant consideration is being given to architectural and design strategies that are responsive to the topography, climate, and existing site conditions. Strategies considered include optimizing building orientation to the site; the use of mixed-mode with natural ventilation; daylighting; renewable energy solutions, such as photovoltaics and solar thermal; the preference to use locally available materials; water treatment and reuse; landscaping with drought-tolerant and native plants; and adapting the buildings to the site topography to reduce the amount of grading and excavation necessary. Cumulatively, these strategies, if employed, could result in higher building performance, lower maintenance and operation costs, and reduced demand for energy and water.

3.4.4.1 GREEN EDUCATIONAL FACILITIES

When the 1998 LRDP and the 2000 EIS were being prepared, the Green building movement was just beginning and the concept of sustainable building design was not yet widespread. In 2002 the University of Hawai'i adopted sustainability as a guiding principle and began instituting sustainability policies and practices throughout the UH System (http://jabsom.hawaii.edu/jabsom/sustainability.php). "Sustainability" is defined as living in ways that meet our present needs without limiting the potential of future generations to meet their needs. Thus, the Green campus, as embodied by the current Proposed Action, contains more environmentally-focused features than in the original project, particularly in regard to energy systems.

Green educational facilities are intended to reduce or eliminate negative impacts to the environment. They also increase the productivity of students and faculty, and lower operating costs. Other benefits of Green educational facilities include reduced student absenteeism, increased ability to attract and retain teachers, increased ability to secure research funding, and an enhanced community image. The initial costs of a Green building are often greater than a conventional building. However, total long term costs (lifecycle costs) are much reduced for a Green building. The State of Hawai'i as well as the University of Hawai'i has made a commitment to provide Green educational facilities wherever possible. Since the new UHCWH campus will be completely new, it gives the University the rare opportunity to build a totally Green campus.

Faculty and administration from the Hawai'i Community College, community members, the contractor, the developer, and the design team collaborated during the April 14, 2009 UHCWH Eco-Charrette to come up with an overall sustainable design directive and vision for the new campus. It is intended that design and development of all the buildings on the new UHCWH campus will endeavor to meet this sustainable vision, which is stated as follows:

> "Our vision is to create a zero-carbon footprint campus integrating proven design strategies to enhance learning that also embraces sustainability and the Hawaiian culture."

3.4.4.2 LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN (LEED™)

The United States Green Building Council (USGBC) developed theLEED Green Building Rating System, an internationally recognized standard for green buildings. LEED certification entails verification by an independent third-party that a building project's location and design are environmentally responsible and sustainable. Certification also recognizes and rewards building owners for providing the highest performance standards and conveys to the building's users that their facility is durable, promotes good health, and is environmentally friendly. LEED supports the principles of waste reduction, toxics reduction, resources conservation, and energy efficiency. The Green Building Rating System recognizes high performance in six key areas: sustainable site development, water savings, energy efficiency, materials selection, indoor environmental quality, and innovative design process.

A LEED Silver level rating is mandated by the state; however, the UHCWH would like to obtain a higher certification—LEED Gold or Platinum. The massing and orientation of the buildings, as well as other design details are aimed at achieving the LEED™ Platinum level rating for the UHCWH, with an ultimate goal of the campus obtaining net zero energy consumption. The UHCWH design team (including architect, consulting engineers and building contractor) has registered and begun the online application process for LEED™ certification with the USGBC for the first two buildings.

While obtaining LEED Platinum certification for the first two phases of development is the ultimate goal, whether or not the project actually achieves this goal remains to be seen until after construction is completed, funds are collected for renewable energy sources and the constructed wetland wastewater treatment system, and the building has undergone Commissioning of the Building Energy Systems. LEED Platinum and net zero energy consumption-related systems would be installed as soon as funding is available. Phase 1 would have up to two years after receiving the Certificate of Occupancy to complete all renovations and submit documentation for the final LEED application. Some example systems that may be installed include roof top, trellis and covered parking PV arrays; high-SRI asphalt coating; and the constructed wetlands/septic tanks connection.

Additionally, at the completion of each phase, the University would allocate a portion of the Land Bank (the archaeological preserve and its protective buffer) as dedicated open space for each completed building. The open space dedicated would be twice the building footprint and shall remain an undisturbed Greenfield for the entire life of the project.

Following are some examples of designed environmental characteristics, which are anticipated to earn LEED points toward certification:

SUSTAINABLE SITES

- *Alternative Transportation, Public Transportation Access*: Discussions have been initiated with the Hawai'i County Mass Transit Agency (Hele-On Bus Service) to provide public transit access to the UHCWH. The county has indicated that it intends to provide three bus routes that would provide public access to the UHCWH.
- *Alternative Transportation, Bike Storage and Changing*: Secure bike storage would be provided within 200 yards of the building entrance for 5 percent of peak occupancy, and showers to accommodate 0.5 percent FTES building occupants.
- *Alternative Transit, Low-emission, Fuel-efficient Vehicles*: Five percent of parking capacity would be allocated for low-emitting, fuel-efficient vehicles.
- *Alternative Transi, Parking Capacity*: Parking would be limited to the County of Hawai'i minimum requirements as various sources of alternative transit would be encouraged and promoted on campus. Five percent of parking capacity would be allocated for carpool/vanpool spaces.
- *Heat Island Effect, Non-Roof Surfaces*: The heat island effect is the phenomenon where temperatures in urban and suburban areas can be as much as 10 degrees higher than rural areas as a result of built surfaces absorbing and trapping solar heat. To counteract this effect, the landscape plan would provide shading, paving materials would be employed with a solar reflectance index (SRI) of at least 29 would be used for 50 percent of the site's hardscape (roads, sidewalks, courtyards, and parking lots). In addition, a high-SRI asphalt coating, covered parking stalls with PV panels, light-colored concrete, and bio-retention parking islands would be used to meet both American with Disabilities Act (ADA) requirements and reduce the heat island effect.
- *Heat Island Effect, Roof Surfaces*: The building design would specify roofing materials with a SRI of 78 for less than 2:12 slope roofs and 29 for greater than 2:12 slope roofs, for a minimum of 75 percent of the total exposed roof area.
- *Light Pollution Reduction*: Interior light fixtures would limit light trespass beyond the building property line and minimize light pollution. For site lighting, solar fixtures with batteries are being considered. Site lighting can be minimized by using destination lighting instead of area flooding.

WATER EFFICIENCY

- *Water Efficient Landscaping, No Potable Water Use*: Potable water usage for irrigation and landscaping would be reduced by at least 50 percent. Drought tolerant or xerophilous plants would be used in the landscape design. Project designers are investigating the possible use of a constructed wetland to treat wastewater from the first two buildings. The resultant R-2 water from the constructed wetland, as well as harvested rainwater from the site, and AC condensate would be used to eliminate the use of potable water for irrigation.

ENERGY AND ATMOSPHERE

- *Fundamental Building Systems Commissioning*: Commissioning of the building systems would verify that the energy systems are installed; calibrated; and are performing according to the owner's project requirements, basis of design, and construction documents. At a minimum, commissioning systems to be evaluated would include heating, ventilating, air conditioning (HVAC) and refrigeration; lighting and daylighting controls; domestic hot water systems; and renewable energy systems (wind, solar, etc.). Other systems such as the building envelope may also be evaluated.
- *Minimum Energy Performance*: A minimum level of energy efficiency would be established for the proposed buildings and systems in accordance with American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) / Illuminating Engineering Society of North America standards.
- *Fundamental and Enhanced Refrigerant Management*: HVAC systems would not use CFC-based (chlorofluorocarbon) or HCFC-based (hydrochlorofluorocarbon) refrigerants, which would help to reduce ozone depletion.
- *Optimize Energy Performance*: Accurate energy modeling would be undertaken to facilitate optimization of energy performance and reduce environmental impacts due to excessive energy use.
- *On-Site Renewable Energy*: On-site renewable energy systems would offset building energy costs, thereby reducing negative environmental and economic impacts due to use of fossil fuels. Roof-mounted PV arrays and solar water heaters would be used. Wind turbines and water pipe impeller energy generation are also being considered. Engineers are investigating necessary amounts of Solar Panel Field and covered parking PV canopies to obtain net zero energy consumption. Hawai'i Community College is exploring as many different renewable energy technologies as possible for implementation at the new Kalaoa campus.

MATERIALS AND RESOURCES

- *Storage and Collection of Recyclables*: Recycling rooms would be incorporated into the design of the first two buildings (Culinary Arts and Health Services). The architects would consult with UH to come up with a preferred recycling plan for paper, glass, cardboard, aluminum and plastic in the facility.
- *Construction Waste Management*: Attempts would be made to divert 50 to 75 percent of construction waste from disposal in landfills and incinerators. Recyclable recovered resources would be redirected back to the manufacturing process. Reusable materials would be redirected to appropriate sites. Diversion may include donation of materials to charitable or non-profit organizations.

INDOOR ENVIRONMENTAL QUALITY

- *Indoor Air Quality (IAQ) Performance*: Calculations would be provided to demonstrate that the project design meets minimum ASHRAE requirements. Meeting minimum indoor IAQ would enhance air quality in buildings, thereby contributing to the comfort and well-being of the occupants.

- *Outdoor Air Delivery Monitoring*: Carbon dioxide (CO_2) sensors would be provided for normally occupied spaces and an outdoor air measurement device for each mechanical ventilation system would be installed to monitor the CO_2 levels and adjust outdoor air intake accordingly.
- *Increased Ventilation*: Ventilation rates for each space would be provided to show that breathing zone outdoor air ventilation rates are increased by at least 30 percent higher than ASHRAE requirements.
- *Low-Emitting Materials*: The quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of both installers and occupants would be reduced. Low-emitting materials would fall under the general categories of adhesives and sealants, paints and coatings, carpet systems, and composite wood (not including furniture and equipment).
- *Controllability of Systems, Lighting*: Adjustable individual task lights at occupant workstations (offices, open plan workstations, receptionist stations) would be provided for 90 percent of the occupants. Appropriate flexible and adjustable lighting would also be provided in classrooms, cafeteria, fine dining, labs, and other multi-occupant spaces. Daylighting sensors would be incorporated into the building design.
- *Controllability of Systems, Thermal Comfort*: Thermostats would be required for individual occupant spaces. Shared occupied spaces would have at least one means of accessible control.
- *Daylight and Views, Daylight 75 Percent of Spaces*: Interior spaces would be designed to achieve a glazing factor of 2 percent, in 75 percent of all regularly occupied areas. This would reduce the electrical lighting load and energy consumption of the building by relying on natural daylighting for the majority of operational hours. Glare control and photo-dimmer sensors would be used in conjunction with optimal glazing orientation and interior light shelves.
- *Daylight and Views, Views for 90 Percent of Spaces*: Interior spaces would be designed to have direct views to the outdoor environment from 90 percent of all regularly occupied areas. This would provide building occupants a connection between indoor spaces and the outdoors through the introduction of daylight and views into occupied areas of buildings.

INNOVATION AND DESIGN PROCESS

- Innovation in design was demonstrated through maximizing open space to more than double the building footprint; reducing water requirements by 40 percent with automatic sensors, low-flow fixtures, etc.; and incorporating an educational program that would highlight sustainable features of the campus using the buildings and signage as a teaching tool.
- LEED Accredited Professionals: The design team includes one or more LEED accredited professionals.

3.5 PROJECT PHASING

The Proposed Action would be developed in four incremental phases. Phasing allows for the development of the UHCWH as enrollment and program requirements increase and funding becomes available. Because the UHCWH will tie into Palamanui's infrastructure, initial development of the campus would occur in the extreme northwest corner of the proposed site, nearest to Palamanui's Village Town Center. Successive development phases will gradually move farther away from the corner.

The projected timetable for the incremental development of the UHCWH's four phases is presented below in Table 3. Phases 1 through 3 comprise the 750 FTES campus. Phase 4 would double the size of the campus from 750 FTES to 1,500 FTES. These dates are only estimates; the actual timing of development, particularly for Phase 4, would be dependent on available funds and future enrollment.

Table 3. Development Timetable

	Phase	Year
750 FTES Campus	Phase 1	2011
	Phase 2	2012
	Phase 3	2017
1,500 FTES Campus	Phase 4	2023

Sections 3.5.1 through 3.5.2 below briefly describes each of the four development phases. Table 4 below cumulatively summarizes the major site components and total built-up area at each phase.

Table 4. Cumulative Summary of Major Site Components at each Development Phase

Ultimate Site Plan	# of Bldgs	Building (GSF)	Covered Area (SF)	Roadway & Parking (SF)	Overflow Parking (SF)	Pedestrian Walkways (SF)	Built-up Area (Acres)
Phase 1	2	26,354	15,170	67,300	0	25,200	4.2
Phase 1 & 2	2	38,358	22,160	94,400	0	28,200	6.5
Phase 1 thru 3	5	96,646	31,660	237,600	12,000	66,500	12.3
Phase 1 thru 4	9	165,815	59,380	340,000	95,000	80,000	22.7

3.5.1 Phase 1

The first phase will consist of two buildings—the Culinary Arts building and the upper section of the Health Science/Student Services building (see Figure 11, *Development Plan Phase 1*). The Culinary Arts building with approximately 17,792 GSF would be built first. As a condition of their zone change, Palamanui is being required by the county to fund and construct the first 20,000 square feet of building at the UHCWH up to a cost of $5,000,000, with the University paying the balance. In addition to the Culinary Arts building, the upper section of the Health Science/Student Services building with approximately 8,562 GSF would also be built in the first phase. These two buildings would provide sufficient space to house the present enrollment and programs accommodated at Kealakekua. General instruction classrooms and other office and service functions initially will be housed in these two buildings.

Two vehicular accesses to the campus would be developed in the first phase. The primary access is a 30-foot wide driveway connecting Main Street Road to the parking lot located on the western side of the first two buildings. The interior campus roundabout would not be built in this first phase, but a drop-off area would be provided. The secondary service-vehicle access is via University Drive. It is a 25-foot wide temporary driveway that would mainly serve the loading areas required for the main kitchen located in the Culinary Arts building. Full vehicular access is not being provided from University Drive, since in this initial phase University Drive would only extend up to the Palamanui Village roundabout and perhaps a short distance east of the roundabout.

In this initial phase, only one main parking lot would be provided for campus users. A small parking area would also be provided on the northeastern side of the first two buildings. This small parking lot would be accessible from the temporary service entry on University Drive.

In the planning process, attention has been given to creating a link between the UHCWH and Palamanui, as well as promoting pedestrian circulation within the campus core. As a result, the pedestrian entry plaza and the 20-foot wide north-south pedestrian mall would be constructed at the beginning of campus development. Another two integral site planning elements included in Phase 1 are the marae/piko and the circular cultural plaza.

Water and sewer mains would be connected to Palamanui's utility systems in University Drive. Initially, power will be provided from a HELCO 12.47 kV overhead transmission line. Ultimately when a planned electrical substation is completed by Palamanui, the UHCWH would be served from the new substation.

3.5.2 Phase 2

In Phase 2, the construction of the Health Science/Student Services building would be completed. An additional floor area of approximately 12,004 GSF would be added to the campus.

To accommodate the increase of building space and occupancy, parking would have to be expanded. As shown in Figure 12, *Development Plan Phase 2*, the area of approximately 2,800 square feet south of the main parking lot would be graded and used for this expansion.

3.5.3 Phase 3 – Completion of the 750 FTES Campus

Phase 3 would add another three buildings to the campus to support an enrollment capacity of 750 FTES. These buildings are the Administration/Academic Support building, the General Education I building, and the O & M building. See Figure 13, *Development Plan Phase 3*. Theses new buildings would provide additional space required to serve the five major functions— Institutional Support (Director), Academic Support, Continuing Education, Instruction, and Institutional Support (O & M). Some of the functions (e.g., library and administration) previously located in the first two buildings would be relocated to these new buildings. As a result, the existing Culinary Arts and Health Science/Student Services buildings can expand to their full capacity as described in the 2008 Ed Specs, since they no longer need to house other functions on a temporary basis.

To handle the increase in vehicular traffic, the main entrance would be widened and the 55-foot radius roundabout would be added to the campus. Most importantly, the 30-foot wide interior campus roadway would be constructed to provide convenient access to all major buildings and connect the main entrance on Main Street Road to the secondary access on University Drive.

In Phase 3, more parking areas would be constructed to provide a sufficient number of stalls to meet Hawai'i County Code. To meet this requirement, additional parking areas would be added to the campus core; one located on the western side of the Administration/Academic Support building and another located on the northeastern side of the Culinary Arts building. Parallel parking stalls and loading spaces would be provided along the campus roadway section south of the General Education I building, while the O & M building would be provided its own small parking lot. In addition, two overflow parking areas would be provided to meet the UH parking standard.

A possible addition in Phase 3 is an Early Childhood Education program and associated Children's Center. An Early Childhood Education program would provide attitudes, skills, and knowledge for people who work with young children and their families in a variety of early childhood programs. The program could offer certificates and degrees that prepare students for support roles in early childhood programs, to be teachers or lead practitioners. The Children's Center, similar to the one at the Manono Campus, would provide a setting for early childhood students to gain practical experience with young children. The Center would serve children of students, faculty and staff from the UHCWH.

3.5.4 Phase 4 – The 1,500 FTES Campus

This final development phase would include construction of the remaining General Instruction classrooms and Division Offices, which would be housed in four new buildings: the General Education II, Vocational Technology I, Vocational Technology II, and Hawaiian Studies buildings (see Figure 14, *Development Plan Phase 4*). Phase 4 would complete the physical plant of the UHCWH as described in the 2009 LRDP for a total maximum enrollment of 1,500 FTES. The General Education II, Vocational Technology I, and Vocational Technology II buildings would be grouped together and located on the western end of the campus core and would replace the parking lot and overflow parking built in the previous phase. The Hawaiian Studies building would be located in the open area adjacent to the cultural plaza, so students can use the plaza for ceremonies and instructional purposes. Attached to the Hawaiian Studies building is the outdoor amphitheater, which also would be built in the last phase.

In this phase, land area in the Open Zone would have to be used for roadway and parking. The main parking lot located in the Open Zone will cover approximately 76,000 square feet, while the overflow parking will take up another 95,000 square feet. The western section of the campus roadway constructed in the previous phase would be reconfigured to allot more space to the buildings. Additional separate small parking areas and loading spaces also would be constructed.

When fully developed, the 1,500 FTES campus would cover about 23 acres of land. An approximately seven acre open area on the eastern portion of the 73-acre subdivision would be set aside for future campus expansion, beyond 1,500 FTES. Possible functions for the expansion area include student/transient housing and recreational facilities.

3.6 PROJECT COST AND FUNDING

As part of the 2009 LRDP, costs for the four development phases were estimated. A summary of the estimated total cost for each phase is shown in Table 5 below (June 2009 dollars). Design costs were based on the DAGS compensation curves for design services. Construction costs vary widely and are influenced by a number of factors. The costs shown are initial estimates only and are subject to change.

Table 5. Estimated Cost Summary

	Phase 1		Phase 2	Phase 3	Phase 4
	Phase IA Culinary Arts bldg.	Phase IB Health Science/Student Services bldg. (upper section)	Health Science/Student Services bldg. (completed)	Academic Support and Gen Ed II bldgs.	1,500 FTES Campus
Building Cost	5,850,827	2,921,028	5,700,895	15,873,450	25,942,850
Infrastructure Cost	3,446,384	1,720,609	966,058	7,863,372	5,720,238
Total Construction Cost	9,297,211	4,641,637	6,666,953	23,736,822	31,663,088
Design Cost	383,525	191,475	440,000	854,000	2,300,000
Total Cost	9,680,736	4,833,112	7,106,953	24,590,822	33,963,088
Cumulative Total	**9,680,736**	**14,513,848**	**21,620,801**	**46,211,623**	**80,174,711**

As stated earlier, Palamanui is committed to designing and constructing the first 20,000-square foot UHCWH building, up to a cost of $5,000,000. If the cost of the first building exceeds $5,000,000, the University is obligated to make up the difference. Hawai'i Campus Developers is currently under contract with the University to prepare the 2009 LRDP and the associated SEIS (this document), and design the first three state-funded buildings. The first building, plus the three subsequent state-funded buildings comprise the 750 FTES campus (development phases 1 through 3). Total design costs are estimated to be $4,169,000, of which $2,454,000 is unfunded and reflects the costs above the amount allocated under Hawai'i Campus Developers contract. Funding sources to construct additional facilities as the UHCWH expands have yet to be definitively identified.

3.7 PLANNING AND DESIGN PROCESS

The planning effort for the UHCWH consists of two major components: the 2008 Ed Specs, the 2009 LRDP.

3.7.1 Educational Specifications

The purpose of the 2008 Ed Specs, prepared by Hawai'i Campus Developers, was to update or revise the 1998 Ed Specs for the UHCWH. The 2008 Ed Specs, in conjunction with new site information and guidance from UH, were used to update the 1998 LRDP. Preparation of the Ed

Specs is the first major activity of the LRDP update process. Data from the Ed Specs is used to formulate a basis for physical planning and any required incremental development strategies.

The 2008 Ed Specs reflect the physical space needs and requirements for the new UHCWH. The document provides functional relationship diagrams for five major activity areas: Instruction, Academic Support, Student Services, Continuing Education and Institutional Support; a space allocation table with the space name, number of rooms and known or estimated square footage for each space; and furniture and equipment requirements and general design requirements for the spaces in each of the five activity areas. The 2008 Ed Specs were approved by UH in September 2008.

Two other documents were prepared by Hawai'i Campus Developers as addenda to the main 2008 Ed Specs document. The "Educational Technology Plan," dated October 23, 2008, addresses the future of educational technology and how the UHCWH envisions integrating that technology into their new campus. The directions established in the plan will help determine the design of the data, audio and video systems for the new campus. The second addenda, "The Learning Landscape," also dated October 23, 2008, addresses formal spaces, academic support spaces and corridors. The primary purpose of this document is to suggest an approach and present concepts and ideas on how to design these spaces.

3.7.2 Long Range Development Plan

With the UHCWH functions, square footage, and design requirements established in the 2008 Ed Specs, a site plan for the University Center was developed via the LRDP process. This process addresses long range site planning, infrastructure and utility requirements, general design considerations, and implementation strategies. The LRDP site planning process consists of three major components: site utilization, alternative site plans, and the ultimate plans.

Site utilization analysis is the first step in the LRDP planning and design process; the main purpose of which is to provide the University with rational information that can be used in deciding which part of the 500-acre project area would be the best location for the UHCWH campus core. The analysis also illustrates other significant site considerations, such as connections to the adjacent community, connections to infrastructure and utilities, vehicle and pedestrian circulation patterns, compatibility with various site constraints, and potential impacts on the environment. Site utilization schemes are presented in the form of bubble diagrams, which portray major site elements. These elements include major campus educational components, vehicular and pedestrian circulation patterns, parking, and open space. As such a bubble, rather than an actual building footprint represents each function. As a result of the site utilization analysis, a Preferred Site Utilization Scheme is adopted following an evaluation of the various alternative utilization schemes developed. The selection of the campus core location is dictated by the Preferred Site Utilization Scheme.

The second step in the LRDP planning and design process is the site planning phase, which consists of refining and further developing the Preferred Site Utilization Scheme chosen as a result of the site utilization analysis. In the site planning phase, building locations and footprints rather bubbles are placed within the site in accordance with the Preferred Site Utilization

Scheme. As well, other site elements are designed and laid out in more detail. Three alternative campus site plans are generated and evaluated, and a Preferred Campus Site Plan is selected.

The final step in the site design process is the development of the Ultimate Campus Site Plan and associated ultimate plans. The Preferred Campus Site Plan is further developed and refined to generate the Ultimate Campus Site Plan. Associated ultimate plans also are developed to support the Ultimate Campus Site Plan. These include: Ultimate Civil Plans (grading, drainage, water and wastewater), the Ultimate Landscaping Plan, Ultimate Electrical Plans (electrical, lighting, telecommunications, and building automation), and Ultimate Mechanical Plan. These ultimate plans are schematic in nature and serve as a guide for the long range development of the UHCWH campus. The Ultimate Campus Site Plan and associated ultimate plans are the Proposed Action addressed by this SEIS. A detailed discussion of the Proposed Action is discussed in Sections 3.3, 3.4, and 3.5 above.

3.8 ALTERNATIVES TO THE PROPOSED ACTION

The previous EIS, prepared in 2000, analyzed potential impacts associated with the project as it was proposed in the 1998 LRDP. The current SEIS builds upon the 2000 EIS by evaluating a new alternative, the current Proposed Action as proposed in the 2009 LRDP. The major change from the 1998 LRDP to the 2000 LRDP is the relocation of the campus core from the southwestern portion of the 500-acre University site to the extreme northwestern corner. The opportunity to tie in to Palamanui’s infrastructure, as well as benefit from the proximity to Palamanui’s village town center, served as the impetus for this change in location. Since the original 2000 EIS already evaluated various project alternatives (access road, water system, and wastewater system options), the SEIS only addresses the revised Proposed Action and No Action.

3.8.1 No Action

Under the No Action alternative, the UHCWH would continue operating in its current location at the Kealakekua Business Plaza. No new permanent facility would be developed for the UHCWH.

Lack of a permanent facility for higher education in West Hawai‘i would inhibit the growth and development of higher education programs and opportunities in the region. The current facilities have inadequate space for the programs currently being offered and cannot accommodate any planned program expansion. With No Action, it would become increasingly difficult for the UHCWH to provide the diversity of courses and programs necessary to allow the West Hawai‘i workforce to prepared and adapt to changing technology, thus affecting job development and growth. The breadth and depth of programs and courses offered would be further compromised if a greater portion of the budget for the UHCWH must be allotted for lease rent as opposed to equipment, supplies, faculty, and staff.

The present temporary facilities at Kealakekua have several shortcomings that would be mitigated by the construction of new and permanent facilities for the UHCWH. These shortcomings include:

1) The location of the facilities is not centrally located within the West Hawai'i region;
2) The present site does not convey the proper image of a higher education institution;
3) The existing space is under-sized, especially the classrooms; and there is a lack of space for meetings and support activities;
4) The classrooms are not sound-proof (i.e. some classroom doors cannot be closed during use); and
5) Lease rent is being paid because the land and facilities are not owned by the State of Hawai'i.
6) Current facilities do not provide room for expansion of the educational program.

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Tax Map Key Figure 6

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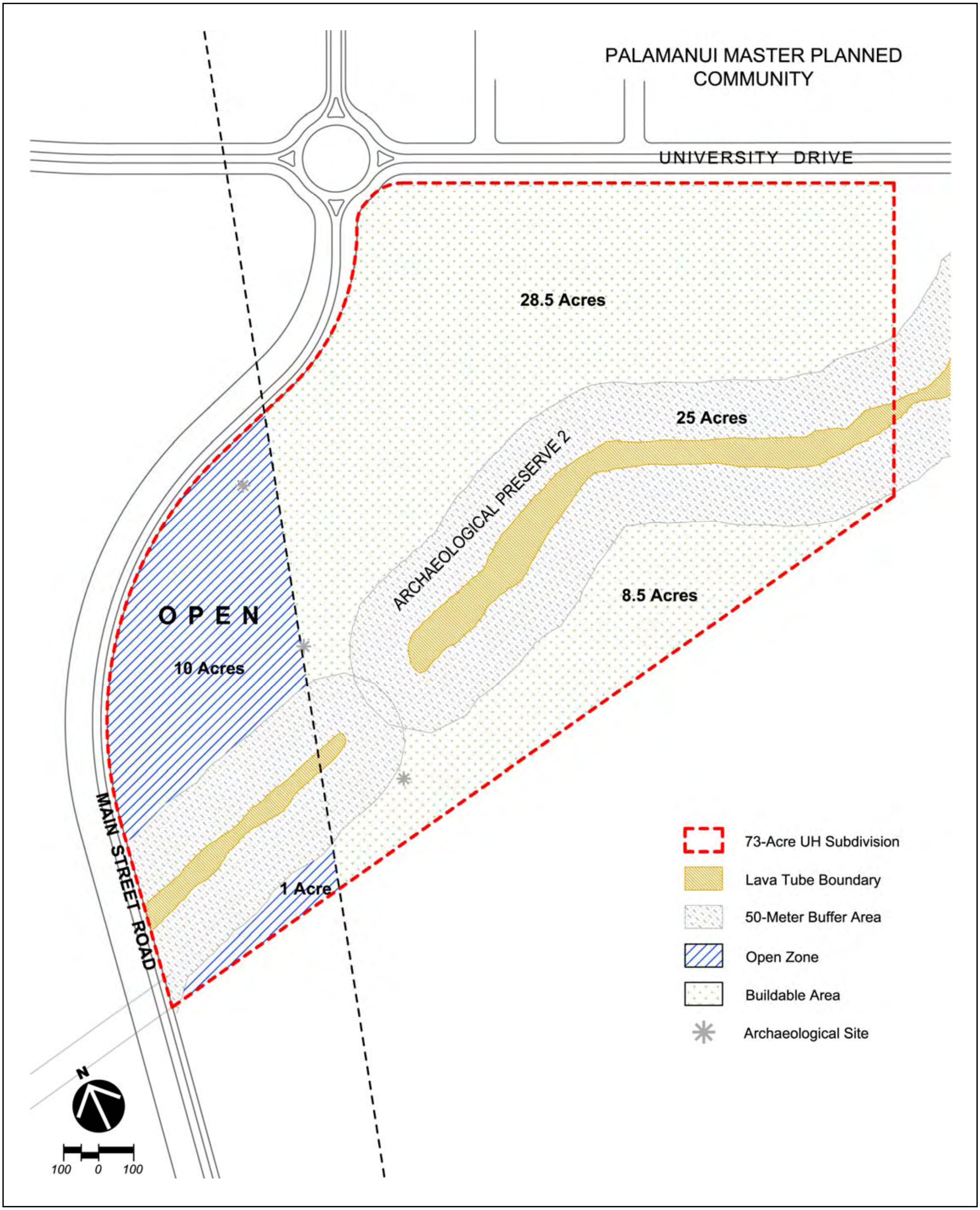

Site Constraints

Figure 7

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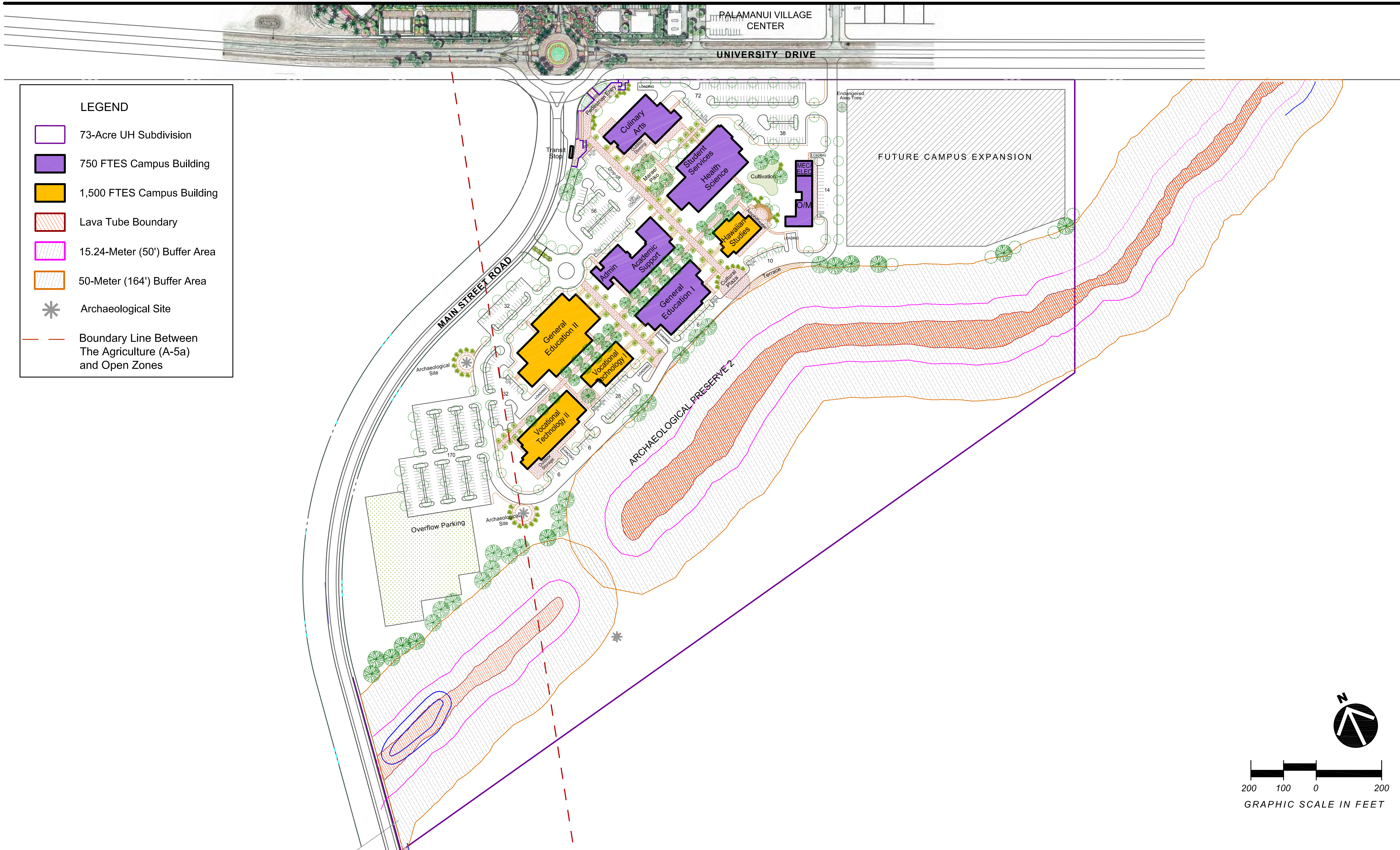

Ultimate Campus Site Plan Figure 8

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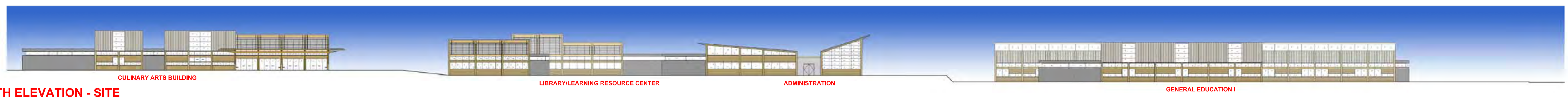

NORTH ELEVATION - SITE

ELEVATION ALONG THE CAMPUS MALL

Site Elevations Figure 9

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3-D Site Rendering

Figure 10

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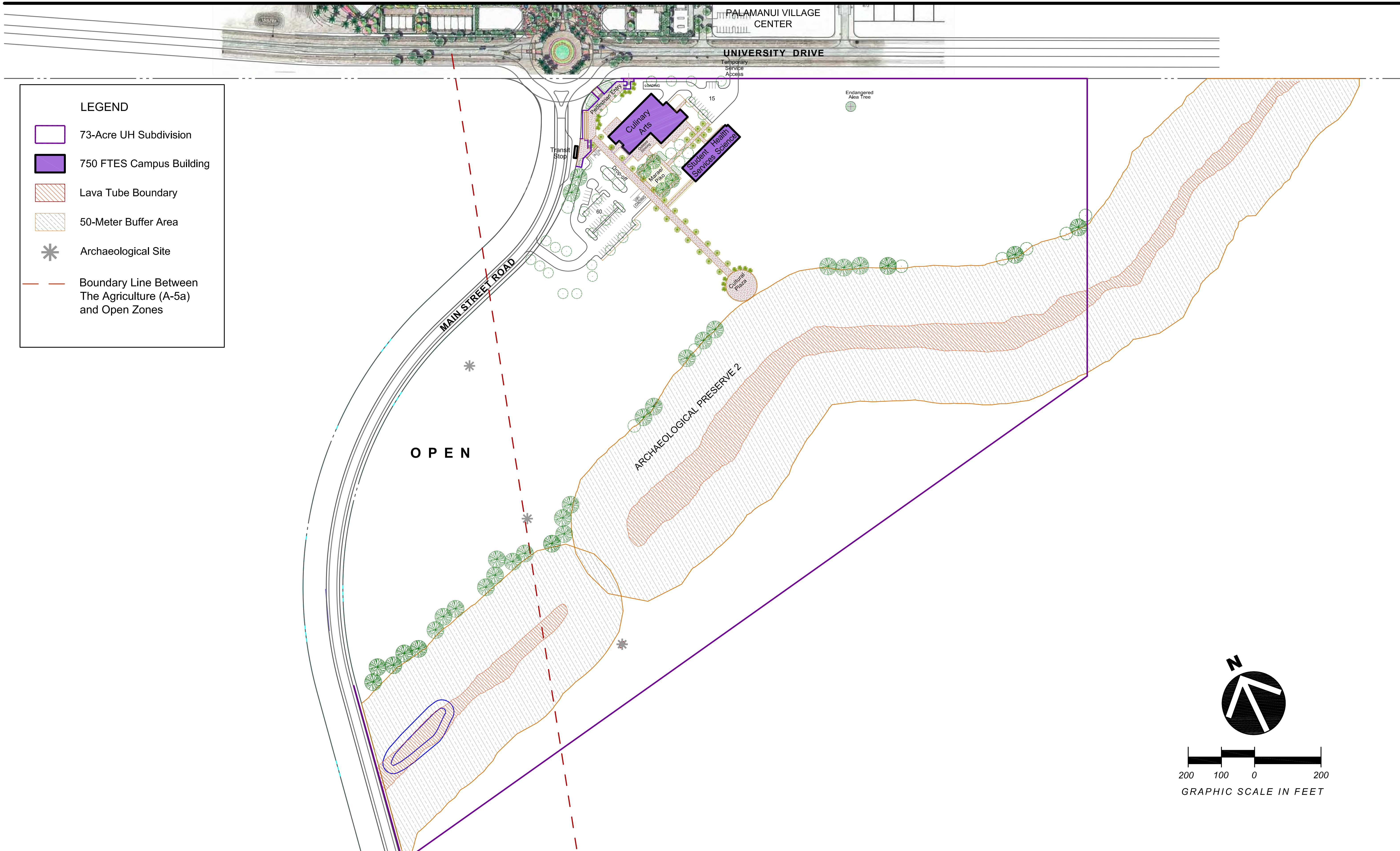

Development Plan Phase 1 Figure 11

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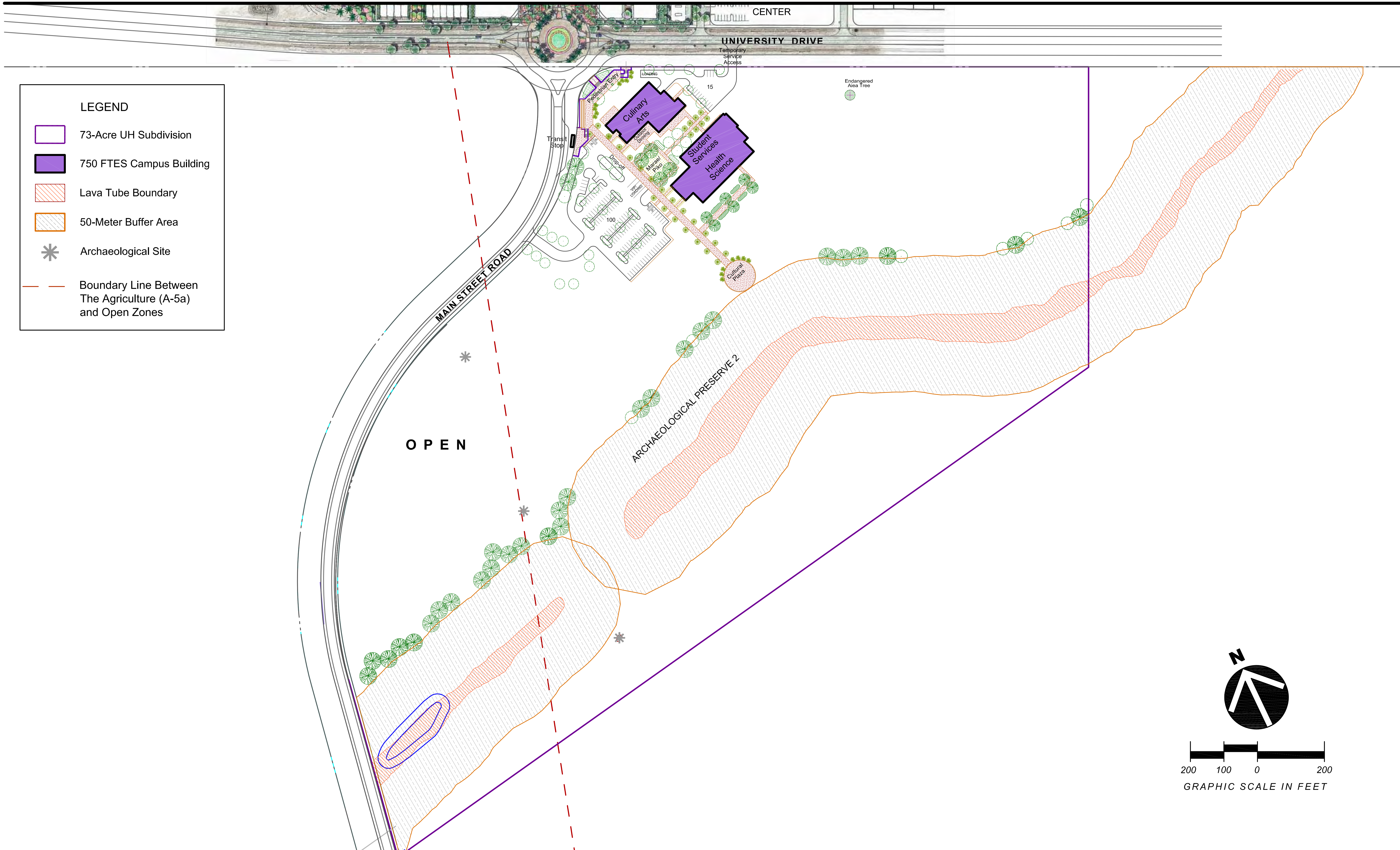

Development Plan Phase 2 Figure 12

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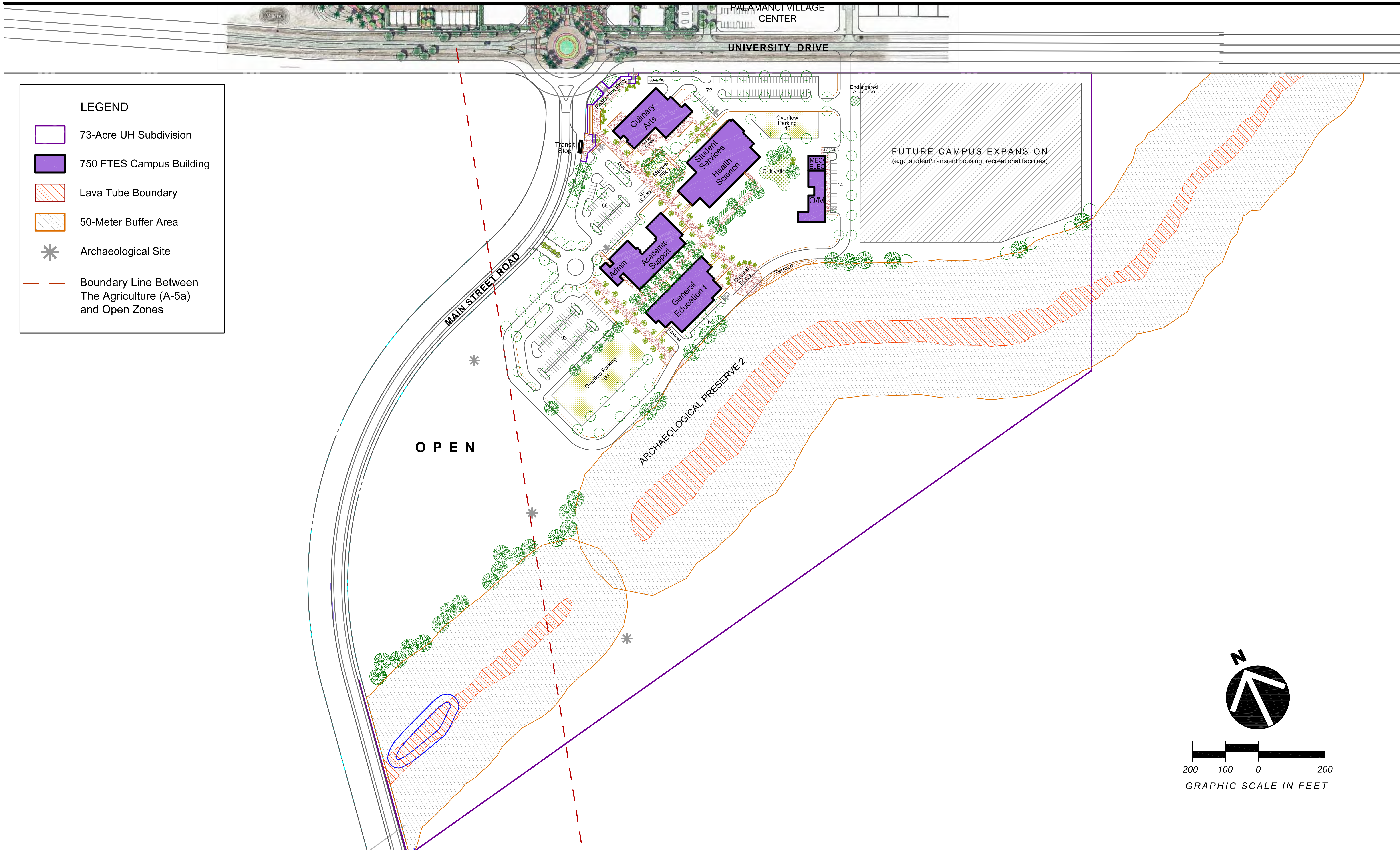

Development Plan Phase 3 Figure 13

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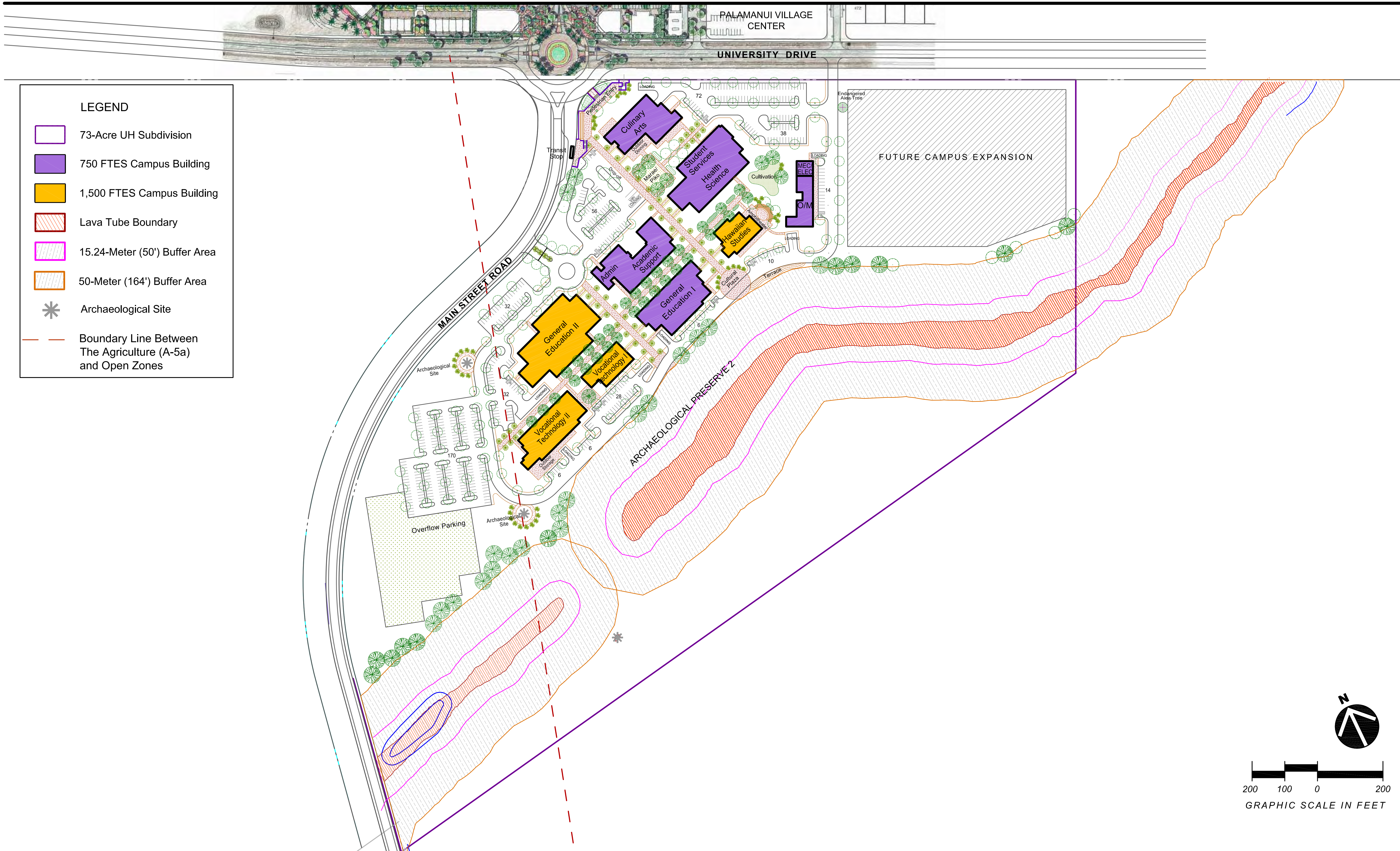

Development Plan Phase 4 Figure 14

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4.0 DESCRIPTION OF THE AFFECTED ENVIRONMENT, POTENTIAL IMPACTS AND MITIGATION MEASURES

This section provides background or baseline information on the existing natural, man-made and socio-economic environment. Information in this section pertains to the entire project area and where necessary, the environment specific to the proposed site also is discussed. Discussions also include potential environmental impacts that could result from implementing the Proposed Action on the natural, man-made and socio-economic environments. Where warranted, mitigation measures have been identified for adverse affects.

Note that usage of the term "project area" is used interchangeably with 500-acre University site or University parcel and the term "proposed site" refers to the 73-acre subdivision in the northwest corner of the project area that is being proposed as the new location for the UHCWH campus core.

4.1 NATURAL ENVIRONMENT

4.1.1 Climate

4.1.1.1 AFFECTED ENVIRONMENT

Most of Hawai‘i is characterized by slight seasonal variations that create a climate of year-round mild and equitable temperatures, moderate humidity and predominantly northeast trade winds. By comparison, the climate at the project area is characteristically hot and arid. The landmasses of Mauna Loa, Mauna Kea and Mt. Hualālai shelter the project area from the prevailing trade winds such that southerly and southwesterly land and sea breezes predominate in the project area. From season to season, coastal temperatures typically vary approximately 15 to 20 degrees Fahrenheit (°F) with an average temperature of about 75° F. Data recorded at the Kailua monitoring station, located at an elevation of 30 feet above mean sea level (msl) indicates the mean low annual temperature ranges from 60° to 65° F and the mean high annual temperature ranges from 80° to 82° F (National Weather Service, Pacific Region, 1982 in Armstrong, 1983, p. 64). Weather data recorded at Keahole Point and Kona International Airport indicate that calm conditions prevail in the North Kona district approximately 28.8 and 23.6 percent of the time, respectively (Ibid, p. 65).

Rainfall distribution patterns for West Hawai‘i closely follow the topographic contours of the land. Annual average rainfall decreases as you move from a band known as the rainfall belt of Hualālai at 2,000 and 3,000 feet above msl, to lower elevations near the coast (Fukunaga & Associates, Inc., 1994, p. II-2). This belt receives a peak rainfall of 75 inches a year, whereas the average annual precipitation recorded at the Kailua monitoring station is 25 inches (DBEDT, 1998, p. 160). The project area is located between 300 and 600 feet above msl, well below the rainfall belt and has been estimated to receive less than 20 inches of rain per year.

In the vicinity of the project area, rainfall is more frequent during the late afternoon and evening periods. Offshore cloud masses form to the west, picking up precipitation from the ocean during the day. Sea breezes that blow from the south/southwest move this band of clouds, along with warm moist air, onto shore, pushing the clouds upslope throughout the day. As these clouds rise in elevation, the air begins to cool and condense creating a drop in pressure, causing them to drop their load in the form of rain. This mechanism is known as the orographic effect and accounts for most rainfall received at higher elevations on mountain ranges throughout the Hawaiian Islands (Juvik & Juvik, 1998).

4.1.1.2 POTENTIAL IMPACTS

NO ACTION

With No Action, the project area would remain undeveloped and there would be no impact on climate.

PROPOSED ACTION

The Proposed Action is anticipated to result in a minimal impact on the climate. Although the scope of the Proposed Action is not large enough to change or alter the climate by itself, every individual and organization generates a carbon footprint by consuming energy both directly and indirectly, which contribute to climate change cumulatively. Carbon footprint is a "measure of the impact that human activities have on the environment in terms of the amount of greenhouse gases produced, measured in units of carbon dioxide" (http://www.carbonfootprint.com, 2008). The main greenhouse gases in the atmosphere are water vapor, CO_2, methane, nitrous oxide, and ozone.

As a result of the Proposed Action, increased greenhouse gases (GHG) emissions can be expected from operating a new permanent UHCWH campus. Emission sources range from using electricity for lighting and cooling, maintaining vehicle fleets, and vehicular traffic, among other things. However, as energy and resources conservation is an integral part of the planning and design process, scores of energy conservation measures and programs have been recommended for the UHCWH. Implementation of these recommendations would significantly lower the UHCWH's GHG emissions. The BOR, in November 2009, approved the 2009 LRDP and its goal of attaining a LEED Platinum rating, minimizing the campus' carbon footprint and moving the campus toward net zero energy consumption.

Specific measures are being considered to conserve energy and reduce GHG include using natural/passive ventilation in certain areas of the facility, particularly during cooler months; employing passive design cooling and shading strategies; maximizing the use of natural daylighting; harvesting sunlight for energy; employing LEED criteria in building and site design; and encouraging use of distance learning through technology such as tele/video-conferencing to reduce commuting. By adopting these and other measures, the UHCWH can effectively reduce its carbon footprint.

In addition, the UHCWH administration intends set up sustainable policies for daily operation. Such policies would encourage behavioral changes among students, staff and faculties to reduce, reuse and recycle; turn off lights and computers when not in use, and use public transit and bicycles to commute.

4.1.1.3 MITIGATION

As a result of the project features to conserve energy, no mitigation is warranted or proposed.

4.1.2 Soils

4.1.2.1 AFFECTED ENVIRONMENT

The soils in the project area are designated as lava flows association and are categorized as rLV or *‘a‘ā* flows, and rLW or *pāhoehoe* flows (refer to Figure 15) (SCS, 1973). This soil association consists of gently sloping to steep, excessively drained, nearly barren lava flows. Coarse-textured and medium-textured soils exist. *Pāhoehoe* lava flows make up about 40 percent of this association and *‘a‘ā* flows about 30 percent. This soil association is used for grazing, wildlife habitat and recreation; however, the carrying capacity for grazing and wildlife is low.

Primarily, the ground surface is exposed as barren rock with soils deposited within the cracks of the hardened lava flows. For most of the project area, the surface layer of soil is thin and does not provide the most suitable growing conditions for vegetation. This surface layer consists of approximately four inches of rapidly permeable black peat. A less-permeable *pāhoehoe* lava bedrock composes the subsurface. This combination results in slow flowing surface runoff and minor erosion (Ibid, p. 48). A thin layer of brown, silty volcanic ash may reside in pockets where residual ground soils are absent. There are a few resilient species of plants that are able to grow in this type of volcanic environment due to the combination of meager soil and inhospitable terrain.

The soils in the project area are low in agriculture productivity. The Agricultural Lands of Importance in the State of Hawai‘i (ALISH) System does not classify any lands within the project area. As well, the Land Study Bureau does not assign a productivity rating to any land in the project area.

4.1.2.2 POTENTIAL IMPACTS

NO ACTION

With No Action, the project area would remain undeveloped and there would be no impact on soils.

PROPOSED ACTION

Impacts to soils could occur from implementing the Proposed Action. Construction activities, such as excavation, clearing, grading, and grubbing to prepare the site for construction of facilities and supporting infrastructure on the undeveloped property would disturb and/or expose soils for the duration of site work periods. Exposed soils are susceptible to erosion, especially during periods of heavy rain. Wind erosion may also cause some soil loss during construction, but the greater concern is silt runoff.

Urban development of the project area would not result in any loss of prime or productive agricultural lands due to the low productivity of the soils in the project area.

4.1.2.3 MITIGATION

Project actions would be accomplished using both temporary and permanent erosion and sedimentation control measures, as warranted. The minimal or non-existent surface soil deposits in affected areas may minimize the need for erosion control devices such as cut-off ditches, detention ponds, temporary ground cover vegetation, and various soil stabilization and protection materials. Potential soil loss through wind erosion could be controlled through the implementation of a watering program. Other measures would include implementation of standard construction site Best Management Practices (BMPs). All grading activities would be conducted in compliance with dust and erosion control requirements imposed by the County of Hawai'i. In the long-term, preparation of an appropriate site drainage plan by the design civil engineers will contribute to the control of erosion. Incorporating appropriate landscaping into the Proposed Action and continued management of the property would also contribute to the long-term control of erosion.

4.1.3 Geology and Topography

4.1.3.1 AFFECTED ENVIRONMENT

The existing geomorphology in the project area is the product of large-scale eruptions from Mt. Hualālai—a now-dormant shield volcano. Large-scale eruptions from this volcano may have ceased some 130,000 years ago; however, the most recent lava flows occurred in circa 1800 – 1801. Expectedly, the landscape of the North Kona area is shaped by Hualālai Volcano. The most recent flow from the 1800 – 1801 eruption and earlier flows created a harsh landscape that slopes toward the sea.

The project area is located within the lowlands along the southwestern slopes of Mt. Hualālai. Much of the project area is located at elevations ranging from 300 to 600 feet above msl (refer to Figure 16). A generalized slope study in the *Keahole to Kailua Development Plan* (1991) shows that the lowland areas, which are between the coastal areas and the steeper uplands, are level to gently sloping, with slopes in the zero to five percent and five to ten percent ranges. The coastal areas are generally level with slopes in the zero to five percent range, while the uplands are steeper with slopes of 10 to 15 percent, and even 15 to 20 plus percent in some areas (refer to Figure 17). Slopes in the project area, which is situated in the lowland area, generally vary from five to ten percent at lower elevations with a few locations over 10 percent at the upper elevations (refer to Figure 18). Localized mounds and depressions, which are characteristic of lava flows, are present throughout the project area. Relative to the proposed site, elevations range from approximately 400 to 500 feet above msl.

Geomorphology of the project area, as well as the proposed site, consists of multiple interbedded *pāhoehoe* and *'a'ā* flows. A *pāhoehoe* flow hardens to form a generally smooth surface whereas *'a'ā* flows form splintered or jagged fragments. Multiple flows of differing ages overlap each other creating a layered landscape of varying colors, each reflecting the differences in age, chemical composition and each flow's state of weathering. The terrain is rough; rolling embankments of crusted *pāhoehoe* flows continuously change the contour of the surface, while uneven, sharp edged *'a'ā* rocks jut out, making it difficult to traverse.

Both types of lava can contain subsurface voids like pockets, blisters, extensive lava tubes and tunnels that form as a result of residual lava draining beneath the solidified surface of cooled molten rock. Numerous lava tubes and/or voids including several prominent lava tube features have been discovered in the vicinity of the project area. A prominent lava tube feature in northwestern portion of the project area, within the proposed site, has been documented by several studies conducted over the past 15 plus years.

4.1.3.2 POTENTIAL IMPACTS

NO ACTION

With No Action, the project area would remain undeveloped and there would be no impact on geology and topography.

PROPOSED ACTION

Construction of the Proposed Action would have no affect on the geology of the area. It would not affect the underlying geologic composition of the affected area because construction would involve primarily surface activities that do not require the excavation or replacement of vast areas of sub-surface resources. The overall design of the UHCWH would incorporate the sloping terrain of the proposed site to minimize grading and site modification to the extent practicable. However, localized alteration of the topography from land disturbing activities such as clearing, cutting, excavating and filling to prepare the site for construction is inevitable. These changes to the topography would occur to create level areas for project elements such as buildings, roadways, parking areas, and pedestrian paths. All site modification work would conform to grading standards set forth in the Hawai'i County Code, which should keep prevent and minimize any potential impacts. All clearing, cutting, excavating and filling for site preparation shall be conducted in accordance with BMPs for construction sites.

4.1.3.3 MITIGATION

No mitigation is warranted or proposed.

4.1.4 Water Resources

4.1.4.1 AFFECTED ENVIRONMENT

Groundwater. The project area overlies the Keauhou Aquifer System, a system of basal and high-level aquifers which consist of a fresh to brackish water lens floating on a layer of salt water. The Keauhou Aquifer, which is part of the Hualālai Aquifer Sector, has an estimated sustainable yield of 38 million gallons per day (mgd) (Wilson Okamoto, 2007). The Hualālai Aquifer Sector Area has a total sustainable yield of 56 mgd. As of 2005, water use, by both DWS and private wells, from the Keauhou Aquifer and the Hualālai Aquifer Sector Area was 10.723 mgd and 14.426 mgd, respectively (Ibid.).

Fresh water is found at an approximate elevation of 1,800 feet above msl. The fresh water layer becomes thinner and more saline as it approaches sea level (Waimea Water Service, 2003). Under ideal conditions, fresh ground water flows downgradient from the recharge area at 2,000 feet to sea level. Rainfall above an elevation of 2,000 feet is the primary source of ground water recharge in the Kona region. Over one-third of the rain falls within a four- to five-mile wide belt and most of the annual 30 to 75 inches of rain percolates into the ground and recharges the aquifer (Fukunaga & Associates, Inc., 1994, p. III-1).

Surface Water. There are no streams and no surface water flows into the Pacific Ocean from or through the project area. The lack of streams is due to the porosity of the bedrock, which is characteristic of the interbedded *pāhoehoe* and hardened *‘a‘ā* flows of the Hualālai volcanic sequence. Even during periods of heavy rainfall, surface runoff in the Kona region rarely reaches the coast in a direct manner or flows into drainage ways that reach the coast, because most of it percolates into the porous volcanic bedrock (Ibid).

The closest offshore surface water is the Pacific Ocean off Keahole Point. These waters are located approximately 2.5 miles from the project area and are classified as AA waters. In accordance with HAR 11-54-06, the objective of Class AA waters is to preserve them "in their natural Pristine state as nearly as possible with an absolute minimum of pollution or alteration of water quality of any human-caused source or actions."

4.1.4.2 POTENTIAL IMPACTS

NO ACTION

With No Action, the project area would remain in an undeveloped state and no impacts on water resources (ground water or surface) or water quality would occur.

PROPOSED ACTION

Ground Water.

The Proposed Action's potable water demand would affect groundwater sources by contributing to the region's total withdrawal; however, the UHCWH's share of the withdrawal is not expected to be significant. Refer to Section 4.3.1 for further discussion on potable water service for the UHCWH. Project features that reduce the demand for potable water are being considered for implementation. Such features include the use of drought tolerant plants for campus landscaping; use of R-2 water, captured rainwater, and AC condensate for irrigation; and the use of water-saving plumbing fixtures. Reduced use of potable water would decrease any impacts on the demand for groundwater sources.

Construction of the UHCWH would result in the creation of impervious surfaces that would increase localized runoff. The loss of localized groundwater recharge is expected to be negligible and inconsequential to the overall function of the natural hydrological system and total recharge of the underlying aquifer.

Impacts to ground water also can occur when the ground is very porous and contaminants, such as leaked automobile fluids, combine with surface runoff and both percolate into the aquifer. The Surface runoff from the Proposed Action is not expected to result in significant adverse impacts to the environment as the Proposed Action would include plans to control drainage and runoff from roads and other impermeable surfaces, with filters and retention or settling basins provided, as warranted, to remove contaminants so they do not percolate into the aquifer.

Surface Water. The project area has no surface water bodies and is not within close proximity to the shoreline. Impacts to surface water from runoff are not a major concern due to the inherent geologic properties of the project area. No drainage ways exist on the property and runoff percolates into the porous lava rock. As such, there is very little potential for impacts to surface water as a result of the Proposed Action.

The Proposed Action would result in an increase in impermeable surfaces. Increased impermeable surfaces degrade the efficiency of the land to absorb surface water, and contribute to increased runoff flow. Project designers would utilize design features and materials to reduce the amount of runoff from impervious surfaces. While the project has yet to be fully designed, such measures could include the use of alternative paving materials, such as grid pavers, which promote infiltration and reduce the amount of impervious cover. Surface runoff from impervious surfaces would be contained on-site with the use of inlets and drywells, as needed.

4.1.4.3 MITIGATION

Ground Water. No mitigation is warranted or proposed.

Surface Water. No impacts to surface water are anticipated as there are no surface water bodies within or near the proposed site. However, the use of temporary and permanent erosion and runoff controls shall be implemented as warranted, which should prevent any potential effects to surface waters.

4.1.5 Natural Hazards

4.1.5.1 AFFECTED ENVIRONMENT

There are two major sources of geologic hazards in the area, earthquakes and volcanic activity; lava tube collapse is a minor geologic hazard. Other natural hazards include flooding and tsunamis.

Seismic Hazards. The island of Hawai'i is seismically active with most of the earthquakes occurring on the southern flank of the island. However, the Kona area is subject to earthquakes with intensities up to VIII on the Modified Mercalli Scale, which roughly corresponds to magnitudes 6.0 to 6.9 on the Richter scale. This intensity is enough to damage structures and buildings with inadequate foundations or that have not been structurally reinforced to withstand such tremors. The last major earthquake to hit Kona was on October 15, 2006. The epicenter of the quake was located approximately10 miles to the west of Kiholo Bay, reaching a magnitude of 6.7 on the Richter scale (Wyss and Koyanagi, 2006). Prior to that, a 6.9 magnitude quake hit Kona in August of 1951 causing extensive damage island-wide. Earlier, in 1929 there was a series of earthquakes that caused damage in West Hawai'i (Garcia, 2004).

Volcanic Hazards. The project area is located entirely within Lava Hazard Zone 4, which encompasses the entire region affected by Hualālai (refer to Figure 19). Hualālai is the least active volcano on the island of Hawai'i and its eruptions are infrequent and appear to occur in clusters separated by intervals of centuries. Volcanic eruptions may be preceded by a long period of localized seismic activity (Garcia, 2004).

Lava Tube Collapse. Lava tubes form when the molten *pāhoehoe* surface flows begin to cool and crust over, eventually forming a hardened outer surface layer. As the supply of fluid magma decreases during an eruption, the level of its residual subsurface flow gradually drops as it drains from primary pathways. This essentially leaves pockets of open space between a ceiling and floor of solidified magma, forming hollow underground cavities and tunnels just below the hardened surface. The closer lava tubes are to the surface, the thinner their roofs, which make them more hazardous as they are more likely to collapse if significant weight is added at the ground surface or even just due to natural weathering processes.

Flood Potential. The project area is located in a dry and arid environment where flood risks are low. The combination of low rainfall, a thin soil layer and the porosity of the bedrock create a condition of very low to almost non-existent flood potential. During periods of heavy rainfall, ponding and some scouring by flowing surface water may occur, but normally it does not last long. Storm water rapidly percolates into the substrate and does not reach the sea. Flood maps indicate that the area is designated as Zone X, which represents areas that are determined to be outside of the 500-year floodplain.

Tsunamis. Tsunamis occur as a series of waves that strike a coastline, which can cause serious damage to coastal areas. The degree of tsunami damage is dependent upon several factors including the topography of the affected area, wave origin, and wave intensity. The general tsunami inundation lines are concentrated within short distances of the shoreline. The project area is located some 2.5 miles from the coastline of West Hawai'i and at elevations of 400 feet or more above msl. These conditions presumably place the project area outside high risk areas that are subject to a tsunami hazard.

4.1.5.2 POTENTIAL IMPACTS

NO ACTION.

Seismic Hazards. With No Action, the project area would be susceptible to seismic hazards even in an undeveloped state. However, the potential for impacts to human safety and property damage would be eliminated.

Volcanic Hazards. With No Action, the project area would be susceptible to volcanic hazards even in an undeveloped state. However, the potential for impacts to human safety and property damage would be eliminated.

Lava Tube Collapse. There are documented lava tubes within the project area, and some already have portions of roofs that have collapsed. With No Action, the project area would remain undeveloped, which would minimize the potential to contribute to the collapse of lava tubes. Also, No Action would minimize the impacts to human safety, since the likelihood of human activity within the project area would be significantly reduced.

Flood Potential. With No Action, the project area would remain undeveloped and there would be no impact on the flood potential of the area.

Tsunamis. With No Action, the project area would remain undeveloped and there would be no impact on the tsunami potential of the area.

PROPOSED ACTION

Seismic Hazards. The threat from seismic hazards will always exist because humans have little control over the frequency and intensity of these unpredictable events. The entire island of Hawai‘i is subject to earthquakes and the resultant impacts to human safety and property.

Volcanic Hazards. The Kailua-Kona area is located in Zone 4 on volcanic hazard maps. Zone 4 includes all of Hualālai where the recurrence intervals of eruptions are in the centuries. Therefore, while miniscule, implementing the Proposed Action would increase the potential for human exposure to volcanic hazards.

Lava Tube Collapse. The Proposed Action has the potential to contribute to the collapse of lava tubes. Earth movement resulting from construction activities as well general human occupation of the area could contribute to this occurrence. As well, development within the project area would increase exposure to this hazard, thus impacting human safety.

Flood Potential. The flood potential within the project area is very low to almost non-existent. Implementing the Proposed Action would not impact the flood potential of the project area.

Tsunamis. Due to the project area's distance and upslope location from the coast, the Proposed Action would not affect human safety and potential for property damage resulting from a tsunami.

4.1.5.3 MITIGATION

Seismic Hazards. Facilities would be designed and constructed in conformance with all applicable regulations and guidelines, such as the Uniform Building Code requirements for Seismic Zone 3 (which includes structural design standards for earthquake resistance).

Volcanic Hazards. There is adequate room upslope from the project area upon which to build lava diversion barriers, if the technology for such devices improves and their effectiveness is proven. Otherwise, there are currently no effective mitigation measures for volcanic eruptions, other than maintaining an evacuation plan for the campus, given enough advance warning of an eruption.

Lava Tube Collapse. To eliminate any potential hazards due to the collapse of a lava tube that may be located within the proposed site, a geotechnical investigation should be performed for construction areas and appropriate measures employed to address site specific conditions. Such measures may include backfilling the lava tube; spanning the lava tube with girders or other means of support to minimize the stress on the cave roof; or modifying the facility layout to avoid the lava tube altogether.

Flood Potential. No mitigation is required to address flooding.

Tsunamis. No mitigation is required to address tsunamis.

4.1.6 Air Quality

4.1.6.1 AFFECTED ENVIRONMENT

The air quality of a given location is affected by a myriad of influences from the surrounding environment. Regional and local climatology, including prevailing wind patterns, average annual and seasonal temperatures, atmospheric turbulence, mixing height, and rainfall each contribute to the general air quality of a given location. Attributes of the surrounding built environment can also be significant; including automobile and industrial emissions, among other characteristics. Other influences on a location's air quality include topography and the presence of natural features such as volcanoes, swamps or other gas emitting features, or proximity to forests and other natural environments, which may be beneficial to a location's air quality. At the proposed site, air pollutants from natural, industrial, and vehicular sources each influence the air quality of the area.

The project area is located within an area that, at times, is exposed to high levels of natural air pollution, primarily resulting from its proximity to three natural features: Kilauea, Mauna Kea, and Mt. Hualālai. Kilauea, as one of the world's most active volcanoes, can be a major source of air pollution, not only affecting the proposed site, but the entire island of Hawai'i, and at times, the entire state. The Hawai'i Volcanoes National Park—with Kilauea Caldera—is roughly 40 to 50 miles from the proposed site. Pollution in the form of Sulfur Dioxide (SO_2) out-gassed from volcanic activity at Kilauea can have a negative influence on air quality. Volcanic out-gassing, referred to as volcanic haze or vog, is the most significant source of air pollution that influences air quality in the project area.

The Hawaiian Islands are located within the belt of the northeast trade winds, resulting in wind patterns that flow predominantly from the northeast. Mauna Kea and Mt. Hualālai lay to the northeast and east of the proposed site and act as a wind shield, drastically reducing the site's exposure to the predominant trade winds. However, volcanic emissions, which are vented on the other side of these mountain barriers do reach West Hawai'i. Winds can carry vog from Kilauea around Mauna Kea and Mauna Loa, where it amasses in the Kona and Kohala districts. On days when volcanic activity is most vigorous and winds are calm, a thick layer of persistent vog may be present in the West Hawai'i region.

The HELCO's Keahole Generating Station is an industrial source of air pollution in the vicinity of the project area. The Keahole Generating Station is located approximately .7 miles (3,700 feet) southwest of the project area. According to the Climate and Air Quality Assessment in the *Final Environmental Impact Statement for Keahole Generating Station and Airport Substation Urban Reclassification* (Belt Collins, 2005), air emissions from HELCO's CT-4 and CT-5 in conjunction with other existing diesel and combustion turbine units will meet both federal and state Ambient Air Quality Standards (AAQS).

Another potential industrial source of airborne contaminants is the Pu'u Anahulu Landfill, about 15 miles northeast of the project area. Pu'u Anahulu is the only landfill in West Hawai'i, accommodating approximately 51.3 percent of the island's solid waste disposal. Smoke and noxious fumes from underground fires at the landfill may influence the region's air quality.

Other sources of air pollution are motor vehicle exhaust from traffic on Queen Kaʻahumanu Highway, located less than a mile due west of the project area and Mamalahoa Highway, approximately two miles to the east. Both are major West Hawaiʻi arterial roadways in close proximity to the project area. Elevated concentrations of exhaust are generally attributed to periods of traffic congestion in limited areas near intersections during poor dispersion conditions.

Existing impacts on air quality from traffic on Queen Kaʻahumanu Highway were observed on December 14 and 15, 2009 and outlined in an Air Quality Impact Report (AQIR) (Morrow, 2009), included as Appendix B. Concentrations of carbon monoxide (CO) were measured at the Queen Kaʻahumanu Highway and Kaiminani Drive intersection on both dates. Test results presented in Table 6 below demonstrate that CO levels resulting from morning and afternoon traffic on Queen Kaʻahumanu Highway are well below both federal and state AAQS.

Table 6. Carbon Monoxide Levels – Queen Kaʻahumanu Highway at Kaiminani Drive

<table>
<tr><th>Sampling Date</th><th>Hourly Traffic Volume</th><th>1-Hour Mean CO Level</th><th>National AAQS Primary 1-Hour</th><th>State 1-Hour Standard</th></tr>
<tr><td>12/14/2009 (P.M.)</td><td>1,823</td><td>1.1</td><td rowspan="2">40</td><td rowspan="2">10</td></tr>
<tr><td>12/15/2009 (A.M.)</td><td>1,171</td><td>0.9</td></tr>
</table>

Source: Morrow, 2009.

Recently published data from the nearest DOH monitoring station in Kealakekua (see Table 2 in the appended AQIR) is indicative of the generally good air quality on the island of Hawaiʻi and could be considered representative of the air quality in the vicinity of the project area. Currently, concentrations of man-made pollutants do not exceed state and federal AAQS. The only threat to human health from degraded air quality is due to concentrations of volcanic emissions or vog.

4.1.6.2 POTENTIAL IMPACTS

NO ACTION

With No Action, the project area would remain undeveloped and there would be no impacts on air quality.

PROPOSED ACTION

On-site Impacts. Short-term air quality impacts would occur during grading and construction activities as a result of fugitive dust and particulate emissions. Construction vehicle activity, and the potential for increased stop and go traffic during construction, may at times increase vehicular pollution concentrations. This would impact the air quality along streets, as well as at the proposed site. During construction on unpaved on-site areas, increased particulate matter emissions can be anticipated as well. These impacts are temporary in nature, however, and can be reduced substantially with proper mitigation techniques.

At completion, the UHCWH would not be a major stationary source of air pollutant emissions. Anticipated air quality impacts to be generated by the UHCWH activities at the project area would be substantively similar if the same improvements were situated at Kealakekua or any other site, since planned program activities and uses anticipated for the UHCWH would be the same regardless of its location. Therefore, the proposed UHCWH activities would generally result in similar air quality impacts to their respective ambient environment.

In the long-term, traffic generated by the Proposed Action would contribute to non-stationary sources of pollutants in the form of vehicular emissions along existing roadways traversed by students, faculty, and staff of the UHCWH; however, this increase is anticipated to be minor. Modeling of potential impacts on air quality resulting from project-generated traffic was based on the projected FTES for the years 2012, 2017, and 2022. By year 2022, it is estimated that concentrations of CO at receptor locations 10 meters and beyond the edges of roadways, even under worst case conditions, would still be well under federal and state standards. Further, vehicle emission standards get progressively more stringent over time. Therefore, it is plausible to expect that in the future, usage of older vehicles would be replaced with newer, lower-emitting vehicles, thus helping to minimize CO levels attributable to traffic.

In an effort to address potential increased vehicular emissions caused by a larger student enrollment (up to 1,500 FTES), the UHCWH would provide parking and loading areas for shuttles and vans to reduce commuting by personal vehicles. As well, preferential parking would be provided for users of hybrid and other zero or low-emission vehicles. Ultimately, it would be the responsibility of conscientious students, faculty, and staff to utilize carpools, public transportation, and other more environmentally friendly modes of travel as opposed to the personal vehicle. Given these considerations, no mitigation for future non-stationary impacts to air quality is proposed or deemed warranted.

Off-site Impacts. Off-site impacts may result from the operation of concrete and asphalt batching plants that produce materials needed for construction (e.g., asphalt and concrete). These plants routinely emit particulate material and other gaseous pollutants. The DOH, Clean Air Branch requires these plants to obtain permitting and to meet stringent environmental regulations. Any emissions would be strictly regulated by the DOH permit, which each plant must have in order to operate.

An increased demand for electrical power and the demand for solid waste disposal could generate off-site stationary source impacts in the form of pollutant emissions from the fuel that has to be burned to create electricity and the movement of heavy equipment for solid waste transport and burial at a municipal landfill.

4.1.6.3 MITIGATION

Anticipated short-term air quality impacts associated with construction activities can be effectively mitigated through the use of dust control measures during the construction period, such as the erection of dust control screens around the construction site and the frequent watering of unpaved roads and areas of exposed soils. The EPA estimates that watering can reduce fugitive dust emission by as much as 50 percent if completed twice per day (Morrow, 2009). It is also recommended that paving roadways and landscaping of completed areas be accomplished as soon as possible to minimize fugitive dust emissions. Construction activities would be conducted in accordance with standard BMPs for construction sites and in compliance with all applicable air quality regulations including provisions contained in HAR 11-60.1-33 *Fugitive Dust*.

Mitigation for off-site stationary source impacts associated with the electrical demand includes incorporating energy efficient design into the Proposed Action, thus minimizing the energy demands of the facility. Relative to operation and maintenance of the UHCWH, establishing a program to reduce waste material and encouraging reuse and recycling can help mitigate impacts associated with the off-site disposal of solid waste.

4.1.7 Flora & Fauna

4.1.7.1 AFFECTED ENVIRONMENT

A biological survey of the 73-acre project site was conducted by AECOS Consultants in 2009 (attached as Appendix C). Previous studies of the project area were conducted in 1992 by Char Associates and Helber Hastert & Fee, Planners; in 1998 by Derral R. Herbst, Ph.D.; and in 2000 and 2005 by AECOS Consultants. The 2005 study assessed conditions along the proposed Main Street Collector Road corridor that extends north to south and generally forms the western boundary of the project area. The four studies completed between 1992 and 2005 were conducted as part of previous planning efforts related to the UHCWH. The dry and arid conditions that affect most of North Kona may contribute to the low diversity of biological resources observed within the project area. Cumulative findings from all five studies are compiled and described in the following sections.

Flora. The main objective of the five surveys was to determine if any endangered, threatened, proposed or candidate plants, as federally listed by the U.S. Fish and Wildlife Service (USFWS) under the Endangered Species Act (ESA) of 1973, as amended (16 United States Code 1531-1543), were located within the 500-acre University site.

The entire 500-acre project area can be classified as a Lowland Vegetation Community. Included in this community are two distinctive vegetation associations: the Lowland Dry Grassland and the Lowland Dry Shrubland (Gagne & Cuddihy, 1990 in Herbst 1998). The northern portion of the project area exhibits characteristics of the Fountain Grass Grassland subtype of the Lowland Dry Grassland community. It is a nearly monotypic stand of fountain grass (*Pennisetum setaceum*), a non-native from northern Africa that was introduced into the Kona District in the 1920s, which now dominates much of the arid, lava-strewn landscape in the project area. Sparsely scattered throughout the grassland are pockets of mostly native trees and shrubs, such as ‘ilima (*Sida fallax*), alahe‘e (*Psydrax odoratum*), maua (*Xylosma hawaiiensis*), naio (*Myoporum sandwicense*) and maiapilo (*Capparis sandwichiana DC*), a plant listed by the USFWS to be a species of concern. The maiapilo may be vulnerable because it is located in areas likely to be affected by urban development or human disturbances. The southern portions of the project area may be classified as a degraded ‘A‘ali‘i Lowland Shrubland subtype of the Lowland Dry Shrubland community; however, it is also dominated by fountain grass. The 2005 plant survey recorded 42 species growing across the 500-acre project area (AECOS Consultants, 2009). Of the 42 species, 10 (23.8 percent) were recognized as native, with three categorized as endemic and seven as indigenous.

The 73-acre project site is entirely within the northern portion of the 500-acre project area and exhibits characteristics of the Fountain Grass Grassland as described in the above paragraph. There is an east-west gradient in vegetation across the 73-acre project site as well. The higher elevations show a transition from a Fountain Grass Grassland to a Lowland Dry Shrubland, which is still dominated by fountain grass with scattered shrubs and trees. In the current survey (2009), 38 plant species were recorded in the 73-acre project site, 26 of which are ferns and flowering plants. Of the 26, nine or 35 percent are native, of which five are endemic. The majority of plants were alien introductions that have become naturalized at lower elevation environments along the leeward slopes of Hualālai. The site varies from relatively bare to relatively dense growth of fountain grass. Trees are very sparsely distributed and widely scattered within the project site and are limited mostly to the eastern half (upper elevation) (see Figure 20, *Botanical Resources*). Maiapilo was not recorded within the 73-acre project site.

The project area lies within the historical distributional range of several flora species included on the USFWS ESA list for threatened, endangered, and candidate threatened or endangered species such as ko'oko'olau (*Bidens micrantha ssp. Ctenophylla*), uhiuhi (*Caesalpinia kavaiensis*), kauila (*Colubrina oppositifolia*), hala pepe (*Pleomele hawaiiensis*), and 'aiea (*Nothocestrum breviflorum*). An historical distributional range is defined as the extent or limits of a spatial region over which a population or species is scattered, arranged or located, characteristic of past records and research. At this time however, only a single 'aiea tree has been recorded within the 73-acre project site. The 'aiea is protected under the ESA and cannot be destroyed, which would be considered a "take" under the ESA. The 'aiea tree was located and verified by geographic positioning system (GPS). It is shown on the Ultimate Campus Site Plan and labeled "Endangered 'Aiea Tree."

Fauna. The information contained in the following section represents cumulative results from studies conducted by various consultants during five faunal surveys that entailed a search for invertebrates and vertebrates within and in the vicinity of the 500-acre University site. The most recent survey was performed by AECOS Consultants in 2009, which focused on the 73-acre project site. As a whole, the main objective of the surveys was to determine if any of the faunal resources present are federally listed as threatened, endangered, or proposed threatened or endangered species. Findings of all previous surveys conducted have been fairly consistent.

Invertebrates. During a survey conducted by AECOS Consultants in 1999, no more than 15 different invertebrates were detected, with all encountered species presumably alien. Commonly encountered species included various wasps (*Polistes sp.* and *Vespula sp.*), the honey bee (*Apis mellifera*), and the garden orb-weaver spider (*Argiope sp.*). Conditions within explored caves (i.e., lava tubes) were found to be quite dry. The caves harbored bigheaded ants (*Pheidole megacephala*) and a harvestman spider (*Phalangidae* or *Pholcidae*).

In 2005, AECOS consultants conducted both surface and lava tube investigations during the day and again at night, preceding a period of above average rainfall. This resulted in healthy, well-developed host plants, which invertebrate populations depend upon, as well as the absence or low levels of introduced predators.

The results of the 2005 study turned up only a few native arthropods. No native invertebrates on the federal or state endangered, threatened, proposed or candidate lists were observed. Only one native snail was seen, *Succinea sp*. That individual was found on a rotting log. It is possible that if a survey was made immediately following a rain, more would be found since this genus is a very prevalent native snail.

The most recent survey (2009) was conducted at the end of the winter rains and vegetation was in good condition to support arthropod populations. A few native arthropods were collected or observed; however, no native arthropods or other invertebrates on the federal or state endangered, threatened, proposed, or candidate lists were seen during the survey. The area provides habitat for only a few native arthropods. The lack of native host plants is a major factor in the lack of native invertebrates. Further, goat feeding damage and the presence of predatory ant species combine to create a setting that is unlikely to support high levels of native arthropods. No native snails were observed in the survey. Despite the absence of significant cave fauna found during the faunal surveys, cave habitats may harbor unique endemic arthropods. It remains possible that unknown lava tubes or inaccessible segments of known tubes could contain native fauna.

Many alien species of medical importance (e.g., centipedes, scorpions, widow spiders) were not observed during the most recent survey, but could be present. Honey bee colonies and common paper wasp nests, however, were observed.

The sphinx moth (*Manduca blackburni*), which is listed as an endangered species under the ESA (Federal Register, 2004) is known to occur on the island of Hawai'i and may occur in the vicinity of the project area. No adult moths were seen in the most recent survey (2009). None of the introduced hosts suitable for moth caterpillars was seen (e.g., tree tobacco). One native host, the 'aiea tree, is located within the project site; however, no caterpillars or feeding evidence was noted on this tree.

<u>Vertebrate</u>s. Evidence of five alien mammalian species was detected during the five surveys completed between 1992 and 2009. Evidence of dogs (*Cannis f. familiaris*), cats (*Felis cattus*), goats (*Capra h. hircus*), pigs (*Sus s. scrofa*) and cattle (*Bos taurus*) was found in the area. During a 1992 survey, six small Indian mongoose (*Herpestes a. auropunctatus*) were detected (Bruner, 1992). Though no rodents (*Rattus rattus, Mus domesticus*) were visually observed, it is almost a certainty that these species use resources in the project area. It is difficult to assess the population densities of any of these mammals unless more comprehensive and costly studies are performed. All of these species are threats to avian and floral components of the remaining native ecosystem.

In a 2000 assessment conducted by Eric Guinther and Reginald David (Rana Productions, Ltd.), a single gecko (*Geytha mutilata*) was observed in the project area, which suggests that the environment may support populations of similar small lizards.

No endemic (or native) birds are expected to frequent the project area. The habitat found in the project area is typical of the fountain grass dominated, xeric communities of the North Kona District, which are not conducive to supporting native bird species. Faunal surveys suggest that the project area contains no particularly special or unique birds, including threatened or endangered species. Species that could potentially be present, yet uncommon, to the area include the Short-eared Owl or Pueo (*Asio flammeus sandwichensis*) and the endangered Hawaiian Hawk or 'Io (*Buteo solitarius*). The only migratory species recorded during any faunal survey was the Pacific Golden Plover (*Pluvialis fulva*). A total of 14 plovers were counted in a 1992 study (Ibid).

During the most recent study (2009), which focused on the 73-acre project site, 61 individual birds of 10 different species were recorded. All species detected are considered alien to Hawai'i. Avian diversity and densities were exceptionally low, typical of the xeric nature of the habitat on the project area. The most abundant avian species sighted were the African Silverbill (*Lonchura cantans*), the Northern Mockingbird (*Mimus polyglottos*), and the Black Francolin (*Francolinus francolinus*), accounting for over half of the total avian sightings. In previous studies the more abundant species were the Rock Pigeon (*Columba livia*), Zebra Dove (*Geopelia striata*), Warbling Silverbill (*Lonchura malabarica*), Japanese White-eye (*Zosterops japonicus*), and Nutmeg Mannikin (*Lonchura punctulata*). The 2009 survey also recorded one incidental sighting of a passing Barn Owl (*Tyto alba*).

Current survey techniques available for gathering information on the distribution, abundance and usage of resources in a given area by Hawaiian hoary bats (*Lasiurus cinereus semotus*), or 'ope'ape'a as they are known locally, are inadequate and/or time and cost prohibitive. Hawaiian hoary bats can be expected to fly over the project area. However, the project area currently has little to offer a passing bat due to the relative absence of suitable trees for roosting and the low diversity of volant (flying) insect life that may attract bats (Rana Productions, Ltd., 2000). However, after the campus is constructed, increased water and trees within the project site would attract volant insect, and thus may provide a new foraging resource for bats on a seasonal basis.

4.1.7.2 POTENTIAL IMPACTS

NO ACTION

With No Action, the project area would remain undeveloped and there would be no impacts on flora and fauna.

PROPOSED ACTION

Flora. Although project actions would include some clearing of existing grassland and shrubland vegetation for the creation of buildings, roadways, pedestrian paths, and supporting infrastructure, implementation of the Proposed Action would not result in any significant adverse impacts to botanical resources within the area. 'Aiea (*Nothocestrum breviflorum*), the only plant of special concern recorded during the 2009 survey, has been located and verified by GPS. Information will be transmitted to contractors to avoid inadvertent destruction by grading and other construction activities. This 'aiea tree is designated for preservation in the 2009 LRDP and will be incorporated into the campus landscaping.

Fauna. A No significant adverse impacts on faunal resources are anticipated from the Proposed Action.

Invertebrates. Previous studies conducted within the project area have not identified any native invertebrates on federal or state endangered, threatened, proposed or candidate lists. Known lava tubes within the project area have been explored to the extent possible and no invertebrates or habitat indicative of their presence have been found; however, it is possible that unidentified lava tubes in the area could be found that support significant biota. The destruction of cave habitats from actions such as grading may in turn destroy unique endemic arthropods if any are harbored in those habitats.

Vertebrates. The USFWS, in a letter dated April 3, 2009, stated that there is no federally designated critical habitat in the vicinity of the proposed project. However, the endangered Hawaiian hoary bat and the endangered Hawaiian hawk may be present in the project vicinity. Implementing the Proposed Action would include installing exterior lighting and outdoor landscaping that may attract moths and other flying insects, which in turn could attract the Hawaiian hoary bat. However, applying appropriate mitigation measures should ensure that there are no significant adverse impacts to any of these species if they are present in the vicinity of the project site.

Potential impacts also could occur to endangered seabirds and shorebirds as a result of the Proposed Action. The area is over-flown by populations of Newell’s shearwaters, as well as Dark-rumped Hawaiian Petrels. The Proposed Action could result in an increased potential for birds to be disoriented by the exterior lighting used during construction or operation of the campus, thereby making collisions with powerlines, buildings, as well as the light structures themselves, more likely to occur.

4.1.7.3 MITIGATION

Flora. No mitigation is proposed or deemed warranted. However, desirable plants destroyed during construction of the UHCWH could be reestablished within UHCWH campus as part of the landscaping. Landscaping proposed in the 2009 LRDP would, as much as possible, utilize Native Hawaiian and Polynesian-introduced species common to the area, and which are appropriate to the terrain and climate of the proposed site.

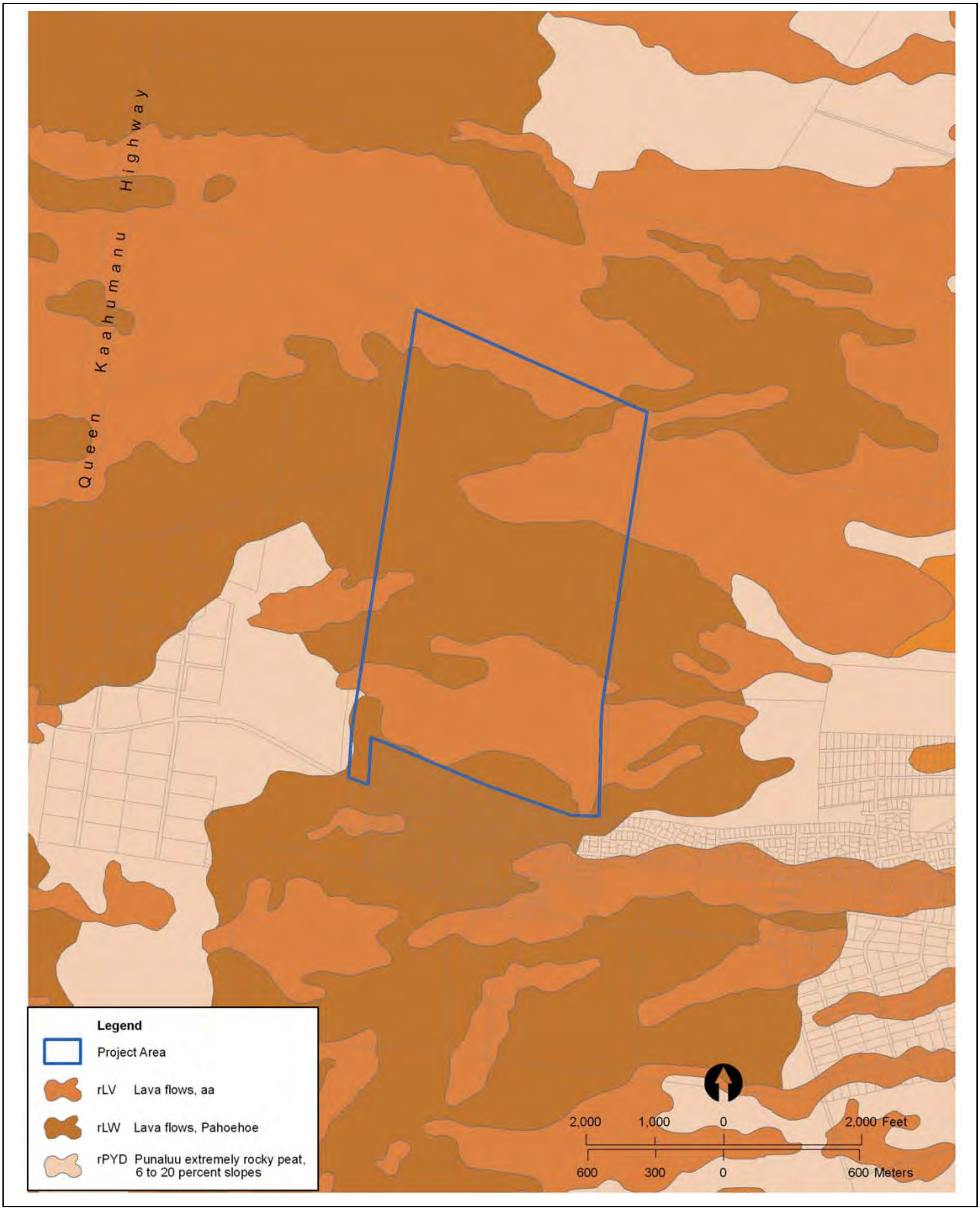
Fauna. Mitigation to address potential impacts to seabirds and shorebirds include the use of shielded lighting. Use of fully shielded, low-pressure sodium lamps shall be used as required by Hawai‘i County Ordinance 92-01. This type of lighting serves a dual purpose of minimizing the threat to seabirds and lowering the ambient glare, which affects the astronomical observatories on Mauna Kea.

While previous surveys of the project area did not record any sightings of the endangered Hawaiian hoary bat or the endangered Hawaiian hawk, it is possible that these species could occur in the vicinity of the project area. The following mitigation measures should be employed to avoid and minimize any potential impacts to these species:

Hawaiian hoary bat. Woody plants that could be used by the Hawaiian hoary bat for roosting and giving birth should not be removed or trimmed during the bat birthing and pup rearing season, which occurs from July through September. If site clearing is to occur during pupping season, it is recommended that a survey be conducted to determine the presence of bats.

Hawaiian hawk. Hawaiian hawks also nest in woody vegetation. Tree clearing should be avoided during the hawks' breeding season, which extends from March to September. If tree clear is to occur during this period, it is recommended that a survey be conducted to determine the presence of the Hawaiian hawk.

Efforts to minimize the destruction of cave habitats during grading also are recommended since these habitats could potentially harbor endemic arthropod. Large caves should be preserved and protected. Smaller caves may be retained as part of the landscape where this is practical. It is likely that due to the existing terrain, the process of land grading will uncover many more small openings. It may be impractical or physically impossible to visit these small openings; however, should any large cave be uncovered that is big enough to be easily entered, a qualified biologist should be notified and consulted and an investigation conducted, if warranted.



Soil Classifications Figure 15

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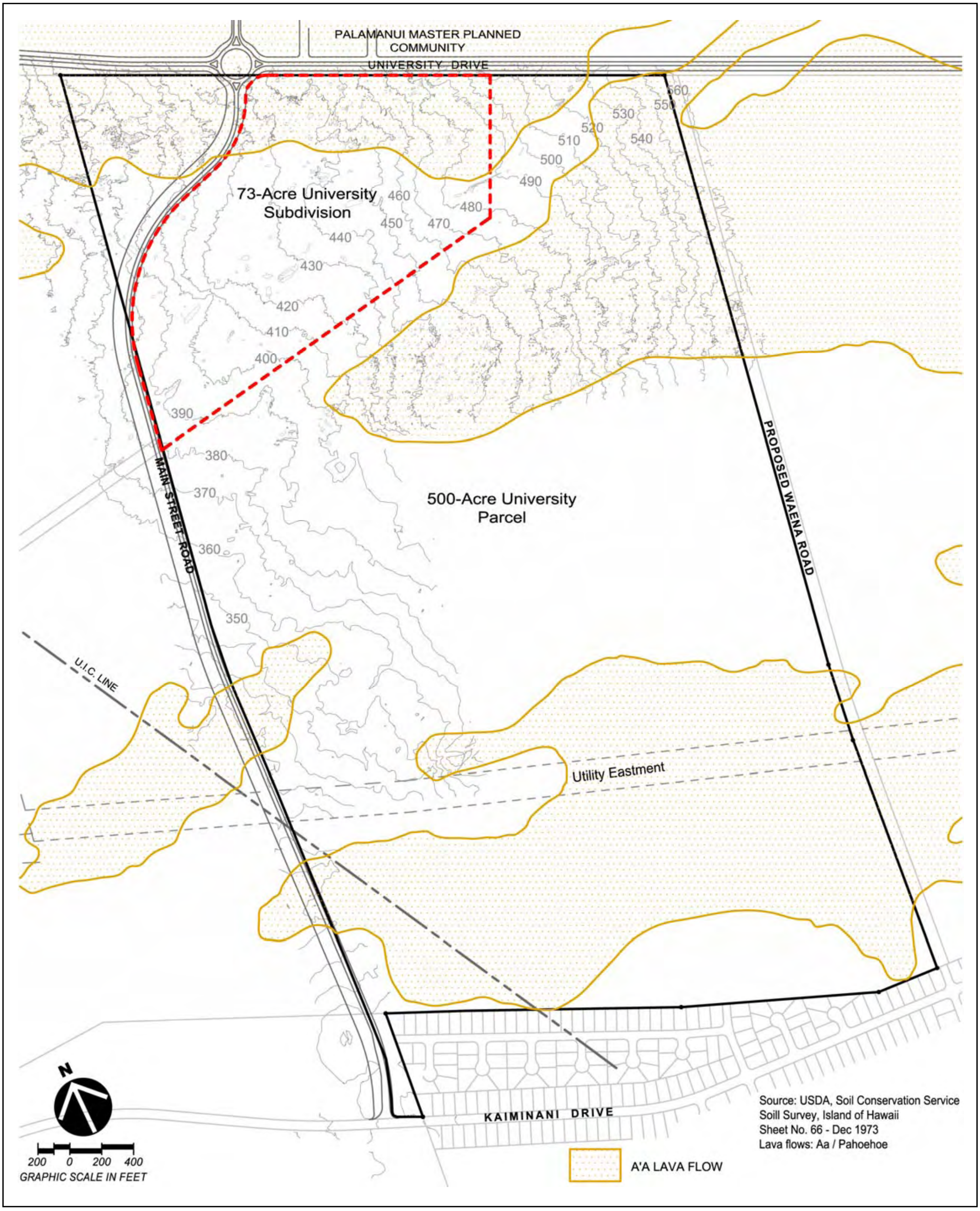

Topography and Lava Flows

Figure 16

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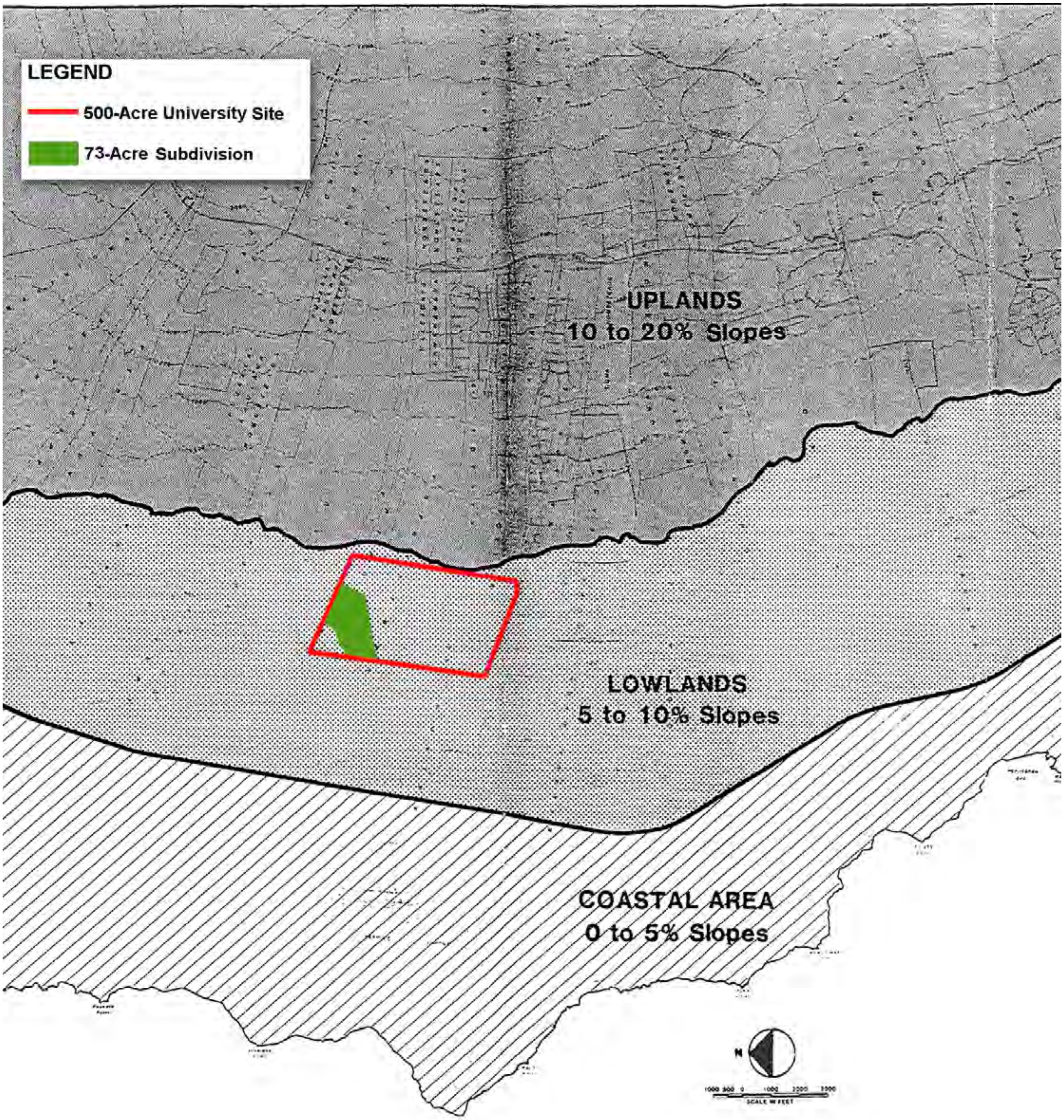

Source: Map excerpted from the *Keahole to Kailua Development Plan*, County of Hawai'i, 1991.

Generalized Slope Map

Figure 17

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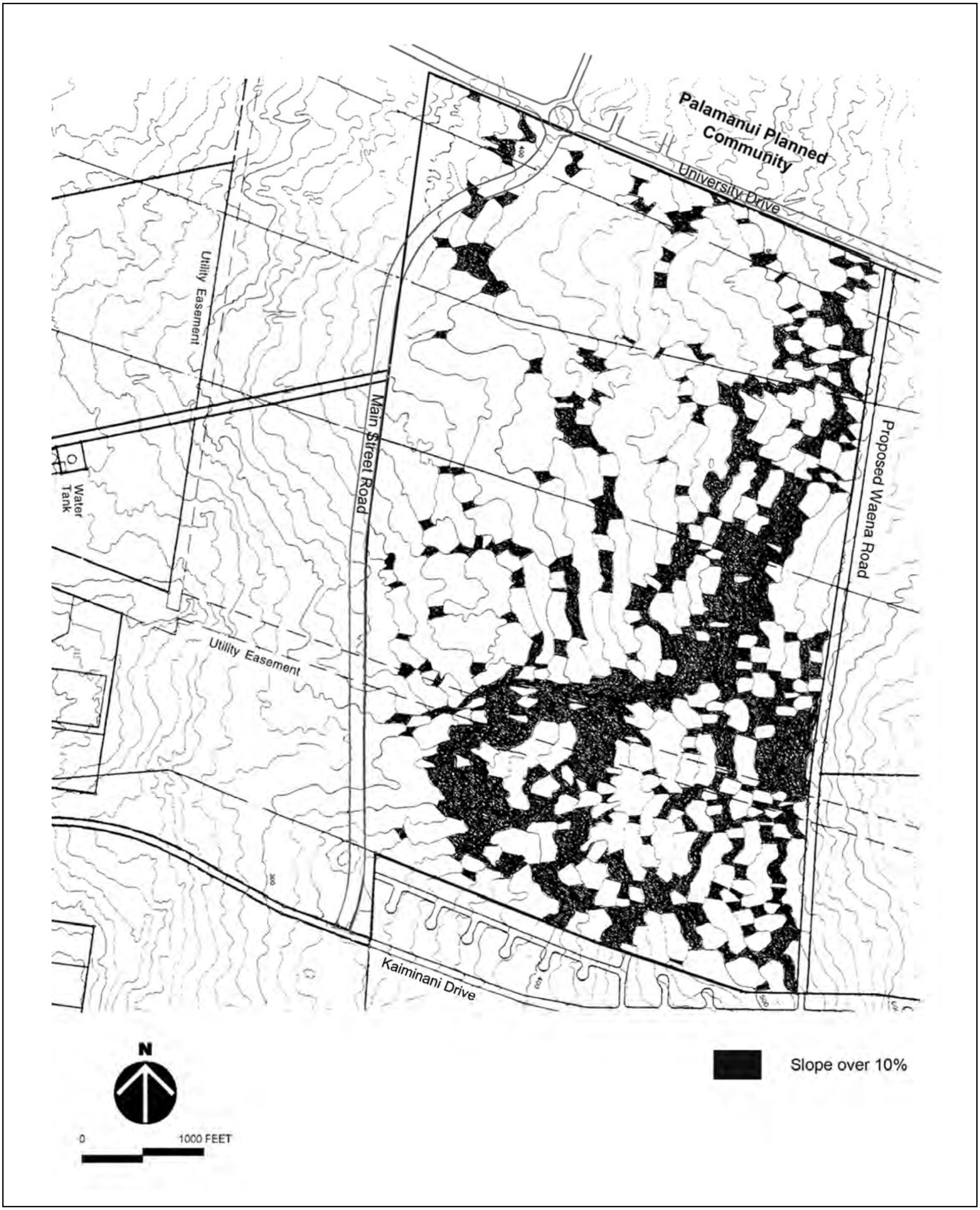

Project Area Slope Analysis

Figure 18

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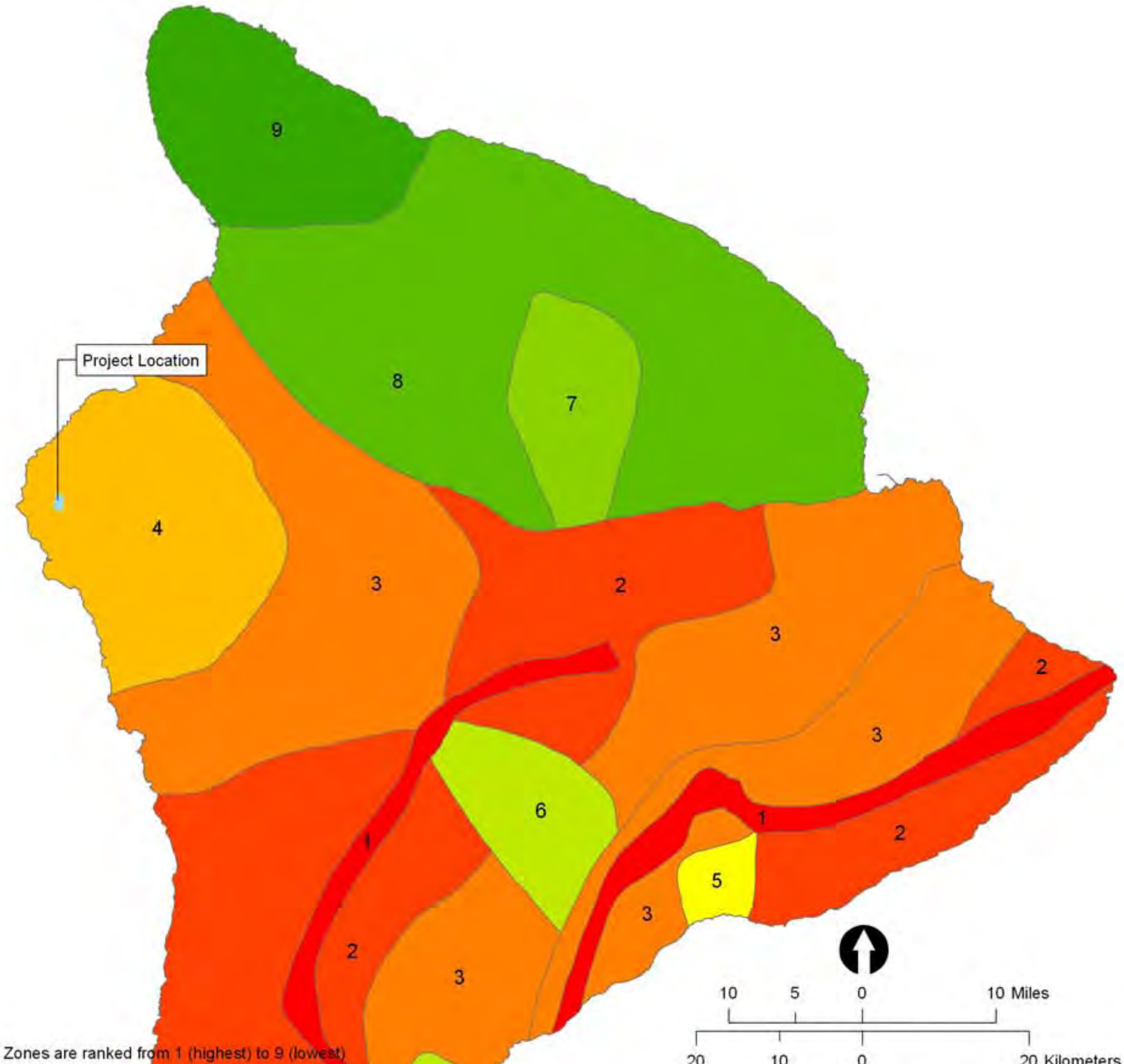

Hazard Zones are ranked from 1 (highest) to 9 (lowest)

1 Summits and rift zones of Kilauea and Mauna Loa, where vents have been repeatedly active in historic time. Boundaries are defined by eruptive fissures, cinder cones, pit craters, and graben and caldera faults. Zone 1 is where lava flows originate.

2 Areas adjacent to and downslope from Zone 1. Fifteen to twenty-five percent of Zone 2 has been covered by lava since 1800, and 25-75 has been covered within the last 750 years. The relative hazard within Zone 2 decreases gradually as one moves away from Zone 1.

3 Areas gradationally less hazardous than Zone 2 because of greater distance from recently active vents and/or because the topography makes it less likely that flows will cover these areas. One to five percent of Zone 3 has been covered since 1800, and 15-75 oercent has been covered within the last 750 years.

4 Includes all of Hualalai. Moore and others (1987) estimate that large eruptions reach the ocean about once every 300 years,a recurrence interval significantly lower than for either Kilauea or Mauna Loa. Lave coverage is proportionally smaller, about 5 percent since 1800, and less than 15 percent within the last 750 years.

5 An area on Kilauea currently protected from rift- or summit-derived lava flows by north-facing fault scarps, south of Kilauea summit.

6 Two areas on Mauna Loa, both protected from rift- or summit- derived lava flows. The area south of Mauna Loa summit is analogous to Kilauea's Zone 5. The northwest flank of Mauna Loa is also protected from eruptions originating on the summit or rift, but three eruptions have originated hight on this flank in the last two centuries. Thus we have included the northwest flank in Zone 3. The area near the south point of the island is protected from southwest rift zone eruptions by a completely faulted topography. The lava underlying this Zone 6 are all older than 4,000 years.

7 The younger part of the dormant volcano Mauna Kea. Twenty percent of this area was covered by lave 3,500-5,000 years ago.

8 The remaining part of Mauna Kea. Only a few percent of this area has been covered by lava in the last 10,000 years.

9 Kohala Volcano, which last erupted over 60,000 years ago.

Lava Hazard Zones Figure 19

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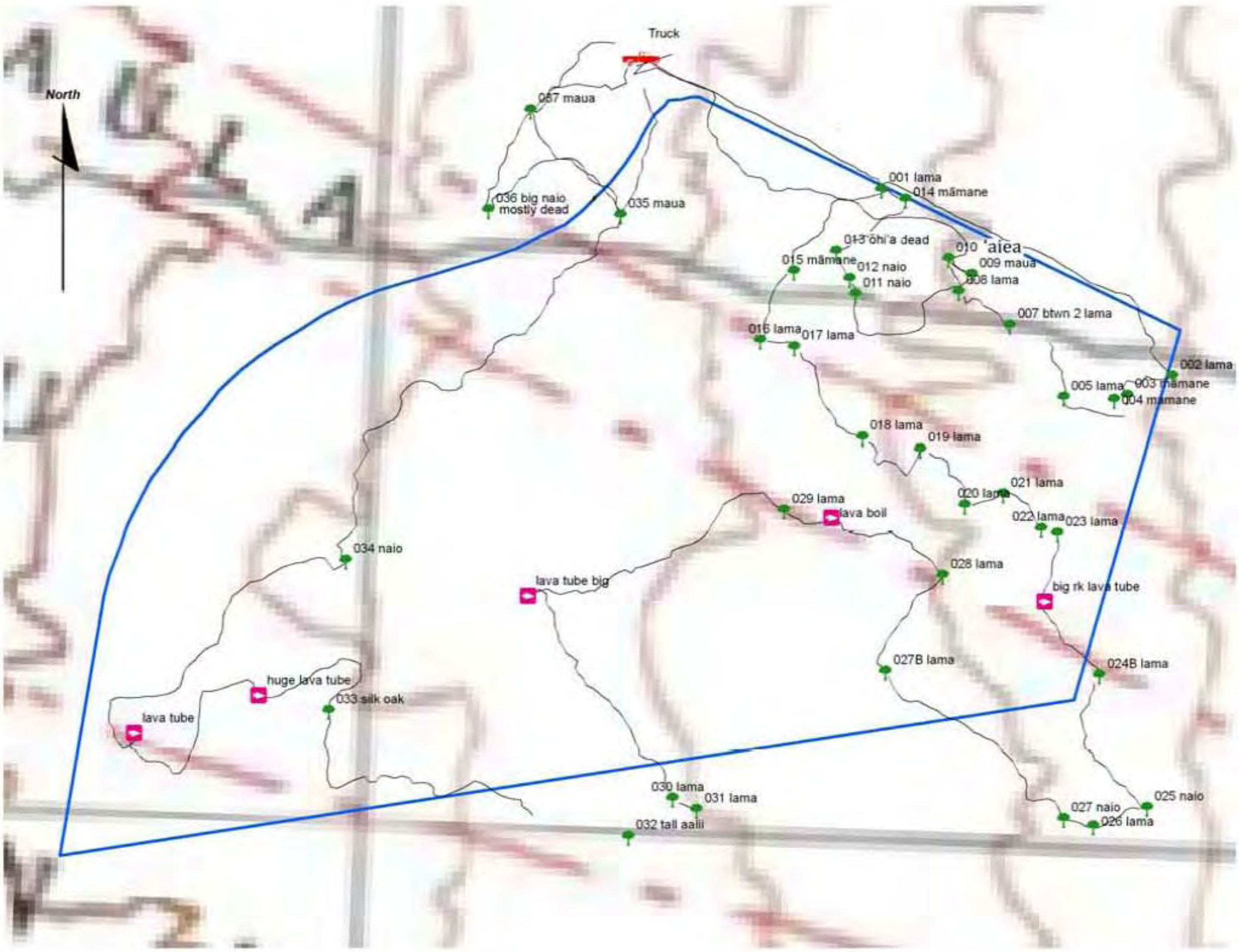
Map of the project site showing track of the botanical survey. The survey area is outlined in blue. Track lines are shown as the thin black lines. Recorded positions of trees are shown in green. All trees were visible from a distance and the survey purposely visited each one. The few shrubs indicated on the map are of exceptional stature. Many more shrubs, aʻaliʻi in particular, exist in the area, but were not recorded. Red symbols mark geologic features (e.g., lava tubes) and vehicle (start/end).

Source: Map excerpted from Biological Surveys for the University of Hawaiʻi Center at West Hawaiʻi (UHCWH), North Kona District, Island of Hawaiʻi (AECOS Consultants, 2009).



Botanical Resources

Figure 20

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4.2 HUMAN ENVIRONMENT

4.2.1 Acoustical Environment

4.2.1.1 AFFECTED ENVIRONMENT

The project site currently is undeveloped and relatively isolated from other developed areas along Kaiminani Drive and Mamalahoa Highway. Thus, existing background ambient noise levels reflect the natural setting and the absence of vehicular traffic and development in the immediate vicinity of the project site. Background ambient noise levels at interior locations of the project site fall into a range of 25 to 45 decibels (dB), which mainly are from the natural sounds of birds and wind-blown foliage (Y. Ebisu & Associates, 2009).

Major noise sources in the vicinity of the project site are highway traffic, aircraft operations at Kona International Airport, and the Keahole Generating Station. However, according to the most recent acoustic study conducted for the UHCWH project by Y. Ebisu & Associates (2009), which is attached to this SEIS as Appendix D, the impacts from those sources on the Proposed Action would be insignificant. The proposed site's large setback distances from Queen Ka'ahumanu Highway, Kaiminani Drive, and Mamalahoa Highway lead to low traffic noise levels that are less than 45 Day-Night Average Sound Level (DNL).[5]

The project area is subject to single noise events due to occasional flyovers by helicopters; light, fixed-wing aircraft; and large jets. However, based on the current Kona International Airport FAR Part 150 Study, the project site is located outside the 55 DNL airport noise contours, thus is considered acceptable for the proposed land use for educational facilities. The DOT, Airports Division currently is updating the FAR Part 150 study for Kona International Airport and based on a review of the draft study, the proposed site is expected to remain outside of the future 55 and 60 DNL aircraft noise contours forecasted through the year 2020 (Ibid.). Existing and future aircraft noise does not impose constraints on the proposed site and no special noise mitigation measures are needed.

The noise levels from the nearby Keahole Generating Station are almost inaudible after a recent technology upgrade that incorporated sound attenuation measures into the station's generating equipment. Thus, the Keahole Generating Station does not adversely impact the proposed site.

4.2.1.2 POTENTIAL IMPACTS

NO ACTION

With No Action, the project area would remain undeveloped and no noise impacts would be generated.

PROPOSED ACTION

Unavoidable, short-term and temporary noise impacts are expected to occur during the construction period. Noise from construction activities, including grading, earth moving,

[5] The Day-Night Average Sound Level or DNL is the noise descriptor used by federal agencies to assess environmental noise. The DNL represents the average noise during a typical day. A DNL exposure of 55 or less is typical of quiet rural or suburban areas. In urbanized areas with medium to high levels of activity and traffic DNL exposure levels typically range from 55 to 65. DNL exposure levels of 65 and higher are typical of densely developed urban area and areas fronting high volume roadways.

trenching, concrete pouring, and hammering is predicted to be approximately 80 to 90+ dB at 50 feet distance (Ibid). Construction work would move from one location to another within the proposed site; therefore, the length of noise exposure at any particular receptor point would probably not be as long as the total construction period. Residences along the Kaiminani Drive, near the future Main Street Road, and new residences in the future Palamanui Master Planned Community would experience the highest levels of construction-related noise (Ibid).

In the long-term, projected increases of traffic noise along primary access roadways to the project site—Queen Ka'ahumanu Highway, Mamalahoa Highway, and Kaiminani Drive—are not expected to be significant. Traffic noise level increases would result from both project and non-project traffic. Between years 2009 and 2022 traffic noise levels along Queen Ka'ahumanu Highway are expected to increase by 3.8 to 4.4 DNL. The contribution to this increase from project-generated traffic is very small, approximately 0.2 DNL. During the same period, traffic noise levels along Kaiminani Drive are expected to increase by 3.3 to 4.2 DNL, with project-related traffic contributing approximately 0.1 to 1.3 DNL of that increase. Along Mamalahoa Highway, south of Makalei Estates, traffic noise levels are predicted to increase by 2.8 to 3.4 DNL, with project traffic contributing between 0.0 to 0.1 DNL. Overall, throughout the project area, the increase in traffic noise attributable the project is predicted to range from 0.0 to 1.3 DNL, which is well below the noise increases attributable to non-project traffic (in excess of 2.8 DNL). Thus, the predicted increase in traffic noise from project-generated traffic would not be significant.

4.2.1.3 MITIGATION

Reducing construction noise to inaudible levels is not practical due to the intensity of construction noise sources and the exterior nature of the work. However, with the application of typical construction noise control measures and adherence to all applicable noise control regulations (HAR 11-46, *Community Noise Control*), construction noise should be reduced to within reasonable levels. Such noise control measures would include, for example, the use of properly muffled equipment, imposing standard noise limits and curfew periods, and locating heavy equipment and portable diesel engines and generators at least 400 to 500 feet from any residences or other sensitive noise receptors.

No long-term mitigation is proposed or warranted.

4.2.2 Historic, Archaeological and Cultural Resources

4.2.2.1 AFFECTED ENVIRONMENT

Historic and Archaeological Resources. Numerous archaeological studies have been conducted for various portions of the 2,640-acre state-owned lands that were reclassified to the State Land Use Urban district in 1993. The 500-acre University site is part of the 2,640 acres. The most recent study was completed in late November 2008 by Pacific Legacy and focuses on the 73-acre proposed site.

The 2,640-acre state-owned lands were the subject of an archaeological assessment study conducted by Paul H. Rosendahl, Ph.D., Inc. (PHRI) in 1993. The study included a background synthesis of existing studies, prior archaeological and historical work, and some new historical work (e.g., aerial reconnaissance, intensive ground surveys, etc.). The assessment was intended to serve as a baseline study for future archaeological studies within these state lands. As such, the historic sites that were identified during the archaeological assessment study were not recorded to inventory level. In addition, only 11.5 percent of these state lands, including portions of the 500-acre University site, were subjected to an intensive ground survey (PHRI, 1993 in Helber Hastert & Fee, Planners, 1993, p. 4-19). As part of the LUC reclassification, SHPD recommended the following conditions be satisfied prior to development of these state lands and the project area:

> "1. Each prospective future developer shall have an archaeological inventory survey conducted by a professional archaeologist prior to submitting an application to the County of Hawai‘i for rezoning. The findings of this survey shall be submitted to the State's Historic Preservation Division in report format for adequacy review. This Division must verify that the survey report is acceptable, must approve significance evaluations, and must approve mitigation commitments for significant historic sites.
>
> 2. If significant historic sites are present, then each prospective future developer shall agree to develop and execute a detailed historic preservation mitigation plan—prior to any ground altering construction in the area. The State's Historic Preservation Division must approve this plan, and that Division must verify, in writing to the Land Use Commission that the plan has been successfully executed" (DLNR-SHDP, 1992 in Helber Hastert & Fee, Planners, 1993, p. 4-28).

Concurrent with the archaeological assessment study, PHRI also conducted an archaeological inventory survey in December 1992 and January 1993 for the 500-acre University site. This survey was conducted in accordance with condition 1 above. During the inventory survey, PHRI identified 43 archaeological sites, which included temporary habitation sites, agricultural sites, religious sites, trails, burials and petroglyphs (Pacific Legacy, 1998). Eleven sites identified in either the assessment study or the inventory survey, were recommended for preservation "as is" or preservation with some level of interpretive development. The northwestern portion of the project area contains four sites; six sites are located in the central region; and one site is located near the southern boundary of the project area.

The location of archaeological sites was critical to the site planning efforts for the UHCWH. As part of the 1998 LRDP effort, an archaeological investigation was conducted that concentrated on approximately 275-acres in the southwestern portion of the 500-acre University site; the area where the campus core originally was to be located. The results of that investigation conducted by Pacific Legacy, Inc. in 1998, under the direction of Paul L. Cleghorn, Ph.D. are summarized below.

> Numerous late prehistoric sites are present within the study area. These archaeological sites appear to be part of the "Kona Field System"—an extremely extensive and intensive agricultural complex in the Kona region. Archaeological sites within this area include lava tubes, modified outcrops, walls, and excavations in the pahoehoe lava flows. Primary activities in the area were presumably related to agricultural pursuits and temporary shelter. Ceremonial activities may also have been performed and selected areas may have been used for burials.
>
> Archaeological sites in the study area are evidence of the adaptability of the early Hawaiian inhabitants. Residents apparently established productive uses on harsh and forbidding land. Lava tubes and outcrops were modified into shelters and habitats. Planting areas were created in broken and roughly circular pits on the surfaces of pahoehoe lava flows. Concentrations for planting areas were

made from mountains of stone rubble on the surface of the flows. Arid-tolerant plants such as sweet potato and gourds may have been the focus of the agricultural pursuits that took place here.

It is recommended that five archaeological preserves be established and managed.

"Preserve 1: This is the eastern site cluster composed of sites 15290, 15291, 15292, 15293, 15294, 15295, and 15296. This cluster consists of two extensively modified lava tubes (15292 and 15297), and several platforms, enclosures, terraces, and pavements. This cluster is an excellent example of how temporary habitations were situated and constructed in the area. This complex should be accessed by a walking trail from the proposed [University Center], and developed (using signs, brochures, etc.) into an interpretive and educational venue.

Preserve 2: This is the northern site cluster composed of sites 15298 and 15302, which are two extensively modified lava tubes. Because these sites contain human burials (15298) and possible ceremonial areas (15302), they should be barricaded or sealed and protected from public access.

Preserve 3: This is a cluster of features in the central portion of the proposed campus. The cluster consists of site 15281, a linear portion of site 15283, site 15282, and site 15285. Sites 15281 and 15282 are temporary habitation areas, and site 15285 is a possible religious shrine. Site 15283 is a large complex of agricultural features. It is proposed that a linear preserve extending from Site 15281, through the southern portion of site 15283, and incorporating sites 15282 and 15285 be established in the central portion of the proposed campus. The sites could be accessed from sidewalks and other walkways in the campus and have interpretive signage explaining the function and antiquity of the sites and how they exemplify the original Hawaiian adaptation to this area.

Preserve 4: This is a small cluster of two sites (15263 and 15287) located on the western edge of the study area. The cluster consists of a small temporary habitation complex and a papamu, or game board for konane, or Hawaiian checkers. This small complex could be incorporated into the campus landscaping and identified with appropriate signage.

Preserve 5: This is a complex of lava tubes (site 6418) at the SW corner of the study area. This complex consists of three sections – a collapsed section of lava tube, a lava tube containing a large stone platform, and a lava tube section with a platform and panels of petroglyphs. The proposed Mid-Level Road runs right through these sites. It is recommended that the road by rerouted to avoid these sites and that they be preserved. Interpreting these features by means of established walkways and interpretive signs may be the most feasible way of preserving these sites and protecting them from vandalism. Petroglyphs are extremely fragile and can be destroyed by even well-intentioned visitors" (pp. 29 – 31).

As an outgrowth of Pacific Legacy's 1998 archaeological investigation, the *Conceptual Historic Preservation Plan for the Proposed University Center at West Hawai'i, North Kona, Hawai'i Island* (HPP) (Cleghorn, 2000) was developed with considerable input from the University of Hawai'i Center at West Hawai'i Advisory Council on Kalaoa Cultural Site Preservation.[6] The 2000 HPP was labeled "Conceptual" because it did not contain details concerning long-term preservation measures and interpretation. The Advisory Council wished to defer completion of

[6] The University of Hawai'i Center at West Hawai'i Advisory Council on Kalaoa Cultural Site Preservation was convened as part of the previous UHCWH LRDP/EIS effort (1998 – 2000) to provide guidance in protecting the numerous cultural resources associated with the project area. This advisory group is no longer in existence. A new advisory group has been convened to provide community input for the current 2009 LRDP effort.

the plan to allow students, faculty, and staff of the UHCWH to participate in the process after construction was completed and the first phase of the Center was fully operational. Therefore, the 2000 HPP must be updated and completed if the University wishes to develop educational and interpretive venues.

In 2005, Pacific Legacy conducted an assessment survey to support preparation of an EA for the Main Street Road, which delineated the western boundary of the 500-acre project area. As a result of this survey, it was recommended that the central and northern portions of the road alignment be moved westward to avoid impacting archaeological features within site 50-10-28-15302 (lava tube). During the staking out of the new road alignment, surveyors found a petroglyph located southwest of site 50-10-28-15302. The road alignment was adjusted to run between the newly found petroglyph and site 50-10-28-15302.

The petroglyph was designated as site 50-10-28-26454 and consists of three images pecked into the surface of a 3.3-foot by 5-foot (1-meter by 1.5-meter) slab of *pāhoehoe* lava. The petroglyphs are situated on the northern lip of a skylight that opens into a lava tube. This lava tube runs northeasterly and connects to the western end of site 50-10-28-15302.

The most recent archaeological investigation was completed in late November 2008 by Pacific Legacy. The L-shaped study area encompassed roughly 133 acres along the western and northern sides of the 500-acre project area. The 73-acre proposed site is located within the 133-acre study area. This investigation focused on mapping archaeological sites within the study area, with particular emphasis on Archaeological Preserve 2 (refer to Figures 21 and 22). Aside from Preserve 2, nine other sites were identified in the study area; two north of Preserve 2 (15262 and 15304) and seven south of Preserve 2 (15264, 15283, 15285, 15287, 15288, 15303, and 26700). Of these nine sites, only three are located within the 73-acre project site (15262, 15304, and 15303). Because the proposed campus development is limited to land north of Preserve 2, only sites 15304 and 15262 could potentially be affected by development. Pacific Legacy's 2008 report is attached as Appendix E.

Archaeological sites 15304 and 15262 have been recommended for preservation by both PHRI (1993) and Pacific Legacy (2005). Site 15304 is an isolated X-shaped petroglyph, which likely is an early historic surveyor's mark created after European contact in 1778 (Pacific Legacy, 2005). No further work is recommended for this site. Site 15262 is located on a prominent knoll and consists of an approximately 13-foot by 10-foot (4-meter by 3-meter) stone terrace with three adjacent stone mounds or *ahu*. Given its composition and its location on a knoll, the site was likely used for religious purposes (Pacific Legacy, 2005). This site is recommended for passive preservation, where the site is left in its current condition and avoided by any development activities.

Preserve 2 is a lava tube complex that stretches across the proposed site from southwest to northeast. In 1993, the Hawai'i State Inventory of Historic Properties designated site number 50-10-28-15298 for the eastern section of the lava tube, while 50-10-28-15302 was designated for the western section. Sixteen separate openings along the length of Preserve 2 were identified. A total of 196 archaeological features were found associated with Preserve 2, most determined to probably date to the pre-Contact period. Among the features recorded were at least six human burials found in 50-10-28-15298. The findings suggest that the tube system was used for habitation, refuge, ceremonial, and burial purposes. Evident bulldozing damage to some of the openings leading into the lava tube was visible. It is supposed that loose *pāhoehoe* slabs at these areas were harvested for masonry.

Cultural Resources. Pacific Legacy, Inc. conducted a Cultural Impact Assessment for the Main Street Collector Road EA in 2005. Interviews and background research indicate that the project area does not support any current traditional resource utilization. The area is not frequented by spiritual and cultural practitioners nor does it provide for any other traditional activity. The area’s only cultural significance appears to lie in its archaeological resources, which have interpretative value. Previous archaeological assessments, as well as the 2000 HPP recommended protection and preservation of selected sites within the project area.

Hunting and gathering activities continue to be practiced in the region. However the locations of these practices are very general for the area and not site specific. Faunal surveys conducted on the site have turned up evidence such as goat skeleton, goat scat and donkey scat suggesting larger vertebrates once inhabited the land. The investigators did not see or hear any goats, pigs or donkeys, nor was there any recent evidence of their presence.

4.2.2.2 POTENTIAL IMPACTS

NO ACTION

With No Action, the project area would remain undeveloped and there would be no impacts to historic, archaeological or cultural resources resulting from the Proposed Action. However, vandalism of historic sites has been documented during recent archaeological studies. It is expected that these acts would continue to occur without development of the UHCWH.

PROPOSED ACTION

The Proposed Action would construct the entire UHCWH campus north of Preserve 2. Of the archaeological and historical resources identified within the 73-acre proposed site, only Preserve 2 and sites 15304 and 15262 could potentially be impacted by the Proposed Action. In the 2009 LRDP, it is proposed that Preserve 2 and the two archaeological sites could be incorporated into the campus plan as landscaping elements and to aid in developing a Hawaiian Sense of Place.

For planning purposes a 164-foot (50-meter) buffer was used to protect Archaeological Preserve 2. The 164-foot buffer around Preserve 2 was preliminarily suggested in the 2000 HPP; however, the HPP also recommended that guidance should be sought from the Hawai‘i Island Burial Council on an appropriate buffer size. A buffer of 50 feet (15 meters) is proposed in the draft BTP, which currently is being prepared for Preserve 2 in accordance with the HPP. Adherence to the buffer surrounding Preserve 2 should offer sufficient protection for the archaeological and cultural resources contained within the preserve. No site improvements, including landscaping, are proposed for the preserve and buffer area. The preserve essentially would be left as is with no clearing of vegetation or re-vegetation of the area. Sealing portions of the lava tube that contain human remains are issues that will be explored with the Hawai‘i Island Burial Council.

Campus development would not occur in the vicinity of sites 15304 and 15262 until Phase 4. Projections are that Phase 4, which would expand the UHCWH from a 750 FTES campus to a 1,500 FTES campus, would not be developed until 2023 at the earliest. While the 2009 LRDP does show these sites as being incorporated into the campus landscaping, this may or may not occur, and is dependent on circumstances and attitudes at the time Phase 4 is planned and developed. As stated in Section 4.2.2.1 above, it is intended that students, faculty, and staff of the UHCWH would participate in the planning process to complete the HPP, which includes determining the long-term treatment of these historic and cultural sites. Ultimately, these two sites will be preserved, but it is undetermined if such preservation would be passive (i.e., sites would be left in an unaltered condition with a non-developed buffer, including any intentional landscaping, within a specified distance from the sites) or deliberately designed into the campus landscaping with fencing, viewing platforms, landscaping and interpretive signage.

With the application of appropriate avoidance and protection procedures, the potential for construction-related impacts would be minimized such that no significant adverse effects are anticipated. In the long-term, adherence to proposed mitigation (e.g., BTP, buffers, and treatment) should prevent any significant adverse impacts to historic and cultural resources.

4.2.2.3 MITIGATION

Pacific Legacy's 2008 investigation report recommended that future planning be conducted in close consultation with SHPD and the Hawai'i Island Burial Council to ensure that the cultural properties within Preserve 2 are protected.

As stated in Section 4.2.2.1 above, an archaeological survey that focused on the proposed site (i.e., the northwestern corner of the project area) was recently completed. Discussions with SHPD and the Hawai'i Island Burial Council have been initiated to identify and resolve any potential archaeological, historic or cultural issues. Following a preliminary presentation to the Hawai'i Island Burial Council on January 15, 2009, it was determined that preservation-in-place of the human burials is the preferred method of treatment.

A BTP is being prepared to address long-term preservation and management of Preserve 2, the lava tube complex that contains human burials. Due to the sensitive nature of this preserve, the BTP is recommending that no activities be allowed in the vicinity of Preserve 2 and that the form of protection would be to restrict access, except for visitation by lineal descendents. Part of preparing the BTP involves identifying lineal descendents. If claimants are found and have any recommendations for long-term preservation treatment, those recommendations will be included in the BTP. Access to the lava tubes should be secured or sealed, depending on the preferences of any recognized lineal descendents.

An interim preservation buffer zone of 50 feet (as measured from the outside edges of the lava tube) is being recommended in the BTP to protect Preserve 2 during construction activities. Recommended short-term protection measures during construction include:

1) Marking the outer margins of the buffer zone with highly visible surveyor's flagging tape prior to any construction activities in the area. Surveyor's

flagging tape should be tied onto low trees, bushes, and grass. No construction activities shall be allowed within the buffer zone.

2) The buffer zone should be accurately plotted on all grading plans and construction plans prior to the start of any land altering activities in the area.
3) Prior to initiating any construction activities, all construction supervisors and crew members shall be instructed as to the nature and location of the archaeological sites, the significance of the buffer zones, the meaning of the brightly colored construction fencing, and that the no construction activities shall occur within the fenced area.
4) All ground disturbing activities in the vicinity of the sites to be preserved shall be monitored on-site.

As state in Section 4.2.2.2 above regarding sites 15262 and 15304, the Proposed Action does not pose any potential affect to these sites until the fourth phase of development. During Phase 4 construction, protective fencing would be erected to protect the sites when activities occur in their immediate vicinity.

Efforts to minimize the destruction of large lava tubes during grading also are recommended. It is likely that due to the existing terrain, the process of land grading may uncover small openings. It may be impractical or physically impossible to visit these small openings; however, should any large cave be uncovered that is big enough to be easily entered, an archaeologist should be notified and consulted, and an investigation conducted, if warranted. Large caves could potentially serve as archaeological and/or paleontological sources of information and should not be destroyed prior to some exploration of their contents.

Further, it is possible that inadvertent discoveries of human remains could occur. An archaeological monitor would be present during all ground disturbing activities. If an inadvertent discovery is made, all construction activity shall stop in the immediate vicinity of the find, SHPD would be notified, the significance of the site shall be determined, and appropriate treatment shall be determined and approved by SHPD.

Note that the recommendations in Pacific Legacy's 1998 study and the HPP described above were applicable to the location of the campus core in the southwestern corner of the 500-acre University site. Now that the campus core has been relocated to the northwestern corner of the University site, some of these recommendations are longer be relevant to the current proposal (see Figure 5 in Chapter 2 for change of campus location). As shown in Figure 8, the current campus layout within the 73-acre subdivision only impacts Archaeological Preserve 2, the lava tube system. The other proposed Preserve Areas 1, 3, 4 and 5 would not be impacted by the development of the UHCWH as proposed in the 2009 LRDP.

The University has two options regarding access to the archaeological preserves outside of the 73-acre proposed site and the requirement to prepare a historic preservation plan.

1) If the University does not provide access to Preserve Areas 1, 3, 4 and 5, there is no need to complete the HPP because the preserve areas are outside the area of development.
2) The 2009 LRDP for the UHCWH does not propose any development, including a trail system and interpretive venues, south of Preserve 2. However, if in the future, the UHCWH does choose to pursue incorporating Preserves 1, 3, 4 and 5 into their Hawaiian studies program by developing the preserves into educational and interpretive venues with a trail system, interpretive signage, etc., the HPP must be finalized, submitted, and approved by SHPD.

4.2.3 Aesthetic Considerations

4.2.3.1 AFFECTED ENVIRONMENT

Aesthetic considerations can be described and analyzed from two visual perspectives. The first perspective considers the 500-acre University parcel itself as a visual resource when viewed from outside the project area. The second perspective looks at the visual resources and view planes as seen from within the project area. Refer to Figure 23 for a diagrammatic depiction of the two visual perspectives relative to the project area.

The visual character of the project area is defined by expanses of pristine lava lands that have never been developed for modern use, and are covered by scrub grass, small trees and shrubs. The best views of the project area are from the vicinity of the Kona International Airport; it is part of the initial viewshed for those arriving in West Hawai‘i. Kona International Airport is a focal point that serves as a gateway for tourism to West Hawai‘i, therefore anything that is part of the vista when looking out at the landscape from the airport influences a person’s first impression of the island, especially if that individual is visiting for the first time.

Glimpses of the project area can also be seen from Mamalahoa Highway (located upslope of the project area) where breaks in vegetation exist, as well as at streets and private driveways, but these views do not hold the same bearing as from the airport. Although the project area can also be seen from the Queen Ka‘ahumanu Highway, views are limited due to obstruction by existing topographical features. Furthermore, current land uses between the highway and the project area restrict continuous views of the property, which can only be seen intermittently as one drives along the roadway.

The other visual perspective that can be considered is the visual resources and view planes seen when looking out from the project area. The most expansive views are from the steeper, higher elevations, most notably at areas above the 500-foot elevation. At elevations below 450 feet, makai views are somewhat restricted by the HELCO power plant, the 0.5-million gallon water tank and the Keahole Agricultural Park. Localized ridges and depressions profoundly affect the quality of views at lower elevations throughout the project area. Looking makai (westward or seaward), expanses of pristine lava lands covered by scrub grass, small trees and shrubs create a distinct contrast between sparsely vegetated lava fields and the Pacific Ocean in the distance. To the east, Mt. Hualālai (mauka of the site) comprises the major visual resource seen from the project area. This feature is a chief natural element in the mauka viewshed. Overall, the expansiveness of views is determined by the specific viewing position within the project area.

4.2.3.2 POTENTIAL IMPACTS

NO ACTION

With No Action, the project area would remain undeveloped and there would be no adverse impacts to visual resources. As well, with No Action, the opportunity to reorganize the UHCWH within a cohesive design framework situated amongst the lava-strewn landscape of Mt. Hualālai would be lost. The creation of a new visual character for the UHCWH and the elevation of its status would be similarly lost.

PROPOSED ACTION

It is anticipated that development of the new UHCWH would not have a significant adverse impact on aesthetics. From a design concept, it is intended that the UHCWH buildings would be limited to a single story, creating a low profile compatible with the expansive setting in the lava fields of Kalaoa. Aside from aesthetic considerations, single-story buildings are being proposed because they provide the most efficient configuration for natural daylighting and ventilation. This low profile would minimize the potential to obstruct views from either within the project area or from without. Roof forms would be a combination of flat and shed configurations. Some roofs may be outfitted with photovoltaic collectors.

The building design concept proposed in the 2009 LRDP is based on long linear building modules. The typical width of each module would be 30 to 40 feet. Spaces between the modules would become pedestrian ways that can be covered by roofing or trellises. Refer to Figures 9 and 10 for conceptual building elevations and a conceptual 3-D rendering of the project. Cut and fill would be minimized to preserve the natural lava field landscape. Use of lava rock material would be used, where practicable, as a unifying design element that would connect the buildings to the land and its volcanic origins.

From within the project area, and particularly the proposed site, no negative impacts are expected in terms of view obstruction. Development of the UHCWH should not result in any barriers that would obstruct scenic views of the coast or Mt. Hualālai.

4.2.3.3 MITIGATION

No mitigation is warranted or proposed.

4.2.4 Land Use

4.2.4.1 AFFECTED ENVIRONMENT

Land immediately surrounding the 73-acre proposed site currently is undeveloped, except for the Palamanui Master Planned Community. Palamanui is an approximately 725-acre private development that is being constructed immediately north of the proposed site. Mass grading and sitework has begun for Palamanui, which will include a mix of residential villages, a 20-acre regional park, a 120-room hotel, a small-town commercial village and a 55-acre lowland native dry forest preserve. The remaining undeveloped land immediately surrounding the proposed site is expected to remain undeveloped for the foreseeable future.

Surrounding the larger 500- acre project area are various private and state-owned land uses. The parcel abutting the western border of the project area currently is undeveloped, but is expected to include provisions for Hawaiian Homelands and possibly some state departmental uses. Along the southern border of the project area is the existing Kona Palisades residential subdivision. Another residential area is being developed just south of the Kona Palisades subdivision. Along the eastern border of the project area are undeveloped state-owned lands.

4.2.4.2 POTENTIAL IMPACTS

NO ACTION

With No Action, the project area would remain undeveloped and would result in no impacts to surrounding land use.

PROPOSED ACTION

The Proposed Action may result in construction-related impacts on adjacent land uses. Temporary construction-related impacts on noise and air quality could affect the nearby residential areas; however, these unavoidable impacts would be short-term and temporary and would be minimized by applying appropriate mitigation measures.

The Proposed Action would not be inconsistent with surrounding existing and proposed land uses and would not result in significant adverse impacts on those uses. Rather, development of the UHCWH's at the proposed site would create a synergistic relationship with the adjacent Palamanui Village Town Center, creating a pedestrian-oriented village core. Further, the Proposed Action fulfills the vision for North Kona's planned growth as represented in both the County General Plan and the KCDP and is consistent with the land use entitlements for the project area (refer to Chapter 6.0, *Relationship to Land Use Plans, Policies, and Controls*).

The Proposed Action is not anticipated to result in any long-term adverse affects to the surrounding land uses in the vicinity of the proposed site or project area.

4.2.4.3 MITIGATION

No mitigation is warranted or proposed.

4.2.5 Circulation and Traffic

4.2.5.1 AFFECTED ENVIRONMENT

Presently, there are no improved roadways leading up to or within the project area. Kaiminani Drive (a County of Hawai'i roadway) provides the only existing east-west (mauka-makai) roadway proximal to the proposed site. This roadway connects Queen Ka'ahumanu Highway (Route 19) with Mamalahoa Highway (Route 190). Queen Ka'ahumanu Highway provides vehicular access to the project vicinity from other parts of the island. This arterial roadway is a Class I state highway that generally parallels the shoreline. The state Department of Transportation (DOT), in March 2009, completed Phase 1 of the Queen Ka'ahumanu widening project. Phase 1 expanded Queen Ka'ahumanu from two lanes to a four lane divided highway, along with other improvements, from Henry Street to Kealakehe Parkway. Phase 2 of the widening project is expected to begin sometime in 2010 and will continue expansion of Queen

Ka'ahumanu Highway from Kealakehe Parkway north to the airport. Mamalahoa Highway is the only other trans-island roadway that provides access to the project vicinity from other parts of the island. This two-lane roadway runs roughly parallel to Queen Ka'ahumanu Highway and is more inland at the 1,600- to 1,800-foot elevation (refer to Figure 24).

Although there are no roadways presently existing to access the 73-acre proposed site, two new roads are being constructed by Palamanui to satisfy this need. The first roadway is Main Street Road, which will extend from Kaiminani Drive northward and end at the future University Drive. Main Street Road was formerly known as the Mid-Level Road and generally forms the project area's western boundary. Main Street Road is included in the KCDP as Phase IV of the proposed Keohokalole Highway, which will function as the trunk transit route connecting Kailua Village with the airport. Main Street Road will be a 60-foot wide roadway, within a 120-foot right-of-way, and have two lanes with paved shoulders. The second roadway being constructed is University Drive, which is planned along the project area's northern boundary. University Drive will connect at its western end (makai) to Queen Ka'ahumanu Highway. Immediate plans are for University Drive to be constructed eastward up to the Palamanui roundabout; however, this road when fully constructed will connect to Mamalahoa Highway. University Drive will have an 88-foot wide right-of-way, two lanes with paved shoulders, and a bike path. Palamanui anticipates both roads to be completed by 2011.

A traffic impact analysis report (TIAR) was conducted as part of the current 2009 LRDP and SEIS process. The draft TIAR, completed in November 2009 (Phillip Rowell and Associates), utilizes the level-of-service (LOS) concept to analyze traffic conditions. LOS is a qualitative measure that takes into account several influencing factors such as spacing, speed, travel time, interruptions, and safety, among others. There are six LOS ratings, A through F, with A being the best driving conditions and F the worst. Generally, a LOS of A connotes free-flowing conditions with no congestion. A LOS of F would mean severe congestion with stop-and-go conditions. In urban conditions, a LOS of D or better is normally considered acceptable.

The TIAR assessed the LOS for five existing intersections in the vicinity of the project area: 1) Queen Ka'ahumanu Highway at Keahole Airport Access Road, 2) Queen Ka'ahumanu Highway at Kaiminani Drive, 3) Mamalahoa Highway at Kaiminani Drive, 4) Mamalahoa Highway at Makalei Estates, and 5) Mamalahoa Highway at Ahikawa Street. Table 7 below, summarizes the overall LOS for each of these intersections during the A.M. and P.M. peak hours. The overall intersection LOS is determined by the lane group with the lowest LOS. The overall LOS for each of the intersections was A or B, except for the intersection of Mamalahoa Highway and Kaiminani Drive, which had an LOS of E and F for the A.M. and P.M. peak hours, respectively.

Table 7. Existing (2009) Levels-of-Service

Intersection	A.M. Peak Hour			P.M. Peak Hour		
	V/C	Delay	LOS	V/C	Delay	LOS
Queen Ka'ahumanu Highway at Keahole Airport Access Road	0.61	11.7	B	0.87	19.1	B
Queen Ka'ahumanu Highway at Kaiminani Drive	0.74	19.0	B	0.63	14.6	B
Mamalahoa Highway at Kaiminani Drive		36.3	E		56.4	F
Mamalahoa Highway at Makalei Estates		10.0	B		9.6	A
Mamalahoa Highway at Ahikawa Street		13.9	B		11.4	B

Excerpted from Traffic Impact Analysis Report University of Hawai'i Center – West Hawai'i, Table 6, p. 7 (Phillip Rowell and Associates, 2009).

4.2.5.2 POTENTIAL IMPACTS

NO ACTION

The TIAR assessed future traffic conditions in the vicinity of the project area with and without the Proposed Action. For analysis purposes, conditions were estimated for years 2011, 2012, 2017 and 2023, which correlate with the projected incremental implementation of the four development phases of the UHCWH. The analysis also takes into account ambient background growth, the expected traffic volumes that would be generated by development of the Palamanui Master Planned Community and the Lokahi Subdivision, as well as completion of Phase 2 of the Queen Ka'ahumanu Highway widening project.

With No Action, the project area would remain in an undeveloped state and there would be no project-generated impacts to existing and future traffic and circulation. However, based on the LOS for background conditions (i.e., conditions that would occur without the Proposed Action), the TIAR concluded that some level of mitigation would be necessary along vicinity roadways for each of the four target years. Recommend mitigation for background conditions listed in Table 8 below and are contained in the TIAR, which is attached as Appendix F.

Table 8. Mitigation Measures to Address Background Conditions

Year	Mitigation
2011	1) Construct a traffic signal at the intersection of Mamalahoa Highway at Kaiminani Drive.
2012	1) Construct a southbound right turn lane along Mamalahoa Highway and Kaiminani Drive.
2017	1) At the intersection of Queen Ka'ahumanu Highway at Kaiminani Drive, construct a second westbound left turn lane. 2) Widen Mamalahoa Highway from two to four lanes from north of Kaiminani Drive southward. 3) Install traffic signals at the intersection of Kaiminani Drive at Main Street.
2023	1) Add third southbound through lane along Queen Ka'ahumanu Highway between Keahole Airport Access Road and Kaiminani Drive. 2) At the intersection of Queen Ka'ahumanu Highway at Kaiminani Drive, add a second southbound left turn lane.

	3) At the intersection of Mamalahoa Highway at Kaiminani Drive, modify traffic signals to provide protected eastbound right turn movement. 4) At the intersection of Mamalahoa Highway at Makalei Estates, install left turn refuge lane along Mamalahoa Highway. 5) At the intersection of Queen Ka'ahumanu Highway at University Drive, add a second southbound left turn lane and a second westbound left turn lane. 6) At the intersection of Mamalahoa Highway at Ahikawa Street, add a left turn refuge lane for eastbound to northbound left turns.

PROPOSED ACTION

To assess the project-generated impacts, the TIAR looked at the five existing intersections discussed in Section 4.2.5.1 above, as well as two future intersections—Queen Ka'ahumanu Highway at University Drive and Kaiminani Drive at Main Street Road—and the UHCWH's main entrance driveway at Main Street Road (refer to Figure 25). The Proposed Action is expected to cumulatively generate 725 trips for Phase 1, 1,055 trips for Phases 1 and 2, 2,705 trips for Phases 1 through 3, and 4,560 trips for Phases 1 through 4 (refer to Table 9 below).

Table 9. Project-related Trip Generation

Period & Direction		Trips per TGSF or Percent	Phase 1	Phases 1 & 2	Phases 1 thru 3	Phases 1 thru 4
			26.354	38.358	98.439	165.815
Weekday Total		27.149	725	1055	2705	4560
A.M. Peak Hour	Total	2.99	80	115	295	495
	Inbound	74%	60	85	220	365
	Outbound	26%	20	30	75	130
P.M. Peak Hour	Total	3.09	65	95	250	420
	Inbound	58%	40	55	145	245
	Outbound	42%	25	40	105	175

Excerpted from the Traffic Impact Analysis Report for University of Hawai'i Center – West Hawai'i, Table 12, p. 14 (Phillip Rowell and Associates, 2009).

Trip distribution from project-generated traffic is projected to be as follows:

- 22 % To and from the north via Queen Ka'ahumanu Highway
- 47 % To and from the south via Queen Ka'ahumanu Highway
- 20 % To and from the north via Mamalahoa Highway
- 11 % To and from the south via Mamalohoa Highway

The LOS analysis concluded that for each of the years 2011, 2012 and 2017 (Phase 1, 2 and 3), the LOS at the eight study intersections would be sufficient such that no additional mitigation, beyond that which would be needed to address background conditions, is warranted. Even without the Proposed Action, road improvements would be needed to accommodate this background growth.

For the first three development phases, the Proposed Action would not generate significant levels of project-generated impacts such that needed road improvements can be attributable to the project alone. It is expected that there would be some degree of decreased LOS due to project-generated traffic, but not to the extent requiring mitigation. For year 2011, the Proposed Action would have no effect on the LOS at each intersection, except for Queen Ka'ahumanu and Kaiminani Drive. At this intersection, the addition of project-generated traffic would reduce the P.M. Peak Hour LOS from B to C. For year 2012, the only intersection that is projected to see a reduced LOS due to the Proposed Action is Kaiminani Drive at Main Street Road. At this intersection, the A.M. Peak Hour LOS would drop from E to F. An LOS of E and F are deemed acceptable for this intersection because this intersection serves as the driveway for the Lokahi Subdivision, which has two other driveways that provide alternative routes. For year 2017, two intersections are expected to see reduced a reduced LOS with the Proposed Action. The P.M. Peak Hour LOS for the eastbound approach at Mamalahoa Highway and Makalei Estates is anticipated to drop from C to E, and the A.M. Peak Hour LOS at Kaiminani Drive and Main Street Road would lower from B to C.

For the fourth phase of UHCWH's development, mitigation is recommended to address project-generated impacts. The LOS for Kaiminani Drive at Main Street Road is expected to lower from B to E during the A.M. Peak Hour and from B to C during the P.M. Peak Hour. Additional mitigation is required to address year 2023 conditions.

Refer to the TIAR, which is attached to this SEIS as Appendix for F, for detailed information on the LOS analysis and anticipated impacts.

4.2.5.3 MITIGATION

For years 2011, 2012, and 2017, which correspond to development Phases 1 through 3 of the UHCWH, no additional mitigation would be required beyond that which would be needed to address the increased traffic volumes attributable to ambient background growth and development of the Palamanui Master Planned Community and the Lokahi Subdivision.

For year 2023, which corresponds to Phase 4 of the UHCWH's development, project-driven mitigation is recommended. In addition to the measures to address background conditions, two additional mitigation measures are recommended to accommodate project-generated traffic as the UHCWH expands from a 750 FTES to a 1,500 FTES campus. They are as follows:

1) Construct a second northbound to eastbound right turn lane along Kaiminani Drive at Queen Ka'ahumanu Highway.
2) Widen Kaiminani Drive, from two lanes to four lanes, from Queen Ka'ahumanu Highway to east of Main Street Road.

Other traffic-related recommendations included in the TIAR include:

1) Conducting a traffic warrant study for the intersection of Main Street Road and Kaiminani Drive prior to completion of Phase 3 of the UHCWH's development.

2) Update the TIAR after completion of Phase 3.

Refer to the TIAR, which is attached to this SEIS as Appendix for F, for a summary of recommended mitigation measures to address both background conditions and project-generated traffic.

4.3 INFRASTRUCTURE

The extension and construction of water, wastewater, drainage, electrical and communication systems are necessary for the adequate provision of these services to support the Proposed Action. In the 1998 LRDP, the presumption was that extension of utilities would be toward the south to Kaiminani Drive which, at that time, was the only existing utility corridor in the vicinity of the 500-acre University parcel. Subsequently, the large planned development, Palamanui, on the northern border of the 500-acre parcel was announced. As discussed above in Section 2.4 *Background*, in 2002, the University entered into a MOU with Palamanui "to consult and discuss joint development opportunities for the adjacent properties, with the developer providing initial infrastructure for UHCWH" (PBR, 2008, p. 11). The general intent of the University is to "piggy-back" on Palamanui's utility systems to reduce the University's infrastructure costs, as much as possible.

No adverse short- or long-term impacts to utilities and services are anticipated since coordination with the appropriate agencies would be accomplished, and is required by the County of Hawaiʻi in order to implement the Proposed Action. Anticipated utility and infrastructure system approvals are listed below:

- Building Permit for Buildings, Electrical, Plumbing, Sidewalk/Driveway Work (County of Hawaiʻi, Department of Public Works)
- Grading, Grubbing and Stockpiling Permit (County of Hawaiʻi, Department of Public Works)
- Water System (County of Hawaiʻi, Department of Water Supply)
- Wastewater System (State Department of Health)

4.3.1 Water System

4.3.1.1 AFFECTED ENVIRONMENT

There currently is no potable water supply to the project area. The nearest water mains run down Kaiminani Drive. There also is an existing transmission main along Queen Kaʻahumanu Highway, at the 325-foot elevation; however, the pressure is too low to serve the proposed site, which is located between the 400- to 600- foot elevations. Thus, potable water for the UHCWH would be provided through the Palamanui water supply infrastructure.

Palamanui has two water sources in the upper limits of the Makalei Estates Subdivision. Well #4458-01 (Kau Well 1) has been drilled and cased, but not outfitted. Well #4458-02 (Kau Well 2) has been outfitted with a pump house and small reservoir. Both wells are intended to produce 0.8 mgd, each.

4.3.1.2 POTENTIAL IMPACTS

NO ACTION

Under No Action, no water system improvements would be required to serve the undeveloped property and there would be no impact on existing transmission systems and potable water sources.

PROPOSED ACTION

While potable water would be provided through the Palamanui water supply infrastructure, the University still would need to make its own arrangements with DWS for water quota and service to the Palamanui improvements, which eventually will be transferred to DWS.

The potable water demand for Palamanui is estimated at 1.2 mgd. The UHCWH is allocated 0.4 mgd of the 1.2 mgd. Water demand for a maximum enrollment of 1,500 FTES is grossly estimated to be 60,000 gallons per day (gpd).

Palamanui will provide water to the UHCWH by extending an existing 12-inch pipeline from the Makalei Estates Subdivision. This pipeline would run down (westward) from Makalei Estates, where it would intersect with and run beneath the future University Drive. This pipeline would eventually connect to the two existing DWS Keahole water tanks located approximately 1,500 feet east of Queen Ka'ahumanu Highway near the 280-foot elevation (refer to Figure 26). The Keahole reservoirs include one 0.5-million-gallon tank and one 1-million-gallon tank. Palamanui is also installing a 343-foot elevation water tank, with a design capacity of one million gallons, that will be located midway between the Keahole water tanks and Main Street Road. Water for the new 343-foot elevation water tank will be supplied by Palamanui's two wells near Mamalahoa Highway, in the Makalei Estates Subdivision. UH and the planning team have initiated discussions with the County's DWS to secure water allocation to support the UHCWH.

Table 10 below shows the estimated water demand for the 750 FTES campus (development Phases 1 through 3). In total, the 750 FTES campus is projected to use 8,886 gpd based on the estimated number of fixtures. Use of rainwater, graywater and AC condensate are being considered for irrigation and other non-potable uses to minimize the demand for potable water.

Table 10. 750 FTES Campus Estimated Domestic Water Demand

	Description	Fixture Units	Water Demand (gpd)
1	Culinary Arts	95.7	3,680
2	Health Science	51.7	1,269
3	Academic Support	87.0	1,215
4	General Education	41.7	2,722
	Totals	**276.1**	**8,886**

4.3.1.3 MITIGATION

As a result of the above features, no mitigation is warranted or proposed.

4.3.2 Wastewater System

4.3.2.1 AFFECTED ENVIRONMENT

There is no existing wastewater treatment facility to serve the Proposed Action. The municipal sewer system in West Hawai‘i currently serves the Keauhou and Kailua areas only and does not extend as far north as Kalaoa.

The existing wastewater treatment plant (WWTP) No. 1 is located approximately five miles south of the proposed site at Kealakehe. Sewer connection to WWTP No. 1 would be prohibitively expensive due to distance. The county has not yet constructed the proposed WWTP No. 2 for this region. In future years, if and when WWTP No. 2 is completed, smaller private/public plants could connect to this municipal system.

4.3.2.2 POTENTIAL IMPACTS

NO ACTION

With No Action, no new wastewater system or improvements to existing systems would be required to serve the undeveloped property.

PROPOSED ACTION

As conditioned by the County of Hawai‘i (see Section 2.4, *Project Background*), the WWTP being constructed for the Palamanui development would accommodate wastewater from the UHCWH. Wastewater generated by the UHCWH would be piped to a 12-inch sewerline located in University Drive that continues west to Palamanui’s proposed self-contained WWTP (refer to Figure 26). Palamanui’s WWTP and associated infrastructure to support the UHCWH would be constructed in phases, but master planned to accommodate all four phases of the UHCWH development (the 1,500 FTES campus). Sewage flow generated by the UHCWH would be reduced by the use of low-flow and dual-flush plumbing fixtures.

Since the Palamanui wastewater system is a self-contained private system, it would not impact any of the existing municipal wastewater systems in the region. The Palamanui wastewater system would benefit the environment because the treatment facility is being designed to produce R-1 water, which the DOH has approved for irrigation purposes. This will help to conserve valuable potable water sources in West Hawai‘i. Table 11 below shows the estimated sewage flow for the 750 FTES campus (development phases 1 through 3).

Table 11. 750 FTES Campus Estimated Sewage Flow

No.	Description	Fixture Units	Sewer Demand (gpd)
1	Culinary Arts	95.7	3,680
2	Health Science	51.7	1,269
3	Academic Support	87.0	1,215
4	General Education	41.7	2,722
	Totals	**276.1**	**8,886**

Project designers are investigating the possible use of a constructed wetland in conjunction with a septic tank system to service the first two campus buildings (Culinary Arts and Health Science/Student Services). This system would serve as a demonstration project and educational tool for the UHCWH, which is striving to become a model of sustainability. A constructed wetland treats blackwater through a biological treatment system that mimics the cleansing functions of natural wetlands and does not produce toxic bi-products, such as sludge. The resultant treated water would be of R-2 quality, which would be applied to non-potable water uses, such as landscape irrigation. The size and type of the constructed wetland has yet to be designed, but preliminary estimates are that it may have a capacity of approximately 3,500 gpd. The constructed wetland could take the form of a surface pond or tank; however, if this is not feasible because of aviation safety concerns, a sub-surface flow system in gravel media could be utilized.

4.3.2.3 MITIGATION

As a result of the above features, no mitigation is warranted or proposed.

4.3.3 Solid Waste Disposal

4.3.3.1 AFFECTED ENVIRONMENT

There is currently no solid waste disposal service to the project area.

4.3.3.2 POTENTIAL IMPACTS

NO ACTION

With No Action, no solid waste disposal service would be required to serve the undeveloped property.

PROPOSED ACTION

The Proposed Action is not anticipated to have a significant adverse impact on solid waste disposal. A private disposal company would be utilized to provide solid waste disposal services for the Proposed Action. Solid waste generated by the UHCWH would be taken to County-approved solid waste disposal facilities. Pu‘u Anahulu Landfill is the closest solid waste disposal facility to the project area. As of 2002, it was projected that Pu‘u Anahulu could accommodate West Hawaii's current waste stream for another 40 years (Wilson Okamoto, 2007). Greenwaste from landscape maintenance can be composted with biosolids at the Palamanui WWTP.

4.3.3.3 MITIGATION

Reduction and recycling programs could be instituted at the UHCWH to reduce the amount of solid waste generated, which would lessen the amount of waste to be transported and disposed at solid waste disposal facilities.

4.3.4 Drainage System

4.3.4.1 Affected Environment

Although the drainage basin (tributary) towards Hualālai reaches the 5,000-foot elevation, there are no developed drainageways and no signs of flow, not even at Mamalahoa Highway at the 1,800-foot elevation. Mauka lands consist of weathered and/or recent lava flows that are very porous. Most of the rainfall percolates into the weathered lava. Rainfall at the proposed site is less than 20 inches per year. The amount of rainfall increases with tributary land elevations to approximately 50 inches at the 4,000-foot elevation. Rainfall gradually decreases to approximately 40 inches per year at the 5,000-foot elevation, which is the highest point in the rainfall tributary system for the UHCWH.

The proposed site currently is undeveloped and there are no man-made drainage systems in place.

4.3.4.2 Potential Impacts

No Action

Under No Action, no drainage systems would be required or constructed within the proposed site.

Proposed Action

The drainage improvements required for the UHCWH development would be minimal. Devices such as field inlets with drywells would be used as needed. The entirety of the Proposed Action is situated above the Underground Injection Control (UIC) line; thus, the use of drywells for the disposal of storm water runoff would require the filing of a UIC permit with the DOH, Safe Drinking Water Branch.

A drainage ditch would be needed to handle the storm water flowing downhill from the eastern portion of the subdivision. The first option being considered by project designers is a ditch that would run from University Drive down along the southern boundary of the campus bordering Preserve 2. A second option being considered is to build a 15-foot wide berm to hold back the water along the same route as the first option. A third option would be to channelize the storm water through the campus under the roadway. During design development, these options would be analyzed more fully to identify the best alternative for managing site drainage.

Future buildings would be raised slightly on pads to allow any rainwater that is not collected for future use to swale around the structures into drywells. The design guidelines contained in the "Storm Drainage Standards" of the Department of Public Works, County of Hawaiʻi shall used to evaluate future drainage systems.

With proper engineering and implementation of BMPs, drainage is not expected to have a significant adverse impact on the environment.

4.3.4.3 Mitigation

No mitigation is proposed or deemed warranted.

4.3.5 Electrical and Communication Systems

4.3.5.1 AFFECTED ENVIRONMENT

The project area has no electrical power and communication services. HELCO currently has an overhead 69 kilovolt (kV) transmission line running through the utility easement along the southern portion of the 500-acre University parcel. The line runs from Mamalahoa Highway to the Keahole Substation located near the Queen Ka'ahumanu Highway.

4.3.5.2 POTENTIAL IMPACTS

NO ACTION

With No Action, no electrical power or communication service would be required for the undeveloped property and there would be no impact on existing systems.

PROPOSED ACTION

The Proposed Action is anticipated to have an insignificant impact on the region's electrical system, which should have sufficient capacity to serve the new UHCWH. Further, the UHCWH is trying to obtain LEED Platinum certification for Phases 1 and 2 of the Proposed Action, and moving the campus toward net zero energy consumption. Achieving these goals should reduce, if not eliminate entirely, the UHCWH's demand on the region's electrical system.

Electrical System. HELCO plans to install a new 12.47 kV lines on the existing transmission line poles below the 69 kV lines. These lines would initially serve the Proposed Action until the new Palamanui substation is built. The 2009 LRDP proposes that the UHCWH electrical system be connected to two 12.47 kV underground HELCO feeders located on University Drive. The two 12.47 kV HELCO circuits would extend to a new primary switchgear station located adjacent to the O & M building. The University is responsible for the design and construction of this new station. The primary switchgear would be housed in a 24-foot by 48-foot electrical switchgear room. The new UHCWH primary switchgear would consist of two key interlocked incoming circuit breakers, HELCO Metering Section and two circuit breakers for two campus distribution feeders. The ultimate anticipated load for the campus is between 3,000 kilovolt amps (kVA) and 3,500 kVA.

The campus distribution system would be via two 12.47 kV, UH-owned primary circuits to service the transformers located at the various on-campus buildings. The primary distribution system for the campus would consist of two 4-inch spare conduits and two 4-inch conduits for the campus distribution feeders with 4-foot by 6-foot electrical primary handholes.

The use of renewable energy sources such as photovoltaics and wind turbines is being considered for the project. These devices may be deployed on roofs, trellises and in parking areas. The project electrical engineer has retained a consultant that specializes in renewable energy systems. The consultant will help the team determine the best and most cost-effective renewable energy system for the UHCWH.

Building Automation System (BAS). A central BAS or energy management system would be incorporated throughout the UHCWH campus. The BAS would control and monitor mechanical systems and lighting. A separate BAS ductline system would be installed throughout the campus to facilitate interconnection of system components. Main equipment would be located in the same room as the fire alarm control panel. Each building would have a sub-panel(s) that would communicate with the main panel. The BAS would interface with the fire alarm and security alarm systems.

Telecommunications. The UHCWH would be equipped with four 4-inch concrete encased ducts from University Drive with 6-foot by 12-foot telephone manholes and a 750-square foot switch room (25’ x 30’) for the telephone equipment. The telephone switch room would be located in the Health Science building. Dedicated fiber is expected to run from the telecommunications center to each proposed building. There would be Category 6 multi-pair cables within each proposed building for data and voice services via local LAN (local area network). The telecom will be IP based.

Cable Television. The Oceanic Time Warner Cablevision system would be extended via underground cables from University Drive for cable television (CATV) service at the UHCWH site. The CATV system shall be designed using Oceanic Time Warner’s specs and guidelines. Distribution of CATV would be via underground ductlines installed along the same route as other telecommunication lines that extend from the telecommunications center.

HITS. One of the main learning resources for the UHCWH is its use of HITS. This service would be delivered via fiber service to the telecommunications center for distribution throughout the campus. From the telecommunications center, ductlines would be installed along the same route as other telecommunication equipment.

4.3.5.3 MITIGATION

Project architects for UHCWH would employ green/climate-appropriate and energy efficient design for campus buildings. Vegetation and landscaping would moderate climatic conditions and buildings would employ LEED™ criteria in their design to reduce energy demand.

4.4 PUBLIC SERVICES AND FACILITIES

4.4.1 Fire

4.4.1.1 AFFECTED ENVIRONMENT

The West Hawai‘i region is served by several fire stations, including volunteer fire stations. The Kailua-Kona Fire Station is the main station and is located roughly eight miles south of the project area, near the intersection of Palani Road and Queen Ka‘ahumanu Highway. Other stations in the region are located in Waikoloa, Keauhou, Kona Palisades, Milolii and Captain Cook. The County of Hawai‘i is planning to construct another fire station at Makalei, which is located approximately 1.9 miles east of the project area, at the intersection of Mamalahoa Highway and Makalei Drive.

4.4.1.2 POTENTIAL IMPACTS

NO ACTION

With No Action, the project area would remain undeveloped and there would be no impacts to fire prevention and protection services.

PROPOSED ACTION

The Proposed Action could increase the potential for wildfires because of increased human activity in an area characterized by hot and arid conditions combined with the nature of the flora found in the project area. However, overall, the Proposed Action is not expected to result in significant impacts to fire services.

Fire prevention and protection elements, such as provision of fire lanes and hydrants at required intervals, would be incorporated into the Proposed Action as required by the Fire Code. The Proposed Action would include a centralized fire alarm that is fully addressable and electrically supervised. Each building would be connected to the central fire alarm panel, but would have its own control panel, pull stations, speakers, ADAAG (American with Disabilities Act Accessibility Guidelines) flashers, smoke detectors, heat detectors, duct detectors, and required sprinkler monitors. There would be a separate Fire Alarm ductline system installed throughout the campus to facilitate interconnection of system components.

4.4.1.3 MITIGATION

No mitigation is warranted or proposed.

4.4.2 Police

4.4.2.1 AFFECTED ENVIRONMENT

Of the three police stations that serve the County of Hawai‘i, the Kealakehe Station has jurisdiction over the North and South Kona districts. It is located approximately 5.5 miles south of the project area, on the mauka side of Queen Ka‘ahumanu Highway. In addition, substations in Keauhou, Kailua-Kona, and Captain Cook operate as satellite bases to the main station.

4.4.2.2 POTENTIAL IMPACTS

NO ACTION

With No Action, the project area would remain undeveloped and there would be no impacts to police services.

PROPOSED ACTION

The Proposed Action is not expected adversely impact police service in the vicinity of the project area.

4.4.2.3 MITIGATION

No mitigation is warranted or proposed.

4.4.3 Medical Services

4.4.3.1 AFFECTED ENVIRONMENT

The Kona Community Hospital is the largest medical facility in West Hawai‘i. It is located approximately 17 miles southeast of the project area, in Kealakekua. Closer in proximity to the project area is the Kaiser Permanente Kona Clinic, which is located about eight miles south in the business district of Kailua-Kona. Other smaller private specialty medical and dental providers are located throughout the region.

4.4.3.2 POTENTIAL IMPACTS

NO ACTION

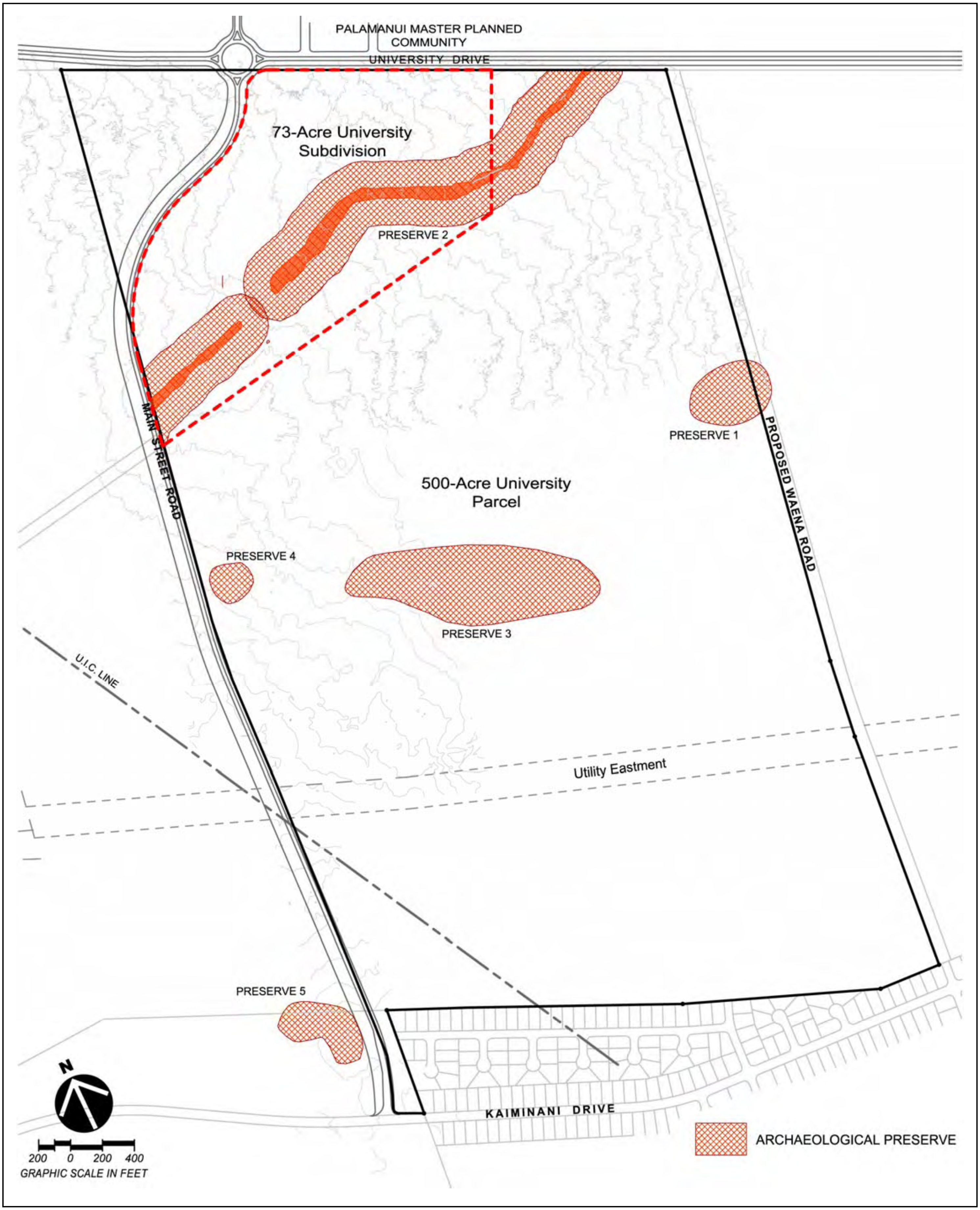
With No Action, the project area would remain undeveloped and there would be no impacts to medical services.

PROPOSED ACTION

The Proposed Action is not expected to impact medical service in the vicinity of the project area.

4.4.3.3 MITIGATION

No mitigation is warranted or proposed.



Archaeological Preserves Figure 21

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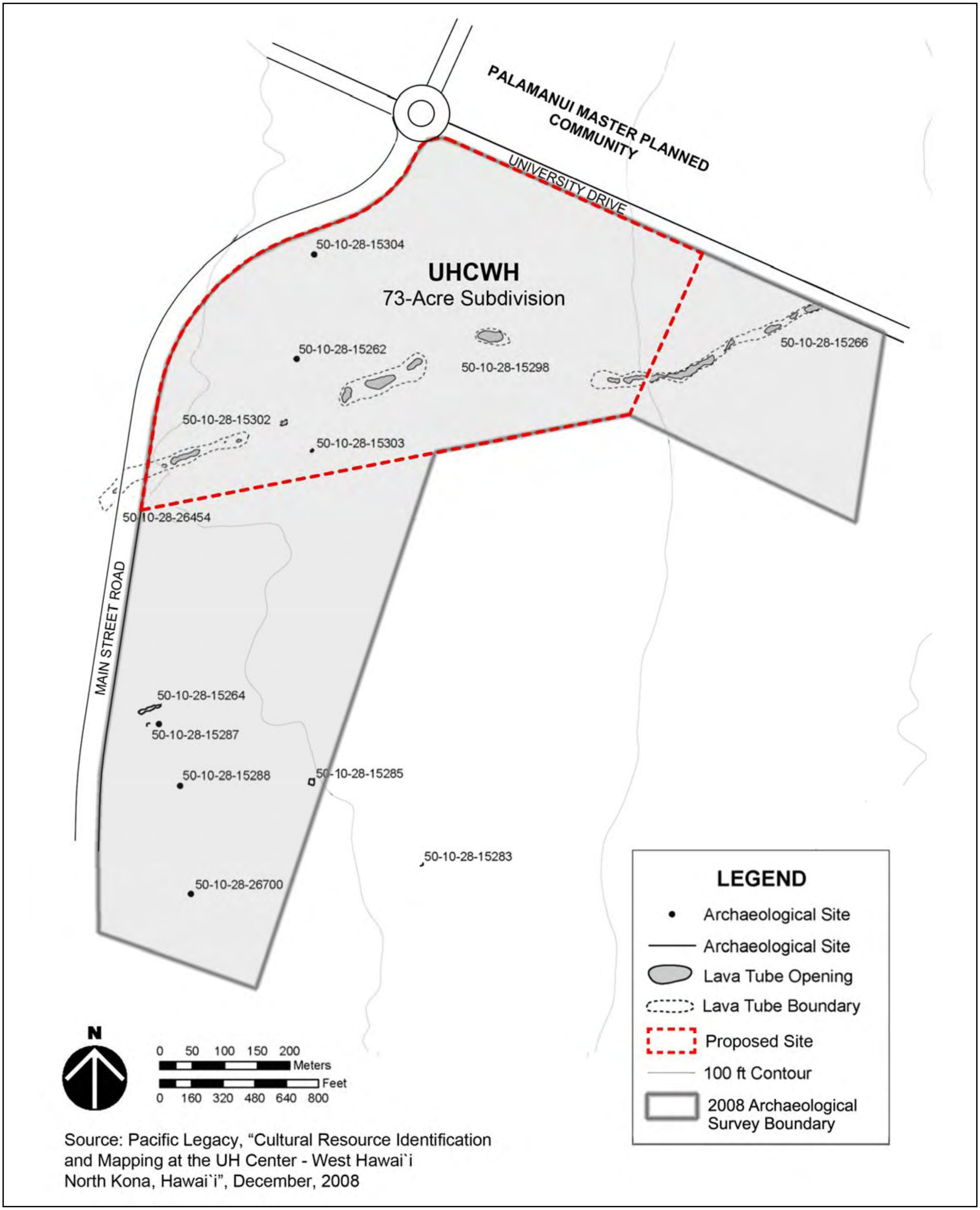

Archaeological Sites Figure 22

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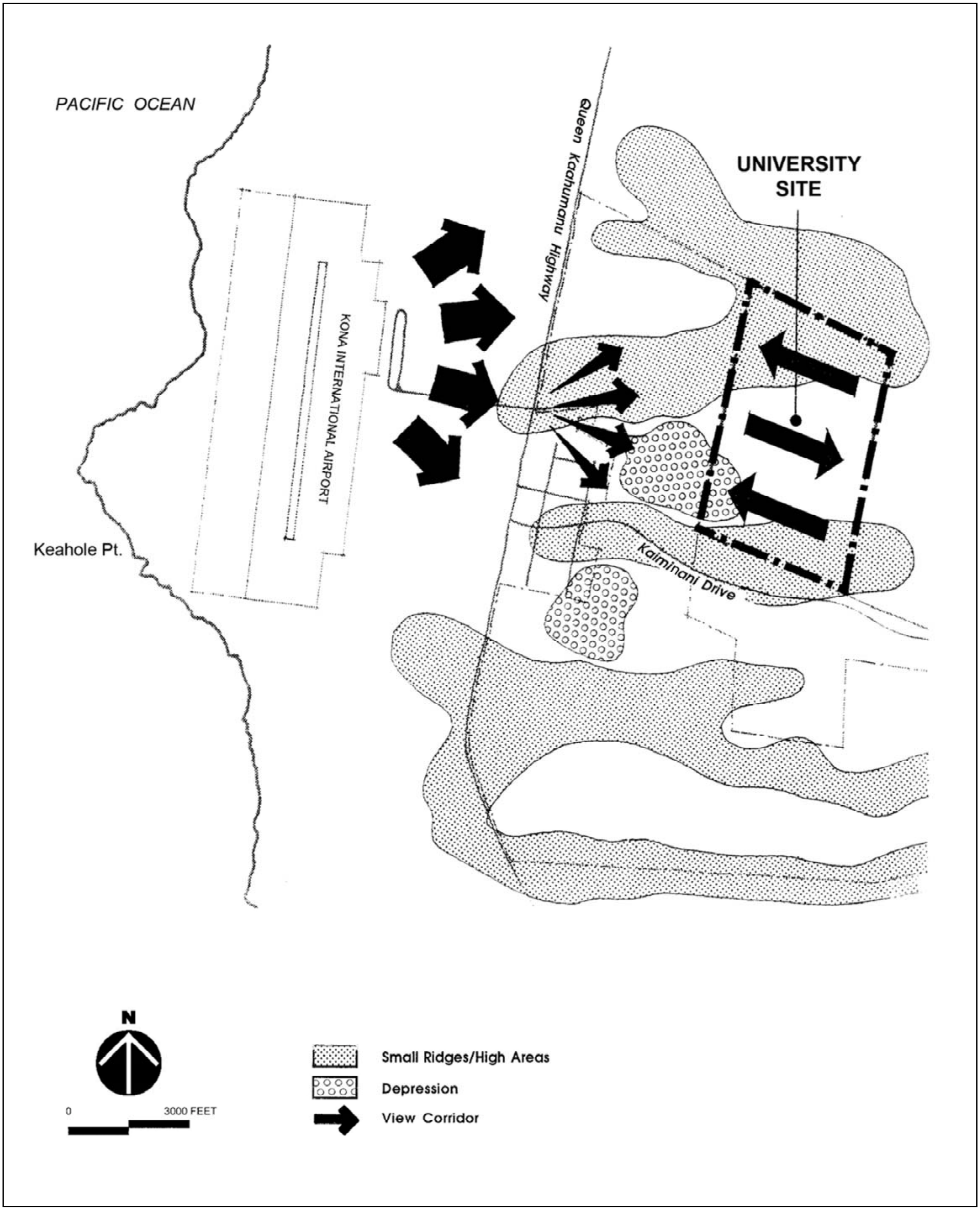

Visual Planes Figure 23

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Major Regional Roadways

Figure 24

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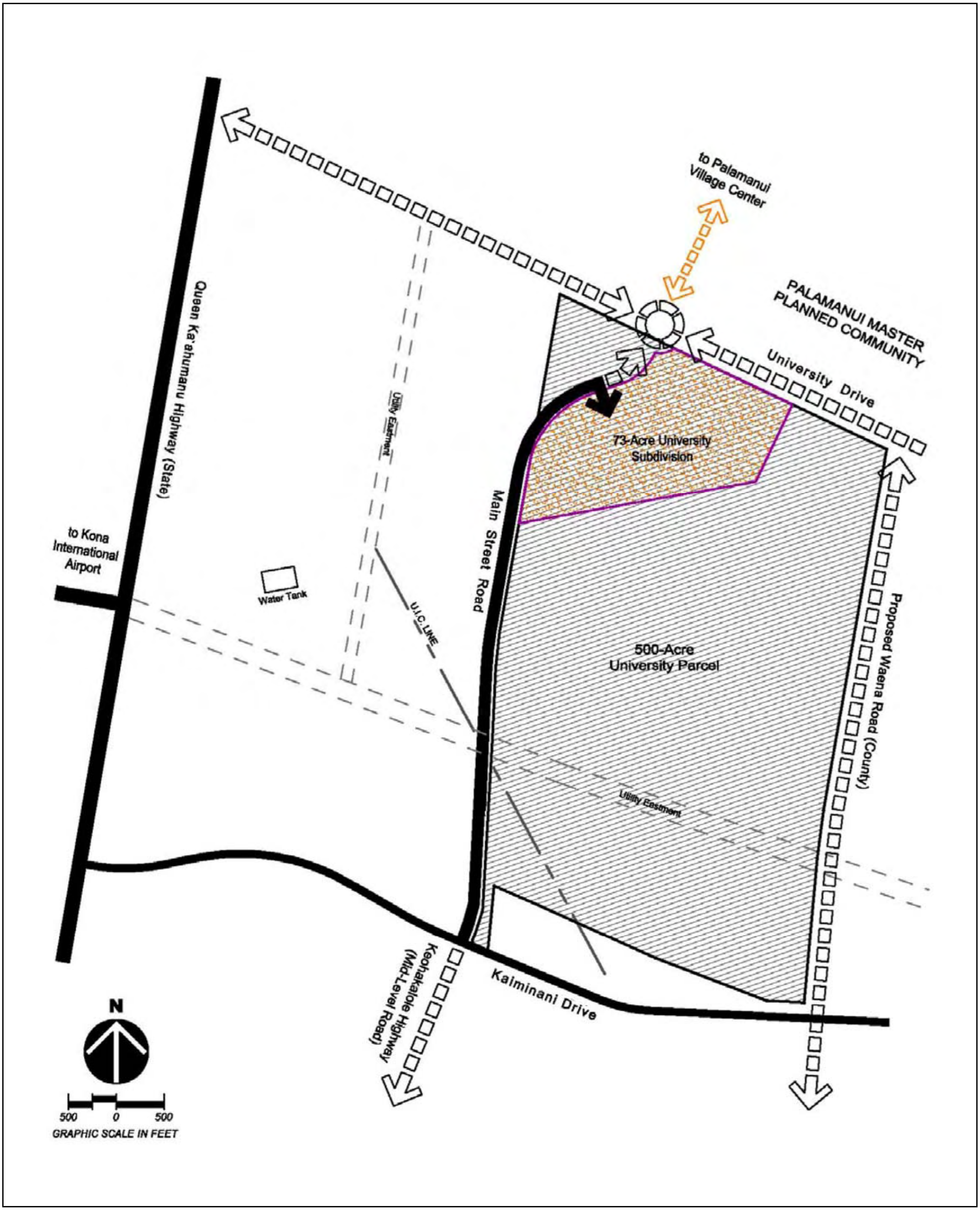

Project Area Roadways Figure 25

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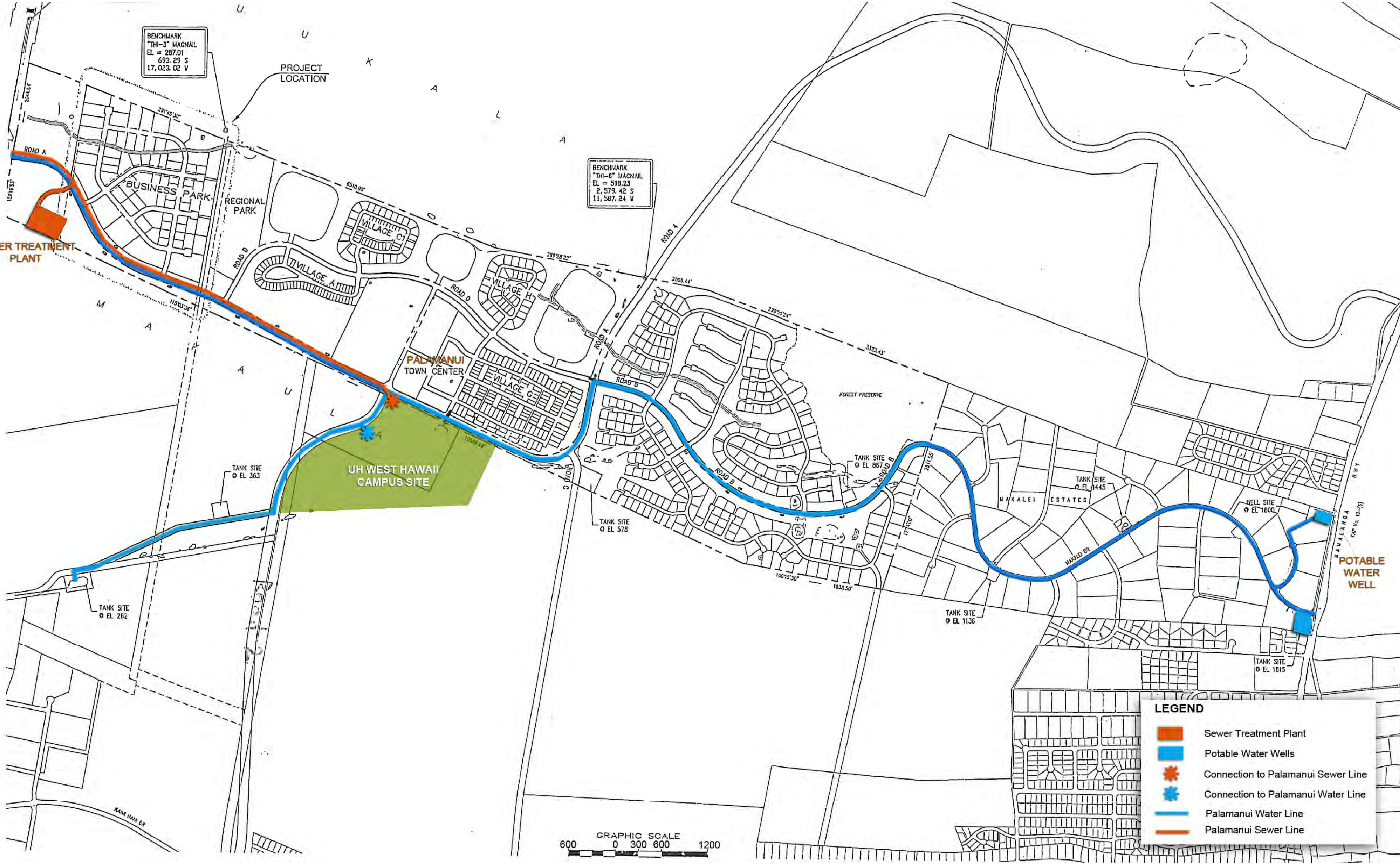

Infrastructure Map

Figure 26

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4.5 SOCIO-ECONOMIC CONDITIONS

4.5.1 Population

4.5.1.1 AFFECTED ENVIRONMENT

The 2000 U.S. Census gives Hawai‘i County’s population at 148,677 persons, a 24 percent increase from 1990 and a 62 percent increase from 1980. In a more recent 2008 study known as the American Community Survey, also conducted by the U.S. Census Bureau, the population of Hawai‘i County numbered 175,784 persons. This represents an 18 percent population increase within a matter of eight years. It also accounts for 35 percent of the entire state’s population growth between 2000 and 2008 (U.S. Census Bureau, 2009). However, given the relatively large land area of Hawai‘i County, the population density remains low, about 43 persons per square mile. The wide dispersion of towns and other populated places, especially in West Hawai‘i, make it more difficult for employees to commute to jobs and educational/training institutions (Lucas, 2009).

The population of the West Hawai‘i region (defined by the four districts of North Kohala, South Kohala, North Kona and South Kona) comprises approximately 38 percent of the county’s total resident population, which is roughly the same percentage as from 1990 to 2000. West Hawaii’s percentage of the total county population is expected to remain the same for the foreseeable future. North Kona and South Kohala are among the fastest growing regions of the state. However, on the island of Hawai‘i, this increase is balanced by rapid population growth in the Puna district of East Hawai‘i. The table below shows the population and its percent change between the years of 1980 through 2000 for the four districts comprising the West Hawai‘i region.

Table 12. West Hawai‘i Population 1980 to 2000

Population	1980	% of Hawai‘i County	1990	% of Hawai‘i County	2000	% of Hawai‘i County	1980-1990 % change	1990-2000 % change
North Kohala	3,249	3.5	4,291	3.6	6,038	4.1	32.1	40.7
South Kohala	4,607	5.0	9,140	7.6	13,131	8.8	98.4	43.7
North Kona	13,748	14.9	22,284	18.5	28,543	19.2	62.1	28.1
South Kona	5,914	6.4	7,658	6.4	8,589	5.8	29.5	12.2
Total West Hawai‘i	27,518	29.9	43,373	36	56,301	37.9	57.6	29.8
Hawai‘i County	92,053	100	120,317	100	148,677	100	30.7	23.6

Source: County of Hawaii General Plan, Table 1-1 and Section 2.4: Districts (February 2005).

North Kona, which extends from Keahole to Waikoloa, remains the most populated region of West Hawai‘i due to it being a hub for major commercial and tourism activities. In a census study conducted in July 2005, the estimated population of North Kona was 31,900 and South Kona was 10,700, totaling 42,600 for both districts (Wilson Okamoto Corporation, 2008).

The current location of the UHCWH in Kealakekua is considerably south of the geographic center of the West Hawai‘i region. Further, the UHCWH is the only public post-secondary institution in West Hawaiʻi, which currently accounts for close to 40 percent of the county's population. Population projections for the West Hawaiʻi region indicate sufficient population to justify the construction of a higher education center serving 1,200 to 1,600 students by year 2010 (HawCC, 1997, p. 10). Recent research conservatively estimates the West Hawaiʻi population to be 90,263 by 2020 (County of Hawaii, 2005, p. 1-17). These projections, coupled with the lack of adequate facilities that prevent growth of the UHCWH, deprives West Hawaiʻi residents of the equal opportunity for higher education. As discussed above in Section 2.3, West Hawaiʻi has a much lower "going rate" compared to East Hawaiʻi and other regions of the state. Only 7.9 percent of West Hawaiʻi high school graduates enrolled in colleges without a break. The limited capacity of the current facilities in West Hawaiʻi is one of the reasons for the low going rate. Community sentiments over the past 20 years indicate the need for increased post-secondary educational opportunities in West Hawaiʻi (HawCC, 1997, p. 12).

4.5.1.2 Potential Impacts

No Action

With No Action, the inadequacies of the existing UHCWH facilities in Kealakekua with respect to population predictions and community concerns for higher education would not be addressed. The opportunity to provide a permanent post-secondary educational facility in Kalaoa would be lost along with the associated benefits to the community.

Proposed Action

Relocating the UHCWH to the region's geographical center at Kalaoa would be a great benefit to West Hawaiʻi by providing both improved facilities and increased accessibility. The more strategically located UHCWH would be more accessible to residents due to reduced commuting distance for over half of the region's population. Further, the improved and larger facilities would enable UHCWH to serve more students. As a result, the "going rate" in West Hawaiʻi would likely increase as more high school graduates can be expected to continue their education without a break. Also, there may be increased interest in life-long learning as various non-credit courses can be provided by the UHCWH in the new facilities. All of these factors contribute to an educated population and add to the quality of life that is essential for maintaining a viable community.

With new facilities and expanded program offerings, it is conceivable that persons could relocate to the West Hawaiʻi region specifically to attend or to teach at the UHCWH. However, these numbers would not be significant, particularly in the context of the region's overall growth, as the UHCWH is expected to primarily serve the existing West Hawaiʻi population and to relieve the region's pent up demand for post-secondary educational opportunities. Thus, is not expected that the UHCWH would be a significant growth-inducing force. The Proposed Action is not anticipated to result in significant adverse impacts to population.

4.5.1.3 Mitigation

No mitigation is warranted or proposed.

4.5.2 Economy

4.5.2.1 AFFECTED ENVIRONMENT

The districts of North and South Kona are considered the governmental, commercial and industrial centers of West Hawai‘i. As with the rest of the island, tourism remains the major industry in Kona. Due to the continued growth of vacationers to North Kona, employment opportunities generated by tourism contributed to a major increase in the region’s population over the past 20 years.

The North Kona district once was the major visitor destination on the island of Hawai‘i. It now shares this distinction with South Kohala, as new resorts and hotel complexes have been developed recently along the South Kohala coast (County of Hawai‘i, 2005). In 2005, Kona provided 5,369 visitor units, including hotels, resorts, condominiums, bed and breakfast operations and other transient units, which comprised 45 percent of the total hotel rooms on the island (DBEDT, 2005). The cruise ship industry is also a contributor to tourism, bringing in a small visitor base to Kona while also boosting the local agricultural economy as produce and fruit supplies are purchased locally in Kona to serve 10,000 to 25,000 passengers a month aboard the ships (DBEDT, 2009).

Second to tourism, the agricultural industry is the next most prominent sector. Most of the island’s coffee production is located within Kona and accounts for one-third of the coffee produced statewide. World renowned “Kona Coffee” is the signature product of Kona and has been since the 1800s. In 1997, the value of gross sales for Kona Coffee grown and manufactured in Kona was $16,200,000 and the market and price continues to grow (County of Hawaii, 2005, p. 2-26).

While North Kona’s most prominent industry is tourism, South Kona’s primary economic activity is agriculture (Ibid). Besides coffee, macadamia nut orchards cover approximately 4,000 acres of the district, accounting for roughly 20 to 25 percent of all macadamia nut production for the State of Hawai‘i (Ibid.). Other agricultural commodities include various fresh fruits and vegetables, such as tomatoes, bananas, papayas, citrus crops and avocado. Raising livestock and cattle ranching are also major industries in Kona. The Hawai‘i Department of Agriculture has reported gains in revenue generated by diversified agriculture in Kona since 1986 (Wilson Okamoto Corporation, 2008).

Besides tourism and diversified agriculture, other important economic activities in West Hawai‘i include UH and other research institutes, such NELHA and the HOST Park, both located in Keahole, North Kona; construction; healthcare; transportation; and education. Kona remains the retail and bank services center for West Hawai‘i. It is home to “big-box” retailers such as Costco, K-Mart and Wal-Mart. Internationally distinguished annual events held in the West Hawai‘i region such as the IronMan Triathlon, the Hawaiian Billfish Tournament and the Senior PGA Tournament of Champions at the Hualālai Resort also generate income for the state.

4.5.2.2 POTENTIAL IMPACTS

NO ACTION

No Action would result in the lost opportunity to develop a permanent post-secondary educational facility for West Hawai'i, which could result in adverse impacts to the region's economy. Ramifications of No Action include the potential loss in higher education and job training opportunities for West Hawai'i residents. With limited job skills, individuals may be inadequately equipped for future jobs in service and sales occupations, executive/managerial and professional occupations, and scientific enterprises related to astronomy, ocean engineering and other high technology fields.

PROPOSED ACTION

The social character of West Hawai'i in the coming years is expected to transition along with the physical environment. Factors contributing to future change include continued development of resorts along the coastline and residential communities in mauka areas. One potential benefit of the transition may be increased job opportunities in the region. Continued coordination between the UHCWH and industry would facilitate the provision of a complementary range of training programs and services at the UHCWH's new facilities that would foster the skills desired by employers. With proper skills, the labor force of West Hawai'i could take advantage of job opportunities and the potential to move up to management, professional and executive positions. The new UHCWH, with its expanded programs and improved facilities, would also help establish a more diversified economy through its education and training programs in fields such as healthcare, construction and Hawaiian culture, thus further strengthening the economic base and stabilizing the local economy.

Construction and operation of the new UHCWH would generate significant short-term and long-term benefits, including additional jobs, economic output, employment earnings and tax revenues to the State of Hawai'i (refer to Section 3.4.2 for details).

No adverse impacts on the economy are anticipated from implementing the Proposed Action.

4.5.2.3 MITIGATION

No mitigation is warranted or proposed.

5.0 SECONDARY AND CUMULATIVE IMPACTS

5.1 POTENTIAL CUMULATIVE IMPACTS

Cumulative impacts may be defined as impacts on the environment that result from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions. The direct impacts due exclusively to the Proposed Action that are discussed in Chapter 4.0 of this document constitute the incremental impact of this project when added to other actions in the past and present.

The area examined that would contribute to cumulative impacts for the Proposed Action is the northern coastal portion of the North Kona district running north from (but not including) Kailua Village to Hualālai on the Kohala Coast. This area is designated mostly “urban” and “urban expansion” in the County of Hawai‘i General Plan LUPAG. Development is expected and encouraged in this part of the North Kona district. In the immediate vicinity of UHCWH are three planned or recent projects, which would contribute to cumulative impacts.

- Palamanui (725 acres). Palamanui will be a planned community on a vacant lot (former Nansei property) in the North Kona district, immediately to the north of the UHCWH site. The project will include mixed residential units, a business park, a regional park, a forest preserve, an 18-hole golf course, a small hotel, a health and wellness center, and a commercial village center with shops and restaurants, which integrates into the adjacent UHCWH campus. The village center will be a pedestrian-oriented development, which would link the UHCWH facilities with compatible commercial, recreational and cultural venues.

- University Drive and Main Street Road. These “collector roads” will be constructed by Palamanui, then turned over to the county. These roads will provide access to the two major north-south highways, Mamalahoa Highway in the mauka (mountain) area of the North Kona district and Queen Ka‘ahumanu Highway in the makai (coastal) area. University Drive will run east-west and will link directly to the highways, while Main Street Road will run north-south linking University Drive to Kaiminani Drive. Main Street Road is Phase IV of the new Keohokālole Highway (formerly Mid-Level Road) which will function as the trunk transit route connecting Kailua Village with Kona International Airport.

- Lokahi Makai (126 acres). Lokahi Makai is a planned 191-unit residential community located south of Kaiminani Drive opposite the Kona Palisades subdivision.

Also within the North Kona district, but farther from the UHCWH are the following existing, planned or proposed development projects, which may also contribute to cumulative impacts. This projects listed in Table 13 below were compiled from two main sources, the recently completed *Kealakehe – La‘i Ōpua Regional Plan*, which was prepared by PBR Hawaii & Associates, Inc. (2009) for DHHL and the *Final Environmental Impact Statement for Palamanui*, prepared by Group 70 (2004) for Hiluhilu Development, LLC.

Table 13. Development Projects in the North Kona Region

Project	Acreage	Description
Hualālai Resort	8,851	Planned residential/resort community.
WB Kūki‘o	957	Planned residential community and 18-hole golf course.
Keāhole Agricultural Park	179	Agricultural park subdivided into 34 individual lots, where tenants are allowed to grow various crops and other agricultural products.
Hu‘ehu‘e Ranch/Makalei Golf Course	1,647	Agricultural subdivision with homes, a golf course, cattle ranch, and equestrian facilities.
Makalei Estates	246	Residential housing; all 77 lots are zoned Ag-3.
NELHA/HOST	548	Science technology park focusing on research, education, and commercial activities that support sustainable industry development, which makes use of deep seawater resources.
Kula Nei	128	Approximately 270 residential units with up to 220 single family home units.
Kaloko Heights	394	1,500 unit master planned community
Kaloko Makai	1,144	Mixed-used planned community with 5,000 units of single-family and multiple-family homes.
‘O‘oma Beachside Village	303	Planned community with 950 to 1,200 homes and neighborhood businesses and services.
The Shores at Kohanaiki	442	500-unit golf course community.
Queen Liliu‘okalani Trust	3,517	Trust lands in the Kona area include the Makalapua Center which includes cinemas and a Macy’s Department Store, Queen Liliu‘okalani Children’s Center, and Kona Industrial Subdivision. Trust lands also include undeveloped, but entitled lands.
Villages of La‘i ‘Ōpua	980	Master planned community (approximately 572 acres owned by DHHL) including single and multi-family residential, recreational and community facilities, neighborhood commercial, parks, and preserves.
Honokohau	200	Commercial development focused on harbor-related uses.
Keahuolu Affordable Housing Project	272	Hawai‘i Housing Finance and Development Corporation project to develop a mixed-use community with affordable and market-priced housing with commercial and public facilities.
DHHL Airport area lands	715	Other DHHL lands near the Kona International Airport are currently zoned for residential and industrial use. DHHL’s *West Hawai‘i Island*

		Plan Update 2008, proposes the following for their Kalaoa region lands: 130 acres for residential, 385 acres for commercial, 100 acres for industrial, and 100 acres for general agriculture.
Kaloko Industrial Park	215	Kaloko Industrial Park is host to many small commercial enterprises. Average lot size is approximately 2.9 acres.
West Hawaiʻi Industrial Park	326	Situated mauka of the Queen Kaʻahumanu Highway, the West Hawai`i Industrial Park is currently a quarry site.
Kohanaiki Business Park	62	Approximately 44 lots that are one acre in size.
Kona View Estates	293	Agricultural lot subdivision. Phase I includes 29 one-acre units. Phase II of Kona View Estates is going through a planning and design phase.
Kona International Airport	1,920	The Kona International Airport is the primary airport hub of West Hawaiʻi. Recent State Legislature appropriations earmarked over $17 million in upgrades and terminal construction. Supporting commercial and industrial uses are also planned for future development.

Incremental Impact of the Proposed Action

The impacts of the Proposed Action, combined with the anticipated impacts from other projects in the district suggest that the natural environment would be affected, but not to a significant extent. Established controls that require developers to consider and manage the undesirable effects attributed to their project should effectively limit and mitigate foreseeable long-term impacts. For example, anticipated potable water requirements and proposed potable water systems for each project must be coordinated with the County of Hawaiʻi DWS to ensure that water resources are available. Wastewater disposal systems must meet DOH requirements to prevent unintended effects to affected water bodies or water resources. Runoff concerns must be addressed with on-site controls in accordance with county construction permits. Compliance with and adherence to established controls are expected to help lessen the impact on natural resources, and achieve lasting effects in resource protection and conservation.

The man-made environment would be impacted as a result of the Proposed Action combined with the anticipated impacts from other regional projects identified above. Each developer must abide by established controls and provide appropriate mitigation for project-generated effects such as traffic and utility demands. Incremental traffic increases are likely to occur from specific and incremental developments that generate trip traffic in relative proportion to their scale of activities. Where deemed to be necessary, developers may be required to include signalization, stop signs, and similar features as part of mitigation for project-generated traffic impacts. Demands for water and wastewater services, solid waste disposal, electrical power and communications need to be coordinated with utility providers to ensure adequate service. For economic reasons and as a function of good policy, projects are encouraged to be designed with energy-efficient and energy conservation features.

Socio-economic impacts resulting from the Proposed Action, in addition to the other regional projects identified above, are generally expected to be mostly beneficial. Construction would generate employment and economic opportunities. Significant population growth or shifts are not anticipated to occur as a result of the Proposed Action due to the relatively small scale of the UHCWH (planned for a maximum enrollment of 1,500 FTES) and its stated purpose as a commuter campus that does not include dormitories, faculty housing, or athletic facilities. Improved access to higher education and continuing education would generate an employable work force required for a growing and diversified economy. In the long-term, the UHCWH would give the West Hawaiʻi community a better educated and trained work force that would contribute to the region's economic growth and prosperity.

Although most of the negative impacts associated with development projects can be mitigated within the project, one overriding cumulative impact to which all projects contribute is traffic congestion. Results of the recently completed TIAR indicated that even without the Proposed Action, nearby residential projects (i.e., Palamahui and Lokahi) would increase traffic volumes to the extent requiring mitigation. Even though the Proposed Action would cumulatively contribute to overall traffic volumes, project-generated traffic would not require additional mitigation, beyond that which would be needed to address background conditions, until development of Phase 4 (1,500 FTES campus). Traffic mitigation would include project-specific adjustments, as well as county and state road infrastructure projects.

One of the most important traffic mitigation projects is the widening of Queen Kaʻahumanu Highway. The DOT commenced design and construction work in the Spring of 2005. The work will increase the existing two lanes to four lanes, create designated turning pockets, and create pedestrian walkways. The project will be completed in two phases. The first phase, which was completed in 2009, widened seven and a half miles of highway from Henry Street to Kealakehe Parkway. The second phase will run from Kealakehe Parkway to the Keahole Airport Access Road. Queen Kaʻahumanu Highway is the only major road through Kona's Gold Coast. Approximately 20 new resort and residential developments have been proposed for this region, so the capacity of the highway must be increased.

Long-term traffic mitigation strategies would include a major expansion of the county's public mass transit service, which would provide a significant alternative to individual automobile use. A second strategy would be the development of multi-modal transportation in a network of interconnected bike lanes, trails, and sidewalks. This would provide a healthy and green alternative to automobile use. A third strategy would be "Transit Oriented Development" (TOD) as promulgated in the KCDP. TOD means the development of compact, mixed-use villages that would integrate housing, employment, shopping, and recreation opportunities. Villages would be designed around transit stations/stops that would reduce the need for daily trips and financially support an expanding transit system.

5.2 POTENTIAL SECONDARY IMPACTS

In 1993, the state reclassified 2,640 acres of state-owned land in the Keahole area to the Urban district. The current Hawaiʻi County General Plan designates these lands Urban Expansion. The major secondary impact that could result from the Proposed Action is that it would spur development and planned growth in the Keahole area. The new UHCWH, along with Palamanui would introduce infrastructure to currently vacant lands mauka of the airport and create a destination node. This node could function like a magnet, attracting additional development to the Keahole area and providing the impetus to initiate plans and projects that have long been in the pipeline, awaiting an appropriate trigger for initiation.

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6.0 RELATIONSHIP TO LAND USE PLANS, POLICIES, AND CONTROLS

Land use controls and planning documents exist for the project area at both the state and county levels. The official government identification of the 500-acre University parcel is Third Tax Division (the island of Hawai‘i), Zone 7, Section 3, Plat 10, Parcel 42 (7-3-010:042).

Implementation of the Proposed Action would be consistent with existing state policy documents (i.e., the Hawaii State Plan and Functional Plans) as evidenced by supporting statements encouraging the creation of opportunities for higher education and job training, especially with the integration of information technology in education. Statements that encourage the development of projects that preserve natural, historic and scenic resources of the physical environment further emphasize compatibility with state policy documents.

Compatibility with various land use plans, such as the State Land Use Law, West Hawai‘i Regional Plan, Hawai‘i County General Plan, and the KCDP is evidenced by the mention and/or depiction of the University Center in Kalaoa in these policy statements and plans. Development of the UHCWH is consistent with the land use entitlements for the project area, such that no mitigation is warranted or proposed.

Hawaii State Plan. The Hawaii State Plan, Chapter 226, HRS (1995) was developed to serve as a guide for the future growth of the State of Hawai‘i by identifying goals, objectives, policies, and priorities. The Plan provides a basis for prioritizing and allocating the state’s limited resources, including public funds, services, human resources, land, energy, and water. It establishes a system for the formulation and program coordination of state and county plans, policies, programs, projects, and regulatory activities and facilitates the integration of all major state and county activities.

The Proposed Action is consistent with and furthers the aims of the following sections of the State Plan:

PART I - GOALS, OBJECTIVES, AND POLICIES

SEC. 226-10 Objective and policies for the economy – potential growth activities.

(b)(8) Develop, promote, and support research and educational and training programs that will enhance Hawaii’s ability to attract and develop economic activities of benefit to Hawaii.

SEC. 226-10.5 Objective and policies for the economy – information industry.

(b)(5) Provide opportunities for Hawaii’s people to obtain job training and education that will allow for upward mobility within the information industry.

SEC. 226-12 Objective and policies for the physical environment – scenic, natural beauty, and historic resources.

(b)(1) Promote the preservation and restoration of significant natural and historic resources.

(b)(2) Promote the preservation of views and vistas to enhance the visual and aesthetic enjoyment of mountains, ocean, scenic landscapes, and other natural features.

<u>SEC. 226-13 Objective and policies for the physical environment – land, air, and water quality.</u>

(b)(7) Encourage urban developments in close proximity to existing services and facilities.

<u>SEC. 226-21 Objectives and policies for socio-cultural advancement – education</u>.

(b)(2) Ensure the provision of adequate and accessible education services and facilities that are designed to meet individual and community needs.

(b)(4) Promote educational programs which enhance understanding of Hawaii’s cultural heritage.

(b)(5) Provide higher educational opportunities that enable Hawaii’s people to adapt to changing employment demands.

(b)(8) Emphasize quality educational programs in Hawaii’s institutions to promote academic excellence.

PART III – PRIORITY GUIDELINES

<u>SEC. 226-107 Quality education</u>. Priority guidelines to promote quality education:

(5) Increase and improve the use of information technology in education and encourage programs which increase the public’s awareness and understanding of the impact of information technologies on our lives.

(6) Pursue the establishment of Hawaii’s public and private universities and colleges as research and training centers of the Pacific.

<u>State Land Use Designation</u>. On December 9, 1993, the State of Hawai‘i Land Use Commission (LUC) issued a Decision and Order to reclassify 2,640 acres of state lands in the North Kona area from the Agricultural and Conservation Districts to the Urban District. Urbanization of the area was recommended by the Office of State Planning (OSP) for the purpose of allocating sufficient land for future urban growth in West Hawai‘i (refer to Figure 27). This action included a proposed subdivision of the affected state lands into 13 parcels. The 500-acre University parcel was identified as Parcel 5 of the subdivision. The LUC Decision and Order regarding these state lands contains 34 conditions. Condition 32 specifically designates Parcel 5 for the proposed West Hawai‘i campus of the UH System.

<u>West Hawai‘i Regional Plan</u>. This plan developed by the OSP and dated November 1989, addresses the long-range planning issues of West Hawai‘i. Its main objectives are the coordination of state activities and capital improvements program within the regional planning framework of West Hawai‘i. The plan designates two subregional planning areas to outline the areas of most probable and desirable expansion. The goal is to concentrate future regional urbanization within these areas and provide for their planning and future development, while optimizing or mitigating subregional problems, issues and opportunities. The Northern Subregional Area includes Kawaihae Harbor and the support communities of Kawaihae, Lalamilo, Waikoloa and Signal Puako. The Southern Subregional Planning Area, of which the

project area is a part, extends from Kailua-Kona to Kona International Airport and includes the support community of Kealakehe.

Agricultural Lands of Importance in the State of Hawai‘i (ALISH) System. No lands within the project area are included in the ALISH system.

County of Hawai‘i General Plan (2005). This is the County of Hawai‘i policy document for long-range comprehensive development of the island of Hawai‘i. It contains land use maps referred to as General Plan Land Use Pattern Allocation Guides (LUPAG). The project area is designated as "University Use" by the LUPAG (see Figure 28).

Keahole to Kailua Development Plan (K to K Plan). The K to K Plan was adopted by the County of Hawai‘i in April 1991. This plan emphasizes the siting of major infrastructure intended to serve the region. The K to K Plan identifies three north-south roadways (a Mid-Level arterial, Waena Drive and Kealakehe Street extension) and three east-west roadways (University Drive, Hina Lani Drive, and Kealakehe Drive) as part of the major future road pattern mauka of the Queen Ka‘ahumanu Highway. In this plan, the project area is identified for "University" uses. Its mauka and makai boundaries are defined by the proposed alignments of Waena Drive and the Mid-Level arterial (now known as the Main Street Collector Road), respectively. This plan has been superseded by the KCDP (see below).

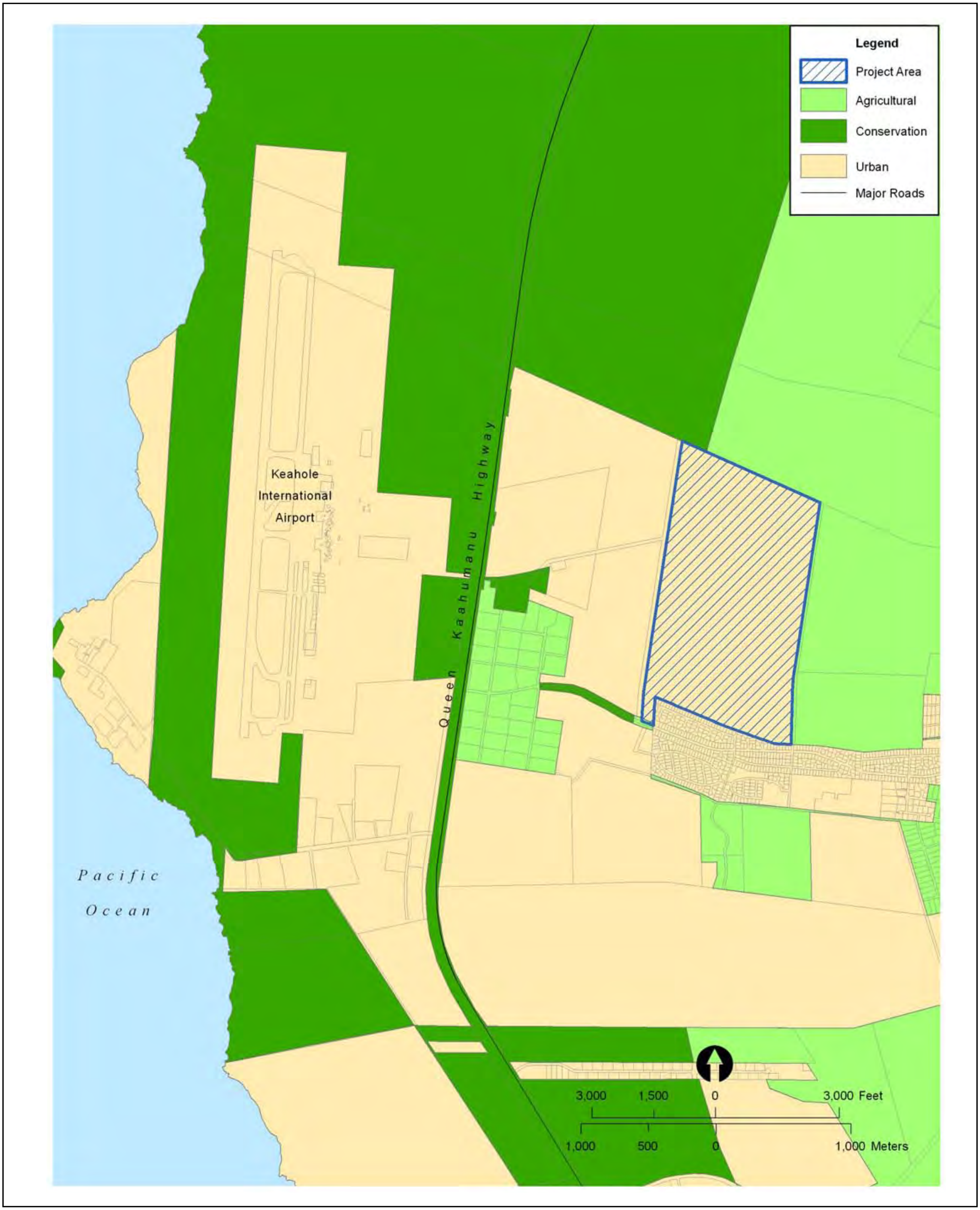
Mapping Kona's Future, Kona Community Development Plan. The KCDP prepared in 2008 encompasses the judicial districts of North and South Kona. This plan stresses the residents' vision for the planning of the district's future progress and provides guidance for development in accordance with that vision, accommodating expected growth and preserving valued assets. Development of the new UHCWH at Kalaoa is consistent with policies set forth in the KCDP, such as the following:

Policy LU-2.3 in the KCDP suggests that the goal is to use the university as a catalyst for complementary commercial opportunities surrounding the campus and to attract students, faculty and staff to live on or near campus. It is hoped that the university will be a center for cultural, performing arts, life-long learning, innovation and workforce development that will benefit the broader community.

Policy ECON-1.4: University as Workforce Development. The synergistic relationship of a university or community college at West Hawai‘i with the hospital, NELHA, and Design Center will provide opportunities for the West Hawai‘i residents to obtain the necessary education and training to fill jobs in the emerging skill areas of healthcare, energy, agriculture and urban design.

Hawai‘i County Zoning. The majority of the project area is zoned A-5a, Agriculture – minimum 5-acres (see Figure 29). However, a portion of the project area, stretching along the western boundary and northwestern corner, is zoned Open. Under the Hawai‘i County Zoning Code, neither structures or parking typically are permitted in the Open zone, unless they are for public use and approved by the Director of the Hawai‘i County's Planning Department. Under Chapter

25 of the Hawai‘i County Code, section 25-5-72(d)(7), schools are permitted in the Agricultural district provided that a “use permit” is issued by the Hawai‘i County Planning Commission.



State Land Use Districts Figure 27

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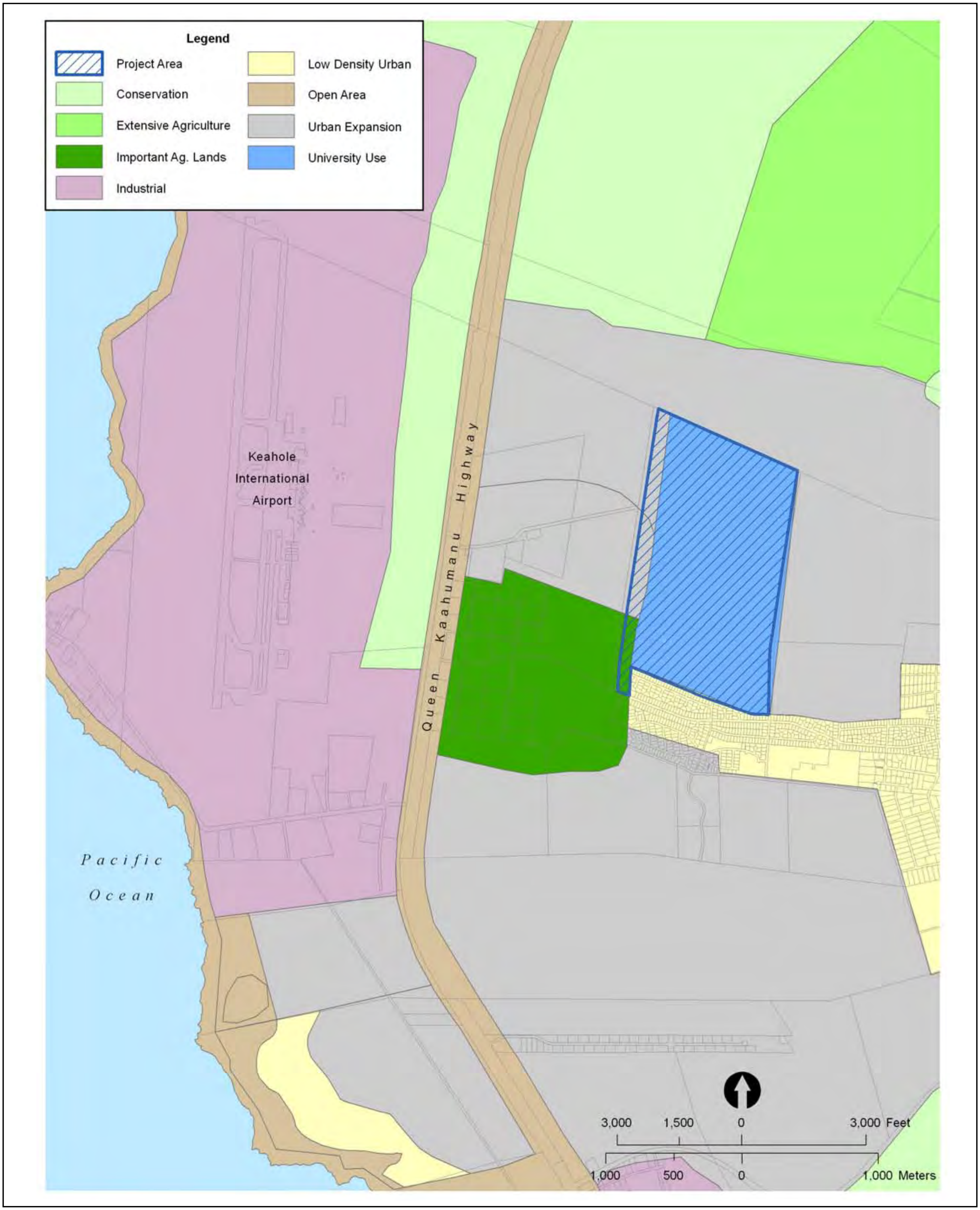

County of Hawaiʻi Land Use Pattern Allocation Guide (LUPAG) Figure 28

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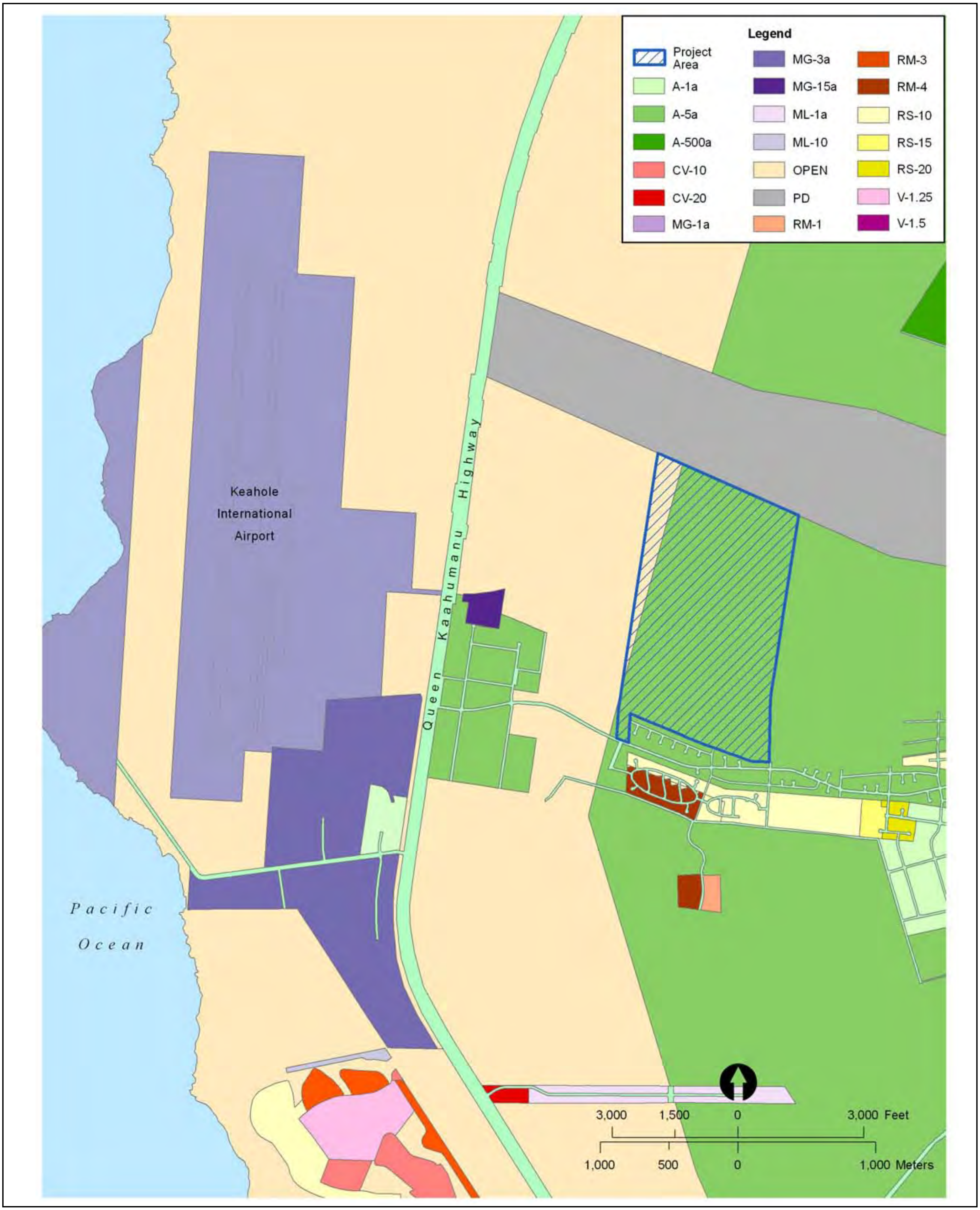

County Zoning Districts

Figure 29

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7.0 RELATIONSHIP OF SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

Local short-term use of the environment due to implementation of the Proposed Action would consist mainly of construction activities related to building the new UHCWH campus. As discussed in Chapter 4.0 (*Description of the Affected Environment, Potential Impacts and Mitigation Measures*), short-term impacts could result from construction. These may include negative impacts such as erosion, which could affect geology and soils, topography and water quality. Air quality may decrease due to exhaust from construction vehicles and the raising of fugitive dust. Noise levels in the vicinity of the Proposed Action may increase due to construction activities. Highways, roadways and traffic may be adversely affected with increased passage of trucks and construction equipment. However, all of these short-term negative impacts can be mitigated.

A positive short-term benefit of construction activities would be the creation of work opportunities for the architect-engineer community during the design phase of the project and employment opportunities for the construction industry and building material suppliers on the island of Hawaiʻi. The overall design and construction schedule for building of the UHCWH is divided into four phases and is estimated to run for many years.

Maintenance of long-term productivity for the County of Hawaiʻi, and the western side of the island in particular, would be assured by a permanent location for higher education. The establishment of the UHCWH would have many spill-over effects on the socio-economic environment that would increase long-term productivity for the West Hawaiʻi community. On a personal level, residents of West Hawaiʻi would have the opportunity to earn degrees and receive training without having to drive to Hilo or leave the island. Advanced and continuing education may also result in higher pay and greater opportunities for career advancement and diversification for the individual resident. On the community level, a better educated work force would allow businesses to expand, diversify and prosper. Further, government would benefit from added revenue as a result of increased economic activity.

The relationship between local short-term uses of the environment and the maintenance of long-term productivity is discussed below in terms of four specific areas of potential concern:

- <u>Narrowing the range of beneficial uses of the environment</u>: A permanent facility for higher education would be considered a beneficial use of the environment. Positive socio-economic impacts derived from the UHCWH would be particularly beneficial to the human environment.

- <u>Long-term risks to health and safety</u>: The UHCWH project would not cause long-term risks to health and safety. Following all required codes and regulations in the design and construction of the facility would promote health and safety. The pursuit of LEED™ certification in building a “Green Campus” promoting energy efficiency and resource conservation would also contribute greatly to long-term health and safety.

- Foreclosure of future options: The Proposed Action only covers 73 acres of the 500-acre parcel designated for use by the University; therefore, the project does not foreclose on future land use options. Although the property is currently zoned for agriculture (A-5a) the large expanses of lava rock, lack of appropriate soils and a relatively arid climate make this location at Kalaoa unsuitable for agriculture.

- Trade-offs among short- and long-term gains and losses: The proposed project would not result in any significant trade-offs between short- and long-term gains and losses. Planned mitigation measures would offset any short-term impacts and long-term impacts of the Proposed Action. Pursuit of LEED™ certification would reduce long-term losses to the environment by reducing dependency on fossil fuels and conserving precious resources. In general, short and long-term gains due to the Proposed Action far outweigh any short and long-term losses to the environment.

The County has designated Palamanui and the University parcel as an "Urban Expansion" area. Although urbanization would result in a loss of open space and the natural environment, urbanization has a unique value that the natural environment does not. Urbanization and infrastructure systems provide communities with an organized means of living using modern technology. A balance between urbanization and the natural environment would be achieved at the UHCWH through sustainable design. The beauty of the natural rugged lava landscape would be preserved as much as possible in open spaces throughout the campus. Grassed lawns typical of college campuses would not be placed on the UHCWH campus. To maintain such lawns would require the consumption of large quantities of precious water resources and would ignore the existing lava environment.

8.0 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Resources such as fossil fuels and construction materials would be irrevocably committed for the construction of the new UHCWH. In addition to fuel and construction materials, approximately $80.2 million (2009 dollars) would be committed to developing the four phases of the Proposed Action.

Labor would be required for construction, planning, engineering, design, landscaping, and other services. Once used, labor is irretrievable; however, the expended effort is also monetarily compensated, thereby supporting the economies of the state and county.

Development of the new UHCWH would also entail the irreversible commitment of pristine lands, which can never be returned to their unaltered state. The natural lava strewn landscape would be modified and some of the natural vegetation at the proposed site would be cleared as a result of the Proposed Action.

The irreversible and irretrievable commitment of resources could be considered an acceptable trade-off for the benefits that would result from the Proposed Action. Such benefits include short- and long-term earnings for the both the state and county in increased tax revenue, expenditures, and the enhanced earning potential of West Hawai‘i residents resulting from the greatly improved facilities for post-secondary education.

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9.0 PROBABLE ADVERSE ENVIRONMENTAL IMPACTS THAT CANNOT BE AVOIDED

It is anticipated that there would be some adverse environmental impacts that cannot be avoided associated with the Proposed Action. Short-term impacts generally would be construction related and temporary in nature, lasting for the duration of the construction period. Long-term impacts would be associated with operation of the new UHCWH facilities. It is anticipated that with the implementation of avoidance and mitigation measures, these impacts would not be significant.

9.1 ADVERSE SHORT-TERM IMPACTS

Adverse short-term impacts to the acoustical environment, air quality and traffic cannot be avoided. During construction, air quality may decrease due to exhaust from construction vehicles and the raising of fugitive dust. Noise levels may increase due to construction activities. Highways, roadways and traffic may be adversely affected with increased passage of trucks and construction equipment. By adhering to applicable regulations, following construction site BMPs, and employing other mitigation measures, these adverse impacts are not expected to be significant.

9.2 ADVERSE LONG-TERM IMPACTS

In the long-term, the Proposed Action would contribute to an overall increase in traffic volumes in the vicinity of the project area. The results of the TIAR indicated that for Phases 1 through 3 (750 FTES campus), no additional mitigation, beyond that which would be needed to address background conditions, is warranted to address project-generated traffic. It is expected that there would be some decrease in LOS, but not to the degree requiring mitigation. However, for Phase 4 (1,500 FTES campus) additional mitigation is recommended to address project-generated traffic impacts. For Phase 4, project-driven mitigation includes: 1) constructing a second northbound to eastbound right turn lane along Kaiminani Drive at Queen Ka'ahumanu Highway, and 2) widening Kaiminani Drive, from two lanes to four lanes, from Queen Ka'ahumanu Highway to east of Main Street Road.

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10.0 UNRESOLVED ISSUES

There are three considerable unresolved issues pertaining to the Proposed Action. The first is the long-term treatment of the various archaeological, historic, and cultural resources within the 500-acre University site and particularly within the 73-acre proposed site. The second issue to be resolved is to determine compensation for the use of ceded lands. The third issue is the undetermined nature of any future expansion of the UHCWH campus, beyond the 1,500 FTES.

10.1 HISTORICAL, CULTURAL AND ARCHAEOLOGICAL RESOURCES

The treatment of historical, cultural, and archaeological resources that potentially could be affected by the Proposed Action remains unresolved. As discussed in Section 4.2.2.2, known resources that could be impacted by project actions are Preserve 2 and sites 15304 and 15262.

In regards to Preserve 2, a preliminary presentation of the Proposed Action was made to the Hawai‘i Island Burial Council in January 2009 where it was determined that preservation-in-place of the human burials contained by Preserve 2 is the preferred method of treatment. A BTP is being prepared to address the long-term preservation and management of Preserve 2. As part of this preparation, an attempt is being made to identify any lineal descendents. If any claimants are found, their preferences and recommendations for long-term treatment shall be incorporated into the BTP. The BTP will need to be approved by both the Hawai‘i Island Burial Council and SHPD.

If and when Phase 4 of the UHCWH’s development becomes imminent, the UHCWH will address the ultimate treatment of sites 15304 and 15262. While the 2009 LRDP does show these two sites as incorporated into the campus landscaping, the ultimate treatment of these sites would be determined by UHCWH students, faculty and staff at the time detailed planning for Phase 4 development is performed. At such time, coordination with SHPD should be undertaken to identify and approve any protection and mitigation measures relative to these two sites.

Also, in the future, the UHCWH students, faculty and staff may wish to integrate the historic and cultural resources within the 500-acre University site into their educational programs through interpretive venues and a trail system as originally proposed in the 1998 LRDP. If such interpretive programs are to be implemented, the UHCWH will coordinate with SHPD to update, finalize and approve the HPP for the long-term protection and management of Preserves 1, 3, 4, and 5.

10.2 CEDED LANDS

The property on which the Proposed Action is located, is owned by the State of Hawai‘i and has been determined to comprise ceded lands. As with all ceded lands that are designated as revenue lands, coordination with OHA will be required to discuss the issue of compensation to the Hawaiian people.

10.3 FUTURE EXPANSION

Approximately seven acres within the 73-acre subdivision have been set aside for future expansion of the UHCWH, beyond the 1,500 FTES campus addressed by the 2009 LRDP (refer to Figure 8). It is unknown at present what uses would be included in this future expansion. The timetable for any future expansion also is unknown and would be dependent on the UHCWH's enrollment growth rate and available funds to plan, design, and develop an expanded campus. If and when any expansion beyond the 1,500 FTES campus takes place, a separate environmental impact assessment would need to be undertaken to address those actions.

11.0 SIGNIFICANCE CRITERIA

According to the DOH rules (HAR 11-200-12), an applicant or agency must determine whether an action may have a significant impact on the environment. Project actions include all phases of the project. Expected consequences include direct and indirect effects, short-and long-term effects, and cumulative impacts taken in consideration with other projects. In making the determination, the Rules establish "Significance Criteria" to be used as a basis for identifying whether significant environmental impacts will occur.

The University of Hawai‘i, OCI has determined that the Proposed Action—development of the new UHCWH at Kalaoa—requires the preparation of a SEIS based on the significance criteria. Reasons supporting this determination are discussed below.

(1) Involves an irrevocable commitment to loss or destruction of any natural or cultural resource.

Resources such as fossil fuels and construction materials would be irrevocably committed for the construction of a permanent UHCWH.

The pristine lands that would be developed for the UHCWH can never be returned to their pristine state. Some natural vegetation at the proposed site, which consists largely of fountain grass and sparsely scattered trees and shrubs, would be cleared and/or replaced with landscaping as a result of project actions. A recent survey of the 73-acre proposed site concluded that there are no botanical species of special concern that could be adversely affected by the Proposed Action, except for a single ‘aiea tree. The ‘aiea is a protected species under the ESA. This plant is to be preserved by incorporating it into the campus landscaping.

Relocation of the campus core to the northwestern corner of the project area puts the Proposed Action within close proximity to lava tubes known to contain human burials and possible ceremonial sites. Discussions have been initiated with SHPD and the Hawai‘i Island Burial Council to address any concerns or issues relative to the Proposed Action. It is anticipated that coordination with SHPD and the Hawai‘i Island Burial Council and adherence to the BTP (currently being prepared), archaeological and cultural resources should be sufficiently protected. As such, it is expected that no irrevocable loss or destruction of cultural resources would occur as a result of the Proposed Action.

(2) Curtails the range of beneficial uses of the environment.

The proposed site is presently undeveloped, and construction of the UHCWH would not curtail the range of beneficial uses of the environment.

The proposed site, as well as the larger 500-acre project area, has been designated for University Use in the county General Plan, but is still zoned for agriculture

(A-5a). However, these lands are unsuitable agricultural use. The ALISH system does not classify any lands within the project area, nor does the Land Study Bureau assign any productivity rating for these lands. Because it is suitable for agriculture, development of the UHCWH on these lands would not preclude its use for future agricultural production. As well, the Proposed Action only utilizes a portion of the 500-acre parcel that was set aside for University use and its development does not foreclose on future options for the remainder of the project area.

(3) Conflicts with the State's long-term environmental policies or goals and guidelines as expressed in Chapter 344, HRS, and any revisions thereof and amendments thereto, court decisions, or executive orders.

The Proposed Action is supportive the State's long-term environmental policies and goals expressed in Chapter 344, HRS and is consistent with the guidelines enumerated in §344-4, in particular the following:

§344-4(9)(B) Promote irrigation and waste water management practices which conserve and fully utilize vital water resources.

The Proposed Action would utilize drought tolerant species for landscaping and non-potable water for irrigation. Low-flow and dual flush plumbing fixtures would be used to reduce the amount of wastewater generated.

§344-4(9)(B) Promote recycling of water.

The Proposed Action would use R-2 water (from the constructed wetland), captured rainwater, and AC condensate for non-potable uses, including landscape irrigation.

§344-4(9)(B) Protect endangered species of indigenous plants and animals and introduce new plants or animals only upon assurance of negligible ecological hazard.

The only identified endangered plant species located within the proposed site, the 'aiea tree, would be preserved and incorporated into the campus landscaping. No endangered faunal species were identified within the project area. However, precautions would be taken during the design of the facilities and during construction to minimize the potential for impacts on species that possibly could occur in the area, though not previously identified.

§344-4(9)(B) Foster the planting of native as well as other trees, shrubs, and flowering plants compatible to the enhancement of our environment.

Campus landscaping would utilize Native Hawaiian and Polynesian-introduced species common to the area, especially those that are wind and drought tolerant. To the extent practicable, the existing grasslands and lava fields would be incorporated into the campus landscaping.

§344-4(9)(B) Encourage the efficient use of energy resources.

The Proposed Action would be designed to maximize natural lighting and ventilation. Also, on-site renewable energy systems, such as photovoltaics and wind turbines, would be used to reduce dependence on fossil fuels. The ultimate goal of the Proposed Action is to obtain net zero energy consumption.

§344-4(9)(B) Encourage both formal and informal environmental education to all age groups.

One of the primary goals of the Proposed Action is to obtain LEEDS Platinum certification for Phases 1 and 2 of the campus development, ultimately moving the entire campus toward net zero energy consumption. It is intended that the new UHCWH become a model of sustainability and that the facility itself become a tool to educate the community on sustainable development.

(4) Substantially affects the economic or social welfare of the community or state.

Implementation of the Proposed Action would substantially affect the economic welfare of the surrounding community and the State of Hawai‘i. The affects would for the most part be beneficial as the Proposed Action would simulate economic activity during construction and provide jobs for faculty and staff in the long-term. Further, the Proposed Action would provide a much-needed permanent higher education facility in the West Hawai‘i region, which in turn would make enhance the educational and workforce development opportunities resulting in a higher-skilled workforce.

(5) Substantially affects public health.

Implementation of the Proposed Action would not affect public health.

(6) Involves substantial secondary impacts, such as population changes or effects on public facilities.

The Proposed Action is not expected to result in substantial secondary impacts to population or on public facilities. The UHCWH is expected to primarily serve the existing West Hawai‘i population and to relieve the region’s pent up demand for post-secondary educational opportunities. The Proposed Action would have a positive secondary impact on region’s socio-economic characteristics. By providing opportunities for educational, professional and personal development, the new UHCWH would enhance educational levels and job skills leading to increased employment opportunities, thereby helping to diversify and spur the economy.

(7) Involves a substantial degradation of environmental quality.

Unavoidable short-term construction related impacts have been discussed in Chapters 9.0 of this document and mitigation measures proposed. In the long-term, the Proposed Action is not expected to involve a substantial degradation of environmental quality.

(8) Is individually limited but cumulatively has considerable effect upon the environment or involves a commitment for larger actions.

The Proposed Action is not expected to cumulatively have considerable effects on the environment, nor will it involve a commitment for larger actions. Although most of the negative impacts associated with the Proposed Action can be mitigated within the project, one overriding cumulative impact to which all projects contribute is traffic congestion. However, the Proposed Action’s incremental impact on the traffic is not expected to be considerable, especially when evaluated relative to the traffic impacts generated by other development projects in the North Kona region.

(9) Substantially affects a rare, threatened, or endangered species, or its habitat.

The Proposed Action would not substantially affect rare, threatened or endangered species or their habitats. There is no federally designated critical habitat in the vicinity of the Proposed Action. A recent survey of the 73-acre proposed site found no native arthropods or other invertebrates of concern, due largely to the lack of native host plants in the area. While a single ‘aiea tree, which is a native host for the endangered sphinx moth, was identified within the proposed site, there was no evidence of caterpillars or feeding on this tree. No vertebrates of concern, including avian species, were identified during the recent survey. However the endangered Hawaiian hawk and Hawaiian hoary bat, as well as endangered seabirds and shorebirds, such as the Newell shearwaters and Dark-rumped Hawaiian Petrels could fly over the proposed site. Mitigation would be employed to address potential impacts to these species that could occur in the vicinity of the proposed site.

(10) Detrimentally affects air or water quality or ambient noise levels.

Short-term and temporary impacts to air quality and the acoustical environment are anticipated. These impacts generally are unavoidable and necessary for construction. Mitigation measures would be employed to control and reduce unavoidable impacts. Short-term, construction-related impacts to water quality are not expected. The overall long-term impacts on water quality, air quality, and the acoustical environment resulting from the Proposed Action are expected to be minimal.

(11) Affects or is likely to suffer damage by being located in an environmentally sensitive area such as a flood plain, tsunami zone, beach, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters;

The project area is located at the foot of Mt. Hualālai and is located in Lava Flow Hazard Zone 4. Lava flow hazard zones are numerically ranked based on the probability of coverage by lava flows, with "1" posing the greatest hazard and "9" posing the least. No mitigation is available to address potential lava flows. Additionally, the entirety of the West Hawai‘i region lies within an earthquake zone (UBC Seismic Zone 3). Design and construction of the new UHCWH would be in accordance with applicable building codes to address seismic hazards.

(12) Substantially affects scenic vistas and view planes identified in county or state plans or studies.

The one-story profile of the UHCWH buildings is not anticipated to obstruct view planes either from within the project area or from without.

(13) Requires substantial energy consumption.

In the short-term construction activities will increase energy consumption in the area. In the long-term, energy consumption also could be increased. Operation of the UHCWH requires electrical power for lighting, cooling, and operation of equipment. However, while the UHCWH has yet to be fully-designed, it is fully intended that it would incorporate design strategies that are responsive to the local climate and existing site conditions. The BOR has approved the 2009 LRDP and its goal of achieving a LEED™ Platinum certification for Phases 1 and 2, with the ultimate goal of net zero energy consumption for the entire campus. Strategies under consideration include, among other things, using natural ventilation and daylighting, using renewable energy solutions such as photovoltaics and wind turbines, using locally available materials, using a central BAS. Cumulatively, these strategies, if employed, could result in higher building performance, lower maintenance and operation costs, and reduced demand for energy.

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Robert L. Lucas		Economist

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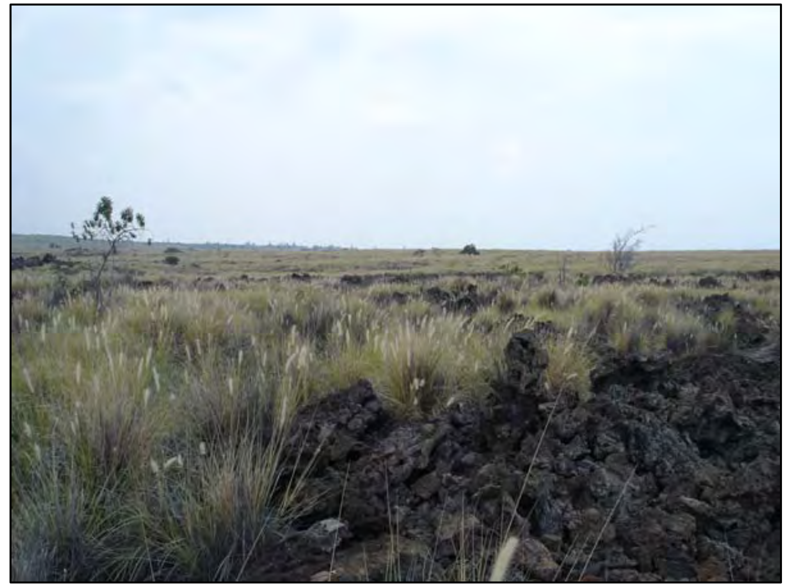
Appendix A

Site Photos

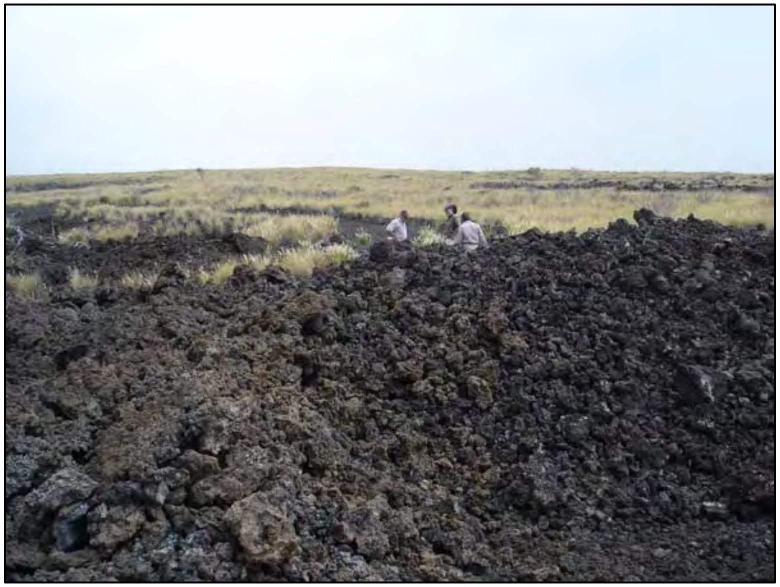
From the project area's northern boundary, facing westward toward the Keahole Generating Station.



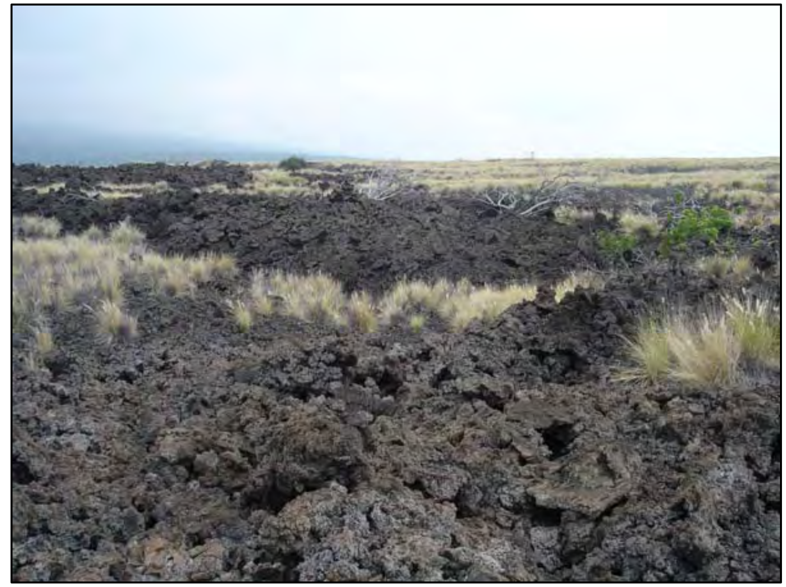
From the project area's northern boundary, facing, southwest toward Kaiminani Drive.

From the project area's northern boundary, facing southward toward Kaiminani Drive.

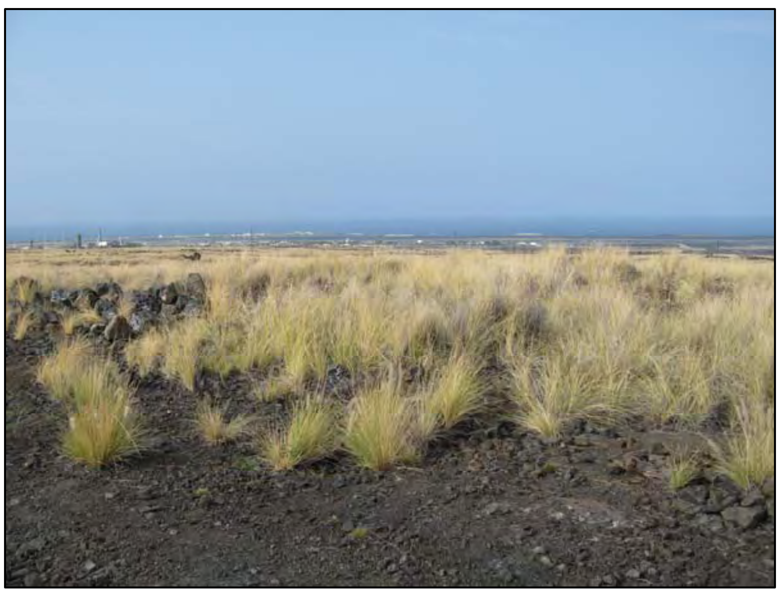
From the project area's northern boundary, facing southeast toward Kona Palisades.



From the project area’s northwest corner, facing south.



From the project area’s northwest corner, facing southeast.



From inside the project area, facing west toward the ocean.

From the inside the project area, facing northwest toward Palamanui.

Appendix B

Air Quality Impact Report

AIR QUALITY IMPACT REPORT (AQIR)

UNIVERSITY OF HAWAII CENTER - WEST HAWAII
KAILUA-KONA, HAWAII

PREPARED FOR:

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30 December 2009

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1. INTRODUCTION

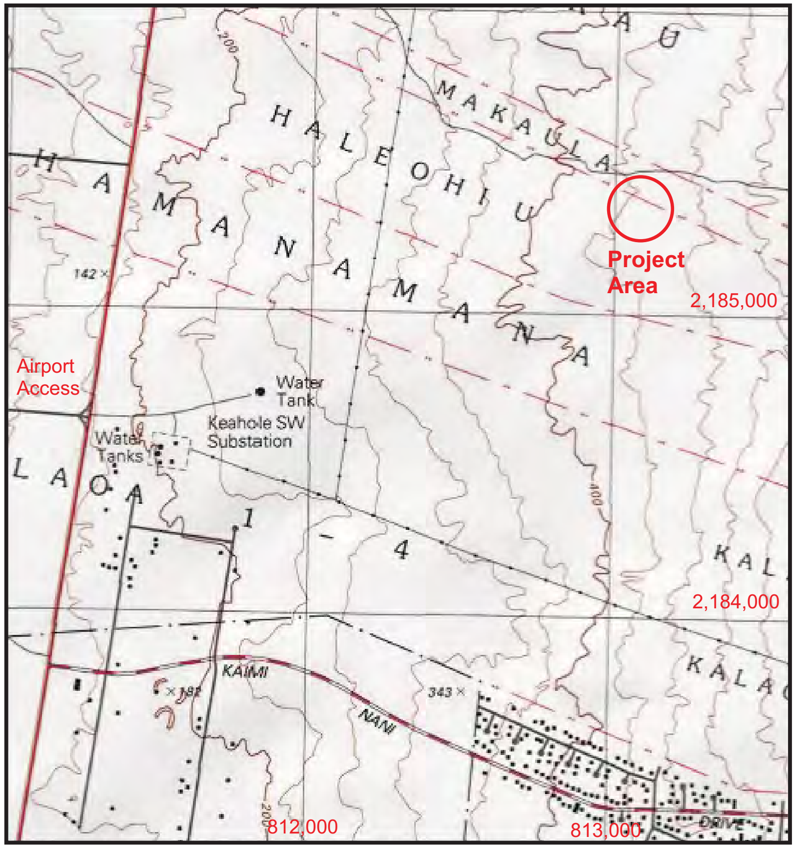
The University of Hawaii is proposing to construct a new campus on the west side of the island of Hawaii. The proposed site is situated between Queen Kaahumanu Highway and Mamalahoa Highway east of the Keahole Airport (Figure 1). The project will be completed in four phases between 2011 and 2023.

The purpose of this report is to assess the short and long-term impacts of the proposed campus on air quality. The overall project can be considered an "indirect source" of air pollution as defined in the federal Clean Air Act[1] since its primary association with air quality is its inherent attraction for mobile sources, i.e., motor vehicles. Much of the focus of this analysis, therefore, is on the project's ability to generate additional traffic and the resultant impact on air quality. Air quality impact was evaluated for existing (2009) and future (2012, 2117, 2022) conditions with and without the proposed development.

Finally, during construction of the roadway air pollutant emissions will be generated onsite and offsite due to vehicular movement, grading, concrete and asphalt batching, and general dust-generating construction activities. These impacts have also been addressed.

FIGURE 1

PROJECT LOCATION



USGS Quad Keahole Point (1996)
1:24,000 (NAD-83)

2. AIR QUALITY STANDARDS

A summary of State of Hawaii and national ambient air quality standards (NAAQS) is presented in Table 1.[2, 3, 4] Note that Hawaii's standards are not divided into primary and secondary standards as are the federal standards.

Primary standards are intended to protect public health with an adequate margin of safety while secondary standards are intended to protect public welfare through the prevention of damage to soils, water, vegetation, man-made materials, animals, wildlife, visibility, climate, and economic values [5]. Note that in the case of the principal automotive pollutants [CO, NO_2, and O_3], the primary and secondary standards are identical.

Some of Hawaii's standards (CO, NO_2, and O_3) are clearly more stringent than their federal counterparts and like their federal counterparts in the case of short-term standards, they may be exceeded once per year.

Finally, the State of Hawaii also has fugitive dust regulations for particulate matter (PM) emanating from construction activities [6]. There simply can be no visible emissions from fugitive dust sources.

TABLE 1

SUMMARY OF STATE OF HAWAII AND FEDERAL AMBIENT AIR QUALITY STANDARDS

POLLUTANT	AVERAGING PERIOD	NAAQS PRIMARY	NAAQS SECONDARY	STATE STANDARDS
PM_{10}	Annual	50	50	50
	24-hr	150	150	150
$PM_{2.5}$	Annual	15	15	---
	24-hr	35	35	---
SO_2	Annual	80	---	80
	24-hr	365	---	365
	3-hr	---	1,300	1,300
NO_2	Annual	100	100	70
CO	8-hr	10	---	5
	1-hr	40	---	10
O_3	8-hr	147	147	100
H_2S	1-hr	---	---	35
Pb	3-month	0.15	0.15	1.5

KEY:
- PM_{10} - particulate matter ≤ 10 microns
- $PM_{2.5}$ - particulate matter ≤ 2.5 microns
- SO_2 - sulfur dioxide
- NO_2 - nitrogen dioxide
- CO - carbon monoxide
- O_3 - ozone
- H_2S - hydrogen sulfide
- Pb - lead

All concentrations in micrograms per cubic meter ($\mu g/m^3$) except CO which is in milligrams per cubic meter.

3. EXISTING AIR QUALITY

3.1 General. The state Department of Health (DOH) maintains a network of air monitoring stations around the state to gather data on the following regulated pollutants:

- particulate matter ≤ 10 microns (PM_{10})
- particulate matter ≤ 2.5 microns ($PM_{2.5}$)
- sulfur dioxide (SO_2)
- nitrogen dioxide (NO_2)
- carbon monoxide (CO)
- ozone (O_3)

In the case of PM_{10} and $PM_{2.5}$, measurements are made on a 24-hour basis to correspond with the averaging period specified in state and federal standards. Depending on the sampling equipment and site, samples are collected either continuously or once every six days in accordance with U. S. Environmental Protection Agency (EPA) guidelines. Carbon monoxide, sulfur dioxide, and ozone, however, are measured on a continuous basis due to their short-term (1- and 3-, and 8-hour) standards. Nitrogen dioxide is also measured with continuous instruments and averaged over a full year to correspond to its annual standards. Lead sampling was discontinued in October 1997 with EPA approval. This was largely due to the elimination of lead in gasoline and the resulting reduction of

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ambient lead levels in Hawaii to essentially zero. The federal; ambient standard for lead was revised in November 2008 resulting in a value 1/10 of the previous standard.[7]

3.2 Department of Health Monitoring. There are no DOH monitoring stations in the vicinity of the project site. A summary of the most recent published air quality data [8] from the nearest site at Kealakekua on the Big Island and other Oahu sites is presented in Table 2. These data are indicative of the generally good air quality in Hawaii County and may be considered reasonably representative of existing air quality in the project area.

3.3 Onsite Carbon Monoxide Sampling. In conjunction with this project, air sampling was conducted in December 2009, at the Kaimi Nani Drive - Queen Kaahumanu Highway intersection. A continuous carbon monoxide (CO) instrument was set up and operated during the a.m. and p.m. peak traffic hours. An anemometer and vane were also installed to record onsite surface winds during the sampling period. A simultaneous manual count of traffic was performed. The variability of each of the parameters measured during the peak hours is clearly seen in Figures 2 and 3.

On the afternoon of 14 December 2009, the equipment was set up on the southeast side of the aforementioned intersection. Sky conditions were overcast with onshore southwesterly winds averaging 4.7 mph. The total hourly traffic entering the intersection was 1,823 vehicles, and the hourly mean CO level was 1.1 mg/m^3.

On the morning of Tuesday, 15 December 2009, sampling equipment was set up on the northwest side of the intersection due to early morning offshore air flow. Weather conditions during the morning peak hour were characterized by hazy skies (due to VOG) and light easterly winds averaging 3.6 mph. Carbon monoxide concentrations measured were again low, averaging 0.9 mg/m^3 for the 1-hour period. Traffic volume entering the intersection was 1,171 vehicles between 7:00 and 8:00 Hawaiian Standard Time (HST).

4. CLIMATE AND METEOROLOGY

4.1 Climate. Climate in the project area is typical of most of Hawaii with monthly temperatures ranging from the low 70's (^{o}F) in the coolest month to the high 70's in the warmest months. [9] As is also true in much of Hawaii, rainfall varies greatly as one moves "mauka", i.e. towards the mountains, or "makai" towards the shoreline as well is in and out of the "rain shadow" of high mountains. In this instance, annual rainfall is only in the 10 - 20 inches range due in large part to the blocking effect of the 8,000-foot Hualalai and 14,000-foot Mauna Loa mountains east northeast of the site. In accordance with Thornwaite's scheme for climatic classification, this results in a precipitation/evaporation (P/E) index which classifies the area as "semi-arid". [10]

TABLE 2

AIR QUALITY DATA
DEPARTMENT OF HEALTH MONITORING SITES
2008

Pollutant	Concentration ($\mu g/m^3$)
Particulate matter ≤ 10 microns (PM_{10}) 24-hr (max)	61
Annual	18
Particulate matter ≤ 2.5 microns ($PM_{2.5}$) 24-hr (max)	12
Annual	4.1
Sulfur dioxide (SO_2) 3-hr (max)	325
24-hr (max)	142
Annual	23
Carbon monoxide (CO) 1-hr (max)	2.5
8-hr (max)	0.8
Ozone (O_3) 8-hr (max)	98
Nitrogen Dioxide (NO_2) Annual	8

Notes: 1. CO, NO_2 , PM_{10} and $PM_{2.5}$ data from the Kapolei, Oahu site.
2. SO_2 data from the Kona, Hawaii site.
3. O_3 data from the Sand Island, Oahu site.
4. CO data are milligrams per cubic meter (mg/m^3)

Source: Hawaii Department of Health (Reference 8)

FIGURE 2

A.M. PEAK HOUR CONDITIONS
QUEEN KAAHUMANU HIGHWAY AT KA'IMI NANI DRIVE
15 DECEMBER 2009

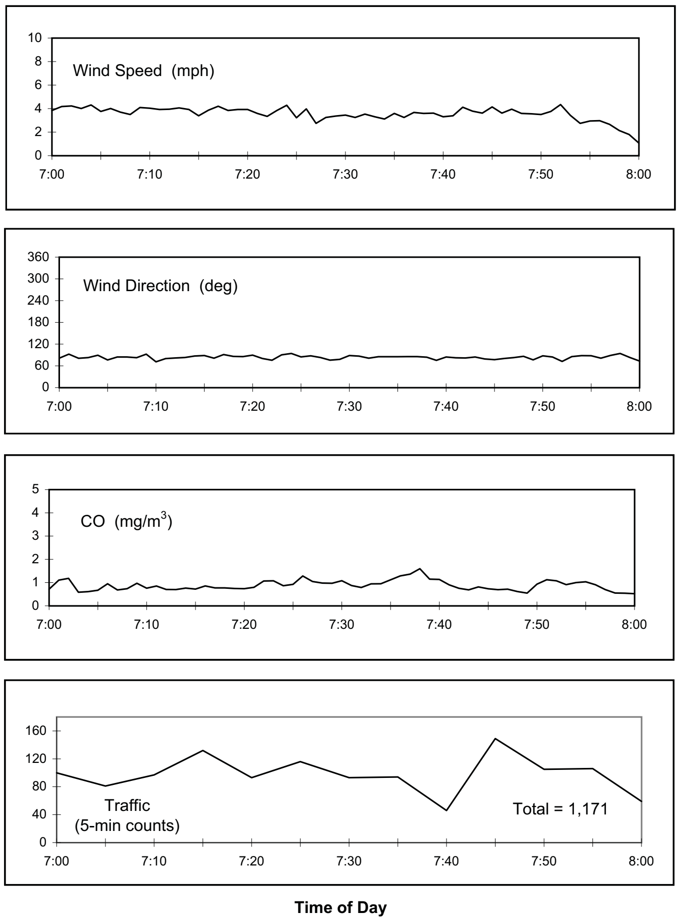
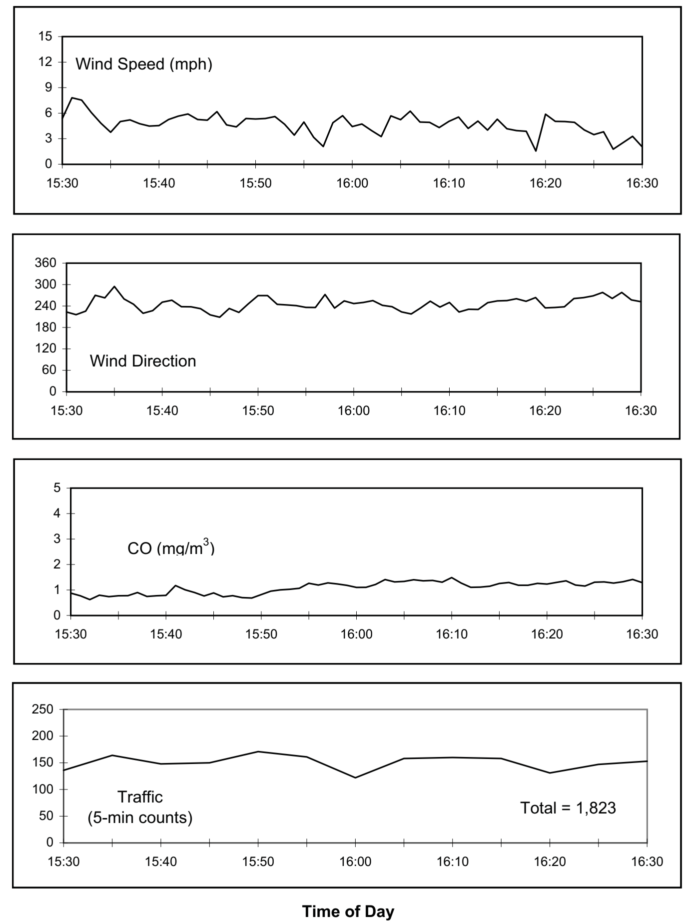


FIGURE 3

P.M. PEAK HOUR CONDITIONS
QUEEN KAAHUMANU HIGHWAY AT KA'IMI NANI DRIVE
14 DECEMBER 2009



4.2 Surface Winds. Wind data collected in 1993-94 near the Keahole Generating Station were obtained and analyzed to determine annual and seasonal patterns. The predominance of northeast trade winds typical of many sites in Hawaii is not evident in the annual windrose depicted in Figure 4 (see also Table 3). There is a wider distribution of wind directions with two groups appearing to predominate, i.e., ENE to SE (36%) and SW (27%). As is the case with rainfall, this is in large part due to the blocking effect of the large volcanic mountain masses northeast of the site which block the synoptic northeasterly trade winds. Wind speeds are also quite low with over 97% less than 4 knots (4.6 mph).

When seasonal patterns were investigated, results again differed somewhat from what is typically observed. While the "winter" (January) windrose (Figure 5) shows a fairly typical diversity of wind directions due to the weakening of the prevailing trade winds at that time of year, the "summer (July) windrose (Figure 6) shows a predominance of southerly winds in contrast to the northeasterly trade winds which generally prevail during that season of the year.

5. SHORT-TERM IMPACTS

5.1 Onsite Impacts. The principal source of short-term air quality impact will be construction activity. Construction vehicle activity can at times increase automotive pollutant concentrations along adjoining existing streets as well as on the project site itself. Construction activity itself as well as additional construction vehicle traffic may at times cause a temporary reduction in average travel speeds with a concomitant increase in vehicle emissions due to the "stop and go" traffic conditions.

FIGURE 4

ANNUAL WIND ROSE

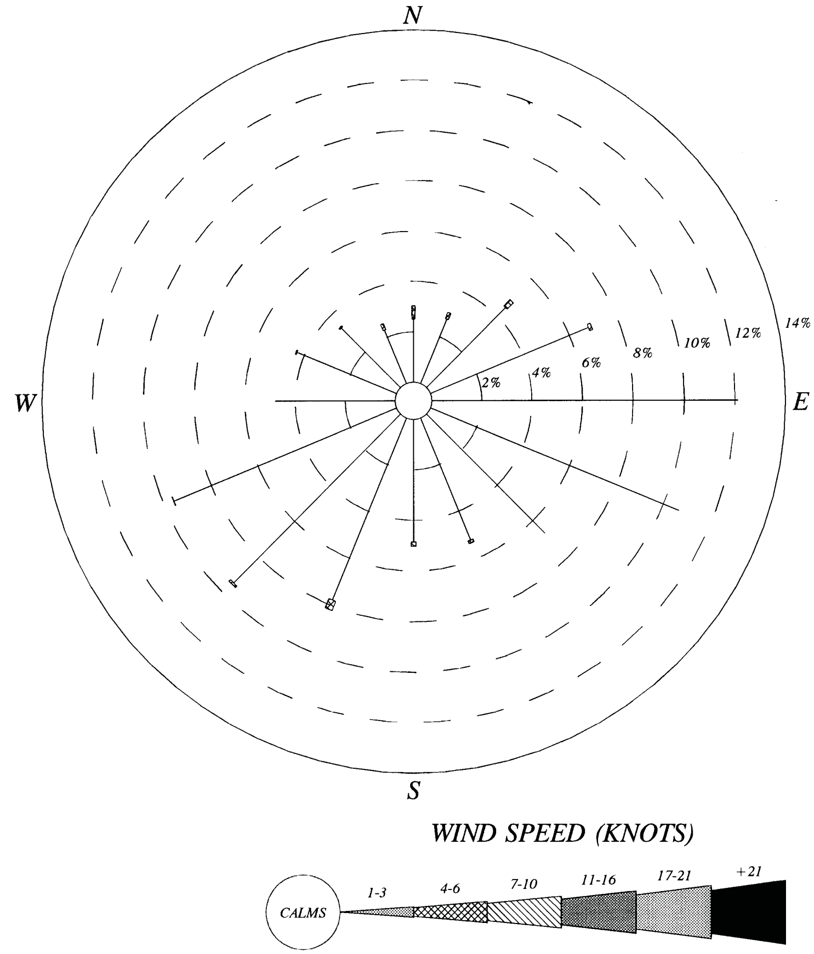


TABLE 3

ANNUAL JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION KEAHOLE, HAWAII

Direction	Wind Speed (knots)						
	1 - 3	4 - 6	7 - 10	11 - 16	17 - 21	> 21	TOTAL
N	0.02502	0.00524	0.00000	0.00000	0.00000	0.00000	0.03026
NNE	0.02764	0.00262	0.00000	0.00000	0.00000	0.00000	0.03026
NE	0.04479	0.00345	0.00000	0.00000	0.00000	0.00000	0.04824
ENE	0.06814	0.00119	0.00000	0.00000	0.00000	0.00000	**0.06933**
E	0.12102	0.00000	0.00000	0.00000	0.00000	0.00000	**0.12102**
ESE	0.10649	0.00000	0.00000	0.00000	0.00000	0.00000	**0.10649**
SE	0.06683	0.00000	0.00000	0.00000	0.00000	0.00000	**0.06683**
SSE	0.05229	0.00119	0.00000	0.00000	0.00000	0.00000	0.05348
S	0.04848	0.00179	0.00000	0.00000	0.00000	0.00000	0.05027
SSW	0.07778	0.00393	0.00000	0.00000	0.00000	0.00000	**0.08172**
SW	0.09422	0.00083	0.00000	0.00000	0.00000	0.00000	**0.09506**
WSW	0.09589	0.00012	0.00000	0.00000	0.00000	0.00000	**0.09601**
W	0.04789	0.00000	0.00000	0.00000	0.00000	0.00000	0.04789
WNW	0.04312	0.00036	0.00000	0.00000	0.00000	0.00000	0.04348
NW	0.03359	0.00048	0.00000	0.00000	0.00000	0.00000	0.03407
NNW	0.02299	0.00262	0.00000	0.00000	0.00000	0.00000	0.02561
Total	**0.97618**	0.02382	0.00000	0.00000	0.00000	0.00000	

FIGURE 5

JANUARY WIND ROSE

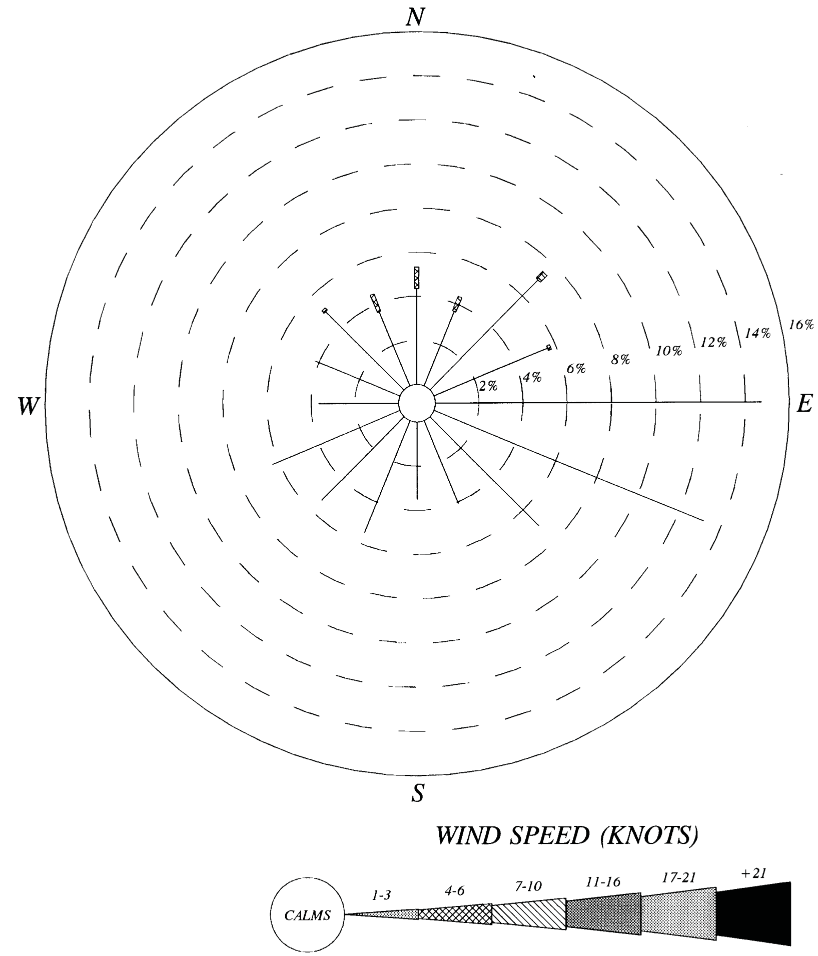
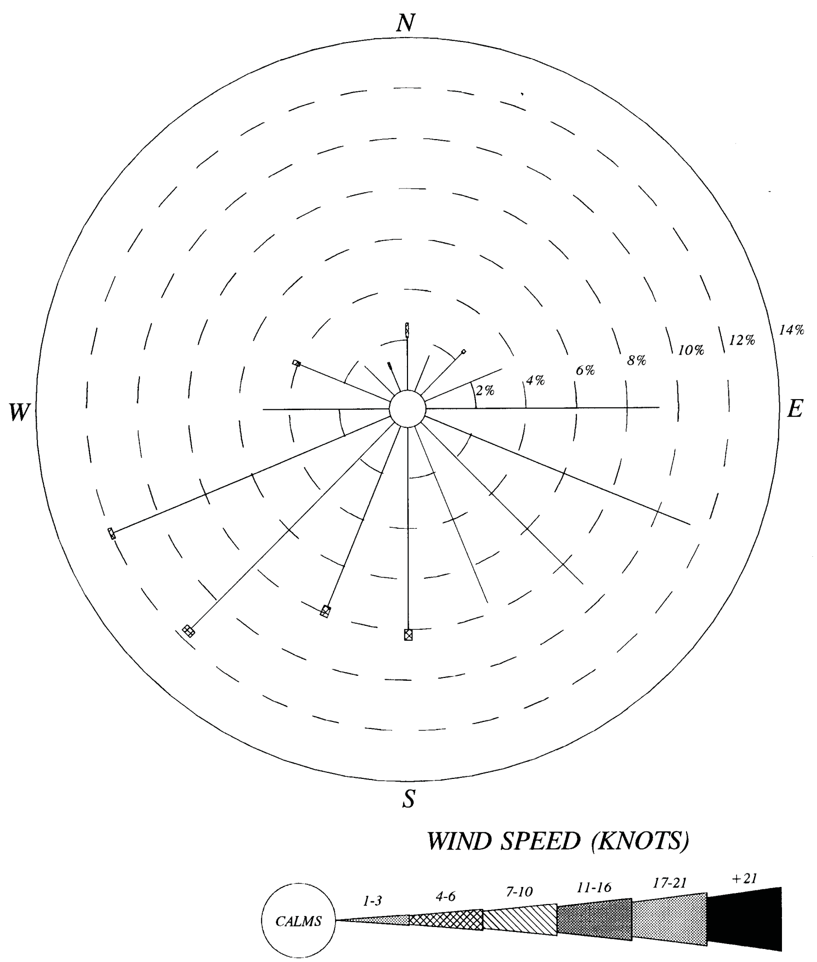


FIGURE 6

JULY WIND ROSE



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Construction vehicle movement on unpaved on-site areas will also generate particulate matter (PM) emissions. EPA studies on fugitive dust emissions from construction sites indicate that about 1.2 tons/acre per month of activity may be expected under conditions of medium activity, moderate soil silt content (30%), and a precipitation/ evaporation (P/E) index of 50 [10, 11].

5.2 <u>Offsite Impacts</u>. In addition to the onsite impacts attributable to construction activity, there will also be offsite impacts due to the operation of concrete and asphalt batching plants needed for road construction. Such plants routinely emit particulate matter and other gaseous pollutants; however. it is too early to identify the specific facilities that will be providing these materials and thus the discussion of air quality impacts is necessarily generic. The batch plants which will be producing this concrete and asphalt must be permitted by the Department of Health Clean Air Branch pursuant to state regulations [6]. In order to obtain these permits they must demonstrate their ability to continuously comply with both emission [6] and ambient air quality [4] standards. Under the federal Title V operating permit requirements [12], now incorporated in Hawaii's rules [8], air pollution sources must regularly attest to their compliance with all applicable requirements. A typical concrete batch plant in Hawaii is equipped with fabric filters, i.e., "baghouses" for particulate matter (PM) control. Similarly, a typical asphalt plant is equipped with either a wet venturi scrubber or fabric filters. The efficiency of such controls is normally 95 - 99%.

6. MOBILE SOURCE IMPACTS

6.1 Mobile Source Activity. The traffic analysis report [13] prepared for the proposed project served as the basis for this mobile source impact analysis. Existing and projected future peak-hour traffic volumes for the intersections with the highest traffic volumes serving the project area were obtained from that report. This included scenarios with and without the proposed UH campus.

6.2 Emission Factors. Automotive emission factors for carbon monoxide (CO) were generated for calendar years 2009, 2012, 2017 and 2022 using EPA's Mobile Source Emissions Model (MOBILE 6.2). [14] To localize the emission factors as much as possible, an age distribution for registered vehicles in the City & County of Honolulu [15] was used in lieu of national statistics. That same age distribution was the basis for the distribution of vehicle miles traveled as well.

6.3 Modeling Methodology. Mobile source air quality modeling has historically focused on estimating concentrations of non-reactive pollutants, primarily carbon monoxide (CO). This has been the case because CO is relatively stable in the atmosphere having a half-life on the order of about one (1) month,[16] and it comprises the largest fraction of automotive emissions. [14]

Using the traffic data provided, modeling was performed for the years 2009, 2012, 2017 and 2022 with and without the project. The latest version of the EPA guideline model CAL3QHC [17, 18] as revised to allow for use of hourly meteorological data files [19, 20] was employed to estimate near-intersection carbon monoxide concentrations. CO concentrations were estimated at an array of 60 receptor sites,

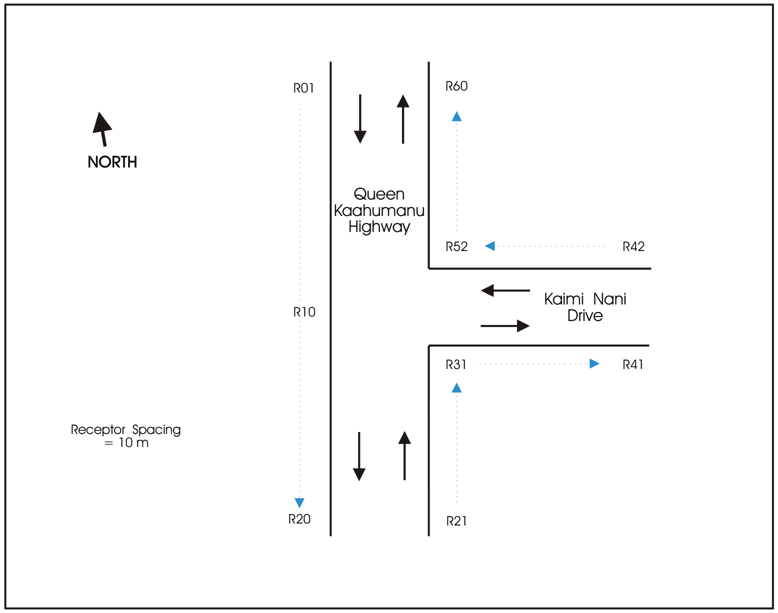
spaced at a distance of 10 meters around the various intersections studied. A background concentration of 0.34 mg/m^3 from the Department of Health's 2008 monitoring data was also used as the background concentration in the modeling. Hourly meteorological data for a.m. and p.m. peak traffic hours used in the model were extracted from data collected at the nearby Keahole Generating Station site and preprocessed with EPA's PCRAMMET program. [21]

6.4 Results: 1-Hour CO Concentrations. The results of this modeling are summarized in Figures 7 and 8. Maximum estimated 1-hour CO concentrations in milligrams per cubic meter (mg/m^3) for each of the evaluated scenarios are presented along with the particular receptor location at which they were predicted. The results suggest that, under *worst case* conditions of meteorology and traffic, both the federal and state 1-hour CO standards would be met at receptor locations 10 meters and beyond the edge of roadways expected to be affected by project-related traffic. The changes in CO levels are insignificant due to the relatively small increase in projected traffic and also the offsetting effect of the federal motor vehicle emissions control program. Vehicle emissions standards for motor vehicles get progressively more stringent over time; thus, older, higher emitting vehicles lost by attrition, are replaced by newer, lower-emitting vehicles which comply with the more stringent standards.

6.5 Results: 8-Hour CO Concentrations. The 8-hour values presented in Figures 7 and 8 are very conservative estimates because they are based on averages of the worst case 1-hour values during a.m. and p.m. peak hour traffic and meteorology. Nevertheless, the results are similar to the 1-hour findings in that compliance with state and federal standards is indicated.

FIGURE 7

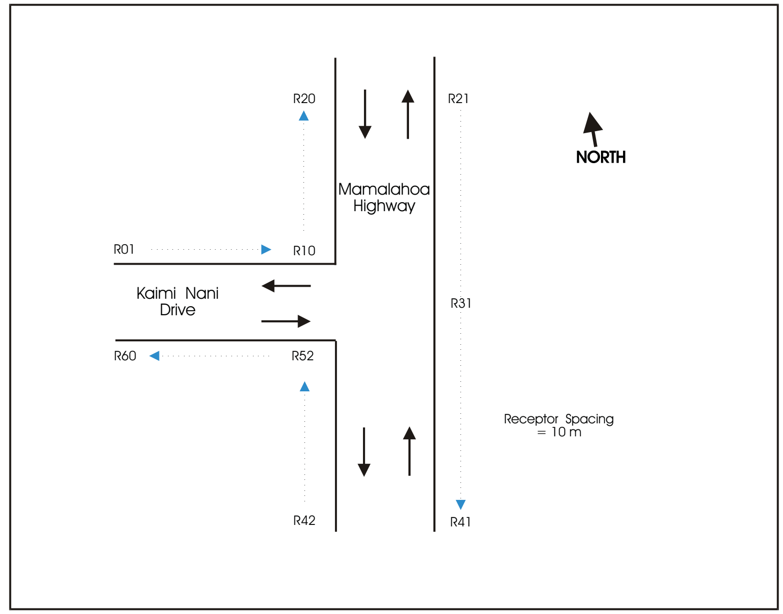
ESTIMATED MAXIMUM 1- AND 8-HOUR
CARBON MONOXIDE CONCENTRATIONS
Queen Kaahumanu Highway at Kaimi Nani Drive
Peak Traffic Hours
2009 - 2022



	CO Concentration (mg/m^3)						
Period	**Existing**	**2012 w/o UH**	**2012 w/UH**	**2017 w/o UH**	**2017 w/UH**	**2022 w/o UH**	**2022 w/UH**
A.M.	1.71 @ R07	1.71 @ R08	1.71 @ R07	2.05 @ R17	2.05 @ R17	2.17 @ R02	2.28 @ R03
P.M.	0.91 @ R52	1.03 @ R52	1.03 @ R52	1.03 @ R10	1.03 @ R10	1.14 @ R09	1.14 @ R09
8-hour	0.62	0.62	0.62	0.70	0.70	0.78	0.78

FIGURE 8

ESTIMATED MAXIMUM 1- AND 8-HOUR
CARBON MONOXIDE CONCENTRATIONS
Mamalahoa Highway at Kaimi Nani Drive
Peak Traffic Hours
2009 - 2022



	CO Concentration (mg/m^3)						
Period	**Existing**	**2012 w/o UH**	**2012 w/UH**	**2017 w/o UH**	**2017 w/UH**	**2022 w/o UH**	**2022 w/UH**
A.M.	1.14 @ R08	1.37 @ R07	1.37 @ R07	1.37 @ R08	1.37 @ R08	1.48 @ R08	1.48 @ R08
P.M.	0.68 @ R33	0.57 @ R10	0.68 @ R31	0.68 @ R52	0.68 @ R52	0.68 @ R32	0.80 @ R52
8-hour	0.46	0.47	0.47	0..49	0.49	0.46	0.54

7. CONCLUSIONS AND MITIGATION

7.1 Short-Term Impacts. Since, as noted in Section 4, the project area is considered to be "semi-arid" by Thornwaite's climatic classification system with a P/E index lower than that associated with the EPA fugitive dust emission factor, there appears to be an increased potential for fugitive dust. It will therefore be important to employ adequate dust control measures during the construction period, particularly during the drier summer months. Dust control could be accomplished through frequent watering of unpaved roadways and areas of exposed soil. The EPA estimates that twice daily watering can reduce fugitive dust emissions by as much as 50%. [11] The soonest possible paving of roadways will also help.

Short-term air quality impacts due to offsite activities supporting the proposed development, i.e., concrete and asphalt production, appear to be *de minimus* due in large part to the high removal of control devices typically found on such production facilities. Furthermore, any emissions will be strictly regulated by the Department of Health permit which each batch plant must have in order to operate.

7.2 Mobile Source Impacts. As reported in Section 6, compliance with federal and state carbon monoxide standards is demonstrated under *worst case* conditions of meteorology and peak hour traffic; thus, no special mitigative measures are required.

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Appendix C

Biological Report

Biological surveys for the
University of Hawaii Center at West Hawaii
(UHCWH), North Kona District,
Island of Hawai'i

Fountain grass dominates the landscape at UHCWH Photo by Eric Guinther

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Kāne'ohe, Hawai`i 96744

August 26, 2009

Biological surveys for the University of Hawai'i Center at West Hawai'i (UHCWH), North Kona District, Island of Hawai'i[1]

August 26, 2009 Report No. AC047B

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Introduction

The purpose of this report prepared by *AECOS* Consultants is to summarize previous survey efforts and present results of recent biological surveys for the proposed University of Hawai'i Center at West Hawai'i (UHCWH), North Kona District on the Island of Hawai'i (Fig. 1). Previous surveys of the University of Hawai'i (UH) property were undertaken in 1998-9 and 2005 (see Herbst, 1998; David and Guinther, 2000; Guinther, David, & Montgomery, 2005). Revisions to the long-range plans for the proposed facility, including a finalization of the campus subdivision site within the larger property, necessitate preparation of a Supplemental Environmental Impact Statement (WCP, 2009). The 73-ac (29.5-ha) campus site is located along the western side of the state parcel, directly upslope of the proposed Main Street Connector Road and adjacent to the town center being developed for the Palamanui Master Planned Community. The campus site includes parts of Makaula, Haleohiu, and Hamanamana *nā ahupua'a*.

Survey Methods

PLANTS — The 500-ac (202-ha), University of Hawai'i property at Kalaoa (above Keāhole) has been surveyed several times in the past, as have surrounding parcels (Herbst, 1998; Hart, 2003; DOFAW, 2005; Guinther, David, and Montgomery, 2005). The primary purpose of the most recent botanical survey was to locate all trees of the remnant "dry-land forest" known to be present in this area occurring within the campus

[1] Report prepared for Wil Chee – Planning, Inc. for the Supplemental EIS and to become part of the public record for the University of Hawai'i Center—West Hawai'i Long Range Development Plan.

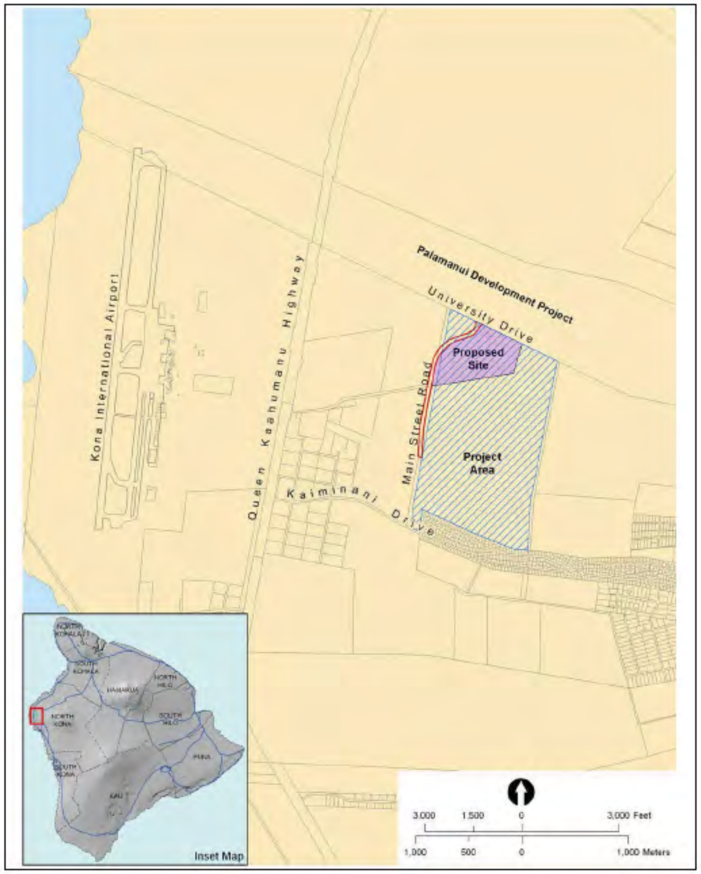

Figure 1. Map showing the project general location on Island of Hawai'i (inset), the 500-ac property ("Project Area"), the 73-ac survey area ("Proposed Site"), and the Main Street Connector Road (red) taken from WCP (2009).

subdivision. This remnant forest does include some federally listed plants. Federal and State of Hawai'i listed species status follows species identified in the following documents (DLNR, 1998, Federal Register, 1999a, 1999b, 2001, 2002, 2004). The botanical survey was undertaken on March 31, 2009 by Eric Guinther under conditions of favorable weather and following a period of average rainfall over preceding months, such that the vegetation was generally healthy and well-developed. Thus, no problems arose with regard to identification of plants encountered either due to there being no flowers or fruit or to not encountering resident plants that would simply not be growing during the dry season (that officially starts in May).

Although all plant species and vegetation types present were noted and estimates of relative abundance (abundant, common, rare, etc.) made, the survey was conducted using a wandering transect that visited each and every tree species (and many of the larger shrubs), recording the position of each with a Trimble GeoXT GPS unit. The survey track was also recorded (Addendum Map).

A plant checklist compiled from observations made by traversing the site in 2005 is included herein, incorporating all new information gained during the March 2009 survey of the campus site. Results of these surveys were compared with a previous survey of the same area (Herbst, 1998) and nearby properties (Char, 1992, 2003; Hart, 2003; DOFAW, 2005). The nomenclature of the higher plants follows that of Wagner, Herbst, and Sohmer (1990, 1999) for both the native and naturalized plants and follows Palmer (2003) for ferns.

INVERTEBRATES — Steven L. Montgomery, Ph. D, provided expertise in invertebrate zoology. The primary purpose of the invertebrates survey was to determine if any federally listed endangered, threatened, proposed, or candidate species are extant within the area proposed for UHCWH campus site. Federal and State of Hawaii listed species status follows species identified in DLNR (1998) and Federal Register (1999a, 1999b, 2001, 2002, 2004, 2008b). No attempt was made in this survey to document the many alien species common throughout the lowlands of the Hawaiian Islands. Those mentioned here are important to the health of native invertebrates or humans.

Prior to the field survey, a search was made for publications relating to invertebrates associated with the project area. The review shows no previous native invertebrate surveys in the project area except those done by the present team in prior visits to adjacent UHCWH areas. Searches were made in the electronic catalogs of the Hawaii Public and University of Hawai'i libraries, and electronic and manual catalogs of Bishop Museum Library. The online data bases of Agricola, Google Scholar, Hawaii's Office of Environmental Quality Control, and the NBII Pacific Basic Information Node[2] were

[2] Searches the cataloged specimens of Bishop Museum.

searched. The University of Hawaii's Hawaii Pacific Journal Index which includes listings for the *Proceedings of the Hawaiian Entomological Society* also was searched.

A field survey was conducted at the site in April 15-16, 2009. A general assessment of terrain and habitats was conducted at the start of the survey. Surveying efforts were conducted at various times of day and night, a technique which is vital for a thorough survey. Transects were walked through the property, selecting sampling sites to represent differences in vegetation, and other ecological factors. Special attention was given to known host plants for native invertebrate species which could shelter native invertebrate populations. In addition to host plant searches and visual observation for flying or resting invertebrates, a fine mesh net was swept across plants, leaf litter, rocks, etc. to census any flying, perching, or crawling insects. A light survey was conducted on the night of April 15 using an ultra violet or black light bulb known to be attractive to night active insects. The light survey location is marked on Fig. 2.

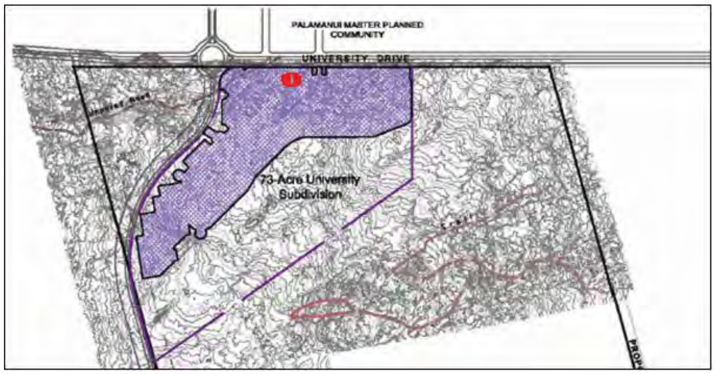

Figure 2. ● = Ultraviolet light study (base map from Figure 3 in UH, 2009).

Invertebrate nomenclature follows *Hawaiian Terrestrial Arthropod Checklist* (HBS2002; Nishida 2002), *Insects of Hawaii* (Zimmerman 1948-80), and *Common Names of Insects & Related Organisms* (HES 1990).

VERTEBRATES — Reginald David provided expertise in vertebrate biology. The primary purpose of the zoological surveys was to determine if there were any avian or mammalian species currently listed as endangered, threatened, or proposed for listing under either the federal or the State of Hawaiʻi endangered species programs on, or within in the immediate vicinity of the proposed development site. Federal and State of

Hawaiʻi listed species status follows species identified in the following referenced documents (Division of Land and Natural Resources (DLNR) 1998, Federal Register 2005, U. S. Fish & Wildlife Service (USFWS, 2005a, 2008).

Avian phylogenetic order and nomenclature follows *The American Ornithologists' Union Check-list of North American Birds 7th Edition* (American Ornithologists' Union 1998), and the 42nd through the 49th supplements to *Check-list of North American Birds* (American Ornithologists' Union 2000; Banks et al. 2002, 2003, 2004, 2005, 2006, 2007, 2008). Mammal scientific names follow *Mammals in Hawaii* (Tomich 1986). Higher native and naturalized plant names follow *Manual of the Flowering Plants of Hawaiʻi* (Wagner et al. and Wagner and Herbst, 1990, 1999). Place names follow *Place Names of Hawaii* (Pukui et al. 1974).

Eight avian point count stations were placed across the campus project site on March 31, 2009. Stations were evenly spread across the 73-ac site. One eight-minute point count was conducted at each station. Field observations were made using Leitz 10 X 42 binoculars, and by listening for vocalizations. Counts took place between 08:30 a.m. and 10:30 a.m., the peak of daily bird activity. Time not spent conducting point counts was used to search the study site for species and habitats that were not detected during count sessions.

All observations of mammalian species were of an incidental nature. With the exception of the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), or *ʻOpeʻapeʻa* as it is known locally, all terrestrial mammals currently found on the Island of Hawaiʻi are alien species. Most are ubiquitous. No trapping program was proposed or undertaken to quantify the use of the area by alien mammalian species. The survey of mammals was limited to visual and auditory detection, coupled with visual observation of scat, tracks, and other animal sign. A running tally was kept of all vertebrate species observed and heard within the study area.

Survey Results

The site is located on the western face of Hualālai, upslope from the Keāhole Airport (Kona International Airport) between elevations of about 400 to 560 ft (120 and 170 m; Fig. 1). The site is characterized by sloping and undulating ground. The generalized slope map for this area (Hawaii County, 1989) designates the general vicinity as "lowlands" with 5 to 10% slopes. The subdivision (campus) site is a mixture of pahoehoe and ʻaʻa flows and varies somewhat in ruggedness. At least one large lava tube passes through the campus parcel, evident as a series of depressions and openings where the roof has collapsed. This feature, extending the length of the campus parcel along its southern side, has been designated Archaeological Preserve No. 2.

VEGETATION — The vegetation over the 500-ac UH parcel was noted to change distinctly from the southern part of the property to the northern part within the Connector Road corridor. An east-west (*mauka-makai*) gradient is present, as well (Herbst, 1998). The northern sector (campus area) is characterized by a nearly monotypic stand of fountain grass (*Pennisetum setaceum*; Fig. 3) with very widely scattered trees and shrubs (Fig.4), these tending to be a mix of natives and non-natives. Using the classification of Hawaiian plant communities developed by Gagne and Cuddihy (1990), this assemblage represents a Lowland Dry Grassland; specifically, the alien-dominated *Fountain Grass (Pennisetum) Grassland*.

Figure 3. Typical aspect of the lower elevation part of the site near the Main Street Collector Road corridor (photograph taken in 2005).

Nearly all of the herbaceous plants recorded (other than fountain grass) from the Lowland Dry Grassland within the corridor were observed within or on the rocky, stepped margins of collapsed lava tubes or areas disturbed by grading. The upper (higher elevation) part of the campus site shows a transition from a *Fountain Grass (Pennisetum) Grassland* to a Lowland Dry Shrubland, still dominated by fountain grass, but with scattered *koa haole* (*Leucaena leucocephala*), Christmas berry (*Schinus terebinthefolius*), *'a'ali'i* (*Dodonaea viscosa*), *māmane* (*Sophora chrysophylla*), and *'alahe'e* (*Psydrax odoratum*) shrubs present. Widely scattered trees also occur in this area representing the very low elevation limit of the Dry Land Forest developed further

upslope. These trees are mostly *lama* (*Diospyros sandwicensis*) and *maua* (*Xylosma hawaiiensis*), with one *'aiea* (*Nothocestrum breviflorum*) and one large silk oak (*Grevillea robusta*) on the campus site (see Addendum Map).

Figure 4. Typical aspect of the upper area of the UH campus site, with very scattered shrubs and trees growing on mixed 'a'a and pahoehoe lava flows dominated by fountain grass (March 2009).

FLORA — Table 1 in this report incorporates the most recent survey results with the species listing and abundance estimates from the northern portion of the Connector Road survey undertaken previously (Guinther, David and Montgomery, 2005). The southern sector of the 2005 survey area was noted to differ in a number of respects (see Vegetation, above) from the northern sector and the campus site is entirely within the vegetation area described as the northern sector.

Only 26 species of ferns and flowering plants were recorded in the most recent (March 2009) survey of the campus site. Of these 26 species, 9 (35%) are native species (five are endemics). An additional early Polynesian introduction (*noni* or *Morinda citrifolia*) was recorded.

In the plant survey of April 2005 (Guinther, David, and Montgomery, 2005), a total of 42 different species of plants were recorded as growing in the survey area that extended

Table 1. Listing of plants (flora) for the UHCWH segment of the Main Street Collector Road and the West Hawai'i Campus Center, North Kona District, Hawai`i

Species	Common name	Status	Abundance AREA N	CAMPUS CTR	Notes
FERNS					
PTERIDOPHYTA					
DRYOPTERIDACEAE					
Nephrolepis multiflora (Roxb.) Jarrett ex Morton.	Asian sword fern	Nat	R	R	<1>
THELYPTERIDACEAE					
Christella cf. *parasitica* (L.) H. Lév	---	Nat	---	R	<1>
FLOWERING PLANTS					
DICOTYLEDONE					
AMARANTHACEAE					
Amaranthus spinosus L.	spiny amaranth	Nat	R	---	<1>
ANACARDIACEAE					
Schinus terebinthifolius L.	Christmas berry	Nat	---	O	
ASTERACEAE (COMPOSITAE)					
Gamochaeta purpurea (L.) Cabr.	---	Nat	R	R	<1>
Pluchea carolinensis (Jacq.) G. Don	sourbush	Nat	R	---	
CACTACEAE					
Opuntia ficus-indica (L.) Mill.	*panini*	Nat	R	---	
CAPPARACEAE					
Capparis sandwichiana DC	*maiapilo*	**End**	O	---	
CHENOPODIACEAE					
Chenopodim carinatum R. Br..	---	Nat	R	R	<1>
Chenopodium murale L.	*`aheahea*	Nat	U	---	<1>
CUCURBITACEAE					
Momordica charantia L.	wild bittermelon	Nat	R	---	<1>
Indet.	?squash	Orn	R	R	<2>
EBENACEAE					
Diospyros sandwicensis (A. DC) Fosb.	*lama*	**End**	---	O	
EUPHORBIACEAE					
Chamaesyce hirta (L.) Millsp.	garden spurge	Nat	R	---	
Ricinus communis L.	castor bean	Nat	---	R	<1>
FABACEAE					
Acacia farnesiana (L.) Willd.	*klu*	Nat	R	R	
Chamaecrista nictitans (L.) Moench	partridge pea	Nat	R	R2	
Indigofera suffruticosa Mill.	indigo	Nat	O	U	
Leucaena leucocephala (Lam.) deWit	*koa haole*	Nat	O	O	
Sophora chrysophylla (Salisb.) Seem.	*māmane*	**End**	--	U	

Table 1. (continued).

Species	Common name	Status	Abundance AREA N	CAMPUS CTR	Notes
FLACOURTIACEAE					
Xylosma hawaiiensis Seem.	*maua*	**End**	R	R	
LAMIACEAE					
Plectranthus parviflorus Willd.	*'ala'ala wai nui wahine*	**Ind**	U	---	<1>
MALVACEAE					
Abutilon grandifolium (Willd.) Sweet	hairy abutilon	Nat	R	R	<1>
Sida fallax Walp.	*`ilima*	**Ind**	---	---	
MYOPORACEAE					
Myoporum sandwicense A. Gray	*naio*	**Ind**	O	U	
MYRTACEAE					
Metrosideros polymorpha Gaud.	*'ōhi'a lehua*	**End**	R	R	
PHYTOLACCACEAE					
Rivina humils L.	coral berry	Nat	R	---	<1>
PIPERACEAE					
Peperomia leptostachya Hook & Arnott	*'ala'ala wai nui*	**Ind**	U	---	<1>
PORTULACACEAE					
Portulaca oleracea L.	pigweed	Nat	U	R	<1>
Portulaca pilosa L.		Nat	U	---	<1>
Talinum fruticosum (L.) Juss.	---	Nat	U	---	<1>
PROTEACEAE					
Grevillea robusta A. Cunn. Ex R. Br.	silk oak	Nat	R	R	
RUBIACEAE					
Morinda citrifolia L.	*noni*, Indian mulberry	**Pol**	U	R	<1>
Psydrax odoratum (G. Forster) A.C. Sm. & S. Darwin	*alahe'e*	**Ind**	O	O	
SAPINDACEAE					
Dodonaea viscosa Jacq.	*'a'ali'i*	**Ind**	O	O	
SOLANACEAE					
Nothocestrum breviflorum A. Gray	*'aiea*	**End**	O	O	<3>
STERCULIACEAE					
Waltheria indica L.	*`uhaloa*	**Ind**	R	R	
VERBENACEAE					
Lantana camara L.	lantana	Nat.	R	R	
MONOCOTYLEDONES					
COMMELINACEAE					
Commelina benghalensis L.	---	Nat.	R	--	<1>
POACEAE (GRAMINEAE)					
Pennisetum setaceum (Forssk.) Chiov.	fountain grass	Nat.	AA	AA	

Table 1 (continued).

Legend to Table 1

Status = distributional status
End. = endemic; native to Hawaii and found naturally nowhere else.
Ind. = indigenous; native to Hawaii, but not unique to the Hawaiian Islands.
Nat. = naturalized, exotic, plant introduced to the Hawaiian Islands since the arrival of Cook Expedition in 1778, and well-established outside of cultivation.
Orn. = exotic, ornamental or cultivated; plant not naturalized (not well-established outside of cultivation).
Pol. = Polynesian introduction before 1778.

Abundance = occurrence ratings for plants in Areas "N" on April 21, 2005 and Campus Center in 2009..
R – Rare - only one or two plants seen.
U - Uncommon - several to perhaps a dozen plants observed.
O - Occasional - found regularly, but not abundant anywhere.
C - Common - considered an important part of the vegetation and observed numerous times.
A - Abundant - found in large numbers; may be locally dominant.
AA - Abundant - abundant and dominant; defining vegetation type.

"AREA N" refers to the northern portion of the Main Street Connector Road corridor surveyed by Guinther, David, and Montgomery (2005).
"CAMPUS CTR" lists species and relative abundances for the March 31, 2009 survey.

Notes:
<1> Observed only in AREA N in or associated with collapsed lava tubes.
<2> Plant lacking fruits or flowers; identification uncertain.
<3> Listed species (endangered).

fully across the University of Hawai'i parcel (a survey concentrated on the proposed route for the Connector Road). The entire 500-ac parcel had been surveyed previously for plants by Herbst (1998), who recorded 35 different species. Of the 42 different species found in the 2005 survey, 10 species (23.8%) are recognized as native to the Hawaiian Islands, with three endemic (unique to the Islands) and 7 indigenous (native to Hawai`i, but also found naturally elsewhere in the Pacific Basin) plants. Herbst (1998) found 13 (37%) native species in his survey. Thus, while the majority of species present are alien plants that have become naturalized in this low elevation environment on leeward Hawai'i, the proportion of native species (nearly one-quarter to a third) is moderately high in comparison with most lowland locations in the Islands. Unfortunately, with the exception of *`ilima*, numbers of individuals and total biomass of native species in the road corridor and the campus site are very low in comparison with alien species numbers and biomass.

In Table 1, entries to the listing of plants present in the survey areas are arranged alphabetically under family names (separated by higher taxa, in this case monocots and dicots). Estimated qualitative abundance values are relative to the specified subareas within the survey boundaries. Included are the scientific name, the common name, and status of the species. Separate abundance columns are provided for the present (2009) and previous (2005, northern sector) surveys.

INVERTEBRATES — Few native arthropods were observed during the searches, and no telltale species specific feeding damage was found One abundant, introduced

arthropod was the bigheaded ant (*Pheidole megacephala*) which tends sap-sucking insects, as well as eating most other insects. Also plentiful were longlegged ants (*Anoplolepis longipes*). Table 2 lists invertebrates encountered, including the prominent alien species and the few native arthropods collected or observed.

Table 2. Listing of Invertebrates for the UHCWH segment of the Main Street Collector Road and the West Hawai'i Campus Center, North Kona District, Hawai`i

Species	Common name	Status	Abundance	Notes
INSECTA (INSECTS)				
Coleoptera				
Anobiidae				
Xyletobius euphorbiae Perkins, 1910		End	U	on *akoko*
Cerambycidae				
Plagithmysus montgomeryi Gressitt & Davis, 1972.?	longhorn borer	End	?	visual only
Scolytidae				
Hypothenemus eruditus (Westwood, 1835)	shot hole borer	Adv	U	on *akoko*
Diptera: Drosophilidae				
Drosophila melanogaster Meigen, 1830	vinegar gnat	Adv	U	on *lama* fruits
Lepidoptera:				
Cosmopterigidae				
Hyposmocoma liturata Walsingham, 1907	casebearers	End	C	at light
Hyposmocoma sp. 2		End	C	at light
Crambidae	micro-moths			
Orthomecyna sp. near *amphilyca*		End	U	at light
Tamsica hyacinthata (Meyrick, 1899)	grass moth	End	R	
Alucitidae				
Alucita objurgatella (Walsingham, 1907)		Adv	U	at light
Xyloryctidae				
Thyrocopa pulverulenta Walsingham, 1907		End	R	at light
Homoptera: Psyllidae				
Trioza hawaiiensis Crawford, 1918		End	U	*ohia* galls
Hymenoptera				
Anthophoridae				
Ceratina sp.	small carpenter bee	Adv	C	
Apidae				
Apis mellifera Linnaeus, 1758	honey bee	Pur	C	
Formicidae				
Pheidole megacephala (Fabricius, 1793)	bigheaded ant	Adv	O	
Anoplolepis gracilipes (F. Smith, 1857)	longlegged ant	Adv	C	
Vespidae	wasps			
Polistes exclamans Viereck, 1906	common paper wasp	Adv	C	

Table 2 (continued).

ARACHNIDA				
Acari: Eriophyidae	broom mites			
Eriophyes sp.		?	U	galls on *lama*
Araneae: (SPIDERS)				
Araneidae				
Argiope appensa (Walckenaer, 1841)	garden spider	Adv	A	
Pholcidae				
Pholcus phalangiodes (Fuesslins, 1775)	long legged spider	Adv	U	

Legend to Table2

Status:
- End endemic to Hawaiian Islands
- Ind indigenous to Hawaiian Islands
- Adv adventive
- Pur purposefully introduced
- ? unknown

Abundance = occurrence ratings:
- R Rare: seen in only one or perhaps two locations
- U Uncommon: seen at most in several locations
- O Occasional: seen with some regularity
- C Common: observed numerous times during survey
- A Abundant: found in large numbers
- AA Very abundant: abundant and dominant

COLEOPTERA (Beetles)

Cerambycidae: *Plagithmysus* sp. presumed *montgomeryi* Gressitt & David, 1972

Plagithmysus is a large group of beetles with many endemic species on Hawai'i Island. The larvae of this native beetle make distinctive feeding galleries. Empty galleries which may have been made by this species were seen in Akoko plants. Habitat and host plants are fairly restricted meaning this is most likely *Plagithmysus montgomeryi*. This genus feeds only on dead, dying, or injured parts of the tree and is not considered a 'pest' (Swezey 1954).

Hypothenemus eruditus (Westwood, 1835) was previously described as an endemic, *H. insularis* Perkins (1900), by Swezey (1954), but is now considered 'lumped' with *H. eruditus*, an adventive species.

LEPIDOPTERA

Cosmopterigidae: *Hyposmocoma*

Two species of adult native *Hyposmocoma* moths came to light, but no caterpillars were seen. Properly called "case bearers," the caterpillars are sometimes misleadingly called "bagworms." Very young caterpillars of case bearers find safety in a hiding place like a leaf curl. When growth forces them out of that protection, they intricately weave a portable shell of their own silk from a lip spinneret. For camouflage, they add bits of

their surroundings to the case using their silk: snips of dry grass or leaves, flakes of bark, maybe a little dirt. The case is then easily mistaken by a predator as another part of the landscape. These bunkers are fitted with a hinged lid (operculum), pulled shut by mini-mandibles to defend them from enemies like beetles and micro wasps. Their relationship to the case is similar to that of a hermit crab to his shell. Although not physically connected to the case as a snail or turtle, they are dependent on it, and die if removed – even if protected from predators and given food. They don't move far, but feed while partly emerged from the case, dragging along their protective armor by their six true legs. (Manning/Montgomery in Liittschwager & Middleton 2001) With over 500 kinds, *Hyposmocoma* micromoths are the greatest assemblage of Hawaiian Island moths, showing astonishing diversity. After writing 630 pages on them, Dr. Elwood Zimmerman lamented the inadequacy of his study. He noted an enormous cluster of species with explosive speciation and diverging radiation (Zimmerman 1978). Much remains to be learned about the life ways of this interesting group of insects now under study by University of Hawaii's Dr. Daniel Rubinoff and colleagues (Rubinoff et al. 2008).

ARACHINIDA

Acari: *Eriophyes* sp.

Only two species are known from Hawai'i Island: adventive *E. cynodoniensis* (Sayed, 1946) and possible endemic *E. peleae* Keifer, 1973.

MEDICALLY IMPORTANT INVERTEBRATES — The large garden spider (*Argiope appensa*) is occasionally found in the area. It is not considered a human health risk. Honey bee colonies, and common paper wasp nests were observed. Many of the alien species of medical importance (centipedes, scorpions, widow spiders**)** were not observed during this survey, but could be present anywhere in the Hawaiian Islands. Employees should always be alert for their presence. Any of the species may pose a serious risk to specific individuals, and supervisors should be aware of any special allergy by employees. Some individuals can experience anaphylactic reactions to venom and should immediately seek medical assistance.

The stinging nettle caterpillar (*Darna pallivitta*) is known on Hawai'i Island, but not from dry areas such as the project site. This introduced pest is spreading; however the project site is at present unlikely to support this species. After construction, care should be taken. Decorative plantings can create a moister environment more inviting to the pest, or eggs could be brought in on a potted plant. The caterpillar's stinging spines may cause burning and itching sensations on the skin. Swelling and welts can last for several days, then a persistent rash may last for weeks. For any severe symptoms, especially breathing difficulty, seek medical help immediately. (DOA, HEAR)

When moving trash, stones, or piled brush, the use of gloves and long sleeves, covered shoes and long pants will greatly reduce the risk of accidental contact and bites or stings by any of the mentioned species. Pulling socks up over pant cuffs (socks on outside) reduces the chance of a stinging invertebrate crawling up a pant leg. Please see *What Bit Me?* (Nishida and Tenorio 1993) and *What's Bugging Me* (Tenorio & Nishida, 1995) for photos and discussion of Hawaii's long-standing invertebrate health hazards.

BIRDS — A total of 61 individual birds of 10 different species, representing 8 separate families were recorded during station counts (Table 3). One additional species, Barn Owl (*Tyto alba*), was detected as an incidental observation while transiting between count stations. All of the species detected are considered to be alien to the Hawaiian Islands.

Table 3. Avian species detected within the proposed UH Center, West Hawaii campus site.

Common Name	***Scientific Name***	***ST***	***RA***
	GALLIFORMES		
	PHASIANIDAE - Pheasants & Partridges		
	Phasianinae - Pheasants & Allies		
Black Francolin	*Francolinus francolinus*	A	1.25
	COLUMBIFORMES		
	COLUMBIDAE - Pigeons & Doves		
Rock Pigeon	*Columba livia*	A	0.13
Zebra Dove	*Geopelia striata*	A	0.13
	STRIGIFORMES		
	TYTONIDAE - BARN OWLS		
Barn Owl	*Tyto alba*	A	I-1
	PASSERIFORMES		
	MIMIDAE - Mockingbirds & Thrashers		
Northern Mockingbird	*Mimus polyglottos*	A	1.38
	STURNIDAE - Starlings		
Common Myna	*Acridotheres tristis*	A	0.63
	CARDINALIDAE - Cardinals Saltators & Allies		
Northern Cardinal	*Cardinalis cardinalis*	A	0.75
	FRINGILLIDAE - Fringilline and Carduleline Finches & Allies		
	Carduelinae - Carduline Finches		
House Finch	*Carpodacus mexicanus*	A	1.13
Yellow-fronted Canary	*Serinus mozambicus*	A	0.50
	ESTRILDIDAE - Estrildid Finches		
	Estrildinae - Estrildine Finches		
African Silverbill	*Lonchura cantans*	A	1.63
Java Sparrow	*Padda oryzivora*	A	0.13

Table 3 (continued).

Legend to Table 3

ST	Status:
A	Alien Species
RA	Relative Abundance - Number of birds detected divided by the number of count stations (8)
I-	Incidental observation – A species recorded as an incidental observation followed by the number detected

Avian diversity and densities were exceptionally low, though in keeping with the xeric nature of the habitat present on the project site. Three species, African Silverbill (*Lonchura cantans*), Northern Mockingbird (*Mimus polyglottos*), and Black Francolin (*Francolinus francolinus*), accounted for 56% of the total number of birds recorded. African Silverbills were the most frequently recorded species, accounting for 21% of he total number of birds recorded during the course of this survey.

MAMMALS — Four mammalian species were detected during the course of this survey. A number of barking dogs (*Canis f. familiaris*) were heard barking from within the Palisades subdivision. The entire study area was strewn with goat (*Capra h. hircus*) scat. Additionally, skeletal remains of both cattle (*Bos taurus*), and goats were encountered at several locations on the site. All four of the mammalian species detected during the course of this survey are considered to be alien to the Hawaiian Islands.

Discussion

PLANT RESOURCES — Within the general project area, there occurs an elevational shift in the character of the vegetation related to the rainfall gradient: much drier conditions prevail at the coast (median annual rainfall of around 15 in or 380 mm; Taliaferro, 1959; Waimea Water Services, 2003), giving way to annual rainfall medians of 40 to 50 inches (1000-1300 mm) at the 4000-ft (1200-m) elevation. Even wetter conditions prevail around the southwest side of Hualālai above Kailua-Kona, but the increase in rainfall and fog drip received on average above Keāhole Point is sufficient to significantly effect the vegetation. A survey by Hart (2003) of the adjacent Palamanui parcel and covering a wider elevational range than our current survey, described the vegetation patterns thusly:

> *Below 500 ft (<150 m)* – *Pennisetum* grassland with scattered native and introduced trees and shrubs.
> *500 to 650 ft (150 – 200 m)* – *Pennisetum* scrub: shrubs (mostly *`a`ali`i*, *koa-haole*, and Christmas berry) co-dominant with fountain grass; occasional native trees such as *lama*, *alahe`e*, *mamane*, *iliahi*, and *wiliwili*).
> *650-900 ft (200-275 m)* – Lowland Dryland Forest (Gagne and Cuddihy, 1990) dominated by *lama*, *alahe`e*, and *iliahi*.

In consideration of the remnant dryland forest containing many rare native trees reported by Hart (2003) for Palamanui (Kau *ʻahapuaʻa*), the State of Hawaii conducted its own informal survey of state-owned lands at Puʻukala, directly adjacent to Kau on the north (DOFAW, 2005). Again, remnants of a native dry land forest were found with a number of listed or rare native tree species. It is clear from both of these surveys, that most of the vegetation having high resource value and/or sensitivity occurs above 600 ft (180 m). The plot of rare trees by Hart (2003) on an aerial photograph of Kau, shows the native trees below 650 ft (200 m) are mostly associated with the more barren lava areas (that is, areas of sparse fountain grass). Possibly, this distribution reflects areas at low (barren) and high (grassy) risk for fires. The campus site is a mix of relatively bare and relative dense growth areas of fountain grass. Scattered occurrences of several native trees occur within the project area, although the remnant trees of this association are very sparsely distributed on the campus site.

A total of 38 plants were logged, although some were large *ʻaʻaliʻi*, *naio*, and *mamane* shrubs. Primary interest was in the *ʻaiea* (1), *maua* (3), *ʻōhiʻa* (1 live, 1 dead), and *lama* (21) trees on the site (numbers in parentheses represent number of individuals logged). Not logged were several large trees, no longer alive that resembled *kiawe*). As can be seen from the map, the trees are limited mostly to the eastern half of the subdivision parcel and are rather widely spread apart. The area surveyed was entirely covered by fountain grass, which was however sparse in some areas of bare lava. A similar survey conducted by Hart (2003) for the adjacent Palamanui Planned Community development showed a similar scattered growth of maua, ʻaiea, uhiuhi, and wiliwili near the boundary separating the Palamanui and UH parcels. In fact, four plants whose positions were recorded by Hart plot to the south side of the Kau/Makaula boundary: two *maua* (*Xylosma hawaiiense*), one *ʻaiea* (*Nothocestrum breviflorum*), and one *wiliwili* (*Erythrina sandwicensis*); all but the last species are within the UH campus parcel (see Addendum Map). A *maua*, *lama*, and *ʻaiea* growing close together were at one time surrounded by an orange plastic exclosure fence. The fence has since deteriorated and damage by goats to the *ʻaiea* is evident.

One unusual result of the March 2009 survey was the apparent absence of *maiapilo* (*Capparis sandwichiana*; Fig. 5), which although not common in 2005 was listed as an occasional species, particularly towards the north end of the proposed road corridor. It is possible that this plant is still present in the same area, but simply does not occur further up the slope, where the March 2009 survey was conducted (note the dogleg in the road as now proposed eliminated much of the far northern part of the road corridor survey area from the campus site survey; Fig, 1).

In a 1999 report for the UHCWH project, Herbst included a table of listed and rare plant species found or potentially found on the 500-ac property. This table is reproduced and updated here as Table 4. Only species followed by Note **<1>** are known to be present in the UH campus site.

Figure 5. Shruby *maiapilo* (*Capparis sandwichiana*), present in the roadway corridor but not seen in the campus site, is a native endemic whose populations are considered vulnerable throughout the state.

Table 4. Listed and rare or vulnerable plants occurring or potentially occurring in the University of Hawaiʻi 500-ac parcel.

SPECIES (*Hawaiian name*)	STATUS	NOTE
Bidens micrantha ssp. *ctenophylla* (*koʻokoʻolau*)	Candidate species	<3>
Caesalpinia kavaiensis (*uhiuhi*)	Listed, endangered	<2>
Capparis sandwichiana (*maiapilo*)	Rare, vulnerable	<2>
Colubrina oppositifolia (*kauila*)	Listed, endangered	<3>
Nothocestrum breviflorum (*ʻaiea*)	Listed, endangered	**<1>**
Pleomele hawaiiensis (*hala pepe*)	Listed, endangered	<2>

Notes:
<1> Present on the campus parcel in small numbers (see text).
<2> Reported from on and off the property, but not the campus subdivision site.
<3> Not reported in recent surveys on or off property; known from leeward Hawai`i.

INVERTEBRATE RESOURCES — Arthropod life cycles often are keyed to seasonal changes, cyclically altering the species collected. Many arthropods time their emergence and breeding to overlap or follow seasonal weather or to coincide with growth spurts of an important plant food. This survey came at the end of the winter rains and the vegetation was in good condition to support arthropod populations. Weather was favorable for collecting on both days of the survey. Monitoring at a different time of the year would produce a longer or different arthropod list. At 65% of the disk visible the waning gibbous moon did presented some competition to the light survey, but rose after mid-night leaving several moon-free hours for monitoring (USNO). There were no competing streetlights or other distractions, however, and passing clouds reduced interference from time to time. The absence of native invertebrate host plants was a much greater factor in survey findings.

No native arthropods or other invertebrates on the federal or state endangered, threatened, proposed, or candidate lists were seen (Fed. Reg. 2008a). The area provides habitat for only a few native arthropods. Native forest cover accounts for a very small portion of the vegetation and large areas are dominated by fountain grass (*Pennisetum setaceum*). The lack of native host plants is a major factor in the lack of native invertebrates. *Maiapilo* occurs scattered on parts of the larger 73-acre parcel. Its leaves, however, were not chewed by caterpillars of the micromoth in the *Plutella capparidis* complex. Goat feeding damage to all native species is common, and the presence of predatory ant species (*Pheidole megacephala* and *Anoplolepis longipes*) combines to provide a setting unlikely to support high native arthropod levels.

No native snails were located in this survey.

The project location does not provide appropriate habitat for the Hawai'i Island native *Drosophila* species recently listed as threatened or endangered (Fed Reg 2006, 2008).

The survey did not locate any native *Hylaeus* or yellow-faced bees now being considered for Federal protected status (Hon Star-Bull 2009). Examples of the small carpenter bee (*Ceratina* sp.), known from the Kona area, were found in this survey. Both species access similar host plants in similar ways and on first viewing, in field conditions, it is possible to confuse the two bees (Daly & Magnacca 2003) which have similar overall body size & shape. On close examination, however, the two bees are easily distinguished (Fig. 6).

North Kona is known to support larvae of Blackburn's hawk moth (*Manduca blackburni*)—a federally listed species—on host plants in the Family Solanaceae, such as introduced tree tobacco (*Nicotiana glauca*) and native `*aiea* (*Nothocestrum* sp.) (USFWS 2005b). None of the introduced hosts suitable for Blackburn's hawk moth caterpillars was seen during the survey. One `*aiea* was examined, but no caterpillars, or feeding evidence was seen. The adult moth was not seen.
A few non-native species reasonably expected to occur on the property were not found. Expected would be the adventive sweet potato hawkmoth (*Agrius cingulata*) and white line sphinx (*Hyles lineata*). Either of these species may be misidentified in flight as *Manduca blackburni*. Difficulties in sampling a large area, at only one season, for a

diversity of invertebrates results in the probability some species may elude even the most experienced collector. Not finding a species does not mean it is not present. Missing species might be found with further survey work, in a longer or seasonally different survey of the property.

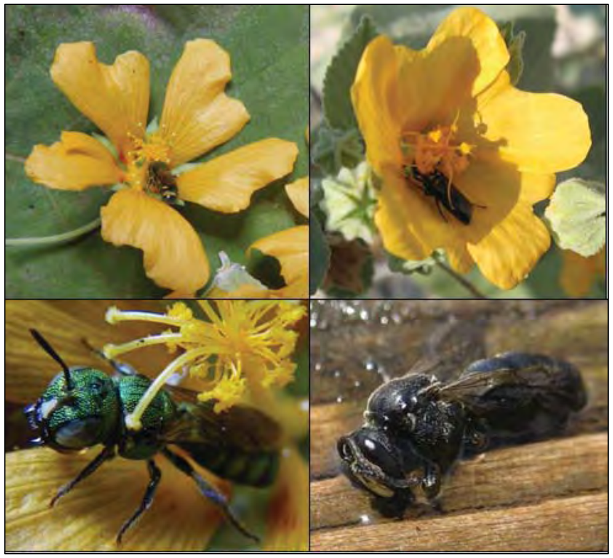

Figure 6. Comparison of small carpenter bee (left) and yellow faced bee (right). (photos by A. Manning & S. Montgomery)

Biological Assessments

Native shrubs and trees

The UHCWH site supports a sparse growth of native trees and shrubs within a non-native *Pennisetum* grassland. Avoiding all of the trees individually will be difficult, but only one has legal status (i.e., is listed as endangered). That specimen is located near the northern edge of the parcel and can be avoided by the proposed campus development. Indeed, the small cluster of *'aiea*, *lama*, and *maua* (one specimen each) here was once protected by an exclosure fence and this fence needs to be restored. Once construction begins, this cluster of three trees must be protected from damage; in the end, the health and safety of these trees will benefit from care and oversight that the campus can provide.

All of the native trees and shrubs in this area are vulnerable to fire and depredation by goats. These trees are surviving at the extreme lower elevation end of their extant range on western Hualālai. To whatever extent existing trees can be included in the landscaping should be considered, and these trees flagged to prevent their loss during construction. Mitigation for plants destroyed by the construction of the campus should include funding plantings of the same species on campus and in the archaeological preserve area expected to be established on the UHCWH site.

Special consideration must be given to the single *'aiea* tree located on the campus site. If federal funding (or any federal nexus) is involved, consultation with U.S. Fish and Wildlife (USFWS) will be required under Section 7 of the Endangered Species Act (ESA). Otherwise, the plant remains protected under ESA and cannot be destroyed (considered a "take" under ESA). This tree, located at the northern edge of the campus site —along with two other trees: a *lama* and a *maua*—should be protected temporarily by erecting a fence around the small cluster to exclude goats and keep construction activities away. A design for long term protection could be erecting a low rock wall around the cluster and providing care for the trees. Once construction is completed, depredation by goats should cease. *Lama*, *maua*, and *māmane* plants elsewhere on the site are not protected by statute, but should be protected from construction damage if these are located in areas not planned for grading. These would also make excellent landscaping species to replace unavoidable losses.

Cave (Lava tube) Fauna

A lava tube system crosses the campus site as recognized by the Archaeological Preserves (UH 2009). One feature was explored to the extent possible in 2005 (Guinther, David, and Montgomery, 2005) and no native invertebrates, or habitat likely to support native invertebrates, were discovered. However, it remains possible that unknown lava tubes, or inaccessible segments of known lava tubes, could be present and contain native cave fauna. Lava tubes supporting significant biological resources were discovered at adjacent Kau (Palamanui Project) above 500 ft (150 m) elevation and supported by a surface dryland forest with native trees (Howarth, Preston, & James, 2003). At least two and possibly three large lava tubes cross the roadway corridor, their presence evidenced by collapsed sections. It is highly likely lava tubes, which have access outside this portion of the surveyed property, cross under it and that those tubes could support cave fauna.

Hawaiian Petrel and Newell's Shearwater

The principal potential impact that the construction and operation of the university campus poses to Hawaiian Petrels and Newell's Shearwaters is the increased threat that birds will be downed after becoming disoriented by exterior lighting that may be required in conjunction with the construction and/or subsequent operation of the campus.

To reduce the potential for interactions between nocturnally flying Hawaiian Petrels and Newell's Shearwaters with external lights and man-made structures, it is recommended that any external lighting that is to be used during construction or is being proposed as permanent outdoor lighting, be shielded (Reed et al. 1985, Telfer et al., 1987). This mitigation would serve the dual purpose of minimizing the threat of disorientation and downing of Hawaiian Petrels and Newell's Shearwaters, while at the same time complying with the Hawaii County Code § 14 – 50 et seq. which requires the shielding of exterior lights, so as to lower the ambient glare caused by unshielded lighting to the astronomical observatories located on Mauna Kea.

Hawaiian hoary bat

The construction and operation of the proposed campus site is not expected to result in any adverse impacts to the endangered Hawaiian hoary bat, the only listed terrestrial mammalian species present in Hawai'i. It is likely that following build-out of the campus, the increased water, and trees that are likely to be installed will attract volant insect, and thus may provide a new foraging resource for bats on a seasonal basis.

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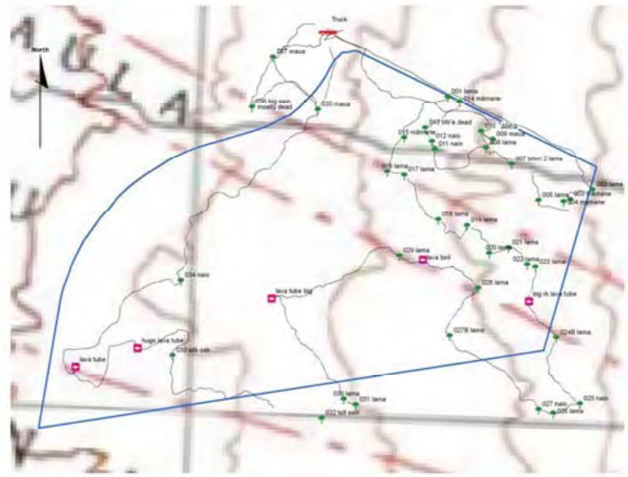
Addendum Map. Project area (survey area outlined in blue; see Figs. 1 and 2 in text) showing track (thin black line) of botanical survey by Guinther and recorded positions of all trees (green) on the property. Background is USGS topographic map. Trees were visible from a distance and the wandering transect purposely visited each one. Many more shrubs of *a'ali'i* in particular exist in this area but shrubs were generally not recorded; the few indicated here are of exceptional stature. Red symbols mark geologic features (e.g., lava tube openings) and vehicle ("truck" at north end) where survey started and ended.



Appendix D

Acoustic Study

ACOUSTIC STUDY FOR THE UNIVERSITY OF HAWAII CENTER WEST HAWAII NORTH KONA, HAWAII

Prepared for:

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NOVEMBER 2009

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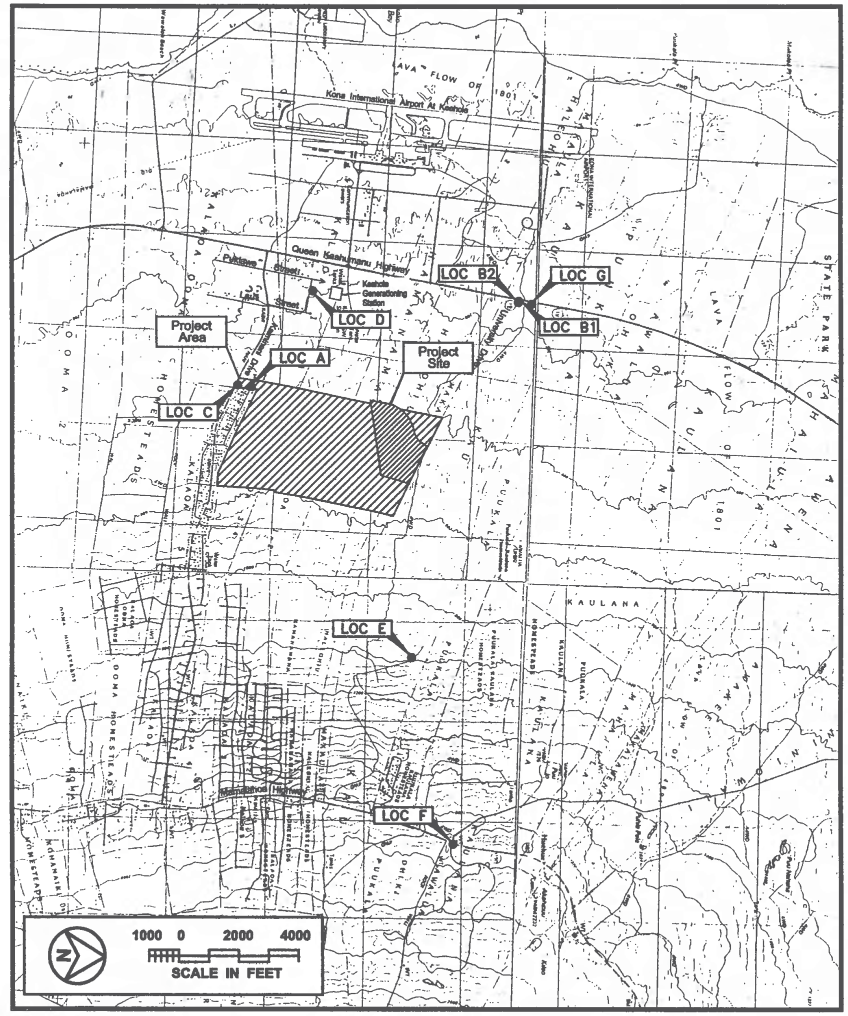
CHAPTER I. SUMMARY

The existing and future traffic noise levels in the vicinity of the proposed University of Hawaii Center - West Hawaii Project in North Kona, Hawaii were evaluated for their potential impact on present and future noise sensitive areas. Figure 1 depicts the location of the project site. The future traffic noise levels along the primary access roadways to the project were calculated for the years 2011 through 2022.

Along the existing Queen Kaahumanu Highway north of the project, traffic noise levels are expected to increase by 3.8 DNL between CY 2009 and CY 2022 as a result of both project and non-project traffic. The project traffic contributions to these increases along Queen Kaahumanu Highway are very small and approximately 0.2 DNL. Along Kaiminani Drive, traffic noise levels are predicted to increase by 3.5 to 4.2 DNL between 2009 and 2022, which project traffic contributions ranging from 0.1 to 1.3 DNL. Along Mamalahoa Highway north of Makalei Estates, traffic noise levels are predicted to increase by 3.4 DNL between 2009 and 2022, which project traffic contributions being 0.4 DNL. Along Mamalahoa Highway south of Makalei Estates, traffic noise levels are predicted to increase by 2.8 to 3.4 DNL between 2009 and 2022, which project traffic contributions ranging from 0.0 to 0.1 DNL. Throughout the project area, traffic noise increases due to project traffic are predicted to range from 0.0 to 1.3 DNL which is well below the range of the noise increases (in excess of 2.8 DNL) caused by non-project traffic on the area's roadway. These increases in traffic noise levels associated with project traffic are considered to be insignificant, particularly when averaged over the 11 year forecast period from 2011 to 2022.

Based on previously published FAR Part 150 aircraft noise contours for Kona International Airport at Keahole (KOA), the project site is located outside of the existing and forecasted 55 DNL noise contours, and is considered to be acceptable for the development of noise sensitive uses as planned. Noise contours for CY 2010 and CY 2020, which were developed during the 1996 Master Plan and FAR Part 150 Study updates for KOA, confirm that the project site is outside of the airport noise contours, and special aircraft noise attenuation measures are not required over the project area. The 1996 Master Plan and FAR Part 150 Studies are currently being updated by the Hawaii State Department of Transportation, Airports Division, and the draft results to date indicate that the project site will continue to remain outside the 55 DNL airport noise contours. The implementation of the airport noise disclosure provisions of Act 208 is not considered to be necessary over the entire project area because the existing and forecasted 55 DNL noise contours are not expected to encompass noise sensitive developments within the project area.

Project educational facilities should not be impacted by traffic noise from Queen Kaahumanu or Kaiminani Drive since adequate setback distances have been provided from the primary access roadways to the project site.



PROJECT LOCATION MAP AND NOISE MEASUREMENT LOCATIONS

FIGURE 1

Noise impacts from the nearby Keahole Generating Station are not expected to occur due to the large distances between the station and the project site. In addition, sound attenuation measures have been recently incorporated into the station's generating equipment, which have reduced plant noise levels to inaudible levels.

Unavoidable, but temporary, noise impacts may occur during the construction of the proposed project. Because construction activities are predicted to be audible at adjoining properties, the quality of the acoustic environment may be degraded to unacceptable levels during periods of construction. Mitigation measures to reduce construction noise to inaudible levels will not be practical in all cases. For this reason, the use of quiet equipment and construction curfew periods as required under the State Department of Health noise regulations are recommended to minimize construction noise impacts.

CHAPTER II. PURPOSE

The objectives of this study were to describe the existing and future noise environment in the environs of the proposed University of Hawaii Center - West Hawaii Project in North Kona on the island of Hawaii. Traffic noise level increases and impacts associated with the proposed development were to be determined within the project site as well as along the public roadways expected to service the project traffic. A specific objective was to determine the future traffic noise level increases associated with both project and non-project traffic, and the potential noise impacts associated with these increases. Assessments of possible impacts from noise resulting from fixed and rotary wing aircraft operations at nearby Kona International Airport at Keahole, from the nearby Keahole Generating Station, and from short term construction noise at the project site were also included in the noise study objectives. Recommendations for minimizing these noise impacts were also to be provided as required.

CHAPTER III. NOISE DESCRIPTORS AND THEIR RELATIONSHIP TO LAND USE COMPATIBILITY

The noise descriptor currently used by federal agencies to assess environmental noise is the Day-Night Average Sound Level (DNL or Ldn). This descriptor incorporates a 24-hour average of instantaneous A-Weighted sound levels as read on a standard Sound Level Meter. The maximum A-Weighted sound level occurring while a noise source such as a heavy truck or aircraft is moving past a listener (i.e., the maximum sound level from a "single event") is referred to as the "Lmax value". The mathematical product (or integral) of the instantaneous sound level times the duration of the event is known as the "Sound Exposure Level", or Lse, which is analogous to the energy of the time-varying sound levels associated with a single event.

The DNL values represent the average noise during a typical day of the year. DNL exposure levels of 55 or less are typical of quiet rural or suburban areas. DNL exposure levels of 55 to 65 are typical of urbanized areas with medium to high levels of activity and street traffic. DNL exposure levels above 65 are representative of densely developed urban areas and areas fronting high volume roadways.

By definition, the minimum averaging period for the DNL descriptor is 24 hours. Additionally, sound levels which occur during the nighttime hours of 10:00 PM to 7:00 AM are increased by 10 decibels (dB) prior to computing the 24-hour average by the DNL descriptor. Because of the averaging used, DNL values in urbanized areas typically range between 50 and 75 DNL. In comparison, the typical range of intermittent noise events may have maximum Sound Level Meter readings between 75 and 105 dBA. A more complete list of noise descriptors is provided in Appendix B to this report. In Appendix B, the Ldn descriptor symbol is used in place of the DNL descriptor symbol.

Table 1, extracted from Reference 1, categorizes the various DNL levels of outdoor noise exposure with severity classifications. Table 2, also extracted from Reference 1, presents the general effects of noise on people in residential use situations. Figure 2, extracted from Reference 2, presents suggested land use compatibility guidelines for residential and nonresidential land uses. A general consensus among federal agencies has developed whereby residential housing development is considered acceptable in areas where exterior noise does not exceed 65 DNL. This value of 65 DNL is used as a federal regulatory threshold for determining the necessity for special noise abatement measures when applications for federal funding assistance are made.

As a general rule, noise levels of 55 DNL or less occur in rural areas, or in areas which are removed from high volume roadways. In urbanized areas which are shielded from high volume streets, DNL levels generally range from 55 to 65 DNL, and are usually controlled by motor vehicle traffic noise. Residences which front major roadways are generally exposed to levels of 65 DNL, and as high as 75 DNL when the

TABLE 1

EXTERIOR NOISE EXPOSURE CLASSIFICATION (RESIDENTIAL LAND USE)

NOISE EXPOSURE CLASS	DAY-NIGHT SOUND LEVEL	EQUIVALENT SOUND LEVEL	FEDERAL (1) STANDARD
Minimal Exposure	Not Exceeding 55 DNL	Not Exceeding 55 Leq	Unconditionally Acceptable
Moderate Exposure	Above 55 DNL But Not Above 65 DNL	Above 55 Leq But Not Above 65 Leq	Acceptable(2)
Significant Exposure	Above 65 DNL But Not Above 75 DNL	Above 65 Leq But Not Above 75 Leq	Normally Unacceptable
Severe Exposure	Above 75 DNL	Above 75 Leq	Unacceptable

Notes: (1) Federal Housing Administration, Veterans Administration, Department of Defense, and Department of Transportation.

(2) FHWA uses the Leq instead of the Ldn descriptor. For planning purposes, both are equivalent if: (a) heavy trucks do not exceed 10 percent of total traffic flow in vehicles per 24 hours, and (b) traffic between 10:00 PM and 7:00 AM does not exceed 15 percent of average daily traffic flow in vehicles per 24 hours. The noise mitigation threshold used by FHWA for residences is 67 Leq.

TABLE 2

EFFECTS OF NOISE ON PEOPLE
(Residential Land Uses Only)

EFFECTS[1] / DAY-NIGHT AVERAGE SOUND LEVEL IN DECIBELS	Hearing Loss	Speech Interference		Annoyance[2]	Average Community Reaction[4]	General Community Attitude Towards Area
		Indoor	Outdoor			
	Qualitative Description	%Sentence Intelligibility	Distance in Meters for 95% Sentence Intelligibility	% of Population Highly Annoyed[3]		
75 and above	May Begin to Occur	98%	0.5	37%	Very Severe	Noise is likely to be the most important of all adverse aspects of the community environment.
70	Will Not Likely Occur	99%	0.9	25%	Severe	Noise is one of the most important adverse aspects of the community environment.
65	Will Not Occur	100%	1.5	15%	Significant	Noise is one of the important adverse aspects of the community environment.
60	Will Not Occur	100%	2.0	9%	Moderate to Slight	Noise may be considered an adverse aspect of the community environment.
55 and below	Will Not Occur	100%	3.5	4%		Noise considered no more important than various other environmental factors.

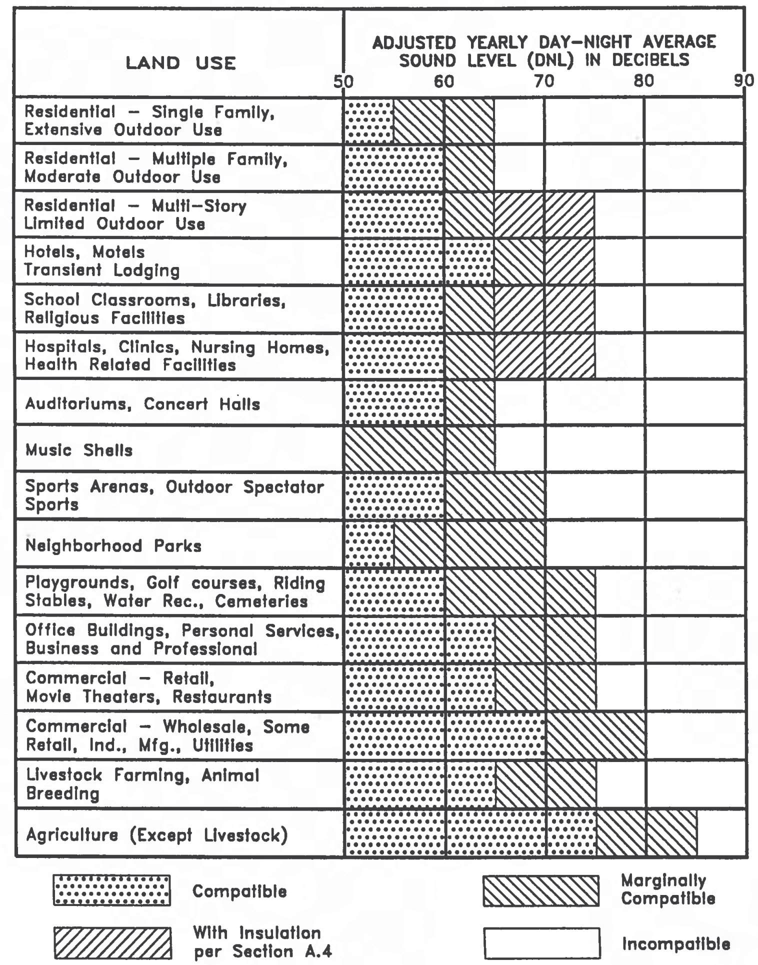
1. "Speech Interference" data are drawn from the following tables in EPA's "Levels Document": Table 3, Fig. D-1, Fig. D-2, Fig. D-3. All other data from National Academy of Science 1977 report "Guidelines for Preparing Environmental Impact Statements on Noise, Report of Working Group 69 on Evaluation of Environmental Impact of Noise."

2. Depends on attitudes and other factors.

3. The percentages of people reporting annoyance to lesser extents are higher in each case. An unknown small percentage of people will report being "highly annoyed" even in the quietest surroundings. One reason is the difficulty all people have in integrating annoyance over a very long time.

4. Attitudes or other non-acoustic factors can modify this. Noise at low levels can still be an important problem, particularly when it intrudes into a quiet environment.

NOTE: Research implicates noise as a factor producing stress-related health effects such as heart disease, high-blood pressure and stroke, ulcers and other digestive disorders. The relationships between noise and these effects, however, have not as yet been quantified.



LAND USE COMPATIBILITY WITH YEARLY AVERAGE DAY-NIGHT AVERAGE SOUND LEVEL (DNL) AT A SITE FOR BUILDINGS AS COMMONLY CONSTRUCTED.
(Source: American National Standards Institute S12.9-1998/Part 5)

FIGURE 2

roadway is a high speed freeway. Due to noise shielding effects from intervening structures, interior lots are usually exposed to 3 to 10 DNL lower noise levels than the front lots which are not shielded from the traffic noise.

For the purposes of determining noise acceptability for funding assistance from federal agencies, an exterior noise level of 65 DNL or lower is considered acceptable. These federal agencies include the Federal Aviation Administration (FAA), Department of Defense (DOD); Federal Housing Administration, Housing and Urban Development (FHA/HUD), and Veterans Administration (VA). This standard is applied nationally (see Reference 3), including Hawaii.

Because of our open-living conditions, the predominant use of naturally ventilated dwellings, and the relatively low exterior-to-interior sound attenuation afforded by these naturally ventilated structures, an exterior noise level of 65 DNL does not eliminate all risks of noise impacts. Because of these factors, a lower level of 55 DNL is considered as the "Unconditionally Acceptable" (or "Near-Zero Risk") level of exterior noise (see Reference 4). For typical, naturally ventilated structures in Hawaii, an exterior noise level of 55 DNL results in an interior level of approximately 45 DNL, which is considered to be the "Unconditionally Acceptable" (or "Near-Zero Risk") level of interior noise. However, after considering the cost and feasibility of applying the lower level of 55 DNL, government agencies such as FHA/HUD and VA have selected 65 DNL as a more appropriate regulatory standard.

For aircraft noise, the Hawaii State Department of Transportation, Airports Division (HDOTA), has recommended that 60 DNL be used as the common level for determining land use compatibility in respect to noise sensitive uses near its airports. Table 3 summarizes the recommendations for compatible land uses at various levels of aircraft noise. For those noise sensitive land uses which are exposed to aircraft noise greater than 55 DNL, the division recommends that disclosure of the aircraft noise levels be provided prior to any real property transactions. Reference 5 requires that such disclosure be provided prior to real property transactions concerning properties located within Air Installation Compatibility Use Zones (AICUZ) or located within airport noise maps developed under Federal Aviation Regulation (FAR) Part 150 - Airport Noise Compatibility Planning (14 CFR Part 150). The most recent FAR Part 150 noise contours for Kona International Airport at Keahole were completed in 1996 and reflect conditions through 2001 (see Reference 6). Additional airport noise contours for 2010 and 2020 were developed by the HDOTA for information purposes only during the 1996 to 1997 time frame. These noise contours are currently being updated by HDOTA, and the draft results do not indicate that significant increases in airport noise will occur over the project site.

For commercial, industrial, and other non-noise sensitive land uses, exterior noise levels as high as 75 DNL are generally considered acceptable. Exceptions to this occur when naturally ventilated office and other commercial establishments are exposed to exterior levels which exceed 65 DNL.

TABLE 3

HAWAII STATE DEPARTMENT OF TRANSPORTATION RECOMMENDATIONS FOR LOCAL LAND USE COMPATIBILITY WITH YEARLY DAY–NIGHT AVERAGE SOUND LEVELS (DNL)

TYPE OF LAND USE	**** Yearly Day-Night Average Sound Level ****					
	< 60	60-65	65-70	70-75	75-80	80-85
RESIDENTIAL						
Low density residential, resorts, and hotels (outdoor facil.)	Y(a)	N(b)	N	N	N	N
Low density apartment with moderate outdoor use	Y	N(b)	N	N	N	N
High density apartment with limited outdoor use	Y	N(b)	N(b)	N	N	N
Transient lodgings with limited outdoor use	Y	N(b)	N(b)	N	N	N
PUBLIC USE						
Schools, day-care centers, libraries, and churches	Y	N(c)	N(c)	N(c)	N	N
Hospitals, nursing homes, clinics, and health facilities	Y	Y(d)	Y(d)	Y(d)	N	N
Indoor auditoriums and concert halls	Y(c)	Y(c)	N	N	N	N
Government services and office buildings serving the general public	Y	Y	Y(d)	Y(d)	N	N
Transportation and Parking	Y	Y	Y(d)	Y(d)	Y(d)	Y(d)
COMMERCIAL AND GOVERNMENT USE						
Offices - government, business, and professional	Y	Y	Y(d)	Y(d)	N	N
Wholesale and retail - building materials, hardware and heavy equipment	Y	Y	Y(d)	Y(d)	Y(d)	Y(d)
Airport businesses - car rental, tours, lei stands, ticket offices, etc.	Y	Y	Y(d)	Y(d)	N	N
Retail, restaurants, shopping centers, financial institutions, etc.	Y	Y	Y(d)	Y(d)	N	N
Power plants, sewage treatment plants, and base yards	Y	Y	Y(d)	Y(d)	Y(d)	N
Studios without outdoor sets, broadcasting, production facilities, etc.	Y(c)	Y(c)	N	N	N	N
MANUFACTURING, PRODUCTION, AND STORAGE						
Manufacturing, general	Y	Y	Y(d)	Y(d)	Y(d)	N
Photographic and optical	Y	Y	Y(d)	Y(d)	N	N
Agriculture (except livestock) and forestry	Y	Y(e)	Y(e)	Y(e)	Y(e)	Y(e)
Livestock farming and breeding	Y	Y(e)	Y(e)	N	N	N
Mining and fishing, resource production and extraction	Y	Y	Y	Y	Y	Y
RECREATIONAL						
Outdoor sports arenas and spectator sports	Y	Y(f)	Y(f)	N	N	N
Outdoor music shells, amphitheaters	Y(f)	N	N	N	N	N
Nature exhibits and zoos, neighborhood parks	Y	Y	Y	N	N	N
Amusements, beach parks, active playgrounds, etc.	Y	Y	Y	Y	N	N
Public golf courses, riding stables, cemeteries, gardens, etc.	Y	Y	N	N	N	N
Professional/resort sport facilities, locations of media events, etc.	Y(f)	N	N	N	N	N
Extensive natural wildlife and recreation areas	Y(f)	N	N	N	N	N

Numbers in parentheses refer to notes.

KEY TO TABLE 3:

Y(Yes) = Land Use and related structures compatible without restrictions.
N(No) = Land Use and related structures are not compatible and should be prohibited.

TABLE 3 (CONTINUED)

HAWAII STATE DEPARTMENT OF TRANSPORTATION RECOMMENDATIONS FOR LOCAL LAND USE COMPATIBILITY WITH YEARLY DAY–NIGHT AVERAGE SOUND LEVELS (DNL)

NOTES FOR TABLE 3:

(a) A noise level of 60 DNL does not eliminate all risks of adverse noise impacts from aircraft noise. However, the 60 DNL planning level has been selected by the State Airports Division as an appropriate compromise between the minimal risk level of 55 DNL and the significant risk level of 65 DNL.

(b) Where the community determines that these uses must be allowed, Noise Level Reduction (NLR) measures to achieve interior levels of 45 DNL or less should be incorporated into building codes and be considered in individual approvals. Normal local construction employing natural ventilation can be expected to provide an average NLR of approximately 9 dB. Total closure plus air conditioning may be required to provide additional outdoor to indoor NLR, and will not eliminate outdoor noise problems.

(c) Because the DNL noise descriptor system represents a 24-hour average of individual aircraft noise events, each of which can be unique in respect to amplitude, duration, and tonal content, the NLR requirements should be evaluated for the specific land use, interior acoustical requirements, and properties of the aircraft noise events. NLR requirements should not be based solely upon the exterior DNL exposure level.

(d) Measures to achieve required NLR must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas, or where the normal noise level is low.

(e) Residential buildings require NLR. Residential buildings should not be located where noise is greater than 65 DNL.

(f) Impact of amplitude, duration, frequency, and tonal content of aircraft noise events should be evaluated.

In the State of Hawaii, the State Department of Health (DOH) regulates noise from on-site activities. State DOH noise regulations are expressed in maximum allowable property line noise limits rather than DNL (see Reference 7). The noise limits apply on all islands of the State, including Hawaii. Although they are not directly comparable to noise criteria expressed in DNL, State DOH noise limits for preservation/residential, apartment/commercial, and agricultural/industrial lands equate to approximately 55, 60, and 76 DNL, respectively.

Because the proposed project facilities may be located on lands designated for public or business uses, various DOH noise limits would be applicable along the lot boundary lines or receptor locations for any stationary machinery, or equipment related to commercial or construction activities. The DOH noise limits are determined by the zoning designations of the lands on which the noise sources are located. These property line limits are 60 dBA and 50 dBA during the daytime and nighttime periods, respectively, for business uses or receptors. For public facility uses, the State DOH limits are 55 dBA and 45 dBA during the daytime and nighttime periods, respectively. These noise limits cannot be exceeded for more than 2 minutes in any 20-minute time period under the State DOH noise regulations. The State DOH noise regulations do not apply to aircraft or motor vehicles.

CHAPTER IV. GENERAL STUDY METHODOLOGY

Existing traffic and background ambient noise levels were measured at various locations in the project environs to provide a basis for developing the traffic noise contours along the roadways which will service the proposed development: Queen Kaahumanu Highway, Mamalahoa Highway, and Kaiminani Drive; and for determining the existing background ambient noise levels in the project area.

The locations of the measurement sites are shown in Figure 1. Noise measurements were performed during March 2009, and supplemented by measurements performed in July 2003 for the Palamanui Development. The traffic noise measurement results, and their comparisons with computer model predictions of existing traffic noise levels are summarized in Table 4. The results of the traffic noise measurements were compared with calculations of existing traffic noise levels to validate the computer model used.

Traffic noise calculations for the existing conditions as well as noise predictions for the future conditions with and without the project were performed using the Federal Highway Administration (FHWA) Noise Prediction Model (Reference 8). Traffic data entered into the noise prediction model were: hourly traffic volumes, average vehicle speeds, estimates of traffic mix, and loose soil propagation loss factor. The traffic assignments for the project (Reference 9) and Hawaii State Department of Transportation counts on Queen Kaahumanu Highway (Reference 10) were the primary sources of data inputs to the model. For existing and future traffic, it was assumed that the average noise levels, or Leq(h), during the highest of the AM or PM peak hour were 1 dB less than the 24-hour DNL along each roadway segment. This assumption was based on computations of both the hourly Leq and the 24-hour DNL of traffic noise on Queen Kaahumanu Highway (see Figure 3).

Traffic noise calculations for both the existing and future conditions in the project environs were developed for ground level receptors without the benefit of shielding effects. The Main Street Road was assumed to provide access to the project site from Kaiminani Drive, and University Drive was assumed to provide access to the project site from Queen Kaahumanu Highway and Mamalahoa Highway. Traffic assignments with and without the project were obtained from the project's traffic turning movements (Reference 9). The forecasted increases in traffic noise levels over existing levels were calculated for both scenarios, and noise impact risks evaluated. The relative contributions of non-project and project related traffic to the total noise levels were also calculated, and an evaluation was made of possible traffic noise impacts resulting from the project.

The relationships of the aircraft flight tracks and noise contours for Kona International Airport to the project site and its proposed land uses were examined to determine if potential noise impacts were possible at the project site. The locations of

TABLE 4
TRAFFIC AND BACKGROUND NOISE MEASUREMENT RESULTS

	LOCATION	Time of Day (HRS)	Ave. Speed (MPH)	Hourly Traffic Volume AUTO	M.TRUCK	H.TRUCK	Measured Leq (dB)	Predicted Leq (dB)
A	84 FT west of Kona Palisades Subdivision (3/08/09)	1413 TO 1513	N/A	N/A	N/A	N/A	44.2	N/A
B1	50 FT from centerline of Q. Kaahumanu Hwy. (3/09/09)	0656 TO 0756	61	1,058	28	44	72.8	72.8
B2	100 FT from centerline of Q. Kaahumanu Hwy. (3/09/09)	0656 TO 0756	61	1,058	28	44	66.7	66.9
C	50 FT from centerline of Kaiminani Dr. (3/09/09)	0812 TO 0912	47	547	6	12	65.8	65.8
B1	50 FT from centerline of Q. Kaahumanu Hwy. (3/09/09)	1612 TO 1712	55	1,237	9	13	70.9	70.5
B2	100 FT from centerline of Q. Kaahumanu Hwy. (3/09/09)	1612 TO 1712	55	1,237	9	13	63.9	65.1
C	50 FT from centerline of Kaiminani Dr. (7/01/03)	1000 TO 1100	35	294	8	1	61.7	61.8

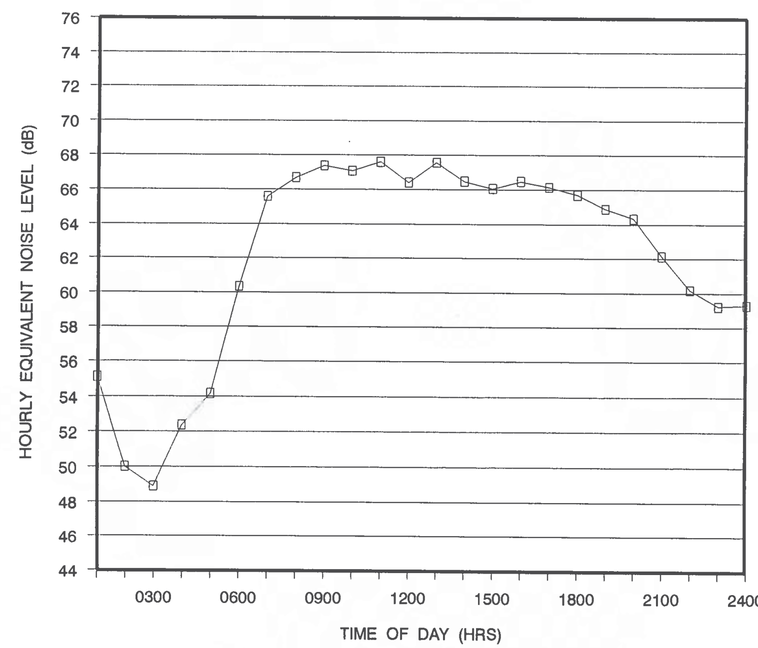
TABLE 4 (CONTINUED)
TRAFFIC AND BACKGROUND NOISE MEASUREMENT RESULTS

LOCATION	Time of Day (HRS)	Ave. Speed (MPH)	Hourly Traffic Volume AUTO	M.TRUCK	H.TRUCK	Measured Leq (dB)	Predicted Leq (dB)
D 400 FT from Pukiawa St. on Kupaloke St. (7/01/03)	1427 TO 1443	N/A	N/A	N/A	N/A	54.2	N/A
E At west end of Makalei Esates Subdivision Road (7/02/03)	0856 TO 0956	N/A	N/A	N/A	N/A	32.9	N/A
G 90 FT from centerline of Q. Kaahumanu Hwy. (7/01/03)	0716 TO 0816	65	846	26	49	68.5	68.8
G 90 FT from centerline of Q. Kaahumanu Hwy. (7/01/03)	1546 TO 1646	65	1,296	24	20	68.6	68.9
F 66 FT from centerline of Mamalahoa Hwy. (7/01/03)	0841 TO 940	45	223	6	10	64.1	65.4
F 66 FT from centerline of Mamalahoa Hwy. (7/01/03)	1500 TO 1530	45	288	6	10	65.7	65.8

Note: Measurements of 7/01/03 obtained from Hiluhilu (Palamanui) Development Noise Study; Y. Ebisu & Associates; July 2003.

FIGURE 3

HOURLY VARIATIONS OF TRAFFIC NOISE AT 100 FT SETBACK DISTANCE FROM THE CENTERLINE OF QUEEN KA'AHUMANU HIGHWAY AT KEAHOLE AIRPORT ROAD (STA. B71001909280) (MAY 20–21, 2008)



□ 100 FT from Roadway Centerline (67.5 DNL) the airport noise contours for 2001, 2010, and 2020 were compared with the location of the project site, and risks of noise impacts were evaluated. The need for special aircraft noise attenuation measures or disclosures of aircraft noise level at the project site was determined by comparing the locations of the most recently published 2001 FAR Part 150 airport noise contours with the location of the project site.

CHAPTER V. EXISTING NOISE ENVIRONMENT

Traffic Noise. The existing traffic noise levels at the project site are less than 45 DNL due to its large setback distances (greater than 4,000 feet) from Queen Kaahumanu Highway, Kaiminani Drive, and Mamalahoa Highway. Traffic noise levels along Queen Kaahumanu Highway are less than 65 DNL at 138 to 162 FT or greater setback distances from the highway centerline. Traffic noise levels along Mamalahoa Highway are less than 65 DNL at 54 to 92 FT or greater setback distances from the highway centerline. Traffic noise levels along Kaiminani Drive are less than 65 DNL at 34 to 45 FT or greater setback distances from the roadway centerline.

Calculations of existing traffic noise levels during the AM and PM peak traffic hours are presented in Tables 5A and 5B. The hourly Leq (or Equivalent Sound Level) contribution from each roadway section in the project environs was calculated for comparison with forecasted traffic noise levels with and without the project. The existing setback distances from the roadways' centerlines to their associated 65 and 75 DNL contours were also calculated as shown in Table 6. The contour line setback distances do not take into account noise shielding effects or the additive contributions of traffic noise from intersecting street sections. Based on the results of Table 6, it was concluded that the existing 65 DNL traffic noise contour is located approximately 138 FT from the centerline of Queen Kaahumanu Highway, approximately 54 FT from the centerline of Mamalahoa Highway, and approximately 45 feet from the centerline of Kaiminani Drive in the immediate vicinity of the project site.

Existing traffic noise levels at the interior portions of the project site are low (less than 45 DNL) due to their large setback distances from the two highways to the east and west of the project area. At these interior locations on the project site, aircraft noise and the natural sounds of birds and winds in foliage are the dominant noise sources. A discussion of existing aircraft noise levels on the project site is provided in the following section. Between aircraft noise events, background ambient noise levels drop to a range of 25 to 45 dB. During calm wind periods, background ambient noise levels decrease to levels less than 40 dB. The minimum background ambient noise levels at these interior locations are controlled by distant traffic and wind noise.

Aircraft Noise. Aircraft noise sources in the project environs are associated with fixed and rotary wing aircraft operations at Kona International Airport at Keahole. Figures 4 through 6 depict aircraft flight tracks in the project environs during CY 2003, which were similar to those reported in Reference 6. Occasionally, depending on weather, visibility, or air traffic conditions, helicopter and light, fixed wing aircraft may cross over the western boundary of project site as indicated by the arrival flight track to Runway 35 shown in Figure 5. The noisier jet aircraft flight tracks typically remain west of the project site and are aligned with Kona International Airport's single runway. However, large overseas jet aircraft may occasionally overfly the center of the project

TABLE 5A

EXISTING (CY 2009) TRAFFIC VOLUMES AND NOISE LEVELS ALONG VARIOUS ROADWAY SECTIONS (AM PEAK HOUR)

LOCATION	SPEED (MPH)	TOTAL VPH	********* VOLUMES (VPH) *********** AUTOS	M TRUCKS	H TRUCKS	50' Leq	100' Leq	200' Leq
Mamalahoa Hwy. - North of Makalei Estates	45	355	337	9	9	63.3	57.9	52.0
Mamalahoa Hwy. - South of Makalei Estates	45	390	370	10	10	63.8	58.3	52.4
Mamalahoa Hwy. - North of Kaiminani Dr.	45	945	897	24	24	67.6	62.1	56.2
Mamalahoa Hwy. - South of Kaiminani Dr.	45	1,250	1,188	31	31	68.8	63.3	57.4
Q. Kaahumanu Hwy. - N. of Entrance Rd.	61	1,090	1,019	27	44	72.5	66.9	60.7
Q. Kaahumanu Hwy. - S. of Entrance Rd.	61	1,090	1,019	27	44	72.5	66.9	60.7
Q. Kaahumanu Hwy. - N. of Airport Rd.	61	1,090	1,019	27	44	72.5	66.9	60.7
Q. Kaahumanu Hwy. - S. of Airport Rd.	61	1,325	1,239	33	53	73.3	67.7	61.5
Q. Kaahumanu Hwy. - N. of Kaiminani Dr.	61	1,250	1,169	31	50	73.1	67.4	61.2
Q. Kaahumanu Hwy. - S. of Kaiminani Dr.	61	1,525	1,426	38	61	73.9	68.3	62.1
Kaiminani Dr. - East of Q. Kaahumanu Hwy.	35	795	771	20	4	63.0	57.6	51.6
Kaiminani Dr. - West of Mamalahoa Hwy.	35	505	489	13	3	61.1	55.7	49.7
Kaiminani Dr. - East of Main Street	35	795	771	20	4	63.0	57.6	51.6
Kaiminani Dr. - West of Main Street	35	795	771	20	4	63.0	57.6	51.6
Entrance Rd. - West of Mamalahoa Hwy.	35	55	54	1	0	50.9	45.5	39.4
University Dr. - E. of Q. Kaahumanu Hwy.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Main Street - North of Kaimiani Drive	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Airport Rd. - West of Q. Kaahumanu Hwy.	35	445	432	11	2	61.0	55.6	49.6

TABLE 5B

EXISTING (CY 2009) TRAFFIC VOLUMES AND NOISE LEVELS ALONG VARIOUS ROADWAY SECTIONS (PM PEAK HOUR)

LOCATION	SPEED (MPH)	TOTAL VPH	********* VOLUMES (VPH) *********** AUTOS	M TRUCKS	H TRUCKS	50' Leq	100' Leq	200' Leq
Mamalahoa Hwy. - North of Makalei Estates	45	470	446	12	12	64.6	59.1	53.2
Mamalahoa Hwy. - South of Makalei Estates	45	480	456	12	12	64.6	59.2	53.2
Mamalahoa Hwy. - North of Kaiminani Dr.	45	905	859	23	23	67.6	61.9	56.0
Mamalahoa Hwy. - South of Kaiminani Dr.	45	1,190	1,130	30	30	68.6	63.1	57.2
Q. Kaahumanu Hwy. - N. of Entrance Rd.	55	1,285	1,266	6	13	70.8	65.1	58.6
Q. Kaahumanu Hwy. - S. of Entrance Rd.	55	1,285	1,266	6	13	70.8	65.1	58.6
Q. Kaahumanu Hwy. - N. of Airport Rd.	55	1,285	1,266	6	13	70.8	65.1	58.6
Q. Kaahumanu Hwy. - S. of Airport Rd.	55	1,515	1,492	8	15	71.5	65.8	59.3
Q. Kaahumanu Hwy. - N. of Kaiminani Dr.	55	1,560	1,536	8	16	71.6	65.9	59.5
Q. Kaahumanu Hwy. - S. of Kaiminani Dr.	55	1,770	1,743	9	18	72.2	66.5	60.0
Kaiminani Dr. - East of Q. Kaahumanu Hwy.	35	810	786	20	4	63.1	57.6	51.7
Kaiminani Dr. - West of Mamalahoa Hwy.	35	465	451	12	2	60.7	55.2	49.2
Kaiminani Dr. - East of Main Street	35	810	786	20	4	63.1	57.6	51.7
Kaiminani Dr. - West of Main Street	35	810	786	20	4	63.1	57.6	51.7
Entrance Rd. - West of Mamalahoa Hwy.	35	30	29	1	0	48.6	43.2	37.2
University Dr. - E. of Q. Kaahumanu Hwy.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Main Street - North of Kaimiani Drive	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Airport Rd. - West of Q. Kaahumanu Hwy.	35	470	456	12	2	60.7	55.3	49.3

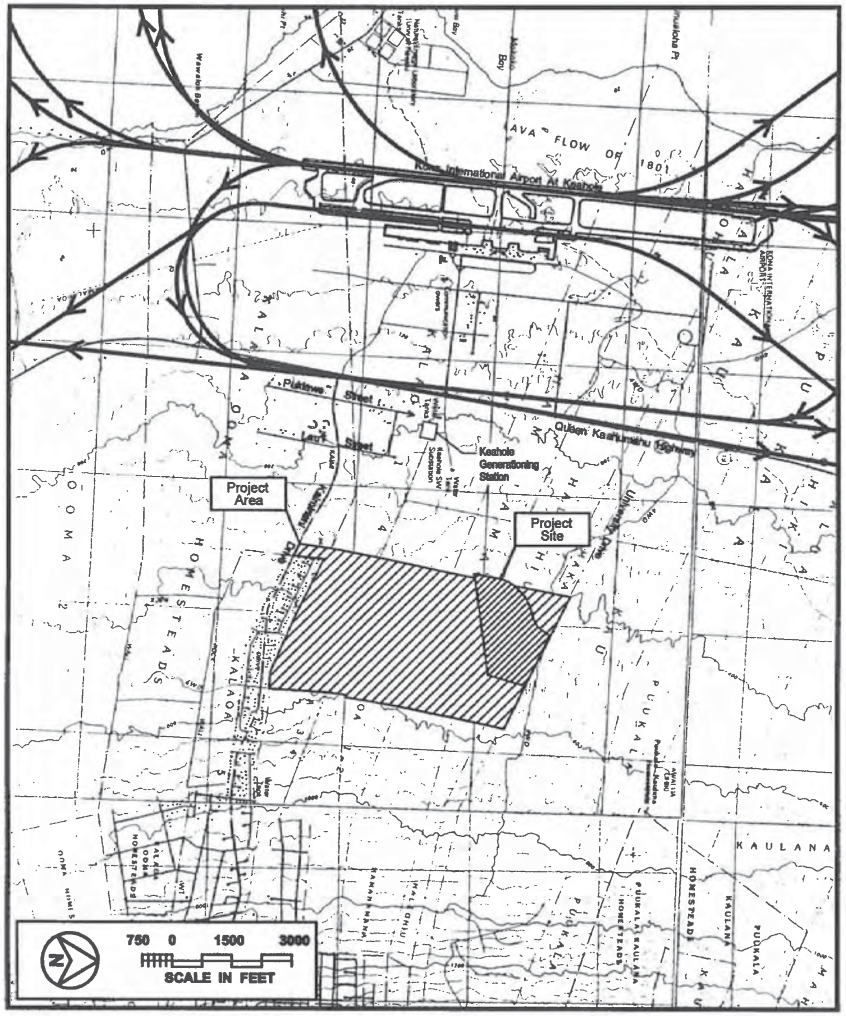
TABLE 6

YEAR 2009 AND 2022 DISTANCES TO 65 AND 75 DNL CONTOURS (USING HIGHEST AM OR PM PEAK HOUR)

STREET SECTION	65 DNL SETBACK (FT) CY 2009	65 DNL SETBACK (FT) CY 2022	75 DNL SETBACK (FT) CY 2009	75 DNL SETBACK (FT) CY 2022
Mamalahoa Hwy. - North of Makalei Estates	54	83	29	44
Mamalahoa Hwy. - South of Makalei Estates	54	83	28	44
Mamalahoa Hwy. - North of Kaiminani Dr.	79	114	42	60
Mamalahoa Hwy. - South of Kaiminani Dr.	92	133	49	72
Q. Kaahumanu Hwy. - N. of Entrance Rd.	138	211	77	123
Q. Kaahumanu Hwy. - S. of Entrance Rd.	138	214	77	124
Q. Kaahumanu Hwy. - N. of Airport Rd.	138	214	77	125
Q. Kaahumanu Hwy. - S. of Airport Rd.	151	232	85	134
Q. Kaahumanu Hwy. - N. of Kaiminani Dr.	146	226	82	133
Q. Kaahumanu Hwy. - S. of Kaiminani Dr.	162	247	92	147
Kaiminani Dr. - East of Q. Kaahumanu Hwy.	45	76	24	40
Kaiminani Dr. - West of Mamalahoa Hwy.	34	55	18	29
Kaiminani Dr. - East of Main Street	45	69	24	37
Kaiminani Dr. - West of Main Street	45	70	24	37
Entrance Rd. - West of Mamalahoa Hwy.	N/A	30	N/A	16
University Dr. - E. of Q. Kaahumanu Hwy.	N/A	75	N/A	40
Main Street - North of Kaimiani Drive	N/A	30	N/A	16
Airport Rd. - West of Q. Kaahumanu Hwy.	33	45	17	24

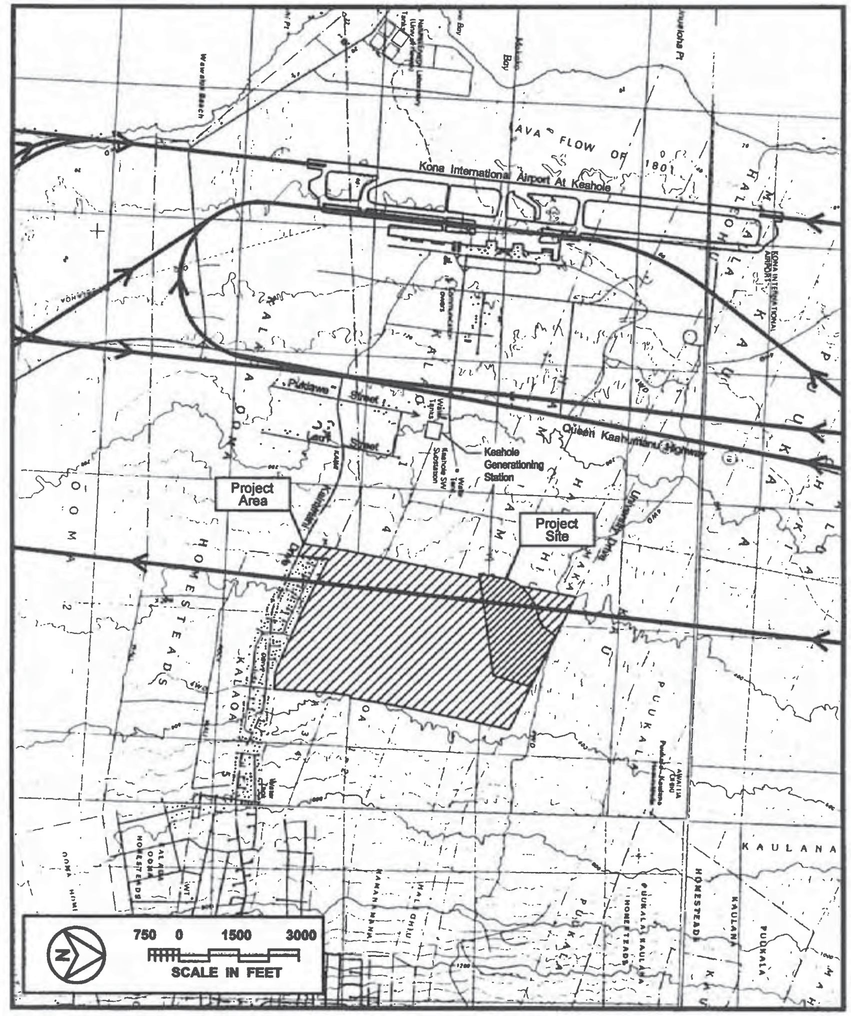
Notes:

(1) All setback distances are from the roadways' centerlines.
(2) See TABLES 5A through 10B for traffic volume, speed, and mix assumptions.
(3) Setback distances are for unobstructed line-of-sight conditions.



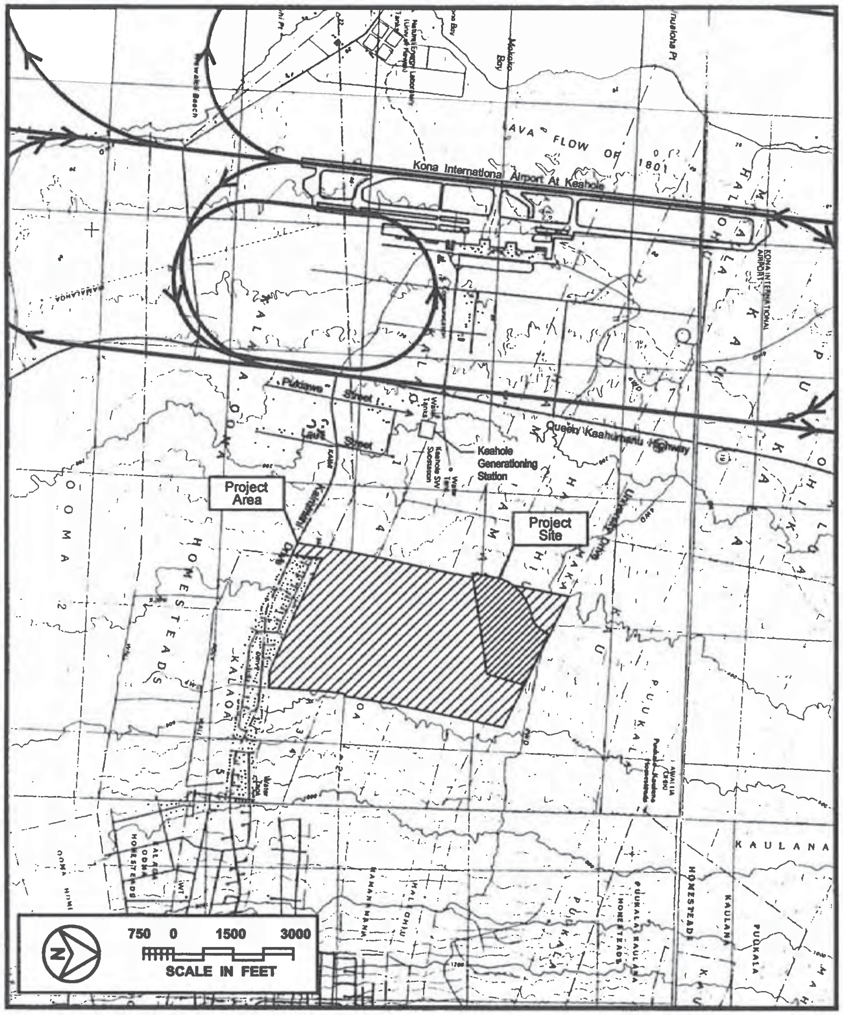
LOCATIONS OF EXISTING AVERAGE AIRCRAFT DEPARTURE FLIGHT TRACKS IN PROJECT ENVIRONS

FIGURE 4



LOCATIONS OF EXISTING AVERAGE AIRCRAFT ARRIVAL FLIGHT TRACKS IN PROJECT ENVIRONS

FIGURE 5



LOCATIONS OF EXISTING AVERAGE AIRCRAFT TRAINING FLIGHT TRACKS IN PROJECT ENVIRONS

FIGURE 6

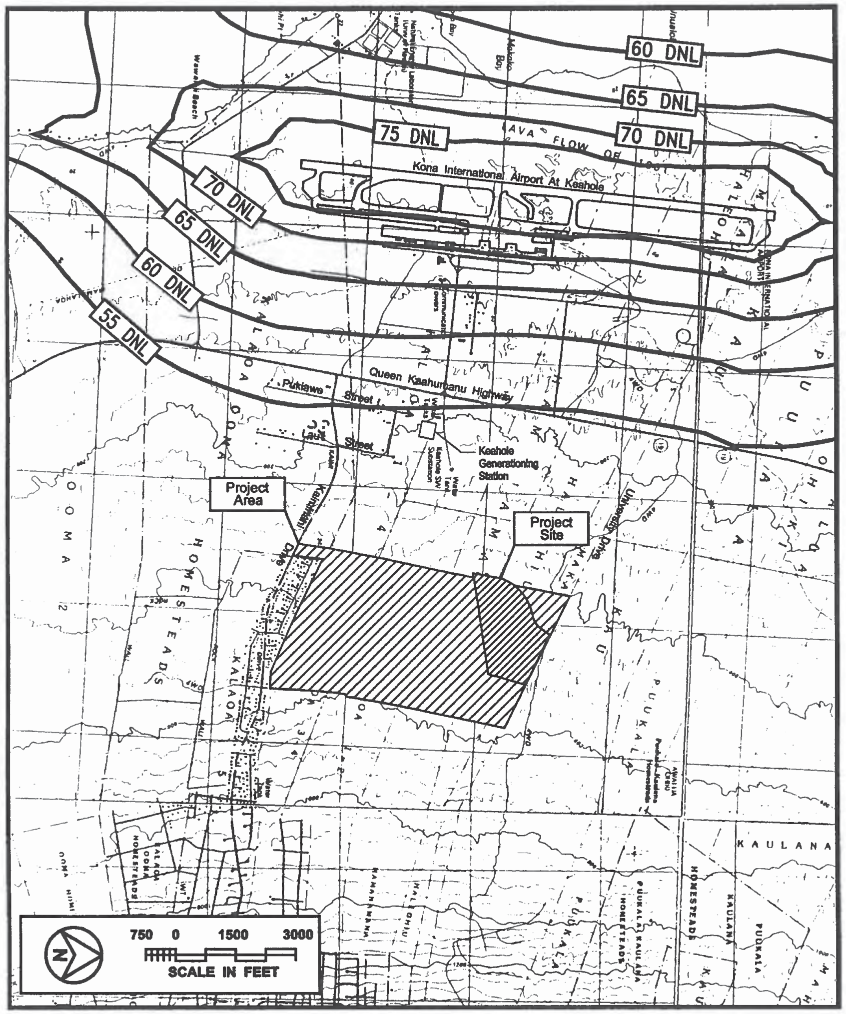
site where shown in Figure 5 when landing using a right hand turn during north flow pattern conditions (Runway 35 in use). This approach to the airport is used due to the presence of other aircraft traffic approaching the airport from the west.

Figure 7 depicts the locations of the 55 through 75 DNL aircraft noise contours during the CY 2001 period. These noise contours were obtained from the Kona International Airport FAR Part 150 report (Reference 6). From Figure 7, aircraft noise levels over the project site are below 55 DNL, and as such, are considered to be in the "Minimal Exposure, Unconditionally Acceptable" category for the planned land uses on the project site. The 1996 Master Plan and FAR Part 150 Studies are currently being updated by the Hawaii State Department of Transportation, Airports Division, and the draft results to date indicate that the project site will continue to remain outside the 55 DNL airport noise contours.

The highest, single event, aircraft noise levels over the project site will occur during north wind conditions when aircraft land from the south and depart toward the north using the airport's Runway 35. Typical maximum noise levels from the noisier B-737(200) jet aircraft are expected to range from 75 to 80 dB. The newer, and quieter B-717(200) and CRJ 200 interisland jet aircraft are typically quieter, and less than 75 dB. Noise levels from helicopters, fixed wing air taxi, and general aviation aircraft are generally less than 70 dB. Higher noise levels of helicopter and light fixed wing aircraft which exceed 70 dB are also possible during flyovers over the project site.

Based on the most current information on aircraft noise levels operations at Kona International Airport, the location of the existing 55 DNL contour is estimated to be west of the project site as shown in Figure 7. The location of the existing 60 DNL contour is estimated to be approximately 6,000 FT west of the project site. Based on these FAR Part 150 noise contours for Kona International Airport and their relationship to the project site, it was concluded that the 60 DNL aircraft noise contour is located outside the project site, with at least 12 DNL of margin for increased contour expansion. The 55 DNL aircraft noise contour also does not cross through the project site, and has a smaller 7 DNL of margin for increased contour expansion. Based on these airport noise contours in the project environs, it was concluded that special aircraft noise mitigation measures are not required, and existing aircraft noise levels do not place special development constraints on the project site.

<u>Generating Station Noise</u>. A possible noise source in the project environs is the Keahole Generating Station, which is operated by Hawaii Electric Light Company, Inc. (HELCO). The location of the generating station is approximately 3,500 FT southwest of the project site as shown in Figure 1. Six 2.5 megawatt diesel generators and three combustion turbine generators operate at the generating station. The combustion turbine units were outfitted with silencer packages to minimize their noise emissions, and the diesel generators were also silenced with exhaust mufflers.



LOCATIONS OF CY 2001 AIRCRAFT NOISE CONTOURS FROM FAR PART 150 REPORT	FIGURE 7

Predicted worst case noise level from the generating station with all six diesel sets and all three combustion turbine units on-line is approximately 41 dBA at the project's southwest boundary line. This worst case level of noise is considered to be very low, and should not cause adverse noise impacts at the project site.

CHAPTER VI. FUTURE NOISE ENVIRONMENT

Traffic Noise. Predictions of future traffic noise levels were made using the traffic volume assignments of Reference 9 for CY 2011 through 2022 with and without the proposed project. The future assignments of project plus non-project traffic on the roadway sections which would service the project are shown in Tables 7A through 10B for the AM and PM peak hours of traffic. As indicated in Tables 11A and 11B, by CY 2022 and following complete project build-out, traffic noise levels on Queen Kaahumanu Highway in the areas fronting the project are predicted to increase by 3.8 to 4.4 Leq or DNL. Along Mamalahoa Highway, traffic noise levels are predicted to increase by 2.8 to 3.7 Leq or DNL. South of the project, and along Kaiminani Drive, traffic noise levels are predicted to increase by 3.3 to 4.2 Leq or DNL. This range of increases in traffic noise levels from 2.8 to 4.4 Leq or DNL is considered to be low to moderate, and primarily reflects the growth in forecasted non-project rather than project traffic in the project environs by CY 2022.

Table 6 summarizes the predicted increases in the future setback distances to the 65 and 75 DNL traffic noise contour lines along the roadways in the project environs and attributable to both project plus non-project traffic in CY 2022. The setback distances in Table 6 do not include the beneficial effects of noise shielding from terrain features and highway cuts, or the detrimental effects of additive contributions of noise from intersecting streets. As indicated in Table 6, the setback distances to the 65 DNL contour are predicted to range from 211 to 247 FT from the centerline of Queen Kaahumanu Highway following project build-out in CY 2022. Along Mamalahoa Highway, setback distances to the 65 DNL contour are predicted to range from 83 to 133 FT from the centerline of Mamalahoa Highway. Along Kaiminani Drive and the project's future East/West connector road, setback distances to the 65 DNL contour are expected to range from 30 to 76 FT.

Tables 11A and 11B separate the predicted increases in traffic noise levels associated with non-project and project traffic by CY 2022, and as measured by the Leq or DNL descriptor systems. As indicated in Tables 11A and 11B, the increases in traffic noise along Queen Kaahumanu Highway due to project traffic range from zero to 0.3 Leq or DNL. Along Mamalahoa Highway, project traffic noise contributions are predicted to range from zero to 0.6 Leq or DNL by CY 2022. Along Kaiminani Drive, project traffic is expected to increase traffic noise levels above those associated with non-project traffic by 0.1 to 1.3 Leq or DNL. The largest increases in traffic noise levels attributable to project traffic are expected to occur along the project's Main Street entrance road at Kaiminani Drive. Overall, the increases in noise levels associated with project traffic are expected to be difficult to measure along Queen Kaahumanu and Mamalahoa Highways and along Kaiminani Drive, and are expected to be much smaller than those associated with non-project traffic.

Aircraft Noise. The aircraft noise contours in the project environs for the CY 2010 and 2020 periods were developed during the most recently completed Master

TABLE 7A

FUTURE (PHASE 1, CY 2011) TRAFFIC VOLUMES AND NOISE LEVELS ALONG VARIOUS ROADWAY SECTIONS (AM PEAK HOUR, WITH PROJECT)

LOCATION	SPEED (MPH)	TOTAL VPH	********* VOLUMES (VPH) *********** AUTOS	M TRUCKS	H TRUCKS	50' Leq	100' Leq	200' Leq
Mamalahoa Hwy. - North of Makalei Estates	45	440	418	11	11	64.3	58.8	52.8
Mamalahoa Hwy. - South of Makalei Estates	45	475	451	12	12	64.6	59.1	53.2
Mamalahoa Hwy. - North of Kaiminani Dr.	45	1,080	1,026	27	27	68.2	62.7	56.7
Mamalahoa Hwy. - South of Kaiminani Dr.	45	1,460	1,386	37	37	69.5	64.0	58.1
Q. Kaahumanu Hwy. - N. of Entrance Rd.	61	1,300	1,215	33	52	73.2	67.6	61.4
Q. Kaahumanu Hwy. - S. of Entrance Rd.	61	1,280	1,197	32	51	73.2	67.5	61.3
Q. Kaahumanu Hwy. - N. of Airport Rd.	61	1,280	1,197	32	51	73.2	67.5	61.3
Q. Kaahumanu Hwy. - S. of Airport Rd.	61	1,535	1,436	38	61	73.9	68.3	62.1
Q. Kaahumanu Hwy. - N. of Kaiminani Dr.	61	1,455	1,361	36	58	73.7	68.1	61.9
Q. Kaahumanu Hwy. - S. of Kaiminani Dr.	61	1,795	1,678	45	72	74.6	69.0	62.8
Kaiminani Dr. - East of Q. Kaahumanu Hwy.	35	1,090	1,058	27	5	64.4	58.9	52.9
Kaiminani Dr. - West of Mamalahoa Hwy.	35	700	678	18	4	62.5	57.1	51.1
Kaiminani Dr. - East of Main Street	35	1,010	980	25	5	64.1	58.6	52.6
Kaiminani Dr. - West of Main Street	35	1,090	1,058	27	5	64.4	58.9	52.9
Entrance Rd. - West of Mamalahoa Hwy.	35	55	54	1	0	50.9	45.5	39.4
University Dr. - E. of Q. Kaahumanu Hwy.	35	20	19	1	0	47.1	41.9	35.9
Main Street - North of Kaimiani Drive	35	60	58	2	0	51.7	46.2	40.1
Airport Rd. - West of Q. Kaahumanu Hwy.	35	485	471	12	2	60.8	55.4	49.4

TABLE 7B

FUTURE (PHASE 1, CY 2011) TRAFFIC VOLUMES AND NOISE LEVELS ALONG VARIOUS ROADWAY SECTIONS (PM PEAK HOUR, WITH PROJECT)

LOCATION	SPEED (MPH)	TOTAL VPH	********* VOLUMES (VPH) *********** AUTOS	M TRUCKS	H TRUCKS	50' Leq	100' Leq	200' Leq
Mamalahoa Hwy. - North of Makalei Estates	45	570	542	14	14	65.4	59.9	53.9
Mamalahoa Hwy. - South of Makalei Estates	45	580	550	15	15	65.5	60.0	54.1
Mamalahoa Hwy. - North of Kaiminani Dr.	45	1,050	998	26	26	68.0	62.5	56.6
Mamalahoa Hwy. - South of Kaiminani Dr.	45	1,440	1,368	36	36	69.4	63.9	58.0
Q. Kaahumanu Hwy. - N. of Entrance Rd.	55	1,450	1,428	7	15	71.3	65.6	59.2
Q. Kaahumanu Hwy. - S. of Entrance Rd.	55	1,435	1,414	7	14	71.3	65.5	59.1
Q. Kaahumanu Hwy. - N. of Airport Rd.	55	1,455	1,433	7	15	71.3	65.6	59.2
Q. Kaahumanu Hwy. - S. of Airport Rd.	55	1,710	1,684	9	17	72.0	66.3	59.9
Q. Kaahumanu Hwy. - N. of Kaiminani Dr.	55	1,750	1,723	9	18	72.1	66.4	60.0
Q. Kaahumanu Hwy. - S. of Kaiminani Dr.	55	2,110	2,078	11	21	72.9	67.2	60.8
Kaiminani Dr. - East of Q. Kaahumanu Hwy.	35	1,110	1,076	28	6	64.5	59.1	53.1
Kaiminani Dr. - West of Mamalahoa Hwy.	35	710	688	18	4	62.6	57.1	51.2
Kaiminani Dr. - East of Main Street	35	1,045	1,014	26	5	64.2	58.7	52.8
Kaiminani Dr. - West of Main Street	35	1,110	1,076	28	6	64.5	59.1	53.1
Entrance Rd. - West of Mamalahoa Hwy.	35	30	29	1	0	48.6	43.2	37.2
University Dr. - E. of Q. Kaahumanu Hwy.	35	15	15	0	0	44.9	39.3	33.0
Main Street - North of Kaimiani Drive	35	50	49	1	0	50.5	45.1	39.0
Airport Rd. - West of Q. Kaahumanu Hwy.	35	515	499	13	3	61.2	55.7	49.8

TABLE 8A

FUTURE (PHASE 2, CY 2012) TRAFFIC VOLUMES AND NOISE LEVELS ALONG VARIOUS ROADWAY SECTIONS (AM PEAK HOUR, WITH PROJECT)

LOCATION	SPEED (MPH)	TOTAL VPH	********* VOLUMES (VPH) *********** AUTOS	M TRUCKS	H TRUCKS	50' Leq	100' Leq	200' Leq
Mamalahoa Hwy. - North of Makalei Estates	45	465	441	12	12	64.5	59.1	53.1
Mamalahoa Hwy. - South of Makalei Estates	45	510	484	13	13	64.9	59.4	53.5
Mamalahoa Hwy. - North of Kaiminani Dr.	45	1,135	1,079	28	28	68.3	62.9	56.9
Mamalahoa Hwy. - South of Kaiminani Dr.	45	1,530	1,454	38	38	69.7	64.2	58.3
Q. Kaahumanu Hwy. - N. of Entrance Rd.	61	1,360	1,272	34	54	73.4	67.8	61.6
Q. Kaahumanu Hwy. - S. of Entrance Rd.	61	1,335	1,249	33	53	73.3	67.7	61.5
Q. Kaahumanu Hwy. - N. of Airport Rd.	61	1,335	1,249	33	53	73.3	67.7	61.5
Q. Kaahumanu Hwy. - S. of Airport Rd.	61	1,605	1,501	40	64	74.1	68.5	62.3
Q. Kaahumanu Hwy. - N. of Kaiminani Dr.	61	1,535	1,436	38	61	73.9	68.3	62.1
Q. Kaahumanu Hwy. - S. of Kaiminani Dr.	61	1,885	1,763	47	75	74.8	69.2	63.0
Kaiminani Dr. - East of Q. Kaahumanu Hwy.	35	1,160	1,125	29	6	64.7	59.2	53.3
Kaiminani Dr. - West of Mamalahoa Hwy.	35	745	722	19	4	62.8	57.3	51.4
Kaiminani Dr. - East of Main Street	35	1,055	1,024	26	5	64.2	58.8	52.8
Kaiminani Dr. - West of Main Street	35	1,140	1,105	29	6	64.6	59.2	53.2
Entrance Rd. - West of Mamalahoa Hwy.	35	65	63	2	0	52.0	46.5	40.4
University Dr. - E. of Q. Kaahumanu Hwy.	35	25	24	1	0	47.9	42.6	36.6
Main Street - North of Kaimiani Drive	35	85	83	2	0	53.0	47.5	41.3
Airport Rd. - West of Q. Kaahumanu Hwy.	35	510	494	13	3	61.2	55.7	49.8

TABLE 8B

FUTURE (PHASE 2, CY 2012) TRAFFIC VOLUMES AND NOISE LEVELS ALONG VARIOUS ROADWAY SECTIONS (PM PEAK HOUR, WITH PROJECT)

LOCATION	SPEED (MPH)	TOTAL VPH	********* VOLUMES (VPH) *********** AUTOS	M TRUCKS	H TRUCKS	50' Leq	100' Leq	200' Leq
Mamalahoa Hwy. - North of Makalei Estates	45	595	565	15	15	65.6	60.1	54.2
Mamalahoa Hwy. - South of Makalei Estates	45	605	575	15	15	65.6	60.1	54.2
Mamalahoa Hwy. - North of Kaiminani Dr.	45	1,100	1,044	28	28	68.2	62.8	56.9
Mamalahoa Hwy. - South of Kaiminani Dr.	45	1,505	1,429	38	38	69.6	64.1	58.2
Q. Kaahumanu Hwy. - N. of Entrance Rd.	55	1,060	1,044	5	11	70.0	64.2	57.8
Q. Kaahumanu Hwy. - S. of Entrance Rd.	55	1,040	1,025	5	10	69.9	64.1	57.7
Q. Kaahumanu Hwy. - N. of Airport Rd.	55	1,520	1,497	8	15	71.5	65.8	59.4
Q. Kaahumanu Hwy. - S. of Airport Rd.	55	1,780	1,753	9	18	72.2	66.5	60.1
Q. Kaahumanu Hwy. - N. of Kaiminani Dr.	55	1,825	1,798	9	18	72.3	66.6	60.2
Q. Kaahumanu Hwy. - S. of Kaiminani Dr.	55	2,210	2,177	11	22	73.1	67.4	61.0
Kaiminani Dr. - East of Q. Kaahumanu Hwy.	35	1,165	1,130	29	6	64.7	59.2	53.3
Kaiminani Dr. - West of Mamalahoa Hwy.	35	745	722	19	4	62.8	57.3	51.4
Kaiminani Dr. - East of Main Street	35	1,100	1,066	28	6	64.5	59.0	53.1
Kaiminani Dr. - West of Main Street	35	1,170	1,135	29	6	64.7	59.3	53.3
Entrance Rd. - West of Mamalahoa Hwy.	35	30	29	1	0	48.6	43.2	37.2
University Dr. - E. of Q. Kaahumanu Hwy.	35	20	19	1	0	47.1	41.9	35.9
Main Street - North of Kaimiani Drive	35	85	83	2	0	53.0	47.5	41.3
Airport Rd. - West of Q. Kaahumanu Hwy.	35	540	523	14	3	61.4	55.9	50.0

TABLE 9A

FUTURE (PHASE 3, CY 2017) TRAFFIC VOLUMES AND NOISE LEVELS ALONG VARIOUS ROADWAY SECTIONS (AM PEAK HOUR, WITH PROJECT)

LOCATION	SPEED (MPH)	TOTAL VPH	********* VOLUMES (VPH) *********** AUTOS	M TRUCKS	H TRUCKS	50' Leq	100' Leq	200' Leq
Mamalahoa Hwy. - North of Makalei Estates	45	645	613	16	16	65.9	60.4	54.5
Mamalahoa Hwy. - South of Makalei Estates	45	660	626	17	17	66.1	60.6	54.7
Mamalahoa Hwy. - North of Kaiminani Dr.	45	1,455	1,383	36	36	69.4	64.0	58.0
Mamalahoa Hwy. - South of Kaiminani Dr.	45	2,020	1,918	51	51	70.9	65.4	59.5
Q. Kaahumanu Hwy. - N. of Entrance Rd.	61	2,125	1,987	53	85	75.4	69.7	63.5
Q. Kaahumanu Hwy. - S. of Entrance Rd.	61	2,245	2,099	56	90	75.6	70.0	63.8
Q. Kaahumanu Hwy. - N. of Airport Rd.	61	2,240	2,094	56	90	75.6	70.0	63.8
Q. Kaahumanu Hwy. - S. of Airport Rd.	61	2,575	2,408	64	103	76.2	70.6	64.4
Q. Kaahumanu Hwy. - N. of Kaiminani Dr.	61	2,450	2,291	61	98	76.0	70.4	64.2
Q. Kaahumanu Hwy. - S. of Kaiminani Dr.	61	2,940	2,748	74	118	77.3	71.6	65.2
Kaiminani Dr. - East of Q. Kaahumanu Hwy.	35	1,490	1,446	37	7	65.7	60.3	54.3
Kaiminani Dr. - West of Mamalahoa Hwy.	35	935	907	23	5	63.8	58.3	52.3
Kaiminani Dr. - East of Main Street	35	1,380	1,338	35	7	65.4	60.0	54.0
Kaiminani Dr. - West of Main Street	35	1,450	1,407	36	7	65.6	60.2	54.2
Entrance Rd. - West of Mamalahoa Hwy.	35	235	228	6	1	57.7	52.2	46.3
University Dr. - E. of Q. Kaahumanu Hwy.	35	1,080	1,048	27	5	64.4	58.9	52.9
Main Street - North of Kaimiani Drive	35	270	262	7	1	58.3	52.8	46.8
Airport Rd. - West of Q. Kaahumanu Hwy.	35	635	616	16	3	62.1	56.6	50.6

TABLE 9B

FUTURE (PHASE 3, CY 2017) TRAFFIC VOLUMES AND NOISE LEVELS ALONG VARIOUS ROADWAY SECTIONS (PM PEAK HOUR, WITH PROJECT)

LOCATION	SPEED (MPH)	TOTAL VPH	********* VOLUMES (VPH) *********** AUTOS	M TRUCKS	H TRUCKS	50' Leq	100' Leq	200' Leq
Mamalahoa Hwy. - North of Makalei Estates	45	825	783	21	21	67.0	61.5	55.6
Mamalahoa Hwy. - South of Makalei Estates	45	860	816	22	22	67.2	61.7	55.8
Mamalahoa Hwy. - North of Kaiminani Dr.	45	1,470	1,396	37	37	69.5	64.0	58.1
Mamalahoa Hwy. - South of Kaiminani Dr.	45	2,080	1,976	52	52	71.0	65.5	59.6
Q. Kaahumanu Hwy. - N. of Entrance Rd.	55	2,565	2,526	13	26	73.8	68.1	61.6
Q. Kaahumanu Hwy. - S. of Entrance Rd.	55	2,815	2,773	14	28	74.2	68.5	62.0
Q. Kaahumanu Hwy. - N. of Airport Rd.	55	2,840	2,798	14	28	74.2	68.5	62.1
Q. Kaahumanu Hwy. - S. of Airport Rd.	55	3,165	3,117	16	32	74.7	69.0	62.6
Q. Kaahumanu Hwy. - N. of Kaiminani Dr.	55	3,235	3,187	16	32	74.8	69.1	62.6
Q. Kaahumanu Hwy. - S. of Kaiminani Dr.	55	3,625	3,571	18	36	75.3	69.6	63.1
Kaiminani Dr. - East of Q. Kaahumanu Hwy.	35	1,600	1,552	40	8	66.1	60.6	54.6
Kaiminani Dr. - West of Mamalahoa Hwy.	35	960	931	24	5	63.9	58.4	52.4
Kaiminani Dr. - East of Main Street	35	1,445	1,402	36	7	65.6	60.2	54.2
Kaiminani Dr. - West of Main Street	35	1,470	1,426	37	7	65.7	60.2	54.3
Entrance Rd. - West of Mamalahoa Hwy.	35	295	287	7	1	58.6	53.1	47.1
University Dr. - E. of Q. Kaahumanu Hwy.	35	1,680	1,630	42	8	66.3	60.8	54.8
Main Street - North of Kaimiani Drive	35	280	272	7	1	58.4	52.9	46.9
Airport Rd. - West of Q. Kaahumanu Hwy.	35	665	645	17	3	62.3	56.8	50.8

TABLE 10A

FUTURE (PHASE 4, CY 2022) TRAFFIC VOLUMES AND NOISE LEVELS ALONG VARIOUS ROADWAY SECTIONS (AM PEAK HOUR, WITH PROJECT)

LOCATION	SPEED (MPH)	TOTAL VPH	********* VOLUMES (VPH) *********** AUTOS	M TRUCKS	H TRUCKS	50' Leq	100' Leq	200' Leq
Mamalahoa Hwy. - North of Makalei Estates	45	825	783	21	21	67.0	61.5	55.6
Mamalahoa Hwy. - South of Makalei Estates	45	835	793	21	21	67.0	61.6	55.6
Mamalahoa Hwy. - North of Kaiminani Dr.	45	1,825	1,733	46	46	70.4	65.0	59.0
Mamalahoa Hwy. - South of Kaiminani Dr.	45	2,530	2,404	63	63	71.8	66.4	60.4
Q. Kaahumanu Hwy. - N. of Entrance Rd.	61	2,620	2,449	66	105	76.3	70.7	64.5
Q. Kaahumanu Hwy. - S. of Entrance Rd.	61	2,735	2,558	68	109	76.5	70.8	64.6
Q. Kaahumanu Hwy. - N. of Airport Rd.	61	2,730	2,553	68	109	76.4	70.8	64.6
Q. Kaahumanu Hwy. - S. of Airport Rd.	61	3,145	2,940	79	126	77.1	71.4	65.3
Q. Kaahumanu Hwy. - N. of Kaiminani Dr.	61	3,015	2,819	75	121	76.9	71.3	65.1
Q. Kaahumanu Hwy. - S. of Kaiminani Dr.	61	3,660	3,422	92	146	77.7	72.1	65.9
Kaiminani Dr. - East of Q. Kaahumanu Hwy.	35	1,885	1,829	47	9	66.8	61.3	55.3
Kaiminani Dr. - West of Mamalahoa Hwy.	35	1,135	1,101	28	6	64.6	59.1	53.2
Kaiminani Dr. - East of Main Street	35	1,680	1,630	42	8	66.3	60.8	54.8
Kaiminani Dr. - West of Main Street	35	1,820	1,765	46	9	66.6	61.2	55.2
Entrance Rd. - West of Mamalahoa Hwy.	35	360	349	9	2	59.6	54.2	48.2
University Dr. - E. of Q. Kaahumanu Hwy.	35	1,305	1,265	33	7	65.2	59.8	53.8
Main Street - North of Kaimiani Drive	35	380	368	10	2	59.9	54.4	48.5
Airport Rd. - West of Q. Kaahumanu Hwy.	35	785	761	20	4	63.0	57.5	51.6

TABLE 10B

FUTURE (PHASE 4, CY 2022) TRAFFIC VOLUMES AND NOISE LEVELS ALONG VARIOUS ROADWAY SECTIONS (PM PEAK HOUR, WITH PROJECT)

LOCATION	SPEED (MPH)	TOTAL VPH	********* VOLUMES (VPH) *********** AUTOS	M TRUCKS	H TRUCKS	50' Leq	100' Leq	200' Leq
Mamalahoa Hwy. - North of Makalei Estates	45	1,045	993	26	26	68.0	62.5	56.6
Mamalahoa Hwy. - South of Makalei Estates	45	1,045	993	26	26	68.0	62.5	56.6
Mamalahoa Hwy. - North of Kaiminani Dr.	45	1,805	1,715	45	45	70.4	64.9	59.0
Mamalahoa Hwy. - South of Kaiminani Dr.	45	2,560	2,432	64	64	71.9	66.4	60.5
Q. Kaahumanu Hwy. - N. of Entrance Rd.	55	3,200	3,152	16	32	74.7	69.0	62.6
Q. Kaahumanu Hwy. - S. of Entrance Rd.	55	3,485	3,433	17	35	75.1	69.4	63.0
Q. Kaahumanu Hwy. - N. of Airport Rd.	55	3,515	3,462	18	35	75.2	69.4	63.0
Q. Kaahumanu Hwy. - S. of Airport Rd.	55	3,925	3,866	20	39	75.6	69.9	63.5
Q. Kaahumanu Hwy. - N. of Kaiminani Dr.	55	4,000	3,940	20	40	75.7	70.0	63.6
Q. Kaahumanu Hwy. - S. of Kaiminani Dr.	55	4,505	4,437	23	45	76.2	70.5	64.1
Kaiminani Dr. - East of Q. Kaahumanu Hwy.	35	1,985	1,925	50	10	67.3	61.9	56.1
Kaiminani Dr. - West of Mamalahoa Hwy.	35	1,165	1,130	29	6	64.7	59.2	53.3
Kaiminani Dr. - East of Main Street	35	1,785	1,731	45	9	66.6	61.1	55.1
Kaiminani Dr. - West of Main Street	35	1,830	1,775	46	9	66.7	61.2	55.2
Entrance Rd. - West of Mamalahoa Hwy.	35	380	368	10	2	59.9	54.4	48.5
University Dr. - E. of Q. Kaahumanu Hwy.	35	2,095	2,033	52	10	67.2	61.8	55.8
Main Street - North of Kaimiani Drive	35	410	398	10	2	60.1	54.7	48.7
Airport Rd. - West of Q. Kaahumanu Hwy.	35	830	805	21	4	63.2	57.8	51.8

TABLE 11A

CALCULATIONS OF PROJECT AND NON-PROJECT TRAFFIC NOISE CONTRIBUTIONS (CY 2022) (AM PEAK HOUR)

STREET SECTION	NOISE LEVEL (DB) INCREASE DUE TO: NON-PROJECT TRAFFIC	PROJECT TRAFFIC
Mamalahoa Hwy. - North of Makalei Estates	3.1	0.6
Mamalahoa Hwy. - South of Makalei Estates	3.2	0.0
Mamalahoa Hwy. - North of Kaiminani Dr.	2.8	0.0
Mamalahoa Hwy. - South of Kaiminani Dr.	3.0	0.0
Q. Kaahumanu Hwy. - N. of Entrance Rd.	3.6	0.2
Q. Kaahumanu Hwy. - S. of Entrance Rd.	4.0	0.0
Q. Kaahumanu Hwy. - N. of Airport Rd.	3.9	0.0
Q. Kaahumanu Hwy. - S. of Airport Rd.	3.8	0.0
Q. Kaahumanu Hwy. - N. of Kaiminani Dr.	3.8	0.0
Q. Kaahumanu Hwy. - S. of Kaiminani Dr.	3.5	0.3
Kaiminani Dr. - East of Q. Kaahumanu Hwy.	3.2	0.6
Kaiminani Dr. - West of Mamalahoa Hwy.	3.3	0.2
Kaiminani Dr. - East of Main Street	3.1	0.2
Kaiminani Dr. - West of Main Street	3.0	0.6
Entrance Rd. - West of Mamalahoa Hwy.	7.2	1.5
University Dr. - E. of Q. Kaahumanu Hwy.	63.6	1.6
Main Street - North of Kaimiani Drive	53.4	6.5
Airport Rd. - West of Q. Kaahumanu Hwy.	2.0	0.0

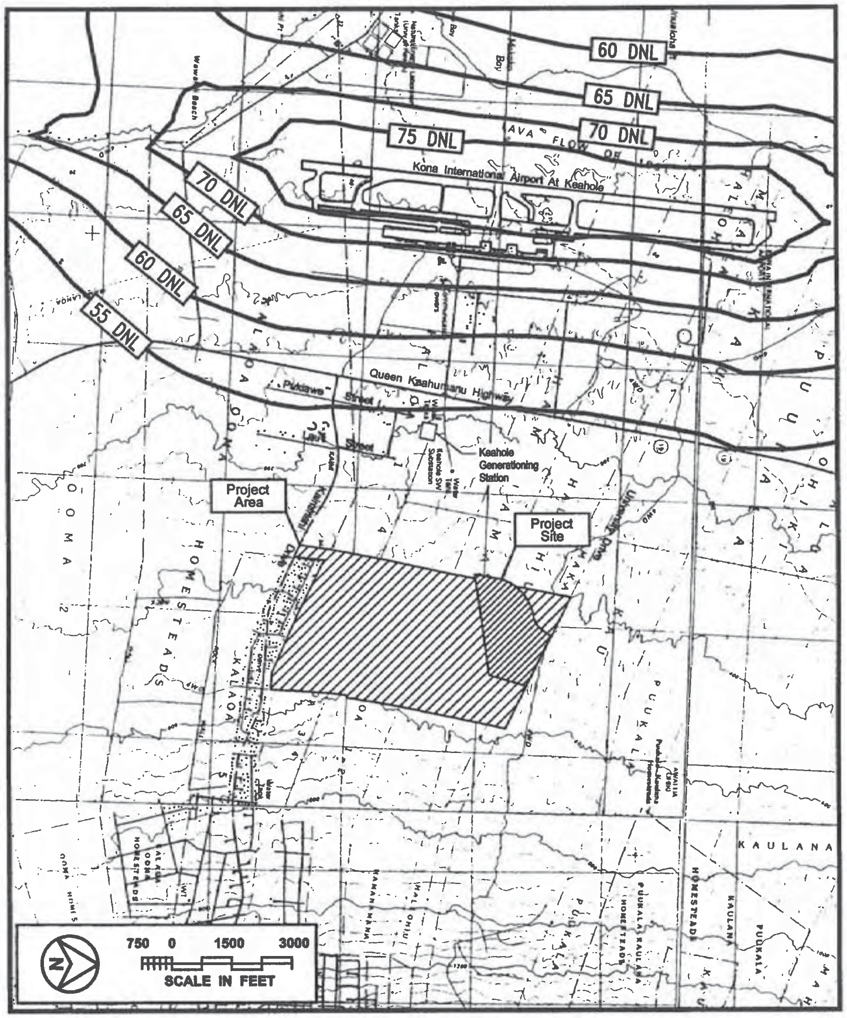
TABLE 11B

CALCULATIONS OF PROJECT AND NON-PROJECT TRAFFIC NOISE CONTRIBUTIONS (CY 2022) (PM PEAK HOUR)

STREET SECTION	NOISE LEVEL (DB) INCREASE DUE TO: NON-PROJECT TRAFFIC	PROJECT TRAFFIC
Mamalahoa Hwy. - North of Makalei Estates	3.0	0.4
Mamalahoa Hwy. - South of Makalei Estates	3.4	0.0
Mamalahoa Hwy. - North of Kaiminani Dr.	2.8	0.0
Mamalahoa Hwy. - South of Kaiminani Dr.	3.2	0.1
Q. Kaahumanu Hwy. - N. of Entrance Rd.	3.8	0.1
Q. Kaahumanu Hwy. - S. of Entrance Rd.	4.3	0.0
Q. Kaahumanu Hwy. - N. of Airport Rd.	4.4	0.0
Q. Kaahumanu Hwy. - S. of Airport Rd.	4.1	0.0
Q. Kaahumanu Hwy. - N. of Kaiminani Dr.	4.1	0.0
Q. Kaahumanu Hwy. - S. of Kaiminani Dr.	3.8	0.2
Kaiminani Dr. - East of Q. Kaahumanu Hwy.	2.9	1.3
Kaiminani Dr. - West of Mamalahoa Hwy.	3.8	0.2
Kaiminani Dr. - East of Main Street	3.4	0.1
Kaiminani Dr. - West of Main Street	3.1	0.5
Entrance Rd. - West of Mamalahoa Hwy.	10.0	1.3
University Dr. - E. of Q. Kaahumanu Hwy.	67.0	0.2
Main Street - North of Kaimiani Drive	56.3	3.8
Airport Rd. - West of Q. Kaahumanu Hwy.	2.5	0.0

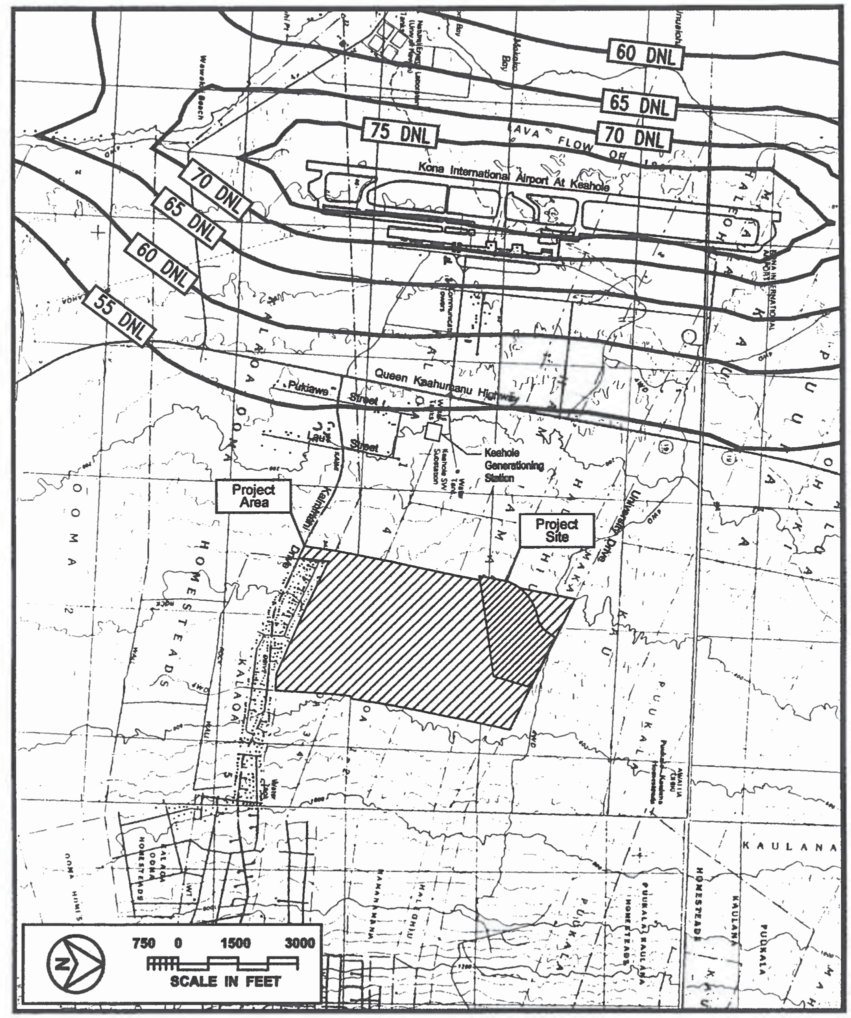
Plan and FAR Part 150 Study Updates for Kona International Airport at Keahole. These airport noise contours are shown in Figures 8 and 9. These noise contours may overstate the forecasted aircraft noise levels since they do not include the 100 percent replacement of the noisier DC-9(50) aircraft by the quieter B-717(200) aircraft by Hawaiian Airlines, and the discontinuation of B-737(200) passenger flights by Aloha Airlines. Nevertheless, the forecasted 2010 and 2020 airport noise contours are expected to remain outside the project area. Based on the relationships of the project site to the forecasted airport noise contours shown in Figures 8 and 9, it was concluded that risks of adverse noise impacts from aircraft noise should be minimal at the project site.

The available forecasts for aircraft noise over the project site indicate that the 55 and 60 DNL contours will not extend into the project site by CY 2010 or 2020 (see Figures 8 and 9). Therefore, unless significant changes occur in the operational activity and forecasts for Kona International Airport at Keahole, the project site is expected to remain outside the 55 and 60 DNL aircraft noise contours through the CY 2020 time period. These conclusions were confirmed by a review of the drafts of the FAR Part 150 contours for Kona International Airport at Keahole which are currently being updated by the Hawaii State Department of Transportation, Airports Division.



LOCATIONS OF CY 2010 AIRCRAFT NOISE CONTOURS (KONA INTERNATIONAL AIRPORT)

FIGURE 8



LOCATIONS OF CY 2020 AIRCRAFT NOISE CONTOURS (KONA INTERNATIONAL AIRPORT)

FIGURE 9

CHAPTER VII. DISCUSSION OF PROJECT RELATED NOISE IMPACTS AND POSSIBLE NOISE MITIGATION MEASURES

Traffic Noise. The increases in traffic noise levels attributable to the project from the present to CY 2022 are predicted to range from 0.0 to 0.3 DNL along Queen Kaahumanu Highway, where traffic noise levels are expected to be above 65 DNL along the highway Rights-of-Way. These increases in traffic noise levels along Queen Kaahumanu Highway which are attributable to the project are considered to be insignificant, and are much lower than the traffic noise increases expected as a result of non-project traffic. In addition, the lands along the highway Rights-of-Way are generally vacant in the project environs. For these reasons, traffic noise impacts along Queen Kaahumanu Highway and resulting from project traffic are not considered to be significant. However, setback distances to the 65 DNL contour are expected to increase as a result of both project and non-project traffic.

Relatively small increases (less than 0.5 DNL) in traffic noise levels along the sections of Mamalahoa Highway north and south of the project are expected to occur as a result of the proposed project. By CY 2022, project traffic is expected to increase traffic noise levels along the north sections of Mamalahoa Highway by approximately 0.4 DNL. This level of increase is not considered significant, and traffic noise impacts resulting from project traffic along these sections of the highway are not expected to occur.

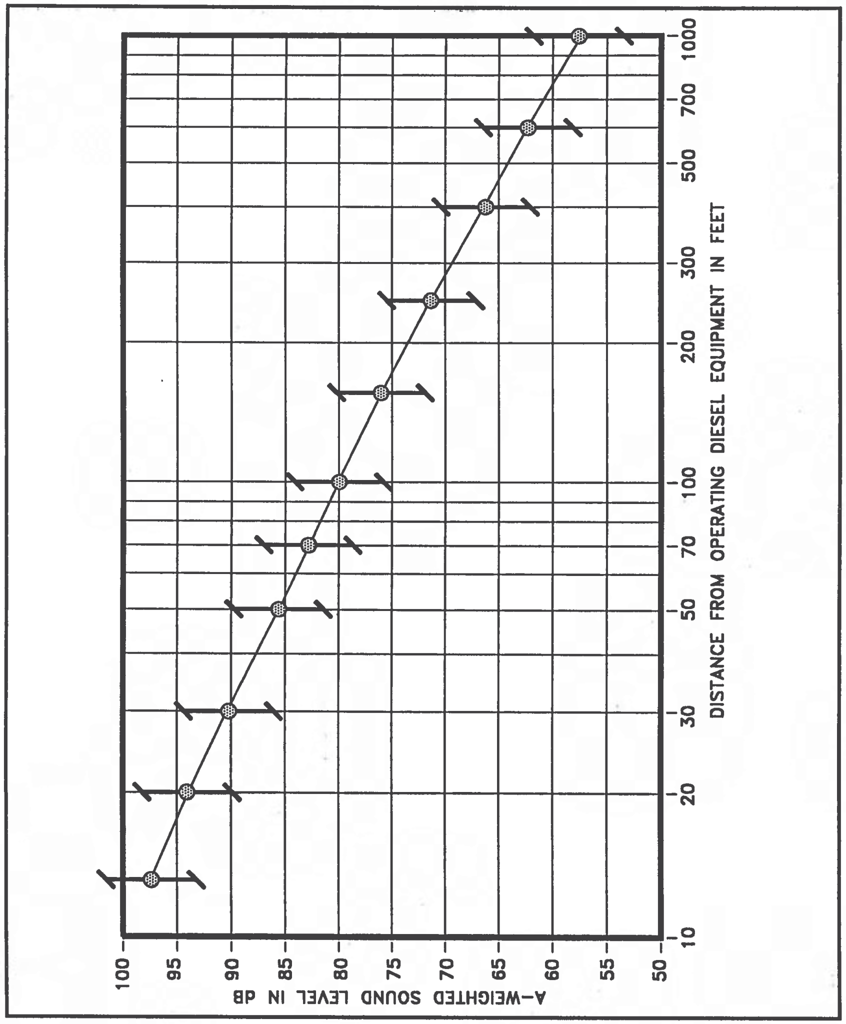
Along the south sections of Mamalahoa Highway, potential noise impacts from project and non-project traffic are possible, both in respect to existing and planned noise sensitive receptors along these roadways. Existing and future residences which are located along the sections of Mamalahoa Highway south of the project's entrance road may be impacted by the future traffic noise along the highway if their setback distances from the highway centerline are less than 133 FT. Because traffic noise along public roadways such as Mamalahoa Highway are generated by non-project as well as project traffic, mitigation of offsite traffic noise impacts are generally performed by individual property owners along the roadways' Rights-of-Way or by public agencies during roadway improvement projects. These mitigation measures generally take the form of increased setbacks, sound attenuating walls, total closure and air conditioning, or the use of sound attenuating windows. Where adequate setbacks beyond the 65 DNL noise contour are not available, the construction of 6 FT high sound walls is generally effective for attenuating traffic noise at single story structures, or at the ground floors of multistory structures. Whenever mitigation of traffic noise at the upper floors are required, the use of closure and air conditioning, or the use of sound attenuating windows are the more appropriate sound attenuation measures. Along Mamalahoa Highway, the homes are generally well below the highway grade due to the sloped terrain, and for this reason, 6 FT high sound attenuation walls which are located along the west highway Right-of-Way should be effective for traffic noise mitigation.

Small to moderate increases (0.1 to 1.3 DNL) in traffic noise levels along the sections of Kaiminani Drive between Queen Kaahumanu and Mamalahoa Highways are expected to occur as a result of the proposed project. By CY 2022, project traffic is expected to increase traffic noise levels along the west section of Kaiminani Drive by approximately 1.3 DNL and along the east section of Kaiminani Drive by approximately 0.2 DNL. These increases are not considered to be significant, and traffic noise increases resulting from project traffic along these sections of Kaiminani Drive are not expected to be discernible over the 11 year forecast period.

Aircraft Noise. Based on currently available existing and forecasted aircraft noise contours over the project site, special aircraft noise attenuation measures are not considered mandatory on the project site. The implementation of the airport noise disclosure provisions of Act 208 is not required because the existing and forecasted 55 DNL noise contours do not enter into the project area.

Construction Noise. Audible construction noise will probably be unavoidable during the entire project construction period. The total time period for construction is unknown, but it is anticipated that the actual work will be moving from one location on the project site to another during that period. Actual length of exposure to construction noise at any receptor location will probably be less than the total construction period for the entire project. Typical levels of noise from construction activity (excluding pile driving activity) are shown in Figure 10. The noise sensitive properties which are predicted to experience the highest noise levels during construction activities on the project site are the existing residences along the project entrance road at Kaiminani Drive and any new developments of the proposed Palamanui Development. Adverse impacts from construction noise are not expected to be in the "public health and welfare" category due to the temporary nature of the work and due to the administrative controls available for its regulation. Instead, these impacts will probably be limited to the temporary degradation of the quality of the acoustic environment in the immediate vicinity of the project site.

Mitigation of construction noise to inaudible levels will not be practical in all cases due to the intensity of construction noise sources (80 to 90+ dB at 50 FT distance), and due to the exterior nature of the work (grading and earth moving, trenching, concrete pouring, hammering, etc.). The use of properly muffled construction equipment should be required on the job site. The incorporation of State Department of Health construction noise limits and curfew times, which are applicable on the island of Hawaii (Reference 7), is another noise mitigation measure which can be applied to this project. Figure 11 depicts the normally permitted hours of construction for normal construction noise as well as the curfew periods for construction noise. Noisy construction activities are not allowed on Sundays and holidays under the DOH permit procedures.



ANTICIPATED RANGE OF CONSTRUCTION NOISE LEVELS VS. DISTANCE

FIGURE 10

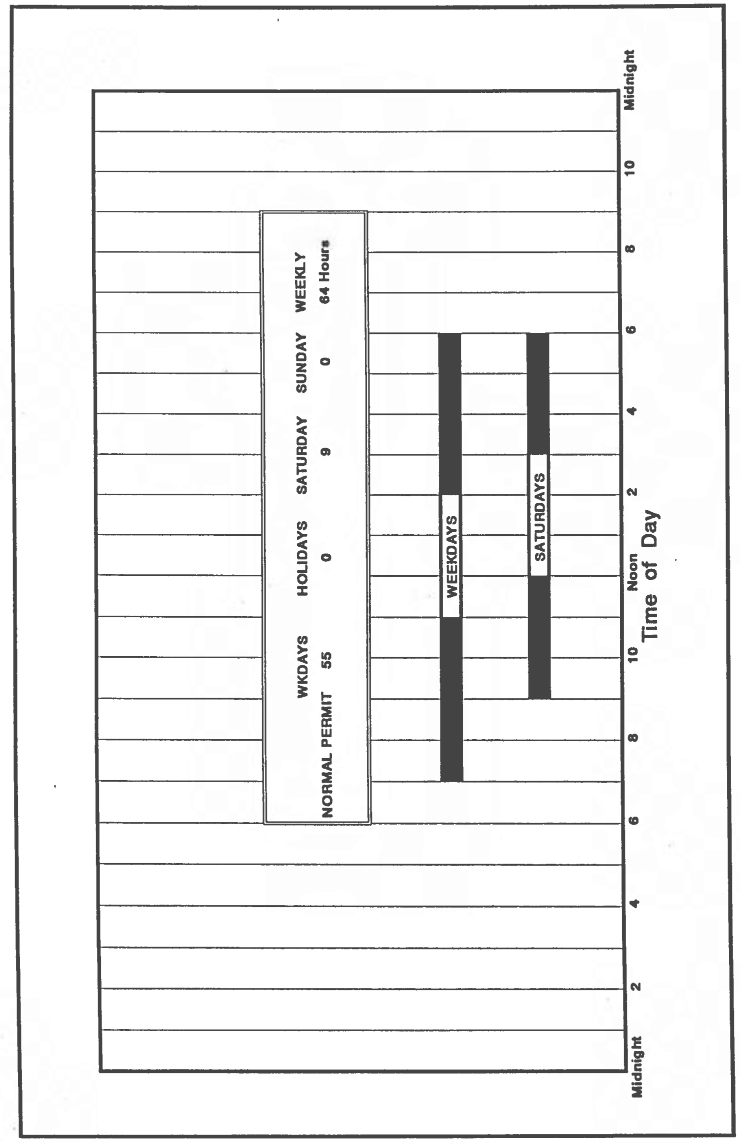


FIGURE 11

AVAILABLE WORK HOURS UNDER DOH PERMIT PROCEDURES FOR CONSTRUCTION NOISE

APPENDIX A. REFERENCES

(1) "Guidelines for Considering Noise in Land Use Planning and Control;" Federal Interagency Committee on Urban Noise; June 1980.

(2) American National Standard, "Sound Level Descriptors for Determination of Compatible Land Use," ANSI S12.9-1998/ Part 5; Acoustical Society of America.

(3) "Environmental Criteria and Standards, Noise Abatement and Control, 24 CFR, Part 51, Subpart B;" U.S. Department of Housing and Urban Development; July 12, 1979.

(4) "Information on Levels of Environmental Noise Requisite to Protect the Public Health and Welfare with an Adequate Margin of Safety;" U.S. Environmental Protection Agency; EPA 550/9-74-004; March 1974.

(5) "Mandatory Seller Disclosures in Real Estate Transactions;" Chapter 508D, Hawaii Revised Statutes; July 1, 1996.

(6) "FAR Part 150 Noise Compatibility Program Report; Kona International Airport At Keahole" State Department of Transportation, Airports Division; December 1997.

(7) "Title 11, Administrative Rules, Chapter 46, Community Noise Control;" Hawaii State Department of Health; September 23, 1996.

(8) "FHWA Highway Traffic Noise Model User's Guide;" FHWA-PD-96-009, Federal Highway Administration; Washington, D.C.; January 1998 and Version 2.5 Upgrade (April 14, 2004).

(9) "Traffic Impact Analysis Report for University of Hawaii Center - West Hawaii;" Phillip Rowell and Associates; November 16, 2009.

(10) 24-Hour Traffic Counts, Station B71001909280, Queen Kaahumanu Highway at Keahole Airport Road; State Department of Transportation; May 20-21, 2008.

APPENDIX B

EXCERPTS FROM EPA'S ACOUSTIC TERMINOLOGY GUIDE

Descriptor Symbol Usage

The recommended symbols for the commonly used acoustic descriptors based on A-weighting are contained in Table I. As most acoustic criteria and standards used by EPA are derived from the A-weighted sound level, almost all descriptor symbol usage guidance is contained in Table I.

Since acoustic nomenclature includes weighting networks other than "A" and measurements other than pressure, an expansion of Table I was developed (Table II). The group adopted the ANSI descriptor-symbol scheme which is structured into three stages. The first stage indicates that the descriptor is a level (i.e., based upon the logarithm of a ratio), the second stage indicates the type of quantity (power, pressure, or sound exposure), and the third stage indicates the weighting network (A, B, C, D, E.....). If no weighting network is specified, "A" weighting is understood. Exceptions are the A-weighted sound level and the A-weighted peak sound level which require that the "A" be specified. For convenience in those situations in which an A-weighted descriptor is being compared to that of another weighting, the alternative column in Table II permits the inclusion of the "A". For example, a report on blast noise might wish to contrast the LCdn with the LAdn.

Although not included in the tables, it is also recommended that "Lpn" and "LepN" be used as symbols for perceived noise levels and effective perceived noise levels, respectively.

It is recommended that in their initial use within a report, such terms be written in full, rather than abbreviated. An example of preferred usage is as follows:

The A-weighted sound level (LA) was measured before and after the installation of acoustical treatment. The measured LA values were 85 and 75 dB respectively.

Descriptor Nomenclature

With regard to energy averaging over time, the term "average" should be discouraged in favor of the term "equivalent". Hence, Leq, is designated the "equivalent sound level". For Ld, Ln, and Ldn, "equivalent" need not be stated since the concept of day, night, or day-night averaging is by definition understood. Therefore, the designations are "day sound level", "night sound level", and "day-night sound level", respectively.

The peak sound level is the logarithmic ratio of peak sound pressure to a reference pressure and not the maximum root mean square pressure. While the latter is the maximum sound pressure level, it is often incorrectly labelled peak. In that sound level meters have "peak" settings, this distinction is most important.

"Background ambient" should be used in lieu of "background", "ambient", "residual", or "indigenous" to describe the level characteristics of the general background noise due to the contribution of many unidentifiable noise sources near and far.

With regard to units, it is recommended that the unit decibel (abbreviated dB) be used without modification. Hence, DBA, PNdB, and EPNdB are not to be used. Examples of this preferred usage are: the Perceived Noise Level (Lpn was found to be 75 dB. Lpn = 75 dB). This decision was based upon the recommendation of the National Bureau of Standards, and the policies of ANSI and the Acoustical Society of America, all of which disallow any modification of bel except for prefixes indicating its multiples or submultiples (e.g., deci).

Noise Impact

In discussing noise impact, it is recommended that "Level Weighted Population" (LWP) replace "Equivalent Noise Impact" (ENI). The term "Relative Change of Impact" (RCI) shall be used for comparing the relative differences in LWP between two alternatives.

Further, when appropriate, "Noise Impact Index" (NII) and "Population Weighed Loss of Hearing" (PHL) shall be used consistent with CHABA Working Group 69 Report Guidelines for Preparing Environmental Impact Statements (1977).

APPENDIX B (CONTINUED)

TABLE I

A-WEIGHTED RECOMMENDED DESCRIPTOR LIST

	TERM	SYMBOL
1.	A-Weighted Sound Level	L_A
2.	A-Weighted Sound Power Level	L_{WA}
3.	Maximum A-Weighted Sound Level	L_{max}
4.	Peak A-Weighted Sound Level	L_{Apk}
5.	Level Exceeded x% of the Time	L_x
6.	Equivalent Sound Level	L_{eq}
7.	Equivalent Sound Level over Time (T) [1]	$L_{eq(T)}$
8.	Day Sound Level	L_d
9.	Night Sound Level	L_n
10.	Day-Night Sound Level	L_{dn}
11.	Yearly Day-Night Sound Level	$L_{dn(Y)}$
12.	Sound Exposure Level	L_{SE}

(1) Unless otherwise specified, time is in hours (e.g. the hourly equivalent level is $L_{eq(1)}$). Time may be specified in non-quantitative terms (e.g., could be specified a $L_{eq(WASH)}$ to mean the washing cycle noise for a washing machine).

SOURCE: EPA ACOUSTIC TERMINOLOGY GUIDE, BNA 8-14-78,

APPENDIX B (CONTINUED)

TABLE II

RECOMMENDED DESCRIPTOR LIST

	TERM	A-WEIGHTING	ALTERNATIVE[1] A-WEIGHTING	OTHER[2] WEIGHTING	UNWEIGHTED
1.	Sound (Pressure)[3] Level	L_A	L_{pA}	L_B, L_{pB}	L_p
2.	Sound Power Level	L_{WA}		L_{WB}	L_W
3.	Max. Sound Level	L_{max}	L_{Amax}	L_{Bmax}	L_{pmax}
4.	Peak Sound (Pressure) Level	L_{Apk}		L_{Bpk}	L_{pk}
5.	Level Exceeded x% of the Time	L_x	L_{Ax}	L_{Bx}	L_{px}
6.	Equivalent Sound Level	L_{eq}	L_{Aeq}	L_{Beq}	L_{peq}
7.	Equivalent Sound Level [4] Over Time(T)	$L_{eq(T)}$	$L_{Aeq(T)}$	$L_{Beq(T)}$	$L_{peq(T)}$
8.	Day Sound Level	L_d	L_{Ad}	L_{Bd}	L_{pd}
9.	Night Sound Level	L_n	L_{An}	L_{Bn}	L_{pn}
10.	Day-Night Sound Level	L_{dn}	L_{Adn}	L_{Bdn}	L_{pdn}
11.	Yearly Day-Night Sound Level	$L_{dn(Y)}$	$L_{Adn(Y)}$	$L_{Bdn(Y)}$	$L_{pdn(Y)}$
12.	Sound Exposure Level	L_S	L_{SA}	L_{SB}	L_{Sp}
13.	Energy Average Value Over (Non-Time Domain) Set of Observations	$L_{eq(e)}$	$L_{Aeq(e)}$	$L_{Beq(e)}$	$L_{peq(e)}$
14.	Level Exceeded x% of the Total Set of (Non-Time Domain) Observations	$L_{x(e)}$	$L_{Ax(e)}$	$L_{Bx(e)}$	$L_{px(e)}$
15.	Average L_x Value	L_x	L_{Ax}	L_{Bx}	L_{px}

(1) "Alternative" symbols may be used to assure clarity or consistency.

(2) Only B-weighting shown. Applies also to C,D,E,.....weighting.

(3) The term "pressure" is used only for the unweighted level.

(4) Unless otherwise specified, time is in hours (e.g., the hourly equivalent level is Leq(1). Time may be specified in non-quantitative terms (e.g., could be specified as Leq(WASH) to mean the washing cycle noise for a washing machine.

APPENDIX C1

SUMMARY OF BASE YEAR AND FUTURE YEAR (PHASE 1, 2011) TRAFFIC VOLUMES

ROADWAY LANES	**** CY 2009 ***** AM VPH	PM VPH	CY 2011 (NON PROJ.) AM VPH	PM VPH	CY 2011 (BUILD) AM VPH	PM VPH
Mamalahoa Hwy. - North of Makalei Estates (NB)	130	270	155	325	160	330
Mamalahoa Hwy. - North of Makalei Estates (SB)	225	200	270	230	280	240
Two-Way	355	470	425	555	440	570
Mamalahoa Hwy. - South of Makalei Estates (NB)	145	275	170	330	175	335
Mamalahoa Hwy. - South of Makalei Estates (SB)	245	205	290	235	300	245
Two-Way	390	480	460	565	475	580
Mamalahoa Hwy. - North of Kaiminani Dr. (NB)	250	555	285	635	290	640
Mamalahoa Hwy. - North of Kaiminani Dr. (SB)	695	350	780	400	790	410
Two-Way	945	905	1,065	1,035	1,080	1,050
Mamalahoa Hwy. - South of Kaiminani Dr. (NB)	365	650	455	750	460	755
Mamalahoa Hwy. - South of Kaiminani Dr. (SB)	885	540	1,000	680	1,000	685
Two-Way	1,250	1,190	1,455	1,430	1,460	1,440
Q. Kaahumanu Hwy. - N. of Entrance Rd. (NB)	675	490	815	535	820	540
Q. Kaahumanu Hwy. - N. of Entrance Rd. (SB)	415	795	465	900	480	910
Two-Way	1,090	1,285	1,280	1,435	1,300	1,450
Q. Kaahumanu Hwy. - S. of Entrance Rd. (NB)	675	490	815	535	815	535
Q. Kaahumanu Hwy. - S. of Entrance Rd. (SB)	415	795	465	900	465	900
Two-Way	1,090	1,285	1,280	1,435	1,280	1,435
Q. Kaahumanu Hwy. - North of Airport Rd. (NB)	675	490	820	555	820	555
Q. Kaahumanu Hwy. - North of Airport Rd. (SB)	415	795	460	900	460	900
Two-Way	1,090	1,285	1,280	1,455	1,280	1,455
Q. Kaahumanu Hwy. - South of Airport Rd. (NB)	855	570	1015	645	1,015	645
Q. Kaahumanu Hwy. - South of Airport Rd. (SB)	470	945	520	1,065	520	1,065
Two-Way	1,325	1,515	1,535	1,710	1,535	1,710
Q. Kaahumanu Hwy. - N. of Kaiminani Dr. (NB)	745	615	895	690	895	690
Q. Kaahumanu Hwy. - N. of Kaiminani Dr. (SB)	505	945	560	1,060	560	1,060
Two-Way	1,250	1,560	1,455	1,750	1,455	1,750
Q. Kaahumanu Hwy. - S. of Kaiminani Dr. (NB)	635	900	705	1,115	735	1,130
Q. Kaahumanu Hwy. - S. of Kaiminani Dr. (SB)	890	870	1,050	970	1,060	980
Two-Way	1,525	1,770	1,755	2,085	1,795	2,110

SUMMARY OF BASE YEAR AND FUTURE YEAR (PHASE 1, 2011) TRAFFIC VOLUMES

ROADWAY LANES	**** CY 2009 ***** AM VPH	PM VPH	CY 2011 (NON PROJ.) AM VPH	PM VPH	CY 2011 (BUILD) AM VPH	PM VPH
Kaiminani Dr. - E. of Q. Kaahumanu Hwy. (WB)	645	225	865	285	875	295
Kaiminani Dr. - E. of Q. Kaahumanu Hwy. (EB)	150	585	185	800	215	815
Two-Way	795	810	1,050	1,085	1,090	1,110
Kaiminani Dr. - West of Mamalahoa Hwy. (WB)	215	185	315	260	330	275
Kaiminani Dr. - West of Mamalahoa Hwy. (EB)	290	280	365	425	370	435
Two-Way	505	465	680	685	700	710
Kaiminani Dr. - East of Main Street (WB)	645	225	805	280	820	295
Kaiminani Dr. - East of Main Street (EB)	150	585	185	740	190	750
Two-Way	795	810	990	1,020	1,010	1,045
Kaiminani Dr. - West of Main Street (WB)	645	225	865	285	875	295
Kaiminani Dr. - West of Main Street (EB)	150	585	185	800	215	815
Two-Way	795	810	1,050	1,085	1,090	1,110
Entrance Rd. - West of Mamalahoa Hwy. (WB)	25	15	25	15	25	15
Entrance Rd. - West of Mamalahoa Hwy. (EB)	30	15	30	15	30	15
Two-Way	55	30	55	30	55	30
University Dr. - E. of Q. Kaahumanu Hwy. (WB)	N/A	N/A	N/A	N/A	5	5
University Dr. - E. of Q. Kaahumanu Hwy. (EB)	N/A	N/A	N/A	N/A	15	10
Two-Way	N/A	N/A	N/A	N/A	20	15
Main Street - North of Kaimiani Drive (NB)	N/A	N/A	N/A	N/A	45	30
Main Street - North of Kaimiani Drive (SB)	N/A	N/A	N/A	N/A	15	20
Two-Way	N/A	N/A	N/A	N/A	60	50
Airport Rd. - West of Q. Kaahumanu Hwy. (WB)	285	200	310	220	310	220
Airport Rd. - West of Q. Kaahumanu Hwy. (EB)	160	270	175	295	175	295
Two-Way	445	470	485	515	485	515

APPENDIX C2

SUMMARY OF BASE YEAR AND FUTURE YEAR (PHASE 2, 2012) TRAFFIC VOLUMES

ROADWAY LANES	**** CY 2009 *****		CY 2012 (NON PROJ.)		CY 2012 (BUILD)	
	AM VPH	PM VPH	AM VPH	PM VPH	AM VPH	PM VPH
Mamalahoa Hwy. - North of Makalei Estates (NB)	130	270	165	335	170	345
Mamalahoa Hwy. - North of Makalei Estates (SB)	225	200	280	240	295	250
Two-Way	355	470	445	575	465	595
Mamalahoa Hwy. - South of Makalei Estates (NB)	145	275	185	340	190	350
Mamalahoa Hwy. - South of Makalei Estates (SB)	245	205	305	245	320	255
Two-Way	390	480	490	585	510	605
Mamalahoa Hwy. - North of Kaiminani Dr. (NB)	250	555	300	665	305	675
Mamalahoa Hwy. - North of Kaiminani Dr. (SB)	695	350	815	415	830	425
Two-Way	945	905	1,115	1,080	1,135	1,100
Mamalahoa Hwy. - South of Kaiminani Dr. (NB)	365	650	475	780	480	790
Mamalahoa Hwy. - South of Kaiminani Dr. (SB)	885	540	1,045	705	1,050	715
Two-Way	1,250	1,190	1,520	1,485	1,530	1,505
Q. Kaahumanu Hwy. - N. of Entrance Rd. (NB)	675	490	850	555	855	565
Q. Kaahumanu Hwy. - N. of Entrance Rd. (SB)	415	795	485	935	505	495
Two-Way	1,090	1,285	1,335	1,490	1,360	1,060
Q. Kaahumanu Hwy. - S. of Entrance Rd. (NB)	675	490	850	555	850	555
Q. Kaahumanu Hwy. - S. of Entrance Rd. (SB)	415	795	485	935	485	485
Two-Way	1,090	1,285	1,335	1,490	1,335	1,040
Q. Kaahumanu Hwy. - North of Airport Rd. (NB)	675	490	850	580	850	580
Q. Kaahumanu Hwy. - North of Airport Rd. (SB)	415	795	485	940	485	940
Two-Way	1,090	1,285	1,335	1,520	1,335	1,520
Q. Kaahumanu Hwy. - South of Airport Rd. (NB)	855	570	1,055	670	1,055	670
Q. Kaahumanu Hwy. - South of Airport Rd. (SB)	470	945	550	1,110	550	1,110
Two-Way	1,325	1,515	1,605	1,780	1,605	1,780
Q. Kaahumanu Hwy. - N. of Kaiminani Dr. (NB)	745	615	930	720	930	720
Q. Kaahumanu Hwy. - N. of Kaiminani Dr. (SB)	505	945	585	1,105	605	1,105
Two-Way	1,250	1,560	1,515	1,825	1,535	1,825
Q. Kaahumanu Hwy. - S. of Kaiminani Dr. (NB)	635	900	735	1,155	775	1,180
Q. Kaahumanu Hwy. - S. of Kaiminani Dr. (SB)	890	870	1,095	1,010	1,110	1,030
Two-Way	1,525	1,770	1,830	2,165	1,885	2,210

APPENDIX C2 (CONTINUED)

SUMMARY OF BASE YEAR AND FUTURE YEAR (PHASE 2, 2012) TRAFFIC VOLUMES

ROADWAY LANES	**** CY 2009 *****		CY 2012 (NON PROJ.)		CY 2012 (BUILD)	
	AM VPH	PM VPH	AM VPH	PM VPH	AM VPH	PM VPH
Kaiminani Dr. - E. of Q. Kaahumanu Hwy. (WB)	645	225	895	295	910	315
Kaiminani Dr. - E. of Q. Kaahumanu Hwy. (EB)	150	585	190	825	250	850
Two-Way	795	810	1,085	1,120	1,160	1,165
Kaiminani Dr. - West of Mamalahoa Hwy. (WB)	215	185	330	265	350	285
Kaiminani Dr. - West of Mamalahoa Hwy. (EB)	290	280	385	440	395	460
Two-Way	505	465	715	705	745	745
Kaiminani Dr. - East of Main Street (WB)	645	225	835	290	855	310
Kaiminani Dr. - East of Main Street (EB)	150	585	108	770	200	790
Two-Way	795	810	943	1,060	1,055	1,100
Kaiminani Dr. - West of Main Street (WB)	645	225	895	295	910	315
Kaiminani Dr. - West of Main Street (EB)	150	585	190	830	230	855
Two-Way	795	810	1,085	1,125	1,140	1,170
Entrance Rd. - West of Mamalahoa Hwy. (WB)	25	15	30	15	30	15
Entrance Rd. - West of Mamalahoa Hwy. (EB)	30	15	35	15	35	15
Two-Way	55	30	65	30	65	30
University Dr. - E. of Q. Kaahumanu Hwy. (WB)	N/A	N/A	N/A	N/A	5	10
University Dr. - E. of Q. Kaahumanu Hwy. (EB)	N/A	N/A	N/A	N/A	20	10
Two-Way	N/A	N/A	N/A	N/A	25	20
Main Street - North of Kaimiani Drive (NB)	N/A	N/A	N/A	N/A	60	45
Main Street - North of Kaimiani Drive (SB)	N/A	N/A	N/A	N/A	25	40
Two-Way	N/A	N/A	N/A	N/A	85	85
Airport Rd. - West of Q. Kaahumanu Hwy. (WB)	285	200	325	230	325	230
Airport Rd. - West of Q. Kaahumanu Hwy. (EB)	160	270	185	310	185	310
Two-Way	445	470	510	540	510	540

APPENDIX C3

SUMMARY OF BASE YEAR AND FUTURE YEAR (PHASE 3, 2017) TRAFFIC VOLUMES

ROADWAY LANES	**** CY 2009 ***** AM VPH	PM VPH	CY 2017 (NON PROJ.) AM VPH	PM VPH	CY 2017 (BUILD) AM VPH	PM VPH
Mamalahoa Hwy. - North of Makalei Estates (NB)	130	270	220	445	235	465
Mamalahoa Hwy. - North of Makalei Estates (SB)	225	200	370	330	410	360
Two-Way	355	470	590	775	645	825
Mamalahoa Hwy. - South of Makalei Estates (NB)	145	275	285	515	285	515
Mamalahoa Hwy. - South of Makalei Estates (SB)	245	205	375	345	375	345
Two-Way	390	480	660	860	660	860
Mamalahoa Hwy. - North of Kaiminani Dr. (NB)	250	555	440	915	440	915
Mamalahoa Hwy. - North of Kaiminani Dr. (SB)	695	350	1,015	555	1,015	555
Two-Way	945	905	1,455	1,470	1,455	1,470
Mamalahoa Hwy. - South of Kaiminani Dr. (NB)	365	650	645	1,060	670	1,075
Mamalahoa Hwy. - South of Kaiminani Dr. (SB)	885	540	1,340	995	1,350	1,005
Two-Way	1,250	1,190	1,985	2,055	2,020	2,080
Q. Kaahumanu Hwy. - N. of Entrance Rd. (NB)	675	490	1,215	1,035	1,230	1,060
Q. Kaahumanu Hwy. - N. of Entrance Rd. (SB)	415	795	845	1,475	895	1,505
Two-Way	1,090	1,285	2,060	2,510	2,125	2,565
Q. Kaahumanu Hwy. - S. of Entrance Rd. (NB)	675	490	1,380	1,135	1,380	1,135
Q. Kaahumanu Hwy. - S. of Entrance Rd. (SB)	415	795	865	1,680	865	1,680
Two-Way	1,090	1,285	2,245	2,815	2,245	2,815
Q. Kaahumanu Hwy. - North of Airport Rd. (NB)	675	490	1,380	1,160	1,380	1,160
Q. Kaahumanu Hwy. - North of Airport Rd. (SB)	415	795	860	1,680	860	1,680
Two-Way	1,090	1,285	2,240	2,840	2,240	2,840
Q. Kaahumanu Hwy. - South of Airport Rd. (NB)	855	570	1,635	1,275	1,635	1,275
Q. Kaahumanu Hwy. - South of Airport Rd. (SB)	470	945	940	1,890	940	1,890
Two-Way	1,325	1,515	2,575	3,165	2,575	3,165
Q. Kaahumanu Hwy. - N. of Kaiminani Dr. (NB)	745	615	1,480	1,340	1,460	1,340
Q. Kaahumanu Hwy. - N. of Kaiminani Dr. (SB)	505	945	990	1,895	990	1,895
Two-Way	1,250	1,560	2,470	3,235	2,450	3,235
Q. Kaahumanu Hwy. - S. of Kaiminani Dr. (NB)	635	900	1,255	1,855	1,360	1,925
Q. Kaahumanu Hwy. - S. of Kaiminani Dr. (SB)	890	870	1,545	1,650	1,580	1,700
Two-Way	1,525	1,770	2,800	3,505	2,940	3,625

APPENDIX C3 (CONTINUED)

SUMMARY OF BASE YEAR AND FUTURE YEAR (PHASE 3, 2017) TRAFFIC VOLUMES

ROADWAY LANES	**** CY 2009 ***** AM VPH	PM VPH	CY 2017 (NON PROJ.) AM VPH	PM VPH	CY 2017 (BUILD) AM VPH	PM VPH
Kaiminani Dr. - E. of Q. Kaahumanu Hwy. (WB)	645	225	1,075	360	1,090	410
Kaiminani Dr. - E. of Q. Kaahumanu Hwy. (EB)	150	585	295	1,120	400	1,190
Two-Way	795	810	1,370	1,480	1,490	1,600
Kaiminani Dr. - West of Mamalahoa Hwy. (WB)	215	185	390	320	415	335
Kaiminani Dr. - West of Mamalahoa Hwy. (EB)	290	280	510	615	520	625
Two-Way	505	465	900	935	935	960
Kaiminani Dr. - East of Main Street (WB)	645	225	1,045	390	1,070	405
Kaiminani Dr. - East of Main Street (EB)	150	585	300	1,030	310	1,040
Two-Way	795	810	1,345	1,420	1,380	1,445
Kaiminani Dr. - West of Main Street (WB)	645	225	1,075	360	1,110	410
Kaiminani Dr. - West of Main Street (EB)	150	585	235	990	340	1,060
Two-Way	795	810	1,310	1,350	1,450	1,470
Entrance Rd. - West of Mamalahoa Hwy. (WB)	25	15	120	150	160	180
Entrance Rd. - West of Mamalahoa Hwy. (EB)	30	15	60	95	75	115
Two-Way	55	30	180	245	235	295
University Dr. - E. of Q. Kaahumanu Hwy. (WB)	N/A	N/A	435	865	450	890
University Dr. - E. of Q. Kaahumanu Hwy. (EB)	N/A	N/A	580	760	630	790
Two-Way	N/A	N/A	1,015	1,625	1,080	1,680
Main Street - North of Kaimiani Drive (NB)	N/A	N/A	30	35	160	120
Main Street - North of Kaimiani Drive (SB)	N/A	N/A	65	100	110	160
Two-Way	N/A	N/A	95	135	270	280
Airport Rd. - West of Q. Kaahumanu Hwy. (WB)	285	200	405	285	405	285
Airport Rd. - West of Q. Kaahumanu Hwy. (EB)	160	270	230	380	230	380
Two-Way	445	470	635	665	635	665

APPENDIX C4

SUMMARY OF BASE YEAR AND FUTURE YEAR (PHASE 4, 2022) TRAFFIC VOLUMES

ROADWAY LANES	**** CY 2009 ***** AM VPH	PM VPH	CY 2022 (NON PROJ.) AM VPH	PM VPH	CY 2022 (BUILD) AM VPH	PM VPH
Mamalahoa Hwy. - North of Makalei Estates (NB)	130	270	265	555	290	590
Mamalahoa Hwy. - North of Makalei Estates (SB)	225	200	460	405	535	455
Two-Way	355	470	725	960	825	1,045
Mamalahoa Hwy. - South of Makalei Estates (NB)	145	275	355	620	355	620
Mamalahoa Hwy. - South of Makalei Estates (SB)	245	205	480	425	480	425
Two-Way	390	480	835	1,045	835	1,045
Mamalahoa Hwy. - North of Kaiminani Dr. (NB)	250	555	550	1,120	550	1,120
Mamalahoa Hwy. - North of Kaiminani Dr. (SB)	695	350	1,275	685	1,275	685
Two-Way	945	905	1,825	1,805	1,825	1,805
Mamalahoa Hwy. - South of Kaiminani Dr. (NB)	365	650	800	1,300	840	1,325
Mamalahoa Hwy. - South of Kaiminani Dr. (SB)	885	540	1,675	1,215	1,690	1,235
Two-Way	1,250	1,190	2,475	2,515	2,530	2,560
Q. Kaahumanu Hwy. - N. of Entrance Rd. (NB)	675	490	1,465	1,300	1,495	1,340
Q. Kaahumanu Hwy. - N. of Entrance Rd. (SB)	415	795	1,045	1,805	1,125	1,860
Two-Way	1,090	1,285	2,510	3,105	2,620	3,200
Q. Kaahumanu Hwy. - S. of Entrance Rd. (NB)	675	490	1,700	1,380	1,700	1,380
Q. Kaahumanu Hwy. - S. of Entrance Rd. (SB)	415	795	1,035	2,105	1,035	2,105
Two-Way	1,090	1,285	2,735	3,485	2,735	3,485
Q. Kaahumanu Hwy. - North of Airport Rd. (NB)	675	490	1,700	1,415	1,700	1,415
Q. Kaahumanu Hwy. - North of Airport Rd. (SB)	415	795	1,030	2,100	1,030	2,100
Two-Way	1,090	1,285	2,730	3,515	2,730	3,515
Q. Kaahumanu Hwy. - South of Airport Rd. (NB)	855	570	2,020	1,555	2,020	1,555
Q. Kaahumanu Hwy. - South of Airport Rd. (SB)	470	945	1,125	2,370	1,125	2,370
Two-Way	1,325	1,515	3,145	3,925	3,145	3,925
Q. Kaahumanu Hwy. - N. of Kaiminani Dr. (NB)	745	615	1,825	1,630	1,825	1,630
Q. Kaahumanu Hwy. - N. of Kaiminani Dr. (SB)	505	945	1,190	2,370	1,190	2,370
Two-Way	1,250	1,560	3,015	4,000	3,015	4,000
Q. Kaahumanu Hwy. - S. of Kaiminani Dr. (NB)	635	900	1,560	2,245	1,730	2,360
Q. Kaahumanu Hwy. - S. of Kaiminani Dr. (SB)	890	870	1,870	2,065	1,930	2,145
Two-Way	1,525	1,770	3,430	4,310	3,660	4,505

APPENDIX C4 (CONTINUED)

SUMMARY OF BASE YEAR AND FUTURE YEAR (PHASE 4, 2022) TRAFFIC VOLUMES

ROADWAY LANES	**** CY 2009 ***** AM VPH	PM VPH	CY 2022 (NON PROJ.) AM VPH	PM VPH	CY 2022 (BUILD) AM VPH	PM VPH
Kaiminani Dr. - E. of Q. Kaahumanu Hwy. (WB)	645	225	1,300	435	1,360	515
Kaiminani Dr. - E. of Q. Kaahumanu Hwy. (EB)	150	585	355	1,355	525	1,470
Two-Way	795	810	1,655	1,790	1,885	1,985
Kaiminani Dr. - West of Mamalahoa Hwy. (WB)	215	185	465	385	505	410
Kaiminani Dr. - West of Mamalahoa Hwy. (EB)	290	280	615	735	630	755
Two-Way	505	465	1,080	1,120	1,135	1,165
Kaiminani Dr. - East of Main Street (WB)	645	225	1,285	480	1,325	505
Kaiminani Dr. - East of Main Street (EB)	150	585	340	1,260	355	1,280
Two-Way	795	810	1,625	1,740	1,680	1,785
Kaiminani Dr. - West of Main Street (WB)	645	225	1,305	440	1,365	520
Kaiminani Dr. - West of Main Street (EB)	150	585	285	1,195	455	1,310
Two-Way	795	810	1,590	1,635	1,820	1,830
Entrance Rd. - West of Mamalahoa Hwy. (WB)	25	15	165	170	240	220
Entrance Rd. - West of Mamalahoa Hwy. (EB)	30	15	95	125	120	160
Two-Way	55	30	260	295	360	380
University Dr. - E. of Q. Kaahumanu Hwy. (WB)	N/A	N/A	475	1,110	505	1,150
University Dr. - E. of Q. Kaahumanu Hwy. (EB)	N/A	N/A	425	890	800	945
Two-Way	N/A	N/A	900	2,000	1,305	2,095
Main Street - North of Kaimiani Drive (NB)	N/A	N/A	40	45	250	185
Main Street - North of Kaimiani Drive (SB)	N/A	N/A	55	125	130	225
Two-Way	N/A	N/A	95	170	380	410
Airport Rd. - West of Q. Kaahumanu Hwy. (WB)	285	200	505	350	505	350
Airport Rd. - West of Q. Kaahumanu Hwy. (EB)	160	270	280	480	280	480
Two-Way	445	470	785	830	785	830

Appendix E

Cultural Resource Identification and Mapping

Pacific Legacy

Incorporated

CULTURAL RESOURCES CONSULTANTS

CULTURAL RESOURCE
IDENTIFICATION AND MAPPING
AT THE
UNIVERSITY OF HAWAIʻI CENTER -
WEST HAWAIʻI,
DISTRICT OF NORTH KONA
ISLAND OF HAWAIʻI

Pacific Legacy: Exploring the past, informing the present, enriching the future.

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CULTURAL RESOURCE
IDENTIFICATION AND MAPPING
AT THE
UNIVERSITY OF HAWAIʻI CENTER - WEST HAWAIʻI,
DISTRICT OF NORTH KONA
ISLAND OF HAWAIʻI

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December 2008

ABSTRACT

At the request of Wil Chee-Planning and Environmental, Inc., Pacific Legacy, Inc. conducted archaeological mapping of sites within the newly designated 133 acre University of Hawai'i Center at West Hawai'i project area. The planned University development is located within portions of the seven *ahupua'a* of Maka'ula, Hale'ohi'u, Hamanamana, and Kalaoa 1-4 in the district of North Kona on the leeward side of the island of Hawai'i. The project area is part of a larger parcel that had been the subject of a previous archaeological survey. Pacific Legacy was tasked with determining the extent of archaeological Preserve 2, a lava tube complex that stretches across the project area from southwest to northeast, and recording its location using a geographic positioning system (GPS). Identifying the limits of the tube complex will make it possible to establish appropriate protective buffers around it during campus construction. The positions of a number of other previously identified sites situated within the 133 acre property were also recorded using the GPS.

A total of 16 separate openings were identified along the length of the Preserve 2 lava tube system. These took the form of either skylight openings in the roof of surviving sections of subsurface tubes, or linear depressions formed by the collapse of a section of tube roof. Many of the openings and intact tube sections had previously been found to contain archaeological features, and four separate site numbers had been assigned to different sections of the tube complex.

Evidence of recent damage to the Preserve area was also discovered and documented. A backhoe or some other form of earth moving equipment had been used to break up the *pahoehoe* lava around some of the tube openings. This was most probably done to obtain stone slabs for use in the construction of rock walls. At one opening (Opening #6), the entrance to a subterranean chamber containing several archaeological features, among them a possible ceremonial structure, had been filled in with rubble, sealing up access to the chamber. This damage is relatively recent and similar bulldozing is actively taking place within an adjacent property. There is a strong likelihood that further damage may occur to the tube complex and its associated sites, particularly to petroglyphs carved into the *pahoehoe* slabs that edge the lava tube openings.

The Appendices at the end of this report contain descriptions, measurements, photographs and GPS coordinates for the 16 openings of the Preserve 2 lava tube. They also contain a descriptive list and GPS coordinates for the seven other sites relocated during the present survey, as well as a single newly discovered site. These appendices should be detached prior to the distribution of this report to the general public.

TABLE OF CONTENTS

*Due to the sensitive nature of the resources contained in Preserve 2, Appendices A and B have been detached from this report prior to public distribution.

LIST OF FIGURES

Frontispiece: Newly discovered human figure petroglyph at site 50-10-28-26700 (View West).

1.0 INTRODUCTION

At the request of Wil Chee-Planning and Environmental, Inc., Pacific Legacy Inc. undertook to map the locations of archaeological sites and preservation areas situated within the c. 133 acre parcel chosen for the development of the University of Hawai'i Center at West Hawai'i (Figure 1). The project area includes portions of the seven *ahupua'a* of Maka'ula, Hale'ohi'u, Hamanamana, and Kalaoa 1-4 in the district of North Kona on the leeward side of the island of Hawai'i. In order to design the placement of campus structures, Wil Chee Planning needed to know the exact location of Preservation Area 2, an extensive lava tube complex containing numerous archaeological features (including human burials and possible ceremonial areas). The planners were also interesting in knowing the locations of other preservation areas and archaeological sites within the northern portion of the project area. To accomplish this, Pacific Legacy archaeologists conducted four days of field work, using a geographic positioning system (GPS) to document the limits of the lava tube complex and the locations of individual tube openings. Each tube opening was briefly described and its dimensions were recorded. This information will be useful in planning for the protection and/or sealing of tube entrances both during construction and after completion of the West Hawai'i campus. A GPS was also used to identify the locations of individual archaeological sites within the limits of the proposed project area.

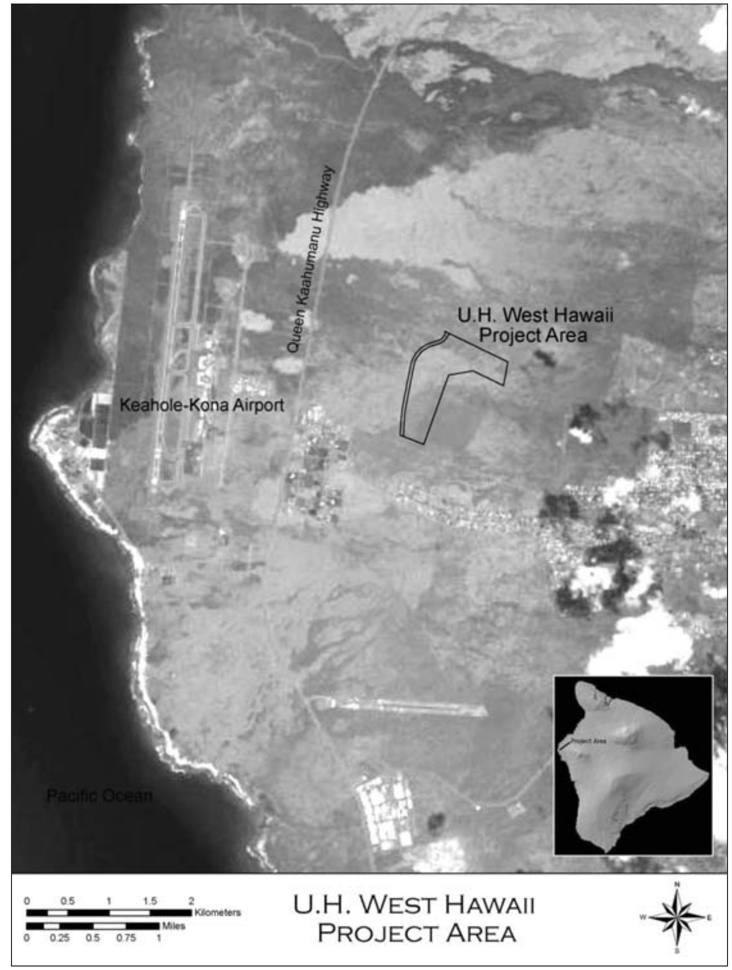

Figure 1. Location of the University of Hawai'i Center at West Hawai'i project area (base map from Google Earth).

2.0 PROJECT BACKGROUND

The original site of the future University of Hawai‘i Center at West Hawai‘i covered an approximately 500 acre parcel located east and upslope of the Keahole-Kona Airport on the leeward side of the island of Hawai‘i. This has been scaled back to the current 133 acre area

2.1 Location and Environmental Setting

Located within the district of North Kona, this 500 acre property (Tax Map Key parcel (3)-7-3-010:042) includes portions of seven *ahupua‘a*: Maka‘ula, Hale‘ohi‘u, Hamanamana, and Kalaoa 1-4. It extends from about the 320 foot (97.5 meter) elevation to the 580 foot (176.7 meter) elevation (Figure 2). The gently east to west sloping terrain of the project area is composed of both *‘a‘a* and *pahoehoe* lava flows. Within these flows are lava tube systems that run primarily *mauka* to *makai* (from the mountains to the shore), which is roughly east to west within the study area. *Pahoehoe* lava flows are the dominant terrain type. These flows can be described as possessing, “a billowy, glassy surface that is relatively smooth ... in some areas, however the surface is rough and broken, and there are hummocks and pressure domes” (Sato et al. 1973:34). Barren stretches of *‘a‘a* lava flow are also encountered within the project area. Sato et al. (1973:34) describe such flows as, “a mass of clinkery, hard, glassy, sharp pieces piled in rumbled heaps.”

Located on the leeward side of the island, the project area is relatively arid, receiving 20 to 30 inches (510 to 760 mm) of rainfall annually (Armstrong 1983:63). The mean low annual temperature is 60 to 65 degrees Fahrenheit (15.6 - 18.3° C), and the mean high annual temperature is 80 to 82 degrees Fahrenheit (26.7 - 27.8° C) (Armstrong 1983:64). The primary vegetation within the study area is fountain grass (*Pennisetum setaceurri*). There are also scattered shrubs such as *a ‘ali ‘i* (*Dodonaea viscosa*), *noni* (*Morinda citnfolia*), *koa haole* (*Leucaena leucocephala*), and *Christmas-berry* (*Schinus terebinthifolius*).

2.2 Previous Archaeological Research

The entire 500 acre University of Hawai‘i Center at West Hawai‘i project area was the subject of an archaeological inventory survey conducted by Paul H. Rosendahl Inc. in 1993 (Head and Rosendahl 1993). In their report, Head and Rosendahl provide an extensive review of previous archaeological studies undertaken within the surrounding area (Head and Rosendahl 1993:4-16).

The Head and Rosendahl (1993) survey identified and documented 43 archaeological sites within the 500 acre U. H. West Hawai‘i parcel. These sites included temporary habitation shelters, agricultural features, trails, burials, religious sites, and petroglyphs. Based on their findings, Head and Rosendahl concluded that the project area may mark the northern extension of the Kona Field System.

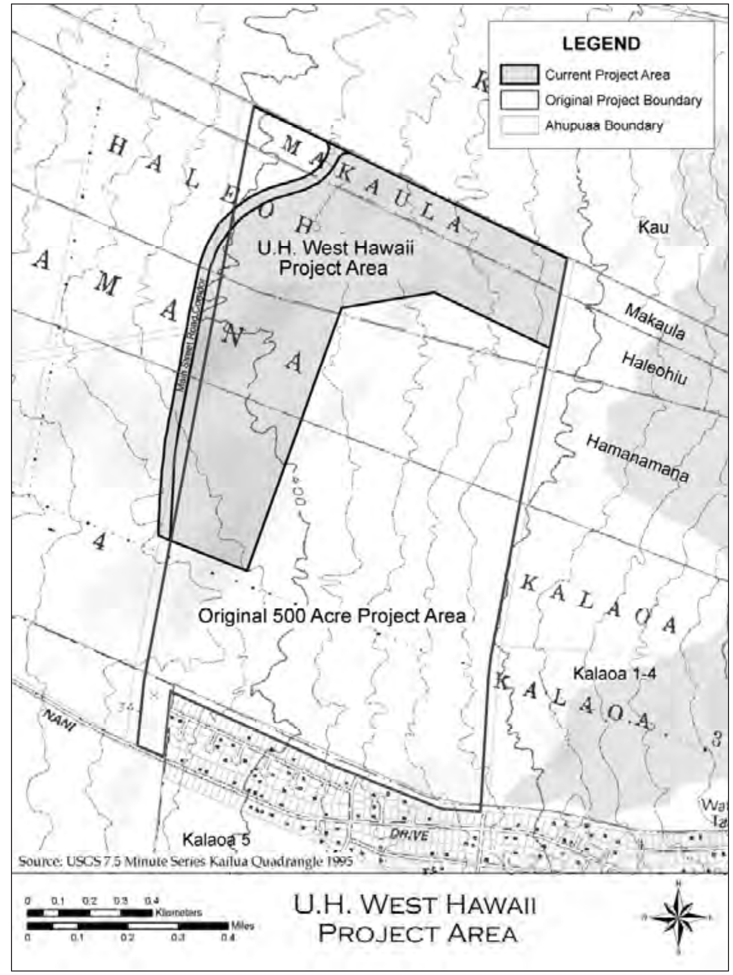

Figure 2. Location of the original and present U. of H. Center at West Hawai‘i project areas.

Limited test excavations were conducted by Head and Rosendahl within the 500 acre parcel. These produced five charcoal samples that were submitted for radiocarbon analysis. Based upon these samples, the sites within the area appear to date to the late prehistoric and early historic periods, from around AD 1487 to the late 1800s (Head and Rosendahl 1993: 45-46, 64).

Following the Head and Rosendahl survey, the project area was reduced from 500 to 275 acres. Among the archaeological sites identified and recorded within this 275 acre portion of the study area were shelters and lava tubes that appear to have served as sites of temporary habitation; a possible water catchment inside a lava tube; agricultural features such as mounds, excavations, and clearings; a *papamū* (a stone slab marked with a pattern of shallow circular depressions that was used as a board for the playing of *kōnane*, a game similar to checkers); and an enclosure that may have been used either for habitation or as a religious shrine.

In March of 1998, Pacific Legacy archaeologists were contracted by Will Chee Planning to relocate all of the previously recorded archaeological sites within the 275 acre project area. They were also requested to evaluate the condition of the sites and, if necessary, to revise the original significance assessments and recommendations based upon existing conditions. An additional ca. 900 by 30 meter access road corridor (the Main Street road) running along the western boundary of the property was also surveyed for the presence of surface archaeological remains. The report of this work (Cleghorn 1998) included recommendations regarding the preservation and interpretation of sites within the 275 acre project area. It was recommended that five archaeological preserves be established and maintained (Cleghorn 1998:29-31). The map showing the locations of these preservation areas (Cleghorn 1998:Figure 10) has been reproduced below (Figure 3).

Following on the recommendations made in the 1998 report (Cleghorn 1998:34), a conceptual historic preservation plan was prepared by Pacific Legacy with the input of the University of Hawai‘i Center at West Hawai‘i Advisory Council on Kalaoa Cultural Site Preservation. This report summarized 18 guidelines which the Advisory Council wanted to be used in shaping all cultural protection activities within the University Center parcel. It also provided procedures for the management of the cultural resources located within the University of Hawai‘i Center at West Hawai‘i project area (Cleghorn 2000). As part of this report, a map was created showing the previously recorded sites (as adapted from Head and Rosendahl 1993:Figure 3) and their relation to the designated preserve areas (Cleghorn 2000:Figure 3) (Figure 4).

An assessment survey was undertaken by Pacific Legacy in 2005 to relocate previously identified sites within the Main Street road corridor, record their position using a geographic positioning system (GPS), and assess their present condition (Cleghorn and McIntosh 2005). Ten of the 12 previously recorded sites were relocated. Among the recommendations presented in the report of these investigations, it was suggested that the central and northern portions of the roadway be extended west as far as possible to avoid impacting archaeological features within lava tube site of 50-10-28-15302.

Figure 3. Locations of recommended archaeological preserves (after Cleghorn 1998:Figure 10).

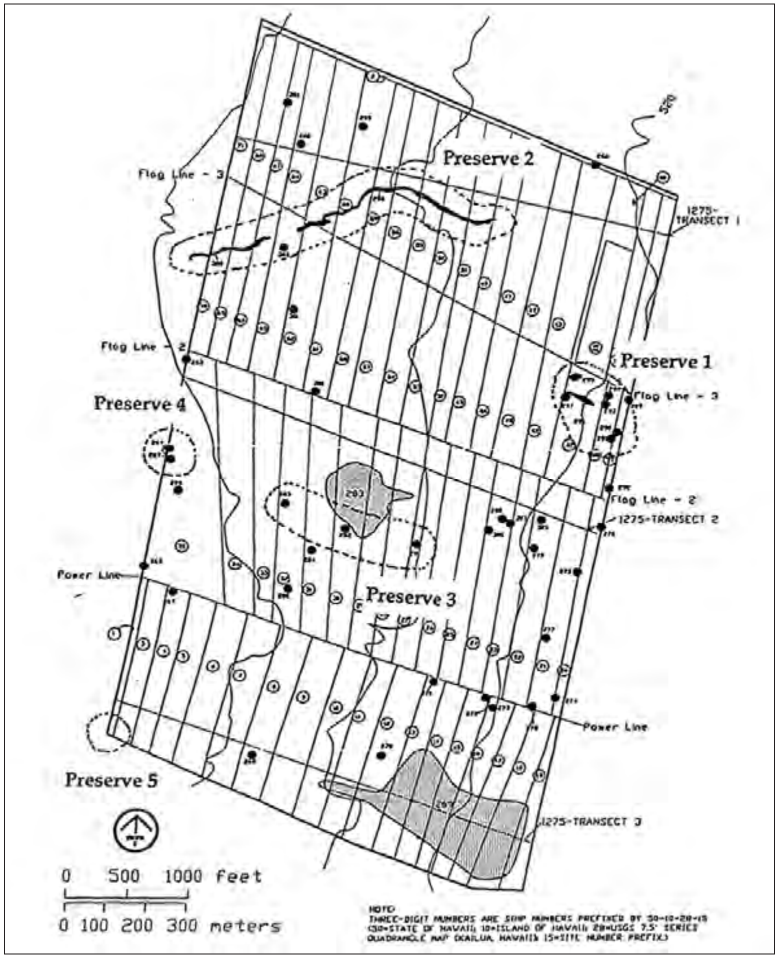

Figure 4. Location of archaeological sites and preserve areas (after Cleghorn 2000:Figure 3).

When the central and northern portions of the road were realigned to the west, this new road corridor passed outside the limits of the original 500 acres into property that had not been the subject of a previous archaeological survey (Tax Map Key parcel (3)-7-3-010:033). During the staking out of this new road alignment, surveyors discovered a petroglyph resting to the southwest (*makai*) of site 50-10-28-15302. As a result of this discovery, Pacific Legacy archaeologists were called in to document the petroglyph site (designated site 50-10-28-26454). They were also asked to survey the newly aligned road corridor and the area between it and the original corridor in order to determine whether it might be possible to reroute the road so that it ran between site 50-10-28-15302 and the recently discovered petroglyph.

Site 50-10-28-26454 was found to consist of three petroglyph images pecked into the surface of a roughly 1 by 1.5 meter slab of *pahoehoe* lava (Reeve 2007:1-9). The petroglyphs are situated on the northern lip of a skylight that opens down into a lava tube. This lava tube was discovered to run below the surface in a northeasterly direction and to connect with the western end of site 50-10-28-15302. Four archaeological features (three slightly modified natural terraces and an area of modified roof fall) were found to rest within the lava tube between these two sites. The results of this investigation were included in an archaeological letter report sent to the State Historic Preservation Division (Reeve 2007).

In 2008, the proposed development within the West Hawai‘i parcel was shifted to the northern end of the property. This was done to take advantage of utility connections to the recently approved Palamanui Development, located immediately north of the U. H. property. At this time a new, roughly 133 acre project area was established that covered much of the northern and eastern portions of the original 500 acre property (Figures 2 and 5). The northern portion of this new circa 133 acre project area is the subject of the present report.

2.1 Archaeological Preserve 2

One of the most prominent physical features within the U. H. West Hawai‘i project area is a large lava tube complex that crosses the northern half of the property from northeast to southwest. While some portions of the lava tube remain intact, along other sections the tube roof has collapsed leaving either a small open skylight or a larger linear depression in the terrain. During Head and Rosendahl’s initial 1993 survey this lava tube was found to contain numerous archaeological features. Upon completion of the survey the lava tube complex was assigned two separate Hawaii State Inventory of Historic Properties site numbers. The eastern portion of the tube was given site number 50-10-28-15298, while the western section was designated site 50-10-28-15302 (Figure 6). In Cleghorn’s 1998 report this “northern site cluster” was recommended for preservation as archaeological Preserve 2.

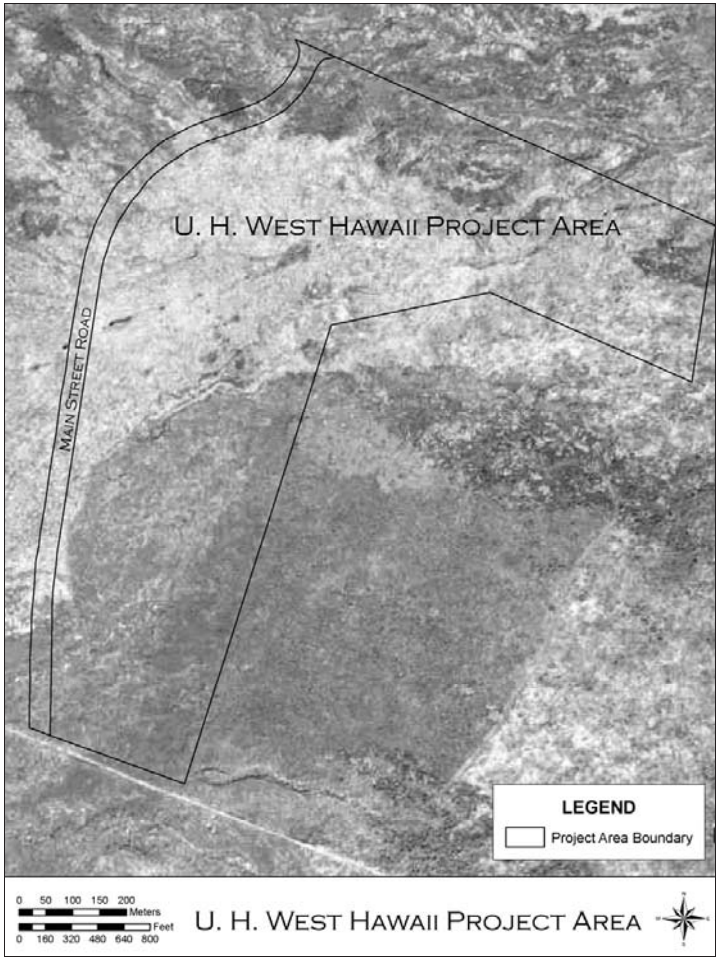

Figure 5. University of Hawai'i Center at West Hawai'i project area (base map from Google Earth).

Site 50-10-28-15302, which covers the western (*makai*) portion of the tube complex, was found to contain over 31 features. These features include ten piles of rock, two stone alignments, five enclosures, three walls, one cairn, eight midden scatters, one modified depression, and one terrace. All of these features probably date to the pre-Contact period and served a variety of functions from habitation to ceremonial (Cleghorn 2000:15). The lava tube consists of two levels. One of the features recorded by Head and Rosendahl (Feature BH) was described as ceremonial due to the presence of a large upright boulder (1.2 x 0.9 x 0.5 meters) which is placed against the N wall of the tube in association with two contiguous enclosures. Shell midden, charcoal, ash, a water worn cobble, and a piece of coral are present in the immediate vicinity of this feature. No human remains were observed within this site (Cleghorn 1998:23).

Site 50-10-28-15298 occupies the eastern (*mauka*) portion of the tube complex. It consists of over 165 features, including at least six human burials (Cleghorn 1998:22). Like site 50-10-28-15302, this tube also consists of two levels. Twelve surface or sink features were found to be associated with the main lava tube, 57 subsurface features were located within a lower level tube, and the remaining ca. 100 features were located on the *pahoehoe* lava surface adjacent to the tube. These features included three pavements, five modified outcrops, six mounds, nine terraces, three cupboards, eleven piles of rock, six enclosures, six petroglyphs and one *papamū*, two pecked stones, one excavated area, ninety midden scatters, nine walls, five alignments, one platform, one stepping stone trail, one cairn, one cleared area, and one modified depression. As with site 50-10-28-15302, these features probably date to the pre-Contact period. Most appear to be associated with habitation or refuge, though human burials are also present (Cleghorn 2000:15).

Both sites were assessed as being culturally significant due to the large number of archaeological features found within them. It was recommended that they be included within an archaeological preserve (Preserve 2), and that a minimum buffer of 50 meters (165 feet) be established around this preserve. Given the culturally sensitive natures of the burials, no access would be allowed into the preserve with the exception of lineal descendants, if any were identified (Cleghorn 200:15).

Although not identified at the time archaeological Preserve 2 was established, the site 50-10-28-26454 petroglyphs were found to be associated with the western end of the lave tube complex and might be considered as belonging within the preserve.

3.0 FIELD INVESTIGATIONS

With the shift of development focus to the northern portion of the U. H. West Hawai'i property, it became necessary to identify the exact perimeters of Preservation Area 2 so that the lava tube complex and its associated archaeological features could be properly protected. In order to accomplish this, archaeological field investigations were undertaken by Pacific Legacy archaeologists Rowland B. Reeve, M.A., James McIntosh, B.A., and Kim Mooney, B.A., over a period of four days between 23-26 September 2008. Paul Cleghorn, Ph.D. served as the Principle Investigator for the project.

Field work was first focused on identifying and documenting the limits of the Preservation Area 2 lava tube complex. A hand held Thales Mobile Mapper geographic positioning system (GPS), with a maximum error of plus or minus 3 meters, was used to record the locations of individual tube openings as well as to trace out the approximate boundaries of the intact sections of the lava tube. The various maps of the tube system contained in this report were created using the GPS data obtained during these recordings. Each tube opening was then photographed, measured and described. This detailed information is contained in Appendix A.

The second phase of field work consisted in determining the exact locations of other known sites within the newly established 133 acre project area. This was again accomplished using a Thales Mobile Mapper GPS. A total of 7 sites were located. Their GPS locations, recorded in Universal Transverse Mercator, North American Datum for 1983, Zone 5 (UTM NAD 83 Z5) coordinates, are listed in Appendix B.

4.0 FINDINGS

During the GPS mapping of archaeological Preserve 2, a total of 16 separate tube entrances were identified within the University of Hawai'i property (Figure 6). A 17th entrance was noted immediately northeast of Opening #16 on the Palamanui property, while additional entrances were also observed to the southwest of Opening #1 outside the property boundary. A detailed description of each opening and its dimensions can be found in Appendix A. Included with these descriptions are photographs of the individual openings. A GPS location, taken at the westernmost point of each opening and recorded in Universal Transverse Mercator, North American Datum for 1983, Zone 5 (UTM NAD 83 Z5) coordinates, is also listed in Appendix A.

4.1 SITES 50-10-28-26454 AND 50-10-28-15302

The western half of the archaeological Preserve 2 lava tube complex includes both sites 50-10-28-15302, originally recorded by Head and Rosendahl (1993), and the more recently recorded site 50-10-28-26454 petroglyph panel (Reeve 2007). This section of the tube extends in a southwest to northeast direction for roughly 325 meters and possesses 6 openings (Figure 7). Its western end is marked by a skylight on the lip of which rest the site 50-10-28-26454 petroglyphs (Opening #1).

Opening #1 (Skylight)

Opening #1 is a roughly oval opening in the lava tube roof. Due to the height of the tube at this point, the skylight does not provide easy access into the tube (Figure 8).

Tube: Subsurface from Opening #1 to Opening #2

From Opening #1 the lava tube extends below the ground surface in a northeasterly direction for approximately 69 meters (c. 226 feet). It passes beneath the Main Street road corridor before becoming visible again through Opening #2. The tube contains one archaeological feature that has been the subject of a data recovery excavation (Reeve 2008).

Opening #2 (Skylight)

Opening #2 is a relatively small, roughly circular skylight. There is no easy access into the tube from this skylight.

Tube: Subsurface from Opening # 2 to Opening # 3

The tube continues subsurface roughly 7.5 meters (c. 24.6 feet) *mauka* of the Opening #2 skylight before ending at the western end of Opening #3. It contains a few very rough archaeological features (Reeve 2007).

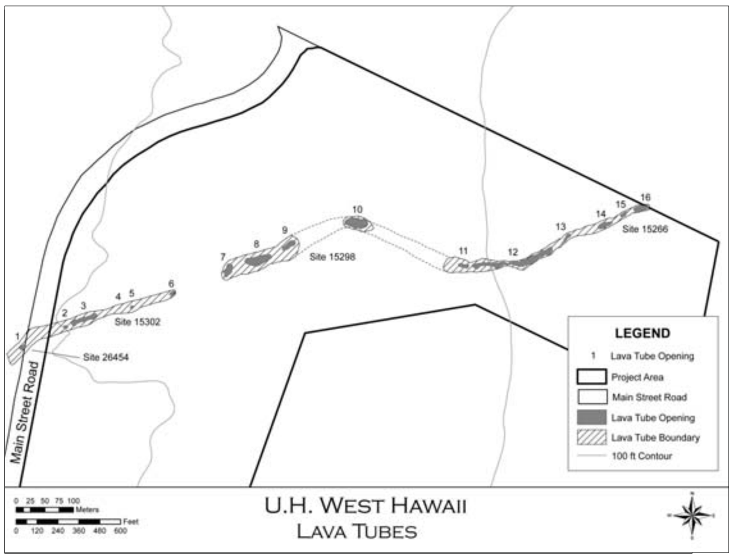

Figure 6. Lava tube openings within archaeological Preserve 2.

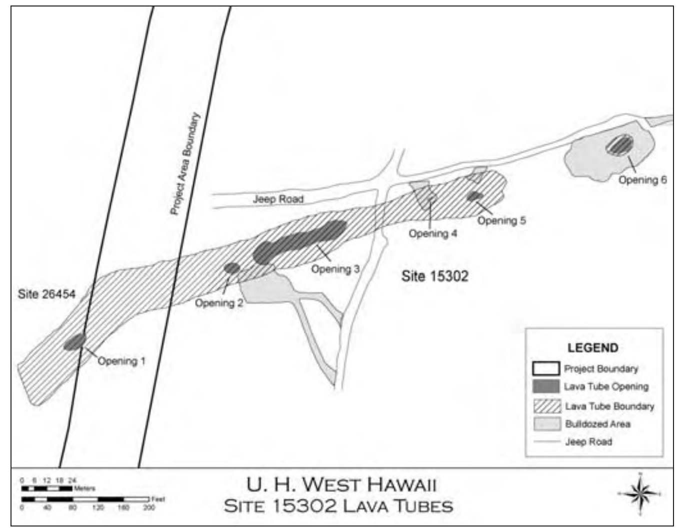

Figure 7. Lava tube openings in the western half of archaeological Preserve 2.

Opening #3 (Collapsed Tube Section)

Opening #3 consists of a collapsed section of lava tube that forms a roughly eight meter deep linear depression in the terrain. This depression stretches for approximately 48 meters. Opening #3 marks the beginning of site 50-10-28-15302 as it was originally recorded by Head and Rosendahl (1993). There is no visible subsurface tube between Opening #3 and Opening #5.

Opening #4 (Lava Bubble)

Opening #4 consists of a relatively small and shallow lava bubble. The roof of the bubble has been broken open, and the area immediately surrounding it has been bulldozed. Opening #4 does not connect to a subsurface lava tube

Opening #5 (Skylight)

Opening #5 is a skylight with no easy access into the subsurface tube that connects it to Opening #6.

Tube: Subsurface from Opening # 5 to Opening # 6

A subsurface lava tube runs between Opening #5 and Opening #6. This tube was mapped by Head and Rosendahl during their 1993 survey (Head and Rosendahl 1993:Figure 7). At least nineteen archaeological features were documented as being located within this stretch of tube. Among these is a possible ceremonial structure (Feature BH, Head and Rosendahl 1993:A-73 and A-74).

Opening #6 (Collapsed Tube Section)

Opening #6 consists of a shallow collapsed section of lava tube roughly 10 by 5 meters in area. This opening marks the eastern end of site 50-10-27-15302 as recorded by Head and Rosendahl (1993). A map in Head and Rosendahl's 1993 site survey report (Head and Rosendahl 1993:Figure 7) indicates that Opening #6 was once the "Main Entrance" to the subsurface lava tube that connects it with Opening #5. Recent bulldozing has closed off this entrance.

Tube: Subsurface for a short distance *mauka* of Opening #6

Head and Rosendahl's map (1993:Figure 7) shows the subterranean tube continuing northeast beyond Opening #6 for at least another 20 meters. At this point the map simply ends with a note that states "passageway continues". It is uncertain how much further northeast the tube runs.

4.1.1 Recent Damage at Site 50-10-28-15302

At present a jeep road passes between Opening #3 and Opening #4. This north-south running jeep road connects to a roughly east-west running track located just north of the tube complex (Figure 7).

Figure 8. Skylight of Opening #1 (View Northeast).

Figure 9. Opening # 6 filled with bulldozed rubble (View West)

During the present survey, the archaeological field crew noted evidence of recent ground disturbing activities at the southwestern end of Opening #3, and some rock and soil debris has been pushed into the tube. This disturbance was found to be part of a much larger area of bulldozing that extends off of the nearby jeep road (Figure 7).

Similar areas of bulldozing were visible elsewhere in the western portion of Preserve 2. The bulldozing appears to be concentrated around lava tube openings, such as at Openings #4 and #6 (Figure 7). To the west of the U. of H. property the field crew observed similar damage caused by a backhoe actively tearing up the *pahoehoe* surface to obtain loose slabs of rock. These stones were being removed for use in building stacked stone walls.

It is evident that bulldozing has damaged the archaeological sites within Preserve 2. The ground surface immediately surrounding Opening #6 has been extensively bulldozed, and rubble now fills most of the floor of the opening (Figure 9). It appears that the bulldozing carried out around Opening #6 has covered over the entrance to the subterranean tube that connects it to Opening #5 (Head and Rosendahl 1993:Figure 7). With the Opening #6 entrance now blocked by bulldozer push, the only way to reach the features recorded by Head and Rosendahl would be by descending through the Opening #5 skylight using climbing ropes.

4.2 SITE 50-10-28-15298

There appears to be a gap in the lava tube between Openings #6 and #7. This gap marks the division between site 50-10-27-15302 and site 50-10-27-15298, as recorded by Head and Rosendahl (Figure 6). Site 50-10-28-15298 covers most of the central portion of the archaeological Preserve 2 lava tube complex, including eight openings (Opening #7 to Opening #14) (Figure 10). Most of these openings consist of linear depressions formed by collapsed sections of lava tube.

Opening #7 (Collapsed Tube Section)

Opening #7 is a collapsed section of lava tube that marks the western end of site 50-10-27-15298. It forms a 23.8 meters long trench, roughly five meters deep. There is no evidence of a subsurface tube connecting it to Opening #8.

Opening #8 (Collapsed Tube Section)

Opening #8 consists of a linear depression roughly 47 meters in length formed by a collapsed section of lava tube. Near the western end of the collapse is a skylight that opens onto a subsurface lava tube. This subsurface tube runs east (*mauka*) as far as Opening #12. The subsurface tube has been mapped by Head and Rosendahl and appears as Figure 6 in their 1993 site survey report (Head and Rosendahl 1993:Figure 6). It contains numerous archaeological sites, including at least five human burials. Three of these burials (B-1, B-2a and B-2b) are located beneath Opening #8. An accessible entrance to this subsurface tube is located at the eastern end of Opening #8.

Tube: Subsurface from Opening #8 to Opening #9

The subsurface tube appears to follow roughly the same alignment as the line of surface collapsed tubes. This stretch of tube contains numerous archaeological features.

Opening #9 (Collapsed Tube Section)

Opening #9 forms a roughly three meter deep trench running for 26 meters. A skylight at its western end provides access to the subsurface lava tube that is show in Figure 6 of Head and Rosendahl's 1993 site survey report.

Tube: Subsurface between Opening #9 and Opening #10

The line of the lava tube complex makes a distinct bend after Opening #9, turning northeast to Opening #10 before curving southeast again to Opening #11. This bend is reflected in Head and Rosendahl's map of the subsurface tube, indicating that the alignments of both the surface openings and the subsurface tube are roughly the same (Figures 11 and 12). Head and Rosendahl's map indicates that several archaeological features, including a subsurface burial (B-3) is located between Openings #9 and #10.

Opening #10 (Collapsed Tube Section)
Opening #10 is a very shallow, grass filled depression. It possesses no skylights or other entrances to the subsurface lava tube that runs beneath it.

Tube: Subsurface between Opening #10 and Opening #11
Although there are no entrances to the subsurface tube at either Opening #10 or #11, Head and Rosendahl's 1993 map indicates that it does run beneath these openings. A number of archaeological features, including burial B-4, are located within this section of tube.

Opening #11 (Collapsed Tube Section)
Opening #11 is a short and shallow depression. There are no skylights or entrances to the lower tube visible from the surface.

Tube: Subsurface between Opening #11 and Opening #12
The subsurface lava tube that runs *mauka* from Opening #8, and contains numerous archaeological features, opens into the western end of Opening #12.

Opening #12 (Collapsed Tube Section)
Opening #12 is by far the longest of the collapsed lava tube segments within the Preserve 2 complex. It forms a shallow, grass and shrub filled trough that extends for over 138 meters in length. The subsurface tube recorded by Head and Rosendahl emerges at the western end of Opening #12. Several skylights into another subsurface lava tube located east (*mauka*) of the tube recorded by Head and Rosendahl were noted within Opening #12. This tube section does not appear to extend east of Opening #12.

Opening #13 (Collapsed Tube Section)
Opening #13 consists of a shallow depression measuring only 22 meters in length. There is no visible evidence of a subsurface lava tube beneath this opening.

Opening #14 (Collapsed Tube Section)
Opening #14 is a shallow trench partially covered in grass. At its western end is an opening into a subsurface lava tube that runs 50 to 60 meters west before growing too narrow to be easily investigated. This tube does not connect to Opening #15.

4.3 Site 50-10-28-15266
Site 50-10-28-15266 was originally recorded as a pair of habitation terraces located adjacent to the eastern end of Preserve 2 lava tube complex (Head and Rosendahl 1993). These terraces are situated near Openings #15 and #16. The site boundary has been extended to include these two easternmost openings within the University of Hawai‘i Center at West Hawai‘i project area (Figure 10). As has been mentioned, the lava tube complex continues east (*mauka*)beyond the boundaries of the University of Hawai‘i property.

Opening #15 (Collapsed Tube Section)
Opening #15 is a relatively small, but steep sided collapsed section of lava tube measuring less than 15 meters in length.

Tube: Subsurface between Opening #15 and Opening #16
A roughly 10 meter long arched overhang connects the eastern end of Opening #15 with the western end of Opening #16. Just inside this opening, along the south wall, is a small ash deposit. There are no other signs of human activity, though these may be obscured by roof fall. In amongst this roof fall the Pacific Legacy field crew discovered an old site tag dating from the initial archaeological survey of the project area in 1993. The tag indicates that this portion of the lava tube complex was initially identified as site 50-10-28-15298, but was re-designated as site 50-10-28-15266.

Opening #16 (Collapsed Tube Section)
Opening #16 is the easternmost opening within the project area. It consists of a collapsed section of lava tube that measures approximately 27.5 meters in length. Except for the connecting tube into Opening #15, it contains no entrances to subsurface tubes.

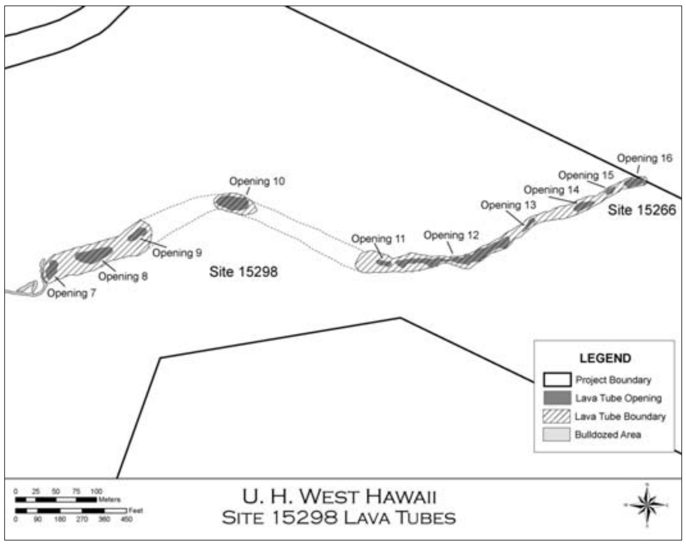

Figure 10. Lava tube openings in the eastern half of archaeological Preserve 2.

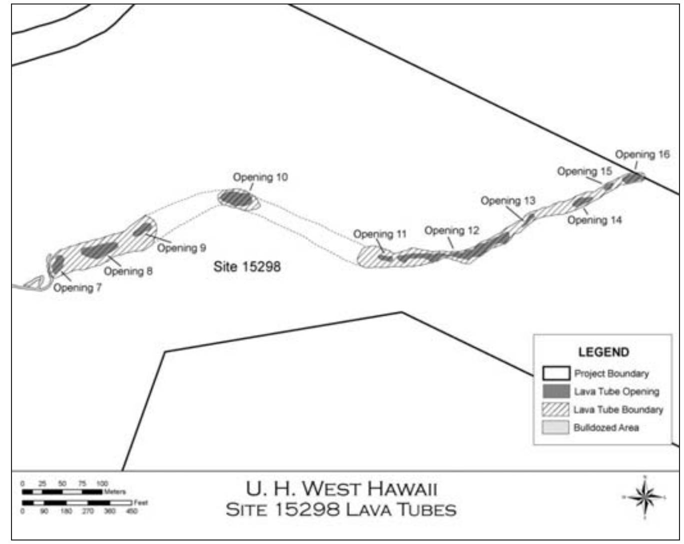

Figure 11. Upper tube alignment as mapped during the present project.

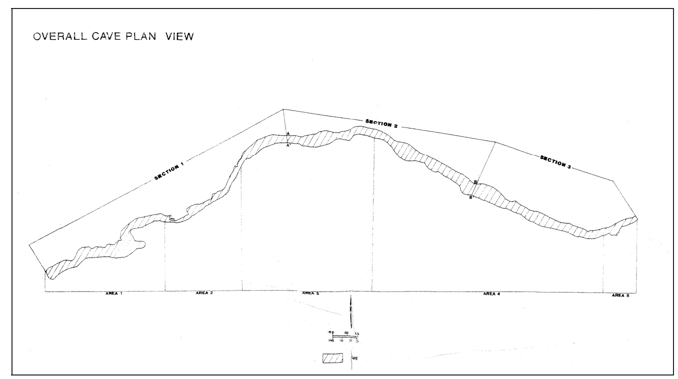

Figure 12. Lower tube alignment between Openings #8 and #12 (Head and Rosendahl 1993:Figure 6).

4.3 Sites Outside Preservation Area 2

In addition to locating and describing the openings that lie along the length of the archaeological Preserve 2 lava tube complex, the Pacific Legacy field team also obtained GPS locations for other previously recorded archaeological sites within the newly established 133 acre U. of H. West Hawai'i project area. A total of 7 sites were revisited. A brief descriptive list of these sites is included in Appendix B. Appendix B also contains a table of their GPS locations, recorded in Universal Transverse Mercator, North American Datum for 1983, Zone 5 (UTM NAD 83 Z5) coordinates. Included within this table are the GPS coordinates for two additional sites located north of Preserve 2. The GPS coordinates of these two sites (50-10-28-15262 and 50-10-28-15304), both of which are scheduled for preservation, were recorded by Pacific Legacy archaeologists in 2005 (Cleghorn and McIntosh 2005:30).

Of the three archaeological sites originally identified as being located north of the archaeological Preserve 2 lava tube complex (Head and Rosendahl 1993:Appendix A), two were relocated, recorded and recommended for preservation during the 2005 Main Street Roadway assessment survey (Cleghorn and McIntosh 2005). These are site 50-10-28-15262, a roughly 4 x 3 meter stone terrace with three adjacent stone mounds (Cleghorn and McIntosh 2005:10-11), and site 50-10-28-15304, an isolated X shaped petroglyph (Cleghorn and McIntosh 2005:19). Site 50-10-28-15299, a modified outcrop (Head and Rosendahl 1993:A-70), was not able to be relocated in 2005. GPS locations for both sites 50-10-28-15262 and 50-10-28-15304 were recorded at that time and are listed in the 2005 report (Cleghorn and McIntosh 2005:30). Their coordinates are included in Appendix B.

South of archaeological Preserve 2, the present study obtained GPS locations for seven sites (Figure 13). These include:

Site 50-10-28-15303: A modified overhang shelter that is located southeast of site 50-10-28-15302 and southwest of site 50-10-28-15298. Site 50-10-28-15303 is situated close enough to these two lava tube complex sites to rest within the boundaries of Preserve 2. This site was relocated and described during the 2005 assessment survey (Cleghorn and McIntosh 2005:17-18).

Site 50-10-28-15285: This roughly rectangular enclosure contains a single piece of branch coral outside its eastern wall. It was relocated during the 1998 assessment survey (Cleghorn 1998:19-20) and interpreted as a possible religious shrine. This site forms the western end of Preserve 3.

Site 50-10-28-15283: This agricultural complex of 72 plus features, includes a number of terraces, walls, alignments, mounds and modified outcrops (Cleghorn 1998:18-20). The southern portion of it was included in Preserve 3 (Figure 4). GPS mapping conducted during the present survey reveals that the westernmost fringe of this site complex is located east of and outside the limits of the present project area (Figure 12).

Site 50-10-28-15264: This site consists of a small lava tube and two modified outcrops. It forms part of Preserve 4. The site was relocated and described during the 2005 assessment survey

(Cleghorn and McIntosh 2005:12).

Site 50-10-28-15287: A *papamū* (a natural *pahoehoe* slab marked with a pattern of shallow circular depressions that was used as a board for the playing of *kōnane*, a game similar to checkers); and associated stone alignment that also form part of Preserve 4. This site was relocated and described during the 2005 assessment survey (Cleghorn and McIntosh 2005:13).

Site 50-10-28-15288: This site consists of a partially collapsed stone mound. Though site 50-10-28-15288 is located just south and outside the boundaries of Preserve 4, it was also recommended for preservation (Cleghorn and McIntosh 2005:14).

The boundaries of both archaeological Preserve 3 and 4 had previously been mapped by a licensed surveyor contracted by Wil Chee Planning. Due to their level of accuracy, these mapped boundaries should be used in the planning of any development in the vicinity of the two more southern preserve areas.

The original 1993 survey identified three additional sites located south of Preserve 2 and north of Preserves 3 and 4 (Figure 4). Site 50-10-28-15263, a modified depression (Head and Rosendahl 1993:A-2), was not relocated during the 2005 survey. Site 50-10-28-15300 was described in Head and Rosendahl's 1993 report as a utilized lava tube (Head and Rosendahl 1993:A-71). A lava tube was found during the 2005 survey at the location shown on Head and Rosendahl's site map, but it did not match the description given in their report, nor was any human modification or cultural material noted within the tube. Site 50-10-28-15301 appears on Head and Rosendahl 1993 site maps, but there is no description of the site in the text. It is possible that the feature given this site number was determined not to be a site, but its number was not removed from the site maps. No site was noted in this location during any of the subsequent surveys.

During the present investigations the Pacific Legacy field team discovered a single previously unrecorded feature located roughly 250 meters southwest of site 50-10-28-15285. This site, which has been assigned State Inventory of Historic Properties number 50-10-28-26700, consists of a petroglyph, measuring approximately 51 centimeters in length and 45 centimeters in width, pecked into a roughly 1 by 1 meter slab of *pahoehoe* lava. The *pahoehoe* slab forms part of an uplifted ridge of lava surrounded by fountain grass. The petroglyph is quite large and visible from a distance (Figure 14). The image itself consists of a linear male human figure with uplifted arms (Figure 15). A very faint, possible second image is situated approximately 1 meter to the north of the first figure. This possible second figure appears to be a legless human figure with a reverse triangular torso.

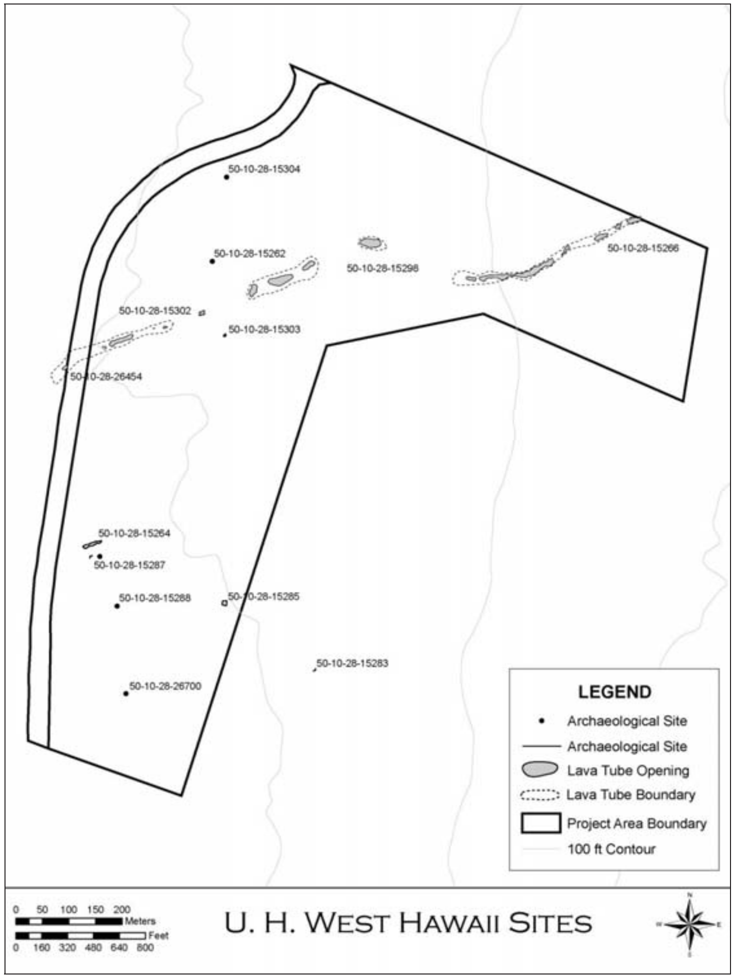

Figure 13. Archaeological site locations.

Figure 14. Site 50-10-28-26700 (View West).

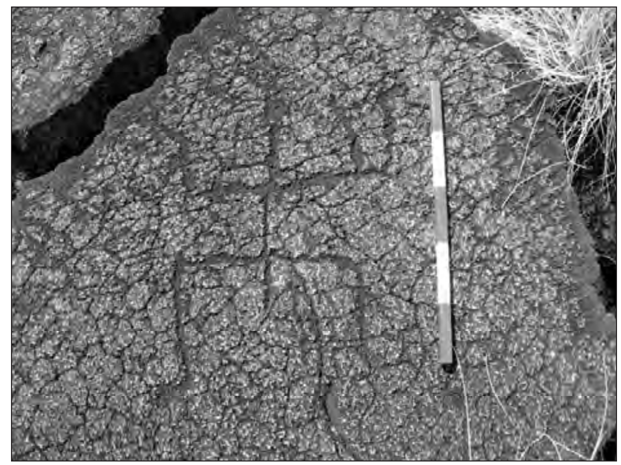

Figure 15. Site 50-10-28-26700 petroglyph image.

5.0 SUMMARY AND DISCUSSION

During the present project, Pacific Legacy archaeologist employed a geographic positioning system (GPS) to map the extent of the archaeological Preserve 2 lava tube complex and to identify the locations of its various openings. The GPS was also used to fix the positions of 7 other previously identified sites, all of which were situated within the 133 acre University of Hawaiʻi Center - West Hawaiʻi property.

A total of 16 separate openings were identified along the length of the Preserve 2 lava tube. These took the form of both skylights (openings in the roof of surviving sections of subsurface tube) and collapsed tube sections (linear depressions in the terrain formed by the collapse of a portion of tube roof). Different sections of the tube complex were identified as belonging within the three previously recorded archaeological site that make up Preserve 2. Descriptions, measurements, photographs and GPS coordinates for the 16 tube openings can be found in Appendix A at the end of this report. The GPS coordinates of 7 other previously identified sites were also recorded. Appendix B contains a descriptive list and GPS coordinates for these 7 sites. It also contains information and coordinates for a single site that was discovered during the present survey. This site consists of a human figure petroglyph pecked into an outcropping of *pahoehoe* lava. Due to the sensitive nature of these sites, some of which contain human burials, it is important that their exact GPS locations not become common knowledge. For this reason, the appendices should be detached prior to the distribution of this report to the public.

Evidence of recent damage to the Preserve 2 area was also discovered and documented during the course of field operations. The ground surface immediately surrounding some of the tube openings was found to be disturbed by bulldozing. It was apparent that a backhoe or some other form of earth moving equipment had been used to break up the *pahoehoe* lava, most probably to obtain stone slabs for use in the construction of rock walls. At Opening #6, the entrance to a subterranean tube containing several archaeological features, among them a possible ceremonial structure, had been filled in with rubble. This effectively sealed up access to the tube, since the only other possible entrance (Opening #5) is a skylight that can only be accessed using climbing ropes. The bulldozer damage appears to be relatively recent. Similar bulldozing was found to be actively taking place within the property immediately to the west of the U. of H. parcel. There appears to be a strong likelihood that unless steps are taken, further damage may occur to the tube complex and its associated sites. Such bulldozing could easily obliterate surface petroglyphs carved into the *pahoehoe* slabs that edge the lava tube openings. Such petroglyphs have been found at sites 50-10-28-26454 and 50-10-28-15298.

It is recommended that future planning for the University of Hawaiʻi Center - West Hawaiʻi campus be conducted in close consultation with the Hawaiʻi State Historic Preservation Division and the Hawaiʻi Island Burial Council. This will help to ensure that the cultural properties present within Preserve 2, and at other preserve areas on the U. of H. parcel, will be properly protected.

”

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Due to the sensitive nature of the resources contained in Preserve 2, Appendices A and B have been detached from this report prior to public distribution.

Appendix F

Traffic Impact Analysis Report

TRAFFIC IMPACT ANALYSIS REPORT FOR

UNIVERSITY OF HAWAII CENTER - WEST HAWAII

IN KAILUA-KONA, HAWAII

Prepared For

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1. INTRODUCTION

Phillip Rowell and Associates prepared this Traffic Impact Analysis Report for the proposed University of Hawaii Center - West Hawaii in the Kailua-Kona area of the Island of Hawaii. This introductory chapter describes the proposed project, purposes of the traffic study, study methodology and order of presentation.

Project Location and Description

The proposed project is a new university campus to be developed in four phases between 2009 and 2023. The development plan is summarized in Table 1. Site plans for each phase is presented as Appendix A.

Table 1 Development Plan Summary

Phase	Estimated Completion Year	Gross Square Feet of Building Area
1	2011	26,354
1 and 2	2012	38,358
1 thru 3	2017	98,439
1 thru 4	2023	165,815

The proposed project will be located on a parcel mauka of the Keahole Airport at the intersection of two new roadways, University Drive and Main Street. University Drive will be located along the east side of Queen Kaahumanu Highway and north of Keahole Airport Access Road and is the primary access to and egress from Palamanui subdivision. University Drive will have an east-west orientation. Initially, University Drive will connect Queen Kaahumanu Highway to the UHCWH campus. Ultimately, University Drive will be extended to Mamalahoa Highway.

Main Street will be a collector roadway with a north-south orientation between the proposed Palamanui Subdivision and Kaimi Nani Drive. The roadway will be parallel to and between Queen Kaahumanu Highway and Mamalahoa Highway. The roadway has been referred to as the Mid-Level Road in previous documents, but has been renamed Main Street.

Purpose and Objectives of Study

1. Determine and describe the traffic characteristics of project.
2. Quantify and document the traffic related impacts of project.
3. Identify and evaluate traffic related improvements required to provide adequate access to and egress from the project and to mitigate the project's traffic impacts.

Study Area

The study area is shown in Figure 2. The study area includes the following intersections, which are shown in the figure:

1. Queen Kaahumanu Highway at Keahole Airport Road
2. Queen Kaahumanu Highway at Kaimi Nani Drive
3. Mamalahoa Highway at Kaimi Nani Drive
4. Mamalahoa Highway at Makalei Access Road
5. Mamalahoa Highway at Ahikawa Street
6. Queen Kaahumanu Highway at University Drive (Future Intersection)
7. Main Street at Kaimi Nani Drive (Future Intersection)

Design Year

The design, or horizon, year of a project is the future year for which background traffic conditions are estimated. The TIAR assessed the impacts of each phase of the project. Therefore, there are four design years: 2011, 2012, 2017 and 2023.

Study Methodology

The following is a summary list of the tasks performed:

1. A site reconnaissance was performed to identify existing roadway cross-sections, intersection lane configurations, traffic control devices, and surrounding land uses.
2. Existing peak-hour traffic volumes for the study intersections were obtained and summarized.
3. Existing levels-of-service of the study intersections were determined using the methodology described in the *Highway Capacity Manual*.

4. A list of related development projects within and adjacent to the study area that will impact traffic conditions at the study intersections was compiled. This list included both development projects and anticipated roadway improvement projects.

5. Future background traffic volumes at the study intersections were estimated.

6. Traffic generated by each phase of the University of Hawaii Center at West Hawaii (UHCWH) development was estimated.

7. A level-of-service analysis for future traffic conditions with was performed.

8. Locations with unacceptable traffic operating conditions were identified.

9. Recommendations, improvements or modifications necessary to mitigate the traffic impacts of project generated traffic and to provide adequate access to and egress from the site were formulated.

10. A report documenting the conclusions of the analyses performed and recommendations was prepared.

Order of Presentation

Chapter 2 describes existing traffic conditions, the Level-of-Service (LOS) concept and the results of the LOS analysis of existing conditions.

Chapter 3 describes the process used to estimate future background traffic projections for each of the design years. Background conditions are defined as future background traffic conditions without the project. Improvements required to mitigate unacceptable background conditions are identified.

Chapter 4 describes the methodology used to estimate the traffic that the proposed project will generate. The amount of traffic that the campus will generate at the end of each phase is summarized.

Chapter 5 describes the results of the LOS analysis, identifies potential mitigation measures and summarizes the traffic impacts of the project.

2. EXISTING CONDITIONS

This chapter presents the existing traffic conditions on the roadways adjacent to the project site. The Level-of-Service (LOS) concept and the results of the LOS analysis for existing conditions are also presented. The purpose of this analysis is to establish the base conditions for the determination of the impacts of the project which are described in a subsequent chapter.

Existing Roadway and Traffic Conditions

A schematic of the existing roadway network serving the project is shown in Figure 2. Shown are the existing lane configurations and right-of-way controls of the study intersections. The traffic characteristics of the roadways serving the project are summarized in Table 2.

Table 2 Summary of Existing Roadways

Roadway	Section	Jurisdiction	Number of Lanes	Divided
Queen Kaahumanu Highway	South of Kaimi Nani Drive to North of Keahole Airport Road	State	2	No
Mamalahoa Highway	Palani Road to North of Makalei Estates Subdivision	State	2	No
Kaimi Nani Drive	Queen Kaahumanu Highway to Mamalahoa Highway	County	2	No

Existing Peak Hour Traffic Volumes

The morning and afternoon peak hourly traffic volumes are shown in Figures 3 and 4, respectively. The dates of the traffic counts are summarized as Table 3. These counts include mopeds, buses, trucks and other large vehicles. Bicycles are not included. The traffic count worksheets are provided as Appendix B.

Table 3 Traffic Count Schedule

Intersection	Date
Queen Kaahumanu Highway at Airport Access Road	August 26, 2009
Queen Kaahumanu Highway at Kaimi Nani Road	August 25, 2009
Mamalahoa Highway at Kaimi Nani Road	August 25, 2009
Mamalahoa Highway at Makalei Access Road	August 26, 2009
Mamalahoa Highway at Ahikawa Street	October 29, 2009

Level-of-Service Concept

Signalized Intersections

"Level-of-Service" is a term which denotes any of an infinite number of combinations of traffic operating conditions that may occur on a given lane or roadway when it is subjected to various traffic volumes. Level-of-Service (LOS) is a qualitative measure of the effect of a number of factors which include space, speed, travel time, traffic interruptions, freedom to maneuver, safety, driving comfort and convenience.

There are six levels-of-service, A through F, which relate to the driving conditions from best to worst, respectively. The characteristics of traffic operations for each Level-of-Service are summarized in Table 4. In general, LOS A represents free-flow conditions with no congestion. LOS F, on the other hand, represents severe congestion with stop-and-go conditions. ***Level-of-Service D is typically considered acceptable for peak hour conditions in urban areas***.

Corresponding to each Level-of-Service shown in the table is a volume/capacity ratio. This is the ratio of either existing or projected traffic volumes to the capacity of the intersection. Capacity is defined as the maximum number of vehicles that can be accommodated by the roadway during a specified period of time. The capacity of a particular roadway is dependent upon its physical characteristics such as the number of lanes, the operational characteristics of the roadway (one-way, two-way, turn prohibitions, bus stops, etc.), the type of traffic using the roadway (trucks, buses, etc.) and turning movements.

Table 4 Level-of-Service Definitions for Signalized Intersections(1)

Level of Service	Interpretation	Volume-to-Capacity Ratio(2)	Control Delay (Seconds)
A, B	Uncongested operations; all vehicles clear in a single cycle.	0.000-0.700	<10.0
C	Light congestion; occasional backups on critical approaches	0.701-0.800	10.1-20.0
D	Congestion on critical approaches but intersection functional. Vehicles must wait through more than one cycle during short periods. No long standing lines formed.	0.801-0.900	20.1-35.0
E	Severe congestion with some standing lines on critical approaches. Blockage of intersection may occur if signal does not provide protected turning movements.	0.901-1.000	35.1-80.0
F	Total breakdown with stop-and-go operation	>1.001	>80.0

Notes:
(1) Source: *Highway Capacity Manual*, 2000.
(2) This is the ratio of the calculated critical volume to Level-of-Service E Capacity.

Unsignalized Intersections

Like signalized intersections, the operating conditions of intersections controlled by stop signs can be classified by a Level-of-Service from A to F. However, the method for determining Level-of-Service for unsignalized intersections is based on the use of gaps in traffic on the major street by vehicles crossing or turning through that stream. Specifically, the capacity of the controlled legs of an intersection is based on two factors: 1) the distribution of gaps in the major street traffic stream, and 2) driver judgement in selecting gaps through which to execute a desired maneuver. The criteria for Level-of-Service at an unsignalized intersection is therefore based on delay of each turning movement. Table 5 summarizes the definitions for Level-of-Service and the corresponding delay.

Table 5 Level-of-Service Definitions for Unsignalized Intersections(1)

Level-of-Service	Expected Delay to Minor Street Traffic	Control Delay (Seconds)
A	Little or no delay	>10
B	Short traffic delays	10.1 to 15.0
C	Average traffic delays	15.1 to 25.0
D	Long traffic delays	25.1 to 35.0
E	Very long traffic delays	35.1 to 50.0
F	See note (2) below	>50.1

Notes:
(1) Source: *Highway Capacity Manual*, 2000.
(2) When demand volume exceeds the capacity of the lane, extreme delays will be encountered with queuing which may cause severe congestion affecting other traffic movements in the intersection. This condition usually warrants improvement of the intersection.

Level-of-Service Analysis of Existing Conditions

The results of the Level-of-Service analysis for the signalized intersections are shown in Table 6. For signalized intersections, the volume-to-capacity ratios, average control delays and the levels-of-service for the overall intersections are shown.

For unsignalized intersections, the average control delays and levels-of-service of the lane group with the longest delay and lowest level-of-service are shown for controlled movements only. Volume-to-capacity ratios are not calculated for unsignalized intersections. Overall intersection level-of-service is determined by the lane group with the lowest level-of-service.

Table 6 Existing (2009) Levels-of-Service

	AM Peak Hour			PM Peak Hour		
Intersection	V/C	Delay [1]	LOS [2]	V/C	Delay	LOS
Queen Kaahumanu Highway at Keahole Airport Access Road	0.61	11.7	B	0.87	19.1	B
Queen Kaahumanu Highway at Kaimi Nani Drive	0.74	19.0	B	0.63	14.6	B
Mamalahoa Highway at Kaimi Nani Drive		36.3	E		56.4	F
Mamalahoa Highway at Makalei Estates		10.0	B		9.6	A
Mamalahoa Highway at Ahikawa Street		13.9	B		11.4	B

Notes:
(1) V/C denotes volume-to-capacity ratio.
(2) LOS denotes level-of-service
(3) See Appendix B for detailed Level-of-Service Worksheets

The findings of the level-of-service analysis are:

1. The intersection of Queen Kaahumanu Highway at Keahole Airport Access Road will operate at Level-of-Service B during morning and afternoon peak hours.

2. The intersection of Queen Kaahumanu Highway at Kaimi Nani Drive will operate at Level-of-Service B during both peak periods.

3. At the intersection of Mamalahoa Highway at Kaimi Nani Drive, the eastbound left turn operates at Level-of-Service E during the morning peak hour and Level-of-Service F during the afternoon peak hour. The TIAR for Palamanui indicated that this intersection will be signalized for base conditions before Phase 1of the Palamanui project[1].

4. At the intersection of Mamalahoa Highway at Makalei Estates, the eastbound approach will operate at Level-of-Service B during the morning peak hour and Level-of-Service A during the afternoon peak hour.

5. At the intersection of Mamalahoa Highway at Ahikawa Street, the eastbound (Ahikawa Street) approach will operate at Level-of-Service B during the morning peak hour and the afternoon peak hour.

[1] Austin, Tsutsumi & Associates, Inc., *Traffic Impact Analysis Report Palamanui*, January 27, 2004, page 23

3. BACKGROUND TRAFFIC CONDITIONS

The purpose of this chapter is to discuss the assumptions and data used to estimate background traffic conditions for each phase of the project (2011, 2012, 2017 and 2023). Background traffic conditions are defined as future traffic volumes without the proposed project.

Future traffic growth consists of two components. The first is ambient background growth that is a result of regional growth and cannot be attributed to a specific project. The second component is estimated traffic that will be generated by other development projects in the vicinity of the proposed project.

Background Traffic Growth

Information provided in the traffic study for Palamanui and the *Keahole to Honaunau Regional Circulation Plan*[2] concluded that traffic along the adjacent sections of Queen Kaahumanu and Mamalahoa Highways would increase approximately 4.5% per year. Accordingly, this growth rate was used to estimate the background growth between 2009 and the design year for each phase of the project. The growth factor was calculated using the following formula:

$$F = (1 + i)^n$$

where F = Growth Factor
i = Average annual growth rate, or 0.045
n = Growth period, or 11 years

This growth factor was applied to all traffic movements at the study intersections.

[2] Austin, Tsutsumi & Associates, *Traffic Impact Analysis Report for Palamanui*, January 2004, p. 19

Related Projects

The second component in estimating background traffic volumes is traffic resulting from other proposed projects in the vicinity. Related projects are defined as those projects that are under construction, have been approved for construction or have been the subject of a traffic study and would significantly impact traffic in the study area. Related projects may be development projects or roadway improvements.

It was determined that there are two development projects in the area that will generate additional traffic at the study intersections. The traffic characteristics of these projects are summarized in Table 7. It was also assumed that the intersection of Mamalahoa Highway at Kaimi Nani Drive would be signalized before 2011 (Phase 1) as described in the TIAR for Palamanui and that the widening of Queen Kaahumanu Highway would be completed after 2012 (Phase 2) and before 2017 (Phase 3).

Table 7 Trip Generation Summary of the Related Projects

	AM Peak Hour			PM Peak Hour		
Related Project	Total	In	Out	Total	In	Out
Palamanui[1]	1,704	1,027	677	2,918	1,391	1,527
Lokahi Subdivision[2]	145	35	110	190	125	70
TOTAL	1,849	1,062	787	3,108	1,516	1,597

Notes:
(1) Austin, Tsutsumi & Associates, *Traffic Impact Analysis Report for Palamanui*, January 2004
(2) Calculated from data provided in project's final Environmental Assessment, October 2003.

Background Traffic Projections

background traffic projections were calculated by expanding existing traffic volumes by the appropriate growth rates and then superimposing traffic generated by the related projects. The resulting weekday background morning and afternoon peak hourly traffic projections are shown in Figures 5 thru 12.

Level-of-Service of Background Conditions

The lane configurations used for the level-of-service analysis for background conditions are shown on Figures 13 and 14.

2011 Background

The results of the level-of-service analysis of 2011 background conditions without project generated traffic is summarized In Table 8. All signalized intersections will operate at Level-of-Service A or B except Queen Kaahumanu Highway at Kaimi Nani Drive, which will operate at Level-of-Service C during the morning peak hour. At the unsignalized intersections, all movements will operate at Level-of-Service C, or better, except the northbound approach of Main Street at Kaimi Nani Drive, which will operate at Level-of-Service E during the morning peak hour and Level-of-Service D during the afternoon peak hour. This approach is the driveway to and from Lokahi Subdivision. No mitigation is recommended for 2011 conditions at this intersection as the subdivision has two additional driveways along Kaimi Nani Drive. Traffic that considers the delay too long has alternative routes to use.

Table 8 2011 Background Levels-of-Service

	AM Peak Hour			PM Peak Hour		
	Without Mitigation			Without Mitigation		
Intersection	V/C	Delay [1]	LOS [2]	V/C	Delay	LOS
Queen K Hwy at Keahole Airport Access Rd	0.72	12.8	B	0.87	19.1	B
Queen K Hwy at Kaimi Nani Dr	0.81	27.2	C	0.73	19.7	B
Mamalahoa Hwy at Kaimi Nani Dr	0.96	13.2	B	0.77	7.9	A
Mamalahoa Hwy at Makalei Estates		10.8	B		11.2	B
Queen K Hwy at University Dr	0.58	11.6	B	0.58	11.0	B
Kaimi Nani Dr at Main St		38.6	E		27.0	D
Mamalahoa Hwy at Ahikawa St		15.0	C		11.9	B

Notes:
(1) V/C denotes volume-to-capacity ratio.
(2) LOS denotes level-of-service
(3) See Appendix D for detailed Level-of-Service Worksheets

2012 Background

The results of the level-of-service analysis of 2012 background conditions without project generated traffic is summarized In Table 9. Mitigation is required at the intersection of Mamalahoa Highway at Kaimi Nani Drive. The volume-to-capacity during the morning peak hour will be 1.04 without mitigation. The recommended mitigation measure is to install a southbound right turn only and deceleration lane. This will improve the morning peak hour volume-to-capacity ratio from 1.04 to 0.93. The afternoon volume-to-capacity ratio will remain at 0.79.

Table 9 2012 Background Levels-of-Service

	AM Peak Hour						PM Peak Hour					
	Without Mitigation			With Mitigation			Without Mitigation			With Mitigation		
Intersection	V/C	Delay [1]	LOS [2]	V/C	Delay	LOS	V/C	Delay	LOS	V/C	Delay	LOS
Queen K Hwy at Keahole Airport Access Rd	0.75	13.4	B				0.90	20.3	C			
Queen K Hwy at Kaimi Nani Dr	0.84	28.7	C				0.75	20.4	C			
Mamalahoa Hwy at Kaimi Nani Dr	1.04	16.7	B	0.93	12.7	B	0.79	8.2	A	0.79	8.0	A
Mamalahoa Hwy at Makalei Estates		11.0	B					11.4	B			
Queen K Hwy at University Dr	0.60	12.3	B				0.60	11.6	B			
Kaimi Nani Dr at Main St		42.4	E					28.7	D			
Mamalahoa Hwy at Ahikawa St		16.2	C					12.4	B			

Notes:
(1) V/C denotes volume-to-capacity ratio.
(2) LOS denotes level-of-service
(3) See Appendix E for detailed Level-of-Service Worksheets

2017 Background

The results of the level-of-service analysis of 2017 background conditions without project generated traffic is summarized In Table 10 Mitigation is required at the intersections of Queen Kaahumanu Highway at Kaimi Nani Drive and Mamalahoa Highway at Kaimi Nani Drive because the volume-to-capacity ratios will be 1.00 or greater without mitigation. Traffic signals should also be installed at the intersection of Kaimi Nani Drive at Main Street when traffic signal warrants are satisfied. Mitigation measures assessed include the following:

1. Install second left turn lane from westbound Kaimi Nani Drive to southbound Kaahumanu Highway.

2. Widen Mamalahoa Highway from two to four lanes from north of Kaimi Nani Drive to south of Kaimi Nani Drive.

3. Install traffic signals at the intersection of Kaimi Nani Drive at Main Street when traffic signals are warranted. A traffic signal warrant study should be performed to determine if the warrants are satisfied as only peak hour projections are available and the peak hour warrant may not be applicable to this intersection.

Table 10 2017 Background Levels-of-Service

	AM Peak Hour						PM Peak Hour					
	Without Mitigation			With Mitigation			Without Mitigation			With Mitigation		
Intersection	V/C	Delay [1]	LOS [2]	V/C	Delay	LOS	V/C	Delay	LOS	V/C	Delay	LOS
Queen K Hwy at Keahole Airport Access Rd	0.73	12.0	B				0.95	17.9	B			
Queen K Hwy at Kaimi Nani Dr	0.96	36.1	D	0.78	21.9	C	1.00	27.7	C	0.95	23.3	C
Mamalahoa Hwy at Kaimi Nani Dr	1.19	48.9	D	0.98	18.0	B	1.03	19.3	B	0.92	13.1	B
Mamalahoa Hwy at Makalei Estates		18.0	C					23.6	C			
Queen K Hwy at University Dr	0.73	21.0	C				0.95	27.8	C			
Kaimi Nani Dr at Main St		86.5	F	0.75	11.9	B		174.0	F	0.79	17.9	B
Mamalahoa Hwy at Ahikawa St		22.3	C					15.1	C			

Notes:
(1) V/C denotes volume-to-capacity ratio.
(2) LOS denotes level-of-service
(3) See Appendix F for detailed Level-of-Service Worksheets

2023 Background

The results of the level-of-service analysis of 2023 background conditions without project generated traffic is summarized In Table 11. The following mitigation measures were assessed:

1. At the intersection of Queen Kaahumanu Highway at Keahole Airport Access Road, construct a third southbound through lane.

2. At the intersection of Queen Kaahumanu Highway at Kaimi Nani Drive, construct a second left turn lane from southbound Queen Kaahumanu Highway at eastbound Kaimi Nani Drive.

3. At the intersection of Mamalahoa Highway at Kaimi Nani Drive, modify the traffic signals to provide a protected eastbound to southbound right turn.

4. At the intersection of Mamalahoa Highway at Makalei Estates, construct a left turn refuge lane for eastbound to northbound left turns.

5. At the intersection of Queen Kaahumanu Highway at University Drive construct a second westbound to southbound left turn lane and construct a second southbound to eastbound left turn lane.

6. At the intersection of Mamalahoa Highway at Ahikawa Street, construct a left turn refuge lane for left turns from eastbound Ahikawa Street to northbound Mamalahoa Highway.

Table 11 2023 Background Levels-of-Service

	AM Peak Hour						PM Peak Hour					
	Without Mitigation			With Mitigation			Without Mitigation			With Mitigation		
Intersection	V/C	Delay [1]	LOS [2]	V/C	Delay	LOS	V/C	Delay	LOS	V/C	Delay	LOS
Queen K Hwy at Keahole Airport Access Rd	0.88	20.0	C	0.85	14.7	B	1.19	50.9	D	0.97	18.2	B
Queen K Hwy at Kaimi Nani Dr	0.94	28.4	C	0.89	25.2	C	1.15	47.8	D	0.95	22.7	C
Mamalahoa Hwy at Kaimi Nani Dr	1.14	31.1	C	0.98	16.4	B	1.06	16.9	B	0.92	12.7	B
Mamalahoa Hwy at Makalei Estates		22.8	C		17.0	C		58.2	F		24.4	C
Queen K Hwy at University Dr	0.87	26.2	C	0.72	16.9	B	1.15	47.6	D	0.91	22.0	C
Kaimi Nani Dr at Main St	0.86	16.5	B				0.89	19.9	B			
Mamalahoa Hwy at Ahikawa St		58.5	F		46.0	E		21.7	C		15.9	C

Notes:
(1) V/C denotes volume-to-capacity ratio.
(2) LOS denotes level-of-service
(3) See Appendix G for detailed Level-of-Service Worksheets

4. PROJECT-RELATED TRAFFIC CHARACTERISTICS

This chapter discusses the methodology used to estimate peak hour traffic projections with traffic associated with the project. In this case, this involves estimating the traffic diverted to Main Street from the adjacent roadnet, assigning traffic from the related projects described in the previous chapter and then assigning traffic generated by the new UHCWH. This chapter presents the resulting traffic projections. The results of the Level-of-Service analysis of background plus project conditions is presented in the following chapter.

Trip Generation Analysis

Traffic volumes generated by the project were estimated using the procedures described in the *Trip Generation Handbook* [3] and data provided in *Trip Generation*.[4] The methodology uses trip generation rates or equations to estimate the number of trips that a project will generate. Rates and/or equations are typically provided for the following conditions:

Weekday Total
Weekday AM Peak Hour of the Adjacent Street
Weekday PM Peak Hour of the Adjacent Street
Weekday AM Peak Hour of the Generator
Weekday PM Peak Hour of the Generator
Saturday Daily
Saturday Peak Hour
Sunday Daily

[3] Institute of Transportation Engineers, *Trip Generation Handbook*, Washington, D.C., 1998, p. 7-12

[4] Institute of Transportation Engineers, *Trip Generation, Seventh Edition*, Washington, D.C., 2003

Sunday Peak Hour

However, in many cases, *Trip Generation* does not provide data for all the conditions listed above. For example, for residential uses, *Trip Generation* provides data for the “AM Peak Hour” and “PM Peak Hour” and not distinguish between the peak hour of the street and peak hour of the generator. Therefore, it is assumed that the peak hours of the adjacent street and peak hours of the generator coincide.

The trip generation analysis are summarized in Table 12.

Table 12 Trip Generation Analysis

Period & Direction		Trips per TGSF or Percent (1)	Phase 1	Phases 1 & 2	Phases 1 thru 3	Phases 1 thru 4
			26.354	38.358	98.439	165.815
Weekday Total		27.49	725	1055	2705	4560
AM Peak Hour	Total	2.99	80	115	295	495
	Inbound	74%	60	85	220	365
	Outbound	26%	20	30	75	130
PM Peak Hour	Total	3.09	65	95	250	420
	Inbound	58%	40	55	145	245
	Outbound	42%	25	40	105	175

Notes:
(1) Trip rates for the morning and afternoon peak hours of the adjacent street are used for the AM and PM peak hours, respectively.

Trip Distribution and Assignments

Trips to and from the project were distributed in proportion to the estimated 2010 population of West Hawaii (North Kohala, South Kohala, North Kona, South Kona and Hamakua) as reported in the Hawaii County General Plan 2005. The distribution calculations are summarized in Table 13. Based on the results shown, trips to and from the project were distributed as follows:

22% To and from north via Queen Kaahumanu Highway
47% To and from south via Queen Kaahumanu Highway
20% To and from north via Mamalahoa Highway
11% To and from south via Mamalahoa Highway

The project trip assignments are shown on Figures 15 thru 22.

Table 13 Trip Distribution Calculations

	Percent Approaching via					Population Approaching via			
	Queen K		Mamalahoa			Queen K		Mamalahoa	
District	From North	From South	From North	From South	2010 Population	From North	From South	From North	From South
N. Kohala	100%				7,917	7,917	0	0	0
S. Kohala	50%		50%		18,184	9,092	0	9,092	0
N. Kona		75%		25%	34,024	0	25,518	0	8,506
S. Kona		100%			11,414	0	11,414	0	0
Hamakua			100%		6,561	0			0
TOTALS						17,009	36,932	9,092	8,506
PERCENT						22%	47%	20%	11%

NOTES
(1) Source: Hawaii County, *County of Hawaii General Plan 2005*, Table 1.6a

Background Plus Project Traffic Projections

Future background traffic projections were calculated by adding the project generated traffic to the background traffic projections discussed in the previous chapter. The resulting background plus project peak hour traffic projections are shown on Figures 23 through 30.

5. TRAFFIC IMPACT ANALYSIS

The purpose of this chapter is to summarize the results of the level-of-service analysis, which identifies the project-related impacts for build out of the project. In addition, any mitigation measures necessary and feasible are identified and other access, egress and circulation issues are discussed.

The impact of the project was assessed by analyzing the changes in levels-of-service at the study intersections. Mitigation measures are described in the following chapter.

Methodology for Level-of-Service Analysis

1. State of Hawaii Department of Transportation (Honolulu) has requested the Synchro software package be used to performed level-of-service analyses on previous projects. Accordingly, Synchro 6 was used to perform the level-of-service analysis for both signalized and unsignalized intersections.

2. For signalized intersections, only the overall intersection levels-of-service are shown in the following level-of-service tables. Detailed results indicating the results of the level-of-service analysis for each lane group is presented as Appendices.

3. The *Highway Capacity Manual* methodology does not report a volume-to-capacity ratio for unsignalized intersections or results for the overall intersection. The methodology calculates the delay and level-of-service of controlled movements only. Shown in the following tables are the delay and level-of-service of the controlled movement with the longest delay and lowest level-of-service.

4. The *Highway Capacity Manual* defines level-of-service by delay.

Assumptions of the Level-of-Service Analysis

1. The level-of-service analysis assumed worse-case conditions. It was assumed that:
    a. The peak hours of all the study intersections coincide with the peak hour of the study project.
    b. All the related projects and the study project are 100% occupied,
    c. The peak hourly traffic of all the related projects and the study project coincide with the with all the intersection peak hours.
2. The minimum acceptable level-of-service is Level-of-Service D for the overall intersection and the major through movements. Level-of-Service E or F is acceptable for short periods during peak hours for minor movements and side street approaches.
3. Volume-to-capacity ratios cannot be greater than 1.00.
4. It was assumed that the traffic impacts of the related projects have been mitigated. This means that unacceptable levels-of-service for background without project traffic conditions have been mitigated by the mitigation measure described in Chapter 3.

Results of Level-of-Service Analysis

The results of the level-of-service analysis is discussed separately for each phase.

Phase 1 - 2011

The results of the level-of-service analysis for 2011 background plus project conditions are summarized in Table 14. All intersections will operate at Level-of-Service C or better except the northbound approach of Main Street at Kaimi Nani Drive. This is the driveway to and from Lokahi Subdivision. No mitigation is recommended as there are two other driveways serving the subdivision that provide alternative routes.

Table 14 2011 Background Plus Phase 1 Levels-of-Service

	AM Peak Hour						PM Peak Hour					
	Without Project			With Project			Without Project			With Project		
Intersection	V/C	Delay [1]	LOS [2]	V/C	Delay	LOS	V/C	Delay	LOS	V/C	Delay	LOS
Queen K Hwy at Keahole Airport Access Rd	0.72	12.8	B	0.72	12.8	B	0.87	19.1	B	0.87	19.1	B
Queen K Hwy at Kaimi Nani Dr	0.82	27.7	C	0.82	27.7	C	0.75	20.1	B	0.75	20.1	C
Mamalahoa Hwy at Kaimi Nani Dr	0.97	13.5	B	0.97	13.5	B	0.77	8.0	A	0.77	8.0	A
Mamalahoa Hwy at Makalei Estates		11.0	B		11.0	B		11.4	B		11.4	B
Queen K Hwy at University Dr	0.58	11.8	B	0.58	11.8	B	0.58	11.1	B	0.58	11.1	B
Kaimi Nani Dr at Main St		51.9	F		51.9	F		29.4	D		29.4	D
Mamalahoa Hwy at Ahikawa St		15.0	C		15.2	C		11.9	B		12.0	B
Main St at UH Driveway					8.8	A					8.6	A

Notes:
(1) V/C denotes volume-to-capacity ratio.
(2) LOS denotes level-of-service
(3) See Appendix H for detailed Level-of-Service Worksheets

Phase 2 - 2012

The results of the level-of-service analysis for 2012 background plus project conditions are summarized in Table 15. The levels-of-service shown reflect the improvements required to mitigate background without project traffic conditions at the intersection of Mamalahoa Highway at Kaimi Nani Drive. No additional mitigation is required.

Table 15 2012 Background Plus Phases 1 and 2 Levels-of-Service

	AM Peak Hour						PM Peak Hour					
	Without Project			With Project			Without Project			With Project		
Intersection	V/C	Delay [1]	LOS [2]	V/C	Delay	LOS	Without Project			With Project		
Queen K Hwy at Keahole Airport Access Rd	0.75	13.4	B	0.75	13.4	B	0.90	20.3	C	0.90	20.3	C
Queen K Hwy at Kaimi Nani Dr	0.84	28.7	C	0.86	31.7	C	0.75	20.4	C	0.78	21.2	C
Mamalahoa Hwy at Kaimi Nani Dr	0.93	12.7	B	0.94	13.2	B	0.79	8.0	A	0.80	8.2	A
Mamalahoa Hwy at Makalei Estates		11.0	B		11.2	B		11.4	B		11.5	B
Queen K Hwy at University Dr	0.60	12.3	B	0.75	13.2	B	0.60	11.6	B	0.61	11.8	B
Kaimi Nani Dr at Main St		42.4	E		66.4	F		28.7	D		33.8	D
Mamalahoa Hwy at Ahikawa St		16.2	C		16.6	C		12.4	B		12.6	B
Main St at UH Driveway					8.9	A					7.3	A

Notes:
(1) V/C denotes volume-to-capacity ratio.
(2) LOS denotes level-of-service
(3) See Appendix I for detailed Level-of-Service Worksheets

Phase 3 - 2017

The results of the level-of-service analysis for 2017 background plus project conditions are summarized in Table 16. All movements will operate at Level-of-Service C or better, except the eastbound approach at the intersection of Mamalahaoa Highway at Makalei Estates. No additional mitigation is required.

Table 16 2017 Background Plus Phases 1, 2 and 3 Levels-of-Service

	AM Peak Hour						PM Peak Hour					
	Without Project			With Project			Without Project			With Project		
Intersection	V/C	Delay [1]	LOS [2]	V/C	Delay	LOS	V/C	Delay	LOS	V/C	Delay	LOS
Queen K Hwy at Keahole Airport Access Rd	0.73	12.0	B	0.73	12.0	B	0.95	17.9	B	0.95	17.9	B
Queen K Hwy at Kaimi Nani Dr	0.78	21.9	C	0.83	18.6	C	0.95	23.3	C	1.00	25.2	C
Mamalahoa Hwy at Kaimi Nani Dr	0.98	18.0	B	1.00	19.3	B	0.92	13.1	B	0.94	13.4	B
Mamalahoa Hwy at Makalei Estates		18.0	C		16.0	C		23.6	C		35.3	E
Queen K Hwy at University Dr	0.73	21.0	C	0.76	22.8	C	0.95	27.8	C	0.97	28.9	C
Kaimi Nani Dr at Main St	0.75	11.9	B	0.84	23.8	C	0.79	17.9	B	0.80	16.5	B
Mamalahoa Hwy at Ahikawa St		22.3	C		22.3	C		15.1	C		15.1	C
Main St at UH Driveway					11.0	B					10.8	B

Notes:
(1) V/C denotes volume-to-capacity ratio.
(2) LOS denotes level-of-service
(3) See Appendix J for detailed Level-of-Service Worksheets

Phase 4 - 2023

The results of the level-of-service analysis for 2023 background plus project conditions are summarized in Table 17. Additional mitigation is required as follows:

1. Construct a second northbound to eastbound right turn lane along Kaimi Nani Drive at Queen Kaahumanu Highway.

2. Widen Kaimi Nani between Queen Kaahumanu Highway to east of Main Street.

Table 17 2023 Background Plus Phases 1, 2, 3 and 4 Levels-of-Service

	AM Peak Hour						PM Peak Hour					
	Without Project			With Project			Without Project			With Project		
Intersection	V/C	Delay [1]	LOS [2]	V/C	Delay	LOS	V/C	Delay	LOS	V/C	Delay	LOS
Queen K Hwy at Keahole Airport Access Rd	0.85	14.7	B	0.85	14.7	B	0.97	18.2	B	0.97	18.2	B
Queen K Hwy at Kaimi Nani Dr	0.89	25.2	C	0.89	26.0	C	0.95	22.7	C	1.03	24.4	C
Mamalahoa Hwy at Kaimi Nani Dr	0.98	16.4	B	0.98	17.5	B	0.92	12.7	B	0.93	13.2	B
Mamalahoa Hwy at Makalei Estates		17.0	C		17.0	C		24.4	C		44.0	E
Queen K Hwy at University Dr	0.72	16.9	B	0.77	18.3	B	0.91	22.0	C	0.95	22.7	C
Kaimi Nani Dr at Main St	0.86	16.5	B	1.01	59.6	E	0.89	19.9	B	0.92	24.7	C
Mamalahoa Hwy at Ahikawa St		46.0	E		46.0	E		15.9	C		15.9	C
Main St at UH Driveway					13.5	B					14.5	B

Notes:
(1) V/C denotes volume-to-capacity ratio.
(2) LOS denotes level-of-service
(3) See Appendix K for detailed Level-of-Service Worksheets

Mitigation

The following is a summary of the mitigation measures assessed:

2011 Background Conditions Without Project Traffic

1. Construct a traffic signal at the intersection of Mamalahoa Highway at Kaimi Nani Drive.

2011 Background Conditions Plus Phase 1 Traffic

1. No additional mitigation required

2012 Background Conditions Without Project Traffic

1. Construct southbound right turn lane along Mamalahoa Highway at Kaimi Nani Drive.

2012 Background Conditions With Phases 1 and 2 Traffic

1. No additional mitigation required.

2017 Background Conditions Without Project Traffic

1. At the intersection of Queen Kaahumanu Highway at Kaimi Nani Drive, construct a second westbound left turn lane.

2. Widen Mamalahoa Highway from two to four lanes from north of Kaimi Nani Drive southward.

3. Install traffic signals at the intersection of Kaimi Nani Drive at Main Street.

2017 Background Plus Phases 1, 2 and 3 Project Traffic

1. No additional mitigation required.

2023 Background Conditions Without Project Traffic

1. Add third southbound through lane along Queen Kaahumanu highway between Keahole Airport Access Road and Kaimi Nani Drive.

2. At the intersection of Queen Kaahumanu Highway at Kaimi Nani Drive, add second southbound left turn lane.

3. At intersection of Mamalahoa Highway at Kaimi Nani Drive, modify traffic signals to provide protected eastbound right turn movement.

4. At intersection of Mamalahoa Highway at Makalei Estates, install left turn refuge lane along Mamalahoa Highway.

5. At the intersection of Queen Kaahumanu Avenue at University Drive, add second southbound left turn lane and second westbound left turn lane.

6. At the intersection of Mamalahoa Highway at Ahikawa Street, add a left turn refuge lane for eastbound to northbound left turns.

2023 Background Plus Phases 1, 2, 3 and 4 Project Traffic

1. Construct a second northbound to eastbound right turn lane along Kaimi Nani Drive at Queen Kaahumanu Highway.

2. Widen Kaimi Nani between Queen Kaahumanu Highway to east of Main Street..

Main Street Collector Road

One of the purposes of this traffic report is to provide left turn storage lane requirements for the intersections of Main Street at Kaimi Nani Drive and Main Street at the UHCWH Driveway.

The left turn storage lengths required to accommodate estimated traffic volumes were calculated using guidelines in *A Policy on Geometric Design of Highways and Streets* published by the American Association of State Highway and Transportation Officials, 1990 edition. There are separate policies for signalized and unsignalized intersections. Based on this policy, the assumptions used to determine the required lengths of the left turn storage lanes are:

(1) For signalized intersections, the length of the left turn storage lane should be "1.5 to 2.0 times the average number of vehicles that would store per cycle, which is predicted on the design volume."

(2) For unsignalized intersections, the length of the left turn storage lane is "based on the number of vehicles likely to arrive in an average 2-minute period within the peak hour. As a minimum requirements, space for at least two passenger cars should be provided; with over 10 percent truck traffic, provisions should be made for at least one car and one truck."

(3) The average length required per vehicle is 20 feet.

(4) The traffic signal cycle lengths are described in Table 1.

Using the above criteria, the turn storage lane requirements were calculated for 2022 conditions with project generated traffic. The results are summarized in Table 18.

Table 17 Turn Storage Lane Requirements

Intersection	Approach	Design Volume	Cycle Length (Seconds)	Cycles per Hour	Average Vehicles per Cycle	Recommended Length (1)				Length Recommended (Ft)
						Minimum		Desirable		
						Veh	Ft	Veh	Ft	
Main Street at Kaimi Nani Drive	NB	80	180	20	4	6	120	8	160	160
	SB	145	180	20	7	11	220	14	280	280
	EB	170	180	20	9	14	280	18	360	360
	WB	20	180	20	1	2	60	2	40	60
Main Street at UHCWH	SB	155	120	30	5	8	160	10	200	200

NOTE:
(1) Minimum queue length is 1.5 time average number of vehicles. Desirable queue length is 2.0 time average number of vehicles.

Comments received regarding the previously submitted TIAR for Main Street questioned the viability of a roundabout at the intersection of Main Street at Kaimi Nani Drive. The results of the level-of-service analysis of the intersection as a roundabout is summarized in Table 19. As shown, the westbound approach will operate at Level-of-Service F during the morning peak hour and the eastbound approach will operate at Level-of-Service F during the afternoon peak hour.

Table 19 2022 Levels-of-Service - Main Street at Kaimi Nani Road Roundabout Conditions

Intersection and Movement	AM Peak Hour		PM Peak Hour	
	V/C [1]	LOS [2]	V/C	LOS
Eastbound Left, Thru & Right	0.39	B	1.10	F
Westbound Left, Thru & Right	1.29	F	0.44	B
Northbound Left, Thru & Right	0.11	A	0.11	A
Southbound Left, Thru & Right	0.33	B	0.26	B

NOTES:
(1) Delay in seconds per vehicle.
(2) LOS denotes Level-of-Service calculated using the operations method described in Highway Capacity Manual. Level-of-Service is based on delay.

Other Traffic Related Recommendations

1. A traffic signal warrant study should be performed for the intersection of Main Street at Kaimi Nani Drive prior to completion of Phase 3 of the UHCWH project.

2. A bus stop should be constructed in the vicinity of the UHCWH entrance along Main Street. This should be coordinated with Hele On to provide public transportation to the campus.

3. The TIAR should be updated after completion of Phase 3.

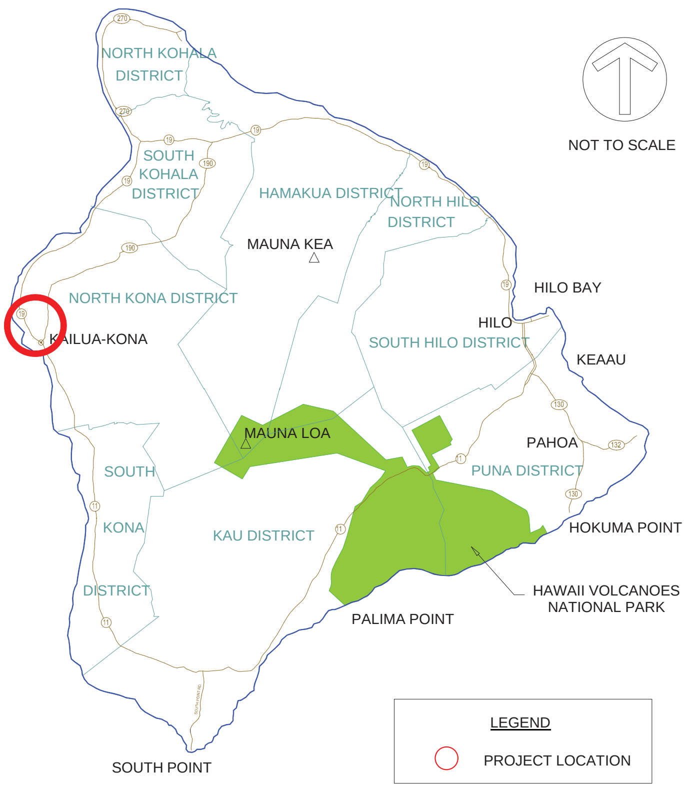


Figure 1
PROJECT LOCATION MAP

Phillip Rowell and Associates

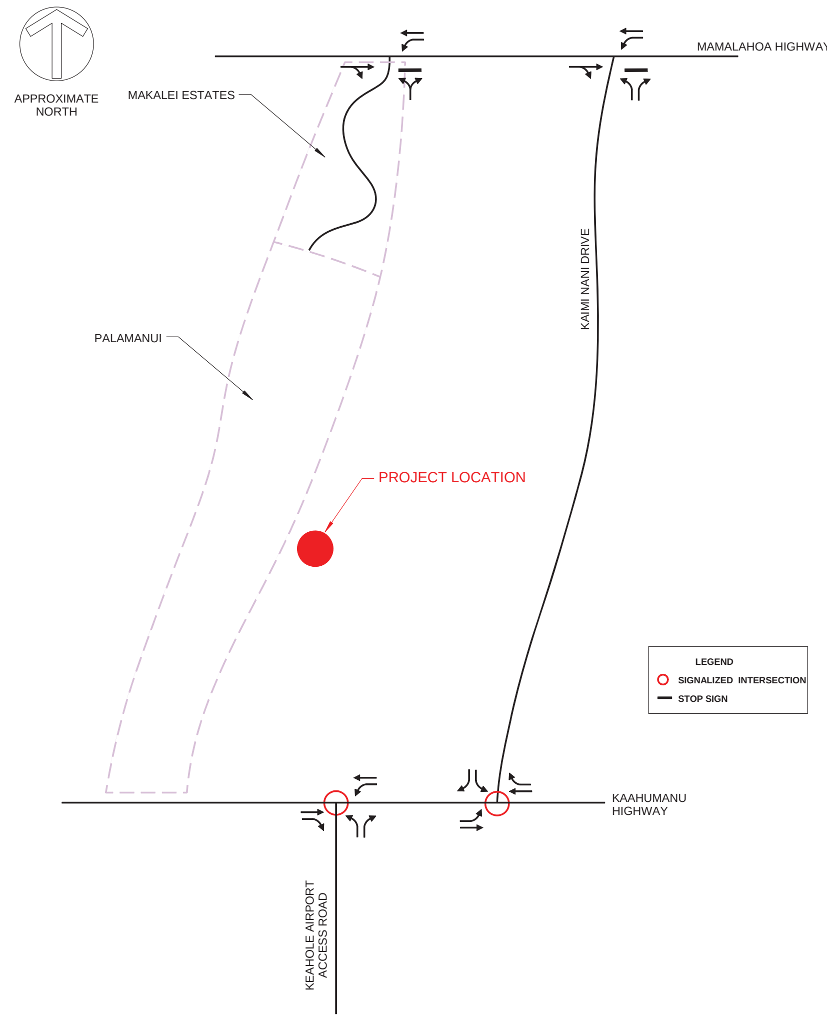


Figure 2
STUDY INTERSECTIONS, EXISITNG (2009) ROADWAY NETWORK AND LANE CONFIGURATIONS

Phillip Rowell and Associates

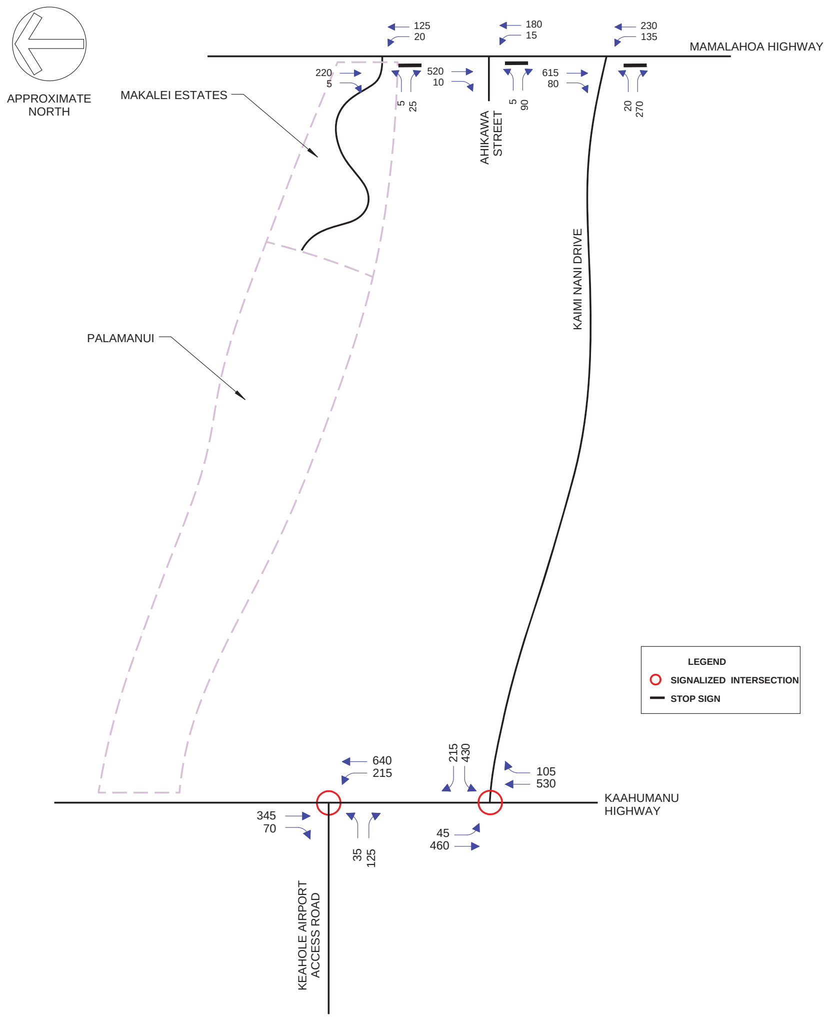


Figure 3
EXISTING (2009) AM PEAK HOUR TRAFFIC VOLUMES

Phillip Rowell and Associates

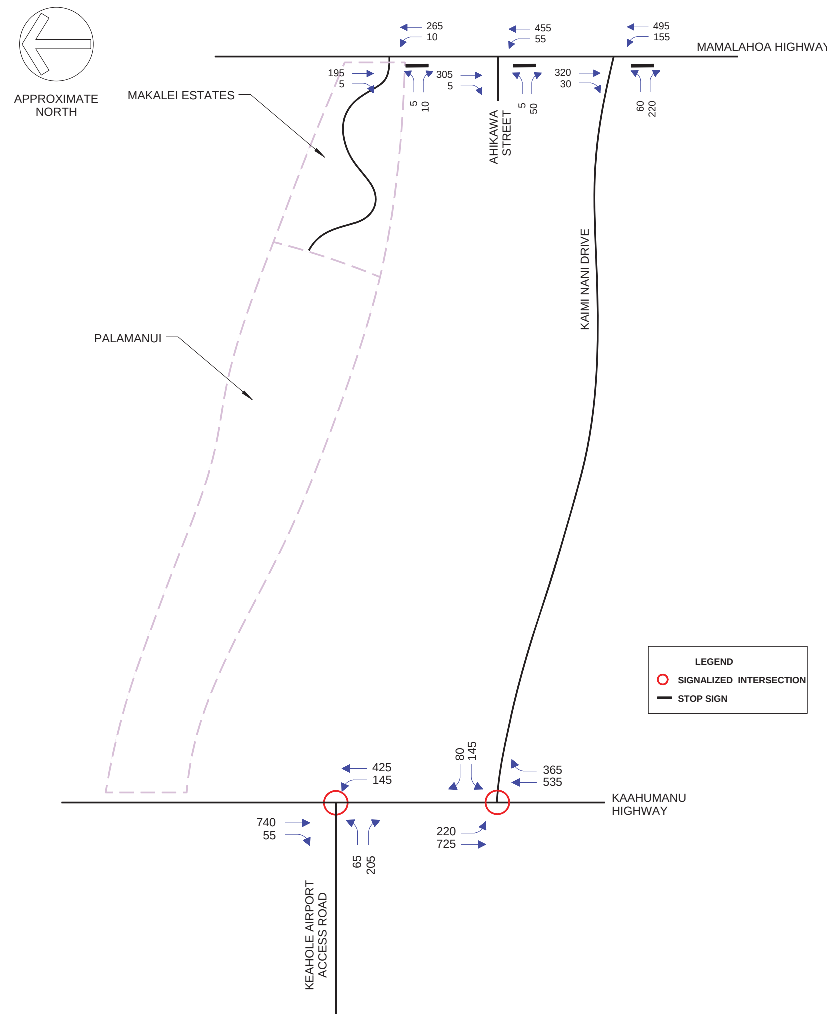


Figure 4
EXISTING (2009) PM PEAK HOUR TRAFFIC VOLUMES

Phillip Rowell and Associates

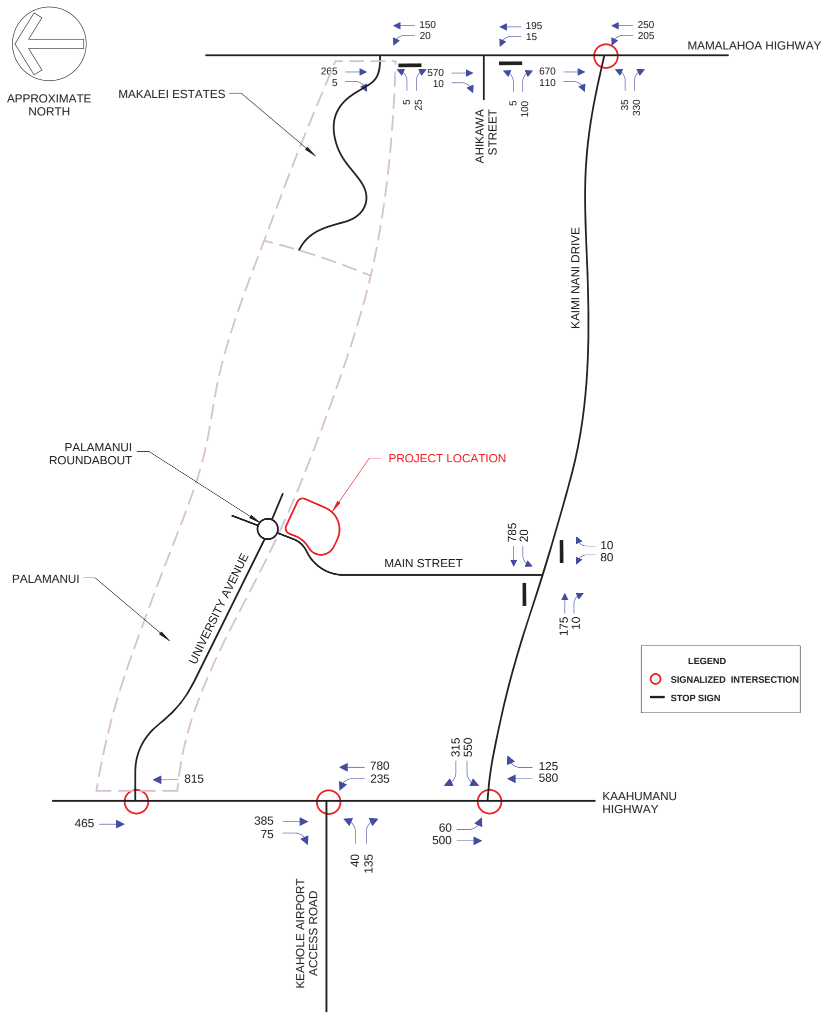


Figure 5
2011 BACKGROUND AM PEAK HOUR TRAFFIC PROJECTIONS

Phillip Rowell and Associates

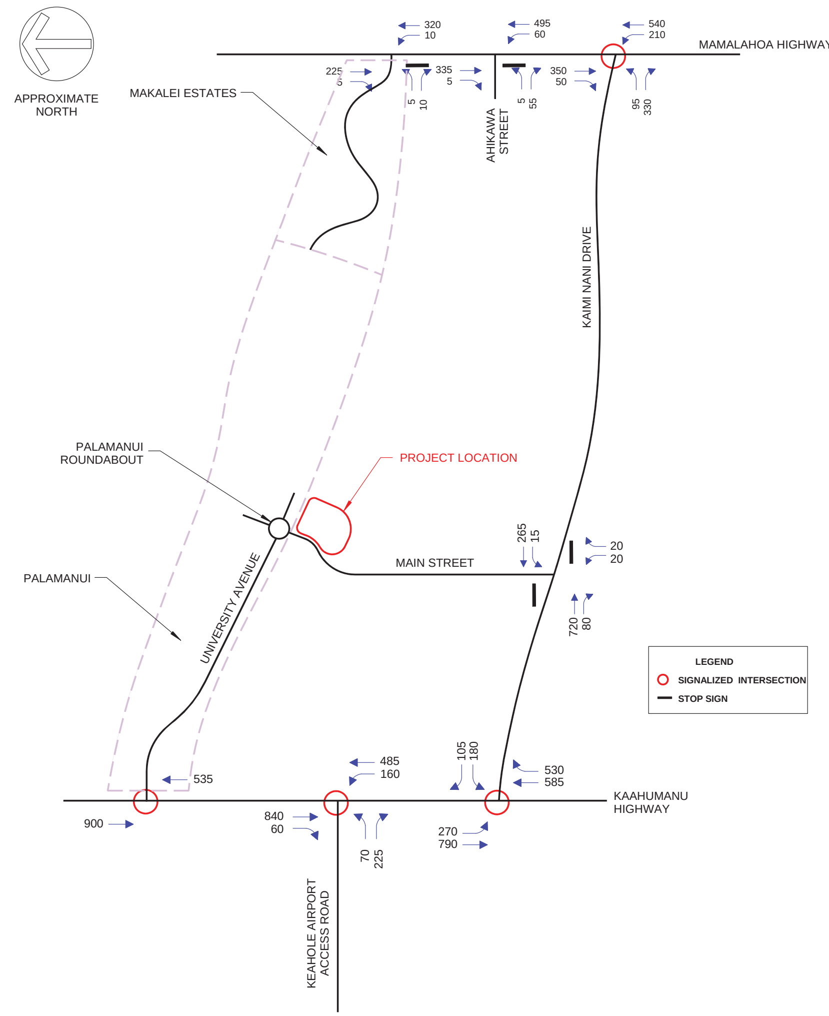


Figure 6
2011 BACKGROUND PM PEAK HOUR TRAFFIC PROJECTIONS

Phillip Rowell and Associates

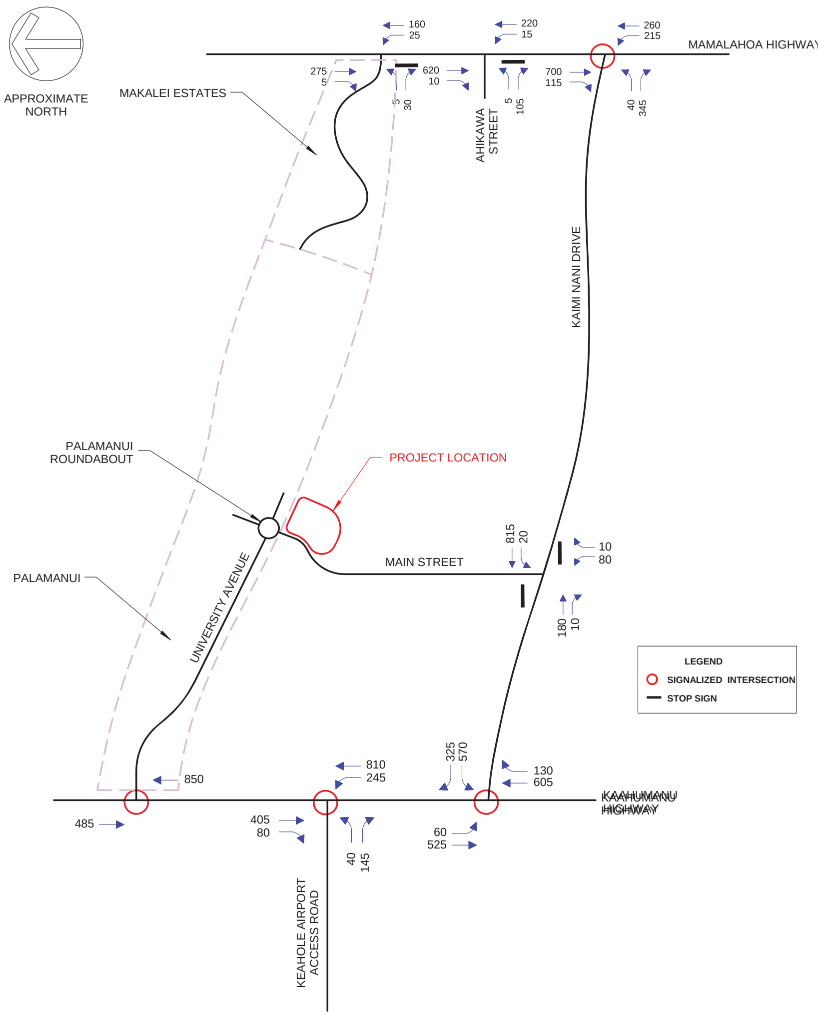


Figure 7
2012 BACKGROUND AM PEAK HOUR TRAFFIC PROJECTIONS

Phillip Rowell and Associates

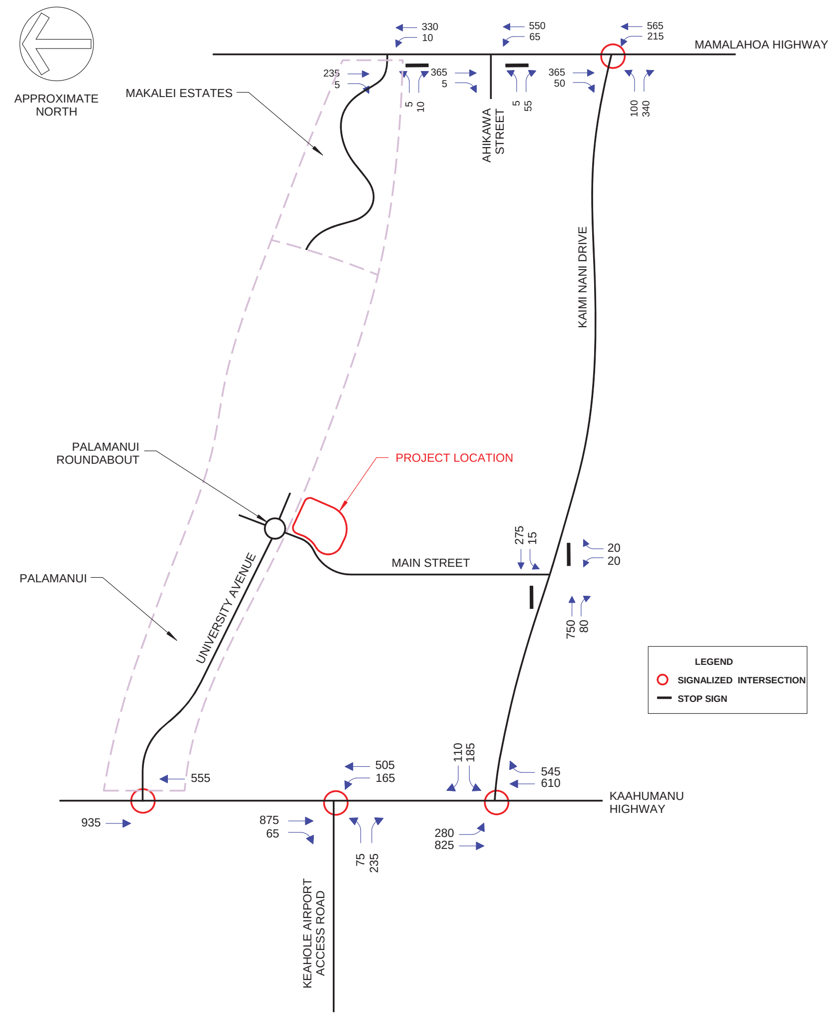


Figure 8
2012 BACKGROUND PM PEAK HOUR TRAFFIC PROJECTIONS

Phillip Rowell and Associates

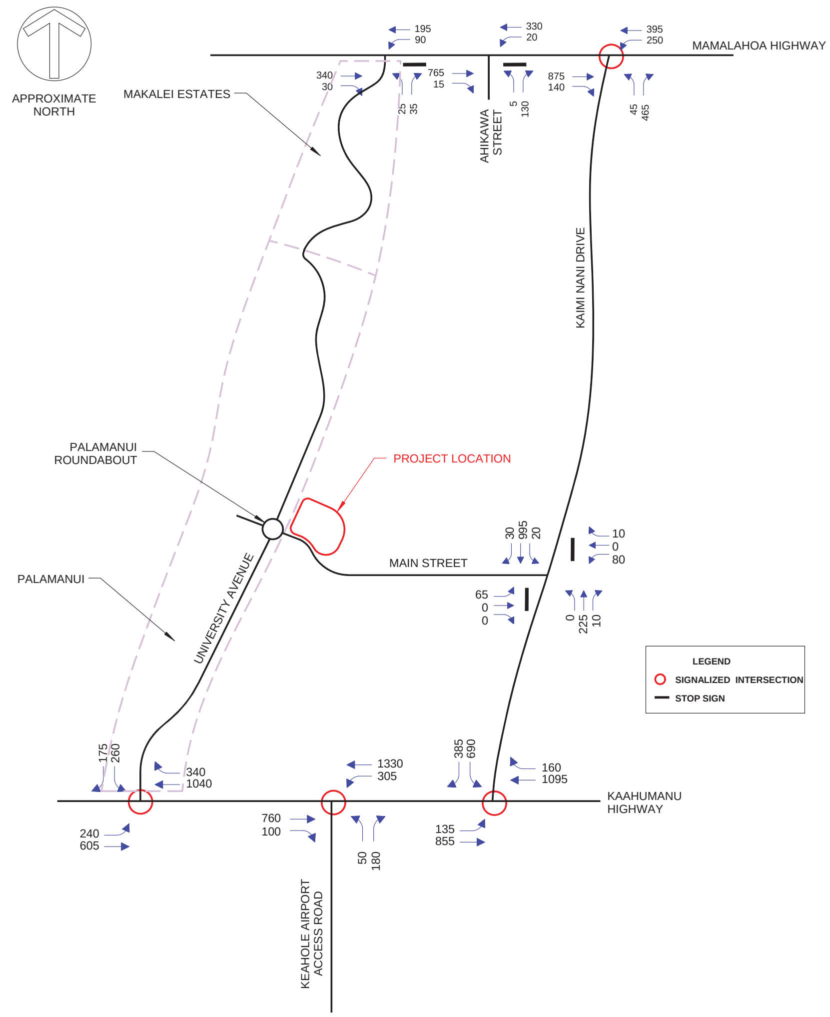


Figure 9
2017 BACKGROUND AM PEAK HOUR TRAFFIC PROJECTIONS

Phillip Rowell and Associates

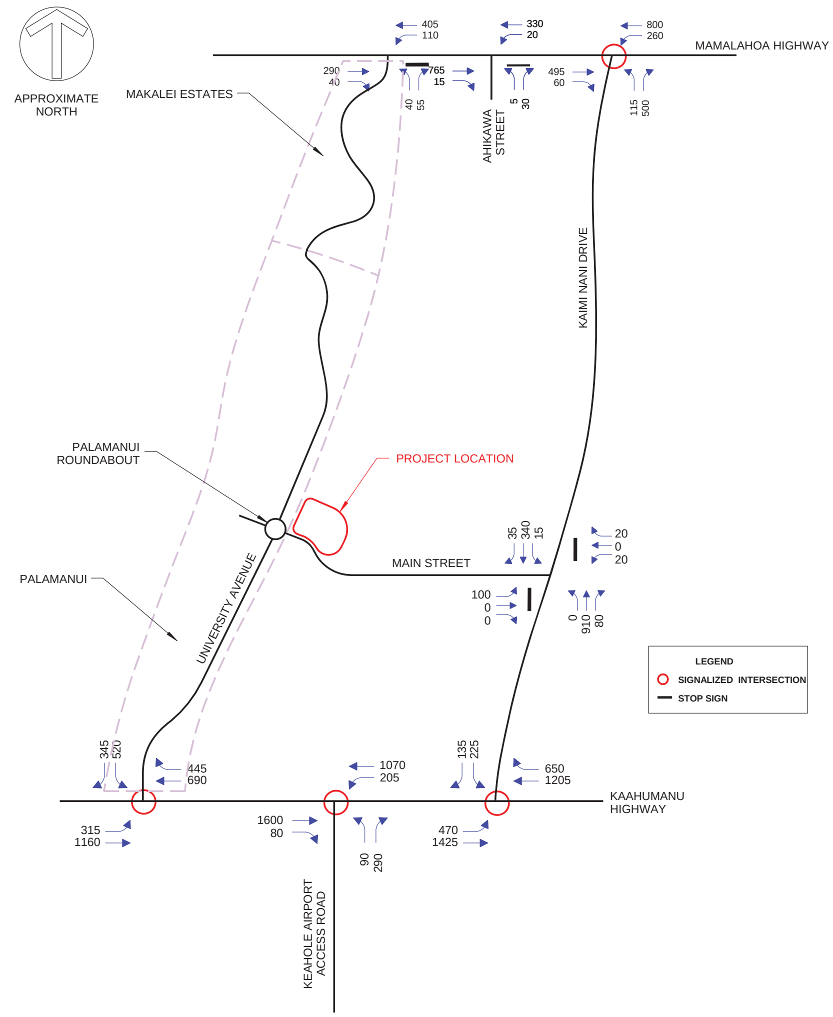


Figure 10
2017 BACKGROUND PM PEAK HOUR TRAFFIC PROJECTIONS

Phillip Rowell and Associates

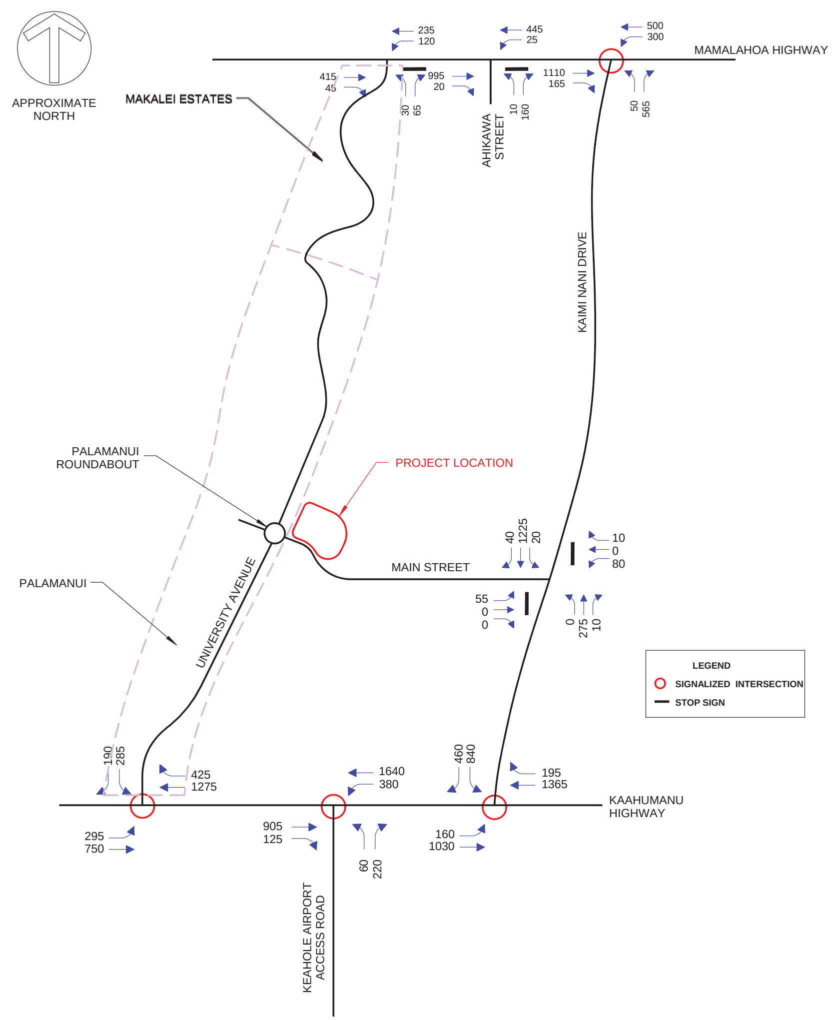


Figure 11
2022 BACKGROUND AM PEAK HOUR TRAFFIC PROJECTIONS

Phillip Rowell and Associates

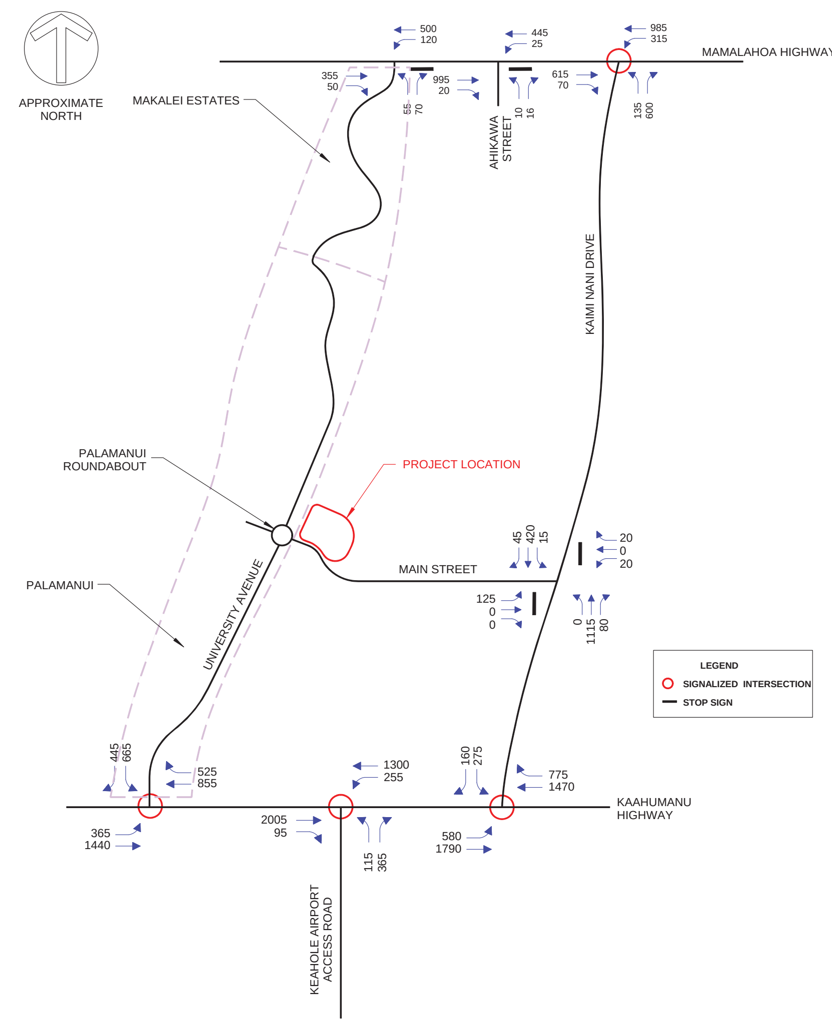


Figure 12
2022 BACKGROUND PM PEAK HOUR TRAFFIC PROJECTIONS

Phillip Rowell and Associates

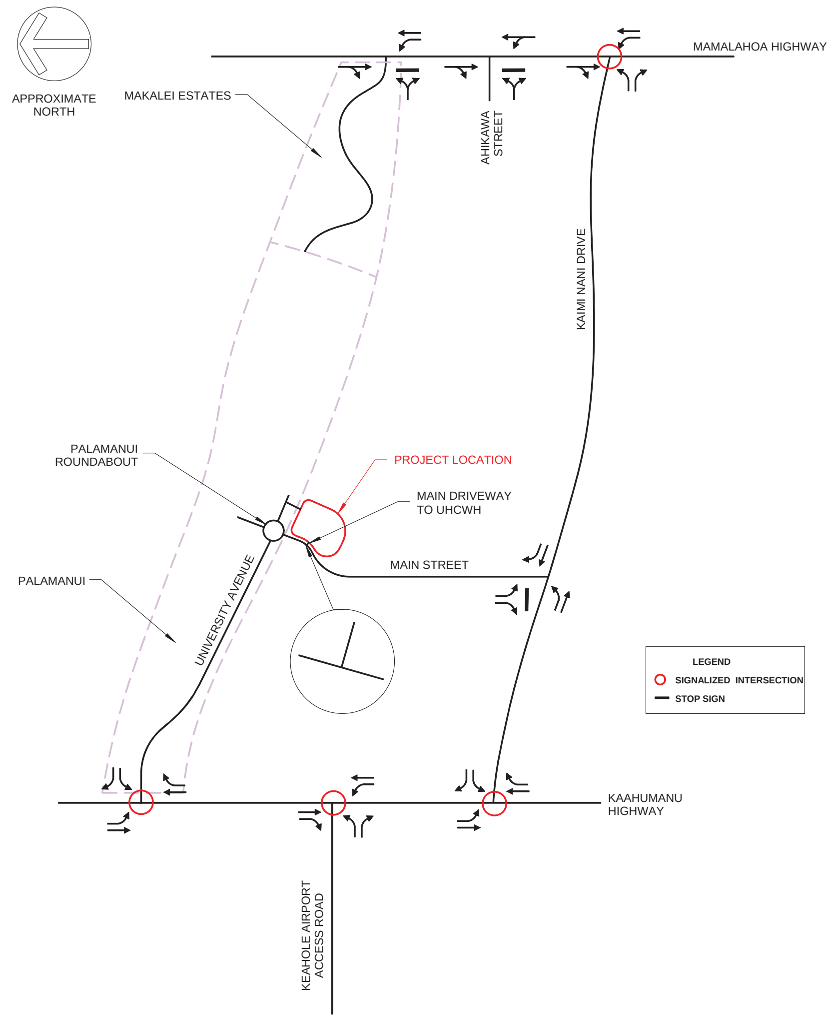


Figure 13
2011 AND 2012 ROADWAY NETWORK AND LANE CONFIGURATIONS

Phillip Rowell and Associates

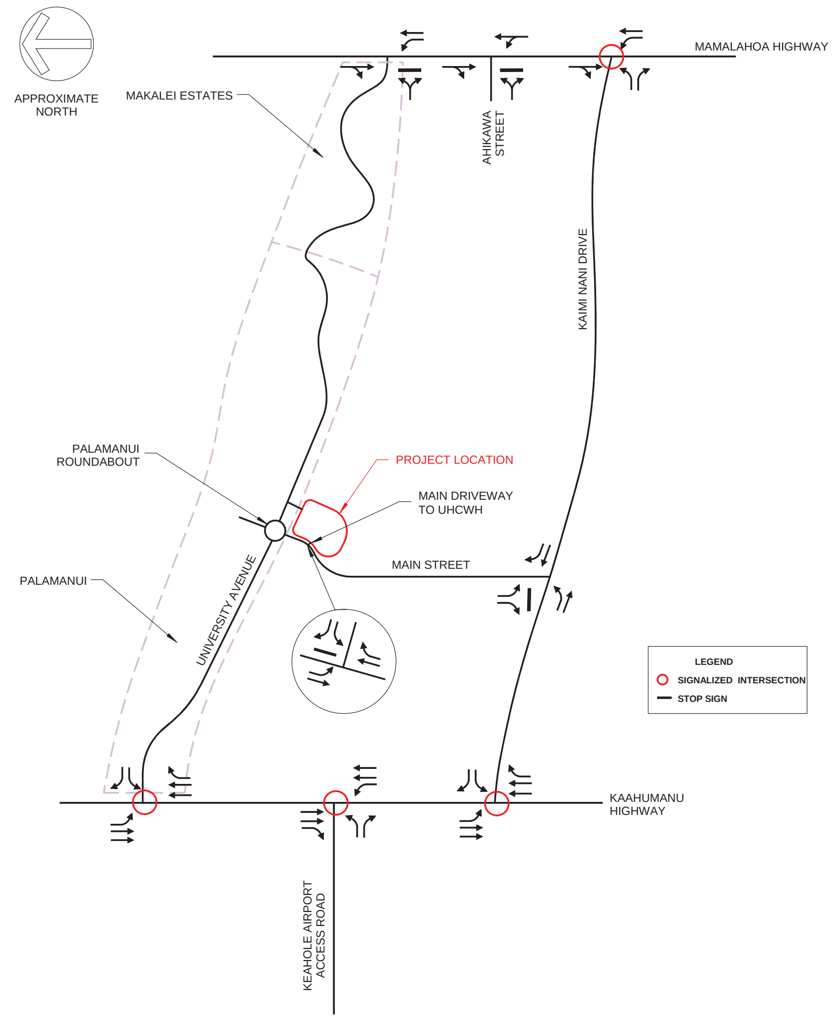


Figure 14
2017 AND 2022 ROADWAY NETWORK AND LANE CONFIGURATIONS

Phillip Rowell and Associates

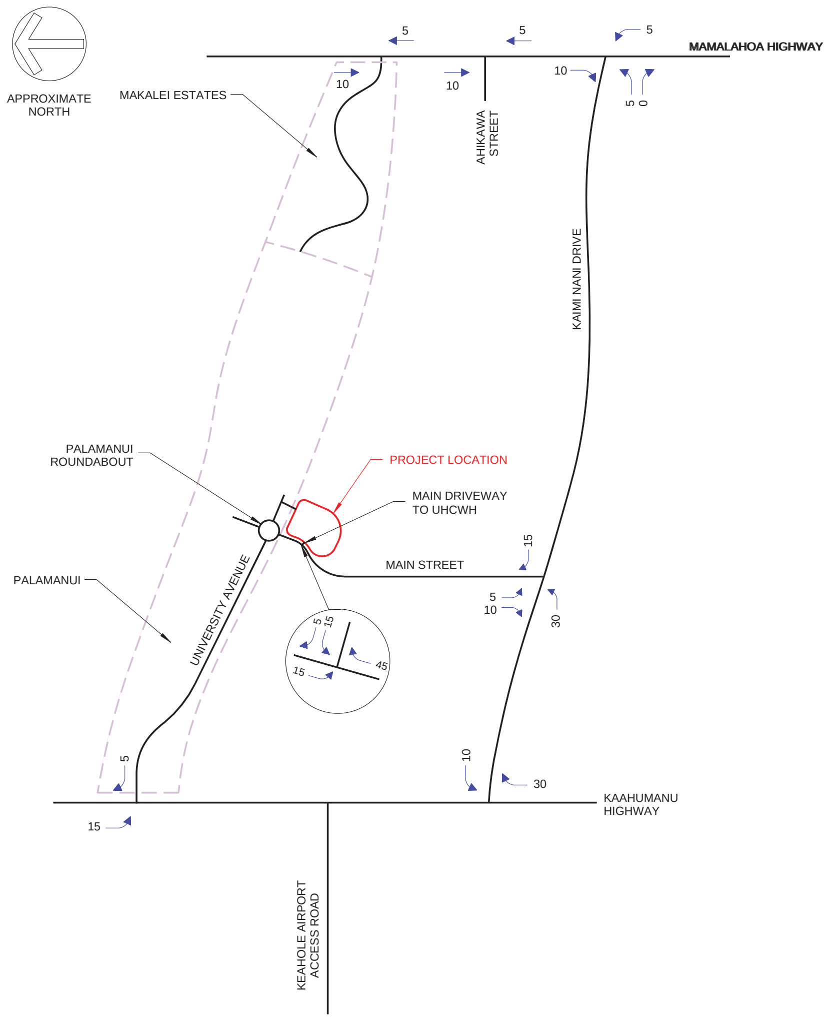


Figure 15
PHASE 1 AM PEAK HOUR PROJECT TRIP ASSIGNMENTS

Phillip Rowell and Associates

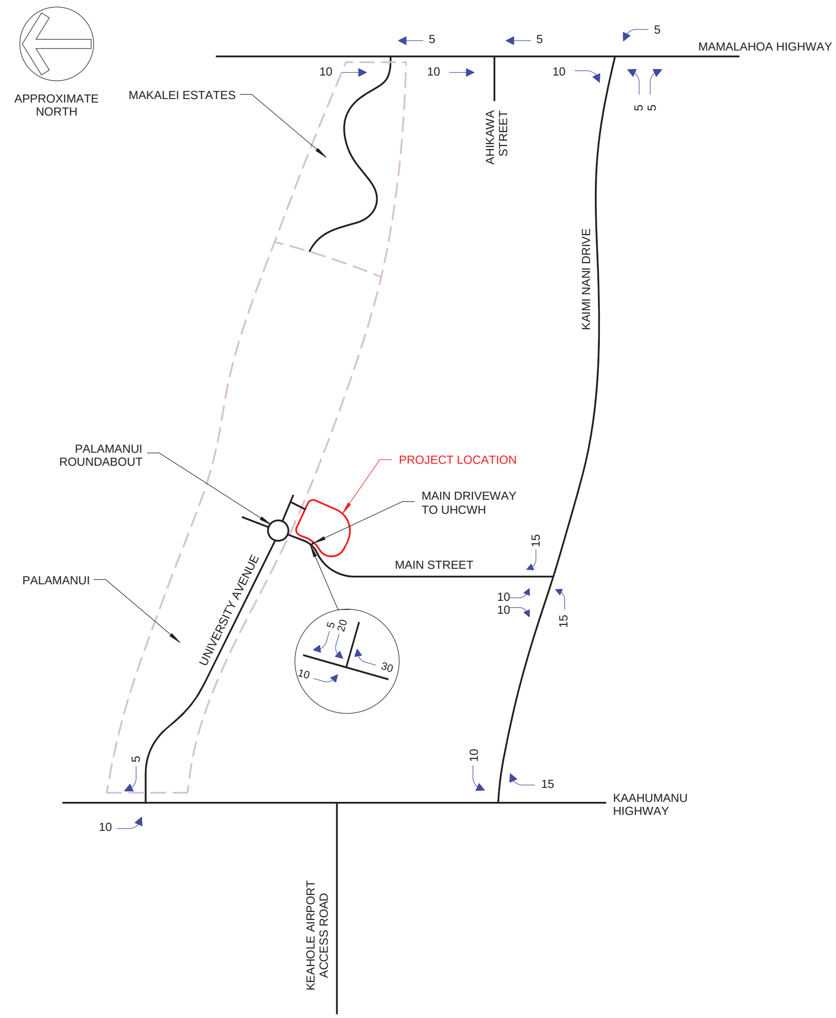


Figure 16
PHASE 1 PM PEAK HOUR PROJECT TRIP ASSIGNMENTS

Phillip Rowell and Associates

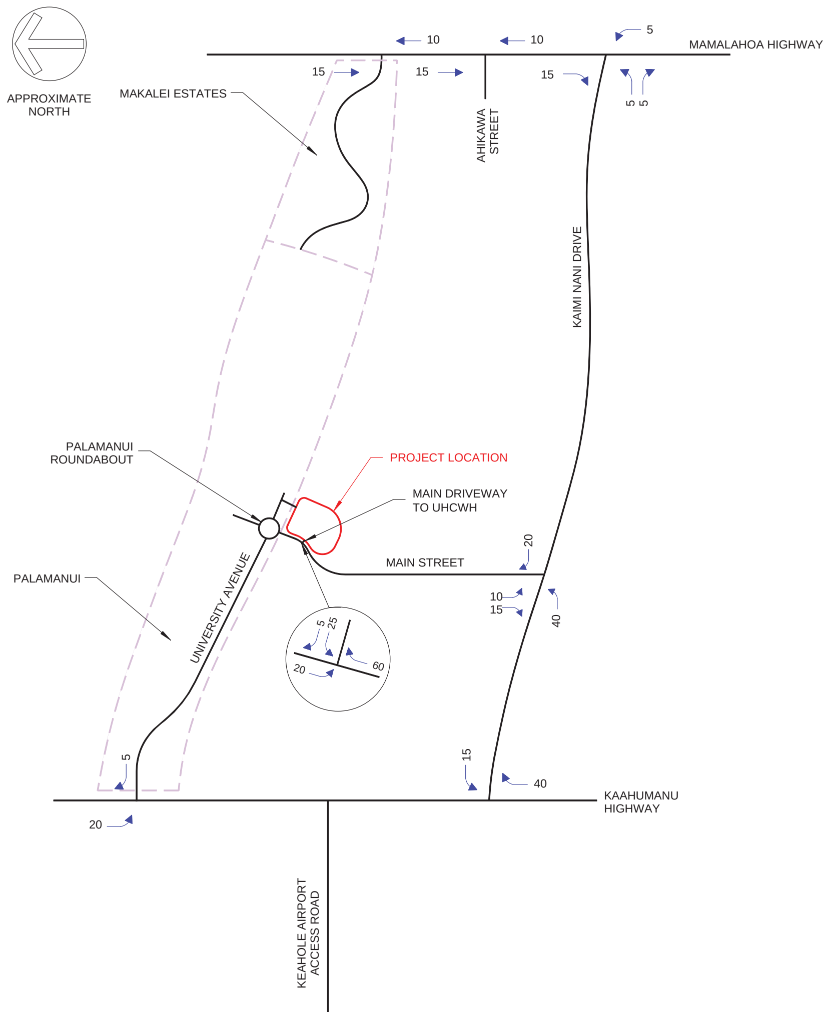


Figure 17
PHASES 1 AND 2 AM PEAK HOUR PROJECT TRIP ASSIGNMENTS

Phillip Rowell and Associates

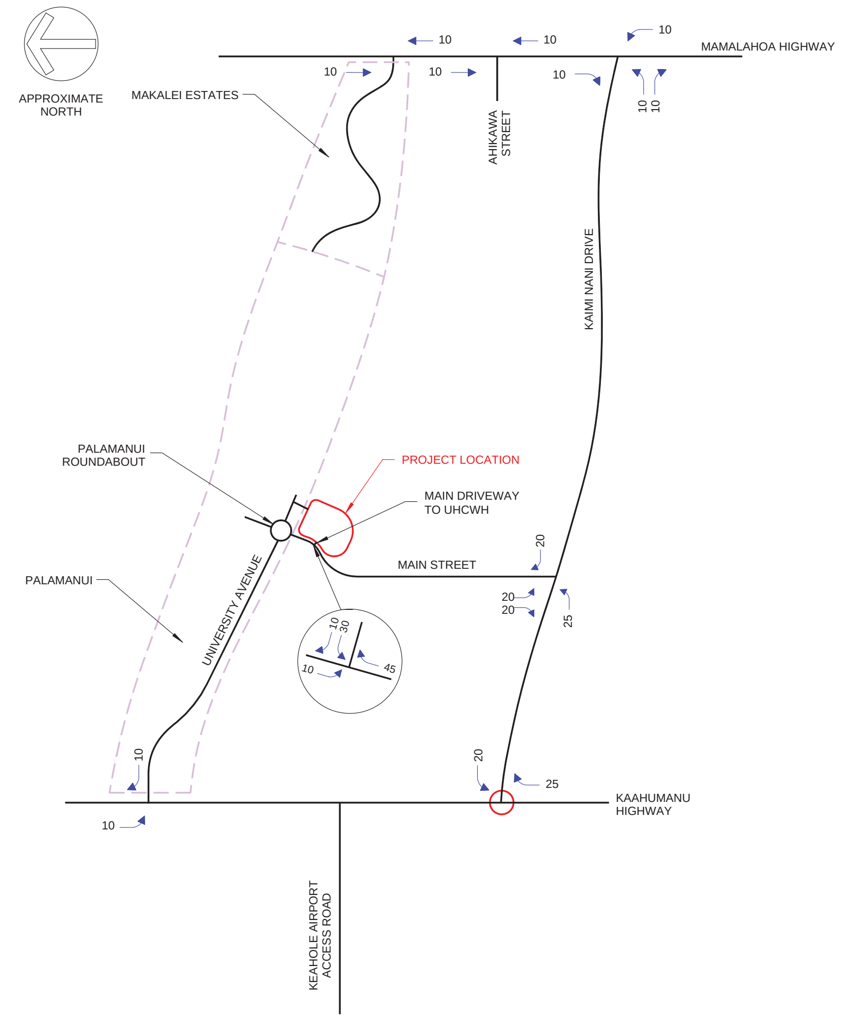


Figure 18
PHASES 1 AND 2 PM PEAK HOUR PROJECT TRIP ASSIGNMENTS

Phillip Rowell and Associates

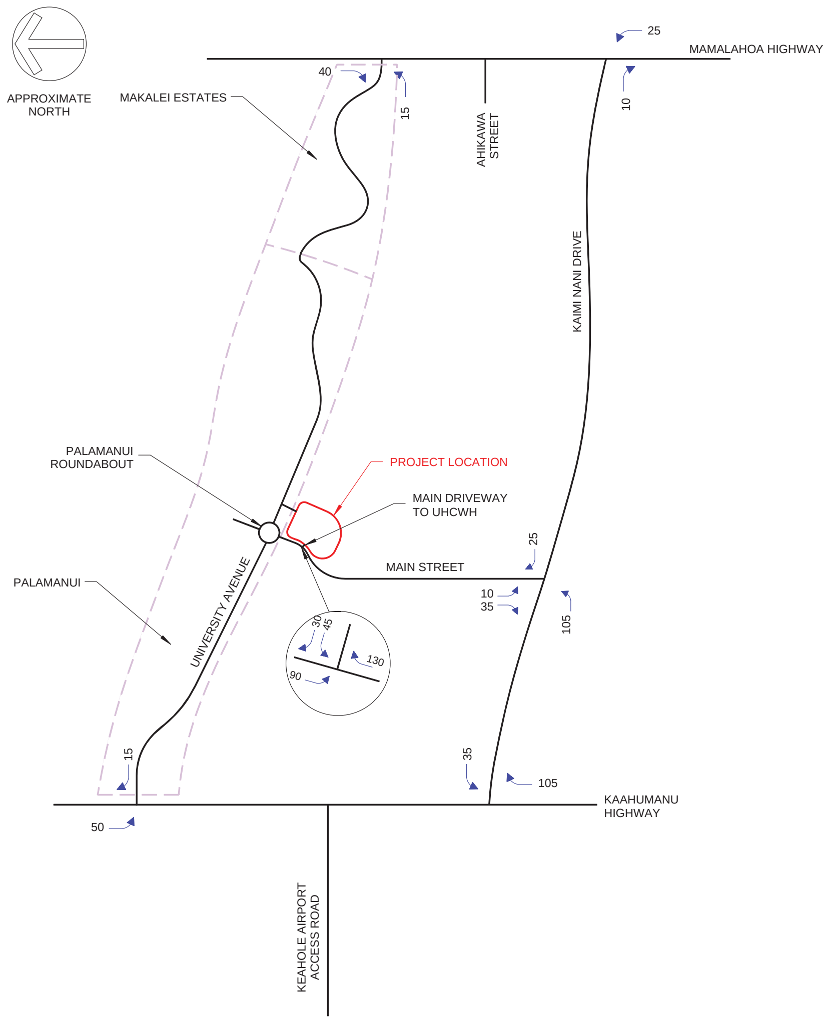


Figure 19
PHASES 1, 2, AND 3 AM PEAK HOUR PROJECT TRIP ASSIGNMENTS

Phillip Rowell and Associates

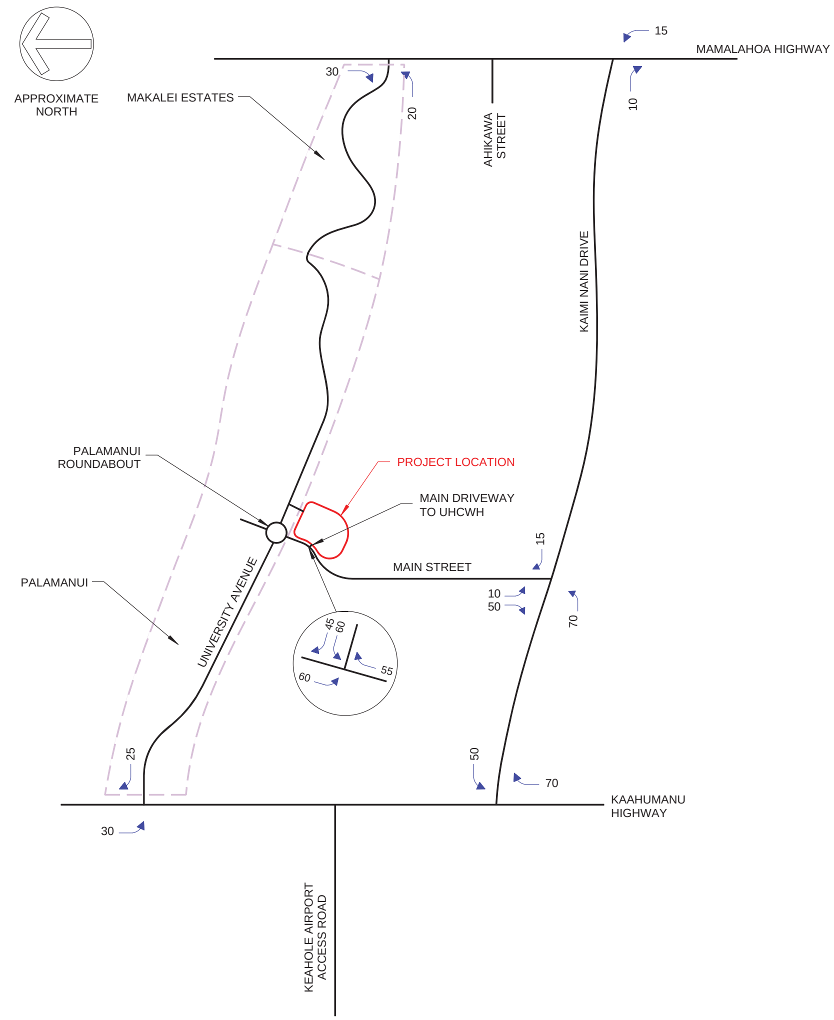


Figure 20
PHASES 1, 2, AND 3 PM PEAK HOUR PROJECT TRIP ASSIGNMENTS

Phillip Rowell and Associates

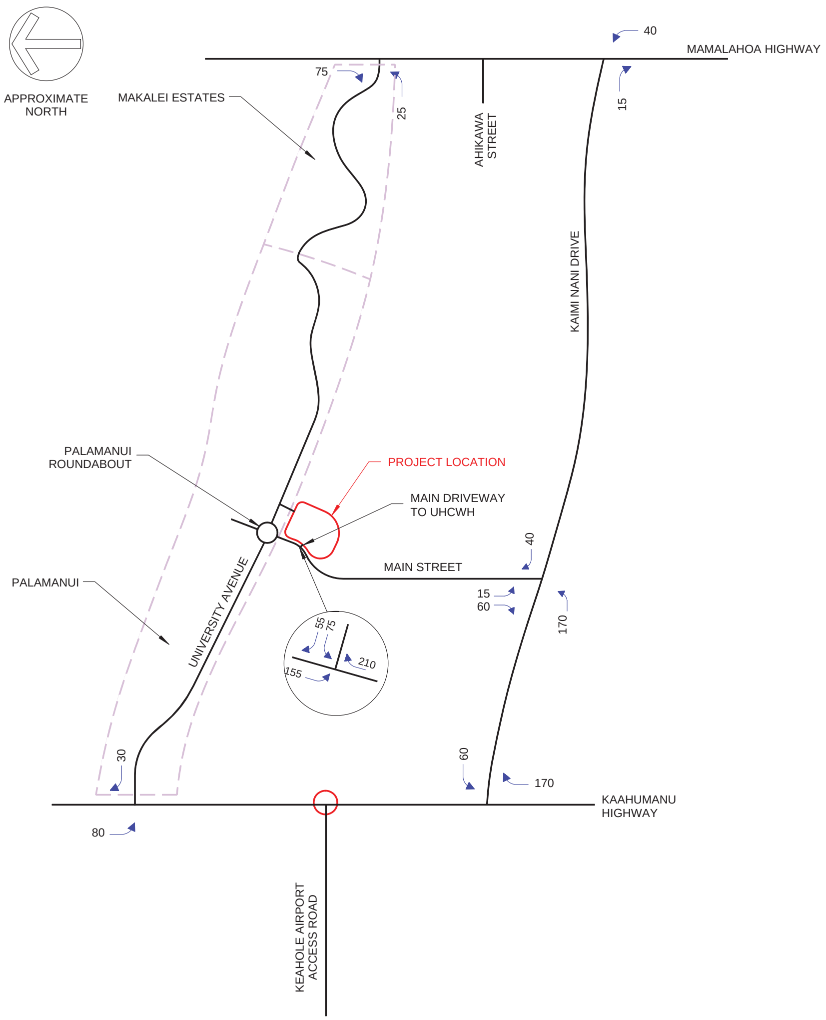


Figure 21
PHASES 1, 2, 3 AND 4 AM PEAK HOUR PROJECT TRIP ASSIGNMENTS

Phillip Rowell and Associates

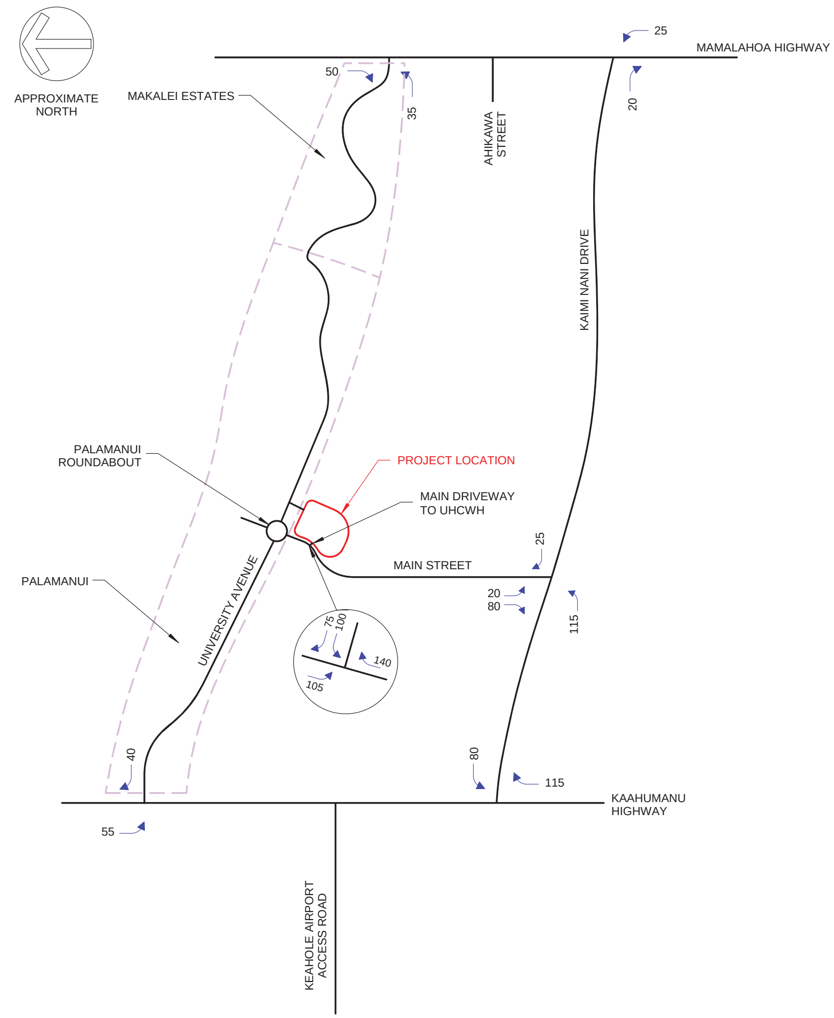


Figure 22
PHASES 1, 2, 3 AND 4 PM PEAK HOUR PROJECT TRIP ASSIGNMENTS

Phillip Rowell and Associates

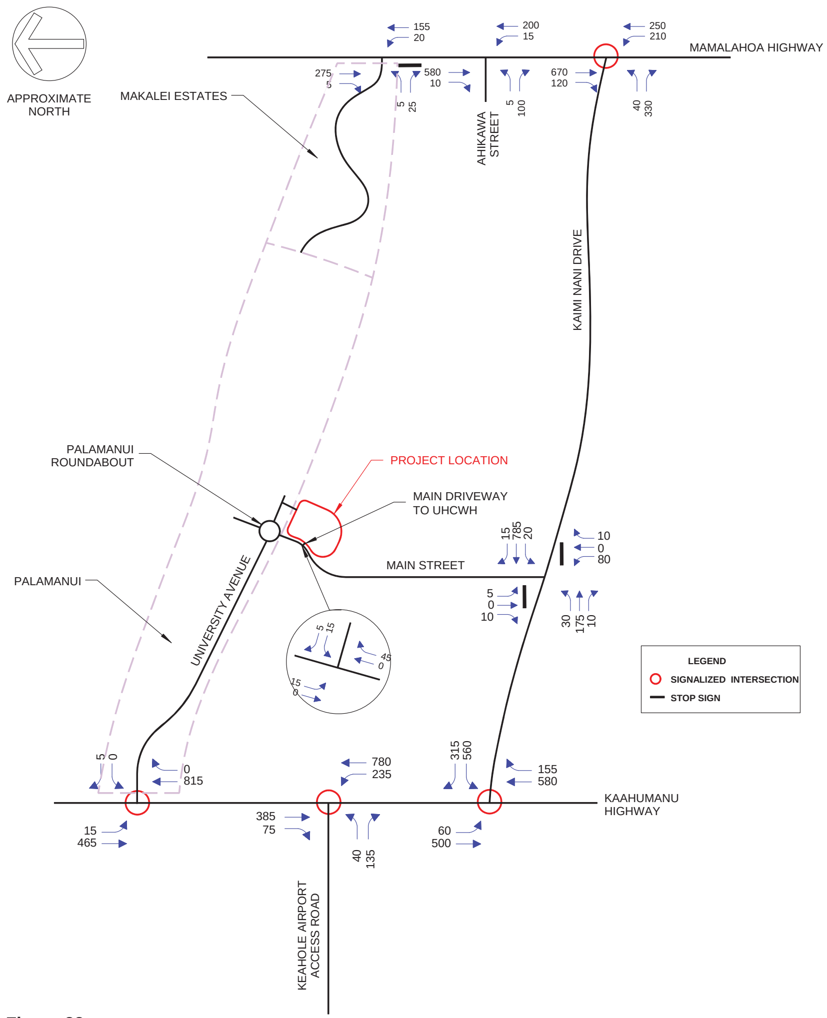


Figure 23
2011 BACKGROUND PLUS PHASE 1
AM PEAK HOUR TRAFFIC PROJECTIONS

Phillip Rowell and Associates

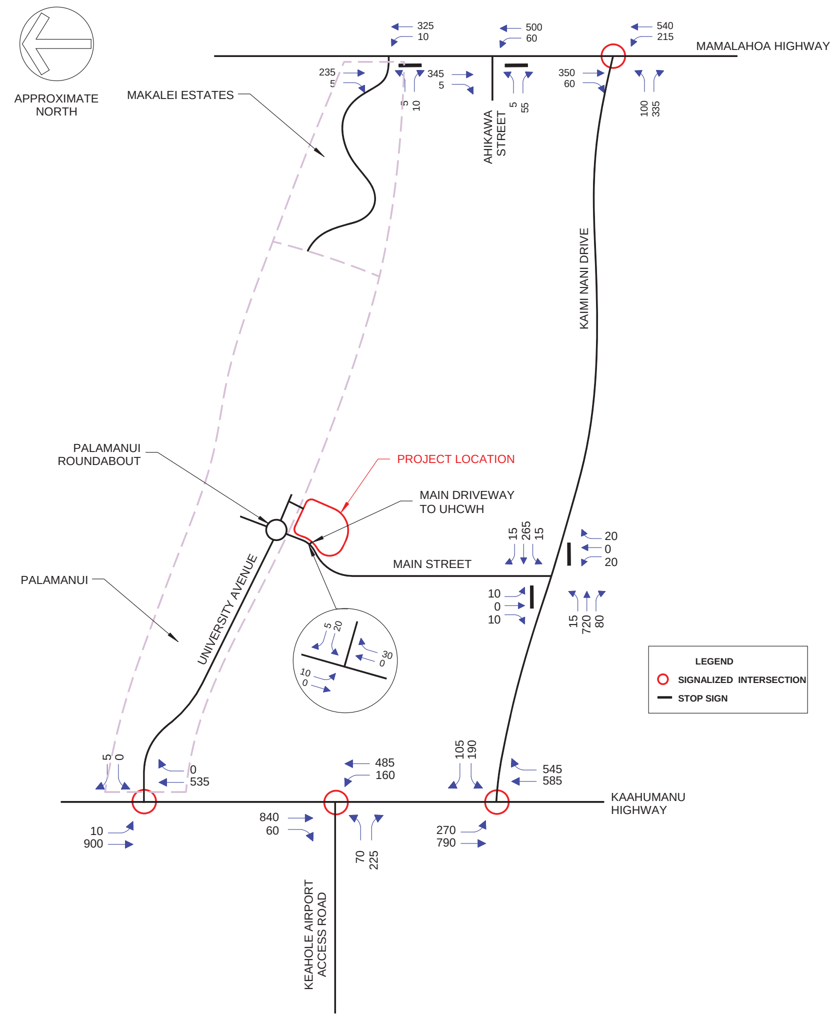


Figure 24
2011 BACKGROUND PLUS PHASE 1
PM PEAK HOUR TRAFFIC PROJECTIONS

Phillip Rowell and Associates

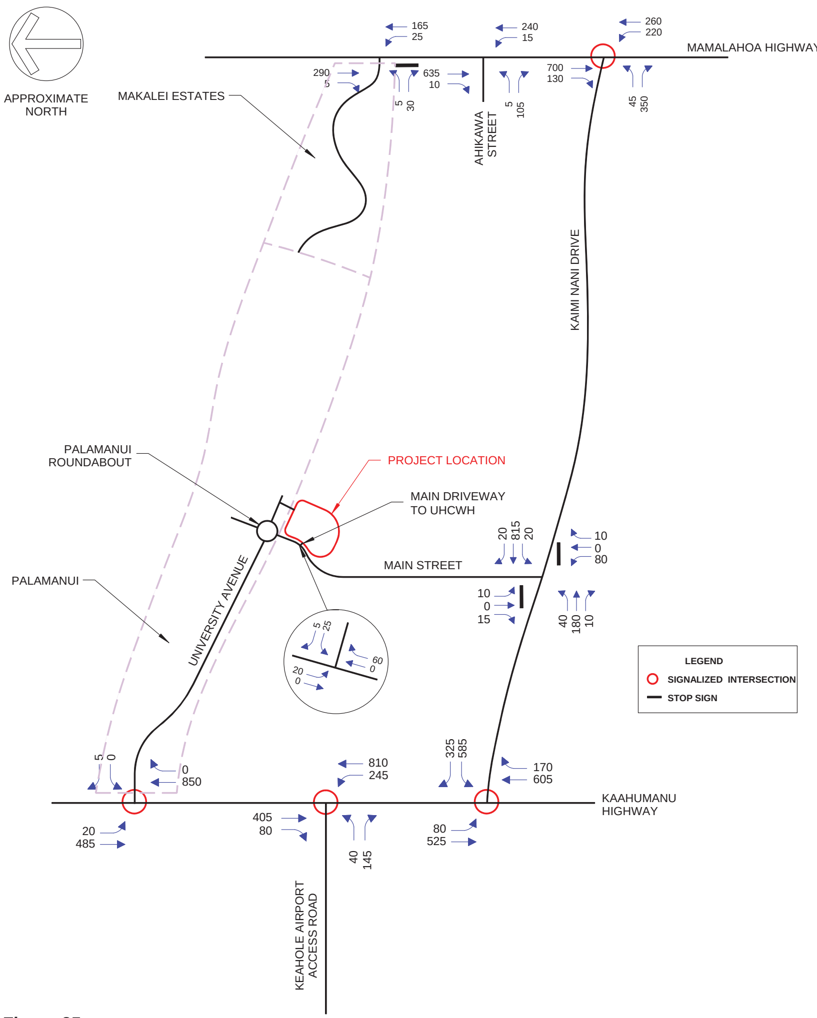


Figure 25
2012 BACKGROUND PLUS PHASES 1 AND 2
AM PEAK HOUR TRAFFIC PROJECTIONS

Phillip Rowell and Associates

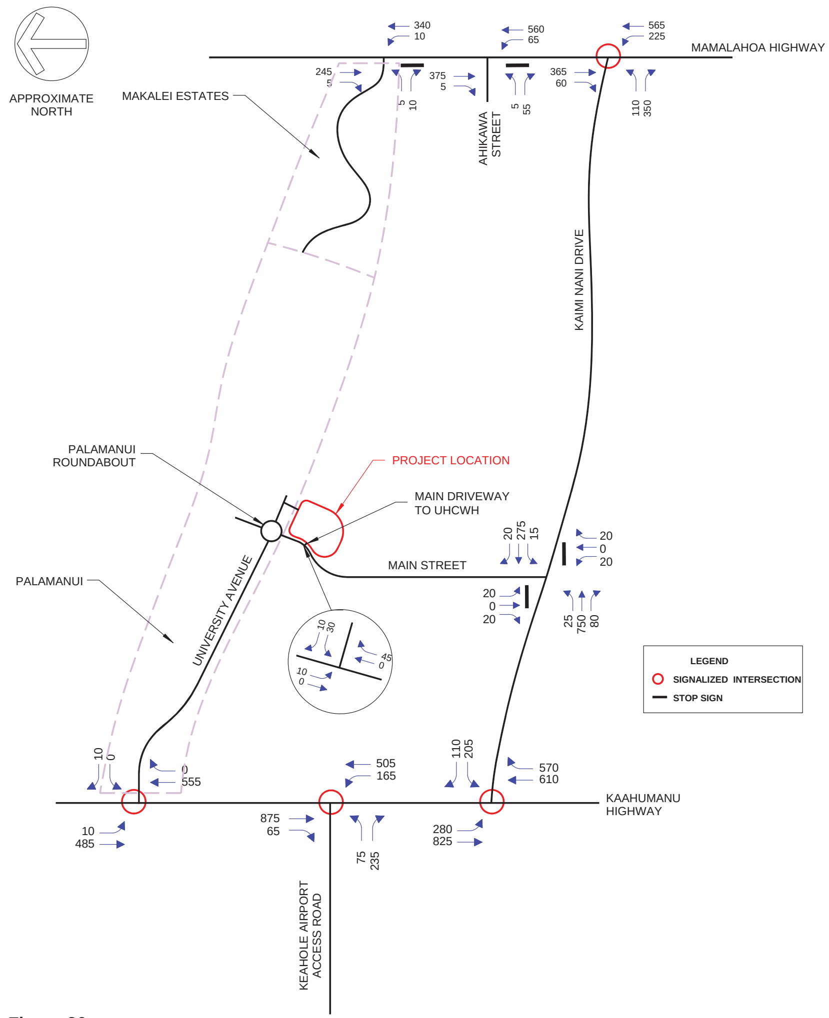


Figure 26
2012 BACKGROUND PLUS PHASES 1 AND 2
PM PEAK HOUR TRAFFIC PROJECTIONS

Phillip Rowell and Associates

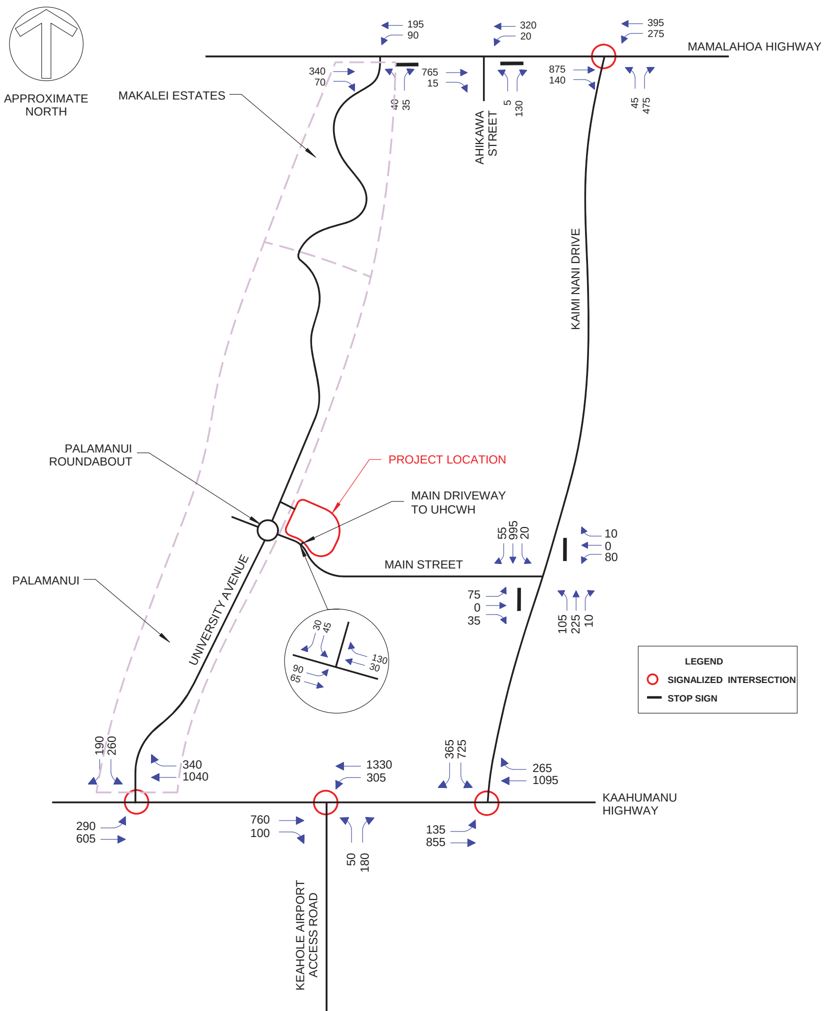


Figure 27
2017 BACKGROUND PLUS PHASES 1, 2 AND 3
AM PEAK HOUR TRAFFIC PROJECTIONS

Phillip Rowell and Associates

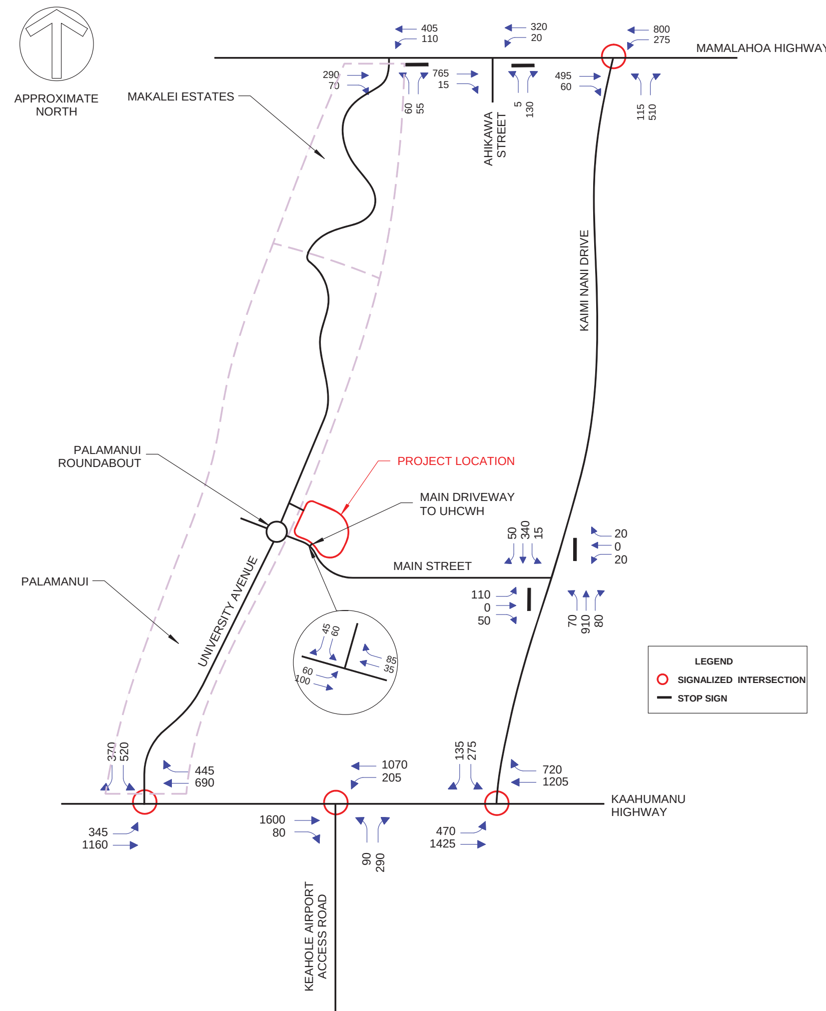


Figure 28
2017 BACKGROUND PLUS PHASES 1, 2 AND 3
PM PEAK HOUR TRAFFIC PROJECTIONS

Phillip Rowell and Associates

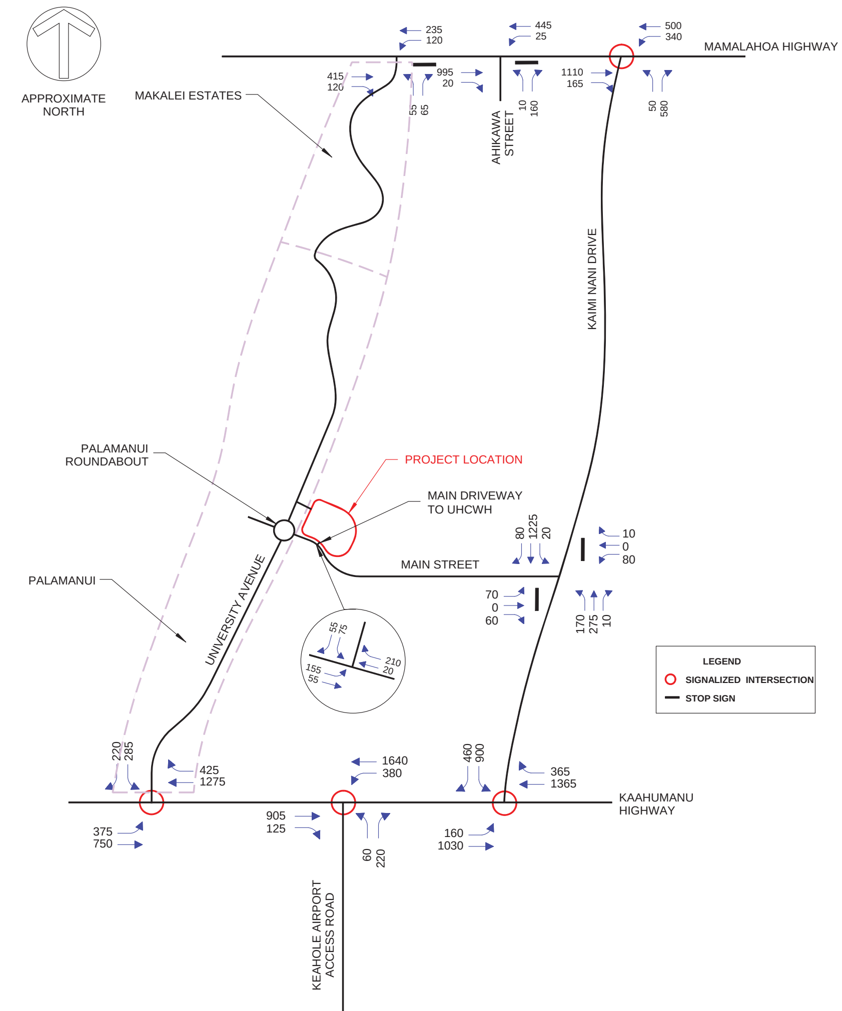


Figure 29
2022 BACKGROUND PLUS PHASES 1, 2, 3 AND 4
AM PEAK HOUR TRAFFIC PROJECTIONS

Phillip Rowell and Associates

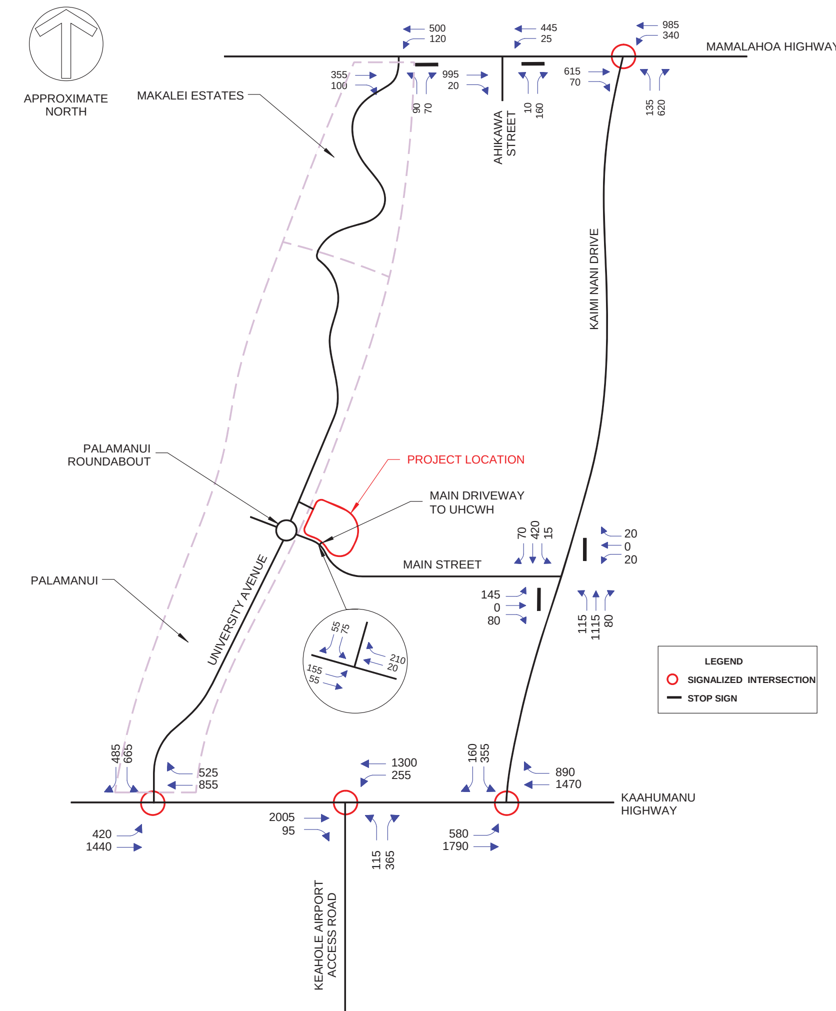
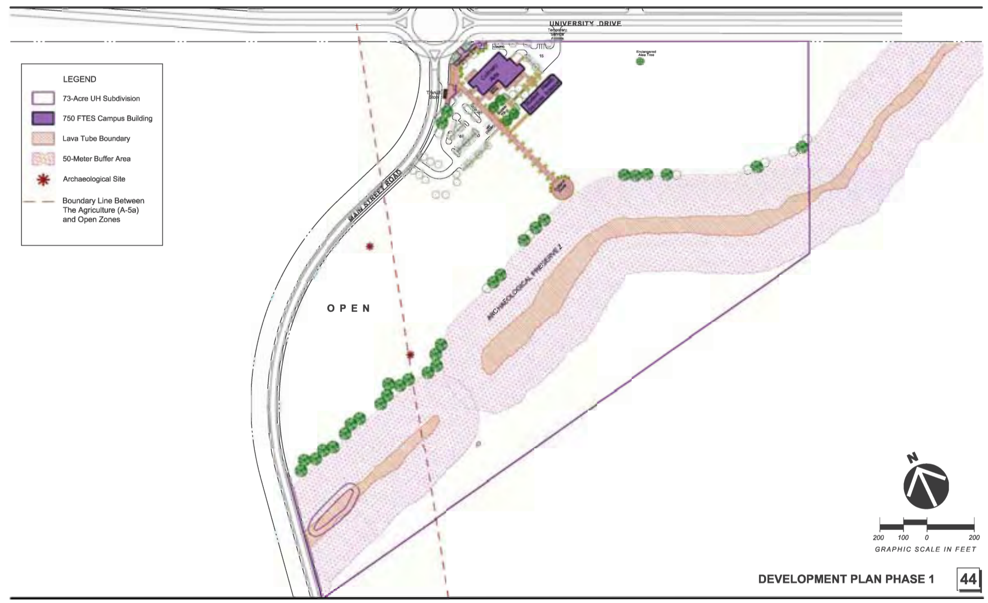


Figure 30
2022 BACKGROUND PLUS PHASES 1, 2, 3 AND 4
PM PEAK HOUR TRAFFIC PROJECTIONS

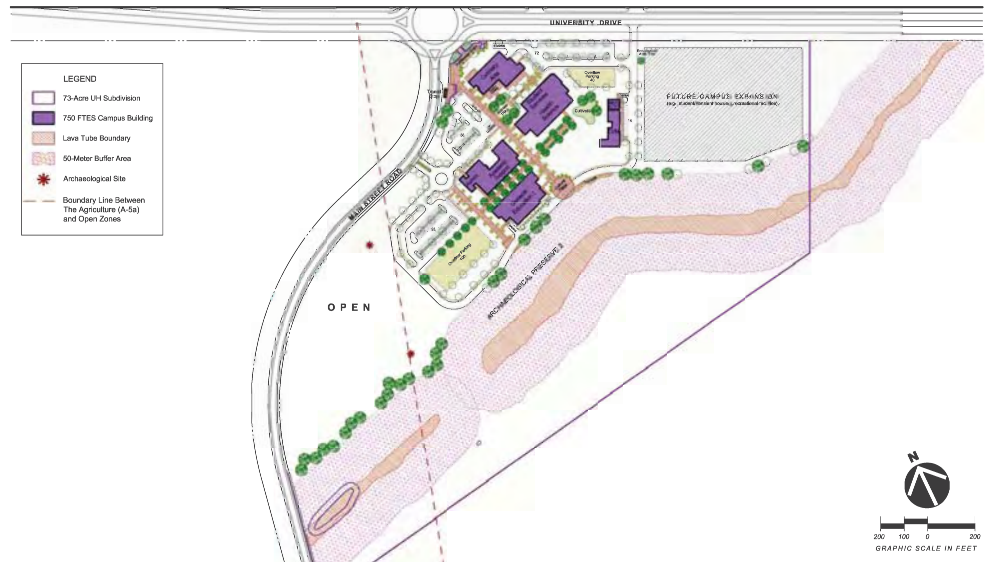
Phillip Rowell and Associates

Appendix A Site Plan
(Provided by Others)

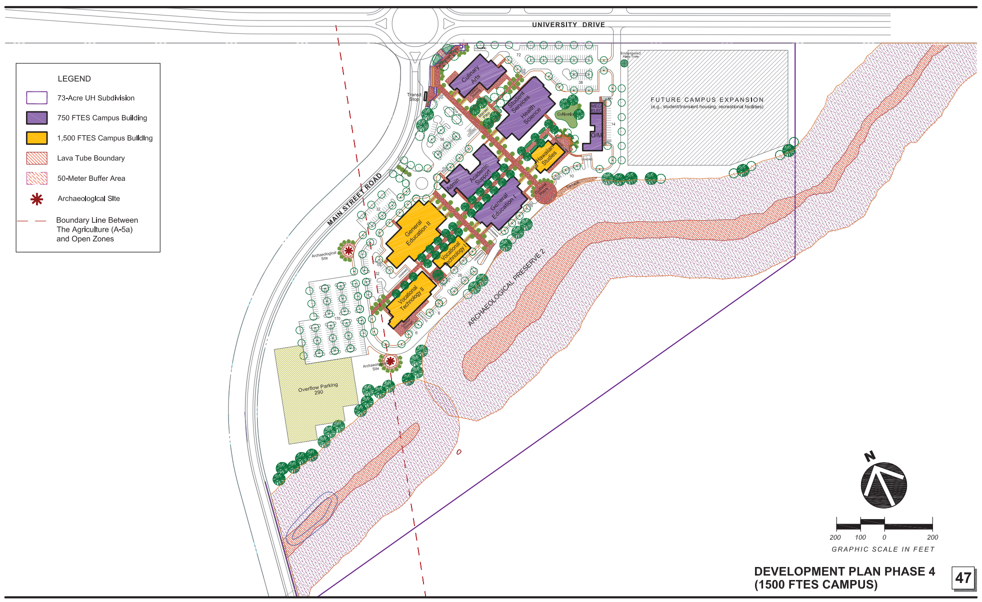


DEVELOPMENT PLAN PHASE 1 44

DEVELOPMENT PLAN PHASE 2 45



DEVELOPMENT PLAN PHASE 3 (750 FTES CAMPUS) 46

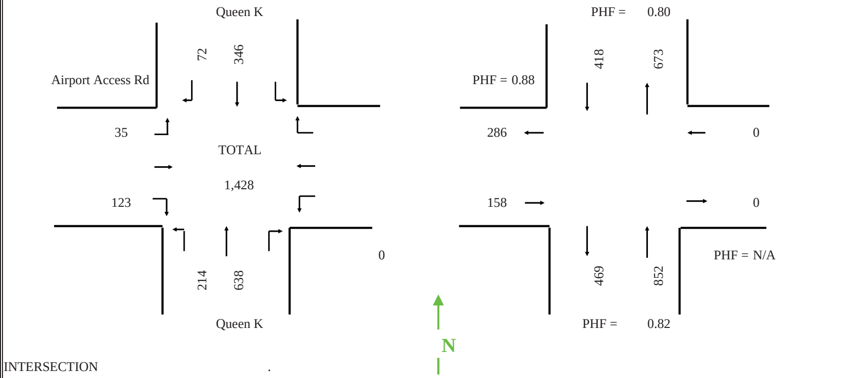


Appendix B
Traffic Count Summary Worksheets

INTERSECTION TURNING MOVEMENT SUMMARY

INTERSECTION:	**Queen K + Airport Access Road**	**TIME:**	**6:30 AM to 8:30 AM**
JURISDICTION:		**DATE:**	**8-26-09, Wed**
PROJECT TITLE:		**PROJECT NO:**	

PEAK HOUR PERIOD: 6:45 AM to 7:45 AM
PEAK 15 MINUTE PERIO 6:45 AM to 7:00 AM



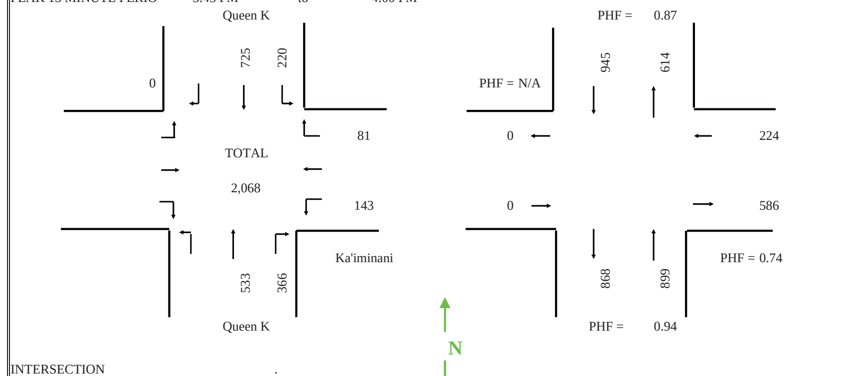
INTERSECTION
PEAK HOUR FACTOR: 0.91

RUNNING COUNTS	Airport Access Rd Eastbound Left	Thru	Right	Westbound Left	Thru	Right	Queen K Northbound Left	Thru	Right	Queen K Southbound Left	Thru	Right	
Period End	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**TOTAL**
6:45 AM	22		24				38	201			61	7	353
7:00 AM	32		59				89	410			132	22	744
7:15 AM	43		87				138	562			211	44	1085
7:30 AM	54		113				189	695			289	66	1406
7:45 AM	57		147				252	839			407	79	1781
8:00 AM	66		165				310	950			487	89	2067
8:15 AM	74		199				365	1075			573	102	2388
8:30 AM	87		240				419	1170			655	115	2686
PERIOD COUNTS													
Period End	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**TOTAL**
6:45 AM	22		24				38	201			61	7	353
7:00 AM	10		35				51	209			71	15	391
7:15 AM	11		28				49	152			79	22	341
7:30 AM	11		26				51	133			78	22	321
7:45 AM	3		34				63	144			118	13	375
8:00 AM	9		18				58	111			80	10	286
8:15 AM	8		34				55	125			86	13	321
8:30 AM	13		41				54	95			82	13	298
HOURLY TOTALS													
Beginning At	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**TOTAL**
6:30 AM	54		113				189	695			289	66	1406
6:45 AM	35		123				214	638			346	72	1428
7:00 AM	34		106				221	540			355	67	1323
7:15 AM	31		112				227	513			362	58	1303
7:30 AM	33		127				230	475			366	49	1280

INTERSECTION TURNING MOVEMENT SUMMARY

INTERSECTION:	**Queen K +Ka'iminani**	**TIME:**	**3:30 PM to 5:30 PM**
JURISDICTION:		**DATE:**	**8-25-09, Tue**
PROJECT TITLE:		**PROJECT NO:**	

PEAK HOUR PERIOD: 3:30 PM to 4:30 PM
PEAK 15 MINUTE PERIO 3:45 PM to 4:00 PM



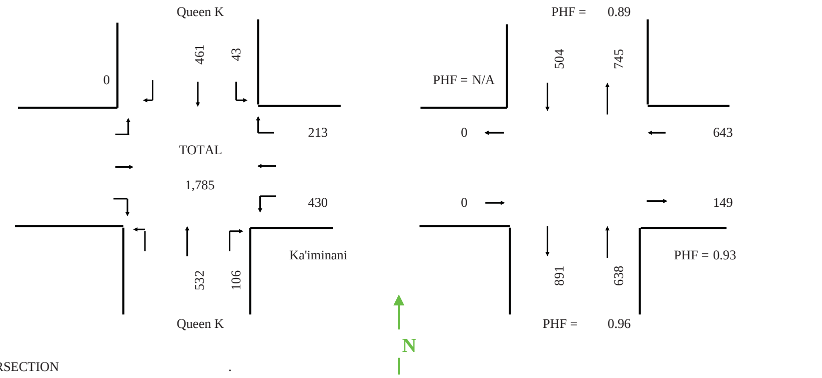
INTERSECTION
PEAK HOUR FACTOR: 0.92

RUNNING COUNTS	Eastbound Left	Thru	Right	Ka'iminani Westbound Left	Thru	Right	Queen K Northbound Left	Thru	Right	Queen K Southbound Left	Thru	Right	
Period End	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**TOTAL**
3:45 PM				45		31		125	79	43	183		506
4:00 PM				89		45		261	178	106	392		1071
4:15 PM				119		60		394	283	156	550		1562
4:30 PM				143		81		533	366	220	725		2068
4:45 PM				171		100		660	455	266	869		2521
5:00 PM				218		117		820	560	298	989		3002
5:15 PM				254		137		936	670	334	1129		3460
5:30 PM				292		160		1047	774	368	1272		3913
PERIOD COUNTS													
Period End	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**TOTAL**
3:45 PM				45		31		125	79	43	183		506
4:00 PM				44		14		136	99	63	209		565
4:15 PM				30		15		133	105	50	158		491
4:30 PM				24		21		139	83	64	175		506
4:45 PM				28		19		127	89	46	144		453
5:00 PM				47		17		160	105	32	120		481
5:15 PM				36		20		116	110	36	140		458
5:30 PM				38		23		111	104	34	143		453
HOURLY TOTALS													
Beginning At	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**TOTAL**
3:30 PM				143		81		533	366	220	725		2068
3:45 PM				126		69		535	376	223	686		2015
4:00 PM				129		72		559	382	192	597		1931
4:15 PM				135		77		542	387	178	579		1898
4:30 PM				149		79		514	408	148	547		1845

INTERSECTION TURNING MOVEMENT SUMMARY

INTERSECTION:	**Queen K +Ka'iminani**	**TIME:**	**6:30 AM to 8:30 AM**
JURISDICTION:		**DATE:**	**8-25-09, Tue**
PROJECT TITLE:		**PROJECT NO:**	

PEAK HOUR PERIOD: 7:00 AM to 8:00 AM
PEAK 15 MINUTE PERIO 7:30 AM to 7:45 AM



INTERSECTION .
PEAK HOUR FACTOR: 0.96

RUNNING COUNTS	Eastbound Left	Eastbound Thru	Eastbound Right	Ka'iminani Westbound Left	Ka'iminani Westbound Thru	Ka'iminani Westbound Right	Queen K Northbound Left	Queen K Northbound Thru	Queen K Northbound Right	Queen K Southbound Left	Queen K Southbound Thru	Queen K Southbound Right	
Period End	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**TOTAL**
6:45 AM				88		70		132	34	11	67		402
7:00 AM				178		142		277	57	24	144		822
7:15 AM				284		192		404	80	37	254		1251
7:30 AM				391		258		538	104	47	357		1695
7:45 AM				499		306		682	126	54	491		2158
8:00 AM				608		355		809	163	67	605		2607
8:15 AM				702		395		917	202	76	700		2992
8:30 AM				760		435		1047	266	90	817		3415

PERIOD COUNTS

Period End	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**TOTAL**
6:45 AM				88		70		132	34	11	67		402
7:00 AM				90		72		145	23	13	77		420
7:15 AM				106		50		127	23	13	110		429
7:30 AM				107		66		134	24	10	103		444
7:45 AM				108		48		144	22	7	134		463
8:00 AM				109		49		127	37	13	114		449
8:15 AM				94		40		108	39	9	95		385
8:30 AM				58		40		130	64	14	117		423

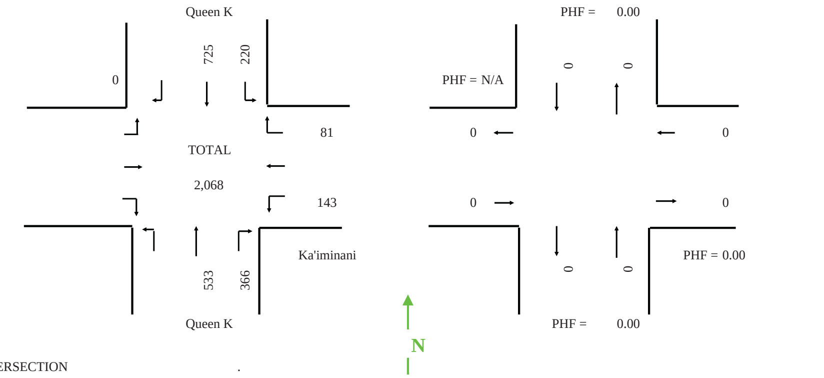
HOURLY TOTALS

Beginning At	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**TOTAL**
6:30 AM				391		258		538	104	47	357		1695
6:45 AM				411		236		550	92	43	424		1756
7:00 AM				430		213		532	106	43	461		1785
7:15 AM				418		203		513	122	39	446		1741
7:30 AM				369		177		509	162	43	460		1720

INTERSECTION TURNING MOVEMENT SUMMARY

INTERSECTION:	**Queen K +Ka'iminani**	**TIME:**	**3:30 PM to 5:30 PM**
JURISDICTION:		**DATE:**	**8-25-09, Tue**
PROJECT TITLE:		**PROJECT NO:**	

PEAK HOUR PERIOD: 3:30 PM to 4:30 PM
PEAK 15 MINUTE PERIO 3:45 PM to 4:00 PM



INTERSECTION .
PEAK HOUR FACTOR: 0.92

RUNNING COUNTS	Eastbound Left	Eastbound Thru	Eastbound Right	Ka'iminani Westbound Left	Ka'iminani Westbound Thru	Ka'iminani Westbound Right	Queen K Northbound Left	Queen K Northbound Thru	Queen K Northbound Right	Queen K Southbound Left	Queen K Southbound Thru	Queen K Southbound Right	
Period End	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**TOTAL**
3:45 PM				45		31		125	79	43	183		506
4:00 PM				89		45		261	178	106	392		1071
4:15 PM				119		60		394	283	156	550		1562
4:30 PM				143		81		533	366	220	725		2068
4:45 PM				171		100		660	455	266	869		2521
5:00 PM				218		117		820	560	298	989		3002
5:15 PM				254		137		936	670	334	1129		3460
5:30 PM				292		160		1047	774	368	1272		3913

PERIOD COUNTS

Period End	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**TOTAL**
3:45 PM				45		31		125	79	43	183		506
4:00 PM				44		14		136	99	63	209		565
4:15 PM				30		15		133	105	50	158		491
4:30 PM				24		21		139	83	64	175		506
4:45 PM				28		19		127	89	46	144		453
5:00 PM				47		17		160	105	32	120		481
5:15 PM				36		20		116	110	36	140		458
5:30 PM				38		23		111	104	34	143		453

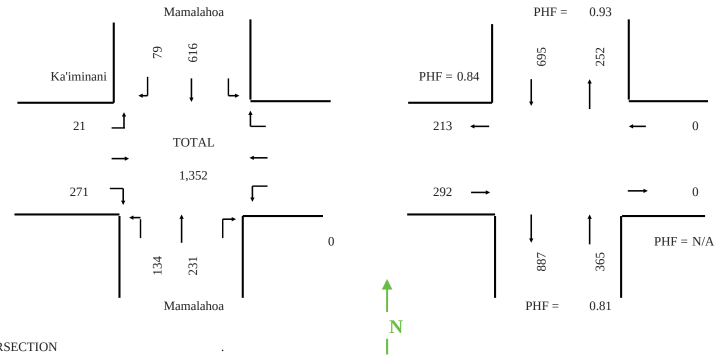
HOURLY TOTALS

Beginning At	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**TOTAL**
3:30 PM				143		81		533	366	220	725		2068
3:45 PM				126		69		535	376	223	686		2015
4:00 PM				129		72		559	382	192	597		1931
4:15 PM				135		77		542	387	178	579		1898
4:30 PM				149		79		514	408	148	547		1845

INTERSECTION TURNING MOVEMENT SUMMARY

INTERSECTION:	**Mamalahoa + Ka'iminani**	**TIME:**	**6:30 AM to 8:30 AM**
JURISDICTION:		**DATE:**	**8-25-09, Tue**
PROJECT TITLE:		**PROJECT NO:**	

PEAK HOUR PERIOD: 6:45 AM to 7:45 AM
PEAK 15 MINUTE PERIO 7:30 AM to 7:45 AM



INTERSECTION
PEAK HOUR FACTOR: 0.90

RUNNING COUNTS	Ka'iminani Eastbound Left	Thru	Right	Westbound Left	Thru	Right	Mamalahoa Northbound Left	Thru	Right	Mamalahoa Southbound Left	Thru	Right	
Period End	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**TOTAL**
6:45 AM	10		55				41	35			89	16	246
7:00 AM	14		96				67	81			227	40	525
7:15 AM	21		176				106	128			386	59	876
7:30 AM	28		250				144	185			539	75	1221
7:45 AM	31		326				175	266			705	95	1598
8:00 AM	39		366				202	304			777	107	1795
8:15 AM	44		398				228	376			868	123	2037
8:30 AM	50		437				252	443			920	133	2235
8:45 AM													
9:00 AM													

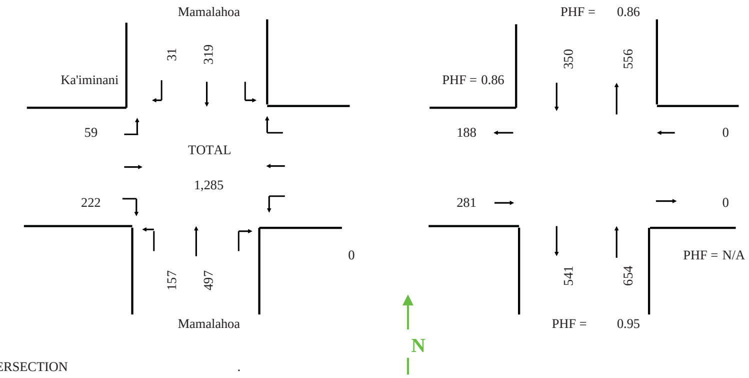
PERIOD COUNTS													
Period End	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**TOTAL**
6:45 AM	10		55				41	35			89	16	246
7:00 AM	4		41				26	46			138	24	279
7:15 AM	7		80				39	47			159	19	351
7:30 AM	7		74				38	57			153	16	345
7:45 AM	3		76				31	81			166	20	377
8:00 AM	8		40				27	38			72	12	197
8:15 AM	5		32				26	72			91	16	242
8:30 AM	6		39				24	67			52	10	198
8:45 AM													
9:00 AM													

HOURLY TOTALS													
Beginning At	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**TOTAL**
6:30 AM	28		250				144	185			539	75	1221
6:45 AM	21		271				134	231			616	79	1352
7:00 AM	25		270				135	223			550	67	1270
7:15 AM	23		222				122	248			482	64	1161
7:30 AM	22		187				108	258			381	58	1014
7:45 AM													
8:00 AM													

INTERSECTION TURNING MOVEMENT SUMMARY

INTERSECTION:	**Mamalahoa + Ka'iminani**	**TIME:**	**3:30 PM to 5:30 PM**
JURISDICTION:		**DATE:**	**8-25-09, Tue**
PROJECT TITLE:		**PROJECT NO:**	

PEAK HOUR PERIOD: 3:45 PM to 4:45 PM
PEAK 15 MINUTE PERIO 4:15 PM to 4:30 PM



INTERSECTION
PEAK HOUR FACTOR: 0.97

RUNNING COUNTS	Ka'iminani Eastbound Left	Thru	Right	Westbound Left	Thru	Right	Mamalahoa Northbound Left	Thru	Right	Mamalahoa Southbound Left	Thru	Right	
Period End	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**TOTAL**
3:45 PM	13		50				39	100			76	10	288
4:00 PM	25		112				87	222			144	17	607
4:15 PM	34		168				127	325			235	22	911
4:30 PM	50		234				166	459			301	33	1243
4:45 PM	72		272				196	597			395	41	1573
5:00 PM	87		309				240	702			458	51	1847
5:15 PM	100		352				284	819			533	65	2153
5:30 PM	117		391				326	944			600	74	2452

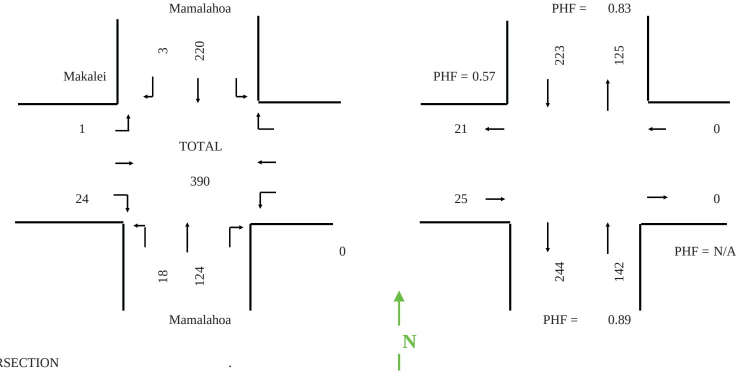
PERIOD COUNTS													
Period End	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**TOTAL**
3:45 PM	13		50				39	100			76	10	288
4:00 PM	12		62				48	122			68	7	319
4:15 PM	9		56				40	103			91	5	304
4:30 PM	16		66				39	134			66	11	332
4:45 PM	22		38				30	138			94	8	330
5:00 PM	15		37				44	105			63	10	274
5:15 PM	13		43				44	117			75	14	306
5:30 PM	17		39				42	125			67	9	299

HOURLY TOTALS													
Beginning At	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**TOTAL**
3:30 PM	50		234				166	459			301	33	1243
3:45 PM	59		222				157	497			319	31	1285
4:00 PM	62		197				153	480			314	34	1240
4:15 PM	66		184				157	494			298	43	1242
4:30 PM	67		157				160	485			299	41	1209

INTERSECTION TURNING MOVEMENT SUMMARY

INTERSECTION:	**Mamalahoa + Makalei Access Road**	**TIME:**	**6:30 AM**	**to**	**8:30 AM**
JURISDICTION:		**DATE:**		**8-26-09, Wed**	
PROJECT TITLE:		**PROJECT NO:**			

PEAK HOUR PERIOD: 6:45 AM to 7:45 AM
PEAK 15 MINUTE PERIO 6:45 AM to 7:00 AM



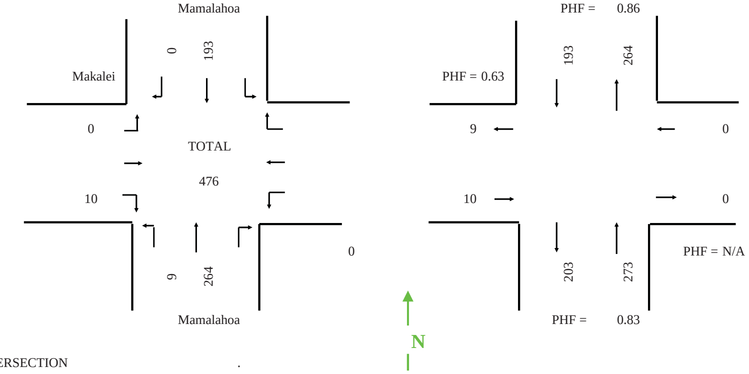
INTERSECTION .
PEAK HOUR FACTOR: 0.87

RUNNING COUNTS	Makalei Eastbound Left	Thru	Right	Westbound Left	Thru	Right	Mamalahoa Northbound Left	Thru	Right	Mamalahoa Southbound Left	Thru	Right	
Period End	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**TOTAL**
6:45 AM	0		0				0	27			51	0	78
7:00 AM	0		5				5	62			117	1	190
7:15 AM	1		8				9	94			162	1	275
7:30 AM	1		13				10	125			224	2	375
7:45 AM	1		24				18	151			271	3	468
8:00 AM	1		31				23	182			313	3	553
8:15 AM	1		33				25	205			352	3	619
8:30 AM	2		37				29	246			405	3	722
PERIOD COUNTS													
Period End	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**TOTAL**
6:45 AM	0		0				0	27			51	0	78
7:00 AM	0		5				5	35			66	1	112
7:15 AM	1		3				4	32			45	0	85
7:30 AM	0		5				1	31			62	1	100
7:45 AM	0		11				8	26			47	1	93
8:00 AM	0		7				5	31			42	0	85
8:15 AM	0		2				2	23			39	0	66
8:30 AM	1		4				4	41			53	0	103
HOURLY TOTALS													
Beginning At	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**TOTAL**
6:30 AM	1		13				10	125			224	2	375
6:45 AM	1		24				18	124			220	3	390
7:00 AM	1		26				18	120			196	2	363
7:15 AM	0		25				16	111			190	2	344
7:30 AM	1		24				19	121			181	1	347

INTERSECTION TURNING MOVEMENT SUMMARY

INTERSECTION:	**Mamalahoa + Makalei Access Road**	**TIME:**	**3:30 PM**	**to**	**5:30 PM**
JURISDICTION:		**DATE:**		**8-26-09, Wed**	
PROJECT TITLE:		**PROJECT NO:**			

PEAK HOUR PERIOD: 3:45 PM to 4:45 PM
PEAK 15 MINUTE PERIO 3:45 PM to 4:00 PM



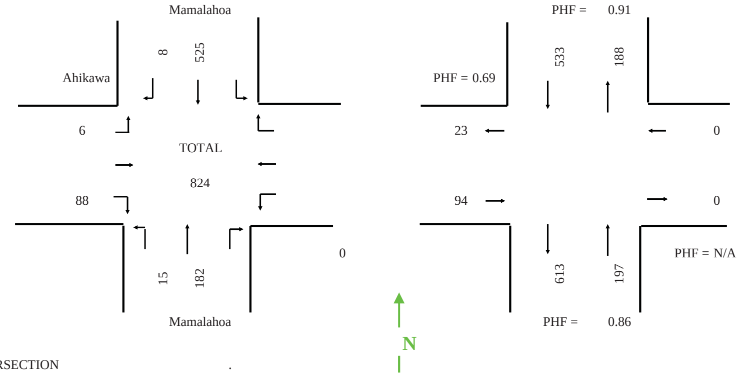
INTERSECTION .
PEAK HOUR FACTOR: 0.84

RUNNING COUNTS	Makalei Eastbound Left	Thru	Right	Westbound Left	Thru	Right	Mamalahoa Northbound Left	Thru	Right	Mamalahoa Southbound Left	Thru	Right	
Period End	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**TOTAL**
3:45 PM	0		4				4	51			33	0	92
4:00 PM	0		7				6	131			89	0	233
4:15 PM	0		8				7	196			128	0	339
4:30 PM	0		10				11	266			181	0	468
4:45 PM	0		14				13	315			226	0	568
5:00 PM	0		16				16	368			261	0	661
5:15 PM	0		18				18	416			307	0	759
5:30 PM	0		21				23	462			340	1	847
PERIOD COUNTS													
Period End	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**TOTAL**
3:45 PM	0		4				4	51			33	0	92
4:00 PM	0		3				2	80			56	0	141
4:15 PM	0		1				1	65			39	0	106
4:30 PM	0		2				4	70			53	0	129
4:45 PM	0		4				2	49			45	0	100
5:00 PM	0		2				3	53			35	0	93
5:15 PM	0		2				2	48			46	0	98
5:30 PM	0		3				5	46			33	1	88
HOURLY TOTALS													
Beginning At	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**TOTAL**
3:30 PM	0		10				11	266			181	0	468
3:45 PM	0		10				9	264			193	0	476
4:00 PM	0		9				10	237			172	0	428
4:15 PM	0		10				11	220			179	0	420
4:30 PM	0		11				12	196			159	1	379

INTERSECTION TURNING MOVEMENT SUMMARY

INTERSECTION:	**Mamalahoa + Ahikawa**	**TIME:**	**6:30 AM**	**to**	**8:30 AM**
JURISDICTION:		**DATE:**	**10-29-09, Thu**		
PROJECT TITLE:		**PROJECT NO:**			

PEAK HOUR PERIOD: 7:00 AM to 8:00 AM
PEAK 15 MINUTE PERIO 7:15 AM to 7:30 AM



INTERSECTION .
PEAK HOUR FACTOR: 0.94

RUNNING COUNTS	**Ahikawa** Eastbound Left	Thru	Right	Westbound Left	Thru	Right	**Mamalahoa** Northbound Left	Thru	Right	**Mamalahoa** Southbound Left	Thru	Right	
Period End	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**TOTAL**
6:45 AM	4		15				2	33			133	1	188
7:00 AM	9		34				5	71			257	3	379
7:15 AM	10		52				8	108			390	3	571
7:30 AM	11		72				13	155			534	6	791
7:45 AM	15		88				16	200			664	9	992
8:00 AM	15		122				20	253			782	11	1203
8:15 AM	16		137				28	325			861	17	1384
8:30 AM	17		148				32	376			936	18	1527

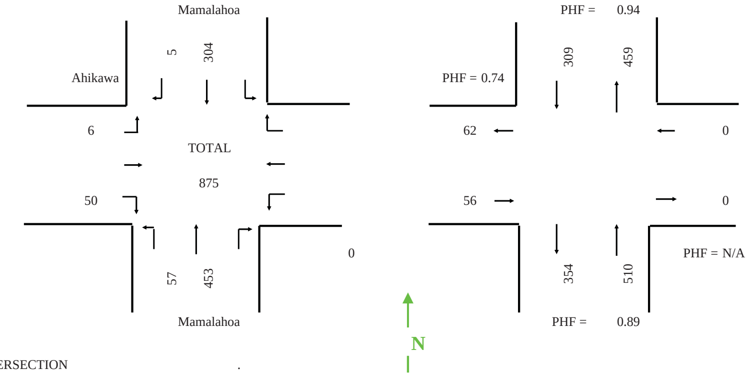
PERIOD COUNTS													
Period End	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**TOTAL**
6:45 AM	4		15				2	33			133	1	188
7:00 AM	5		19				3	38			124	2	191
7:15 AM	1		18				3	37			133	0	192
7:30 AM	1		20				5	47			144	3	220
7:45 AM	4		16				3	45			130	3	201
8:00 AM	0		34				4	53			118	2	211
8:15 AM	1		15				8	72			79	6	181
8:30 AM	1		11				4	51			75	1	143

HOURLY TOTALS													
Beginning At	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**TOTAL**
6:30 AM	11		72				13	155			534	6	791
6:45 AM	11		73				14	167			531	8	804
7:00 AM	6		88				15	182			525	8	824
7:15 AM	6		85				20	217			471	14	813
7:30 AM	6		76				19	221			402	12	736

INTERSECTION TURNING MOVEMENT SUMMARY

INTERSECTION:	**Mamalahoa + Ahikawa**	**TIME:**	**3:30 PM**	**to**	**5:30 PM**
JURISDICTION:		**DATE:**	**10-29-09, Thu**		
PROJECT TITLE:		**PROJECT NO:**			

PEAK HOUR PERIOD: 3:30 PM to 4:30 PM
PEAK 15 MINUTE PERIO 3:45 PM to 4:00 PM



INTERSECTION .
PEAK HOUR FACTOR: 0.93

RUNNING COUNTS	**Ahikawa** Eastbound Left	Thru	Right	Westbound Left	Thru	Right	**Mamalahoa** Northbound Left	Thru	Right	**Mamalahoa** Southbound Left	Thru	Right	
Period End	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**TOTAL**
3:45 PM	1		7				19	111			76	1	215
4:00 PM	4		19				30	243			152	3	451
4:15 PM	5		37				46	360			223	4	675
4:30 PM	6		50				57	453			304	5	875
4:45 PM	8		63				74	555			370	7	1077
5:00 PM	10		72				90	662			435	8	1277
5:15 PM	13		86				108	747			512	8	1474
5:30 PM	15		99				125	844			596	11	1690

PERIOD COUNTS													
Period End	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**TOTAL**
3:45 PM	1		7				19	111			76	1	215
4:00 PM	3		12				11	132			76	2	236
4:15 PM	1		18				16	117			71	1	224
4:30 PM	1		13				11	93			81	1	200
4:45 PM	2		13				17	102			66	2	202
5:00 PM	2		9				16	107			65	1	200
5:15 PM	3		14				18	85			77	0	197
5:30 PM	2		13				17	97			84	3	216

HOURLY TOTALS													
Beginning At	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**TOTAL**
3:30 PM	6		50				57	453			304	5	875
3:45 PM	7		56				55	444			294	6	862
4:00 PM	6		53				60	419			283	5	826
4:15 PM	8		49				62	387			289	4	799
4:30 PM	9		49				68	391			292	6	815

Appendix C
Level-of-Service Analysis Worksheets for Existing Conditions

HCM Signalized Intersection Capacity Analysis
1: KEAHOLE AIRPORT ACCESS ROAD & KAAHUMANU HIGHWAY 1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	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	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	1863	1863	1583
Volume (vph)	35	123	214	638	346	72
Peak-hour factor, PHF	0.88	0.88	0.82	0.82	0.80	0.80
Adj. Flow (vph)	40	140	261	778	432	90
RTOR Reduction (vph)	0	124	0	0	0	50
Lane Group Flow (vph)	40	16	261	778	432	40
Turn Type		Perm	Prot			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Actuated Green, G (s)	6.0	6.0	11.5	39.1	23.6	23.6
Effective Green, g (s)	6.0	6.0	11.5	39.1	23.6	23.6
Actuated g/C Ratio	0.11	0.11	0.22	0.74	0.44	0.44
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	200	179	383	1372	828	704
v/s Ratio Prot	0.02		c0.15	c0.42	0.23	
v/s Ratio Perm		0.09				0.06
v/c Ratio	0.20	0.09	0.68	0.57	0.52	0.06
Uniform Delay, d1	21.4	21.1	19.1	3.2	10.7	8.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.5	0.2	4.9	1.7	2.3	0.2
Delay (s)	21.9	21.3	24.1	4.9	13.0	8.6
Level of Service	C	C	C	A	B	A
Approach Delay (s)	21.4			9.7	12.2	
Approach LOS	C			A	B	

Intersection Summary			
HCM Average Control Delay	11.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	53.1	Sum of lost time (s)	8.0
Intersection Capacity Utilization	43.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: KAIMI NANI DRIVE & KAAHUMANU HIGHWAY

1/4/2010

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	1863	1583	1770	1863
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	1863	1583	1770	1863
Volume (vph)	430	213	532	106	43	461
Peak-hour factor, PHF	0.93	0.93	0.96	0.96	0.89	0.89
Adj. Flow (vph)	462	229	554	110	48	518
RTOR Reduction (vph)	0	160	0	60	0	0
Lane Group Flow (vph)	462	69	554	50	48	518
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	18.0	18.0	27.4	27.4	2.3	33.7
Effective Green, g (s)	18.0	18.0	27.4	27.4	2.3	33.7
Actuated g/C Ratio	0.30	0.30	0.46	0.46	0.04	0.56
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	534	477	855	727	68	1052
v/s Ratio Prot	c0.26		c0.30		0.03	c0.28
v/s Ratio Perm		0.14		0.07		
v/c Ratio	0.87	0.14	0.65	0.07	0.71	0.49
Uniform Delay, d1	19.7	15.2	12.4	9.0	28.4	7.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	13.7	0.1	3.8	0.2	28.3	1.6
Delay (s)	33.4	15.4	16.2	9.2	56.6	9.5
Level of Service	C	B	B	A	E	A
Approach Delay (s)	27.4		15.1			13.5
Approach LOS	C		B			B

Intersection Summary			
HCM Average Control Delay	19.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	59.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	65.2%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
3: KAIMI NANI DRIVE & MAMALAHOA HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	21	271	134	231	616	79
Peak Hour Factor	0.84	0.84	0.81	0.81	0.93	0.93
Hourly flow rate (vph)	25	323	165	285	662	85
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1321	705	747			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1321	705	747			
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	26	81			
cM capacity (veh/h)	140	437	861			

Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1
Volume Total	25	323	165	285	747
Volume Left	25	0	165	0	0
Volume Right	0	323	0	0	85
cSH	140	437	861	1700	1700
Volume to Capacity	0.18	0.74	0.19	0.17	0.44
Queue Length (ft)	16	150	18	0	0
Control Delay (s)	36.3	33.2	10.2	0.0	0.0
Lane LOS	E	D	B		
Approach Delay (s)	33.4		3.7		0.0
Approach LOS	D				

Intersection Summary			
Average Delay	8.6		
Intersection Capacity Utilization	60.7%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	1	24	18	124	220	3
Peak Hour Factor	0.57	0.57	0.89	0.89	0.83	0.83
Hourly flow rate (vph)	2	42	20	139	265	4
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	447	267	269			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	447	267	269			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	95	98			
cM capacity (veh/h)	561	772	1295			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	44	20	139	269
Volume Left	2	20	0	0
Volume Right	42	0	0	4
cSH	760	1295	1700	1700
Volume to Capacity	0.06	0.02	0.08	0.16
Queue Length (ft)	5	1	0	0
Control Delay (s)	10.0	7.8	0.0	0.0
Lane LOS	B	A		
Approach Delay (s)	10.0	1.0		0.0
Approach LOS	B			

Intersection Summary			
Average Delay	1.3		
Intersection Capacity Utilization	25.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	5	90	15	180	520	10
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	98	16	196	565	11
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	799	571	576			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	799	571	576			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	81	98			
cM capacity (veh/h)	349	521	997			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	103	212	576
Volume Left	5	16	0
Volume Right	98	0	11
cSH	507	997	1700
Volume to Capacity	0.20	0.02	0.34
Queue Length (ft)	19	1	0
Control Delay (s)	13.9	0.8	0.0
Lane LOS	B	A	
Approach Delay (s)	13.9	0.8	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	40.5%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
1: KEAHOLE AIRPORT ACCESS ROAD & KAAHUMANU HIGHWAY 1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	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	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	1863	1863	1583
Volume (vph)	64	207	147	424	739	55
Peak-hour factor, PHF	0.88	0.88	0.82	0.82	0.80	0.80
Adj. Flow (vph)	73	235	179	517	924	69
RTOR Reduction (vph)	0	210	0	0	0	26
Lane Group Flow (vph)	73	25	179	517	924	43
Turn Type		Perm	Prot			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Actuated Green, G (s)	8.9	8.9	10.7	66.1	51.4	51.4
Effective Green, g (s)	8.9	8.9	10.7	66.1	51.4	51.4
Actuated g/C Ratio	0.11	0.11	0.13	0.80	0.62	0.62
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	190	170	228	1484	1154	980
v/s Ratio Prot	0.04		c0.10	0.28	c0.50	
v/s Ratio Perm		0.15				0.04
v/c Ratio	0.38	0.15	0.79	0.35	0.80	0.04
Uniform Delay, d1	34.5	33.6	35.0	2.4	11.9	6.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.3	0.4	16.1	0.6	5.9	0.1
Delay (s)	35.8	34.0	51.2	3.0	17.8	6.3
Level of Service	D	C	D	A	B	A
Approach Delay (s)	34.4			15.4	17.0	
Approach LOS	C			B	B	

Intersection Summary			
HCM Average Control Delay	19.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	83.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	60.6%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: KAIMI NANI DRIVE & KAAHUMANU HIGHWAY 1/4/2010

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	1863	1583	1770	1863
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	1863	1583	1770	1863
Volume (vph)	143	81	533	366	220	725
Peak-hour factor, PHF	0.93	0.93	0.96	0.96	0.89	0.89
Adj. Flow (vph)	154	87	555	381	247	815
RTOR Reduction (vph)	0	73	0	207	0	0
Lane Group Flow (vph)	154	14	555	174	247	815
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	8.8	8.8	25.6	25.6	9.7	39.3
Effective Green, g (s)	8.8	8.8	25.6	25.6	9.7	39.3
Actuated g/C Ratio	0.16	0.16	0.46	0.46	0.17	0.70
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	278	248	850	722	306	1305
v/s Ratio Prot	c0.09		0.30		c0.14	c0.44
v/s Ratio Perm		0.05		0.24		
v/c Ratio	0.55	0.06	0.65	0.24	0.81	0.62
Uniform Delay, d1	21.8	20.1	11.8	9.3	22.3	4.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.4	0.1	3.9	0.8	14.4	2.3
Delay (s)	24.2	20.2	15.7	10.1	36.7	6.7
Level of Service	C	C	B	B	D	A
Approach Delay (s)	22.8		13.4			13.7
Approach LOS	C		B			B

Intersection Summary			
HCM Average Control Delay	14.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	56.1	Sum of lost time (s)	8.0
Intersection Capacity Utilization	58.2%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
3: KAIMI NANI DRIVE & MAMALAHOA HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	59	222	157	497	319	31
Peak Hour Factor	0.84	0.84	0.81	0.81	0.93	0.93
Hourly flow rate (vph)	70	264	194	614	343	33
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1361	360	376			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1361	360	376			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	49	61	84			
cM capacity (veh/h)	137	685	1182			

Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1
Volume Total	70	264	194	614	376
Volume Left	70	0	194	0	0
Volume Right	0	264	0	0	33
cSH	137	685	1182	1700	1700
Volume to Capacity	0.51	0.39	0.16	0.36	0.22
Queue Length (ft)	61	46	15	0	0
Control Delay (s)	56.4	13.5	8.6	0.0	0.0
Lane LOS	F	B	A		
Approach Delay (s)	22.5		2.1		0.0
Approach LOS	C				

Intersection Summary			
Average Delay	6.1		
Intersection Capacity Utilization	40.7%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
4: MAKALEI ESTATES & MAMALAHOA HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	0	10	9	264	193	0
Peak Hour Factor	0.57	0.57	0.89	0.89	0.83	0.83
Hourly flow rate (vph)	0	18	10	297	233	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	549	233	233			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	549	233	233			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	98	99			
cM capacity (veh/h)	493	807	1335			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	18	10	297	233
Volume Left	0	10	0	0
Volume Right	18	0	0	0
cSH	807	1335	1700	1700
Volume to Capacity	0.02	0.01	0.17	0.14
Queue Length (ft)	2	1	0	0
Control Delay (s)	9.6	7.7	0.0	0.0
Lane LOS	A	A		
Approach Delay (s)	9.6	0.3		0.0
Approach LOS	A			

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	23.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	5	50	55	455	305	5
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	54	60	495	332	5
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	948	334	337			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	948	334	337			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	92	95			
cM capacity (veh/h)	275	708	1222			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	60	554	337
Volume Left	5	60	0
Volume Right	54	0	5
cSH	619	1222	1700
Volume to Capacity	0.10	0.05	0.20
Queue Length (ft)	8	4	0
Control Delay (s)	11.4	1.4	0.0
Lane LOS	B	A	
Approach Delay (s)	11.4	1.4	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	1.5		
Intersection Capacity Utilization	56.7%	ICU Level of Service	B
Analysis Period (min)	15		

Appendix D
Level-of-Service Analysis Worksheets for 2011 Background Conditions

HCM Signalized Intersection Capacity Analysis
1: KEAHOLE AIRPORT ACCESS ROAD & KAAHUMANU HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	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	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	1863	1863	1583
Volume (vph)	40	135	235	780	385	75
Peak-hour factor, PHF	0.88	0.88	0.82	0.82	0.80	0.80
Adj. Flow (vph)	45	153	287	951	481	94
RTOR Reduction (vph)	0	136	0	0	0	53
Lane Group Flow (vph)	45	17	287	951	481	41
Turn Type		Perm	Prot			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Actuated Green, G (s)	6.0	6.0	11.7	38.6	22.9	22.9
Effective Green, g (s)	6.0	6.0	11.7	38.6	22.9	22.9
Actuated g/C Ratio	0.11	0.11	0.22	0.73	0.44	0.44
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	202	181	394	1367	811	689
v/s Ratio Prot	0.03		0.16	c0.51	0.26	
v/s Ratio Perm		0.10				0.06
v/c Ratio	0.22	0.10	0.73	0.70	0.59	0.06
Uniform Delay, d1	21.2	20.9	19.0	3.8	11.3	8.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.6	0.2	6.6	2.9	3.2	0.2
Delay (s)	21.7	21.1	25.6	6.8	14.5	8.8
Level of Service	C	C	C	A	B	A
Approach Delay (s)	21.2			11.1	13.5	
Approach LOS	C			B	B	

Intersection Summary			
HCM Average Control Delay	12.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	52.6	Sum of lost time (s)	8.0
Intersection Capacity Utilization	51.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: KAIMI NANI DRIVE & KAAHUMANU HIGHWAY

1/4/2010

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	1863	1583	1770	1863
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	1863	1583	1770	1863
Volume (vph)	550	315	580	125	60	500
Peak-hour factor, PHF	0.93	0.93	0.96	0.96	0.89	0.89
Adj. Flow (vph)	591	339	604	130	67	562
RTOR Reduction (vph)	0	180	0	73	0	0
Lane Group Flow (vph)	591	159	604	57	67	562
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	31.9	31.9	38.4	38.4	4.7	47.1
Effective Green, g (s)	31.9	31.9	38.4	38.4	4.7	47.1
Actuated g/C Ratio	0.37	0.37	0.44	0.44	0.05	0.54
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	649	580	822	699	96	1009
v/s Ratio Prot	c0.33		c0.32		0.04	c0.30
v/s Ratio Perm		0.21		0.08		
v/c Ratio	0.91	0.27	0.73	0.08	0.70	0.56
Uniform Delay, d1	26.2	19.4	20.1	14.1	40.5	13.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	17.0	0.3	5.8	0.2	19.8	2.2
Delay (s)	43.2	19.7	25.9	14.3	60.3	15.3
Level of Service	D	B	C	B	E	B
Approach Delay (s)	34.6		23.8			20.1
Approach LOS	C		C			C

Intersection Summary			
HCM Average Control Delay	27.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	87.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	74.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.85	1.00	1.00	0.98	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1770	1583	1770	1863	1827	
Flt Permitted	0.95	1.00	0.24	1.00	1.00	
Satd. Flow (perm)	1770	1583	438	1863	1827	
Volume (vph)	35	330	205	250	670	110
Peak-hour factor, PHF	0.84	0.84	0.81	0.81	0.93	0.93
Adj. Flow (vph)	42	393	253	309	720	118
RTOR Reduction (vph)	0	242	0	0	8	0
Lane Group Flow (vph)	42	151	253	309	830	0
Turn Type		Perm	Perm			
Protected Phases	4			2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	10.6	10.6	37.0	37.0	37.0	
Effective Green, g (s)	10.6	10.6	37.0	37.0	37.0	
Actuated g/C Ratio	0.19	0.19	0.67	0.67	0.67	
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	337	302	291	1240	1216	
v/s Ratio Prot	0.02			0.17	0.46	
v/s Ratio Perm		0.25	c0.58			
v/c Ratio	0.12	0.50	0.87	0.25	0.68	
Uniform Delay, d1	18.7	20.1	7.4	3.7	5.7	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.2	1.3	23.0	0.1	1.6	
Delay (s)	18.8	21.4	30.4	3.8	7.3	
Level of Service	B	C	C	A	A	
Approach Delay (s)	21.2			15.8	7.3	
Approach LOS	C			B	A	

Intersection Summary			
HCM Average Control Delay	13.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	55.6	Sum of lost time (s)	8.0
Intersection Capacity Utilization	69.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0		4.0	4.0
Lane Util. Factor	1.00		1.00		1.00	1.00
Frt	1.00		1.00		1.00	1.00
Flt Protected	0.95		1.00		0.95	1.00
Satd. Flow (prot)	1770		1863		1770	1863
Flt Permitted	0.95		1.00		0.95	1.00
Satd. Flow (perm)	1770		1863		1770	1863
Volume (vph)	5	0	815	0	5	465
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	5	0	886	0	5	505
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	5	0	886	0	5	505
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	16.0		58.0		4.0	66.0
Effective Green, g (s)	16.0		58.0		4.0	66.0
Actuated g/C Ratio	0.18		0.64		0.04	0.73
Clearance Time (s)	4.0		4.0		4.0	4.0
Lane Grp Cap (vph)	315		1201		79	1366
v/s Ratio Prot	c0.00		c0.48		0.00	c0.27
v/s Ratio Perm						
v/c Ratio	0.02		0.74		0.06	0.37
Uniform Delay, d1	30.5		10.8		41.2	4.4
Progression Factor	1.00		1.00		1.00	1.00
Incremental Delay, d2	0.1		4.1		1.5	0.8
Delay (s)	30.6		14.9		42.7	5.2
Level of Service	C		B		D	A
Approach Delay (s)	30.6		14.9			5.5
Approach LOS	C		B			A

Intersection Summary			
HCM Average Control Delay	11.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	52.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
5: KAIMI NANI DRIVE & MAIN STREET

1/4/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	0	175	10	20	785	0	80	0	10	0	0	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	190	11	22	853	0	87	0	11	0	0	0
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	853			201			1087	1087	190	1098	1098	853
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	853			201			1087	1087	190	1098	1098	853
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			98			55	100	99	100	100	100
cM capacity (veh/h)	786			1371			191	213	852	186	209	359

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	0	190	11	22	853	0	87	11	0	0
Volume Left	0	0	0	22	0	0	87	0	0	0
Volume Right	0	0	11	0	0	0	0	11	0	0
cSH	1700	1700	1700	1371	1700	1700	191	852	1700	1700
Volume to Capacity	0.00	0.11	0.01	0.02	0.50	0.00	0.45	0.01	0.00	0.00
Queue Length (ft)	0	0	0	1	0	0	54	1	0	0
Control Delay (s)	0.0	0.0	0.0	7.7	0.0	0.0	38.6	9.3	0.0	0.0
Lane LOS				A			E	A	A	A
Approach Delay (s)	0.0			0.2			35.4		0.0	
Approach LOS							E		A	

Intersection Summary			
Average Delay	3.1		
Intersection Capacity Utilization	52.4%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
6: AHIKAWA STREET & MAMALAHOA HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	5	100	15	195	570	10
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	109	16	212	620	11
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	870	625	630			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	870	625	630			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	78	98			
cM capacity (veh/h)	317	485	952			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	114	228	630
Volume Left	5	16	0
Volume Right	109	0	11
cSH	473	952	1700
Volume to Capacity	0.24	0.02	0.37
Queue Length (ft)	23	1	0
Control Delay (s)	15.0	0.8	0.0
Lane LOS	C	A	
Approach Delay (s)	15.0	0.8	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	1.9		
Intersection Capacity Utilization	43.7%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
7: MAKALEI ESTATES & MAMALAHOA HIGHWAY 1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	5	25	20	150	265	5
Peak Hour Factor	0.57	0.57	0.89	0.89	0.83	0.83
Hourly flow rate (vph)	9	44	22	169	319	6
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	536	322	325			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	536	322	325			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	94	98			
cM capacity (veh/h)	496	719	1234			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	53	22	169	325
Volume Left	9	22	0	0
Volume Right	44	0	0	6
cSH	669	1234	1700	1700
Volume to Capacity	0.08	0.02	0.10	0.19
Queue Length (ft)	6	1	0	0
Control Delay (s)	10.8	8.0	0.0	0.0
Lane LOS	B	A		
Approach Delay (s)	10.8	0.9		0.0
Approach LOS	B			

Intersection Summary			
Average Delay	1.3		
Intersection Capacity Utilization	26.6%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
1: KEAHOLE AIRPORT ACCESS ROAD & KAAHUMANU HIGHWAY 1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	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	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	1863	1863	1583
Volume (vph)	70	225	160	485	840	60
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	76	245	174	527	913	65
RTOR Reduction (vph)	0	218	0	0	0	24
Lane Group Flow (vph)	76	27	174	527	913	41
Turn Type		Perm	Prot			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Actuated Green, G (s)	9.1	9.1	10.0	66.1	52.1	52.1
Effective Green, g (s)	9.1	9.1	10.0	66.1	52.1	52.1
Actuated g/C Ratio	0.11	0.11	0.12	0.79	0.63	0.63
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	194	173	213	1480	1167	991
v/s Ratio Prot	0.04		c0.10	0.28	c0.49	
v/s Ratio Perm		0.15				0.04
v/c Ratio	0.39	0.15	0.82	0.36	0.78	0.04
Uniform Delay, d1	34.5	33.6	35.7	2.5	11.4	6.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.3	0.4	20.9	0.7	5.3	0.1
Delay (s)	35.8	34.0	56.6	3.1	16.7	6.0
Level of Service	D	C	E	A	B	A
Approach Delay (s)	34.4			16.4	16.0	
Approach LOS	C			B	B	

Intersection Summary			
HCM Average Control Delay	19.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	83.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	67.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: KAIMI NANI DRIVE & KAAHUMANU HIGHWAY

1/4/2010

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	1863	1583	1770	1863
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	1863	1583	1770	1863
Volume (vph)	180	105	585	530	270	790
Peak-hour factor, PHF	0.93	0.93	0.96	0.96	0.89	0.89
Adj. Flow (vph)	194	113	609	552	303	888
RTOR Reduction (vph)	0	95	0	282	0	0
Lane Group Flow (vph)	194	18	609	270	303	888
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	13.8	13.8	42.5	42.5	18.6	65.1
Effective Green, g (s)	13.8	13.8	42.5	42.5	18.6	65.1
Actuated g/C Ratio	0.16	0.16	0.49	0.49	0.21	0.75
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	281	251	911	774	379	1396
v/s Ratio Prot	c0.11		0.33		c0.17	0.48
v/s Ratio Perm		0.07		0.35		
v/c Ratio	0.69	0.07	0.67	0.35	0.80	0.64
Uniform Delay, d1	34.5	31.1	16.9	13.7	32.4	5.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	7.1	0.1	3.9	1.2	11.2	2.2
Delay (s)	41.7	31.2	20.7	14.9	43.6	7.4
Level of Service	D	C	C	B	D	A
Approach Delay (s)	37.8		18.0			16.6
Approach LOS	D		B			B

Intersection Summary			
HCM Average Control Delay	19.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	86.9	Sum of lost time (s)	12.0
Intersection Capacity Utilization	65.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
3: KAIMI NANI DRIVE & MAMALAHOA HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.85	1.00	1.00	0.98	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1770	1583	1770	1863	1831	
Flt Permitted	0.95	1.00	0.48	1.00	1.00	
Satd. Flow (perm)	1770	1583	898	1863	1831	
Volume (vph)	95	330	210	540	350	50
Peak-hour factor, PHF	0.84	0.84	0.81	0.81	0.93	0.93
Adj. Flow (vph)	113	393	259	667	376	54
RTOR Reduction (vph)	0	303	0	0	9	0
Lane Group Flow (vph)	113	90	259	667	421	0
Turn Type		Perm	Perm			
Protected Phases	4			2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	8.7	8.7	21.3	21.3	21.3	
Effective Green, g (s)	8.7	8.7	21.3	21.3	21.3	
Actuated g/C Ratio	0.23	0.23	0.56	0.56	0.56	
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	405	362	503	1044	1026	
v/s Ratio Prot	0.06			c0.36	0.23	
v/s Ratio Perm		0.25	0.29			
v/c Ratio	0.28	0.25	0.51	0.64	0.41	
Uniform Delay, d1	12.1	12.0	5.2	5.7	4.8	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.4	0.4	0.9	1.3	0.3	
Delay (s)	12.4	12.3	6.1	7.0	5.0	
Level of Service	B	B	A	A	A	
Approach Delay (s)	12.4			6.7	5.0	
Approach LOS	B			A	A	

Intersection Summary			
HCM Average Control Delay	7.9	HCM Level of Service	A
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	38.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	48.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: PALAMANUI & KAAHUMANU HIGHWAY

1/4/2010

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0		4.0	4.0
Lane Util. Factor	1.00		1.00		1.00	1.00
Frt	1.00		1.00		1.00	1.00
Flt Protected	0.95		1.00		0.95	1.00
Satd. Flow (prot)	1770		1863		1770	1863
Flt Permitted	0.95		1.00		0.95	1.00
Satd. Flow (perm)	1770		1863		1770	1863
Volume (vph)	5	0	535	0	5	900
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	5	0	582	0	5	978
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	5	0	582	0	5	978
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	17.0		56.0		5.0	65.0
Effective Green, g (s)	17.0		56.0		5.0	65.0
Actuated g/C Ratio	0.19		0.62		0.06	0.72
Clearance Time (s)	4.0		4.0		4.0	4.0
Lane Grp Cap (vph)	334		1159		98	1346
v/s Ratio Prot	c0.00		0.31		0.00	c0.53
v/s Ratio Perm						
v/c Ratio	0.01		0.50		0.05	0.73
Uniform Delay, d1	29.7		9.3		40.3	7.3
Progression Factor	1.00		1.00		1.00	1.00
Incremental Delay, d2	0.1		1.6		1.0	3.5
Delay (s)	29.8		10.9		41.2	10.8
Level of Service	C		B		D	B
Approach Delay (s)	29.8		10.9			10.9
Approach LOS	C		B			B

Intersection Summary			
HCM Average Control Delay	11.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	57.4%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
5: KAIMI NANI DRIVE & MAIN STREET

1/4/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	0	720	80	15	265	0	20	0	20	0	0	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	783	87	16	288	0	22	0	22	0	0	0
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	288			870			1103	1103	783	1125	1190	288
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	288			870			1103	1103	783	1125	1190	288
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			98			88	100	94	100	100	100
cM capacity (veh/h)	1274			775			186	207	394	169	184	751

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	0	783	87	16	288	0	22	22	0	0
Volume Left	0	0	0	16	0	0	22	0	0	0
Volume Right	0	0	87	0	0	0	0	22	0	0
cSH	1700	1700	1700	775	1700	1700	186	394	1700	1700
Volume to Capacity	0.00	0.46	0.05	0.02	0.17	0.00	0.12	0.06	0.00	0.00
Queue Length (ft)	0	0	0	2	0	0	10	4	0	0
Control Delay (s)	0.0	0.0	0.0	9.7	0.0	0.0	27.0	14.7	0.0	0.0
Lane LOS				A			D	B	A	A
Approach Delay (s)	0.0			0.5			20.8		0.0	
Approach LOS							C		A	

Intersection Summary			
Average Delay	0.9		
Intersection Capacity Utilization	47.9%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
6: AHIKAWA STREET & MAMALAHOA HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	5	55	60	495	335	5
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	60	65	538	364	5
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1035	367	370			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1035	367	370			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	91	95			
cM capacity (veh/h)	243	678	1189			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	65	603	370
Volume Left	5	65	0
Volume Right	60	0	5
cSH	590	1189	1700
Volume to Capacity	0.11	0.05	0.22
Queue Length (ft)	9	4	0
Control Delay (s)	11.9	1.5	0.0
Lane LOS	B	A	
Approach Delay (s)	11.9	1.5	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	61.0%	ICU Level of Service	B
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
7: MAKALEI ESTATES & MAMALAHOA HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	5	10	10	320	225	5
Peak Hour Factor	0.57	0.57	0.89	0.89	0.83	0.83
Hourly flow rate (vph)	9	18	11	360	271	6
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	656	274	277			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	656	274	277			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	98	99			
cM capacity (veh/h)	426	765	1286			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	26	11	360	277
Volume Left	9	11	0	0
Volume Right	18	0	0	6
cSH	605	1286	1700	1700
Volume to Capacity	0.04	0.01	0.21	0.16
Queue Length (ft)	3	1	0	0
Control Delay (s)	11.2	7.8	0.0	0.0
Lane LOS	B	A		
Approach Delay (s)	11.2	0.2		0.0
Approach LOS	B			

Intersection Summary			
Average Delay	0.6		
Intersection Capacity Utilization	26.8%	ICU Level of Service	A
Analysis Period (min)	15		

Appendix E
Level-of-Service Analysis Worksheets for 2012 Background Conditions

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	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	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	1863	1863	1583
Volume (vph)	40	145	245	810	405	80
Peak-hour factor, PHF	0.88	0.88	0.82	0.82	0.80	0.80
Adj. Flow (vph)	45	165	299	988	506	100
RTOR Reduction (vph)	0	146	0	0	0	57
Lane Group Flow (vph)	45	19	299	988	506	43
Turn Type		Perm	Prot			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Actuated Green, G (s)	6.0	6.0	11.9	38.4	22.5	22.5
Effective Green, g (s)	6.0	6.0	11.9	38.4	22.5	22.5
Actuated g/C Ratio	0.11	0.11	0.23	0.73	0.43	0.43
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	203	181	402	1365	800	680
v/s Ratio Prot	0.03		0.17	c0.53	0.27	
v/s Ratio Perm		0.10				0.06
v/c Ratio	0.22	0.10	0.74	0.72	0.63	0.06
Uniform Delay, d1	21.1	20.8	18.8	4.0	11.7	8.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.6	0.3	7.3	3.4	3.8	0.2
Delay (s)	21.6	21.0	26.1	7.3	15.5	8.9
Level of Service	C	C	C	A	B	A
Approach Delay (s)	21.2			11.7	14.4	
Approach LOS	C			B	B	

Intersection Summary			
HCM Average Control Delay	13.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	52.4	Sum of lost time (s)	8.0
Intersection Capacity Utilization	52.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: KAIMI NANI DRIVE & KAAHUMANU HIGHWAY 1/4/2010

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	1863	1583	1770	1863
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	1863	1583	1770	1863
Volume (vph)	570	325	605	130	60	525
Peak-hour factor, PHF	0.93	0.93	0.96	0.96	0.89	0.89
Adj. Flow (vph)	613	349	630	135	67	590
RTOR Reduction (vph)	0	171	0	76	0	0
Lane Group Flow (vph)	613	178	630	59	67	590
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	32.7	32.7	38.3	38.3	4.7	47.0
Effective Green, g (s)	32.7	32.7	38.3	38.3	4.7	47.0
Actuated g/C Ratio	0.37	0.37	0.44	0.44	0.05	0.54
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	660	590	814	691	95	998
v/s Ratio Prot	c0.35		c0.34		0.04	c0.32
v/s Ratio Perm		0.22		0.09		
v/c Ratio	0.93	0.30	0.77	0.09	0.71	0.59
Uniform Delay, d1	26.4	19.4	21.0	14.5	40.8	13.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	19.3	0.3	7.1	0.2	21.1	2.6
Delay (s)	45.7	19.7	28.1	14.7	61.9	16.4
Level of Service	D	B	C	B	E	B
Approach Delay (s)	36.3		25.7			21.0
Approach LOS	D		C			C

Intersection Summary			
HCM Average Control Delay	28.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	87.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	76.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
3: KAIMI NANI DRIVE & MAMALAHOA HIGHWAY 1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	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	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.27	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	494	1863	1863	1583
Volume (vph)	40	345	215	260	700	115
Peak-hour factor, PHF	0.84	0.84	0.81	0.81	0.93	0.93
Adj. Flow (vph)	48	411	265	321	753	124
RTOR Reduction (vph)	0	205	0	0	0	45
Lane Group Flow (vph)	48	206	265	321	753	79
Turn Type		Perm	Perm			Perm
Protected Phases	4			2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	12.4	12.4	35.4	35.4	35.4	35.4
Effective Green, g (s)	12.4	12.4	35.4	35.4	35.4	35.4
Actuated g/C Ratio	0.22	0.22	0.63	0.63	0.63	0.63
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	393	352	313	1182	1182	1004
v/s Ratio Prot	0.03			0.17	0.40	
v/s Ratio Perm		0.26	c0.54			0.08
v/c Ratio	0.12	0.59	0.85	0.27	0.64	0.08
Uniform Delay, d1	17.3	19.4	8.1	4.5	6.3	3.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	2.5	18.6	0.1	1.1	0.0
Delay (s)	17.5	21.9	26.7	4.6	7.4	4.0
Level of Service	B	C	C	A	A	A
Approach Delay (s)	21.4			14.6	6.9	
Approach LOS	C			B	A	

Intersection Summary			
HCM Average Control Delay	12.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	55.8	Sum of lost time (s)	8.0
Intersection Capacity Utilization	64.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: PALAMANUI & KAAHUMANU HIGHWAY

1/4/2010

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0		4.0	4.0
Lane Util. Factor	1.00		1.00		1.00	1.00
Frt	1.00		1.00		1.00	1.00
Flt Protected	0.95		1.00		0.95	1.00
Satd. Flow (prot)	1770		1863		1770	1863
Flt Permitted	0.95		1.00		0.95	1.00
Satd. Flow (perm)	1770		1863		1770	1863
Volume (vph)	5	0	850	0	5	485
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	5	0	924	0	5	527
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	5	0	924	0	5	527
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	16.0		58.0		4.0	66.0
Effective Green, g (s)	16.0		58.0		4.0	66.0
Actuated g/C Ratio	0.18		0.64		0.04	0.73
Clearance Time (s)	4.0		4.0		4.0	4.0
Lane Grp Cap (vph)	315		1201		79	1366
v/s Ratio Prot	c0.00		c0.50		0.00	c0.28
v/s Ratio Perm						
v/c Ratio	0.02		0.77		0.06	0.39
Uniform Delay, d1	30.5		11.3		41.2	4.5
Progression Factor	1.00		1.00		1.00	1.00
Incremental Delay, d2	0.1		4.8		1.5	0.8
Delay (s)	30.6		16.1		42.7	5.3
Level of Service	C		B		D	A
Approach Delay (s)	30.6		16.1			5.6
Approach LOS	C		B			A

Intersection Summary			
HCM Average Control Delay	12.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	54.7%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
5: KAIMI NANI DRIVE & MAIN STREET

1/4/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	0	180	10	20	815	0	80	0	10	0	0	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	196	11	22	886	0	87	0	11	0	0	0
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	886			207			1125	1125	196	1136	1136	886
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	886			207			1125	1125	196	1136	1136	886
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			98			52	100	99	100	100	100
cM capacity (veh/h)	764			1365			180	202	846	175	199	344

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	0	196	11	22	886	0	87	11	0	0
Volume Left	0	0	0	22	0	0	87	0	0	0
Volume Right	0	0	11	0	0	0	0	11	0	0
cSH	1700	1700	1700	1365	1700	1700	180	846	1700	1700
Volume to Capacity	0.00	0.12	0.01	0.02	0.52	0.00	0.48	0.01	0.00	0.00
Queue Length (ft)	0	0	0	1	0	0	58	1	0	0
Control Delay (s)	0.0	0.0	0.0	7.7	0.0	0.0	42.4	9.3	0.0	0.0
Lane LOS				A			E	A	A	A
Approach Delay (s)	0.0			0.2			38.7		0.0	
Approach LOS							E		A	

Intersection Summary			
Average Delay	3.3		
Intersection Capacity Utilization	54.0%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
6: AHIKAWA STREET & MAMALAHOA HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	5	105	15	220	620	10
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	114	16	239	674	11
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	951	679	685			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	951	679	685			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	75	98			
cM capacity (veh/h)	283	451	909			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	120	255	685
Volume Left	5	16	0
Volume Right	114	0	11
cSH	440	909	1700
Volume to Capacity	0.27	0.02	0.40
Queue Length (ft)	27	1	0
Control Delay (s)	16.2	0.8	0.0
Lane LOS	C	A	
Approach Delay (s)	16.2	0.8	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	2.0		
Intersection Capacity Utilization	46.7%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
7: MAKALEI ESTATES & MAMALAHOA HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	5	30	25	160	275	5
Peak Hour Factor	0.57	0.57	0.89	0.89	0.83	0.83
Hourly flow rate (vph)	9	53	28	180	331	6
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	570	334	337			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	570	334	337			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	93	98			
cM capacity (veh/h)	472	708	1222			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	61	28	180	337
Volume Left	9	28	0	0
Volume Right	53	0	0	6
cSH	660	1222	1700	1700
Volume to Capacity	0.09	0.02	0.11	0.20
Queue Length (ft)	8	2	0	0
Control Delay (s)	11.0	8.0	0.0	0.0
Lane LOS	B	A		
Approach Delay (s)	11.0	1.1		0.0
Approach LOS	B			

Intersection Summary			
Average Delay	1.5		
Intersection Capacity Utilization	30.8%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
1: KEAHOLE AIRPORT ACCESS ROAD & KAAHUMANU HIGHWAY 1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱	↰	↑	↑	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	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	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	1863	1863	1583
Volume (vph)	75	235	165	505	875	65
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	82	255	179	549	951	71
RTOR Reduction (vph)	0	227	0	0	0	27
Lane Group Flow (vph)	82	28	179	549	951	44
Turn Type		Perm	Prot			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Actuated Green, G (s)	9.3	9.3	10.0	66.1	52.1	52.1
Effective Green, g (s)	9.3	9.3	10.0	66.1	52.1	52.1
Actuated g/C Ratio	0.11	0.11	0.12	0.79	0.62	0.62
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	197	177	212	1477	1164	989
v/s Ratio Prot	0.05		c0.10	0.29	c0.51	
v/s Ratio Perm		0.16				0.04
v/c Ratio	0.42	0.16	0.84	0.37	0.82	0.04
Uniform Delay, d1	34.5	33.5	35.9	2.5	12.0	6.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.4	0.4	25.2	0.7	6.4	0.1
Delay (s)	35.9	33.9	61.1	3.3	18.4	6.1
Level of Service	D	C	E	A	B	A
Approach Delay (s)	34.4			17.5	17.5	
Approach LOS	C			B	B	

Intersection Summary			
HCM Average Control Delay	20.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	83.4	Sum of lost time (s)	12.0
Intersection Capacity Utilization	69.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: KAIMI NANI DRIVE & KAAHUMANU HIGHWAY 1/4/2010

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑	↱	↰	↑
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	1863	1583	1770	1863
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	1863	1583	1770	1863
Volume (vph)	185	110	610	545	280	825
Peak-hour factor, PHF	0.93	0.93	0.96	0.96	0.89	0.89
Adj. Flow (vph)	199	118	635	568	315	927
RTOR Reduction (vph)	0	99	0	294	0	0
Lane Group Flow (vph)	199	19	635	274	315	927
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	14.0	14.0	42.0	42.0	19.1	65.1
Effective Green, g (s)	14.0	14.0	42.0	42.0	19.1	65.1
Actuated g/C Ratio	0.16	0.16	0.48	0.48	0.22	0.75
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	285	254	898	763	388	1392
v/s Ratio Prot	c0.11		0.34		c0.18	0.50
v/s Ratio Perm		0.07		0.36		
v/c Ratio	0.70	0.07	0.71	0.36	0.81	0.67
Uniform Delay, d1	34.6	31.0	17.7	14.1	32.3	5.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	7.3	0.1	4.7	1.3	12.2	2.5
Delay (s)	41.8	31.2	22.4	15.4	44.5	8.1
Level of Service	D	C	C	B	D	A
Approach Delay (s)	37.9		19.1			17.3
Approach LOS	D		B			B

Intersection Summary			
HCM Average Control Delay	20.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	87.1	Sum of lost time (s)	12.0
Intersection Capacity Utilization	67.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

3: KAIMI NANI DRIVE & MAMALAHOA HIGHWAY

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	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	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.51	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	956	1863	1863	1583
Volume (vph)	100	340	215	565	365	50
Peak-hour factor, PHF	0.84	0.84	0.81	0.81	0.93	0.93
Adj. Flow (vph)	119	405	265	698	392	54
RTOR Reduction (vph)	0	312	0	0	0	23
Lane Group Flow (vph)	119	93	265	698	392	31
Turn Type		Perm	Perm			Perm
Protected Phases	4			2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	8.9	8.9	22.0	22.0	22.0	22.0
Effective Green, g (s)	8.9	8.9	22.0	22.0	22.0	22.0
Actuated g/C Ratio	0.23	0.23	0.57	0.57	0.57	0.57
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	405	362	541	1054	1054	895
v/s Ratio Prot	0.07			c0.37	0.21	
v/s Ratio Perm		0.26	0.28			0.03
v/c Ratio	0.29	0.26	0.49	0.66	0.37	0.03
Uniform Delay, d1	12.4	12.3	5.1	5.9	4.6	3.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.4	0.4	0.7	1.6	0.2	0.0
Delay (s)	12.8	12.7	5.8	7.4	4.9	3.8
Level of Service	B	B	A	A	A	A
Approach Delay (s)	12.7			7.0	4.7	
Approach LOS	B			A	A	

Intersection Summary			
HCM Average Control Delay	8.0	HCM Level of Service	A
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	38.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	46.9%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

4: PALAMANUI & KAAHUMANU HIGHWAY

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0		4.0	4.0
Lane Util. Factor	1.00		1.00		1.00	1.00
Frt	1.00		1.00		1.00	1.00
Flt Protected	0.95		1.00		0.95	1.00
Satd. Flow (prot)	1770		1863		1770	1863
Flt Permitted	0.95		1.00		0.95	1.00
Satd. Flow (perm)	1770		1863		1770	1863
Volume (vph)	5	0	555	0	5	935
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	5	0	603	0	5	1016
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	5	0	603	0	5	1016
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	17.0		56.0		5.0	65.0
Effective Green, g (s)	17.0		56.0		5.0	65.0
Actuated g/C Ratio	0.19		0.62		0.06	0.72
Clearance Time (s)	4.0		4.0		4.0	4.0
Lane Grp Cap (vph)	334		1159		98	1346
v/s Ratio Prot	c0.00		0.32		0.00	c0.55
v/s Ratio Perm						
v/c Ratio	0.01		0.52		0.05	0.75
Uniform Delay, d1	29.7		9.5		40.3	7.6
Progression Factor	1.00		1.00		1.00	1.00
Incremental Delay, d2	0.1		1.7		1.0	4.0
Delay (s)	29.8		11.2		41.2	11.6
Level of Service	C		B		D	B
Approach Delay (s)	29.8		11.2			11.8
Approach LOS	C		B			B

Intersection Summary			
HCM Average Control Delay	11.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	59.2%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

5: KAIMI NANI DRIVE & MAIN STREET

1/4/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	0	750	80	15	275	0	20	0	20	0	0	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	815	87	16	299	0	22	0	22	0	0	0
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	299			902			1147	1147	815	1168	1234	299
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	299			902			1147	1147	815	1168	1234	299
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			98			87	100	94	100	100	100
cM capacity (veh/h)	1262			753			173	195	377	158	173	741

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	0	815	87	16	299	0	22	22	0	0
Volume Left	0	0	0	16	0	0	22	0	0	0
Volume Right	0	0	87	0	0	0	0	22	0	0
cSH	1700	1700	1700	753	1700	1700	173	377	1700	1700
Volume to Capacity	0.00	0.48	0.05	0.02	0.18	0.00	0.13	0.06	0.00	0.00
Queue Length (ft)	0	0	0	2	0	0	11	5	0	0
Control Delay (s)	0.0	0.0	0.0	9.9	0.0	0.0	28.7	15.1	0.0	0.0
Lane LOS				A			D	C	A	A
Approach Delay (s)	0.0			0.5			21.9		0.0	
Approach LOS							C		A	

Intersection Summary			
Average Delay	0.9		
Intersection Capacity Utilization	49.5%	ICU Level of Service	A
Analysis Period (min)	15		

6: AHIKAWA STREET & MAMALAHOA HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	5	55	65	550	365	5
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	60	71	598	397	5
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1139	399	402			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1139	399	402			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	97	91	94			
cM capacity (veh/h)	209	650	1156			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	65	668	402
Volume Left	5	71	0
Volume Right	60	0	5
cSH	553	1156	1700
Volume to Capacity	0.12	0.06	0.24
Queue Length (ft)	10	5	0
Control Delay (s)	12.4	1.6	0.0
Lane LOS	B	A	
Approach Delay (s)	12.4	1.6	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	65.7%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	5	10	10	330	235	5
Peak Hour Factor	0.57	0.57	0.89	0.89	0.83	0.83
Hourly flow rate (vph)	9	18	11	371	283	6
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	679	286	289			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	679	286	289			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	98	99			
cM capacity (veh/h)	413	753	1273			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	26	11	371	289
Volume Left	9	11	0	0
Volume Right	18	0	0	6
cSH	591	1273	1700	1700
Volume to Capacity	0.04	0.01	0.22	0.17
Queue Length (ft)	3	1	0	0
Control Delay (s)	11.4	7.9	0.0	0.0
Lane LOS	B	A		
Approach Delay (s)	11.4	0.2		0.0
Approach LOS	B			

Intersection Summary			
Average Delay	0.6		
Intersection Capacity Utilization	27.4%	ICU Level of Service	A
Analysis Period (min)	15		

Appendix F
Level-of-Service Analysis Worksheets for 2017 Background Conditions

HCM Signalized Intersection Capacity Analysis
1: KEAHOLE AIRPORT ACCESS ROAD & KAAHUMANU HIGHWAY — 1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	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	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	1863	1863	1583
Volume (vph)	40	145	245	810	405	80
Peak-hour factor, PHF	0.88	0.88	0.82	0.82	0.80	0.80
Adj. Flow (vph)	45	165	299	988	506	100
RTOR Reduction (vph)	0	146	0	0	0	57
Lane Group Flow (vph)	45	19	299	988	506	43
Turn Type		Perm	Prot			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Actuated Green, G (s)	6.0	6.0	11.9	38.4	22.5	22.5
Effective Green, g (s)	6.0	6.0	11.9	38.4	22.5	22.5
Actuated g/C Ratio	0.11	0.11	0.23	0.73	0.43	0.43
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	203	181	402	1365	800	680
v/s Ratio Prot	0.03		0.17	c0.53	0.27	
v/s Ratio Perm		0.10				0.06
v/c Ratio	0.22	0.10	0.74	0.72	0.63	0.06
Uniform Delay, d1	21.1	20.8	18.8	4.0	11.7	8.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.6	0.3	7.3	3.4	3.8	0.2
Delay (s)	21.6	21.0	26.1	7.3	15.5	8.9
Level of Service	C	C	C	A	B	A
Approach Delay (s)	21.2			11.7	14.4	
Approach LOS	C			B	B	

Intersection Summary			
HCM Average Control Delay	13.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	52.4	Sum of lost time (s)	8.0
Intersection Capacity Utilization	52.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: KAIMI NANI DRIVE & KAAHUMANU HIGHWAY — 1/4/2010

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	1863	1583	1770	1863
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	1863	1583	1770	1863
Volume (vph)	570	325	605	130	60	525
Peak-hour factor, PHF	0.93	0.93	0.96	0.96	0.89	0.89
Adj. Flow (vph)	613	349	630	135	67	590
RTOR Reduction (vph)	0	171	0	76	0	0
Lane Group Flow (vph)	613	178	630	59	67	590
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	32.7	32.7	38.3	38.3	4.7	47.0
Effective Green, g (s)	32.7	32.7	38.3	38.3	4.7	47.0
Actuated g/C Ratio	0.37	0.37	0.44	0.44	0.05	0.54
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	660	590	814	691	95	998
v/s Ratio Prot	c0.35		c0.34		0.04	c0.32
v/s Ratio Perm		0.22		0.09		
v/c Ratio	0.93	0.30	0.77	0.09	0.71	0.59
Uniform Delay, d1	26.4	19.4	21.0	14.5	40.8	13.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	19.3	0.3	7.1	0.2	21.1	2.6
Delay (s)	45.7	19.7	28.1	14.7	61.9	16.4
Level of Service	D	B	C	B	E	B
Approach Delay (s)	36.3		25.7			21.0
Approach LOS	D		C			C

Intersection Summary			
HCM Average Control Delay	28.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	87.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	76.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
3: KAIMI NANI DRIVE & MAMALAHOA HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	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	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.27	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	494	1863	1863	1583
Volume (vph)	40	345	215	260	700	115
Peak-hour factor, PHF	0.84	0.84	0.81	0.81	0.93	0.93
Adj. Flow (vph)	48	411	265	321	753	124
RTOR Reduction (vph)	0	205	0	0	0	45
Lane Group Flow (vph)	48	206	265	321	753	79
Turn Type		Perm	Perm			Perm
Protected Phases	4			2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	12.4	12.4	35.4	35.4	35.4	35.4
Effective Green, g (s)	12.4	12.4	35.4	35.4	35.4	35.4
Actuated g/C Ratio	0.22	0.22	0.63	0.63	0.63	0.63
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	393	352	313	1182	1182	1004
v/s Ratio Prot	0.03			0.17	0.40	
v/s Ratio Perm		0.26	c0.54			0.08
v/c Ratio	0.12	0.59	0.85	0.27	0.64	0.08
Uniform Delay, d1	17.3	19.4	8.1	4.5	6.3	3.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	2.5	18.6	0.1	1.1	0.0
Delay (s)	17.5	21.9	26.7	4.6	7.4	4.0
Level of Service	B	C	C	A	A	A
Approach Delay (s)	21.4			14.6	6.9	
Approach LOS	C			B	A	

Intersection Summary			
HCM Average Control Delay	12.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	55.8	Sum of lost time (s)	8.0
Intersection Capacity Utilization	64.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: PALAMANUI & KAAHUMANU HIGHWAY

1/4/2010

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0		4.0	4.0
Lane Util. Factor	1.00		1.00		1.00	1.00
Frt	1.00		1.00		1.00	1.00
Flt Protected	0.95		1.00		0.95	1.00
Satd. Flow (prot)	1770		1863		1770	1863
Flt Permitted	0.95		1.00		0.95	1.00
Satd. Flow (perm)	1770		1863		1770	1863
Volume (vph)	5	0	850	0	5	485
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	5	0	924	0	5	527
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	5	0	924	0	5	527
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	16.0		58.0		4.0	66.0
Effective Green, g (s)	16.0		58.0		4.0	66.0
Actuated g/C Ratio	0.18		0.64		0.04	0.73
Clearance Time (s)	4.0		4.0		4.0	4.0
Lane Grp Cap (vph)	315		1201		79	1366
v/s Ratio Prot	c0.00		c0.50		0.00	c0.28
v/s Ratio Perm						
v/c Ratio	0.02		0.77		0.06	0.39
Uniform Delay, d1	30.5		11.3		41.2	4.5
Progression Factor	1.00		1.00		1.00	1.00
Incremental Delay, d2	0.1		4.8		1.5	0.8
Delay (s)	30.6		16.1		42.7	5.3
Level of Service	C		B		D	A
Approach Delay (s)	30.6		16.1			5.6
Approach LOS	C		B			A

Intersection Summary			
HCM Average Control Delay	12.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	54.7%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
5: KAIMI NANI DRIVE & MAIN STREET

1/4/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	0	180	10	20	815	0	80	0	10	0	0	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	196	11	22	886	0	87	0	11	0	0	0
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	886			207			1125	1125	196	1136	1136	886
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	886			207			1125	1125	196	1136	1136	886
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			98			52	100	99	100	100	100
cM capacity (veh/h)	764			1365			180	202	846	175	199	344

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	0	196	11	22	886	0	87	11	0	0
Volume Left	0	0	0	22	0	0	87	0	0	0
Volume Right	0	0	11	0	0	0	0	11	0	0
cSH	1700	1700	1700	1365	1700	1700	180	846	1700	1700
Volume to Capacity	0.00	0.12	0.01	0.02	0.52	0.00	0.48	0.01	0.00	0.00
Queue Length (ft)	0	0	0	1	0	0	58	1	0	0
Control Delay (s)	0.0	0.0	0.0	7.7	0.0	0.0	42.4	9.3	0.0	0.0
Lane LOS				A			E	A	A	A
Approach Delay (s)	0.0			0.2			38.7		0.0	
Approach LOS							E		A	

Intersection Summary			
Average Delay	3.3		
Intersection Capacity Utilization	54.0%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
6: AHIKAWA STREET & MAMALAHOA HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	5	105	15	220	620	10
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	114	16	239	674	11
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	951	679	685			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	951	679	685			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	75	98			
cM capacity (veh/h)	283	451	909			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	120	255	685
Volume Left	5	16	0
Volume Right	114	0	11
cSH	440	909	1700
Volume to Capacity	0.27	0.02	0.40
Queue Length (ft)	27	1	0
Control Delay (s)	16.2	0.8	0.0
Lane LOS	C	A	
Approach Delay (s)	16.2	0.8	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	2.0		
Intersection Capacity Utilization	46.7%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
7: MAKALEI ESTATES & MAMALAHOA HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	5	30	25	160	275	5
Peak Hour Factor	0.57	0.57	0.89	0.89	0.83	0.83
Hourly flow rate (vph)	9	53	28	180	331	6
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	570	334	337			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	570	334	337			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	93	98			
cM capacity (veh/h)	472	708	1222			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	61	28	180	337
Volume Left	9	28	0	0
Volume Right	53	0	0	6
cSH	660	1222	1700	1700
Volume to Capacity	0.09	0.02	0.11	0.20
Queue Length (ft)	8	2	0	0
Control Delay (s)	11.0	8.0	0.0	0.0
Lane LOS	B	A		
Approach Delay (s)	11.0	1.1		0.0
Approach LOS	B			

Intersection Summary			
Average Delay	1.5		
Intersection Capacity Utilization	30.8%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
1: KEAHOLE AIRPORT ACCESS ROAD & KAAHUMANU HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	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	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	1863	1863	1583
Volume (vph)	75	235	165	505	875	65
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	82	255	179	549	951	71
RTOR Reduction (vph)	0	227	0	0	0	27
Lane Group Flow (vph)	82	28	179	549	951	44
Turn Type		Perm	Prot			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Actuated Green, G (s)	9.3	9.3	10.0	66.1	52.1	52.1
Effective Green, g (s)	9.3	9.3	10.0	66.1	52.1	52.1
Actuated g/C Ratio	0.11	0.11	0.12	0.79	0.62	0.62
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	197	177	212	1477	1164	989
v/s Ratio Prot	0.05		c0.10	0.29	c0.51	
v/s Ratio Perm		0.16				0.04
v/c Ratio	0.42	0.16	0.84	0.37	0.82	0.04
Uniform Delay, d1	34.5	33.5	35.9	2.5	12.0	6.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.4	0.4	25.2	0.7	6.4	0.1
Delay (s)	35.9	33.9	61.1	3.3	18.4	6.1
Level of Service	D	C	E	A	B	A
Approach Delay (s)	34.4			17.5	17.5	
Approach LOS	C			B	B	

Intersection Summary			
HCM Average Control Delay	20.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	83.4	Sum of lost time (s)	12.0
Intersection Capacity Utilization	69.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: KAIMI NANI DRIVE & KAAHUMANU HIGHWAY

1/4/2010

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	1863	1583	1770	1863
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	1863	1583	1770	1863
Volume (vph)	185	110	610	545	280	825
Peak-hour factor, PHF	0.93	0.93	0.96	0.96	0.89	0.89
Adj. Flow (vph)	199	118	635	568	315	927
RTOR Reduction (vph)	0	99	0	294	0	0
Lane Group Flow (vph)	199	19	635	274	315	927
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	14.0	14.0	42.0	42.0	19.1	65.1
Effective Green, g (s)	14.0	14.0	42.0	42.0	19.1	65.1
Actuated g/C Ratio	0.16	0.16	0.48	0.48	0.22	0.75
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	285	254	898	763	388	1392
v/s Ratio Prot	c0.11		0.34		c0.18	0.50
v/s Ratio Perm		0.07		0.36		
v/c Ratio	0.70	0.07	0.71	0.36	0.81	0.67
Uniform Delay, d1	34.6	31.0	17.7	14.1	32.3	5.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	7.3	0.1	4.7	1.3	12.2	2.5
Delay (s)	41.8	31.2	22.4	15.4	44.5	8.1
Level of Service	D	C	C	B	D	A
Approach Delay (s)	37.9		19.1			17.3
Approach LOS	D		B			B

Intersection Summary			
HCM Average Control Delay	20.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	87.1	Sum of lost time (s)	12.0
Intersection Capacity Utilization	67.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
3: KAIMI NANI DRIVE & MAMALAHOA HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	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	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.51	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	956	1863	1863	1583
Volume (vph)	100	340	215	565	365	50
Peak-hour factor, PHF	0.84	0.84	0.81	0.81	0.93	0.93
Adj. Flow (vph)	119	405	265	698	392	54
RTOR Reduction (vph)	0	312	0	0	0	23
Lane Group Flow (vph)	119	93	265	698	392	31
Turn Type		Perm	Perm			Perm
Protected Phases	4			2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	8.9	8.9	22.0	22.0	22.0	22.0
Effective Green, g (s)	8.9	8.9	22.0	22.0	22.0	22.0
Actuated g/C Ratio	0.23	0.23	0.57	0.57	0.57	0.57
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	405	362	541	1054	1054	895
v/s Ratio Prot	0.07			c0.37	0.21	
v/s Ratio Perm		0.26	0.28			0.03
v/c Ratio	0.29	0.26	0.49	0.66	0.37	0.03
Uniform Delay, d1	12.4	12.3	5.1	5.9	4.6	3.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.4	0.4	0.7	1.6	0.2	0.0
Delay (s)	12.8	12.7	5.8	7.4	4.9	3.8
Level of Service	B	B	A	A	A	A
Approach Delay (s)	12.7			7.0	4.7	
Approach LOS	B			A	A	

Intersection Summary			
HCM Average Control Delay	8.0	HCM Level of Service	A
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	38.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	46.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: PALAMANUI & KAAHUMANU HIGHWAY

1/4/2010

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0		4.0	4.0
Lane Util. Factor	1.00		1.00		1.00	1.00
Frt	1.00		1.00		1.00	1.00
Flt Protected	0.95		1.00		0.95	1.00
Satd. Flow (prot)	1770		1863		1770	1863
Flt Permitted	0.95		1.00		0.95	1.00
Satd. Flow (perm)	1770		1863		1770	1863
Volume (vph)	5	0	555	0	5	935
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	5	0	603	0	5	1016
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	5	0	603	0	5	1016
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	17.0		56.0		5.0	65.0
Effective Green, g (s)	17.0		56.0		5.0	65.0
Actuated g/C Ratio	0.19		0.62		0.06	0.72
Clearance Time (s)	4.0		4.0		4.0	4.0
Lane Grp Cap (vph)	334		1159		98	1346
v/s Ratio Prot	c0.00		0.32		0.00	c0.55
v/s Ratio Perm						
v/c Ratio	0.01		0.52		0.05	0.75
Uniform Delay, d1	29.7		9.5		40.3	7.6
Progression Factor	1.00		1.00		1.00	1.00
Incremental Delay, d2	0.1		1.7		1.0	4.0
Delay (s)	29.8		11.2		41.2	11.6
Level of Service	C		B		D	B
Approach Delay (s)	29.8		11.2			11.8
Approach LOS	C		B			B

Intersection Summary			
HCM Average Control Delay	11.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	59.2%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
5: KAIMI NANI DRIVE & MAIN STREET

1/4/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	0	750	80	15	275	0	20	0	20	0	0	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	815	87	16	299	0	22	0	22	0	0	0
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	299			902			1147	1147	815	1168	1234	299
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	299			902			1147	1147	815	1168	1234	299
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			98			87	100	94	100	100	100
cM capacity (veh/h)	1262			753			173	195	377	158	173	741

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	0	815	87	16	299	0	22	22	0	0
Volume Left	0	0	0	16	0	0	22	0	0	0
Volume Right	0	0	87	0	0	0	0	22	0	0
cSH	1700	1700	1700	753	1700	1700	173	377	1700	1700
Volume to Capacity	0.00	0.48	0.05	0.02	0.18	0.00	0.13	0.06	0.00	0.00
Queue Length (ft)	0	0	0	2	0	0	11	5	0	0
Control Delay (s)	0.0	0.0	0.0	9.9	0.0	0.0	28.7	15.1	0.0	0.0
Lane LOS				A			D	C	A	A
Approach Delay (s)	0.0			0.5			21.9		0.0	
Approach LOS							C		A	

Intersection Summary			
Average Delay	0.9		
Intersection Capacity Utilization	49.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	5	55	65	550	365	5
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	60	71	598	397	5
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1139	399	402			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1139	399	402			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	97	91	94			
cM capacity (veh/h)	209	650	1156			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	65	668	402
Volume Left	5	71	0
Volume Right	60	0	5
cSH	553	1156	1700
Volume to Capacity	0.12	0.06	0.24
Queue Length (ft)	10	5	0
Control Delay (s)	12.4	1.6	0.0
Lane LOS	B	A	
Approach Delay (s)	12.4	1.6	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	65.7%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	5	10	10	330	235	5
Peak Hour Factor	0.57	0.57	0.89	0.89	0.83	0.83
Hourly flow rate (vph)	9	18	11	371	283	6
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	679	286	289			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	679	286	289			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	98	99			
cM capacity (veh/h)	413	753	1273			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	26	11	371	289
Volume Left	9	11	0	0
Volume Right	18	0	0	6
cSH	591	1273	1700	1700
Volume to Capacity	0.04	0.01	0.22	0.17
Queue Length (ft)	3	1	0	0
Control Delay (s)	11.4	7.9	0.0	0.0
Lane LOS	B	A		
Approach Delay (s)	11.4	0.2		0.0
Approach LOS	B			

Intersection Summary			
Average Delay	0.6		
Intersection Capacity Utilization	27.4%	ICU Level of Service	A
Analysis Period (min)	15		

Appendix G
Level-of-Service Analysis Worksheets for 2022 Background Conditions

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
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
Volume (vph)	60	220	380	1640	905	125
Peak-hour factor, PHF	0.88	0.88	0.82	0.82	0.80	0.80
Adj. Flow (vph)	68	250	463	2000	1131	156
RTOR Reduction (vph)	0	212	0	0	0	102
Lane Group Flow (vph)	68	38	463	2000	1131	54
Turn Type		Perm	Prot			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Actuated Green, G (s)	7.8	7.8	14.0	36.1	18.1	18.1
Effective Green, g (s)	7.8	7.8	14.0	36.1	18.1	18.1
Actuated g/C Ratio	0.15	0.15	0.27	0.70	0.35	0.35
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	266	238	477	2462	1234	552
v/s Ratio Prot	0.04		c0.26	c0.57	0.32	
v/s Ratio Perm		0.16				0.10
v/c Ratio	0.26	0.16	0.97	0.81	0.92	0.10
Uniform Delay, d1	19.5	19.2	18.7	5.5	16.2	11.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.5	0.3	33.6	3.1	12.1	0.4
Delay (s)	20.0	19.5	52.3	8.6	28.3	11.8
Level of Service	B	B	D	A	C	B
Approach Delay (s)	19.6			16.8	26.3	
Approach LOS	B			B	C	

Intersection Summary			
HCM Average Control Delay	20.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	51.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	59.4%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

2: KAIMI NANI DRIVE & KAAHUMANU HIGHWAY

1/4/2010

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	3539	1583	1770	3539
Volume (vph)	840	460	1365	195	160	1030
Peak-hour factor, PHF	0.93	0.93	0.96	0.96	0.89	0.89
Adj. Flow (vph)	903	495	1422	203	180	1157
RTOR Reduction (vph)	0	173	0	110	0	0
Lane Group Flow (vph)	903	322	1422	93	180	1157
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	25.8	25.8	41.1	41.1	10.9	56.0
Effective Green, g (s)	25.8	25.8	41.1	41.1	10.9	56.0
Actuated g/C Ratio	0.29	0.29	0.46	0.46	0.12	0.62
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	986	455	1620	725	215	2207
v/s Ratio Prot	0.26		c0.40		c0.10	0.33
v/s Ratio Perm		0.31		0.13		
v/c Ratio	0.92	0.71	0.88	0.13	0.84	0.52
Uniform Delay, d1	30.9	28.6	22.1	14.0	38.6	9.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	12.7	5.0	7.1	0.4	23.7	0.9
Delay (s)	43.7	33.6	29.1	14.4	62.3	10.3
Level of Service	D	C	C	B	E	B
Approach Delay (s)	40.1		27.3			17.3
Approach LOS	D		C			B

Intersection Summary			
HCM Average Control Delay	28.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	89.8	Sum of lost time (s)	12.0
Intersection Capacity Utilization	80.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

3: KAIMI NANI DRIVE & MAMALAHOA HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
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
Volume (vph)	50	565	300	500	1110	165
Peak-hour factor, PHF	0.84	0.84	0.81	0.81	0.93	0.93
Adj. Flow (vph)	60	673	370	617	1194	177
RTOR Reduction (vph)	0	349	0	0	0	111
Lane Group Flow (vph)	60	324	370	617	1194	66
Turn Type		Perm	Prot			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Actuated Green, G (s)	19.4	19.4	19.6	53.9	30.3	30.3
Effective Green, g (s)	19.4	19.4	19.6	53.9	30.3	30.3
Actuated g/C Ratio	0.24	0.24	0.24	0.66	0.37	0.37
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	422	378	427	2346	1319	590
v/s Ratio Prot	0.03		c0.21	0.17	c0.34	
v/s Ratio Perm		0.43				0.11
v/c Ratio	0.14	0.86	0.87	0.26	0.91	0.11
Uniform Delay, d1	24.4	29.6	29.6	5.6	24.1	16.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.2	17.2	16.6	0.1	9.0	0.1
Delay (s)	24.5	46.8	46.2	5.7	33.2	16.8
Level of Service	C	D	D	A	C	B
Approach Delay (s)	45.0			20.9	31.1	
Approach LOS	D			C	C	

Intersection Summary			
HCM Average Control Delay	31.1	HCM Level of Service	C
HCM Volume to Capacity ratio	1.14		
Actuated Cycle Length (s)	81.3	Sum of lost time (s)	12.0
Intersection Capacity Utilization	72.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: PALAMANUI & KAAHUMANU HIGHWAY 1/4/2010

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	3539	1583	1770	3539
Volume (vph)	285	190	1275	425	295	750
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	310	207	1386	462	321	815
RTOR Reduction (vph)	0	163	0	259	0	0
Lane Group Flow (vph)	310	44	1386	203	321	815
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	18.7	18.7	38.6	38.6	18.5	61.1
Effective Green, g (s)	18.7	18.7	38.6	38.6	18.5	61.1
Actuated g/C Ratio	0.21	0.21	0.44	0.44	0.21	0.70
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	377	337	1556	696	373	2463
v/s Ratio Prot	c0.18		c0.39		c0.18	0.23
v/s Ratio Perm		0.13		0.29		
v/c Ratio	0.82	0.13	0.89	0.29	0.86	0.33
Uniform Delay, d1	33.0	28.0	22.7	15.8	33.4	5.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	13.5	0.2	8.1	1.1	18.0	0.4
Delay (s)	46.4	28.1	30.8	16.9	51.4	5.6
Level of Service	D	C	C	B	D	A
Approach Delay (s)	39.1		27.3			18.6
Approach LOS	D		C			B

Intersection Summary			
HCM Average Control Delay	26.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	87.8	Sum of lost time (s)	12.0
Intersection Capacity Utilization	77.4%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
5: KAIMI NANI DRIVE & MAIN STREET 1/4/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	
Lane Util. Factor		1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	
Frt		1.00	0.85	1.00	1.00	0.85		1.00	0.85		1.00	
Flt Protected		1.00	1.00	0.95	1.00	1.00		0.95	1.00		0.95	
Satd. Flow (prot)		1863	1583	1770	1863	1583		1770	1583		1770	
Flt Permitted		1.00	1.00	0.95	1.00	1.00		0.72	1.00		0.70	
Satd. Flow (perm)		1863	1583	1770	1863	1583		1337	1583		1305	
Volume (vph)	0	275	10	20	1225	40	80	0	10	55	0	0
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)	0	299	11	22	1332	43	87	0	11	60	0	0
RTOR Reduction (vph)	0	0	3	0	0	9	0	0	10	0	0	0
Lane Group Flow (vph)	0	299	8	22	1332	34	0	87	1	0	60	0
Turn Type	Prot		Perm	Prot		Perm	Perm		Perm	Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8	2		2	6		6
Actuated Green, G (s)		63.0	63.0	1.5	68.5	68.5		10.7	10.7		10.7	
Effective Green, g (s)		63.0	63.0	1.5	68.5	68.5		10.7	10.7		10.7	
Actuated g/C Ratio		0.72	0.72	0.02	0.79	0.79		0.12	0.12		0.12	
Clearance Time (s)		4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	
Lane Grp Cap (vph)		1346	1144	30	1463	1244		164	194		160	
v/s Ratio Prot		0.16		0.01	c0.72							
v/s Ratio Perm			0.01			0.03		c0.07	0.01		0.05	
v/c Ratio		0.22	0.01	0.73	0.91	0.03		0.53	0.01		0.38	
Uniform Delay, d1		4.0	3.4	42.7	7.0	2.0		35.9	33.6		35.2	
Progression Factor		1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	
Incremental Delay, d2		0.1	0.0	63.0	8.8	0.0		3.3	0.0		1.5	
Delay (s)		4.1	3.4	105.6	15.8	2.1		39.2	33.6		36.7	
Level of Service		A	A	F	B	A		D	C		D	
Approach Delay (s)		4.1			16.8			38.5			36.7	
Approach LOS		A			B			D			D	

Intersection Summary			
HCM Average Control Delay	16.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	87.2	Sum of lost time (s)	8.0
Intersection Capacity Utilization	82.2%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
6: AHIKAWA STREET & MAMALAHOA HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	10	160	25	445	995	20
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	174	27	484	1082	22
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1630	1092	1103			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1630	1092	1103			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	90	33	96			
cM capacity (veh/h)	107	261	633			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	185	511	1103
Volume Left	11	27	0
Volume Right	174	0	22
cSH	240	633	1700
Volume to Capacity	0.77	0.04	0.65
Queue Length (ft)	139	3	0
Control Delay (s)	56.8	1.2	0.0
Lane LOS	F	A	
Approach Delay (s)	56.8	1.2	0.0
Approach LOS	F		

Intersection Summary			
Average Delay	6.2		
Intersection Capacity Utilization	70.7%	ICU Level of Service	C
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
7: MAKALEI ESTATES & MAMALAHOA HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	30	65	120	235	415	45
Peak Hour Factor	0.57	0.57	0.89	0.89	0.83	0.83
Hourly flow rate (vph)	53	114	135	264	500	54
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1061	527	554			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1061	527	554			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	76	79	87			
cM capacity (veh/h)	215	551	1016			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	167	135	264	554
Volume Left	53	135	0	0
Volume Right	114	0	0	54
cSH	369	1016	1700	1700
Volume to Capacity	0.45	0.13	0.16	0.33
Queue Length (ft)	57	11	0	0
Control Delay (s)	22.6	9.1	0.0	0.0
Lane LOS	C	A		
Approach Delay (s)	22.6	3.1		0.0
Approach LOS	C			

Intersection Summary			
Average Delay	4.5		
Intersection Capacity Utilization	46.9%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
1: KEAHOLE AIRPORT ACCESS ROAD & KAAHUMANU HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
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
Volume (vph)	115	365	255	1300	2005	95
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	125	397	277	1413	2179	103
RTOR Reduction (vph)	0	212	0	0	0	45
Lane Group Flow (vph)	125	185	277	1413	2179	58
Turn Type		Perm	Prot			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Actuated Green, G (s)	13.1	13.1	14.0	66.1	48.1	48.1
Effective Green, g (s)	13.1	13.1	14.0	66.1	48.1	48.1
Actuated g/C Ratio	0.15	0.15	0.16	0.76	0.55	0.55
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	266	238	284	2683	1952	873
v/s Ratio Prot	0.07		c0.16	0.40	c0.62	
v/s Ratio Perm		0.25				0.07
v/c Ratio	0.47	0.78	0.98	0.53	1.12	0.07
Uniform Delay, d1	33.9	35.7	36.4	4.2	19.6	9.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.3	14.8	46.2	0.7	60.0	0.1
Delay (s)	35.2	50.5	82.6	5.0	79.6	9.2
Level of Service	D	D	F	A	E	A
Approach Delay (s)	46.8			17.7	76.4	
Approach LOS	D			B	E	

Intersection Summary			
HCM Average Control Delay	50.9	HCM Level of Service	D
HCM Volume to Capacity ratio	1.19		
Actuated Cycle Length (s)	87.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	85.9%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: KAIMI NANI DRIVE & KAAHUMANU HIGHWAY

1/4/2010

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	3539	1583	1770	3539
Volume (vph)	275	160	1470	775	580	1790
Peak-hour factor, PHF	0.93	0.93	0.96	0.96	0.89	0.89
Adj. Flow (vph)	296	172	1531	807	652	2011
RTOR Reduction (vph)	0	147	0	266	0	0
Lane Group Flow (vph)	296	25	1531	541	652	2011
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	12.5	12.5	34.1	34.1	28.0	66.1
Effective Green, g (s)	12.5	12.5	34.1	34.1	28.0	66.1
Actuated g/C Ratio	0.14	0.14	0.39	0.39	0.32	0.76
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	496	228	1394	623	572	2701
v/s Ratio Prot	0.09		0.43		c0.37	0.57
v/s Ratio Perm		0.11		0.51		
v/c Ratio	0.60	0.11	1.10	0.87	1.14	0.74
Uniform Delay, d1	34.7	32.2	26.2	24.2	29.3	5.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.9	0.2	55.7	15.2	82.5	1.9
Delay (s)	36.6	32.4	81.9	39.3	111.8	7.5
Level of Service	D	C	F	D	F	A
Approach Delay (s)	35.1		67.2			33.1
Approach LOS	D		E			C

Intersection Summary			
HCM Average Control Delay	47.8	HCM Level of Service	D
HCM Volume to Capacity ratio	1.15		
Actuated Cycle Length (s)	86.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	90.6%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
3: KAIMI NANI DRIVE & MAMALAHOA HIGHWAY 1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱	↰	↑↑	↑↑	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
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
Volume (vph)	135	600	315	985	615	70
Peak-hour factor, PHF	0.84	0.84	0.81	0.81	0.93	0.93
Adj. Flow (vph)	161	714	389	1216	661	75
RTOR Reduction (vph)	0	486	0	0	0	54
Lane Group Flow (vph)	161	228	389	1216	661	21
Turn Type		Perm	Prot			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Actuated Green, G (s)	14.9	14.9	18.4	39.8	17.4	17.4
Effective Green, g (s)	14.9	14.9	18.4	39.8	17.4	17.4
Actuated g/C Ratio	0.24	0.24	0.29	0.63	0.28	0.28
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	421	376	519	2246	982	439
v/s Ratio Prot	0.09		c0.22	0.34	c0.19	
v/s Ratio Perm		0.45				0.05
v/c Ratio	0.38	0.61	0.75	0.54	0.67	0.05
Uniform Delay, d1	20.0	21.3	20.1	6.4	20.1	16.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.6	2.7	5.9	0.3	1.8	0.0
Delay (s)	20.6	24.0	25.9	6.6	22.0	16.6
Level of Service	C	C	C	A	C	B
Approach Delay (s)	23.4			11.3	21.4	
Approach LOS	C			B	C	

Intersection Summary			
HCM Average Control Delay	16.9	HCM Level of Service	B
HCM Volume to Capacity ratio	1.06		
Actuated Cycle Length (s)	62.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	60.8%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: PALAMANUI & KAAHUMANU HIGHWAY 1/4/2010

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑↑	↱	↰	↑↑
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	3539	1583	1770	3539
Volume (vph)	665	445	855	525	365	1440
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	723	484	929	571	397	1565
RTOR Reduction (vph)	0	294	0	429	0	0
Lane Group Flow (vph)	723	190	929	142	397	1565
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	34.0	34.0	22.4	22.4	21.6	48.0
Effective Green, g (s)	34.0	34.0	22.4	22.4	21.6	48.0
Actuated g/C Ratio	0.38	0.38	0.25	0.25	0.24	0.53
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	669	598	881	394	425	1887
v/s Ratio Prot	c0.41		0.26		c0.22	0.44
v/s Ratio Perm		0.31		0.36		
v/c Ratio	1.08	0.32	1.05	0.36	0.93	0.83
Uniform Delay, d1	28.0	19.8	33.8	27.9	33.5	17.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	58.6	0.3	45.7	2.6	27.6	4.4
Delay (s)	86.6	20.1	79.5	30.4	61.1	22.0
Level of Service	F	C	E	C	E	C
Approach Delay (s)	60.0		60.8			29.9
Approach LOS	E		E			C

Intersection Summary			
HCM Average Control Delay	47.6	HCM Level of Service	D
HCM Volume to Capacity ratio	1.15		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	90.7%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
5: KAIMI NANI DRIVE & MAIN STREET
1/4/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	
Lane Util. Factor		1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	
Frt		1.00	0.85	1.00	1.00	0.85		1.00	0.85		1.00	
Flt Protected		1.00	1.00	0.95	1.00	1.00		0.95	1.00		0.95	
Satd. Flow (prot)		1863	1583	1770	1863	1583		1770	1583		1770	
Flt Permitted		1.00	1.00	0.95	1.00	1.00		0.57	1.00		0.74	
Satd. Flow (perm)		1863	1583	1770	1863	1583		1071	1583		1384	
Volume (vph)	0	1115	80	15	420	45	20	0	20	125	0	0
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)	0	1212	87	16	457	49	22	0	22	136	0	0
RTOR Reduction (vph)	0	0	27	0	0	12	0	0	19	0	0	0
Lane Group Flow (vph)	0	1212	60	16	457	37	0	22	3	0	136	0
Turn Type	Prot		Perm	Prot		Perm	Perm		Perm	Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8	2		2	6		6
Actuated Green, G (s)		56.5	56.5	1.3	61.8	61.8		12.0	12.0		12.0	
Effective Green, g (s)		56.5	56.5	1.3	61.8	61.8		12.0	12.0		12.0	
Actuated g/C Ratio		0.69	0.69	0.02	0.76	0.76		0.15	0.15		0.15	
Clearance Time (s)		4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	
Lane Grp Cap (vph)		1287	1093	28	1407	1196		157	232		203	
v/s Ratio Prot		c0.65		0.01	c0.25							
v/s Ratio Perm			0.05			0.03		0.02	0.01		c0.10	
v/c Ratio		0.94	0.05	0.57	0.32	0.03		0.14	0.01		0.67	
Uniform Delay, d1		11.2	4.1	40.0	3.2	2.5		30.4	29.8		33.0	
Progression Factor		1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	
Incremental Delay, d2		13.5	0.0	25.2	0.1	0.0		0.4	0.0		8.1	
Delay (s)		24.7	4.1	65.1	3.4	2.5		30.8	29.9		41.1	
Level of Service		C	A	E	A	A		C	C		D	
Approach Delay (s)		23.3			5.2			30.3			41.1	
Approach LOS		C			A			C			D	

Intersection Summary			
HCM Average Control Delay	19.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	81.8	Sum of lost time (s)	12.0
Intersection Capacity Utilization	78.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
6: AHIKAWA STREET & MAMALAHOA HIGHWAY
1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	10	90	95	850	580	10
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	98	103	924	630	11
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1766	636	641			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1766	636	641			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	87	80	89			
cM capacity (veh/h)	82	478	943			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	109	1027	641
Volume Left	11	103	0
Volume Right	98	0	11
cSH	322	943	1700
Volume to Capacity	0.34	0.11	0.38
Queue Length (ft)	36	9	0
Control Delay (s)	21.7	2.9	0.0
Lane LOS	C	A	
Approach Delay (s)	21.7	2.9	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	3.0		
Intersection Capacity Utilization	97.2%	ICU Level of Service	F
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	55	70	120	500	355	50
Peak Hour Factor	0.57	0.57	0.89	0.89	0.83	0.83
Hourly flow rate (vph)	96	123	135	562	428	60
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1289	458	488			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1289	458	488			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	39	80	87			
cM capacity (veh/h)	158	603	1075			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	219	135	562	488
Volume Left	96	135	0	0
Volume Right	123	0	0	60
cSH	269	1075	1700	1700
Volume to Capacity	0.81	0.13	0.33	0.29
Queue Length (ft)	162	11	0	0
Control Delay (s)	58.2	8.8	0.0	0.0
Lane LOS	F	A		
Approach Delay (s)	58.2	1.7		0.0
Approach LOS	F			

Intersection Summary			
Average Delay	9.9		
Intersection Capacity Utilization	45.7%	ICU Level of Service	A
Analysis Period (min)	15		

Appendix H
Level-of-Service Analysis Worksheets for 2011 Background Plus Project Conditions

HCM Signalized Intersection Capacity Analysis
1: KEAHOLE AIRPORT ACCESS ROAD & KAAHUMANU HIGHWAY 1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	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	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	1863	1863	1583
Volume (vph)	40	135	235	780	385	75
Peak-hour factor, PHF	0.88	0.88	0.82	0.82	0.80	0.80
Adj. Flow (vph)	45	153	287	951	481	94
RTOR Reduction (vph)	0	136	0	0	0	53
Lane Group Flow (vph)	45	17	287	951	481	41
Turn Type		Perm	Prot			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Actuated Green, G (s)	6.0	6.0	11.7	38.6	22.9	22.9
Effective Green, g (s)	6.0	6.0	11.7	38.6	22.9	22.9
Actuated g/C Ratio	0.11	0.11	0.22	0.73	0.44	0.44
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	202	181	394	1367	811	689
v/s Ratio Prot	0.03		0.16	c0.51	0.26	
v/s Ratio Perm		0.10				0.06
v/c Ratio	0.22	0.10	0.73	0.70	0.59	0.06
Uniform Delay, d1	21.2	20.9	19.0	3.8	11.3	8.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.6	0.2	6.6	2.9	3.2	0.2
Delay (s)	21.7	21.1	25.6	6.8	14.5	8.8
Level of Service	C	C	C	A	B	A
Approach Delay (s)	21.2			11.1	13.5	
Approach LOS	C			B	B	

Intersection Summary			
HCM Average Control Delay	12.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	52.6	Sum of lost time (s)	8.0
Intersection Capacity Utilization	51.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: KAIMI NANI DRIVE & KAAHUMANU HIGHWAY 1/4/2010

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	1863	1583	1770	1863
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	1863	1583	1770	1863
Volume (vph)	560	315	580	155	60	500
Peak-hour factor, PHF	0.93	0.93	0.96	0.96	0.89	0.89
Adj. Flow (vph)	602	339	604	161	67	562
RTOR Reduction (vph)	0	179	0	90	0	0
Lane Group Flow (vph)	602	160	604	71	67	562
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	32.3	32.3	38.4	38.4	4.7	47.1
Effective Green, g (s)	32.3	32.3	38.4	38.4	4.7	47.1
Actuated g/C Ratio	0.37	0.37	0.44	0.44	0.05	0.54
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	654	585	819	696	95	1004
v/s Ratio Prot	c0.34		c0.32		0.04	c0.30
v/s Ratio Perm		0.21		0.10		
v/c Ratio	0.92	0.27	0.74	0.10	0.71	0.56
Uniform Delay, d1	26.3	19.3	20.3	14.4	40.7	13.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	18.4	0.3	5.9	0.3	21.1	2.3
Delay (s)	44.7	19.6	26.2	14.7	61.8	15.6
Level of Service	D	B	C	B	E	B
Approach Delay (s)	35.6		23.8			20.5
Approach LOS	D		C			C

Intersection Summary			
HCM Average Control Delay	27.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	87.4	Sum of lost time (s)	12.0
Intersection Capacity Utilization	74.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.85	1.00	1.00	0.98	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1770	1583	1770	1863	1825	
Flt Permitted	0.95	1.00	0.24	1.00	1.00	
Satd. Flow (perm)	1770	1583	438	1863	1825	
Volume (vph)	40	330	210	250	670	120
Peak-hour factor, PHF	0.84	0.84	0.81	0.81	0.93	0.93
Adj. Flow (vph)	48	393	259	309	720	129
RTOR Reduction (vph)	0	244	0	0	8	0
Lane Group Flow (vph)	48	149	259	309	841	0
Turn Type		Perm	Perm			
Protected Phases	4			2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	10.7	10.7	39.4	39.4	39.4	
Effective Green, g (s)	10.7	10.7	39.4	39.4	39.4	
Actuated g/C Ratio	0.18	0.18	0.68	0.68	0.68	
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	326	292	297	1263	1238	
v/s Ratio Prot	0.03			0.17	0.47	
v/s Ratio Perm		0.25	c0.59			
v/c Ratio	0.15	0.51	0.87	0.24	0.68	
Uniform Delay, d1	19.9	21.3	7.4	3.6	5.6	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.2	1.5	23.3	0.1	1.5	
Delay (s)	20.1	22.8	30.7	3.7	7.1	
Level of Service	C	C	C	A	A	
Approach Delay (s)	22.5			16.0	7.1	
Approach LOS	C			B	A	

Intersection Summary			
HCM Average Control Delay	13.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	58.1	Sum of lost time (s)	8.0
Intersection Capacity Utilization	69.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0
Lane Util. Factor		1.00	1.00		1.00	1.00
Frt		0.85	1.00		1.00	1.00
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		1583	1863		1770	1863
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		1583	1863		1770	1863
Volume (vph)	0	5	815	0	15	465
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	5	886	0	16	505
RTOR Reduction (vph)	0	4	0	0	0	0
Lane Group Flow (vph)	0	1	886	0	16	505
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)		16.0	58.0		4.0	66.0
Effective Green, g (s)		16.0	58.0		4.0	66.0
Actuated g/C Ratio		0.18	0.64		0.04	0.73
Clearance Time (s)		4.0	4.0		4.0	4.0
Lane Grp Cap (vph)		281	1201		79	1366
v/s Ratio Prot			c0.48		0.01	c0.27
v/s Ratio Perm		0.00				
v/c Ratio		0.00	0.74		0.20	0.37
Uniform Delay, d1		30.4	10.8		41.5	4.4
Progression Factor		1.00	1.00		1.00	1.00
Incremental Delay, d2		0.0	4.1		5.7	0.8
Delay (s)		30.5	14.9		47.2	5.2
Level of Service		C	B		D	A
Approach Delay (s)	30.5		14.9			6.5
Approach LOS	C		B			A

Intersection Summary			
HCM Average Control Delay	11.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	52.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	30	175	10	20	785	15	80	0	10	5	0	10
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	33	190	11	22	853	16	87	0	11	5	0	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	870			201			1163	1168	190	1163	1163	853
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	870			201			1163	1168	190	1163	1163	853
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	96			98			45	100	99	97	100	97
cM capacity (veh/h)	775			1371			159	182	852	162	184	359

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	33	190	11	22	853	16	87	11	5	11
Volume Left	33	0	0	22	0	0	87	0	5	0
Volume Right	0	0	11	0	0	16	0	11	0	11
cSH	775	1700	1700	1371	1700	1700	159	852	162	359
Volume to Capacity	0.04	0.11	0.01	0.02	0.50	0.01	0.55	0.01	0.03	0.03
Queue Length (ft)	3	0	0	1	0	0	69	1	3	2
Control Delay (s)	9.8	0.0	0.0	7.7	0.0	0.0	51.9	9.3	28.0	15.3
Lane LOS	A			A			F	A	D	C
Approach Delay (s)	1.4			0.2			47.2		19.6	
Approach LOS							E		C	

Intersection Summary			
Average Delay	4.4		
Intersection Capacity Utilization	59.1%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	5	100	15	200	580	10
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	109	16	217	630	11
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	886	636	641			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	886	636	641			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	77	98			
cM capacity (veh/h)	310	478	943			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	114	234	641
Volume Left	5	16	0
Volume Right	109	0	11
cSH	466	943	1700
Volume to Capacity	0.24	0.02	0.38
Queue Length (ft)	24	1	0
Control Delay (s)	15.2	0.8	0.0
Lane LOS	C	A	
Approach Delay (s)	15.2	0.8	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	1.9		
Intersection Capacity Utilization	44.3%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
7: MAKALEI ESTATES & MAMALAHOA HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	5	25	20	155	275	5
Peak Hour Factor	0.57	0.57	0.89	0.89	0.83	0.83
Hourly flow rate (vph)	9	44	22	174	331	6
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	553	334	337			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	553	334	337			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	94	98			
cM capacity (veh/h)	485	708	1222			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	53	22	174	337
Volume Left	9	22	0	0
Volume Right	44	0	0	6
cSH	657	1222	1700	1700
Volume to Capacity	0.08	0.02	0.10	0.20
Queue Length (ft)	7	1	0	0
Control Delay (s)	11.0	8.0	0.0	0.0
Lane LOS	B	A		
Approach Delay (s)	11.0	0.9		0.0
Approach LOS	B			

Intersection Summary			
Average Delay	1.3		
Intersection Capacity Utilization	26.6%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
8: UH DRIVEWAY & MAIN STREET

1/4/2010

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	15	5	0	45	15	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	16	5	0	49	16	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						860
pX, platoon unblocked						
vC, conflicting volume	33	0			49	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	33	0			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 %	98	99			99	
cM capacity (veh/h)	971	1085			1558	

Direction, Lane #	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	16	5	0	49	16	0
Volume Left	16	0	0	0	16	0
Volume Right	0	5	0	49	0	0
cSH	971	1085	1700	1700	1558	1700
Volume to Capacity	0.02	0.01	0.00	0.03	0.01	0.00
Queue Length (ft)	1	0	0	0	1	0
Control Delay (s)	8.8	8.3	0.0	0.0	7.3	0.0
Lane LOS	A	A			A	
Approach Delay (s)	8.7		0.0		7.3	
Approach LOS	A					

Intersection Summary			
Average Delay	3.5		
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
1: KEAHOLE AIRPORT ACCESS ROAD & KAAHUMANU HIGHWAY 1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	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	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	1863	1863	1583
Volume (vph)	70	225	160	485	840	60
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	76	245	174	527	913	65
RTOR Reduction (vph)	0	218	0	0	0	24
Lane Group Flow (vph)	76	27	174	527	913	41
Turn Type		Perm	Prot			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Actuated Green, G (s)	9.1	9.1	10.0	66.1	52.1	52.1
Effective Green, g (s)	9.1	9.1	10.0	66.1	52.1	52.1
Actuated g/C Ratio	0.11	0.11	0.12	0.79	0.63	0.63
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	194	173	213	1480	1167	991
v/s Ratio Prot	0.04		c0.10	0.28	c0.49	
v/s Ratio Perm		0.15				0.04
v/c Ratio	0.39	0.15	0.82	0.36	0.78	0.04
Uniform Delay, d1	34.5	33.6	35.7	2.5	11.4	6.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.3	0.4	20.9	0.7	5.3	0.1
Delay (s)	35.8	34.0	56.6	3.1	16.7	6.0
Level of Service	D	C	E	A	B	A
Approach Delay (s)	34.4			16.4	16.0	
Approach LOS	C			B	B	

Intersection Summary			
HCM Average Control Delay	19.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	83.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	67.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: KAIMI NANI DRIVE & KAAHUMANU HIGHWAY 1/4/2010

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	1863	1583	1770	1863
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	1863	1583	1770	1863
Volume (vph)	190	105	585	545	270	790
Peak-hour factor, PHF	0.93	0.93	0.96	0.96	0.89	0.89
Adj. Flow (vph)	204	113	609	568	303	888
RTOR Reduction (vph)	0	95	0	291	0	0
Lane Group Flow (vph)	204	18	609	277	303	888
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	14.2	14.2	42.5	42.5	18.6	65.1
Effective Green, g (s)	14.2	14.2	42.5	42.5	18.6	65.1
Actuated g/C Ratio	0.16	0.16	0.49	0.49	0.21	0.75
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	288	257	907	771	377	1389
v/s Ratio Prot	c0.12		0.33		c0.17	0.48
v/s Ratio Perm		0.07		0.36		
v/c Ratio	0.71	0.07	0.67	0.36	0.80	0.64
Uniform Delay, d1	34.6	31.0	17.1	13.9	32.6	5.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	7.7	0.1	4.0	1.3	11.7	2.3
Delay (s)	42.3	31.1	21.0	15.2	44.4	7.7
Level of Service	D	C	C	B	D	A
Approach Delay (s)	38.3		18.2			17.0
Approach LOS	D		B			B

Intersection Summary			
HCM Average Control Delay	20.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	87.3	Sum of lost time (s)	12.0
Intersection Capacity Utilization	66.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
3: KAIMI NANI DRIVE & MAMALAHOA HIGHWAY 1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.85	1.00	1.00	0.98	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1770	1583	1770	1863	1826	
Flt Permitted	0.95	1.00	0.47	1.00	1.00	
Satd. Flow (perm)	1770	1583	880	1863	1826	
Volume (vph)	100	335	215	540	350	60
Peak-hour factor, PHF	0.84	0.84	0.81	0.81	0.93	0.93
Adj. Flow (vph)	119	399	265	667	376	65
RTOR Reduction (vph)	0	307	0	0	11	0
Lane Group Flow (vph)	119	92	265	667	430	0
Turn Type		Perm	Perm			
Protected Phases	4			2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	8.8	8.8	21.2	21.2	21.2	
Effective Green, g (s)	8.8	8.8	21.2	21.2	21.2	
Actuated g/C Ratio	0.23	0.23	0.56	0.56	0.56	
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	410	367	491	1039	1019	
v/s Ratio Prot	0.07			c0.36	0.24	
v/s Ratio Perm		0.25	0.30			
v/c Ratio	0.29	0.25	0.54	0.64	0.42	
Uniform Delay, d1	12.0	11.9	5.3	5.8	4.9	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.4	0.4	1.1	1.4	0.3	
Delay (s)	12.4	12.3	6.5	7.2	5.1	
Level of Service	B	B	A	A	A	
Approach Delay (s)	12.3			7.0	5.1	
Approach LOS	B			A	A	

Intersection Summary			
HCM Average Control Delay	8.0	HCM Level of Service	A
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	38.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	49.5%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: PALAMANUI & KAAHUMANU HIGHWAY 1/4/2010

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0
Lane Util. Factor		1.00	1.00		1.00	1.00
Frt		0.85	1.00		1.00	1.00
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		1583	1863		1770	1863
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		1583	1863		1770	1863
Volume (vph)	0	5	535	0	10	900
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	5	582	0	11	978
RTOR Reduction (vph)	0	4	0	0	0	0
Lane Group Flow (vph)	0	1	582	0	11	978
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)		17.0	56.0		5.0	65.0
Effective Green, g (s)		17.0	56.0		5.0	65.0
Actuated g/C Ratio		0.19	0.62		0.06	0.72
Clearance Time (s)		4.0	4.0		4.0	4.0
Lane Grp Cap (vph)		299	1159		98	1346
v/s Ratio Prot			0.31		0.01	c0.53
v/s Ratio Perm		0.00				
v/c Ratio		0.00	0.50		0.11	0.73
Uniform Delay, d1		29.6	9.3		40.4	7.3
Progression Factor		1.00	1.00		1.00	1.00
Incremental Delay, d2		0.0	1.6		2.3	3.5
Delay (s)		29.6	10.9		42.7	10.8
Level of Service		C	B		D	B
Approach Delay (s)	29.6		10.9			11.1
Approach LOS	C		B			B

Intersection Summary			
HCM Average Control Delay	11.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	50.7%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
5: KAIMI NANI DRIVE & MAIN STREET

1/4/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	15	720	80	15	265	15	20	0	20	10	0	10
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	16	783	87	16	288	16	22	0	22	11	0	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	304			870			1147	1152	783	1158	1223	288
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	304			870			1147	1152	783	1158	1223	288
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			98			87	100	94	93	100	99
cM capacity (veh/h)	1256			775			169	191	394	159	173	751

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	16	783	87	16	288	16	22	22	11	11
Volume Left	16	0	0	16	0	0	22	0	11	0
Volume Right	0	0	87	0	0	16	0	22	0	11
cSH	1256	1700	1700	775	1700	1700	169	394	159	751
Volume to Capacity	0.01	0.46	0.05	0.02	0.17	0.01	0.13	0.06	0.07	0.01
Queue Length (ft)	1	0	0	2	0	0	11	4	5	1
Control Delay (s)	7.9	0.0	0.0	9.7	0.0	0.0	29.4	14.7	29.2	9.9
Lane LOS	A			A			D	B	D	A
Approach Delay (s)	0.1			0.5			22.0		19.5	
Approach LOS							C		C	

Intersection Summary			
Average Delay	1.3		
Intersection Capacity Utilization	54.6%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
6: AHIKAWA STREET & MAMALAHOA HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	5	55	60	500	345	5
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	60	65	543	375	5
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1052	378	380			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1052	378	380			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	91	94			
cM capacity (veh/h)	237	669	1178			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	65	609	380
Volume Left	5	65	0
Volume Right	60	0	5
cSH	581	1178	1700
Volume to Capacity	0.11	0.06	0.22
Queue Length (ft)	9	4	0
Control Delay (s)	12.0	1.5	0.0
Lane LOS	B	A	
Approach Delay (s)	12.0	1.5	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	61.8%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	5	10	10	325	235	5
Peak Hour Factor	0.57	0.57	0.89	0.89	0.83	0.83
Hourly flow rate (vph)	9	18	11	365	283	6
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	674	286	289			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	674	286	289			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	98	99			
cM capacity (veh/h)	416	753	1273			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	26	11	365	289
Volume Left	9	11	0	0
Volume Right	18	0	0	6
cSH	593	1273	1700	1700
Volume to Capacity	0.04	0.01	0.21	0.17
Queue Length (ft)	3	1	0	0
Control Delay (s)	11.4	7.9	0.0	0.0
Lane LOS	B	A		
Approach Delay (s)	11.4	0.2		0.0
Approach LOS	B			

Intersection Summary			
Average Delay	0.6		
Intersection Capacity Utilization	27.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	20	5	0	30	0	10
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	22	5	0	33	0	11
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						860
pX, platoon unblocked						
vC, conflicting volume	11	0			33	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	11	0			33	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	98	99			100	
cM capacity (veh/h)	1009	1085			1579	

Direction, Lane #	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	22	5	0	33	0	11
Volume Left	22	0	0	0	0	0
Volume Right	0	5	0	33	0	0
cSH	1009	1085	1700	1700	1700	1700
Volume to Capacity	0.02	0.01	0.00	0.02	0.00	0.01
Queue Length (ft)	2	0	0	0	0	0
Control Delay (s)	8.6	8.3	0.0	0.0	0.0	0.0
Lane LOS	A	A				
Approach Delay (s)	8.6		0.0		0.0	
Approach LOS	A					

Intersection Summary			
Average Delay	3.3		
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		

Appendix I
Level-of-Service Analysis Worksheets for 2012 Background Plus Project Conditions

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	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	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	1863	1863	1583
Volume (vph)	40	145	245	810	405	80
Peak-hour factor, PHF	0.88	0.88	0.82	0.82	0.80	0.80
Adj. Flow (vph)	45	165	299	988	506	100
RTOR Reduction (vph)	0	146	0	0	0	57
Lane Group Flow (vph)	45	19	299	988	506	43
Turn Type		Perm	Prot			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Actuated Green, G (s)	6.0	6.0	11.9	38.4	22.5	22.5
Effective Green, g (s)	6.0	6.0	11.9	38.4	22.5	22.5
Actuated g/C Ratio	0.11	0.11	0.23	0.73	0.43	0.43
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	203	181	402	1365	800	680
v/s Ratio Prot	0.03		0.17	c0.53	0.27	
v/s Ratio Perm		0.10				0.06
v/c Ratio	0.22	0.10	0.74	0.72	0.63	0.06
Uniform Delay, d1	21.1	20.8	18.8	4.0	11.7	8.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.6	0.3	7.3	3.4	3.8	0.2
Delay (s)	21.6	21.0	26.1	7.3	15.5	8.9
Level of Service	C	C	C	A	B	A
Approach Delay (s)	21.2			11.7	14.4	
Approach LOS	C			B	B	

Intersection Summary			
HCM Average Control Delay	13.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	52.4	Sum of lost time (s)	8.0
Intersection Capacity Utilization	52.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: KAIMI NANI DRIVE & KAAHUMANU HIGHWAY

1/4/2010

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	1863	1583	1770	1863
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	1863	1583	1770	1863
Volume (vph)	585	325	605	170	80	525
Peak-hour factor, PHF	0.93	0.93	0.96	0.96	0.89	0.89
Adj. Flow (vph)	629	349	630	177	90	590
RTOR Reduction (vph)	0	169	0	101	0	0
Lane Group Flow (vph)	629	180	630	76	90	590
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	33.7	33.7	38.3	38.3	4.7	47.0
Effective Green, g (s)	33.7	33.7	38.3	38.3	4.7	47.0
Actuated g/C Ratio	0.38	0.38	0.43	0.43	0.05	0.53
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	672	601	804	684	94	987
v/s Ratio Prot	c0.36		c0.34		c0.05	0.32
v/s Ratio Perm		0.22		0.11		
v/c Ratio	0.94	0.30	0.78	0.11	0.96	0.60
Uniform Delay, d1	26.5	19.2	21.6	15.0	41.9	14.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	20.4	0.3	7.5	0.3	78.1	2.7
Delay (s)	46.8	19.5	29.2	15.4	120.0	17.0
Level of Service	D	B	C	B	F	B
Approach Delay (s)	37.1		26.1			30.6
Approach LOS	D		C			C

Intersection Summary			
HCM Average Control Delay	31.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	88.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	78.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
3: KAIMI NANI DRIVE & MAMALAHOA HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	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	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.27	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	497	1863	1863	1583
Volume (vph)	45	350	220	260	700	130
Peak-hour factor, PHF	0.84	0.84	0.81	0.81	0.93	0.93
Adj. Flow (vph)	54	417	272	321	753	140
RTOR Reduction (vph)	0	205	0	0	0	50
Lane Group Flow (vph)	54	212	272	321	753	90
Turn Type		Perm	Perm			Perm
Protected Phases	4			2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	12.8	12.8	36.9	36.9	36.9	36.9
Effective Green, g (s)	12.8	12.8	36.9	36.9	36.9	36.9
Actuated g/C Ratio	0.22	0.22	0.64	0.64	0.64	0.64
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	393	351	318	1191	1191	1012
v/s Ratio Prot	0.03			0.17	0.40	
v/s Ratio Perm		0.26	c0.55			0.09
v/c Ratio	0.14	0.60	0.86	0.27	0.63	0.09
Uniform Delay, d1	18.0	20.2	8.3	4.5	6.3	4.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.2	2.9	19.6	0.1	1.1	0.0
Delay (s)	18.2	23.1	27.8	4.7	7.4	4.0
Level of Service	B	C	C	A	A	A
Approach Delay (s)	22.5			15.3	6.9	
Approach LOS	C			B	A	

Intersection Summary			
HCM Average Control Delay	13.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	57.7	Sum of lost time (s)	8.0
Intersection Capacity Utilization	65.2%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: PALAMANUI & KAAHUMANU HIGHWAY

1/4/2010

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.0			4.0
Lane Util. Factor			1.00			1.00
Frt			1.00			1.00
Flt Protected			1.00			1.00
Satd. Flow (prot)			1863			1863
Flt Permitted			1.00			1.00
Satd. Flow (perm)			1863			1863
Volume (vph)	0	0	850	0	0	485
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	924	0	0	527
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	924	0	0	527
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)			58.0			66.0
Effective Green, g (s)			58.0			66.0
Actuated g/C Ratio			0.64			0.73
Clearance Time (s)			4.0			4.0
Lane Grp Cap (vph)			1201			1366
v/s Ratio Prot			c0.50			c0.28
v/s Ratio Perm						
v/c Ratio			0.77			0.39
Uniform Delay, d1			11.3			4.5
Progression Factor			1.00			1.00
Incremental Delay, d2			4.8			0.8
Delay (s)			16.1			5.3
Level of Service			B			A
Approach Delay (s)	0.0		16.1			5.3
Approach LOS	A		B			A

Intersection Summary			
HCM Average Control Delay	12.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	28.0
Intersection Capacity Utilization	48.1%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
5: KAIMI NANI DRIVE & MAIN STREET

1/4/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	40	180	10	20	815	20	80	0	10	10	0	15
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	43	196	11	22	886	22	87	0	11	11	0	16
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	908			207			1228	1234	196	1223	1223	886
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	908			207			1228	1234	196	1223	1223	886
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	94			98			38	100	99	93	100	95
cM capacity (veh/h)	750			1365			139	164	846	146	166	344

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	43	196	11	22	886	22	87	11	11	16
Volume Left	43	0	0	22	0	0	87	0	11	0
Volume Right	0	0	11	0	0	22	0	11	0	16
cSH	750	1700	1700	1365	1700	1700	139	846	146	344
Volume to Capacity	0.06	0.12	0.01	0.02	0.52	0.01	0.62	0.01	0.07	0.05
Queue Length (ft)	5	0	0	1	0	0	83	1	6	4
Control Delay (s)	10.1	0.0	0.0	7.7	0.0	0.0	66.4	9.3	31.7	16.0
Lane LOS	B			A			F	A	D	C
Approach Delay (s)	1.8			0.2			60.0		22.3	
Approach LOS							F		C	

Intersection Summary			
Average Delay	5.4		
Intersection Capacity Utilization	60.7%	ICU Level of Service	B
Analysis Period (min)	15		

6: AHIKAWA STREET & MAMALAHOA HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	5	105	15	239	635	10
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	114	16	260	690	11
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	988	696	701			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	988	696	701			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	74	98			
cM capacity (veh/h)	269	442	896			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	120	276	701
Volume Left	5	16	0
Volume Right	114	0	11
cSH	429	896	1700
Volume to Capacity	0.28	0.02	0.41
Queue Length (ft)	28	1	0
Control Delay (s)	16.6	0.7	0.0
Lane LOS	C	A	
Approach Delay (s)	16.6	0.7	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	2.0		
Intersection Capacity Utilization	47.5%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis

7: MAKALEI ESTATES & MAMALAHOA HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	5	30	25	165	290	5
Peak Hour Factor	0.57	0.57	0.89	0.89	0.83	0.83
Hourly flow rate (vph)	9	53	28	185	349	6
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	594	352	355			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	594	352	355			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	92	98			
cM capacity (veh/h)	457	691	1203			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	61	28	185	355
Volume Left	9	28	0	0
Volume Right	53	0	0	6
cSH	644	1203	1700	1700
Volume to Capacity	0.10	0.02	0.11	0.21
Queue Length (ft)	8	2	0	0
Control Delay (s)	11.2	8.1	0.0	0.0
Lane LOS	B	A		
Approach Delay (s)	11.2	1.1		0.0
Approach LOS	B			

Intersection Summary			
Average Delay	1.4		
Intersection Capacity Utilization	30.8%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
8: UH DRIVEWAY & MAIN STREET
1/4/2010

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	25	5	0	60	20	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	27	5	0	65	22	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						860
pX, platoon unblocked						
vC, conflicting volume	43	0			65	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	43	0			65	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	97	99			99	
cM capacity (veh/h)	954	1085			1537	

Direction, Lane #	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	27	5	0	65	22	0
Volume Left	27	0	0	0	22	0
Volume Right	0	5	0	65	0	0
cSH	954	1085	1700	1700	1537	1700
Volume to Capacity	0.03	0.01	0.00	0.04	0.01	0.00
Queue Length (ft)	2	0	0	0	1	0
Control Delay (s)	8.9	8.3	0.0	0.0	7.4	0.0
Lane LOS	A	A			A	
Approach Delay (s)	8.8		0.0		7.4	
Approach LOS	A					

Intersection Summary			
Average Delay	3.7		
Intersection Capacity Utilization	13.7%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
1: KEAHOLE AIRPORT ACCESS ROAD & KAAHUMANU HIGHWAY
1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	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	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	1863	1863	1583
Volume (vph)	75	235	165	505	875	65
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	82	255	179	549	951	71
RTOR Reduction (vph)	0	227	0	0	0	27
Lane Group Flow (vph)	82	28	179	549	951	44
Turn Type		Perm	Prot			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Actuated Green, G (s)	9.3	9.3	10.0	66.1	52.1	52.1
Effective Green, g (s)	9.3	9.3	10.0	66.1	52.1	52.1
Actuated g/C Ratio	0.11	0.11	0.12	0.79	0.62	0.62
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	197	177	212	1477	1164	989
v/s Ratio Prot	0.05		c0.10	0.29	c0.51	
v/s Ratio Perm		0.16				0.04
v/c Ratio	0.42	0.16	0.84	0.37	0.82	0.04
Uniform Delay, d1	34.5	33.5	35.9	2.5	12.0	6.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.4	0.4	25.2	0.7	6.4	0.1
Delay (s)	35.9	33.9	61.1	3.3	18.4	6.1
Level of Service	D	C	E	A	B	A
Approach Delay (s)	34.4			17.5	17.5	
Approach LOS	C			B	B	

Intersection Summary			
HCM Average Control Delay	20.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	83.4	Sum of lost time (s)	12.0
Intersection Capacity Utilization	69.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis

2: KAIMI NANI DRIVE & KAAHUMANU HIGHWAY 1/4/2010

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	1863	1583	1770	1863
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	1863	1583	1770	1863
Volume (vph)	205	110	610	570	280	825
Peak-hour factor, PHF	0.93	0.93	0.96	0.96	0.89	0.89
Adj. Flow (vph)	220	118	635	594	315	927
RTOR Reduction (vph)	0	98	0	308	0	0
Lane Group Flow (vph)	220	20	635	286	315	927
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	14.7	14.7	42.0	42.0	19.1	65.1
Effective Green, g (s)	14.7	14.7	42.0	42.0	19.1	65.1
Actuated g/C Ratio	0.17	0.17	0.48	0.48	0.22	0.74
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	296	265	891	757	385	1381
v/s Ratio Prot	c0.12		0.34		c0.18	0.50
v/s Ratio Perm		0.07		0.38		
v/c Ratio	0.74	0.07	0.71	0.38	0.82	0.67
Uniform Delay, d1	34.8	30.8	18.1	14.6	32.7	5.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	9.7	0.1	4.8	1.4	12.7	2.6
Delay (s)	44.4	30.9	23.0	16.0	45.4	8.5
Level of Service	D	C	C	B	D	A
Approach Delay (s)	39.7		19.6			17.8
Approach LOS	D		B			B

Intersection Summary			
HCM Average Control Delay	21.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	87.8	Sum of lost time (s)	12.0
Intersection Capacity Utilization	69.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis

3: KAIMI NANI DRIVE & MAMALAHOA HIGHWAY 1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	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	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.51	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	951	1863	1863	1583
Volume (vph)	110	350	225	565	365	60
Peak-hour factor, PHF	0.84	0.84	0.81	0.81	0.93	0.93
Adj. Flow (vph)	131	417	278	698	392	65
RTOR Reduction (vph)	0	319	0	0	0	29
Lane Group Flow (vph)	131	98	278	698	392	36
Turn Type		Perm	Perm			Perm
Protected Phases	4			2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	9.3	9.3	22.1	22.1	22.1	22.1
Effective Green, g (s)	9.3	9.3	22.1	22.1	22.1	22.1
Actuated g/C Ratio	0.24	0.24	0.56	0.56	0.56	0.56
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	418	374	533	1045	1045	888
v/s Ratio Prot	0.07			c0.37	0.21	
v/s Ratio Perm		0.26	0.29			0.04
v/c Ratio	0.31	0.26	0.52	0.67	0.38	0.04
Uniform Delay, d1	12.4	12.3	5.4	6.1	4.8	3.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.4	0.4	0.9	1.6	0.2	0.0
Delay (s)	12.8	12.6	6.3	7.7	5.0	3.9
Level of Service	B	B	A	A	A	A
Approach Delay (s)	12.7			7.3	4.9	
Approach LOS	B			A	A	

Intersection Summary			
HCM Average Control Delay	8.2	HCM Level of Service	A
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	39.4	Sum of lost time (s)	8.0
Intersection Capacity Utilization	47.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: PALAMANUI & KAAHUMANU HIGHWAY

1/4/2010

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0
Lane Util. Factor		1.00	1.00		1.00	1.00
Frt		0.85	1.00		1.00	1.00
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		1583	1863		1770	1863
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		1583	1863		1770	1863
Volume (vph)	0	10	555	0	10	935
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	11	603	0	11	1016
RTOR Reduction (vph)	0	9	0	0	0	0
Lane Group Flow (vph)	0	2	603	0	11	1016
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)		17.0	56.0		5.0	65.0
Effective Green, g (s)		17.0	56.0		5.0	65.0
Actuated g/C Ratio		0.19	0.62		0.06	0.72
Clearance Time (s)		4.0	4.0		4.0	4.0
Lane Grp Cap (vph)		299	1159		98	1346
v/s Ratio Prot			0.32		0.01	c0.55
v/s Ratio Perm		0.01				
v/c Ratio		0.01	0.52		0.11	0.75
Uniform Delay, d1		29.6	9.5		40.4	7.6
Progression Factor		1.00	1.00		1.00	1.00
Incremental Delay, d2		0.0	1.7		2.3	4.0
Delay (s)		29.7	11.2		42.7	11.6
Level of Service		C	B		D	B
Approach Delay (s)	29.7		11.2			11.9
Approach LOS	C		B			B

Intersection Summary			
HCM Average Control Delay	11.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	52.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
5: KAIMI NANI DRIVE & MAIN STREET

1/4/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	25	750	80	15	275	20	20	0	20	20	0	20
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	27	815	87	16	299	22	22	0	22	22	0	22
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	321			902			1223	1223	815	1223	1288	299
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	321			902			1223	1223	815	1223	1288	299
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	98			98			85	100	94	85	100	97
cM capacity (veh/h)	1239			753			147	172	377	142	157	741

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	27	815	87	16	299	22	22	22	22	22
Volume Left	27	0	0	16	0	0	22	0	22	0
Volume Right	0	0	87	0	0	22	0	22	0	22
cSH	1239	1700	1700	753	1700	1700	147	377	142	741
Volume to Capacity	0.02	0.48	0.05	0.02	0.18	0.01	0.15	0.06	0.15	0.03
Queue Length (ft)	2	0	0	2	0	0	13	5	13	2
Control Delay (s)	8.0	0.0	0.0	9.9	0.0	0.0	33.8	15.1	34.8	10.0
Lane LOS	A			A			D	C	D	B
Approach Delay (s)	0.2			0.5			24.5		22.4	
Approach LOS							C		C	

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	56.1%	ICU Level of Service	B
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
6: AHIKAWA STREET & MAMALAHOA HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	5	55	65	560	375	5
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	60	71	609	408	5
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1160	410	413			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1160	410	413			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	97	91	94			
cM capacity (veh/h)	203	641	1146			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	65	679	413
Volume Left	5	71	0
Volume Right	60	0	5
cSH	543	1146	1700
Volume to Capacity	0.12	0.06	0.24
Queue Length (ft)	10	5	0
Control Delay (s)	12.5	1.6	0.0
Lane LOS	B	A	
Approach Delay (s)	12.5	1.6	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	66.8%	ICU Level of Service	C
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
7: MAKALEI ESTATES & MAMALAHOA HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	5	10	10	340	245	5
Peak Hour Factor	0.57	0.57	0.89	0.89	0.83	0.83
Hourly flow rate (vph)	9	18	11	382	295	6
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	703	298	301			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	703	298	301			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	98	99			
cM capacity (veh/h)	400	741	1260			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	26	11	382	301
Volume Left	9	11	0	0
Volume Right	18	0	0	6
cSH	577	1260	1700	1700
Volume to Capacity	0.05	0.01	0.22	0.18
Queue Length (ft)	4	1	0	0
Control Delay (s)	11.5	7.9	0.0	0.0
Lane LOS	B	A		
Approach Delay (s)	11.5	0.2		0.0
Approach LOS	B			

Intersection Summary			
Average Delay	0.5		
Intersection Capacity Utilization	27.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	30	10	0	45	10	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	33	11	0	49	11	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						860
pX, platoon unblocked						
vC, conflicting volume	22	0			49	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	22	0			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 %	97	99			99	
cM capacity (veh/h)	988	1085			1558	

Direction, Lane #	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	33	11	0	49	11	0
Volume Left	33	0	0	0	11	0
Volume Right	0	11	0	49	0	0
cSH	988	1085	1700	1700	1558	1700
Volume to Capacity	0.03	0.01	0.00	0.03	0.01	0.00
Queue Length (ft)	3	1	0	0	1	0
Control Delay (s)	8.8	8.4	0.0	0.0	7.3	0.0
Lane LOS	A	A			A	
Approach Delay (s)	8.7		0.0		7.3	
Approach LOS	A					

Intersection Summary			
Average Delay	4.4		
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		

Appendix J
Level-of-Service Analysis Worksheets for 2017 Background Plus Project Conditions

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
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
Volume (vph)	50	180	305	1330	760	100
Peak-hour factor, PHF	0.88	0.88	0.82	0.82	0.80	0.80
Adj. Flow (vph)	57	205	372	1622	950	125
RTOR Reduction (vph)	0	180	0	0	0	77
Lane Group Flow (vph)	57	25	372	1622	950	48
Turn Type		Perm	Prot			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Actuated Green, G (s)	6.1	6.1	13.3	36.9	19.6	19.6
Effective Green, g (s)	6.1	6.1	13.3	36.9	19.6	19.6
Actuated g/C Ratio	0.12	0.12	0.26	0.72	0.38	0.38
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	212	189	462	2561	1360	608
v/s Ratio Prot	0.03		c0.21	c0.46	0.27	
v/s Ratio Perm		0.13				0.08
v/c Ratio	0.27	0.13	0.81	0.63	0.70	0.08
Uniform Delay, d1	20.4	20.1	17.6	3.6	13.2	10.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.7	0.3	9.8	1.2	3.0	0.3
Delay (s)	21.1	20.4	27.5	4.8	16.2	10.2
Level of Service	C	C	C	A	B	B
Approach Delay (s)	20.5			9.0	15.5	
Approach LOS	C			A	B	

Intersection Summary			
HCM Average Control Delay	12.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	51.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	51.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	3539	1583	1770	3539
Volume (vph)	725	385	1095	265	135	855
Peak-hour factor, PHF	0.93	0.93	0.96	0.96	0.89	0.89
Adj. Flow (vph)	780	414	1141	276	152	961
RTOR Reduction (vph)	0	214	0	156	0	0
Lane Group Flow (vph)	780	200	1141	120	152	961
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	15.9	15.9	26.4	26.4	6.4	36.8
Effective Green, g (s)	15.9	15.9	26.4	26.4	6.4	36.8
Actuated g/C Ratio	0.26	0.26	0.43	0.43	0.11	0.61
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	899	415	1539	688	187	2146
v/s Ratio Prot	0.23		c0.32		c0.09	0.27
v/s Ratio Perm		0.26		0.17		
v/c Ratio	0.87	0.48	0.74	0.17	0.81	0.45
Uniform Delay, d1	21.4	18.9	14.3	10.5	26.6	6.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	8.9	0.9	3.3	0.6	22.9	0.7
Delay (s)	30.3	19.8	17.6	11.0	49.4	7.1
Level of Service	C	B	B	B	D	A
Approach Delay (s)	26.6		16.3			12.9
Approach LOS	C		B			B

Intersection Summary			
HCM Average Control Delay	18.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	60.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	68.4%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

3: KAIMI NANI DRIVE & MAMALAHOA HIGHWAY

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
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
Volume (vph)	45	475	275	395	875	140
Peak-hour factor, PHF	0.84	0.84	0.81	0.81	0.93	0.93
Adj. Flow (vph)	54	565	340	488	941	151
RTOR Reduction (vph)	0	378	0	0	0	97
Lane Group Flow (vph)	54	187	340	488	941	54
Turn Type		Perm	Prot			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Actuated Green, G (s)	12.5	12.5	16.6	43.8	23.2	23.2
Effective Green, g (s)	12.5	12.5	16.6	43.8	23.2	23.2
Actuated g/C Ratio	0.19	0.19	0.26	0.68	0.36	0.36
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	344	308	457	2411	1277	571
v/s Ratio Prot	0.03		c0.19	0.14	c0.27	
v/s Ratio Perm		0.36				0.10
v/c Ratio	0.16	0.61	0.74	0.20	0.74	0.10
Uniform Delay, d1	21.5	23.7	21.9	3.8	17.9	13.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.2	3.4	6.5	0.0	2.3	0.1
Delay (s)	21.7	27.0	28.4	3.8	20.1	13.7
Level of Service	C	C	C	A	C	B
Approach Delay (s)	26.6			13.9	19.3	
Approach LOS	C			B	B	

Intersection Summary			
HCM Average Control Delay	19.3	HCM Level of Service	B
HCM Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	64.3	Sum of lost time (s)	12.0
Intersection Capacity Utilization	60.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

4: PALAMANUI & KAAHUMANU HIGHWAY

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	3539	1583	1770	3539
Volume (vph)	260	190	1040	340	290	605
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	283	207	1130	370	315	658
RTOR Reduction (vph)	0	165	0	204	0	0
Lane Group Flow (vph)	283	42	1130	166	315	658
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	17.6	17.6	38.9	38.9	18.2	61.1
Effective Green, g (s)	17.6	17.6	38.9	38.9	18.2	61.1
Actuated g/C Ratio	0.20	0.20	0.45	0.45	0.21	0.70
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	359	321	1588	710	372	2494
v/s Ratio Prot	c0.16		c0.32		c0.18	0.19
v/s Ratio Perm		0.13		0.23		
v/c Ratio	0.79	0.13	0.71	0.23	0.85	0.26
Uniform Delay, d1	32.8	28.3	19.4	14.7	32.9	4.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	10.9	0.2	2.7	0.8	16.1	0.3
Delay (s)	43.7	28.5	22.1	15.5	49.0	4.9
Level of Service	D	C	C	B	D	A
Approach Delay (s)	37.3		20.5			19.2
Approach LOS	D		C			B

Intersection Summary			
HCM Average Control Delay	22.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	86.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	69.2%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
5: KAIMI NANI DRIVE & MAIN STREET

1/4/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	105	225	10	20	995	55	80	0	10	75	0	35
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	114	245	11	22	1082	60	87	0	11	82	0	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)												
pX, platoon unblocked												
vC, conflicting volume	1141			255			1636	1658	245	1609	1609	1082
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1141			255			1636	1658	245	1609	1609	1082
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	81			98			0	100	99	0	100	86
cM capacity (veh/h)	612			1310			58	78	794	70	84	265

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	114	245	11	22	1082	60	87	11	82	38
Volume Left	114	0	0	22	0	0	87	0	82	0
Volume Right	0	0	11	0	0	60	0	11	0	38
cSH	612	1700	1700	1310	1700	1700	58	794	70	265
Volume to Capacity	0.19	0.14	0.01	0.02	0.64	0.04	1.49	0.01	1.16	0.14
Queue Length (ft)	17	0	0	1	0	0	194	1	157	12
Control Delay (s)	12.2	0.0	0.0	7.8	0.0	0.0	407.2	9.6	259.1	20.9
Lane LOS	B			A			F	A	F	C
Approach Delay (s)	3.8			0.1			363.0		183.3	
Approach LOS							F		F	

Intersection Summary			
Average Delay	33.7		
Intersection Capacity Utilization	79.3%	ICU Level of Service	D
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
6: AHIKAWA STREET & MAMALAHOA HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	5	130	20	330	765	15
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	141	22	359	832	16
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1242	840	848			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1242	840	848			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	97	61	97			
cM capacity (veh/h)	188	365	790			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	147	380	848
Volume Left	5	22	0
Volume Right	141	0	16
cSH	353	790	1700
Volume to Capacity	0.42	0.03	0.50
Queue Length (ft)	50	2	0
Control Delay (s)	22.3	0.9	0.0
Lane LOS	C	A	
Approach Delay (s)	22.3	0.9	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	2.6		
Intersection Capacity Utilization	56.2%	ICU Level of Service	B
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
7: MAKALEI ESTATES & MAMALAHOA HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	25	35	90	195	340	30
Peak Hour Factor	0.57	0.57	0.89	0.89	0.83	0.83
Hourly flow rate (vph)	44	61	101	219	410	36
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	849	428	446			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	849	428	446			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	85	90	91			
cM capacity (veh/h)	301	627	1114			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	105	101	219	446
Volume Left	44	101	0	0
Volume Right	61	0	0	36
cSH	432	1114	1700	1700
Volume to Capacity	0.24	0.09	0.13	0.26
Queue Length (ft)	24	7	0	0
Control Delay (s)	16.0	8.6	0.0	0.0
Lane LOS	C	A		
Approach Delay (s)	16.0	2.7		0.0
Approach LOS	C			

Intersection Summary			
Average Delay	2.9		
Intersection Capacity Utilization	38.2%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
8: UH DRIVEWAY & MAIN STREET

1/4/2010

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	45	30	30	130	90	65
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	49	33	33	141	98	71
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						860
pX, platoon unblocked						
vC, conflicting volume	299	33			174	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	299	33			174	
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	97			93	
cM capacity (veh/h)	644	1041			1403	

Direction, Lane #	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	49	33	33	141	98	71
Volume Left	49	0	0	0	98	0
Volume Right	0	33	0	141	0	0
cSH	644	1041	1700	1700	1403	1700
Volume to Capacity	0.08	0.03	0.02	0.08	0.07	0.04
Queue Length (ft)	6	2	0	0	6	0
Control Delay (s)	11.0	8.6	0.0	0.0	7.8	0.0
Lane LOS	B	A			A	
Approach Delay (s)	10.1		0.0		4.5	
Approach LOS	B					

Intersection Summary			
Average Delay	3.7		
Intersection Capacity Utilization	21.7%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
1: KEAHOLE AIRPORT ACCESS ROAD & KAAHUMANU HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
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
Volume (vph)	90	290	205	1070	1600	80
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	98	315	223	1163	1739	87
RTOR Reduction (vph)	0	224	0	0	0	37
Lane Group Flow (vph)	98	91	223	1163	1739	50
Turn Type		Perm	Prot			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Actuated Green, G (s)	10.5	10.5	13.3	66.1	48.8	48.8
Effective Green, g (s)	10.5	10.5	13.3	66.1	48.8	48.8
Actuated g/C Ratio	0.12	0.12	0.16	0.78	0.58	0.58
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	220	196	278	2765	2041	913
v/s Ratio Prot	0.06		c0.13	0.33	c0.49	
v/s Ratio Perm		0.20				0.05
v/c Ratio	0.45	0.46	0.80	0.42	0.85	0.05
Uniform Delay, d1	34.4	34.4	34.4	3.0	14.9	7.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.4	1.7	15.2	0.5	4.7	0.1
Delay (s)	35.8	36.2	49.6	3.5	19.6	7.9
Level of Service	D	D	D	A	B	A
Approach Delay (s)	36.1			10.9	19.1	
Approach LOS	D			B	B	

Intersection Summary			
HCM Average Control Delay	17.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	84.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	70.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: KAIMI NANI DRIVE & KAAHUMANU HIGHWAY

1/4/2010

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	3539	1583	1770	3539
Volume (vph)	275	135	1205	720	470	1425
Peak-hour factor, PHF	0.93	0.93	0.96	0.96	0.89	0.89
Adj. Flow (vph)	296	145	1255	750	528	1601
RTOR Reduction (vph)	0	124	0	282	0	0
Lane Group Flow (vph)	296	21	1255	468	528	1601
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	12.5	12.5	34.7	34.7	27.4	66.1
Effective Green, g (s)	12.5	12.5	34.7	34.7	27.4	66.1
Actuated g/C Ratio	0.14	0.14	0.40	0.40	0.32	0.76
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	496	228	1418	634	560	2701
v/s Ratio Prot	0.09		0.35		c0.30	0.45
v/s Ratio Perm		0.09		0.47		
v/c Ratio	0.60	0.09	0.89	0.74	0.94	0.59
Uniform Delay, d1	34.7	32.1	24.1	22.1	28.8	4.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.9	0.2	8.4	7.5	24.5	1.0
Delay (s)	36.6	32.3	32.5	29.6	53.4	5.4
Level of Service	D	C	C	C	D	A
Approach Delay (s)	35.2		31.4			17.3
Approach LOS	D		C			B

Intersection Summary			
HCM Average Control Delay	25.2	HCM Level of Service	C
HCM Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	86.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	77.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
3: KAIMI NANI DRIVE & MAMALAHOA HIGHWAY 1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱	↰	↑↑	↑↑	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
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
Volume (vph)	115	510	275	800	495	60
Peak-hour factor, PHF	0.84	0.84	0.81	0.81	0.93	0.93
Adj. Flow (vph)	137	607	340	988	532	65
RTOR Reduction (vph)	0	475	0	0	0	48
Lane Group Flow (vph)	137	132	340	988	532	17
Turn Type		Perm	Prot			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Actuated Green, G (s)	11.5	11.5	15.5	33.5	14.0	14.0
Effective Green, g (s)	11.5	11.5	15.5	33.5	14.0	14.0
Actuated g/C Ratio	0.22	0.22	0.29	0.63	0.26	0.26
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	384	343	518	2237	935	418
v/s Ratio Prot	0.08		c0.19	0.28	c0.15	
v/s Ratio Perm		0.38				0.04
v/c Ratio	0.36	0.38	0.66	0.44	0.57	0.04
Uniform Delay, d1	17.6	17.7	16.4	5.0	16.9	14.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.6	0.7	3.0	0.1	0.8	0.0
Delay (s)	18.2	18.4	19.4	5.1	17.7	14.5
Level of Service	B	B	B	A	B	B
Approach Delay (s)	18.4			8.8	17.3	
Approach LOS	B			A	B	

Intersection Summary			
HCM Average Control Delay	13.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	53.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	51.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: PALAMANUI & KAAHUMANU HIGHWAY 1/4/2010

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑↑	↱	↰	↑↑
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	3539	1583	1770	3539
Volume (vph)	520	370	690	445	345	1160
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	565	402	750	484	375	1261
RTOR Reduction (vph)	0	260	0	352	0	0
Lane Group Flow (vph)	565	142	750	132	375	1261
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	30.6	30.6	23.6	23.6	20.6	48.2
Effective Green, g (s)	30.6	30.6	23.6	23.6	20.6	48.2
Actuated g/C Ratio	0.35	0.35	0.27	0.27	0.24	0.56
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	624	558	962	430	420	1965
v/s Ratio Prot	c0.32		0.21		c0.21	0.36
v/s Ratio Perm		0.25		0.31		
v/c Ratio	0.91	0.25	0.78	0.31	0.89	0.64
Uniform Delay, d1	26.7	20.0	29.2	25.1	32.0	13.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	16.7	0.2	6.2	1.8	20.6	1.6
Delay (s)	43.4	20.2	35.4	26.9	52.6	15.0
Level of Service	D	C	D	C	D	B
Approach Delay (s)	33.8		32.1			23.6
Approach LOS	C		C			C

Intersection Summary			
HCM Average Control Delay	28.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	86.8	Sum of lost time (s)	12.0
Intersection Capacity Utilization	77.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
5: KAIMI NANI DRIVE & MAIN STREET 1/4/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	70	910	80	15	340	50	20	0	20	110	0	50
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	76	989	87	16	370	54	22	0	22	120	0	54
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	424			1076			1598	1598	989	1565	1630	370
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	424			1076			1598	1598	989	1565	1630	370
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	93			97			70	100	93	0	100	92
cM capacity (veh/h)	1135			648			73	97	299	78	92	676

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	76	989	87	16	370	54	22	22	120	54
Volume Left	76	0	0	16	0	0	22	0	120	0
Volume Right	0	0	87	0	0	54	0	22	0	54
cSH	1135	1700	1700	648	1700	1700	73	299	78	676
Volume to Capacity	0.07	0.58	0.05	0.03	0.22	0.03	0.30	0.07	1.53	0.08
Queue Length (ft)	5	0	0	2	0	0	27	6	244	7
Control Delay (s)	8.4	0.0	0.0	10.7	0.0	0.0	73.5	18.0	385.7	10.8
Lane LOS	A			B			F	C	F	B
Approach Delay (s)	0.6			0.4			45.7		268.6	
Approach LOS							E		F	

Intersection Summary			
Average Delay	27.4		
Intersection Capacity Utilization	74.0%	ICU Level of Service	D
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
6: AHIKAWA STREET & MAMALAHOA HIGHWAY 1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	5	70	80	770	490	5
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	76	87	837	533	5
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1546	535	538			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1546	535	538			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	95	86	92			
cM capacity (veh/h)	115	545	1030			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	82	924	538
Volume Left	5	87	0
Volume Right	76	0	5
cSH	437	1030	1700
Volume to Capacity	0.19	0.08	0.32
Queue Length (ft)	17	7	0
Control Delay (s)	15.1	2.2	0.0
Lane LOS	C	A	
Approach Delay (s)	15.1	2.2	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	2.1		
Intersection Capacity Utilization	85.6%	ICU Level of Service	E
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
7: MAKALEI ESTATES & MAMALAHOA HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	60	55	110	405	290	70
Peak Hour Factor	0.57	0.57	0.89	0.89	0.83	0.83
Hourly flow rate (vph)	105	96	124	455	349	84
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1094	392	434			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1094	392	434			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	50	85	89			
cM capacity (veh/h)	211	657	1126			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	202	124	455	434
Volume Left	105	124	0	0
Volume Right	96	0	0	84
cSH	312	1126	1700	1700
Volume to Capacity	0.65	0.11	0.27	0.26
Queue Length (ft)	105	9	0	0
Control Delay (s)	35.3	8.6	0.0	0.0
Lane LOS	E	A		
Approach Delay (s)	35.3	1.8		0.0
Approach LOS	E			

Intersection Summary			
Average Delay	6.7		
Intersection Capacity Utilization	42.3%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
8: UH DRIVEWAY & MAIN STREET

1/4/2010

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	60	45	35	85	60	100
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	65	49	38	92	65	109
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						860
pX, platoon unblocked						
vC, conflicting volume	277	38			130	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	277	38			130	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	90	95			96	
cM capacity (veh/h)	681	1034			1455	

Direction, Lane #	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	65	49	38	92	65	109
Volume Left	65	0	0	0	65	0
Volume Right	0	49	0	92	0	0
cSH	681	1034	1700	1700	1455	1700
Volume to Capacity	0.10	0.05	0.02	0.05	0.04	0.06
Queue Length (ft)	8	4	0	0	4	0
Control Delay (s)	10.8	8.7	0.0	0.0	7.6	0.0
Lane LOS	B	A			A	
Approach Delay (s)	9.9		0.0		2.8	
Approach LOS	A					

Intersection Summary			
Average Delay	3.9		
Intersection Capacity Utilization	20.0%	ICU Level of Service	A
Analysis Period (min)	15		

Appendix K
Level-of-Service Analysis Worksheets for 2022 Background Plus Project Conditions

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	0.95	0.91	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	5085	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	3539	5085	1583
Volume (vph)	60	220	380	1640	905	125
Peak-hour factor, PHF	0.88	0.88	0.82	0.82	0.80	0.80
Adj. Flow (vph)	68	250	463	2000	1131	156
RTOR Reduction (vph)	0	212	0	0	0	108
Lane Group Flow (vph)	68	38	463	2000	1131	48
Turn Type		Perm	Prot			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Actuated Green, G (s)	7.8	7.8	16.0	36.1	16.1	16.1
Effective Green, g (s)	7.8	7.8	16.0	36.1	16.1	16.1
Actuated g/C Ratio	0.15	0.15	0.31	0.70	0.31	0.31
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	266	238	546	2462	1577	491
v/s Ratio Prot	0.04		0.26	c0.57	0.22	
v/s Ratio Perm		0.16				0.10
v/c Ratio	0.26	0.16	0.85	0.81	0.72	0.10
Uniform Delay, d1	19.5	19.2	16.8	5.5	15.9	12.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.5	0.3	11.7	3.1	2.8	0.4
Delay (s)	20.0	19.5	28.5	8.6	18.7	13.1
Level of Service	B	B	C	A	B	B
Approach Delay (s)	19.6			12.3	18.0	
Approach LOS	B			B	B	

Intersection Summary			
HCM Average Control Delay	14.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	51.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	55.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: KAIMI NANI DRIVE & KAAHUMANU HIGHWAY

1/4/2010

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.95	1.00	0.97	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	3539	1583	3433	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	3539	1583	3433	3539
Volume (vph)	900	460	1365	365	160	1030
Peak-hour factor, PHF	0.93	0.93	0.96	0.96	0.89	0.89
Adj. Flow (vph)	968	495	1422	380	180	1157
RTOR Reduction (vph)	0	116	0	201	0	0
Lane Group Flow (vph)	968	379	1422	179	180	1157
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	28.4	28.4	42.0	42.0	7.0	53.0
Effective Green, g (s)	28.4	28.4	42.0	42.0	7.0	53.0
Actuated g/C Ratio	0.32	0.32	0.47	0.47	0.08	0.59
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	1091	503	1663	744	269	2098
v/s Ratio Prot	0.28		c0.40		c0.05	0.33
v/s Ratio Perm		0.31		0.24		
v/c Ratio	0.89	0.75	0.86	0.24	0.67	0.55
Uniform Delay, d1	29.0	27.4	21.0	14.2	40.1	11.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	8.9	6.3	5.9	0.8	6.2	1.0
Delay (s)	37.9	33.7	26.9	14.9	46.3	12.1
Level of Service	D	C	C	B	D	B
Approach Delay (s)	36.5		24.3			16.7
Approach LOS	D		C			B

Intersection Summary			
HCM Average Control Delay	26.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	89.4	Sum of lost time (s)	12.0
Intersection Capacity Utilization	78.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
3: KAIMI NANI DRIVE & MAMALAHOA HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
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
Volume (vph)	50	580	340	500	1110	165
Peak-hour factor, PHF	0.84	0.84	0.81	0.81	0.93	0.93
Adj. Flow (vph)	60	690	420	617	1194	177
RTOR Reduction (vph)	0	336	0	0	0	101
Lane Group Flow (vph)	60	354	420	617	1194	76
Turn Type		Over	Prot			Perm
Protected Phases	4	5	5	2	6	
Permitted Phases						6
Actuated Green, G (s)	4.8	21.1	21.1	53.8	28.7	28.7
Effective Green, g (s)	4.8	21.1	21.1	53.8	28.7	28.7
Actuated g/C Ratio	0.07	0.32	0.32	0.81	0.43	0.43
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	128	502	561	2859	1525	682
v/s Ratio Prot	c0.03	c0.44	0.24	0.17	c0.34	
v/s Ratio Perm						0.11
v/c Ratio	0.47	0.70	0.75	0.22	0.78	0.11
Uniform Delay, d1	29.7	20.0	20.4	1.5	16.3	11.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.7	4.5	5.4	0.0	2.7	0.1
Delay (s)	32.4	24.5	25.8	1.5	19.0	11.4
Level of Service	C	C	C	A	B	B
Approach Delay (s)	25.1			11.4	18.0	
Approach LOS	C			B	B	

Intersection Summary			
HCM Average Control Delay	17.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	66.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	73.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: PALAMANUI & KAAHUMANU HIGHWAY
1/4/2010

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.95	1.00	0.97	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	3539	1583	3433	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	3539	1583	3433	3539
Volume (vph)	285	220	1275	425	375	750
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	310	239	1386	462	408	815
RTOR Reduction (vph)	0	203	0	208	0	0
Lane Group Flow (vph)	310	36	1386	254	408	815
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	13.1	13.1	47.3	47.3	13.8	65.1
Effective Green, g (s)	13.1	13.1	47.3	47.3	13.8	65.1
Actuated g/C Ratio	0.15	0.15	0.55	0.55	0.16	0.76
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	522	241	1942	869	550	2673
v/s Ratio Prot	0.09		c0.39		c0.12	0.23
v/s Ratio Perm		0.15		0.29		
v/c Ratio	0.59	0.15	0.71	0.29	0.74	0.30
Uniform Delay, d1	34.1	31.7	14.4	10.5	34.5	3.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.8	0.3	2.3	0.9	5.4	0.3
Delay (s)	35.9	32.0	16.7	11.3	39.9	3.7
Level of Service	D	C	B	B	D	A
Approach Delay (s)	34.2		15.3			15.7
Approach LOS	C		B			B

Intersection Summary			
HCM Average Control Delay	18.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	86.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	64.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
5: KAIMI NANI DRIVE & MAIN STREET
1/4/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85		1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		0.95	1.00		0.95	1.00
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583		1770	1583		1770	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00		0.71	1.00		0.69	1.00
Satd. Flow (perm)	1770	1863	1583	1770	1863	1583		1318	1583		1277	1583
Volume (vph)	170	275	10	20	1225	80	80	0	10	70	0	60
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)	185	299	11	22	1332	87	87	0	11	76	0	65
RTOR Reduction (vph)	0	0	3	0	0	23	0	0	10	0	0	57
Lane Group Flow (vph)	185	299	8	22	1332	64	0	87	1	0	76	8
Turn Type	Prot		Perm	Prot		Perm	Perm		Perm	Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8	2		2	6		6
Actuated Green, G (s)	9.0	69.7	69.7	1.9	62.6	62.6		11.3	11.3		11.3	11.3
Effective Green, g (s)	9.0	69.7	69.7	1.9	62.6	62.6		11.3	11.3		11.3	11.3
Actuated g/C Ratio	0.09	0.73	0.73	0.02	0.66	0.66		0.12	0.12		0.12	0.12
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0
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)	168	1368	1163	35	1229	1044		157	188		152	188
v/s Ratio Prot	c0.10	0.16		0.01	c0.72							
v/s Ratio Perm			0.01			0.05		c0.07	0.01		0.06	0.04
v/c Ratio	1.10	0.22	0.01	0.63	1.08	0.06		0.55	0.01		0.50	0.04
Uniform Delay, d1	43.0	4.0	3.4	46.1	16.2	5.7		39.4	36.9		39.2	37.0
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	99.1	0.1	0.0	30.3	51.6	0.0		4.2	0.0		2.6	0.1
Delay (s)	142.1	4.1	3.4	76.5	67.7	5.8		43.6	36.9		41.7	37.1
Level of Service	F	A	A	E	E	A		D	D		D	D
Approach Delay (s)		55.6			64.1			42.9			39.6	
Approach LOS		E			E			D			D	

Intersection Summary			
HCM Average Control Delay	59.6	HCM Level of Service	E
HCM Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	94.9	Sum of lost time (s)	12.0
Intersection Capacity Utilization	95.0%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
6: AHIKAWA STREET & MAMALAHOA HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	10	160	25	445	20	995
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	174	27	484	22	1082
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1101	562	1103			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1101	562	1103			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	95	67	96			
cM capacity (veh/h)	225	526	633			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	185	511	1103
Volume Left	11	27	0
Volume Right	174	0	1082
cSH	488	633	1700
Volume to Capacity	0.38	0.04	0.65
Queue Length (ft)	44	3	0
Control Delay (s)	16.8	1.2	0.0
Lane LOS	C	A	
Approach Delay (s)	16.8	1.2	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	2.1		
Intersection Capacity Utilization	79.7%	ICU Level of Service	D
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
7: MAKALEI ESTATES & MAMALAHOA HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	30	65	120	235	415	45
Peak Hour Factor	0.57	0.57	0.89	0.89	0.83	0.83
Hourly flow rate (vph)	53	114	135	264	500	54
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	TWLTL					
Median storage veh)	1					
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1061	527	554			
vC1, stage 1 conf vol	527					
vC2, stage 2 conf vol	534					
vCu, unblocked vol	1061	527	554			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)	5.4					
tF (s)	3.5	3.3	2.2			
p0 queue free %	85	79	87			
cM capacity (veh/h)	347	551	1016			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	167	135	264	554
Volume Left	53	135	0	0
Volume Right	114	0	0	54
cSH	465	1016	1700	1700
Volume to Capacity	0.36	0.13	0.16	0.33
Queue Length (ft)	40	11	0	0
Control Delay (s)	17.0	9.1	0.0	0.0
Lane LOS	C	A		
Approach Delay (s)	17.0	3.1		0.0
Approach LOS	C			

Intersection Summary			
Average Delay	3.6		
Intersection Capacity Utilization	46.9%	ICU Level of Service	A
Analysis Period (min)	15		

8: UH DRIVEWAY & MAIN STREET

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	0	40	0	0	55
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	43	0	0	60
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						860
pX, platoon unblocked						
vC, conflicting volume	103	43			43	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	103	43			43	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	100			100	
cM capacity (veh/h)	895	1027			1565	

Direction, Lane #	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	0	0	43	0	0	60
Volume Left	0	0	0	0	0	0
Volume Right	0	0	0	0	0	0
cSH	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.00	0.00	0.03	0.00	0.00	0.04
Queue Length (ft)	0	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	A	A				
Approach Delay (s)	0.0		0.0		0.0	
Approach LOS	A					

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	6.7%	ICU Level of Service	A
Analysis Period (min)	15		

1: KEAHOLE AIRPORT ACCESS ROAD & KAAHUMANU HIGHWAY

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	0.95	0.91	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	5085	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	3539	5085	1583
Volume (vph)	115	365	255	1300	2005	95
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	125	397	277	1413	2179	103
RTOR Reduction (vph)	0	275	0	0	0	48
Lane Group Flow (vph)	125	122	277	1413	2179	55
Turn Type		Perm	Prot			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Actuated Green, G (s)	11.7	11.7	16.4	66.1	45.7	45.7
Effective Green, g (s)	11.7	11.7	16.4	66.1	45.7	45.7
Actuated g/C Ratio	0.14	0.14	0.19	0.77	0.53	0.53
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	241	216	338	2726	2708	843
v/s Ratio Prot	0.07		c0.16	0.40	c0.43	
v/s Ratio Perm		0.25				0.07
v/c Ratio	0.52	0.57	0.82	0.52	0.80	0.07
Uniform Delay, d1	34.4	34.7	33.3	3.8	16.4	9.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.9	3.4	14.3	0.7	2.7	0.1
Delay (s)	36.3	38.1	47.6	4.5	19.1	9.9
Level of Service	D	D	D	A	B	A
Approach Delay (s)	37.6			11.5	18.6	
Approach LOS	D			B	B	

Intersection Summary			
HCM Average Control Delay	18.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	85.8	Sum of lost time (s)	12.0
Intersection Capacity Utilization	69.2%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: KAIMI NANI DRIVE & KAAHUMANU HIGHWAY

1/4/2010

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.95	1.00	0.97	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	3539	1583	3433	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	3539	1583	3433	3539
Volume (vph)	355	160	1470	890	580	1790
Peak-hour factor, PHF	0.93	0.93	0.96	0.96	0.89	0.89
Adj. Flow (vph)	382	172	1531	927	652	2011
RTOR Reduction (vph)	0	144	0	257	0	0
Lane Group Flow (vph)	382	28	1531	670	652	2011
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	14.1	14.1	43.4	43.4	18.6	66.0
Effective Green, g (s)	14.1	14.1	43.4	43.4	18.6	66.0
Actuated g/C Ratio	0.16	0.16	0.49	0.49	0.21	0.75
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	549	253	1743	780	725	2651
v/s Ratio Prot	c0.11		0.43		c0.19	0.57
v/s Ratio Perm		0.11		0.59		
v/c Ratio	0.70	0.11	0.88	0.86	0.90	0.76
Uniform Delay, d1	35.0	31.6	20.0	19.7	33.8	6.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	3.8	0.2	6.6	11.8	14.0	2.1
Delay (s)	38.8	31.8	26.6	31.5	47.8	8.5
Level of Service	D	C	C	C	D	A
Approach Delay (s)	36.6		28.5			18.1
Approach LOS	D		C			B

Intersection Summary			
HCM Average Control Delay	24.4	HCM Level of Service	C
HCM Volume to Capacity ratio	1.03		
Actuated Cycle Length (s)	88.1	Sum of lost time (s)	12.0
Intersection Capacity Utilization	78.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
3: KAIMI NANI DRIVE & MAMALAHOA HIGHWAY

1/4/2010

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
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
Volume (vph)	135	620	340	985	615	70
Peak-hour factor, PHF	0.84	0.84	0.81	0.81	0.93	0.93
Adj. Flow (vph)	161	738	420	1216	661	75
RTOR Reduction (vph)	0	433	0	0	0	53
Lane Group Flow (vph)	161	305	420	1216	661	22
Turn Type		Over	Prot			Perm
Protected Phases	4	5	5	2	6	
Permitted Phases						6
Actuated Green, G (s)	8.7	21.1	21.1	43.0	17.9	17.9
Effective Green, g (s)	8.7	21.1	21.1	43.0	17.9	17.9
Actuated g/C Ratio	0.15	0.35	0.35	0.72	0.30	0.30
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	258	559	626	2549	1061	475
v/s Ratio Prot	c0.09	c0.47	0.24	0.34	c0.19	
v/s Ratio Perm						0.05
v/c Ratio	0.62	0.55	0.67	0.48	0.62	0.05
Uniform Delay, d1	24.0	15.5	16.4	3.6	18.0	14.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.6	1.1	2.8	0.1	1.1	0.0
Delay (s)	28.6	16.5	19.2	3.7	19.1	14.9
Level of Service	C	B	B	A	B	B
Approach Delay (s)	18.7			7.7	18.7	
Approach LOS	B			A	B	

Intersection Summary			
HCM Average Control Delay	13.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	59.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	62.1%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.95	1.00	0.97	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	3539	1583	3433	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	3539	1583	3433	3539
Volume (vph)	665	485	855	525	420	1440
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	723	527	929	571	457	1565
RTOR Reduction (vph)	0	396	0	323	0	0
Lane Group Flow (vph)	723	131	929	248	457	1565
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	22.3	22.3	38.9	38.9	16.2	59.1
Effective Green, g (s)	22.3	22.3	38.9	38.9	16.2	59.1
Actuated g/C Ratio	0.25	0.25	0.44	0.44	0.18	0.66
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	856	395	1540	689	622	2340
v/s Ratio Prot	0.21		0.26		c0.13	0.44
v/s Ratio Perm		0.33		0.36		
v/c Ratio	0.84	0.33	0.60	0.36	0.73	0.67
Uniform Delay, d1	31.9	27.5	19.3	16.9	34.6	9.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	7.7	0.5	1.8	1.5	4.5	1.5
Delay (s)	39.6	28.0	21.1	18.4	39.1	10.7
Level of Service	D	C	C	B	D	B
Approach Delay (s)	34.7		20.1			17.1
Approach LOS	C		C			B

Intersection Summary			
HCM Average Control Delay	22.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	89.4	Sum of lost time (s)	12.0
Intersection Capacity Utilization	65.4%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85		1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		0.95	1.00		0.95	1.00
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583		1770	1583		1770	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00		0.52	1.00		0.74	1.00
Satd. Flow (perm)	1770	1863	1583	1770	1863	1583		963	1583		1384	1583
Volume (vph)	115	1115	80	15	420	70	20	0	20	145	0	80
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)	125	1212	87	16	457	76	22	0	22	158	0	87
RTOR Reduction (vph)	0	0	27	0	0	30	0	0	19	0	0	73
Lane Group Flow (vph)	125	1212	60	16	457	46	0	22	3	0	158	14
Turn Type	Prot		Perm	Prot		Perm	Perm		Perm	Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8	2		2	6		6
Actuated Green, G (s)	8.4	57.3	57.3	1.3	50.2	50.2		13.1	13.1		13.1	13.1
Effective Green, g (s)	8.4	57.3	57.3	1.3	50.2	50.2		13.1	13.1		13.1	13.1
Actuated g/C Ratio	0.10	0.68	0.68	0.02	0.60	0.60		0.16	0.16		0.16	0.16
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0
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)	178	1275	1084	27	1117	949		151	248		217	248
v/s Ratio Prot	c0.07	c0.65		0.01	0.25							
v/s Ratio Perm			0.05			0.05		0.02	0.01		c0.11	0.05
v/c Ratio	0.70	0.95	0.05	0.59	0.41	0.05		0.15	0.01		0.73	0.05
Uniform Delay, d1	36.4	11.9	4.3	40.9	8.9	6.9		30.5	29.8		33.6	30.0
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	11.8	14.9	0.0	30.3	0.2	0.0		0.4	0.0		11.5	0.1
Delay (s)	48.3	26.9	4.3	71.2	9.1	6.9		30.9	29.9		45.1	30.1
Level of Service	D	C	A	E	A	A		C	C		D	C
Approach Delay (s)		27.4			10.6			30.4			39.8	
Approach LOS		C			B			C			D	

Intersection Summary			
HCM Average Control Delay	24.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	83.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	86.7%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	10	90	95	850	10	580
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	98	103	924	11	630
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1457	326	641			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1457	326	641			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	91	86	89			
cM capacity (veh/h)	127	715	943			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	109	1027	641
Volume Left	11	103	0
Volume Right	98	0	630
cSH	489	943	1700
Volume to Capacity	0.22	0.11	0.38
Queue Length (ft)	21	9	0
Control Delay (s)	14.5	2.9	0.0
Lane LOS	B	A	
Approach Delay (s)	14.5	2.9	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	2.6		
Intersection Capacity Utilization	102.5%	ICU Level of Service	G
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	90	70	120	500	355	100
Peak Hour Factor	0.57	0.57	0.89	0.89	0.83	0.83
Hourly flow rate (vph)	158	123	135	562	428	120
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	TWLTL					
Median storage veh)	1					
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1319	488	548			
vC1, stage 1 conf vol	488					
vC2, stage 2 conf vol	831					
vCu, unblocked vol	1319	488	548			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)	5.4					
tF (s)	3.5	3.3	2.2			
p0 queue free %	42	79	87			
cM capacity (veh/h)	274	580	1021			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	281	135	562	548
Volume Left	158	135	0	0
Volume Right	123	0	0	120
cSH	356	1021	1700	1700
Volume to Capacity	0.79	0.13	0.33	0.32
Queue Length (ft)	164	11	0	0
Control Delay (s)	44.0	9.1	0.0	0.0
Lane LOS	E	A		
Approach Delay (s)	44.0	1.8		0.0
Approach LOS	E			

Intersection Summary			
Average Delay	8.9		
Intersection Capacity Utilization	50.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	100	75	125	140	105	125
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	109	82	136	152	114	136
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						860
pX, platoon unblocked						
vC, conflicting volume	500	136			288	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	500	136			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 %	77	91			91	
cM capacity (veh/h)	483	913			1274	

Direction, Lane #	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	109	82	136	152	114	136
Volume Left	109	0	0	0	114	0
Volume Right	0	82	0	152	0	0
cSH	483	913	1700	1700	1274	1700
Volume to Capacity	0.23	0.09	0.08	0.09	0.09	0.08
Queue Length (ft)	21	7	0	0	7	0
Control Delay (s)	14.6	9.3	0.0	0.0	8.1	0.0
Lane LOS	B	A			A	
Approach Delay (s)	12.3		0.0		3.7	
Approach LOS	B					

Intersection Summary			
Average Delay	4.5		
Intersection Capacity Utilization	27.9%	ICU Level of Service	A
Analysis Period (min)	15		

Appendix G

Economic Impact Study

Economic Impact Study for University of Hawaii Center West Hawaii

Prepared For

Wil Chee – Planning, INC.
Honolulu, Hawaii

January 2010

Prepared By

Robert L. Lucas

Table of Contents

List of Abbreviations

BOR – Board of Regents
DBEDT – Department of Business, Economic Development & Tourism
DL – Distance Learning
EIS – Environmental Impact Statement
FTE – Full-Time Equivalent
FTES – Full-Time Equivalent Students
GED – General Education Development
HCC – Hawaii Community College
HITS – Hawaii Interactive Television System
HOST – Hospitality and Tourism Program
HTA – Hawaii Tourism Authority
I-0 – Input-Output
IEP – Intensive English Program
IRO – Institutional Research Office
LRDP – Long-Range Development Plan
MOU – Memorandum of Understanding
NAICS – North American Industry Classification System
OCET – Office of Continuing Education and Training
OSU – Oregon State University
SF – Square Feet
TIM – Travel Industry Management
UHCC – University of Hawaii Community Colleges
UHCWH – University of Hawaii Center – West Hawaii
UHH – University of Hawaii Hilo
UHM – University of Hawaii Manoa
UHWO – University of Hawaii – West Oahu

List of Tables

1.0 Introduction

The University of Hawaii Center – West Hawaii serves as both an outreach campus of the Hawaii Community College and as a University Center that provides access to upper division university level programs and courses leading to a baccalaureate degree, and to graduate level programs leading to a masters or graduate certificate via distance learning in partnership with University of Hawaii campuses in Hilo, Manoa and West Oahu.

Although UH Hilo began offering courses in West Hawaii in 1971, and the Hawaii Community College (HCC) joined in offering lower division courses at various sites in the region in 1981, it was not until 1987 that programs were consolidated in a single location, in leased commercial building space in Kealakekua, South Kona. Administered as a unit of HCC since 1991, the Center in Kealakekua was designated a University of Hawaii Center in 1996 by the University's Board of Regents (BOR).

Based on the postsecondary education and training needs of the West Hawaii region, the BOR in July 1991 designated a 500-acre site in Kalaoa, near the Kona Airport, as the future location for higher education facilities in the region.

With limited facilities not suitable for its education and training requirements, and poor location relative to a majority of jobs and population in the region, the University, in 1996 began the long-range physical and academic planning for a new campus at Kalaoa for the University of Hawaii Center – West Hawaii (UHCWH). A Long-Range Development Plan (LRDP) for the Center was updated in 1998 and an EIS was prepared in 2000 for the UHCWH campus, which at that point in time was to be located on an approximately 33-acre parcel in the southwestern corner of the overall 500-acre state owned Kalaoa site.

Subsequently, in March 2002 when design work on the new Center was still in progress, work was stopped as the UH Administration reconsidered its planning options for developing the Center. In November 2002, with BOR approval, the UH signed a Memorandum of Understanding (MOU) with the developer of Palamanui, a 725-acre planned residential-commercial community on land adjacent to the northern boundary of the 500-acre state-owned Kalaoa site. The MOU provided for some of the critical infrastructure (e.g. roadways, water) to be constructed by the Palamanui developer for joint use with the new UHCWH campus. With the relocation of the proposed Center to a new location in the northwestern portion of the State-owned Kalaoa site, a Supplemental EIS is now required. This impact analysis addresses the economic importance of the new Center campus to the West Hawaii region and the Big Island.

The bulk of tourism, the Big Island's leading industry, is situated in West Hawaii. Agriculture, construction, healthcare and education are other important industries. These industries and their employees represent very substantial demand (i.e. needs) for both short- and long-term education and training programs. At the same time, the very large geographic area and wide dispersal of jobs and population currently depend mainly on the Kealakekua UH Center, with its inadequate physical facilities. Unmet or "pent-up" demand

clearly represents a drag on growth and diversification of the regional, and in turn, entire Big Island economy.

Building an expanded, full-service UH Center in Kalaoa can be expected to bring substantial benefit to the economy in terms of raising productivity of the workforce and in enabling the supply of critical skills required of companies, non-profits and government to deliver innovative goods and services, including healthcare, education and social services currently not available or in short-supply. The prospective UH Center in Kalaoa also would generate employment, household income and tax revenue, both in the short-term as construction of the new campus takes place, and in the long-run through the operational impact of increased state expenditures on education and training.

2.0 Economic Setting

The Big Island economy is heavily dependent on tourism, its leading industry. This is especially true of the West Hawaii region. In the decades before 1980, the island had a thriving agricultural sector mainly consisting of sugar, but also having significant cattle ranching, coffee and macadamia nut orchard farming, along with many other diversified fruit, vegetable and floriculture industries. Sugar is largely gone and cattle production has diminished. However, diversified agriculture is still an important sector overall, the largest among the counties in the state and one which gives the Big Island economy an element of diversity not enjoyed to the same extent by the other "Neighbor Island" counties.

In Table A1 structure and size of the Big Island economy is shown relative to those of the other counties comprising the state.

Table A1. Employment, Per Capita Income and Population of Hawaii County Relative to Other Counties and State

Indicator	Employment 2007 (number)	Per Capita Personal Income 2006 (million 2006 $)	Resident Population 2007 (number)
State	**631,850**	**37,023**	**1,283,400**
Hawaii	**83,400**	**28,036**	**173,100**
Honolulu	**438,600**	**39,653**	**905,600**
Maui	**77,450**	**33,383**	**141,900**
Kauai	**32,400**	**31,377**	**62,800**

Source: Source: State DBEDT, *Quarterly Statistical and Economic Report*, 1st Quarter 2009, p.12, (http://www.hawaii.gov/dbedt/info/economic/) ; and D BEDT, *County Social, Business and Economic Trends in Hawaii: 1990-2007*, December 2008.

Hawaii County is indeed the "Big Island" given its land area of just over 4,000 square miles, 63 percent of the State's total land area. It is often noted that all of the other islands in the State would fit within the geographic boundaries of the Big Island. Consequent low population density (about 43 persons/square mile) and wide dispersal of towns and other populated places – especially in West Hawaii, make it more difficult for employees to commute to jobs and for education and training institutions to meet resident needs.

With relatively small, largely rural population and consequent small market size and economies of scale, the County does not have the industrial diversification of Honolulu, and similar to Kauai and Maui, has a significantly lower per capital personal income (Table A1).

Tourism is the Big Island's main economic engine of growth. Along with diversified agriculture and a significant complex of research and development activities (e.g., astronomy, UH and other state funded research), tourism in the long-run can be expected to account for most of the export income to support sustainable growth and development. Other major "derived demand" sectors of the economy include construction, education, healthcare, transportation and utilities, and government.

Table A2. Hawaii County Employment by Industry: 2006-2008
(number)

Industry	2008	2007	2006
Construction	5,350	5,750	5,300
Manufacturing	1,650	1,700	1,550
Retail & Wholesale	11,250	11,150	10,900
Transportation & Utilities	3,000	3,150	3,100
Professional & Business Services, and Information	5,600	5,650	5,650
Financial Activities	2,900	2,850	2,750
Education, Healthcare & Social Services	7,500	7,350	6,950
Accommodation	6,550	6,950	7,150
Food services & Drinking Places	5,750	5,850	5,500
Other Services	4,150	4,050	3,700
Agriculture	2,300	2,450	2,450
Government	12,750	12,200	11,500
Total Wage & Salary Jobs	68,750	69,100	66,500
Self-Employed	15,000	14,400	16,050
Total Employment	83,750	83,500	82,550

Source: State DBEDT, *Quarterly Statistical and Economic Report*, 1st Quarter 2009, p.12, (http://www.hawaii.gov/dbedt/info/economic/)); and for 2006, DBEDT, *2006 State Databook*, Table 12.13.

Table A2 presents employment by industry following the NAICS (North American Industry Classification System) industry definition system. The two largest tourism sub-industries – Accommodation and Food Services & Drinking Places – have been separately

shown, but even these large employment industries (representing 12,300 jobs in 2008) only account for part of tourism. Tourism as a distinct economic sector in not defined separately in the NAICS, but rather in those state and local economies in the U.S. with large tourism sectors, size and impact is typically defined in terms of actual tourist spending (based on surveys) within those NAICS industries in which tourists spend their money (e.g., retail trade shops, entertainment, tours). According to the School of Travel Industry Management (TIM) at the University of Hawaii at Manoa (UHM), in 2005 it was estimated that tourism expenditures in Hawaii County generated 21 percent of all direct jobs, including the self-employed (UHM, November 2007, p.II-1). In the Big Island, not only are the hotels and resorts largely catering to visitors, but a large portion of sales of such industries as transportation, retail trade, and restaurants is also derived from visitor spending.

In this economic impact report, it is assumed that West Hawaii encompasses the four county districts: North and South Kohala, and North and South Kona. Based on U.S. Census data, in 1990 the resident population of West Hawaii was 43,373, 36 percent of total County resident population (see Table A3). Although growth was rapid in the decade to 2000 in North and South Kohala, West Hawaii only marginally increased its share of total Big Island resident population, to 38 percent. Puna District's 51 percent growth, from a large base of 20,781 residents, kept the largest share of county resident population in the environs of Hilo and its surrounding area to the south. While the east-west population balance was largely maintained, the increasing concentration of population in the South Kohala-North Kona area will likely prove beneficial for the proposed new UHCWH campus in terms of reducing commuting distance for the majority of students.

Table A3. Hawaii County Population by District: 1990 and 2000

District	1990	2000	Percent Change
Puna	20,781	31,335	50.8
South Hilo	44,639	47,386	6.2
North Hilo	1,541	1,720	11.6
Hamakua	5,545	6,108	10.2
North Kohala	4,291	6,038	40.7
South Kohala	9,140	13,131	43.7
North Kona	22,284	28,543	28.1
South Kona	7,658	8,589	12.2
Kau	4,438	5,827	31.3
Total	120,317	148,677	23.6

Source: *2006 County of Hawaii Data Book*, Table 1.5.

Industry jobs and other measures of industry economic activity are generally unavailable at the sub-county geographic level. However, for the visitor industry, hotel and other accommodation units are inventoried by area in Hawaii County. In 2004 total county hotel, condominium and other accommodation units numbered 10,037, of which 8,890 were hotel units. Out of the 10,037 units, 84 percent were located in the Waimea-Kawaihae-Kohala or Kona areas in West Hawaii.

In regard to the diversified agriculture industry, data are not readily available to quantify production or employment by district or other sub-county geographic area. It is generally known that a majority of the floriculture industries are located in East Hawaii, together with most of the papaya. Vegetable, orchard and other diversified commodities, including aquaculture commodities are produced in multiple locations on the island. Kona coffee, a high-value commodity with worldwide reputation, is grown and processed in the Kona region.

As shown in Table A4, there was very little unemployment in the Big Island labor market in the period 2005-2007, and in 2006 the unemployment rate fell to 2.9 percent, an unusually low rate of unemployment. Unemployment rates below 4.0 percent typically indicate tight labor market conditions in which many employers have trouble filling job openings, particularly in skilled job positions.

With the severe downturn in national economic conditions occurring in the fourth quarter 2008, both the state and county economies felt the effects. In Hawaii County significant job losses occurred in most industries, including accommodation (-550), construction (-450), and transportation and utilities (-350). Even though state and federal employment increased (550 state and 200 federal jobs), widespread job losses outside government combined with increases in the labor force contributed to a sharp rise in the Big Island unemployment rate from 3.5 percent in fourth quarter 2007 to 6.9 percent in fourth quarter 2008 (DBEDT, Quarterly Statistical & Economic Report, 1st Quarter 2009 (http://www.hawaii.gov/dbedt/info/economic/)).

Table A4. Hawaii County Labor Force, Employment and Unemployment: 2005-2008

Item	2008	2007	2006	2005
Labor Force	88,650	86,300	85,050	81,850
Employment	83,750	83,400	82,550	79,150
Unemployment	4,900	2,900	2,500	2,700
Unemployment Rate (%)	5.5	3.3	2.9	3.3

Source: DBEDT, Quarterly Statistical & Economic Report, 1st Quarter 2009, Tables G2, G6, G10, G14.

With a slowing economy that has adversely impacted tourism, and a declining real estate market that has been impacted by the sub-prime mortgage crisis nationally and real estate prices that have become increasingly unaffordable in Hawaii, construction activity is expected to suffer further decline. In the Big Island, also, construction spending is expected to decline, with consequent rising construction industry unemployment.

In light of these conditions, building the new UHCWH campus within the next 2-3 years would help mitigate expected construction industry job losses, and at the same time bring significant long-term benefits through the enhanced education and training capacity to serve the community.

3.0 Role of New UH Center Campus

Although the proposed new UHCWH would serve a number of community and personal socio-cultural interests, this section is aimed at identifying community and personal economic interests that would be reflected in demand for the expanded number and range of programs and courses that can be provided by the new Center campus in Kalaoa, Kona.

From an economic standpoint student personal interest in pursuing community college education and training can be considered largely congruent with business and civil community needs. That is, the personal desire to obtain further education as a pathway to more interesting and challenging work, along with better pay, is an important factor motivating residents to enroll in community college. Whether the personal goal is to obtain a university degree needed to pursue a professional or management career, or to obtain vocational-technical training (degree/certificate programs requiring less time and credits than BA or BS degree) to gain promotion in an existing job or more interesting work in another industry, the end result can be expected to benefit the local or regional economy. In the increasingly competitive global economy, workforce skills must be continually rising to create and utilize advanced technology that contributes to innovative goods and services and further diversification of the economy.

3.1 Demographic Factors

The entire Big Island community is in need of a new UH Center in Kona, one that can provide the full range of community college functions needed by students, industry and civil community. The West Hawaii region is "….one of the most underserved areas in the state", and in addressing this concern both for the community as a whole and for Native Hawaiians, the HCC has made the establishment of a West Hawaii branch campus a priority strategic outcome (*Hawaii Community College Strategic Plan 2008-2015*, May 1, 2008 Draft, pgs. 32, 38).

The UH Center in Kealakekua in Fall 2008 had FTE student enrollment of 231, only 12.8 percent of HCC's total enrollment of 1,807. It is obvious that given the extremely limited leased floor space available for classrooms, library, labs and other facilities (see 3.2 below), community demand for programs and courses is not being fully met. Population in West Hawaii in 2000 accounted for 38 percent of the County's total resident population, as noted earlier.

A second very significant factor constraining the existing Center's capacity to serve the region is the location of the Kealakekua campus, which requires a driving time of 40 minutes or more for over half of the region's population (Wil Chee – Planning, Inc., November 2008, p.1-7). In an educational needs survey, 65 percent of respondents cited "distance to the site" as the greatest barrier to enrollment (UH Social Sciences Research Institute, February 1988, as cited in HCC, 1997).

Another measure of unmet demand or need is the very low "going rate" that prevails in West Hawaii, compared to East Hawaii. The going rate is the percentage of high school graduates that continue their schooling without a break, enrolling directly in a 2-year or 4-year college or university. The University of Hawaii has computed going rates for each of its 10 system campuses. For the community colleges, this is the 2-year going rate, which in Fall 2007 was only 7.9 percent for West Hawaii high schools, compared with the East Hawaii schools going rate of 24.1 percent. For other areas in the state in Fall 2007, going rates also were generally (except for Waianae) more than two times the West Hawaii rate. For example, for central Oahu high schools the going rate was 19.1 percent, in East Oahu the rate was 28.3 percent, and for windward it was 16.5 percent. On Oahu, the North Shore and Waianae are, like West Hawaii, considered "underserved" areas; North Shore and Waianae going rates were 19.6 and 12.8 percent, respectively (UH Institutional Research Office, *High School Background of First-Time Students University of Hawaii Fall 2007*, December 2007, Table 3).[1]

Evaluating the going rate is not a straight forward task in the sense that availability of other 2- and 4-year colleges in an island area does not seem to have a predictable affect. For example, the Central Oahu rate was low (19.1% compared to 28.3% in East Oahu), even though Leeward Community College is readily accessible to most of the high schools in the Central and Leeward Districts and the University of West Oahu has just begun operating from its new campus and is just now adding its freshmen class. And in East Hawaii, the going rate in Fall 2007 was 24.1 percent for public high school graduates, which is comparable to the East Oahu going rate of 28.3 percent, even though in both areas there is availability of university level programs, with the offering much more extensive for East Oahu, where high school graduates have access to several UH community colleges, in addition to UHM and other private 4-year university programs.

Population, geography and workforce requirements constitute other major influences affecting the level of demand for West Hawaii based community college programs and courses. In Table A5 population projections by district are presented. Hawaii Community College enrollment projections are shown in Table A6. Based on the projected District resident population data in Table A5, West Hawaii in 2008 accounted for 40.5 percent of Big Island population. West Hawaii is considered to include the Kohala and Kona Districts for the purpose of this analysis, as mentioned earlier. According to the projected population data in Table A5, West Hawaii's share of island-wide total population would be 41.4, 42.2, and 42.2 percent in 2015, 2020 and 2025, respectively[2].

Table A5. Projected Hawaii County Resident Population: 2007-2025

District	2008	2015	2020	2025
Puna	42,400	52,300	60,300	65,200
S. Hilo	47,100	51,000	51,500	55,700
N. Hilo	1,800	1,900	2,000	2,200
Hamakua	6,500	7600	7,700	8,300
N. Kohala	7,900	9,900	11,700	12,700
S. Kohala	18,100	22,200	25,200	27,300
N. Kona	33,800	39,900	43,700	47,200
S. Kona	11,400	13,400	14,600	15,800
Kau	7,000	8,000	8,800	9,500
Total	176,000	206,200	225,500	243,900

Source: *County of Hawaii Data Book*, Table 1.6a; and DBEDT, *Population and Economic Projections for the State of Hawaii to 2035*, (DBEDT 2035 Series), January 2008. See endnote 2.

The UH Institutional Research Office (IRO) has made enrollment projections for each of the UH system's 10 campuses. The Hawaii Community College projection is shown in Table A6 (headcount enrollment). The IRO projections covered the years 2008-2014. Since this projection was made, actual enrollments for 2008 have been reported. Therefore, in column two, the IRO projection growth trend was applied to the same years but with the starting year 2008 adjusted to reflect the actual headcount enrollment of 2,884. The UH IRO growth trend indicates little growth to 2014, barely 1.0 percent per annum growth on average, with a 2014 headcount of about 3,070 in 2014.

Based on the West Hawaii share of island-wide population in 2015 (41.4%), the hypothetical headcount enrollment at a new UH Center in Kalaoa, would be about 1,270 ((3070) x (.414)). The UH IRO also projects FTE student enrollment based on historical trends, and for its projections uses the ratio of 1.629 (headcount to FTE) for calculating projected HCC FTE student enrollment.

The Fall 2008 FTE student enrollment of only 231 at the Center is the consequence of severely limited building space for classrooms and other facilities at the Kealakekua campus, and this has made it necessary for HCC to offer many programs/courses via distance learning (DL) modes including the UH's Hawaii Interactive Television System (HITS), cable TV programming, internet/email, and other DL technology (see 3.3 below). Relative to the main Hilo campus, the incidence of part-time students is higher, as would be expected given the Center's limited building space. Headcount enrollment at the Kealakekua campus in Fall 2008 was 421 (HC/FTE = 1.823).

Table A6. Projected Fall Student Enrollment – Hawaii Community College: 2009-2014

Year	Headcount (number)	Adjusted Headcount (number)		Adjusted FTE (number)	
2007 actual	2,603		2,603	(actual)	1,601
2008	2,681	(actual)	2,884	(actual)	1,807
2009	2,732		2,914		1,826
2010	2,760		2,945		1,845
2011	2,776		2,976		1,864
2012	2,782		3,007		1,884
2013	2,792		3,038		1,904
2014	2,800		3,070		1,924

Source: UH Institutional Research Office, *Enrollment Projections University of Hawaii, Community Colleges, Fall 2008 To Fall 2014*, July 2008.

Notes: 1. Headcount and adjusted headcount are unduplicated number of enrollees.
2. The actual FTE enrollment number is derived by taking student semester credit hours and dividing by 15. Projections of HCC FTE enrollment is based on use of historical ratio of headcount to FTE of about 1.629.

The above discussion is not meant to suggest that the opening of a new Center in Kalaoa, Kona in 2014, would result in a sudden jump in FTE student enrollment at the Center and a corresponding decline in enrollment at the main HCC campus in Hilo. However, there is good reason to believe that workforce need, large geographic area over which jobs and population are dispersed, and other factors, all contribute to substantial unmet demand for education and training. If this is in fact the case, overall Big Island community college enrollments can be expected to rise significantly over a fairly short time-frame, perhaps over a 2-3 year period. The balance of this section will address the main factors that contribute to this unmet demand for education and training to be provided by the new Center campus.

Student enrollment data from HCC indicates a large percentage of students attend on a part-time basis (34% of FTE students) and average student age (age 26) is well above that of high school graduates directly entering the college (Table A7). Enrollment data are not separately broken out for the West Hawaii Center, but the Center has confirmed from internal information that there is a relatively larger share of part-time students and average age is older than for students attending the main HCC campus (Staff Communication, 3/18/09).

Table A7. Characteristics of Enrolled Credit Students at HCC: Fall 2007

Characteristic	Number	Percent
Headcount Enrollment:		
Males	992	38.1
Females	1,597	61.4
Total *	2,589	99.5
FTE Enrollment:		
Full-Time	1,056	66.1
Part-Time	541	33.9
Total	1,597	100.0
Age Distribution:		
Mean Age	25.8	na
<18	179	6.9
18-19	717	27.5
20-21	446	17.1
22-24	364	14.0
25-29	285	10.9
30-34	178	6.8
35-59	404	15.5
60 and over	30	1.2
Total	2,603	99.9
Registration Status:		
Continuing	1,271	48.8
Returning	250	9.6
First-Time	721	27.7
Transfer	361	13.9
Total	2,603	100.0

Source: Same as in Table A6. Note: Total headcount is 2,603. No data for 14 in M-F distribution is reason for discrepancy. Rounding accounts for age distribution percent sum not totaling to 100.0.

Mean age of almost 26 suggests that many students are or have been in the workforce. Among first-time enrollees at HCC (Table A8), Hawaii high school graduates in 2007 and projected years, 2008-2014 comprise about half of all first-time enrollees. About 42 percent of all first-time enrollees consist of high school graduates and others (those with GED diplomas or non-graduates) who have had a break before entering HCC. It would be from this category of first-time enrollees that many would have been or are currently in the workforce.

Table A8. Projected Headcount Enrollment of First-Time Students: 2008-2014

Year	All First-Time Students	Percent	Direct From Hawaii High School	Percent	Out of State High School	Percent	Other First-Time Students	Percent
2007 actual	721	100.0	349	48.4	70	9.7	302	41.9
2008	740	100.0	368	50.3	70	9.5	302	40.8
2009	744	100.0	372	50.0	70	9.4	302	40.6
2010	736	100.0	364	49.6	70	9.5	302	41.0
2011	729	100.0	357	49.0	70	9.6	302	41.4
2012	719	100.0	347	48.3	70	9.7	302	42.0
2013	725	100.0	353	48.7	70	9.7	302	41.7
2014	728	100.0	356	48.9	70	9.6	302	41.5

Source: U.H. IRO, *Enrollment Projections University of Hawaii, Community Colleges, Fall 2008 To Fall 2014*, July 2008, Table A1. Notes: Direct from Hawaii high schools includes both public and private. Out-of-state refers to direct from both other states and foreign high schools, including U.S. Territories. Other first-time students refer to all other first-time entering students NOT entering directly from high school.

In view of existing unmet demand in the West Hawaii region, the opening of a new UHCWH campus in Kalaoa, Kona would likely produce an increase in the number and share of Other First-Time students, and also would produce a corresponding increase in total First-Time students and total Center enrollment. In the absence of a formal workforce needs survey, it would be impossible to quantify the expected increase.

With respect to the Hawaii High School component of first-time student enrollees, the low going rate (7.9%), discussed earlier, could be expected to increase significantly to approximate that in East Hawaii (24.1%). The share of public high school students in West Hawaii is about 40 percent, which given the 2014 projection of 1,470 seniors (UH IRO, July 2008, Appendix A), would result in a boost of about 100 enrollees in Fall 2015, given an island-wide assumed going rate of 25%[3]. Consistent with statewide demographic trends, the enrollment trend in high schools is expected to level out and even decline in the long-run as the population ages. This means that growth in HCC enrollments can be expected to come increasingly from workers (and others not in the labor force) seeking to upgrade skills and complete degrees and certificates needed to gain promotions or pursue alternative career choices.

3.2 Industry Needs

The West Hawaii region, primarily the South Kohala and North Kona Districts include the lion's share of total Big Island hotel and resort room inventory, and thus the largest share of visitor activity and industry jobs. The existing UHCWH campus at Kealakekua, South Kona has a FTE faculty/lecturer staff of about 20 and 10 classrooms/labs and a small kitchen for the culinary arts program (about 14,000 SF of total Center assignable floor space, compared to new Center's planned 69,000 SF (for 750 FTES capacity campus). Four of the 10 classrooms are equipped for use in the distance learning (DL) program for HITS or video conferencing (*Hawai'i Community College UH Center – West Hawaii Unit Review Report*, November 13, 2006, p.7). These limited facilities are clearly inadequate to handle training needs of the visitor industry in West Hawaii, nor all the needs of industries such as healthcare, education and agriculture. Although the Center and main Hilo HCC campus have striven with limited facilities to serve the needs of the visitor, agriculture, healthcare and other industries, the shortfall in resources has been very frustrating in light of regional need.

To stretch limited resources, the strategy of utilizing DL via HITS, cable TV and the internet has been used extensively at the Center, and while this has enabled access for students to programs/courses that would not otherwise be available, the HITS equipped classrooms (4 of 10) are not available for regular classes[4]. This necessarily results in fewer students being able to take regular classes, which many prefer, and which adds to unmet demand. More importantly, the very limited number of classrooms (and kitchen facilities), precludes short-term training that the visitor industry has in the past requested (personal communication, 3/25/09).

The visitor industry in the Big Island in 2005 accounted for 21 percent of all direct jobs (UH School of Travel Industry Management, *Tourism Workforce Development Strategic Plan 2007-2015*, November 2007, Table A). Given the concentration of industry in West Hawaii, an even larger share of all regional jobs are in tourism. Many of the jobs in tourism are part-time jobs, with the average workweek well below 40 hours. Many workers in the industry would be motivated to take community college courses to upgrade skills and qualify for a better job, or to qualify for more interesting work in another occupation. At the same time, visitor industry employers desirous of raising productivity and job retention rates want their workers to upgrade and/or gain other valuable skills to qualify for jobs in the company. A new UH Center campus at Kalaoa would be much more accessible (closer to jobs and better driving conditions), and with expanded, well designed and equipped campus facilities and associated program/course offerings, a significant increase in number of visitor industry workers taking Center courses could be expected. Part of this increased enrollment would likely be part of industry funded short-term training.

Healthcare (nursing), education, and agriculture would be other industries likely to benefit from an expected increase in enrollments (and number graduating) afforded by the expanded program/course offerings, and facilities designed to accommodate student support facilities not found in the current Center. Again, industry and community resources could be expected to further support both the provision of needed short-term training and employees taking programs/courses to upgrade skills or qualifications.

The UH's School of Travel Industry Management (TIM), in their *Tourism Workforce Strategic Plan 2007-2015*[5], has recommended the UHCC's expand a number of their workforce education and training programs, including the HOST (Hospitality and Tourism Program) program, host culture training for managers in hospitality positions, and TIM's course offerings to the neighbor islands. The TIM Tourism Strategic Plan also recommends that the community colleges' Office(s) of Continuing Education and Training (OCET), including that of HCC, expand their non-credit work related training – supervisory and management training on how to deliver on-the-job training, increase productivity and retain employees (UH TIM, November 2007, pgs.IV-20, IV-21, IV-27). The TIM courses could be offered in West Hawaii, if TIM faculty/lecturers develop DL courses and sufficient numbers of students could be enrolled in targeted courses. Given the expanded new campus facilities this would seem to be a distinct possibility.

The new Kalaoa Center campus is expected to have a number of critical support functions that are largely missing at the Kealakekua Center campus, including an OCET, dedicated IT specialist to support DL and computer lab systems, and career/job placement center. The OCET would incorporate an Intensive English Program (IEP), non-credit basic skills programs, and the kinds of short-term workforce education and training programs like those recommended for tourism.

3.3 Distance Learning

The HCC has been a leader among the state's community colleges in developing a DL or e-learn program to serve its island wide constituency. In Spring 2009, HCC offered 82 online courses, of which 38 were provided by the UHCWH and 3 were provided by the North Hawaii extension Center. With its relatively small teaching staff of about 20, this meant that virtually all instructional staff at the West Hawaii Center were involved in teaching online courses. Compared with Maui CC, with 14 percent higher headcount enrollment in Fall 2008, HCC offered 55 percent more online courses (82, compared to MCC's 53). Even in relation to the much larger community colleges, such as Leeward and Kapiolani, which offered 74 and 91 courses, respectively, in Spring 2009, HCC's extensive online program is very impressive.

A sampling of the courses offered by the UHCWH in Spring 2009 (http://www.hawaii.edu/dl/courses/?vw_campus_id=CC; http accessed 3/28/09) include the following:

Elementary Accounting I	ACC 201
Elementary Survey of Chemistry	CHEM 151
Human Development	FAMR 230
World Regional Geography	GEOG 102
Hospitality Law	HOST 260
Principles of Hotel Management	HOST 44
Hospitality Marketing	HOST 47
Hawaiian Culture in Transition	HWST 221
Ecology and Society	SSCI 150

Data are not readily available in the UH system that gives the number of degrees and certificates awarded to individuals earning all or a majority of their program credits through completion of DL courses. Data on degrees and certificates have been specially tabulated for UHCWH (UHCWH internal data compilation, July 22, 2008).

In 11-year period, 1998-2008, 632 degrees and certificates were awarded West Hawaii students. These degrees and certificates included: Liberal Arts (282 AA degrees), Early Childhood Education (12 AS degrees, 10 Certificates), Food Service (79 AAS degrees, 120 Certificates), Human Services (51 Certificates), and Nursing (22 AS degrees, 20 Certificates). Relatively new programs at the Center include: Substance Abuse, Environmental Science, and Tropical Forest Ecosystem and Agro Forestry, all of which grant a certificate (UHCWH, July 22, 2008).

The UHCWH has been very active in partnering with the UH university campuses (UHH, UHM, and UHWO) to enable West Hawaii students to earn bachelor's, master's and postsecondary education certificates. In the 11 years, 1998-2008, students supported by the Center have earned 92 bachelor's degrees, 17 master's degrees, and 36 post-baccalaureate certificates in Secondary Education (enabling individuals with non-education bachelor's degrees to teach in secondary schools) (UHCWH, July 22, 2008).

With the opening of the new Kalaoa, Kona campus, it is expected that HCC and UHCWH's extensive investment in DL technology and personnel e-learning/teaching development will be up-scaled in a major way to serve the West Hawaii region and larger island wide community.

It is UH system policy that any UHCC enrolled student may take a DL or e-learn class given by any community college or university center in the UH system, provided there is an opening in any given course. [A center may limit off-island students if the given class/lab is a necessary program prerequisite and on-island students in the program are expected to fill available class/lab openings. To date this has rarely happened in the UHCC system (University of Hawaii, *Status of Distance Learning in the University of Hawaii Community College System*, April 2007, p.34)]. This policy provides the basis for collaboration among system centers and community college campuses to coordinate programming and delivery of programs/courses needed to meet workforce needs in given labor markets, or even statewide. However, to comprehensively address both student's personal needs and community workforce needs, the University needs to extent the policy to encompass the university campuses as well.

In accordance with their mandates, the university centers (including UHCWH) have as one of their fundamental goals, the enabling of their students to transition from community college programs (certificates and 2-year degrees) to university 4-year degrees and graduate degrees. Consistent with this strategic goal is the meeting of workforce needs, as in West Hawaii and other outreach areas in the state, and the provision of the postsecondary Education professional certificate and MEd in Counseling and Guidance (UH, April 2007, Appendix 39).

With a new full-service Center campus in Kona, there will be tremendous potential to broaden the range of programs to meet workforce needs (and student's personal needs, which largely coincide). An example of how this potential can be achieved is the soon to be implemented HCC-Oregon State University program (HCC-OSU agreement posted on HCC website: http://hawaii.hawaii.edu). Under the new program HCC students will simultaneously enroll at both institutions and will be able to began earning program course credits while at HCC, online via OSU Extended Campus: http://ecampus.oregonstate.edu , and on campus in Corvallis, Oregon. A number of science and agricultural programs at OSU are of interest to HCC and UHCWH students. The articulation agreement governing transfer of HCC student course credits to OSU is about to be finalized and the program is expected to begin in Fall 2009 (OSU, Personal Communication, 3/27/09). There is a similar agreement between OSU and Leeward CC, but the status of implementation is not known.

4.0 Construction Related Economic Impacts

Building the new UH Center campus will generate significant short-term benefits, including additional jobs, economic output, employment earnings and tax revenues to state government. These benefits will mainly accrue to the Big Island economy (except for state tax revenues) over a 36 month period for each building phase associated with the two levels of student enrollment capacity. The initial phase or build-out stage would be the construction of the buildings, library, labs and other facilities needed to accommodate a full-time student enrollment of 750 students[6]. As discussed in Section 3.0, 750 FTE students is approximately equivalent to 1,220 headcount students.

For the first phase UH West Hawaii Center campus, construction costs for buildings would amount to about $30.3 million, and corresponding infrastructure (e.g. roadways, water and sewer lines, power lines) would cost about $14.0 million more[7]. These costs are in terms of estimated 2009 dollar prices. The investment of the $44.3 million in campus construction represents additional final demand in the Big Island construction industry. The economic impacts generated by the $44.3 million Campus center capital improvements have been calculated by using multipliers from the input-output study produced by the Hawaii Department of Economic Development and Tourism (*The 2005 State Input-Output Study For Hawaii*, August 2008)[8].

Construction costs for the second stage 1,500 FTE student capacity campus would amount to about $31.7 million (buildings - $26.0 million and infrastructure – $5.7 million). When added to the first phase costs, total cumulative construction costs to build the 1,500 FTES campus sum to a total of $76.0 million. Again, these costs are in terms of 2009 construction prices.

4.1Employment

Construction of the phase one 750 FTE student capacity campus would result in the creation of about 263 direct construction industry jobs, and another 347 indirect jobs in other industries supplying inputs to the construction industry and to households spending the earnings of construction industry employees working on the campus project. As shown in Table A9, including the 263 construction jobs, a total of 610 jobs could be expected to be created by the building of the new 750 student capacity campus. These are total annual jobs, and therefore taking into account a 36-month period for campus construction, on average there would be about 7.3 (263/36) full-time equivalent construction industry jobs, and about 9.6 (347/36) FTE jobs in other industries. Most of these jobs would be on the Big Island, but some would be in Honolulu along with a small number in the other counties.

Table A9. Employment Generated by UH Center Construction
(millions 2009 dollars)

Category	750 FTE Students	1500 FTE Students
	Jobs	Jobs
Direct Impact (number)	263	444
Total Impact (number)	610	1038

As shown in Table A9, for the future build-out of phase two of Center development to a student capacity of 1,500 FTE students, direct construction spending of $76.0 million (cumulative, including the phase one construction spending) would generate about 444 annual industry jobs, and an additional 594 (1038-444) annual jobs in other supplying industries. To calculate average monthly jobs for the build-out of both phases to the 1,500 FTES capacity campus, total jobs generated need to be averaged over 6 years or 72 months since each phase is assumed to be a period of 36 months. This means that on average about 6.2 monthly construction industry jobs (444/72), and about an additional 8.3 monthly jobs (594/72) in other supplying industries would be generated.

It is important to note that since the timing of future construction is unknown, construction spending (and the multipliers based on this spending) is based on 2009 dollars (construction costs in 2009 prices). In future, inflation would raise the price of construction, but productivity gains in construction (and other supplying industries) would tend to offset the effects of inflation. On the DBEDT website (http://hawaii.gov/dbedt/info/economic/data_reports/2005_state_io/), the agency has provided projected job multipliers to 2015 (*2005 State Input-Output Tables – Detailed).*

4.2 Output

Table A10 presents the direct and total economic output generated by each phase of campus development. The capital investment in building the campus would represent additional final demand construction expenditures. The initial direct effect output would be

$44.3 million in the case of the 750 FTE campus, and $76.0 million (including phase one construction costs) for the 1,500 FTE student campus. Direct effects of the initial construction capital investment, through the multiplier effects of consequent rounds of spending by suppliers and households (expenditure of earnings generated by the project – referred to as the "induced" indirect effect) would result in the total impact shown in Table A10. As indicated in the last row of Table A10, the total output impact of constructing the 750 FTE student campus would amount to about $88.2 million, and for the 1,500 capacity campus, cumulative total impact of about $151.1 million. As in the case of employment impacts, the additional output created by construction of the new campus would occur mostly in Big Island industries.

Examining the ratios of total output impact to initial capital investment for each of the different capacity campuses, the statewide total economic output would amount to about twice (1.99) the amount of the initial construction spending (direct effect). This "multiplier" affect is a consequence of the flow of sales and purchases in the economy due to suppliers selling inputs (indirect effect) required to enable the delivery of final demand (i.e. the buildings and infrastructure of the new Center campus), and households spending employment earnings generated by the project (induced effect). Total impact represents the sum of the direct, indirect and induced effects.

Table A10. Output Generated by UH Center Construction
(millions 2009 dollars)

Category	750 FTE Students	1500 FTE Students
Direct Impact	44.3	76.0
Total Impact	88.2	151.1

4.3 Earnings

The earnings generated by construction of the UH Center campus refer to the return to labor in the form of wage and salary payments to employees and to the self-employed, and therefore contribute to household income. Direct impact refers to the earnings of employees and self-employed persons working directly on the Center campus construction project. As indicated in Table A11, direct earnings would amount to $14.4 million for the 750 FTE student capacity campus, and would amount to $24.6 million for the 1,500 FTE campus (cumulatively, including first phase earnings).

Table A11. Earnings Generated by UH Center Construction
(millions 2009 dollars)

Category	750 FTE Students	1500 FTE Students
Direct Impact	14.4	24.6
Total Impact	27.8	47.5

Taking into account the multiplier effects of supplying industries and the spending of household income based on earnings of all persons working in the industries affected by the initial capital investment in the new campus, the total earnings impact would be almost twice (1.93) the direct impact, as shown in Table A11. Given that earnings represent a share of output, as in the case of output, the additional earnings generated would be paid mostly to Big Island employees and self-employed, and thus would contribute to household income in the County.

4.4 State Taxes

Construction of the UH Center in Kalaoa, Kona would result in significant tax revenues for state government. These tax revenues would come from a wide range of taxes on output (sales) and earnings, including the general excise and use tax, individual income tax, corporate income tax, and the transient accommodations tax. In all, some 13 state taxes were taken into account in designing the State I-O study and resulting derivation of multipliers (DBEDT, August 2008, p.16).

Table A12. State Taxes Generated by UH Center Construction
(millions 2009 dollars)

Category	750 FTE Students	1500 FTE Students
Total Impact	4.5	7.9

In table A12 the total state tax impact is shown for each phase of the UHCWH campus development. The $7.9 million in taxes generated in building campus to 1,500 FTES capacity includes the $4.5 million generated by the first phase build-out. In contrast to employment, output and earnings impacts, tax revenues generated by construction of the new UH Center for the most part would not remain in the Big Island economy. Some of the state tax revenues generated by the UH Center construction project would in time return to the Big Island in the normal course of state government operations wherein funds would be appropriated by the State Legislature to support the operational and capital spending of state departmental offices in Hawaii County (and in the other three counties). The UH

Center to be built in Kalaoa is an example, in that state funds would have to be appropriated to fund this proposed Hawaii Community College capital improvement project.

5.0 Long-Term Economic Impacts

5.1 West Hawaii Center in Kealakekua

The new West Hawaii Center campus at Kalaoa can be expected to generate significant long-term employment, income and government fiscal benefits in comparison with the existing Center facilities in Kealakekua. To determine the additional or net new benefits created in operating the new campus, baseline operational measures need to be specified for the current campus at Kealakekua, South Kona. These are shown in Table A13.

Table A13. Baseline Operational Measures of Center at Kealakekua

Measure	Fall 2008
FTE Student Enrollment	231
FTE Personnel - 1	43
Budget (FY-2009) - 2	2.280
Earnings	1.750
State Taxes	0.296

Table Notes: 1. Includes all staff, including instructional
2. Fiscal 2009 budget in millions of 2009 dollars.

Given the uncertainty of funding for the new Center campus, the expected opening date for the 750 FTES capacity campus is not known but is anticipated to occur within the 2012-2016 timeframe.

Direct employment and income can be estimated in current 2009 dollar terms by utilizing Hawaii Community College budgetary and academic operational data, scaled to the 750 FTES level of the new Center campus. Once the total number of FTE jobs and operating expenditures has been estimated for the initial campus complex (750 FTES capacity), net new employment (jobs), income and fiscal impacts can be calculated utilizing the methodology used for estimating short-term construction impacts.

In Table A13 the direct employment and output are already indicated for the Kealakekua Center in FY-2009; these are the 43 FTE jobs and $2.28 million in budgeted appropriations. Budgeted operating expenditures are assumed to be all spent in the period budgeted. In FY-2009, total compensation for Center personnel, including faculty and lecturers, amounted to $1.75 million. In the Colleges, Universities and Professional Schools sector of the I-O model, earnings account for 90.5 percent of total compensation,

or in this case $1.58 million. Based on total output, the Center is expected to generate about $296,000 in state tax revenues in fiscal 2009.

5.2 Proposed New UH Center in Kalaoa

With the anticipated building of the new UH Center in Kalaoa, North Kona, a substantially full-service community college campus will be more centrally located in relation to most of the jobs and homes in the West Hawaii region. Presently, the Kealakekua campus facilities are fully utilized, and even those at the main Hilo campus are approaching capacity usage. The projected opening of the new Kalaoa campus with capacity for 750 FTE students, although uncertain in terms of timeframe, is expected to represent additional final demand for education and training (net of existing Center services). This initial component of the Phase I development program, would likely be substantially utilized in the short- to mid-term (2011-2014). Build-out of the new campus to the 1,500 FTE student capacity in Phase II, could be expected to occur in the longer-term.

5.2.1 Employment

The long-term additional or new jobs generated by the new UH Center in Kalaoa are shown in Table A14. When the initial Phase I campus with 750 FTE student capacity begins to approach its design capacity, an additional 77 direct jobs in the Center will have been created by the expansion. These jobs are net of the 43 that already existed at the Kealakekua in Fall 2008. Including indirect and induced multiplier effects generated by operating expenditures at the new Center, an additional 48 (125-77) new jobs would be generated in other industries in the state, but mostly in the Big Island. The total employment impact of the 750 FTE student, would then be 125 additional long-term jobs.

Table A14. New Employment Generated by UH Center Operations in Kalaoa

Category	750 FTE Students	1500 FTE Students
	Jobs	Jobs
Direct Impact (number)	77	178
Total Impact (number)	125	289

In the same manner, in the long-run when the UH Center is built-out to the 1,500 FTE student capacity size in Phase II, additional new long-term jobs (net of those already existing at Kealakekua campus) would be created by campus operations. As shown in Table A14, there would be 178 direct new jobs at the 1,500 FTE student capacity campus. These would be jobs in the new UH Center. Total employment impact of the 1,500 FTE student capacity Center would be 289 jobs. Subtracting the 178 direct campus jobs from the 289 total new jobs, 111 of the new jobs would be in other industries, mostly on the Big Island.

5.2.2 Output

Operating expenditures at the new Kalaoa UH Center campus represent final demand output. In Table A15, the direct output of Center operations is shown for each of the two campus capacity configurations. The direct output shown in Table A15 is net of the $2.3 million output of the Kealakekua Center campus (see Table A13). Direct output is $10.6 million for the 750 FTE student capacity campus, and $21.4 million for the 1,500 FTE student campuses.

Table A15. New Output Generated by UH Center Operations in Kalaoa
(million 2009 dollars)

Category	750 FTE Students	1500 FTE Students
Direct Impact	10.6	21.4
Total Impact	23.2	46.9

Total output shown in the last row of Table A15, includes the direct output, and therefore after subtracting out the direct output shown in row one, the indirect and induced output generated in other industries by the multiplier effects of campus operating expenditures, is $23.2 million and $46.9 million, respectively, for the 750 and 1,500 FTE student capacity levels. Indirect and induced output would be produced mostly in Big Island industries by the sale of goods and services to the Center, together with the subsequent rounds of spending by suppliers purchasing inputs to enable their output, and by household spending of earnings of employees of the Center and suppliers in the subsequent rounds of spending.

5.2.3 Earnings

Additional long-run operating benefits of the new Kalaoa Center would include the direct earnings of administrative, instructional and other support staff of the Center[9]. The earnings would accrue to Big Island households of the Center's personnel (Table A16). Campus direct earnings impacts according to FTE student capacity, would be $6.1million and $12.6 million, respectively, for the 750 and 1,500 FTE student capacity campuses.

Table A16. New Earnings Generated by UH Center Operations in Kalaoa
(millions of 2009 dollars)

Category	750 FTE Students	1500 FTE Students
Direct Impact	6.1	12.6
Total Impact	10.1	20.9

Total earnings impact incorporates the multiplier effects of other industries supplying goods and services inputs directly to the Center (and other suppliers in the subsequent rounds of spending), and the impact of household spending of direct earnings received. Subtracting the direct impacts (total – direct in each column of Table A16), indirect and induced earnings impacts would be $4.0 million and $8.3 million, respectively, for the 750 and 1,500 FTE student capacity campuses. A large majority of this indirect impact in other industries would accrue to Big Island households, but not all. Honolulu, and to a much lesser extent Maui and Kauai, would receive a small share of the indirect earnings generated by the new UH Center campus in Kalaoa.

5.2.4 State Taxes

The long-run operating expenditures (output) of the Kalaoa Center would generate significant state tax revenues (Table A17), $1.4 million and $2.8 million annually for the 750 FTE and 1,500 FTE student capacity campuses, respectively. As discussed in 4.4, direct and indirect expenditures associated with output (sales) and earnings (household income) would generate state tax revenues based on a wide range of taxes, the most important being the general excise and use tax, and income taxes. In contrast to other long-term Center generated economic benefits, the tax revenues would accrue to state government, mostly outside of the Big Island. However, eventually a share of these tax revenues would find their way back to the Big Island through budget appropriations to support state government departments and agencies located in Hawaii County, including Hawaii Community College.

Table A17. New State Taxes Generated by UH Center Operations in Kalaoa
(millions of 2009 dollars)

Category	750 FTE Students	1500 FTE Students
Total Impact	1.4	2.8

6.0 Summary

The UH Community College System's Hawaii Community College (HCC), with main campus in Hilo, serves the education and training needs of the entire County of Hawaii at the 2-year postsecondary level. However, the West Hawaii region (essentially the four districts of North and South Kohala and North and South Kona), with about 40 percent of the total County population, is dependent on the UH West Hawaii Center, located in cramped leased facilities in a retail-commercial center in Kealakekua, South Kona. Given its severely limited physical facilities, the Center serves as both an extension campus of HCC offering a range of 2-year degree and certificate programs, and other shorter vocational programs; and resident access to baccalaureate and graduate degree programs offered by UH university campuses (i.e. UHM, UHH and UHWO) via a mix of distance learning (DL) modes.

Tourism is the Big Island's leading industry, and much of the industry is based in the West Hawaii region which contains over 80 percent of the County's hotel and other accommodation room inventory (over 8,000 rooms in 2004). Tourist or visitor expenditures also account for a large share of sales of retail and wholesale trade, eating and drinking establishments, air and ground transportation, and other service activities in the region, and therefore directly and indirectly account for a major portion of all jobs in the region, and in the County.

Diversified agriculture (including Kona Coffee, macadamia nuts, floriculture, fruits and vegetables), construction, research and development, healthcare and education are other important industries in the Big Island economy. Hawaii Community College and the West Hawaii Center have a critically important role in providing a comprehensive range of postsecondary education and training programs to meet both industry workforce and resident personal needs. In the increasingly competitive global economy, workforce skills must be continually rising to create and utilize advanced technology that contributes to innovative goods and services and further diversification of the economy. Individual personal needs include the desire to upgrade job skills to obtain promotion to better paying or more interesting work. Both employer and employee/personal motivation to seek further education and training contribute to a more productive and diversified economy.

Economic Rationale and Need for New Center

Current UHCWH facilities at Kealakekua are limited to 10 classrooms/labs, that along with administration and support functions, fully utilize the approximately 14,000 SF of available floor space. Location of the Center within the region also acts as a service constraint, as over half of the region's population would require a driving time commute of 40 minutes or more to take courses at the Center. Current full-time-equivalent (FTE) enrollment (Fall 2008) is 231, and in part because of limited facilities and poor location relative to the majority of regional jobs and population, the Center offers an extensive DL program. Despite the extensive DL offering of many credit programs and courses (including those serving the visitor, education and healthcare industries), the severe facilities constraint at

the Kealakekua Center has contributed to significant unmet workforce and personal education and training needs in the West Hawaii region.

A significant indicator of "pent-up" or unmet demand is the "going rate". The going rate is the percentage of high school graduates that continue their schooling without a break, enrolling directly in a 2-year or 4-year college or university. The University of Hawaii has computed going rates for each of its 10 system campuses. For the community colleges, this is the 2-year going rate, which in Fall 2007 was only 7.9 percent for West Hawaii high schools, compared with the East Hawaii schools going rate of 24.1 percent. On Oahu in all areas except Waianae (12.8% rate), the going rate is more than twice as high as that of West Hawaii high schools. Going rates for East Oahu, Central Oahu and Windward Oahu were 28.3, 19.1 and 16.5 percent, respectively, in Fall 2007.

Another indicator of unmet demand is the unavailability of short-term training for industry at the current Center campus in Kealakekua because of limited physical facilities. The necessity to offer an extensive DL program has compounded the problem of limited facilities. While DL has afforded many residents access to programs/courses they otherwise would not have had, about 40 percent of the classrooms/labs are equipped with DL technology and therefore are dedicated to this use and are not available for short-term training.

The state's Tourism Strategic Plan has recommended the UHCC's expand a number of their workforce education and training programs, including the HOST (Hospitality and Tourism Program) program, host culture training for managers in hospitality positions, and UHM travel industry management course offerings to the neighbor islands. The Strategic Plan also recommends that the community colleges' Office(s) of Continuing Education and Training (OCET), including that of HCC, expand their non-credit work related training, including supervisory and management training on how to deliver on-the-job training and increase productivity. Without the proposed new UHCWH campus facilities at Kalaoa, these kinds of short-term training cannot be provided nor can the unmet demand for credit programs for tourism and other industries be met.

Healthcare (nursing), education, and agriculture are other industries likely to benefit from an expected increase in enrollments afforded by the expanded program/course offerings (including student and industry support facilities) at the proposed new Center at Kalaoa. With the expanded facilities offered by the new Center, industry and community resources could be expected to further support both the provision of needed short-term training and employees taking programs/courses to upgrade skills or qualifications.

The HCC has been a leader among the state's community colleges in developing a DL or e-learning program to serve its island wide constituency. In Spring 2009, HCC offered 82 online courses, of which 38 were provided by the UHCWH and 3 were provided by the North Hawaii extension Center. With its relatively small teaching staff of about 20, this means that virtually all instructional staff at the West Hawaii Center are involved in teaching online courses.

The UHCWH has been very active in partnering with the UH university campuses to enable West Hawaii students to earn bachelor's, master's and postsecondary education certificates. In the 11 years, 1998-2008, students supported by the Center have earned 92 bachelor's degrees, 17 master's degrees, and 36 post-baccalaureate certificates in Secondary Education (enabling individuals with non-education bachelor's degrees to teach in secondary schools).

With the opening of the new Kalaoa, Kona campus, it is expected that HCC and UHCWH's extensive investment in DL technology and personnel e-learning/teaching development will be up-scaled in a major way to serve the West Hawaii region and larger island wide community.

Economic Impact of New Center

Construction and operation of the proposed UHCWH campus at Kalaoa, Kona can be expected to generate significant short-term (construction-related) and long-term (campus operations) benefits, including additional jobs, economic output, employment earnings and tax revenues to state government. These benefits will mainly accrue to the Big Island economy (except for state tax revenues). With respect to construction-related benefits, these would be realized over a 36 month period for each building phase associated with the two levels of student enrollment capacity. The initial phase or build-out stage would be the construction of the buildings, library, labs and other facilities needed to accommodate a full-time student enrollment of 750 students. In view of the uncertainty of future state capital improvements appropriations to the University, the timeframe for construction of the proposed new UHCWH is unknown. For this reason all construction and operating costs associated with the proposed new Center are presented in 2009 dollar terms.

Construction costs for the first phase (750 FTES capacity) facilities would amount to about $30.3 million, and corresponding infrastructure (e.g. roadways, water and sewer, and power lines) would cost about another $14.0 million. These costs are in terms of estimated 2009 prices. The investment of the $44.3 million in campus construction would represent additional final demand in the Big Island construction industry.

Short-term construction related impacts are summarized in Table G1. With respect to employment, construction of the new UH Center Phase I capacity (750 FTES) would generate about 263 direct annual jobs. These would be jobs involved with construction of the campus, and a large majority of these jobs would be in the Big Island. Taking into account the 36 month construction period, the average monthly number of FTE jobs would be about 7.3. Total direct plus indirect jobs would number 610, and after deducting the 263 direct jobs, there would be an additional 347 indirect jobs, or about 9.6 FTE jobs on average over the 36 months of construction. These latter jobs would be in other industries that supply inputs to the construction industry, together with the jobs generated by households spending the direct and indirect earnings created by campus construction. Similarly, the Phase II construction of the 1,500 FTES capacity campus would cumulatively result in 444 direct annual jobs (6.2 FTE jobs/month over the 6 years build-out period), and an additional 594 indirect jobs (8.3 FTE jobs/monthly).

Construction related output refers to the value of construction and purchases/sales of industries providing inputs to enable completion of the campus building project. For the 750 FTES campus, the direct investment of $44.3 million in construction represents

Table G1. Construction Related Employment, Output, Earnings and Tax Benefits
(millions 2009 $, except jobs)

Jobs	750 FTES Campus	1500 FTES Campus
Direct (number)	263	444
Total (number)	610	1,038
Output		
Direct	44.3	76.0
Total	88.2	151.1
Earnings		
Direct	14.4	24.6
Total	27.8	47.5
Taxes		
Total	4.5	7.9

final demand in the Big Island construction industry. Total output includes the direct construction investment, plus the additional purchases/sales of suppliers in other industries providing intermediate goods and services required to deliver the completed campus project (i.e. output created through multiplier effects). Indirect output also includes the sale of goods and services created by household spending of the earnings of direct and indirect jobs in construction and supplying industries (i.e. induced multiplier effects). After subtracting the direct output impact ($44.3 million), the net additional indirect impact of Phase I construction would be $43.9 million in sales of other industries. Most but not all of this additional indirect output (sales) would be in Big Island industries. Similarly, the Phase II construction of the new Center (with FTES capacity of 1,500) would result in a direct output impact of $76.0 million (including the phase one output), and an additional net indirect impact of $151.1 million.

Earnings refer to the remuneration of employees holding the direct and indirect jobs created by the construction of the new UH Center in Kalaoa. The construction related earnings shown in Table G1 end up in households, and therefore may be thought of as household income. The total income impact (direct + indirect) of building the Phase I Center would be $27.8 million, and for the Phase II Center it would be $47.5 million, including the earnings generated by the first phase build-out. A large majority, but not all, of the income generated by construction would accrue to Big Island households.

Construction of the new UHCWH also would generate significant state tax revenues. These revenues would be derived from about a dozen different taxes associated with construction related output (sales) and household income (and expenditures) of job earnings. The main sources of state tax revenues would be general excise and use taxes, and personal and corporate income taxes. As shown in Table G1, construction related tax revenues would amount to about $4.5 million and $7.9 million (including the $4.5 million in phase one taxes), respectively, for the Phase I and Phase II Center construction projects. Unlike output and earnings, the state tax revenues would largely be collected outside of the Big Island. Of course, some of these tax revenues would ultimately come back to Hawaii County via the budget expenditures of state agencies (e.g. HCC) located in the County.

In contrast to construction related impacts, the long-term operational impacts of the proposed new UH Center would be ongoing. In estimating the long-term operational impact of the new Center, the current impact of the existing Kealakekua Center campus must be determined so that it is properly accounted for in estimating the net additional impact of the new Center. Another significant planning assumption relates to the extent to which the projected impact of the new Center represents additional final demand (for education and training services), or in part substitutes for final demand (i.e. at HCC in Hilo). Given the facilities constraint at the existing Center in Kealakekua, and the consequential extent of unmet demand in the region, together with limited facilities also at the HCC main campus, it is assumed that the Phase I new Center campus operating level would fully reflect additional final demand.

In Fall 2008, FTES enrollment at the Kealakekua Center campus was 231. In fiscal year 2009 there were 43 FTE personnel employed at the Center, including instructional, administrative and other support staff. These baseline measures along with those for earnings and state taxes generated have been deducted from the corresponding estimated long-run operational impacts of the new Center in Kalaoa, which are shown in Table G2.

Table G2. Long-Run Operational Employment, Output, Earnings and Tax Benefits
(millions 2009 $, except jobs)

Jobs	750 FTES Campus	1500 FTES Campus
Direct (number)	77	178
Total (number)	125	289
Output		
Direct	10.6	21.4
Total	23.2	46.9
Earnings		
Direct	6.1	12.6
Total	10.1	20.9
Taxes		
Total	1.4	2.8

It is anticipated that within 1-3 years after opening, the new UHCWH in Kalaoa will be operating at or close to its Phase I capacity of 750 FTE students. At this point in time, the direct long-run employment impact would be about 77 FTE jobs at the Center, and an additional 48 indirect jobs in other industries, for a total employment impact of 125 jobs. Most but not all of the indirect jobs, generated via the multiplier effects of Center and supplier spending (and the spending of employment earnings), would be in the Big Island. In the more distance future when the Phase II Center campus becomes operational, total direct plus indirect additional jobs would number 289.

Direct output of the new Center in the course of operating at the 750 FTES capacity would amount to about $10.6 million per annum, and the total operational output impact, including both direct and indirect multiplier effects, would amount to $23.2 million per annum. In the more distant future, when the Phase II campus becomes operational at or near its 1,500 FTES capacity, the total direct plus indirect impact would amount to about $46.9 million. Again, the direct impact ($21.4 million) would be associated with the Center’s annual operating expenses, whereas the indirect impact ($25.5 million) would be output or sales generated in other industries, mostly those in the Big Island.

As in the case of the construction related impact, earnings refer to remuneration (i.e. return to labor) of those holding the jobs that were created by the long-run operation of the new Center. The direct earnings impact of the new Center operating at the 750 FTES capacity would amount to about $6.1 million annually. These earnings would accrue to the households of Center employees. Total earnings impact of the new Center operating at the 750 FTES capacity (including the indirect multiplier effects in other industries) would amount to about $10.1 million per annum. When, in the more distant future, the new Center campus is operating at the 1,500 FTES capacity, the total direct plus indirect earnings impact would amount to about $20.9 million.

With respect to state tax revenues, the long-run operational impact of the new UHCWH would produce about $1.4 million and $2.8 million in annual tax revenues to the state, respectively, for the 750 and 1,500 FTES capacity campuses, taking into account direct and indirect effects. Most of these tax revenues would be collected outside the Big Island, but as in the case of the construction-related tax revenue impact, part of the revenue would ultimately return to the County in budgetary support of the state departments and agencies operating on the Big Island (e.g. HCC).

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End Notes

[1] The rates used here are for the public high schools, and therefore exclude private high schools. The Central Oahu high schools include all schools in the Central and Leeward Districts, except Waialua (which is the North Shore high school, and Nanakuli and Waianae High Schools which are the schools used to compute the Waianae going rate. East Oahu included all public high schools in the Honolulu city and East Honolulu areas (i.e. Aina Haina to Hawaii Kai). Kahuku High School is part of the Windward District.

[2] The County population by District projections only went to 2020, and therefore this end year projection was used to distribute the DBEDT 2035 Series projections in both 2020 and 2025, and this is why the West Hawaii share remained constant at 42.2 percent in 2020 and 2025.

[3] With about 40 percent of public high school seniors in 2014 ((1470)x(.40) = 588), a going rate of 25 percent would result in 147 seniors entering UHCWH in Fall 2015. With the 7.9 percent going rate, only about 46 would have entered the Center, a difference of 101.

[4] It is not being suggested that the DL strategy is not appropriate or beneficial. It has been made necessary in the case of HCC and the extension Center because of: 1) lack of resources, including severely limited facilities, 2) wide dispersal of population in West Hawaii over a very large geographic area, and 3) recognition on the part of HCC that given the substantial commitment to DL, HCC should as fully as possible utilize the DL facilities (special hardware and software technology) and DL knowledge and experienced teaching staff to provide Big Island (and other UHCC students) residents access to high demand baccalaureate and graduate degree programs offered by the UH university campuses at Hilo, Manoa and West Oahu.

[5] The TIM Tourism Workforce Development Strategic Plan 2007-2015 was prepared for the Hawaii Tourism Authority, and this plan in turn became one of main source documents contributing to the HTA's *Hawaii Tourism Strategic Plan: 2005-2015*.

[6] Completion of construction of the UH Center in Kalaoa to accommodate 750 FTE students was encompassed by Phase I in the preliminary LRDP planning in April 2009 when this economic impact study was completed. Subsequently, growing concern about the impact of the economic recession on the University's budget led to splitting Phase I into three distinct phases, with the completion of Phase III (in the LRDP issued 10.06.09) representing the equivalent build-out of the UH Center campus to the 750 FTE students. In these revisions of the economic impact study to reflect the 10.06.09 LRDP, the Phase I and Phase II terminology will be retained, keeping in mind that Phase I of this economic impact report is the equivalent of Phases 1-3 of the 10.06.09 LRDP, and Phase II of this report is equivalent to Phase 4 (build-out to 1,500 FTE student capacity) of the 10.06.09 LRDP.

[7] Construction costs have been extensively revised since this economic impact study was completed in April 2009 when work on the LRDP for UHCWH was still in process of determining final construction cost estimates. Construction-related impacts discussed herein are based on the final construction cost estimates contained in the 10.06.09 LRDP.

[8] An input-output or interindustry model is a mathematical representation of a given economy. The input-output transactions matrix is the central component of the model. The transactions matrix or table is comprised of rows and columns that represent industries, final demand sectors (e.g. households, government), and owners of the primary factors of production – labor, capital and land. Each row and column of the interindustry part of the overall transactions table defines the structure of production in the economy. Each row element in this part of the table stands for the amount of goods and services sold by each row industry to a (purchasing) column industry, to enable the column industry to produce $1.00 of final demand goods and services. The I-O transactions matrix, together with direct and total requirements tables enable the computation of employment, output, earnings and other multipliers for each industry.

[9] In the State I-O model, earnings exclude employer and employee social security contributions and employer contributions to private pensions. These are excluded because they represent employee benefits that cannot be spent on goods and services, and therefore earnings are less than employee total compensation (DBEDT, August 2008, p.15).

Appendix H

SEISPN Comment Letters and Responses

United States Department of the Interior

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

In Reply Refer To:
2009-TA-0179

APR 03 2009

Ms. Celia Shen
Wil Chee-Planning and Environmental
1018 Palm Drive
Honolulu, HI 96814

Subject: Comments for the Supplemental Environmental Impact Statement Regarding Revisions and Updates to the University of Hawaii Center, West Hawaii Long Range Development Plan

Dear Ms. Shen:

We are in receipt of your March 5, 2009 letter, requesting our comments on the Supplemental Environmental Impact Statement addressing revisions and updates to the University of Hawaii Center, West Hawaii Long Range Development Plan. The existing Long Range Development Plan was prepared in 1998 and the associated Environmental Impact Statement was completed in 2000. Changes to the long-term vision for the University of Hawaii Center, West Hawaii, as well as changes in the West Hawaii community have necessitated an update and revision of the 1998 Long Range Development Plan.

Based on information in our files, including data compiled by the Hawaii Biodiversity and Mapping Program, and the Hawaii GAP Program, the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), the endangered Hawaiian hawk (*Buteo solitarius*) and the endangered Blackburn's sphinx moth (*Manduca blackburni*) may occur in the project vicinity. There is no federally designated critical habitat in the vicinity of this proposed project.

Page 3.13 of the Supplemental Environmental Impact Statement states "The sphinx moth (*Manduca blackburni*), which is listed as an endangered species under the ESA (Federal Register, 2004) may occur in the vicinity of the project area, although it is believed to be no longer present on the island of Hawaii." This statement is incorrect. Blackburn's sphinx moth is currently known to occur on the island of Hawaii. Please correct this statement in your final document.

We commend your decision to conduct a new biological resource study and incorporate the results into your Draft Supplemental Environmental Impact Statement. There is always the potential taxa were overlooked in the first study or listed taxa may have become established since the original study was completed in 2000.

In preparing your Supplemental Environmental Impact Statement, we recommend you address potential project impacts to the Hawaiian hoary bat, Hawaiian hawk and Blackburn's sphinx moth and we offer the following reccomendations to assist you in avoiding and minimizing potential impacts to these species:

- Hawaiian hoary bats roost and give birth in both exotic and native woody vegetation. However, use of the project area by Hawaiian hoary bats is currently unknown. To avoid potential impacts to this species, no woody plants suitable for bat roosting should be removed or trimmed during the bat birthing and pup rearing season (July through September). If you must clear the property during the Hawaiian hoary bat pupping season, we recommend conducting biological surveys to determine if bats are present. Please contact our office regarding survey methodology.

- Hawaiian hawks nest in both exotic and native woody vegetation. To avoid impacts to Hawaiian hawks we recommend avoiding tree clearing during the breeding season for Hawaiian hawks (March through September). If you must clear the property during the Hawaiian hawk breeding season, we recommend conducting biological surveys to determine if hawk nests are present.

- There are no known occurrences of Blackburn's sphinx moth's preferred native host plants in the area of your proposed project, however, the moth is known to lay eggs on the non-native tree tobacco (*Nicotiana glauca*) plants. To pupate, Blackburn's sphinx moth larvae burrow into the soil near to host plants and can remain in a state of torpor for up to a year before emerging from the soil. Because tree tobacco may occur within the vicinity of the proposed project site, we recommend the following:
    - The project area should be surveyed for the presence of tree tobacco by a qualified botanist.
    - If tree tobacco plants are found, these plants should be surveyed by a qualified entomologist for the presence of Blackburn's sphinx moth eggs and larvae. Please contact our office for survey methods.

Thank you for the opportunity to provide comments on this Supplemental Environmental Impact Statement. If you have any questions regarding this letter, please contact Dr. Jeff Zimpfer, Fish and Wildlife Biologist, Consultation and Technical Assistance Program (phone: 808-792-9431; email: jeff_zimpfer@fws.gov).

Sincerely,

for Patrick Leonard
Field Supervisor

WIL CHEE – PLANNING & ENVIRONMENTAL

October 21, 2009

Mr. Patrick Leonard
Field Supervisor
U.S. Department of the Interior, Fish and Wildlife Service
300 Ala Moana Boulevard, Room 3-122, Box 50088
Honolulu, Hawai'i 96850

Subject: Revisions and Updates to the University of Hawai'i Center – West Hawai'i Long Range Development Plan, Response to Comments on the Supplemental Environmental Impact Statement Preparation Notice (SEISPN)

Dear Mr. Leonard,

On behalf of the University of Hawai'i Office of Capital Improvements (OCI), we thank you for your letter dated April 3, 2009 (2009-TA-0179) regarding the SEISPN. In response to your comments, we offer the following:

The statement regarding the occurrence of the Blackburn's Sphinx Moth on the island of Hawai'i and the project area will be corrected in the forthcoming Draft Supplemental Environmental Impact Statement (SEIS).

Your recommendations to avoid and minimize potential impacts to the Hawaiian Hoary bat, the Hawaiian hawk and the Blackburn's sphinx moth are noted and will be incorporated into the Draft SEIS.

We appreciate your agency's interest and participation in the environmental review process, as well as your comments on the SEISPN. The U.S. Fish and Wildlife Service will receive a copy of the Draft SEIS when it becomes available.

Sincerely,

Celia Shen
Planner

cc: Mr. Brian Minaai, OCI

FILE COPY

DEPARTMENT OF BUSINESS,
ECONOMIC DEVELOPMENT & TOURISM

LINDA LINGLE
GOVERNOR
THEODORE E. LIU
DIRECTOR
MARK K. ANDERSON
DEPUTY DIRECTOR

STRATEGIC INDUSTRIES DIVISION
235 South Beretania Street, Leiopapa A Kamehameha Bldg., 5th Floor, Honolulu, Hawaii 96813
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Telephone: (808) 587-3807
Fax: (808) 586-2536
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March 13, 2009

Mr. Brian Minami
University of Hawaii
Office of Capital Improvements (OCI)
1960 East-West Road, Biomedical Sciences, B-102
Honolulu, Hawaii 96822
Attn: Mr. Maynard Young

Re: Supplemental Environmental Impact Statement Preparation Notice for Revisions and Updates to the University of Hawaii Center – West Hawaii Long Range Development Plan

In response to your March 4, 2009, notice, thank you for the opportunity to provide comments on the SEISPN for revisions and updates to the University of Hawaii Center West Hawaii Long Range Development Plan .

We would like to call your attention to: (l) State energy conservation goals; and, (2) energy and resource efficiency and renewable energy and resource development.

1. **State energy conservation goals.** Project buildings, activities, and site grounds should be designed and/or retrofit with energy saving considerations. The mandate for such consideration is found in Chapter 344, HRS ("State Environmental Policy") and Chapter 226 ("Hawaii State Planning Act"). In particular, we would like to call to your attention HRS 226 18(c) (4) which includes a State objective of promoting all cost-effective energy conservation through adoption of energy-efficient practices and technologies.

2. **Energy and resource efficiency and renewable energy and resource development.** We would like to encourage that the University, in its planning efforts, consider Act 96, SLH 2006, which directs that state agencies meet the requirements of the Leadership in Energy and Environmental Design (LEED) program, among others. We note that page 5-3 of the SEISPN says that UH Center West Hawaii will consider the use of natural ventilation and daylighting, use of renewable energy solutions such as photovoltaics, use of locally available materials, and adapting the buildings to the site topography to reduce the amount of grading and excavation necessary.

In addition, please review Act 160,2006 SLH which requires state agencies to report annually their electricity consumption, the steps taken to reduce energy use, and their plans for future reductions.

Our website provides detailed information on guidelines, directives and statutes, as well as studies and reports on aspects of energy and resource efficiency at: (http://www.hawaii.gov/dbedt/info/energy/efficiency/state). Please also do not hesitate to contact Carilyn Shon, Energy Efficiency Branch Manager, at telephone number 587-3810, for additional information on LEED, energy efficiency, and renewable energy resources.

Sincerely,

Theodore A. Peck
Administrator

c: OEQC
Celia Shen, WCP

WIL CHEE – PLANNING & ENVIRONMENTAL

October 21, 2009

Mr. Theodore A. Peck
Administrator
Dept. of Business, Economic Development & Tourism, Strategic Industries Division
P.O. Box 2359
Honolulu, Hawai'i 96804

Subject: Revisions and Updates to the University of Hawai'i Center – West Hawai'i Long Range Development Plan, Response to Comments on the Supplemental Environmental Impact Statement Preparation Notice (SEISPN)

Dear Mr. Peck,

On behalf of the University of Hawai'i Office of Capital Improvements (OCI), we thank you for your letter dated March 13, 2009 regarding the SEISPN. In response to your comments, we offer the following:

The project will achieve at a minimum the State of Hawai'i mandated LEED Silver rating level. However, the University has directed that as a goal the project strive for the LEED Platinum rating level with the ultimate aim of achieving net zero energy consumption and minimizing the campus' carbon footprint. This goal is strongly supported by the West Hawai'i community, members of the UH Board of Regents, the Hawai'i Community College Chancellor's Advisory Councils (East Hawai'i and West Hawai'i) and the state's U.S. Congressional delegation. Energy saving efforts and other proposed steps to achieve the above-state goals will be discussed in the Draft Supplemental Environmental Impact Statement (SEIS).

We acknowledge the requirement that state agencies report their annual energy consumption, steps taken to reduce energy use, and plans for future reductions.

We appreciate your agency's interest and participation in the environmental review process, as well as your comments on the SEISPN. The Department of Business, Economic Development & Tourism, Strategic Industries Divisions will receive a copy of the Draft SEIS when it becomes available.

Sincerely,

Celia Shen
Planner

cc: Mr. Brian Minaai, OCI

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LINDA LINGLE
GOVERNOR OF HAWAII

LAURA H. THIELEN
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 3, 2009

Mr. Brian Minaai
University of Hawaii
Office of Capital Improvements
1960 East-West Road, Biomedical Sciences, B-102
Honolulu, Hawaii 96822

Attention: Mr. Maynard Young

Ladies and Gentlemen:

Subject: Supplemental Environmental Impact Statement Preparation Notice for Revisions and Updates to the University of Hawaii Center-West Hawaii Long Range Development Plan

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 comment.

Other than the comments from Division of State Parks, Division of Forestry & Wildlife, Land Division, Engineering Division, the Department of Land and Natural Resources has no other comments to offer on the subject matter. Should you have any questions, please feel free to call our office at 587-0433. Thank you.

Sincerely,

Morris M. Atta
Administrator

Cc: Wil Chee-Planning & Environmental

52980

LINDA LINGLE
GOVERNOR OF HAWAII

LAURA H. THIELEN
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

March 6, 2009

MEMORANDUM

TO: **DLNR Agencies:**
x Div. of Aquatic Resources
x Div. of Boating & Ocean Recreation
x Engineering Division
x ~~Div. of Forestry & Wildlife~~
x Div. of State Parks
x ~~Commission on Water Resource Management~~
x Office of Conservation & Coastal Lands
x Land Division –Hawaii District / Gary Martin

FROM: for Morris M. Atta Charlene
SUBJECT: Supplemental Environmental Impact Statement Preparation Notice for Revisions and Updates to the University of Hawaii Center – West Hawaii Long Range Development Plan
LOCATION: North Kona, Hawaii
APPLICANT: Wil Chee – Planning & Environmental

Transmitted for your review and comment on the above referenced document. We would appreciate your comments on this document. Please submit any comments by April 1, 2009.

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact my office at 587-0433. Thank you.

Attachments

( ) We have no objections.
(✓) We have no comments.
( ) Comments are attached.

Signed: [signature]
Date: 3/12/09

RECEIVED
LAND DIVISION
MAR 13 A

WIL CHEE – PLANNING & ENVIRONMENTAL

October 21, 2009

Administrator
Dept. of Land & Natural Resources, Division of State Parks
P.O. Box 621
Honolulu, Hawai'i 96809

Subject: Revisions and Updates to the University of Hawai'i Center – West Hawai'i Long Range Development Plan, Response to Comments on the Supplemental Environmental Impact Statement Preparation Notice (SEISPN)

Dear Sir/Madam,

On behalf of the University of Hawai'i Office of Capital Improvements (OCI), we thank you for your comments dated March 12, 2009 regarding the SEISPN. Although you had no comments at this juncture, we appreciate your agency's interest and participation in the environmental review process. The DLNR, Division of State Parks will receive a copy of the Draft Supplemental Environmental Impact Statement when it becomes available.

Sincerely,

Celia Shen

Celia Shen
Planner

cc: Mr. Brian Minaai, OCI
Mr. Morris M. Atta, Administrator DLNR Land Division

Providing Services Since 1976
Land Use Planners and Environmental Consultants

1018 Palm Drive • Honolulu, Hawai'i 96814 • Phone 808-596-4688 • Fax 808-597-1851 • E-Mail wcp@wcphawaii.com

Division of Forestry & Wildlife

1151 Punchbowl Street, Rm. 325 • Honolulu, HI 96813 • (808) 587-0166 • Fax: (808) 587-0160

March 11, 2009

MEMORANDUM

TO: Morris M. Atta, Administrator
Land Division

FROM: Paul J. Conry, Administrator
Division of Forestry and Wildlife

SUBJECT: Request for Comments: Supplemental EISPN for Revisions and Updates to the UH Center – W. Hawaii Long Range Development Plan. North Kona, Hawaii TMK: 7-3-010: 042

DOFAW has reviewed the subject project request for comments and provide the following for your consideration. The EISPN for UH West Hawaii states that a biological resource study will be conducted for the proposed site and the results will be included in the draft supplemental EIS. The known plant species of concern are uhiuhi - *Caesalpinia kavaiensis*, kauili - *Colubrina oppositifolia*, hala pepe - *Pleomele hawaiiensis*, and aiea - *Nothocestrum breviflorum*. Please have a trained botanist verify the presence of these plant species, its location, and number of plants in the survey area. Should impacts require a Habitat Conservation Plan, please contact our Botanist Staff on the Big Island, (808) 974-4221 or on Oahu (808) 587-0166. Thank you for the opportunity to comment on this project.

C: DOFAW, Hawaii Branch – Lyman Perry
DOFAW, Administration - Vickie Caraway

WIL CHEE – PLANNING & ENVIRONMENTAL

October 21, 2009

Mr. Paul J. Conry
Administrator
Dept. of Land & Natural Resources, Division of Forestry & Wildlife
1151 Punchbowl Street, Room 325
Honolulu, Hawai'i 96813

Subject: Revisions and Updates to the University of Hawai'i Center – West Hawai'i Long Range Development Plan, Response to Comments on the Supplemental Environmental Impact Statement Preparation Notice (SEISPN)

Dear Mr. Conry,

On behalf of the University of Hawai'i Office of Capital Improvements (OCI), we thank you for your letter dated March 11, 2009 regarding the SEISPN. In response to your comments, we offer the following:

A botanical survey of the project site was conducted in March 2009, the focus of which was to identify if any federally or State of Hawai'i listed species or species of concern are present and which could be impacted by the project. Of the species listed in your letter, only a single 'aiea tree was located within the project site. Results of this survey and proposed mitigation measures will be fully discussed in the forthcoming Draft SEIS.

We appreciate your agency's interest and participation in the environmental review process, as well as your comments on the SEISPN. The DLNR Division of Forestry & Wildlife will receive a copy of the Draft SEIS when it becomes available.

Sincerely,

Celia Shen
Planner

cc: Mr. Brian Minaai, OCI
Mr. Morris M. Atta, Administrator DLNR Land Division

Providing Services Since 1976
Land Use Planners and Environmental Consultants

LINDA LINGLE
GOVERNOR OF HAWAII

LAURA H. THIELEN
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

March 6, 2009

RECEIVED
LAND DIVISION
2009 MAR 30 A 9:21
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

MEMORANDUM

TO: **DLNR Agencies:**
x Div. of Aquatic Resources
x Div. of Boating & Ocean Recreation
x Engineering Division
x Div. of Forestry & Wildlife
x Div. of State Parks
x Commission on Water Resource Management
x Office of Conservation & Coastal Lands
x Land Division –Hawaii District / Gary Martin

FROM: Morris M. Atta Charlene
SUBJECT: Supplemental Environmental Impact Statement Preparation Notice for Revisions and Updates to the University of Hawaii Center – West Hawaii Long Range Development Plan
LOCATION: North Kona, Hawaii
APPLICANT: Wil Chee – Planning & Environmental

Transmitted for your review and comment on the above referenced document. We would appreciate your comments on this document. Please submit any comments by April 1, 2009.

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact my office at 587-0433. Thank you.

Attachments

( ) We have no objections.
( ) We have no comments.
(X) Comments are attached.

Signed: [signature]
Date: 3/26/09

DEPARTMENT OF LAND AND NATURAL RESOURCES
ENGINEERING DIVISION

LM/MorrisAtta
REF.:SEISPNRevisionsUpdatesUHNorthKona
Hawaii:426

COMMENTS

(X) **We confirm that the project site, according to the Flood Insurance Rate Map (FIRM), is located in Zone X. The National Flood Insurance Program does not have any regulations for developments within Zone X.**

( ) Please take note that the project site, according to the Flood Insurance Rate Map (FIRM), is located in Zone.

( ) Please note that the correct Flood Zone Designation for the project site according to the Flood Insurance Rate Map (FIRM) is ___.

( ) Please note that the project must comply with the rules and regulations of the National Flood Insurance Program (NFIP) presented in Title 44 of the Code of Federal Regulations (44CFR), whenever development within a Special Flood Hazard Area is undertaken. If there are any questions, please contact the State NFIP Coordinator, Ms. Carol Tyau-Beam, of the Department of Land and Natural Resources, Engineering Division at (808) 587-0267.

Please be advised that 44CFR indicates the minimum standards set forth by the NFIP. Your Community's local flood ordinance may prove to be more restrictive and thus take precedence over the minimum NFIP standards. If there are questions regarding the local flood ordinances, please contact the applicable County NFIP Coordinators below:

( ) Mr. Robert Sumitomo at (808) 768-8097 or Mr. Mario Siu Li at (808) 768-8098 of the City and County of Honolulu, Department of Planning and Permitting.
( ) Mr. Kelly Gomes at (808) 961-8327 (Hilo) or Mr. Kiran Emler at (808) 327-3530 (Kona) of the County of Hawaii, Department of Public Works.
( ) Mr. Francis Cerizo at (808) 270-7771 of the County of Maui, Department of Planning.
( ) Mr. Mario Antonio at (808) 241-6620 of the County of Kauai, Department of Public Works.

( ) The applicant should include water demands and infrastructure required to meet project needs. Please note that projects within State lands requiring water service from the Honolulu Board of Water Supply system will be required to pay a resource development charge, in addition to Water Facilities Charges for transmission and daily storage.

(X) **The applicant should provide the water demands and calculations to the Engineering Division so it can be included in the State Water Projects Plan Update.**

( ) Additional Comments: ______

( ) Other: ______

Should you have any questions, please call Ms. Suzie S. Agraan of the Planning Branch at 587-0258.

Signed: [signature]
ERIC T. HIRANO, CHIEF ENGINEER

Date: 3/26/09

WIL CHEE – PLANNING & ENVIRONMENTAL

October 21, 2009

Mr. Eric T. Hirano
Chief Engineer
Dept. of Land & Natural Resources, Engineering Division
1151 Punchbowl Street
Honolulu, Hawai'i 96813

Subject: Revisions and Updates to the University of Hawai'i Center – West Hawai'i Long Range Development Plan, Response to Comments on the Supplemental Environmental Impact Statement Preparation Notice (SEISPN)

Dear Mr. Hirano,

On behalf of the University of Hawai'i Office of Capital Improvements (OCI), we thank you for your comments dated March 26, 2009 regarding the SEISPN. In response to your comments, we offer the following:

We acknowledge your confirmation that the project site is located in Zone X according to the Flood Insurance Rate Map.

Water demands and calculations for the project will be provided to the Engineering Division as requested.

We appreciate your agency's interest and participation in the environmental review process, as well as your comments on the SEISPN. The DLNR Engineering Division will receive a copy of the Draft SEIS when it becomes available.

Sincerely,

Celia Shen
Planner

cc: Mr. Brian Minaai, OCI
Mr. Morris M. Atta, Administrator DLNR Land Division

Providing Services Since 1976
Land Use Planners and Environmental Consultants

DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

MEMORANDUM

To: Morris Atta
Administrator

From: Charlene Unoki
Assistant Administrator

Date: April 3, 2009

Re: Supplemental Environmental Impact Statement Preparation Notice for Revisions and Updates to the Unviersity of Hawaii Center-West Hawaii Long Range Development Plan

The following recommendations should be included in any comments regarding the above-referenced project:

1. Require a slope study to determine the risks of rockfalls or landslides if any portion of the subdivision or development project includes hillsides or cliffs with a slope grade of 20% or greater;

2. If any adjacent property includes hillsides or cliffs with a slope grade of 20% or greater, require a risk assessment to determine whether and to what extent the conditions on the adjacent property poses a risk of harm to the proposed subdivision, development, future homeowners, or occupants thereof; and

3. If a rockfall or landslide risk is determined or is suspected to exist, create a hazard buffer zone or implement other appropriate mitigation measures in areas susceptible to such hazards that is of sufficient width to protect the health and safety of future homeowners and occupants of the property in the vicinity of those risks and provide a written disclosure of those risks to all potential homeowners.

Should you have any questions, please call me at 587-0426.

WIL CHEE – PLANNING & ENVIRONMENTAL

October 21, 2009

Mr. Morris M. Atta
Administrator
Dept. of Land & Natural Resources, Land Division
P.O. Box 621
Honolulu, Hawai'i 96809

Subject: Revisions and Updates to the University of Hawai'i Center – West Hawai'i Long Range Development Plan, Response to Comments on the Supplemental Environmental Impact Statement Preparation Notice (SEISPN)

Dear Mr. Atta,

On behalf of the University of Hawai'i Office of Capital Improvements (OCI), we thank you for your comments dated April 3, 2009 regarding the SEISPN. In response to your comments, we offer the following:

The 500-acre project area is located on the lower slopes of Mt. Hualalai with average slopes of 5 to 10 percent. There are some areas where slopes exceed 10 percent, mostly in the upper portion (mauka area) and the southeast corner of the project area. Within the 73-acre project site, there are a few isolated pockets where grades exceed 10 percent. The area in general is characterized as a gradual sloping terrain and there are no hillsides or cliffs within the 73-acre project site that pose a potential risk for rockfall or landslide. Slopes and associated potential hazards will be discussed in forthcoming Draft Supplemental Environmental Impact Statement (SEIS).

We appreciate your agency's interest and participation in the environmental review process, as well as your comments on the SEISPN. The DLNR Engineering Division will receive a copy of the Draft SEIS when it becomes available.

Sincerely,

Celia Shen
Planner

cc: Mr. Brian Minaai, OCI

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LINDA LINGLE
GOVERNOR OF HAWAII

LAURA H. THIELEN
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

March 6, 2009

MEMORANDUM

From: ~~TO~~: **DLNR Agencies:**
x Div. of Aquatic Resources
x Div. of Boating & Ocean Recreation
x Engineering Division
x Div. of Forestry & Wildlife
x ~~Div. of State Parks~~
x Commission on Water Resource Management
~~x Office of Conservation & Coastal Lands~~
x Land Division –Hawaii District / Gary Martin

To: ~~FROM~~: for Morris M. Atta Charlene
SUBJECT: Supplemental Environmental Impact Statement Preparation Notice for Revisions and Updates to the University of Hawaii Center – West Hawaii Long Range Development Plan
LOCATION: North Kona, Hawaii
APPLICANT: Wil Chee – Planning & Environmental

Transmitted for your review and comment on the above referenced document. We would appreciate your comments on this document. Please submit any comments by April 1, 2009.

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact my office at 587-0433. Thank you.

Attachments

( ) We have no objections.
( ) We have no comments.
(X) Comments are attached.

Signed: [signature]
Date: April 7, 2009

RECEIVED ... A 9:45

LINDA LINGLE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT
P.O. BOX 621
HONOLULU, HAWAII 96809

April 7, 2009

REF: NA

TO: Morris Atta, Administrator
Land Division

FROM: Ken C. Kawahara, P.E., Deputy Director
Commission on Water Resource Management

SUBJECT: Supplemental Environmental Impact Statement Preparation Notice for Revisions and Updates to the University of Hawaii Center - West Hawaii Long Range Development Plan

FILE NO.: UHWestHI.doc
TMK NO.: (3) 7-3-010:042

Thank you for the opportunity to review the subject document. The Commission on Water Resource Management (CWRM) is the agency responsible for administering the State Water Code (Code). Under the Code, all waters of the State are held in trust for the benefit of the citizens of the State, therefore, all water use is subject to legally protected water rights. CWRM strongly promotes the efficient use of Hawaii's water resources through conservation measures and appropriate resource management. For more information, please refer to the State Water Code, Chapter 174C, Hawaii Revised Statutes, and Hawaii Administrative Rules, Chapters 13-167 to 13-171. These documents are available via the Internet at http://www.hawaii.gov/dlnr/cwrm.

Our comments related to water resources are checked off below.

☒ 1. We recommend coordination with the county to incorporate this project into the county's Water Use and Development Plan. Please contact the respective Planning Department and/or Department of Water Supply for further information.

☒ 2. We recommend coordination with the Engineering Division of the State Department of Land and Natural Resources to incorporate this project into the State Water Projects Plan.

☐ 3. We recommend coordination with the Hawaii Department of Agriculture (HDOA) to incorporate the reclassification of agricultural zoned land and the redistribution of agricultural resources into the State's Agricultural Water Use and Development Plan (AWUDP). Please contact the HDOA for more information.

☒ 4. We recommend that water efficient fixtures be installed and water efficient practices implemented throughout the development to reduce the increased demand on the area's freshwater resources. Reducing the water usage of a home or building may earn credit towards Leadership in Energy and Environmental Design (LEED) certification. More information on LEED certification is available at http://www.usgbc.org/leed. A listing of fixtures certified by the EPA as having high water efficiency can be found at http://www.epa.gov/watersense/pp/index.htm.

☒ 5. We recommend the use of best management practices (BMP) for stormwater management to minimize the impact of the project to the existing area's hydrology while maintaining on-site infiltration and preventing polluted runoff from storm events. Stormwater management BMPs may earn credit toward LEED certification. More information on stormwater BMPs can be found at http://hawaii.gov/dbedt/czm/initiative/lid.php.

☒ 6. We recommend the use of alternative water sources, wherever practicable.

☒ 7. There may be the potential for ground or surface water degradation/contamination and recommend that approvals for this project be conditioned upon a review by the State Department of Health and the developer's acceptance of any resulting requirements related to water quality.

Permits required by CWRM:
Additional information and forms are available at http://hawaii.gov/dlnr/cwrm/resources_permits.htm.

☐ 8. The proposed water supply source for the project is located in a designated water management area, and a Water Use Permit is required prior to use of water.

☐ 9. A Well Construction Permit(s) is (are) required any well construction work begins.

☐ 10. A Pump Installation Permit(s) is (are) required before ground water is developed as a source of supply for the project.

☐ 11. There is (are) well(s) located on or adjacent to this project. If wells are not planned to be used and will be affected by any new construction, they must be properly abandoned and sealed. A permit for well abandonment must be obtained.

☐ 12. Ground water withdrawals from this project may affect streamflows, which may require an instream flow standard amendment.

☐ 13. A Stream Channel Alteration Permit(s) is (are) required before any alteration(s) can be made to the bed and/or banks of a stream channel.

☐ 14. A Stream Diversion Works Permit(s) is (are) required before any stream diversion works is (are) constructed or altered.

☐ 15. A Petition to Amend the Interim Instream Flow Standard is required for any new or expanded diversion(s) of surface water.

☐ 16. The planned source of water for this project has not been identified in this report. Therefore, we cannot determine what permits or petitions are required from our office, or whether there are potential impacts to water resources.

☐ OTHER:

If there are any questions, please contact Jeremy Kimura at 587-0269.

WIL CHEE – PLANNING & ENVIRONMENTAL

October 21, 2009

Mr. Ken C. Kawahara, P.E.
Deputy Director
Dept. of Land & Natural Resources, Commission on Water Resource Management
P.O. Box 621
Honolulu, Hawai'i 96809

Subject: Revisions and Updates to the University of Hawai'i Center – West Hawai'i Long Range Development Plan, Response to Comments on the Supplemental Environmental Impact Statement Preparation Notice (SEISPN)

Dear Mr. Kawahara,

On behalf of the University of Hawai'i Office of Capital Improvements (OCI), we thank you for your letter dated April 7, 2009 regarding the SEISPN. In response to your comments, we offer the following:

Per your recommendations, Hawaii Campus Developers and the University will coordinate with the County of Hawai'i, Department of Water Supply and the Engineering Division of the Department of Land and Natural Resources to have the project included in their respective water plans.

The project will achieve at a minimum the State of Hawai'i mandated LEED Silver rating level. However, the University has directed that as a goal the project strive for the LEED Platinum rating level. This will include water saving measures to reduce the demand on potable water resources. These water saving measures will be discussed in the forthcoming Draft Supplemental Environmental Impact Statement (SEIS).

We acknowledge your comments regarding the use of alternative water sources, the use of stormwater Best Management Practices, potential impacts to water quality and project review by the State Department of Health. These issues will be discussed in the forthcoming Draft SEIS.

We appreciate your agency's interest and participation in the environmental review process, as well as your comments on the SEISPN. The Commission on Water Resource Management will receive a copy of the Draft SEIS when it becomes available.

Sincerely,

Celia Shen
Planner

cc: Mr. Brian Minaai, OCI
Mr. Morris M. Atta, Administrator, DLNR Land Division

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1018 Palm Drive • Honolulu, Hawai'i 96814 • Phone 808-596-4688 • Fax 808-597-1851 • E-Mail wcp@wcphawaii.com

---

LINDA LINGLE
GOVERNOR OF HAWAII

RECEIVED
UNIVERSITY OF HAWAII
OCI
2009 APR -7 P 3:08

LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

RUSSELL Y. TSUJI
FIRST DEPUTY

KEN C. KAWAHARA
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
STATE HISTORIC PRESERVATION DIVISION
601 KAMOKILA BOULEVARD, ROOM 555
KAPOLEI, HAWAII 96707

March 31, 2009

Mr. Brian Minaai
University of Hawai'i
Office of Capital Improvements
1960 East-West Road, Biomedical Sciences, B-102
Honolulu, Hawaii 96822
Attention: Mr. Maynard Young

LOG NO: 2009.0768
DOC NO: 0903TD19
Archaeology

Dear Mr. Minaai:

Subject: **Chapter 6E-8 Historic Preservation Review –**
Supplemental Environmental Impact Statement Preparation Notice
University of Hawai'i Center – West Hawai'i Long Range Development Plan
Kalaoa and Hamanamana Ahupua'a, Kona District, Island of Hawai'i
TMK: (3) 7-3-10: 42

Thank you for providing advanced notice of the Supplemental EIS being prepared for the University of Hawai'i West Hawai'i campus (UHCWH). Our comments at this time will focus on the archaeological preserves within the 73-acre area designated for initial campus construction, and within the four site utilization schemes presented. We have the following observations and comments:

1. Section 1.8, List of Anticipated Permits or Approvals: A Burial Treatment Plan (BTP) is included in this list, with the Administering Agency given as the Hawai'i Island Burial Council (HIBC). The Burial Council makes determinations regarding the disposition of Native Hawaiian ancestral remains; the Department of Land and Natural Resources Historic Preservation Division is the Administering Agency regarding approval of Burial Treatment Plans. Please include both the HIBC and SHPD as the Administering Agency for the BTP in this table. See other items below for additional SHPD approvals that potentially apply.

2. Section 1.8, List of Anticipated Permits or Approvals: It is not certain whether this list is intended to apply only to the Preferred Campus Site Plan. If Site Utilization Schemes 1 through 3 are considered, a final preservation plan for Archaeological Preserves 3 and 4; and the unidentified preserve shown in Figures 6 and 7 will need to be submitted to our office for review and approval. See items 4, 8 and 11 below for additional discussion of the preservation plan for non-burial sites.

3. Section 2.3.1 (page 2-3), discussion of critical site constraints: Item 3), Archaeological/Cultural Sites and Preserves. This section begins by citing a recent survey by Pacific Legacy, Inc. (2008). We are not certain whether this citation references a document or field work activities. There is no citation in your bibliography and we have no record of receiving a report from Pacific Legacy in 2008. We have a letter report (Reeve 2007) and a Data Recovery Report (Reeve 2009). Please clarify this reference and if it is a document, please include the full citation in the bibliography. The reference is also found in Section 3.2.2.1 (page 3-17).

4. Section 2.3.1 (page 2-3), Item 3): The fifth sentence of this section states that, "As previously recommended by the State Historic Preservation Division (SHPD), a buffer guideline of 50 meters (164 feet) is maintained on both sides of the lava tube." We wish to clarify that the recommendation for a 50 meter buffer zone is found in the Conceptual Historic Preservation Plan, prepared by Pacific Legacy (July 2000). Our office tentatively approved this conceptual plan in December 2000, noting that "final approval of the historic preservation plan for the proposed center will require a decision by the Hawai'i Island Burial Council concerning the burials in Preserve 2" (Don Hibbard letter to Maynard Young, December 18, 2000, Log No. 26680).

5. Section 2.3.1, Site Utilization Schemes 2 through 3: These schemes place campus infrastructure and facilities in generally close proximity to Archaeological Preserves 3, 4 and an unidentified site preserve area. The Conceptual Plan for Preserves 3 and 4 calls for the development of a trail system within the campus to access the preserves and a trail system through the preserves to allow viewing of the various features. The Plan also calls for interpretive signage, to be developed concurrently with a re-vegetation plan for these preserves (Cleghorn 2000). The Utilization Schemes as depicted in Figures 6 and 7 do not include the proposed trail system, and the access trails are not discussed in the text.

6. Section 2.3.1.2 (page 2-5): Near the end of the first paragraph, it is stated that "Locating the pedestrian pathway within the buffer area is an issue that would have to be discussed with the Hawai'i Island Burial Council." We agree with this statement and request that you include SHPD in this discussion; the Division is responsible for final approval of the preservation/burial treatment plan.

7. Site Utilization Schemes 1-3, Figures 5, 6 and 7: The archaeological preserve located between Preserves 3 and 4 as shown on these maps is not labeled. Please include the appropriate label on future maps.

8. Figure 12, Archaeological Preserves: This map shows preserves and archaeological sites. Please clarify the status of the sites shown – are they also in preservation status? The site numbers should be included on this map.

9. Section 3.2.2.1: This discussion notes that there are numerous sites within the UHCWH area. Inventory survey reports and preservation plans are described, however there is no reference to any data recovery work, past or proposed. Please check with Pacific Legacy to verify whether all of the identified significant sites are being preserved. If not, please verify whether or not some of the sites are recommended for further data recovery. If so, this work will need to be completed at the affected sites prior to development, and a data recovery plan should be included among the anticipated approvals listed in Table 1.8.

10. Main Street Road: We understand that this roadway is being constructed by Palamanui, and that interim preservation buffers have been approved for the construction phase (Nancy McMahon letter to Roger Harris, November 11, 2008; doc 2008.4037). It would be helpful to have a better understanding of the relationship between this road and the overall UHCWH project. Is the road considered a separate project? We note that interim preservation buffers proposed in grading plans for the road are not consistent with the preservation buffers proposed for the campus in the Conceptual Preservation Plan.

11. Section 3.2.2.2: The proposed action discussion states that the Conceptual Preservation Plan for the project may need to be revisited and revised as necessary to reflect changes in the project. We would prefer to see a final preservation plan for all of the affected preserve areas, as opposed to a revised conceptual plan. As noted above, the Conceptual Preservation Plan (Cleghorn 2000) is not a final approved preservation plan. It was tentatively approved, with the understanding that a BTP would be submitted for approval, and that additional information as required for long-term preservation would be forthcoming. This additional information is listed in the recommendations found in Section 4 of the Conceptual Plan and in correspondence from our office (Don Hibbard letter to Maynard Young, May 25, 2000; Doc No. 25446).

12. In a recent review of data recovery fieldwork at Site 13502, we requested that archaeological monitoring occur during construction work within and in the near vicinity of Archaeological Preserve 2 (Nancy McMahon letter to Paul Cleghorn, January 20, 2009; Doc 2008.5237). This is a mitigation measure that you may wish to include in Section 3.2.2.2.

We look forward to receiving a copy of the Supplemental EIS for this project, and to continued discussions regarding the preservation of historic properties within the project area. If you have any questions regarding our comments at this time, please contact Theresa Donham at (808) 933-7653.

Aloha,

Nancy A. McMahon

Nancy McMahon, Deputy SHPO/State Archaeologist
and Historic Preservation Manager
Historic Preservation Division

WIL CHEE – PLANNING & ENVIRONMENTAL

October 21, 2009

Ms. Nancy McMahon
Deputy SHPO/State Archaeologist
Dept. of Land & Natural Resources, Historic Preservation Division
601 Kamokila Boulevard, Room 555
Kapolei, Hawaii 96707

Subject: Revisions and Updates to the University of Hawai'i Center – West Hawai'i Long Range Development Plan, Response to Comments on the Supplemental Environmental Impact Statement Preparation Notice (SEISPN)

Dear Ms. McMahon,

On behalf of the University of Hawai'i Office of Capital Improvements (OCI), we thank you for your letter dated March 31, 2009 regarding the SEISPN. Your comments and recommendations are presented below in italics followed by our responses.

1. *Section 1.8, List of Anticipated Permits or Approvals: A Burial Treatment Plan (BTP) is included in this list, with the Administering Agency give as the Hawai'i Island Burial Council (HIBC). The Burial Council makes determinations regarding the disposition of Native Hawaiian ancestral remains; the Department of Land and Natural Resources Historic Preservation division is the Administering Agency regarding approval of Burial Treatment Plans. Please include both the HIBC and SHPD as the Administering Agency for the BTP in this table.*

   In Section 1.8, List of Anticipated Permits or Approvals, SHPD will be added as an Administering Agency for the Burial Treatment Plan.

2. *Section 1.8, List of Anticipated Permits or Approvals: It is not certain whether this list is intended to apply only to the Preferred Campus Site Plan. If Site Utilization Schemes 1 through 3 are considered, a final preservation plan for Archaeological Preserves 3 and 4; and the unidentified preserve shown in Figures 6 and 7 will need to be submitted to our office for review and approval.*

   The list of Anticipated Permits or Approvals (Section 1.8, p.1-10) was meant to pertain to the Preferred Campus Site Plan. Since issuance of the SEISPN, planning for the UHCWH has progressed and the Preferred Campus Site Plan has evolved into the Ultimate Campus Site Plan, which will be addressed as the Preferred Alternative/Proposed Action in the forthcoming Draft Supplemental Environmental

   Impact Statement (SEIS). The Ultimate Campus Site Plan remains situated in the extreme northwest corner of the 500-acre parcel, the identical location as represented in the Preferred Campus Site Plan. In the Preferred Campus Site Plan no development is planned for areas south of Archaeological Preserve 2.

3. *Section 2.3.1 (page 2-3), discussion of critical site constraints: Item 3), Archaeological/Cultural Sites and Preserves. This section begins by citing a recent survey by Pacific Legacy, Inc. (2008). We are not certain whether this citation references a document or field work activities. There is no citation in your bibliography and we have no record of receiving a report from Pacific Legacy in 2008. We have a letter report (Reeve 2007) and a Data Recover Report (Reeve 2009). Please clarify this reference and if it is a document, please include a full citation in the bibliography.*

   The 2008 Pacific Legacy survey and accompanying report was inadvertently omitted from the References section. It will be included in the Draft SEIS.

4. *Section 2.3.1 (page 2-3), Item 3): The fifth sentence of this section states that, "As previously recommended by the State Historic Preservation Division (SHPD), a buffer guideline of 50 meters (164 feet) is maintained on both sides of the lava tube." We wish to clarify that the recommendation for a 50 meter buffer zone is found in the Conceptual Historic Preservation Plan, prepared by Pacific Legacy (July 2000). Our office tentatively approved this conceptual plan in December 2000, noting that "final approval of the historic preservation plan for the proposed center will require a decision by the Hawai'i Island Burial Council concerning the burials in Preserve 2" (Don Hibbard letter to Maynard Young, December 18, 2000, Log No. 26680).*

   Verbiage in Section 2.3.1 will be revised to correct the source of the 50 meter buffer guideline. The project has been presented to the Hawai'i Island Burial Council and a Burial Treatment Plan is being prepared for review and approval by the Council.

5. *Section 5.3.1, Site Utilization Schemes 2 through 3: These schemes place campus infrastructure and facilities in generally close proximity to Archaeological Preserves 3, 4 and an unidentified site preserve area. The Conceptual Plan for Preserves 3 and 4 calls for the development of a trail system within the campus to access the preserves and a trail system through the preserves to allow viewing of the various features. The Plan also calls for interpretive signage, to be developed concurrently with a re-vegetation plan for these preserves (Cleghorn 2000). The Utilization Schemes as depicted in Figures 6 and 7 do not include the proposed trail system, and the access trails are not discusses in the text.*

   In the site planning process, the purpose of developing site utilization schemes is, as stated on p. 2-2 of the SEISPN, to provided information that can be used in determining which part of the larger project area would be the best location for the campus. Within this context, it is unnecessary to develop a level of detail that would include laying out a trail system and access trails. Further, as project planning has progressed since issuance of the SEISPN, it has been decided that the future UHCWH campus will be located in the northwest corner of the project area, north of Archaeological Preserve 2. No development is currently planned south of Preserve 2, in the vicinity of Preserves 3 and 4. With the change in campus location, away from Preserves 3 and 4, the Ultimate Site Plan does not incorporate a trail system as part of the campus.

6. *Section 2.3.1.2 (page 2-5): Near the end of the first paragraph, it is state that "Locating the pedestrian pathway within the buffer area is an issue that would have to be discussed with the Hawai'i Island Burial Council." We agree with this statement and request that you include SHPD in this discussion; the Division is responsible for final approval of the preservation/burial treatment plan.*

   Site Utilization Scheme 2, to which this comment refers, has been superseded by project evolution inherent in the planning process. The site utilization schemes were preliminary to developing the Ultimate Campus Site Plan, which will be the Preferred Alternative/Proposed Action in the forthcoming Draft SEIS. The Ultimate Campus Site Plan does not incorporate a pedestrian pathway within the archaeological preserve buffer area as no development is proposed south of Preserve 2.

7. *Site Utilization Schemes 1 – 3, Figures 5, 6 and 7: The archaeological preserve located between Preserves 3 and 4 as shown on these maps is not labeled. Please include the appropriate label on future maps.*

   The archaeological preserve to which this comment refers was marked in error as a preserve in figures 5, 6 and 7. It is an archaeological site (50-10-28-15288), but not a preserve. This will be corrected and labeled in the Draft SEIS.

8. *Figure 12, Archaeological Preserves: This map shows preserves and archaeological sites. Please clarify the status of the sites shown – are they also in preservation status? The site numbers should be included on this map.*

   In Figure 12 the archaeological sites indicated by asterisks did not have the necessary attributes to warrant preservation status. Since the main intent of Figure 12 is to show archaeological preserves on the 500-acre University parcel, the archaeological sites (asterisks) will be removed from Figure 12 to avoid confusion.

9. *Section 3.2.2.1: This discussion notes that there are numerous sites within the UHCWH area. Inventory survey reports and preservation plans are described, however there is no reference to any data recovery work past or proposed. Please check with Pacific Legacy to*

verify whether all of the identified significant sites are being preserved. If not, please verify whether or not some of the sites are recommended for further data recovery. If so, this work will need to be completed at the affected sites prior to development, and a data recover plan should be included among the anticipated approvals listed in Table 1.8.

   The archaeological sites below (south of) Preserve Area 2 that were not assigned preservation status will be passively preserved. No data recovery for these sites is anticipated because they will not be impacted by the 73-acre UHCWH development.

10. *Main Street Road: We understand that this roadway is being constructed by Palamanui, and that interim preservation buffers have been approved for the construction phase (Nancy McMahon letter to Roger Harris, November 11, 2008; doc 2008.4037). It would be helpful to have a better understanding of the relationship between this road and the overall UHCWH project. Is the road considered a separate project? We note that interim preservation buffers proposed in grading plans for the road are not consistent with the preservation buffers proposed for the campus in the Conceptual Preservation Plan.*

   Although Main Street Road will provide access to the UHCWH campus, the construction of Main Street Road is a separate project from the development of the campus. Plans for the construction of Main Street Road, including the determination of interim archaeological buffers, were made more recently than the Conceptual Preservation Plan. Since the road alignment has changed, the interim preservation buffers proposed in grading plans for the road are not necessarily consistent with the buffers proposed in the Conceptual Preservation Plan. It should also be noted that in the Conceptual Preservation Plan the campus was located in the southwestern portion of the 500-acre University Parcel, while the current project is now located in the extreme northwestern corner of the parcel.

11. *Section 3.2.2.2: The proposed action discussion states that the Conceptual Preservation Plan for the project may need to be revisited and revised as necessary to reflect changes in the project. We would prefer to see a final preservation plan for all of the affected preserve areas, as opposed to a revised conceptual plan. As noted above, the Conceptual Preservation Plan (Cleghorn 2000) is not a final approved preservation plan. It was tentatively approved, with the understanding that a BTP would be submitted for approval, and that additional information as required for long-term preservation would be forthcoming. This additional information is listed in the recommendations found in Section 4 of the Conceptual Plan and in correspondence from our office (Don Hibbard letter to Maynard Young, May 25, 2000; Doc No. 25446).*

   With the change of location of the UHCWH campus from the southwestern corner of the 500-acre University parcel to the northwestern corner of the parcel, construction of the campus will no longer impact Preservation Areas 1, 3 and 4. Only Preservation Area 2 will be within the development area. Since Preservation Area 2 contains human burials, a burial treatment plan has been prepared and submitted to the Hawai'i Island Burial Council and SHPD for review and approval. Therefore the need to finalize the Conceptual Preservation Plan is no longer necessary.

12. *In a recent review of data recovery fieldwork at Site 13502, we requested that archaeological monitoring occur during construction work within and in the near vicinity of Archaeological Preserve2 (Nancy McMahon letter to Paul Cleghorn, January 20, 2009; Doc 2008.5237). This is a mitigation measure that you may wish to include in Section 3.2.2.2.*

Archaeological monitoring during construction for work in the vicinity of Archaeological Preserve 2 will be included as a mitigation measure in the Draft SEIS.

We appreciate your agency's interest and participation in the environmental review process, as well as your comments on the SEISPN. The State Historic Preservation Division will receive a copy of the Draft SEIS when it becomes available.

Sincerely,

Celia Shen
Planner

cc: Mr. Brian Minaai, OCI
Mr. Morris M. Atta, Administrator DLNR Land Division

LINDA LINGLE
GOVERNOR

RUSS K. SAITO
COMPTROLLER

BARBARA A. ANNIS
DEPUTY COMPTROLLER

(P)1113.9

STATE OF HAWAII
DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES
P.O. BOX 119, HONOLULU, HAWAII 96810

APR - 9 2009

Mr. Brian Minaai
University of Hawaii
Office of Campus Improvements
1960 East-West Road, Biomedical Sciences, B-102
Honolulu, Hawaii 96822

Attention: Mr. Maynard Young

Dear Mr. Minaai:

Subject: Supplemental Environmental Impact Statement
University of Hawaii Center – West Hawaii Long Range Development Plan
Kalaoa, Island of Hawaii
TMK: (3) 7-3-010:042

Thank you for the opportunity to provide comments for the subject project. The proposed project does not impact any of the Department of Accounting and General Services' projects or existing facilities, and we have no comments to offer at this time.

If you any questions regarding the above, please have your staff call Mr. David DePonte of the Planning Branch at 586-0492.

Sincerely,

ERNEST Y. W. LAU
Public Works Administrator

DD:mo
c: Ms. Katherine Kealoha
Mr. Glenn Okada, DAGS Engineer, Hawaii
Ms. Celia Shen, Wil Chee – Planning and Environmental

WIL CHEE – PLANNING & ENVIRONMENTAL

October 21, 2009

Mr. Ernest Y.W. Lau
Public Works Administrator
Department of Accounting and General Services
P.O. Box 119
Honolulu, Hawai'i 96810

Subject: Revisions and Updates to the University of Hawai'i Center – West Hawai'i Long Range Development Plan, Response to Comments on the Supplemental Environmental Impact Statement Preparation Notice (SEISPN)

Dear Mr. Lau,

On behalf of the University of Hawai'i Office of Capital Improvements (OCI), we thank you for your letter dated April 9, 2009 regarding the SEISPN. Although you had no comments at this juncture, we appreciate your agency's interest and participation in the environmental review process. The Department of Accounting and General Services will receive a copy of the Draft Supplemental Environmental Impact Statement when it becomes available.

Sincerely,

Celia Shen
Planner

cc: Mr. Brian Minaai, OCI

PHONE (808) 594-1888 FAX (808) 594-1865

STATE OF HAWAI'I
OFFICE OF HAWAIIAN AFFAIRS
711 KAPI'OLANI BOULEVARD, SUITE 500
HONOLULU, HAWAI'I 96813

HRD09/3975B

May 13, 2009

Brian Minaai
University of Hawai'i
Office of Capital Improvements
1960 East-West Road, Biomedical Sciences, B-102
Honolulu, HI 96822

RE: Request for comments on supplemental environmental impacts statement (SEIS) preparation notice, University of Hawai'i Center-West Hawai'i long range development plan, Kalaoa, Hawai'i, TMK: 7-3-010:042.

Aloha e Brian Minaai,

The Office of Hawaiian Affairs (OHA) is in receipt of the above-mentioned letter dated March 4, 2009. OHA has reviewed the project and offers the following comments.

OHA notes that West Hawai'i is the only remaining major geographic area and population center in the State of Hawai'i that does not have a permanent facility for higher education. In addition the nearest UH campus is in Hilo, over 100 miles from the center of the West Hawai'i region. As such, we are pleased to offer our general support and offer comments to better shape this proposal.

We do see that many studies and assessment of associated impacts from this proposal are not complete at this early stage. We are appreciative that the applicant is aware of and thinking about such things as the increased amounts of impermeable surface areas, increase in surface runoff, biological and cultural resources, and even the project's carbon footprint (as required by Act 96 enacted by the Legislature of the State of Hawai'i (2006) and Hawaii Revised Statutes §196-9 *Energy efficiency and environmental standards for state facilities, motor vehicles, and transportation fuel*) We do, however, look forward to a complete presentation of the project for review and comment in the forthcoming Draft SEIS.

OHA points out that landscaping not only adds beauty and value to your property, but also helps control erosion by reducing the amount and speed of runoff. Ground covers are one of the best erosion controls and include any plant material that covers the ground surface so the soil cannot be seen from above and rain does not strike directly upon it. As such, OHA would like to suggest that the project area be landscaped with drought tolerant native or indigenous species that are common to the area. Any invasive species should also be removed. Doing so would not only serve as practical water-saving landscaping practices, but also serve to further the traditional Hawaiian concept of mālama ʻāina and create a more Hawaiian sense of place. This would also help to reduce the amount of impervious surfaces in the project area, thereby reducing runoff as well. Tree and landscape planting to shade paved parking areas and provide shade and cooling to building elements and outdoor use areas should also be considered.

Thank you for the opportunity to comment. If you have further questions, please contact Grant Arnold by phone at (808) 594-0263 or e-mail him at granta@oha.org.

ʻO wau iho nō me ka ʻoiaʻiʻo,

Clyde W. Nāmuʻo
Administrator

C: OHA Kona CRC

Celia Shen
Wil Chee- Planning & Environmental
1018 Palm Drive
Honolulu, HI 96814

WIL CHEE – PLANNING & ENVIRONMENTAL

October 21, 2009

Mr. Clyde W. Nāmuʻo
Administrator
Office of Hawaiian Affairs
711 Kapiʻolani Boulevard, Suite 500
Honolulu, Hawaiʻi 96813

Subject: Revisions and Updates to the University of Hawaiʻi Center – West Hawaiʻi Long Range Development Plan, Response to Comments on the Supplemental Environmental Impact Statement Preparation Notice (SEISPN)

Dear Mr. Nāmuʻo,

On behalf of the University of Hawaiʻi Office of Capital Improvements (OCI), we thank you for your letter dated March 13, 2009 regarding the SEISPN. In response to your comments, we offer the following:

One of the overarching goals of the Long Range Development Plan (LRDP) and resultant development of the new UH Center - West Hawaiʻi is to be a model of sustainability. The project will attain, at a minimum, LEED Silver certification; although, the project is striving for a higher target – LEED Platinum, with the ultimate goal of net zero energy consumption. As part of this sustainable effort, an ecological approach to landscaping will be employed that recognizes the existing site conditions and climate. The Landscape Design Guidelines contained in the LRDP recommend appropriate native Hawaiian and Polynesian-introduced plant species that are drought and wind tolerant and that require minimal maintenance and irrigation. In addition to the sustainability aspect, using primarily Native Hawaiian and Polynesian-introduced plant species would help create a Hawaiian Sense of Place. To foster increased knowledge and appreciation of Hawaiian flora, interpretive signs could be used to provide information pertaining to any historical or cultural significance of the plants. Other introduced species that are associated with the local climate also may be considered for landscaping use. Trees and other shade-providing plants will be used in parking areas and around buildings. Wherever possible, the existing grassland/lava landscape will be preserved and incorporated into the campus' outdoor landscaped areas.

The ground surface in the project area is barren rock with soils deposited within the cracks of the hardened lava flows. Vegetation consists largely of fountain grass with widely scattered trees and shrubs. The surface layer consists of approximately four inches of rapidly permeable black peat. A less-permeable pahoehoe lava bedrock composes the subsurface. This combination results in slow flowing surface runoff and minor erosion.

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Office of Hawaiian Affairs
October 21, 2009
Page 2

These issues will be discussed in further detail in the forthcoming Draft Supplemental Environmental Impact Statement (SEIS).

We appreciate your agency's interest and participation in the environmental review process, as well as your comments on the SEISPN. The Office of Hawaiian Affairs will receive a copy of the Draft SEIS when it becomes available.

Sincerely,

Celia Shen

Celia Shen
Planner

cc: Mr. Brian Minaai, OCI

LINDA LINGLE
GOVERNOR

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

BRENNON T. MORIOKA
DIRECTOR

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MICHAEL D. FORMBY
FRANCIS PAUL KEENO
BRIAN H. SEKIGUCHI
JIRO A. SUMADA

IN REPLY REFER TO:

DIR 0348
STP 8.3212

April 7, 2009

Mr. Brian Minaai
University of Hawaii
Office of Capital Improvements (OCI)
1960 East-West Road
Biomedical Sciences, B-102
Honolulu, Hawaii 96822

Attention: Mr. Maynard Young

Dear Mr. Minaai:

Subject: University of Hawaii Center West Hawaii (UHCWH)
Revisions and Updates to the Long Range Development Plan (LRDP)
Supplemental Environmental Impact Statement Preparation Notice (SEISPN)

Thank you for providing the subject document for review and comments.

The State Department of Transportation (DOT) understands that the subject SEISPN addresses proposed revisions and updates to the UHCWH LRDP. Significant changes to the LRDP include: 1) the proposed relocation of the campus core from the southwestern portion of the 500-acre parcel to the northwestern corner; 2) the revised long-term target enrollment of 1,500 full-time equivalent students (FTES) to 3,000 FTES; and 3) the inclusion of additional instruction programs. The Draft SEIS will examine potential impacts of the project and propose mitigation measures to alleviate these impacts. A traffic study is also being conducted as part of the current LRDP update process. Results of the study will be included in the Draft SEIS. While there are no improved roadways leading up to or within the project area, Kaiminani Drive is the closest east-west roadway that could connect the project to Queen Kaahumanu Highway and to Mamalahoa Highway.

The subject project will impact State highway facilities by its contribution of traffic to Queen Kaahumanu Highway and to Mamalahoa Highway.

DOT's prior comments in letters STP 8.9367 and STP 8.9620 dated 7/25/00 (copies attached) to the University of Hawaii for the UHCWH's initial EIS document are still applicable. Further, the applicant should undertake early consultation with DOT Highways Division Planning Branch at telephone number (808) 587-1830 and the Highways Division Hawaii District Office at (808) 933-8866 to address the following comments.

1. The SEIS will need to include an updated traffic impact analysis report (TIAR) that appropriately addresses access to State highway facilities. The updated TIAR must identify the proposed internal roadways and the connection of these proposed roadways to the existing highway network.

2. As noted in the SEISPN, Kaiminani Drive and Queen Kaahumanu Highway currently operate at LOS E during peak periods. The TIAR must appropriately address these existing congested conditions as well as identify interim measures to mitigate project-generated traffic impacts. Use of Kaiminani Drive as an access to this development may also be a challenge due to the grades and roadway cross-section involved.

3. It should also be noted that it is DOT policy to preserve the Queen Kaahumanu Highway corridor to accommodate a future high-speed, access-controlled facility in order to meet the long-term needs for regional movement of people and goods. As a high-speed, access-controlled facility, access onto Queen Kaahumanu Highway would only be allowed through grade-separated interchanges and direct access onto Queen Kaahumanu Highway from adjoining properties would be restricted. Based on preliminary DOT engineering plans, a grade-separated interchange to Queen Kaahumanu Highway is currently proposed at the Kona International Airport. Therefore, project access to Queen Kaahumanu Highway will have to be gained through the use of other parallel north-south and mauka-makai facilities within the region that connect to grade-separated interchanges.

The applicant should also address the following comments from the DOT Airports Division in the SEIS.

1. The proposed project will be subject to overflights and occasional single noise events due to its close proximity to Kona International Airport.

2. No water or landscaping features should be constructed at the project site that would attract birds.

In addition to the preceding issues, the SEIS should identify the proposed phasing of the development and the timing of the specific improvements recommended with each phase.

DOT appreciates the opportunity to provide these initial comments and will defer additional comments until its review of the revised TIAR. Also, DOT requests that four (4) copies of the revised TIAR, and any other additional environmental documents prepared for this project, be provided.

If there are any questions, please contact Mr. David Shimokawa of the DOT Statewide Transportation Planning Office at (808) 587-2356.

Very truly yours,

BRENNON T. MORIOKA, PH.D., P.E.
Director of Transportation

c: Ms. Celia Shen, Wil Chee - Planning & Environmental
Ms. Kathy Kealoha, Office of Environmental Quality Control

WIL CHEE – PLANNING & ENVIRONMENTAL

January 7, 2010

Mr. Brennan Morioka, Ph.D., P.E.
Director of Transportation
Department of Transportation
869 Punchbowl Street
Honolulu, Hawaii 96813-5097

Subject: Revisions and Updates to the University of Hawai'i Center – West Hawai'i Long Range Development Plan, Response to Comments on the Supplemental Environmental Impact Statement Preparation Notice (SEISPN)

Dear Mr. Morioka,

On behalf of the University of Hawai'i Office of Capital Improvements (OCI), we thank you for your letter dated April 7, 2009 regarding the SEISPN. In response to your comments, we offer the following:

1) We acknowledge your comment that the project will impact State highway facilities by contributing to traffic on Queen Ka'ahumanu and Mamalahoa Highways. An updated traffic impact analysis report (TIAR) is being prepared that will assess current traffic conditions along these roadways, identify proposed roadways and connections to the existing highway network, identify potential project-generated impacts, and propose mitigation measures, as warranted. Findings from the updated TIAR will be fully discussed in the Supplemental Environmental Impact Statement (SEIS).

2) We note that it is DOT policy to preserve Queen Ka'ahumanu Highway for a future high-speed, access controlled facility with a grade separated interchange at the Kona International Airport and that access to Queen Ka'ahumanu Highway will have to be gained through other north-south and mauka-makai facilities in the region. The revised and updated LRDP, which is the subject of the SEIS, no longer proposes to provide direct access to the UHCWH campus from Queen Ka'ahumanu Highway via the existing paved service road that begins at the intersection of Keahole Airport Access Road at Queen Ka'ahumanu Highway. Proposed access to the campus will be from two (2) roads that currently are being constructed by Palamanui. The first road is University Drive, which extends eastward from Queen Ka'ahumanu Highway to the Palamanui roundabout. Eventually, University Drive will extend further east, linking to Mamalahoa Highway. The second road is Main Street Road, which run north-south from Kaiminani Drive to the future University Drive and the Palamanui roundabout.

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3) We acknowledge that your department's prior comments on the original 2000 EIS are still applicable (DOT letters STP 8.9367 and STP 8.9620).

   a. Regarding STP 8.9367, the TIAR currently being prepared will reflect traffic generated from other planned projects in the area. Specifically, trip generation from the adjacent Palamanui Master Planned Community and the Lokahi Subdivision (south of the propose UHCWH site) will be included in the cumulative effects analysis. As well, the intersections of Mamalahoa Highway at Kaiminani Drive and Mamalahoa Highway at Ahikawa Street will be looked at in the TIAR.

   b. Regarding STP 8.9620, the updated TIAR currently being prepared does assume that Queen Ka'ahumanu Highway has been widened to four (4) lanes as proposed under Phase 2 of the highway widening project. However, the study does not take into consideration any long-term highway improvements that DOT may be considering for Queen Ka'ahumanu Highway (i.e., a future high-speed, access-controlled facility with grade separated interchanges). We believe it appropriate for analysis purposes to assume that Queen Ka'ahumanu Highway has been widened, as Phase 1 of the project was completed earlier this year and the process of awarding the Phase 2 contract is underway. The updated TIAR will identify potential project-generated impacts and propose mitigation measures, as warranted.

   Also, because the project no longer proposes direct access from Queen Ka'ahumanu Highway, we believe comments 2 and 3 are no longer relevant (see the discussion under item 2 above).

4) In regards to the comments from DOT Airports Division, we provide the following:

   a. We acknowledge that the project area is subject to overflights and single noise events due to its proximity to the Kona International Airport. An Acoustic Study is being conducted that will identify the noise contours associated with the airport and analyze any potential noise impacts and mitigation or attenuation measures, as needed. Findings of the Acoustic Study will be fully discussed in the forthcoming SEIS.

   b. The project involves relatively minimal landscaping and proposes an ecological and sustainable approach, preserving wherever possible the existing grassland and lava fields. During the project's design phase, the potential to attract birds will be brought to the attention of project designers to avoid creating any safety concerns for airport operations.

Please note that since issuance of the SEISPN, the stated long-term target enrollment for the UHCWH has been reduced from 3,000 full-time equivalent students (FTES) to 1,500 FTES. Projections indicated that the UHCWH cannot attain the 3,000 FTES level for more than 100 years and therefore would be beyond a reasonable time frame to be encompassed by the Long Range Development Plan.

We appreciate your agency's interest and participation in the environmental review process, as well as your comments on the SEISPN. Per your request, your department will be provided four (4) copies of the Draft Supplemental Environmental Impact Statement (with TIAR included) to facilitate your review.

Sincerely,

Celia Shen
Planner

cc. Mr. Brian Minaai, OCI

William P. Kenoi
Mayor

BJ Leithead Todd
Director

Margaret K. Masunaga
Deputy

County of Hawaii

PLANNING DEPARTMENT

Aupuni Center • 101 Pauahi Street, Suite 3 • Hilo, Hawaii 96720
Phone (808) 961-8288 • Fax (808) 961-8742

April 23, 2009

Ms. Celia Chen, Senior Planner
Wil Chee – Planning & Environmental
1018 Palm Drive,
Honolulu, HI. 96814

Dear Ms. Chen:

Supplemental Environmental Impact Statement Notice
Request for Comments
University of Hawai'i Center – West Hawai'i
Tax Map Key: 7-3-010:42

This is to acknowledge receipt of your letter dated March 4, 2009, requesting our comments on the Supplemental Environmental Impact Statement Preparation Notice (SEISPN) for the Revisions and Updates to the University of Hawai'i Center – West Hawai'i Long Range Development Plan.

We affirm the State and County land use designations and that the project site is outside of the Special Management Area.

We have the following comments:

1) **2.3.2.1 COMMON DESIGN ELEMENTS**

a) The Kona Community Development Plan, 2008 (KCDP) includes the following Policies that should be considered in arriving at the *"the Ultimate Campus Site Plan"*:

i) **KCDP Policy LU-2.2:** Transit Oriented Development/Traditional Neighborhood Development (TOD/TND) Components. The components of a TOD/TND include Urban Core, Secondary Core, and Greenbelt. A TOD/TND contains a higher density urban core surrounded by a lower density secondary area. A greenbelt will, in turn, surround and define the outer edge of the secondary area.

(1) **Urban Core:** To control the scale and intensity of development within the urban core of a TOD/TND, there shall be two types of urban cores:

(a) Regional Center. Regional centers are intended for mixed use and higher density residential, retail, commercial, employment, and/or regional one-of-a-kind facilities, such as major civic, medical, education, and entertainment facilities. Regional centers shall be designed around a Commercial Center, which is the focus for the Village and designed to encourage pedestrian activity.

ii) **KCDP Policy LU-2.3:** TODs Identified. To control the spacing of transit stations in support of Policy TRAN-1.2, TOD floating zones, identifying the general location of TOD, shall be limited to the following, as shown on the Official Kona Land Use Map (KCDP Figure 4-7):

(1) University Village (Regional Center). The goal is to use the university as a catalyst for complementary commercial opportunities surrounding the campus and to attract students, faculty, and staff to live on or near campus. The university would hopefully be a center for cultural and performing arts, life-long learning, innovation, and workforce development that would benefit the broader community.

Recommendation: *KCDP Action ECON–1.4c establishes the need to "Develop the TOD master plan for the surrounding areas of the University in coordination with the adjoining Pālamanui project". In fulfilling this goal it is suggested that a meeting is held between the County Planning Department, the University of Hawaii and the developers of the Pālamanui project with the goal of identifying common goals and serving to coordinate both projects under one vision for the TOD Regional Center Village.*

Comment: *In the SEISPN the "Common Design Elements" states that "a large plaza and an amphitheater are sited at the northwestern corner of the proposed site, close to the Pālamanui Village Town Center". This is consistent with the KCDP policy for the area establishing that "growth would be directed to compact villages located along proposed transit routes" (KCDP page 4-7).*

Comment: *Also consistent with the "Common Design Elements" is KCDP Policy LU-2.3, which identifies the University Village as a Regional Center TOD intended for mixed use*

and higher density residential, retail, commercial, employment, and/or regional one-of-a-kind facilities, such as major civic, medical, education, and entertainment facilities.

To further enhance the Policies identifying the site as a Regional Center TOD, we suggest that a transit stop, designed with a shelter and seating, be incorporated as part of the campus plaza.

1) **2.3.2.3 Preferred Campus Site Plan**

a) "Although the Preferred Campus Site Plan extends parking area into the Open Zone, it does not meet the required parking and is deficient by approximately 500 parking stalls. In order to satisfy parking requirements, some of the buildings may have to be increased to 2-stories in height, which would then allow a reduction in the number of buildings. The reduced number of buildings would provide more land area for parking. As well, parking requirements could be reduced by employing Leadership in Energy and Environmental Design (LEED) criteria (e.g., providing bicycle parking in exchange for a reduction in the number of required vehicular stalls)."

Recommendation: *In the development of "the Ultimate Campus Site Plan", we strongly suggest that preference to limit building heights to one-story be revisited. Consideration of increased heights for campus structures including parking facilities adhere to Smart Growth Transit Oriented Design Standards and have a potential cost savings element as well (See the KCDP Village Design Guidelines, Attachment B). It is difficult to justify one-story structures when two-story buildings can be successfully designed to blend into the surrounding environment.*

Comment: *Also, we wish to caution that "employing Leadership in Energy and Environmental Design (LEED) criteria (e.g., providing bicycle parking in exchange for a reduction in the number of required vehicular stalls)" can not be viewed in isolation, without considering the overall TOD planning for the area that needs to consider such things as*

(1) The on and off campus non-automobile transportation infrastructure

(2) The availability of student housing within the Pālamanui project

Obviously, automobile parking spaces can not be exchanged for bike storage if housing is not available in the immediate vicinity.

Ms. Celia Chen, Senior Planner
Wil Chee – Planning & Environmental
Page 4
April 23, 2009

Thank you for the opportunity to comment on the proposed project. Should you have questions, please contact Allen A. Salavea of our Kona office at 327-3510.

Sincerely,

for BJ LEITHEAD TODD
Planning Director

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xc: Office of Environmental Quality Control
235 South Beretania Street, Suite702
Honolulu HI 96813

Planning Department, Kona

WIL CHEE – PLANNING & ENVIRONMENTAL

October 21, 2009

Ms. BJ Leithead Todd, Planning Director
County of Hawai'i Planning Department
Aupuni Center
101 Pauahi Street, Suite 3
Hilo, Hawaii 96720

Subject: Revisions and Updates to the University of Hawai'i Center – West Hawai'i Long Range Development Plan, Response to Comments on the Supplemental Environmental Impact Statement Preparation Notice (SEISPN)

Dear Ms. Leithead Todd,

On behalf of the University of Hawai'i Office of Capital Improvements (OCI), we thank you for your letter dated April 23, 2009 regarding the SEISPN. Your comments and recommendations are presented below in italics followed by our responses.

It should be noted that the subject SEISPN was issued prior to completion of the UHCWH Long Range Development Plan (LRDP). The Preferred Campus Site Plan shown in Figure 8, was the preferred of three alternative site schemes. Subsequent to that, an Ultimate Site Plan was developed which is somewhat different than the Preferred Campus Site Plan shown in the SEISPN. In the Ultimate Site Plan the ultimate student population was reduced from 3,000 full-time equivalent students (FTES) to 1,500 FTES for reasons that will be explained in the forthcoming Draft SEIS.

2.3.2.1 COMMON DESIGN ELEMENTS

***Recommendation**: KCDP Action ECON-1.4c establishes the need to "Develop the TOD master plan for the surrounding areas of the University in coordination with the adjoining Palamanui project". In fulfilling this goal it is suggested that a meeting is held between the County Planning Department, the University of Hawaii and the developers of the Palamanui project with the goal of identifying common g goals and serving to coordinate both projects under one vision for the TOD Regional Center Village.*

The University of Hawaii (UH) has had discussions with the owners of the adjacent 725-acre Palamanui master-planned community, since 2002 when a Memorandum of Understanding (MOU) was signed between the two parties. By the MOU, UH agreed to consult and discuss joint development opportunities for the two adjacent properties, with Palamanui providing critical infrastructure for UHCWH's development. Palamanui has had many discussions with the Planning Department in its efforts to change its Agriculture (A-3a) zoning to Project District. More recently Hawai'i Campus Developers LLC, prime contractors responsible for the planning and design of the new UHCWH campus, has met with Planning Director, BJ Leithead Todd to discuss the project.

Comment: *In the SEISPN the "Common Design Elements" states that "a large plaza and an amphitheater are sited at the northwestern corner of the proposed site, close to the Palamanui Village Town Center." This is consistent with the KCDP policy for the area establishing that "growth would be directed to compact villages located along proposed transit routes" (KCDP page 4-7).*

In the Ultimate Site Plan the entry plaza has been moved between the first two buildings of the campus, the Culinary Arts building and the Health Science building. This large open space is referred to as the Marae / Piko. Marae is a Maori word which refers to a sacred gathering place that serves both religious and social purposes and was common throughout Polynesia. This approximately 10,000 square feet outdoor gathering space will serve the campus's ceremonial activities.

In the Ultimate Site Plan the amphitheater has been moved to the interior of the campus because it was feared that the bright lights and noise of night-time activities could be disruptive to adjacent areas which may be residential.

Comment: *Also consistent with the "Common Design Elements" is KCDP Policy LU-2.3, which identifies the University Village as a Regional Center TOD intended for mixed use and higher density residential, retail, commercial employment, and/or regional one-of-a-kind facilities, such as major civic, medical, education, and entertainment facilities.*

UHCWH is a "one-of-a-kind" educational facility for higher education which will serve the entire western region of the island of Hawaii and is consistent with KCDP Policy LU-2.3.

To further enhance the Policies identifying the site as a Regional Center TOD, we suggest that a transit stop, designed with a shelter and seating, be incorporated as part of the campus plaza.

Subsequent to the completion of the SEISPN, a transit stop was added to the project and is shown in the Ultimate Site Plan. This Ultimate Site Plan will be included in the Draft SEIS. The transit stop will be located on Main Street Road (currently under construction) near the Palamanui Village Center roundabout. Communication has been initiated with Tom Brown, Administrator for the Hawai'i County Mass Transit Agency. He has indicated his interest in providing Hele On bus service to UHCWH. He anticipates running three different bus routes through the Kalaoa area: Intra Kona route, Kau to Kona route, and North Kohala – Kona route.

2.3.2.3 Preferred Campus Site Plan

Recommendation: *In the development of "the Ultimate Campus Site Plan", we strongly suggest that preference to limit building heights to one-story be revisited. Consideration of increased heights for campus structures including parking facilities adhere to Smart Growth Transit Oriented Design Standards and have a potential cost savings element as well (See the KCDP Village Design Guidelines, Attachment B). It is difficult to justify one-story structures when two-story buildings can be successfully designed to blend into the surrounding environment.*

The issue of one-story vs. multi-story buildings has been discussed by the UH administration and the design team since the beginning of the project. The design team understands the intent of the County of Hawaii's Smart Growth TOD design standards and the preference for multi-story buildings in the Village core. However, UH is committed to building a state-of-the-art "Green Campus" which will be a model for other community colleges in the Pacific. The UH administration has directed the design team to achieve a minimum LEED "Silver" rating, but to strive for the maximum "Platinum" level certification. The University feels that this is a rare opportunity to create such a campus since it is the only one that can currently be built "starting from scratch." The vision is to create a zero-carbon footprint campus integrating proven design strategies to enhance learning that also embraces sustainability and the Hawaiian culture. The intent of the University is to "walk lightly on the land", a unique land characterized by pristine and rugged lava flows. The design team and the UH administration felt that the best way to achieve these visions and goals would be with one-story buildings, because one-story buildings are the most efficient for natural day-lighting and ventilation. The buildings are being designed so that spaces can be air conditioned during hot weather, but can also take advantage of natural ventilation in cooler weather.

Comment: *Also, we wish to caution that "employing Leadership in Energy and Environmental Design (LEED) criteria (e.g., providing bicycle parking in exchange for a reduction in the number of required vehicular stalls)" can not be viewed in isolation, without considering the overall TOD planning for the area that needs to consider such things as*

(1) The on and off campus non-automobile transportation infrastructure

(2) The availability of student housing within the Palamanui project.

Obviously, automobile parking spaces can not be exchanged for bike storage if housing is not available in the immediate vicinity.

The campus is being designed to meet minimum County of Hawai'i parking requirements based on one stall for each ten students of design capacity, plus one stall for each four hundred square feet of office floor space (County of Hawai'i: Zoning Code, Subdivision Code, and Planning Rules, Section 25-4-51 (a) (20)). The UH parking standard has a larger requirement of one parking space for every two students. The difference between the County requirement and the

UH requirement is being handled by "Overflow Parking" which is unpaved with unmarked stalls. The design team is not reducing required parking in exchange for providing bicycle stalls.

Regarding student housing, the University of Hawaiʻi Community Colleges system is intended to serve the resident population and the campuses are regarded as "commuter schools." With the exception of Maui Community College, none of the other community colleges provide student housing. The Maui campus is served by a privately owned and operated apartment complex which houses students from the outlying areas of Maui County, including Lanai and Molokai. Although a transient facility for students and faculty has been discussed, UHCWH will not provide student or faculty housing in the foreseeable future.

Sincerely,

Celia Shen
Planner

cc: Mr. Brian Minaai, OCI

William P. Kenoi
Mayor

Lono A. Tyson
Director

Ivan M. Torigoe
Deputy Director

County of Hawaiʻi
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
25 Aupuni Street • Hilo, Hawai`i 96720
(808) 961-8083 · Fax (808) 961-8086
http://co.hawaii.hi.us/directory/dir_envmng.htm

March 30, 2009

Celia Shen
Senior Planner
Wil Chee Planning & Environmental
1018 Palm Drive
Honolulu, HI 96814

RE: Supplemental Environmental Impact Statement Preparation Notice for Revisions and Updates to the University of Hawai`i Center – West Hawai`i Long Range Development Plan

Dear Ms. Shen,

We have enclosed our comments.

Thank you for allowing us to review and comment on this project.

Sincerely,

Lono A. Tyson
DIRECTOR

enclosure: Wastewater Comment Memo

cc:
WWD

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
WASTEWATER DIVISION

COUNTY OF HAWAII –108 RAILROAD AVENUE – HILO, HI 96720
HILO (808) 961-8338 FAX (808) 961-8644

MEMORANDUM

March 26, 2009

To: Lono Tyson, Director

From: Dora Beck, P.E., Division Chief DB

Subject: **University of Hawai`i Center – West Hawai`i Long Range Development Plan Supplemental Environmental Impact Statement Preparation Notice (SEISPN)**

The County of Hawai`i Department of Environmental Management, Wastewater Division (WWD) has reviewed the Supplemental EISPH dated February 25, 2009 for the University of Hawai`i Center – West Hawai`i (UHCWH) and provides the following comments:

1. As indicated under Section 3.3.2 of the subject document the initial campus would be serviced by the Palamanui treatment facility which will be a privately-owned and operated treatment facility. However, the Palamanui treatment facility would not be able to accommodate additional facilities that may be constructed for the UHCWH and recommends that UHCWH consider construction of additional facilities on state land adjacent to their treatment facility.
    - The report does not identify the adjacent State Land but it is presumed that the State land referred to is TMK 7-3-010:033 (163.49 acres) since it is adjacent to the UHCWH facility.
2. The Kona Community Development Plan (KCDP) Policy PUB-4.4, Action Item PUB-4.4c requires that the Department of Environmental Management update the sewerage master plan to service the entire Kona Urban Area with priority to the TODs and the areas within approximately 1 mile of the shoreline.
    - Policy PUB-4.4 further requires that private wastewater collection systems within 1 mile of the shoreline be designed and constructed to County standards to enable potential connection to the County sewer system.
        i. While the Palamanui and UHCWH developments are both within the Kona Urban Area but are not within 1 mile of the shoreline, in the event that there is a potential that operation of the additional treatment facility on adjacent State Lands to accommodate further expansion of the campus would become the responsibility of the County, construction of the wastewater collection system to County standards would be required.

Should there be any comments or questions on the above please contact Lyle Hirota at 961-8333 (lhirota@co.hawaii.hi.us) of me at 961-8513 (dbeck@co.hawaii.hi.us).

WIL CHEE – PLANNING & ENVIRONMENTAL

October 21, 2009

Mr. Lono A. Tyson
Director
Department of Environmental Management
25 Aupuni Street
Hilo, Hawai'i 96720

Subject: Revisions and Updates to the University of Hawai'i Center – West Hawai'i Long Range Development Plan, Response to Comments on the Supplemental Environmental Impact Statement Preparation Notice (SEISPN)

Dear Mr. Tyson,

On behalf of the University of Hawai'i Office of Capital Improvements (OCI), we thank you for your letter dated March 26, 2009 regarding the SEISPN. In response to your comments, we offer the following:

Palamanui's wastewater treatment plant (WWTP) and associated infrastructure to support the UHCWH will be constructed in phases, but master planned to accommodate all four phases of the UHCWH development (1,500 full-time equivalent students). Any development planned by the UHCWH beyond the 1,500 FTES campus is outside the scope of the Long-Range Development Plan (LRDP). We acknowledge that any development beyond the four phases encompassed by the LRDP will require the University to construct a separate wastewater treatment facility, which would likely be located on state land adjacent to Palamanui's WWTP.

Note that the SEISPN was issued early in the LRDP development process. Therefore, many of the initial proposals regarding wastewater have evolved since issuance of the SEISPN. Since completion of the SEISPN, the Ultimate Site Plan was developed from the Preferred Campus Site Plan and reflects several project changes, the most significant of which is the reduction from 3,000 FTES to 1,500 FTES. The Ultimate Site Plan facilities will accommodate up to 1,500 FTES. Population projections indicate that the UHCWH cannot attain the 3,000 FTES level for more than 100 years. Therefore, any campus expansion beyond the 1,500 FTES campus addressed by the LRDP will be many years into the future at which time proposals to accommodate additional WWTP facilities would be explored.

We appreciate your agency's interest and participation in the environmental review process, as well as your comments on the SEISPN. The Department of Environmental Management, Wastewater Division will receive a copy of the Draft SEIS when it becomes available.

Sincerely,

Celia Shen
Planner

cc: Mr. Brian Minaai, OCI

William P. Kenoi
Mayor

Darryl J. Oliveira
Fire Chief

Glen P. I. Honda
Deputy Fire Chief

County of Hawai'i
FIRE DEPARTMENT
25 Aupuni Street • Suite 103 • Hilo, Hawai'i 96720
(808) 981-8394 • Fax (808) 981-2037

March 16, 2009

Mr. Brian Minaai
University of Hawaii
Office of Capital Improvements (OCI)
1960 East-West Rd., Biomedical Sciences, B-102
Honolulu, HI 96822
Attn: Mr. Maynard Young

Dear Mr. Minaai,

RE: SUPPLMENTAL ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE FOR REVISIONS AND UPDATES TO THE UNIVERSITY OF HAWAII CENTER – WEST HAWAII LONG RANGE DEVELOPMENT PLAN

This responds to your request for comments regarding the above-referenced project. We have no comments to offer at this time concerning this proposal.

Thank you for the opportunity to participate in the planning stages of the project.

Sincerely,

DARRYL OLIVEIRA
Fire Chief

GN:lk

cc: Ms. Celia Shen, Wil Chee – Planning & Environmental

WIL CHEE – PLANNING & ENVIRONMENTAL

October 21, 2009

Fire Chief Darryl Oliveira
County of Hawai'i Fire Department
25 Aupuni Street, Suite 103
Hilo, Hawai'i 96720

Subject: Revisions and Updates to the University of Hawai'i Center – West Hawai'i Long Range Development Plan, Response to Comments on the Supplemental Environmental Impact Statement Preparation Notice (SEISPN)

Dear Fire Chief Oliveira,

On behalf of the University of Hawai'i Office of Capital Improvements (OCI), we thank you for your letter dated March 16, 2009 regarding the SEISPN. Although you had no comments at this juncture, we appreciate your agency's interest and participation in the environmental review process. The County of Hawai'i Fire Department will receive a copy of the Draft Supplemental Environmental Impact Statement when it becomes available.

Sincerely,

Celia Shen
Planner

cc: Mr. Brian Minaai, OCI

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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 16, 2009

Ms. Celia Shen
Senior Planner
Wil Chee – Planning & Environmental
1018 Palm Drive
Honolulu, Hawaii 96814

Dear Ms. Shen:

SUBJECT: Supplemental Environmental Impact Statement Preparation Notice for **Revisions and Updates to the University of Hawai'i Center – West Hawai'i Long Range Development Plan**

This responds to your March 4, 2009, submittal regarding review and comments of your Supplemental Environmental Impact Statement Preparation Notice (SEISPN) for the University of Hawai'i Center – West Hawai'i Long Range Development Plan in North Kona, Hawaii.

Staff has reviewed the above-referenced SEISPN and submits the following comments:

- Any additional development/project utilizing Queen Kaahumanu Highway as an access will adversely impact traffic conditions throughout Queen Kaahumanu Highway particularly during peak traffic hours or during emergency conditions.
- Recommend against any further development in this area until such time as the second phase of improvements to Queen Kaahumanu Highway (Kealakehe Parkway to Keahole Airport) has been completed and is open to traffic.
- Recommend frontage road parallel to Queen Kaahumanu Highway be completed and open to traffic prior to completion of project.

Should you have any further questions or comments, please feel free to contact Captain Chad Basque, Commander of the Kona District, at 326-4646, extension 249.

Sincerely,

HARRY S. KUBOJIRI
POLICE CHIEF

HENRY J. TAVARES JR.
ASSISTANT CHIEF
AREA II OPERATIONS

"Hawai'i County is an Equal Opportunity Provider and Employer"

WIL CHEE – PLANNING & ENVIRONMENTAL

January 7, 2010

Mr. Harry S. Kubojiri
Police Chief
County of Hawai'i Police Department
349 Kapi'olani Street
Hilo, Hawai'i 96720-3998

Subject: Revisions and Updates to the University of Hawai'i Center – West Hawai'i Long Range Development Plan, Response to Comments on the Supplemental Environmental Impact Statement Preparation Notice (SEISPN)

Chief Kubojiri,

On behalf of the University of Hawai'i Office of Capital Improvements (OCI), we thank you for your letter dated March 16, 2009 regarding the SEISPN. In response to your comments, we offer the following:

1) While it may be desirable to suspend all development in the area until the second phase of improvements to Queen Ka'ahumanu Highway are complete and open to traffic, in the case of the University of Hawaii Center – West Hawai'i (UHCWH), it may not be practicable or necessary. It is our understanding that the State DOT has targeted Phase 2 of the Queen Ka'ahumanu widening project to begin sometime in 2010. The initial or Phase 1 development of the UHCWH is anticipated to begin in late 2010 or 2011, which should dovetail with the highway widening project. However, if the highway widening project should experience additional delays, it would not be reasonable to expect the UHCWH to delay its opening until highway improvements are complete.

   The new campus for the UHCWH is critically needed and has been long-desired by the people of West Hawai'i. As evidence of this, the Hawai'i County Council recently passed an ordinance (Ord. 09 131, effective November 4, 2009) amending Chapter 25 (Zoning Code) of the Hawai'i County Code. This amendment reclassified 20,000 square feet within the Palamanui Master Planned Community from Project District (PD) to Industrial-Commercial Mixed (MCX-20). As a condition of approval, a maximum 75,000-square-foot limit on the total retail space is imposed until Phase 2 of the Queen Ka'ahumanu widening improvements has been secured by the state by entering into a construction contract for the improvements. However, square footage leased to the University of Hawai'i shall not count against this limit (i.e., provision of the University facilities does not have to wait until widening improvements are secured, much less completed and open to traffic). Plans currently have Palamanui

   assisting the UHCWH with constructing their initial facility, rather than leasing space to the University. Regardless of whether the new UHCWH facilities are leased from Palamanui or constructed new on state land, the intent of this condition is clear; relocation of the UHCWH to Kalaoa is a priority and should not be tied to the completion of the second phase of the Queen Ka'ahumanu Highway widening.

   Please note that since issuance of the SEISPN, the stated long-term target enrollment for the UHCWH has been reduced from 3,000 full-time equivalent students (FTES) to 1,500 FTES. Projections indicated that the UHCWH cannot attain the 3,000 FTES level for more than 100 years and therefore would be beyond a reasonable time frame to be encompassed by the Long Range Development Plan. Phase 1 development of the UHCWH will accommodate relocation from their existing facilities in Kealakekua to Kalaoa. Subsequent development phases of the UHCWH will provide for future growth and program expansion. Build-out of the 1,500 FTES campus will not occur until at least 10+ years into the future (2023) and is dependent on the actual growth rate of the UHCWH and available funds.

2) It is assumed that the frontage road to which you refer would be the service road along the side of the high-speed, access-controlled facility that is being planned by the state for Queen Ka'ahumanu Highway. Based on the current population and traffic volumes in West Hawai'i, it is expected that this high-speed, access-controlled facility and related grade-separated interchanges and service roads would not be needed for at least another 20 to 25 years in the future. As such, it would be unreasonable to delay development of the new UHCWH campus in Kalaoa until such frontage road is open to traffic.

A Traffic Impact Assessment Report (TIAR) is being completed as part of the SEIS preparation process. Findings from this study will be discussed in the SEIS and mitigation will be proposed as warranted.

We appreciate your agencies interest and participation in the environmental review process, as well as your comments on the SEISPN. The County of Hawai'i Police Department will receive a copy of the Draft SEIS when it becomes available.

Sincerely,

Celia Shen
Planner

cc. Mr. Brian Minaai, OCI

APR-08-2009 17:51 FROM:REP EVANS 8085868514 TO:8085971851 P.1/1

HOUSE OF REPRESENTATIVES

STATE OF HAWAII
STATE CAPITOL
HONOLULU, HAWAII 96813

April 8, 2009

Brian Minaai
Associate Vice President of Capitol Improvements
1960 East-West Road
Honolulu, HI 96822

Dear Mr. Brian Minaai,

I am writing in support of the long range development plan for the University of Hawai'i Center –West Hawai'i and keeping all of the 500 acres a college campus knowing that years out in the future it could be co-located with a University Campus. The 500 acres should be devoted in perpetuity to higher education.

On page 3-34, section 3.5.1.2, "Potential Impacts," states that there is a projected population of 1200-1600 by the year 2010 (HawCC, 1997, p. 10). Currently there is a population size of 400 enrolled. My understanding is 2,000 is a better projection for student population.

What this tells me is that the current campus is grossly undersized to service the community of West Hawaii, as 2010 is next year. Secondly, I am questioning the reference to the projected population of 1200-1600. Currently, we are in the year 2009, and to use a source dated 1997 seems completely out of touch with demand and proper size of a campus.

In closing West Hawaii is under served and I appreciate your work in completing a long range development plan to meet the educational needs of our community. Thank you for your attention to this matter and I am looking forward to hearing from you soon.

Sincerely,

Cindy Evans
Floor Majority Leader
District 7 Representative

State Representative Cindy Evans
Room 425, State Capitol Building
TEL: 808.586.8510, Hawai'i Direct Dial 974.4000 ext. 6-8510#
Fax: 808.586.8514, repevans@capitol.hawaii.gov, www.repcindyevans.com

UNIVERSITY of HAWAI'I® SYSTEM

Office of Capital Improvements

April 16, 2009

The Honorable Cindy Evans
House of Representatives
State of Hawai'i
Hawai'i State Capitol, Room 425
415 South Beretania Street
Honolulu, Hawai'i 96813

Dear Representative Evans,

Thank you for your comment letter dated April 8, 2009 concerning the SEISPN for Revision and Updates to the Long Range Development Plan (LRDP) for the University of Hawai'i Center at West Hawai'i.

We appreciate your comments in support of the LRDP and the need to retain all of the 500 acres for university purposes. As you may know, the Department of Land and Natural Resources, identified only 73 acres of the 500 acres for the new West Hawai'i Center. The remaining 427 acres now has an "unclassified" designation and may or may not be available should additional acreage be needed.

Regarding enrollment planning, we agree that West Hawai'i is "under served," and the University is preparing to accommodate a much higher number of students at the new center. The LRDP will contain a Transition Plan and an Ultimate Site Plan which in turn will contain an interim plan and a final plan. The interim plan (750 FTES) will accommodate more than three times the amount of students currently (227 FTES) enrolled at the West Hawai'i Center in Kealakekua.

Should you have any additional questions, please call me at (808) 956-7935.

Sincerely,

Brian K. Minaai
Associate Vice President for Capital Improvements

1960 East West Road, Biomedical Sciences B-102
Honolulu, Hawai'i 96822
Telephone: (808) 956-7935
Fax: (808) 956-3175