Final Environmental Impact Statement: Appendices

KEAHUOLU

AFFORDABLE HOUSING PROJECT

Kailua-Kona, North Kona, Island of Hawaii

Volume 2 of 2

PREPARED BY

BeltCollins®

PREPARED FOR

Hawaii Housing Finance & Development Corporation
State of Hawaii 1959
Ua mau ke ea o ka aina i ka pono

September 2008

Volume 2 of 2

KEAHUOLU

AFFORDABLE HOUSING PROJECT

Kailua-Kona, North Kona, Island of Hawaii

This Environmental Impact Statement has been prepared by Belt Collins Hawaii Ltd.
acting as a consultant to the Hawaii Housing Finance & Development Corporation

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Appendix A

April 2007 – List of stakeholders who received two preliminary land use concept plans for the HHFDC Keahuolu Affordable Housing Project:

A. State Agencies

Department of Business, Economic Development and Tourism (DBEDT)
- Ms. Laura Thielen, Director, Office of Planning

Department of Education (DOE) (Ms. Heidi Meeker)

Department of Hawaiian Home Lands (DHHL)
- Mr. Micah A. Kane, Chairman
- Mr. Larry Sumida

Department of Land & Natural Resources (DLNR)
- Chairperson
- Administrator, State Historic Preservation Division

Department of Transportation (DOT)
- Mr. Barry Fukunaga, Director
- Mr. Stanley Tamura, Engineering Program Manager, Highways Division – Hawaii District Office

Office of Hawaiian Affairs (Mr. Clyde Namuʻo, Administrator)

Office of the Governor
- Mr. Andy Smith, Liaison Officer, Kona/West Hawaii Office

B. County of Hawaiʻi

Department of Environmental Management
- Ms. Barbara Bell, Director
- Ms Dora Beck

Department of Parks and Recreation (Ms. Pat Engelhard, Director)

Department of Public Works (Mr. Bruce McClure, Director)

Department of Research and Development (Ms Jane Testa, Director)

Department of Water Supply (Mr. Milton Pavao, Manager)

Fire Department (Mr. Darryl Oliveira, Fire Chief)

Office of Housing and Community Development (Mr. Edwin Taira, Housing Administrator)

Office of the Mayor;
- Ms Dixie Kaetsu, Managing Director
- Mr. Roy Takemoto, Executive Assistant

Planning Department (Mr. Chris Yuen, Director)

Police Department (Mr. Lawrence Mahuna, Chief of Police)

C. Elected Officials

Councilmember Dominic Yagong, County of Hawaiʻi District 1

Councilmember Donald Ikeda, County of Hawaiʻi District 2

Councilmember J. Yoshimoto, County of Hawaiʻi District 3

Councilmember Stacy Higa, County of Hawaiʻi District 4

Councilmember Emily Naeole, County of Hawaiʻi District 5

Councilmember Bob Jacobson, County of Hawaiʻi District 6

Councilmember Brenda Ford, County of Hawaiʻi District 7

Councilmember Angel Pilago, Vice Chair, County of Hawaiʻi District 8

Councilmember Pete Hoffman, Chair, County of Hawaiʻi District 9

Representative Josh M.D. Green, State of Hawaiʻi, District 6

Senator Paul Whalen, State of Hawaiʻi, District 3

D. Local Utilities

Hawaii Electric Light Company, Inc. – Hilo
- Mr. Hal Kamigaki
- Ms. Shelley Tomita
- Mr. Kevin Whitener

Hawaiian Telecom, Inc.
- Mr. Kevin Ayano
- Mr. Gordon Yadao
- Mr. Michael Chang

Oceanic Time Warner (Mr. Robert Moeller)

E. Community Organizations, Associations, and Other Groups

A & B Properties, Inc. (Mr. Stanley M. Kuriyama, Chief Executive Officer)

Akinaka and Associates, Ltd. (Mr. Robert Akinaka)

Stanford S. Carr Development Corporation (Mr. Stanford S. Carr)

Castle & Cooke Homes Hawaii, Inc. (Mr. W. Bruce Barrett)

Community Planning and Engineering, Inc. (Mr. Bernard P. Kea, P.E.)

D.R. Horton, Schuler Division (Ms. Tracy Nagata AIA, Vice President of Development, Neighbor Island Group)

Hawai‘i Leeward Planning Conference (Ms. Jacqui Hoover, President)

Kamehameha Schools
- Mr. Jeffrey Mau, Senior Asset Manager, Commercial Asset Division, Asset Mgmt & Operations Endowment Group
- Ms. Susan W.F. Todani, CRE, Director, Special Projects Endowment Group

Kona Community Development Plan Steering Committee
- Mr. Ken Melrose
- Mr. J. Curtis Tyler III

Kona-Kohala Chamber of Commerce (Ms. Vivian Landrum, Executive Director)

Kona Traffic Safety Committee (Mr. Joel Gimpel)

The Maryl Group, Inc. (Mr. Mark Richards, President)

Neighborhood Place of Kona (Mr. Wally Lau)

Pacific Kona Landscaping (Ms. Brenda Lam, President)

Queen Lili‘uokalani Trust (Ms. LeeAnn E.P. Crabb)

Steelhead Capital (Mr. Sean Aguila)

UniDev Hawaii, LLC (Mr. Jeffrey A. Minter, Chief Executive Officer)

F. Individuals

Ms. Elaine Watai

Appendix B

B-1

November 2007

Botanical Survey

of

The Proposed Keahuolu Affordable Housing Project

North Kona, Island of Hawai‘i

by

Art Whistler, Ph.D.
Isle Botanica
Honolulu, Hawai‘i

Report prepared for

Belt Collins and Associates
Honolulu, Hawai‘i

November 2007

INTRODUCTION

The study site encompasses 272 acres located in North Kona on the island of Hawai‘i. The project site is part of the former Queen Lili‘uokalani Trust (QLT) lands that have been subdivided into several portions earmarked for development and conservation, and is situated just northeast of Kailua-Kona town, and mauka (inland) of Queen Ka‘ahumanu Highway. The project site is an irregularly shaped polygon (Fig. 1) bordered on the south side by Palani Road, just northeast of where Henry Street intersects it, and the northeast corner abuts Kealakehe Drive. The project parcel is Tax Map Key 7-4-021: 020. Construction of homes and other facilities is planned for the project area, called Keahuolu, and this requires an up-to-date botanical survey, especially since there are federally listed threatened and endangered plant species occurring in the general vicinity.

The project area is comprised of lava flows of various ages that are covered mostly by an alien-dominated scrub vegetation that has been highly disturbed in the past. A botanical survey was carried out by Char and Associates in 1989 on the area, but that survey included a much larger area comprising 1100 acres, some of it extending west of the present study site and makai of the Queen Ka‘ahumanu Highway.

The objectives of the current field study were to provide a general description of the vegetation types present at the project site (particularly any sensitive types of vegetation that may harbor rare plant species), to make a checklist of all native and naturalized vascular plants found, and to search for threatened and endangered species.

METHODOLOGY

Before the fieldwork was carried out, a review of the literature was undertaken by the Principal Investigator (PI). The current status of any endangered species previously reported from the general area was checked using the official database of threatened and endangered species (USFWS 2005). This list is identical to the State of Hawai‘i list of threatened and endangered plant species. In addition, information about threatened and endangered plant species found in the area was extracted from the Hawai‘i Natural Heritage Program database (Anon. 2005) of federally listed plant species (Fig. 2). Topographic maps and aerial photos were studied to determine the best access points and to locate places where native species are most likely to be found (lava flows).

After the literature review, a botanical field survey was conducted at the Keahuolu project site by a two-person botanical team consisting of the PI (Art Whistler) and a Field Assistant (Beate Neher) from 4 to 7 April 2007. No roads lead into the property, so access was attained from Palani Road for the southern portions and from Kealakehe Drive for the northeastern corner. A walk-through survey was employed, with transect lines marked for the purpose with flagging tape being used to keep bearings. All plant species encountered during the survey were recorded, along with an indication of their frequency. Particular care was taken in ‘a‘a areas, since this type of habitat is where most of the native species and endangered species are most likely to occur. New lists were made for each vegetation type and/or day, and these were combined into a comprehensive checklist of all plants found at the study site (see Table 2).

Fig. 1. The Keahuolu Affordable Housing Project Study Site.

Notes were also taken on vegetation types present, indicating the dominance and frequency of the plant species found there. This was later analyzed and written up to form the vegetation section below. All of the species encountered during the fieldwork were familiar to the field team and were identified in the field.

THE VEGETATION

Four types of vegetation can be recognized on the Keahuolu property: (1) Managed Land Vegetation; (2) *Prosopis* woodland; (3) *Leucaena* Scrub; and (4) *Schinus*/*Psydrax* Scrub. These types are described below.

(1) Managed Land Vegetation

This comprises the areas of the parcel that are under periodic or frequent management, such as the edges of roads. This is a relatively minor component of the overall vegetation on the property, since only the roadsides of Palani Road are currently being managed. The roadsides are dominated by alien weedy species, such as swollen fingergrass (*Chloris barbata*) and the dicot herbs coat buttons (*Tridax procumbens*), garden spurge (*Chamaesyce hirta*), Florida beggarweed (*Desmodium tortuosum*), and cow pea (*Macroptilium lathyroides*). There are also a number of ornamentals planted along the roadside, particularly bougainvillea (*Bougainvillea glabra*), mulberry (*Morus alba*), and candlenut (*Aleurites moluccana*), although the latter may be natural there since it is a naturalized Polynesian introduction to Hawai‘i.

(2) *Prosopis* Woodland

This type of vegetation, which is dominated by the tall alien tree species kiawe (*Prosopis pallida*), is found only in an indistinct zone north of and paralleling Palani Road (Fig. 3). It is an open woodland with few other tree species besides the koa haole (*Leucaena leucocephala*). The two other trees more common outside of this zone, Christmas berry (*Schinus terebinthifolius*) and the native alahe‘e (*Psydrax odoratum*), are occasional here. The ground cover is sometimes dense, dominated mostly by Guinea grass (*Panicum maximum*) and Philippine violet (*Barleria cristata*), two species otherwise uncommon at the study site. Talinum (*Talinum triangulare*), a succulent weed, is also often common in places. Other than the alahe‘e, few native species are found here, mostly because of the dominance of the kiawe. This type of vegetation was called “Kiawe woodland” by Char and Associates (1989).

(3) *Leucaena* Scrub

This is the type of vegetation found on areas of older lava flows dominated by the alien scrubby tree koa haole (*Leucaena leucocephala*). It is not a homogeneous type of vegetation, since with increasing elevation going eastward up the slope, its density and the species associated with it change. On the lower portions (Fig. 4) of the study site, koa haole is mostly 1–3 m in height, scattered in an open-to-dense matrix of *Pennisetum setaceum* (fountain grass). Also significant here is the native shrub or small tree alahe‘e (*Psydrax odoratum*), which in some places is almost a co-dominant. Several other trees and shrubs are found here, but in low

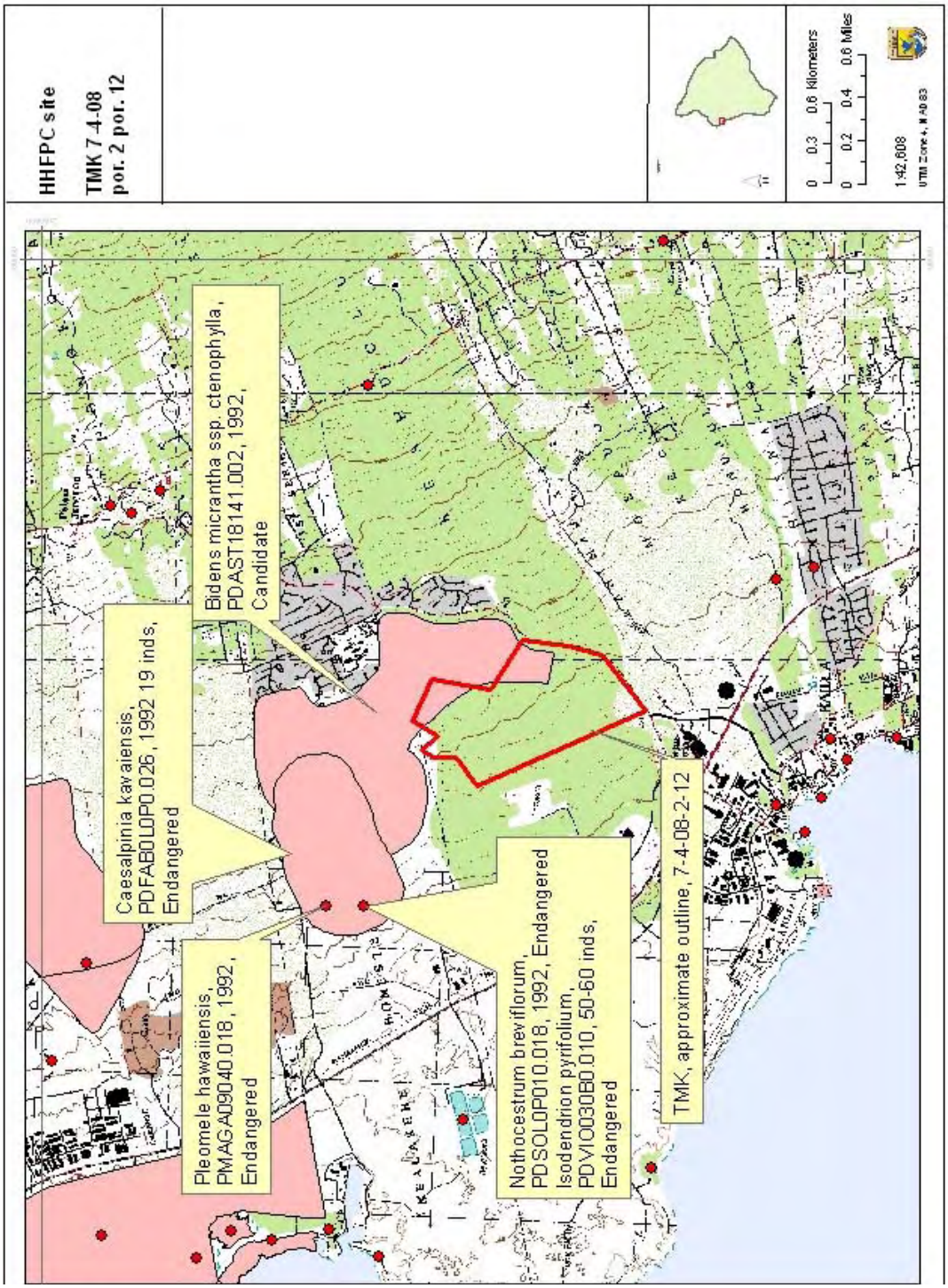

Fig. 2. Hawai‘i Natural Heritage Program database map of federally listed plant species.

numbers. This includes the alien tree Christmas berry (*Schinus terebinthifolius*) and the alien shrub klu (*Acacia farnesiana*). Fountain grass dominates most of the open areas having some soil, but a number of other herbaceous species are found in the shade of koa haole or on pahoehoe rocks free of fountain grass, particularly talinum (*Talinum triangulare*), air plant (*Kalanchoë pinnata*), lantana (*Lantana camara*), and carrion flower (*Stapelia gigantea*). Two indigenous vines are found in the area, huehue (*Cocculus trilobus*), which is common, and the kowali-ʻawa (*Ipomoea indica*), which is uncommon. The native herb ʻalaʻala-wai-nui (*Peperomia leptostachya*) is occasional on rocks. At higher elevations, koa haole is generally less dominant, and is gradually replaced with Christmas berry (*Schinus terebinthifolius*). On deeper soils, however, it extends up to higher elevations (Fig. 5). This vegetation was called "Scrub" by Char and Associates (1989).

Leucaena scrub is classified as disturbed, since fires periodically sweep through the area and goats are known to be present. These two factors account for the dominance of alien species, which are better adapted to these disruptive conditions than are the native species. According to the flora of Hawaiʻi (Wagner et al. 1999), fountain grass "is rapidly expanding its range in the Kona district of Hawaii." Introduced into the Kona District "in the early 1900s as an ornamental, [it] has aggressively spread and now dominates abandoned pastures, young lava flows, and burn areas. Fountain grass poses one of the most serious contemporary conservation problems because it is disrupting the more sparsely vegetated lowland native dry forests and shrublands, which contain several endangered and many candidate endangered plant species."

(4) *Schinus*/*Psydrax* Scrub

This is the type of vegetation on more recent lava flows, ones that are decidedly composed of ʻaʻa lava. It is the same vegetation described by Char and Associates (1989) as "*Canthium*/ Christmas Berry Shrubland" (*Canthium* is the old name for *Psydrax*). It is found in a patchy distribution within the site, which comprises lava flows of various ages and stages of development into soil. It gradually increases in frequency with increasing elevation, particularly above 400 ft. elevation (Fig. 6), since it is dominated by species that do better in the somewhat wetter conditions found upslope. The main species dominating this community is the alien tree Christmas berry (*Schinus terebinthifolius*), along with the indigenous tree alaheʻe (*Psydrax odoratum*). These two species are also found at lower elevations, mostly on or near aʻa lava flows, but at the higher elevations at the site they dominate rather than being of secondary importance to koa haole (*Leucaena leucocephala*). The third most prevalent tree in this community is the koa haole, which, as noted above, sometimes forms nearly pure strands on some soil types. The fourth most prevalent tree is perhaps the introduced shrub or small tree klu (*Acacia farnesiana*). Other tree species found here include the uncommon endemic ʻohe (*Reynoldsia sandwicensis*), the uncommon indigenous shrub pua pilo (*Capparis sandwichiana),* the somewhat more common endemic shrub or tree mamane (*Sophora chrysophylla*), the occasional indigenous shrub ʻaʻaliʻi (*Dodonaea viscosa*), and the introduced (by Polynesians) noni (*Morinda citrifolia*).

The ground cover is also sparse in this type of vegetation, with scattered clumps of *Pennisetum setaceum* (fountain grass) found mostly in pockets of soil or pahoehoe, and perhaps being the most common species found here. The ground cover is particularly sparse (Fig. 7) under the dense canopy of the Christmas berry trees. Second in importance is probably the air

plant (*Kalanchoë pinnata*), which forms a dense undergrowth in some places, but is entirely lacking in others. There are many patches of huehue (*Cocculus trilobus*), and a few patches of kowali-ʻawa (*Ipomoea indica*), and the native fern kupukupu (*Nephrolepis exaltata*), as well as the thorny alien shrub *Lantana camara* (lantana). In a few places at the highest elevations of the plot, the endemic subshrub *Bidens micrantha* ssp. *ctenophylla* occurs. This species was a candidate for federal listing as endangered or threatened, but was never classified as such, and hence has no protected status. It is occasional in other areas of similar vegetation at about the same elevation in the area (Whistler 2006).

Like *Leucaena* Scrub, this vegetation is classified as disturbed, since fires periodically sweep through the area, and goats are known to be in the area. It somewhat matches the description of the "Lowland Dry Shrublands" described in Wagner et al. (1999), which is described as occurring in leeward situations on most of the main islands, at 330 to 2000 ft elevation, and being open and not exceeding 10 ft in height.

THE FLORA

A total of 83 plant species (see Table 2) was recorded in the study site. Seventeen of the 83 species recorded are native and six of these native species are endemic. Indigenous plants are species that are native to a region or place, but are also found elsewhere. Endemic plants are species restricted to a single region or area, i.e., in the case of Hawaiʻi, they are found only in Hawaiʻi. In biodiversity terms, the endemic status is the more important of the two categories, since if a species belonging to it is endangered or threatened in Hawaiʻi, it would likewise be classified globally. Indigenous species, however, can be rare in Hawaiʻi, but may be common elsewhere in the Pacific. Over 90% of the native plants in Hawaiʻi are endemic, one of the highest rates in the world.

The majority of the 83 species encountered during the survey are naturalized "alien" plants that were accidentally or intentionally introduced to Hawaiʻi, but which have now become established in the islands and can spread on their own. The checklist of Char and Associates (1989) for the area included 148 species, but that study, which included the present study site, was for a larger property (about 2.5 times the area of the present study site) and included areas that are much nearer to the coast. The present survey was conducted during a fairly dry part of the year, and if done in a rainy part or a wetter year, it is likely that additional species, mostly herbaceous alien weeds, would have been recorded.

Most of these additional species found by Char and Associates were adventive species (weeds) that would be expected in the area, but many of these are herbaceous species that die back during the dry season, and consequently might have turned up during the current survey. Char and Associates also found several native species in their study that did not turn up in the present study: *Doryopteris decora* (an endemic fern occasional on the lava flows of the area); *Fimbristylis hawaiiensis* (an endemic sedge of coastal areas, not to be expected in the present study site); *Pandanus tectorius* (an indigenous tree-like monocot of coastal areas, not to be expected in the present study site), *Digitaria setigera* (a coastal grass not to be expected in the present study site); *Heliotropium curassavica* (a native coastal herb not to be expected at this inland study site); *Ipomoea pes-caprae* (an indigenous coastal vine not to be expected at this inland study site); *Diospyros sandwicensis* (an endemic tree occasional on lava flows at higher elevations in the area); *Senna gaudichaudii* (an indigenous tree occasional on lava flows at

higher elevations in the area); *Plectranthus parviflorus* (an indigenous herb occasional on lava flows at higher elevations in the area); *Argemone glauca* (an indigenous herb occasional on lava flows at higher elevations in the area); *Osteomeles anthyllidifolia* (an indigenous shrub occasional on lava flows at higher elevations in the area); and *Solanum americanum* (an indigenous herb common in Hawai‘i). None of these native species are particularly uncommon and are not even listed as species of concern (SOC).

Several threatened or endangered species have been reported in the area, and are shown on the Hawai‘i Natural Heritage Program database map (Fig. 2). Uhiuhi (*Caesalpinia kavaiensis*) was recorded in the vicinity north of the present study site, but it was not found on the project site during the present study nor in the larger study area surveyed by Char and Associates (1989). There is a single record of hala pepe (*Pleomele hawaiiensis*) collected in the uhiuhi area northwest of the study site in 1992, but it was not seen by Char and Associates in the larger area south of this population nor during the present study. There is, however, a relatively large population at Kaloko a few miles north of the current study site (Whistler 2006). ‘Aaea (*Nothocestrum brevifolium*) was found in 1992 near the record of hala pepe, but it was not seen by Char and Associates (1989) in the larger area south of this population, nor during the present study. At about the same point, a population of about 50 to 60 individuals of aupaka (*Isodendrion pyrifolium*) was found in 1992, but this shrub was not seen by Char and Associates in the larger area south of this population, nor during the present study. Figure 2 also lists “species of concern” *Bidens micrantha* ssp. *ctenophylla* as occurring in the area north of the present study site. This species was found during the present study, but it has not been listed as Threatened or Endangered, and thus has no official status.

Table 1. Native species found at the study site

Bidens micrantha ssp. *ctenophylla* (Asteraceae)	ko‘oko‘olau	Endemic
Capparis sandwichiana (Capparaceae)	pua pilo	Endemic
Cocculus trilobus (Menispermaceae)	huehue	Indigenous
Cuscuta sandwichiana (Cuscutaceae)	dotter	Endemic
Dodonaea viscosa (Sapindaceae)	a‘ali‘i	Indigenous
Erythrina sandwicensis (Fabaceae)	wiliwili	Endemic
Heteropogon contortus (Poaceae)	pili grass	Indigenous?
Ipomoea indica (Convolvulaceae)	koali-‘awa	Indigenous
Nephrolepis exaltata (Nephrolepidaceae)	kupukupu	Indigenous
Peperomia leptostachya (Piperaceae)	‘ala‘ala-wai-nui	Indigenous
Plumbago zeylanica (Plumbaginaceae)	‘ilie‘e	Indigneous
Psilotum nudum (Psilotaceae)	moa	Indigenous
Psydrax odoratum (Rubiaceae)	alahe‘e	Indigenous
Reynoldsia sandwicensis (Araliaceae)	‘ohe	Endemic
Sida fallax (Malvaceae)	‘ilima	Indigenous
Sophora chrysophylla (Fabaceae)	mamane	Endemic
Waltheria indica (Sterculiaceae)	‘uhaloa	Indigenous

DISCUSSION

A total of 83 plant species (see Table 2) was recorded at the study site, with 17 of them native—six endemic and eleven indigenous. No species federally listed as threatened or endangered were found at the site. One endemic subshrub found in the study site, koʻokoʻolau (*Bidens micrantha* ssp. *ctenophylla*), was at one time considered a candidate species for one of these categories, but it has no current protected status. It occurs in other places north of Kona where it is sometimes even found in disturbed places such as quarries (see Whistler 2006). It is shown in the Hawaiʻi Natural Heritage Program Database map (Fig. 2) as occupying the northeastern part of the current study site, and this was found to be the case.

That database map also shows a record of the federally listed endangered tree uhiuhi (*Caesalpinia kavaiensis*) as occurring in the area just northwest of the study site, but it has not been recorded from the study site nor was it seen there during the botanical studies of Char and Associates (1989) nor during the present study. The tree is restricted to populations found in the Waianae Mts. on Oʻahu, Hualalai on Hawaiʻi, and on Lanaʻi. Subpopulations on Maui and Kauai are now apparently extinct. Currently fewer than 50 reproductive individuals are known, and a preserve of 11.2 acres near the study site has been set aside for their protection.

Three other federally listed threatened or endangered species have been recorded from the general area, as shown in Fig. 2 on the Hawaiʻi Natural Heritage Program Database map: hala pepe (*Pleomele hawaiiensis*), ʻaiea (*Nothocestrum breviflorum*), and aupaka (*Isodendrion pyrifolium*). Hala pepe is a member of the agave family, and historically had many uses by native Hawaiians. Currently, these plants are experiencing poor reproductive success in the wild, which may be attributed to a number of causes. Eight populations of this plant are known to exist, comprising about 250 to 300 individuals, with two of the populations in the Kaloko to Kona area (USFWS 1995).

ʻAiea can be found at elevations of 590–6000 ft and typically grows in lowland dry forests and montane dry or mesic forests dominated by koa (*Acacia koa*), ʻohiʻa lehua (*Metrosideros polymorpha*), and/or lama (*Diospyros sandwicensis*). Associated species include uhiuhi (*Caesalpinia kavaiensis*) and wiliwili (*Erythrina sandwicensis*) (USFWS 1994). The ten remaining populations can be found throughout much of the species' historic range, including the nearby Kaloko site. In the later area, however, the species may have disappeared (Whistler 2006). In 1997 there were 10 known populations containing 60 individuals total (Bruegmann 1997).

Aupaka was presumed extinct for over 100 years, until 1991 when four plants were found on State-owned land on the island of Hawaiʻi northwest of the current study site. The area around their location was slated for development for residential housing and a golf course. Further searches of that site added an additional 50 to 60 plants to the known population, but due to pressure from residential and recreational development, as well as invasive species, only 15 plants were recorded during a recent survey of the site (USFWS 2001). Two small preserve have been established for this species to the north of the current study site, adjacent to Kealakehe High School (Anon. 2007).

No sensitive types of vegetation were found at the current study site. Such types of vegetation include wetlands and dryland forest. No wetland could occur here due to the dry, lava-covered surface at the site. Dryland forest with sensitive plant species is found at Kaloko to the north of the present study site, but none was encountered at the study site itself.

CONCLUSIONS AND RECOMMENDATIONS

Based upon the survey, there are four main kinds of vegetation at the site: (1) Managed land along Palani Road, dominated by alien species; (2) *Prosopis* Woodland dominated by kiawe (*Prosopis pallida*) and koa haole (*Leucaena leucocephala*) along the southern boundary of the study site; (3) *Leucaena* Scrub dominated by koa haole (*Leucaena leucocephala*) in combination with alahe‘e (*Psydrax odoratum*) and fountain grass (*Pennisetum setaceum*) in the lower part of the study site and on soil on the upper part; and (4) *Schinus*/*Psydrax* scrub dominated by Christmas berry (*Schinus terebinthifolius*) and alahe‘e (*Psydrax odoratum*) on or near lava flows.

A total of 83 plant species were recorded from the study site. Of these, 17 are native species—11 indigenous species and 6 endemic species. None of these are federally listed as “threatened” or “endangered.” No areas of wetlands or undisturbed native vegetation occur at the site. Consequently, there are no botanical impediments to carrying out the proposed construction.

It is also recommended that some of the rare and endemic species occurring on the site or in the general area should be considered for any landscaping that will be done, such as around utility buildings and public structures. This would be a win-win situation. Some of the species make attractive ornamentals, and are already adapted to the dryland conditions at the site. Thus they require little maintenance and watering. Using rare or culturally significant species would also help to alleviate any local or governmental concerns that the project would be detrimental to the survival of these rare species. Some of these species are already being propagated by local gardeners and gardens, such as the nearby Amy Greenwell Garden. These may be available for purchase, or these individuals or gardens could be hired to do the local plant landscaping. Some species recommended for landscaping are as follows:

Alahe‘e (*Psydrax odoratum*)—A small indigenous tree or shrub fairly common at the site, to which it is well adapted. It has attractive dark green leaves, a thick canopy, and baseball-sized clusters of fragrant, attractive white flowers.

Hala pepe (*Pleomele hawaiiensis*)—A federally listed endangered endemic species. This yucca-like plant is similar to the money tree (*Dracaena marginata*) that is a popular ornamental plant in Hawai‘i. It was not found at the site, but a population of it occurs at a similar elevation to the north at Kalolo.

‘Ilima (*Sida fallax*)—An indigenous shrub common at the site. It is a popular ornamental in Hawai‘i, where the orange mallow-like flowers are fashioned into exquisite leis.

Kolomona (*Senna gaudichaudii*)—Small indigenous tree with pale yellow flowers. It is similar to the scrambled eggs tree (*Senna surattensis*) that is a popular ornamental tree in Hawai‘i.

Ko‘oko‘olau (*Bidens micrantha* ssp. *ctenophylla*)—An endemic shrub that is a candidate, federally listed endemic species. It is restricted mostly to this part of the island of Hawai‘i and has small, attractive, yellow, sunflower-like flowers.

Kukui (*Aleurites moluccana*)—This species is a Polynesian introduction to Hawai‘i rather than a native species, but it has important cultural significance since it seeds were traditionally used for night time illumination (hence its English name candlenut). Currently the seeds are used to produce massage oil and the fruits are fashioned into attractive seed leis. Its gray-green leaves and large stature make it a popular ornamental tree in Hawai‘i.

Mamane (*Sophora chrysophylla*)—An endemic small tree or shrub common on the Big Island, especially at higher elevations. It has attractive yellow, sweetpea-like flowers and an unusual, bead-necklace-like pod.

Naio (*Myoporum sandwicense*)—An indigenous small tree or shrub with small, fragrant white flowers. Its English name is false sandalwood, indicative of its fragrant wood once used like sandalwood. The plant is easily grown from cuttings.

‘Ohe (*Reynoldsia sandwicensis*)—A large, fast growing endemic tree with an open canopy.

‘Ohi‘a lehua (*Metrosideros polymorpha*)—This is the indigenous, medium-sized tree covering much of the island, and has attractive red or yellow, powderpuff-like flowers. Some varieties also have attractive gray-green leaves. It was not found at the present study site, probably because the area does not get enough rainfall to allow it to flourish, but it dominates the intact forests upslope.

Pua pilo (*Capparis sandwichiana*)—An endemic shrub or small tree with large, attractive white, fragrant flowers. It is relatively rare in Hawai‘i, but does well on lowland lava flows.

‘Ulei (*Osteomeles anthyllidifolia*)—A sprawling indigenous shrub that makes a nice shrubby ground cover, but was not found at the site (but was reported by Char and Associates [1989] during their survey of the larger area). It has attractive but small, white, rose-like flowers (it is a member of the rose family).

Wiliwili (*Erythrina sandwicensis*)—A spreading endemic tree with showy seasonal red flowers, found in the area, but not recorded from the study site other than a few trees that appear to have been planted along Palani Road. It is a popular, long-lived, native ornamental tree in Hawai‘i that is related to the ornamental coral tree (*Erythrina variegata*).

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TABLE 2. CHECKLIST OF PLANT SPECIES

The following is a checklist of the vascular plants inventoried during the field studies on the Hawaii Housing Finance and Development Corporation's Keahuolu Affordable Housing project parcel. The plants are divided into three groups, Ferns (including fern allies), Monocots, and Dicots. Within these groups, the species are presented taxonomically by family, with each family and each species in the family in alphabetical order. The taxonomy and nomenclature of the ferns follow Palmer 2003 and the flowering plants (Monocots and Dicots) follow Wagner *et al*. (1990). In most cases, common English and/or Hawaiian names listed here have been taken from St. John (1973) or Porter (1972).

For each species, the following information is provided:

1. Scientific name with author citation.
2. Common English and/or Hawaiian name, when known.
3. Biogeographic status. The following symbols are used.
   - E = endemic (found only in Hawai‘i).
   - I = indigenous (native to Hawai‘i as well as other geographic areas).
   - P = Polynesian introduction (introduced to Hawai‘i by Polynesians before the advent of the Europeans).
   - X = Introduced or alien (not native, introduced to Hawai‘i, either accidentally or intentionally, after the advent of the Europeans).

Species	Common Names	Status
FERNS AND FERN ALLIES		
NEPHROLEPIDACEAE (Sword Fern Family)		
Nephrolepis exaltata (L.) Schott	kupukupu	I
POLYPODIACEAE (Common Fern Family)		
Phymatosorus grossus (Langsd. & Fisch.) Brownlie	laua‘e	X
PSILOTACEAE (Psilotum Family)		
Psilotum nudum L.	moa	I
MONOCOTS		
COMMELINACEAE (Spiderwort Family)		
Rhoeo spathacea (Sw.) Stearn	oyster plant	X
POACEAE (Grass Family)		
Chloris barbata (L.) Sw.	swollen fingergrass	X
Heteropogon contortus (L.) P. Beauv. ex Roem. & Schult.	pili grass	I?
Panicum maximum Jacq.	Guinea grass	X
Pennisetum setaceum (Forssk.) Chiov.	fountain grass	X
Rhynchelytrum repens (Willd.) C.E. Hubb.	Natal redtop	X

Species	Common Names	Status
	DICOTS	
ACANTHACEAE (Acanthus Family)		
Barleria cristata L.	Philippine violet	X
ANACARDIACEAE (Mango Family)		
Schinus terebinthifolius Raddi	Christmas berry	X
APOCYNACEAE (Periwinkle Family)		
Catharanthus roseus (L.) G. Don	Madagascar periwinkle	X
ARISTOLOCHIACEAE (Dutchman's Pipe Family)		
Aristolochia littoralis Parodi	pelican flower	X
ARALIACEAE		
Reynoldsia sandwicensis A. Gray	'ohe	E
Schefflera actinophylla (Endl.) Harms	octopus tree	X
ASCLEPIADACEAE (Milkweed Family)		
Stapelia gigantea N.E. Brown	carrion flower	X
ASTERACEAE (Sunflower Family)		
Bidens cynapiifolia Kunth	West Indian beggar's-tick	X
Bidens micrantha Gaud. ssp. *ctenophylla* (Sherff) Nagatga & Ganders	----------	E
Bidens pilosa L.	beggar's-tick	X
Emilia sonchifolia (L.) DC.	pualele, emilia	X
Pluchea carolinensis (Jacq.) G. Don	pluchea	X
Tridax procumbens L.	coat buttons	X
BIGNONIACEAE (Bignonia Family)		
Jacaranda mimosifolia D. Don	jacaranda	X
Spathodea campanulata P. Beauv.	African tulip tree	X
BUDDLEIACEAE (Butterfly-bush Family)		
Buddleia asiatica Lour.	dogtail, heulo'ilio	X
CACTACEAE (Cactus Family)		
Opuntia ficus-indica (L.) Mill.	prickly pear, panini	X
CANNABACEAE (Marijuana Family)		
Cannabis sativa L.	pakalolo, marijuana	X
CAPPARACEAE (Caper Family)		
Capparis sandwichiana DC	pua pilo	E
Cleome gynandra L.	African spider flower	X
CARICACEAE (Papaya Family)		
Carica papaya L.	papaya	X
CLUSIACEAE (Mangosteen Family)		
Clusia rosea Jacq.	autograph tree	X
CONVOLVULACEAE (Morning-Glory Family)		
Ipomoea indica (J. Burm.) Merr.	koali-'awa	I
Ipomoea obscura (L.) Ker-Gawl.	bindweed	X

Species	Common Names	Status
CRASSULACEAE (Stonecrop Family)		
Kalanchoë pinnata (Lam.) Pers.	air plant	X
Kalanchoë tubiflora (Haw.) Raym.-Hamet	chandelier plant	X
CUCURBITACEAE (Gourd Family)		
Coccinea grandis (L.) Voigt	ivy gourd	X
Momordica charantia L.	wild bittermelon	X
CUSCUTACEAE (Dodder Family)		
Cuscuta sandwichiana (Cuscutaceae)	kauna ‘oa	E
EUPHORBIACEAE (Spurge Family)		
Aleurites moluccana (L.) Willd.	candlenut, kukui	P
Chamaesyce hirta (L.) Millsp.	garden spurge	X
Euphorbia heterophylla L.	kaliko	X
Phyllanthus debilis Klein ex Willd.	phyllanthus weed	X
Ricinus communis L.	castor bean	X
FABACEAE (Pea Family)		
Abrus precatorius L.	rosary pea	X
Acacia farnesiana (L.) Willd.	klu	X
Chamaecrista nictitans (L.) Moench	partridge pea, lau-ki	X
Crotalaria pallida Aiton	smooth rattlepod	X
Desmodium tortuosum (Sw.) DC.	Florida beggarweed	X
Erythrina sandwicensis	wiliwili	E
Indigofera suffruticosa Mill.	indigo, ‘iniko	X
Leucaena leucocephala (Lam.) de Wit	koa haole	X
Macroptilium lathyroides (L.) Urb.	cow pea	X
Pithecellobium dulce (Roxb.) Benth.	‘opiuma, Manila tamarind	X
Prosopis pallida (Humb. & Bonpl.ex Willd.) Kunth	kiawe, mesquite	X
Samanea saman (Jacq.) Merr.	monkeypod	X
Senna occidentalis (L.) Link	coffee senna	X
Sophora chrysophylla (Salisb.) Seem.	mamane	E
LAMIACEAE (Mint Family)		
Hyptis pectinata (L.) Poir.	comb hyptis	X
MALVACEAE (Mallow Family)		
Malvastrum coromandelianum (L.) Garcke	false mallow	X
Sida fallax Walp.	‘ilima	I
Sida spinosa L.	prickly sida	X
MENISPERMACEAE (Moonseed Family)		
Cocculus trilobus (Thunb.) DC.	huehue	I

Species	Common Names	Status
MORACEAE (Mulberry Family)		
Ficus microcarpa L. f.	Chinese banyan	X
Ficus rubiginosa Desf.	Port Jackson fig	X
Morus alba L.	mulberry	X
MYRTACEAE (Myrtle Family)		
Psidium guajava L.	guava	X
NYCTAGINACEAE (Four-o'-Clock Family)		
Boerhavia coccinea Mill.	----------	X
Bougainvillea glabra Choisy	bougainvillea	X
PASSIFLORACEAE (Passionflower Family)		
Passiflora foetida L.	love-in-a-mist	X
PHYTOLACCACEAE (Pokeweed Family)		
Rivina humilis L.	rouge plant	X
PIPERACAEAE (Pepper Family)		
Peperomia leptostachya Hooker & Arnott	‘ala‘ala-wai-nui	I
PLUMBAGINACEAE (Leadwort Family)		
Plumbago zeylanica L.	‘ilie‘e	I
PORTULACACEAE (Purslane Family)		
Portulaca oleracea L.	common purslane	X
Portulaca pilosa L.	‘ihi	X
Talinum triangulare (Jacq.) Willd.	talinum	X
PROTACEAE (Protea Family)		
Macadamia ternifolia F. Muell.	macadamia	X
RUBIACEAE (Coffee Family)		
Morinda citrifolia L.	Indian mulberry, noni	P
Psydrax odoratum (Forst. f.) A. C. Sm. & S. Darwin	alahe‘e	I
SAPINDACEAE (Soapberry Family)		
Dodonaea viscosa Jacq.	‘a‘ali‘i	I
STERCULIACEAE (Cacao Family)		
Waltheria indica L.	‘uhaloa	I
VERBENACEAE (Verbena Family)		
Lantana camara L.	lantana	X
Stachytarpheta cayennensis (Rich.) Vahl	blue rat's-tail	X

Fig. 3. *Prosopis* Woodland near Palani Road on the south side of the study site.

Fig. 4. *Leucaena* Scrub at lower elevations at the study site.

Fig. 5. *Leucaena* scrub at upper elevations of the study site.

Fig. 6. *Schinus*/*Psydrax* Scrub at the study site.

Fig. 7. A‘a lava flow at the study site.

B-2

January 2008

Botanical Survey
of the
Keahuolu Affordable Housing Project
Proposed Reservoir Site,
North Kona,
Island of Hawai‘i

by

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Report prepared for

Belt Collins Hawai‘i Ltd.
Honolulu, Hawai‘i

January 2008

INTRODUCTION

The study site comprises a parcel of land proposed for construction of a reservoir that will service the Keahuolu Affording Housing Project (Fig. 1). It is located adjacent to the northeast corner of the housing project site at an elevation of about 595 feet. Its 7.8-acre area comprises a 530 x 520 ft reservoir site and a 1100 x 50 foot access road. It is located on TMK (3) 7-4-21: portion of 014 and portion of 021. The construction of the facility requires an up-to-date botanical survey, especially since federally listed, threatened and endangered plant species occur in the general vicinity. The site is currently covered with a scrubby vegetation dominated by native and alien shrub and tree species on lava flows of various ages.

A botanical survey was carried out nineteen years ago by Char and Associates (1989) on the area adjacent to the reservoir site, and included a much larger area comprising 1100 acres, some of it extending west of the present study site and makai of the Queen Kaʻahumanu Highway. Another botanical survey was carried out in 2007 on the Keahuolu parcel (Whistler 2007), which is contiguous with the present study site.

The objectives of the current field study were to provide a general description of the vegetation types present (particularly any sensitive types that may harbor rare plant species), to make a checklist of all native and naturalized vascular plants found, and to search for threatened and endangered species.

METHODOLOGY

Before the fieldwork was carried out, a review of the literature was undertaken by the Principal Investigator (PI). The current status of any endangered species previously reported from the general area was checked using the official database of threatened and endangered species (USFWS 2005). This list is identical to the State of Hawaiʻi list of threatened and endangered plant species. In addition, information about threatened and endangered plant species found in the area was extracted from the Hawaiʻi Natural Heritage Program database (Anon. 2005) of federally listed plant species, and is presented here in the form of a map of these collections and sightings (Fig. 2). Topographic maps and aerial photos were studied to determine the best access points and to locate places where native species are most likely to be found (lava flows).

After the literature review, a botanical field survey was conducted at the site by a two-person botanical team consisting of the PI (Art Whistler) and a Field Assistant (Beate Neher) on 5 and 15 December 2007. The site was accessed from Keanalehu Drive, a narrow road leading from Kealakehe High School to Palani Road to the east. A walk-through survey, involving walking parallel lines through the site, was employed to study the vegetation and flora. All plant species encountered during the survey were recorded, along with an indication of their frequency. Particular care was taken in ʻaʻa areas, since this type of habitat is where native species, including threatened and endangered plants, are most likely to occur. New lists were made for each vegetation type and/or day, and these were combined into a comprehensive checklist of all plants found at the study site (see Table 2 in the Appendix). Notes were also taken on vegetation types present, indicating the dominance and frequency of the plant species found there. These were later analyzed and written up to form the vegetation section below. All of the species encountered during the fieldwork were familiar to the field team and were identified in the field.

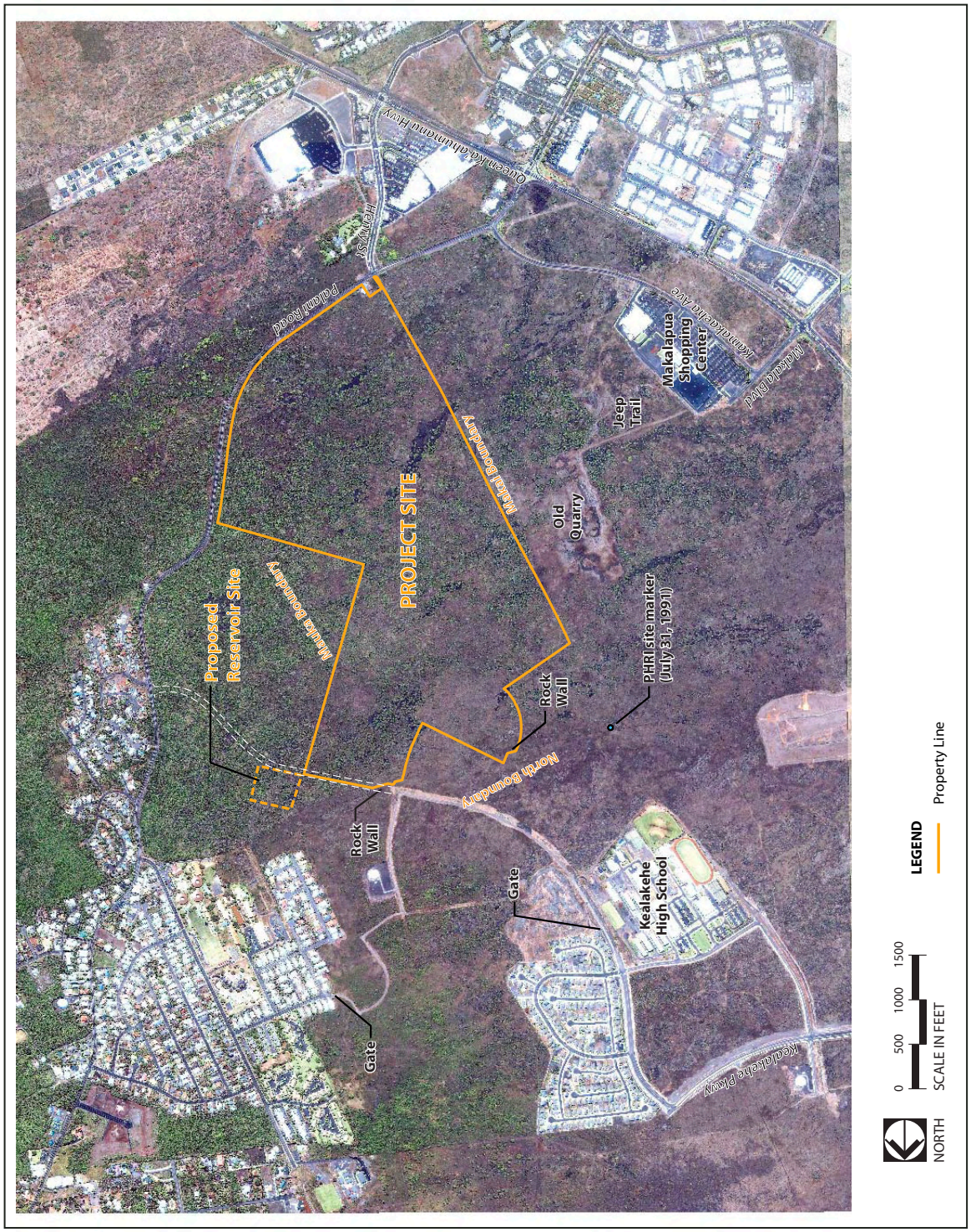

Fig. 1. The Keahuolu Affordable Housing Project Proposed Reservoir study site.

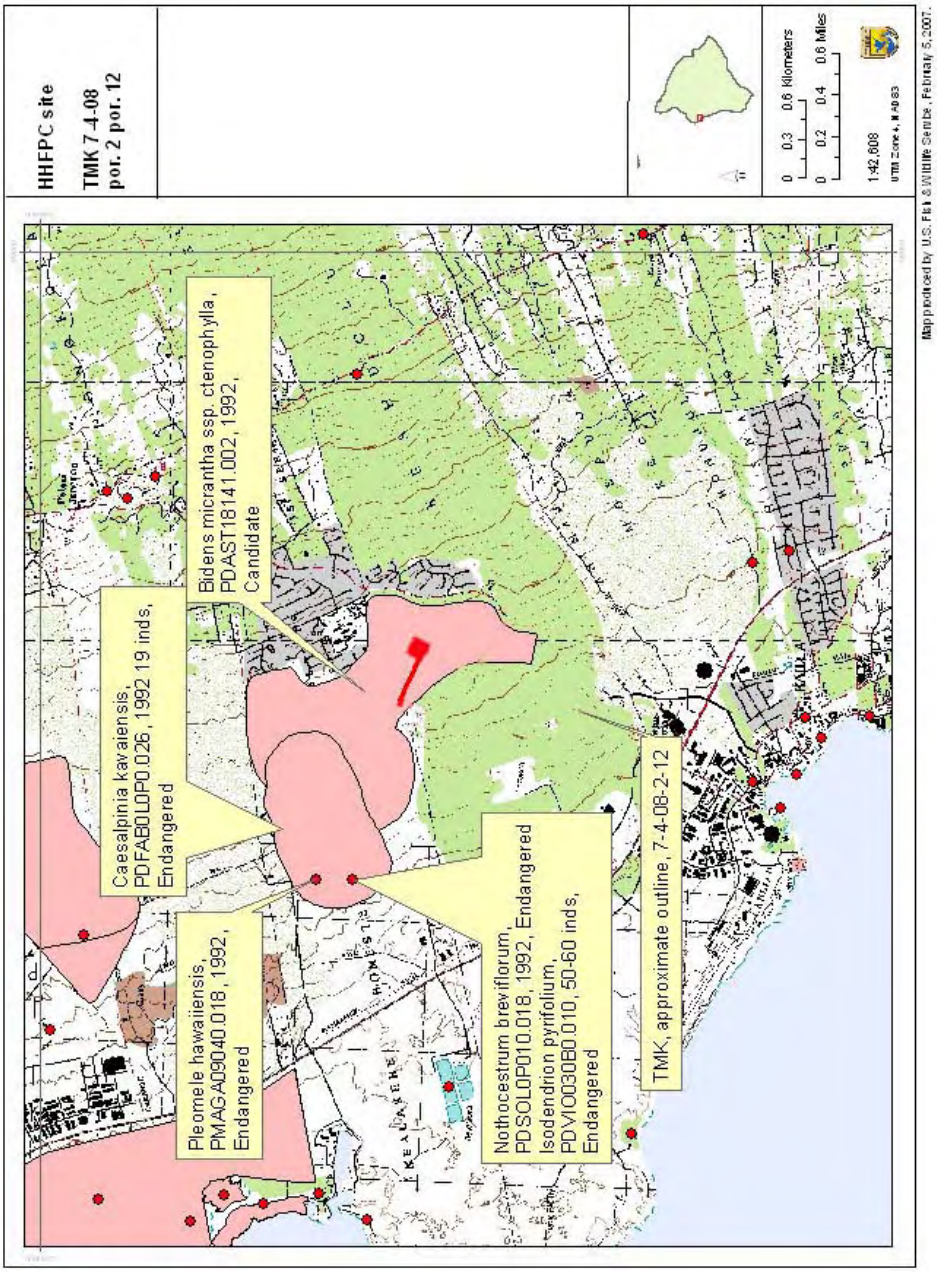

Fig. 2. Hawai‘i Natural Heritage Program map of federally listed plant species in the area, with the study site indicated in red.

Only two types of vegetation can be recognized at the study site: (1) Managed Land Vegetation; and (2) *Schinus*/*Psydrax* Scrub. These are described below.

(1) Managed Land Vegetation

This comprises land that is under periodic or frequent management, such as dirt roads or recently bulldozed tracks. It is a relatively minor component of the overall vegetation at the study site, where it consists only of a short, recently bulldozed track dominated mostly by weeds, particularly the alien subshrub coffee senna (*Senna occidentalis*), fountain grass (*Pennisetum setaceum*), koa haole (*Leucaena leucocephala*), and talinum (*Talinum triangulare*).

(2) *Schinus*/*Psydrax* Scrub

This is the type of vegetation that covers the whole reservoir site and proposed access road, and is particularly characteristic of more recent lava flows, ones that are decidedly composed of ‘a‘a lava (Fig. 3). It is the same vegetation described by Char and Associates (1989) as "*Canthium*/ Christmas Berry Shrubland" (*Canthium* is the old name for *Psydrax*). It is also the same vegetation at the Keahuolu Affordable Housing Project described by Whistler (2007) under the same name, but the amount of the alien koa haole (*Leucaena leucocephala*) present is nearly equal to that of the other two main species—the alien Christmas berry (*Schinus terebinthifolius*) and the indigenous alahe‘e (*Psydrax odoratum*).

Other less common native tree and shrub species found here include the indigenous ‘a‘ali‘i (*Dodonaea viscosa*) and ‘ilima (*Sida fallax*), the endemic mamane (*Sophora chrysophylla*) and *Bidens micrantha* ssp. *ctenophylla*. Several other alien tree and shrub species are also occasional to uncommon here, including silk oak (*Grevillea robusta*), jacaranda (*Jacaranda mimosifolia*), autograph tree (*Clusia rosea*), Chinese banyan (*Ficus microcarpa*), monkey pod (*Samanea saman*), guava (*Psidium guajava*), klu (*Acacia farnesiana*), and the Polynesian-introduced noni (*Morinda citrifolia*).

The ground cover is sparse in this type of vegetation, with scattered clumps of fountain grass (*Pennisetum setaceum*) found mostly in pockets of soil or pahoehoe, and perhaps being the most common herbaceous species present (Fig. 4). The ground cover is particularly sparse under the dense canopy of the Christmas berry trees, which are sometimes spreading and cast a denser shade than most of the other species. Second in importance in the ground cover is probably the alien grass Natal redtop (*Rhynchelytrum repens*), which occurs mostly in patches. The indigenous herbaceous vine huehue (*Cocculus trilobus*) is common climbing over the low trees, and the indigenous vine kowali-‘awa (*Ipomoea indica*) occurs in a few patches. Scattered pockets or individuals of the thorny alien shrub *Lantana camara* (lantana) are also present. Other native species present include the herbs ‘ala‘ala-wai-nui (*Peperomia leptostachya*) and spurflower (*Plectranthus parviflorus*), and the subshrub ‘uhaloa (*Waltheria indica*). Other alien ground cover species include the succulent air plant (*Kalanchoë pinnatum*), partridge pea (*Chamaecrista nictitans*), and Madagascar periwinkle (*Catharanthus roseus*).

This vegetation is classified as disturbed because of the high number of alien species present. The main disturbance is caused by fires that periodically sweep through the vegetation. Additionally, goats probably occur in the area and affect its vegetation by grazing. The current vegetation somewhat matches the description of the "Lowland Dry Shrublands" noted in Wagner

et al. (1999). It was described as being open and not exceeding 10 ft in height, and as occurring in leeward situations on most of the main islands from 330 to 2000 ft elevation.

THE FLORA

Forty plant species were recorded at the study site. The majority of these are naturalized "alien" plants that were accidentally or intentionally introduced to Hawai‘i, but which have now become established in the islands and can spread on their own. The remaining plants, which are termed native species, comprise indigenous and endemic species. Indigenous plants are species that are native to a region or place, but are also found elsewhere. Endemic plants are species restricted to a single region or area, i.e., in the case of Hawai‘i, they are found only in Hawai‘i. In biodiversity terms, the endemic status is the more important of the two categories, since if a species belonging to it is endangered or threatened in Hawai‘i, it would likewise be classified globally. Indigenous species, however, can be rare in Hawai‘i, but may be common elsewhere in the Pacific. Over 90% of the native plants in Hawai‘i are endemic, one of the highest rates in the world.

The reservoir site contained, among its 40 recorded species, ten native plant species—two endemic and eight indigenous species. A checklist of all species found at the site is shown in Table 2 in the Appendix.

Table 1. Native species recorded at the reservoir site.

Species	Common Name
Endemic Species	
Bidens micrantha ssp. *ctenophylla*	----------
Sophora chrysophylla	mamane
Indigenous Species	
Cocculus trilobus	huehue
Dodonaea viscosa	‘a‘ali‘i
Ipomoea indica	koali-‘awa
Peperomia leptostachya	‘ala‘ala-wai-nui
Plectranthus parviflorus	spurflower
Psydrax odoratum	alahe‘e
Sida fallax	‘ilima
Waltheria indica	‘uhaloa

DISCUSSION

Based upon the survey, two main kinds of vegetation occur at the study site: (1) Managed Land Vegetation; and (2) *Schinus*/*Psydrax* Scrub. Both of these are highly disturbed. No sensitive types of vegetation are present. Sensitive vegetation types include wetlands and

dryland forest. No wetland could occur at the study site due to its dry, lava-covered surface. Dryland forest with sensitive plant species is found at Kaloko to the north of the present study site, but none was encountered at the study site itself.

Forty plant species were recorded at the reservoir site, ten of them native—two endemic and eight indigenous species. No species federally listed as threatened or endangered were found. One endemic subshrub present, *Bidens micrantha* ssp. *ctenophylla*, was at one time considered a candidate species for one of these categories, but it has no current protected status. It occurs in other places north of Kona, where it is sometimes found even in disturbed places such as quarries (Whistler 2006). It is shown in the Hawai‘i Natural Heritage Program Database map (Fig. 2) as occupying the area of the reservoir site, and this was found to be true.

Several threatened or endangered species have been reported in the area of the reservoir site, and are shown on the Hawai‘i Natural Heritage Program database map. Uhiuhi (*Caesalpinia kavaiensis*) was recorded north of the reservoir site, but it was not found during the present study nor in the larger study area surveyed for the main part of the Keahuolu housing (Whistler 2007). There is a single record of hala pepe (*Pleomele hawaiiensis*) collected in the uhiuhi area northwest of the study site in 1992, but it was not seen by Char and Associates (1989) in the larger area south of this population nor during the earlier Keahuolu study (Whistler 2007). There is a relatively large population of it at Kaloko a few miles north of the current study site (Whistler 2006). ‘Aaea (*Nothocestrum brevifolium*) was found in 1992 near the record of hala pepe, but it was not seen by Char and Associates (1989) in the larger area south of this population, nor during the earlier Keahuolu study (Whistler 2006). At about the same point, a population of about 50 to 60 individuals of aupaka (*Isodendrion pyrifolium*) was found in 1992, but this shrub was not seen by Char and Associates in the larger area south of this population, nor during the earlier Keahuolu study (Whistler 2007). Consequently, no endangered or threatened species are found at either study site.

CONCLUSIONS AND RECOMMENDATIONS

Forty plant species were recorded from the study site, 30 of them alien species and ten of them are native—two endemic and eight indigenous species. None of these are federally listed as “threatened” or “endangered.” No areas of wetlands or undisturbed native vegetation occur at the site. Consequently, there are no botanical impediments to carrying out the proposed construction.

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APPENDIX

Table 3. Checklist of Plant Species at the Reservoir Site

The following is a checklist of the vascular plants inventoried during the field studies on the Keahuolu Affordable Housing project well and reservoir sites. The plants are divided into three groups, Ferns (including fern allies), Monocots, and Dicots. Within these groups, the species are presented taxonomically by family, with each family and each species in the family in alphabetical order. The taxonomy and nomenclature of the ferns follow Palmer 2003 and the flowering plants (Monocots and Dicots) follow Wagner *et al*. (1990). In most cases, common English and/or Hawaiian names listed here have been taken from St. John (1973) or Porter (1972).

For each species, the following information is provided:

1. Scientific name with author citation.
2. Common English and/or Hawaiian name, when known.
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   - E = endemic (found only in Hawai‘i).
   - I = indigenous (native to Hawai‘i as well as other geographic areas).
   - P = Polynesian introduction (introduced to Hawai‘i by Polynesians before the advent of the Europeans).
   - X = Introduced or alien (not native, introduced to Hawai‘i, either accidentally or intentionally, after the advent of the Europeans).

Species	Common Names	Status[1]
FERNS AND FERN ALLIES		
POLYPODIACEAE (Common Fern Family)		
Phymatosorus grossus (Langsd. & Fisch.) Brownlie	laua‘e	X
MONOCOTS		
CYPERACEAE (Sedge Family)		
Cyperus compressus L.	----------	X
POACEAE (Grass Family)		
Melinus minutiflora P. Beauv.	molasses grass	X
Pennisetum setaceum (Forssk.) Chiov.	fountain grass	X
Rhynchelytrum repens (Willd.) C.E. Hubb.	Natal redtop	X
DICOTS		
ANACARDIACEAE (Mango Family)		
Schinus terebinthifolius Raddi	Christmas berry	X
APOCYNACEAE (Periwinkle Family)		
Catharanthus roseus (L.) G. Don	Madagascar periwinkle	X

Species	Common Names	Status[1]
ASCLEPIADACEAE (Milkweed Family)		
Stapelia gigantea N.E. Brown	carrion flower	X
ASTERACEAE (Sunflower Family)		
Bidens micrantha Gaud. ssp. *ctenophylla* (Sherff) Nagatga & Ganders	----------	E
Bidens pilosa L.	beggar's-tick	X
BIGNONIACEAE (Bignonia Family)		
Jacaranda mimosifolia D. Don	jacaranda	X
Spathodea campanulata P. Beauv.	African tulip tree	X
CLUSIACEAE (Mangosteen Family)		
Clusia rosea Jacq.	autograph tree	X
CONVOLVULACEAE (Morning-Glory Family)		
Ipomoea indica (J. Burm.) Merr.	koali-'awa	I
CRASSULACEAE (Stonecrop Family)		
Kalanchoë pinnata (Lam.) Pers.	air plant	X
FABACEAE (Pea Family)		
Abrus precatorius L.	rosary pea	X
Acacia farnesiana (L.) Willd.	klu	X
Chamaecrista nictitans (L.) Moench	partridge pea, lau-ki	X
Indigofera suffruticosa Mill.	indigo, 'iniko	X
Leucaena leucocephala (Lam.) de Wit	koa haole	X
Samanea saman (Jacq.) Merr.	monkeypod	X
Senna occidentalis (L.) Link	coffee senna	X
Sophora chrysophylla (Salisb.) Seem.	mamane	E
Tephrosia purpurea (L.) Pers.	auhuhu `	P
LAMIACEAE (Mint Family)		
Plectranthus parviflorus Willd.	spurflower	I
MALVACEAE (Mallow Family)		
Sida fallax Walp.	'ilima	I
MENISPERMACEAE (Moonseed Family)		
Cocculus trilobus (Thunb.) DC.	huehue	I
MORACEAE (Mulberry Family)		
Ficus microcarpa L. f.	Chinese banyan	X
MYRTACEAE (Myrtle Family)		
Psidium guajava L.	guava	X
PHYTOLACCACEAE (Pokeweed Family)		
Rivina humilis L.	rouge plant	X
PIPERACAEAE (Pepper Family)		
Peperomia leptostachya Hooker & Arnott	'ala'ala-wai-nui	I
PORTULACACEAE (Purslane Family)		
Talinum triangulare (Jacq.) Willd.	talinum	X

Species	Common Names	Status[1]	Site 1	Site 2

PROTACEAE (Protea Family)		
Grevillea robusta A. Cunn. ex R. Br.	silk oak	X
RUBIACEAE (Coffee Family)		
Morinda citrifolia L.	Indian mulberry, noni	P
Psydrax odoratum (Forst. f.) A. C. Sm. & S. Darwin	alahe‘e	I
SOLANACEAE (Nightshade Family)		
Solanum americanum Mill.	black nightshade, popolo	I?
SAPINDACEAE (Soapberry Family)		
Dodonaea viscosa Jacq.	‘a‘ali‘i	I
STERCULIACEAE (Cacao Family)		
Waltheria indica L.	‘uhaloa	I
VERBENACEAE (Verbena Family)		
Lantana camara L.	lantana	X
Stachytarpheta cayennensis (Rich.) Vahl	blue rat’s-tail	X

Status[1]: I = Indigenous. E = Endemic. X = Alien (introduced). P = Polynesian introduction.

Fig. 3. A‘a flow at the study site, with the margins dominated by several tree species.

Fig. 4. Fountain grass dominating in an opening at the study site.

Appendix C

C-1

May 2008

AVIFAUNAL AND FERAL MAMMAL SURVEY OF THE PROPOSED KEAHUOLU AFFORDABLE HOUSING PROJECT AND RESERVOIR SITE, NORTH KONA, ISLAND OF HAWAII

Report prepared for:

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30 May 2008

INTRODUCTION

The purpose of this report is to present the results of a two day (27, 28, May 2008) field survey of the proposed Keahuolu Affordable Housing Project and Reservoir site [TMK (3) 7-4-021: 020], and TMK (3) 7-4-021: Por. 021]. In addition to the data obtained from the field survey pertinent published and unpublished sources are also noted in the report. These sources add a broader perspective of the wildlife resources in this region of the island. In particular data are compared with an earlier study (Bruner 1989) that I conducted in this area and surrounding lands. The goals of the survey were:

1- Document the species of birds and mammals currently on the property.
2- Examine the site for the purpose of identifying the natural resources available to wildlife in this region.
3- Devote special attention to documenting the presence and possible use of this property by native and migratory species particularly those that are listed as threatened or endangered.

SITE DESCRIPTION

The property is presently covered in dense, second growth forest composed of primarily alien (non-native) species of trees, brush and grass. Surrounding lands contain residential, commercial, schools, and other similar undeveloped property (Fig. 1).

SURVEY PROTOCOL

The field survey was conducted over two consecutive days (27, 28 May 2008). Observations were made in the early morning and late in the day when birds are most active and more easily detected. The site was covered on foot and all birds seen or heard were noted. All four habitats recognized by Whistler (2007): Managed Land Vegetation, *Prosopis* Woodland, *Leucaena* Scrub, and *Schinus/Psydrax* Scrub were investigated. Observations of mammals were limited to visual sightings and evidence in the form of tracks and skeletal remains. No attempts were made to trap mammals in order to obtain relative abundance estimates. The evening of 27 May was devoted to a search for the presence of the endangered Hawaiian Hoary Bat (*Lasiurus cinereus semotus*). A Petterson Elektronic AB Ultrasound Detector D 100 was used to listen for echolocating bats at several sites on the property.

Weather during the survey was overcast. The winds were relatively light which made for easy detection of vocalizing birds. Scientific and common vernacular names used in this report follow Honacki et al. (1982), and Pyle (2002).

RESULTS AND DISCUSSION

Native land Birds:

No native land birds were observed on this survey. This was also the case in the Bruner (1989) survey. The only species that might on occasion be seen in this area are the endangered Hawaiian Hawk or ‘Io (*Buteo solitarius*)) and the Hawaiian Short-eared Owl or Pueo (*Asio flammeus sanwichensis*) (Pratt et al. 1987, Hawaii Audubon Society 2005). Pueo are not listed as endangered or threatened on the island of Hawaii, however, the State of Hawaii does list the population on Oahu as endangered. Aside from ‘Io and Pueo no other native land birds would be expected to occur on this property.

Native Waterbirds:

No native waterbirds were recorded and would not be expected on this site. No wetland habitat was found on the survey.

Seabirds:

No nesting seabirds were seen on the survey and would not be expected to nest in this area due to predators and human disturbance. Some species might on rare occasion be seen flying over the site (pers. observ.)

Migratory Birds:

No migratory shorebirds were observed. No habitat suitable for shorebirds currently occurs on this site.

Alien (Introduced) Birds:

Nineteen alien species were observed during the course of the survey. Table One notes these species along side those recorded during the Bruner (1989) survey. None of these birds are listed as threatened or endangered. The array of species was typical of what was found on recent (Bruner 2005, 2006a, 2006b) surveys in similar habitat in this region of the island.

Mammals:

Nine introduced Small Indian Mongooses (*Herpestes javanicus*) were tallied on the survey. The skeletal remains of a feral pig (*Sus scrofa*) and two live adult pigs were observed on 27 May 2008. No rats (*Rattus spp.*), mice (*Mus musculus*), or cats (*Felis catus*) were seen but likely occur on and around the property. No endangered Hawaiian Hoary Bats (*Lasiurus cinereus semotus*) were detected by the ultrasound device during a night search of the property on 27 May 2008. The Hawaiian Hoary bat generally roosts solitarily in trees. They forage for flying insects in a wide variety of habitats including forests, agricultural lands, urban areas, as well as over bays and ponds (Tomich 1986, Kepler and Scott 1990, Jacobs 1991, 1993, and Reynolds et al. 1998).

EXECUTIVE SUMMARY AND CONCLUSION

All habitats on the property were thoroughly surveyed. The birds and mammals found were those to be expected in this region of the Island of Hawaii and conformed to an earlier survey of this area and surrounding lands (Bruner 1989). The endangered ‘Io and the non-endangered Pueo occur in man- altered as well as native habitats throughout the Big Island. None were recorded on this or the Bruner (1989) survey. The endangered Hawaiian Hoary bat is frequently seen on the Island of Hawaii and Kauai but is much less common on the other islands. No bats were detected on this 2008 or the Bruner (1989) survey. The habitats on this property are not unusual or unique. Similar lands occur throughout this region. A change in land use at this site will produce some small, local increases and decreases in the populations of alien birds. Habitat for migratory shorebirds such as Pacific Golden-Plover (*Pluvialis fulva*) will become available as second growth forest is converted to lawns and residential habitat.

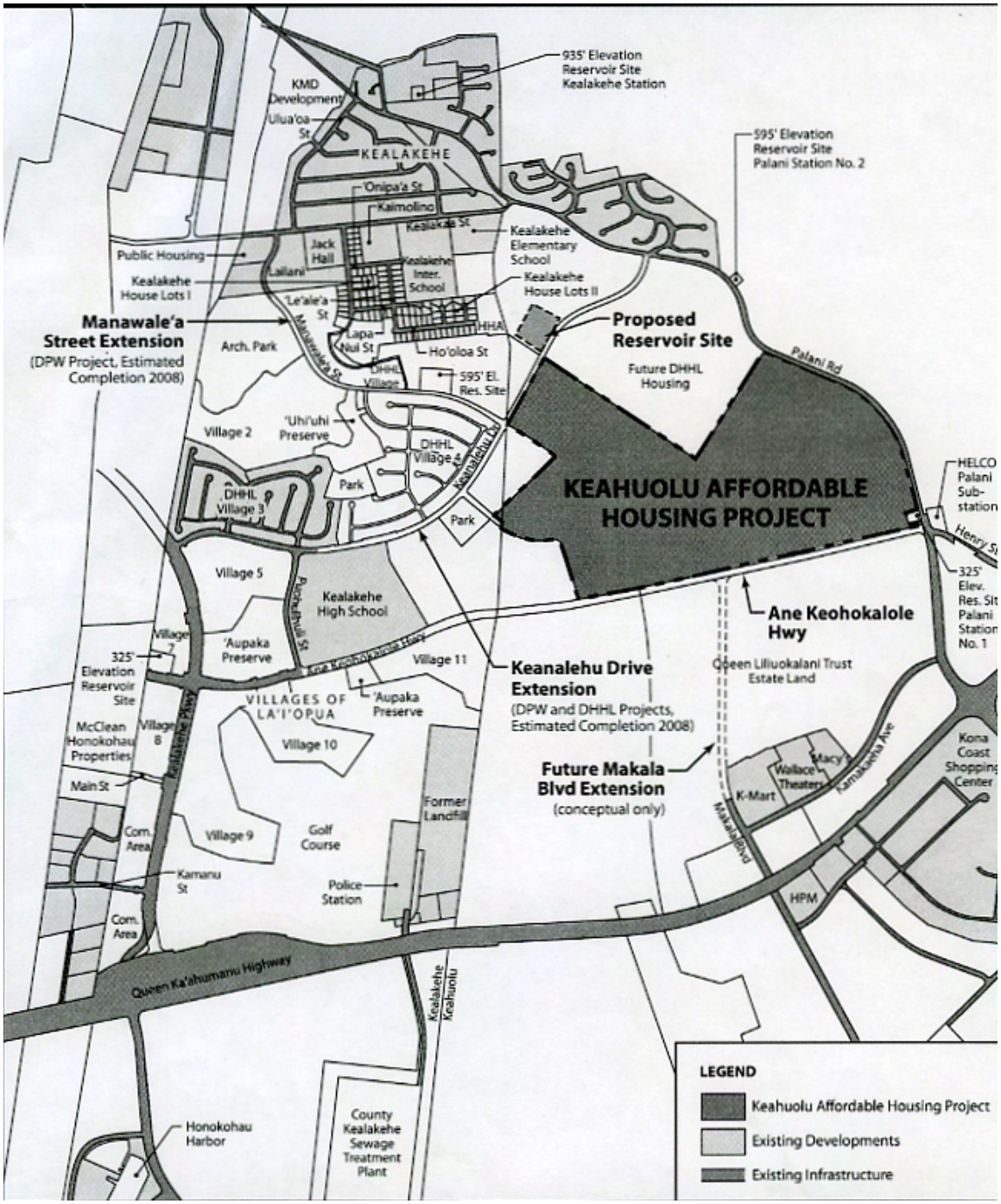

Fig. 1. Location of faunal survey at Keahuolu Affordable Housing Project and Proposed Reservoir Site.

TABLE ONE

Alien (introduced birds) found on the field survey conducted on 27, 28 May 2008 at the proposed Keahuolu Affordable Housing Project and Reservoir site, North Kona, Island of Hawaii. Alien species recorded on the Bruner (1989) survey of this area and surrounding lands are also shown for comparative purposes. An "* " indicates name change, a " +" indicates presence and a "–" not observed.

Common Name	Scientific Name	2008	1989
Gray Francolin	*Francolinus pondicerianus*	+	+
Black Francolin	*Francolinus francolinus*	+	+
Red Junglefowl *	*Gallus gallus*	+	+
Ring-necked Pheasant	*Phasianus colchicus*	-	+
Spotted Dove	*Streptopelia chinensis*	+	+
Wild Turkey	*Meleagris gallopavo*	+	-
Spotted Dove	*Streptopelia chinensis*	+	+
Zebra Dove	*Geopelis striata*	+	+
Parrot	*Psittacula spp.*	-	+
Barn Owl	*Tyto alba*	+	+
Japanese White-eye	*Zosterops japonicus*	+	+
Common Myna	*Acridotheres tristis*	+	+
Saffron Finch	*Sicalis flaveola*	+	-
Yellow-billed Cardinal	*Paroaria capitata*	+	+
Northern Cardinal	*Cardinalis cardinalis*	+	+
House Finch	*Carpodacus mexicanus*	+	+
Yellow-fronted Canary	*Serinus mozambicus*	+	-
House Sparrow	*Passer domesticus*	+	-
Lavender Finch	*Estrilda caerulescens*	-	+
African Silverbill **	*Lonchura cantans* **	+	+
Nutmeg Mannikin	*Lonchura punctulata*	+	+
Java Sparrow	*Padda oryzivora*	+	-

* Feral Chicken in 1989 study
** Warbling Silverbill in 1989 study
** *Lonchura malabarica* in 1989 study

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C-2

July 1989

SURVEY OF THE AVIFAUNA AND FERAL MAMMALS AT QUEEN LILIUOKALANI TRUST PROPERTY, KAILUA, KONA, HAWAII

Prepared for

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7 July 1989

SURVEY OF THE AVIFAUNA AND FERAL MAMMALS AT QUEEN LILIUOKALANI TRUST PROPERTY, KAILUA, KONA, HAWAII

INTRODUCTION

The purpose of this report is to summarize the findings of a four day (28 June-1 July 1989) bird and mammal field survey of Queen Liliuokalani Trust Property, Kailua, Kona, Hawaii (see Fig. 1). Also included are references to pertinent literature as well as unpublished reports.

The objectives of the field survey were to:

1- Document what bird and mammal species occur on the property or may likely occur given the type of habitats available.

2- Provide some baseline data on the relative abundance of each species as well as general habitat preferences.

3- Determine the presence or likely occurrence of any native fauna particularly any that are considered "Endangered" or "Threatened". If such occur or may likely be found on the property identify what

features of the habitat may be essential for these species and suggest how those resources may best be protected.

4- Determine if the property contains any special habitats that if lost or altered by development might result in a significant impact on the fauna in this region of the island.

GENERAL SITE DESCRIPTION

The project site is located on approximately 1,100 acres at Kailua, Kona, Hawaii (see Fig. 1). Both dry coastal as well as slightly wetter higher elevation second growth forest occur on the site. The makai sections contain grasslands with a few scattered low trees (Kiawe (Prosopis pallida) and Fountain Grass (Pennisetum setaceum) are the most abundant plants. A row of Ironwood (Casuarina spp.) border one side of the makai section of the property and provide a refuge for wildlife. Small coastal patches of forest also provide important habitat. The mauka property is covered by a dense second growth forest with Christmas Berry (Schinus terebinthifolius) one of the dominant species.

Weather during the field survey was variable with

clear mornings and cloudy afternoons. Winds were also variable with both calm and gusty periods. The direction of the wind was primarily from the east.

STUDY METHODS

Field observations were made with the aid of binoculars and by listening for vocalizations. These observations were concentrated during the peak bird activity periods of early morning and late afternoon. Attention was also paid to the presence of tracks and scats as indicators of bird and mammal activity.

At various locations (see Fig.1) eight minute counts were made of all birds seen or heard. Between these counts stations walking tallys of birds seen or heard were also kept. These data provide the basis for the relative abundance estimates given in this report. Unpublished reports of birds known from similar habitat on lands elsewhere in West Hawaii were also consulted in order to acquire a more complete picture of possible avifaunal activity (Bruner 1979, 1980, 1984a, 1984b, 1984c, 1985a, 1985b, 1985c, 1988a, 1988b, 1989). Observations of feral mammals were limited to visual sightings and evidence in the form of skeletal remains, scats and tracks. No attempts were made to trap mammals

in order to obtain data on their relative abundance and distribution. Three nights were devoted to searching for the presence of owls and the Hawaiian Hoary Bat (Lasiurus cinerus semotus).

Scientific names used herein follow those given in the most recent American Ornithologist's Union Checklist (A.O.U. 1983), Hawaii's Birds (Hawaii Audubon Society 1984), A Field Guide to the Birds of Hawaii and the Tropical Pacific)Pratt et al. 1987) and Mammal Species of the World (Honacki et al. 1982).

RESULTS AND DISCUSSION

Resident Endemic (Native) Land and Water Birds:

No endemic species were recorded during the course of the field survey. The Short-eared Owl or Pueo (Asio flammeus sandwichensis) might be expected to occur on occasion at this site. This species is relatively common on Hawaii particularly at higher elevations (Berger 1972, Hawaii Audubon Society 1984, Pratt et al. 1987). The Short-eared Owl is an endemic subspecies which is listed by the State of Hawaii Department of Land and Natural Resources, Division of Forestry and Wildlife as "endangered" on Oahu but not elsewhere in the State. Although not recorded on this field survey Pueo have been found in similar habitat elsewhere in West Hawaii. No other endemic birds

would be expected at this site given the location and nature of the habitats available. Several small anchialine ponds located on property makai of the actual site may provide occasional foraging opportunities for the endemic and endangered Black-necked Stilt or Ae'o (Himantopus mexicanus knudseni).

Migratory Indigenous (Native) Birds:

Migratory shorebirds winter in Hawaii between the months of August through May. Some juveniles will stay through the summer months as well (Johnson et al. 1983, 1989). Of all the shorebird species which winter in Hawaii the Pacific Golden Plover (Pluvialis fulva) is the most abundant. Plovers prefer open areas such as mud flats, lawns, pastures, plowed fields and roadsides. They arrive in Hawaii in early August and depart to their arctic breeding grounds during the last week of April (Johnson et al. 1981). Bruner (1983) and Johnson et al. (1989) have also shown plover are extremely site-faithful on their wintering grounds and many establish foraging territories which they defend vigorously. Such behavior makes it possible to acquire a fairly good estimate of the abundance of plover in any one area. These populations likewise remain relatively stable over many years. No plover were recorded during the survey.

This result was not unexpected due to the time of year of the survey. The present nature of the habitat, however, is largely unsuitable for plover as the vegetation is much too tall and dense. It is likely that during the time of year when plover are in Hawaii that very few actually utilize this property. Two migratory species were recorded along the shoreline makai of the property, Ruddy Turnstone (Arenaria interpres) and Wandering Tattler (Heteroscelus incanus).

Resident Indigenous (Native) Birds:

No indigenous species were recorded nor would any be expected at this site. Black-crowned Night Heron (Nycticorax nycticorax) probably forage infrequently at the anchialine ponds makai of the actual property.

Resident Indigenous (Native) Seabirds:

No seabirds were observed on the property. Some seabirds nest and roost in barren lava flows in Hawaii but at a much higher elevation than the project property (Pratt et al. 1987).

Exotic (Introduced) Birds:

A total of 17 species of exotic birds were recorded during the field survey. Table One shows the relative

abundance of each species as well as general habitat preferences. The most abundant species were Japanese White-eye (Zosterops japonicus), Nutmeg Mannikin (Lonchura punctulata), and Zebra Dove (Geopelia striata). Black Francolin (Francolinus francolinus) and Gray Francolin (Francolinus pondicerianus) were also common. Given the present habitat and based on previous surveys (Bruner 1979, 1980, 1984a, 1984b, 1984c, 1985a, 1985b, 1985c, 1988a, 1988b) as well as information provided in Berger (1972), Hawaii Audubon Society (1984), and Pratt et al. (1987) the following exotic bird species might also occur on or near the property: Erckel's Francolin (Francolinus erckelii), California Quail (Callipepla californica), Japanese Quail (Coturnix japonica), and Northern Mockingbird (Mimus polyglottos). The most unexpected sightings were the Lavender Waxbill (Estrilda caerulescens) and a parrot (Psittacula spp?). The parrot,probably an escaped pet, was seen flying over the upper section of the property. The bird was all green with a long pointed tail but was too far away to determine the exact species.

Feral Mammals:

A total of 18 Small Indian Mongoose (Herpestes auropunctatus) were seen during the survey. Two cats

were also recorded along with the skeletal remains of pigs and cows. Evidence of rats and mice were also found. Although no trapping was done in order to assess the relative abundance of mammals on this property, there was no obvious indication that the feral mammals in this area were more or less numerous than elsewhere in similar habitat in West Hawaii.

Records of the endemic and endangered Hawaiian Hoary Bat (Lasiurus cinerus semotus) are sketchy but the species has been reported from Hawaii (Tomich 1986). None were observed on this field survey despite three nights of observations. This species roosts solitarily in trees. Much remains to be known about the natural history of this bat and its ecological requirements here in Hawaii. Bruner (1984d) found bats on the Sheraton Waikoloa Beach Resort property located to the NW of this site.

CONCLUSION

A brief field survey can at best provide only a limited perspective of the wildlife present in any given area. Not all species will necessarily be observed and information on their use of the site must be sketched together from brief observations and the

available literature. The number of species and the relative abundance of each species may vary throughout the year due to available resources and reproductive success. Species which are migratory will quite obviously be a part of the faunal picture only at certain times during the year. Exotic species sometimes prosper for a time only to later disappear or become a less significant part of the ecosystem (Williams 1987). Thus only long term studies can provide an in depth view of the bird and mammal populations in a particular area. However, when brief field studies are coupled with data gathered from other similar habitats the value of the conclusions drawn are significantly increased.

The following are some general conclusions related to bird and mammal activity on the property.

1- The present habitat provides a limited range of living spaces which are utilized by the typical array of exotic species of birds one would expect at this elevation and in this type of environment in Hawaii. However, some species typically found in this habitat were not recorded. This could have been due to the fact that the survey was too brief or that their numbers are so low that they went undetected or a combination of these and other factors. No endemic birds or seabirds were recorded

nor would they be expected to occur on this property. The creation of open short grass habitat such as lawns will increase the usuable space for birds like Pacific Golden Plover.

2- The proposed development will create a more urban environment. Species which might increase in abundance on the site following development include: Common Myna (Acridotheres tristis) and the ubiquitous House Sparrow (Passer domesticus). This latter species is typically limited to areas of human activity. Other species such as Japanese White-eye (Zosterops japonicus), Warbling Silverbill (Lonchura malabarica) and game birds like Black Francolin (Francolinus francolinus) may decline in number.

3- In order to obtain more definitive data on mammals, a trapping program would be required. No endangered species were observed. Populations of Mongoose, mice and rats may increase slightly following the development of the property.

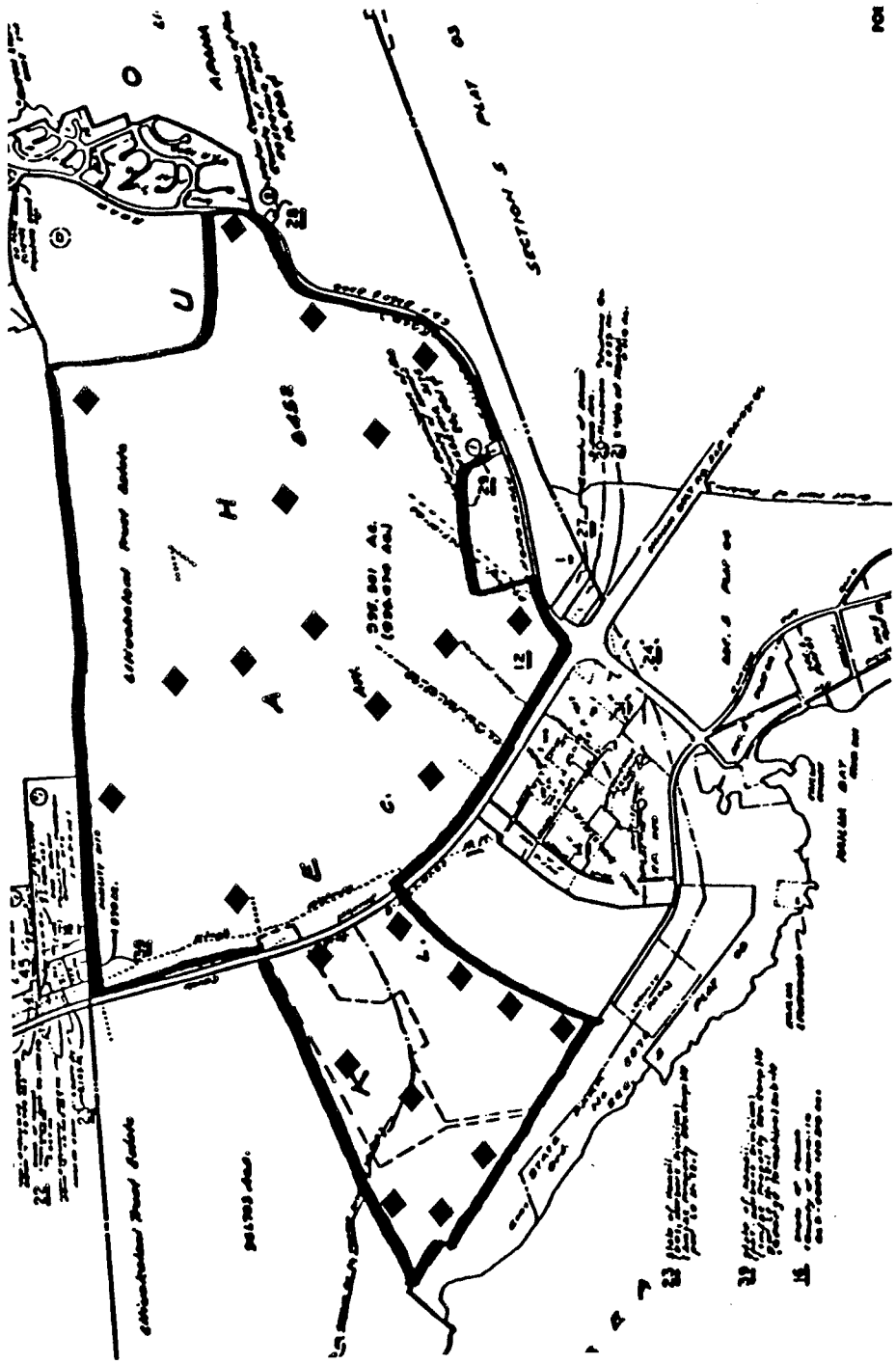

Fig. 1. Project property with eight minute count stations marked by a ◆.

TABLE 1

Exotic species of birds recorded on Queen Liliuokalani Truat Property, Kailua, Kona, Hawaii.

COMMON NAME	SCIENTIFIC NAME	RELATIVE ABUNDANCE*	HABITAT PREFERENCES*
Feral Chicken	*Gallus gallus*	R= 3	T,E
Ring-necked Pheasant	*Phasianus colchicus*	R= 2	G,E
Black Francolin	*Francolinus francolinus*	C= 5	G,E
Gray Francolin	*Francolinus pondicerianus*	C= 5	E,T
Spotted Dove	*Streptopelia chinensis*	U= 4	E
Zebra Dove	*Geopelia striata*	A= 12	E
Common Barn Owl	*Tyto alba*	R= 1	G,E
Parrot	*Psittacula* spp.	R= 1	T
Common Myna	*Acridotheres tristis*	C= 8	E
Yellow-billed Cardinal	*Paroaria capitata*	C= 6	T
Northern Cardinal	*Cardinalis cardinalis*	C= 7	T
Japanese White-eye	*Zosterops japonicus*	A= 18	T,E
Nutmeg Mannikin	*Lonchura punctulata*	A= 11	G,E
Warbling Silverbill	*Lonchura malabarica*	C= 6	G,E
Lavender Waxbill	*Estrilda caerulescens*	R= 15	E,G
House Finch	*Carpodacus mexicanus*	C= 8	T,E
House Sparrow	*Passer domesticus*	C= 9	E

* (See page 13 for key to symbols)

KEY TO TABLE 1

RELATIVE ABUNDANCE= Number of times observed during survey or average number on eight minute counts in appropriate habitat.

A = abundant (ave. 10+) Number which follows is average of data from all survey days

C = common (ave. 5-10) Number which follows is average of data from all survey days

U = uncommon (ave. less than 5) Number which follows is average of data from all survey days

R = recorded (seen or heard at times other than on 8 min. counts. Number which follows is the actual number seen or heard).

HABITAT PREFERENCE = habitat type most frequently recorded in during survey. If more than one then listed in descending order of usage.

G = grassland

T = thickets of brush and trees

E = edge habitat: roadsides, forest edge

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Appendix D

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Report 2667-

Archaeological Survey and Cultural Impact Assessment in Support of an EIS for the Kona Non-Ceded Lands

Land of Keahuolu, North Kona District
Island of Hawai'i

PHRI
Paul H. Rosendahl, Ph.D., Inc.
Archaeological • Historical • Cultural Resource Management Studies & Services

Report 2667-101907

Archaeological Survey and Cultural Impact Assessment in Support of an EIS for the Kona Non-Ceded Lands

Land of Keahuolu, North Kona District Island of Hawai'i TMK:3-7-4-21:020,Por.014,Por.021)

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DECEMBER 2007

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SUMMARY

At the request of Ms. Sue Sakai of Belt Collins Hawaii, Ltd., on behalf of the Hawai'i Housing Finance & Development Corporation, Paul H. Rosendahl, Ph.D., Inc. (PHRI) conducted an archaeological inventory survey and prepared a cultural impact assessment (CIA) in connection with preparation of an Environmental Impact Statement (EIS) for the Kona Non-Ceded Lands project area, for which is planned an approximately 272-acre community of affordable housing. The parcel is bounded on the north by the *ahupua'a* of Kealakehe, on the east by land belonging to the Department of Hawaiian Home Lands, on the south and southeast by Palani Road, and on the west by Keahuolu *ahupua'a* land.

The archaeological survey was conducted in general accordance with the appropriate standards of the Hawai'i State Historic Preservation Division (SHPD) as contained in the SHPD Administrative Rules Chapter 275: *Rules Governing Procedures for Historic Preservation Review for Government Projects Covered Under Sections 6E-7 and 6E-8, HRS*; Hawai'i Administrative Rules; Title 13, DLNR; Subtitle 13, SHPD (effective December 2003), and, in connection with development planning and permit applications, complies with all current and appropriate historic preservation requirements of the SHPD and the Hawaii County Planning Department. The basic purpose of the cultural impact assessment study was to comply with the requirements of Chapter 343 (Haw. Rev. Stat.), as amended by H.B. No. 2895 H.D. 1 of the Hawai'i State Legislature (2000) and approved by the Governor as Act 50 on April 26, 2000.

During the archaeological survey, 12 archaeological sites were re-identified and re-located. The 12 sites had been previously identified during an archaeological survey conducted in 1990, during which time significance assessments and recommendations for the sites were presented. The assessments and recommendations were reiterated in an archaeological mitigation plan for the project area. The final significance assessments and recommendations are summarized in this report. One of the sites, Site 13396, a platform, was not re-located and apparently was destroyed by construction of a firebreak road corridor subsequent to the original project area inventory survey.

The Cultural Impact Assessment (CIA) portion for this project initially involved compiling a list of potential informants for Keahuolu Ahupua'a. This was done by contacting informants known for the area through past projects, and inquiries with various departments and cultural specialists. A list containing over thirty potential informants was compiled and the informants were preliminarily assessed as to their potential to provide information. From this list, a few informants were selected for further interviews.

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INTRODUCTION

BACKGROUND

At the request of Ms. Sue Sakai of Belt Collins Hawaii, Ltd., on behalf of the Hawai'i Housing Finance & Development Corporation, Paul H. Rosendahl, Ph.D., Inc. (PHRI) conducted an archaeological inventory survey and prepared a cultural impact assessment (CIA) in connection with preparation of an Environmental Impact Statement (EIS) for the project area, for which is planned an approximately 272-acre community of affordable housing. The parcel is bounded on the north by the *ahupua'a* of Kealakehe, on the east by land belonging to the Department of Hawaiian Home Lands, on the south and southeast by Palani Road, and on the west by Keahuolu *ahupua'a* land (*Figure 1).* The overall objective of the inventory survey and CIA was to comply with the current historic preservation requirements of the Hawai'i State Historic Preservation Division (SHPD).

PURPOSE AND OBJECTIVES

Archaeological Survey

The archaeological survey was conducted in general accordance with the appropriate standards of the Hawai'i State Historic Preservation Division (SHPD) as contained in the SHPD Administrative Rules Chapter 275: *Rules Governing Procedures for Historic Preservation Review for Government Projects Covered Under Sections 6E-7 and 6E-8, HRS*; Hawai'i Administrative Rules; Title 13, DLNR; Subtitle 13, SHPD (effective December 2003), and, in connection with development planning and permit applications, complies with all current and appropriate historic preservation requirements of the SHPD and the Hawai'i County Planning Department. The specific objectives of the survey were fourfold: (a) to identify all potentially significant archaeological remains present within the corridor study area; (b) to collect information sufficient to evaluate and document the potential significance of all identified remains; (c) to evaluate the potential impacts of any proposed development upon any identified significant remains; and (d) to recommend appropriate measures that would mitigate any adverse impacts upon identified significant remains.

Cultural Impact Assessment

The basic purpose of the cultural impact assessment study was to comply with the requirements of Chapter 343 (Haw. Rev. Stat.), as amended by H.B. No. 2895 H.D. 1 of the Hawai'i State Legislature (2000) and approved by the Governor as Act 50 on April 26, 2000, and which among other things requires that environmental assessments (EA) and environmental impact statements (EIS) identify and assess the potential effects of any proposed project upon the "...cultural practices of the community and State..." Chapter 343 (Haw.Rev.Stat.) was amended by the State legislature because of the perceived need to assure that the environmental review process explicitly addressed the potential effects of any proposed project upon "... Hawai'i's culture, and traditional and customary rights." Guidelines previously prepared and adopted by the State Office of Environmental Quality Control (OEQC) (1997) provide compliance guidance. Both *Act 50* and the OEQC *Guidelines for Assessing Cultural Impacts* mandate consideration of all the different groups comprising the multi-ethnic community of Hawaii.

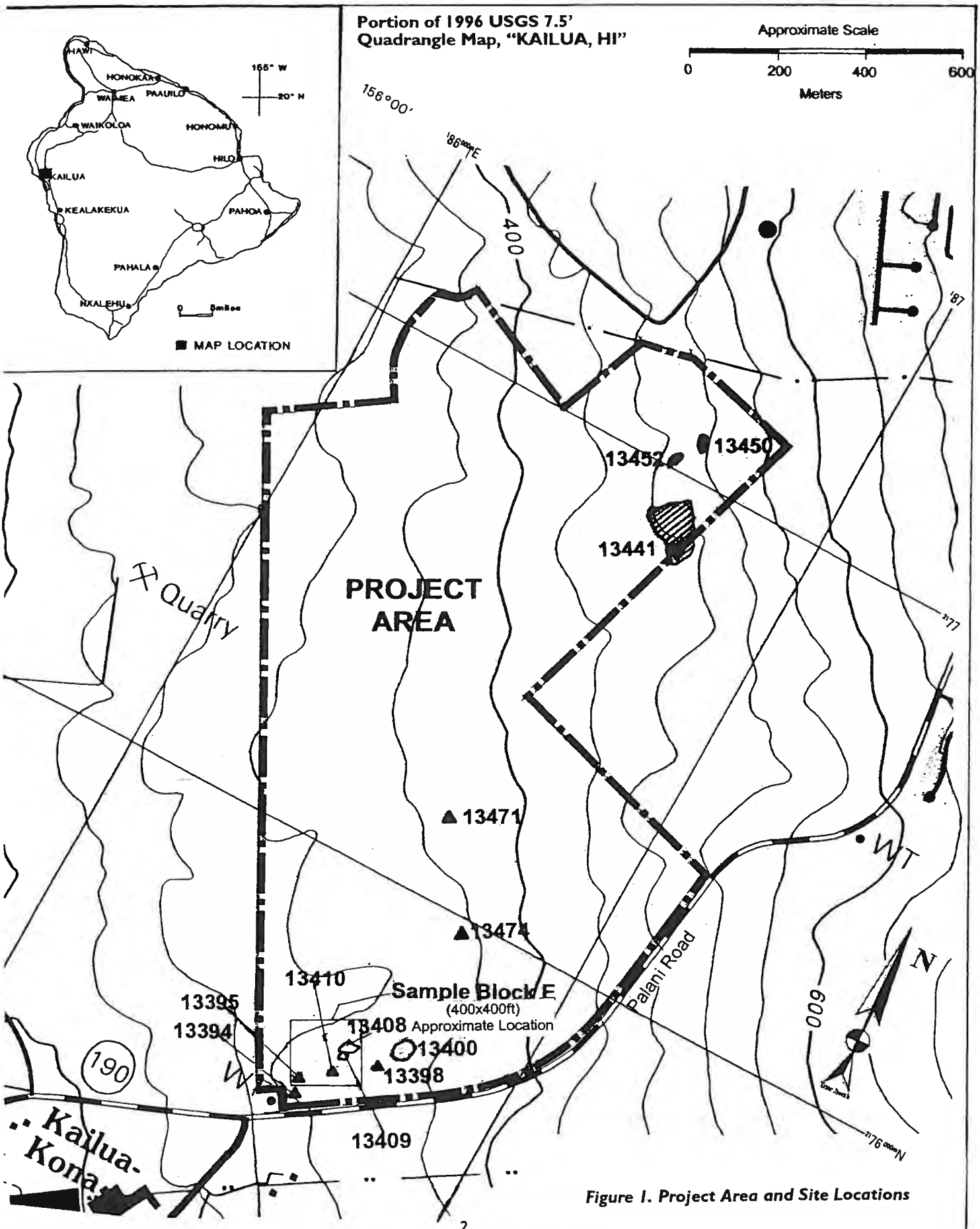

Figure 1. Project Area and Site Locations

The specific objectives of the cultural impact assessment study were to determine the following: (a) if the project area is currently being accessed by native Hawaiian cultural practitioners, or individuals of any other cultural groups, for any traditional and customary cultural uses; (b) if the proposed project would have any adverse impacts upon any identified current native Hawaii or other cultural group uses of the area; and (c) what measures might be proposed to mitigate any adverse impacts the proposed project might have upon any identified current native Hawaiian or other cultural group uses of the area.

SCOPE OF WORK

Based on (a) project specifications provided by Ms. Sue Sakai of Belt Collins Hawaii, (b) prior PHRI work within the Lands of Keahuolu and Kealakehe, and (c) our familiarity with both the general project area and the current regulatory review requirements of the SHPD and the HCPD, the following tasks were determined to constitute an adequate and appropriate scope of work for the historic preservation aspects of the project area:

1. Conduct (a) appropriate archaeological and historical documentary background review and research; and (b) identification of and consultation with appropriate local informants and agency staff;

2. Conduct informal (non-taped) interviews with identified knowledgeable informants;

3. Mobilization – including fieldwork preparations, field crew travel, and demobilization;

4. Fieldwork – Site relocation, clearing vegetation, detailed recording (including photography, plan view drawings, updating of written descriptions, etc.) for c. 70 sites;

5. Fieldwork – test excavations of selected archaeological sites/features;

6. Post-field data analyses;

7. Preparation of draft and final reports (including reformatting, upgrading of information, drafting of location map, plan maps and profiles, photographs, formatting, editing, and submission of completed final report);

8. Coordination and consultation with client, client representatives, local informants, agency staff, etc.

Subsequent to preparation of this scope of work it was decided, in discussions between PHRI and Belt Collins representatives, that further data collection, as expressed in points 4 and 5 above, will be done as a separate data recovery program. The current scope of work is therefore limited to site re-location (using GPS equipment) and re-identification, with further data recovery work to be conducted at a later time on those sites recommended for further work. Recommended general treatments for previously discovered sites, re-identified and re-located as part of the current project, have been presented in the SHPD-approved Archaeological Inventory Survey (Donham 1990a)(SHPD approval letter of 2/17/93, Log 6839, Doc. 9302RC34;see *Appendix*), and Archaeological Mitigation Program (Jensen et al. 1992)(SHPD approval letter of 10/21/93, Log 10361, Doc. 9312RC02;see *Appendix*), which were amended in a subsequent letter (PHRI Letter 1152-052493) to Dr. Don Hibbard, then Administrator of DLNR (the assessments and recommendations in the amendment letter supersede those made in Donham (1990a) and Jensen et al. (1992).

PROJECT AREA DESCRIPTION

Keahuolu and Kealakehe lie along the western slope of Mt. Hualalai. Hualalai Series flows form the surface mantle. These flows are composed primarily of alkalic olivine basalt (Macdonald, Abbott, and Peterson 1983:366). Specifically, the flows consist of *pāhoehoe* flats, fissures, and upthrusts, with collapsed blisters and tubes interspersed with fingers of *'a'ā* that are generally oriented east-west. There are three soil/substrate types in the project area: (a) bare *pahoehoe* lava flows (rLW), (b) bare *'a'ā* lava flows (rLV), and (c) Punaluu extremely rocky peat (6-20% slopes), representing the Punaluu series of well-drained, thin organic soils that have developed over *pāhoehoe* lava bedrock; they are found on uplands and are rapidly permeable, with slow run-off, and a slight erosion hazard (Sato et al. 1973:48). Types rLV and rLW predominate. Although the topography of the flows is rough in places, the overall aspect is a gradual slope from east to west. Elevation in the project area increases from approximately 300 feet in the west to 500 feet on the eastern boundary. Annual median rainfall within the project area is approximately 500-1,000 mm (20-40 inches).

Predominant tree species within the general area include *kiawe* (*Prosopis pallida*), *koa-haole* (*Leucaena leucocephala*), *alahe'e* (*Canthium odoratum*), and Christmas-berry (*Schinus terebinthifolius*). Understory plants consist predominantly of lantana (*Lantana camara*), *kolu* (*Acasis farnesiana*), *'ilima* (*Sida cordifollia*), fountain grass (*Pennisetum setaceum*), California grass, (*Brachiaria mutica*), Jamaica vervain (*Stachytarpheta jamaicensis*), and airplant (*Bryophyllum pinnatum*).

PREVIOUS ARCHAEOLOGICAL RESEARCH

Much archaeological work has been done in the *ahupua'a* of Keahuolu, including reconnaissance surveys, inventory surveys and excavations, and data recovery excavations.

Coastal Keahuolu

Several *heiau* were recorded by early investigators along the coast. Stokes (1919) described three coastal *heiau* sites in Keahuolu: Halepua, Kawaluna, and Palihiolo (at or very near the Keahuolu/Lanihau boundary). Halepua was described by Stokes as a *ko'a*, or fishing shrine, near the shore in a coconut grove. Reinecke located structural remains at Halepua, consisting of a house site of coral and remains of a pen around it, but he did not identify the *heiau* per se. He also identified an enclosure, a short distance to the north, paved with coral. This enclosure may actually be the *ko'a* of Stokes; however, Stokes places the *ko'a* in a coconut grove, whereas Reinecke places the enclosure in an oasis of pools, *kiawe*, and grass (1930:6).

Kawaluna Heiau was described by Stokes as a rebuilt enclosure located on the beach at Pawai Bay. It was identified as a *heiau* by a local informant, who stated that it was where an old fisherman made offerings (Stokes 1919). The interior of the enclosure was filled with loose stones. Interestingly, the informant also mentioned Halepa'u Heiau as being a *ko'a*, although Kawaluna Heiau was (apparently) not a *ko'a*, although fish were offered there (c.f. Stokes 1919). In 1930, Reinecke identified four house platforms, enclosure ruins, and an unidentifiable ruin at Pawai Bay, but again he did not identify any remains as specifically a *heiau*. A later survey of the Pawai Bay area by Neighbor Island Consultants in 1973 failed to identify Kawaluna Heiau, although they did note an enclosure with historic period burials.

The Heiau of Palihiolo was described by Stokes as being at or near the Keahuolu/Lanihau boundary, and consisting of an enclosure with coral paving. According to Stokes' informants, this *heiau* was used for human sacrifice, and King Kalakaua had it rebuilt prior to his departure from Hawai'i. Reinecke, although not identifying the *heiau*, did identify an enclosure associated with house platforms in the vicinity. Newman tentatively identified this *heiau* but located it in Lanihau (Newman 1970b).

During his survey, Reinecke located 12 sites in Keahuolu and eight sites in Lanihau (Reinecke 1930:4-8). The Keahuolu sites, located on a flat north of Keahuolu Point, consisted primarily of habitation platforms and enclosed yards. Within the 12 sites Reinecke listed 41 platforms, most of which were interpreted as house sites, and seven enclosures. Another concentration of seven house sites was identified at the Keahuolu/Lanihau boundary. Reinecke also identified petroglyphs, modified pools, burials, and a canoe landing. The eight Lanihau sites included 15 platforms, nine of which Reinecke interpreted as house sites. Eight of the house platforms were concentrated in what is called the Makeo complex, which also includes a modified fishpond and several modified anchialine pools. Petroglyphs, enclosures, and burials were also identified.

In 1970, Emory mentioned the two Keahuolu *heiau* sites in his inventory of archaeological and historical sites in the districts of Kona, Ka'u, and Anaehoomalu (1970). Newman in 1970 surveyed the old Kona Airport grounds, which later became a State Park, and described three sites in Lanihau, and one in Keahuolu consisting of historic period burials and a cluster of ground "bait cups" (Newman 1970b).

In 1975 Sinoto surveyed a road corridor in coastal Keahuolu, north of the current project area. He identified seven sites, all small, semi-permanent or temporary structures associated with coastal marine activities (Sinoto 1975:3).

Several additional reconnaissance surveys were completed between 1973 and 1980 in conjunction with development of the old Kona Airport State Park in Keahuolu and Lanihau (Neighbor Island Consultants 1973; Fuke and Goldstein 1978; Estioko-Griffin and Lovelace 1980; Neller 1980). The most frequently identified site types were caves, petroglyphs, burials, and house sites (Estioko-Griffin and Lovelace 1980:iii).

In 1978, a reconnaissance survey of all Keahuolu lands between the shoreline and Queen Ka'ahumanu Highway was undertaken by Ching. He identified 59 sites containing 140 component features, the most frequent of which were salt pans (29), cave shelters (25), pavings (21), and cairns (21) (Ching 1978:32).

Another reconnaissance and testing survey was performed in selected coastal Keahuolu parcels by Folk in 1980 (Folk 1980). His reconnaissance revealed no sites; however, in test excavating a *kipuka* near the shoreline, he found seven pavements, three caves, two platforms, four historic/recent campsites, a burial or shrine, a historic animal enclosure, and three habitation areas (Folk 1980::21-22).

Inland Keahuolu

Numerous archaeological projects have been conducted in the vicinity of the project area, within the *ahupua'a of* Keahuolu. Two projects have included the current project area. In 1983, Rosendahl (1983) surveyed a 100-acre parcel located east of Queen Ka'ahumanu Highway and along the north side of Palani Road. He identified seven sites/site complexes, of which two (Complexes D and E) appear to extend into

the current project area. Complex D was described as consisting of a large low platform, mounds, alignments, modified outcrops and cleared areas, while Complex E consisted of numerous walls, platforms, enclosures, caves, pavements and alignments. In 1989, Donham conducted a survey of the 1,100-acre Queen Lili'uokalani Trust Property project, an area which includes the entire current project area (Donham 1990a). She relocated Rosendahl's Complexes D and E, and separated the component features into eight sites (Sites 13370-13376, 13381 and 13382). Two of these, Sites 13372 and 13373, appear to have been within the current project area. Site 13372 appears to have been destroyed by earth-moving equipment subsequent to Donham's survey. These sites comprise over 21 features, including platforms, enclosures, cairns, mounds, *pâhoehoe* excavations and terraces, and the sites have functions ranging from agriculture and habitation to possible ceremonial and possible burial. The sites were assessed as important for information content and as excellent examples of site types, and all were recommended for preservation within an archaeological preserve area.

Donham's 1989-1990 survey and excavations identified 239 sites with 1,810+ component features at the c. 1,100 acre proposed Queen Liliuokalani Trust Property project area. The predominant feature types identified were *pāhoehoe* quarry and agricultural excavations, rock mounds, and modified blisters or outcrops. These together comprised 76% of all features (1,374 of 1,810) and were interpreted as agricultural features. Other features identified included small terraces, low platforms, C-shapes, enclosures, and rubble walls, which constituted another 9 to 14 % of the project's total features (Donham 1990a).

In 1989, PHRI conducted an inventory survey of the proposed Kealakehe Planned Development, which included a 150-acre parcel in Keahuolu east of the current project area (Burgett and Rosendahl 1993), and immediately east of the area Donham surveyed in 1989 and 1990. Sites and features identified were similar to those found during the 1989-1990 Donham survey. Donham concluded that the predominance of these features such as modified outcrops, terraces, small enclosures, and low mounded walls indicated relatively intensive use of the area for agriculture.

In 1990, PHRI conducted an archaeological inventory survey of a portion of the proposed Palani Road Improvements project area, adjacent and south of Palani Road, opposite the lower portion of the current project area. During this survey, 32 sites containing 44 component features were identified. Agricultural/boundary-related components account for up to 30 of the 44 features identified; the remaining 14 components include a single special-purpose cave (14218, cache), 13 features believed to represent temporary habitation, including one small cave, five bedrock outcrops which appear to have been modified for habitation use, and seven surface features (four C-shapes and three irregular- and U-shaped enclosures (Jensen 1990).

In 1993, O'Hare and Rosendahl (1993) surveyed an approximately 100-acre parcel south of Donham's project – the Queen Liliuokalani Trust KIS Expansion Site. She recorded 18 sites with 38 component features consisting of modified outcrops, *pāhoehoe* excavations, filled depressions, alignments, mounds, terraces, walls, hearths, walled overhangs, an enclosure, a kerbstone trail, a modified depression, a cairn, a cave shelter, and a burial cave. These features had the following functions: agriculture, temporary habitation, temporary habitation/possibly ceremonial, ceremonial (burial), historic dump, transportation, quarry, marker, and indeterminate.

Also in 1993, a field inspection was conducted by PHRI. The project area extended from the junction of Palani Road and Queen Ka'ahumanu Highway east for c. 1,157 ft, and was c. 20-36.5 m wide with the northern edge of Palani Road as the southern boundary and Site 1445-17 (temporary site number) located near the western boundary of the current project area. Sixteen of the sites were located inside the previously mentioned archaeological preserve (established during the Donham 1990a project, discussed above)(Sites 1445-1 to 1445-16, with Site 1445-16 being located on the very western edge of this preserve). This latter

site was assigned a permanent site number by the SHPD (Site 19763). This site contained seven features consisting of Feature A (platform), Feature B (rock mound), and several other mounds and agricultural features. Feature B, upon excavation, was found to contain a human burial, which was left in place (PHRI 1994). The remaining Sites (1445-1 to 1445-15) are in the general area of Donham's Sites 13372, 13373, and 13382 (Donham 1990a) and generally correspond to the Donham sites in formal and functional types. These three sites had not been fully recorded by Donham, due to the fact they are located within the archaeological preserve, and were to be subsequently inventoried in detail as part of the archaeological preserve program. The majority of the Donham features, those assigned an agricultural function, are considered part of the Kona Field System (Goodfellow and Walker 1993).

HISTORICAL BACKGROUND

The area of North Kona between Kailua Bay and Keauhou Bay to the south is generally recognized as containing the population core and the most fertile agricultural area of North Kona (Kirch 1985:166;Kelly 1983). To the north of Kailua Bay, beginning at Honokōhau, is the relatively dry Kekaha district of North Kona, with its barren lava inlands and coastal fishponds (Springer 1986:121). Keahuolu is situated in the transition zone between these two contrasting environmental districts, and is immediately north of Kailua Bay, a center of both political and economic activities since before Western contact.

The southern boundary of Keahuolu, at the shoreline, is located at Mahaihale, approximately 1.8 km north of Kukailimoku Point, named after the deity of victory in battle. Between Kukailimoku Point and the Keahuolu boundary is a narrow strip of coastal land that is within Lanihau *ahupua'a* (where much of the old Kona Airport is located). Consequently, the shoreline of Keahuolu is considerably narrower than expected, given the width of the *ahupua'a* less than 1.00 km inland of the coast. About 2.0 km of Keahuolu lands (N-S) are fronted by Lanihau along the shoreline.

Kukailimoku Point and the coastal sand dunes to the north and south were apparently repeatedly used during the prehistoric and early historic periods as burial grounds. Jackson's 1883 survey map locates graves at Kukailiomoku and a relatively large burial ground at Kaliliki Point to the south. Jackson referred to one massive masonry tomb as "Kamehameha's Tomb" (Neller 1980:5). Reinecke located additional graves in Lanihau and Keahuolu in 1930, and more recently Neller reported on exposed human remains at nine different locations along the coast, five in Lanihau and four at the Lanihau/Keahuolu boundary (Neller 1980:11-13). Historic period burials were also recently identified at Pawai Bay by Neighbor Island Consultants (1973).

According to Ellis:

> The environs were cultivated to a considerable extent; small gardens were seen among the barren rocks on which the houses are built, wherever soil could be found sufficient to nourish the sweet potatoe (sic), the watermelon, or even a few plants of tobacco, and in many places these seemed to be growing literally in the fragments of lava, collected in small heaps around their roots (Ellis 1963:31).

The *ahupua'a* of Keahuolu was awarded to Ane Keohokalole during the Mahele of 1848. According to testimony documented during the Mahele, two walled houselots in Keahuolu had been held by Keohokalole's ancestors "from very ancient times" (Foreign Testimony 3:573). At least one of these lots was located along the shoreline. Keohokalole sold portions of her 15,000-20,000-acre grant to the government and other parties, with the balance being transferred to her heir, Liliuokalani.

There is little historic information concerning traditional Hawaiian land use for the inland portion of the project area in Keahuolu, and no *kuleana* grants were awarded there. Nineteenth century descriptions of inland Keahuolu by government surveyors reflect the same general environmental conditions present in the barren lava lands of Kekaha to the north. Emerson surveyed the area in the 1880s, and his map (Reg. Map 1280) denotes "rough *pāhoehoe*, little vegetation" in the Keahuolu *ahupua'a*. David Kalakaua (1869) described the lower inland portions of Keahuolu as being suitable for livestock grazing (*Appendix B*), an assessment found in numerous nineteenth century descriptions of North Kona *kula* lands.

No historic references specifically describing traditional agricultural activities in inland Keahuolu have been located; but, it is apparent from the archaeological record observed at Keahuolu, Kealakehe, and Honokohau 2nd, that agricultural activities (apparently prehistoric) were relatively intense in the area designated historically as grazing land.

Comparisons by Kelly (1983) between the *kuleana* lands claimed and lands actually awarded in North Kona indicate to her that dryland agriculture was being conducted historically until the time of the Mahele, when vast expanses of *Kula* lands were granted to *konohiki*, who utilized it as livestock grazing land (Kelly 1983:67). Kelly found that garden land claims located in the *Kula* zone were generally not awarded to the claimants.

The forested upland area of Keahuolu was historically the primary agricultural zone and the location of *kuleana* grants. In a letter dated July 8, 1869, from David K. Kalakaua to his sister, Lili'uokalani, a detailed description of Keahuolu is provided. Kalakaua writes:

> This land is situated in the District of North Kona, bounded by the *ahupua'a* of Lanihau (in Kailua) belonging to Prince Lunalilo on the Ka'u side, and on the Kohala side, by Kealakehe, a government land and Honokohaniki belonging to Ke'elikolani. Keahuolu runs clear up to the mountains and includes a portion of nearly one half of Hualalai mountains. On the mountains the koa, kukui and 'ohi'a abounds in vast quantities. The upper land or inland is arable, and suitable for growing coffee, oranges, taro, potatoes, bananas etc. Breadfruit trees grow wild as well as the Koli oil seed. The lower land is adopted for grazing cattle, sheep, goat, &c. The fishery is very extensive and a fine grove of cocoanut trees of about 200 to 300 grows on the beach. The flat land near the sea beach is composed chiefly of lava, but herbs and shrubbery grows on it and [it is] suitable for feed of sheep and goats. It is estimated at 15,000 to 20,000 acres or more.

During Emerson's 1880 Government Survey of North Kona, he identified the *makai* (seaward) edge of a forest zone, which he described as "lava covered with scattering forest and dense masses of *ki* root" (Kelly 1983:58). The land below this forest edge was described as "rocks covered with long grass" (Kelly 1983:58). According to Kelly's estimations, the forest edge occurred at an average elevation of 550 to 650 ft around Kailua and to the south (1983:58). However, it appears that the forest edge was somewhere between 750 and 800 ft elevation in Keahuolu (see reproduction of Emerson's map in Kelly 1983:59). This approximation places the nineteenth century forest edge very close to the eastern (*mauka*) boundary of the entire QLT project area. According to Emerson's documentation of nineteenth century vegetation, the project area would be within the *Kula* zone.

It was shortly after the systematic delineation of *Kula* lands as grazing land that Kuakini Wall was constructed. This wall extends from Kahalu'u Bay to the southern portion of Keahuolu, at an average distance of 1.6 km from the coastline. At the northern end in Keahuolu, the wall is at an elevation of 220 ft; further to the south, its average elevation is 160 ft. The purpose of the wall, as proposed by Kelly (1983:75), was to keep the free-ranging livestock contained within the *Kula* zone, and out of the coastal

settlements and gardens. Kuakini Wall does not cross Keahuolu, but extends 183.00 m north of Palani Road, at which point it turns west (or a later western extension was added) for a distance of approximately 380.00 m. Why the wall ends where it does, rather than at an *ahupua'a* boundary, trail, or some type of land division feature, is unknown. There is a definite concentration of habitation and agricultural features at the end of the wall, to the south of the western extension.

Sometime during the late 1890s, a sisal mill was established in Keahuolu along the south side of the old Palani Road corridor. This mill location is shown on a 1924 USGS topographic map, at 428 ft AMSL . Kelly reports that a 500-acre tract of land was cultivated in sisal, and was known as the McWayne sisal tract (Kelly 1983:89). Recent informant interviews conducted by Wong-Smith indicate that as much as 1,000 acres may have been in sisal cultivation in Keahuolu and Kealakehe. According to informant Mr. Minoru Inaba, the mill was surrounded by sisal fields and was in operation until 1924.

The location of the sisal tract is yet to be determined; if, however, it surrounded the mill, as indicated by Mr. Inaba, it would have been near the current project area. There are scattered clumps of sisal near the project area, and a very concentrated growth along a section of the old Palani Roadbed, at 600 ft AMSL. In the area of the concentrated sisal are a series of walled enclosures and ramps that abut the old roadbed (SIHP Site 13435). This site is apparently at too high an elevation to correlate with the mill; it may, however, be associated with the sisal transport operations.

In comparing Keahuolu land use with Kealakehe to the north, it appears that Keahuolu was exposed to far less livestock grazing than Kealakehe. Lands in Kealakehe between 200 and 600 ft AMSL appear to have been used in this manner for about a century. The absence of ranching features and the relatively good preservation of most surface features in Keahuolu attests to a more limited use of the area for cattle.

REGIONAL SETTLEMENT PATTERN

Several general settlement pattern models have been generated by researchers such as Cordy (1981, 1995, 2000), Newman (1970a), Kelly (1983), and others. Though differing in detail, these models generally divide up the region into five basic environmental zones: the Shoreline, Kula, Kalu'ulu, 'Apa'a, and 'Ama'u.

The Shoreline zone extends, typically, from the high-tide line inland approximately 200 meters. In Kailua this is the area from the shore to approximately Ali'i Drive. In this zone, permanent settlement began in Kona c. A.D. 1000-1200 (Cordy 2000:248). Several large and densely populated royal centers were situated at several locations along the shoreline between Kailua and Hōnaunau (Cordy 1981;1995) such as Kailua, Hōlualoa, Kahalu'u, and Kealakekua (Cordy 2000:248). These included dwellings for rulers, chiefs, and the supporting populace, places of refuge, and other structures. Within these residential areas, large and small *heiau*, sporting areas, and burial clusters, are present. These may extend beyond the shoreline zone. Burials occur in caves, within finely built platforms, rock mounds, and houses in the shoreline, and are more often to be found in the near-shore Kula zone (Cordy 1995; Haun et al. 1998; Schilt 1984; Tainter 1973). Fishing and farming, of course, were the major exploitation avenues, with clearings in the forest uplands and small garden plots in the Kula zone. Thus, trails existed to facilitate transportation between the shoreline and the upper regions.

The Kula zone consists primarily of dry and open land with few trees and considerable grass cover. Soil development in Central Kona is limited however, with a fair amount of exposed lava bedrock. This land was planted primarily in scattered sweet potato patches. However, behind Kailua, breadfruit, taro, and forest banana were also grown in this zone (Cordy 2000:255), at least in the historic period. Use of this zone appears to have occurred as early as AD 1000s to 1300s. It is considered to extend to the 500 ft elevation mark, although it may extend further, to approximately the 600-800 ft elevation, the 40-50 inch rainfall line (c.f. Cordy 1995:17). Archaeologically, this zone is characterized by stone planting/clearing mounds, terraces, small soil clearings, and planting pits. Some permanent habitations are found, but at a much lower density than at the shore. Permanent habitation may have first started in the 1400's to 1600's, at least in the adjacent *ahupua'a* of Pua'a (Cordy 2000:255).

The Kalu'ulu is zone is referred to as the breadfruit zone. Early explorers described this zone as breadfruit with sweet potatoes and *wauke* (paper mulberry) underneath (cf. Menzies 1920:75-76). It may have been perhaps one-half mile wide (Kelly 1983:62). Here walled fields occur at the 600-800 ft elevation, which may be start of this breadfruit zone in this area.

The 'Āpa'a zone is described as a dryland taro and sweet potato zone. In historic accounts it is described as an area divided by low stone and earth walls into cleared rectangular fields in which sweet potato and dryland taro were planted. On the edges of the walls, sugarcane and ti were planted (cf. Menzies 1920:75-76). Also, bananas and *wauke* were present (cf. Ellis 1963:32). Newman estimated that this zone began at the 1,000 ft elevation and extended to the 2,500 ft elevation, although recent archaeological research has found formal walled fields beginning more commonly at the 600-800 ft elevation. In reality, it has been found that there is much variation within the Kona Field System (cf. Cordy 1995:10-13).

The 'Ama'u zone is the banana zone, which may extend from the 2,000 ft elevation to 3,000 ft, and is characterized by bananas and plantains being grown in cleared forest areas.

Chronology

This brief chronology uses terminology developed by Burtchard (1993) and Haun et al. (1998).

The Kona Field System was not brought to Kona as a fully developed system. Rather, it grew out of, and integrated with, the evolving socio-political structure and increasing population in the island chain. The first inhabitants of Hawai'i Island probably arrived by at least AD 600, and focused habitation and subsistence activity on the windward side of the island (Burtchard 1993; Kirch 1985; Hommon 1976). To date, there is no archaeological evidence for occupation of the Kona region during this initial, or Colonization (AD 300 to 600) stage of island occupation.

There is also little indication that during the subsequent period, Early Expansion (AD 600 to 1100), much activity was taking place in Kona (Burtchard 1993: Table 3-3). Through the first half of the Early Expansion Period, permanent habitation was still concentrated on the windward side. It is likely that windward residents traveled to the leeward Kona coast to fish and collect other resources (Cordy 1995). By the latter half of the Early Expansion Period, permanent habitation was beginning in Kona (Cordy 1981, 1995; Schilt 1984). Habitation was concentrated along the shoreline and lowland slopes, and informal fields were probably situated in the *Kula* and higher elevations, areas with higher rainfall.

Agricultural fields and habitation areas expanded across the slopes and coastal area of Hualālai during the Late Expansion Period (AD 1100 to 1400) (Burtchard 1993; Cordy 1995). The earliest fields may have been located in the southern portion of the system (Schilt 1984; Wolforth and Rosendahl 1998), with new fields expanding northward over time (Haun et al. 1998).

The development of the extensive formal walled fields sometime during the initial stages of the Intensification Period (AD 1400 to 1600) is taken as a mark of the initiation of the Kona Field System (Schilt 1984). The development of formal walled fields may be in part a by-product of the need to extract more subsistence resources from an increasingly limited agricultural base, since the population in Kona had increased dramatically during this period. Radiocarbon dates from habitation structures, shelter caves, and agricultural soils are plentiful from this period (Burtchard 1995; Haun et al. 1998; Schilt 1984). During this period, the stratified chiefdom structure becomes clearly developed in the archaeological record. Large residential complexes and *heiau* reflect the segregation of places and power for the growing hierarchy of high and lower chiefs, and ceremonial stewards (Cordy 1981; Haun et al. 1998; Hommon 1976). The produce from the formal walled fields was distributed to higher chiefs through a hierarchy of lower chiefs responsible for management and collection of the cultivated and wild resources.

By the time of the Competition Period (AD 1600 to 1800), the chiefly centers and larger *heiau* were in place, reflecting the growth in power of the rulers and chiefs in the region (Barrera 1971; Hammatt and Folk 1980). Resources may have reached their maximum carrying capacity, resulting in social stress between neighboring groups. Hostility between groups is reflected archaeologically with the development of refuge caves during this period (Schilt 1984). This volatile period was probably accompanied by internal rebellion and territorial annexation (Hommon 1986; Kirch 1985). It is thought by some researchers that population declined during this period, but several researchers, e.g. Cordy (1995), contend that population continued to grow up to the time of European contact (Burtchard 1993). Afterwards, during the next time period, that of the last of the ruling chiefs (1800 to 1819), settlement and land use patterns stayed primarily the same as previously. But the next period, the period of the merchants and missionaries, 1820 to 1847, saw the introduction of foreign ideas, plants, animals, diseases, religion, and trade, and the end of the *kapu* system. The royal centers were no longer functioning as focal points for religious and political activity, and the population at the royal centers and the population of the commoners dropped overall. During the next period, the Great Mahele and Its Legacy, 1848-1899, the implementation of privately owned land resulted in major changes to the settlement and land use patterns in Kona. By the end of this period, foreign landowners and business people had greater control over broad land use practices. The upland agricultural fields were modified to coffee growing, and permanent habitations were built with modern materials upland and along the shore. The population, due to disease, reached a low during this period, but began to climb as foreign laborers and more business people arrived. Finally, during the last period 1900-1959, the Territorial Period, the population remained relatively stable and lowland occupation was concentrated in the small villages of Kailua and Keauhou, with permanent residences with gardens and pens scattered along the shoreline, while upland habitation was associated with agricultural and ranching pursuits (Haun et al. 1998).

ARCHAEOLOGICAL SURVEY

FIELD METHODS

The archaeological field survey began on March 1, 2007 and concluded on July 9, 2007. Conducting the survey were PHRI Supervisory Archaeologist Alan B. Corbin, M.A., assisted by Field Technician Leonard Kubo, B.A. The initial stage of site re-location involved the study of previously compiled site inventory maps, overall project maps, and aerial photos in order to determine the probable locations of sites that had been previously identified during the inventory stage. If the site was not found at its probable location, a further methodology was employed. Using office-compiled distance and bearing from known points in the landscape, compass and tape were used in the field to estimate the site's probable location. If the site was not found at that location, a circular grid was established at that point, and surveyors walked 33-50.0 meter transects that radiated in all directions out from that point. In this manner, despite extremely overgrown and dense vegetation that limited visibility to under ten feet at times, all sites were eventually located. All re-located sites were flagged with white-and-red stripped flagging. Subsequent to the re-location and flagging, all re-located sites were located using GPS equipment and personnel provided by Tom Dye & Associates. Sites were located with GPS as single points for smaller, single-feature sites, or by multiple points that established a polygonal area.

FINDINGS AND CONCLUSION

During the course of the survey, 12 archaeological sites were re-identified and re-located within the project area (*Table 1 and Figure 1*). These sites had been previously identified during the course of an archaeological survey conducted in 1990, during which time significance assessments and recommendations for the sites were presented (Donham 1990) (SHPD approval letter of 2/17/93, Log 6839, Doc. 9302RC34; see *Appendix*). The assessments and recommendations were reiterated in an archaeological mitigation plan for the project area (Jensen et al. 1992)(SHPD approval letter of 12/21/93, Log 10361, Doc. 9312RC02; see *Appendix*); later the plan was amended by PHRI Letter Report 1152-052493, which outlined the sampling block methodology to be used during mitigation (dated June 10, 1993; PHRI Letter 1152-052493, to D. Hibbard, SHPD, from A. Walker, PHRI; SHPD approval letter dated 7/28/1993, Log 8976, Doc 9307RC40; see *Appendix*). The final significance assessments and recommendations are summarized in *Table 1*.

One of the sites slated for preservation and interpretive development, Site 13396, a platform originally located a short distance west of Sites 13394 and 13395, was not relocated during the course of the survey and apparently was destroyed by construction of a firebreak road corridor subsequent to the original Donham survey.

Four sites (Sites 13395, 13408, 13409 and 13410) are located within Block E (*Figure 1*). This block was established as a sample block of the Queen Liliuokalani Trust mitigation plan (Jensen et al. 1992). The block, 400 ft by 400 ft, was chosen so that data collected from it could be compared with similar-sized blocks on the Queen Liliuokalani Trust Property (Blocks A-D, and F). These results in turn could then be compared to similar sized blocks placed on the adjacent *ahupua'a* of Kealakehe. The blocks were placed so that they would, as a group, incorporate a wide variety of the site and feature types, and would incorporate various soil and bedrock types at different elevation levels. During future data recovery work, each feature within Block E is to be recorded in detail, and sites within the block are to undergo further data collection. Further data collection at Sites 13395, 13408, and 13409 will include testing features to determine whether human skeletal remains are present.

Table 1. Summary of General Significance Assessments and Recommended General Treatments

SIHP Site Number	Formal Site Type	Functional Interpretation	Significance Category					General Recommendations			
			A	B	C	D	E	FDC	NFW	PID	PAI
13394	Alignment	Agriculture	-	-	-	+	-	+	-	-	+
13395	Platform	Habitation/possible burial	-	-	+	+	*	+	-	+	*
13398	Platform, wall, cairn	Habitation/agricultural	-	-	+	+	-	+	-	+	-
13400	Wall, enclosure	Agricultural/land division	-	-	+	+	-	+	-	+	-
13408	Platform, terrace, five walls, two enclosures, 10+ *pahoehoe* excavations	Habitation/agricultural/possible burial	-	-	+	+	*	+	-	+	*
13409	Three platforms, two walls, an enclosure, and three terraces	Habitation/agricultural/possible burial	-	-	+	+	*	+	-	+	*
13410	Platform	Habitation	-	-	+	+	-	+	-	+	-
13441	Seven platforms, five terraces, wall remnant, wall, mound, cave, enclosure	Habitation/agriculture	-	-	+	+	-	-	+	+	-
13450	Steppingstone trail	Transportation	-	-	-	+	-	+	-	-	-
13452	Paved trail	Transportation	-	-	-	+	-	+	-	-	-
13471	Upright, platform, cave	Habitation/agricultural/ceremonial	-	-	-	+	-	+	-	-	-
13474	Cave	Habitation	-	-	-	+	-	+	-	-	-

General Significance Categories:
A = Important for historical contribution to significant events and/or broad patterns of history
B = Important for association with the lives of important individuals in history
C = Excellent example of site type at local, region, island, State, or National level
D = Important for information content
E = Culturally significant

Recommended General Treatments:
FDC = Further data collection necessary (detailed recording, surface collections, and limited excavations, and possibly subsequent data recovery/mitigation excavations)
NFW = Nor further work of any kind necessary, sufficient data collected, archaeological clearance recommended, no preservation potential
PID = Preservation with some level of interpretive development recommended (including appropriate related data recovery work)
PAI = Preservation "as is", with no further work (and possible inclusion into landscaping), or possibly minimal further data collection necessary
**=Provisional assessment; definite assessment pending completion of further data collection*

CULTURAL IMPACT ASSESSMENT STUDY

PURPOSE, BACKGROUND, AND OBJECTIVES

The purpose of this cultural impact assessment is to comply with the requirements of *Chapter 343 (Haw. Rev. Stat.),* as amended by H.B. No.2895 H.D. 1 of the Hawai'i State Legislature (2000) and approved by the Governor as *Act 50* on April 26, 2000, and which among other things requires that environmental assessments (EA) and environmental impact statements (EIS) identify and assess the potential effects of any proposed project upon the "...cultural practices of the community and State...." *Chapter 343 (Haw.Rev.Stat.)* was amended by the State legislature because of the perceived need to assure that the environmental review process explicitly addressed the potential effects of any proposed project upon "...Hawai'i's culture, and traditional and customary rights." Guidelines previously prepared and adopted by the State Office of Environmental Quality Control (OEQC 1997) provide compliance guidance. Both *Act 50* and the OEQC *Guidelines for Assessing Cultural Impacts* mandate consideration of all the different groups comprising the multi-ethnic community of Hawaii. This inclusiveness, however, is generally understated, and the emphasis – as indicated by a background review (see below) of the cultural impact assessment issue, and the intent and evolution of both the legislative action and the guidelines – is clearly meant to be primarily upon aspects of Native Hawaiian culture – particularly traditional and customary access and use rights.

Cultural resources include a broad range of often overlapping categories of cultural items – places, behaviors, values, beliefs, objects, records, stories, and so on. A traditional cultural property ("TCP") is one specific type of cultural resource that falls within the purview of the historic preservation review process. A "TCP" is a historic property or place that is important because it possesses "traditional cultural significance":

> "Traditional" in this context refers to those beliefs, customs, and practices of a living community of people that have been passed down through the generations, usually orally or through practice. The traditional cultural significance of a historic property, then, is significance derived from the role the property plays in a community's historically rooted beliefs, customs, and practices....
>
> A traditional cultural property, then, can be defined generally as one that is...[important/significant]...because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community (Parker and King 1990:1).

In addition, it is important to realize that sometimes a traditional cultural property may not have a visible physical manifestation:

> Although many traditional cultural properties have physical manifestations that anyone walking across the surface of the earth can see, others do not have this kind of visibility, and more important, the meaning, the historical importance of most traditional cultural properties can only be evaluated in terms of the oral history of the community (Sebastian 1993:22).

There are at least two significant differences that distinguish traditional cultural properties as a subset within the larger sphere of cultural resources. First, while cultural resources such as practices and beliefs may be spatially associated with general types of geographical areas, such as the exposed lava lands of the Keahole Point area, a traditional cultural property is a specific physical entity or feature with a definable boundary, such as a specific location within the current project site. Second, while cultural resources such as practices and beliefs can include general cultural behaviors such as the gathering of various natural resources for general subsistence, industrial, or ceremonial uses, a traditional cultural property is a specific place or feature directly associated with specific behaviors the continuity of which over time, in either actual practice or remembrance, can be demonstrated.

Based on these two significant distinctions, it is possible to suggest three types of practitioner claims relating to cultural practices, beliefs, and features that are likely to be encountered in the course of conducting a cultural impact assessment study. These claims can be referred to as (a) traditional cultural property claims, (b) traditional and customary cultural practice claims, and (c) contemporary or neo-traditional cultural practice claims.

Traditional cultural property claims would be those which lie within the purview of the current historic preservation review process (DLNR 2001a,b); that is, they are claims involving the traditional practices and beliefs of a local ethnic community or members of that community that (a) are associated with a definable physical property (an entity such as a site, building, structure, object, or district), (b) are founded in the history of the local community, (c) contribute to the maintenance of the cultural identity of the community, and (d) demonstrate a historical continuity of practice or belief up to the present–through either actual practice or historical documentation. Furthermore, to qualify as a legitimate traditional cultural property within the historic preservation context, a potential traditional cultural property must be able to demonstrate its historical significance in terms of established evaluation criteria, such as those of the National Register of Historic Places and/or the Hawai'i Register of Historic Places.

Traditional and customary cultural practice claims would be those native Hawaiian claims which lie within the purview of Article XII, Section 7, of the Hawai'i State Constitution ("Traditional and Customary Rights"), and various other state laws and court rulings, particularly as reaffirmed in 1995 by the Hawai'i State Supreme Court in the decision commonly referred to as the "PASH decision," and as further clarified more recently in its 1998 decision in State of Hawai'i v. Alapa'i Hanapi and its 2000 decision in Ka Pa'akai o Ka 'Aina et al. v. Land Use Commission, State of Hawai'i et al. The notable points of the decisions in PASH and in Hanapi can be summarized as follows: (a) the reasonable exercise of ancient Hawaiian usage is entitled to protection under Article XII, Section 7 of the Hawai'i State Constitution; and (b) those persons claiming their conduct is constitutionally protected must prove that they are a native Hawaiian as defined in PASH, that the claimed right is constitutionally protected as a traditional or customary native Hawaiian practice, and that the exercise of the right is occurring on undeveloped or less than fully developed property. Ka Pa'akai generally reaffirms the same points as in the PASH and Hanapi decisions and, in addition, (a) indicates the explicit responsibility of the regulatory agency involved in any application review to arrive at affirmative and substantive conclusions regarding potential impacts upon traditional and customary native Hawaiian cultural practices and resources, and (b) suggests an "analytical framework" for the identification of and potential impacts upon any such cultural practices and resources.

Traditional native Hawaiian cultural practices can be categorized as two general types: (a) practices with active behaviors involving both observable activities with material results and their inherent values or beliefs; and (b) practices with more passive behaviors that seek to produce nonmaterial results. The former type of behaviors – practices with active behaviors, for example, would involve practices like the gathering and collecting of different animal and plant resources for various purposes, such as subsistence, medicinal, adornment, social, and ceremonial possibly other uses. Uses such as these usually have associated beliefs and values (both explicit and implicit) relating to a pervasive general theme that flows throughout traditional native Hawaiian culture and binds it together. To native Hawaiians, the natural elements of the physical environment–the land, sea, water, winds, rains, plants, and animals, and their various embodied spiritual aspects–comprise the very foundation of all cultural life and activity – subsistence, social, and ceremonial; to native Hawaiians, the relationship with these natural elements is one of family and kinship. The latter type of behaviors – practices with more passive behaviors – involves more experiential activities focused on "communing with nature"; that is, behaviors relating to spiritual communication and interaction that reaffirm and reinforce familial and kinship relationships with the natural environment.

While traditional cultural property claims, as defined above, would certainly fall within the general domain of traditional and customary cultural practice claims, not all traditional and customary cultural practice claims would necessarily qualify as traditional cultural property claims. Traditional and customary cultural practice claims subsume a broad range of cultural practices and beliefs associated with a general geographical area or region, rather than a clearly definable property or site–for example, the gathering of marine resources from along a section of shoreline for traditional subsistence or ceremonial purposes, in contrast to the gathering of a specific marine resource species for a specific use by current generation members of a family that had obtained the same resource from the same recognized site for several generations.

Contemporary, or "neo-traditional", cultural practice claims overlap with neither traditional property claims nor traditional and customary practice claims. Contemporary cultural practice claims would be those made by cultural practitioners relating to current practices or beliefs for which no clear specific historical basis in traditional culture can be clearly established or demonstrated; for example, the conducting of ritual ceremonies of uncertain authenticity at sites or features for which no such prior use can be demonstrated.

The specific purpose of the present cultural impact assessment study is to assess the potential impacts of the proposed project upon the cultural resources – the practices, features and/or beliefs – of native Hawaiians or any other ethnic group that might be associated with project area. To accomplish this purpose, several specific objectives were established:

1. Identify any native Hawaiian or other ethnic group cultural practices currently being conducted by individual cultural practitioners or groups;

2. Collect sufficient information so as to define the general nature, location, and authenticity of any identified cultural practices;

3. Assess the potential impacts of the proposed project upon identified cultural practices; and

4. Recommend appropriate mitigation measures for any potentially adverse impacts upon identified cultural practices.

Thus, the overall goal or objective of the present cultural impact assessment study was to identify any native Hawaiian or other cultural practices currently being conducted within or immediately adjacent to present project area that might potentially be in some manner constrained, restricted, prohibited, or eliminated if the proposed project were to be approved. The types of practices to be identified would be inclusive; that is, claims for all three types of practices – traditional cultural property, traditional and customary cultural practices, and contemporary cultural practices – would be identified and considered. More specifically, the objectives of the cultural impact assessment were to determine the following: (a) if the project area is currently being accessed by native Hawaiian cultural practitioners for any traditional and customary cultural uses; (b) if the proposed project would have any adverse impacts upon any identified current native Hawaii cultural uses of the area; and (c) what measures might be proposed to mitigate any adverse impacts the proposed project might have upon any identified current native Hawaiian uses of the area.

CULTURAL IMPACT ASSESSMENT AND OEQC GUIDELINES

To understand the cultural impact assessment issue, particularly as it is addressed by the present study, a summary review of the intent and evolution of the OEQC guidelines is necessary. The guidelines evolved out of what are commonly referred to as "PASH/Kohanaiki" issues – issues relating to native Hawaiian traditional and customary access and land use rights as they were reasserted by a State Supreme Court decision in August 1995 and further clarified in its 1998 decision in State v. Hanapi – and the need for appropriate means to address these issues within the State environmental impact review process. For a good discussion of the issues and options involved, the "Report on Native Hawaiian Traditional and Customary Practices Following the Opinion of the Supreme Court of the State of Hawai'i in Public Access Shoreline Hawai'i v. Hawai'i County Planning Commission" prepared by the PASH/Kohanaiki Study Group (1998) should be consulted.

Initial attempts to address various issues relating to native Hawaiian traditional and customary access and land use rights within the framework of the State environmental impact review process were made in the form of proposed changes to the State EIS law as contained in Chapter 343 (HRS). These attempts to require a formal cultural impact assessment failed to pass the State legislature in 1996 and 1997.

A subsequent, second attempt to address various issues relating to native Hawaiian traditional and customary access and land use rights was made in the form of proposed changes in the "Administrative Rules" for compliance with Chapter 343 (DOH Title 11, Chapter 200). This attempt to require an explicitly defined cultural impact assessment also failed, as the governor declined to approve the proposed amendments.

The third attempt to address various issues relating to native Hawaiian traditional and customary access and land use rights within the State environmental impact review process resulted in the current OEQC "Guidelines for Assessing Cultural Impacts" (OEQC 1997b). Draft guidelines were initially issued for public review and comment on September 8, 1997. The Environmental Council formally adopted the guidelines in their final form on November 19, 1997.

The relationship of the OEQC guidelines to the State Supreme Court "PASH decision" was clearly stated on the front page of the September 8, 1997 issue of the OEQC bulletin, *"The Environmental Notice,"* when the draft guidelines were first issued for public review and comment:

> For years, a controversy has simmered over developer's responsibility to perform a "Cultural Impact Study" prior to building a project. The recent Supreme Court "PASH" decision reaffirmed the state's duty to protect the gathering rights of native Hawaiians. In light of these events, the Environmental Council has drafted a guidance document to provide clarity on when and how to assess a project's impacts on the cultural practices of host communities.

It should be noted that the guidelines for cultural impact assessment are meant to include consideration of all the different groups comprising the multi-ethnic community of Hawai'i; however, this inclusiveness is generally understated, and the clear emphasis is meant to be upon aspects of native Hawaiian culture.

More than 20 letters were received by OEQC in response to the publication of the draft guidelines, and relevant comments were said to have been incorporated into a final version of the guidelines (OEQC n.d.). The Environmental Council formally adopted the final guidelines (OEQC 1997b) on November 19, 1997. The final guidelines are virtually identical to the draft guidelines initially published on September 8, 1997, and the degree to which any of the received comments on the draft guidelines were considered prior to issuance of the final guidelines is uncertain. In fact, the overall process through which the guidelines were prepared and adopted brings out several important questions relating to such topics as (a) the source or basis utilized for the content of the guidelines, (b) the background and qualifications of the preparer(s) of the guidelines, (c) the criteria to be used for the adequacy of cultural impact assessment studies prepared in response to the guidelines, and (d) the legal question of how compliance can be required when the standards are guidelines.

According to the Chair's Report contained in *The 1997 Annual Report of the Environmental Council*, the Cultural Impacts Committee drafted the guidelines:

> The Committee drafted guidelines recommending a methodology to assess the impact of proposed actions on cultural resources, including Native Hawaiian cultural resources, values, and beliefs. The guidelines also specify the contents of a cultural impact assessment.
>
> To prepare the Guidelines, the Committee reviewed public testimony and solicited input from interested parties. Expertise from the DLNR's Historic Preservation Division as well as Federal regulations governing the "Protection of Historic Properties" were used to model the draft guidelines.
>
> The draft cultural impact guidelines were published for review and comment in the Sept. 8 *Environmental Notice*, and over 20 letters were received. Relevant comments were incorporated into a final draft version of the guidelines, which were adopted as a policy document by the Environmental Council on November 19, 1997 (OEQC n.d.:5).

Direct inquiries to OEQC (Gary Gill, then-Director) and SHPD (Dr. Holly McEldowney, then-Staff Specialist in the History and Culture Branch) provided additional background information relating to the formulation of the cultural impact assessment guidelines. The principal author or compiler of the guidelines was Arnold Lum, Esq., a member of the Environmental Council's Cultural Impacts Committee. Mr. Lum was also a staff attorney at the Native Hawaiian Legal Corporation. OEQC staff also assisted in the preparation of the guidelines. Several internal drafts were prepared, reviewed, and revised. Preparation of the guidelines relied to some degree upon National Register Bulletin No. 38, *Guidelines for Evaluating and Documenting Traditional Cultural Properties* (Parker and King 1990) for basic content information. Other sources, including the SHPD draft rules for conducting ethnographic surveys and dealing with traditional cultural properties (DLNR n.d.), were consulted; in fact, a copy of the SHPD draft rules was provided to OEQC and the Cultural Impacts Committee by then-SHPD Administrator, Dr. Don Hibbard. Professional staff in the SHPD-History and Culture Branch took part in the preparation and review of the guidelines. Certainly the inclusion of such professional anthropological and historical expertise in the preparation of the guidelines was appropriate; however, much of the professional advice on the extent to which detailed expectations – regarding study scope, content, methodology, documentation, and impact assessment – should be explicitly addressed in the guidelines was apparently discounted.

The most recent attempt to address various issues relating to native Hawaiian traditional and customary access and land use rights within the State environmental impact review process resulted in the amendment to *Chapter 343 (Haw.Rev.Stat.),* as amended by H.B. No.2895, H.D.1 of the Hawai'i State Legislature (2000) and approved by the Governor as *Act 50* on April 26, 2000. While no specific administrative rules for the implementation of this amendment have been adopted, it is generally accepted that the *Guidelines* previously prepared and adopted by the State Office of Environmental Quality Control (OEQC 1997) are meant to provide general compliance guidance.

The OEQC *Guidelines* consist of three basic sections. The first section is an introduction which notes the various statutory and other bases for addressing potential impacts upon cultural resources within the context of the environmental assessment review process, and "...encourages preparers of environmental assessments and environmental impact statements to analyze the impact of a proposed action on cultural practices and features associated with the project area" (OEQC 1997:1). The second section of the guidelines discusses methodological considerations for conducting cultural impact assessments, and presents a recommended six-step protocol to be followed by the assessment preparers. The third section of the guidelines outlines eleven topics or "matters" that a cultural assessment should address; these topics basically represent the desired content and organization of a cultural impact assessment report.

As "guidelines," the OEQC Guidelines would seem to have neither the specific statutory authority of law, nor the regulatory authority of administrative rules. As guidelines, they can be regarded as providing general guidance; that is, they represent general suggestions and recommendations as to how to approach the assessment of potential cultural impacts. The guidelines provide little or no guidance relative to many important questions, perhaps the most significant of which would be the following:

1. How would project-specific determinations be made as to whether or not a cultural impact assessment study might even be necessary or appropriate – given the specific nature and location of a proposed project;

2. If a cultural impact assessment study is to be conducted, how does one determine what constitutes an appropriate project-specific level of effort – that is, the general scope of work or objectives for the study, and the specific tasks or activities required to accomplish successfully the scope of work or objectives;

3. What criteria are to be used for determining the credibility and reliability of potential cultural information sources (generally referred to as "informants" or "knowledgeable individuals");

4. If specific cultural practices, beliefs, or features are definitely identified as being associated with a project area, what criteria are to be applied for evaluating (a) the descriptive adequacy and (b) the cultural authenticity of the identified practices, beliefs, or features;

5. If specific culturally authentic practices, beliefs, or features are definitely identified as being associated with a project area, what criteria are to be used for assessing the nature and extent of potential impacts of a proposed project on the identified practices, beliefs, or features – that is, "no effect," "no adverse effect," or "adverse effect;"

6. If a project is determined to have potentially adverse impacts upon specific identified culturally authentic practices, beliefs, or features, what criteria are to be used for evaluating the adequacy and appropriateness of alternative potential mitigation actions;

7. Within the purview of what regulatory office or agency would the review and acceptance or rejection of a completed cultural impact assessment study legitimately fall; and

8. What standards or criteria are to be used to evaluate the overall adequacy or acceptability of a completed cultural impact assessment study?

Consideration of these questions, and their implications, has direct relevance to the present cultural impact assessment study. These implications relate most importantly to (a) the level of study effort believed appropriate for the project-specific context, and (b) the rationale adopted for both the study overall, as well as for the identification and evaluation of any identified cultural practice claims, the assessment of potential project-specific impacts, and the formulation of any specific recommendations for further study or other mitigation actions.

BASIC GUIDANCE DOCUMENTS

Several references are available to serve as basic guidance documents for carrying out cultural impact assessment studies of various scopes and intensities. The principal sources are the following:

1. The OEQC Guidelines for Assessing Cultural Impacts (OEQC 1997);

2. The Native Hawaiian Rights Handbook (MacKenzie 1991), and more specifically the discussions of traditional and customary rights contained in the two chapters on access rights (Lucas 1991a) and gathering rights (Lucas 1991b);

3. The Report on Native Hawaiian Traditional and Customary Practices Following the Opinion of the Supreme Court of the State of Hawai`i in Public Access Shoreline Hawaii v. Hawai`i County Planning Commission prepared by the PASH/Kohanaiki Study Group (1998);

4. The text of several relevant decisions of the Hawai'i Supreme Court, including the decision commonly referred to as the "PASH decision" (1995), and the more recent decisions in State of Hawai'i v. Alapa'i Hanapi (1998) and Ka Pa'akai o Ka 'Aina et al. v. Land Use Commission, State of Hawai'i et al. (2000);

5. The federal regulations of the Advisory Council on Historic Preservation for the National Register of Historic Places (CFR 1981) and the Protection of Historic Properties (CFR 1986);

6. National Register Bulletin No. 38, Guidelines for Evaluating and Documenting Traditional Cultural Properties (Parker and King 1990); and

7. Recently approved versions of the State Historic Preservation Division (SHPD) administrative rules (effective December 11, 2003), including Chapter 275: Rules Governing Procedures for Historic Preservation Review for Governmental Projects Covered Under Sections 6E-7 and 6E-8, HRS (DLNR 2002a), and Chapter 284: Rules Governing Procedures for Historic Preservation Review to Comment on Chapter 6E-42, HRS, Projects (2002b), as well as an earlier draft Chapter 284--Rules Governing Procedures for Ethnographic Inventory Surveys, Treatment of Traditional Cultural Properties, and Historical Data Recovery (DLNR n.d.).

While the general nature and content of the first four referenced sources are self-explanatory, further comment should be made regarding the final three items. In the absence of any formally adopted administrative rule specifically addressing the treatment of traditional cultural properties, SHPD currently utilizes National Register Bulletin No. 38, *Guidelines for Evaluating and Documenting Traditional Cultural Properties* (Parker and King 1990), as its principal source of guidance for reviewing and evaluating the adequacy and acceptability of traditional cultural property study reports prepared in connection with various permit applications for which SHPD regulatory review is required. Bulletin No. 38 provides detailed guidance for the assessment of traditional cultural properties within the framework of the National Register significance criteria evaluation process (NPS 1990).

The SHPD draft administrative rule relating to ethnographic surveys and traditional cultural properties (DLNR n.d.) has existed in finalized draft version since at least early 1997; however, it has never been circulated openly, much less formally provided for public review, comment, and eventual adoption by the Department of Land and Natural Resources. This situation is unfortunate because the draft rule goes well beyond National Register Bulletin No. 38 in providing detailed guidance for conducting traditional cultural property studies, and more specifically for dealing with the identification, evaluation, and documentation of native Hawaiian traditional cultural properties and their associated cultural practices and beliefs.

In the absence of any formally adopted administrative rule specifically addressing the treatment of traditional cultural properties, SHPD can also be said to basically follow the federal regulations of the Advisory Council on Historic Preservation for guidance in the evaluation of significance – as contained in Section 60.4 ("Criteria for evaluation") of the "National Register of Historic Places" (CFR 1981), and for guidance in the assessment of potential effects – as contained in Section 800.9 ("Criteria of effect and adverse effect") of the "Protection of Historic Properties" (CFR 1986).

PRESENT STUDY SCOPE AND METHODOLOGY

The scope of work and methodology for the current project is based on the general assumption that the level of study effort appropriate in any project-specific context should involve the consideration of several factors, the most relevant of which are the following: (a) the probable number and significance of known or

suspected cultural properties, features, practices, or beliefs within or associated with the specific project area; (b) the potential number of individuals (potential informants) with cultural knowledge of the specific project area; (c) the availability of historical and cultural information on the specific project area or immediately adjacent lands; (d) the physical size, configuration, and natural and human modification history of the specific project area; and (e) the potential effects of the project on known or expected cultural properties, features, practices, or beliefs within or related to the specific project area.

Consideration of these factors within the specific nature and context of the proposed project, it was thought that the most appropriate level of study for an adequate assessment of potential cultural impacts would be a limited assessment study. Based on the location, size, number and quality of sites, this study assumes that (a) potential cultural impact assessment issues would be moderate, (b) the results of the archaeological survey conducted for the project would confirm both the limited number and scope of cultural resources within or related to the project area, and (c) in the instance that any legitimate cultural impact assessment issues should arise during the environmental review period, they could be addressed adequately within the framework of the review process (i.e., from Draft to Final Environmental Impact Statement).

Consideration of these factors within the specific nature and context of the proposed project indicated that the relatively greater levels of study effort that can be characterized as identification or documentation studies would be inappropriate and excessive. The distinctive characteristics of an identification study are that it would be restricted to (a) the identification of native Hawaiian or other ethnic group cultural practices, beliefs, properties, features, or exploitable natural resources associated with and/or present within or related to the specific project area that are currently being conducted by and/or known to individual cultural practitioners or groups, and (b) the collection of information reasonably sufficient so as to define the general nature, location, and likely authenticity of identified cultural claims. An identification study would not involve the considerably greater level of study effort – both calendar months and hours of labor – needed to carry out a full documentation study. The distinctive characteristics of the latter, which would commonly be referred to as a full ethnographic or oral history study, would be (a) the collection of detailed information regarding identified native Hawaiian or other ethnic group cultural practices by means of formal oral history interviews which are usually tape recorded and transcribed, and (b) the analysis and synthesis of all collected data – from interviews, as well as relevant historical documentary and archival research – within the general cultural-historical context of traditional native Hawaiian or other ethnic group culture and the defined specific geographical area of a specific project.

The overall rationale guiding the present limited assessment study has been that the level of study effort should be commensurate with the potential of the proposed project for making any adverse impacts upon any native Hawaiian or other ethnic group cultural practices currently conducted by cultural practitioners within the project area. The study presented in this report (*Appendix B*) is believed to comprise a reasonable approach for the assessment of potential cultural impacts within this specific project area.

CIA STUDY BY HELEN WONG-SMITH

PHRI contracted Cultural Resources Specialist Helen Wong-Smith, M.A., to conduct the current CIA study. Ms. Wong-Smith has extensive experience in historical documentary and informant research, having worked for many years as a Historical Researcher/Cultural Resources Specialist for PHRI. She is currently the Hawaiian and Pacific Collection librarian at University of Hawaii at Hilo.

The informant research for this project initially involved compiling a list of potential informants for the Keahuolu project area (TMK:3-7-4-21:020). Later, at the request of Belt Collins Hawaii, the study was expanded to include an additional small reservoir site in Keahuolu (TMK:3-7-4-21:020,Por.14,Por.21). *Figure 2* depicts the areas covered by this CIA study. The list of potential informants was compiled by contacting informants known through past projects, and through inquiries with departments and cultural specialists such as Kepā Maly, OHA, Ruby McDonald, and Keola Lindsey, formerly of the Hawaii Island SHPD office. One contact usually led to another until a list of over thirty potential informants was compiled (*Table 2*). The potential informants were contacted by phone and e-mail and those responsive were interviewed preliminarily to assess their potential to and willingness to provide information. To further assess informants, informants were asked to fill out written forms to answer some preliminary questions such as: Who are in your immediate family? What was your previous occupation and education? What is your family background? What are your residential ties? Do you know of any specific historic/cultural properties, practices, and/or beliefs relevant to the project area? This was followed up with phone conversations. Historical Researcher and Cultural Specialist Helen Wong-Smith was then contracted to conduct further interviews with a few selected individuals who had potential to provide further information, and to provide further documentary information on the Keahuolu project area. Ms. Wong-Smith's CIA study is presented in its entirety in *Appendix B*.

The historical documentary study by Helen Wong-Smith suggests limited cultural activity within the project area. Most of the events and documentary evidence concerns the more seaward portion of Keahuolū. Texts indicate that the shoreline area was a rich marine resource. The coastal area also in included springs, and brackish water ponds from which people harvested, among other things, shrimp. *Heiau* were located near the shore: Kawaluna, Palihiolo, and Halepana. Inland areas were used primarily for agriculture. Planting evidently was widespread and took place wherever there was a little soil. Even rocky areas were planted with crops such as sweet potatoes, which could thrive in small pockets of soil and mulch.

The Helen Wong-Smith informant study, despite considerable effort, yielded only limited information. Pili grass (*Heteropogon contortus*) was apparently harvested from the project area at some time in the past. Clarence Medeiros, Jr. states that he continues to gather pilo (*Capparis sandwichiana*) for medicinal uses. Mahealani Pai indicates that the project area contains plants such as *alahe'e*, *kauila*, and *uhiuhi*, which were important, useful plants in pre-Contact times. No informant, however, had knowledge of any other cultural/traditional use of the project area.

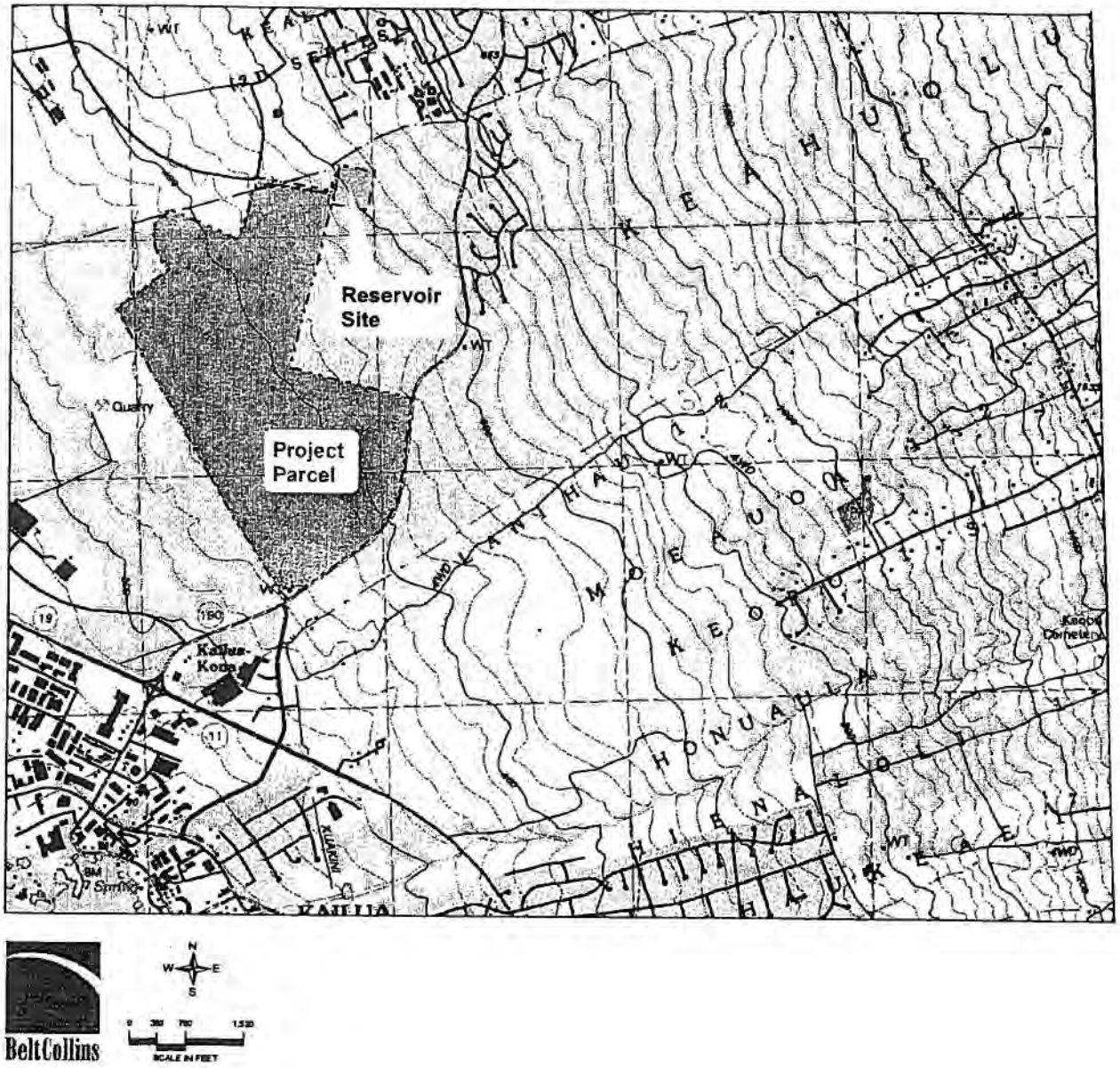

Figure 2. CIA Study Area

Table 2. List of Potential Informants

	Name	Status/Expertise	Affilliation
1	Ruby P. Keana'aina McDonald	Native Hawaiian, executive director	OHA, NAHKHAC
2	Elaine Watai	Native Hawaiian	KCA/SAFIS
3	Craig "Bo" Kahui	Native Hawaiian, president of organization	KCAVL
4	Wally Lau	Native Hawaiian, executive director	NPK
5	Reginald Lee	Native Hawaiian	DOCARE
6	Elizabeth Lee	Native Hawaiian, *lauhala* weaving master	
7	Michael Ikeda	Community Building Facilitator IV	QLCC
8	Mahealani Pai	Native Hawaiian, cultural specialist	BHI
9	J. Curtis Tyler III	Native Hawaiian, cultural resource specialist	KCDPSC
10	Geraldine Bell	Native Hawaiian, park superintendent	KHNHP, NAHKHAC
11	Kahu Akahai	Native Hawaiian, *kahu*, minister, pastor	MZCC
12	David Garcia	Counselor	QLCC
13	Clarence Medeiros, Jr.	Native Hawaiian, journeyman mason	
14	Lily Kong	Native Hawaiian	KOONKOK
15	Ulalia Ka'ai-Berman	Native Hawaiian, *kumu hula*	NAHKHAC
16	Taro Fujimori	Native Hawaiian	N/A
17	Zachary Kanuha	Native Hawaiian	N/A
18	Clement "Junior" Kanuha	Native Hawaiian	N/A
19	Raeanne Kahaiali'i	Native Hawaiian	N/A
20	Clarence Rapoza	Native Hawaiian	N/A
21	E. Kalani Flores	Native Hawaiian, *kumu olelo* Hawaii	HL-HCCW
22	Gail Souza-Save	General knowledge	QLCC
23	Lydia Mahi	General knowledge	KCDPSC,HCEOC
24	Arthur "Uncle Aka" Mahi	Native Hawaiian	N/A
25	Rae Ann (Fujimori) Godden	Native Hawaiian	N/A
26	Gloria Muraki	General knowledge	N/A
27	Violet Leihulu Mamac	General knowledge	N/A
28	Angel Pilago	Native Hawaiian	HCC
29	Kelly Greenwell	General knowledge	N/A
30	Michael Keala Ching	General knowledge	N/A
31	Iris Nalei Napaepae-Kunewa	General knowledge	N/A
32	Dr. Frank Sayre	General knowledge	N/A
33	Robert Kawaiula Brancp	General knowledge	N/A
34	Kahu Henry Kanoelani Boshard	Native Hawaiian, *kahu*, minister, pastor	MC
35	Kahu Brian Boshard	Native Hawaiian, *kahu*, minister, pastor	MC
36	Ka'ea Lyons Alapai	Native Hawaiian, *kumu olelo* Hawaii	KAPA, EHES

TABLE KEY:

Affiliation:

N/A	Not Available
KCA	Kealakehe Community Association
SAFIS	Salvation Army Family Intervention Services
OHA	Office of Hawaiian Affairs
QLCC	Queen Liliuokalani Children's Center
BHI	Bishop Holdings, Inc.
MZCC	Mauna Ziona Congregational Church
KHNHP	Kaloko-Honokōhau National Historical Park
NPK	Neighborhood Place of Kona
NAHKHAC	Na Hoapili o Kaloko Honokōhau Advisory Commission
KCAVL	Kaniohale Comm. Association at the Villages of La'I 'Ōpua
DOCARE	State of Hawaii DLNR – Department of Conservation and Resources Enforcement Division
KCDPSC	Kona Community Development Plan Steering Committee
KOONKOK	Ka 'Ohana O Na Kupuna O Kona
HCEOC	Hawaii County Economic Opportunity Council
HL-HCCW	Hawaiian Lifestyles – West Hawaii Community College
MC	Mokuaikaua Church
HCC	Hawaii County Council
KAPA	Kapa Radio
EHES	Ehunuikaimalino Hawaiian Immersion School

CURRENT HISTORIC PRESERVATION STATUS

At the time of this writing, SHPD has approved the archaeological inventory survey (Donham 1990a) and the archaeological mitigation plan for the project area (Jensen et al. 1992). The SHPD reviewed the Donham (1990a) report and approved it via a letter dated 2/17/93, Log 6839, Doc. 9302RC34. The SHPD reviewed an amended PHRI Archaeological Mitigation Plan and approved it via a letter dated July 28, 1993, Log 8976, Doc 9307RC40. Copies of the SHPD approval letters are in *Appendix A*.

The archeological mitigation plan outlines all of the data recovery work that remains to be done in the project area. Data recovery work (detailed recording, surface collections, possible excavations) needs to take place at eleven sites in the project area. In addition, the entire Sample Block E needs to be recorded in detail (definition of the block, vegetation clearing, and detailed mapping of the entire block). A report on the data recovery work would have to be written and would have to be approved by the SHPD.

The data recovery works would also include burial testing at Sites 13395, 13408, and 13409. If human skeletal remains are found at any of the sites, a burial treatment plan for the project area will have to be prepared and implemented. This plan will be prepared in consultation with the SHPD and the Hawai'i Island Burial Council, and also requires the final approval of these two agencies. The plan will include a search for lineal and cultural descendents, detailed descriptions of each burial and burial treatments, including preservation buffers and possible structural protection measures.

For the sites currently recommended for preservation "as is" or with some level of interpretive development (other than burials), a preservation plan detailing preservation treatments (preservation buffer zones, interpretation measures, maintenance, etc.) will have to be prepared, approved by the SHPD, and implemented.

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APPENDIX A:
SHPD APPROVAL LETTERS

JOHN WAIHEE
GOVERNOR OF HAWAII

HRI 89-596/ 89-738
Project 91 1152

C: ATW

STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

WILLIAM W. PATY, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCE

DEPUTIES

JOHN P. KEPPELER, II
DONA L. HANAIKE

AQUACULTURE DEVELOPMENT PROGRAM
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CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION DIVISION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

February 17, 1993

LOG NO: 6839
DOC NO: 9302RC34

Virginia Goldstein, Director
Planning Department
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Ms. Goldstein:

SUBJECT: County of Hawaii Change of Zone -- QLT Lands
Keahuolu, North Kona, Hawaii
TMK: 7-4-8: portion 2, 12

We have reviewed the archaeological inventory survey for these lands and have found the survey to be acceptable. We are currently reviewing the detailed mitigation plan for the lands, and we will be meeting with the consulting archaeological firm (PHRI) next week to finalize the research design for the data recovery plan.

At this point, we believe that the project will have "no adverse effect" on significant historic sites, if a condition -- worded similar to the following -- is attached to ensure that the work is adequately carried out. This condition is similar to that we requested for the State Land Use Commission petition for this project.

The applicant has committed to preserving some significant historic sites in the project area and to archaeological data recovery of the other sites which are significant solely for their information content. The applicant shall prepare a detailed historic preservation mitigation plan to treat these sites. This plan shall consist of a detailed archaeological data recovery plan (scope of work with research design) and a detailed preservation plan. The mitigation plan must be approved by the County Planning Department and the State of Hawaii's Historic Preservation Division prior to its implementation. These same two agencies must verify in writing the successful execution of the plan, prior to land altering activities in the area of the historic sites.

3/11/

We will advise you on the results of our meeting on Februarty 22, 1993, with PHRI regarding the scope of the detailed mitigation plan.

Sincerely,

DON HIBBARD, Administrator
State Historic Preservation Division

RC:amk

c: OCEA (File 93-270)
Paul Rosendahl, PHRI

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STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

December 21, 1993

Ms. Susan S. Rutka
Belt Collins & Associates
680 Ala Moana Boulevard, First Floor
Honolulu, Hawaii 96813-5406

LOG NO: 10361
DOC NO: 9312RC02

Dear Ms. Rutka:

SUBJECT: **Mitigation Plan for Significant Historic Sites -- Liliuokalani Trust Keahuolu Lands**
Keahuolu, North Kona, Hawaii
TMK: 7-4-8: portion 2 & 12

This responds to your letter of November 24, 1993. This package was supplemented on December 9, 1993, with the summary table of significant sites in the project area and their proposed mitigation treatment which you supplied us at our request.

Mitigation Commitments

We have no objection to combining the mitigation plan for the Queen Liliuokalani Trust (QLT) lands mauka and makai of the Queen Ka'ahumanu Highway.

We find it acceptable to switch the Mamalahoa Trail segment which lies makai of the highway from preservation to data recovery. It is an isolated remnant, with a large gap separating it from the rest of the trail, and the rest of the trail is mauka of the highway. Also, Na Ala Hele has stated that they do not wish to preserve it for public access. It must be clear, however, that the portions of this trail mauka of the highway are to be preserved. We should add that losing a small part of the trail mauka of the highway to a turn lane onto the highway is acceptable. Data recovery should be done of that portion (primarily photography and a few measurements). Preservation of the trail will probably need to involve restoration of damaged areas.

We also find it acceptable to move 3 sites in the KIS Expansion Area (18513, 18515, 18518) out of data recovery and into no further work -- the Exhibit E argument of PHRI dated November 23, 1993. We agree that these types of sites (small agricultural and habitation features) will be well represented in the sample blocks.

We also acknowledge that the 8 burial sites are to be preserved as-is, by vote of our Hawai'i Island Burial Council, as noted in our November 29, 1993, letter to Mr. Nakoa.

Thus, at this time, the mitigation commitment is to preserve 23 sites and data recover 19 sites, as indicated on your summary table.

Detailed Archaeological Data Recovery Plan

In a July 28, 1993, letter, we approved the research design of PHRI based on sampling blocks. That letter details the nature of the research design. The focus is to study similarities and differences in agricultural fields and in types of habitations, to see if there are notable spatial patterns, and to date the growth of the agricultural system.

We understand that this data recovery work is not planned to start right away, so the sites will technically be in the preservation form of mitigation for a period of time. Interim protection measures must be agreed upon prior to the soon to occur construction. We agree that only a few sites will be threatened by construction (those in the preserve, the trail, 18506 and 18511 in the KIS Expansion area, and Data Recovery Block C and sites 133913340 in Phase 1). We also agree that these should be fenced as you propose, with the buffer zones and fence locations shown in Exhibit C being acceptable. Construction firms must be briefed as to the presence of these sites, and the fact that substantial fines and seizure of equipment can result from their damage.

Based on discussions in our December 9, 1993, meeting, all data recovery work would occur in the makai areas (KIS Expansion Area & Phase 3) and in Phase 1 within 5 years, with a final report prepared -- by January 1, 1999. (As this date is approached, an extension could be requested if no development is occurring in the areas and the sites do not seem threatened. A request letter with justification should be submitted for our review at that time.) At the completion of the data recovery report, the data recovery plan would then be re-evaluated by our Division for the sites in the remaining mauka Phase 2 area. If adjustments to the plan are needed, these will then be agreeably worked out by the Trust, our Division, and the County Planning Department. For example, research methods may not be successful in answering some research questions, so some approaches may be dropped in the final phase of the data recovery. Then within 5 additional years these Phase 2 mauka lands would have to have their data recovery work concluded. It must be clear that all data recovery work must be verified to have been successfully executed by our Division and by the County Planning Department.

Detailed Preservation Plan

The sites to be preserved include the 8 isolated burials, the Mamalahoa Trail mauka of the highway, and the sites within the historic preserve. We understand that you wish to defer

development and execution of this plan. This would again mean that interim protection measures are needed as well as the development and execution of a long-range preservation plan.

The first step of interim preservation measures is to fix buffer zones around these sites. We understand that our Hawai'i Island Burial Council has recommended a 30 foot buffer zone around each burial site; we find this to be acceptable. Buffer zones around the preserve as shown in Exhibit C are acceptable. The buffers for the Mamalahoa Trail on the mauka side of the highway will temporarily be 50 feet out from the center line on each side of the trail, with the final buffer to be specified in the detailed preservation plan discussed in the next paragraph. Barrier fences need to be erected across the end of the trail to be cut by the turn lane from Makalapua Blvd., along the west and south edges of the preserve, and around burial site 18511 -- as these sites will be subject to possible construction damage. Construction firms must be briefed as to the presence of these sites, and the fact that substantial fines and seizure of equipment can result from their damage.

Based on discussions in our meeting of December 9, 1993, within one year (by January 1, 1995), an acceptable detailed long-range preservation plan shall be completed for the preserve and the other sites. This plan will include a schedule for execution of the plan's tasks. Again, our Division and the County Planning Department must approve the plan and eventually verify its successful execution.

In summary, this letter shall constitute the acceptance of the mitigation commitments for the significant sites, the acceptance of the interim protection measures, the acceptance of the data recovery plan and its scheduled implementation, and the acceptance of a schedule for preparation of the long-term preservation plan. If the County is in agreement, we believe that with the implementation of the protection measures, construction in Increment A-1 and related off-site infrastructure could begin.

Sincerely yours,

DON HIBBARD, Administrator
State Historic Preservation Division

RC:amk

c: Virginia Goldstein, Planning Dept., County of Hawaii
Alan Walker, PHRI

JOHN WAIHEE
GOVERNOR OF HAWAII

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STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

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HISTORIC PRESERVATION DIVISION
LAND MANAGEMENT
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WATER AND LAND DEVELOPMENT

July 28, 1993

Ms. Susan Rutka
Belt, Collins & Associates
680 Ala Moana Boulevard, First Floor
Honolulu, Hawaii 96813-5406

LOG NO: 8976
DOC NO: 9307RC40

Dear Ms. Rutka:

SUBJECT: **Historic Preservation Mitigation Plan for Queen Liliuokalani Trust Lands Keahuolu, North Kona, Hawaii TMK: 7-4-8: portion 2, 12**

This responds to your letter of July 19, 1993. We did receive PHRI's June 10, 1993, addendum to their mitigation plan of March 1992 (Jensen, Donham & Rosendahl 1992. Archaeological Mitigation Program, Queen Liliuokalani Trust Property. PHRI ms. 1152-012192.) -- this addendum being prepared to met concerns stated in our letter of March 5, 1993 to Dr. Rosendahl. The survey had found 155 significant historic sites and also numerous agricultural features which covered the landscape. The mitigation commitment was to preserve 32 of these sites and to archaeological data recover 123 of the sites.

We find that the addendum to the mitigation plan acceptably identifies 6 sampling blocks for studying the agricultural features and associated sites and identifies 23 other sites outside the blocks for data recovery work. This sample is acceptable to cover data recovery work for the project area. The key research aim of this work is to study the agricultural features and associated temporary habitations in this area in a slightly different approach, to lead to a better understanding of the historic sites in this region. The research is to focus on establishing similarities and differences in agricultural fields and in types of habitations, to see if there are notable spatial patterns, and to date the growth of the agricultural system. The intent of the sample blocks is to conduct a series of micro-study samples. Tasks will involve:

1. Mapping all agricultural features and all sites within each block and associated localized topography (depressions, bare ridges, soil areas, etc.). For each block, an overall map must be prepared showing these items.

2. Within each block, horizontal excavation of 50% or more of each habitation structure that has deposits, to try to identify activity areas and determine if there were different types of temporary habitations in use.
3. Within each block, surface collection in a 20 meter radius around all habitation structures with surface artifacts and/or food remains -- again to establish functional interpretations and identify differences.
4. Within each block, take soil samples from agricultural and habitation features and process pollen analyses -- to attempt to identify local flora, cultivated plants and collected species and to determine what similarities and differences existed.
5. From all blocks, submit 50-100 charcoal samples from agricultural and habitation features -- to identify species and reconstruct associated cultivated and collected plants and to determine if differences exist between the types of sites.
6. From all blocks, submit a large number of radiocarbon samples, 30-50.
7. Prior studies of relic botanical species shall be used in the final report's botanical analyses, along with the pollen studies and charcoal species identification.
8. In the final report's analyses, specific block patterns must be analyzed first and then comparisons be made between the blocks. It needs to be emphasized that the analyses are expected to be thorough and detailed and probably lengthy, given the research questions and the approaches used. It is expected that formal types of agricultural and habitation features will be identified and that functional analysis of these types will rely on locational information, pollen studies, charcoal species studies, relic botanical species, surface collection of artifacts and food remains, and excavated artifacts, food remains and features. Chronology must be looked at in part through extensive radiocarbon dating.

Before we can approve the mitigation plan, however, several things are needed. First, your letter indicates that 450 acres of the project area has been sold. We need to know which of the sites and study blocks remain in the QLT project area. We and the County Planning Department can then amend the data recovery and preservation commitments for this project. If a map of the sites, showing the study blocks, could be marked with the current QLT border and be sent to us, this also would help. Also, we need to know how many burials or probable burials remain in the project area. Second, the proposed mitigation treatment (preservation in-place or disinterment/reinterment) for the burial sites must be approved by our Hawaii Island Burial Council before we can approve the detailed mitigation plan, as noted in Condition D. Please contact Edward Ayau of our Burial Programs staff (587-0010) for information on how to be placed on the agenda.

You also had asked if we could agree that the development of Increment A-1 (which evidently includes roads Queen Liliuokalani Blvd. and Keohokalole St.) would have no effect on significant historic sites. Usually, all mitigation work for a project needs to be completed, before land altering construction would occur. It is not that common to have a request to parcel the project. In this case, you note that surveyors established that A-1 avoided significant historic sites and sampling blocks. We need to see the historic site and sample block locations on a map which also

shows A-1 and its roads to be able to verify this point. You could overlay A-1 and the roads on PHRI's survey map. If all sites and blocks were missed, then we can consider the request. Clearly, there would have to be an acceptable interim protection plan (if some sites are nearby and might be impacted by construction). Also, we would need to know what a schedule for completion of the remaining data recovery and preservation work might be, and to receive some ideas on interim protection for the entire project area if the completion of the remaining mitigation work will not occur for several years (as indicated by your letter). With those items, we could consider this request.

If you have any questions, please feel free to contact Ross Cordy (587-0012), our Branch Chief for Archaeology.

Sincerely yours,

Ross Cordy

for DON HIBBARD, Administrator
State Historic Preservation Division

RC:amk

c: Alan Walker, PHRI
Virginia Goldstein, Planning Dept., County of Hawaii

APPENDIX B:
CULTURAL IMPACT ASSESSMENT STUDY

by Helen Wong-Smith, M.A., Cultural Resources Specialist

ABSTRACT

This report, prepared at the request of Paul H. Rosendahl, Ph.D., Inc. (PHRI), provides a cultural impact assessment for TMK 3-7-4-21:20,Por.14,Por.21) in Keahuolū. The assessment is based on a review of a wide range of written material – archaeological reports, government and other historical records, Hawaiian language sources translated into English, and interviews with long-term residents, including native Hawaiians, familiar with the cultural history and resources of Keauholu. The research took place between August 17 and December 15, 2007 and utilized resources at the Hawai'i State Archives, Edwin H. Mo'okini Library of the University of Hawai'i-Hilo, the Hilo Public Library, online resources, and previous historical and cultural reports and interviews.

INTRODUCTION

Keahuolū has been written in several ways in historic records. In *Place Names of Hawai`i*[1] it is written as "Ke-ahu-o-Lu" and given the interpretive translation of "the heap [cairn] of Lu" without an explanation of who Lu may be. Tangaro translates the name as "Shrine of Lū, a legendary voyager" but does not provide a reference for this translation[2]. The place name has also been written "Ke-`ohu-`olu," which can be translated as "the cool mists." Kaiokekoa, a native Hawaiian resident of the Kekaha region relayed to Kepā Maly in 1994 he recalled his elders pronouncing the place name the second way[3].

Keahuolū is located in the *moku o loko* (district) of Kona, this northern section of Kona was divided into two regions, Kona kai `opua (Maly provides the interpretive translations "Kona of the distant horizon clouds above the ocean[4]) and Kekaha-wai-`ole (the waterless place). Kekaha-wai-`ole-o-nā-Kona spans from Kalaoa ahupua`a (Keāhole Point) to Kealakehe ahupua`a. Keahuolū is located just south of this section, as Keahuolū abuts Kealakehe. Kekaha is described as "a dry, sun-baked land[5]." Sheltered by the abrupt rise of Hualālai, Kekaha receives very little rain below the 1,000-ft elevation contour. Maly provides the following description of residential movement within Kekaha-wai-`ole-o-nā-Kona during the late 1800s and early 1900s in the Hawaiian Newspaper *Ke Hōkū o Hawai`i*:.

> "O ia ka wāe ne`e `ana ka lā iā Kona, hele a malo`o ka `āina i ka `ai kupakupa `ia e ka lā, a o nā kānaka, nā li`I o Kona, pūhe`e aku la a noho i kahakai kāhi o ka wai e ola ai nā kānaka. (It was during the season, when the sun moved over

---

[1] Pukui, Elbert, and Mookini 1974
[2] Tangarō et al. 2006:19 A search in *Hawaiian Mythology* by Martha Beckwith revealed a voyager by the name of Kaulu but none by the name of Lū
[3] Maly IN Wulzen et al. 1996:12
[4] Maly IN O`Hare 1993:Appendix B1
[5] Kelly 1972:2

> Kona, drying and devouring the land, that the chiefs and people fled from the uplands to dwell along the shore where water could be found to give life to the people[6].

Hawaiian authority and *kumu hula* Pualani Kanaka`ole Kanahele states: "This clearly communicates that the natives of Kekaha-wai-`ole-o-nā-Kona had great knowledge of their land's cycles and its productive abilities. There were springs and brackish water ponds inland from the shore and the ocean was abundant. They planted in the *ma uka* or upland forest and had sufficient amount of rain for their crop. When the rainy season passed, they camped at the shore, grew sweet potato, and fished. Their basic needs were satisfied[7]."

Kekaha has been streaked with ancient and recent (1801 and 1859) lava flows, which contribute to its desolate appearance. Emerson surveyed the area in the 1880s and his map (Reg. Map 1280) denotes "rough pahoehoe [*pāhoehoe],* little vegetation" within Keahuolū.

Ka`iwi Point is the boundary between Keahuolū and Kealakehe. Kanahele reports "Kaiwi Point houses a mamamo ko`a[8] [a shrine to increase the catch of *mamo* or sergeant fish *Abudefduf abdominalis*].

Mahaihale is the southern boundary of Keahuolū, some 1.8 km north of Kukailimoku Point – named after the deity of victory in battle. Between Kukailimoku and the Keahuolū boundary is a narrow strip of land belonging to *ahupua`a* of Lanihau reducing Keahuolū shoreline dramatically. Kukailimoku Pont and the surrounding sand dunes were used in both pre-contact and early historic periods as burial grounds. An 1883 map depicts graves at Kukailimoku and a larger cluster at Kaliliki Point to the south. The surveyor, Jackson, identified a massive masonry tomb as "Kamehameha's Tomb[9]." A 1930 survey identified graves in Lanihau and Keahuolū as do consequent surveys. Neller[10] reported four locations of exposed human remains at the Lanihau/ Keahuolū boundary and historic burials were identified at Pāwai Bay by Neighbor Island Consultants in 1973.

MO`OLELO `AINA: NATIVE TRADITIONS AND HISTORIC ACCOUNTS OF KEAHUOLŪ

Kekāhi Mo`olelo Hawai`i (Selected Hawaiian Traditions)

Legendary references to Keahuolū are few. In his report of a reconnaissance survey of the Old Kona Airport area, now a state park in Keahuolū, Earl Neller erroneously ascribes the O'ahu chief Kuali'i to Keahuolū:

> The area around the old Kona airport may also have some connection with the legendary Hawaiian chief Kuali'i. He was said to have been born at Kalapawai in Kailua, and defied the oppression of Lono-ikaika during the dedication of the

[6] Hawaiian orthography will be employed by this author except when directly quoting. For this reason many of the quotations will lack diacritical and other marks as they are presented verbatim.
[7] Kanehele 2001:4
[8] Kanahele 2001:10
[9] Neller 1980:5
[10] Neller 1980:11-13

heiau at Kawaluna. He is associated with Ku-kaili-moku, the god of victory in battle. Perhaps by coincidence, all of these place names are found in the beach park area[11].

Neller's reference is Beckwith, who states the Kailua referred to is on O'ahu[12]. As Kalapawai is the name of the beach in Kailua, O`ahu, (and memorialized by the Kalapawai Store at the entrance of Kailua Beach Park) it is unlikely Neller's references have anything to do with Kailua on Hawai`i Island. The *heiau* at Kawaluna is located in Waiolani in upper Nu'uanu Valley[13].

A legendary reference to Keahuolū is found in *Ka`ao Ho`oniua Pu`uwai No Ka-Miki* (The Heart Stirring Story of Ka-Miki) translated by Kepā Maly, a legendary account of two supernatural brothers, Ka-Miki and Maka-`iole, who traveled around Hawai`i Island in the period when Pili-a-Ka`aiea was chief of Kona, ca. 12th-13th century). It was originally published in serial form between 1914 and 1917 in the Hilo-based Hawaiian language newspaper *Ka Hōkū o Hawai`i* by Hawaiian historians John H. Wise and John Whalley Hermosa Isaac Kihe. Here are excerpts from Maly's translation:

> ...Within the lands of Keahuolū you saw Hale-pa`u which is also near Ka-pā-wai (The water enclosure). Kapāwai is also known as Makā`eo (Look with anger), and a coconut grove encircled those places. Further on, between the lands of Keahuolū and Kealakehe was the *āhua* (Hillock-plantation mound) of Lae-oniau...[14]
>
> ...The priest who officiated over rituals of Keahuolū and Kealakehe was named Kalua`ōlapauila. He was the priest of the temple Kalihi, which is also called Kalua`ōlapauila. This temple is in the coastal area[15] along the border of Keahuolū and Kealakehe, near the old road into Kailua....[16]
>
> ...The district of Keahuolū and divisions of Lanihau (1 and 2) were under the rule of Kapohuku`imaile (kāne) and Papalūlā (wahine), and Papaumauma was their warriors champion. When Papaumauma competed with Ka-Miki at the contest site `Iwa`awa`a (at Kohana-iki), he was defeated. Papumauma was honorable, and he greatly admired the superior skills of Ka-Miki and asked to turn his status and land rights over to Ka-Miki, but Ka-Miki declined...[17]
>
> *Ka-noenoe* (The mist, fogginess) – The mound-hill called Pu`u-o-Kaloa sits upon the plain of Kanoenoe which is associated with both Keahuolū and Kealakeha. The setline of mists upon Pu`u-o-Kaloa was a sign of pending rains; thus the traditional farmers of this area would prepare their fields. This plain was referenced by Pili when he described to Ka-Miki the extent of the lands which Ka-Miki would over see upon marrying the sacred chiefess Paehala of Honokōhau. The inheritance lands included everything from the uplands of Hikuhia above Nāpu`u and the lands of the waterless Kekaha, which spanned from the rocky plain of Kanikū (Keahualono) to the plain of Kanoenoe at Pu`uokaloa[18].

---

[11] Neller 1980:15
[12] Beckwith 1972:395
[13] Pukui et al. 1974:226
[14] April 2 and 9, 1914
[15] Boundary Commission Testimony places this place at the midpoint of Keahuolū rather than the coast.
[16] April 30, 1914
[17] May 21, 1914
[18] October 25, 1917

*Pu`u-okaloa* (Mound, or hill of Kaloa) – The narratives of Ka-Miki identify Pu`uokaloa as "*Pu`uokaloa I ka malo o Ka`eha e waiho ala...*" Pu`uokaloa where Ka`eha's loin cloth (symbolic of the mists) was spread out[19].

Ka Hōkū o Hawai`i published another legendary account provided by J.W.H.I. Kihe entitled "Nā Ho`onanea o ka Manawa, Kekāhi mau wahi pana o Kekaha ma Kona" (A pleasant passing of time, [stories from] some of famous places of Kekaha in Kona]. This section describing agricultural practices as related to Pu`uokaloa is translated by Maly:

> *Pu`u-o-kaloa* is a mound-hill site in the lands of Keahuolū – Kealakehe, not far from the shore of Kaiwi and Hi`iakanoholae. During periods of dry weather (*ka lā malo`o*) when planted crops, from the grassy plains to the *`āma`auma`u* (fern forest zone), and even the ponds (*ki`o wai*) were dry, people would watch this hill for signs of coming rains. When the *lihau* (light dew mists) sat atop the hill of Pu`u-o-kaloa, rains were on the way. Planters of the districts agricultural fields watched for omens at Pu`uokaloa, and it was from keen observation and diligent work that people prospered on the land. If a native of the land was hungry, and came asking for food, the person would be asked:
>
> *Ua ka ua I Pu`uokaloa, ihea `oe?*
> When rains fell at Pu`uokaloa, where were you?
>
> [If the answer was...]
>
> *I Kona nei no!*
> In Kona!
>
> [There would be no sweet potatoes for this person.]
>
> [But if the answer was:]
>
> *I Kohala nei no!*
> In Kohala!
>
> [The person would be given food to eat for they had been away, thus unable to accomplish the planting[20].]

Within S.N. Hale`ole's epic *Ka Mo`olelo o Lā`ieikawai* (The Hawaiian Romance of Lā`ieikawai a short reference to Keahuolū and Lanihau as parents is found in the story of *Hiku and Kawelu*:

> The son of Keaauolu [sic] and Lanihau, who live in Kaumalumalu, Kona, once sends his arrow, called Puane, into the hut of Kawelu, a chiefess of Kona. She falls violently in love with the stranger who follows to seek it, and will not let him depart. He escapes, and she dies of grief for him, her spirit descending to Milu. Hiku, hearing of her death, determines to fetch her thence. He goes out into mid-ocean, lets down a *koali* vine, smears himself with rancid *kukui* oil to cover the

[19] October 25, 1917; Maly 1996:12-13
[20] May 19, 1914; 1996:13

> smell of a live person, and lowers himself on another vine. Arrived in the lower world, he tempts the spirits to swing on his vines. At last he catches Kawelu, signals to his friends above, and brings her back with him to the upper world. Arrived at the house where the body lies, he crowds the spirit in from the feet up. After some days the spirit gets clear in. Kawelu crows like a rooster and is taken up, warmed, and restored[21].

Fornander provides a longer version of this tradition providing the father's name as Keahuolū[22].

The origin of the place name Ka`iwi on the shoreline on the boundary of Keahuolū and Kealakehe is presented in this excerpt:

> *Ka`iwī* (The bone) is also called Ka-lae-o-ka-iwi (The point of Ka-iwi) and is the name of a shark shaped stone near heiau of Kalua`ōlapauila. The priest Kalua`ōlapauila had two body forms, one human, as the priest, and the other body form as a shark in which he swam along the shore of Kealakehe and Keahuolū, attacking people. The shark form was named Kaiwi, and the point Ka-lae-o-Kaiwi is named after him[23].

Kanahele provides additional insight to this story adding that Ka`iwi and Kalua`ōlapauila are destroyed by "their" grandmother, Kauluhenuihihikolo, who teaches her grandchildren to call up the fires of Pele to rid the land of this man-eating shark. "Hi`iakanoholae, known today as Ka Lae Keahuolū, was the boundary direction for the lava flow. The protocol for lava is that a course of flow is given and Hi`iakanoholae is the southern limit of the flow. The flow did exactly what it was asked to do with Kaiwi and the characteristic of a Hi`iakaikeale`ī and Hi`iakaikealemoe flow is seen at Kaiwi Point[24]."

Figure 1 (*at end*) provides the location of these and other place names compiled by Lloyd Soehren and presented as *Hawaiian Place Names*[25]. Soehren assigned their locations from Boundary Commission testimonies, surveyor field books, and a myriad of primary resources.

Keahuolū Described in the Journals and Logs of Historic Visitors (1815 to 1902)

The earliest reference to Kailua concerns Kamehameha's residence there after his unification of the islands:

> In 1812, two years after all the islands and finally been united under his rule, Kamehameha returned to Hawai`i island from O`ahu, where he had lived for the past nine years. Kamehameha lived most of his remaining years in Kailua, at his principal residence at Kamakahonu in Lanihau ahupua`a [Lanihau is between Keahuolū and Hienaloli][26].

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[21] Hale`ole 1997:660
[22] Fornander 1919 v5:182-184
[23] Maly 1996:14
[24] Kanahele 2001:10
[25] http://www.ulukau.org/cgi-bin/hpn?
[26] Kelly 1983:3

> The accounts of early visitors at Kailua were, in the main, those of explorers...The *Columbia* came to Kailua Bay five times between 1815 and 1818, and then was sold to Kamehameha for sandalwood. The ship [was] renamed the *Laholile*...
>
> On its first visit to Kailua, in January of 1815, the *Columbia* took on board "hogs, vegetables, rope, and cloth of the country" (Corney 1896:35). Peter Corney, one of its officers, who remained in Hawai`i when the ship was sold and left descendants here, remarked that "island rope" made excellent running rigging[27]. Corney noted that the American ship *Milwood* was then at Kailua, "purchasing sandalwood at the rate of 7 dollars for 133 pounds (a picul)[28]" ...Corney provides a unique and graphic account of the sea traffic at Kailua Bay in the early 1800s.
>
> At the time of Kamehameha's death in May 1819, and for the early months of Liholiho's reign, the court households at Kailua apparently were very large[29].
>
> It was at Kailua in November 1819, approximately six months after the death of Kamehameha, that the "free eating" (*`ai noa*) incident took place, symbolizing the end of the kapu system....The act of "free eating" at Kailua was followed by a general purging and burning of god images from the large heiau[30].

Hawaiian historian Samuel Kamakau offers this reference to the life in the area at the time of Liholiho:

> Many of the old chiefs were alive in Liholiho's day...The sands of Kaiakeakua were worn down like a dromedary's back by the many feet of chiefs and chiefesses tramping over them, and at Kamakahonu could be seen at night the sparkle of lights reflected in the sea like diamonds, from the homes of the chiefs from Kahelo [in Puapua`a *ahupua`a*] to Lanihau. The number of chiefs and lesser chiefs reached into the thousands[31].

At this time M. Gaimard, a member of de Freycinet's expedition, wrote the following description of the Kailua environs:

> In order to reach the mountain that lies to the southeast of the village...we first went across dry fields, where hardly any young growth was visible; but, after reaching a certain elevation; we found much richer terrain where the paper mulberry, breadfruit tree, the mountain apple, tobacco, cabbage, sweet potatoes and yams were cultivated. We were given water of a delicious coolness[32].

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[27] Ibid:48
[28] Ibid:47
[29] Ibid:5
[30] Ibid:6
[31] Kamakau 1961:221-222
[32] de Freycinet 1978:8

Missionary occupation of Hawai`i had its beginnings at Kailua. Kelly notes that:

> Liholiho...[was] at Kailua when the first band of Protestant missionaries arrived there in April of 1820...the missionaries were granted permission to remain in the kingdom on trial for a year. Two missionary families remained in Kailua, while the rest went on to Honolulu[33].

It was at Kailua that Liholiho entrusted the island to Kuakini, younger brother of Ka`ahumanu and faithful aide of Kamehameha I. Three years into Kuakini's stewardship, the Reverend William Ellis began his tour around the island at Kailua in 1823. This passage from his journal reflects the population and resources of Kailua:

> Kairua, though healthy and populous, is destitute of fresh water, except what is found in pools, or small streams, in the mountains, four or five miles from the shore[34].

Ellis reports the observations made by Reverends Thurston and Bishop who walked the coastline from Kailua toward Ka`iwi Point crossing the entire coastline of Keahuolū:

> The environs were cultivated to a considerable extent; small gardens were seen among the barren rocks on which the houses were built, wherever soil could be found sufficient to nourish the sweet potato, the watermelon, or even a few plants of tobacco, and in many places these seemed to be growing literally in the fragments of lava, collected in small heaps around their roots.
>
> The next morning, Messrs. Thurston, Goodrich, and Harwood, walked towards the mountains, to visit the high cultivated parts of the district. After traveling over the lava for about a mile, the hollows of the rocks began to be filled with a light brown soil; and about half a mile further, the surface was entirely covered with a rich mould, formed by decayed vegetable matter and decomposed lava.
>
> Here they enjoyed the agreeable shade of bread-fruit and ohia trees; the latter is a deciduous plant, a variety of Eugenia, resembling the *Eugenia malaccensis*, bearing red pulpy fruit, of the size and consistence of an apple, juicy, but rather insipid to the taste. The trees are elegant in form, and grow to the height of twenty or thirty feet; the leaf is oblong and pointed, and the flowers are attached to the branches by a short stem. The fruit is abundant, and is generally ripe, either on different places in the same island, or on different islands, during all the summer months[35].

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[33] Kelly 1983:7
[34] Ellis 1969:29
[35] Ellis 1963:31-32

The cultivation and environs described above fall within the zone the project area is located and dispenses the assumption this was all barren lava supporting little life.

This type of gardening in lava is called *makaili*[36] when even small pockets of semi-disintegrated lava are utilized, and potatoes are grown by fertilizing with rubbish and by heaping up fine gravel and stones around the vines. Handy writes, "Such cultivation produces inferior potatoes; they are said to be rather tasteless and ridged (*`awa`awa*) or wrinkled[37].

Commodore Wilkes of the U.S. Exploring Expedition made these comments about the environs of Kailua in 1840:

> The natives during the rainy season...plant, in excavations among the lava rocks, sweet potatoes, melons, and pineapples... The...staple commodities are sweet potatoes, upland taro, and yams. Sugar cane, bananas...bread-fruit, cocoa-nuts, and melons, are also cultivated. The Irish potato, Indian corn, beans, coffee, cotton, figs, oranges, guavas, and grapes, have been introduced....[Two miles from the coast, in a belt half a mile wide, the bread-fruit is met with in abundance, and above this the taro is cultivated with success...A considerable trade is kept up between the south and north end of this district. The inhabitants of the barren portion of the latter are principally occupied in fishing and the manufacture of salt, which articles are bartered with those who live in the more fertile regions of other south, for food and clothing[38].

CHRONOLOGICAL HISTORY OF RESIDENCY AND LAND OWNERSHIP IN KEAHUOLŪ

The above description of subsistence farming and trading within the land divisions is characteristic of pre-contact Hawaiian culture. With the introduction of a market system and the call for labor to harvest sandalwood, agriculture in the Kailua area changed greatly, as did the native population. Early demographics for Keahuolū are difficult to ascertain. Schmitt recorded epidemics for the years 1848 and 1849 as follows:

> Four devastating epidemics occurred in rapid succession in 1848 and 1849: measles, whooping cough, diarrhea, and influenza. Together, these four diseases killed more than 10,000 of the perhaps 87,000 persons in little more than a twelve-month period[39].

Kelly presents population demographics for North Kona between 1836-1980 reflecting what she suspects reflects successes and failures of various commercial agriculture ventures dependent on the rise and fall of world prices of crops[40]:

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[36] Fornander 1919-1920, Vol. 6:164
[37] Handy 1972:129
[38] Wilkes 1845:4, 91-92, 95-97 IN Kelly 1983:19
[39] Schmitt 1968:37
[40] Kelly 1983:92

Year	Population	% Increase/Decrease
1836	5,957	----
1853	4,110	-31.0
1860	3,488	-15.1
1866	3,268	-6.3
1872	2,218	-32.1
1878	1.967	-11.3
1884	1,773	-9.8
1890	1,753	-1.1
1896	3,061	+74.6
1900	3,819	-24.7
1910	3,377	-11.5

During Kuakini's stewardship of the island, walls were built to protect the cultivated lands from the ravages of free-roaming dogs and pigs kept near the coastal habitations[41]. One of these walls was recorded by John Papa I`i at Honua`ula in 1812; I`i writes, "A stone wall to protect food plots stretched back of the village from one end to the other and beyond[42]." Kelly postulates this wall was later incorporated into what became known as Kuakini Wall, which may be traced from its starting point at Palani Road above Kailua Bay to beyond Kahalu`u Bay. It has long been presumed this wall built sometime during Kuakini's governorship (1820-1844) to protect the cultivated uplands from the depredations of cattle, introduced to the island by Captain George Vancouver in 1793. It was not known by this name until after 1855. Until that time it was consistently referred to as the Great Wall, or the Great Stone Wall by surveyors. The Emerson-Kanakanui map of Kailua Town & Vicinity (Reg. Map No. 1676, dated c.1880) identifies it as the "Kuakini Great Wall." The following reference to what is no doubt Kuakni Wall was made by the Reverend Albert Baker:

> Just a little above [the stone church at Kahaluu], and continuing all the way to Kailua, is the huge stone wall built in Kuakini's time to keep pigs from the cultivated lands above[43].

In his reconnaissance survey of Keahuolū, Rosendahl (1972) notes, "...the Great Wall of Kuakini...is a historic period structure built during the period A.D. 1830-1840 at the direction of Kuakini, Governor of the Island of Hawaii..." Kelly writes of Kuakini Wall:

> It has long been presumed that this wall was built sometime during the governorship of John Adam Kuakini (1820-1844) to protect the cultivated uplands from the depredations of cattle. However, as the wall is at all points less than a mile from the seacoast, only the food plots in the coastal region would have been protected by it. It probably would have only kept cattle and horses grazing on the kula away from the houselots and small gardens along the shoreline[44].

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[41] *Ke Au `Ōkoa*, March 19, 1868
[42] I`i: 1959:111
[43] Baker 1915:83
[44] ibid:75

> Unnecessarily high as a barrier to roaming...the Kuakini wall may have been the Pa'aina named as the makai boundary in several claims to land along its course. At times, the wall reaches a height of 8 or 9 feet, which seems cattle or pigs...The fact that the term used in the register of claims is "papipi," which refers to to a wall or enclosure for cattle, not pigs, should answer the question of what kind of animal the wall was meant to restrict in the 1840s. Perhaps in more recent years it served other purposes. Why it is located between the grazing land and the gardens, or why it is so high in places, we can only surmise[45].

In addition to this notable structure were smaller historic walls for similar and boundary purposes. In her report of subsistence lifestyles in Kona, Schilt writes of the *ahupua`a* in this vicinity:

> 62 historic walls listed....23 walls trending *mauka-makai* pass through the ROW, defining *ahupua`a* boundaries. All are double-faced and core-filled, in good to excellent states of repair. Functioning today as portions of cattle range boundaries, theses walls probably originated in historic times, as early as the mid-1800s, having been built for that purpose[46].

In 1848, during the reign of Kamehameha III, the traditional Hawaiian land ownership system was replaced with a more Western-style system. This radical restructuring was called The Great *Mahele* (division). The *Mahele* separated and defined the undivided land interests of the King and the high-ranking chiefs, and the *konohiki*, who were originally in charge of tracts of land on behalf o the king or a chief[47]. More than 240 of the highest-ranking chiefs and *konohiki* in the kingdom joined Kamehameha III in this division.

Keahuolū was awarded to Anealea Keohokālole (c.1814-1869) who numbered among her offspring King David Kalākaua, Queen Lydia Lili'uokalani, and William Pitt Leleiōhoku (adopted by Ruth Ke'elikōlani). Keohokālole was a great-granddaughter of both Kame'eiamoku and Keaweaheulu two of the important chiefs who supported Kamehameha I in his rise to power[48]. Kame'eleihiwa states, "Keohokālole was regarded by the Kamehameha clan as an *Ali'I Nui* in honor of the great courage and loyalty proffered by her ancestors in their support of Kamehameha[49]." As *Ali'i Nui* Keohokālole held the fifth largest number of *'āina* after the *Māhele* with 50 parcels[50]. She relinquished 48% of her original 96 *'āina* to the *Mō'I* [King] retaining 23 parcels on Hawai'i, 25 on Maui, and two on O'ahu. Of her lands on the island of Hawai'i two-thirds were located in the Kona District[51].

Keohokālole award for Keahuolū is LCA 8452, Apana 12 (Royal Patent 6851). This award had a total area of 4,071 acres. She conveyed 15,000-20,000 acres of Keahuolū lands with the balance going to her heir, Lili`ūokalani. Attached to the following letter is a list of lands including Keahuolū:

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[45] ibid:76
[46] Schilt 1984:44
[47] Chinen 1958:vii and Chinen 1961:13
[48] Kame'eleihiwa 1992:230
[49] ibid.
[50] Kame'eilihiwa 1992:245
[51] Kelly 1983:31

To Highness, John Young
Minister of Interior

Greetings:
This is to inform you and the Privy Council of my desire to convey some of my lands for the Governments one third in the land which remain as mine. Grant me this, of course, with the approval of the Privy Council Below is a list of the lands I wish to convey to the government[52].

To Your Highness, John Young
Minister of Interior

Greetings:
Here is a list of names of my lands which has been left for me pending for an approval of its distribution....Keahuolū ahupuaa, Kona, Hawaii...

With appreciation,
Keohokalole[53]

The following testimony was given by Awahua, to verify Keohokālole's holding for LCA 8452 in Kona:

Awahua, sworn, says he knows the house lots claimed by Keohokalole at Kaawaloa, Hawaii. The first one is fenced all round with a stone wall. It is bounded makai by the sea shore, on Kailua side by the Government land, mauka by the land of Nahaku, and Awahua, and on the other side by the road. Claimant derived this lot from her ancestors, who held it from very ancient times. There is a stonehouse and several grass houses in it belonging to claimant, besides a tomb.

The second lot is called "Awili," and is fenced all round. It is bounded makai by government road., on Kailua side by the same, mauka the same, on the side next [to] the pali by the road.

Claimant derived this lot from her ancestors, who held it from older times.

Witness knows the three house lots in Kealakekua, claimed by Keohokalole. The first lot is called "Kulou" and is fenced in. It is bounded makai by the sea beach, Kaawaloa side by government land, mauka by the road, south Kona side by a lot belonging to T. Cummings.

The second lot is called "Kaahaloa" [and] it is enclosed all round, and bounded on Kona Hema by a lot belongning to T. Cummings, mauka by the lot of Nakoko, North Kona by an hold heiau, makai by the road.

[52] Native Testimony v10:326
[53] Native Testimony v10:327

The third lot is called "Wailokoalii" and is bounded on the South Kona side by an old Heiau , mauka by a Government lot and the lot of Ialua, makai by the sea beach, on the other side by a pali.

Claimant inherited these lots from her ancestors by the mother's side, who possessed them from ancient times. Kekaalua, sworn, says he knows these lots perfectly and confirms in full the testimony by Awahua[54].

Whenever *ali'i* received an entire *ahupua'a*, they were bound to respect the rights of the existing tenants. These tenants, if they filed a claim to The Board of Commissioners to Quiet Land Titles, could continue to cultivate and reside on their parcels. The following testimonies are for such awards granted within Keahuolū:

Land Commission Award (LCA) 11071 to Aki for .60 acres
Kuia sworn, He has seen Aki's land that which he had cultivated himself, it is in the *ili* land of Pauaaiki of Keohoeolu [sic] ahupuaa in Hawaii. Section 1, five cultivated kihapais. Section 2, one kihapai not cultivated. Section 6, four cultivated kihapai. Section 7, one cultivated kihapai. These interest have been made from Kaea, Nahaalualu and Kalekahi at the time of Kamehameha I[55].

LCA 10303 to Maa for 2.25 acres
Mahu sworn, He had seen a whole section of land, however, it is just as he has indicated in his claim that there are eleven taro kihapais, and ten potato kihapais in the *ili* land of Maili of Keahuolū ahupuaa. That land is not cultivated completely, but, Maa had planted seven palm trees. The fruit is for Samuela, both Maa and Samuela have joint interest in the seven fan palm trees. There is also a coconut grove which had been planted by Maa's grandparents for the Chings who owned the land, they were the caretakers. The same had applied to Maa's parents and to him at the present time. The coconuts went to Keohokalole upon the death of Keoua and it has been that way to the present time.

One whole section is salt land and it is still yielding salt...Land passed down to Maa's parents, these to him now. Maa's grandparents received the ili land Maili of Keahuolū during the time of Kamehameha I. Kamauoha had given to Maa the land section of Lanihau ahupuaa in 1848, no one had object to him[56].

LCA 10345 to Nahaalualu (Naalualu) for 2 acres
Kuia sworn, He had seen Naalualu) place that he had cultivated himself in the ili land of Puuokaliu of Keahuolū ahupuaa in Hawaii. Section 1 (boundaries given) one section cultivated. Section 2, four cultivated kihapai, Section 3, one cultivated kihapai, Section 4, four cultivated kihapais...[57]

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[54] Foreign Testimony v3:573
[55] Native Testimony v4:527
[56] Native Testimony v4:526
[57] Native Testimony v4:527

LCA 10198 to Hailewalewa (Kailewalewa) for 1.30 acres
Mahu sworn, He has seen the place on which Hailewalewa had cultivated with his own hands, it is in Ulelele ili of Keahuolū ahupuaa. Section 1 taro. Section 2, Kaluulu. Land has been cultivated, one land section. On land from Hailewalewa's parents to him. Uncertainty for one section[58].

LCA 8012 to Apiki for 1.10 acres
Mahu, sworn, says he knows the kuleana of Claimant in Kailua, Kona. It consists of five patches of Kalo and a lot of patches of potatoes. The kalo patches form one piece, bounded on Kau side by Lanihau, makai by Papaula's land, Kohala side the same, mauka by Hai's land. The potato land is bounded mauka by Haino's land, Kau side by Lanihau, makai by Kahili's land, Kohala side the same. Claimant derived the land from the Konohiki, before the death of Kuakini, and has held it ever since without disputes[59].

LCA 7351 to Kahuanui for 2.90 acres
Papaula, sworn says I know the claim of Kahuanui. It is in the ahupuaa of Keahuolū, Kona. It consists of one piece of kalo land, five patches—all lying together. One of these patches if planted with coffee. It is bounded mauka by the land of Kahookohukaneole, Kau by Lanihau, makai by the land Nahaalualu, Kohala by the konohiki. Claimant received this land from his brother in 1846, and his title has never been disputed[60].

Two references to Keahuolū were found in the Hawaiian language newspapers that have been digitized and available online at *Ulukau: Hawaiian Digital Library*[61]. Unfortunately, they provide little insight to land use

Olelo Hoolaha.
O MAUA NA MEA NONA NA INOA Malalo nei, ke hai aku nei maua i na mea a pau; e kii mai i ko oukou mau holoholona, e hele ana Ma Keahuolū a me Lanihau, iloko o keia malama o Dekemaba, 1862, me ka uku kupono. A o na holoholona e loaa ia maua mahope o keia makahiki, e hoopaa ana maua ma kahi kupono, a e uku mai ka mea nana ka holoholona, a o ke kahu paha nana e malama $5 00. A oi aku paha no ke komo hewa, a me ka poino, a me ka luhi i ka ho-a ana; no ka mea, ua pilikia na hoaaina i ka oukou holoholona.
P. KAPAE.[62]
J. NAKEWIKI.
Kailua, Hawaii, Nov. 28. 1862. 56-3t[63]

Announcement.
We are the ones whose names are below, we would like to let everyone know to come and collect your animals that are moving about in the Keahuolū and Lanihau areas in December 1862, with the proper payment. And as for those animals that still remain with us after this year, we will secure them in the proper area, and owner of the animal will pay us, and his keeper will profit $5.00 or more

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[58] Native Testimony v4:525
[59] Foreign Testimony v8:676
[60] Foreign Testimony v8:682
[61] www.ulukau.org
[62] These names are most likely aliases.
[63] *Nupepa Kuakoa*, Vol.1 No. 56, 20 December 1862

for trespassing and danger, and for roam and the trouble it caused to the land for these animals

Olelo Hoolaha
EIA MA KO'U LIMA KEKAHI WAA UUKU, ua loaa ia'u ma ka moana, ma kahi e kokoke ana I ke awa poe o Pawai, aole he aina, he mau ia kono nae, ua loaa ia'u kela Waa, iloko o na la hope o ka malama o Maraki i hala ae nei. E kii kokie mai ka mea nona keia Waa, me ka uku mai he $15.00, ina aole e kii mai ka mea nona keia Waa, alaila, e lilo no ia'u keia waa, e like me na laau pae.
MAA.
Keahuolū, Kona A., Hawaii, Mei 16, 1865.
5-2t[64]

Announcement.
I have a small canoe that I got in the deep ocean, near the round bay of Pawai, not near land, but it did have some fish in the last days of this past March. Whoever this canoe belongs to should come and get it quickly and pay $15.00, if you don't claim your canoe I will possess this canoe as my own like the pieces of wood that just wash ashore.

Correspondence to the Minister of Interior often provides insights to land use and transactions. In a report by J.H. Kalaiheana, dated April 25, 1866, Keahuolū is said to belong to Keohokālole. In a letter dated July 8, 1869 from David K. Kalākaua to his sister, Lili'ūokalani, a detailed description of Keahuolū is provided. Kalākaua writes:

> This land is situated in the District of North Kona, bounded by the ahupuaa of Lanihau (in Kailua) belonging to Prince Lunalilo on the Kau side, and on the Kohala side, by Kealakeha, a government land and Honokohaniki belonging to Keelikolani. Keahuolū runs clear up to the mountains and includes a portion of nearly one half of Hualalai mountains. On the mountains the koa, kukui and ohia abounds in vast quantities. The upper land or inland is arable, and suitable for growing coffee, oranges, taro, potatoes, bananas &c. Breadfruit trees grow wild as well as the Koli oil seed. The lower land is adopted for grazing cattle, sheep, goat &c. The fishery is very extensive and a fine grove of cocoanut trees of about 200 to 300 grows on the beach. The flat land near the sea beach is composed chiefly of lava, but herbs and shrubbery grows on it and [it is] suitable for feed of sheep and goats. It is estimated at 15,000 to 20,000 acres or more.

A letter written by Lili'ūokalani to the Minister of the Interior, dated October 6, 1894, gives permission for a road to run through Keahuolū, and includes orders for the Government to fence both sides of this road.

On a map drafted by J.S. Emerson in the 1880s (Reg. Map 1280), a narrow band of shading running in a north-south direction crosses Keahuolū. This band is at the approximate elevation of 6,250 to 7,250 ft. In Emerson's Field Notebook sketches, this line is identified as the "Commencement of the Forest." The notebook notes that *ma uka* of the forest line, the land is "lava covered with scattering forest and dense masses of *ki* [ti] root[65]." *Ma kai* of the forest line he

[64] *Ke au Okoa,* Vol. 1, No. 6, 29 May 1865
[65] Kelly 1983:58

described as "rocks covered with long grass[66]. Kelly approximates this forest edge at an average elevation of 550 to 650 ft. from Kailua south[67].

As recently as the 20th century existed a small village of *'ōpelu* (Mackerel scad) fishermen who resided at a coconut grove in Keahuolū. Behind this village, known as Makaeo, were several large brackish water ponds where *'ōpae'ula* (*Crangon ventrosus)* thrived. These shrimps were used to mix in the *palu* or chum, used for catching *ōpelu.* Several springs and one well provided potable water. The village, coconut grove, and all the pools but one were destroyed during the construction of the Old Kona Airport[68].

Cartographic material depicting Keahuolū was sought at the State Department of Accounting and General Services, Survey Division. A 1929 U.S.G.S. topographic quadrangle indicates a sisal (*Agave sislana*) mill located in Keahuolū. Kelly briefly discusses this crop in her 1983 history of the *Gardens of Kona*, quoting Thrum in 1905: "The McWayne sisal tract consisted of about 500 acres at or near Kailua[69]." Kelly adds, "...how much of this acreage was actually planted in sisal is unclear[70]." In an attempt to locate the cultivated area, various articles were consulted and informant interviews were conducted. Early periodical reports focus on sisal cultivating efforts on O'ahu. However, the earliest mention of McWayne's efforts were found in the *Honolulu Advertiser's* column "History from our Files," which reports for 1918 that "[t]en tons of baled sisal, first of an estimated crop of 200 tons from the McWayne Estate, Kailua, Kona, reached Honolulu for transshipment to San Francisco[71]." Herman D. Nichols, vice-president of Tubbs Cordage Co., suggested in a 1949 editorial that utilization of sisal fiber of wild plants throughout the Territory be explored[72].

Mr. Minoru Inaba was interviewed by the author in February 1990, as he was employed at the sisal mill after he finished the 8th grade in 1921. He said the mill was owned and operated by Luther S. Aungst from 1917 until its closing in 1924. Inaba recollects there were over 1,000 acres in cultivation in the *ahupua'a* of Kealakehe and Keahuolū. The mill, abutting Palani Road, was surrounded by sisal fields. The challenge, Mr. Inaba noted, was getting the sisal from the fields to the mill, as it was very bulky and sharp. Field workers cut the sisal in the field, then bundled and transported it on donkeys to the mill. At the mill the sisal was thrashed, dried, and baled. From Kailua Bay, the bales of dried sisal would be shipped to San Francisco on steamers. Mr. Inaba's job was to dispose of the by-products. Working with the sisal "made his skin itchy," and he wore protective clothing. According to Mr. Inaba, Mr. Aungst played an important role in the development of the Kona district. He started the telephone company that connected Kona with Waimea, and later added Volcano to its line. This phone systems was eventually sold to Mutual Telephone Co., Aungst was also the postmaster and owned a garage in Kona[73].

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[66] ibid:59
[67] ibid:58
[68] Clark 1985:110
[69] Thrum 1905:185
[70] Kelly 1983:89
[71] *Honolulu Advertiser* July 31, 1948, editorial page
[72] *Honolulu Advertiser* September 20, 1949
[73] pers. comm. February 1 and 8, 1990

SELECTED DOCUMENTATION OF THE HISTORY AND ARCHAEOLOGY OF KEAHUOLŪ

Table 1 provides a summary of selected archaeology projects that have been conducted in the study area.

An island-wide description of sites was published by Henry Kinney in the earlier part of the 20th century. Kinney writes of the Keahuolū shoreline:

> From the point where the Honokohau Trail leaves Kailua a poor trail leads makai over the lava to the lighthouse. Hence it continues along the beach for a couple of miles. After passing several old stone mausoleums, the trail passes an abandoned grass house where is a stone wall, the remnants of the heiau Keohuulu [sic]. Still further north is a coconut grove, where there were several kuula here, one particularly powerful one, the idol of which is still remembered as having been in a fair state of preservation, only one arm missing, when a Christian pries took it from the cave where it was kept. Since then, say the inhabitants, the fishing has been comparatively poor. In the grove are two cocoanut stumps which served as gallows for the first execution conducted by hanging in Hawaii. A chief, Kekuakahaku was the victim.
>
> Beyond the main [coconut] grove are a few isolated trees near the edge of the flow. Here was the heiau of Pauai, and here the trail ends[74].

The area in which Pauai *heiau* is located is known as Pāwai. Research by the Lili'uokalani Trust has determined that Pāwai is an abbreviation of Papawai and this is the name the Trust uses. Papawai's literal meaning is water stratum. It is also known as Bean's Beach[75].

In his 1919 report on *heiau* on the island, J.F.G. Stokes reports the following sites within Keahuolū:

> Ko'a of Halepau, in Halepa'u Section...A small fishing heiau on the pahoehoe, 100 feet north-west of Keahuolū. Well preserved walls, 4 feet high (Site #10-27-2139)
>
> Heiau of Kawaluna...on the beach, a quarter mile from the boundary of Lanihau, in a section (ili) called Pawai. An enclosure, the walls of which have been carefully rebuilt, without opening. The interior was filled with loose stones piled up without arrangement. The local informant stated that an old fisherman was in the habit of offering fish in this heiau. Asked as to the resulting luck, the answer was that it was not as much as that of other fishermen, perhaps because the offering was made at a heiau instead of the ko'a (Halepa'u) nearby.

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[74] Kinney 1913
[75] Clark 2000

Table 1 – Summary of Archaeological Findings Within Keahuolū

Year	Author	Scope	Zone	Findings
1919	Stokes	*Heiau* Survey	Coastal/Inland	3 *heiau*
1930	Reinecke	Reconnaissance Survey	Coastal	12 sites primarily habitation platforms & enclosed yards
1970	Emory	Site Inventory	Coastal/Inland	2 *heiau* discussed
1970a	Newman	Inspection	Coastal	Historic burials and "bait cups"
1972	Bevacqua	Reconnaissance Survey	Coastal	9 sites
1973	Neighbor Island Consultants	Reconnaissance Survey	Coastal	Historic burials located
1975	Sinoto	Reconnaissance Survey	Coastal	7 sites – temporary structures
1978	Ching	Reconnaissance Survey	Coastal	59 sites – salt pans, cave shelters, paving, cairns
1979	Rosendahl	Reconnaissance Survey	Coastal	4 complexes, 2 modified sinkholes, 2 wall sections, 1 cairn, 1 rock shelter, 2 petroglyph areas, 1 walled enclosure
1980	Estioko-Griffin & Lovelace	Reconnaissance Survey	Coastal	35 sites – caves, petroglyphs, burials, house sites
1980	Folk	Reconnaissance Survey & Test Excavations	Coastal	21 sites in 3 *kipuka* – 7 pavements, 3 caves, 2 platforms, 4 historic/recent campsites, 1 burial/shrine, animal enclosure, 3 habitation areas
1980	Neller	Reconnaissance Survey	Coastal	
1983	Soehren	Survey	Inland	Sisal plantation remnants
1983	Rosendahl	Survey	Inland	2 sites – agricultural and habitations, possible ceremonial and burial. One site was later found destroyed
1984	Schilt	Field Work	Coastal/Inland	Kuakini Highway realignment crossing 24 *ahupua`a*. Within Keahuolu – cairn and modified outcrop
1990	Donham	Reconnaissance Survey	Coastal/Inland	239 sites – *pāhoehoe* quarry, agricultural excavations, rock mounds, modified blisters or outcrop, the majority interpreted as agricultural features
1989	PHRI	Inventory Survey	Inland	Sites indicate relatively intensive agricultural activities
1990	PHRI	Inventory Survey	Inland	32 sites – agricultural/boundary-related, temporary habitation
1993	O`Hare & Rosendahl	Inventory Survey	Inland	18 sites – agricultural, temporary habitation, burial, historic dump, transportation feature, quarry and marker
1993	PHRI	Field Inspection	Inland	16 sites – ceremonial and burials
2007	Haun	Inventory Survey and Assessment	Inland	5 sites – agricultural, temporary and permanent habitation

Heiau of Palihiolo, at Waikilohi, at or near the boundary of Keahuolū and Lanihau, North Kona; on the beach in an old coco-palm grove; this is an insignificant pen, 25 by 29 feet in size with small, thin walls built on the upper slopes of the beach. Coral has been spread over the floor as a paving. The only interest attaching to the place is the account given by a very old native living in the grove. He said that Palihiolo was formerly a heiau for human sacrifice [luakini], and that it was rebuilt by Kalakaua's orders before the latter left for the United States (ca 1890). The old native also said that Kalakaua promised to have a sacrifice at Palihiolo on his return from America, but that he died in that country[76]. The old native was very insistent on the truth of his statements. It might be mentioned that the surrounding grove of palms is where Kalakaua's grandfather was hanged for murder[77]. Other information from the old native is given here for convenience, that this king ordered the rebuilding of the two heiaus of Kawaluna and Palihiolo where human sacrifices were formerly offered, and the ko'as of Halepa'u and Maka'eo....It might be remarked that these four structures have the appearance of having been rebuilt in recent times[78].

Ko'a of Maka'eo...This is a small pen, 200 feet from the sea and about half a mile to the southeast of Palihiolo.

In 1930 John Reinecke conducted a survey of Hawaiian sites on the Island and reported on sites in Keahuolū. Comments for these sites [in parentheses] were provided by Earl Neller in 1980:

Site 4. A group of masonry platform graves on the sand beach. (Referred to as "graves of chiefs" in Jackson's 1883 Field Notes, p.32)

Site 5. Remains of a platform of large stones. Near this is a notable group of petroglyphs. There is also a hole with a ring around it, a form of carving which I have found elsewhere, but what it represented is hard to say—perhaps a *kohe*. There are also *papamū*[79]: a clear one 16 x 13; a very fine one with evenly arranged holes 1½ in diameter; and a third too dim to make out the rows, but there must have been about 12 each way.

Site 6. A large masonry tomb or powder magazine with very massive walls. (Note; This is probably the structure referred to as "Kamehameha's Tomb" in George Jackson's 1883 Field Notes, p.30)

Site 7. ON the beach, the ruins of a platform and pen of boulders; on the *pāhoehoe* back of this, a small house platform of *pāhoehoe* fragments. (This could be Stoke's "*Ko'a of Maka'eo*")

Site 8. Remains of a medium-sized platform, sand-covered. From its position, it may be a fishing *heiau*. By it is an old *papamū,* 12 x 11. (This could be Stoke's "*Ko'a of Maka'eo*")

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[76] Kalākaua died on January 20, 1891 in San Francisco attributed to Bright's disease. Balileу:1975:302

[77] Kamanawa, Kalākaua's paternal grandfather was hung for murdering his ex-wife Kamoku'iki by giving her poison in a cup of *'awa*. Kamanawa was the first public execution under the 1840 laws.

[78] Stokes 1919

[79] Stone on which the checker-like game, kōnane, was played

Site 9. Group of ruins centering about the ponds of Makeo. (This site has been largely destroyed by construction of the old Kona Airport.) About 200' NW of Site 8 is a modern pen, and by it a large coral-strewn platform (perhaps Stoke's "*Heiau of Palihiolo*") and the remains of a very old pen. Back of that, among *kiawe*, are five house platforms, all but one being coral-strewn, two enclosures which seem to be walled house sites, and two very old house platforms. The small fishpond is divided into seven sections. It is now shallow and muddy, but was once carefully walled up—a feature common to the brackish ponds along this coast. Even yet they are occasionally cleansed of their scum. Between it and the large pond is a small platform like a *puoa* [*pū'o'a*][80]. The marsh contains one large pond, with many small pools land waterholes, some of them walled round.

Site 10. Well-built walled platform, walls 3½' wide and 3' high; inside dimensions 12 x 11½; floor about 6" off the ground. A small platform near. (This site destroyed by construction of old Kona Airport – EN)

Site 11. Near the house at Makeo, on the beach: a very dim *papamū,* 7 x 6, and a petroglpyh. (This site probably destroyed)

Site 12. A series of yard walls by the house of Makeo:
a. House site in the yard of the present residence. (This site probably destroyed)
b. Modern house site with brackish pool behind.
c. Pen, probably once surrounding a water pool.
d. House, platform and pool.
e. Old, small house platform on a knoll. Farther on is a pen and three old, small house platforms, and perhaps a *puoa*.

Site 13. Modern house platform and graveyard. (This could be Stoke's *Kawaluna Heiau*)

Site 14. Three small old house platforms; canoe landing; a modern house platform with an old house site in the same lot; a pen (about 50' x 35') containing a platform, chiefly a mass of rough, large stones—uses unknown.

In 1970 Kenneth Emory prepared an inventory of known sites for parts of the Big Island including Keahuolū. [Comments in parentheses by Earl Neller]

[80] Tower, steeple, pyramid, peak; house for depositing a corpse

3841 (D9-4) Lanihau, Kailua-Kona, SW of old airport. Petroglyphs, located in three clusters, totaling 75 units, includes dots, circles, diagrams, and triangular and linear figures. (This site is probably the one southeast of the old airport)

3842 (D10-1) Waikilohi beach at Keahuolū. Palihiolu Heiau, and enclosure 25 by 29 feet with a coral pavement, not located.

3843 (D10-2) Pawai beach at Keahuolū. Kawaluna Heiau, an enclosure used until recently by fishermen as a *ko'a* or fishing shrine, not located.

Also in 1970 Thomas Stell Newman made a field inspection for State Parks and reported on a few sites [comments in parentheses by Earl Neller]:

10-27-2000 Lanihau Petroglyphs. Southeast of runway. Traditional Hawaiian stick figures; about 15 figures, on a *pāhoehoe* blister. Recommend valuable (This site on fringe of Bishop Museum's Site #3841)

10-27-2001 Lanihau Papamu. 50 meters *ma kai* of runway. A single human stick figure petroglyph holding something in right hand. A large *pāpamu* of 11 by 12 rows of holes. Nearby is a very small *kōnane* board of 3 by 4 rows of holes. Condition good. This site is important. (This seems to be part of Reinecke's "Site 8")

10-24-2002 House & burials. Located 100 meters west of *pāpamu*, site 2001. 25 meters *ma kai* of the runway. Rectangular enclosure, 5 by 6 meters, stacked stone walls about.5 meters high, walls partly collapsed, artifact collectors have excavated a portion of the interior; no midden seen. 10 meters north of enclosure are two graves, slab-lined crypts barely visible, about 2 x 4 meters. The central area of both graves is filled with small rubble (This could be part of Reinecke's "Site 9." It could also be Stoke's Palihiolo Heiau)[81]

[No site number] A modern burial area lies off the west end of the main runway and I suspect there are still living relatives for those buried there. Numerous bait cups or holes ground in the rocks just back of the high tide mark are to be found all along the beach but it would not appear to be in any danger from construction. (This is probably Reinecke's "Site 13")

A walk-through archaeological survey of the Queen Lili'uokalani Village – Unit 3 Tract[82], some 100 acres, was conducted in September 1972 by Paul Rosendahl. The subject parcel is located on the *ma kai* side of Palani Road. Fourteen archaeological features were found including five stone walls, two platforms, two stone mounds, two stone-walled enclosures, one foot trail, one small cave shelter, and one road causeway. Rosendahl noted "none have any real excavation potential, none are features of outstanding structural or other characteristics, and none have any real known historical interest, value, or significance[83]." Two stone walls were recommended to be preserved for their scenic value.

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[81] Palihiolo Heiau was later placed within Lanihau and assigned SIHP Site #2002 with several burials identified by Newman.
[82] TMK 7-4-08
[83] Rosendahl 1972:7

In 1975 Aki Sinoto surveyed a road corridor in coastal Keahuolū. He identified seven sites, all small, semi-permanent or temporary structures associated with coastal marine activities[84].

Lloyd Soehren conducted a reconnaissance survey of two parcels near Kamakahonu in Lanihau 1st August 1976. Soehren identified a "*kuaiwi* or low mounding of small stones into a row containing scattered pebbles of waterworn coral" which he considered an *ahupua'a* boundary marker between Lanihau and Keahuolū[85]. This "windrow extended some 300 yards eastward before it is obliterated, and is coincident with the present boundary. It continues to the west, prolonging the line toward the shore rather than following the present, deviant boundary which parallels the shore for some distance. The antiquity of the feature is unknown, but almost certainly predates European contact[86]." These two parcels are both *ma kai* of Kuakini Highway outside of the present project area.

An archaeological survey of a section *ma kai* of the Queen Ka'ahumanu Highway near the Old Kona Airport, also owned by Lili'ūokalani Trust, was conducted in November 1978. Fifty-nine sites with 140 separate features were discovered. Most of the features were concentrated along the coast and were subject to ocean damage. Although small cave shelters along the coast and slightly inland contained cultural deposits and were deemed to have value for excavation and subsequent historic interpretation, it was noted the inland portion of the parcel was devoid of significant remains. The single exception was Site 6540, which consisted of a cluster of occupation features including platforms, paved areas and cave shelters[87].

An additional reconnaissance survey of a c. 20-acre parcel, where the QLT Education Center is located, was conducted by Folk in 1980, revealing no sites. However within three *kipuka* near the shore Folk documented seven pavements, three caves, two platforms, four historic campsites, a burial or shrine, a historic animal enclosure, and three habitation areas[88].

In January 1983, Lloyd Soehren conducted an archaeological survey on a Keahuolū parcel (TMK 7-4-08:001) *ma uka* of the Queen Ka'ahumanu Highway and adjoining Queen Lili'ūokalani Village, between 800 and 1000 feet elevation. Soehren identified the parcel as part of the former sisal plantation. He did not identify any archaeological sites save the entrance to a small lava tube near the west boundary, which he deemed void of any Hawaiian cultural activity.

Theresa Donham, working for Paul H. Rosendahl, Inc. (PHRI), conducted an archaeological inventory survey for a portion of the current project area (TMK 3-7-04-08:Por 2, 12) between 1989 and 1990. Two hundred thirty-seven newly identified and two previously recorded sites containing a total of 1,810+ component features were identified. Twenty-five sites were assessed as having value as examples of site types and were recommended for interpretive development. All but two of the 25 sites are within an area designated as an archaeological preserve by QLT. Eight of the 25 sites were assessed as having provisional cultural value due to the possible presence of burials. Two of the 25 sites, Māmalahoa Trail and Kuakini Wall, were assessed as having interpretive and cultural values. Six cave sites were recommended for preservation the due to the presence of human skeletal remains[89].

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[84] Sinoto 1975:3
[85] Soehren 1976:1
[86] ibid.
[87] Archaeological Research Center Hawaii (Ching) 1978:1
[88] Folk 1980:21-22
[89] Jensen 1992:1

Haun & Associates recently conducted archaeological surveys for Queen Lili`ūokalani Trust. A survey of TMK:7-4-015:15, a c. 5-acre parcel, was conducted in March 2007. A survey of TMK: 7-4-015:14, a 3.982-acre parcel, was conducted in May 2007. No archaeological sites were identified in the former survey area, and five sites with seven features were identified in the latter. The features were interpreted as agricultural, temporary and permanent habitation; no features were recommended for preservation[90].

INFORMANT INTERVIEWS

Informant information for the current project is from interviews conducted for a number of previous cultural impact assessments prepared for Keahuolū, and from follow-up interviews conducted recently. Only information from the interviews that is pertinent to this study is presented here.

Mahealani Pai

Mahealani Pai, Cultural Specialist for Kamehameha Investment Corporation [Bishop Holding Corporation], is a descendent of an *'ohana* who traces their residence in the Kona district to the 1700s, specifically to Honokōhau-Kaloko. He is widely recognized as a cultural practitioner and authority representing the Royal Order of Kamehameha at many public hearings. He is also a contributor to published works, e.g., *Islands in Captivity: The International Tribunal on the Rights of Indigenous Hawaiians* and *All Our Relations: Native Struggles for Land and Life*[91]; and is tireless advocate for the preservation of Hawaiian sites and practices.

Mahealani's *`ohana* resided near the shoreline of Keahuolū during the 1930s, moving there from Honokōhau. They fished Keahuolū waters for *`ōpelu* and *aku*, selling their catch to George Kailiwai *mā*. Mahealani's young father found temporary employment at the sisal mill *ma uka* of the present Queen Ka`ahumanu Highway. Mahealani's grandfather utilized sisal for the making of *kaula* (rope), and he dyed the rope, and used it to secure and hang fishing implements.

Mr. Pai noted that *alahe`e* (*Canthium odoratum*) which was used for the batten of traditional thatched structures, was gathered in the *ma uka* lands of Keahuolū. Mahealani's concern for the present project is that cultural resources like *kauila* (*Alphitonia ponderosa* ), *uhiuhi* (*Mezoneuron kauaiense*), and *alahe`e* (*Canthium odoratum*) be preserved.

Mr. Pai was able to provide information on several places and geographical features in Keahuolū. Mahealani noted a trail his mother would utilize as recently as the 1950s. Starting in Kailua between the current Taco Bell and a car rental agency office, the trail went through Keahuolū onto Kealakehe and Honokōhau. When the seas were *mālie* (calm) they would take the canoe to reach Honokōhau, but when the seas were rough, they would take this trail. The home of Kaelemakule was located at the Kailua end of this trail.

Pai said that Makaeo is the place name for the stretch of area formerly known as the Kailua Kona Airport, where cattle were held before being shipped out on the steamer *Humu`ula*. Makaeo was identifiable by a large coconut grove.

A landmark known as *Pohakūloa* is located south of patches of sand beaches owned by Queen Lili`ūokalani Trust, stands as a lone sentinel for locating a nearby *`ōpelu ko`a*. The *'ōpelu*

[90] Haun May 2007:ii
[91] Churchill, W. et al. 2005; Laduke, W, 1999

ko`a* is known as *Halepao'o,* for the jumping fish *`o`opu (general name for fishes included in the families Eleotridae, Gobiidae, and Blennidae).

Mr. Pai also noted that Kalualapauila Heiua is located on the northern *ma uka* boundary of the Kealakehe and Honokohauiki, in the vicinity of La'iopua near the Kealakehe Homestead [this would place the *heiau* outside the current project area]. If this *heiau* can be identified, he notes, it too should be preserved.

Clarence A. Medeiros, Jr.

Clarence A. Medeiros, Jr. is a descendant of several well-known *kama`āina* families of the Kona region. The son of Clarence A. Medeiros, Sr. and Pansy Wiwoole Hua Medeiros, his grandparents include Frank C. Medeiros and Violet Mokuohai Parker and Charles Hua, Sr. and Annie Man Sing Zen Hua Weeks. He has familial ties to the lands of Honokua, South Kona, and Haleki`i and Kanaueue, North Kona. Both of his parents were native speakers. His mother, an accomplished weaver, is a descendent of native fishermen and canoe builders. His father descended from two renowned canoe builders, John Mokuohai and Charlie Mokuohai Parker. Clarence Sr. repaired rock walls in Kona and Kohala, including the walls of the National Parks of Pu`uhonua o Hōnaunau and Pu`ukoholā. Clarence Sr. was recognized as a cultural and historical resource, and it was from him and Earl Leslie, Sr. that Clarence Jr. learned much of his knowledge of Hawaiian cultural practices and history.

Clarence, Jr. continues to harvest *maiapilo* or *pilo* (*Capparis sandwichiana)* within Keahuolū for the plant's medicinal properties. During an interview on December 17, 2007 he stated the *pilo* grew readily on the area currently being cleared by Queen Lili`ūokalani Trust, near the Queen Ka`ahumanu Highway. According to Clarence, *pilo* does grow *ma uka* of the highway and up to the 300' elevation, but at these elevations it is mixed in with other shrubs and harder to procure. Clarence, Jr. also referred to the sisal plants in Keahuolū used to make rope. Provided with maps of the project areas, Clarence voiced his concern that the environment will be compromised and the *pilo* will be endangered.

Clement "Junior" Kanuha

Clement "Junior" Kanuha is a *kama`āina* of Kona, active in perpetuating Hawaiian practices. He has represented cultural practitioners and cultural descendants on the west side of the island as a member of the West Hawai`i Fisheries Council, at Burial Council hearings, and at many other cultural/environmental organizations. He has assumed the role of caretaker of Keolonahihi *heiau* in Kailua. "Junior" was provided maps of the current subject parcel. During conversations with him on November 9 and December 17, 2008 Junior did not mention any specific cultural practices or sites within the project areas.

Ulalia Ka`ai-Berman

Ulalia Ka`ai-Berman is a *kupuna* with the Department of Education's Kūpuna Hawaiian Studies Program. A child of Ernest Kakihoku Ka`ai and Josephine Ulalia `Ikuwā Ka`ai, her family has over 70 years of residential ties with North Kona. Learned of the *mo`olelo* of Keahuolū from A`ala Roy Akoa between 1970-1981, she is knowledgeable regarding the fishing and farming traditions of the area. During conversations with Ms. Berman she noted the cultural practice of gathering grasses for thatching and the building a hālau at Pāwai in Keahuolū.

Cultural information pertinent to the current project area is presented in this table:

Table 2. Summary of Cultural Knowledge of Informants

Informant	Relation	Reporter	Site	Notes
Mahealani Pai	`Ohana traces vicinity residency to the 1700s	H.W. Smith	Maka`eo, Pohakūloa near an *`ōpelu ko`a*, Kalualapauila *heiau*. Cultural plants: *alahe`e, kauila, uhluhi.*	Kalualapauila Heiau on the boundary of Kealakehe and Honokohauiki at La`iopua.
Peter Keka	Kona kama`āina	Kanahele[92]	Maliu Point	Aka Pu`uoina
			Kaukauholo is the name of the beach and cliff area within Keahuolū	
			Hale La`ī o Hi`iaka is synonymous with Hi`iakanoholae and Keahuolū Point	
			Pu`ukaloa	A small *ahu* near a guava tree in Keahuolū
			Hale o Pao`o	Keka considers Pāwai and Papawai different locations. The latter is a flat area *ma uka* of Makaeau rock out side of the old airport, which was made of red cinders.
			Ka`iwi Point	There was an abundance of *pili* grass here.
Michael Ikeda	Employee of QLT & Kona resident for 30 years	PHRI	Areas where lobsters, *āholehole, mamamo and `opelu* can be found	
Clarence Medeiros, Jr.	Kona kama`āina	PHRI	From 300 ft. elevation and below is found the endemic plant *Maiapilo* or *pilo* (*Capparis sandwichiana*)	This plant used for medicinal purposes and is vulnerable. He continues to gather *pilo* for medicinal uses.
			Sisal plant also found in Keahuolū	His father was employed by QLCC and would harvest sisal to use for thatching.
			Repaired boundary and retainer walls in 1974 during the widening and resurfacing of Palani Road from the Palani Junction to Kuakini Hwy.	
Ulalia Ka`ai-Berman	Kupuna	H.W. Smith	Keahuolū	Gathering of grasses for thatching

[92] Kanahele 2001:30-31

SUMMARY AND RECOMMENDATIONS

The cultural impacts to any locale in Hawai`i are not always readily evident. What might be assessed by Western eyes as "barren land" may be a rich resource to Hawaiians; for example, trails would be highly valued, the land may yield harvesting material like *pili* grass, or may have spiritual aspects having to do with the wind or other natural phenomenon.

Based on previous and the current research, permanent prehistoric populations in Keahuolū appear to have been present along the coast, the midlands were used for temporary habitation and were crossed by trails linking the coast to the uplands, and the uplands were used for agricultural cultivation.

The documentary information on Keahuolū indicates several *heiau* along the coast, along with several probable permanent residential sites with enclosed yards. Sources reveal the preponderance of burials in coastal areas, and in particular in sand dunes. Further inland, caves, lava blisters and other modified features revealed human remains less frequently. Inland there are sites and features indicative of dryland agriculture substantiated by Mahele testimonies of *kalo*, potato, and limited coffee cultivation. Features indicating temporary habitation were also identified. In the upper elevations, there was a substantial increase in rock mounds, particularly faced mounds and modified lava blisters collaborating with the tradition of increased agricultural activities *ma uka*, where the moisture increases. Documentary information indicates Keahuolū was exposed to far less livestock grazing than Kealakehe to the north. The lesser grazing activity increases the likelihood of cultural sites to remain intact or to suffer less degradation.

Reviewing the information presented in this cultural impact assessment – historical documentation, archaeological surveys and research, and oral reminiscences – reveal limited cultural activities in the project area. For Keahuolu, contemporary or continuing cultural practices include gathering of ocean resources and specific plants from the 300-foot elevation seaward. One cultural practitioner has spoken of the availability and the gathering of *pili*, and in the literature are general references to features such as the wind. Halepao'o, an *'ōpelu ko'a*, is referenced at Pāwai.

Based on the findings of this assessment, the current project area development will have limited impact on Hawaiian cultural resources, beliefs, and practices. Care should be taken to preserve the habitat of endemic plants, i.e. *pilo*, *alahe'e*, *kauila*, and *uhiuhi*, in addition to preserving access for gathering activities.

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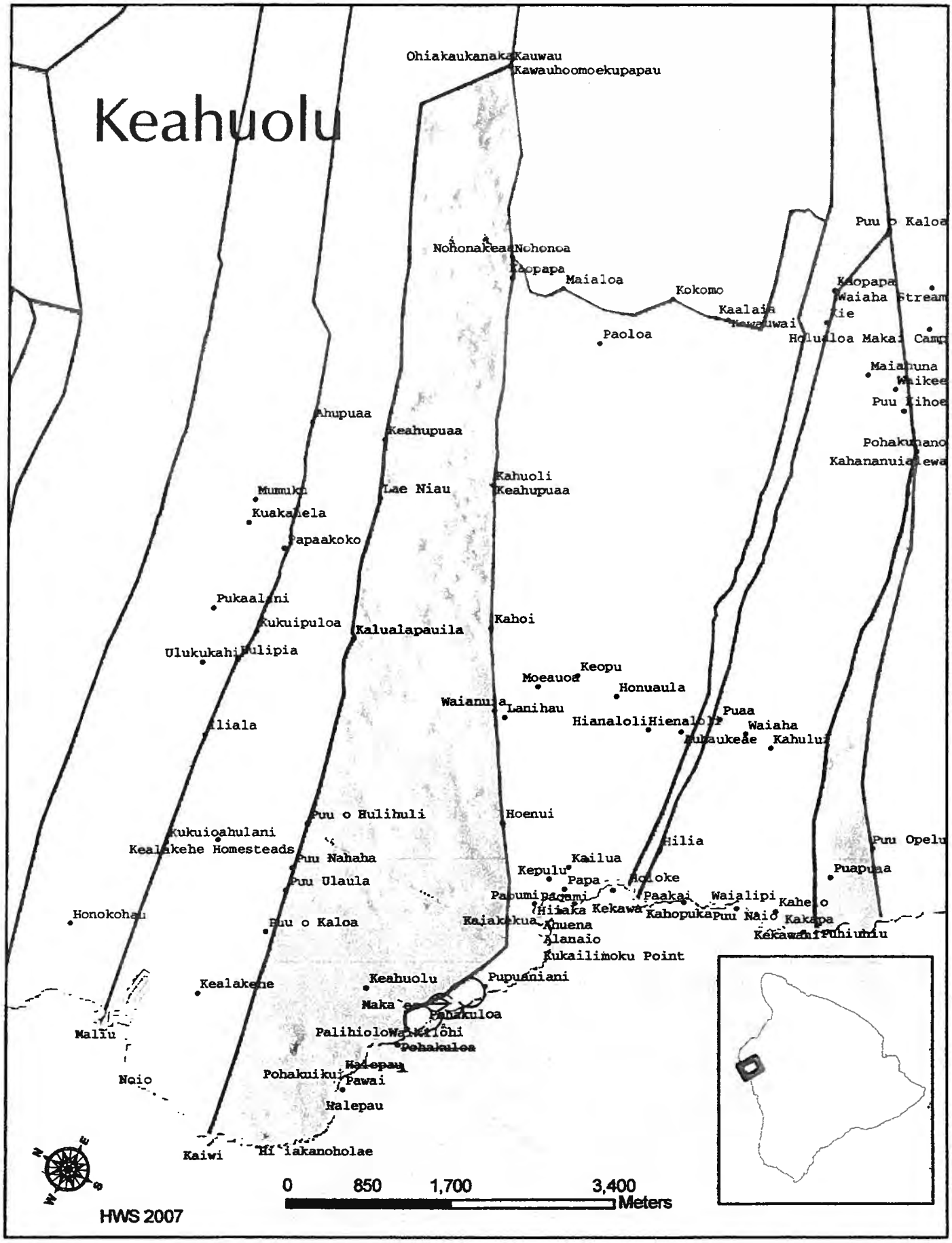
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Kaopapa
Waiaha Stream
Holualoa
Makai Camp
Maiahuna
Waikee
Puu Kihoe
Pohakumano
Kahananuiakewa
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Appendix E

E-1

January 2008

RC-0525

An Archaeological Inventory Survey for the Proposed Development of a Water Reservoir and Service Road (TMK:3-7-4-21:por. 014, 020, and 021)

Keahuolū and Kealakehe *ahupua‘a*
North Kona District
Island of Hawai‘i

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ARCHAEOLOGICAL, CULTURAL, AND HISTORICAL STUDIES

An Archaeological Inventory Survey for the Proposed Development of a Water Reservoir and Service Road (TMK:3-7-4-21:por. 014, 020, and 021)

Keahuolū and Kealakehe *ahupua‘a*
North Kona District
Island of Hawai‘i

RECHTMAN CONSULTING

EXECUTIVE SUMMARY

At the request of Mary O'Leary, AICP of Belt Collins Hawaii Ltd., Rechtman Consulting, LLC has conducted an Archaeological Inventory Survey for the construction of a proposed reservoir site and associated service road within Keahuolū and Kealakehe *ahupua'a*, North Kona District, Island of Hawai'i. The current project area is located west of Palani Road and consists of a proposed reservoir site situated at 595 feet above sea level and an associated service road that extends west from the reservoir site. The reservoir and service road are located on undeveloped land owned by the State Department of Hawaiian Homelands and encompass an area measuring roughly 7.3 acres within a portion of parcels 014, 020, and 021on TMK: 3-7-4-21.

As a result of the current inventory survey, four newly recorded sites and two previously recorded sites were identified. The previously recorded sites include an agricultural complex (SIHP Site 13220) and a boundary wall (SIHP Site 5011) (Donham 1990a). The newly recorded sites consist of three cairns (SIHP Sites 26395, 26396, and 26397), and a multi-feature site (SIHP Site 26398). All of the sites with the exception of Site 5011 appear to have been constructed and/or utilized during the Precontact period. SIHP Site 5011 is a core-filled boundary wall and because of its construction method was likely built during the Historic Period.

Sites 5011, 13220, 26395, 26396, 26397, and 26398 are all considered significant under Criterion D for information they have yielded relative to past use of the current project area. It is argued that the information collected during the previous and current inventory surveys is sufficient to document these sites and to mitigate any potential negative impacts resulting from the proposed development of the reservoir and service road. Therefore, no further work is recommended for these sites. It is recommended, however, that an archaeological monitor be present during the initial grubbing and grading associated with this project in an effort to insure the protection of nearby archaeological features observed during the original survey of the project area. A monitoring plan for the proposed development area should be prepared and submitted to DLNR-SHPD prior to any groundbreaking activities.

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INTRODUCTION

At the request of Mary O'Leary, AICP of Belt Collins Hawaii Ltd., Rechtman Consulting, LLC has conducted an Archaeological Inventory Survey for the construction of a proposed reservoir site and associated service road within Keahuolū and Kealakehe *ahupua'a*, North Kona District, Island of Hawai'i (Figure 1). The proposed service road will lead east across TMK:3-7-4-21:por. 014, 020, and 021 from an existing, unused road (Manawalea Road) to the proposed location of a reservoir site (Figure 2). At the time of the current fieldwork, the centerline of the proposed service road and reservoir site were both clearly marked in the field. Four newly recorded sites and two previously recorded sites were identified during the current survey. The previously recorded sites include an agricultural complex (SIHP Site 13220) and a boundary wall (SIHP Site 5011) (Donham 1990a). The newly recorded sites consist of three cairns (SIHP Sites 26395, 26396, and 26397), and a multi-feature site (SIHP Site 26398). The current project was undertaken in compliance with both the historic preservation review process requirements (HAR 13§13-275-5) of the Department of Land and Natural Resources-State Historic Preservation Division (DLNR-SHPD) and the County of Hawai'i Planning Department.

This report contains summary background information concerning the project area's physical setting, cultural contexts, previous archaeological work, and current survey expectations based on the previous work. Also presented is an explanation of the project's methods, descriptions of the archaeological features encountered, interpretation and evaluation of those resources, and treatment recommendations for sites documented within the proposed development area.

Project Area Description

The current project area is located in Keahuolū and Kealakehe *ahupua'a*, approximately 0.37 kilometers west of Palani Road and consists of a proposed reservoir site that measures roughly 161 meters (530-feet) by 158 meters (520-feet) and an associated service road that measures roughly 15-meters (50-feet) wide and 335 meters (1,100-feet) long (see Figure 1). The reservoir and service road are located on undeveloped land owned by the State Department of Hawaiian Homelands and encompass an area measuring roughly 7.3 acres within a portion of parcels 014, 020, and 021 on TMK: 3-7-4-21 (see Figure 2). The proposed reservoir and service road are part of the off-site development of infrastructure facilities associated with the proposed Keahuolu Affordable Housing project. The project area is accessed from the west via Queen Kaahumanu Highway and then by traversing east through a construction site. There is a large (20+ meter tall) construction spoils pile encroaching on the proposed service road corridor, approximately 30 meters from the western end (Figure 3). At the time of the current fieldwork, surveyors had recently marked the centerline of the proposed service road with blue flagging tape and the five-acre area slated for the reservoir was marked with yellow flagging tape.

Elevations within the project area range from 500 to 640 feet above sea level. The proposed reservoir site is located at 595 feet above sea level. Soil in the *mauka* portion of the study area consists of Kaimu extremely stony peat (rKED) on 6 to 20 percent slopes (Sato et al. 1973). This ground surface consists of well-drained, thin organic soils over *'a'ā* lava that originated from Hualālai between 1,500 and 3,000 years ago (Wolfe and Morris 1996). In the *makai* portion of the study area the land is characterized as *pāhoehoe* lava flow (rLW) with no overlying soil and originated from Hulalālai 3,000 to 5,000 years ago (Wolfe and Morris 1996). Vegetation within the study area is fairly thick (Figure 4), consisting primarily of *koa-haole, ekoa* (*Leucaena leucocephala*), fountain grass (*Pennisetum setaceum*), *noni* (*Morinda citrifolia*), lantana (*Lantana camara*), silver oak (*Grevillea robusta*), *kiawe (Prosopis pallida*) and Christmas-berry (*Schinus terebinthifolius*).

Figure 1. Project area location.

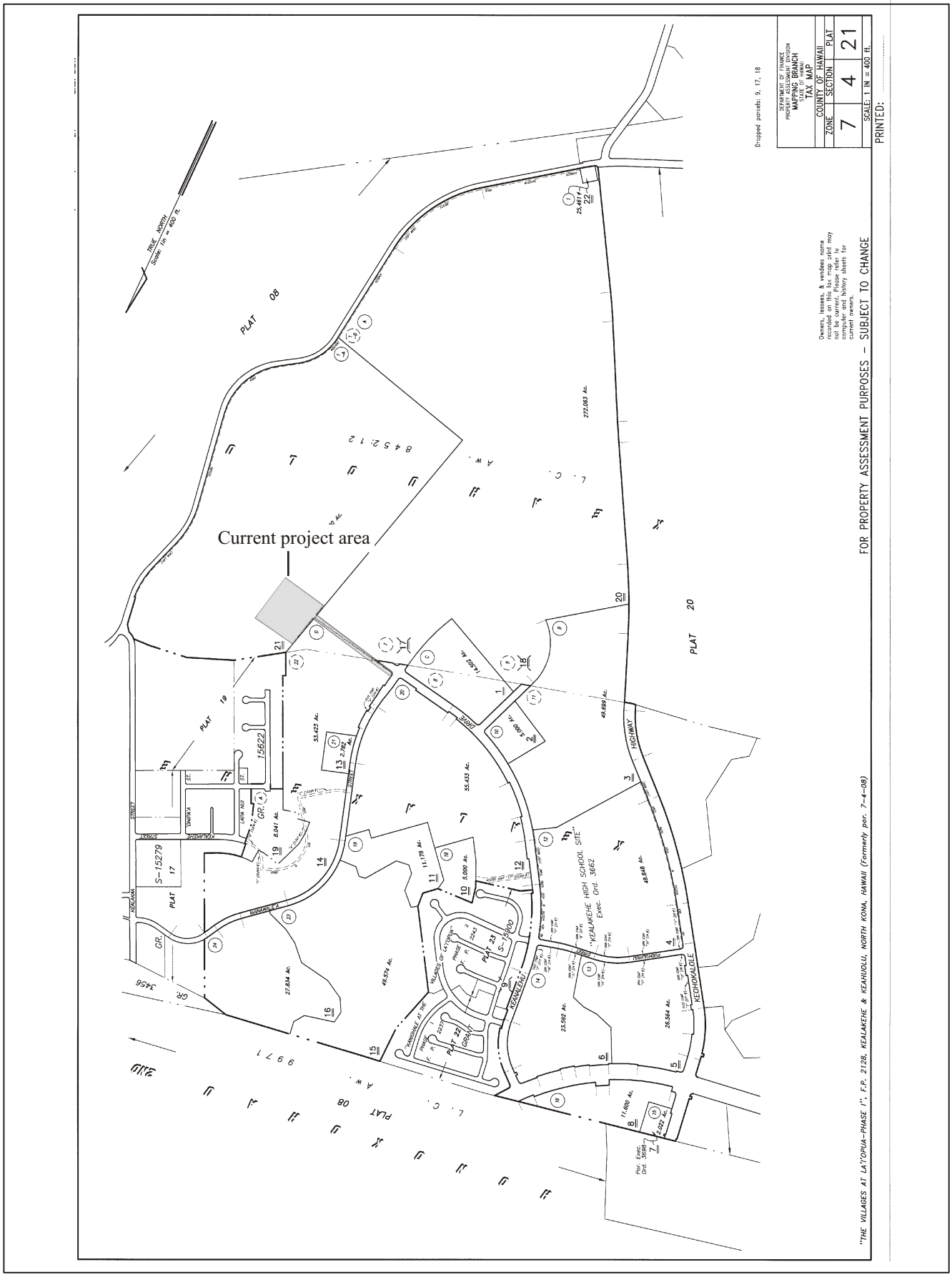


Figure 2. Tax Map Key (TMK):3-7-4-21: por. 014, 020, and 021.

Figure 3. Construction spoils pile, view to the northwest.

Figure 4. Vegetation within the project area, view to the west.

BACKGROUND

To generate a set of expectations regarding the nature of archaeological resources that might be encountered on the study parcel, and to establish an environment within which to assess the significance of any such resources, previous archaeological studies relative to the project area and a general historical context for the region are summarized.

Previous Archaeological Research

Numerous archaeological studies have been completed within Keahuolū and Kealakehe *ahupuaʻa* (Table 1). These studies have included large portions of both *ahupuaʻa*, mostly *makai* of the current project area. Collectively, these previous studies provide sufficient data to develop a predictive model for the current study area. The current study area has been previously surveyed by two studies (Donham 1990a and 1990b).

Table 1. Previous archaeological studies in Keahuolū and Kealakehe *ahupuaʻa*.

Study	*Type of Project*	*Elevation**
Stokes (1919)	Reconnaissance Survey	<40
Reinecke (1930)	Reconnaissance Survey	<40
Ladd (1968)	Site Testing	<40
Sekido (1968)	Site Testing	<40
Emory and Soehren (1971)	Reconnaissance Survey	<40
Sinoto (1975)	Reconnaissance Survey	<40
Cluff (1971)	Reconnaissance Survey	<40
Ching (1978)	Reconnaissance Survey	0-80
Soehren (1980)	Reconnaissance Survey	20-80
Soehren (1983)	Field Inspection	800-1000
Rosendahl (1983)	Reconnaissance Survey	30-200
Hammatt et al. (1987)	Inventory Survey	700-760
Walker and Haun (1987)	Reconnaissance Survey	900
Hammatt and Folk (1984)	Inventory Survey	700
Donham (1990a and c)	Inventory Survey/Addendum	600-800
Donham (1990b)	Inventory Survey	30-600
Jensen (1990)	Inventory Survey	180-580
Burgett and Rosendahl (1992)	Inventory Survey	70-700
Borthwick and Hammatt (1992)	Inventory Survey	10-75
Borthwick et al. (1993)	Reconnaissance Survey	50-90
O'Hare and Goodfellow (1994)	Data Recovery	70-700
Jensen and Head (1994)	Inventory Survey	1670-1730
Walsh and Hammatt (1995)	Inventory Survey	50-90
Rechtman et al. (2000)	Inventory Survey	1500-1600
Haun and Henry (2001)	Inventory Survey	30-85
Rechtman and Dougherty (2002)	Inventory Survey	1500-1600
Rechtman and Escott (2002)	Inventory Survey	30-80
Clark and Rechtman (2005)	Inventory Survey	575-1400
Clark et al. (2008)	Inventory Survey	1670-1710

*feet above sea level.

In 1989, Paul H. Rosendahl, Ph.D., Inc. (PHRI) conducted an archaeological survey of 950-acres for the proposed Kealakehe Planned Community in Kealakehe and Keahuolū *ahupuaʻa* (Donham 1990a). This survey included the eastern portion of the current project area at approximately 600 feet above sea level (Figure 5). As a result of their survey, seventy-eight new sites were identified and recorded and four sites previously identified by Hammatt et al. (1987) were relocated. 840 individual feature types were recorded within eight functional categories. The categories of site function included: agricultural, habitation, transportation, possible ceremonial, agricultural/habitation, indeterminate marker, land division/ranching, and possible burial. Within these site categories, the features present were indicative of Precontact

agricultural use with Historic Period additions: rock mound (n=350), *pāhoehoe* excavation (n=258), terrace (n=73), modified outcrop (n=46), cairn (n=26), enclosure (n=22), wall (n=18), platform (n=16), steppingtone trail (n=11), pavement (n=5), kerbstone trail (n=5), cave (n=3), hearth (n=2), trail (n=2), c-shape (n=1), midden scatter (n=1), and roadbed (n=1). Of the eighty-two sites located within their survey, fifty-three were located within Kealakehe Ahupuaʻa, twenty-eight in Keahuolū Ahupuaʻa and one site within both (a boundary wall). The survey concluded that the area was intensively used for agriculture. Following this survey, PHRI wrote an addendum (Donham 1990c) in which 52 acres that were previously surveyed by an earlier report (Donham 1990b) were reinvestigated. This area of 950-acres was surveyed again by PHRI (Burgett and Rosendahl 1992).

Between 1989 and 1990, PHRI conducted an archaeological inventory survey of 1,100-acres within Keahuolū Ahupuaʻa (Donham 1990b). The western end of the proposed service road investigated during this current study passes through this project area (see Figure 5). As a result of their survey, 239 sites were recoded of which two were previously assigned SIHP numbers (SIHP Site 0002 Mamalahoa Trail, and SIHP Site 7276 Kuakini Wall). Within the 239 sites located during their survey, more than 1,810 individual features were recoded. The predominant feature types were *pāhoehoe* excavations, mounds, modified blisters and outcrops. Other feature types included terraces, low platforms, c-shapes, enclosures, and walls. Approximately 85-90% of the features recoded were interpreted as agricultural in function. Donham (1990b) found that feature density was greater at 400 feet above sea level and higher. Feature types found at 400 feet above sea level and higher included: mound (n=139), *pāhoehoe* excavation (n=132), modified blister (n=34), terrace (n=29), modified outcrop (n=27), enclosure (n=18), cairn (n=17), cave (n=17), platform (n=14), faced mound (n=11), pavement (n=9), alignment (n=7), wall (n=7), trail (n=6), petroglyph (n=3), c-shape (n=2), other (n=2), filled crevice (n=1), linear mound (n=1), and overhang (n=1). None of the sites recorded during the Donham (1990b) survey are located within the current project area. The addendum to the Donham (1990a) survey re-investigated a portion of this survey done by Donham (1990b) and provided insight into the differences in land use occurring between Kealakehe and Keahuolū *ahupuaʻa*.

In 1990, PHRI produced an addendum (Donham 1990c) to their previous archaeological inventory survey done for the proposed Kealakehe Planned Community in Kealakehe and Keahuolū *ahupuaʻa* (Donham 1990a) (see Figure 5). The addendum report re-investigated 53 acres originally surveyed by PHRI between 1989 and 1990 in which 24 new sites including 279 features were recorded (Donham 1990b). As a result of the addendum report, differences in land use between Kealakehe and Keahuolū *ahupuaʻa* were obtained. Donham (1990c) found that more features, mainly agriculturally related, were present in Keahuolū than Kealakehe due to location (ie. rainfall patterns) and a former sisal plantation and mill operations. The location of the Kuakini Wall within Keahuolū Ahupuaʻa suggested the presence of either politically important or relatively concentrated residential sites in association with Kailua town (Donham 1990c: 43 and 44). Although Kealakehe Ahupuaʻa was found to have a greater range of functional site types, the use of the area for cattle ranching was likened to have impeded preservation of sites and features, resulting in the variations found between Kealakehe and Keahuolū *ahupuaʻa*.

The earliest archaeological surveys conducted in the region generated brief descriptions of major coastal sites (Stokes 1919, Reinecke 1930). In 1906 Stokes documented Laupauwila Heiau (Bishop Museum Catalogue: 50-Ha-D11-28) in Kealakehe Ahupuaʻa and provided the following description: "Heiau of Laupauwila, land of Kealakehe, North Kona. Said to be on the ʻelemakule homestead. Grant No. 3756, 3.5 miles from the sea" (Stokes and Dye 1991:40). In the late 1920s Reinecke conducted an archaeological inventory of the coastal areas from Kona to Kohala. He documented twelve sites each in the coastal portions of Kealakehe and Keahuolū *ahupuaʻa*. The Kealakehe sites included residential platforms and house yards, Hale o Lono Heiau (Site 33), and an unidentified *heiau* (Site 35). The Keahuolū sites included 41 platforms and 12 enclosures mostly interpreted as house sites, several petroglyphs (Site 20), two modified pools (Sites 12 and 17), three burials (Sites 12, 13, and 19), and a canoe landing (Site 14).

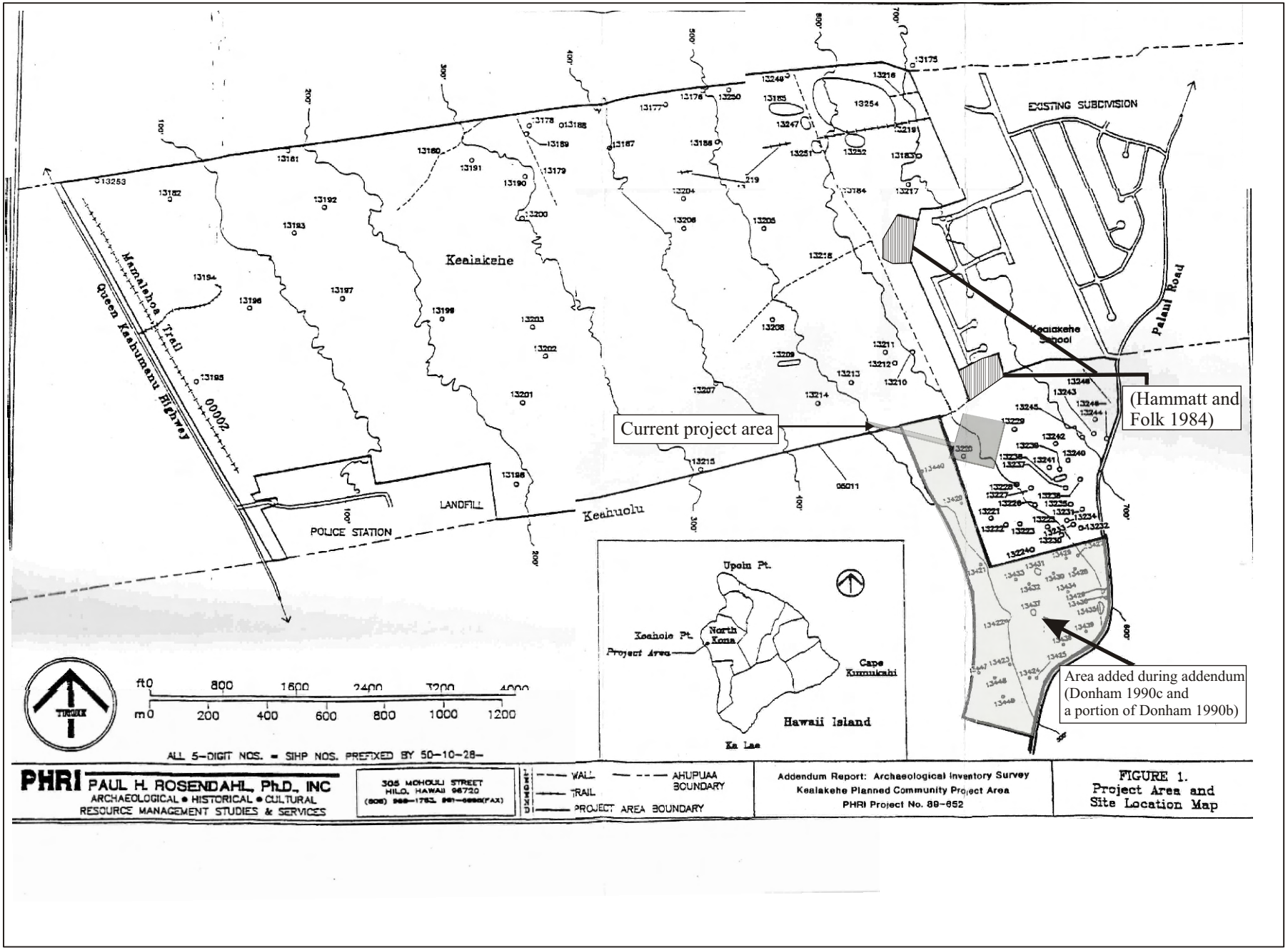


Figure 5. Slightly modified Donham 1990c site map with the survey locations of Hammatt and Folk (1994), Donham 1990a and 1990b and the current project area.

During the 1960s and 1970s, increased coastal development within the Kailua area created a need for further archaeological study at the sites previously recorded by Reinecke (1930). As a result of the continuing development of Honokōhau Harbor, excavations were carried out at three of the Kealakehe sites recorded by Reinecke (Ladd 1968; Sekido 1968). These sites included a house platform, a habitation cave, and a burial. Also, Sinoto (1975) conducted an additional reconnaissance on 100 acres located just inland of Honokōhau Bay, identified three previously recorded sites, but recommended no further archaeological work in the area.

In the early 1960s Emory (Emory and Soehren 1971) conducted an archaeological reconnaissance of the coastal areas of Honokōhau I and II, Kealakehe, and Kaloko *ahupuaʻa*. A total of 27 sites were recorded in Kealakehe Ahupuaʻa. The documented sites included ten house sites, ten burial sites, three enclosures, two *heiau* (both previously identified by Reinecke), and two indeterminate sites. In addition, a "modern" graveyard was documented that reflected both traditional Hawaiian and European burial practices. The report suggests that the Honokōhau Bay area, including its fishponds, ceremonial *heiau*, *holua*, and residential complexes, was a primary locus of political and ceremonial activity along the northern Kona coast. A study by Cluff (1971) supplemented the reconnaissance by Emory and Soehren by expanding the survey area coverage, and provided significance evaluations and treatment recommendations for the identified sites.

Ching (1978) conducted a reconnaissance survey of coastal Keahuolū Ahupuaʻa between the shore and Queen Kaʻahumanu Highway (987 acres). As a result of the survey Ching identified fifty-nine sites containing 140 distinct features that included twenty-nine salt pans, twenty-one pavements, and twenty-one cairns. Nine of these sites had been previously identified by Bevacqua (1972) and seven had been previously identified by Sinoto (1975).

All of these early archaeological studies suggest a pattern of coastal settlements near fishponds and rich marine resources with a decrease in permanent habitation sites and an increase in agricultural features further inland. Beginning in the late 1970s numerous studies were conducted in *mauka* portions of Kealakehe and Keahuolū *ahupuaʻa*. These studies documented the presence of numerous agricultural features associated with the upland field systems in the two *ahupuaʻa* and documented the formal feature types that occur in the Middle Zone (roughly 15 to 800 or 900 feet above sea level) of between the coastal zone and the upland agricultural zone.

Soehren (1980) surveyed a 40-acre parcel and an access corridor for a proposed wastewater treatment plant in coastal Kealakehe at an elevation between 35 and 240 feet above sea level. One trail, SIHP 7704, was documented during the survey. Soehren believed this trail connected Aimakapa Pond, in Honokōhau, with a small settlement at Pawai Bay, in northern Keahuolū (Soehren 1980).

Soehren (1983) surveyed a 10-acre parcel in upper Keahuolū Ahupuaʻa at elevations ranging from 800 to 1,000 feet above sea level to the east of the Queen Liliuokalani Village subdivision. Soehren did not locate any sites or features. He noted that, "Such land appears suited only for arboreal crops, such as paper mulberry, if any", and that "no evidence was found of traditional agricultural structures such as kuaiwi, clearing mounds or terraces, nor were there any other features attributed to prehistoric Hawaiian culture seen on the parcel" (Soehren 1983).

Rosendahl (1983) conducted a reconnaissance survey of three separate areas within Keahuolū Ahupuaʻa. The areas included 100 acres west of Queen Kaʻahumanu Highway along the southern boundary of the *ahupuaʻa*, 100 acres east of the highway along the southern edge of Palani Road, and 12 acres along the northern edge of Palani Road and the southern edge of the *ahupuaʻa*. Rosendahl (1983) identified two large site complexes and five additional sites, but did not record them in detail. He recommended that intensive survey of all three areas be conducted.

Walker and Haun (1987) conducted a reconnaissance survey in Kealakehe Ahupuaʻa of a roughly half-acre parcel at an elevation of 900 feet above sea level. They recorded a single agricultural/habitation complex with eight features. Hammatt and Folk (1984) surveyed a 24-acre parcel along the south boundary of Kealakehe Ahupuaʻa at about 700 feet above sea level and found no archaeological sites, but they did note heavy mechanical disturbance had occurred on the property.

In 1987, Hammatt et al. (1987) conducted an inventory survey north of the current project area on a 15-acre parcel located between 700-760 feet above sea level in Kealakehe Ahupuaʻa. The project identified thirty-two features, seventeen of which were subjected to test excavations. Twenty-five of the features were interpreted as agricultural; the remaining fifteen were considered habitation features. The habitation features were further interpreted as "field hale" and were assigned to the late Precontact Period based on the results of a single radiocarbon date (A.D. 1645-1950). The report described the agricultural features as being part of the Kona Field System, but distinct from the typical dryland fields originally described (Soehren and Newman 1968) for the complex. The features they recorded are less formally arranged and exhibit adaptation to the particular environmental conditions of the area. Prior to testing, these features were considered possible burials. No human remains were discovered during testing and the features were interpreted as agricultural clearing mounds.

Between 1989 and 1992, PHRI conducted an archaeological inventory survey and mitigation program on a 950-acre area for the Kealakehe Planned Community (Burgett and Rosendahl 1992; O'Hare and Goodfellow 1994). Donham (19990a) also surveyed this area. The project area spanned the width of the *ahupuaʻa* and extended from 70 to 700 feet above sea level. Forty-four previously unidentified sites were intensively recorded and were recommended for no further work (Burgett and Rosendahl 1992). Feature types included agricultural, habitation, possible ceremonial and burial features, trails, storage and marker features, and boundary walls. The recording and excavation of sites within all elevational zones enabled the investigators to prepare a synthesis of settlement and land use patterns for the *ahupuaʻa* below 800 feet above sea level. Above approximately 600 feet above sea level the density and formal nature of the agricultural features increased, suggesting that this elevation marked "the lower boundary of a distinct agricultural zone" (O'Hare and Goodfellow 1994:87). They also noted an increase in permanent habitation sites beginning at about 740 feet above sea level, which was further reinforced by the *Māhele* data for Kealakehe Ahupuaʻa.

In 1990, PHRI conducted an inventory survey for improvements to Palani Road within Keahuolū Ahupuaʻa (Jensen 1990). The project area consisted of a 50-foot wide corridor that stretched along the southeastern edge of Palani Road from elevations of 180 to 580 feet above sea level. As a result of the survey Jensen recorded thirty-two sites containing forty-four features. The majority of the features (n=30) including mounds, walls, terraces, enclosures, and modified outcrops were determined to be related to agriculture/boundary. One of the boundary features was the Kuakini Wall. Thirteen of the remaining features including one small cave, five modified outcrops, and seven enclosures were determined to have been used for Precontact temporary habitation purposes. In addition to these features, one sealed lava tube contained a drilled conch shell. Jensen (1990:14) concluded that the cave had been sealed for the sole purpose of caching this artifact and was not used for any other purpose.

Cultural Surveys Hawaii (Borthwick and Hammatt 1992) conducted an inventory survey of a 22-acre corridor in Keahuolū and Kealakehe *ahupuaʻa* at elevations ranging between 10 and 75 feet above sea level. The survey covered an area that stretched across Keahuolū Ahupuaʻa in its entirety and continued into a small portion of southern Kealakehe Ahupuaʻa. Fourteen archaeological sites or complexes were recorded. Identified sites included temporary habitations in lava blisters and sinks, *pāhoehoe* excavations, two caves, and one Historic Period clearing mound.

In 1993, Cultural Surveys Hawaii (Borthwick et al. 1993) completed a reconnaissance survey of an area along both sides of Queen Kaʻahumanu Highway in Kealakehe Ahupuaʻa. During that survey a single site was recorded. The site was situated near the intersection of the highway and the road to Honokōhau Harbor. During a more recent Haun and Associates survey (Haun and Henry 2001) this site could not be relocated.

In 1994, PHRI conducted an inventory survey of two alternate reservoir sites on land own by the Queen Liliuokalani Trust at elevations ranging from 1,670-1,730 feet above sea level within Keahuolū Ahupuaʻa (Jensen and Head 1994). PHRI had previously conducted a field inspection of the access road leading from Mamālahoa Highway and the location of Keahuolū Well Site No. 1, which led to the selection of a development area that did not impact and archaeological features (Rosendahl 1993). The reservoir survey resulted in the identification of five sites containing a total of thirty-one features (Figure 6). The recorded sites included an agricultural complex containing four walls (Site 19688), a linear mound interpreted as

being used for temporary habitation (Site 19689), a cairn (Site 19690), a platform of undetermined function (Site 19691), and an agricultural complex containing twenty-four features including mounds, modified outcrops, terraces, walls, and retaining walls (Site 19692).

In 1995, Cultural Surveys Hawaii (Walsh and Hammatt 1995) conducted an inventory survey for the new Queen Kaʻahumanu Highway between Palani Road and Keahole Airport that crossed several *ahupuaʻa*. This area had been previously subject to a reconnaissance survey conducted by Borthwick et al. (1993). As a result of these surveys two sites a a stepping stone trail running in a *mauka/makai* direction within Kealakehe Ahupuaʻa was recorded as well as the Old Māmalahoa Trail that crosses both Kealakehe and Keahuolū *ahupuaʻa* as it parallels the highway alignment.

In 2000, Rechtman Consulting, LLC conducted an inventory survey in the *mauka* portion of Kealakehe Ahupuaʻa above Māmalahoa Highway at elevations ranging between 1,480 and 1,600 feet above sea level (Rechtman et al. 2000). They recorded six sites: four Historic Period walls and two Precontact agricultural complexes. Combined these two sites contained 41 features typical of Kona Field System sites in the *ʻapaʻa* or Upland Zone. The *mauka* boundary of the parcel was the Old Upper Government Road between Kailua and Waimea (Site 22431).

In 2001, Haun and Associates conducted an inventory survey of approximately 200 acres in Kealakehe Ahupuaʻa at elevations ranging from 30 to 85 feet above sea level for PBR Hawaii and the Department of Hawaiian Homelands (Haun and Henry 2001). A total of 123 archaeological features separated into fifty-six sites were recorded on the parcel. The sites consisted of ten formal feature types including *pāhoehoe* excavations, stone alignments, cairns, mounds, petroglyphs, trails, enclosures, caves, overhangs, and platforms. Two previously recorded sites extended into their survey area, including a trail route (SIHP 7704) recorded by Soehren in 1980, and a second trail route (SIHP 13194) recorded by Borthwick et al. (1993).

In 2002, Rechtman Consulting, LLC conducted an inventory survey (Rechtman and Dougherty 2002) of a property adjacent to the Rechtman et al. (2000) study area in Kealakehe Ahupuaʻa. One archaeological site (SIHP 23274) consisting of 79 features was identified. All of the features were related to a single residence that existed on the property from the 19th to 20th centuries. Features recorded at the site included: walls, agricultural modifications, trail and road alignments, a corral, a concrete mausoleum, and features associated with both landowner and laborer residential activities. The *mauka* boundary of that parcel was also the Old Upper Government Road (Site 22431).

Also in 2002, Rechtman Consulting, LLC (Rechtman and Escott 2002) conducted an inventory survey of a roughly 40-acre area located at elevations raging from 30 to 80 feet above sea level in Kealakehe Ahupuaʻa along the *makai* edge of Queen Kaʻahumanu Highway. As a result of that study five sites were recorded with features including a C-shaped enclosure, three *pāhoehoe* excavations, a collapsed lava blister used for temporary habitation purposes, three trail segments, two cairns (one modern), and a habitation area within a lava tube.

In 2005, Rechtman Consulting, LLC conducted an inventory survey (Clark and Rechtman 2005) of a corridor for the proposed construction of a transmission main water line and a new water tank within Kealakehe and Keahuolū *ahupuaʻa* at elevations ranging from 575-1,400 feet above sea level. The project area consisted of a twenty to fifty-foot wide corridor that stretched from Māmalahoa Highway to two existing water tanks along Palani Road. As a result of the survey seven archaeological sites were recorded including the continuation of a core-filled wall previously recorded by Jensen (1990) paralleling Palani Road (Site 14239), a Historic boundary wall (Site 24853), a Historic residence (Site 24854), a series of Historic wall segments (Site 24855), and three sites related to Precontact/Historic agriculture that were recorded (but not formerly reported on) during inventory fieldwork conducted by Rechtman Consulting, LLC at TMK:3-7-4-09:72 (Sites RC-0161-1, RC-0161-19, and RC-0161-29). All of the recorded sites provided evidence for the Historic Period use of the general project area. Clark and Rechtman note that the intensive residential/agricultural use of the area following the late nineteenth and early twentieth century granting programs obliterated or obscured much of evidence of the earlier Precontact land use.

In 2007, Rechtman Consulting, LLC conducted an inventory survey (Clark et al. 2008) for the proposed Keahuolū Well Site No. 2 and an access road leading to that site, both of which were located *mauka* of the current study and the Māmalahoa Highway within Keahuolū Ahupuaʻa. As a result of their survey four archaeological sites were recorded including a wall (SIHP Site 26271), two mounds (SIHP Sites 26272 and 26274), and an alignment (SIHP Site 26273). Sites 26271 and 26272 were determined agricultural features used during the Precontact or early Historic Period and Sites 26273 and 26274 appeared to represent later Historic use of the area. No further work was the recommendation on all of these sites.

Cultural-Historical Context and Ahupuaʻa Settlement Patterns

The current project area is located in the *ahupuaʻa* of Keahuolū and Kealakehe within the zone of formal agricultural fields commonly referred to as the Kona Field System (Cordy 1995; Haun and Henry 2001; Newman 1970; Schilt 1984). A land use and settlement pattern model applicable to the current study area was presented by Cordy et al. (1991) for nearby Kaloko Ahupuaʻa. This model delineates four environmental zones within the *ahupuaʻa*: the Coastal Zone from shoreline to 15 feet elevation, the Middle Zone from 15 to 800-900 feet elevation, the Lower Upland Zone from 900 to 1,500 feet, and the Upland-Forest Zone between 1,500 and 6,000feet elevation. The current project area is within the Middle Zone and Lower Upland Zone. According to Cordy et al. (1991) these zones represent a transitional area between the coastal habitation zone and the upland agricultural zone.

The Kona Field System and its development are significant to understanding the cultural contexts of the project area because agricultural elements characteristic to the Kona Field System did exist in the *mauka* portion of Kealakehe (Hammatt et al. 1987; Haun and Henry 2001; Rechtman and Dougherty 2002; Rechtman et al. 2000). *Māhele* documents and previous archaeological studies identify Kona Field System agriculture sites in the *kaluʻulu* zone (500 to 1,000 feet elevation) beginning at an elevation of 900 feet and in the *apaʻa zone* (1,000 to 2,500 feet elevation).

While the archaeological record contributes to an understanding of how the Kona Field System developed over time, precisely how the record is interpreted is reflected in the various chronologies proposed for the system (Burtchard 1995; Cordy 1995; Haun et al. 1998; Hommon 1986; Kirch 1985; Schilt 1984). The chronology and terminology outlined by Haun et al. (1998) is used in the present discussion, and the chronological summary below is abstracted from Rechtman et al. (1999).

There is little archaeological evidence for permanent settlements in the Kona region throughout the first half of the Early Expansion Period of Hawaiian history (A.D. 600 to 1100) (Burtchard 1995; Hommon 1986; Kirch 1985). Although permanent habitation was still concentrated on the windward side, it is likely that windward residents may have traveled to the Kona coast to obtain needed resources (Cordy 1995). By the latter half of the Early Expansion Period, permanent settlements were established in Kona along the coast and on lowland slopes, and informal fields were likely established at higher elevations (Cordy 1981; Cordy 1995; Schilt 1984).

An archaeological study by Cordy et al. (1991) along a coastal portion of nearby Kaloko Ahupuaʻa suggests this area was settled between A.D. 900 and 1200. Radiocarbon data from archaeological studies within the *ahupuaʻa* of Kealakehe indicate initial human activity in this region in the 1200s to 1300s, a gradual increase between the 1400s and 1500s, followed by more intensive activity from the 1600s to early Historic Period (Haun and Henry 2001).

Agricultural fields and habitation areas expanded across the slopes and coastal area of Hualālai during the Late Expansion Period (A.D. 1100 to 1400) (Burtchard 1995; Cordy 1995). Walled agricultural fields, planting mounds, and temporary habitations were established at the higher elevations that received greater amounts of rainfall.

The development of the extensive formal walled fields sometime during the initial stages of the Intensification Period (A.D. 1400 to 1600) marks the initiation of the Kona Field System (Schilt 1984). The development of these fields may have been, in part, a by-product of the need to extract more subsistence resources from an increasingly limited agricultural base. Radiocarbon data indicates that the population in Kona increased dramatically during this period (Burtchard 1995; Haun et al. 1998; Schilt 1984).

By the time of the Competition Period (A.D. 1600 to 1800), the environment may have reached its maximum carrying capacity, resulting in social stress between neighboring groups. The resulting hostility is reflected archaeologically by the frequent occurrence of refuge caves dating to this period (Schilt 1984). This volatile period was probably accompanied by internal rebellion and territorial annexation (Hommon 1986; Kirch 1985).

During the first of the defined historic periods (Haun et al. 1998), Last of the Ruling Chiefs (A.D. 1778-1819), Kalaniopuʻu was chief of the Island of Hawaiʻi and often resided in the Kona District. This period covers Kamehamehaʻs consolidation of control over the island to his death at Kailua in 1819. The period ends with the overthrow of the old religion, which took place when Liholiho, Kamehameha's heir, broke the traditional *kapu* laws and won a battle against the supporters of the old religion at Kuamoʻo, along the southern coastline of Keauhou. Early historical accounts emphasize that modern day Kailua Town during this period was a significant political seat and population center. The Kona Field settlement and subsistence system continued to operate in the area through the first few decades of the historic era (Handy and Handy 1972).

William Ellis, one of the first missionaries to arrive on the Island of Hawaiʻi, visited the area above Kailua (likely in the vicinity of the current project area) on a tour around the island in 1825. Ellis' description of what the upland fields looked like at this time:

> After traveling over the lava for about a mile, the hollows in rocks began to be filled with a light brown soil; and about half a mile further, the surface was entirely covered with a rich mould, formed by decayed vegetation and decomposed lava. Here through a beautiful part of the country, quite a garden compared with that through which they had passed, on first leaving town. It was generally divided into small fields, about fifteen rods square, fenced with low stone walls, made of fragments of lava which had been gathered from the surface of the enclosures. These fields were planted with bananas, sweet potatoes, mountain taro, tapa trees, melons, and sugar cane, flourishing luxuriantly in every direction. Having traveled about three or four miles through this delightful region, and passed several pools of fresh water, they arrived at the thick woods, which extends several miles up the sides of the lofty mountain that rises immediately behind Kairua. (1963:27-28)

The second quarter of the 19th century, the Merchants and Missionaries Period (A.D. 1820-1847), was a time of profound social change in Hawaiʻi. Kamehameha I died in mid-1819, and a council of chiefs supported Kamehameha's son Liholiho as successor (Kelly 1983). Liholiho gained the council's support in exchange for the distribution of the profits from the sandalwood trade and the bounty of the land that moved up the hierarchy from the various *ahupuaʻa* under his control; privileges previously retained solely for the ruler. Within six months after Kamehameha's death, Liholiho, Kaʻahumanu, and Queen Keopuolani broke the *kapu* prohibiting men and women eating together. This act of "free eating" symbolized the end of the traditional *kapu* system. The changes in social and economic patterns began to affect the lives of the common people. Liholiho moved his court to Oʻahu, so the burden of resource procurement for the chiefly class lessened considerably. However, some of the work of the commoners shifted from subsistence agriculture to the production of foods and goods for trade to the early Western visitors. Introduced crops, such as yams, coffee, melons, Irish potatoes, Indian corn, beans, figs, oranges, guavas, and grapes (Wilkes 1845) were grown specifically for trade with Westerners. Other commodities, especially sandalwood, were collected to purchase Western goods, often to the detriment of agricultural pursuits. The arrival of the missionaries to Hawaiʻi in the 1820s brought further changes to the social and religious systems of the islands.

The socioeconomic and demographic changes that took place in the period between 1790 and the 1840s, promoted the establishment of a Euroamerican style of land ownership, and the *Māhele* was the vehicle for determining ownership of the native land. During this Legacy of the Great *Māhele* Period (1848-1899) (Haun et al. 1998), the *Māhele* defined the land interests of the King (Kamehameha III), the high-ranking chiefs, and the low-ranking chiefs, the *konohiki*. The chiefs and *konohiki* were required to present their claims to the Land Commission to receive awards for lands provided to them by Kamehameha III. They were also required to provide commutations to the government in order to receive royal patents on their awards. The lands were identified by name only, with the understanding that the ancient boundaries would prevail until the land could be surveyed. This process expedited the work of the Land Commission and speeded the transfers (Chinen 1961:13). During this process all lands were placed in one of three categories: Crown Lands (for the occupant of the throne), Government Lands, and *Konohiki* Lands. All three types of land were subject to the rights of the native tenants. In 1862, the Commission of Boundaries (Boundary Commission) was established in the Kingdom of Hawaiʻi to legally set the boundaries of all the *ahupuaʻa* that had been awarded as a part of the *Māhele*. Subsequently, in 1874, the Commissioners of Boundaries was authorized to certify the boundaries for lands brought before them. The primary informants for the boundary descriptions were old native residents of the lands, many of which had also been claimants for *kuleana* during the *Māhele*. The information was collected primarily between A.D. 1873 and 1885. The testimonies were generally given in Hawaiian and simultaneously transcribed in English.

As a result of the *Māhele*, the *ahupuaʻa* of Keahuolū was awarded in its entirety to Ane Keohokālole as part of LCAw. 8452. Ane Keohokālole was the great granddaughter of Kameʻeiamoku, one of the most important chiefs who supported Kamehameha I (Kelly 1983:31). Keohokālole was married to Kapaʻakea and they were the parents of King (David) Kalākaua and Queen (Lydia Kamakaʻeha) Liliʻuokalani. Their youngest son, William Pitt Leleiohoku, was adopted at birth by Ruth Keʻelikōlani, the governess of Hawaiʻi Island from 1855 to 1874, and named for her first husband; their youngest daughter, Miriam Likelike, was the mother of Kaʻiulani, who was proclaimed heir apparent in 1891 after Queen Liliʻuokalani took the throne following the death of her brother King Kalākaua (Kelly 1983:31).

Six kuleana claims were awarded in Keahuolū Ahupuaʻa, five in the uplands (all southeast of the current project area and *mauka* of Mamalahoa Highway) and one at the coast. Four of the claims in Keahuolū describe the cultivation of taro, one mentions sweet potato, and one mentions coffee; no house lots are mentioned in the claims. The awardee at the coast claimed seven fan palms and a coconut grove, and described the land as salt land that still yielded salt (Jensen 1990:A-4). Kepā Maly (in Jensen and Head 1994) offers the following excerpts from the *Māhele* records pertaining to the *ahupuaʻa* of Keahuolū:

> **Kahuanui - LCA 7351** for 2.90 acres (Foreign Test. 8:682) ... one piece of *kalo* [taro] land, 5 patches-all lying together. One of these patches is planted with coffee. Claimant received this land from his brother in 1846, and his title has never been disputed.
>
> **ʻApiki - LCA 8012** for 1.10 acre (Foreign Test. 8:676) It consists of 5 patches of *kalo* and a lot of patches of potatoes ... Claimant derived the land from the *Konohiki,* before the death of Kuakini [c. 1840].
>
> **Hailewalewa- LCA 10198** for 1.30 ac (Native Test. 4:525) Section 1, *kalo;* Section 2, in the *kalu'ulu …*
>
> **Maʻa - LCA 10303** for 2.25 acres (Native Test. 4:526) There are 11 *kīhāpai* [gardens] *ofkalo,* and 10 klhapai of *'uwala* [sweetpotatoes] ... That land is not completely cultivated but, Ma'a did plant 7 *loulu* (*Pritchardia* palm) trees. The fruit is for Samuela, both Ma'a and Samuela have joint interest in the 7 *loulu.* There is also a coconut grove which had been planted by Maʻa's grandparents for the chiefs who owned the land, his grandparents were the caretakers. The coconuts went to Keohokalole upon the death of Keoua (c.1791). One whole section is salt land and it is still yielding salt...received during the time of Kamehameha I.
>
> **Nahaʻaluʻalu - LCA 10345** for 2 acres (Native Test. 4:527) includes 4 sections of *kīhāpai* ...
> **Aki - LCA 11071** for .60 acres (Native Test. 4:527) Section 1, 5 *kīhāpai;* section 2, 1

> *kīhāpai* not cultivated; section 6, 4 cultivated *kīhāpai.* Section 7, 1 cultivated *kīhāpai …* From the time of Kamehameha I. (Jensen and Head 1994:17)

In a letter dated July 8, 1869, David Kalākaua describes the land of Keahuolū and its possible uses to his sister Lydia Kamakaʻeha (Liliʻuokalani):

> This land is situated in the District of North Kona. Bounded by the ahupuaa of Lanihau (in Kailua) belonging to Prince Lunalilo on the Kaʻu side, and on the Kohala side, by Kealakehe, a government land and Honokoniki belonging to Keelilkolani. Keahuolu runs clear up the mountains and includes a portion of nearly one half of Hualalai mountains. On the mountains the koa, kukui and ohia abounds in vast quantities. The upper land or inland is arable, and suitable for growing coffee, oranges, taro, potatoes, banana & c. Breadfruit trees grow wild as well as Koli oil seed. The lower land is adopted for grazing cattle, sheep, goat, &c. The fishery is very extensive and a fine grove of cocoanut trees of about 200 to 300 grows on the beach. The flat land near the sea beach is composed chiefly of lava, but herbs and shrubbery grows on it and [it is] suitable for feed of sheep and goats. It is estimated at 15,000 to 20,000 acres or more. (Jensen 1990:A-4)

Kealakehe Ahupuaʻa was designated government land. There were eleven *kuleana* land claims made within Kealakehe Ahupuaʻa, all located east of the current project area at elevations ranging between 1,000 and 1,500 feet above sea level. Native testimony shows that the native residents were claiming land used for farming taro, sweet potato, banana, and there were at least ten houses, including some that were fenced in (Donham 1990a:Appendix B).

Following the *Māhele*, and the Homestead Act of 1884, the upper portion of Kealakehe Ahupuaʻa was subdivided and sold as grants (Haun and Henry 2001:9). This area was referred to as the Kealakehe Homesteads (Figure 6). Historic land use of these parcels likely included residential, diversified agriculture, and cattle ranching. The *mauka* boundary of the Kealakehe Homesteads was the Upper Government Road (*Alanui*), which was the primary route of travel between Kailua and Waimea prior to the construction of the Kona Belt Road in 1933 and the current alignment of the Mamālahoa Highway in 1956 (Rechtman and Henry 1998). In Figure 6 this road is shown as a walled alignment *makai* of Grant 1571 within Kealakehe Ahupuaʻa, and as a dashed line running into Keahuolū Ahupuaʻa. It is likely that at the time the grant parcels were subdivided, near the end of the nineteenth century, walls were built along either side of the Upper Government Road. It was at this time that many grant increment roads were established to allow the homesteaders access to their parcels (Clark and Rechtman 2005).

A short lived, but interesting agricultural pursuit began in Hawaiʻi in 1893. It was in this year that the Hawaiian Commissioner of Agriculture and Forestry ordered 20,000 sisal plants from Florida (Conter 1903:11). It appears that at some later point, likely in the early 20th century, a sisal mill, used to process the raw sisal into fibers, was constructed by McWayne in Keahuolū Ahupuaʻa along Palani Road southwest of the current project area. Kelly (1983:89) relates that Kona was naturally adapted to the cultivation of sisal, and that depending on the terrain, anywhere between 500 to 1,000 plants could be grown on an acre. Thrum (1905:181) reported that the "McWayne sisal tract consisted of about 500 acres at or near Kailua". Jensen (1990:A-5) reports that the first crop from the McWayne Estate did not reach Honolulu until 1918. Mr. Minoru Inaba, who worked at the mill from 1920-21, stated that the mill was owned by Luther S. Aungst from 1917 until its closure in 1924 (in Jensen 1990:A-5). Mr. Inaba recalled that over a thousand acres were in cultivation in Kealakehe and Keahuolū *ahupuaʻa* surrounding the mill along Palani Road. Workers would harvest the plants in the field and then bundle and transport them to mill by donkey where they were thrashed, dried, and baled before being sent to San Francisco on steamers (Jensen 1990:A-5).

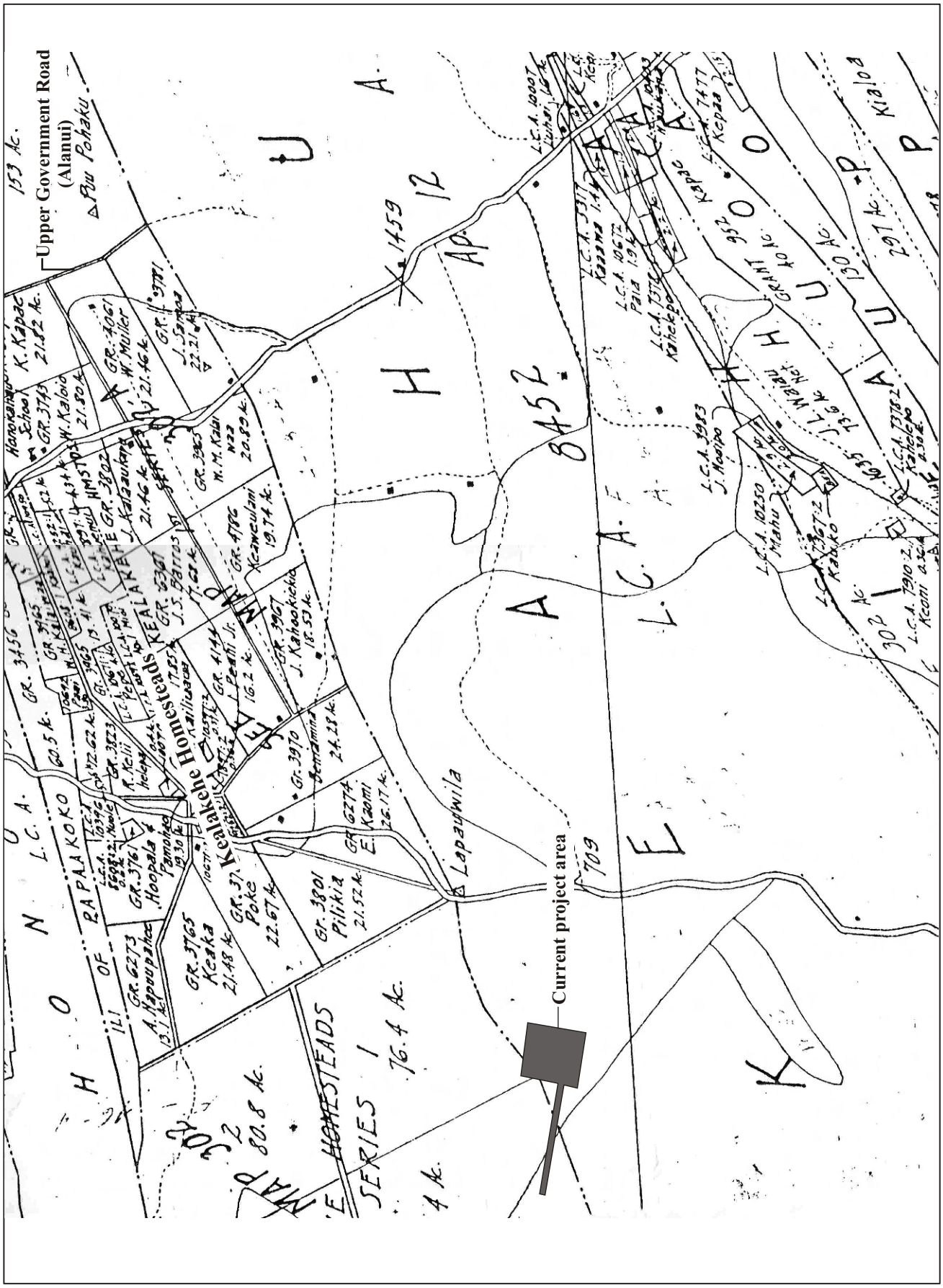


Figure 6. Portion of 1928 Strip Map.

PROJECT AREA EXPECTATIONS

Based on the background information presented above, a set of field expectations can be generated. According to the Cordy et al. (1991) settlement pattern model for Kaloko Ahupuaʻa, the current project area is located within the Lower Upland Zone, which represents a transitional area between the coastal habitation zone and the upland agricultural zone. The Lower Upland Zone is characterized by informal agricultural plots marked by low-walls, terraces, modified outcrops, and mounds, temporary habitations similar to those found in the Middle Zone, and various Historic sites related to habitation, ranching, and agriculture. The findings of previous archaeological studies conducted in Kealakehe and Keahuolū Ahupuaʻa at elevations similar to the current project area (c.f. Jensen and Head 1994; Rechtman et al. 2000; Rechtman and Dougherty 2002) and those occurring within the current project area (Donham 1990a, 1990b, 1990c) have generally confirmed the Cordy et al. (1991) model.

Based on this information, Precontact feature types that may be encountered within the current survey corridor include *pāhoehoe* excavations, mounds, modified outcrops, terraces, and low rock walls (*kuaiwi*) related to agricultural use of the area, enclosures, platforms, or lava tubes used for habitation purposes, and perhaps *mauka*/*makai* trails that connected coastal areas with inland areas. If any burials are present, they may be found within lava tubes or neatly constructed platforms. Historic feature types that may be encountered within the current survey corridor include core-filled walls used for ranching and boundary purposes, roads, habitation features (i.e. enclosures, platforms, cisterns, etc.), and possibly agricultural features similar to those described above. If any Historic Period burials are encountered they may be located in above ground mausoleums.

FIELDWORK

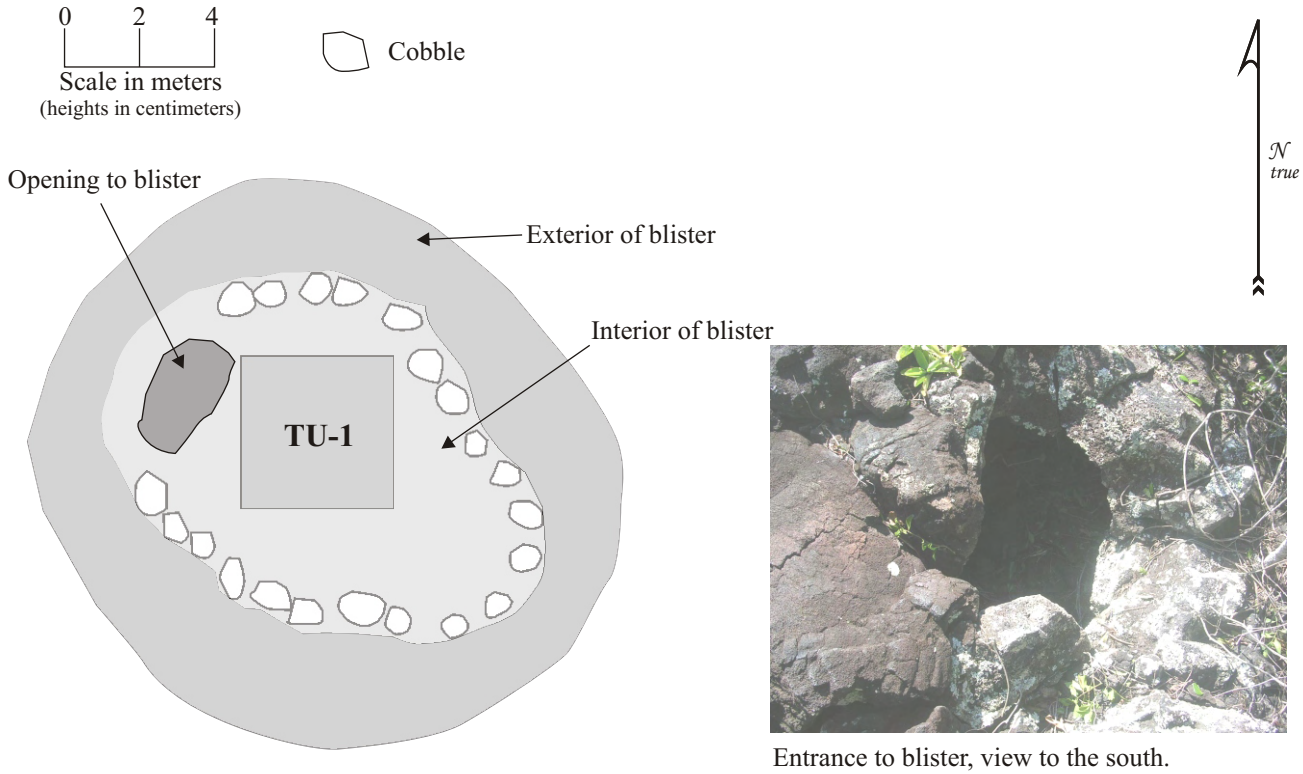
Fieldwork for the current inventory survey was conducted by Christopher S. Hand, B.A., Ashton K. Dircks, B.A., and Johnny R. Dudoit, B.A. on December 18-20 2007 with follow up subsurface testing on January 9 2008 by Matthew R. Clark, B.A. and Christopher S. Hand, B.A. All fieldwork was carried out under the direction of Robert B. Rechtman, Ph.D.

Methods

During the intensive inventory survey of the current project area, the entire survey corridor was subject to pedestrian transects with fieldworkers spaced at 10-meter intervals; one following the corridor centerline, which had been marked by land surveyors prior to the commencement of fieldwork, and one on either side of the centerline ten meters distant. The reservoir site location was surveyed utilizing north/south transects with fieldworkers spaced at 10-meter intervals. When archaeological features were encountered, they were plotted on a map of the study area using a combination of Garmin 76s handheld GPS technology (with sub five-meter accuracy) and tape and compass reckoning. They were then cleared of vegetation, mapped in detail, photographed (with a meter stick for scale), and described using standardized site record forms. A lava blister located in the southeast portion of the reservoir site was thoroughly investigated for cultural material and was subject to subsurface testing (Figure 7). Testing revealed a 2 to 8 centimeter thick layer of very dark grayish brown (10YR 3/2) loamy silt. The test unit was sterile and the feature was determined to be a non-cultural natural blister and was therefore not assigned a SIHP Site number.

Findings

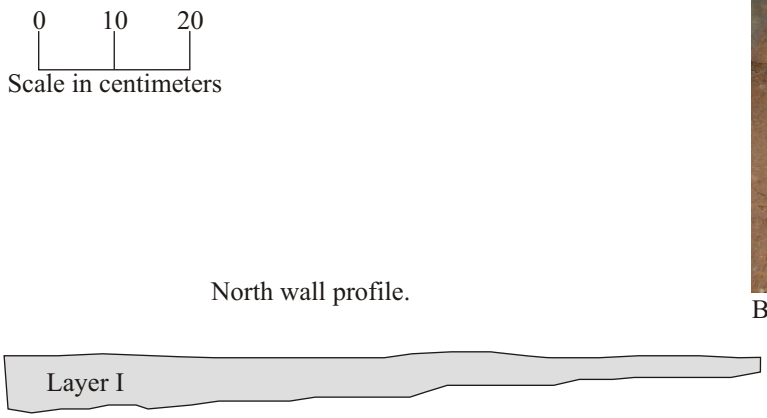
As a result of the current inventory survey, four newly recorded sites and two previously recorded sites were identified. The previously recorded sites included an agricultural complex (SIHP Site 13220) and a boundary wall (SIHP Site 5011) (Donham 1990a). The newly recorded sites consisted of three cairns (SIHP Sites 26395, 26396, and 26397), and a multi-feature site (SIHP Site 26398). Detailed descriptions of all the recorded sites follow below, and their locations are depicted on Figure 8. During the current survey, a triangular stacked mound was observed outside of the project area, along the eastern end of the southern boundary. As this site was outside the project area, it is not detailed in the current study and was not assigned an SIHP site number. It is shown on Figure 8 to facilitate its protection during any future development activities that may occur in association with the construction of the reservoir and service road.



Blister plan view.

Entrance to blister, view to the south.

Base of excavation, view to the east.



North wall profile.

Bedrock

Layer I - Very dark grayish brown (10YR 3/2) loamy silt with rootlets and fractured bedrock

Figure 7. Lava blister plan view and testing.

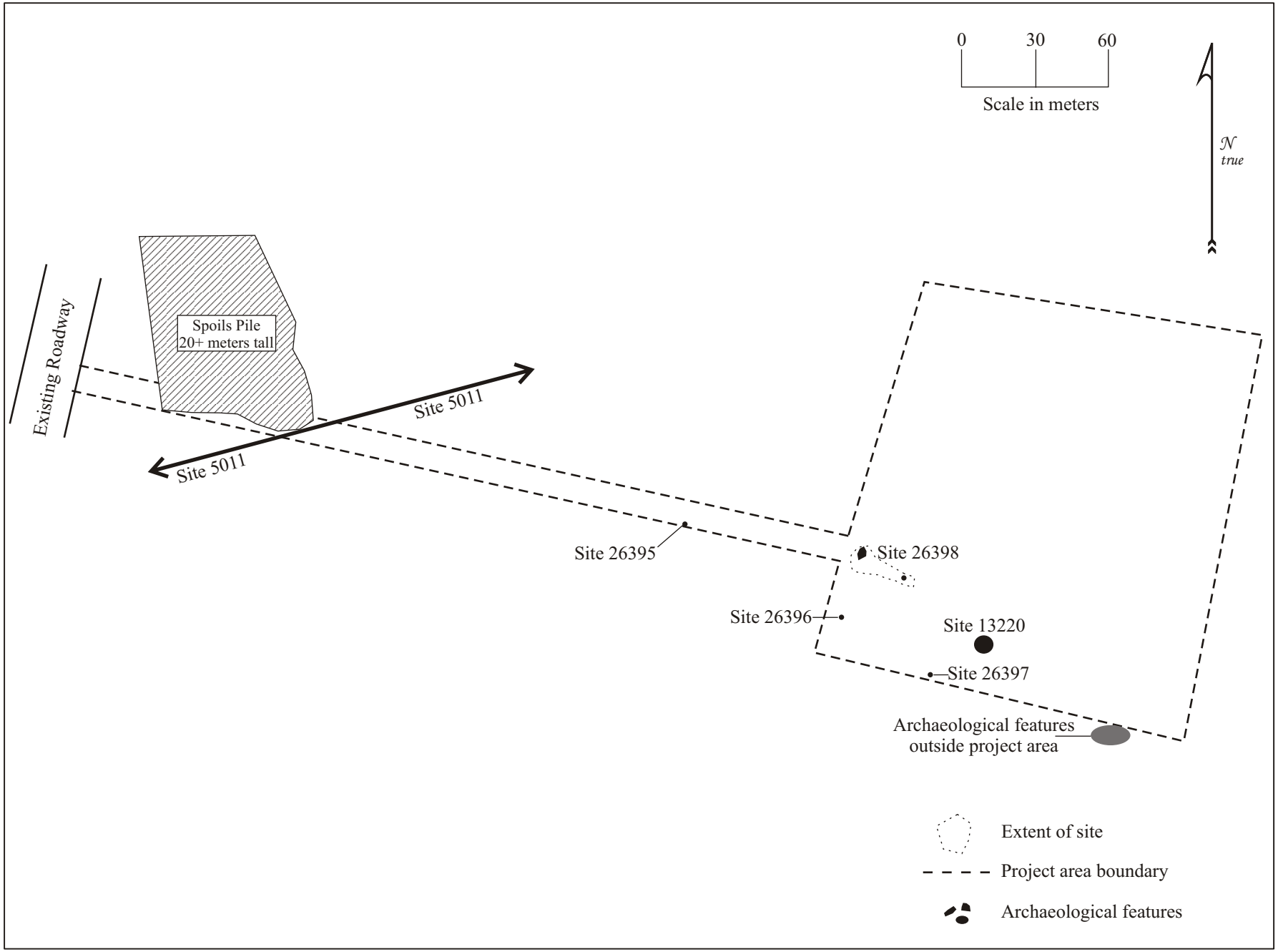


Figure 8. Project area plan view.

SIHP Site 5011

SIHP Site 5011 is a boundary wall located on the border between Kealakehe and Keahuolū *ahupua‘a* (see Figure 8) and was first recorded during an inventory survey conducted by PHRI (Donham 1990a: A-52):

> This wall follows the ahupuaa boundary between Kealakehe and Keahuolu. It consists of aa and pahoehoe, small to medium boulders and small to large cobbles. The wall is bifaced and core-filled. The wall is oriented an average of c. 220/40 degrees Az. And has a few bends in the eastern section. The east and west ends are currently defined by the boundaries of developed areas, and do not represent the original ends of the wall.

Within the current project area the wall crosses through the western portion of the proposed service road in a northeast/southwesterly direction and continues outside the project area on both sides (see Figure 8). It is constructed of small to large *‘a‘ā* and *pāhoehoe* cobbles and measures 60 to 70 centimeters wide. The wall is core-filled and stacked up to 120 centimeters in height (Figure 9). Portions of the wall have collapsed. This wall was likely built during the Historic Period for cattle control.

Figure 9. SIHP Site 5011, view to the south.

SIHP Site 13220

SIHP Site 13220 is an agricultural complex consisting of two features located in the south-central portion of the proposed reservoir area location (see Figure 8). SIHP Site 13220 was first recorded by Donham (1990a) and was then was relocated during the current study. Donham (1990a: A-28 and 30) recorded the site as follows:

> **Description**: A linear rock mound (Feature A), a pahoehoe excavation (Feature B), and a circular rock mound (Feature C) were identified within an area c. 12.20m by 10.0m at this site. No portable remains or deposits were noted.

This site was interpreted by PHRI as an agricultural complex dating to either the Precontact Period or the early Historic Period (Donham 1990a). During the current study only Features A and B could be located. A PHRI site tag reading "T-55 89-652 9-2-89" was observed on Feature A. As recorded during the current study, Feature A is a northeast/southwest extending linear alignment constructed of loosely stacked small and medium *pāhoehoe* cobbles (Figure 10). It measures 5.2 meters by 1.1 meters and is 60 centimeters in height (Figure 11).

Feature B is located 3 meters northeast of Feature A (see Figure 11). As recorded during the current study, Feature B is a square-shaped pile of small and medium *pāhoehoe* cobbles measuring 3.5 meters by 2.8 meters and is 40 centimeters in height (Figure 12). PHRI described this feature as a *pāhoehoe* excavation. During the current study an excavated area measuring approximately 1.7 meters by 0.9 meters was observed on the surface of Feature B, roughly in the center of the feature (see Figure 11). The excavated area measures 65 centimeters deep from the surface of the feature.

Figure 10. SIHP Site 13220 Feature A, view to the northeast.

Figure 11. SIHP Site 13220 plan view.

Figure 12. SIHP Site 13220 Feature B, view to the northwest.

SIHP Site 26395

SIHP Site 26395 is a cairn located in the eastern third of the proposed service road corridor (see Figure 8). It is constructed of medium *'a'ā* cobbles and measures 30 centimeters in width and is piled up to 70 centimeters in height (Figure 13).

Figure 13. SIHP Site 26395, view to the east.

SIHP Site 26396

SIHP Site 26396 is a cairn located in the southwestern corner of the proposed reservoir location (see Figure 8). It is constructed of one large boulder on the ground surface and medium and large cobbles piled on top. The cairn measures 70 centimeters wide and has a height of 50 centimeters (Figure 14).

Figure 14. SIHP Site 26396, view to the west.

SIHP Site 26397

SIHP Site 26397 is a cairn located approximately 42 meters southeast of SIHP Site 26396, along the southern boundary of the proposed reservoir location (see Figure 8). The cairn is constructed of stacked and piled medium and large *pāhoehoe* cobbles up to 60 centimeters in height and was built on top of a *pāhoehoe* outcrop (Figure 15). The base of the cairn measures 70 centimeters in diameter and tapers up to 40 centimeters at the top.

Figure 15. SIHP Site 26397, view to the west.

SIHP Site 26398

SIHP Site 26398 consists of two features; a linear rock mound (Feature A) and a *pāhoehoe* excavation (Feature B) located in the southeastern portion of the proposed reservoir location, near the proposed service road (see Figure 8). Feature A is a linear mound constructed of loosely piled small and medium slab-like *pāhoehoe* cobbles and measures roughly 4.5 meters by 2.2 meters with heights ranging from 20 to 60 centimeters (Figure 16). Small cavities were observed along the edges of Feature A in which soil had accumulated. The west-central surface appears to have a 1.6 meter by 0.8 meter excavated area. There are cobbles piled around the excavated area exhibiting the same weathering coloration and deterioration as the surrounding feature cobbles, suggesting that this excavation is recent (Figure 17).

Feature B is a 40 centimeter deep *pāhoehoe* excavation located approximately 18 meters southeast of Feature A. Feature B measures 70 centimeters by 70 centimeters and consists of small to large *pāhoehoe* cobbles that have been removed from between a *pāhoehoe* outcrop and bedrock (Figure 18). These two features are very similar in type and style to Features A and B of Site 13220 (Donham 1990a).

Summary

As a result of the current inventory survey, four newly recorded sites and two previously recorded sites were identified. The previously recorded sites consisted of an agricultural complex (SIHP Site 13220) and a boundary wall (SIHP Site 5011) (Donham 1990a). The newly recorded sites consisted of three cairns (SIHP Sites 26395, 26396, and 26397), and a multi-feature site (SIHP Site 26398). All of the sites with the exception of Site 5011 appear to have been constructed and/or utilized during the Precontact Period. SIHP Site 5011 is a core-filled boundary wall and because of its construction method was likely built during the Historic Period.

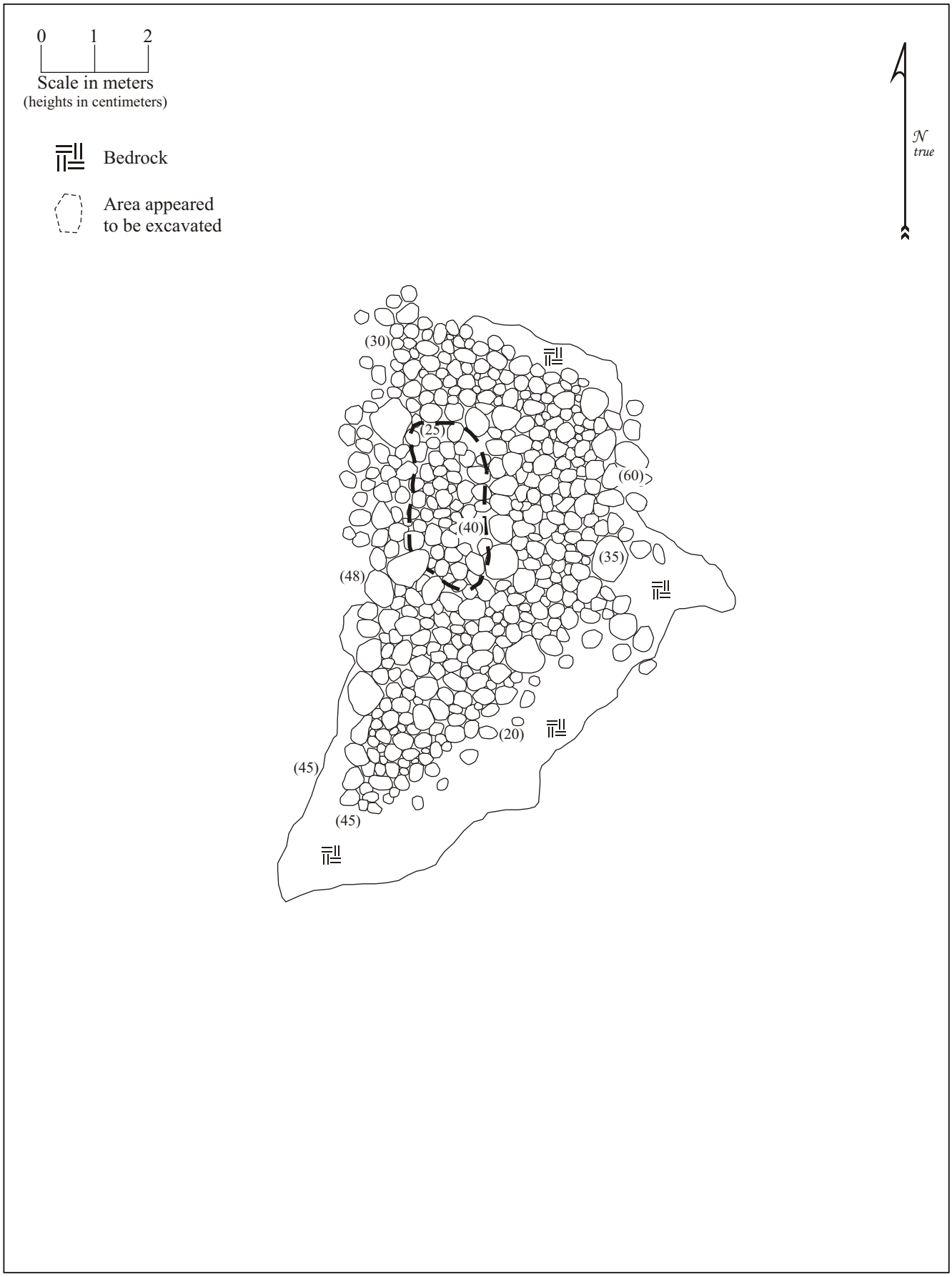


Figure 16. SIHP Site 26398 Feature A plan view.

Figure 17. SIHP Site 26398 showing excavated area, view to the northeast.

Figure 18. Overview of area located southeast from Site 26398 that appeared excavated.

SIGNIFICANCE EVALUATION AND TREATMENT RECOMMENDATIONS

The sites recorded during the current study are assessed for their significance based on criteria established and promoted by the DLNR-SHPD and contained in the Hawai‘i Administrative Rules 13§13-284-6. These significance evaluations should be considered as preliminary until DLNR-SHPD provides concurrence. For resources to be considered significant they must possess integrity of location, design, setting, materials, workmanship, feeling, and association and meet one or more of the following criteria:

A Be associated with events that have made an important contribution to the broad patterns of our history;

B Be associated with the lives of persons important in our past;

C Embody the distinctive characteristics of a type, period, or method of construction; represent the work of a master; or possess high artistic value;

D Have yielded, or is likely to yield, information important for research on prehistory or history;

E Have an important traditional cultural value to the native Hawaiian people or to another ethnic group of the state due to associations with traditional cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts—these associations being important to the group’s history and cultural identity.

The significance and recommended treatments for the four sites are discussed below and are presented in Table 2.

Table 2. Site significance and treatment recommendations.

Site No.	*Site Type*	*Temporal Affiliation*	*Significance*	*Treatment*
5011*	Boundary wall	Historic	D	No further work
13220*	Agricultural complex	Precontact	D	No further work
26395	Cairn	Precontact	D	No further work
26396	Cairn	Precontact	D	No further work
26397	Cairn	Precontact	D	No further work
26398	Cairn	Precontact	D	No further work

*While these sites have been previously subject to evaluation and recommendation, the current study provides a re-evaluation relative to the current project area.

Sites 5011, 13220, 26395, 26396, 26397, and 26398 are all considered significant under Criterion D for information they have yielded relative to past use of the current project area. It is argued that the information collected during the previous and current inventory surveys is sufficient to document these sites and to mitigate any potential negative impacts resulting from the proposed development of the reservoir and service road. Therefore, no further work is recommended for these sites. It is further recommended that an archaeological monitor be present during the initial grubbing and grading associated with this project in an effort to insure the protection of a nearby archaeological features observed during the current survey of the project area (see Figure 8). A monitoring plan for the proposed development area should be prepared and submitted to DLNR-SHPD prior to any groundbreaking activities.

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E-2

May 2008

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May 5, 2008

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LOG NO: 2008.1339
DOC NO: 0805TS02
Archaeology

Dear Dr. Rechtman:

SUBJECT: Chapter 6E-42 Historic Preservation Review –
Archaeological Inventory Survey for Water Reservoir and Service Road
Keahuolū and Kealakehe Ahupua'a, North Kona District, Island of Hawai'i
TMK: (3) 7-4-021: por. 014, 020, 021

Thank you for the opportunity to comment on the above Archaeological Inventory Survey report (Ketner and Rechtman 2008).

This archaeological inventory survey investigated 7.3 acres. Four (4) new archaeological sites (SIHP#'s 50-10-28-26395 through -26398) and two (2) known sites (SIHP#'s 50-10-28-5011 and -13220) were identified and described. Site -13220 and the newly described sites appear to have been constructed and utilized prehistorically for activities related to agricultural production. -5011 is a historic core-filled boundary wall.

The report adequately describes the physical environment of the project area. The background section reviewing previous archaeological work in the vicinity is thorough. We believe the survey has covered the entire area of the property. The descriptions of the identified historic properties are acceptable. The SHPD concurs with the evaluations of significance under HAR §13-284-6 criterion "d." We agree with the recommended treatments for these sites, that none require further work. However we also agree that to mitigate any potential negative effects to nearby archaeological features all initial grubbing and grading activities should be monitored by a qualified archaeologist. We look forward to the submittal of a Monitoring Plan for this area prior to any groundbreaking activities.

The report satisfies the requirements of Hawaii Administrative Rules Chapter 13-276 and we approve of it as final. Please contact Assistant Hawaii Island Archaeologist, Tim Scheffler at (808) 981-2979 or, timothy.e.scheffler@hawaii.gov if you have any questions or concerns regarding this letter.

Aloha,

Nancy McMahon, Acting Archaeology Branch Chief
State Historic Preservation Division

TS

Appendix F

F-1

January 2008

TRAFFIC STUDY
FOR THE
KEAHUOLU AFFORDABLE HOUSING MASTER PLAN
NORTH KONA, ISLAND OF HAWAII, HAWAII

JANUARY 2008

PREPARED FOR

HAWAII HOUSING FINANCE & DEVELOPMENT CORP.

PREPARED BY

FEHR & PEERS

KAKU ASSOCIATES

TRAFFIC STUDY
FOR THE
KEAHUOLU AFFORDABLE HOUSING MASTER PLAN
NORTH KONA, ISLAND OF HAWAII, HAWAII

January 2008

Prepared for:

HAWAII HOUSING FINANCE & DEVELOPMENT CORP.

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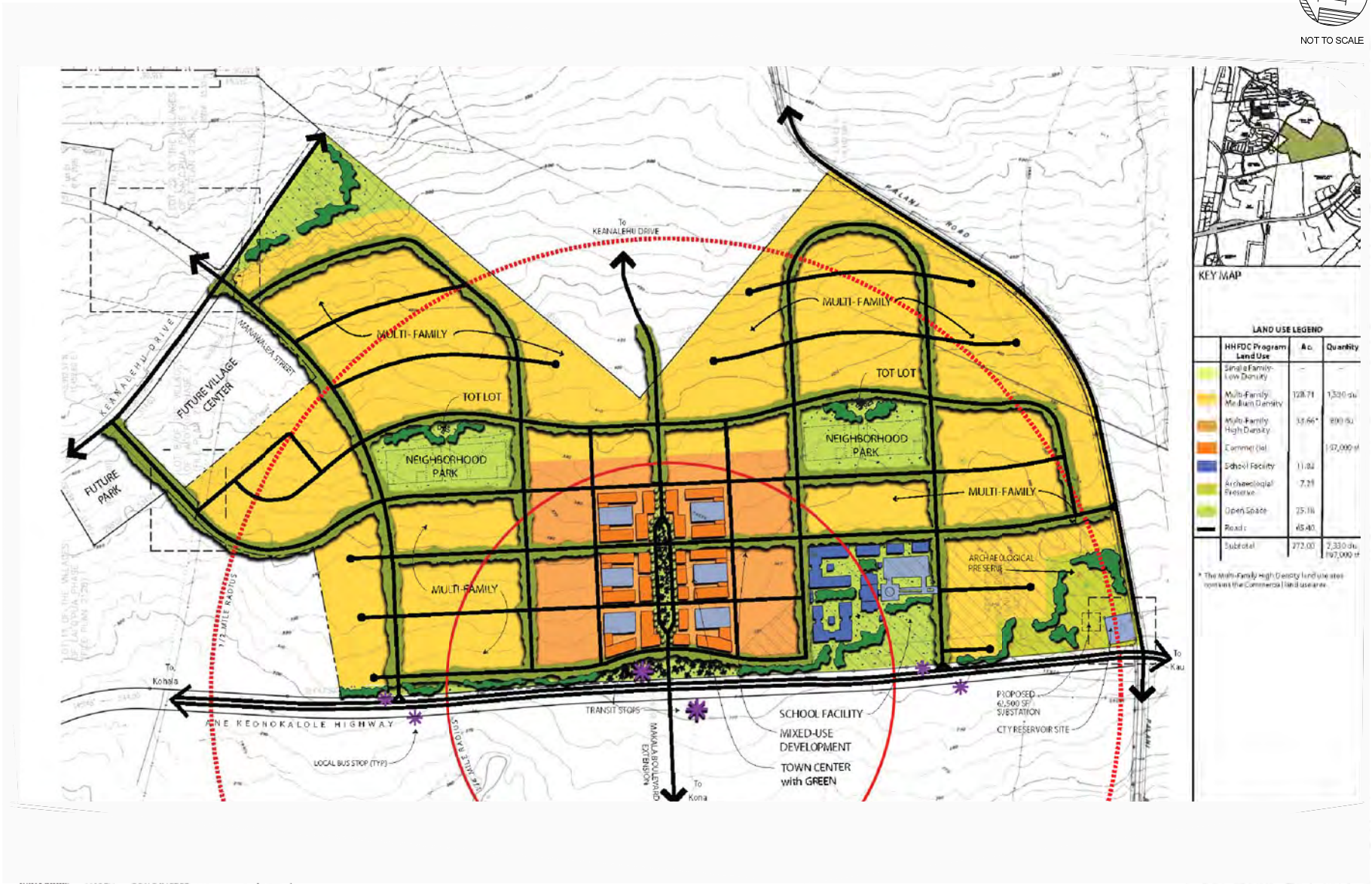
I. INTRODUCTION

This report documents the results of a traffic study conducted by Fehr & Peers/Kaku Associates to evaluate the potential traffic impacts associated with the proposed Keahuolu Affordable Housing Master Plan development (project) located in the North Kona area on the island of Hawaii. It includes a description of the assumptions and methods used to conduct the study as well as a discussion of the results.

PROJECT DESCRIPTION

The project would construct a new mixed-use neighborhood on vacant land in the area northeast of the intersection of Palani Road (SR 190) and Henry Street. Three project alternatives, as well as the No Action alternative, were assessed in this report. Each of the alternatives would have identical street and land use patterns but would vary in the overall intensity of development. Figure 1 presents the proposed land use plan for the project. Each alternative development concept would be focused on a mixed-use town center and would include 197,000 square feet of commercial/retail space, 25 acres of neighborhood parks, a seven-acre archeological preserve, a 12-acre site reserved for a school and between 1,020 and 2,330 housing units.

Concept A would construct 1,020 dwelling units, including 620 multi-family units and 400 single-family units in increments of 300 dwelling units per year from 2010-2012 and 120 additional dwelling units in 2013. Concept B would construct 1,840 dwelling units, including 1,240 multi-family units and 600 single-family units in increments of 300 dwelling units per year from 2010-2015 and 40 additional dwelling units in 2016. Concept C, illustrated in Figure 1, would construct 2,330 multi-family dwelling units in increments of 300 dwelling units from 2010-2016 and 230 additional dwelling units in 2017. Completion of the residential component of the project is anticipated by 2014 under Concept A, by 2015 under Concept B, and 2016 under Concept C. Each concept assumes that the entire project would be completed by the end of 2020.



Source: Belt Collins, 2007

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FIGURE 1
SITE PLAN FOR KEAHUOLU AFFORDABLE HOUSING MASTER PLAN

STUDY SCOPE

The study analyzes potential project-related traffic impacts on the roadway system in the vicinity of the proposed project. The study evaluates projected 2020 conditions with and without project completion when most of the planned streets in the region that are described in *Keahole to Honaunau Regional Circulation Plan* (County of Hawaii Planning Department, August 2006) are expected to be in place. The impact analysis examines projected future conditions, both with and without the proposed project. The following traffic scenarios are analyzed in the study:

- Existing Conditions (2007) – The analysis of existing traffic conditions provides a basis for the remainder of the study. The existing conditions analysis includes an assessment of streets, traffic volumes, and operating conditions.

- Cumulative Base (No Project) Conditions (2020) – The objective of this scenario is to project future traffic growth and operating conditions resulting from regional growth and related projects in the vicinity of the project site, without consideration of traffic generated by the proposed project.

- Cumulative plus Project Conditions (2020) – The objective of this scenario is to project potential impacts of the proposed project on future traffic operating conditions with project traffic added to the cumulative base traffic forecasts in 2020.

The study analyzed the potential project-related traffic impacts under typical weekday a.m. and p.m. peak hour traffic conditions at 12 intersections in the vicinity of the proposed project. The analyzed intersections are illustrated in Figure 2 and are:

1. Henry Street & Queen Kaahumanu Highway (SR 19)
2. Palani Road (SR 190) & Queen Kaahumanu Highway (SR 19)
3. Kamakaeha Avenue & Palani Road (SR 190)
4. Henry Street & Palani Road (SR 190)
5. future intersection of Palani Road (SR 190) & Minor Site Access Road
6. Queen Kaahumanu Highway (SR 19) & Makala Boulevard
7. future intersection of Ane Keohokalole Highway & Major Site Access Road
8. Pahiliholo Street & Palani Road (SR 190)
9. Kealakaa Street & Palani Road (SR 190)
10. Uluaoa Street & Palani Road (SR 190)
11. Queen Kaahumanu Highway (SR 19) & Kealakehe Parkway
12. Kealakehe Parkway & Ane Keohokalole Highway

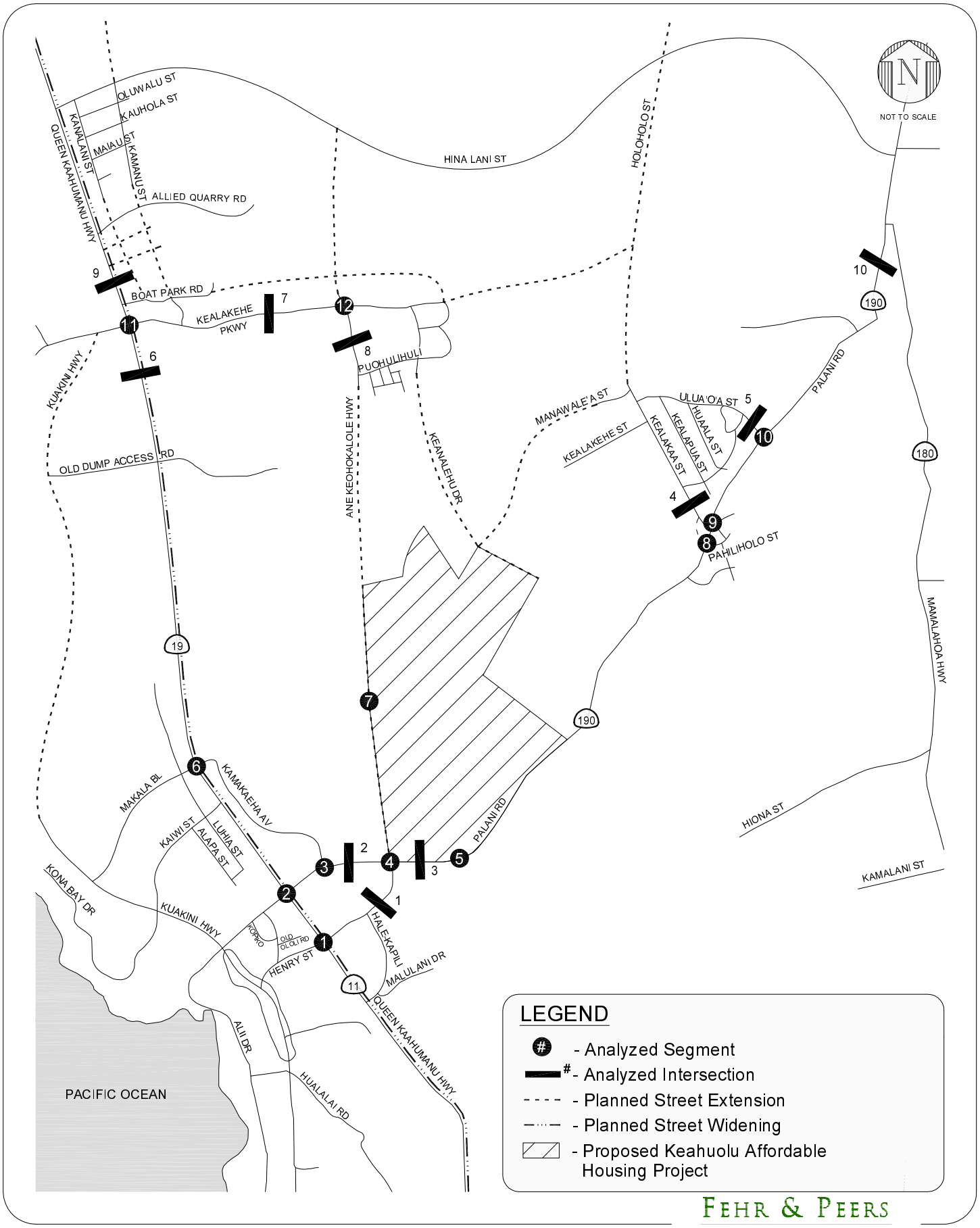

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FIGURE 2
STUDY AREA AND ANALYZED LOCATIONS

The effect of the proposed project options on daily traffic volumes was also measured on 10 street segments, also shown in Figure 2:

1. Henry Street south of Palani Road (SR 190)
2. Palani Road (SR 190) makai (west) of Henry Street
3. Palani Road (SR 190) mauka (east) of Henry Street
4. Kealakaa Street north of Palani Road (SR 190)
5. Uluaoa Street north of Palani Road (SR 190)
6. Queen Kaahumanu Highway (SR 19) south of Kealakehe Parkway
7. Kealakehe Parkway makai (west) of Ane Keohokalole Highway
8. Ane Keohokalole Highway south of Kealakehe Parkway
9. Queen Kaahumanu Highway (SR 19) north of Kealakehe Parkway
10. Palani Road (SR 190) south of Mamalahoa Highway

New baseline traffic counts were collected at these locations in August 2007 except at study intersections #5 and #7, both of which are future intersections.

ORGANIZATION OF REPORT

This report is divided into six chapters, including this introduction. Chapter II describes the existing circulation system, traffic volumes, and operating conditions in the study area as well as describes currently planned transportation improvements. The methodologies used to forecast future cumulative and project traffic volumes and the resultant forecasts are described in Chapter III. Chapter IV presents an assessment of future traffic impacts at intersections in the surrounding area and identifies mitigation measures to address both cumulative and project-specific impacts. Chapter V contains an assessment of potential future street segment impacts and discusses potential mitigation measures. Finally, the conclusions of the study are summarized in Chapter VI.

II. EXISTING CONDITIONS

A comprehensive data collection effort was undertaken to identify existing transportation conditions in the vicinity of the proposed project. The assessment of existing conditions relevant to this study includes an inventory of the street and highway system, traffic volumes on these facilities, and operating conditions at key intersections and street segments.

EXISTING ROADWAY SYSTEM

The study area, as shown in Figure 2, is generally bounded by Kealakehe Parkway on the north, Queen Kaahumanu Highway (SR 19) on the west (makai), and Palani Road (SR 190) on the southeast. The street system in the study area is illustrated in Figure 2. Primary regional access to the area is provided by Queen Kaahumanu Highway, which runs north-south approximately one mile makai of the project site and by Mamalahoa Highway, which runs northeast-southwest approximately two miles mauka of the project site. Henry Street, currently running between Queen Kaahumanu Highway and Palani Road, also provides access to the project site. The proposed Ane Keohokahole Highway (Mid-Level Road) extension will extend Henry Street northward to Hina Lani Street and will serve the project site by providing direct access to Palani Road and Kealakehe Parkway. Diagrams of the existing intersection lane configurations at the ten existing study intersections are provided in Appendix A.

EXISTING TRAFFIC VOLUMES AND OPERATING CONDITIONS

The following sections present the existing peak hour traffic volumes at the study intersections, daily street segment traffic volumes, a description of the methodology used to analyze operating conditions, and the resulting level of service (LOS) at each location under existing conditions.

Existing Peak Hour Traffic Volumes

New weekday peak period intersection turning movement counts were collected between 6:00 and 9:00 a.m. and between 3:00 and 6:00 p.m. at the 10 existing study intersections on Tuesday, August 12, Wednesday, August 13, and Thursday, August 14, 2007. Existing weekday peak hour volumes at these intersections are illustrated in Figure 3 and the traffic count data sheets are provided in Appendix B.

Existing Daily Street Segment Traffic Volumes

24-hour machine counts were conducted at the 10 street segments listed in Chapter I for analysis of impacts of the proposed project on Tuesday, August 12, Wednesday, August 13, and Thursday, August 14, 2007. The existing daily traffic volume data are available in Appendix B.

Level of Service Methodology

LOS is a qualitative measure used to describe the condition of traffic flow ranging from excellent conditions at LOS A to overload conditions at LOS F. LOS definitions for signalized and unsignalized intersections are provided in Tables 1 and 2, respectively. LOS D is considered to be the minimum desirable level of service in this area.

LOS analyses were conducted at each of the existing study intersections to determine their current operating conditions using the operations methodology for signalized intersections and the two-way stop-controlled methodology for unsignalized intersections from *2000 Highway Capacity Manual* (2000 HCM) (Transportation Research Board, 2000).

Existing Peak Hour Intersection Levels of Service

The existing weekday a.m. and p.m. peak hour turning movements depicted in Figure 3 were used in conjunction with the LOS methodologies described above to determine existing operating conditions at each study intersection. Detailed LOS calculation worksheets are included in

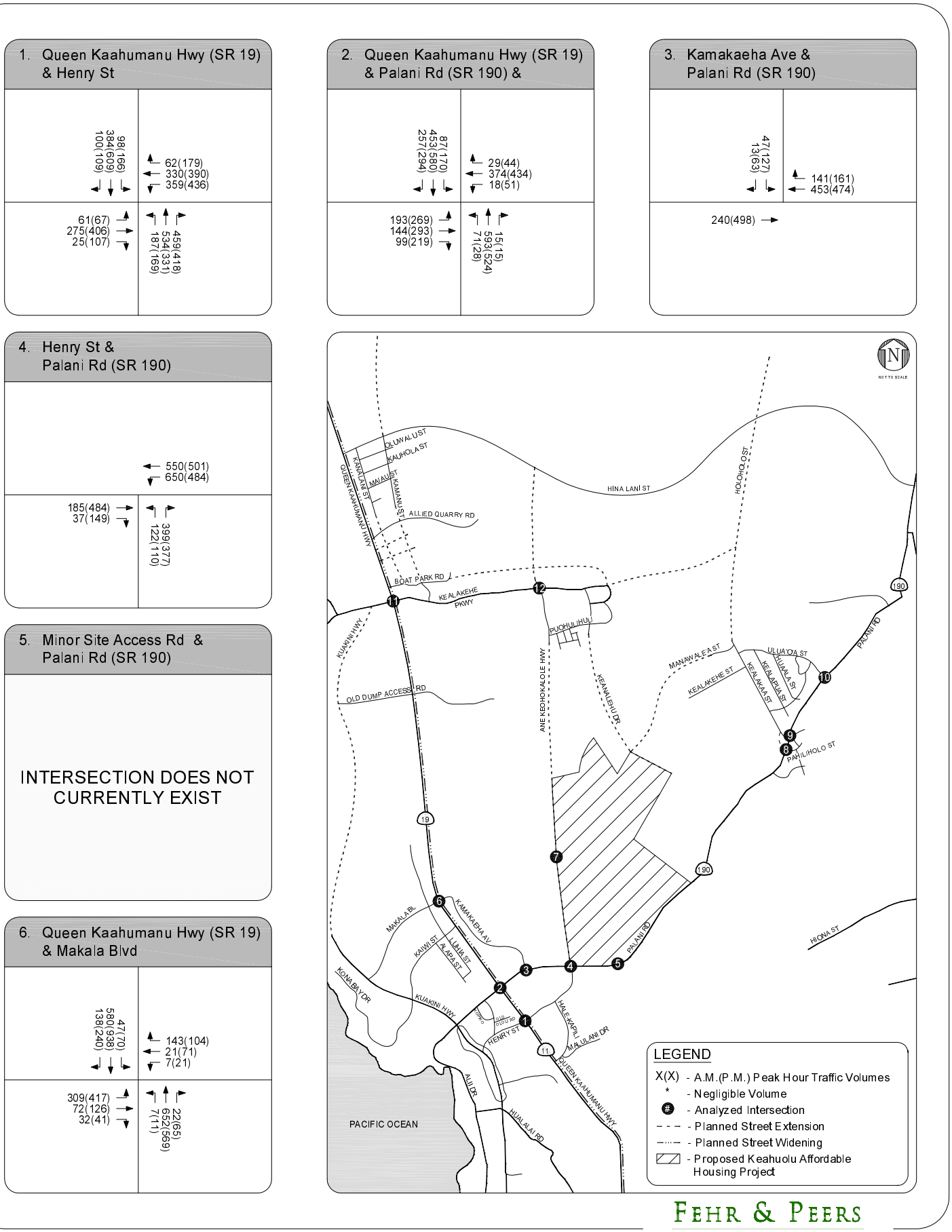

FIGURE 3
EXISTING PEAK HOUR TRAFFIC VOLUMES

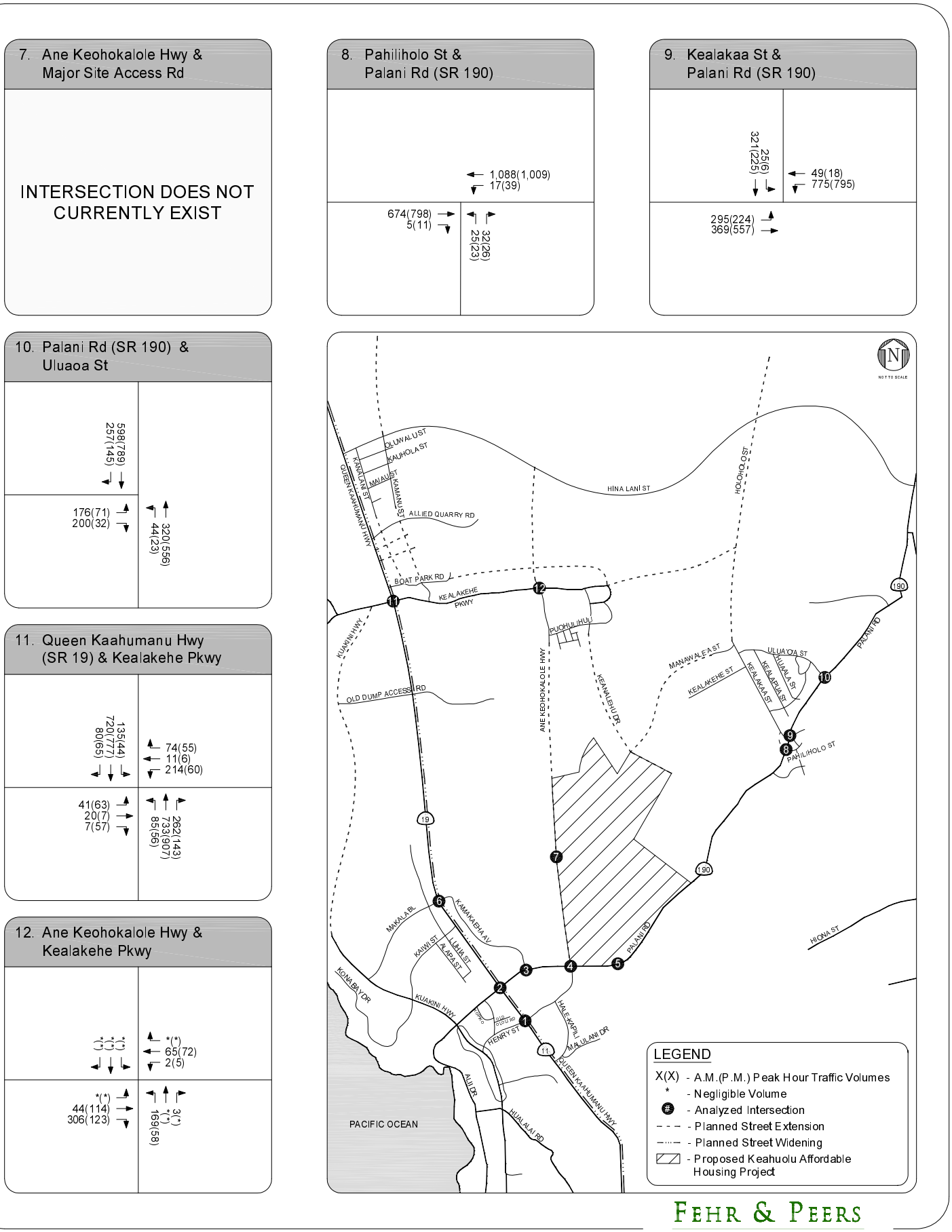

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FIGURE 3 (CONT.)
EXISTING PEAK HOUR TRAFFIC VOLUMES

TABLE 1
LEVEL OF SERVICE DEFINITIONS FOR SIGNALIZED INTERSECTIONS

Level of Service	Volume/Capacity	Average Stopped Delay per Vehicle (seconds)*
A	0.000 - 0.600	≤10
B	>0.600 - 0.700	>10 and ≤20
C	>0.700 - 0.800	>20 and ≤35
D	>0.800 - 0.900	>35 and ≤55
E	>0.900 - 1.000	>55 and ≤80
F	> 1.000	>80

Source: *Highway Capacity Manual*, Transportation Research Board, 2000.

TABLE 2
LEVEL OF SERVICE DEFINITIONS FOR UNSIGNALIZED INTERSECTIONS

Level of Service	Average Total Delay (seconds/vehicle)
A	$\leq$ 10.0
B	> 10.0 and $\leq$ 15.0
C	> 15.0 and $\leq$ 25.0
D	> 25.0 and $\leq$ 35.0
E	> 35.0 and $\leq$ 50.0
F	> 50.0

Source: *Highway Capacity Manual*, Transportation Research Board, 2000.

Appendix C. Table 3 summarizes the results of this analysis, including the average control delay and corresponding LOS during the a.m. and p.m. peak hours. Calculated volume-to-capacity (V/C) ratios are also shown in Table 3. As indicated in Table 3, three of the 10 existing study intersections are operating at LOS E or F during both the a.m. and p.m. peak hours:

8. Palani Road (SR 190) & Pahiliholo Street
9. Kealakaa Street & Palani Road (SR 190)
10. Uluaoa Street & Palani Road (SR 190)

The other seven existing study intersections are operating at LOS D or better during the a.m. and p.m. peak hours.

TABLE 3
YEAR 2006 EXISTING CONDITIONS
PEAK HOUR LEVELS OF SERVICE

Intersections	Peak Hour	V/C	Del/Veh*	LOS
1 Queen Kaahumanu Hwy (SR 19) & Henry St	A.M. P.M.	0.634 0.626	23 25	C C
2 Queen Kaahumanu Hwy (SR 19) & Palani Rd (SR 190)/Alii Dr	A.M. P.M.	0.777 0.874	26 31	C C
3 Kamakaeha Av & Palani Rd (SR 190) [a]	A.M. P.M.	NC NC	15 25	B D
4 Henry St & Palani Rd (SR 190)	A.M. P.M.	0.659 0.804	12 19	B B
5 Project Minor Access & Palani Rd (SR 190) [b]	A.M. P.M.	NA NA	NA NA	NA NA
6 Queen Kaahumanu Hwy (SR 19) & Makala Bl	A.M. P.M.	0.748 0.973	23 36	C D
7 Ane Keohokahole Hwy & Major Site Access Road [b]	A.M. P.M.	NA NA	NA NA	NA NA
8 Palihiolo St & Palani Rd (SR 190) [a]	A.M. P.M.	NC NC	48 **	E F
9 Kealakaa St & Palani Rd (SR 190) [a]	A.M. P.M.	NC NC	** 33	F D
10 Palani Rd & Uluaoa St (SR 190) [a]	A.M. P.M.	NC NC	** **	F F
11 Queen Kaahumanu Hwy (SR 19) & Kealakehe Hwy	A.M. P.M.	0.742 0.652	20 11	B B
12 Ane Keohokalole Hwy & Kealakehe Hwy [a]	A.M. P.M.	NC NC	12 11	B B

Note:
* Delay indicates average stopped delay per vehicle in seconds for signalized intersections. The worst case vehicular delay is reported for stop-controlled intersections.
** Indicates oversaturated conditions. Delay cannot be calculated.
NA = Not Applicable
NC = Not Calculated
[a] Intersection is controlled by stop signs on the minor approaches.
[b] Future intersection.

III. FUTURE TRAFFIC PROJECTIONS

In order to evaluate the potential impact of traffic generated by the proposed project on the surrounding street system, it was necessary to develop estimates of future traffic conditions in the area both with and without the project. Future traffic conditions without the proposed project reflect traffic increases due to general regional growth and development as well as traffic increases generated by other specific developments near the project site. These conditions are referred to as the cumulative base condition (i.e., no project conditions). The sum of the cumulative base and project-generated traffic represents the cumulative plus project conditions. Development of these future 2020 traffic scenarios conditions is described in this chapter.

CUMULATIVE BASE TRAFFIC PROJECTIONS

The cumulative base traffic projections include two elements. The first element is growth in the existing background traffic volumes reflecting the effects of overall regional growth and development in and around the study area, referred to as ambient growth. The second is the traffic generated by specific cumulative projects located in or near the study area.

Areawide Traffic Growth and Cumulative Development Projects

Traffic projections were estimated for this study on the basis of actual traffic growth on Queen Kaahumanu Highway (SR 19) and Mamalahoa Highway/Palani Road (SR 190) between 1998 and 2004, which shows that peak hour traffic volumes have increased at a simple growth rate of approximately 5% per year during the period. That estimate is consistent with the level of growth identified in *Keahole to Honaunau Regional Circulation Plan.* Accordingly, the 2007 northbound and southbound volumes were increased by 65% (5% annual simple growth rate x 13 years) through 2020.

Available information regarding potential future projects either under construction, planned, or proposed for development within or near the study area was obtained from the project team. Estimated trips from the related projects were assigned to the roadway system based on their anticipated distribution patterns. The geographic distribution of traffic generated by new developments depends on several factors, such as the type and density of the proposed land uses, the geographic distribution of the population from which employees and/or patrons may be drawn, the geographic distribution of activity centers (employment, commercial, and other) to which residents of proposed residential projects may be drawn, and its location in relation to the surrounding street system.

The resulting cumulative base traffic volumes, representing future conditions without the project for year 2020, are presented in Figure 4. These future projections take into account the estimated overall growth in the surrounding area without the addition of traffic generated by the proposed Keahuolu Affordable Housing Master Plan project.

Baseline Street System Improvements

Discussions were held with agency staff regarding the roadway improvements in or near the study area planned for completion by 2020. These improvements, whether the result of local capital improvement programs or in connection with planned or approved projects, would result in dramatically improved mobility options for residents and visitors and in capacity changes at various locations throughout the study area as shown in Figure 2 and discussed below. Relevant information from *Keahole to Honaunau Regional Circulation Plan* is presented in Appendix D. It shows that the following roadway system improvements are planned:

- Queen Kaahumanu Highway – The main arterial highway through Kailua-Kona is being widened from two to four lanes (two in each direction) with a median from Kona International Airport to Henry Street in Kailua.

- Main Street (Kamanu Street) – Kamanu Street will be extended to connect with Kealakehe Parkway and north to the proposed University Drive.

- Ane Keohokalole (Mid-Level Road) – This project will extend Henry Street from Palani Road to the existing segment of Ane Keohokalole Highway and northward to Hina Lani Street.

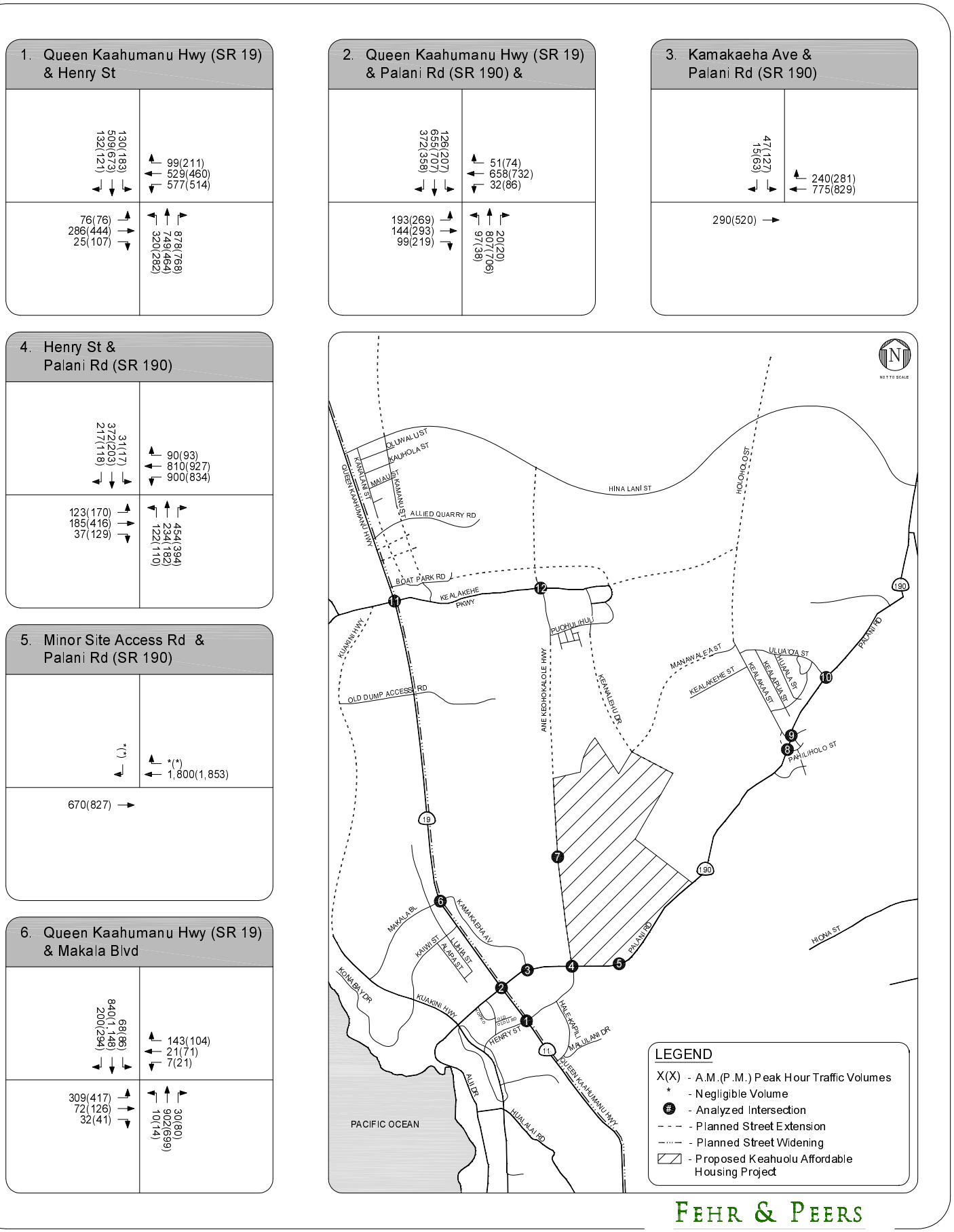

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FIGURE 4
CUMULATIVE BASE (2020) PEAK HOUR TRAFFIC VOLUMES

7. Ane Keohokalole Hwy & Major Site Access Rd

*(*) → *(*)
*(*) ← *(*)
620(338) ↓ *(*)
447(445) ↑ *(*)

8. Kealakaa St/Pahiliholo St & Palani Rd (SR 190)

56(23) ←
1,254(1,265) ←
20(49) ↓
10(2) ↓
15(4) ↓
521(565) ↓
438(506) ↑
476(681) →
6(13) ↓
5(4) ←
20(19) ↑
32(26) ↑

9. Kealakaa St & Palani Rd (SR 190)

SEE INTERSECTION 8

10. Palani Rd (SR 190) & Uluaoa St

723(964) ↓
311(177) ↓
176(71) ↑
200(32) ↓
422(690) ↑
58(29) ←

11. Queen Kaahumanu Hwy (SR 19) & Kealakehe Pkwy

81(60) ←
61(66) ←
231(242) ←
171(55) ↓
910(974) ↓
249(232) ↓
81(106) ↑
107(97) →
10(67) ↓
422(239) ↑
995(1,061) ↑
115(66) ←

12. Ane Keohokalole Hwy & Kealakehe Pkwy

50(23) ←
115(128) ←
2(5) ←
12(50) ↓
295(257) ↓
45(369) ↓
369(165) ↑
94(194) →
323(76) ↓
3(*) ↑
320(288) ↑
124(78) ←

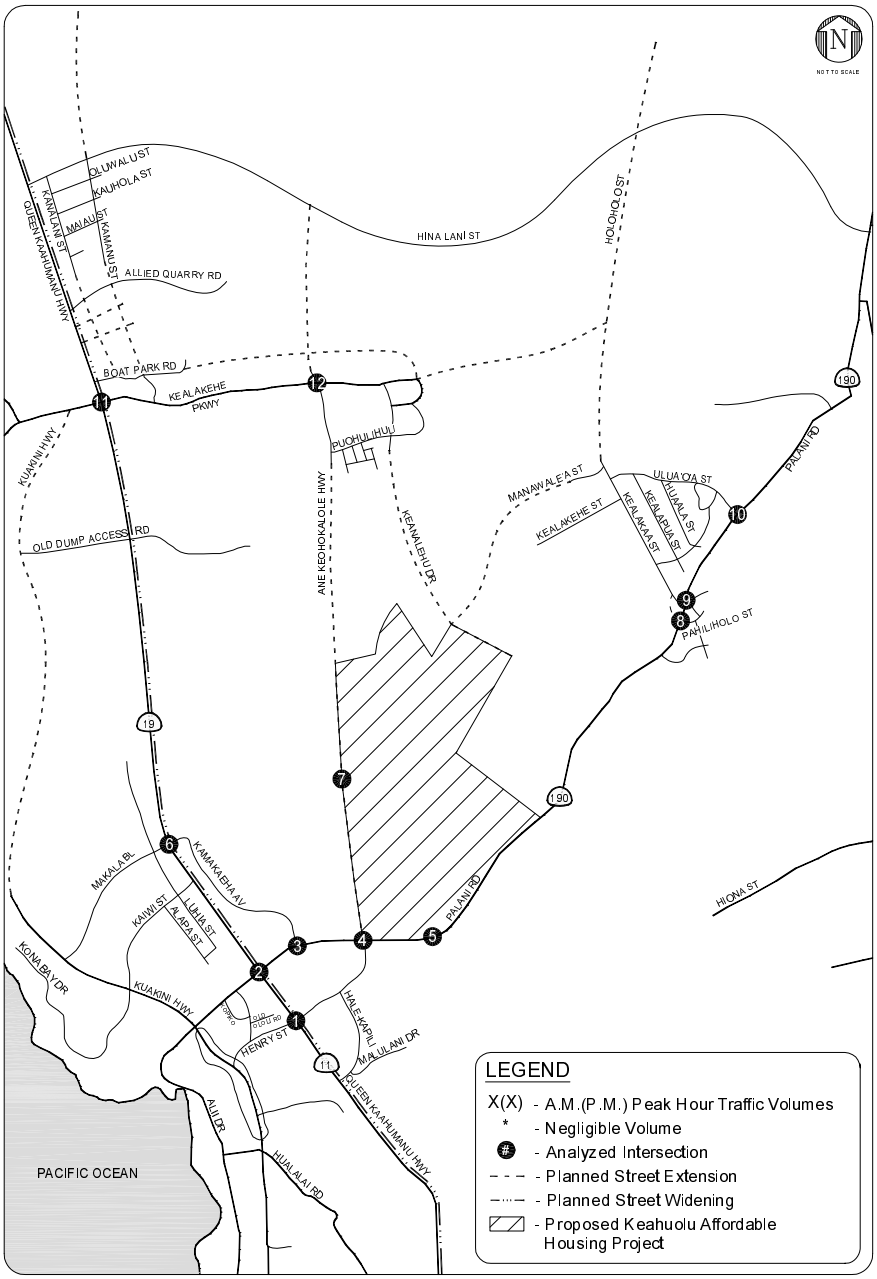

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FIGURE 4 (CONT.)
CUMULATIVE BASE (2020) PEAK HOUR TRAFFIC VOLUMES

- Kealakaa Street/Holoholo Street Extension – This planned street would extend Kealakaa Street northward to Holoholo Street and the planned Kealakehe Parkway.

- Kuakini Highway – Kuakini Highway will be extended northward to connect to Kealakehe Parkway, forming a new north-south roadway on the makai side of Queen Kaahumanu Highway.

- Intersection of Kealakaa Street and Palani Road – Two T-intersections, Kealakaa Street & Palani Road and Palihiolo Street & Palani Road, are being merged into a signalized intersection with additional turn lanes. This will result in the existing intersection of Kealakaa Street & Palani Road (Intersection 9) being limited to right turns in, with all other turning movements focused at Pahiliholo Street & Palani Road (Intersection 8). For this reason, only the latter of these locations is analyzed in the future scenarios.

- Keanalehu Drive and Manawale'a Street – These streets are currently being constructed just north of the project site to create a new mauka-makai connection.

Cumulative Base Traffic Volumes

Forecasts of cumulative base traffic volumes were developed by adding the total projected traffic growth to the background existing volumes and distributing it over the future street network. Estimated traffic shifts for the 2020 horizon year were developed based on field observations and current and future land use patterns. Approximately 20% of the vehicles traveling through Queen Kaahumanu Highway and Mamalahoa Highway/Palani Road are expected to divert to the planned new roads described above that will be parallel to these existing highways. The resulting projected traffic volumes at the analyzed intersections, illustrated in Figure 4, represent the 2020 cumulative base conditions, i.e., future conditions without the project.

PROJECT TRAFFIC PROJECTIONS

Development of future traffic projections for the proposed project involved a three-step process. This process included the estimation of project trip generation, trip distribution, and trip assignment.

Project Trip Generation

Trip generation rates found in *Trip Generation, 7th Edition* (Institute of Transportation Engineers, 2003) were used to estimate number of trips to and from the proposed project. The trip generation rates used in this study and the estimated new trips generated by the proposed project Concepts A, B and C are summarized in Tables 4, 5, and 6, respectively.

As shown in Table 4, Concept A is estimated to generate about 9,953 daily trips, including approximately 1,178 trips during the morning peak hour (631 inbound and 547 outbound) and approximately 1,046 trips during the evening peak hour (543 inbound and 503 outbound).

As shown in Table 5, Concept B is estimated to generate about 16,034 daily trips, including approximately 1,511 trips during the morning peak hour (665 inbound and 846 outbound) and approximately 1,629 trips during the evening peak hour (918 inbound and 711 outbound).

As shown in Table 6, Concept C is estimated to generate about 17,617 daily trips, including approximately 1,580 trips during the morning peak hour (646 inbound and 934 outbound) and approximately 1,695 trips during the evening peak hour (973 inbound and 722 outbound).

Project Trip Distribution and Trip Assignment

Factors considered in the development of the project trip distribution include a review of historic traffic volume data in the area, observations of existing traffic patterns and discussions with residents, the geographic distribution of employment and commercial activity in the vicinity, and the proposed street extension program described in *Keahole to Honaunau Regional Circulation Plan*. Based on these factors, the following trip distribution pattern was estimated for the project-generated traffic and is illustrated in Figure 5:

- Northwest 40%
- Northeast 20%
- Southwest 40%

TABLE 4
PRELIMINARY TRIP GENERATION ESTIMATES
KEAHUOLU AFFORDABLE HOUSING MASTER PLAN
CONCEPT A [a]

Land Use	ITE#	Rate	Daily	A.M. Peak Hour			P.M. Peak Hour		
				Trip Gen	In	Out	Trip Gen	In	Out
Trips Generation Rates [b]									
Single Family Housing	210	per Dwelling Unit [1]	9.57	0.75	25%	75%	1.01	63%	37%
Apartments	220	per Dwelling Unit [1]	6.72	0.51	20%	80%	0.62	65%	35%
Commercial/Retail	710	per 1,000 square feet [2]	11.01	1.55	88%	12%	1.49	17%	83%
High School	530	per ksf	12.89	3.06	71%	29%	0.97	54%	46%

Land Use	ITE#	Size	Daily	A.M. Peak Hour			P.M. Peak Hour		
				In	Out	Total	In	Out	Total
Single Family Housing	210	400 DU	3,828	75	225	300	255	149	404
Apartments	220	620 DU	4,166	63	253	316	250	134	384
Commercial/Retail	710	197 ksf	2,169	268	37	305	50	244	294
High School	530	150 ksf [c]	1,934	326	133	459	79	67	146
TOTAL PROJECT			12,097	732	648	1,380	634	594	1,228
Less: Internal Capture [d]			*-2,144*	*-101*	*-101*	*-202*	*-91*	*-91*	*-182*
Net New Trips			**9,953**	**631**	**547**	**1,178**	**543**	**503**	**1,046**

Notes:
[1] Dwelling Unit = DU
[2] 1,000 square feet = ksf
[a] Source: *Keahuolu Affordable Housing Project Master Plan, Kailua-Kona, Hawaii,* Belt Collins Hawaii Ltd., June 2007.
[b] Source: *Trip Generation, 7th Edition,* Institute of Transportation Engineers (ITE), 2003.
[c] Assume that approximately 30% of the total school site (12 acres) is occupied by building area.
[d] Internal trip caputre estimates were based on methodology described in *Trip Generation Handbook, 2nd Edition,* ITE, 2004.

TABLE 5
PRELIMINARY TRIP GENERATION ESTIMATES
KEAHUOLU AFFORDABLE HOUSING MASTER PLAN
CONCEPT B [a]

Land Use	ITE#	Rate	Daily	A.M. Peak Hour			P.M. Peak Hour		
				Trip Gen	In	Out	Trip Gen	In	Out
Trips Generation Rates [b]									
Single Family Housing	210	per Dwelling Unit [1]	9.57	0.75	25%	75%	1.01	63%	37%
Apartments	220	per Dwelling Unit [1]	6.72	0.51	20%	80%	0.62	65%	35%
Commercial/Retail	710	per 1,000 square feet [2]	11.01	1.55	88%	12%	1.49	17%	83%
High School	530	per ksf	12.89	3.06	71%	29%	0.97	54%	46%

Land Use	ITE#	Size	Daily	A.M. Peak Hour			P.M. Peak Hour		
				In	Out	Total	In	Out	Total
Single Family Housing	210	600 DU	5,742	113	338	450	382	224	606
Apartments	220	1,240 DU	8,333	126	506	632	500	269	769
Commercial/Retail	710	197 ksf	2,169	268	37	305	50	244	294
High School	530	150 ksf [c]	1,934	326	133	459	79	67	146
TOTAL PROJECT			18,178	833	1,014	1,846	1,011	804	1,815
Less: Internal Capture [d]			*-2,144*	*-168*	*-168*	*-335*	*-93*	*-93*	*-186*
Net New Trips			**16,034**	**665**	**846**	**1,511**	**918**	**711**	**1,629**

Notes:
[1] Dwelling Unit = DU
[2] 1,000 square feet = ksf
[a] Source: *Keahuolu Affordable Housing Project Master Plan, Kailua-Kona, Hawaii,* Belt Collins Hawaii Ltd., June 2007.
[b] Source: *Trip Generation, 7th Edition,* Institute of Transportation Engineers (ITE), 2003.
[c] Assume that approximately 30% of the total school site (12 acres) is occupied by building area.
[d] Internal trip caputre estimates were based on methodology described in *Trip Generation Handbook, 2nd Edition,* ITE, 2004.

TABLE 6
PRELIMINARY TRIP GENERATION ESTIMATES
KEAHUOLU AFFORDABLE HOUSING MASTER PLAN
CONCEPT C [a]

Land Use	ITE#	Rate	Daily	A.M. Peak Hour			P.M. Peak Hour		
				Trip Gen	In	Out	Trip Gen	In	Out
Trips Generation Rates [b]									
Apartments	220	per Dwelling Unit [1]	6.72	0.51	20%	80%	0.62	65%	35%
Commercial/Retail	710	per 1,000 square feet [2]	11.01	1.55	88%	12%	1.49	17%	83%
High School	530	per ksf	12.89	3.06	71%	29%	0.97	54%	46%

Land Use	ITE#	Size	Daily	A.M. Peak Hour			P.M. Peak Hour		
				In	Out	Total	In	Out	Total
Apartments	220	2,330 DU	15,658	238	950	1,188	939	506	1,445
Commercial/Retail	710	197 ksf	2,169	268	37	305	50	244	294
High School	530	150 ksf [c]	1,934	326	133	459	79	67	146
TOTAL PROJECT			19,761	832	1,120	1,952	1,068	817	1,885
Less: Internal Capture [d]			*-2,144*	*-186*	*-186*	*-372*	*-95*	*-95*	*-190*
Net New Trips			**17,617**	**646**	**934**	**1,580**	**973**	**722**	**1,695**

Notes:
[1] Dwelling Unit = DU
[2] 1,000 square feet = ksf
[a] Source: *Keahuolu Affordable Housing Project Master Plan, Kailua-Kona, Hawaii,* Belt Collins Hawaii Ltd., June 2007.
[b] Source: *Trip Generation, 7th Edition,* Institute of Transportation Engineers (ITE), 2003.
[c] Assume that approximately 30% of the total school site (12 acres) is occupied by building area.
[d] Internal trip caputre estimates were based on methodology described in *Trip Generation Handbook, 2nd Edition,* ITE, 2004.

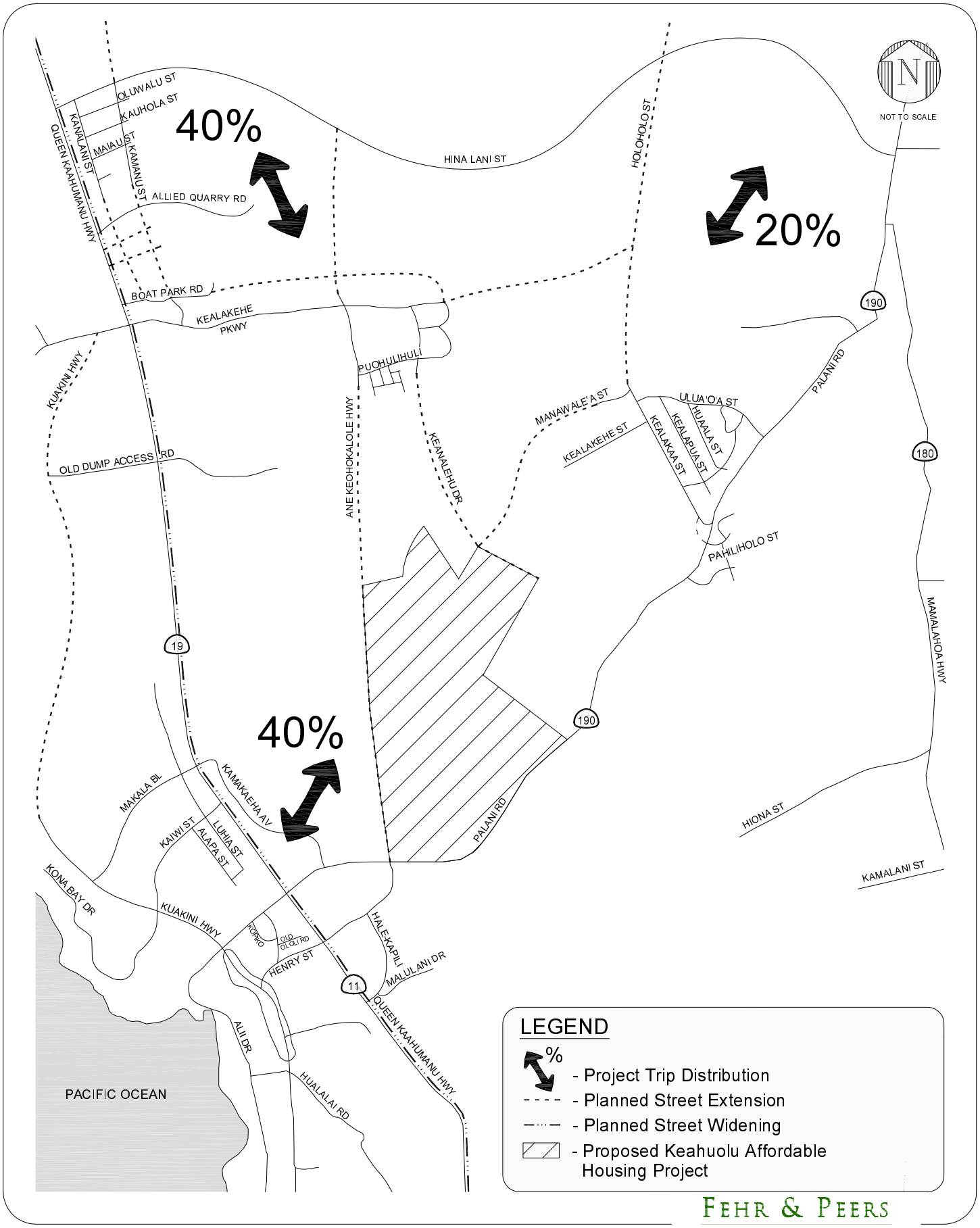

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FIGURE 5
PROJECT TRIP DISTRIBUTION

The project trip assignment took into account the roadway network anticipated to be in place by 2020, when the project would be fully built out. Figures 6, 7, and 8 illustrate the assignment of new project-related traffic at each study intersection.

CUMULATIVE PLUS PROJECT TRAFFIC PROJECTIONS

The project-generated traffic volumes were added to the cumulative base traffic projections to develop the cumulative plus project traffic forecasts for 2020. Figures 9, 10, and 11 illustrate the projected cumulative plus project a.m. and p.m. peak hour traffic volumes at each of the 12 study intersections. Appendix A depicts the anticipated future lane configurations at the study intersections, including assumptions regarding the future intersections of Palani Road (SR 190) & Minor Site Access Road and Ane Keohokalole Highway & Major Site Access Road and the north leg of Henry Street & Palani Road.

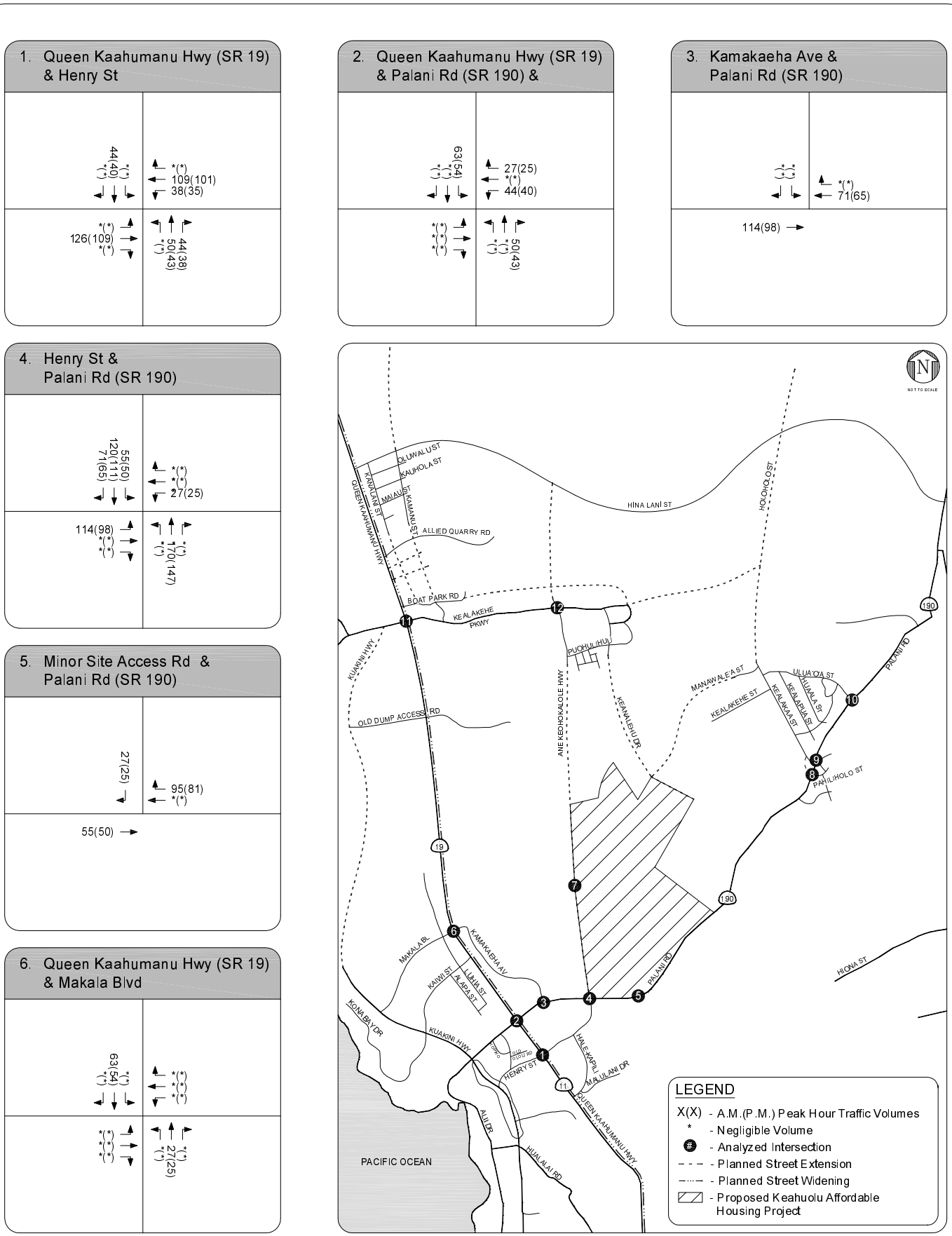

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FIGURE 6

PROJECT ONLY (2020) PEAK HOUR TRAFFIC VOLUMES - SCENARIO A

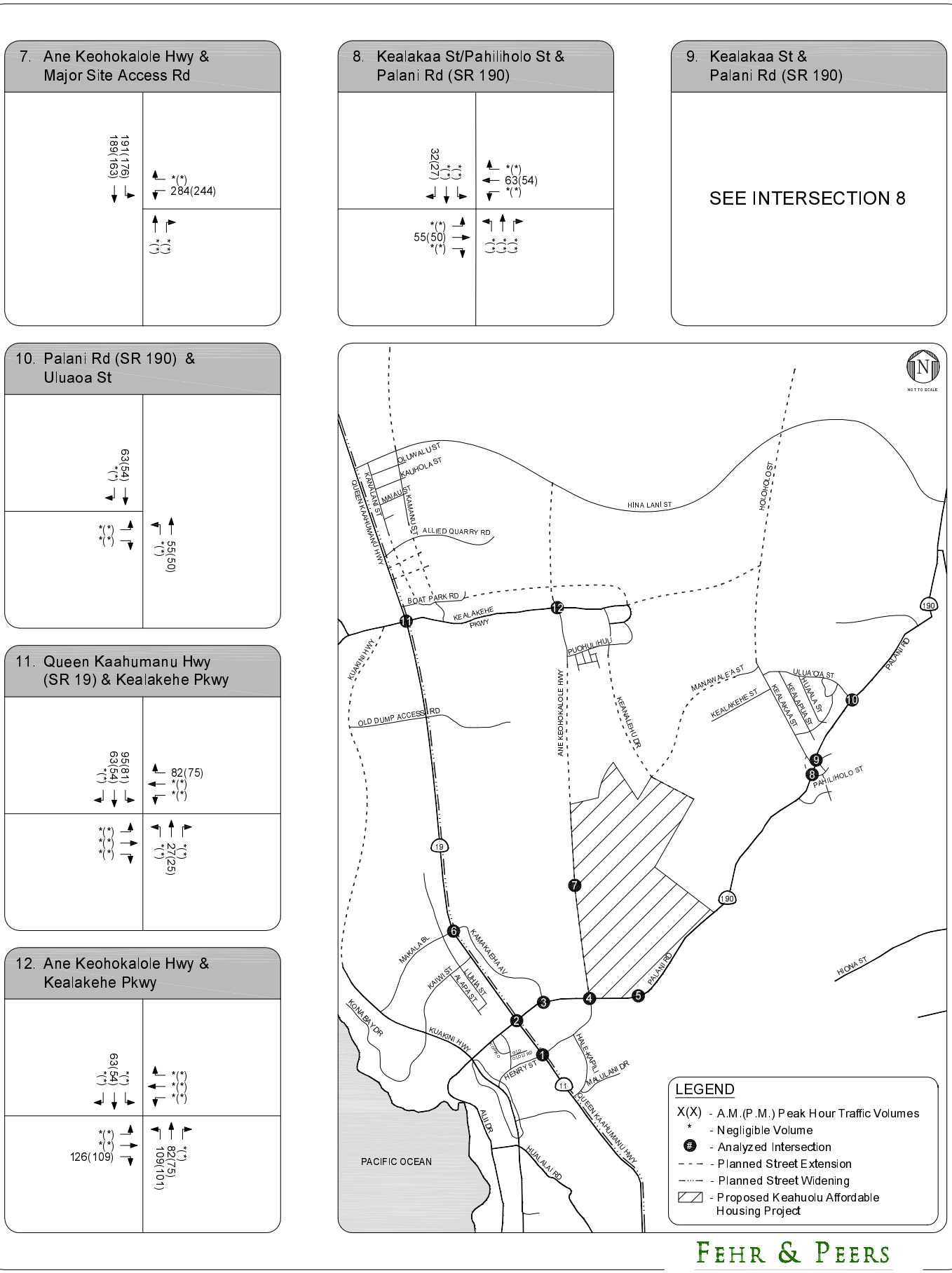

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FIGURE 6 (CONT.)
PROJECT ONLY (2020) PEAK HOUR TRAFFIC VOLUMES - SCENARIO A

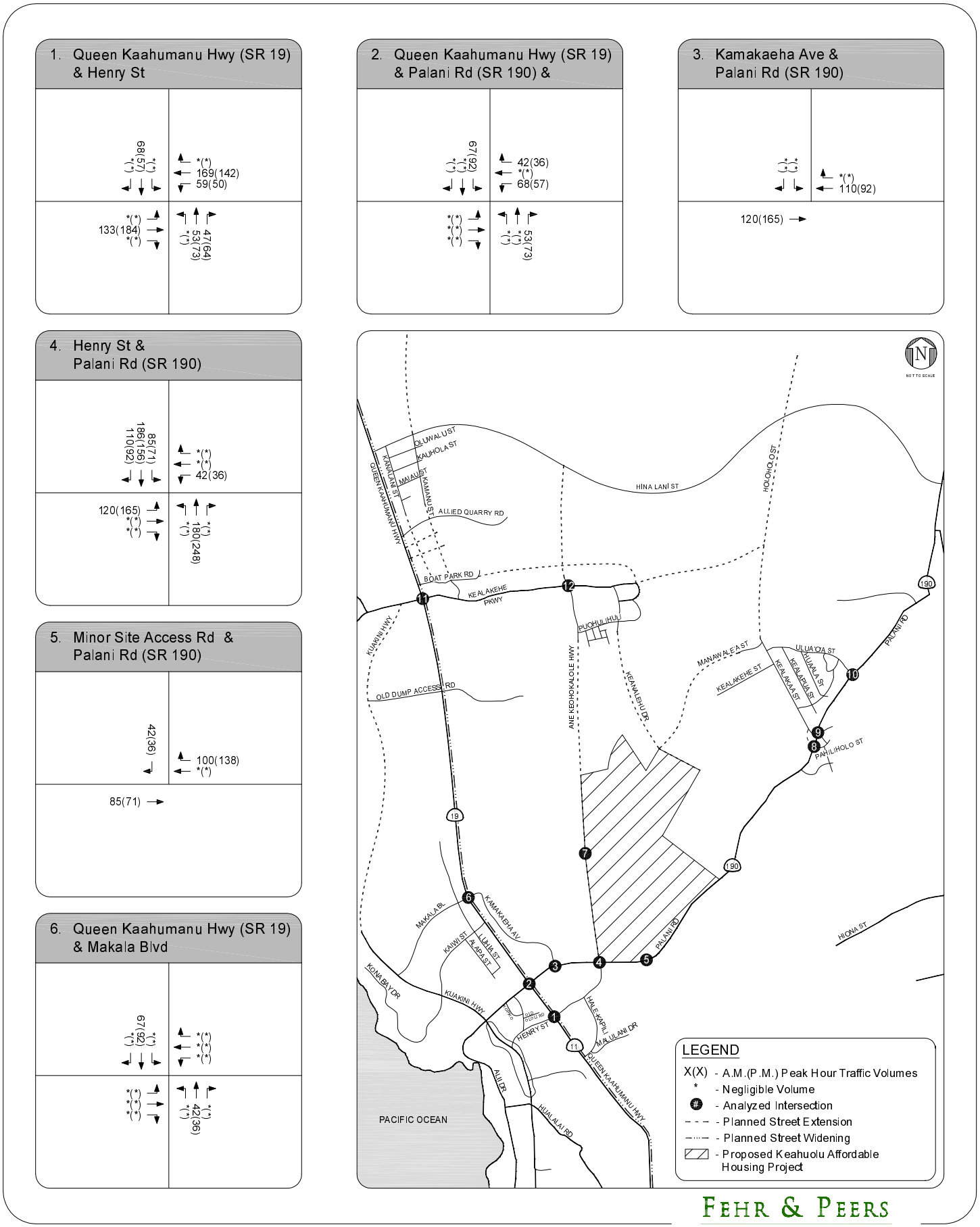

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FIGURE 7
PROJECT ONLY (2020) PEAK HOUR TRAFFIC VOLUMES - SCENARIO B

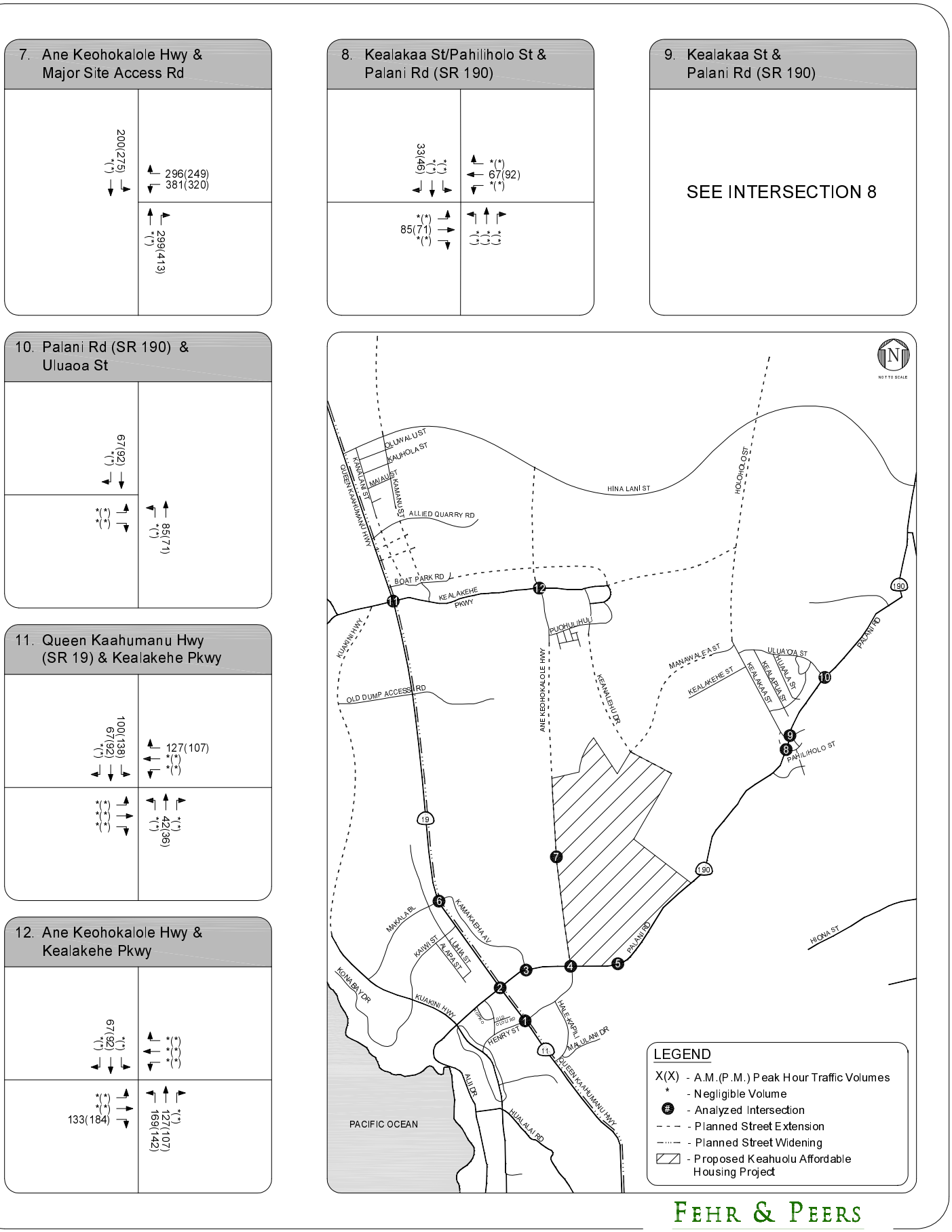

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FIGURE 7 (CONT.)
PROJECT ONLY (2020) PEAK HOUR TRAFFIC VOLUMES - SCENARIO B

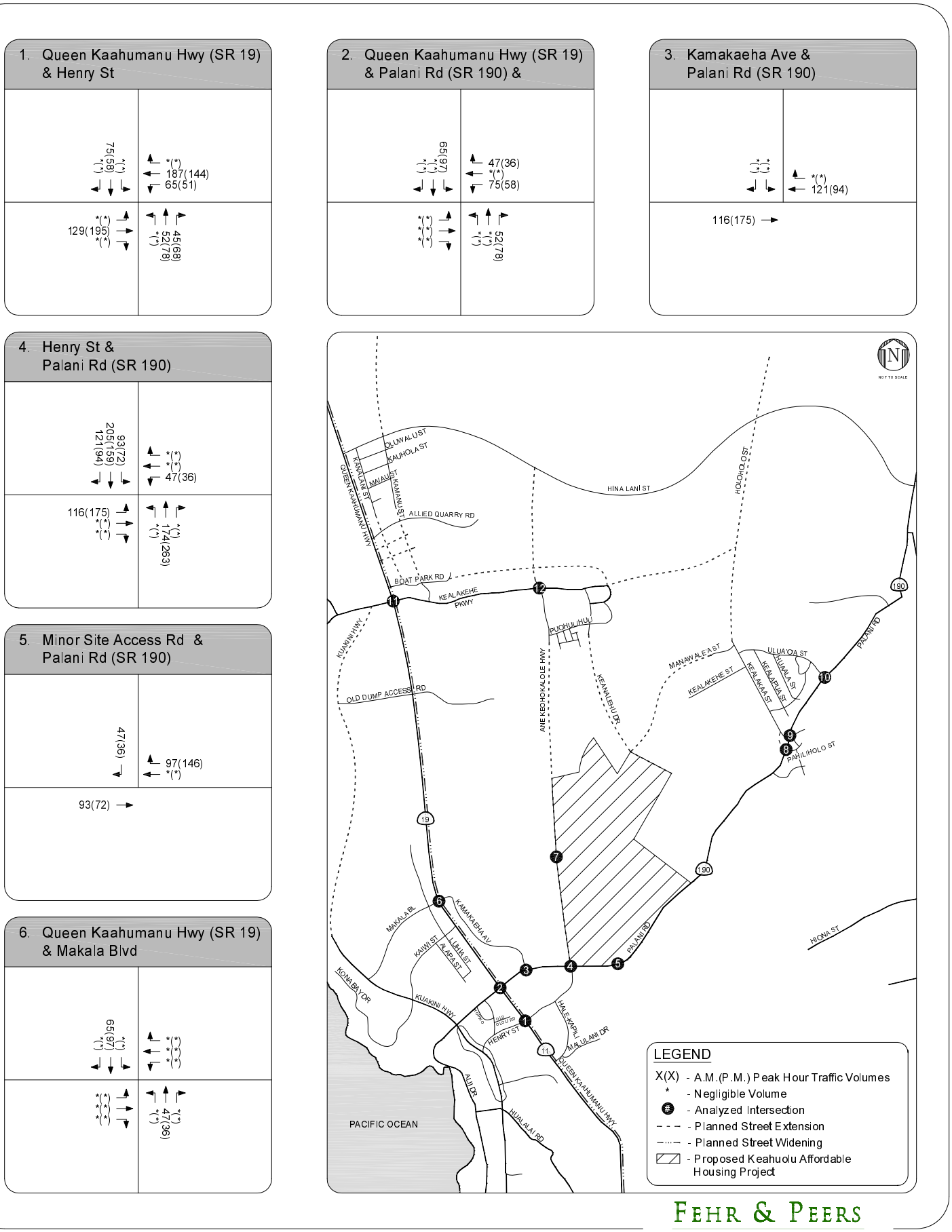

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FIGURE 8
PROJECT ONLY (2020) PEAK HOUR TRAFFIC VOLUMES - SCENARIO C

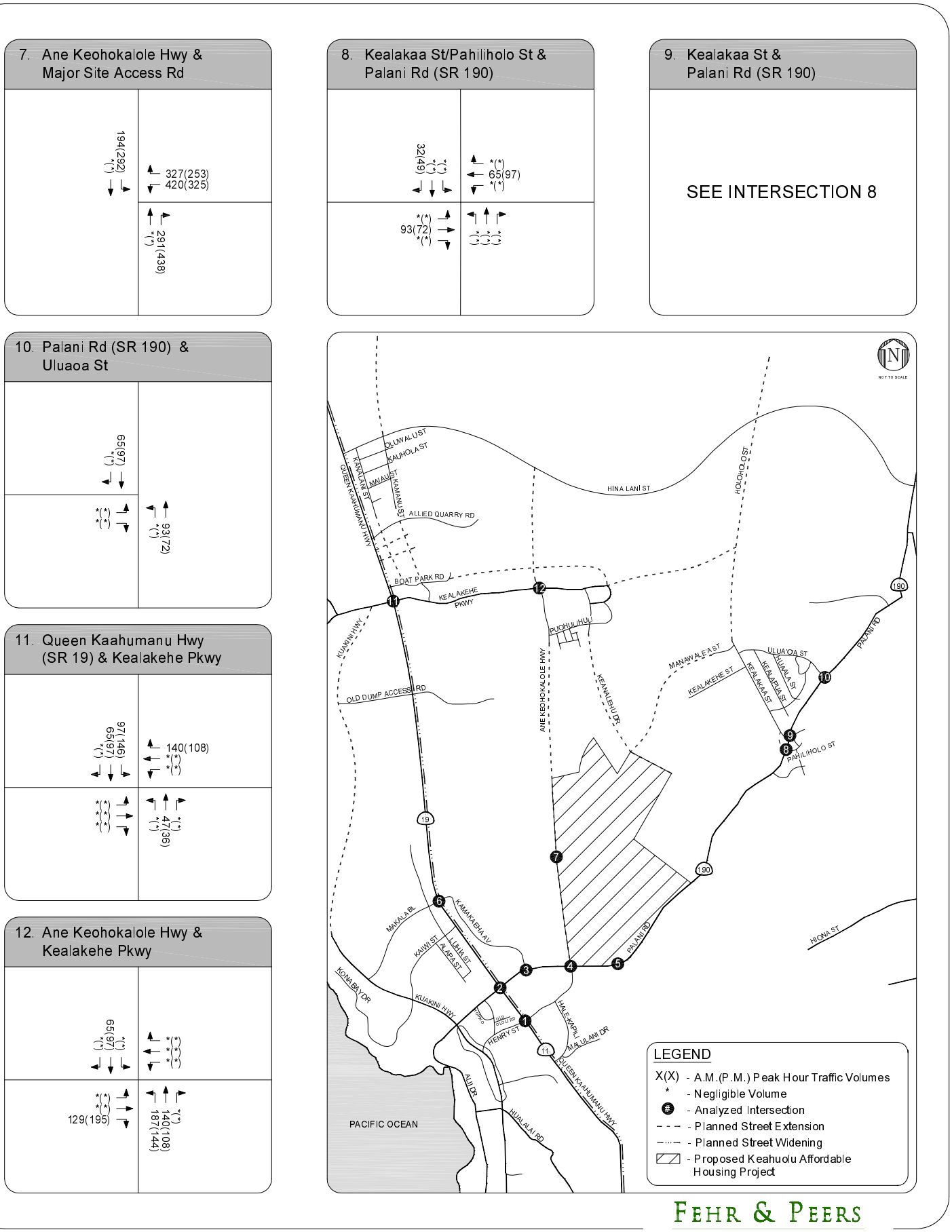

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FIGURE 8 (CONT.)
PROJECT ONLY (2020) PEAK HOUR TRAFFIC VOLUMES - SCENARIO C

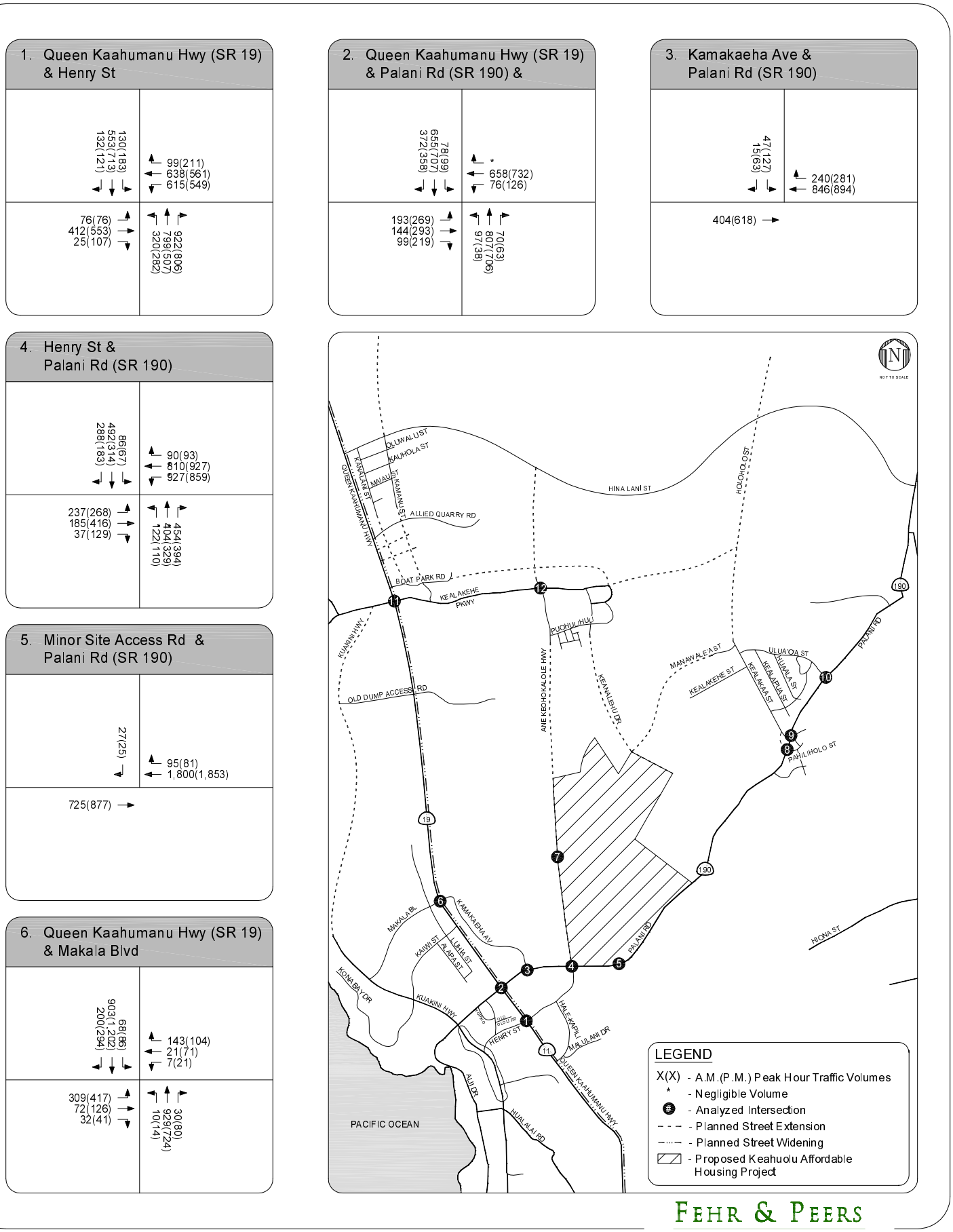

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FIGURE 9
CUMULATIVE PLUS PROJECT (2020) PEAK HOUR TRAFFIC VOLUMES
SCENARIO A

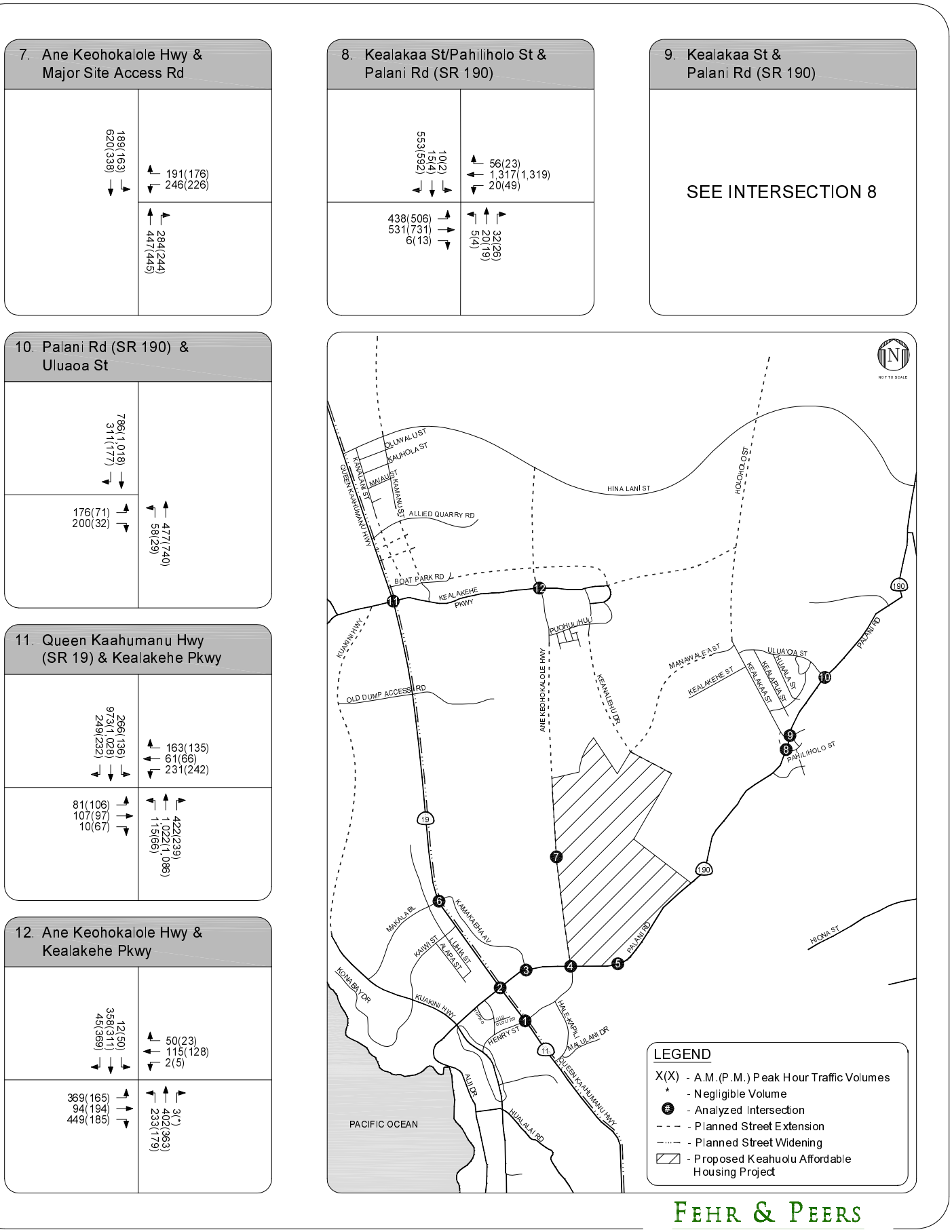

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FIGURE 9 (CONT.)
CUMULATIVE PLUS PROJECT (2020) PEAK HOUR TRAFFIC VOLUMES
SCENARIO A

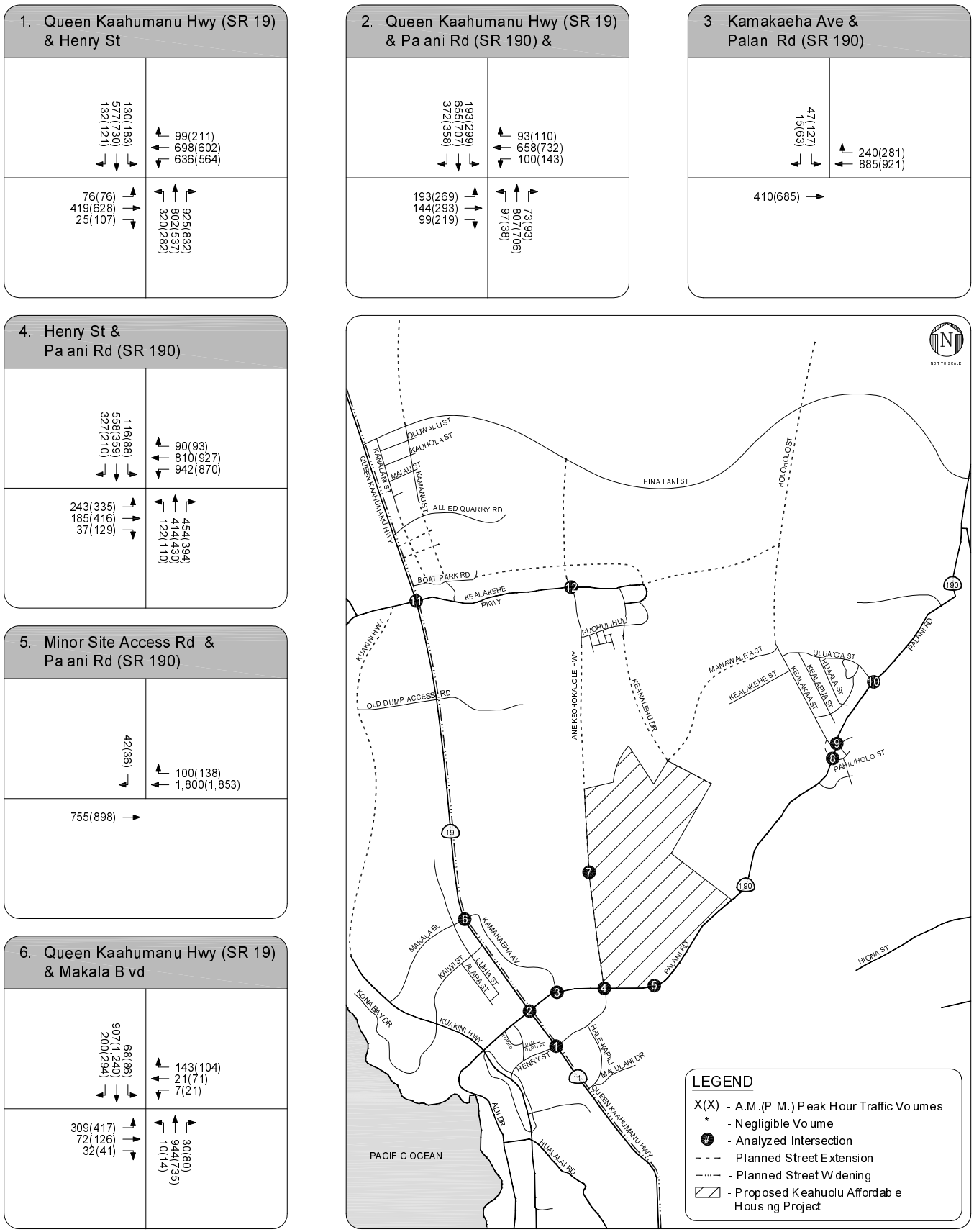

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FIGURE 10
CUMULATIVE PLUS PROJECT (2020) PEAK HOUR TRAFFIC VOLUMES
SCENARIO B

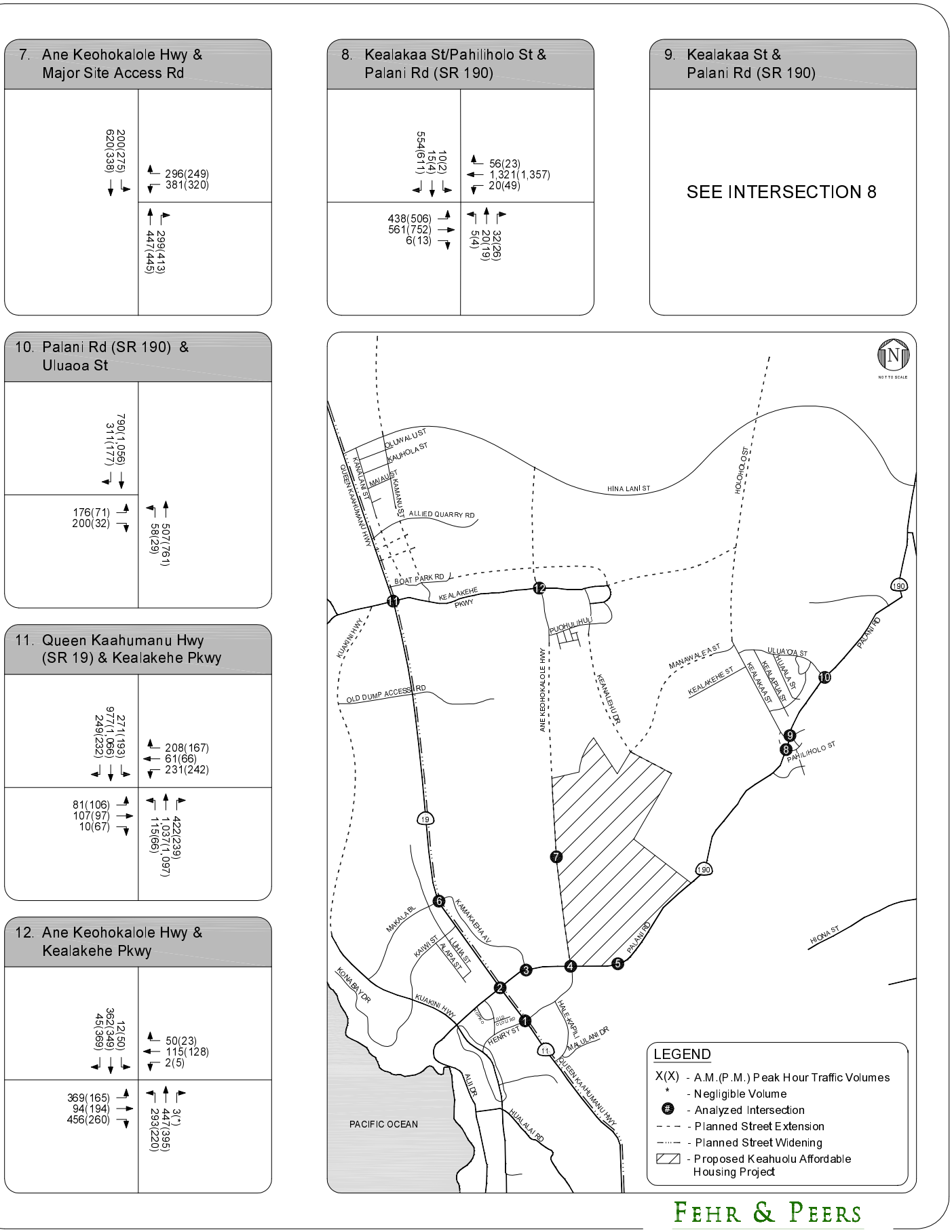

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FIGURE 10 (CONT.)
CUMULATIVE PLUS PROJECT (2020) PEAK HOUR TRAFFIC VOLUMES
SCENARIO B

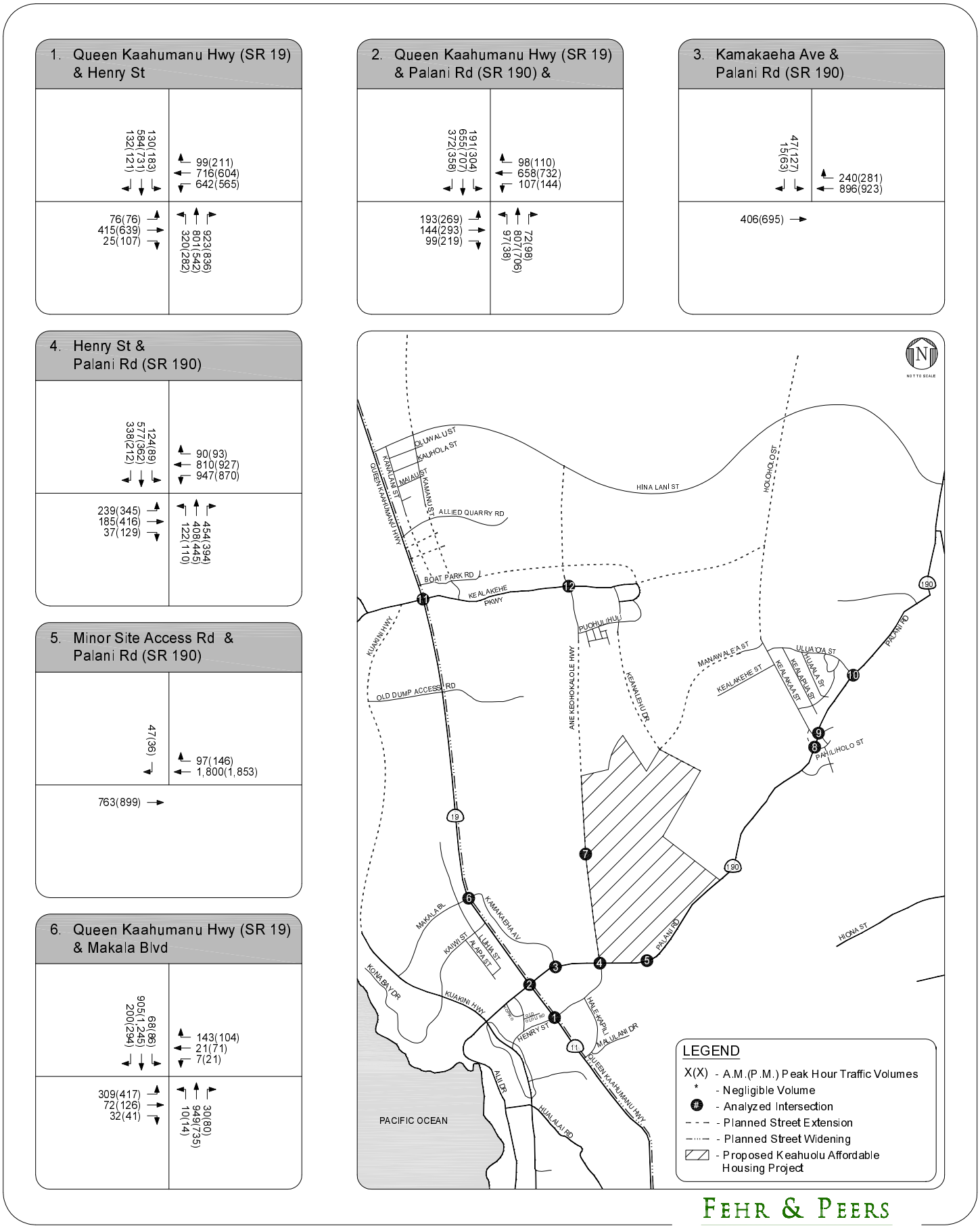

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FIGURE 11
CUMULATIVE PLUS PROJECT (2020) PEAK HOUR TRAFFIC VOLUMES
SCENARIO C

7. Ane Keohokalole Hwy & Major Site Access Rd

194(292)
620(338)

327(253)
420(325)

291(438)
447(445)

8. Kealakaa St/Pahiliholo St & Palani Rd (SR 190)

10(2)
15(4)
553(614)

56(23)
1,319(1,362)
20(49)

438(506)
569(753)
6(13)

5(4)
20(19)
32(26)

9. Kealakaa St & Palani Rd (SR 190)

SEE INTERSECTION 8

10. Palani Rd (SR 190) & Uluaoa St

788(1,061)
311(177)

176(71)
200(32)

515(762)
58(29)

11. Queen Kaahumanu Hwy (SR 19) & Kealakehe Pkwy

268(201)
975(1,071)
249(232)

221(168)
61(66)
231(242)

81(106)
107(97)
10(67)

422(239)
1,042(1,097)
115(66)

12. Ane Keohokalole Hwy & Kealakehe Pkwy

12(50)
360(354)
45(369)

50(23)
115(128)
2(5)

369(165)
94(194)
452(271)

3(*)
460(396)
311(222)

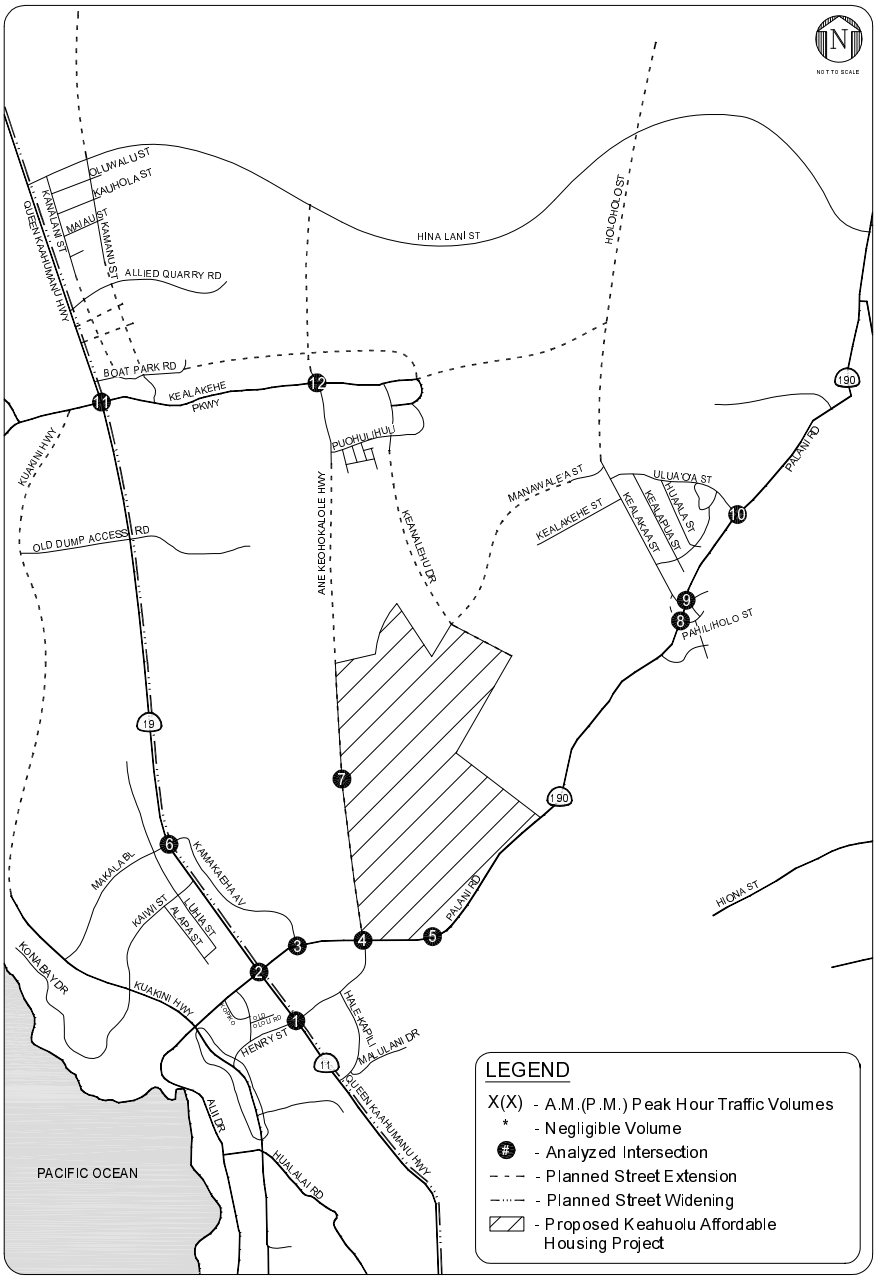

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FIGURE 11 (CONT.)
CUMULATIVE PLUS PROJECT (2020) PEAK HOUR TRAFFIC VOLUMES
SCENARIO C

IV. INTERSECTION TRAFFIC IMPACT ANALYSIS

This chapter presents an analysis of the potential impacts on the roadway system due to projected increase in traffic, including traffic generated by the proposed project under each of the three project development concepts. The analysis compares the projected levels of service at each study intersection under cumulative conditions for 2020 both with and without the proposed project to determine potential project impacts.

INTERSECTION SIGNIFICANT IMPACT CRITERIA

The levels of service range from excellent conditions at LOS A to overloaded conditions at LOS F. LOS D is considered the minimum desirable LOS in this area. If LOS E or F were projected under cumulative base conditions, this would be characterized as a cumulative impact. If the addition of project-generated traffic were to result in LOS E or F, this would be characterized as a project-specific impact.

CUMULATIVE BASE TRAFFIC CONDITIONS

This section presents an analysis of potential future traffic conditions under projected for the year 2020. The cumulative base traffic volumes projected in Chapter III were analyzed using the methodologies described in Chapter II to forecast cumulative base peak hour LOS at the study intersections. The first columns in Tables 7, 8, and 9 summarize the results of this analysis.

Future operations at the Intersections 8 and 9 are presented in the analysis of Intersection 8, as the ongoing safety improvements discussed previously will focus traffic at that location. The following five intersections are projected to operate at LOS E or F during one or both peak hours in 2020:

TABLE 7
INTERSECTION LEVEL OF SERVICE ANALYSIS SUMMARY
KEAHUOLU AFFORDABLE HOUSING MASTER PLAN
FUTURE CONDITIONS (2020)
CONCEPT A

	Intersections	Peak Hour	CUMULATIVE BASE (2020)			CUMULATIVE PLUS PROJECT (2020)			LOS D OR BETTER	CUMULATIVE PLUS PROJECT WITH MITIGATION (2020)			LOS D OR BETTER
			V/C	Del/Veh*	LOS	V/C	Del/Veh*	LOS		V/C	Del/Veh*	LOS	
1	Queen Kaahumanu Hwy (SR 19) & Henry St	A.M. P.M.	0.813 0.819	26 27	C C	0.885 0.881	29 29	C C	YES YES	No mitigation necessary			YES YES
2	Queen Kaahumanu Hwy (SR 19) & Palani Rd (SR 190)/Alii Dr	A.M. P.M.	0.873 0.988	33 40	C D	0.914 1.015	35 43	D D	YES YES	No mitigation necessary			YES YES
3	Kamakaeha Av & Palani Rd (SR 190)	A.M. P.M.	NC NC	23 **	C F	NC NC	29 **	D F	YES NO	0.558 0.652	5 10	A B	YES YES
4	Henry St & Palani Rd (SR 190)	A.M. P.M.	1.099 1.248	81 **	F F	1.677 1.340	** **	F F	NO NO	0.833 0.926	32 33	C C	YES YES
5	Minor Site Access Road & Palani Rd (SR 190) [a]	A.M. P.M.	NC NC	NC NC	NC NC	NC NC	** **	F F	NO NO	- -	- -	A A	YES YES
6	Queen Kaahumanu Hwy (SR 19) & Makala Bl	A.M. P.M.	0.653 0.769	22 25	C C	0.661 0.787	22 25	C C	YES YES	No mitigation necessary			YES YES
7	Ane Keohokahole Hwy & Major Site Access Road	A.M. P.M.	NC NC	NC NC	NC NC	NC NC	** **	F F	NO NO	0.579 0.455	16 16	B B	YES YES
8	Kealakaa St/Palihiolo St & Palani Rd (SR 190) [b]	A.M. P.M.	1.522 1.734	** **	F F	1.638 1.837	** **	F F	NO NO	0.982 1.023	33 41	C D	YES YES
10	Palani Rd (SR 190) & Uluaoa St [a]	A.M. P.M.	NC NC	** **	F F	NC NC	** **	F F	NO NO	0.757 0.725	14 5	B A	YES YES
11	Queen Kaahumanu Hwy (SR 19) & Kealakehe Hwy	A.M. P.M.	0.748 0.713	26 24	C C	0.825 0.781	28 25	C C	YES YES	No mitigation necessary			YES YES
12	Ane Keohokalole Hwy & Kealakehe Hwy [a]	A.M. P.M.	NC NC	** **	F F	NC NC	** **	F F	NO NO	0.686 0.583	19 15	B B	YES YES

Note:
* Delay indicates average stopped delay per vehicle in seconds for signalized intersections. The worst case vehicular delay is reported for stop-controlled intersections.
** Indicates oversaturated conditions. Delay cannot be calculated.
NC = Not Calculated
[a] Intersection is controlled by stop signs on the minor approaches.

TABLE 8
INTERSECTION LEVEL OF SERVICE ANALYSIS SUMMARY
KEAHUOLU AFFORDABLE HOUSING MASTER PLAN
FUTURE CONDITIONS (2020)
CONCEPT B

	Intersections	Peak Hour	CUMULATIVE BASE (2020)			CUMULATIVE PLUS PROJECT (2020)			LOS D OR BETTER	CUMULATIVE PLUS PROJECT WITH MITIGATION (2020)			LOS D OR BETTER
			V/C	Del/Veh*	LOS	V/C	Del/Veh*	LOS		V/C	Del/Veh*	LOS	
1	Queen Kaahumanu Hwy (SR 19) & Henry St	A.M. P.M.	0.813 0.819	26 27	C C	0.890 0.925	29 32	C C	YES YES	No mitigation necessary			YES YES
2	Queen Kaahumanu Hwy (SR 19) & Palani Rd (SR 190)/Alii Dr	A.M. P.M.	0.873 0.988	33 40	C D	0.917 1.031	35 46	D D	YES YES	No mitigation necessary			YES YES
3	Kamakaeha Av & Palani Rd (SR 190)	A.M. P.M.	NC NC	23 **	C F	NC NC	31 **	D F	YES NO	0.582 0.669	5 10	A B	YES YES
4	Henry St & Palani Rd (SR 190)	A.M. P.M.	1.099 1.248	81 **	F F	1.691 1.328	** **	F F	NO NO	0.899 1.009	37 41	D D	YES YES
5	Minor Site Access Road & Palani Rd (SR 190) [a]	A.M. P.M.	NC NC	NC NC	NC NC	NC NC	** **	F F	NO NO	- -	- -	A A	YES YES
6	Queen Kaahumanu Hwy (SR 19) & Makala Bl	A.M. P.M.	0.653 0.769	22 25	C C	0.666 0.799	22 25	C C	YES YES	No mitigation necessary			YES YES
7	Ane Keohokahole Hwy & Major Site Access Road	A.M. P.M.	NC NC	NC NC	NC NC	NC NC	** **	F F	NO NO	0.687 0.679	21 19	C B	YES YES
8	Kealakaa St/Palihiolo St & Palani Rd (SR 190) [b]	A.M. P.M.	1.522 1.734	** **	F F	1.647 1.905	** **	F F	NO NO	0.984 1.045	34 45	C D	YES YES
10	Palani Rd (SR 190) & Uluaoa St [a]	A.M. P.M.	NC NC	** **	F F	NC NC	** **	F F	NO NO	0.759 0.746	14 5	B A	YES YES
11	Queen Kaahumanu Hwy (SR 19) & Kealakehe Hwy	A.M. P.M.	0.748 0.713	26 24	C C	0.834 0.826	28 26	C C	YES YES	No mitigation necessary			YES YES
12	Ane Keohokalole Hwy & Kealakehe Hwy [a]	A.M. P.M.	NC NC	** **	F F	NC NC	** **	F F	NO NO	0.760 0.634	20 16	C B	YES YES

Note:
* Delay indicates average stopped delay per vehicle in seconds for signalized intersections. The worst case vehicular delay is reported for stop-controlled intersections.
** Indicates oversaturated conditions. Delay cannot be calculated.
NC = Not Calculated
[a] Intersection is controlled by stop signs on the minor approaches.

TABLE 9
INTERSECTION LEVEL OF SERVICE ANALYSIS SUMMARY
KEAHUOLU AFFORDABLE HOUSING MASTER PLAN
FUTURE CONDITIONS (2020)
CONCEPT C

	Intersections	Peak Hour	CUMULATIVE BASE (2020)			CUMULATIVE PLUS PROJECT (2020)			LOS D OR BETTER	CUMULATIVE PLUS PROJECT WITH MITIGATION (2020)			LOS D OR BETTER
			V/C	Del/Veh*	LOS	V/C	Del/Veh*	LOS		V/C	Del/Veh*	LOS	
1	Queen Kaahumanu Hwy (SR 19) & Henry St	A.M. P.M.	0.813 0.819	26 27	C C	0.887 0.931	29 32	C C	YES YES	No mitigation necessary			YES YES
2	Queen Kaahumanu Hwy (SR 19) & Palani Rd (SR 190)/Alii Dr	A.M. P.M.	0.873 0.988	33 40	C D	0.915 1.033	35 46	D D	YES YES	No mitigation necessary			YES YES
3	Kamakaeha Av & Palani Rd (SR 190)	A.M. P.M.	NC NC	23 **	C F	NC NC	37 **	E F	NO NO	0.589 0.670	5 10	A B	YES YES
4	Henry St & Palani Rd (SR 190)	A.M. P.M.	1.099 1.248	81 **	F F	1.726 1.326	** **	F F	NO NO	0.923 1.014	39 42	D D	YES YES
5	Minor Site Access Road & Palani Rd (SR 190) [a]	A.M. P.M.	NC NC	NC NC	NC NC	NC NC	** **	F F	NO NO	- -	- -	A A	YES YES
6	Queen Kaahumanu Hwy (SR 19) & Makala Bl	A.M. P.M.	0.653 0.769	22 25	C C	0.668 0.801	22 25	C C	YES YES	No mitigation necessary			YES YES
7	Ane Keohokahole Hwy & Major Site Access Road	A.M. P.M.	NC NC	NC NC	NC NC	NC NC	** **	F F	NO NO	0.718 0.706	22 19	C B	YES YES
8	Kealakaa St/Palihiolo St & Palani Rd (SR 190) [b]	A.M. P.M.	1.522 1.734	** **	F F	1.644 1.914	** **	F F	NO NO	0.983 1.048	33 46	C D	YES YES
10	Palani Rd (SR 190) & Uluaoa St [a]	A.M. P.M.	NC NC	** **	F F	NC NC	** **	F F	NO NO	0.758 0.749	14 5	B A	YES YES
11	Queen Kaahumanu Hwy (SR 19) & Kealakehe Hwy	A.M. P.M.	0.748 0.713	26 24	C C	0.834 0.832	28 26	C C	YES YES	No mitigation necessary			YES YES
12	Ane Keohokalole Hwy & Kealakehe Hwy [a]	A.M. P.M.	NC NC	** **	F F	NC NC	** **	F F	NO NO	0.779 0.640	21 16	C B	YES YES

Note:
* Delay indicates average stopped delay per vehicle in seconds for signalized intersections. The worst case vehicular delay is reported for stop-controlled intersections.
** Indicates oversaturated conditions. Delay cannot be calculated.
NC = Not Calculated
[a] Intersection is controlled by stop signs on the minor approaches.

3. Kamakaeha Avenue & Palani Road (SR 190)
4. Henry Street & Palani Road (SR 190)
8. Palani Road (SR 190) & Kealakaa Street/Pahiliholo Street
10. Uluaoa Street & Palani Road (SR 190)
12. Kealakehe Parkway & Ane Keohokalole Highway

The remaining study intersections are expected to continue operating at a desirable LOS (LOS D or better) during both peak hours.

CUMULATIVE PLUS PROJECT TRAFFIC CONDITIONS

The cumulative plus project Concept A, B, and C peak hour traffic volumes illustrated in Figures 8, 9 and 10 respectively were analyzed to determine 2020 operating conditions with the addition of project-related traffic. The results of the cumulative plus project analysis are presented in Tables 7, 8 and 9. The proposed project would contribute to cumulative impacts (LOS E or F conditions) during one or both peak hours at five study intersections:

3. Kamakaeha Avenue & Palani Road (SR 190)
4. Henry Street & Palani Road (SR 190)
8. Palani Road (SR 190) & Kealakaa Street/Pahiliholo Street
10. Uluaoa Street & Palani Road (SR 190)
12. Kealakehe Parkway & Ane Keohokalole Highway

In addition, project-specific impacts are identified at two future intersections listed below, as the addition of project-generated traffic there would cause them to decline below LOS D in the peak hours:

5. Palani Road (SR 190) & Minor Site Access Road
7. Ane Keohokalole Highway & Major Site Access Road

The number of traffic impacts would be the same under Concepts A, B and C; however, the magnitude of those impacts would be greatest with Concept C.

PROPOSED MITIGATION MEASURES

The mitigation program for the project developed measures to increase the capacity and/or efficiency of the roadway system at the locations where the addition of project-related traffic would cause or contribute to projected poor operating conditions. The primary emphasis was to identify physical and/or operational improvements that could be implemented within the existing or planned roadway rights-of-way. The recommended intersection improvement measures are illustrated in Appendix A. Tables 7, 8 and 9 summarize the projected LOS in 2020 at the impacted locations with these mitigation measures in place.

The recommended mitigation measures to address the identified traffic impacts, both project-related and cumulative, are described below. Each of the identified project-related impacts would be fully mitigated (i.e., the recommended improvements would result in LOS D or better).

- Intersection 3: Kamakaeha Avenue & Palani Road (SR 190) - The intersection of Kamakaeha Avenue & Palani Road (SR 190) could be fully mitigated by installing a traffic signal with the existing lane configuration. Signal warrant analysis was conducted based on the Peak Hour Warrant found in *Manual on Uniform Traffic Control Devices* (MUTCD) (National Committee on Uniform Traffic Control Devices, 2003) and is included in Appendix E. It indicates that a traffic signal at the intersection of Kamakaeha Avenue and Palani Road (SR 190) would be warranted under future plus project conditions. Because this intersection is approximately 750 feet mauka of Queen Kaahumanu Highway and approximately 1,400 feet makai of Henry Street, the proposed traffic signal would need to be coordinated with the existing signals at the two adjacent intersections. With the installation of the traffic signal, the intersection of Kamakaeha Avenue and Palani Road (SR 190) would operate at LOS A.

- Intersection 4: Henry Street & Palani Road (SR 190) – The intersection of Henry Street & Palani Road (SR 190) could be fully mitigated by widening the makai-bound approach to provide two left-turn lanes, one through lane and one shared through/right-turn lane, widening the northbound approach to provide one left-turn lane, one through lane and one shared through/right-turn lane and constructing the southbound approach with one left-turn lane, one through lane and one shared through/right-turn lane. With this configuration, the intersection of Henry Street and Palani Road (SR 190) would operate at LOS D.

- Intersection 5: Palani Road (SR 190) & Minor Site Access Road – The future intersection of Palani Road & Minor Site Access Road would be approximately 1,250 feet mauka of Henry Street and could be fully mitigated by adding a makai-bound deceleration lane into the project site and a makai-bound acceleration lane out from the project, separated by a raised island to channelize traffic. A second makai-bound lane would be added to receive traffic exiting the project site. With this configuration, the intersection would operate at LOS A.

- Intersection 7: Ane Keohokahole Highway & Major Site Access Road – The intersection of Ane Keohokahole Highway & Major Site Access Road could be fully mitigated by installing a traffic signal. The future lane configuration would provide one left-turn lane and one right-turn lane on the makai-bound approach, one through lane and one right-turn lane on the northbound approach and one left-turn lane and one through lane on the southbound approach. Signal warrant analysis was conducted based on the Peak Hour Warrant found in the MUTCD and is included in Appendix E. It indicates that a traffic signal installation at the intersection of Ane Keohokahole Highway & Major Site Access Road would be warranted under future plus project conditions. With the installation of a traffic signal, the intersection of Ane Keohokahole Highway & Major Site Access Road would operate at LOS C or better.

- Intersection 8: Kealakaa Street/Pahiliholo Street & Palani Road (SR 190) – The intersection of Kealakaa Street/Pahiliholo Street & Palani Road (SR 190) is under construction and the future lane configuration is shown in *Palani Road Safety Improvements* (County of Hawaii, August 2005). With the lane configuration shown in that report, the intersection of Kealakaa Street/Pahiliholo Street and Palani Road is projected to operate at LOS F during both peak hours in 2020. A mitigation measure was developed that would widen Palani Road to provide one left-turn lane, one through lane and one shared through/right-turn lane on the southbound approach and two left-turn lanes and one shared through/right-turn lane on the northbound approach. The southbound departure would also be widened to two lanes, which would merge into a single lane downstream of the intersection. While additional right-of-way may be needed to implement this measure, it does not appear that existing development would preclude its implementation. With these improvements, the intersection is projected to operate at LOS C during the a.m. peak hour and LOS D during the p.m. peak hour.

- Intersection 10: Uluaoa Street & Palani Road (SR 190) – The intersection of Uluaoa Street & Palani Road could be fully mitigated by installing a traffic signal within the existing lane configuration. Signal warrant analysis was conducted based on the Peak Hour Warrant found in the MUTCD is included in Appendix E. It indicates that a traffic signal at the intersection of would be warranted under future plus project conditions. With this improvement, the intersection would operate at LOS B and A during the a.m. and p.m. peak hours, respectively.

- Intersection 12: Kealakehe Parkway & Ane Keohokalole Highway – The intersection of Kealakehe Parkway & Ane Keohokalole Highway could be fully mitigated by installing a traffic signal within the existing lane configuration. Signal warrant analysis was conducted based on the Peak Hour Warrant found in the MUTCD and is included in Appendix E. It indicates that a traffic signal at the intersection of would be warranted under future plus project conditions. With this improvement, the intersection would operate at LOS C or better in both peak hours.

V. STREET SEGMENT TRAFFIC IMPACT ANALYSIS

This chapter presents an analysis of the proposed project's potential impacts on several key street segments in the project vicinity. The analysis was conducted for the following 10 street segments, shown in Figure 2:

1. Henry Street south of Palani Road (SR 190)
2. Palani Road (SR 190) makai (west) of Henry Street
3. Palani Road (SR 190) mauka (east) of Henry Street
4. Kealakaa Street north of Palani Road (SR 190)
5. Uluaoa Street north of Palani Road (SR 190)
6. Queen Kaahumanu Highway (SR 19) south of Kealakehe Parkway
7. Kealakehe Parkway makai (west) of Ane Keohokalole Highway
8. Ane Keohokalole Highway south of Kealakehe Parkway
9. Queen Kaahumanu Highway (SR 19) north of Kealakehe Parkway
10. Palani Road (SR 190) south of Mamalahoa Highway

The existing peak hour volumes at each location were based on traffic counts conducted at adjacent intersections in August 2007, as well as new 24-hour machine counts. The peak hour traffic volumes on the 10 study street segments under existing conditions are shown in Tables 10, 11, and 12.

The roadway facility types were based on their physical characteristics as defined in the County of Hawaii General Plan and described in Table 13. The capacity of each facility was defined as the maximum hourly rate at which vehicles can reasonably be expected to traverse a point or uniform section of a lane or roadway during a given time period under prevailing roadway, traffic, and control conditions.

Estimates of future peak hour traffic volumes for the 10 street segments were developed by increasing the existing peak hour traffic volumes to reflect the ambient growth and related development projects on the street system in the study area (cumulative base conditions) and

TABLE 10
STREET SEGMENT IMPACT ANALYSIS - CONCEPT A

Segment	Location	Facility Type	Peak Hour	Dir.	EXISTING (2006)			CUMULATIVE BASE (2020)			CUMULATIVE PLUS PROJECT (2020)			LOS D OR BETTER
					Volumes	V/C	LOS	Volumes	V/C	LOS	Volumes	V/C	LOS	
1. Henry Street	south of Palani Road (SR 190)	Secondary Arterial	A.M.	NB	602	0.24	A	891	0.36	A	1,061	0.42	A	YES
				SB	720	0.29	A	1,342	0.54	A	1,489	0.60	A	YES
			P.M.	EB	646	0.26	A	845	0.34	A	992	0.40	A	YES
				WB	670	0.27	A	1,223	0.49	A	1,359	0.54	A	YES
2. Palani Road (SR 190)	makai (west) of Henry Street	Secondary Arterial	A.M.	EB	309	0.25	A	359	0.29	A	473	0.38	A	YES
				WB	636	0.51	A	1,057	0.85	D	1,128	0.90	E	NO
				WB	*With Mitigation (Second Westbound Lane)*						*1,128*	*0.45*	*A*	*YES*
			P.M.	EB	617	0.49	A	639	0.51	A	737	0.59	A	YES
				WB	658	0.53	A	1,133	0.91	E	1,198	0.96	E	NO
				WB	*With Mitigation (Second Westbound Lane)*						*1,198*	*0.48*	*A*	*YES*
3. Palani Road (SR 190)	mauka (east) of Henry Street	Secondary Arterial	A.M.	EB	716	0.57	A	802	0.64	B	857	0.69	B	YES
				WB	1,215	0.97	E	1,815	1.45	F	1,911	1.53	F	NO
				WB	*With Mitigation (Second Westbound Lane)*						*1,911*	*0.76*	*C*	*YES*
			P.M.	EB	982	0.79	C	982	0.79	C	1,032	0.83	D	YES
				WB	949	0.76	C	1,817	1.45	F	1,898	1.52	F	NO
				WB	*With Mitigation (Second Westbound Lane)*						*1,898*	*0.76*	*C*	*YES*
4. Kealakaa Street	north of Palani Road (SR 190)	Local Street (Existing) Secondary Arterial (Future)	A.M.	NB	520	0.87	D	1,034	0.86	D	1,034	0.86	D	YES
				SB	403	0.67	B	949	0.79	C	981	0.82	D	YES
			P.M.	NB	280	0.47	A	828	0.69	B	828	0.69	B	YES
				SB	305	0.51	A	876	0.73	C	903	0.75	C	YES
5. Uluaoa Street	makai (west) of Palani Road (SR 190)	Local Street	A.M.	EB	376	0.63	B	376	0.63	B	376	0.63	B	YES
				WB	301	0.50	A	369	0.62	B	369	0.62	B	YES
			P.M.	EB	113	0.19	A	113	0.19	A	113	0.19	A	YES
				WB	179	0.30	A	217	0.36	A	217	0.36	A	YES
6. Queen Kaahumanu Highway (SR 19)	south of Kealakehe Parkway	Primary Arterial 2 Lanes (Existing) 4 Lanes (Future)	A.M.	NB	1,093	0.64	B	1,545	0.48	A	1,572	0.49	A	YES
				SB	1,124	0.66	B	1,334	0.42	A	1,397	0.44	A	YES
			P.M.	NB	1,013	0.60	A	1,273	0.40	A	1,298	0.41	A	YES
				SB	987	0.58	A	1,376	0.43	A	1,430	0.45	A	YES
7. Kealakehe Parkway	makai (west) of Ane Keohokalole Highway	Secondary Arterial	A.M.	EB	424	0.34	A	707	0.57	A	802	0.64	B	YES
				WB	348	0.28	A	422	0.34	A	504	0.40	A	YES
			P.M.	EB	221	0.18	A	418	0.33	A	499	0.40	A	YES
				WB	382	0.31	A	629	0.50	A	704	0.56	A	YES
8. Ane Keohokalole Highway	south of Kealakehe Parkway	Secondary Arterial	A.M.	NB	241	0.19	A	561	0.45	A	752	0.60	B	YES
				SB	432	0.35	A	744	0.60	A	933	0.75	C	YES
			P.M.	NB	203	0.16	A	511	0.41	A	687	0.55	A	YES
				SB	150	0.12	A	407	0.33	A	570	0.46	A	YES
9. Queen Kaahumanu Highway (SR 19)	north of Kealakehe Parkway	Primary Arterial 2 Lanes (Existing) 4 Lanes (Future)	A.M.	NB	1,093	0.87	D	1,402	0.44	A	1,511	0.47	A	YES
				SB	1,124	0.90	D	1,519	0.47	A	1,677	0.52	A	YES
			P.M.	NB	1,013	0.81	D	1,215	0.38	A	1,315	0.41	A	YES
				SB	987	0.79	C	1,362	0.43	A	1,497	0.47	A	YES
10. Palani Road (SR 190)	south of Mamalahoa Highway	Secondary Arterial	A.M.	NB	541	0.43	A	643	0.51	A	698	0.56	A	YES
				SB	938	0.75	C	1,117	0.89	D	1,180	0.94	E	NO
				SB	*With Mitigation (Second Southbound Lane)*						*1,180*	*0.47*	*A*	*YES*
			P.M.	NB	659	0.53	A	793	0.63	B	843	0.67	B	YES
				SB	929	0.74	C	1,136	0.91	E	1,190	0.95	E	NO
				SB	*With Mitigation (Second Southbound Lane)*						*1,190*	*0.48*	*A*	*YES*

Note: Roadway Capacity for each facility types were assumed in Table 8.

TABLE 11
STREET SEGMENT IMPACT ANALYSIS - CONCEPT B

Segment	Location	Facility Type	Peak Hour	Dir.	EXISTING (2006)			CUMULATIVE BASE (2020)			CUMULATIVE PLUS PROJECT (2020)			LOS D OR BETTER
					Volumes	V/C	LOS	Volumes	V/C	LOS	Volumes	V/C	LOS	
1. Henry Street	south of Palani Road (SR 190)	Secondary Arterial	A.M.	NB	602	0.24	A	891	0.36	A	1,071	0.43	A	YES
				SB	720	0.29	A	1,342	0.54	A	1,570	0.63	B	YES
			P.M.	EB	646	0.26	A	845	0.34	A	1,093	0.44	A	YES
				WB	670	0.27	A	1,223	0.49	A	1,415	0.57	A	YES
2. Palani Road (SR 190)	makai (west) of Henry Street	Secondary Arterial	A.M.	EB	309	0.25	A	359	0.29	A	479	0.38	A	YES
				WB	636	0.51	A	1,057	0.85	D	1,167	0.93	E	NO
				WB	*With Mitigation (Second Westbound Lane)*						*1,167*	*0.47*	*A*	*YES*
			P.M.	EB	617	0.49	A	639	0.51	A	804	0.64	B	YES
				WB	658	0.53	A	1,133	0.91	E	1,225	0.98	E	NO
				WB	*With Mitigation (Second Westbound Lane)*						*1,225*	*0.49*	*A*	*YES*
3. Palani Road (SR 190)	mauka (east) of Henry Street	Secondary Arterial	A.M.	EB	716	0.57	A	802	0.64	B	887	0.71	C	YES
				WB	1,215	0.97	E	1,815	1.45	F	1,915	1.53	F	NO
				WB	*With Mitigation (Second Westbound Lane)*						*1,915*	*0.77*	*C*	*YES*
			P.M.	EB	982	0.79	C	982	0.79	C	1,053	0.84	D	YES
				WB	949	0.76	C	1,817	1.45	F	1,955	1.56	F	NO
				WB	*With Mitigation (Second Westbound Lane)*						*1,955*	*0.78*	*C*	*YES*
4. Kealakaa Street	north of Palani Road (SR 190)	Local Street (Existing) Secondary Arterial (Future)	A.M.	NB	520	0.87	D	1,034	0.86	D	1,034	0.86	D	YES
				SB	403	0.67	B	949	0.79	C	982	0.82	D	YES
			P.M.	NB	280	0.47	A	828	0.69	B	828	0.69	B	YES
				SB	305	0.51	A	876	0.73	C	922	0.77	C	YES
5. Uluaoa Street	makai (west) of Palani Road (SR 190)	Local Street	A.M.	EB	376	0.63	B	376	0.63	B	376	0.63	B	YES
				WB	301	0.50	A	369	0.62	B	369	0.62	B	YES
			P.M.	EB	113	0.19	A	113	0.19	A	113	0.19	A	YES
				WB	179	0.30	A	217	0.36	A	217	0.36	A	YES
6. Queen Kaahumanu Highway (SR 19)	south of Kealakehe Parkway	Primary Arterial 2 Lanes (Existing) 4 Lanes (Future)	A.M.	NB	1,093	0.64	B	1,545	0.48	A	1,587	0.50	A	YES
				SB	1,124	0.66	B	1,334	0.42	A	1,401	0.44	A	YES
			P.M.	NB	1,013	0.60	A	1,273	0.40	A	1,309	0.41	A	YES
				SB	987	0.58	A	1,376	0.43	A	1,468	0.46	A	YES
7. Kealakehe Parkway	makai (west) of Ane Keohokalole Highway	Secondary Arterial	A.M.	EB	424	0.34	A	707	0.57	A	807	0.65	B	YES
				WB	348	0.28	A	422	0.34	A	549	0.44	A	YES
			P.M.	EB	221	0.18	A	418	0.33	A	556	0.44	A	YES
				WB	382	0.31	A	629	0.50	A	736	0.59	A	YES
8. Ane Keohokalole Highway	south of Kealakehe Parkway	Secondary Arterial	A.M.	NB	241	0.19	A	561	0.45	A	857	0.69	B	YES
				SB	432	0.35	A	744	0.60	A	944	0.76	C	YES
			P.M.	NB	203	0.16	A	511	0.41	A	760	0.61	B	YES
				SB	150	0.12	A	407	0.33	A	683	0.55	A	YES
9. Queen Kaahumanu Highway (SR 19)	north of Kealakehe Parkway	Primary Arterial 2 Lanes (Existing) 4 Lanes (Future)	A.M.	NB	1,093	0.87	D	1,402	0.44	A	1,571	0.49	A	YES
				SB	1,124	0.90	D	1,519	0.47	A	1,686	0.53	A	YES
			P.M.	NB	1,013	0.81	D	1,215	0.38	A	1,358	0.42	A	YES
				SB	987	0.79	C	1,362	0.43	A	1,592	0.50	A	YES
10. Palani Road (SR 190)	south of Mamalahoa Highway	Secondary Arterial	A.M.	NB	541	0.43	A	643	0.51	A	728	0.58	A	YES
				SB	938	0.75	C	1,117	0.89	D	1,184	0.95	E	NO
				SB	*With Mitigation (Second Southbound Lane)*						*1,184*	*0.47*	*A*	*YES*
			P.M.	NB	659	0.53	A	793	0.63	B	864	0.69	B	YES
				SB	929	0.74	C	1,136	0.91	E	1,228	0.98	E	NO
				SB	*With Mitigation (Second Southbound Lane)*						*1,228*	*0.49*	*A*	*YES*

Note: Roadway Capacity for each facility types were assumed in Table 8.

TABLE 12
STREET SEGMENT IMPACT ANALYSIS - CONCEPT C

Segment	Location	Facility Type	Peak Hour	Dir.	EXISTING (2006)			CUMULATIVE BASE (2020)			CUMULATIVE PLUS PROJECT (2020)			LOS D OR BETTER
					Volumes	V/C	LOS	Volumes	V/C	LOS	Volumes	V/C	LOS	
1. Henry Street	south of Palani Road (SR 190)	Secondary Arterial	A.M.	NB	602	0.24	A	891	0.36	A	1,065	0.43	A	YES
				SB	720	0.29	A	1,342	0.54	A	1,594	0.64	B	YES
			P.M.	EB	646	0.26	A	845	0.34	A	1,108	0.44	A	YES
				WB	670	0.27	A	1,223	0.49	A	1,418	0.57	A	YES
2. Palani Road (SR 190)	makai (west) of Henry Street	Secondary Arterial	A.M.	EB	309	0.25	A	359	0.29	A	475	0.38	A	YES
				WB	636	0.51	A	1,057	0.42	A	1,178	0.94	E	NO
				WB	*With Mitigation (Second Westbound Lane)*						*1,178*	*0.47*	*A*	*YES*
			P.M.	EB	617	0.49	A	639	0.51	A	814	0.65	B	YES
				WB	658	0.53	A	1,133	0.45	A	1,227	0.98	E	NO
				WB	*With Mitigation (Second Westbound Lane)*						*1,227*	*0.49*	*A*	*YES*
3. Palani Road (SR 190)	mauka (east) of Henry Street	Secondary Arterial	A.M.	EB	716	0.57	A	802	0.64	B	895	0.72	C	YES
				WB	1,215	0.97	E	1,815	0.73	C	1,912	1.53	F	NO
				WB	*With Mitigation (Second Westbound Lane)*						*1,912*	*0.76*	*C*	*YES*
			P.M.	EB	982	0.79	C	982	0.79	C	1,054	0.84	D	YES
				WB	949	0.76	C	1,817	0.73	C	1,963	1.57	F	NO
				WB	*With Mitigation (Second Westbound Lane)*						*1,963*	*0.79*	*C*	*YES*
4. Kealakaa Street	north of Palani Road (SR 190)	Local Street (Existing) Secondary Arterial (Future)	A.M.	NB	520	0.87	D	1,034	0.83	D	1,034	0.83	D	YES
				SB	403	0.67	B	949	0.76	C	981	0.78	C	YES
			P.M.	NB	280	0.47	A	828	0.66	B	828	0.66	B	YES
				SB	305	0.51	A	876	0.70	C	925	0.74	C	YES
5. Uluaoa Street	makai (west) of Palani Road (SR 190)	Local Street	A.M.	EB	376	0.63	B	376	0.63	B	376	0.63	B	YES
				WB	301	0.50	A	369	0.62	B	369	0.62	B	YES
			P.M.	EB	113	0.19	A	113	0.19	A	113	0.19	A	YES
				WB	179	0.30	A	217	0.36	A	217	0.36	A	YES
6. Queen Kaahumanu Highway (SR 19)	south of Kealakehe Parkway	Primary Arterial 2 Lanes (Existing) 4 Lanes (Future)	A.M.	NB	1,093	0.64	B	1,545	0.48	A	1,592	0.50	A	YES
				SB	1,124	0.66	B	1,334	0.42	A	1,399	0.44	A	YES
			P.M.	NB	1,013	0.60	A	1,273	0.40	A	1,309	0.41	A	YES
				SB	987	0.58	A	1,376	0.43	A	1,473	0.46	A	YES
7. Kealakehe Parkway	makai (west) of Ane Keohokalole Highway	Secondary Arterial	A.M.	EB	424	0.34	A	707	0.57	A	804	0.64	B	YES
				WB	348	0.28	A	422	0.34	A	562	0.45	A	YES
			P.M.	EB	221	0.18	A	418	0.33	A	564	0.45	A	YES
				WB	382	0.31	A	629	0.50	A	737	0.59	A	YES
8. Ane Keohokalole Highway	south of Kealakehe Parkway	Secondary Arterial	A.M.	NB	241	0.19	A	561	0.45	A	888	0.71	C	YES
				SB	432	0.35	A	744	0.60	A	938	0.75	C	YES
			P.M.	NB	203	0.16	A	511	0.41	A	763	0.61	B	YES
				SB	150	0.12	A	407	0.33	A	699	0.56	A	YES
9. Queen Kaahumanu Highway (SR 19)	north of Kealakehe Parkway	Primary Arterial 2 Lanes (Existing) 4 Lanes (Future)	A.M.	NB	1,093	0.87	D	1,402	0.44	A	1,589	0.50	A	YES
				SB	1,124	0.90	D	1,519	0.47	A	1,681	0.53	A	YES
			P.M.	NB	1,013	0.81	D	1,215	0.38	A	1,359	0.42	A	YES
				SB	987	0.79	C	1,362	0.43	A	1,605	0.50	A	YES
10. Palani Road (SR 190)	south of Mamalahoa Highway	Secondary Arterial	A.M.	NB	541	0.43	A	643	0.51	A	736	0.59	A	YES
				SB	938	0.75	C	1,117	0.89	D	1,182	0.95	E	NO
				SB	*With Mitigation (Second Southbound Lane)*						*1,182*	*0.47*	*A*	*YES*
			P.M.	NB	659	0.53	A	793	0.63	B	865	0.69	B	YES
				SB	929	0.74	C	1,136	0.91	E	1,233	0.99	E	NO
				SB	*With Mitigation (Second Southbound Lane)*						*1,233*	*0.49*	*A*	*YES*

Note: Roadway Capacity for each facility types were assumed in Table 8.

TABLE 13
CAPACITY OF FACILITIES

Facility Type*	Definition*	Capacity per lane per hour**
Primary Arterial	Includes major highways, parkways, and primary arterials that move vehicles in large volumes and at higher speeds from one geographic area to another; highest traffic volumes corridor. Designed as a limited access roadway. Primary arterials shall have a minimum right-of-way of 120 feet.	1,700
Secondary Arterial	A street of considerable continuity that is primarily a traffic artery between or through large areas; interconncect with and augment primary system. Designed as a limited access roadwa. Secondary arterials shall have a minium right-of-way of 80 feet.	1,250
Major Collector	Any street supplementary to the arterial street system that is a means of transit between this system and smaller areas; used to some extent for through traffic and to access abutting properties; collect and distribute traffic between nieghborhood and arterial system. Major coleectors shall have a minimum right-of-way of 60 feet.	800
Local Streets - Commercial/Industrial	Local streets within commercial and industrial areas shall have a minimum right-of-way of 60 feet.	600
Minor Collector & Local Street	Minor collectors are used at times as through streets and for access to abutting properties. The principal purpose of a local street is to provide access to property abutting the public right-of-way.	450

*Source: County of Hawaii General Plan Appendix A (County of Hawaii, February 2005)

** Capacity is based on HCM 2000 methodology.

then assigning the new project-generated trips using the same geographic distribution pattern described in Chapter III. The existing and forecast peak hour street segment traffic volumes are presented in Tables 10, 11 and 12 for Concepts A, B, and C, respectively.

As shown, three of the analyzed directional street segments are projected to operate at LOS E or F under cumulative base conditions, and the project would contribute to cumulative impacts at these three locations:

2. Palani Road (SR 190) makai (west) of Henry Street in the makai-bound direction
3. Palani Road (SR 190) mauka (east) of Henry Street in the makai-bound direction
10. Palani Road (SR 190) south of Mamalahoa Highway in the southbound direction

The number of traffic impacts would be the same under Concepts A, B and C; however, the magnitude of those impacts would be greatest with Concept C. The mitigation measures described in Chapter IV for study intersections #3 and #4 (Henry Street & Palani Road and Minor Site Access Road & Palani Road) would also fully mitigate the identified impacts at street segments #2 and #3 by constructing an additional makai-bound lane on Palani Road.

The southbound segment of street segment #10 (Palani Road south of Mamalahoa Highway) is projected to operate at LOS E during both a.m. and p.m. peak hours in the future. As mitigation to address this cumulative impact, to which the project would contribute, the southbound roadway could be widened to provide two lanes. This improvement could be coordinated with and would complement the proposed widening of southbound Palani Road immediately north of this location (between Hina Lani Street and Mamalahoa Highway) identified in *Final Environmental Impact Statement for the Kula Nei Project* (Belt Collins Hawaii Ltd., September 2007). This widening could be extended to Hao Kuni Street, a distance of approximately 2,000 feet, where the two lanes would merge into the single existing southbound lane. While additional right-of-way may be needed to implement this measure, it does not appear that existing development would necessarily preclude its implementation, although it is noted that there are three private driveways on the makai side of Palani Road on this segment. With this improvement, the segment of Palani Road south of Mamalahoa Highway would be fully mitigated.

VI. SUMMARY AND CONCLUSIONS

This study was undertaken to analyze potential traffic impacts of the proposed Keahuolu Affordable Housing Master Plan project in North Kona on the island of Hawaii. The following summarizes the key findings of the study:

- The proposed project would be completed by 2020 and has three alternative development scenarios, varying in the amount of new housing that would be constructed. Each of the alternatives would be focused on a mixed-use town center and would include 197,000 square feet of commercial/retail space, 25 acres of neighborhood parks, a seven-acre archeological preserve, and a 12-acre site reserved for a school. In addition, Concept A would provide 1,020 dwelling units, Concept B would provide 1,840 dwelling units, and Concept C would provide 2,330 dwelling units.

- Peak hour capacity analyses were conducted for 10 existing and two future intersections in the vicinity of the project site. Seven of 10 existing intersections currently operate at LOS D or better during the weekday peak hours.

- Street segment analysis was conducted for 10 street segments. Nine of 10 segments currently operate at LOS D or better during the weekday peak hours.

- Concept A is expected to generate approximately 9,953 weekday daily trips, including 1,178 trips during the weekday morning peak hour, and 1,046 trips during the weekday afternoon peak hour. Concept B is expected to generate approximately 16,034 weekday daily trips, including 1,511 trips during the weekday morning peak hour, and 1,629 trips during the weekday afternoon peak hour. Concept C is expected to generate approximately 17,617 weekday daily trips, including 1,580 trips during the weekday morning peak hour, and 1,695 trips during the weekday afternoon peak hour.

- Analysis of projected year 2020 cumulative base conditions, representing future conditions without the proposed project, indicates that five of the analyzed intersections would operate at LOS E or F during the a.m. peak hour, the p.m. peak hour, or both.

- Analysis of projected year 2020 cumulative base plus project conditions indicates that seven of the analyzed intersections would operate at LOS E or F during one or both peak hours. The project would result in two project-specific traffic impacts and would contribute to five cumulative traffic impacts. The number of traffic impacts would be the same under Concepts A, B and C; however, the magnitude of those impacts would be greatest with Concept C.

- Mitigation strategies were developed to address the identified deficiencies at the seven study intersections with projected poor levels of service (LOS E or F). Each of the

identified cumulative and project-related impacts could be fully mitigated with the recommended improvements.

- Future increases in peak hour traffic volumes were evaluated for 10 street segments. Street segment analysis of projected year 2020 cumulative base plus project conditions indicates that seven of those street segments could adequately accommodate the projected increase in volumes during the peak hours. The mitigation measures proposed to address at two study intersections would also fully mitigate the identified impacts on two of the three impacted street segments. An additional mitigation measure was developed to mitigate the third location. With these improvements, the identified cumulative street segment impacts, to which the project would contribute, would be fully mitigated.

REFERENCES

2000 Highway Capacity Manual, Transportation Research Board, 2000.

County of Hawaii General Plan, County of Hawaii, February 2005.

Final Environmental Impact Statement for the Kula Nei Project, Belt Collins Hawaii Ltd., September 2007.

Keahuolu Affordable Housing Master Plan, Kailua-Kona, Hawaii, Belt Collins Hawaii Ltd., June 2007.

Keahole to Honaunau Regional Circulation Plan, County of Hawaii Planning Department, August 2006.

Manual on Uniform Traffic Control Devices, National Committee on Uniform Traffic Control Devices, 2003.

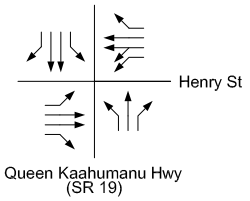
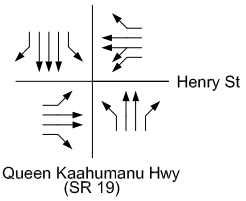
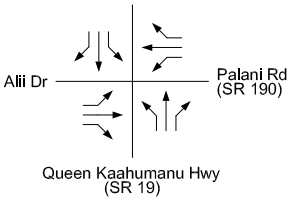
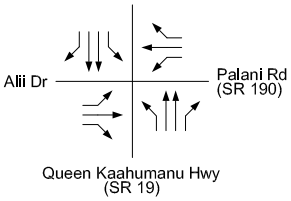
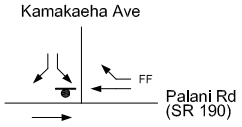
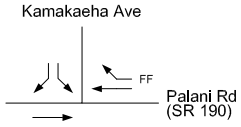
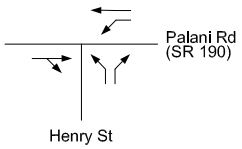
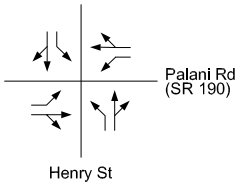
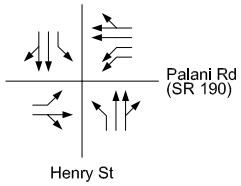
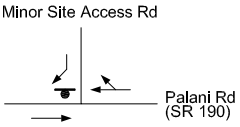
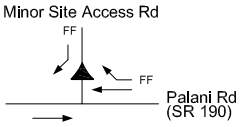
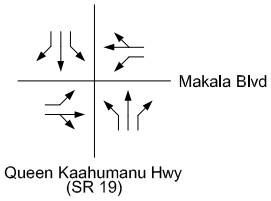
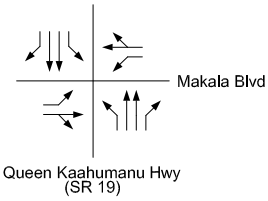
Trip Generation, 7th Edition, Institute of Transportation Engineers, 2003.

Trip Generation Handbook, 2nd Edition, Institute of Transportation Engineers, 2004.

APPENDIX A

INTERSECTION LANE CONFIGURATIONS

INTERSECTION LANE CONFIGURATIONS

	EXISTING CONDITIONS	FUTURE CONDITIONS	FUTURE CONDITIONS WITH MITIGATION
1. Queen Kaahumanu Hwy (SR 19) & Henry St			Same As Future Conditions
2. Queen Kaahumanu Hwy (SR 19) & Palini Rd (SR 190)/Alii Dr			Same As Future Conditions
3. Kamakaeha Ave & Palani Rd (SR 190)		Same As Existing Conditions	
4. Henry St & Palani Rd (SR 190)			
5. Minor Site Access Rd & Palani Rd (SR 190)	Intersection Does Not Currently Exist		
6. Queen Kaahumanu Hwy (SR 19) & Makala Blvd			Same As Future Conditions

LEGEND

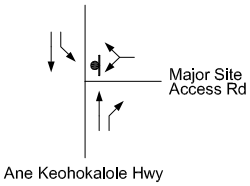
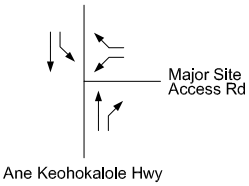
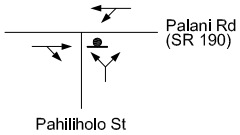
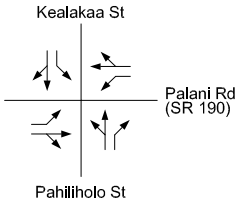
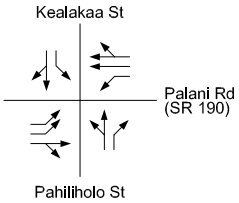
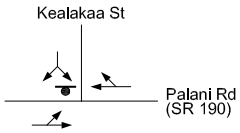
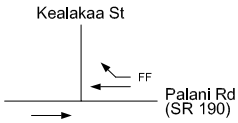
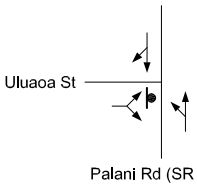
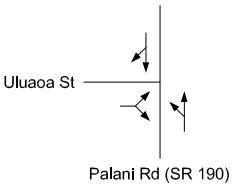
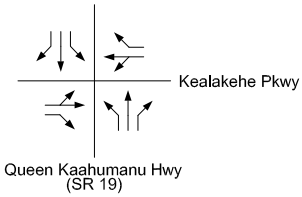
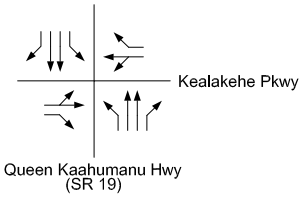
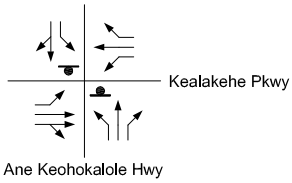
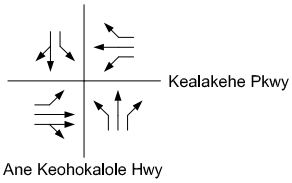
Stop Controlled

FF Free Flow

FEHR & PEERS

KAKU ASSOCIATES

INTERSECTION LANE CONFIGURATIONS

	EXISTING CONDITIONS	FUTURE CONDITIONS	FUTURE CONDITIONS WITH MITIGATION
7. Ane Keohokalole Hwy & Major Site Access Rd	Intersection Does Not Currently Exist		
8. Pahiliholo St & Palani Rd (SR 190)			
9. Kealakaa St & Palani Rd (SR 190)			Same As Future Conditions
		See Also Intersection 8	
10. Palani Rd (SR 190) & Uluaoa St		Same As Existing Conditions	
11. Queen Kaahumanu Hwy (SR 19) & Kealakehe Pkwy			Same As Future Conditions
12. Ane Keohokalole Hwy & Kealakehe Pkwy		Same As Existing Conditions	

LEGEND

Stop Controlled

FF Free Flow

FEHR & PEERS

KAKU ASSOCIATES

APPENDIX B

INTERSECTION AND DAILY TRAFFIC COUNTS

WILTEC

Phone: (626) 564-1944 Fax: (626) 564-0969

24-HOUR ADT COUNT SUMMARY

CLIENT: FEHR AND PEERS / KAKU ASSOCAITES
PROJECT: BIG ISLAND OF HAWAII TRAFFIC COUNTS
LOCATION: HENRY STREET SOUTH OF PALANI ROAD

DATE: TUESDAY, AUGUST 21, 2007

DIRECTION:	NB				
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	20	12	9	3	44
1:00	5	1	5	5	16
2:00	4	3	3	2	12
3:00	1	3	5	4	13
4:00	5	8	2	10	25
5:00	14	14	19	25	72
6:00	54	82	104	110	350
7:00	166	160	158	118	602
8:00	100	116	114	99	429
9:00	74	98	68	107	347
10:00	114	100	113	106	433
11:00	104	110	94	98	406
12:00	97	102	114	113	426
13:00	106	118	103	116	443
14:00	158	154	132	118	562
15:00	112	144	170	159	585
16:00	156	148	150	134	588
17:00	174	188	136	126	624
18:00	138	113	102	104	457
19:00	91	98	108	94	391
20:00	71	71	81	64	287
21:00	71	74	59	64	268
22:00	62	62	44	23	191
23:00	33	17	21	17	88
				TOTAL	7659

AM PEAK HOUR	0700-0800
VOLUME	602
PM PEAK HOUR	1630-1730
VOLUME	646

DIRECTION:	SB				
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	7	3	6	7	23
1:00	4	3	3	5	15
2:00	5	3	2	3	13
3:00	7	4	4	3	18
4:00	7	5	17	18	47
5:00	21	22	41	45	129
6:00	67	92	108	120	387
7:00	198	172	174	176	720
8:00	170	202	138	134	644
9:00	109	112	123	118	462
10:00	114	129	114	126	483
11:00	113	110	112	119	454
12:00	124	124	114	136	498
13:00	107	126	107	134	474
14:00	126	160	196	199	681
15:00	176	169	167	176	688
16:00	155	174	176	182	687
17:00	142	170	124	126	562
18:00	130	99	107	87	423
19:00	82	71	73	61	287
20:00	63	51	60	45	219
21:00	48	52	49	36	185
22:00	37	26	28	23	114
23:00	18	13	15	12	58
				TOTAL	8271

AM PEAK HOUR	0730-0830
VOLUME	722
PM PEAK HOUR	1430-1530
VOLUME	740

TOTAL BI-DIRECTIONAL VOLUME	15930

WILTEC

Phone: (626) 564-1944 Fax: (626) 564-0969

24-HOUR ADT COUNT SUMMARY

CLIENT: FEHR AND PEERS / KAKU ASSOCAITES
PROJECT: BIG ISLAND OF HAWAII TRAFFIC COUNTS
LOCATION: PALANI ROAD MAKAI (WEST) OF HENRY STREET

DATE: THURSDAY, AUGUST 23, 2007

DIRECTION:		EB			
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	14	16	12	9	51
1:00	6	11	2	5	24
2:00	18	6	1	3	28
3:00	3	4	2	2	11
4:00	2	2	3	6	13
5:00	6	7	9	10	32
6:00	20	30	54	50	154
7:00	44	57	68	76	245
8:00	64	85	84	100	333
9:00	94	70	78	92	334
10:00	88	72	90	84	334
11:00	116	104	110	114	444
12:00	108	116	108	120	452
13:00	108	96	108	118	430
14:00	126	97	120	102	445
15:00	128	119	128	146	521
16:00	150	153	168	142	613
17:00	150	162	154	126	592
18:00	120	146	108	129	503
19:00	117	108	88	90	403
20:00	82	82	66	79	309
21:00	88	72	62	48	270
22:00	64	35	32	22	153
23:00	24	9	26	21	80
				TOTAL	6774

AM PEAK HOUR	1100-1200
VOLUME	444
PM PEAK HOUR	1630-1730
VOLUME	622

DIRECTION:		WB			
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	2	3	6	5	16
1:00	3	4	4	3	14
2:00	1	4	5	4	14
3:00	3	6	3	7	19
4:00	4	10	13	21	48
5:00	24	40	43	56	163
6:00	92	113	138	136	479
7:00	139	145	152	162	598
8:00	189	135	150	134	608
9:00	108	104	116	112	440
10:00	102	133	94	131	460
11:00	108	122	117	123	470
12:00	137	122	104	116	479
13:00	102	116	110	112	440
14:00	134	175	162	174	645
15:00	166	145	152	182	645
16:00	180	164	132	166	642
17:00	180	150	142	111	583
18:00	108	78	79	96	361
19:00	78	71	49	60	258
20:00	44	37	38	45	164
21:00	35	38	37	25	135
22:00	22	12	8	8	50
23:00	12	5	3	3	23
				TOTAL	7754

AM PEAK HOUR	0715-0815
VOLUME	648
PM PEAK HOUR	1530-1630
VOLUME	678

TOTAL BI-DIRECTIONAL VOLUME	14528

WILTEC

Phone: (626) 564-1944 Fax: (626) 564-0969

24-HOUR ADT COUNT SUMMARY

CLIENT: FEHR AND PEERS / KAKU ASSOCAITES
PROJECT: BIG ISLAND OF HAWAII TRAFFIC COUNTS
LOCATION: PALANI ROAD MAUKA (EAST) OF HENRY STREET

DATE: TUESDAY, AUGUST 21, 2007

DIRECTION:	EB				
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	33	28	24	14	99
1:00	12	4	8	12	36
2:00	10	6	5	4	25
3:00	1	4	13	5	23
4:00	5	9	4	11	29
5:00	19	16	25	32	92
6:00	62	72	114	130	378
7:00	126	161	212	161	660
8:00	137	174	138	144	593
9:00	116	134	95	140	485
10:00	130	122	131	126	509
11:00	132	150	146	145	573
12:00	136	153	160	142	591
13:00	143	138	160	186	627
14:00	201	236	178	176	791
15:00	180	228	224	238	870
16:00	252	242	214	250	958
17:00	256	212	226	230	924
18:00	210	232	194	173	809
19:00	165	174	162	153	654
20:00	134	108	143	113	498
21:00	112	123	102	92	429
22:00	94	83	66	48	291
23:00	53	30	32	33	148
				TOTAL	11092

AM PEAK HOUR	0730-0830
VOLUME	684
PM PEAK HOUR	1615-1715
VOLUME	962

DIRECTION:	WB				
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	11	6	5	13	35
1:00	5	5	5	3	18
2:00	4	8	2	5	19
3:00	10	5	2	9	26
4:00	16	17	28	30	91
5:00	44	44	82	107	277
6:00	121	170	195	212	698
7:00	297	280	309	310	1196
8:00	326	294	198	214	1032
9:00	184	172	160	172	688
10:00	164	160	142	170	636
11:00	144	144	146	140	574
12:00	144	153	146	170	613
13:00	150	156	144	162	612
14:00	174	242	264	278	958
15:00	238	230	250	244	962
16:00	244	268	234	240	986
17:00	242	216	170	169	797
18:00	182	149	144	137	612
19:00	118	89	92	98	397
20:00	85	70	88	69	312
21:00	42	66	52	40	200
22:00	50	34	28	26	138
23:00	23	21	15	10	69
				TOTAL	11946

AM PEAK HOUR	0730-0830
VOLUME	1239
PM PEAK HOUR	1415-1515
VOLUME	1022

TOTAL BI-DIRECTIONAL VOLUME	23038

WILTEC

Phone: (626) 564-1944 Fax: (626) 564-0969

24-HOUR ADT COUNT SUMMARY

CLIENT: FEHR AND PEERS / KAKU ASSOCAITES
PROJECT: BIG ISLAND OF HAWAII TRAFFIC COUNTS
LOCATION: PALANI ROAD MAUKA (EAST) OF HENRY STREET

DATE: WEDNESDAY, AUGUST 22, 2007

DIRECTION:	EB				
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	26	24	19	17	86
1:00	13	11	8	10	42
2:00	10	13	6	7	36
3:00	4	5	8	6	23
4:00	8	9	6	11	34
5:00	20	15	24	35	94
6:00	73	76	123	142	414
7:00	137	178	227	169	711
8:00	142	116	113	146	517
9:00	134	117	132	112	495
10:00	126	114	150	124	514
11:00	151	128	130	136	545
12:00	140	174	146	144	604
13:00	146	172	146	190	654
14:00	190	210	194	192	786
15:00	188	222	223	238	871
16:00	220	213	240	259	932
17:00	274	289	226	202	991
18:00	210	220	167	150	747
19:00	139	180	157	126	602
20:00	117	118	118	121	474
21:00	136	108	107	91	442
22:00	100	71	49	37	257
23:00	54	52	29	32	167
				TOTAL	11038

AM PEAK HOUR	0715-0815
VOLUME	716
PM PEAK HOUR	1630-1730
VOLUME	1062

DIRECTION:	WB				
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	8	6	9	13	36
1:00	4	5	4	5	18
2:00	4	9	6	7	26
3:00	10	5	6	12	33
4:00	14	15	33	34	96
5:00	40	51	87	103	281
6:00	133	165	186	232	716
7:00	280	276	292	316	1164
8:00	332	292	206	180	1010
9:00	210	186	178	175	749
10:00	148	162	156	162	628
11:00	155	186	140	138	619
12:00	159	162	160	160	641
13:00	176	185	192	162	715
14:00	165	238	281	270	954
15:00	249	236	258	273	1016
16:00	242	253	240	276	1011
17:00	183	190	186	160	719
18:00	153	131	122	112	518
19:00	94	106	121	141	462
20:00	105	82	71	69	327
21:00	77	58	42	52	229
22:00	43	25	23	24	115
23:00	24	20	10	14	68
				TOTAL	12151

AM PEAK HOUR	0730-0830
VOLUME	1232
PM PEAK HOUR	1415-1515
VOLUME	1038

TOTAL BI-DIRECTIONAL VOLUME	23189

WILTEC

Phone: (626) 564-1944 Fax: (626) 564-0969

24-HOUR ADT COUNT SUMMARY

CLIENT: FEHR AND PEERS / KAKU ASSOCAITES
PROJECT: BIG ISLAND OF HAWAII TRAFFIC COUNTS
LOCATION: PALANI ROAD MAUKA (EAST) OF HENRY STREET

DATE: THURSDAY, AUGUST 23, 2007

DIRECTION:	EB				
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	18	19	14	20	71
1:00	14	18	7	7	46
2:00	10	20	7	10	47
3:00	6	6	3	8	23
4:00	11	8	7	11	37
5:00	20	13	22	38	93
6:00	83	81	132	155	451
7:00	148	196	242	177	763
8:00	146	167	149	122	584
9:00	132	126	116	128	502
10:00	127	128	127	151	533
11:00	137	116	143	134	530
12:00	148	152	180	194	674
13:00	162	144	169	174	649
14:00	219	224	184	184	811
15:00	225	224	238	236	923
16:00	228	227	256	265	976
17:00	251	226	216	210	903
18:00	226	181	162	152	721
19:00	177	160	140	126	603
20:00	113	131	117	124	485
21:00	116	105	92	97	410
22:00	77	58	43	54	232
23:00	41	31	33	32	137
				TOTAL	11204

AM PEAK HOUR	0700-0800
VOLUME	763
PM PEAK HOUR	1615-1715
VOLUME	999

DIRECTION:	WB				
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	4	5	13	12	34
1:00	2	4	3	6	15
2:00	3	9	9	8	29
3:00	10	4	10	15	39
4:00	12	12	38	38	100
5:00	35	58	92	99	284
6:00	145	160	176	252	733
7:00	263	272	274	321	1130
8:00	338	290	212	216	1056
9:00	186	178	162	166	692
10:00	128	156	150	160	594
11:00	163	184	152	149	648
12:00	154	166	154	174	648
13:00	207	246	185	201	839
14:00	182	202	274	244	902
15:00	233	254	259	243	989
16:00	261	237	258	213	969
17:00	203	178	165	168	714
18:00	140	133	125	106	504
19:00	98	107	120	95	420
20:00	76	80	69	60	285
21:00	62	47	46	47	202
22:00	30	26	25	24	105
23:00	21	13	12	14	60
				TOTAL	11991

AM PEAK HOUR	0730-0830
VOLUME	1223
PM PEAK HOUR	1515-1615
VOLUME	1017

TOTAL BI-DIRECTIONAL VOLUME	23195

WILTEC

Phone: (626) 564-1944 Fax: (626) 564-0969

24-HOUR ADT COUNT SUMMARY

CLIENT: FEHR AND PEERS / KAKU ASSOCAITES
PROJECT: BIG ISLAND OF HAWAII TRAFFIC COUNTS
LOCATION: KEALAKAA STREET MAKAI (WEST) OF PALANI ROAD

DATE: TUESDAY, AUGUST 21, 2007

DIRECTION:	EB				
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	2	2	0	2	6
1:00	2	2	1	0	5
2:00	2	3	1	2	8
3:00	0	3	4	3	10
4:00	1	10	9	6	26
5:00	13	10	24	28	75
6:00	31	38	38	64	171
7:00	100	105	158	136	499
8:00	121	91	48	44	304
9:00	42	40	42	48	172
10:00	35	32	24	29	120
11:00	34	40	32	36	142
12:00	18	30	28	45	121
13:00	34	26	42	40	142
14:00	92	126	123	98	439
15:00	69	92	79	100	340
16:00	48	67	78	72	265
17:00	74	80	62	64	280
18:00	44	55	42	48	189
19:00	34	38	32	23	127
20:00	42	30	20	22	114
21:00	11	16	20	12	59
22:00	23	8	10	8	49
23:00	4	6	3	6	19
				TOTAL	3682

AM PEAK HOUR	0715-0815
VOLUME	520
PM PEAK HOUR	1400-1500
VOLUME	439

DIRECTION:	WB				
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	12	10	7	10	39
1:00	5	0	3	1	9
2:00	5	2	2	0	9
3:00	3	4	12	5	24
4:00	1	4	3	4	12
5:00	2	7	8	14	31
6:00	24	26	28	60	138
7:00	88	92	134	107	421
8:00	70	50	34	45	199
9:00	28	25	17	29	99
10:00	36	21	23	28	108
11:00	28	26	34	36	124
12:00	24	46	36	38	144
13:00	30	39	60	94	223
14:00	86	83	83	58	310
15:00	54	60	60	58	232
16:00	60	72	61	61	254
17:00	75	78	74	78	305
18:00	73	51	49	56	229
19:00	42	50	48	47	187
20:00	40	40	42	38	160
21:00	25	30	36	37	128
22:00	26	30	28	13	97
23:00	20	12	11	15	58
				TOTAL	3540

AM PEAK HOUR	0700-0800
VOLUME	421
PM PEAK HOUR	1345-1445
VOLUME	346

TOTAL BI-DIRECTIONAL VOLUME	7222

WILTEC

Phone: (626) 564-1944 Fax: (626) 564-0969

24-HOUR ADT COUNT SUMMARY

CLIENT: FEHR AND PEERS / KAKU ASSOCAITES
PROJECT: BIG ISLAND OF HAWAII TRAFFIC COUNTS
LOCATION: ULUAOA STREET MAKAI (WEST) OF PALANI ROAD

DATE: TUESDAY, AUGUST 21, 2007

DIRECTION:	EB				
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	5	2	0	2	9
1:00	0	1	1	2	4
2:00	1	1	3	2	7
3:00	2	1	2	4	9
4:00	1	7	10	5	23
5:00	12	12	26	19	69
6:00	31	27	38	51	147
7:00	43	50	72	108	273
8:00	104	92	31	24	251
9:00	16	17	10	14	57
10:00	9	8	15	16	48
11:00	12	8	24	20	64
12:00	10	12	20	18	60
13:00	28	14	18	28	88
14:00	42	108	86	50	286
15:00	34	38	30	29	131
16:00	34	33	26	37	130
17:00	25	25	26	19	95
18:00	16	12	18	22	68
19:00	20	24	29	50	123
20:00	23	18	13	8	62
21:00	12	14	12	9	47
22:00	12	6	7	6	31
23:00	3	3	0	3	9
				TOTAL	2091

AM PEAK HOUR	0730-0830
VOLUME	376
PM PEAK HOUR	1400-1500
VOLUME	286

DIRECTION:	WB				
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	2	2	1	2	7
1:00	3	0	5	2	10
2:00	0	1	1	0	2
3:00	0	0	0	0	0
4:00	0	1	0	0	1
5:00	3	0	8	4	15
6:00	13	13	4	13	43
7:00	24	56	92	109	281
8:00	54	46	28	14	142
9:00	6	12	8	12	38
10:00	18	11	11	6	46
11:00	9	15	15	11	50
12:00	18	18	20	13	69
13:00	8	21	26	29	84
14:00	59	68	42	46	215
15:00	32	44	24	36	136
16:00	37	38	36	42	153
17:00	43	54	40	36	173
18:00	28	26	18	14	86
19:00	13	22	15	14	64
20:00	14	5	1	12	32
21:00	16	8	8	5	37
22:00	10	7	5	9	31
23:00	2	5	1	3	11
				TOTAL	1726

AM PEAK HOUR	0715-0815
VOLUME	311
PM PEAK HOUR	1400-1500
VOLUME	215

TOTAL BI-DIRECTIONAL VOLUME	3817

WILTEC

Phone: (626) 564-1944 Fax: (626) 564-0969

24-HOUR ADT COUNT SUMMARY

CLIENT: FEHR AND PEERS / KAKU ASSOCAITES
PROJECT: BIG ISLAND OF HAWAII TRAFFIC COUNTS
LOCATION: QUEEN KAAHUMANU HIGHWAY SOUTH OF KEALAKEHE PARKWAY

DATE: TUESDAY, AUGUST 21, 2007

DIRECTION:	NB				
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	16	14	14	13	57
1:00	8	6	0	5	19
2:00	6	7	6	14	33
3:00	13	14	17	22	66
4:00	18	32	47	66	163
5:00	88	144	193	207	632
6:00	246	220	232	224	922
7:00	248	278	268	256	1050
8:00	278	270	258	250	1056
9:00	268	256	264	240	1028
10:00	282	241	268	271	1062
11:00	283	250	264	248	1045
12:00	277	261	282	261	1081
13:00	248	274	258	296	1076
14:00	226	246	268	253	993
15:00	278	255	266	228	1027
16:00	240	270	236	267	1013
17:00	248	235	236	198	917
18:00	176	186	174	182	718
19:00	146	138	125	158	567
20:00	82	92	107	82	363
21:00	98	101	80	46	325
22:00	48	52	28	32	160
23:00	28	23	15	12	78
				TOTAL	15451

AM PEAK HOUR	0715-0815
VOLUME	1080
PM PEAK HOUR	1200-1300
VOLUME	1081

DIRECTION:	SB				
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	18	17	9	11	55
1:00	8	7	1	6	22
2:00	0	4	4	3	11
3:00	6	2	4	12	24
4:00	6	20	12	23	61
5:00	20	28	26	71	145
6:00	84	120	151	147	502
7:00	192	252	265	272	981
8:00	264	273	306	270	1113
9:00	251	240	270	256	1017
10:00	246	268	268	242	1024
11:00	275	283	282	228	1068
12:00	260	268	290	247	1065
13:00	256	268	250	254	1028
14:00	264	283	255	256	1058
15:00	258	244	244	226	972
16:00	246	248	239	247	980
17:00	242	212	250	220	924
18:00	228	221	163	194	806
19:00	213	156	163	148	680
20:00	123	137	112	106	478
21:00	102	94	82	78	356
22:00	80	50	65	58	253
23:00	58	32	32	20	142
				TOTAL	14765

AM PEAK HOUR	0745-0845
VOLUME	1115
PM PEAK HOUR	1200-1300
VOLUME	1065

TOTAL BI-DIRECTIONAL VOLUME	30216

WILTEC

Phone: (626) 564-1944 Fax: (626) 564-0969

24-HOUR ADT COUNT SUMMARY

CLIENT: FEHR AND PEERS / KAKU ASSOCAITES
PROJECT: BIG ISLAND OF HAWAII TRAFFIC COUNTS
LOCATION: QUEEN KAAHUMANU HIGHWAY SOUTH OF KEALAKEHE PARKWAY

DATE: WEDNESDAY, AUGUST 22, 2007

DIRECTION:	NB				
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	18	12	12	9	51
1:00	11	7	3	7	28
2:00	11	6	7	13	37
3:00	11	17	18	23	69
4:00	18	28	52	65	163
5:00	95	134	193	217	639
6:00	261	260	253	251	1025
7:00	261	270	260	270	1061
8:00	268	280	292	270	1110
9:00	264	242	232	258	996
10:00	286	262	262	294	1104
11:00	275	244	259	229	1007
12:00	234	276	257	258	1025
13:00	288	257	219	241	1005
14:00	246	238	249	221	954
15:00	238	220	241	256	955
16:00	289	232	232	238	991
17:00	291	285	240	188	1004
18:00	173	204	165	146	688
19:00	114	126	154	96	490
20:00	114	128	102	115	459
21:00	88	116	92	74	370
22:00	58	42	32	25	157
23:00	30	22	14	18	84
				TOTAL	15472

AM PEAK HOUR	0745-0845
VOLUME	1110
PM PEAK HOUR	1215-1315
VOLUME	1079

DIRECTION:	SB				
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	15	16	10	10	51
1:00	9	5	5	7	26
2:00	1	3	5	4	13
3:00	7	3	7	11	28
4:00	6	17	12	24	59
5:00	20	25	39	68	152
6:00	89	137	142	165	533
7:00	186	242	308	276	1012
8:00	258	282	294	248	1082
9:00	244	240	248	235	967
10:00	216	241	266	273	996
11:00	240	256	281	282	1059
12:00	245	276	279	232	1032
13:00	278	261	242	296	1077
14:00	276	242	258	238	1014
15:00	262	244	252	221	979
16:00	251	231	249	210	941
17:00	230	246	248	242	966
18:00	244	204	195	223	866
19:00	210	155	159	143	667
20:00	141	108	102	93	444
21:00	94	75	75	78	322
22:00	85	52	70	58	265
23:00	51	49	41	26	167
				TOTAL	14718

AM PEAK HOUR	0730-0830
VOLUME	1124
PM PEAK HOUR	1300-1400
VOLUME	1077

TOTAL BI-DIRECTIONAL VOLUME	30190

WILTEC

Phone: (626) 564-1944 Fax: (626) 564-0969

24-HOUR ADT COUNT SUMMARY

CLIENT: FEHR AND PEERS / KAKU ASSOCAITES
PROJECT: BIG ISLAND OF HAWAII TRAFFIC COUNTS
LOCATION: QUEEN KAAHUMANU HIGHWAY SOUTH OF KEALAKEHE PARKWAY

DATE: THURSDAY, AUGUST 23, 2007

DIRECTION:	NB				
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	20	9	9	4	42
1:00	14	8	5	8	35
2:00	15	5	8	12	40
3:00	9	20	18	24	71
4:00	17	24	56	64	161
5:00	102	123	192	226	643
6:00	275	300	274	278	1127
7:00	274	274	266	268	1082
8:00	280	280	278	284	1122
9:00	276	257	251	258	1042
10:00	272	246	273	285	1076
11:00	230	264	288	284	1066
12:00	286	272	236	252	1046
13:00	268	238	276	275	1057
14:00	232	272	258	271	1033
15:00	271	255	266	266	1058
16:00	239	232	260	240	971
17:00	258	268	224	194	944
18:00	173	194	172	169	708
19:00	138	171	163	127	599
20:00	98	110	105	99	412
21:00	93	109	86	60	348
22:00	53	47	30	29	159
23:00	29	23	15	15	82
				TOTAL	15924

AM PEAK HOUR	0600-0700
VOLUME	1127
PM PEAK HOUR	1415-1515
VOLUME	1072

DIRECTION:	SB				
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	12	14	11	8	45
1:00	9	2	8	8	27
2:00	2	1	5	5	13
3:00	7	4	9	9	29
4:00	6	13	12	24	55
5:00	20	22	51	65	158
6:00	94	154	132	182	562
7:00	180	235	266	290	971
8:00	264	301	292	268	1125
9:00	258	256	258	270	1042
10:00	262	252	231	275	1020
11:00	235	230	244	230	939
12:00	252	228	270	272	1022
13:00	218	228	190	210	846
14:00	228	210	208	217	863
15:00	252	254	229	276	1011
16:00	278	260	246	254	1038
17:00	251	240	230	212	933
18:00	216	158	262	228	864
19:00	208	172	156	146	682
20:00	132	123	107	100	462
21:00	98	85	79	78	340
22:00	83	51	68	58	260
23:00	55	41	37	23	156
				TOTAL	14463

AM PEAK HOUR	0745-0845
VOLUME	1147
PM PEAK HOUR	1545-1645
VOLUME	1060

TOTAL BI-DIRECTIONAL VOLUME	30387

WILTEC

Phone: (626) 564-1944 Fax: (626) 564-0969

24-HOUR ADT COUNT SUMMARY

CLIENT: FEHR AND PEERS / KAKU ASSOCAITES
PROJECT: BIG ISLAND OF HAWAII TRAFFIC COUNTS
LOCATION: KEALAKEHE PARKWAY MAKEI (WEST) OF ANE KEOHOKALOLE HIGHWAY

DATE: THURSDAY, AUGUST 23, 2007

DIRECTION:		EB			
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	4	1	3	0	8
1:00	0	1	3	3	7
2:00	1	1	0	2	4
3:00	1	1	0	0	2
4:00	2	0	2	1	5
5:00	2	4	3	10	19
6:00	11	16	10	26	63
7:00	32	50	62	78	222
8:00	120	115	111	49	395
9:00	14	16	16	17	63
10:00	14	18	18	15	65
11:00	16	14	24	26	80
12:00	24	10	16	17	67
13:00	21	23	17	14	75
14:00	30	31	45	70	176
15:00	79	52	44	46	221
16:00	34	30	52	43	159
17:00	40	36	38	32	146
18:00	30	32	36	28	126
19:00	22	20	10	10	62
20:00	20	11	30	12	73
21:00	8	12	13	10	43
22:00	10	7	6	4	27
23:00	10	7	1	3	21
				TOTAL	2129

AM PEAK HOUR	0745-0845
VOLUME	424
PM PEAK HOUR	1430-1530
VOLUME	246

DIRECTION:		WB			
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	0	0	1	0	1
1:00	0	0	1	1	2
2:00	0	1	1	2	4
3:00	2	0	4	3	9
4:00	2	6	4	6	18
5:00	6	13	20	20	59
6:00	20	25	30	38	113
7:00	38	71	69	70	248
8:00	94	96	88	43	321
9:00	24	19	22	20	85
10:00	12	14	24	14	64
11:00	20	18	11	48	97
12:00	67	19	20	11	117
13:00	16	34	28	29	107
14:00	17	14	23	35	89
15:00	182	94	52	54	382
16:00	46	34	30	24	134
17:00	26	50	25	22	123
18:00	26	37	77	46	186
19:00	23	5	20	14	62
20:00	11	18	16	23	68
21:00	32	8	18	10	68
22:00	12	3	3	4	22
23:00	6	1	6	4	17
				TOTAL	2396

AM PEAK HOUR	0745-0845
VOLUME	348
PM PEAK HOUR	1500-1600
VOLUME	382

TOTAL BI-DIRECTIONAL VOLUME	4525

WILTEC

Phone: (626) 564-1944 Fax: (626) 564-0969

24-HOUR ADT COUNT SUMMARY

CLIENT: FEHR AND PEERS / KAKU ASSOCAITES
PROJECT: BIG ISLAND OF HAWAII TRAFFIC COUNTS
LOCATION: ANE KEOHOKALOLE HIGHWAY SOUTH OF KEALAKEHE PARKWAY

DATE: THURSDAY, AUGUST 23, 2007

DIRECTION:	NB				
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	0	0	0	0	0
1:00	0	0	0	0	0
2:00	0	0	0	1	1
3:00	0	0	0	0	0
4:00	0	0	0	2	2
5:00	1	1	1	0	3
6:00	2	5	5	7	19
7:00	15	16	36	42	109
8:00	67	68	64	34	233
9:00	10	8	8	5	31
10:00	6	3	5	4	18
11:00	9	10	2	29	50
12:00	46	11	6	6	69
13:00	17	14	12	13	56
14:00	5	5	16	22	48
15:00	88	54	27	34	203
16:00	31	15	17	11	74
17:00	19	35	13	10	77
18:00	12	22	61	23	118
19:00	9	0	5	4	18
20:00	4	10	7	20	41
21:00	26	2	14	7	49
22:00	4	0	0	1	5
23:00	1	0	0	0	1
				TOTAL	1225

AM PEAK HOUR	0745-0845
VOLUME	241
PM PEAK HOUR	1500-1600
VOLUME	203

DIRECTION:	SB				
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	0	0	1	0	1
1:00	0	0	0	0	0
2:00	1	0	0	0	1
3:00	0	0	0	0	0
4:00	0	0	0	0	0
5:00	0	2	1	4	7
6:00	10	10	7	15	42
7:00	22	48	60	78	208
8:00	122	116	116	52	406
9:00	10	6	8	4	28
10:00	7	4	4	3	18
11:00	6	5	9	14	34
12:00	17	4	7	7	35
13:00	12	14	10	4	40
14:00	10	16	26	56	108
15:00	66	40	27	17	150
16:00	12	12	19	16	59
17:00	15	16	20	21	72
18:00	18	16	18	10	62
19:00	3	1	0	2	6
20:00	4	4	7	3	18
21:00	4	2	1	1	8
22:00	2	0	0	1	3
23:00	1	0	0	0	1
				TOTAL	1307

AM PEAK HOUR	0745-0845
VOLUME	432
PM PEAK HOUR	1445-1545
VOLUME	189

TOTAL BI-DIRECTIONAL VOLUME	2532

WILTEC

Phone: (626) 564-1944 Fax: (626) 564-0969

24-HOUR ADT COUNT SUMMARY

CLIENT: FEHR AND PEERS / KAKU ASSOCAITES
PROJECT: BIG ISLAND OF HAWAII TRAFFIC COUNTS
LOCATION: QUEEN KAAHUMANU HIGHWAY NORTH OF KEALAKEHE PARKWAY

DATE: THURSDAY, AUGUST 23, 2007

DIRECTION:	NB				
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	14	5	10	4	33
1:00	9	9	5	4	27
2:00	13	6	8	7	34
3:00	7	15	18	24	64
4:00	14	26	46	65	151
5:00	96	111	159	203	569
6:00	214	294	262	250	1020
7:00	253	236	242	210	941
8:00	215	202	245	241	903
9:00	242	236	234	244	956
10:00	236	244	258	271	1009
11:00	229	230	228	236	923
12:00	252	260	224	226	962
13:00	242	208	230	266	946
14:00	199	254	224	216	893
15:00	252	296	258	281	1087
16:00	254	236	246	252	988
17:00	264	260	224	188	936
18:00	180	180	188	185	733
19:00	152	170	159	151	632
20:00	84	88	90	90	352
21:00	104	102	77	48	331
22:00	44	54	18	29	145
23:00	20	22	14	14	70
				TOTAL	14705

AM PEAK HOUR	0615-0715
VOLUME	1059
PM PEAK HOUR	1515-1615
VOLUME	1089

DIRECTION:	SB				
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	12	14	11	7	44
1:00	6	3	8	7	24
2:00	4	1	12	4	21
3:00	2	0	8	2	12
4:00	12	12	23	20	67
5:00	24	28	53	96	201
6:00	134	158	158	182	632
7:00	203	252	272	270	997
8:00	298	308	302	237	1145
9:00	232	238	227	275	972
10:00	260	227	242	248	977
11:00	246	209	276	256	987
12:00	215	224	240	262	941
13:00	236	215	167	204	822
14:00	208	235	214	209	866
15:00	228	236	204	275	943
16:00	223	222	260	237	942
17:00	212	229	208	178	827
18:00	180	128	258	170	736
19:00	176	142	128	130	576
20:00	117	114	116	102	449
21:00	76	83	61	62	282
22:00	77	42	63	56	238
23:00	60	24	23	17	124
				TOTAL	13825

AM PEAK HOUR	0745-0845
VOLUME	1178
PM PEAK HOUR	1545-1645
VOLUME	980

TOTAL BI-DIRECTIONAL VOLUME	28530

WILTEC

Phone: (626) 564-1944 Fax: (626) 564-0969

24-HOUR ADT COUNT SUMMARY

CLIENT: FEHR AND PEERS / KAKU ASSOCAITES
PROJECT: BIG ISLAND OF HAWAII TRAFFIC COUNTS
LOCATION: PALANI ROAD SOUTH OF MAMALAHOA HIGHWAY

DATE: TUESDAY, AUGUST 21, 2007

DIRECTION:	NB				
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	15	11	15	6	47
1:00	6	3	5	12	26
2:00	4	4	5	3	16
3:00	2	1	4	8	15
4:00	6	9	21	16	52
5:00	32	20	32	43	127
6:00	82	87	124	137	430
7:00	103	120	124	114	461
8:00	170	133	125	113	541
9:00	114	108	77	107	406
10:00	100	99	98	106	403
11:00	84	100	110	111	405
12:00	90	94	109	96	389
13:00	112	92	78	102	384
14:00	109	154	166	182	611
15:00	128	124	167	150	569
16:00	186	156	158	136	636
17:00	142	147	138	171	598
18:00	170	132	148	118	568
19:00	115	101	115	88	419
20:00	93	84	83	80	340
21:00	78	87	63	48	276
22:00	60	56	32	34	182
23:00	34	13	17	15	79
				TOTAL	7980

AM PEAK HOUR	0745-0845
VOLUME	542
PM PEAK HOUR	1530-1630
VOLUME	659

DIRECTION:	SB				
TIME	00-15	15-30	30-45	45-60	HOUR TOTALS
0:00	10	3	7	12	32
1:00	2	4	7	0	13
2:00	2	7	4	6	19
3:00	5	2	2	9	18
4:00	9	9	14	11	43
5:00	22	31	52	76	181
6:00	85	96	159	184	524
7:00	224	250	256	208	938
8:00	146	162	138	150	596
9:00	147	130	109	116	502
10:00	133	106	129	121	489
11:00	105	135	98	106	444
12:00	124	116	140	121	501
13:00	132	137	120	148	537
14:00	168	178	183	188	717
15:00	188	206	238	238	870
16:00	228	225	225	236	914
17:00	174	202	138	152	666
18:00	128	122	106	91	447
19:00	80	61	66	65	272
20:00	44	52	50	40	186
21:00	51	38	29	36	154
22:00	25	24	29	22	100
23:00	22	12	14	17	65
				TOTAL	9228

AM PEAK HOUR	0700-0800
VOLUME	938
PM PEAK HOUR	1530-1630
VOLUME	929

TOTAL BI-DIRECTIONAL VOLUME	17208

WILTEC

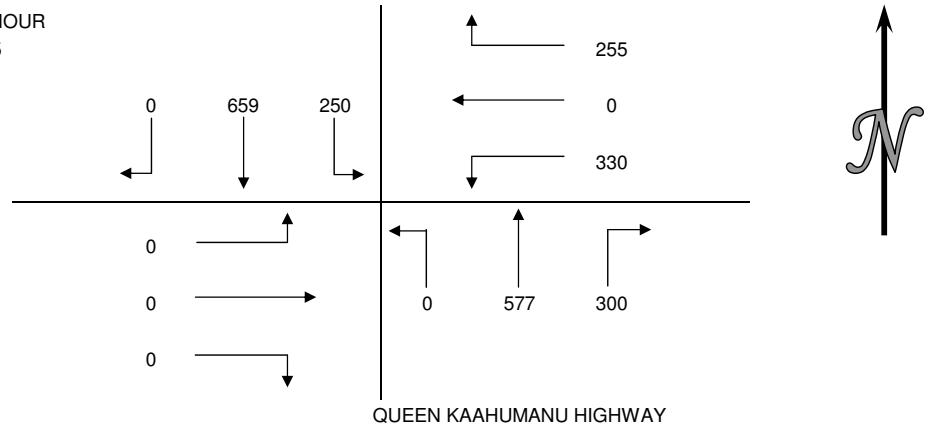
Phone: (626) 564-1944 Fax: (626) 564-0969

INTERSECTION TURNING MOVEMENT COUNT SUMMARY

CLIENT: FEHR AND PEERS / KAKU ASSOCIATES
PROJECT: KONA TRAFFIC COUNTS
DATE: WEDNESDAY AUGUST 22, 2007
PERIOD: 6:00 AM TO 9:00 AM
INTERSECTION: N/S QUEEN KAAHUMANU HIGHWAY
E/W HIINA LANI STREET

15 MIN COUNTS													
	1	2	3	4	5	6	7	8	9	10	11	12	
PERIOD	SBRT	SBTH	SBLT	WBRT	WBTH	WBLT	NBRT	NBTH	NBLT	EBRT	EBTH	EBLT	TOTAL
600-615	0	66	34	55	0	30	35	151	0	0	0	0	371
615-630	0	87	33	78	0	52	36	190	0	0	0	0	476
630-645	0	106	40	73	0	41	44	177	0	0	0	0	481
645-700	0	92	39	54	0	43	48	135	0	0	0	0	411
700-715	0	155	44	82	0	44	58	156	0	0	0	0	539
715-730	0	135	65	92	0	61	61	184	0	0	0	0	598
730-745	0	165	62	68	0	52	67	180	0	0	0	0	594
745-800	0	168	74	45	0	67	92	156	0	0	0	0	602
800-815	0	154	43	70	0	93	78	135	0	0	0	0	573
815-830	0	156	64	58	0	77	53	140	0	0	0	0	548
830-845	0	181	69	82	0	93	77	146	0	0	0	0	648
845-900	0	85	36	48	0	68	60	108	0	0	0	0	405
HOUR TOTALS													
	1	2	3	4	5	6	7	8	9	10	11	12	
TIME	SBRT	SBTH	SBLT	WBRT	WBTH	WBLT	NBRT	NBTH	NBLT	EBRT	EBTH	EBLT	TOTAL
600-700	0	351	146	260	0	166	163	653	0	0	0	0	1739
615-715	0	440	156	287	0	180	186	658	0	0	0	0	1907
630-730	0	488	188	301	0	189	211	652	0	0	0	0	2029
645-745	0	547	210	296	0	200	234	655	0	0	0	0	2142
700-800	0	623	245	287	0	224	278	676	0	0	0	0	2333
715-815	0	622	244	275	0	273	298	655	0	0	0	0	2367
730-830	0	643	243	241	0	289	290	611	0	0	0	0	2317
745-845	0	659	250	255	0	330	300	577	0	0	0	0	2371
800-900	0	576	212	258	0	331	268	529	0	0	0	0	2174

A.M. PEAK HOUR
745-845



APPENDIX C

INTERSECTION LEVEL OF SERVICE WORKSHEETS

EXISTING CONDITIONS

Palani Affordable Housing
Existing Conditions
AM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #1 Queen Kaahumanu Hwy / Henry St

Cycle (sec):	100	Critical Vol./Cap.(X):	0.634
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	23.4
Optimal Cycle:	47	Level Of Service:	C

Street Name:	Queen Kaahumanu Hwy						Henry St					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Prot+Permit			Prot+Permit			Prot+Permit			Prot+Permit		
Rights:		Ovl			Ovl			Ovl			Ovl	
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	1	1 0	2 0	1	1 0	2 0	1	1 1	1 0	1
Volume Module:												
Base Vol:	187	534	459	98	384	100	61	275	25	359	330	62
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	187	534	459	98	384	100	61	275	25	359	330	62
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	197	562	483	103	404	105	64	289	26	378	347	65
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	197	562	483	103	404	105	64	289	26	378	347	65
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	197	562	483	103	404	105	64	289	26	378	347	65
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	1.00	0.85	0.95	0.95	0.85	0.95	0.95	0.85	0.93	0.93	0.85
Lanes:	1.00	1.00	1.00	1.00	2.00	1.00	1.00	2.00	1.00	1.56	1.44	1.00
Final Sat.:	1805	1900	1615	1805	3610	1615	1805	3610	1615	2751	2529	1615
Capacity Analysis Module:												
Vol/Sat:	0.11	0.30	0.30	0.06	0.11	0.07	0.04	0.08	0.02	0.14	0.14	0.04
Crit Moves:		****		****				****		****		
Green/Cycle:	0.58	0.47	0.68	0.37	0.28	0.35	0.20	0.13	0.40	0.36	0.27	0.36
Volume/Cap:	0.28	0.63	0.44	0.29	0.40	0.18	0.25	0.63	0.04	0.48	0.50	0.11
Delay/Veh:	10.5	21.7	7.4	21.5	29.3	22.6	33.9	44.4	18.2	23.8	31.0	21.2
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	10.5	21.7	7.4	21.5	29.3	22.6	33.9	44.4	18.2	23.8	31.0	21.2
LOS by Move:	B	C	A	C	C	C	C	D	B	C	C	C
HCM2kAvgQ:	3	13	7	2	5	2	2	6	0	6	7	1

Note: Queue reported is the number of cars per lane.

Palani Affordable Housing
Existing Conditions
AM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #2 Queen Kaahumanu Hwy / Alli Dr

Cycle (sec):	100	Critical Vol./Cap.(X):	0.777
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	25.8
Optimal Cycle:	66	Level Of Service:	C

Street Name:	Queen Kaahumanu Hwy						Alli Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Prot+Permit			Prot+Permit			Prot+Permit			Prot+Permit		
Rights:		Ovl			Ovl			Ovl			Ovl	
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	1	1 0	1 0	1	1 0	1 0	1	1 0	1 0	1
Volume Module:												
Base Vol:	71	593	15	87	453	257	193	144	99	18	374	29
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	71	593	15	87	453	257	193	144	99	18	374	29
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	75	624	16	92	477	271	203	152	104	19	394	31
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	75	624	16	92	477	271	203	152	104	19	394	31
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	75	624	16	92	477	271	203	152	104	19	394	31
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	1.00	0.85	0.95	1.00	0.85	0.95	1.00	0.85	0.95	1.00	0.85
Lanes:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Sat.:	1805	1900	1615	1805	1900	1615	1805	1900	1615	1805	1900	1615
Capacity Analysis Module:												
Vol/Sat:	0.04	0.33	0.01	0.05	0.25	0.17	0.11	0.08	0.06	0.01	0.21	0.02
Crit Moves:		****		****			****				****	
Green/Cycle:	0.51	0.42	0.47	0.48	0.42	0.56	0.43	0.36	0.43	0.31	0.27	0.33
Volume/Cap:	0.22	0.78	0.02	0.39	0.60	0.30	0.59	0.22	0.15	0.05	0.78	0.06
Delay/Veh:	15.1	29.6	14.1	19.4	23.8	11.6	23.1	22.2	17.3	23.8	41.4	22.8
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	15.1	29.6	14.1	19.4	23.8	11.6	23.1	22.2	17.3	23.8	41.4	22.8
LOS by Move:	B	C	B	B	C	B	C	C	B	C	D	C
HCM2kAvgQ:	1	18	0	2	12	4	6	3	2	0	13	1

Note: Queue reported is the number of cars per lane.

Palani Affordable Housing
Existing Conditions
AM Peak Hour

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #3 Kamakaeha Ave / Palani Rd

Average Delay (sec/veh): 1.0 Worst Case Level Of Service: B[14.6]

Street Name:	Kamakaeha Ave									Palani Rd							
Approach:	North Bound					South Bound				East Bound					West Bound		
Movement:	L	-	T	-	R	L	-	T	-	R	L	-	T	-	R	L	-	T	-	R
Control:	Stop Sign					Stop Sign					Uncontrolled					Uncontrolled				
Rights:	Include					Include					Include					Include				
Lanes:	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	1	0	1
Volume Module:																				
Base Vol:	0	0	0			47	0			13	0	240			0	0	453			141
Growth Adj:	1.00	1.00	1.00			1.00	1.00			1.00	1.00	1.00			1.00	1.00	1.00			1.00
Initial Bse:	0	0	0			47	0			13	0	240			0	0	453			141
User Adj:	1.00	1.00	1.00			1.00	1.00			1.00	1.00	1.00			1.00	1.00	1.00			1.00
PHF Adj:	0.95	0.95	0.95			0.95	0.95			0.95	0.95	0.95			0.95	0.95	0.95			0.95
PHF Volume:	0	0	0			49	0			14	0	253			0	0	477			148
Reduct Vol:	0	0	0			0	0			0	0	0			0	0	0			0
FinalVolume:	0	0	0			49	0			14	0	253			0	0	477			148
Critical Gap Module:																				
Critical Gp:	xxxxx	xxxx	xxxxx			6.4	xxxx			6.2	xxxxx	xxxx	xxxxx			xxxxx	xxxx	xxxxx		
FollowUpTim:	xxxxx	xxxx	xxxxx			3.5	xxxx			3.3	xxxxx	xxxx	xxxxx			xxxxx	xxxx	xxxxx		
Capacity Module:																				
Cnflict Vol:	xxxx	xxxx	xxxxx			729	xxxx			477	xxxx	xxxx	xxxxx			xxxx	xxxx	xxxxx		
Potent Cap.:	xxxx	xxxx	xxxxx			393	xxxx			592	xxxx	xxxx	xxxxx			xxxx	xxxx	xxxxx		
Move Cap.:	xxxx	xxxx	xxxxx			393	xxxx			592	xxxx	xxxx	xxxxx			xxxx	xxxx	xxxxx		
Volume/Cap:	xxxx	xxxx	xxxx			0.13	xxxx			0.02	xxxx	xxxx	xxxx			xxxx	xxxx	xxxx		
Level Of Service Module:																				
2Way95thQ:	xxxx	xxxx	xxxxx			0.4	xxxx			0.1	xxxx	xxxx	xxxxx			xxxx	xxxx	xxxxx		
Control Del:	xxxxx	xxxx	xxxxx			15.5	xxxx			11.2	xxxxx	xxxx	xxxxx			xxxxx	xxxx	xxxxx		
LOS by Move:	*	*	*			C	*			B	*	*	*			*	*	*		
Movement:	LT	-	LTR	-	RT	LT	-	LTR	-	RT	LT	-	LTR	-	RT	LT	-	LTR	-	RT
Shared Cap.:	xxxx	xxxx	xxxxx			xxxx	xxxx			xxxxx	xxxx	xxxx	xxxxx			xxxx	xxxx	xxxxx		
SharedQueue:	xxxxx	xxxx	xxxxx			xxxxx	xxxx			xxxxx	xxxxx	xxxx	xxxxx			xxxxx	xxxx	xxxxx		
Shrd ConDel:	xxxxx	xxxx	xxxxx			xxxxx	xxxx			xxxxx	xxxxx	xxxx	xxxxx			xxxxx	xxxx	xxxxx		
Shared LOS:	*	*	*			*	*			*	*	*	*			*	*	*		
ApproachDel:	xxxxxx					14.6					xxxxxx					xxxxxx				
ApproachLOS:	*					B					*					*				

Note: Queue reported is the number of cars per lane.

Palani Affordable Housing
Existing Conditions
AM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Henry St / Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	0.659
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	12.3
Optimal Cycle:	49	Level Of Service:	B

Street Name:	Henry St						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Permitted			Permitted			Permitted			Prot+Permit		
Rights:	Ovl			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	0 0	1	0 0	0 0	0	0 0	0 1	0	1 0	1 0	0
Volume Module:												
Base Vol:	122	0	399	0	0	0	0	185	37	650	550	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	122	0	399	0	0	0	0	185	37	650	550	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	128	0	420	0	0	0	0	195	39	684	579	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	128	0	420	0	0	0	0	195	39	684	579	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	128	0	420	0	0	0	0	195	39	684	579	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.77	1.00	0.85	1.00	1.00	1.00	1.00	0.98	0.98	0.95	1.00	1.00
Lanes:	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.83	0.17	1.00	1.00	0.00
Final Sat.:	1461	0	1615	0	0	0	0	1547	309	1805	1900	0
Capacity Analysis Module:												
Vol/Sat:	0.09	0.00	0.26	0.00	0.00	0.00	0.00	0.13	0.13	0.38	0.30	0.00
Crit Moves:	****							****		****		
Green/Cycle:	0.13	0.00	0.71	0.00	0.00	0.00	0.00	0.19	0.19	0.77	0.77	0.00
Volume/Cap:	0.66	0.00	0.37	0.00	0.00	0.00	0.00	0.66	0.66	0.50	0.40	0.00
Delay/Veh:	49.2	0.0	5.9	0.0	0.0	0.0	0.0	41.9	41.9	6.1	4.1	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	49.2	0.0	5.9	0.0	0.0	0.0	0.0	41.9	41.9	6.1	4.1	0.0
LOS by Move:	D	A	A	A	A	A	A	D	D	A	A	A
HCM2kAvgQ:	5	0	5	0	0	0	0	8	8	8	6	0

Note: Queue reported is the number of cars per lane.

Palani Affordable Housing
Existing Conditions
AM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu Hwy / Makala Blvd

Cycle (sec):	100	Critical Vol./Cap.(X):	0.748
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	23.3
Optimal Cycle:	61	Level Of Service:	C

Street Name:	Queen Kaahumanu Hwy						Makala Blvd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Prot+Permit			Prot+Permit			Prot+Permit			Prot+Permit		
Rights:	Ovl			Ovl			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	1	1 0	1 0	1	1 0	0 1	0	1 0	0 1	0
Volume Module:												
Base Vol:	7	652	22	47	580	138	309	72	32	7	21	143
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	7	652	22	47	580	138	309	72	32	7	21	143
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	7	686	23	49	611	145	325	76	34	7	22	151
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	7	686	23	49	611	145	325	76	34	7	22	151
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	7	686	23	49	611	145	325	76	34	7	22	151
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	1.00	0.85	0.95	1.00	0.85	0.95	0.95	0.95	0.95	0.87	0.87
Lanes:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.69	0.31	1.00	0.13	0.87
Final Sat.:	1805	1900	1615	1805	1900	1615	1805	1255	558	1805	211	1440
Capacity Analysis Module:												
Vol/Sat:	0.00	0.36	0.01	0.03	0.32	0.09	0.18	0.06	0.06	0.00	0.10	0.10
Crit Moves:		****		****			****				****	
Green/Cycle:	0.49	0.48	0.51	0.54	0.51	0.75	0.40	0.36	0.36	0.16	0.14	0.14
Volume/Cap:	0.03	0.75	0.03	0.24	0.63	0.12	0.62	0.17	0.17	0.03	0.75	0.75
Delay/Veh:	15.1	24.4	12.3	16.7	18.8	3.4	24.5	22.2	22.2	35.2	54.0	54.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	15.1	24.4	12.3	16.7	18.8	3.4	24.5	22.2	22.2	35.2	54.0	54.0
LOS by Move:	B	C	B	B	B	A	C	C	C	D	D	D
HCM2kAvgQ:	0	18	0	1	14	1	9	2	2	0	7	7

Note: Queue reported is the number of cars per lane.

Palani Affordable Housing
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Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #8 Palihiolo St/Palani Rd

Average Delay (sec/veh): 1.6 Worst Case Level Of Service: E[47.5]

Street Name:	Palihiolo St						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1! 0 0			0 0 0 0 0			0 0 0 1 0			0 1 0 0 0		
Volume Module:												
Base Vol:	25	0	32	0	0	0	0	674	5	17	1088	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	25	0	32	0	0	0	0	674	5	17	1088	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	26	0	34	0	0	0	0	709	5	18	1145	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	26	0	34	0	0	0	0	709	5	18	1145	0
Critical Gap Module:												
Critical Gp:	6.4	6.5	6.2	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1893	1893	712	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	715	xxxx	xxxxx
Potent Cap.:	78	71	436	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	895	xxxx	xxxxx
Move Cap.:	77	69	436	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	895	xxxx	xxxxx
Volume/Cap:	0.34	0.00	0.08	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	0.02	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	0.1	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	9.1	xxxx	xxxxx
LOS by Move:	*	*	*	*	*	*	*	*	*	A	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	142	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	1.9	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	0.1	xxxx	xxxxx
Shrd ConDel:	xxxxx	47.5	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	9.1	xxxx	xxxxx
Shared LOS:	*	E	*	*	*	*	*	*	*	A	*	*
ApproachDel:		47.5			xxxxxx			xxxxxx			xxxxxx	
ApproachLOS:		E			*			*			*	

Note: Queue reported is the number of cars per lane.

Palani Affordable Housing
Existing Conditions
AM Peak Hour

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #9 Kealakaa St/Palani

Average Delay (sec/veh): 14.8 Worst Case Level Of Service: F[68.0]

Street Name:	Kealakaa St									Palani Rd											
Approach:	North Bound					South Bound					East Bound					West Bound					
Movement:	L	-	T	-	R	L	-	T	-	R	L	-	T	-	R	L	-	T	-	R	
Control:	Stop Sign					Stop Sign					Uncontrolled					Uncontrolled					
Rights:	Include					Include					Include					Include					
Lanes:	0	0	0	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	1	0	
Volume Module:																					
Base Vol:	0	0	0			25	0			321	295		369		0	0		775		49	
Growth Adj:	1.00	1.00	1.00			1.00	1.00			1.00	1.00		1.00		1.00	1.00		1.00		1.00	
Initial Bse:	0	0	0			25	0			321	295		369		0	0		775		49	
User Adj:	1.00	1.00	1.00			1.00	1.00			1.00	1.00		1.00		1.00	1.00		1.00		1.00	
PHF Adj:	0.95	0.95	0.95			0.95	0.95			0.95	0.95		0.95		0.95	0.95		0.95		0.95	
PHF Volume:	0	0	0			26	0			338	311		388		0	0		816		52	
Reduct Vol:	0	0	0			0	0			0	0		0		0	0		0		0	
FinalVolume:	0	0	0			26	0			338	311		388		0	0		816		52	
Critical Gap Module:																					
Critical Gp:	xxxxx	xxxx	xxxxx			6.4	xxxx			6.2	4.1		xxxx		xxxxx	xxxxx		xxxx		xxxxx	
FollowUpTim:	xxxxx	xxxx	xxxxx			3.5	xxxx			3.3	2.2		xxxx		xxxxx	xxxxx		xxxx		xxxxx	
Capacity Module:																					
Cnflict Vol:	xxxx	xxxx	xxxxx			1851	xxxx			842	867		xxxx		xxxxx	xxxx		xxxx		xxxxx	
Potent Cap.:	xxxx	xxxx	xxxxx			83	xxxx			367	785		xxxx		xxxxx	xxxx		xxxx		xxxxx	
Move Cap.:	xxxx	xxxx	xxxxx			52	xxxx			367	785		xxxx		xxxxx	xxxx		xxxx		xxxxx	
Volume/Cap:	xxxx	xxxx	xxxx			0.51	xxxx			0.92	0.40		xxxx		xxxx	xxxx		xxxx		xxxx	
Level Of Service Module:																					
2Way95thQ:	xxxx	xxxx	xxxxx			1.9	xxxx			9.6	1.9		xxxx		xxxxx	xxxx		xxxx		xxxxx	
Control Del:	xxxxx	xxxx	xxxxx			132.5	xxxx			62.9	12.6		xxxx		xxxxx	xxxxx		xxxx		xxxxx	
LOS by Move:	*	*	*			F	*			F	B		*		*	*		*		*	
Movement:	LT	-	LTR	-	RT	LT	-	LTR	-	RT	LT	-	LTR	-	RT	LT	-	LTR	-	RT	
Shared Cap.:	xxxx	xxxx	xxxxx			xxxx	xxxx			xxxxx	xxxx		xxxx		xxxxx	xxxx		xxxx		xxxxx	
SharedQueue:	xxxxx	xxxx	xxxxx			xxxxx	xxxx			xxxxx	1.9		xxxx		xxxxx	xxxxx		xxxx		xxxxx	
Shrd ConDel:	xxxxx	xxxx	xxxxx			xxxxx	xxxx			xxxxx	12.6		xxxx		xxxxx	xxxxx		xxxx		xxxxx	
Shared LOS:	*	*	*			*	*			*	B		*		*	*		*		*	
ApproachDel:	xxxxxx					68.0					xxxxxx					xxxxxx					
ApproachLOS:	*					F					*					*					

Note: Queue reported is the number of cars per lane.

Palani Affordable Housing
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Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #10 Palani Rd / Uluaoa St

Average Delay (sec/veh): 13.9 Worst Case Level Of Service: F[57.7]

Street Name:	Palani Rd								Uluaoa St							
Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L -	T -	R		L -	T -	R		L -	T -	R		L -	T -	R	
Control:	Uncontrolled				Uncontrolled				Stop Sign				Stop Sign			
Rights:	Include				Include				Include				Include			
Lanes:	0 1	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0
Volume Module:																			
Base Vol:	44	320	0	0	598	257	176	0	200	0	0	0							
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00							
Initial Bse:	44	320	0	0	598	257	176	0	200	0	0	0							
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00							
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95							
PHF Volume:	46	337	0	0	629	271	185	0	211	0	0	0							
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0							
FinalVolume:	46	337	0	0	629	271	185	0	211	0	0	0							
Critical Gap Module:																			
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.4	xxxx	6.2	xxxxx	xxxx	xxxxx							
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	xxxx	3.3	xxxxx	xxxx	xxxxx							
Capacity Module:																			
Cnflict Vol:	900	xxxx	xxxxx	xxxx	xxxx	xxxxx	1194	xxxx	765	xxxx	xxxx	xxxxx							
Potent Cap.:	763	xxxx	xxxxx	xxxx	xxxx	xxxxx	208	xxxx	407	xxxx	xxxx	xxxxx							
Move Cap.:	763	xxxx	xxxxx	xxxx	xxxx	xxxxx	198	xxxx	407	xxxx	xxxx	xxxxx							
Volume/Cap:	0.06	xxxx	xxxx	xxxx	xxxx	xxxx	0.93	xxxx	0.52	xxxx	xxxx	xxxx							
Level Of Service Module:																			
2Way95thQ:	0.2	xxxx	xxxxx	xxxx	xxxx	xxxxx	7.6	xxxx	2.9	xxxx	xxxx	xxxxx							
Control Del:	10.0	xxxx	xxxxx	xxxxx	xxxx	xxxxx	97.2	xxxx	23.0	xxxxx	xxxx	xxxxx							
LOS by Move:	B	*	*	*	*	*	F	*	C	*	*	*							
Movement:	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT							
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx							
SharedQueue:	0.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx							
Shrd ConDel:	10.0	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx							
Shared LOS:	B	*	*	*	*	*	*	*	*	*	*	*							
ApproachDel:	xxxxxx			xxxxxx			57.7			xxxxxx									
ApproachLOS:	*			*			F			*									

Note: Queue reported is the number of cars per lane.

Palani Affordable Housing
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Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #11 Queen Kaahumanu Hwy / Kealakehe Pkwy

Cycle (sec):	100	Critical Vol./Cap.(X):	0.742
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	19.7
Optimal Cycle:	60	Level Of Service:	B

Street Name:	Queen Kaahumanu Hwy						Kaalakehe Pkwy					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Prot+Permit			Prot+Permit			Permitted			Permitted		
Rights:		Ovl			Ovl			Ovl			Ovl	
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	1	1 0	1 0	1	0 1	0 0	1	0 1	0 0	1
Volume Module:												
Base Vol:	85	733	262	135	720	80	41	20	7	214	11	74
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	85	733	262	135	720	80	41	20	7	214	11	74
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	89	772	276	142	758	84	43	21	7	225	12	78
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	89	772	276	142	758	84	43	21	7	225	12	78
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	89	772	276	142	758	84	43	21	7	225	12	78
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	1.00	0.85	0.95	1.00	0.85	0.67	0.67	0.85	0.68	0.68	0.85
Lanes:	1.00	1.00	1.00	1.00	1.00	1.00	0.67	0.33	1.00	0.95	0.05	1.00
Final Sat.:	1805	1900	1615	1805	1900	1615	849	414	1615	1229	63	1615
Capacity Analysis Module:												
Vol/Sat:	0.05	0.41	0.17	0.08	0.40	0.05	0.05	0.05	0.00	0.18	0.18	0.05
Crit Moves:		****		****							****	
Green/Cycle:	0.62	0.55	0.55	0.68	0.58	0.58	0.25	0.25	0.32	0.25	0.25	0.35
Volume/Cap:	0.26	0.74	0.31	0.40	0.69	0.09	0.21	0.21	0.01	0.74	0.74	0.14
Delay/Veh:	11.3	20.2	12.6	13.3	16.4	9.3	30.2	30.2	23.3	43.8	43.8	22.1
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	11.3	20.2	12.6	13.3	16.4	9.3	30.2	30.2	23.3	43.8	43.8	22.1
LOS by Move:	B	C	B	B	B	A	C	C	C	D	D	C
HCM2kAvgQ:	1	19	5	2	17	1	2	2	0	8	8	2

Note: Queue reported is the number of cars per lane.

Palani Affordable Housing
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Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #12 Ane Keohokalole Hwy / Kealakehe Pkwy

Average Delay (sec/veh): 3.4 Worst Case Level Of Service: B[11.7]

Street Name:	Ane Jeohokalole Hwy						Kealakehe Pkwy					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	1 0 1	0 1		1 0 0	1 0		1 0 1	1 0		1 0 1	0 1	
Volume Module:												
Base Vol:	169	0	3	0	0	0	0	44	306	2	65	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	169	0	3	0	0	0	0	44	306	2	65	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	178	0	3	0	0	0	0	46	322	2	68	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	178	0	3	0	0	0	0	46	322	2	68	0
Critical Gap Module:												
Critical Gp:	6.4	6.5	6.2	7.1	6.5	6.2	xxxxx	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	xxxxx	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	280	280	184	96	441	68	xxxx	xxxx	xxxxx	368	xxxx	xxxxx
Potent Cap.:	714	632	863	892	513	1000	xxxx	xxxx	xxxxx	1201	xxxx	xxxxx
Move Cap.:	713	631	863	887	513	1000	xxxx	xxxx	xxxxx	1201	xxxx	xxxxx
Volume/Cap:	0.25	0.00	0.00	0.00	0.00	0.00	xxxx	xxxx	xxxx	0.00	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	1.0	xxxx	0.0	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	0.0	xxxx	xxxxx
Control Del:	11.7	xxxx	9.2	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	8.0	xxxx	xxxxx
LOS by Move:	B	*	A	*	*	*	*	*	*	A	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	0	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	*	*	*	*	*	*	*	*	*	*	*
ApproachDel:	11.7			xxxxxx			xxxxxx			xxxxxx		
ApproachLOS:	B			*			*			*		

Note: Queue reported is the number of cars per lane.

Palani Affordable Housing
Existing Conditions
PM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #1 Queen Kaahumanu Hwy / Henry St

Cycle (sec):	100	Critical Vol./Cap.(X):	0.626
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	24.9
Optimal Cycle:	45	Level Of Service:	C

Street Name:	Queen Kaahumanu Hwy						Henry St					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Prot+Permit			Prot+Permit			Prot+Permit		
Rights:		Ovl			Ovl			Ovl			Ovl	
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	1	1 0	2 0	1	1 0	2 0	1	1 1	1 0	1
Volume Module:												
Base Vol:	169	331	418	166	609	109	67	406	107	436	390	179
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	169	331	418	166	609	109	67	406	107	436	390	179
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	178	348	440	175	641	115	71	427	113	459	411	188
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	178	348	440	175	641	115	71	427	113	459	411	188
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	178	348	440	175	641	115	71	427	113	459	411	188
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	1.00	0.85	0.95	0.95	0.85	0.95	0.95	0.85	0.93	0.93	0.85
Lanes:	1.00	1.00	1.00	1.00	2.00	1.00	1.00	2.00	1.00	1.58	1.42	1.00
Final Sat.:	1805	1900	1615	1805	3610	1615	1805	3610	1615	2784	2490	1615
Capacity Analysis Module:												
Vol/Sat:	0.10	0.18	0.27	0.10	0.18	0.07	0.04	0.12	0.07	0.16	0.16	0.12
Crit Moves:		****		****				****		****		
Green/Cycle:	0.46	0.29	0.56	0.44	0.29	0.37	0.28	0.19	0.35	0.48	0.37	0.52
Volume/Cap:	0.44	0.63	0.49	0.42	0.62	0.19	0.21	0.62	0.20	0.47	0.45	0.22
Delay/Veh:	17.9	33.2	14.0	19.5	32.2	21.3	27.4	38.9	23.0	17.2	24.0	13.1
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	17.9	33.2	14.0	19.5	32.2	21.3	27.4	38.9	23.0	17.2	24.0	13.1
LOS by Move:	B	C	B	B	C	C	C	D	C	B	C	B
HCM2kAvgQ:	4	10	8	4	10	2	2	7	2	7	7	3

Note: Queue reported is the number of cars per lane.

Palani Affordable Housing
Existing Conditions
PM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #2 Queen Kaahumanu Hwy / Alli Dr

Cycle (sec):	100	Critical Vol./Cap.(X):	0.874
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	30.9
Optimal Cycle:	94	Level Of Service:	C

Street Name:	Queen Kaahumanu Hwy						Alli Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Prot+Permit			Prot+Permit			Prot+Permit		
Rights:	Ovl			Ovl			Ovl			Ovl		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0 1	0 1		1 0 1	0 1		1 0 1	0 1		1 0 1	0 1	
Volume Module:												
Base Vol:	28	524	15	170	580	294	269	293	219	51	434	44
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	28	524	15	170	580	294	269	293	219	51	434	44
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	29	552	16	179	611	309	283	308	231	54	457	46
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	29	552	16	179	611	309	283	308	231	54	457	46
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	29	552	16	179	611	309	283	308	231	54	457	46
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	1.00	0.85	0.95	1.00	0.85	0.95	1.00	0.85	0.95	1.00	0.85
Lanes:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Sat.:	1805	1900	1615	1805	1900	1615	1805	1900	1615	1805	1900	1615
Capacity Analysis Module:												
Vol/Sat:	0.02	0.29	0.01	0.10	0.32	0.19	0.16	0.16	0.14	0.03	0.24	0.03
Crit Moves:		****		****			****				****	
Green/Cycle:	0.35	0.33	0.40	0.47	0.42	0.60	0.47	0.38	0.41	0.35	0.28	0.39
Volume/Cap:	0.18	0.87	0.02	0.64	0.76	0.32	0.71	0.42	0.35	0.13	0.87	0.07
Delay/Veh:	23.4	44.3	18.0	25.6	28.6	9.9	27.7	23.0	20.9	22.2	49.7	19.3
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	23.4	44.3	18.0	25.6	28.6	9.9	27.7	23.0	20.9	22.2	49.7	19.3
LOS by Move:	C	D	B	C	C	A	C	C	C	C	D	B
HCM2kAvgQ:	1	19	0	5	17	5	8	7	5	1	17	1

Note: Queue reported is the number of cars per lane.

Palani Affordable Housing
Existing Conditions
PM Peak Hour

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #3 Kamakaeha Ave / Palani Rd

Average Delay (sec/veh): 3.6 Worst Case Level Of Service: D[25.4]

Street Name:	Kamakaeha Ave									Palani Rd								
Approach:	North Bound					South Bound					East Bound					West Bound		
Movement:	L	-	T	-	R	L	-	T	-	R	L	-	T	-	R	L	-	T	-	R
Control:	Stop Sign					Stop Sign					Uncontrolled					Uncontrolled				
Rights:	Include					Include					Include					Include				
Lanes:	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	1	0	1
Volume Module:																				
Base Vol:	0	0	0			127	0			63	0	498			0	0	474			161
Growth Adj:	1.00	1.00	1.00			1.00	1.00			1.00	1.00	1.00			1.00	1.00	1.00			1.00
Initial Bse:	0	0	0			127	0			63	0	498			0	0	474			161
User Adj:	1.00	1.00	1.00			1.00	1.00			1.00	1.00	1.00			1.00	1.00	1.00			1.00
PHF Adj:	0.95	0.95	0.95			0.95	0.95			0.95	0.95	0.95			0.95	0.95	0.95			0.95
PHF Volume:	0	0	0			134	0			66	0	524			0	0	499			169
Reduct Vol:	0	0	0			0	0			0	0	0			0	0	0			0
FinalVolume:	0	0	0			134	0			66	0	524			0	0	499			169
Critical Gap Module:																				
Critical Gp:	xxxxx	xxxx	xxxxx			6.4	xxxx			6.2	xxxxx	xxxx	xxxxx			xxxxx	xxxx	xxxxx		
FollowUpTim:	xxxxx	xxxx	xxxxx			3.5	xxxx			3.3	xxxxx	xxxx	xxxxx			xxxxx	xxxx	xxxxx		
Capacity Module:																				
Cnflict Vol:	xxxx	xxxx	xxxxx			1023	xxxx			499	xxxx	xxxx	xxxxx			xxxx	xxxx	xxxxx		
Potent Cap.:	xxxx	xxxx	xxxxx			263	xxxx			576	xxxx	xxxx	xxxxx			xxxx	xxxx	xxxxx		
Move Cap.:	xxxx	xxxx	xxxxx			263	xxxx			576	xxxx	xxxx	xxxxx			xxxx	xxxx	xxxxx		
Volume/Cap:	xxxx	xxxx	xxxx			0.51	xxxx			0.12	xxxx	xxxx	xxxx			xxxx	xxxx	xxxx		
Level Of Service Module:																				
2Way95thQ:	xxxx	xxxx	xxxxx			2.7	xxxx			0.4	xxxx	xxxx	xxxxx			xxxx	xxxx	xxxxx		
Control Del:	xxxxx	xxxx	xxxxx			32.0	xxxx			12.1	xxxxx	xxxx	xxxxx			xxxxx	xxxx	xxxxx		
LOS by Move:	*	*	*			D	*			B	*	*	*			*	*	*		
Movement:	LT	-	LTR	-	RT	LT	-	LTR	-	RT	LT	-	LTR	-	RT	LT	-	LTR	-	RT
Shared Cap.:	xxxx	xxxx	xxxxx			xxxx	xxxx	xxxxx			xxxx	xxxx	xxxxx			xxxx	xxxx	xxxxx		
SharedQueue:	xxxxx	xxxx	xxxxx			xxxxx	xxxx	xxxxx			xxxxx	xxxx	xxxxx			xxxxx	xxxx	xxxxx		
Shrd ConDel:	xxxxx	xxxx	xxxxx			xxxxx	xxxx	xxxxx			xxxxx	xxxx	xxxxx			xxxxx	xxxx	xxxxx		
Shared LOS:	*	*	*			*	*	*			*	*	*			*	*	*		
ApproachDel:	xxxxxx					25.4					xxxxxx					xxxxxx				
ApproachLOS:	*					D					*					*				

Note: Queue reported is the number of cars per lane.

Palani Affordable Housing
Existing Conditions
PM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Henry St / Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	0.804
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	18.5
Optimal Cycle:	72	Level Of Service:	B

Street Name:	Henry St						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Prot+Permit		
Rights:	Ovl			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	0 0	1	0 0	0 0	0	0 0	0 1	0	1 0	1 0	0
Volume Module:												
Base Vol:	110	0	377	0	0	0	0	484	149	484	501	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	110	0	377	0	0	0	0	484	149	484	501	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	116	0	397	0	0	0	0	509	157	509	527	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	116	0	397	0	0	0	0	509	157	509	527	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	116	0	397	0	0	0	0	509	157	509	527	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.77	1.00	0.85	1.00	1.00	1.00	1.00	0.97	0.97	0.95	1.00	1.00
Lanes:	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.76	0.24	1.00	1.00	0.00
Final Sat.:	1461	0	1615	0	0	0	0	1406	433	1805	1900	0
Capacity Analysis Module:												
Vol/Sat:	0.08	0.00	0.25	0.00	0.00	0.00	0.00	0.36	0.36	0.28	0.28	0.00
Crit Moves:	****							****		****		
Green/Cycle:	0.10	0.00	0.45	0.00	0.00	0.00	0.00	0.45	0.45	0.80	0.80	0.00
Volume/Cap:	0.80	0.00	0.55	0.00	0.00	0.00	0.00	0.80	0.80	0.41	0.35	0.00
Delay/Veh:	71.1	0.0	21.0	0.0	0.0	0.0	0.0	29.4	29.4	6.5	2.9	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	71.1	0.0	21.0	0.0	0.0	0.0	0.0	29.4	29.4	6.5	2.9	0.0
LOS by Move:	E	A	C	A	A	A	A	C	C	A	A	A
HCM2kAvgQ:	6	0	9	0	0	0	0	19	19	5	5	0

Note: Queue reported is the number of cars per lane.

Palani Affordable Housing
Existing Conditions
PM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu Hwy / Makala Blvd

Cycle (sec):	100	Critical Vol./Cap.(X):	0.973
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	35.6
Optimal Cycle:	161	Level Of Service:	D

Street Name:	Queen Kaahumanu Hwy						Makala Blvd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Prot+Permit			Prot+Permit			Prot+Permit			Prot+Permit		
Rights:	Ovl			Ovl			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	1	1 0	1 0	1	1 0	0 1	0	1 0	0 1	0
Volume Module:												
Base Vol:	11	569	65	70	938	240	417	126	41	21	71	104
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	11	569	65	70	938	240	417	126	41	21	71	104
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	12	599	68	74	987	253	439	133	43	22	75	109
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	12	599	68	74	987	253	439	133	43	22	75	109
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	12	599	68	74	987	253	439	133	43	22	75	109
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	1.00	0.85	0.95	1.00	0.85	0.95	0.96	0.96	0.95	0.91	0.91
Lanes:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.75	0.25	1.00	0.41	0.59
Final Sat.:	1805	1900	1615	1805	1900	1615	1805	1380	449	1805	702	1029
Capacity Analysis Module:												
Vol/Sat:	0.01	0.32	0.04	0.04	0.52	0.16	0.24	0.10	0.10	0.01	0.11	0.11
Crit Moves:	****				****		****				****	
Green/Cycle:	0.49	0.48	0.52	0.56	0.53	0.78	0.38	0.32	0.32	0.15	0.11	0.11
Volume/Cap:	0.13	0.66	0.08	0.24	0.97	0.20	0.84	0.30	0.30	0.11	0.97	0.97
Delay/Veh:	25.5	21.6	12.1	13.9	44.4	2.8	37.0	26.0	26.0	36.8	102	101.7
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	25.5	21.6	12.1	13.9	44.4	2.8	37.0	26.0	26.0	36.8	102	101.7
LOS by Move:	C	C	B	B	D	A	D	C	C	D	F	F
HCM2kAvgQ:	0	15	1	1	36	2	15	4	4	1	10	10

Note: Queue reported is the number of cars per lane.

Palani Affordable Housing
Existing Conditions
PM Peak Hour

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #8 Palihiolo St/Palani Rd

Average Delay (sec/veh): 1.7 Worst Case Level Of Service: F[59.5]

Street Name:	Palihiolo St						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1! 0 0			0 0 0 0 0			0 0 0 1 0			0 1 0 0 0		
Volume Module:												
Base Vol:	23	0	26	0	0	0	0	798	11	39	1009	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	23	0	26	0	0	0	0	798	11	39	1009	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	24	0	27	0	0	0	0	840	12	41	1062	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	24	0	27	0	0	0	0	840	12	41	1062	0
Critical Gap Module:												
Critical Gp:	6.4	6.5	6.2	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1990	1990	846	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	852	xxxx	xxxxx
Potent Cap.:	68	61	365	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	796	xxxx	xxxxx
Move Cap.:	65	58	365	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	796	xxxx	xxxxx
Volume/Cap:	0.37	0.00	0.07	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	0.05	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	0.2	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	9.8	xxxx	xxxxx
LOS by Move:	*	*	*	*	*	*	*	*	*	A	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	115	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	2.0	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	0.2	xxxx	xxxxx
Shrd ConDel:	xxxxx	59.5	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	9.8	xxxx	xxxxx
Shared LOS:	*	F	*	*	*	*	*	*	*	A	*	*
ApproachDel:		59.5			xxxxxx			xxxxxx			xxxxxx	
ApproachLOS:		F			*			*			*	

Note: Queue reported is the number of cars per lane.

Palani Affordable Housing
Existing Conditions
PM Peak Hour

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #9 Kealakaa St/Palani

Average Delay (sec/veh): 5.5 Worst Case Level Of Service: D[32.5]

Street Name:	Kealakaa St									Palani Rd													
Approach:	North Bound					South Bound					East Bound					West Bound							
Movement:	L	-	T	-	R	L	-	T	-	R	L	-	T	-	R	L	-	T	-	R			
Control:	Stop Sign					Stop Sign					Uncontrolled					Uncontrolled							
Rights:	Include					Include					Include					Include							
Lanes:	0	0	0	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	1	0			
Volume Module:																							
Base Vol:	0	0	0			6	0			225	224		557		0	0		795		18			
Growth Adj:	1.00	1.00	1.00			1.00	1.00			1.00	1.00		1.00		1.00	1.00		1.00		1.00			
Initial Bse:	0	0	0			6	0			225	224		557		0	0		795		18			
User Adj:	1.00	1.00	1.00			1.00	1.00			1.00	1.00		1.00		1.00	1.00		1.00		1.00			
PHF Adj:	0.95	0.95	0.95			0.95	0.95			0.95	0.95		0.95		0.95	0.95		0.95		0.95			
PHF Volume:	0	0	0			6	0			237	236		586		0	0		837		19			
Reduct Vol:	0	0	0			0	0			0	0		0		0	0		0		0			
FinalVolume:	0	0	0			6	0			237	236		586		0	0		837		19			
Critical Gap Module:																							
Critical Gp:	xxxxx	xxxx	xxxxx			6.4	xxxx			6.2	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx							
FollowUpTim:	xxxxx	xxxx	xxxxx			3.5	xxxx			3.3	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx							
Capacity Module:																							
Cnflict Vol:	xxxx	xxxx	xxxxx			1904	xxxx			846	856	xxxx	xxxxx	xxxx	xxxx	xxxxx							
Potent Cap.:	xxxx	xxxx	xxxxx			77	xxxx			365	793	xxxx	xxxxx	xxxx	xxxx	xxxxx							
Move Cap.:	xxxx	xxxx	xxxxx			56	xxxx			365	793	xxxx	xxxxx	xxxx	xxxx	xxxxx							
Volume/Cap:	xxxx	xxxx	xxxx			0.11	xxxx			0.65	0.30	xxxx	xxxx	xxxx	xxxx	xxxx							
Level Of Service Module:																							
2Way95thQ:	xxxx	xxxx	xxxxx			0.4	xxxx			4.4	1.2	xxxx	xxxxx	xxxx	xxxx	xxxxx							
Control Del:	xxxxx	xxxx	xxxxx			77.0	xxxx			31.3	11.5	xxxx	xxxxx	xxxxx	xxxx	xxxxx							
LOS by Move:	*	*	*			F	*			D	B	*	*	*	*	*							
Movement:	LT	-	LTR	-	RT	LT	-	LTR	-	RT	LT	-	LTR	-	RT	LT	-	LTR	-	RT			
Shared Cap.:	xxxx	xxxx	xxxxx			xxxx	xxxx			xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx							
SharedQueue:	xxxxx	xxxx	xxxxx			xxxxx	xxxx			xxxxx	1.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx							
Shrd ConDel:	xxxxx	xxxx	xxxxx			xxxxx	xxxx			xxxxx	11.5	xxxx	xxxxx	xxxxx	xxxx	xxxxx							
Shared LOS:	*	*	*			*	*			*	B	*	*	*	*	*							
ApproachDel:	xxxxxx					32.5					xxxxxx					xxxxxx							
ApproachLOS:	*					D					*					*							

Note: Queue reported is the number of cars per lane.

Palani Affordable Housing
Existing Conditions
PM Peak Hour

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #10 Palani Rd / Uluaoa St

Average Delay (sec/veh): 3.5 Worst Case Level Of Service: F[53.3]

Street Name:	Palani Rd								Uluaoa St							
Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	- T	- R		L	- T	- R		L	- T	- R		L	- T	- R	
Control:	Uncontrolled				Uncontrolled				Stop Sign				Stop Sign			
Rights:	Include				Include				Include				Include			
Lanes:	0 1	0 0	0		0 0	0 1	0		1 0	0 0	1		0 0	0 0	0	
Volume Module:																
Base Vol:	23	556	0	0	789	145	71	0	32	0	0	0				
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Initial Bse:	23	556	0	0	789	145	71	0	32	0	0	0				
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95				
PHF Volume:	24	585	0	0	831	153	75	0	34	0	0	0				
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0				
FinalVolume:	24	585	0	0	831	153	75	0	34	0	0	0				
Critical Gap Module:																
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.4	xxxx	6.2	xxxxx	xxxx	xxxxx				
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	xxxx	3.3	xxxxx	xxxx	xxxxx				
Capacity Module:																
Cnflict Vol:	983	xxxx	xxxxx	xxxx	xxxx	xxxxx	1541	xxxx	907	xxxx	xxxx	xxxxx				
Potent Cap.:	710	xxxx	xxxxx	xxxx	xxxx	xxxxx	128	xxxx	337	xxxx	xxxx	xxxxx				
Move Cap.:	710	xxxx	xxxxx	xxxx	xxxx	xxxxx	125	xxxx	337	xxxx	xxxx	xxxxx				
Volume/Cap:	0.03	xxxx	xxxx	xxxx	xxxx	xxxx	0.60	xxxx	0.10	xxxx	xxxx	xxxx				
Level Of Service Module:																
2Way95thQ:	0.1	xxxx	xxxxx	xxxx	xxxx	xxxxx	3.0	xxxx	0.3	xxxx	xxxx	xxxxx				
Control Del:	10.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	69.7	xxxx	16.9	xxxxx	xxxx	xxxxx				
LOS by Move:	B	*	*	*	*	*	F	*	C	*	*	*				
Movement:	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT				
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
SharedQueue:	0.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
Shrd ConDel:	10.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
Shared LOS:	B	*	*	*	*	*	*	*	*	*	*	*				
ApproachDel:	xxxxxx			xxxxxx			53.3			xxxxxx						
ApproachLOS:	*			*			F			*						

Note: Queue reported is the number of cars per lane.

Palani Affordable Housing
Existing Conditions
PM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #11 Queen Kaahumanu Hwy / Kealakehe Pkwy

Cycle (sec):	100	Critical Vol./Cap.(X):	0.652
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	10.5
Optimal Cycle:	48	Level Of Service:	B

Street Name:	Queen Kaahumanu Hwy						Kaalakehe Pkwy					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Prot+Permit			Prot+Permit			Permitted			Permitted		
Rights:		Ovl			Ovl			Ovl			Ovl	
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	1	1 0	1 0	1	0 1	0 0	1	0 1	0 0	1
Volume Module:												
Base Vol:	56	907	143	44	777	65	63	7	57	60	6	55
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	56	907	143	44	777	65	63	7	57	60	6	55
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	59	955	151	46	818	68	66	7	60	63	6	58
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	59	955	151	46	818	68	66	7	60	63	6	58
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	59	955	151	46	818	68	66	7	60	63	6	58
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	1.00	0.85	0.95	1.00	0.85	0.67	0.67	0.85	0.64	0.64	0.85
Lanes:	1.00	1.00	1.00	1.00	1.00	1.00	0.90	0.10	1.00	0.91	0.09	1.00
Final Sat.:	1805	1900	1615	1805	1900	1615	1137	126	1615	1104	110	1615
Capacity Analysis Module:												
Vol/Sat:	0.03	0.50	0.09	0.03	0.43	0.04	0.06	0.06	0.04	0.06	0.06	0.04
Crit Moves:		****		****				****				
Green/Cycle:	0.84	0.77	0.77	0.79	0.75	0.75	0.09	0.09	0.15	0.09	0.09	0.13
Volume/Cap:	0.12	0.65	0.12	0.12	0.57	0.06	0.65	0.65	0.25	0.64	0.64	0.28
Delay/Veh:	3.7	6.3	2.9	4.7	5.9	3.2	56.8	56.8	38.4	56.1	56.1	40.1
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	3.7	6.3	2.9	4.7	5.9	3.2	56.8	56.8	38.4	56.1	56.1	40.1
LOS by Move:	A	A	A	A	A	A	E	E	D	E	E	D
HCM2kAvgQ:	0	14	1	0	11	1	3	3	2	3	3	2

Note: Queue reported is the number of cars per lane.

Palani Affordable Housing
Existing Conditions
PM Peak Hour

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #12 Ane Keohokalole Hwy / Kealakehe Pkwy

Average Delay (sec/veh): 1.7 Worst Case Level Of Service: B[10.5]

Street Name:	Ane Jeohokalole Hwy						Kealakehe Pkwy					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	1 0 1 0 1			1 0 0 1 0			1 0 1 1 0			1 0 1 0 1		
Volume Module:												
Base Vol:	58	0	0	0	0	0	0	114	123	5	72	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	58	0	0	0	0	0	0	114	123	5	72	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	61	0	0	0	0	0	0	120	129	5	76	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	61	0	0	0	0	0	0	120	129	5	76	0
Critical Gap Module:												
Critical Gp:	6.4	6.5	6.2	7.1	6.5	6.2	xxxxx	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	xxxxx	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	271	271	125	146	336	76	xxxx	xxxx	xxxxx	249	xxxx	xxxxx
Potent Cap.:	723	639	931	827	588	991	xxxx	xxxx	xxxxx	1328	xxxx	xxxxx
Move Cap.:	720	636	931	824	586	991	xxxx	xxxx	xxxxx	1328	xxxx	xxxxx
Volume/Cap:	0.08	0.00	0.00	0.00	0.00	0.00	xxxx	xxxx	xxxx	0.00	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	0.3	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	0.0	xxxx	xxxxx
Control Del:	10.5	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	7.7	xxxx	xxxxx
LOS by Move:	B	*	*	*	*	*	*	*	*	A	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	0	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	*	*	*	*	*	*	*	*	*	*	*
ApproachDel:	10.5			xxxxxx			xxxxxx			xxxxxx		
ApproachLOS:	B			*			*			*		

Note: Queue reported is the number of cars per lane.

CUMULATIVE BASE CONDITIONS

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #1 Queen Kaahumanu Hwy / Henry St

Cycle (sec):	100	Critical Vol./Cap.(X):	0.813
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	26.1
Optimal Cycle:	74	Level Of Service:	C

Street Name:	Queen Kaahumanu Hwy						Henry St					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Prot+Permit			Prot+Permit			Prot+Permit		
Rights:	Ovl			Ovl			Ovl			Ovl		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0 2 0 1			1 0 3 0 1			1 0 2 0 1			1 1 1 0 1		
Volume Module:												
Base Vol:	320	749	878	130	509	132	76	286	25	577	529	99
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	320	749	878	130	509	132	76	286	25	577	529	99
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	337	788	924	137	536	139	80	301	26	607	557	104
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	337	788	924	137	536	139	80	301	26	607	557	104
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	337	788	924	137	536	139	80	301	26	607	557	104
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	0.95	0.85	0.95	0.91	0.85	0.95	0.95	0.85	0.92	0.93	0.85
Lanes:	1.00	2.00	1.00	1.00	3.00	1.00	1.00	2.00	1.00	1.57	1.43	1.00
Final Sat.:	1805	3610	1615	1805	5187	1615	1805	3610	1615	2754	2525	1615
Capacity Analysis Module:												
Vol/Sat:	0.19	0.22	0.57	0.08	0.10	0.09	0.04	0.08	0.02	0.22	0.22	0.06
Crit Moves:			****	****				****		****		
Green/Cycle:	0.55	0.43	0.70	0.28	0.19	0.25	0.17	0.10	0.44	0.39	0.31	0.40
Volume/Cap:	0.47	0.50	0.81	0.47	0.55	0.34	0.40	0.81	0.04	0.64	0.71	0.16
Uniform Del:	13.1	20.6	10.2	28.0	36.8	30.8	36.5	43.9	15.9	23.6	30.4	18.9
IncremntDel:	0.5	0.3	4.6	1.2	0.7	0.5	1.3	12.8	0.0	0.8	1.5	0.1
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	13.6	20.8	14.8	29.2	37.5	31.3	37.8	56.8	15.9	24.4	31.9	19.1
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	13.6	20.8	14.8	29.2	37.5	31.3	37.8	56.8	15.9	24.4	31.9	19.1
LOS by Move:	B	C	B	C	D	C	D	E	B	C	C	B
HCM2kAvgQ:	7	9	22	4	6	4	3	7	0	11	12	2

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

****

Intersection #2 Queen Kaahumanu Hwy / Alli Dr

****

Cycle (sec): 100 Critical Vol./Cap.(X): 0.873
Loss Time (sec): 10 (Y+R=4.0 sec) Average Delay (sec/veh): 33.3
Optimal Cycle: 93 Level Of Service: C

****

Street Name:	Queen Kaahumanu Hwy						Alli Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Prot+Permit			Prot+Permit			Prot+Permit		
Rights:		Ovl			Ovl			Ovl			Ovl	
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	2 0	1	1 0	2 0	1	1 0	1 0	1	1 0	1 0	1
Volume Module:												
Base Vol:	97	807	20	126	655	372	193	144	99	32	658	51
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	97	807	20	126	655	372	193	144	99	32	658	51
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	102	849	21	133	689	392	203	152	104	34	693	54
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	102	849	21	133	689	392	203	152	104	34	693	54
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	102	849	21	133	689	392	203	152	104	34	693	54
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	0.95	0.85	0.95	0.95	0.85	0.95	1.00	0.85	0.95	1.00	0.85
Lanes:	1.00	2.00	1.00	1.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Sat.:	1805	3610	1615	1805	3610	1615	1805	1900	1615	1805	1900	1615
Capacity Analysis Module:												
Vol/Sat:	0.06	0.24	0.01	0.07	0.19	0.24	0.11	0.08	0.06	0.02	0.36	0.03
Crit Moves:		****		****			****				****	
Green/Cycle:	0.35	0.27	0.37	0.37	0.27	0.40	0.57	0.44	0.52	0.52	0.42	0.50
Volume/Cap:	0.45	0.87	0.03	0.59	0.70	0.60	0.66	0.18	0.12	0.05	0.87	0.07
Uniform Del:	23.8	34.9	19.9	24.0	32.7	23.6	22.0	16.9	12.1	11.7	26.7	12.8
IncremntDel:	1.4	8.8	0.0	3.9	2.3	1.6	5.2	0.1	0.1	0.0	10.5	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	25.2	43.7	19.9	28.0	34.9	25.2	27.2	17.0	12.2	11.7	37.2	12.9
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	25.2	43.7	19.9	28.0	34.9	25.2	27.2	17.0	12.2	11.7	37.2	12.9
LOS by Move:	C	D	B	C	C	C	C	B	B	B	D	B
HCM2kAvgQ:	3	16	0	4	11	10	6	3	2	1	23	1

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Note: Queue reported is the number of cars per lane.

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                      Level Of Service Computation Report
            2000 HCM Unsignalized Method (Base Volume Alternative)
******************************************************************************
Intersection #3 Kamakaeha Ave / Palani Rd
******************************************************************************
Average Delay (sec/veh):      1.2       Worst Case Level Of Service: C[ 22.5]
******************************************************************************
Street Name:          Kamakaeha Ave                       Palani Rd
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Stop Sign        Stop Sign       Uncontrolled     Uncontrolled
Rights:           Include          Include          Include          Ignore
Lanes:        0  0  0  0  0    1  0  0  0  1    0  0  1  0  0    0  0  1  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0    0     0    47    0    15     0  290     0     0  775   240
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:    0    0     0    47    0    15     0  290     0     0  775   240
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.00
PHF Volume:     0    0     0    49    0    16     0  305     0     0  816     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    0    0     0    49    0    16     0  305     0     0  816     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx   6.4 xxxx   6.2 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
FollowUpTim:xxxxx xxxx xxxxx   3.5 xxxx   3.3 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx  1121 xxxx   816  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Potent Cap.: xxxx xxxx xxxxx   230 xxxx   380  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Move Cap.:   xxxx xxxx xxxxx   230 xxxx   380  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Volume/Cap:  xxxx xxxx  xxxx  0.21 xxxx  0.04  xxxx xxxx  xxxx  xxxx xxxx  xxxx
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx   0.8 xxxx   0.1  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx  24.9 xxxx  14.9 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:   *    *     *     C    *     B     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:    *    *     *     *    *     *     *    *     *     *    *     *
ApproachDel:    xxxxxx             22.5           xxxxxx           xxxxxx
ApproachLOS:        *                C               *                *
******************************************************************************
Note: Queue reported is the number of cars per lane.
******************************************************************************
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Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Henry St / Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	1.099
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	81.1
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Henry St						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Prot+Permit		
Rights:	Ovl			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	0 1	0	1 0	0 1	0	1 0	0 1	0	1 0	0 1	0
Volume Module:												
Base Vol:	122	234	454	31	372	217	123	185	37	900	810	90
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	122	234	454	31	372	217	123	185	37	900	810	90
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	128	246	478	33	392	228	129	195	39	947	853	95
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	128	246	478	33	392	228	129	195	39	947	853	95
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	128	246	478	33	392	228	129	195	39	947	853	95
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.16	0.90	0.90	0.09	0.95	0.95	0.95	0.98	0.98	0.96	0.99	0.99
Lanes:	1.00	0.34	0.66	1.00	0.63	0.37	1.00	0.83	0.17	1.00	0.90	0.10
Final Sat.:	312	582	1130	177	1134	661	1805	1544	309	1820	1684	187
Capacity Analysis Module:												
Vol/Sat:	0.41	0.42	0.42	0.18	0.35	0.35	0.07	0.13	0.13	0.52	0.51	0.51
Crit Moves:		****						****		****		
Green/Cycle:	0.35	0.35	0.79	0.35	0.35	0.35	0.07	0.11	0.11	0.48	0.48	0.48
Volume/Cap:	1.16	1.19	0.53	0.45	0.97	0.97	1.06	1.19	1.19	1.09	1.06	1.06
Uniform Del:	32.3	32.3	3.7	24.8	31.8	31.8	46.6	44.7	44.7	26.9	26.1	26.1
IncremntDel:	135.9	103	0.4	4.5	29.1	29.1	98.2	126	126.2	59.5	47.1	47.1
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	168.2	135	4.1	29.3	61.0	61.0	144.8	171	170.9	86.3	73.2	73.2
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	168.2	135	4.1	29.3	61.0	61.0	144.8	171	170.9	86.3	73.2	73.2
LOS by Move:	F	F	A	C	E	E	F	F	F	F	E	E
HCM2kAvgQ:	9	39	8	1	25	25	8	15	15	43	41	41

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu Hwy / Makala Blvd

Cycle (sec):	100	Critical Vol./Cap.(X):	0.653
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	22.0
Optimal Cycle:	48	Level Of Service:	C

Street Name:	Queen Kaahumanu Hwy						Makala Blvd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T	- R		L - T	- R		L - T	- R		L - T	- R	
Control:	Prot+Permit			Prot+Permit			Prot+Permit			Prot+Permit		
Rights:	Ovl			Ovl			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	2 0	1	1 0	2 0	1	1 0	0 1	0	1 0	0 1	0
Volume Module:												
Base Vol:	10	902	30	68	840	200	309	72	32	7	21	143
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	10	902	30	68	840	200	309	72	32	7	21	143
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	11	949	32	72	884	211	325	76	34	7	22	151
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	11	949	32	72	884	211	325	76	34	7	22	151
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	11	949	32	72	884	211	325	76	34	7	22	151
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	0.95	0.85	0.95	0.95	0.85	0.95	0.95	0.95	0.95	0.87	0.87
Lanes:	1.00	2.00	1.00	1.00	2.00	1.00	1.00	0.69	0.31	1.00	0.13	0.87
Final Sat.:	1805	3610	1615	1805	3610	1615	1805	1255	558	1805	211	1440
Capacity Analysis Module:												
Vol/Sat:	0.01	0.26	0.02	0.04	0.24	0.13	0.18	0.06	0.06	0.00	0.10	0.10
Crit Moves:		****		****			****				****	
Green/Cycle:	0.41	0.40	0.43	0.48	0.45	0.73	0.46	0.41	0.41	0.19	0.16	0.16
Volume/Cap:	0.05	0.65	0.05	0.32	0.54	0.18	0.53	0.15	0.15	0.03	0.65	0.65
Uniform Del:	18.0	24.2	16.5	16.6	19.8	4.2	18.2	18.6	18.6	33.1	39.4	39.4
IncremntDel:	0.1	1.1	0.0	0.8	0.4	0.1	0.9	0.1	0.1	0.0	5.7	5.7
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	18.1	25.3	16.6	17.4	20.2	4.3	19.1	18.7	18.7	33.2	45.1	45.1
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	18.1	25.3	16.6	17.4	20.2	4.3	19.1	18.7	18.7	33.2	45.1	45.1
LOS by Move:	B	C	B	B	C	A	B	B	B	C	D	D
HCM2kAvgQ:	0	13	1	2	11	2	8	2	2	0	6	6

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #8 Palihiolo St/Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	1.522
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	171.2
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Palihiolo St						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Prot+Permit			Permitted		
Rights:	Include			Include			Include			Ignore		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 1	0 0	1	1	0 0	1 0	1	0 0	1 0	1	0 1	0 1
Volume Module:												
Base Vol:	5	20	32	10	15	521	438	476	6	20	1254	56
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	5	20	32	10	15	521	438	476	6	20	1254	56
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.00
PHF Volume:	5	21	34	11	16	548	461	501	6	21	1320	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	5	21	34	11	16	548	461	501	6	21	1320	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
FinalVolume:	5	21	34	11	16	548	461	501	6	21	1320	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.64	0.64	0.85	0.75	0.85	0.85	0.24	1.00	1.00	0.95	1.00	1.00
Lanes:	0.20	0.80	1.00	1.00	0.03	0.97	1.00	0.99	0.01	1.00	1.00	1.00
Final Sat.:	243	973	1615	1419	45	1577	451	1873	24	1805	1900	1900
Capacity Analysis Module:												
Vol/Sat:	0.02	0.02	0.02	0.01	0.35	0.35	1.02	0.27	0.27	0.01	0.69	0.00
Crit Moves:					****		****					
Green/Cycle:	0.24	0.24	0.24	0.24	0.24	0.24	0.63	0.63	0.63	0.03	0.48	0.00
Volume/Cap:	0.09	0.09	0.09	0.03	1.44	1.44	1.17	0.42	0.42	0.42	1.44	0.00
Uniform Del:	29.4	29.4	29.4	29.0	37.9	37.9	8.7	9.3	9.3	47.8	25.9	0.0
IncremntDel:	0.1	0.1	0.1	0.0	213	213.0	98.5	0.2	0.2	5.7	205	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Delay/Veh:	29.6	29.6	29.5	29.0	251	250.9	107.2	9.5	9.5	53.6	231	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	29.6	29.6	29.5	29.0	251	250.9	107.2	9.5	9.5	53.6	231	0.0
LOS by Move:	C	C	C	C	F	F	F	A	A	D	F	A
HCM2kAvgQ:	1	1	1	0	40	40	26	8	8	1	90	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #10 Palani Rd / Uluaoa St

Average Delay (sec/veh): 32.4 Worst Case Level Of Service: F[161.1]

Street Name:	Palani Rd						Uluaoa St					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	0 1 0 0 0			0 0 0 1 0			1 0 0 0 1			0 0 0 0 0		
Volume Module:												
Base Vol:	58	422	0	0	723	311	176	0	200	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	58	422	0	0	723	311	176	0	200	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	61	444	0	0	761	327	185	0	211	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	61	444	0	0	761	327	185	0	211	0	0	0
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.4	xxxx	6.2	xxxxx	xxxx	xxxxx
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	xxxx	3.3	xxxxx	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1088	xxxx	xxxxx	xxxx	xxxx	xxxxx	1491	xxxx	925	xxxx	xxxx	xxxxx
Potent Cap.:	649	xxxx	xxxxx	xxxx	xxxx	xxxxx	138	xxxx	329	xxxx	xxxx	xxxxx
Move Cap.:	649	xxxx	xxxxx	xxxx	xxxx	xxxxx	127	xxxx	329	xxxx	xxxx	xxxxx
Volume/Cap:	0.09	xxxx	xxxx	xxxx	xxxx	xxxx	1.46	xxxx	0.64	xxxx	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	0.3	xxxx	xxxxx	xxxx	xxxx	xxxxx	12.7	xxxx	4.2	xxxx	xxxx	xxxxx
Control Del:	11.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	306.2	xxxx	33.5	xxxxx	xxxx	xxxxx
LOS by Move:	B	*	*	*	*	*	F	*	D	*	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	0.3	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	11.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	B	*	*	*	*	*	*	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			161.1			xxxxxx		
ApproachLOS:	*			*			F			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #11 Queen Kaahumanu Hwy / Kealakehe Pkwy

Cycle (sec):	100	Critical Vol./Cap.(X):	0.748
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	25.9
Optimal Cycle:	61	Level Of Service:	C

Street Name:	Queen Kaahumanu Hwy						Kaalakehe Pkwy					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Prot+Permit			Permitted			Permitted		
Rights:		Ovl			Ovl			Ovl			Ovl	
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0 2 0 1			1 0 2 0 1			0 1 0 0 1			0 1 0 0 1		
Volume Module:												
Base Vol:	115	995	422	171	910	249	81	107	10	231	61	81
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	115	995	422	171	910	249	81	107	10	231	61	81
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	121	1047	444	180	958	262	85	113	11	243	64	85
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	121	1047	444	180	958	262	85	113	11	243	64	85
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	121	1047	444	180	958	262	85	113	11	243	64	85
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	0.95	0.85	0.95	0.95	0.85	0.64	0.64	0.85	0.57	0.57	0.85
Lanes:	1.00	2.00	1.00	1.00	2.00	1.00	0.43	0.57	1.00	0.79	0.21	1.00
Final Sat.:	1805	3610	1615	1805	3610	1615	526	694	1615	858	227	1615
Capacity Analysis Module:												
Vol/Sat:	0.07	0.29	0.28	0.10	0.27	0.16	0.16	0.16	0.01	0.28	0.28	0.05
Crit Moves:		****		****							****	
Green/Cycle:	0.49	0.39	0.39	0.55	0.42	0.42	0.38	0.38	0.48	0.38	0.38	0.51
Volume/Cap:	0.38	0.75	0.71	0.57	0.64	0.39	0.43	0.43	0.01	0.75	0.75	0.10
Uniform Del:	15.5	26.4	25.8	16.6	23.2	20.4	23.0	23.0	13.4	26.9	26.9	12.6
IncremntDel:	0.8	2.3	3.8	2.4	0.9	0.4	0.6	0.6	0.0	7.4	7.4	0.1
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	16.3	28.7	29.6	19.0	24.1	20.7	23.7	23.7	13.4	34.3	34.3	12.6
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	16.3	28.7	29.6	19.0	24.1	20.7	23.7	23.7	13.4	34.3	34.3	12.6
LOS by Move:	B	C	C	B	C	C	C	C	B	C	C	B
HCM2kAvgQ:	3	16	13	4	13	6	5	5	0	10	10	1

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #12 Ane Keohokalole Hwy / Kealakehe Pkwy

Average Delay (sec/veh): OVERFLOW Worst Case Level Of Service: F[xxxxx]

Street Name:	Ane Keohokalole Hwy						Kealakehe Pkwy					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	1 0 1	0 1		1 0	0 1	0	1 0	1	1 0	1 0	1	0 1
Volume Module:												
Base Vol:	124	320	3	12	295	45	369	94	323	2	115	50
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	124	320	3	12	295	45	369	94	323	2	115	50
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	131	337	3	13	311	47	388	99	340	2	121	53
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	131	337	3	13	311	47	388	99	340	2	121	53
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1376	1224	219	1120	1341	121	174	xxxx	xxxxx	439	xxxx	xxxxx
Potent Cap.:	124	181	825	185	154	936	1415	xxxx	xxxxx	1132	xxxx	xxxxx
Move Cap.:	0	131	825	0	111	936	1415	xxxx	xxxxx	1132	xxxx	xxxxx
Volume/Cap:	xxxx	2.57	0.00	xxxx	2.79	0.05	0.27	xxxx	xxxx	0.00	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	30.0	0.0	xxxx	xxxx	xxxxx	1.1	xxxx	xxxxx	0.0	xxxx	xxxxx
Control Del:	xxxxx	783	9.4	xxxxx	xxxx	xxxxx	8.5	xxxx	xxxxx	8.2	xxxx	xxxxx
LOS by Move:	*	F	A	*	*	*	A	*	*	A	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	126	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	33.0	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	903.4	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	*	*	*	*	F	*	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			xxxxxx			xxxxxx		
ApproachLOS:	F			F			*			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #1 Queen Kaahumanu Hwy / Henry St

Cycle (sec):	100	Critical Vol./Cap.(X):	0.819
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	27.2
Optimal Cycle:	76	Level Of Service:	C

Street Name:	Queen Kaahumanu Hwy						Henry St					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Prot+Permit			Prot+Permit			Prot+Permit		
Rights:	Ovl			Ovl			Ovl			Ovl		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	2 0	1	1 0	3 0	1	1 0	2 0	1	1 1	1 0	1
Volume Module:												
Base Vol:	282	464	768	183	673	121	76	444	107	514	460	211
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	282	464	768	183	673	121	76	444	107	514	460	211
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	297	488	808	193	708	127	80	467	113	541	484	222
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	297	488	808	193	708	127	80	467	113	541	484	222
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	297	488	808	193	708	127	80	467	113	541	484	222
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	0.95	0.85	0.95	0.91	0.85	0.95	0.95	0.85	0.93	0.93	0.85
Lanes:	1.00	2.00	1.00	1.00	3.00	1.00	1.00	2.00	1.00	1.58	1.42	1.00
Final Sat.:	1805	3610	1615	1805	5187	1615	1805	3610	1615	2783	2491	1615
Capacity Analysis Module:												
Vol/Sat:	0.16	0.14	0.50	0.11	0.14	0.08	0.04	0.13	0.07	0.19	0.19	0.14
Crit Moves:			****	****				****		****		
Green/Cycle:	0.52	0.37	0.61	0.36	0.23	0.30	0.23	0.16	0.43	0.42	0.32	0.45
Volume/Cap:	0.50	0.36	0.82	0.44	0.60	0.26	0.29	0.82	0.16	0.59	0.60	0.30
Uniform Del:	14.6	22.7	15.1	23.0	34.4	26.4	30.9	40.7	17.2	21.8	28.5	17.4
IncremntDel:	0.7	0.2	5.5	0.7	0.8	0.3	0.6	9.1	0.1	0.6	0.6	0.2
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	15.3	22.8	20.6	23.7	35.3	26.7	31.5	49.8	17.3	22.4	29.1	17.6
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	15.3	22.8	20.6	23.7	35.3	26.7	31.5	49.8	17.3	22.4	29.1	17.6
LOS by Move:	B	C	C	C	D	C	C	D	B	C	C	B
HCM2kAvgQ:	6	6	21	5	8	3	2	10	2	9	10	4

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #2 Queen Kaahumanu Hwy / Alli Dr

Cycle (sec):	100	Critical Vol./Cap.(X):	0.988
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	39.8
Optimal Cycle:	180	Level Of Service:	D

Street Name:	Queen Kaahumanu Hwy						Alli Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Prot+Permit			Prot+Permit			Prot+Permit		
Rights:	Ovl			Ovl			Ovl			Ovl		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	2 0	1	1 0	2 0	1	1 0	1 0	1	1 0	1 0	1
Volume Module:												
Base Vol:	38	706	20	207	707	358	269	293	219	86	732	74
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	38	706	20	207	707	358	269	293	219	86	732	74
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	40	743	21	218	744	377	283	308	231	91	771	78
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	40	743	21	218	744	377	283	308	231	91	771	78
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	40	743	21	218	744	377	283	308	231	91	771	78
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	0.95	0.85	0.95	0.95	0.85	0.95	1.00	0.85	0.95	1.00	0.85
Lanes:	1.00	2.00	1.00	1.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Sat.:	1805	3610	1615	1805	3610	1615	1805	1900	1615	1805	1900	1615
Capacity Analysis Module:												
Vol/Sat:	0.02	0.21	0.01	0.12	0.21	0.23	0.16	0.16	0.14	0.05	0.41	0.05
Crit Moves:		****		****			****				****	
Green/Cycle:	0.24	0.21	0.34	0.35	0.30	0.46	0.59	0.43	0.47	0.54	0.41	0.53
Volume/Cap:	0.27	0.99	0.04	0.74	0.69	0.51	0.78	0.37	0.31	0.15	0.99	0.09
Uniform Del:	29.8	39.5	21.9	26.1	31.0	19.2	9.8	19.1	16.6	11.1	29.2	11.5
IncremntDel:	1.0	29.7	0.0	9.5	1.9	0.6	10.6	0.3	0.2	0.1	29.1	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	30.8	69.1	21.9	35.6	32.9	19.8	20.4	19.3	16.8	11.3	58.3	11.5
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	30.8	69.1	21.9	35.6	32.9	19.8	20.4	19.3	16.8	11.3	58.3	11.5
LOS by Move:	C	E	C	D	C	B	C	B	B	B	E	B
HCM2kAvgQ:	1	18	0	8	12	8	9	6	4	1	30	1

Note: Queue reported is the number of cars per lane.

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                      Level Of Service Computation Report
            2000 HCM Unsignalized Method (Base Volume Alternative)
******************************************************************************
Intersection #3 Kamakaeha Ave / Palani Rd
******************************************************************************
Average Delay (sec/veh):      9.2       Worst Case Level Of Service: F[ 74.1]
******************************************************************************
Street Name:          Kamakaeha Ave                       Palani Rd
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Stop Sign        Stop Sign       Uncontrolled     Uncontrolled
Rights:           Include          Include          Include          Ignore
Lanes:        0  0  0  0  0    1  0  0  0  1    0  0  1  0  0    0  0  1  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0    0     0   127    0    63     0  520     0     0  829   281
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:    0    0     0   127    0    63     0  520     0     0  829   281
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.00
PHF Volume:     0    0     0   134    0    66     0  547     0     0  873     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    0    0     0   134    0    66     0  547     0     0  873     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx   6.4 xxxx   6.2 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
FollowUpTim:xxxxx xxxx xxxxx   3.5 xxxx   3.3 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx  1420 xxxx   873  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Potent Cap.: xxxx xxxx xxxxx   152 xxxx   353  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Move Cap.:   xxxx xxxx xxxxx   152 xxxx   353  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Volume/Cap:  xxxx xxxx  xxxx  0.88 xxxx  0.19  xxxx xxxx  xxxx  xxxx xxxx  xxxx
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx   6.0 xxxx   0.7  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx 102.2 xxxx  17.6 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:   *    *     *     F    *     C     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:    *    *     *     *    *     *     *    *     *     *    *     *
ApproachDel:    xxxxxx             74.1           xxxxxx           xxxxxx
ApproachLOS:        *                F               *                *
******************************************************************************
Note: Queue reported is the number of cars per lane.
******************************************************************************
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Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Henry St / Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	1.248
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	94.8
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Henry St						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Prot+Permit		
Rights:	Ovl			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	0 1	0	1 0	0 1	0	1 0	0 1	0	1 0	0 1	0
Volume Module:												
Base Vol:	110	182	394	17	203	118	170	416	129	834	927	93
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	110	182	394	17	203	118	170	416	129	834	927	93
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	116	192	415	18	214	124	179	438	136	878	976	98
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	116	192	415	18	214	124	179	438	136	878	976	98
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	116	192	415	18	214	124	179	438	136	878	976	98
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.29	0.90	0.90	0.14	0.95	0.95	0.95	0.96	0.96	0.60	0.99	0.99
Lanes:	1.00	0.32	0.68	1.00	0.63	0.37	1.00	0.76	0.24	1.00	0.91	0.09
Final Sat.:	543	539	1166	274	1135	660	1805	1398	434	1144	1703	171
Capacity Analysis Module:												
Vol/Sat:	0.21	0.36	0.36	0.07	0.19	0.19	0.10	0.31	0.31	0.77	0.57	0.57
Crit Moves:		****								****		
Green/Cycle:	0.28	0.28	0.66	0.28	0.28	0.28	0.09	0.24	0.24	0.53	0.53	0.53
Volume/Cap:	0.77	1.28	0.54	0.24	0.68	0.68	1.08	1.28	1.28	1.16	1.08	1.08
Uniform Del:	33.2	36.1	9.2	28.0	32.2	32.2	45.4	37.8	37.8	19.0	23.4	23.4
IncremntDel:	21.0	143	0.5	1.6	3.8	3.8	92.6	144	143.8	84.5	52.4	52.4
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	54.3	179	9.7	29.6	36.0	36.0	138.0	182	181.6	103.5	75.9	75.9
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	54.3	179	9.7	29.6	36.0	36.0	138.0	182	181.6	103.5	75.9	75.9
LOS by Move:	D	F	A	C	D	D	F	F	F	F	E	E
HCM2kAvgQ:	5	37	10	1	10	10	11	35	35	45	47	47

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu Hwy / Makala Blvd

Cycle (sec):	100	Critical Vol./Cap.(X):	0.769
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	24.5
Optimal Cycle:	65	Level Of Service:	C

Street Name:	Queen Kaahumanu Hwy						Makala Blvd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Prot+Permit			Prot+Permit			Prot+Permit		
Rights:	Ovl			Ovl			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0 2 0 1			1 0 2 0 1			1 0 0 1 0			1 0 0 1 0		
Volume Module:												
Base Vol:	14	699	80	86	1148	294	417	126	41	21	71	104
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	14	699	80	86	1148	294	417	126	41	21	71	104
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	15	736	84	91	1208	309	439	133	43	22	75	109
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	15	736	84	91	1208	309	439	133	43	22	75	109
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	15	736	84	91	1208	309	439	133	43	22	75	109
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	0.95	0.85	0.95	0.95	0.85	0.95	0.96	0.96	0.95	0.91	0.91
Lanes:	1.00	2.00	1.00	1.00	2.00	1.00	1.00	0.75	0.25	1.00	0.41	0.59
Final Sat.:	1805	3610	1615	1805	3610	1615	1805	1380	449	1805	702	1029
Capacity Analysis Module:												
Vol/Sat:	0.01	0.20	0.05	0.05	0.33	0.19	0.24	0.10	0.10	0.01	0.11	0.11
Crit Moves:	****				****		****				****	
Green/Cycle:	0.37	0.36	0.41	0.47	0.44	0.75	0.47	0.40	0.40	0.19	0.14	0.14
Volume/Cap:	0.15	0.57	0.13	0.30	0.77	0.26	0.68	0.24	0.24	0.08	0.77	0.77
Uniform Del:	22.3	25.9	18.4	16.5	24.0	3.8	18.7	19.7	19.7	33.2	41.5	41.5
IncremntDel:	0.8	0.6	0.1	0.6	2.4	0.1	2.9	0.2	0.2	0.1	14.1	14.1
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	23.1	26.5	18.5	17.1	26.4	3.9	21.6	19.9	19.9	33.4	55.6	55.6
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	23.1	26.5	18.5	17.1	26.4	3.9	21.6	19.9	19.9	33.4	55.6	55.6
LOS by Move:	C	C	B	B	C	A	C	B	B	C	E	E
HCM2kAvgQ:	0	10	2	2	18	3	11	4	4	1	7	7

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #8 Palihiolo St/Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	1.734
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	185.8
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Palihiolo St						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Prot+Permit			Permitted		
Rights:	Include			Include			Include			Ignore		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 1	0 0	1	1	0 0	1 0	1	0 0	1 0	1	0 1	0 1
Volume Module:												
Base Vol:	4	19	26	2	4	565	506	681	13	49	1265	23
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	4	19	26	2	4	565	506	681	13	49	1265	23
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.00
PHF Volume:	4	20	27	2	4	595	533	717	14	52	1332	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	4	20	27	2	4	595	533	717	14	52	1332	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
FinalVolume:	4	20	27	2	4	595	533	717	14	52	1332	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.67	0.67	0.85	0.75	0.85	0.85	0.24	1.00	1.00	0.95	1.00	1.00
Lanes:	0.17	0.83	1.00	1.00	0.01	0.99	1.00	0.98	0.02	1.00	1.00	1.00
Final Sat.:	221	1048	1615	1423	11	1606	447	1859	35	1805	1900	1900
Capacity Analysis Module:												
Vol/Sat:	0.02	0.02	0.02	0.00	0.37	0.37	1.19	0.39	0.39	0.03	0.70	0.00
Crit Moves:					****		****					
Green/Cycle:	0.24	0.24	0.24	0.24	0.24	0.24	0.61	0.61	0.61	0.05	0.46	0.00
Volume/Cap:	0.08	0.08	0.07	0.01	1.52	1.52	1.25	0.63	0.63	0.63	1.52	0.00
Uniform Del:	29.1	29.1	29.1	28.6	37.8	37.8	9.9	12.3	12.3	46.9	26.9	0.0
IncremntDel:	0.1	0.1	0.1	0.0	246	245.9	129.8	1.1	1.1	14.9	239	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Delay/Veh:	29.2	29.2	29.1	28.6	284	283.7	139.7	13.5	13.5	61.8	266	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	29.2	29.2	29.1	28.6	284	283.7	139.7	13.5	13.5	61.8	266	0.0
LOS by Move:	C	C	C	C	F	F	F	B	B	E	F	A
HCM2kAvgQ:	1	1	1	0	45	45	32	15	15	3	97	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #10 Palani Rd / Uluaoa St

Average Delay (sec/veh): 7.8 Worst Case Level Of Service: F[146.1]

Street Name:	Palani Rd								Uluaoa St							
Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	-	R	L	-	T	-	R	L	-	T	-	R	L	-	T	-	R
Control:	Uncontrolled					Uncontrolled					Stop Sign					Stop Sign				
Rights:	Include					Include					Include					Include				
Lanes:	0	1	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0
Volume Module:																				
Base Vol:	29	690		0		0	964		177		71		0		32		0		0	
Growth Adj:	1.00	1.00		1.00		1.00	1.00		1.00		1.00		1.00		1.00		1.00		1.00	
Initial Bse:	29	690		0		0	964		177		71		0		32		0		0	
User Adj:	1.00	1.00		1.00		1.00	1.00		1.00		1.00		1.00		1.00		1.00		1.00	
PHF Adj:	0.95	0.95		0.95		0.95	0.95		0.95		0.95		0.95		0.95		0.95		0.95	
PHF Volume:	31	726		0		0	1015		186		75		0		34		0		0	
Reduct Vol:	0	0		0		0	0		0		0		0		0		0		0	
FinalVolume:	31	726		0		0	1015		186		75		0		34		0		0	
Critical Gap Module:																				
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx					6.4	xxxx			6.2	xxxxx	xxxx	xxxxx		
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx					3.5	xxxx			3.3	xxxxx	xxxx	xxxxx		
Capacity Module:																				
Cnflict Vol:	1201	xxxx	xxxxx	xxxx	xxxx	xxxxx					1895	xxxx			1108	xxxx	xxxx	xxxxx		
Potent Cap.:	588	xxxx	xxxxx	xxxx	xxxx	xxxxx					77	xxxx			258	xxxx	xxxx	xxxxx		
Move Cap.:	588	xxxx	xxxxx	xxxx	xxxx	xxxxx					74	xxxx			258	xxxx	xxxx	xxxxx		
Volume/Cap:	0.05	xxxx	xxxx	xxxx	xxxx	xxxx					1.00	xxxx			0.13	xxxx	xxxx	xxxx		
Level Of Service Module:																				
2Way95thQ:	0.2	xxxx	xxxxx	xxxx	xxxx	xxxxx					5.3	xxxx			0.4	xxxx	xxxx	xxxxx		
Control Del:	11.5	xxxx	xxxxx	xxxxx	xxxx	xxxxx					202.5	xxxx			21.1	xxxxx	xxxx	xxxxx		
LOS by Move:	B	*		*		*	*		*		F	*			C	*	*	*		
Movement:	LT	-	LTR	-	RT	LT	-	LTR	-	RT	LT	-	LTR	-	RT	LT	-	LTR	-	RT
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx					xxxx	xxxx	xxxxx			xxxx	xxxx	xxxxx		
SharedQueue:	0.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx					xxxxx	xxxx	xxxxx			xxxxx	xxxx	xxxxx		
Shrd ConDel:	11.5	xxxx	xxxxx	xxxxx	xxxx	xxxxx					xxxxx	xxxx	xxxxx			xxxxx	xxxx	xxxxx		
Shared LOS:	B	*		*		*	*		*		*	*			*	*	*	*		
ApproachDel:	xxxxxx					xxxxxx					146.1					xxxxxx				
ApproachLOS:	*					*					F					*				

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #11 Queen Kaahumanu Hwy / Kealakehe Pkwy

Cycle (sec):	100	Critical Vol./Cap.(X):	0.713
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	23.5
Optimal Cycle:	56	Level Of Service:	C

Street Name:	Queen Kaahumanu Hwy						Kaalakehe Pkwy					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Prot+Permit			Permitted			Permitted		
Rights:		Ovl			Ovl			Ovl			Ovl	
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0 2 0 1			1 0 2 0 1			0 1 0 0 1			0 1 0 0 1		
Volume Module:												
Base Vol:	66	1061	239	55	974	232	106	97	67	242	66	60
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	66	1061	239	55	974	232	106	97	67	242	66	60
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	69	1117	252	58	1025	244	112	102	71	255	69	63
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	69	1117	252	58	1025	244	112	102	71	255	69	63
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	69	1117	252	58	1025	244	112	102	71	255	69	63
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	0.95	0.85	0.95	0.95	0.85	0.58	0.58	0.85	0.57	0.57	0.85
Lanes:	1.00	2.00	1.00	1.00	2.00	1.00	0.52	0.48	1.00	0.79	0.21	1.00
Final Sat.:	1805	3610	1615	1805	3610	1615	572	524	1615	848	231	1615
Capacity Analysis Module:												
Vol/Sat:	0.04	0.31	0.16	0.03	0.28	0.15	0.19	0.19	0.04	0.30	0.30	0.04
Crit Moves:		****		****							****	
Green/Cycle:	0.51	0.43	0.43	0.47	0.42	0.42	0.42	0.42	0.48	0.42	0.42	0.47
Volume/Cap:	0.33	0.71	0.36	0.33	0.67	0.36	0.46	0.46	0.09	0.71	0.71	0.08
Uniform Del:	15.9	23.2	19.0	17.7	23.4	19.7	20.8	20.8	14.2	23.9	23.9	14.8
IncremntDel:	0.9	1.6	0.3	1.1	1.2	0.3	0.7	0.7	0.1	5.3	5.3	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	16.8	24.8	19.3	18.8	24.6	20.0	21.5	21.5	14.3	29.2	29.2	14.9
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	16.8	24.8	19.3	18.8	24.6	20.0	21.5	21.5	14.3	29.2	29.2	14.9
LOS by Move:	B	C	B	B	C	C	C	C	B	C	C	B
HCM2kAvgQ:	2	16	5	1	14	5	5	5	1	10	10	1

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #12 Ane Keohokalole Hwy / Kealakehe Pkwy

Average Delay (sec/veh): OVERFLOW Worst Case Level Of Service: F[xxxxx]

Street Name:	Ane Keohokalole Hwy						Kealakehe Pkwy					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	1 0 1	0 1		1 0	0 1	0	1 0	1 1	0	1 0	1	0 1
Volume Module:												
Base Vol:	78	288	0	50	257	369	165	194	76	5	128	23
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	78	288	0	50	257	369	165	194	76	5	128	23
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	82	303	0	53	271	388	174	204	80	5	135	24
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	82	303	0	53	271	388	174	204	80	5	135	24
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1078	761	142	746	777	135	159	xxxx	xxxxx	284	xxxx	xxxxx
Potent Cap.:	198	337	911	332	330	920	1433	xxxx	xxxxx	1290	xxxx	xxxxx
Move Cap.:	18	295	911	0	289	920	1433	xxxx	xxxxx	1290	xxxx	xxxxx
Volume/Cap:	4.46	1.03	0.00	xxxx	0.94	0.42	0.12	xxxx	xxxx	0.00	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	10.8	11.2	xxxxx	xxxx	xxxx	xxxxx	0.4	xxxx	xxxxx	0.0	xxxx	xxxxx
Control Del:	1980	98.4	xxxxx	xxxxx	xxxx	xxxxx	7.9	xxxx	xxxxx	7.8	xxxx	xxxxx
LOS by Move:	F	F	*	*	*	*	A	*	*	A	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	485	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	30.0	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	197.9	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	*	*	*	*	F	*	*	*	*	*	*
ApproachDel:	499.3			xxxxxx			xxxxxx			xxxxxx		
ApproachLOS:	F			F			*			*		

Note: Queue reported is the number of cars per lane.

CUMULATIVE PLUS PROJECT CONDITIONS – CONCEPT A

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #1 Queen Kaahumanu Hwy / Henry St

Cycle (sec):	100	Critical Vol./Cap.(X):	0.885
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	28.9
Optimal Cycle:	98	Level Of Service:	C

Street Name:	Queen Kaahumanu Hwy						Henry St					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Prot+Permit			Prot+Permit			Prot+Permit		
Rights:	Ovl			Ovl			Ovl			Ovl		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0 2 0 1			1 0 3 0 1			1 0 2 0 1			1 1 1 0 1		
Volume Module:												
Base Vol:	320	799	922	130	553	132	76	412	25	615	638	99
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	320	799	922	130	553	132	76	412	25	615	638	99
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	337	841	971	137	582	139	80	434	26	647	672	104
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	337	841	971	137	582	139	80	434	26	647	672	104
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	337	841	971	137	582	139	80	434	26	647	672	104
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	0.95	0.85	0.95	0.91	0.85	0.95	0.95	0.85	0.93	0.93	0.85
Lanes:	1.00	2.00	1.00	1.00	3.00	1.00	1.00	2.00	1.00	1.47	1.53	1.00
Final Sat.:	1805	3610	1615	1805	5187	1615	1805	3610	1615	2594	2691	1615
Capacity Analysis Module:												
Vol/Sat:	0.19	0.23	0.60	0.08	0.11	0.09	0.04	0.12	0.02	0.25	0.25	0.06
Crit Moves:			****	****				****		****		
Green/Cycle:	0.50	0.40	0.68	0.27	0.18	0.24	0.20	0.14	0.44	0.44	0.35	0.44
Volume/Cap:	0.54	0.59	0.89	0.52	0.62	0.35	0.37	0.89	0.04	0.68	0.70	0.15
Uniform Del:	15.8	23.7	12.9	29.1	37.8	31.3	33.6	42.5	16.1	21.6	27.8	16.8
IncremntDel:	1.0	0.6	8.8	1.8	1.3	0.5	1.1	17.4	0.0	1.0	1.2	0.1
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	16.8	24.4	21.8	30.8	39.0	31.8	34.7	59.8	16.1	22.6	29.0	16.8
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	16.8	24.4	21.8	30.8	39.0	31.8	34.7	59.8	16.1	22.6	29.0	16.8
LOS by Move:	B	C	C	C	D	C	C	E	B	C	C	B
HCM2kAvgQ:	8	11	27	4	7	4	3	10	0	12	13	2

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #2 Queen Kaahumanu Hwy / Alli Dr

Cycle (sec):	100	Critical Vol./Cap.(X):	0.914
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	35.0
Optimal Cycle:	113	Level Of Service:	D

Street Name:	Queen Kaahumanu Hwy						Alli Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Prot+Permit			Prot+Permit			Prot+Permit		
Rights:		Ovl			Ovl			Ovl			Ovl	
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	2 0	1	1 0	2 0	1	1 0	1 0	1	1 0	1 0	1
Volume Module:												
Base Vol:	97	807	70	189	655	372	193	144	99	76	658	78
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	97	807	70	189	655	372	193	144	99	76	658	78
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	102	849	74	199	689	392	203	152	104	80	693	82
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	102	849	74	199	689	392	203	152	104	80	693	82
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	102	849	74	199	689	392	203	152	104	80	693	82
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	0.95	0.85	0.95	0.95	0.85	0.95	1.00	0.85	0.95	1.00	0.85
Lanes:	1.00	2.00	1.00	1.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Sat.:	1805	3610	1615	1805	3610	1615	1805	1900	1615	1805	1900	1615
Capacity Analysis Module:												
Vol/Sat:	0.06	0.24	0.05	0.11	0.19	0.24	0.11	0.08	0.06	0.04	0.36	0.05
Crit Moves:		****		****			****				****	
Green/Cycle:	0.34	0.26	0.44	0.40	0.29	0.41	0.46	0.34	0.42	0.54	0.40	0.52
Volume/Cap:	0.40	0.91	0.10	0.68	0.65	0.58	0.68	0.24	0.15	0.11	0.91	0.10
Uniform Del:	23.7	36.1	16.2	23.4	31.0	22.6	21.3	24.0	17.9	10.9	28.4	12.2
IncremntDel:	1.0	13.2	0.1	6.4	1.5	1.3	6.3	0.2	0.1	0.1	15.5	0.1
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	24.7	49.3	16.3	29.8	32.5	23.9	27.6	24.2	18.0	11.0	44.0	12.2
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	24.7	49.3	16.3	29.8	32.5	23.9	27.6	24.2	18.0	11.0	44.0	12.2
LOS by Move:	C	D	B	C	C	C	C	C	B	B	D	B
HCM2kAvgQ:	3	17	1	6	11	10	6	3	2	1	24	1

Note: Queue reported is the number of cars per lane.

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                      Level Of Service Computation Report
            2000 HCM Unsignalized Method (Base Volume Alternative)
******************************************************************************
Intersection #3 Kamakaeha Ave / Palani Rd
******************************************************************************
Average Delay (sec/veh):      1.4       Worst Case Level Of Service: D[ 29.1]
******************************************************************************
Street Name:          Kamakaeha Ave                       Palani Rd
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Stop Sign        Stop Sign       Uncontrolled     Uncontrolled
Rights:           Include          Include          Include          Ignore
Lanes:        0  0  0  0  0    1  0  0  0  1    0  0  1  0  0    0  0  1  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0    0     0    47    0    15     0  404     0     0  846   240
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:    0    0     0    47    0    15     0  404     0     0  846   240
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.00
PHF Volume:     0    0     0    49    0    16     0  425     0     0  891     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    0    0     0    49    0    16     0  425     0     0  891     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx   6.4 xxxx   6.2 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
FollowUpTim:xxxxx xxxx xxxxx   3.5 xxxx   3.3 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx  1316 xxxx   891  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Potent Cap.: xxxx xxxx xxxxx   176 xxxx   344  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Move Cap.:   xxxx xxxx xxxxx   176 xxxx   344  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Volume/Cap:  xxxx xxxx  xxxx  0.28 xxxx  0.05  xxxx xxxx  xxxx  xxxx xxxx  xxxx
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx   1.1 xxxx   0.1  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx  33.3 xxxx  16.0 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:   *    *     *     D    *     C     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:    *    *     *     *    *     *     *    *     *     *    *     *
ApproachDel:    xxxxxx             29.1           xxxxxx           xxxxxx
ApproachLOS:        *                D               *                *
******************************************************************************
Note: Queue reported is the number of cars per lane.
******************************************************************************
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Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Henry St / Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	1.677
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	220.8
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Henry St						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Prot+Permit		
Rights:	Ovl			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	0 1	0	1 0	0 1	0	1 0	0 1	0	1 0	0 1	0
Volume Module:												
Base Vol:	122	404	454	86	492	288	237	185	37	927	810	90
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	122	404	454	86	492	288	237	185	37	927	810	90
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	128	425	478	91	518	303	249	195	39	976	853	95
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	128	425	478	91	518	303	249	195	39	976	853	95
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	128	425	478	91	518	303	249	195	39	976	853	95
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.08	0.92	0.92	0.08	0.95	0.95	0.95	0.98	0.98	0.77	0.99	0.99
Lanes:	1.00	0.47	0.53	1.00	0.63	0.37	1.00	0.83	0.17	1.00	0.90	0.10
Final Sat.:	152	824	926	152	1133	663	1805	1544	309	1468	1684	187
Capacity Analysis Module:												
Vol/Sat:	0.84	0.52	0.52	0.60	0.46	0.46	0.14	0.13	0.13	0.66	0.51	0.51
Crit Moves:	****									****		
Green/Cycle:	0.50	0.50	0.82	0.50	0.50	0.50	0.09	0.08	0.08	0.31	0.31	0.31
Volume/Cap:	1.68	1.03	0.63	1.18	0.91	0.91	1.62	1.68	1.68	1.71	1.62	1.62
Uniform Del:	24.9	24.9	3.2	24.9	22.8	22.8	45.7	46.2	46.2	34.6	34.4	34.4
IncremntDel:	355.5	37.2	0.9	161.0	13.0	13.0	308.0	335	334.7	328.3	288	288.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	380.4	62.1	4.0	185.9	35.7	35.7	353.7	381	381.0	362.9	322	322.4
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	380.4	62.1	4.0	185.9	35.7	35.7	353.7	381	381.0	362.9	322	322.4
LOS by Move:	F	E	A	F	D	D	F	F	F	F	F	F
HCM2kAvgQ:	12	37	11	7	27	27	21	20	20	80	74	74

Note: Queue reported is the number of cars per lane.

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                      Level Of Service Computation Report
            2000 HCM Unsignalized Method (Base Volume Alternative)
******************************************************************************
Intersection #5 Gate 2/Palani
******************************************************************************
Average Delay (sec/veh):      0.7       Worst Case Level Of Service: F[ 70.5]
******************************************************************************
Street Name:              Gate 2                          /Palani Rd
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Stop Sign       Yield Sign       Uncontrolled     Uncontrolled
Rights:           Include          Include          Include          Include
Lanes:        0  0  0  0  0    0  0  0  0  1    0  0  1  0  0    0  0  0  1  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0    0     0     0    0    27     0  725     0     0 1800    95
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:    0    0     0     0    0    27     0  725     0     0 1800    95
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.95
PHF Volume:     0    0     0     0    0    28     0  763     0     0 1895   100
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    0    0     0     0    0    28     0  763     0     0 1895   100
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx xxxxx xxxx   6.2 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
FollowUpTim:xxxxx xxxx xxxxx xxxxx xxxx   3.3 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx  xxxx xxxx  1945  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Potent Cap.: xxxx xxxx xxxxx  xxxx xxxx    82  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Move Cap.:   xxxx xxxx xxxxx  xxxx xxxx    82  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Volume/Cap:  xxxx xxxx  xxxx  xxxx xxxx  0.35  xxxx xxxx  xxxx  xxxx xxxx  xxxx
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx  xxxx xxxx   1.3  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx xxxxx xxxx  70.5 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:   *    *     *     *    *     F     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:    *    *     *     *    *     *     *    *     *     *    *     *
ApproachDel:    xxxxxx             70.5           xxxxxx           xxxxxx
ApproachLOS:        *                F                *                *
******************************************************************************
Note: Queue reported is the number of cars per lane.
******************************************************************************
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Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu Hwy / Makala Blvd

Cycle (sec):	100	Critical Vol./Cap.(X):	0.661
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	22.1
Optimal Cycle:	49	Level Of Service:	C

Street Name:	Queen Kaahumanu Hwy						Makala Blvd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Prot+Permit			Prot+Permit			Prot+Permit		
Rights:	Ovl			Ovl			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0 2 0 1			1 0 2 0 1			1 0 0 1 0			1 0 0 1 0		
Volume Module:												
Base Vol:	10	929	30	68	903	200	309	72	32	7	21	143
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	10	929	30	68	903	200	309	72	32	7	21	143
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	11	978	32	72	951	211	325	76	34	7	22	151
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	11	978	32	72	951	211	325	76	34	7	22	151
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	11	978	32	72	951	211	325	76	34	7	22	151
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	0.95	0.85	0.95	0.95	0.85	0.95	0.95	0.95	0.95	0.87	0.87
Lanes:	1.00	2.00	1.00	1.00	2.00	1.00	1.00	0.69	0.31	1.00	0.13	0.87
Final Sat.:	1805	3610	1615	1805	3610	1615	1805	1255	558	1805	211	1440
Capacity Analysis Module:												
Vol/Sat:	0.01	0.27	0.02	0.04	0.26	0.13	0.18	0.06	0.06	0.00	0.10	0.10
Crit Moves:		****		****			****				****	
Green/Cycle:	0.42	0.41	0.44	0.49	0.46	0.73	0.45	0.40	0.40	0.19	0.16	0.16
Volume/Cap:	0.06	0.66	0.04	0.33	0.57	0.18	0.54	0.15	0.15	0.03	0.66	0.66
Uniform Del:	17.8	23.9	16.2	16.5	19.8	4.1	18.6	18.9	18.9	33.3	39.6	39.6
IncremntDel:	0.1	1.1	0.0	0.9	0.5	0.1	1.0	0.1	0.1	0.0	6.2	6.2
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	18.0	25.0	16.2	17.4	20.3	4.2	19.6	19.0	19.0	33.4	45.8	45.8
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	18.0	25.0	16.2	17.4	20.3	4.2	19.6	19.0	19.0	33.4	45.8	45.8
LOS by Move:	B	C	B	B	C	A	B	B	B	C	D	D
HCM2kAvgQ:	0	13	1	2	12	2	8	2	2	0	6	6

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #7 Ane Keohokahole/Main Gate

Average Delay (sec/veh): 91.7 Worst Case Level Of Service: F[410.4]

Street Name:	Ane Keohokahole Hwy									Main Gate												
Approach:	North Bound					South Bound					East Bound					West Bound						
Movement:	L	-	T	-	R	L	-	T	-	R	L	-	T	-	R	L	-	T	-	R		
Control:	Uncontrolled					Uncontrolled					Stop Sign					Stop Sign						
Rights:	Include					Include					Include					Include						
Lanes:	0	0	1	0	1	1	0	1	0	0	0	0	0	0	0	1	0	0	0	1		
Volume Module:																						
Base Vol:	0	447	284	189	620	0	0	0	0	0	246	0	191									
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00									
Initial Bse:	0	447	284	189	620	0	0	0	0	0	246	0	191									
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00									
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95									
PHF Volume:	0	471	299	199	653	0	0	0	0	0	259	0	201									
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0	0									
FinalVolume:	0	471	299	199	653	0	0	0	0	0	259	0	201									
Critical Gap Module:																						
Critical Gp:	xxxxx	xxxx	xxxxx	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.4	xxxx	6.2										
FollowUpTim:	xxxxx	xxxx	xxxxx	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	xxxx	3.3										
Capacity Module:																						
Cnflict Vol:	xxxx	xxxx	xxxxx	769	xxxx	xxxxx	xxxx	xxxx	xxxxx	1521	xxxx	471										
Potent Cap.:	xxxx	xxxx	xxxxx	854	xxxx	xxxxx	xxxx	xxxx	xxxxx	132	xxxx	597										
Move Cap.:	xxxx	xxxx	xxxxx	854	xxxx	xxxxx	xxxx	xxxx	xxxxx	108	xxxx	597										
Volume/Cap:	xxxx	xxxx	xxxx	0.23	xxxx	xxxx	xxxx	xxxx	xxxx	2.39	xxxx	0.34										
Level Of Service Module:																						
2Way95thQ:	xxxx	xxxx	xxxxx	0.9	xxxx	xxxxx	xxxx	xxxx	xxxxx	23.1	xxxx	1.5										
Control Del:	xxxxx	xxxx	xxxxx	10.5	xxxx	xxxxx	xxxxx	xxxx	xxxxx	718.2	xxxx	14.1										
LOS by Move:	*	*	*	B	*	*	*	*	*	F	*	B										
Movement:	LT	-	LTR	-	RT	LT	-	LTR	-	RT	LT	-	LTR	-	RT	LT	-	LTR	-	RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx										
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx										
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx										
Shared LOS:	*	*	*	*	*	*	*	*	*	*	*	*										
ApproachDel:	xxxxxx			xxxxxx			xxxxxx			410.4												
ApproachLOS:	*			*			*			F												

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #8 Palihiolo St/Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	1.638
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	193.6
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Palihiolo St						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Prot+Permit			Permitted		
Rights:	Include			Include			Include			Ignore		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 1	0 0	1	1	0 0	1 0	1	0 0	1 0	1	0 1	0 1
Volume Module:												
Base Vol:	5	20	32	10	15	553	438	531	6	20	1317	56
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	5	20	32	10	15	553	438	531	6	20	1317	56
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.00
PHF Volume:	5	21	34	11	16	582	461	559	6	21	1386	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	5	21	34	11	16	582	461	559	6	21	1386	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
FinalVolume:	5	21	34	11	16	582	461	559	6	21	1386	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.64	0.64	0.85	0.75	0.85	0.85	0.22	1.00	1.00	0.95	1.00	1.00
Lanes:	0.20	0.80	1.00	1.00	0.03	0.97	1.00	0.99	0.01	1.00	1.00	1.00
Final Sat.:	244	977	1615	1419	43	1580	417	1875	21	1805	1900	1900
Capacity Analysis Module:												
Vol/Sat:	0.02	0.02	0.02	0.01	0.37	0.37	1.11	0.30	0.30	0.01	0.73	0.00
Crit Moves:					****		****					
Green/Cycle:	0.25	0.25	0.25	0.25	0.25	0.25	0.63	0.63	0.63	0.02	0.49	0.00
Volume/Cap:	0.09	0.09	0.09	0.03	1.50	1.50	1.21	0.47	0.47	0.47	1.50	0.00
Uniform Del:	29.1	29.1	29.1	28.7	37.7	37.7	32.5	9.7	9.7	48.1	25.7	0.0
IncremntDel:	0.1	0.1	0.1	0.0	240	239.6	114.6	0.3	0.3	7.7	232	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Delay/Veh:	29.3	29.3	29.2	28.7	277	277.3	147.1	10.0	10.0	55.9	258	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	29.3	29.3	29.2	28.7	277	277.3	147.1	10.0	10.0	55.9	258	0.0
LOS by Move:	C	C	C	C	F	F	F	B	B	E	F	A
HCM2kAvgQ:	1	1	1	0	44	44	27	9	9	1	99	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #10 Palani Rd / Uluaoa St

Average Delay (sec/veh): 42.9 Worst Case Level Of Service: F[227.2]

Street Name:	Palani Rd						Uluaoa St					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	0 1 0 0 0			0 0 0 1 0			1 0 0 0 1			0 0 0 0 0		
Volume Module:												
Base Vol:	58	477	0	0	786	311	176	0	200	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	58	477	0	0	786	311	176	0	200	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	61	502	0	0	827	327	185	0	211	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	61	502	0	0	827	327	185	0	211	0	0	0
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.4	xxxx	6.2	xxxxx	xxxx	xxxxx
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	xxxx	3.3	xxxxx	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1155	xxxx	xxxxx	xxxx	xxxx	xxxxx	1615	xxxx	991	xxxx	xxxx	xxxxx
Potent Cap.:	612	xxxx	xxxxx	xxxx	xxxx	xxxxx	115	xxxx	301	xxxx	xxxx	xxxxx
Move Cap.:	612	xxxx	xxxxx	xxxx	xxxx	xxxxx	106	xxxx	301	xxxx	xxxx	xxxxx
Volume/Cap:	0.10	xxxx	xxxx	xxxx	xxxx	xxxx	1.74	xxxx	0.70	xxxx	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	0.3	xxxx	xxxxx	xxxx	xxxx	xxxxx	14.6	xxxx	4.9	xxxx	xxxx	xxxxx
Control Del:	11.5	xxxx	xxxxx	xxxxx	xxxx	xxxxx	439.3	xxxx	40.6	xxxxx	xxxx	xxxxx
LOS by Move:	B	*	*	*	*	*	F	*	E	*	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	0.3	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	11.5	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	B	*	*	*	*	*	*	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			227.2			xxxxxx		
ApproachLOS:	*			*			F			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #11 Queen Kaahumanu Hwy / Kealakehe Pkwy

Cycle (sec):	100	Critical Vol./Cap.(X):	0.825
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	28.1
Optimal Cycle:	78	Level Of Service:	C

Street Name:	Queen Kaahumanu Hwy						Kaalakehe Pkwy					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Prot+Permit			Permitted			Permitted		
Rights:		Ovl			Ovl			Ovl			Ovl	
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0 2 0 1			1 0 2 0 1			0 1 0 0 1			0 1 0 0 1		
Volume Module:												
Base Vol:	115	1022	422	266	973	249	81	107	10	231	61	163
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	115	1022	422	266	973	249	81	107	10	231	61	163
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	121	1076	444	280	1024	262	85	113	11	243	64	172
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	121	1076	444	280	1024	262	85	113	11	243	64	172
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	121	1076	444	280	1024	262	85	113	11	243	64	172
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	0.95	0.85	0.95	0.95	0.85	0.61	0.61	0.85	0.56	0.56	0.85
Lanes:	1.00	2.00	1.00	1.00	2.00	1.00	0.43	0.57	1.00	0.79	0.21	1.00
Final Sat.:	1805	3610	1615	1805	3610	1615	499	659	1615	840	222	1615
Capacity Analysis Module:												
Vol/Sat:	0.07	0.30	0.28	0.16	0.28	0.16	0.17	0.17	0.01	0.29	0.29	0.11
Crit Moves:		****		****							****	
Green/Cycle:	0.47	0.36	0.36	0.58	0.44	0.44	0.35	0.35	0.46	0.35	0.35	0.54
Volume/Cap:	0.38	0.83	0.76	0.68	0.64	0.37	0.49	0.49	0.01	0.83	0.83	0.20
Uniform Del:	16.2	29.1	28.1	22.9	21.6	18.4	25.4	25.4	14.9	29.7	29.7	11.9
IncremntDel:	0.8	4.4	5.8	4.4	0.9	0.3	0.9	0.9	0.0	13.9	13.9	0.1
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	17.0	33.5	34.0	27.3	22.4	18.8	26.3	26.3	14.9	43.6	43.6	12.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	17.0	33.5	34.0	27.3	22.4	18.8	26.3	26.3	14.9	43.6	43.6	12.0
LOS by Move:	B	C	C	C	C	B	C	C	B	D	D	B
HCM2kAvgQ:	3	18	14	7	13	5	5	5	0	11	11	3

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #12 Ane Keohokalole Hwy / Kealakehe Pkwy

Average Delay (sec/veh): OVERFLOW Worst Case Level Of Service: F[xxxxx]

Street Name:	Ane Keohokalole Hwy						Kealakehe Pkwy					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	1 0	1 0	1	1 0	0 1	0	1 0	1 1	0	1 0	1 0	1
Volume Module:												
Base Vol:	233	402	3	12	358	45	369	94	449	2	115	50
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	233	402	3	12	358	45	369	94	449	2	115	50
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	245	423	3	13	377	47	388	99	473	2	121	53
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	245	423	3	13	377	47	388	99	473	2	121	53
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1476	1290	286	1163	1474	121	174	xxxx	xxxxx	572	xxxx	xxxxx
Potent Cap.:	105	165	758	173	128	936	1415	xxxx	xxxxx	1011	xxxx	xxxxx
Move Cap.:	0	119	758	0	93	936	1415	xxxx	xxxxx	1011	xxxx	xxxxx
Volume/Cap:	xxxx	3.54	0.00	xxxx	4.07	0.05	0.27	xxxx	xxxx	0.00	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	41.8	0.0	xxxx	xxxx	xxxxx	1.1	xxxx	xxxxx	0.0	xxxx	xxxxx
Control Del:	xxxxx	1220	9.8	xxxxx	xxxx	xxxxx	8.5	xxxx	xxxxx	8.6	xxxx	xxxxx
LOS by Move:	*	F	A	*	*	*	A	*	*	A	*	*
Movement:	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	103	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	43.8	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	1489	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	*	*	*	*	F	*	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			xxxxxx			xxxxxx		
ApproachLOS:	F			F			*			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #1 Queen Kaahumanu Hwy / Henry St

Cycle (sec):	100	Critical Vol./Cap.(X):	0.881
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	29.4
Optimal Cycle:	97	Level Of Service:	C

Street Name:	Queen Kaahumanu Hwy						Henry St					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Prot+Permit			Prot+Permit			Prot+Permit		
Rights:	Ovl			Ovl			Ovl			Ovl		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0 2 0 1			1 0 3 0 1			1 0 2 0 1			1 1 1 0 1		
Volume Module:												
Base Vol:	282	507	806	183	713	121	76	553	107	549	561	211
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	282	507	806	183	713	121	76	553	107	549	561	211
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	297	534	848	193	751	127	80	582	113	578	591	222
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	297	534	848	193	751	127	80	582	113	578	591	222
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	297	534	848	193	751	127	80	582	113	578	591	222
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	0.95	0.85	0.95	0.91	0.85	0.95	0.95	0.85	0.93	0.93	0.85
Lanes:	1.00	2.00	1.00	1.00	3.00	1.00	1.00	2.00	1.00	1.48	1.52	1.00
Final Sat.:	1805	3610	1615	1805	5187	1615	1805	3610	1615	2614	2671	1615
Capacity Analysis Module:												
Vol/Sat:	0.16	0.15	0.53	0.11	0.14	0.08	0.04	0.16	0.07	0.22	0.22	0.14
Crit Moves:			****	****				****		****		
Green/Cycle:	0.49	0.35	0.60	0.34	0.22	0.29	0.26	0.18	0.43	0.45	0.36	0.48
Volume/Cap:	0.57	0.43	0.88	0.48	0.66	0.27	0.29	0.88	0.16	0.63	0.61	0.29
Uniform Del:	17.1	25.2	17.2	24.4	35.7	27.3	29.0	39.8	17.4	20.3	26.2	15.5
IncremntDel:	1.5	0.2	9.6	0.9	1.5	0.3	0.6	13.2	0.1	0.7	0.6	0.2
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	18.5	25.4	26.7	25.3	37.2	27.6	29.6	53.0	17.5	21.0	26.8	15.7
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	18.5	25.4	26.7	25.3	37.2	27.6	29.6	53.0	17.5	21.0	26.8	15.7
LOS by Move:	B	C	C	C	D	C	C	D	B	C	C	B
HCM2kAvgQ:	7	7	25	5	9	3	2	12	2	10	11	4

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #2 Queen Kaahumanu Hwy / Alli Dr

Cycle (sec):	100	Critical Vol./Cap.(X):	1.015
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	43.4
Optimal Cycle:	180	Level Of Service:	D

Street Name:	Queen Kaahumanu Hwy						Alli Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Prot+Permit			Prot+Permit			Prot+Permit		
Rights:		Ovl			Ovl			Ovl			Ovl	
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	2 0	1	1 0	2 0	1	1 0	1 0	1	1 0	1 0	1
Volume Module:												
Base Vol:	38	706	63	261	707	358	269	293	219	126	732	99
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	38	706	63	261	707	358	269	293	219	126	732	99
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	40	743	66	275	744	377	283	308	231	133	771	104
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	40	743	66	275	744	377	283	308	231	133	771	104
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	40	743	66	275	744	377	283	308	231	133	771	104
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	0.95	0.85	0.87	0.95	0.85	0.81	1.00	0.85	0.95	1.00	0.85
Lanes:	1.00	2.00	1.00	1.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Sat.:	1805	3610	1615	1645	3610	1615	1533	1900	1615	1805	1900	1615
Capacity Analysis Module:												
Vol/Sat:	0.02	0.21	0.04	0.17	0.21	0.23	0.18	0.16	0.14	0.07	0.41	0.06
Crit Moves:		****		****			****				****	
Green/Cycle:	0.24	0.20	0.37	0.37	0.32	0.47	0.53	0.38	0.41	0.57	0.40	0.55
Volume/Cap:	0.24	1.02	0.11	0.80	0.65	0.50	0.80	0.43	0.35	0.22	1.02	0.12
Uniform Del:	30.0	39.9	20.5	25.5	29.5	18.4	13.0	23.1	20.1	10.7	30.2	11.0
IncremntDel:	0.8	39.3	0.1	12.6	1.4	0.5	12.4	0.4	0.3	0.2	38.7	0.1
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	30.8	79.2	20.6	38.2	30.8	18.9	25.4	23.5	20.4	10.9	68.8	11.1
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	30.8	79.2	20.6	38.2	30.8	18.9	25.4	23.5	20.4	10.9	68.8	11.1
LOS by Move:	C	E	C	D	C	B	C	C	C	B	E	B
HCM2kAvgQ:	1	18	1	10	11	8	9	7	5	2	32	2

Note: Queue reported is the number of cars per lane.

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                      Level Of Service Computation Report
            2000 HCM Unsignalized Method (Base Volume Alternative)
******************************************************************************
Intersection #3 Kamakaeha Ave / Palani Rd
******************************************************************************
Average Delay (sec/veh):     14.8       Worst Case Level Of Service: F[132.2]
******************************************************************************
Street Name:          Kamakaeha Ave                       Palani Rd
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Stop Sign        Stop Sign       Uncontrolled     Uncontrolled
Rights:           Include          Include          Include          Ignore
Lanes:        0  0  0  0  0    1  0  0  0  1    0  0  1  0  0    0  0  1  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0    0     0   127    0    63     0  618     0     0  894   281
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:    0    0     0   127    0    63     0  618     0     0  894   281
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.00
PHF Volume:     0    0     0   134    0    66     0  651     0     0  941     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    0    0     0   134    0    66     0  651     0     0  941     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx   6.4 xxxx   6.2 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
FollowUpTim:xxxxx xxxx xxxxx   3.5 xxxx   3.3 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx  1592 xxxx   941  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Potent Cap.: xxxx xxxx xxxxx   119 xxxx   322  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Move Cap.:   xxxx xxxx xxxxx   119 xxxx   322  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Volume/Cap:  xxxx xxxx  xxxx  1.12 xxxx  0.21  xxxx xxxx  xxxx  xxxx xxxx  xxxx
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx   8.0 xxxx   0.8  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx 188.3 xxxx  19.1 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:   *    *     *     F    *     C     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:    *    *     *     *    *     *     *    *     *     *    *     *
ApproachDel:    xxxxxx            132.2           xxxxxx           xxxxxx
ApproachLOS:        *                F               *                *
******************************************************************************
Note: Queue reported is the number of cars per lane.
******************************************************************************
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Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Henry St / Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	1.340
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	157.3
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Henry St						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Prot+Permit		
Rights:	Ovl			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	0 1	0	1 0	0 1	0	1 0	0 1	0	1 0	0 1	0
Volume Module:												
Base Vol:	110	329	394	67	314	183	268	416	129	859	927	93
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	110	329	394	67	314	183	268	416	129	859	927	93
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	116	346	415	71	331	193	282	438	136	904	976	98
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	116	346	415	71	331	193	282	438	136	904	976	98
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	116	346	415	71	331	193	282	438	136	904	976	98
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.12	0.92	0.92	0.12	0.95	0.95	0.95	0.96	0.96	0.67	0.99	0.99
Lanes:	1.00	0.46	0.54	1.00	0.63	0.37	1.00	0.76	0.24	1.00	0.91	0.09
Final Sat.:	232	794	951	232	1134	661	1805	1398	434	1277	1703	171
Capacity Analysis Module:												
Vol/Sat:	0.50	0.44	0.44	0.30	0.29	0.29	0.16	0.31	0.31	0.71	0.57	0.57
Crit Moves:	****									****		
Green/Cycle:	0.34	0.34	0.69	0.34	0.34	0.34	0.12	0.21	0.21	0.44	0.44	0.44
Volume/Cap:	1.46	1.28	0.64	0.89	0.85	0.85	1.31	1.46	1.46	1.30	1.31	1.31
Uniform Del:	32.9	32.9	8.8	31.2	30.6	30.6	44.0	39.3	39.3	25.4	28.1	28.1
IncremntDel:	262.8	137	1.2	65.6	11.1	11.1	167.2	220	219.8	146.5	147	146.7
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	295.7	170	9.9	96.7	41.7	41.7	211.2	259	259.1	171.8	175	174.7
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	295.7	170	9.9	96.7	41.7	41.7	211.2	259	259.1	171.8	175	174.7
LOS by Move:	F	F	A	F	D	D	F	F	F	F	F	F
HCM2kAvgQ:	10	46	14	4	18	18	19	41	41	55	65	65

Note: Queue reported is the number of cars per lane.

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                      Level Of Service Computation Report
            2000 HCM Unsignalized Method (Base Volume Alternative)
******************************************************************************
Intersection #5 Gate 2/Palani
******************************************************************************
Average Delay (sec/veh):      0.7       Worst Case Level Of Service: F[ 74.7]
******************************************************************************
Street Name:              Gate 2                          /Palani Rd
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Stop Sign       Yield Sign       Uncontrolled     Uncontrolled
Rights:           Include          Include          Include          Include
Lanes:        0  0  0  0  0    0  0  0  0  1    0  0  1  0  0    0  0  0  1  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0    0     0     0    0    25     0  877     0     0 1853    81
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:    0    0     0     0    0    25     0  877     0     0 1853    81
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.95
PHF Volume:     0    0     0     0    0    26     0  923     0     0 1951    85
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    0    0     0     0    0    26     0  923     0     0 1951    85
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx xxxxx xxxx   6.2 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
FollowUpTim:xxxxx xxxx xxxxx xxxxx xxxx   3.3 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx  xxxx xxxx  1993  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Potent Cap.: xxxx xxxx xxxxx  xxxx xxxx    77  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Move Cap.:   xxxx xxxx xxxxx  xxxx xxxx    77  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Volume/Cap:  xxxx xxxx  xxxx  xxxx xxxx  0.34  xxxx xxxx  xxxx  xxxx xxxx  xxxx
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx  xxxx xxxx   1.3  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx xxxxx xxxx  74.7 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:   *    *     *     *    *     F     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:    *    *     *     *    *     *     *    *     *     *    *     *
ApproachDel:    xxxxxx             74.7           xxxxxx           xxxxxx
ApproachLOS:        *                F               *                *
******************************************************************************
Note: Queue reported is the number of cars per lane.
******************************************************************************
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Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu Hwy / Makala Blvd

Cycle (sec):	100	Critical Vol./Cap.(X):	0.787
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	24.7
Optimal Cycle:	69	Level Of Service:	C

Street Name:	Queen Kaahumanu Hwy						Makala Blvd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Prot+Permit			Prot+Permit			Prot+Permit		
Rights:	Ovl			Ovl			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0 2 0 1			1 0 2 0 1			1 0 0 1 0			1 0 0 1 0		
Volume Module:												
Base Vol:	14	724	80	86	1202	294	417	126	41	21	71	104
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	14	724	80	86	1202	294	417	126	41	21	71	104
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	15	762	84	91	1265	309	439	133	43	22	75	109
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	15	762	84	91	1265	309	439	133	43	22	75	109
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	15	762	84	91	1265	309	439	133	43	22	75	109
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	0.95	0.85	0.95	0.95	0.85	0.95	0.96	0.96	0.95	0.91	0.91
Lanes:	1.00	2.00	1.00	1.00	2.00	1.00	1.00	0.75	0.25	1.00	0.41	0.59
Final Sat.:	1805	3610	1615	1805	3610	1615	1805	1380	449	1805	702	1029
Capacity Analysis Module:												
Vol/Sat:	0.01	0.21	0.05	0.05	0.35	0.19	0.24	0.10	0.10	0.01	0.11	0.11
Crit Moves:	****				****		****				****	
Green/Cycle:	0.38	0.37	0.42	0.48	0.45	0.75	0.46	0.39	0.39	0.19	0.14	0.14
Volume/Cap:	0.16	0.57	0.12	0.30	0.79	0.25	0.70	0.24	0.24	0.09	0.79	0.79
Uniform Del:	22.0	25.3	17.8	16.1	23.7	3.7	19.4	20.3	20.3	33.6	41.8	41.8
IncremntDel:	0.8	0.6	0.1	0.6	2.7	0.1	3.4	0.2	0.2	0.1	16.1	16.1
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	22.8	25.9	17.9	16.7	26.3	3.8	22.7	20.5	20.5	33.7	57.9	57.9
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	22.8	25.9	17.9	16.7	26.3	3.8	22.7	20.5	20.5	33.7	57.9	57.9
LOS by Move:	C	C	B	B	C	A	C	C	C	C	E	E
HCM2kAvgQ:	0	10	2	2	19	3	12	4	4	1	8	8

Note: Queue reported is the number of cars per lane.

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                      Level Of Service Computation Report
            2000 HCM Unsignalized Method (Base Volume Alternative)
******************************************************************************
Intersection #7 Ane Keohokahole/Main Gate
******************************************************************************
Average Delay (sec/veh):     33.3       Worst Case Level Of Service: F[127.7]
******************************************************************************
Street Name:       Ane Keohokahole Hwy                    Main Gate
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:           Include          Include          Include          Include
Lanes:        0  0  1  0  1    1  0  1  0  0    0  0  0  0  0    1  0  0  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0  445   244   163  338     0     0    0     0   226    0   176
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:    0  445   244   163  338     0     0    0     0   226    0   176
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.95
PHF Volume:     0  468   257   172  356     0     0    0     0   238    0   185
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    0  468   257   172  356     0     0    0     0   238    0   185
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx   4.1 xxxx xxxxx xxxxx xxxx xxxxx   6.4 xxxx   6.2
FollowUpTim:xxxxx xxxx xxxxx   2.2 xxxx xxxxx xxxxx xxxx xxxxx   3.5 xxxx   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx   725 xxxx xxxxx  xxxx xxxx xxxxx  1167 xxxx   468
Potent Cap.: xxxx xxxx xxxxx   887 xxxx xxxxx  xxxx xxxx xxxxx   216 xxxx   599
Move Cap.:   xxxx xxxx xxxxx   887 xxxx xxxxx  xxxx xxxx xxxxx   184 xxxx   599
Volume/Cap:  xxxx xxxx  xxxx  0.19 xxxx  xxxx  xxxx xxxx  xxxx  1.29 xxxx  0.31
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx   0.7 xxxx xxxxx  xxxx xxxx xxxxx  13.4 xxxx   1.3
Control Del:xxxxx xxxx xxxxx  10.0 xxxx xxxxx xxxxx xxxx xxxxx 216.5 xxxx  13.7
LOS by Move:   *    *     *     B    *     *     *    *     *     F    *     B
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:    *    *     *     *    *     *     *    *     *     *    *     *
ApproachDel:    xxxxxx           xxxxxx           xxxxxx            127.7
ApproachLOS:        *                *                *                F
******************************************************************************
Note: Queue reported is the number of cars per lane.
******************************************************************************
```

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #8 Palihiolo St/Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	1.837
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	204.9
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Palihiolo St						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Prot+Permit			Permitted		
Rights:	Include			Include			Include			Ignore		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 1	0 0	1	1	0 0	1 0	1	0 0	1 0	1	0 1	0 1
Volume Module:												
Base Vol:	4	19	26	2	4	592	506	731	13	49	1319	23
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	4	19	26	2	4	592	506	731	13	49	1319	23
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.00
PHF Volume:	4	20	27	2	4	623	533	769	14	52	1388	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	4	20	27	2	4	623	533	769	14	52	1388	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
FinalVolume:	4	20	27	2	4	623	533	769	14	52	1388	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.67	0.67	0.85	0.75	0.85	0.85	0.22	1.00	1.00	0.95	1.00	1.00
Lanes:	0.17	0.83	1.00	1.00	0.01	0.99	1.00	0.98	0.02	1.00	1.00	1.00
Final Sat.:	221	1052	1615	1423	11	1606	421	1861	33	1805	1900	1900
Capacity Analysis Module:												
Vol/Sat:	0.02	0.02	0.02	0.00	0.39	0.39	1.27	0.41	0.41	0.03	0.73	0.00
Crit Moves:					****		****					
Green/Cycle:	0.25	0.25	0.25	0.25	0.25	0.25	0.61	0.61	0.61	0.04	0.47	0.00
Volume/Cap:	0.08	0.08	0.07	0.01	1.57	1.57	1.28	0.68	0.68	0.68	1.57	0.00
Uniform Del:	28.9	28.9	28.8	28.4	37.7	37.7	31.8	12.9	12.9	47.2	26.7	0.0
IncremntDel:	0.1	0.1	0.1	0.0	269	268.8	144.8	1.6	1.6	21.7	262	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Delay/Veh:	29.0	29.0	28.9	28.4	306	306.4	176.5	14.5	14.5	68.9	289	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	29.0	29.0	28.9	28.4	306	306.4	176.5	14.5	14.5	68.9	289	0.0
LOS by Move:	C	C	C	C	F	F	F	B	B	E	F	A
HCM2kAvgQ:	1	1	1	0	48	48	33	16	16	3	104	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #10 Palani Rd / Uluaoa St

Average Delay (sec/veh): 10.1 Worst Case Level Of Service: F[200.1]

Street Name:	Palani Rd								Uluaoa St							
Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	-	R	L	-	T	-	R	L	-	T	-	R	L	-	T	-	R
Control:	Uncontrolled					Uncontrolled					Stop Sign					Stop Sign				
Rights:	Include					Include					Include					Include				
Lanes:	0	1	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0
Volume Module:																				
Base Vol:	29	740		0		0	1018		177		71		0		32		0		0	
Growth Adj:	1.00	1.00		1.00		1.00	1.00		1.00		1.00		1.00		1.00		1.00		1.00	
Initial Bse:	29	740		0		0	1018		177		71		0		32		0		0	
User Adj:	1.00	1.00		1.00		1.00	1.00		1.00		1.00		1.00		1.00		1.00		1.00	
PHF Adj:	0.95	0.95		0.95		0.95	0.95		0.95		0.95		0.95		0.95		0.95		0.95	
PHF Volume:	31	779		0		0	1072		186		75		0		34		0		0	
Reduct Vol:	0	0		0		0	0		0		0		0		0		0		0	
FinalVolume:	31	779		0		0	1072		186		75		0		34		0		0	
Critical Gap Module:																				
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx					6.4	xxxx			6.2	xxxxx	xxxx	xxxxx		
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx					3.5	xxxx			3.3	xxxxx	xxxx	xxxxx		
Capacity Module:																				
Cnflict Vol:	1258	xxxx	xxxxx	xxxx	xxxx	xxxxx					2005	xxxx			1165	xxxx	xxxx	xxxxx		
Potent Cap.:	560	xxxx	xxxxx	xxxx	xxxx	xxxxx					66	xxxx			239	xxxx	xxxx	xxxxx		
Move Cap.:	560	xxxx	xxxxx	xxxx	xxxx	xxxxx					63	xxxx			239	xxxx	xxxx	xxxxx		
Volume/Cap:	0.05	xxxx	xxxx	xxxx	xxxx	xxxx					1.18	xxxx			0.14	xxxx	xxxx	xxxx		
Level Of Service Module:																				
2Way95thQ:	0.2	xxxx	xxxxx	xxxx	xxxx	xxxxx					6.0	xxxx			0.5	xxxx	xxxx	xxxxx		
Control Del:	11.8	xxxx	xxxxx	xxxxx	xxxx	xxxxx					280.1	xxxx			22.5	xxxxx	xxxx	xxxxx		
LOS by Move:	B	*		*		*	*		*		F	*			C	*	*	*		
Movement:	LT	-	LTR	-	RT	LT	-	LTR	-	RT	LT	-	LTR	-	RT	LT	-	LTR	-	RT
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx					xxxx	xxxx	xxxxx			xxxx	xxxx	xxxxx		
SharedQueue:	0.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx					xxxxx	xxxx	xxxxx			xxxxx	xxxx	xxxxx		
Shrd ConDel:	11.8	xxxx	xxxxx	xxxxx	xxxx	xxxxx					xxxxx	xxxx	xxxxx			xxxxx	xxxx	xxxxx		
Shared LOS:	B	*		*		*	*		*		*	*			*	*	*	*		
ApproachDel:	xxxxxx					xxxxxx					200.1					xxxxxx				
ApproachLOS:	*					*					F					*				

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #11 Queen Kaahumanu Hwy / Kealakehe Pkwy

Cycle (sec):	100	Critical Vol./Cap.(X):	0.781
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	24.7
Optimal Cycle:	67	Level Of Service:	C

Street Name:	Queen Kaahumanu Hwy						Kaalakehe Pkwy					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Prot+Permit			Permitted			Permitted		
Rights:		Ovl			Ovl			Ovl			Ovl	
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	2 0	1	1 0	2 0	1	0 1	0 0	1	0 1	0 0	1
Volume Module:												
Base Vol:	66	1086	239	136	1028	232	106	97	67	242	66	135
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	66	1086	239	136	1028	232	106	97	67	242	66	135
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	69	1143	252	143	1082	244	112	102	71	255	69	142
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	69	1143	252	143	1082	244	112	102	71	255	69	142
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	69	1143	252	143	1082	244	112	102	71	255	69	142
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	0.95	0.85	0.95	0.95	0.85	0.55	0.55	0.85	0.56	0.56	0.85
Lanes:	1.00	2.00	1.00	1.00	2.00	1.00	0.52	0.48	1.00	0.79	0.21	1.00
Final Sat.:	1805	3610	1615	1805	3610	1615	546	499	1615	830	226	1615
Capacity Analysis Module:												
Vol/Sat:	0.04	0.32	0.16	0.08	0.30	0.15	0.20	0.20	0.04	0.31	0.31	0.09
Crit Moves:		****		****							****	
Green/Cycle:	0.46	0.41	0.41	0.54	0.45	0.45	0.39	0.39	0.45	0.39	0.39	0.49
Volume/Cap:	0.32	0.78	0.38	0.55	0.67	0.34	0.52	0.52	0.10	0.78	0.78	0.18
Uniform Del:	16.8	25.9	20.9	17.5	21.7	17.9	23.2	23.2	15.8	26.6	26.6	14.0
IncremntDel:	0.8	2.8	0.4	2.6	1.1	0.3	1.2	1.2	0.1	9.2	9.2	0.1
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	17.7	28.6	21.3	20.1	22.7	18.1	24.4	24.4	15.8	35.8	35.8	14.1
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	17.7	28.6	21.3	20.1	22.7	18.1	24.4	24.4	15.8	35.8	35.8	14.1
LOS by Move:	B	C	C	C	C	B	C	C	B	D	D	B
HCM2kAvgQ:	2	18	6	4	14	5	6	6	1	11	11	2

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #12 Ane Keohokalole Hwy / Kealakehe Pkwy

Average Delay (sec/veh): OVERFLOW Worst Case Level Of Service: F[xxxxx]

Street Name:	Ane Keohokalole Hwy						Kealakehe Pkwy					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	1 0	1 0	1	1 0	0 1	0	1 0	1 1	0	1 0	1 0	1
Volume Module:												
Base Vol:	179	363	0	50	311	369	165	194	185	5	128	23
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	179	363	0	50	311	369	165	194	185	5	128	23
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	188	382	0	53	327	388	174	204	195	5	135	24
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	188	382	0	53	327	388	174	204	195	5	135	24
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1164	818	199	786	892	135	159	xxxx	xxxxx	399	xxxx	xxxxx
Potent Cap.:	173	313	847	312	284	920	1433	xxxx	xxxxx	1171	xxxx	xxxxx
Move Cap.:	0	274	847	0	248	920	1433	xxxx	xxxxx	1171	xxxx	xxxxx
Volume/Cap:	xxxx	1.40	0.00	xxxx	1.32	0.42	0.12	xxxx	xxxx	0.00	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	20.5	xxxxx	xxxx	xxxx	xxxxx	0.4	xxxx	xxxxx	0.0	xxxx	xxxxx
Control Del:	xxxxx	235	xxxxx	xxxxx	xxxx	xxxxx	7.9	xxxx	xxxxx	8.1	xxxx	xxxxx
LOS by Move:	*	F	*	*	*	*	A	*	*	A	*	*
Movement:	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	411	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	44.2	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	367.2	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	*	*	*	*	F	*	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			xxxxxx			xxxxxx		
ApproachLOS:	F			F			*			*		

Note: Queue reported is the number of cars per lane.

CUMULATIVE PLUS PROJECT CONDITIONS – CONCEPT B

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #1 Queen Kaahumanu Hwy / Henry St

Cycle (sec):	100	Critical Vol./Cap.(X):	0.890
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	29.3
Optimal Cycle:	100	Level Of Service:	C

Street Name:	Queen Kaahumanu Hwy						Henry St					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Prot+Permit			Prot+Permit			Prot+Permit		
Rights:	Ovl			Ovl			Ovl			Ovl		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0 2 0 1			1 0 3 0 1			1 0 2 0 1			1 1 1 0 1		
Volume Module:												
Base Vol:	320	802	925	130	577	132	76	419	25	636	698	99
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	320	802	925	130	577	132	76	419	25	636	698	99
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	337	844	974	137	607	139	80	441	26	669	735	104
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	337	844	974	137	607	139	80	441	26	669	735	104
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	337	844	974	137	607	139	80	441	26	669	735	104
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	0.95	0.85	0.95	0.91	0.85	0.95	0.95	0.85	0.93	0.93	0.85
Lanes:	1.00	2.00	1.00	1.00	3.00	1.00	1.00	2.00	1.00	1.43	1.57	1.00
Final Sat.:	1805	3610	1615	1805	5187	1615	1805	3610	1615	2522	2768	1615
Capacity Analysis Module:												
Vol/Sat:	0.19	0.23	0.60	0.08	0.12	0.09	0.04	0.12	0.02	0.27	0.27	0.06
Crit Moves:			****	****				****		****		
Green/Cycle:	0.48	0.38	0.68	0.26	0.18	0.24	0.20	0.14	0.42	0.46	0.37	0.46
Volume/Cap:	0.57	0.62	0.89	0.52	0.65	0.36	0.38	0.89	0.04	0.70	0.71	0.14
Uniform Del:	17.1	25.1	13.1	29.3	38.2	31.5	33.5	42.4	16.9	20.7	26.7	15.7
IncremntDel:	1.4	0.9	9.2	1.9	1.7	0.6	1.2	17.8	0.0	1.1	1.2	0.1
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	18.4	26.0	22.3	31.2	39.9	32.0	34.7	60.2	17.0	21.8	28.0	15.8
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	18.4	26.0	22.3	31.2	39.9	32.0	34.7	60.2	17.0	21.8	28.0	15.8
LOS by Move:	B	C	C	C	D	C	C	E	B	C	C	B
HCM2kAvgQ:	8	12	28	4	7	4	3	10	0	13	14	2

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #2 Queen Kaahumanu Hwy / Alli Dr

Cycle (sec):	100	Critical Vol./Cap.(X):	0.917
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	35.1
Optimal Cycle:	114	Level Of Service:	D

Street Name:	Queen Kaahumanu Hwy						Alli Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Prot+Permit			Prot+Permit			Prot+Permit		
Rights:	Ovl			Ovl			Ovl			Ovl		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0 2 0 1			1 0 2 0 1			1 0 1 0 1			1 0 1 0 1		
Volume Module:												
Base Vol:	97	807	73	193	655	372	193	144	99	100	658	93
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	97	807	73	193	655	372	193	144	99	100	658	93
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	102	849	77	203	689	392	203	152	104	105	693	98
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	102	849	77	203	689	392	203	152	104	105	693	98
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	102	849	77	203	689	392	203	152	104	105	693	98
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	0.95	0.85	0.95	0.95	0.85	0.95	1.00	0.85	0.95	1.00	0.85
Lanes:	1.00	2.00	1.00	1.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Sat.:	1805	3610	1615	1805	3610	1615	1805	1900	1615	1805	1900	1615
Capacity Analysis Module:												
Vol/Sat:	0.06	0.24	0.05	0.11	0.19	0.24	0.11	0.08	0.06	0.06	0.36	0.06
Crit Moves:		****		****			****				****	
Green/Cycle:	0.34	0.26	0.48	0.40	0.29	0.42	0.42	0.30	0.39	0.54	0.40	0.52
Volume/Cap:	0.40	0.92	0.10	0.69	0.65	0.58	0.68	0.27	0.17	0.15	0.92	0.12
Uniform Del:	23.6	36.1	14.4	23.3	30.9	22.5	22.4	26.6	20.1	11.2	28.5	12.2
IncremntDel:	1.0	13.6	0.1	6.5	1.5	1.3	6.4	0.3	0.1	0.1	15.9	0.1
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	24.7	49.7	14.4	29.9	32.4	23.9	28.8	26.8	20.2	11.3	44.5	12.3
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	24.7	49.7	14.4	29.9	32.4	23.9	28.8	26.8	20.2	11.3	44.5	12.3
LOS by Move:	C	D	B	C	C	C	C	C	C	B	D	B
HCM2kAvgQ:	3	17	1	7	11	10	6	4	2	2	24	2

Note: Queue reported is the number of cars per lane.

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------------------------------------------------------------------------------
------------------------------------------------------------------------------
                      Level Of Service Computation Report
            2000 HCM Unsignalized Method (Base Volume Alternative)
******************************************************************************
Intersection #3 Kamakaeha Ave / Palani Rd
******************************************************************************
Average Delay (sec/veh):      1.4       Worst Case Level Of Service: D[ 31.3]
******************************************************************************
Street Name:          Kamakaeha Ave                       Palani Rd
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Stop Sign        Stop Sign       Uncontrolled     Uncontrolled
Rights:           Include          Include          Include          Ignore
Lanes:        0  0  0  0  0    1  0  0  0  1    0  0  1  0  0    0  0  1  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0    0     0    47    0    15     0  410     0     0  885   240
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:    0    0     0    47    0    15     0  410     0     0  885   240
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.00
PHF Volume:     0    0     0    49    0    16     0  432     0     0  932     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    0    0     0    49    0    16     0  432     0     0  932     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx   6.4 xxxx   6.2 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
FollowUpTim:xxxxx xxxx xxxxx   3.5 xxxx   3.3 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx  1363 xxxx   932  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Potent Cap.: xxxx xxxx xxxxx   165 xxxx   326  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Move Cap.:   xxxx xxxx xxxxx   165 xxxx   326  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Volume/Cap:  xxxx xxxx  xxxx  0.30 xxxx  0.05  xxxx xxxx  xxxx  xxxx xxxx  xxxx
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx   1.2 xxxx   0.2  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx  36.0 xxxx  16.6 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:   *    *     *     E    *     C     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:    *    *     *     *    *     *     *    *     *     *    *     *
ApproachDel:    xxxxxx             31.3           xxxxxx           xxxxxx
ApproachLOS:        *                D               *                *
******************************************************************************
Note: Queue reported is the number of cars per lane.
******************************************************************************
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Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Henry St / Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	1.691
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	229.3
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Henry St						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Prot+Permit		
Rights:	Ovl			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	0 1	0	1 0	0 1	0	1 0	0 1	0	1 0	0 1	0
Volume Module:												
Base Vol:	122	414	454	116	558	327	243	185	37	942	810	90
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	122	414	454	116	558	327	243	185	37	942	810	90
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	128	436	478	122	587	344	256	195	39	992	853	95
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	128	436	478	122	587	344	256	195	39	992	853	95
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	128	436	478	122	587	344	256	195	39	992	853	95
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.08	0.92	0.92	0.08	0.95	0.95	0.95	0.98	0.98	0.77	0.99	0.99
Lanes:	1.00	0.48	0.52	1.00	0.63	0.37	1.00	0.83	0.17	1.00	0.90	0.10
Final Sat.:	152	836	916	152	1132	663	1805	1544	309	1465	1684	187
Capacity Analysis Module:												
Vol/Sat:	0.84	0.52	0.52	0.80	0.52	0.52	0.14	0.13	0.13	0.68	0.51	0.51
Crit Moves:	****									****		
Green/Cycle:	0.50	0.50	0.83	0.50	0.50	0.50	0.09	0.07	0.07	0.31	0.31	0.31
Volume/Cap:	1.69	1.04	0.63	1.61	1.04	1.04	1.62	1.69	1.69	1.73	1.62	1.62
Uniform Del:	25.0	25.0	3.2	25.0	25.0	25.0	45.6	46.3	46.3	34.6	34.4	34.4
IncremntDel:	360.2	42.2	0.9	325.4	40.1	40.1	306.3	339	339.3	337.0	287	287.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	385.2	67.2	4.1	350.4	65.1	65.1	351.9	386	385.6	371.6	321	321.4
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	385.2	67.2	4.1	350.4	65.1	65.1	351.9	386	385.6	371.6	321	321.4
LOS by Move:	F	E	A	F	E	E	F	F	F	F	F	F
HCM2kAvgQ:	12	39	11	11	39	39	22	20	20	82	74	74

Note: Queue reported is the number of cars per lane.

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                      Level Of Service Computation Report
            2000 HCM Unsignalized Method (Base Volume Alternative)
******************************************************************************
Intersection #5 Gate 2/Palani
******************************************************************************
Average Delay (sec/veh):      1.4       Worst Case Level Of Service: F[ 91.9]
******************************************************************************
Street Name:              Gate 2                          /Palani Rd
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Stop Sign       Yield Sign       Uncontrolled     Uncontrolled
Rights:           Include          Include          Include          Include
Lanes:        0  0  0  0  0    0  0  0  0  1    0  0  1  0  0    0  0  0  1  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0    0     0     0    0    42     0  755     0     0 1800   100
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:    0    0     0     0    0    42     0  755     0     0 1800   100
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.95
PHF Volume:     0    0     0     0    0    44     0  795     0     0 1895   105
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    0    0     0     0    0    44     0  795     0     0 1895   105
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx xxxxx xxxx   6.2 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
FollowUpTim:xxxxx xxxx xxxxx xxxxx xxxx   3.3 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx  xxxx xxxx  1947  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Potent Cap.: xxxx xxxx xxxxx  xxxx xxxx    82  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Move Cap.:   xxxx xxxx xxxxx  xxxx xxxx    82  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Volume/Cap:  xxxx xxxx  xxxx  xxxx xxxx  0.54  xxxx xxxx  xxxx  xxxx xxxx  xxxx
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx  xxxx xxxx   2.4  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx xxxxx xxxx  91.9 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:   *    *     *     *    *     F     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:    *    *     *     *    *     *     *    *     *     *    *     *
ApproachDel:    xxxxxx             91.9           xxxxxx           xxxxxx
ApproachLOS:        *                F               *                *
******************************************************************************
Note: Queue reported is the number of cars per lane.
******************************************************************************
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Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu Hwy / Makala Blvd

Cycle (sec):	100	Critical Vol./Cap.(X):	0.666
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	22.0
Optimal Cycle:	50	Level Of Service:	C

Street Name:	Queen Kaahumanu Hwy						Makala Blvd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Prot+Permit			Prot+Permit			Prot+Permit		
Rights:	Ovl			Ovl			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	2 0	1	1 0	2 0	1	1 0	0 1	0	1 0	0 1	0
Volume Module:												
Base Vol:	10	944	30	68	907	200	309	72	32	7	21	143
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	10	944	30	68	907	200	309	72	32	7	21	143
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	11	994	32	72	955	211	325	76	34	7	22	151
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	11	994	32	72	955	211	325	76	34	7	22	151
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	11	994	32	72	955	211	325	76	34	7	22	151
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	0.95	0.85	0.95	0.95	0.85	0.95	0.95	0.95	0.95	0.87	0.87
Lanes:	1.00	2.00	1.00	1.00	2.00	1.00	1.00	0.69	0.31	1.00	0.13	0.87
Final Sat.:	1805	3610	1615	1805	3610	1615	1805	1255	558	1805	211	1440
Capacity Analysis Module:												
Vol/Sat:	0.01	0.28	0.02	0.04	0.26	0.13	0.18	0.06	0.06	0.00	0.10	0.10
Crit Moves:		****		****			****				****	
Green/Cycle:	0.42	0.41	0.44	0.49	0.46	0.73	0.45	0.40	0.40	0.18	0.16	0.16
Volume/Cap:	0.06	0.67	0.04	0.33	0.57	0.18	0.54	0.15	0.15	0.03	0.67	0.67
Uniform Del:	17.6	23.8	16.0	16.5	19.6	4.1	18.8	19.1	19.1	33.4	39.7	39.7
IncremntDel:	0.1	1.2	0.0	0.9	0.5	0.1	1.0	0.1	0.1	0.0	6.5	6.5
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	17.8	24.9	16.0	17.4	20.1	4.2	19.9	19.2	19.2	33.5	46.2	46.2
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	17.8	24.9	16.0	17.4	20.1	4.2	19.9	19.2	19.2	33.5	46.2	46.2
LOS by Move:	B	C	B	B	C	A	B	B	B	C	D	D
HCM2kAvgQ:	0	14	1	2	12	2	8	2	2	0	6	6

Note: Queue reported is the number of cars per lane.

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                      Level Of Service Computation Report
            2000 HCM Unsignalized Method (Base Volume Alternative)
******************************************************************************
Intersection #7 Ane Keohokahole/Main Gate
******************************************************************************
Average Delay (sec/veh):    238.9       Worst Case Level Of Service: F[788.3]
******************************************************************************
Street Name:       Ane Keohokahole Hwy                    Main Gate
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:           Include          Include          Include          Include
Lanes:        0  0  1  0  1    1  0  1  0  0    0  0  0  0  0    1  0  0  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0  447   299   200  620     0     0    0     0   381    0   296
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:    0  447   299   200  620     0     0    0     0   381    0   296
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.95
PHF Volume:     0  471   315   211  653     0     0    0     0   401    0   312
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    0  471   315   211  653     0     0    0     0   401    0   312
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx   4.1 xxxx xxxxx xxxxx xxxx xxxxx   6.4 xxxx   6.2
FollowUpTim:xxxxx xxxx xxxxx   2.2 xxxx xxxxx xxxxx xxxx xxxxx   3.5 xxxx   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx   785 xxxx xxxxx  xxxx xxxx xxxxx  1544 xxxx   471
Potent Cap.: xxxx xxxx xxxxx   842 xxxx xxxxx  xxxx xxxx xxxxx   128 xxxx   597
Move Cap.:   xxxx xxxx xxxxx   842 xxxx xxxxx  xxxx xxxx xxxxx   103 xxxx   597
Volume/Cap:  xxxx xxxx  xxxx  0.25 xxxx  xxxx  xxxx xxxx  xxxx  3.89 xxxx  0.52
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx   1.0 xxxx xxxxx  xxxx xxxx xxxxx  40.9 xxxx   3.0
Control Del:xxxxx xxxx xxxxx  10.7 xxxx xxxxx xxxxx xxxx xxxxx  1387 xxxx  17.4
LOS by Move:   *    *     *     B    *     *     *    *     *     F    *     C
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:    *    *     *     *    *     *     *    *     *     *    *     *
ApproachDel:    xxxxxx           xxxxxx           xxxxxx            788.3
ApproachLOS:        *                *                *                F
******************************************************************************
Note: Queue reported is the number of cars per lane.
******************************************************************************
```

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #8 Palihiolo St/Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	1.647
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	189.4
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Palihiolo St						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Prot+Permit			Permitted		
Rights:	Include			Include			Include			Ignore		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 1	0 0	1	1	0 0	1 0	1	0 0	1 0	1	0 1	0 1
Volume Module:												
Base Vol:	5	20	32	10	15	554	438	561	6	20	1321	56
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	5	20	32	10	15	554	438	561	6	20	1321	56
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.00
PHF Volume:	5	21	34	11	16	583	461	591	6	21	1391	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	5	21	34	11	16	583	461	591	6	21	1391	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
FinalVolume:	5	21	34	11	16	583	461	591	6	21	1391	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.64	0.64	0.85	0.75	0.85	0.85	0.22	1.00	1.00	0.95	1.00	1.00
Lanes:	0.20	0.80	1.00	1.00	0.03	0.97	1.00	0.99	0.01	1.00	1.00	1.00
Final Sat.:	244	977	1615	1419	43	1580	414	1876	20	1805	1900	1900
Capacity Analysis Module:												
Vol/Sat:	0.02	0.02	0.02	0.01	0.37	0.37	1.11	0.31	0.31	0.01	0.73	0.00
Crit Moves:					****		****					
Green/Cycle:	0.24	0.24	0.24	0.24	0.24	0.24	0.63	0.63	0.63	0.02	0.49	0.00
Volume/Cap:	0.09	0.09	0.09	0.03	1.51	1.51	1.21	0.50	0.50	0.50	1.51	0.00
Uniform Del:	29.1	29.1	29.1	28.7	37.8	37.8	8.6	9.9	9.9	48.2	25.7	0.0
IncremntDel:	0.1	0.1	0.1	0.0	241	241.0	115.4	0.3	0.3	9.0	234	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Delay/Veh:	29.3	29.3	29.2	28.8	279	278.7	124.0	10.2	10.2	57.2	260	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	29.3	29.3	29.2	28.8	279	278.7	124.0	10.2	10.2	57.2	260	0.0
LOS by Move:	C	C	C	C	F	F	F	B	B	E	F	A
HCM2kAvgQ:	1	1	1	0	45	45	27	10	10	1	100	0

Note: Queue reported is the number of cars per lane.

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------------------------------------------------------------------------------
                      Level Of Service Computation Report
            2000 HCM Unsignalized Method (Base Volume Alternative)
******************************************************************************
Intersection #10 Palani Rd / Uluaoa St
******************************************************************************
Average Delay (sec/veh):     45.9       Worst Case Level Of Service: F[247.6]
******************************************************************************
Street Name:            Palani Rd                        Uluaoa St
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:           Include          Include          Include          Include
Lanes:        0  1  0  0  0    0  0  0  1  0    1  0  0  0  1    0  0  0  0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:      58  507     0     0  790   311   176    0   200     0    0     0
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:   58  507     0     0  790   311   176    0   200     0    0     0
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.95
PHF Volume:    61  534     0     0  832   327   185    0   211     0    0     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:   61  534     0     0  832   327   185    0   211     0    0     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:  4.1 xxxx xxxxx xxxxx xxxx xxxxx   6.4 xxxx   6.2 xxxxx xxxx xxxxx
FollowUpTim:  2.2 xxxx xxxxx xxxxx xxxx xxxxx   3.5 xxxx   3.3 xxxxx xxxx xxxxx
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: 1159 xxxx xxxxx  xxxx xxxx xxxxx  1651 xxxx   995  xxxx xxxx xxxxx
Potent Cap.:  610 xxxx xxxxx  xxxx xxxx xxxxx   110 xxxx   300  xxxx xxxx xxxxx
Move Cap.:    610 xxxx xxxxx  xxxx xxxx xxxxx   101 xxxx   300  xxxx xxxx xxxxx
Volume/Cap:  0.10 xxxx  xxxx  xxxx xxxx  xxxx  1.83 xxxx  0.70  xxxx xxxx  xxxx
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:    0.3 xxxx xxxxx  xxxx xxxx xxxxx  15.1 xxxx   4.9  xxxx xxxx xxxxx
Control Del: 11.6 xxxx xxxxx xxxxx xxxx xxxxx 482.3 xxxx  41.1 xxxxx xxxx xxxxx
LOS by Move:   B    *     *     *    *     *     F    *     E     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
SharedQueue:  0.3 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel: 11.6 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:    B    *     *     *    *     *     *    *     *     *    *     *
ApproachDel:    xxxxxx           xxxxxx            247.6           xxxxxx
ApproachLOS:        *                *                F                *
******************************************************************************
Note: Queue reported is the number of cars per lane.
******************************************************************************
```

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #11 Queen Kaahumanu Hwy / Kealakehe Pkwy

Cycle (sec):	100	Critical Vol./Cap.(X):	0.834
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	28.2
Optimal Cycle:	80	Level Of Service:	C

Street Name:	Queen Kaahumanu Hwy						Kaalakehe Pkwy					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Prot+Permit			Permitted			Permitted		
Rights:		Ovl			Ovl			Ovl			Ovl	
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0 2 0 1			1 0 2 0 1			0 1 0 0 1			0 1 0 0 1		
Volume Module:												
Base Vol:	115	1037	422	271	977	249	81	107	10	231	61	208
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	115	1037	422	271	977	249	81	107	10	231	61	208
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	121	1092	444	285	1028	262	85	113	11	243	64	219
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	121	1092	444	285	1028	262	85	113	11	243	64	219
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	121	1092	444	285	1028	262	85	113	11	243	64	219
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	0.95	0.85	0.95	0.95	0.85	0.61	0.61	0.85	0.56	0.56	0.85
Lanes:	1.00	2.00	1.00	1.00	2.00	1.00	0.43	0.57	1.00	0.79	0.21	1.00
Final Sat.:	1805	3610	1615	1805	3610	1615	495	654	1615	837	221	1615
Capacity Analysis Module:												
Vol/Sat:	0.07	0.30	0.28	0.16	0.28	0.16	0.17	0.17	0.01	0.29	0.29	0.14
Crit Moves:		****		****							****	
Green/Cycle:	0.47	0.36	0.36	0.58	0.45	0.45	0.35	0.35	0.45	0.35	0.35	0.54
Volume/Cap:	0.38	0.83	0.76	0.68	0.64	0.36	0.49	0.49	0.01	0.83	0.83	0.25
Uniform Del:	16.1	29.1	28.0	23.3	21.4	18.3	25.7	25.7	15.0	29.9	29.9	12.4
IncremntDel:	0.8	4.8	5.7	4.6	0.9	0.3	1.0	1.0	0.0	15.0	15.0	0.2
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	16.9	33.9	33.8	27.9	22.3	18.6	26.6	26.6	15.1	45.0	45.0	12.5
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	16.9	33.9	33.8	27.9	22.3	18.6	26.6	26.6	15.1	45.0	45.0	12.5
LOS by Move:	B	C	C	C	C	B	C	C	B	D	D	B
HCM2kAvgQ:	3	19	14	7	13	5	5	5	0	11	11	4

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #12 Ane Keohokalole Hwy / Kealakehe Pkwy

Average Delay (sec/veh): OVERFLOW Worst Case Level Of Service: F[xxxxx]

Street Name:	Ane Keohokalole Hwy						Kealakehe Pkwy					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	1 0	1 0	1	1 0	0 1	0	1 0	1 1	0	1 0	1 0	1
Volume Module:												
Base Vol:	293	447	3	12	362	45	369	94	456	2	115	50
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	293	447	3	12	362	45	369	94	456	2	115	50
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	308	471	3	13	381	47	388	99	480	2	121	53
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	308	471	3	13	381	47	388	99	480	2	121	53
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1482	1294	289	1187	1481	121	174	xxxx	xxxxx	579	xxxx	xxxxx
Potent Cap.:	104	164	754	167	127	936	1415	xxxx	xxxxx	1005	xxxx	xxxxx
Move Cap.:	0	119	754	0	92	936	1415	xxxx	xxxxx	1005	xxxx	xxxxx
Volume/Cap:	xxxx	3.96	0.00	xxxx	4.16	0.05	0.27	xxxx	xxxx	0.00	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	47.7	0.0	xxxx	xxxx	xxxxx	1.1	xxxx	xxxxx	0.0	xxxx	xxxxx
Control Del:	xxxxx	1407	9.8	xxxxx	xxxx	xxxxx	8.5	xxxx	xxxxx	8.6	xxxx	xxxxx
LOS by Move:	*	F	A	*	*	*	A	*	*	A	*	*
Movement:	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	102	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	44.4	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	1530	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	*	*	*	*	F	*	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			xxxxxx			xxxxxx		
ApproachLOS:	F			F			*			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #1 Queen Kaahumanu Hwy / Henry St

Cycle (sec):	100	Critical Vol./Cap.(X):	0.925
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	31.6
Optimal Cycle:	119	Level Of Service:	C

Street Name:	Queen Kaahumanu Hwy						Henry St					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Prot+Permit			Prot+Permit			Prot+Permit		
Rights:	Ovl			Ovl			Ovl			Ovl		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	2 0	1	1 0	3 0	1	1 0	2 0	1	1 1	1 0	1
Volume Module:												
Base Vol:	282	537	832	183	730	121	76	628	107	564	602	211
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	282	537	832	183	730	121	76	628	107	564	602	211
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	297	565	876	193	768	127	80	661	113	594	634	222
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	297	565	876	193	768	127	80	661	113	594	634	222
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	297	565	876	193	768	127	80	661	113	594	634	222
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	0.95	0.85	0.95	0.91	0.85	0.95	0.95	0.85	0.93	0.93	0.85
Lanes:	1.00	2.00	1.00	1.00	3.00	1.00	1.00	2.00	1.00	1.45	1.55	1.00
Final Sat.:	1805	3610	1615	1805	5187	1615	1805	3610	1615	2556	2729	1615
Capacity Analysis Module:												
Vol/Sat:	0.16	0.16	0.54	0.11	0.15	0.08	0.04	0.18	0.07	0.23	0.23	0.14
Crit Moves:			****	****				****		****		
Green/Cycle:	0.47	0.34	0.59	0.33	0.21	0.29	0.27	0.20	0.44	0.47	0.38	0.49
Volume/Cap:	0.59	0.47	0.92	0.51	0.69	0.28	0.28	0.92	0.16	0.64	0.62	0.28
Uniform Del:	18.0	26.2	18.7	25.2	36.3	27.7	27.9	39.4	17.1	20.0	25.3	14.9
IncremntDel:	1.9	0.3	14.4	1.1	1.9	0.3	0.6	17.8	0.1	0.8	0.6	0.2
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	19.9	26.5	33.1	26.3	38.2	28.0	28.4	57.2	17.3	20.7	25.8	15.1
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	19.9	26.5	33.1	26.3	38.2	28.0	28.4	57.2	17.3	20.7	25.8	15.1
LOS by Move:	B	C	C	C	D	C	C	E	B	C	C	B
HCM2kAvgQ:	7	7	29	5	9	3	2	15	2	11	11	4

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #2 Queen Kaahumanu Hwy / Alli Dr

Cycle (sec):	100	Critical Vol./Cap.(X):	1.031
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	46.2
Optimal Cycle:	180	Level Of Service:	D

Street Name:	Queen Kaahumanu Hwy						Alli Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Prot+Permit			Prot+Permit			Prot+Permit		
Rights:	Ovl			Ovl			Ovl			Ovl		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	2 0	1	1 0	2 0	1	1 0	1 0	1	1 0	1 0	1
Volume Module:												
Base Vol:	38	706	93	299	707	358	269	293	219	143	732	110
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	38	706	93	299	707	358	269	293	219	143	732	110
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	40	743	98	315	744	377	283	308	231	151	771	116
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	40	743	98	315	744	377	283	308	231	151	771	116
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	40	743	98	315	744	377	283	308	231	151	771	116
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	0.95	0.85	0.80	0.95	0.85	0.71	1.00	0.85	0.95	1.00	0.85
Lanes:	1.00	2.00	1.00	1.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Sat.:	1805	3610	1615	1513	3610	1615	1351	1900	1615	1805	1900	1615
Capacity Analysis Module:												
Vol/Sat:	0.02	0.21	0.06	0.21	0.21	0.23	0.21	0.16	0.14	0.08	0.41	0.07
Crit Moves:		****		****			****				****	
Green/Cycle:	0.23	0.20	0.38	0.38	0.33	0.48	0.50	0.35	0.39	0.56	0.39	0.55
Volume/Cap:	0.22	1.05	0.16	0.84	0.63	0.49	0.82	0.46	0.37	0.25	1.05	0.13
Uniform Del:	30.2	40.2	20.5	25.1	28.5	17.8	14.6	24.9	21.7	11.5	30.6	10.7
IncremntDel:	0.6	46.8	0.1	15.4	1.1	0.5	14.1	0.5	0.4	0.2	46.3	0.1
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	30.9	87.0	20.7	40.6	29.6	18.3	28.6	25.3	22.1	11.7	76.9	10.8
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	30.9	87.0	20.7	40.6	29.6	18.3	28.6	25.3	22.1	11.7	76.9	10.8
LOS by Move:	C	F	C	D	C	B	C	C	C	B	E	B
HCM2kAvgQ:	1	19	2	12	11	8	10	7	5	2	34	2

Note: Queue reported is the number of cars per lane.

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                      Level Of Service Computation Report
            2000 HCM Unsignalized Method (Base Volume Alternative)
******************************************************************************
Intersection #3 Kamakaeha Ave / Palani Rd
******************************************************************************
Average Delay (sec/veh):     19.1       Worst Case Level Of Service: F[180.7]
******************************************************************************
Street Name:          Kamakaeha Ave                       Palani Rd
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Stop Sign        Stop Sign       Uncontrolled     Uncontrolled
Rights:           Include          Include          Include          Ignore
Lanes:        0  0  0  0  0    1  0  0  0  1    0  0  1  0  0    0  0  1  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0    0     0   127    0    63     0  685     0     0  921   281
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:    0    0     0   127    0    63     0  685     0     0  921   281
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.00
PHF Volume:     0    0     0   134    0    66     0  721     0     0  969     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    0    0     0   134    0    66     0  721     0     0  969     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx   6.4 xxxx   6.2 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
FollowUpTim:xxxxx xxxx xxxxx   3.5 xxxx   3.3 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx  1691 xxxx   969  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Potent Cap.: xxxx xxxx xxxxx   104 xxxx   310  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Move Cap.:   xxxx xxxx xxxxx   104 xxxx   310  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Volume/Cap:  xxxx xxxx  xxxx  1.29 xxxx  0.21  xxxx xxxx  xxxx  xxxx xxxx  xxxx
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx   9.2 xxxx   0.8  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx 260.5 xxxx  19.7 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:   *    *     *     F    *     C     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:    *    *     *     *    *     *     *    *     *     *    *     *
ApproachDel:    xxxxxx            180.7           xxxxxx           xxxxxx
ApproachLOS:        *                F               *                *
******************************************************************************
Note: Queue reported is the number of cars per lane.
******************************************************************************
```

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Henry St / Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	1.328
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	188.3
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Henry St						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Prot+Permit		
Rights:	Ovl			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	0 1	0	1 0	0 1	0	1 0	0 1	0	1 0	0 1	0
Volume Module:												
Base Vol:	110	430	394	88	359	210	335	416	129	870	927	93
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	110	430	394	88	359	210	335	416	129	870	927	93
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	116	453	415	93	378	221	353	438	136	916	976	98
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	116	453	415	93	378	221	353	438	136	916	976	98
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	116	453	415	93	378	221	353	438	136	916	976	98
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.11	0.93	0.93	0.11	0.95	0.95	0.95	0.96	0.96	0.78	0.99	0.99
Lanes:	1.00	0.52	0.48	1.00	0.63	0.37	1.00	0.76	0.24	1.00	0.91	0.09
Final Sat.:	211	920	843	211	1133	663	1805	1398	434	1483	1703	171
Capacity Analysis Module:												
Vol/Sat:	0.55	0.49	0.49	0.44	0.33	0.33	0.20	0.31	0.31	0.62	0.57	0.57
Crit Moves:	****							****		****		
Green/Cycle:	0.36	0.36	0.69	0.36	0.36	0.36	0.14	0.21	0.21	0.40	0.40	0.40
Volume/Cap:	1.52	1.36	0.71	1.22	0.92	0.92	1.43	1.52	1.52	1.35	1.43	1.43
Uniform Del:	32.0	32.0	9.2	32.0	30.7	30.7	43.1	39.7	39.7	28.5	29.9	29.9
IncremntDel:	290.5	174	1.9	172.8	19.2	19.2	213.2	248	247.9	167.7	199	199.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	322.5	206	11.2	204.8	49.8	49.8	256.3	288	287.6	196.1	229	228.9
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	322.5	206	11.2	204.8	49.8	49.8	256.3	288	287.6	196.1	229	228.9
LOS by Move:	F	F	B	F	D	D	F	F	F	F	F	F
HCM2kAvgQ:	10	56	17	7	22	22	26	43	43	59	73	73

Note: Queue reported is the number of cars per lane.

```
------------------------------------------------------------------------------
------------------------------------------------------------------------------
                      Level Of Service Computation Report
            2000 HCM Unsignalized Method (Base Volume Alternative)
******************************************************************************
Intersection #5 Gate 2/Palani
******************************************************************************
Average Delay (sec/veh):      1.2       Worst Case Level Of Service: F[ 97.3]
******************************************************************************
Street Name:              Gate 2                          /Palani Rd
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Stop Sign       Yield Sign       Uncontrolled     Uncontrolled
Rights:           Include          Include          Include          Include
Lanes:        0  0  0  0  0    0  0  0  0  1    0  0  1  0  0    0  0  0  1  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0    0     0     0    0    36     0  898     0     0 1853   138
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:    0    0     0     0    0    36     0  898     0     0 1853   138
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.95
PHF Volume:     0    0     0     0    0    38     0  945     0     0 1951   145
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    0    0     0     0    0    38     0  945     0     0 1951   145
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx xxxxx xxxx   6.2 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
FollowUpTim:xxxxx xxxx xxxxx xxxxx xxxx   3.3 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx  xxxx xxxx  2023  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Potent Cap.: xxxx xxxx xxxxx  xxxx xxxx    74  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Move Cap.:   xxxx xxxx xxxxx  xxxx xxxx    74  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Volume/Cap:  xxxx xxxx  xxxx  xxxx xxxx  0.52  xxxx xxxx  xxxx  xxxx xxxx  xxxx
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx  xxxx xxxx   2.1  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx xxxxx xxxx  97.3 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:   *    *     *     *    *     F     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:    *    *     *     *    *     *     *    *     *     *    *     *
ApproachDel:    xxxxxx             97.3           xxxxxx           xxxxxx
ApproachLOS:        *                F                *                *
******************************************************************************
Note: Queue reported is the number of cars per lane.
******************************************************************************
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Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu Hwy / Makala Blvd

Cycle (sec):	100	Critical Vol./Cap.(X):	0.799
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	24.8
Optimal Cycle:	71	Level Of Service:	C

Street Name:	Queen Kaahumanu Hwy						Makala Blvd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Prot+Permit			Prot+Permit			Prot+Permit		
Rights:	Ovl			Ovl			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0 2 0 1			1 0 2 0 1			1 0 0 1 0			1 0 0 1 0		
Volume Module:												
Base Vol:	14	735	80	86	1240	294	417	126	41	21	71	104
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	14	735	80	86	1240	294	417	126	41	21	71	104
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	15	774	84	91	1305	309	439	133	43	22	75	109
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	15	774	84	91	1305	309	439	133	43	22	75	109
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	15	774	84	91	1305	309	439	133	43	22	75	109
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	0.95	0.85	0.95	0.95	0.85	0.95	0.96	0.96	0.95	0.91	0.91
Lanes:	1.00	2.00	1.00	1.00	2.00	1.00	1.00	0.75	0.25	1.00	0.41	0.59
Final Sat.:	1805	3610	1615	1805	3610	1615	1805	1380	449	1805	702	1029
Capacity Analysis Module:												
Vol/Sat:	0.01	0.21	0.05	0.05	0.36	0.19	0.24	0.10	0.10	0.01	0.11	0.11
Crit Moves:	****				****		****				****	
Green/Cycle:	0.39	0.37	0.42	0.48	0.45	0.76	0.46	0.39	0.39	0.18	0.13	0.13
Volume/Cap:	0.16	0.57	0.12	0.30	0.80	0.25	0.70	0.25	0.25	0.09	0.80	0.80
Uniform Del:	21.9	24.9	17.5	15.8	23.5	3.7	19.8	20.7	20.7	33.8	42.0	42.0
IncremntDel:	0.8	0.6	0.1	0.6	2.9	0.1	3.7	0.2	0.2	0.2	17.7	17.7
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	22.7	25.5	17.6	16.3	26.4	3.8	23.5	20.9	20.9	34.0	59.7	59.7
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	22.7	25.5	17.6	16.3	26.4	3.8	23.5	20.9	20.9	34.0	59.7	59.7
LOS by Move:	C	C	B	B	C	A	C	C	C	C	E	E
HCM2kAvgQ:	0	10	2	2	20	3	12	4	4	1	8	8

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #7 Ane Keohokahole/Main Gate

Average Delay (sec/veh): 163.3 Worst Case Level Of Service: F[579.5]

Street Name:	Ane Keohokahole Hwy									Main Gate												
Approach:	North Bound					South Bound					East Bound					West Bound						
Movement:	L	-	T	-	R	L	-	T	-	R	L	-	T	-	R	L	-	T	-	R		
Control:	Uncontrolled					Uncontrolled					Stop Sign					Stop Sign						
Rights:	Include					Include					Include					Include						
Lanes:	0	0	1	0	1	1	0	1	0	0	0	0	0	0	0	1	0	0	0	1		
Volume Module:																						
Base Vol:	0	445	413			275	338			0	0		0		0	320		0		249		
Growth Adj:	1.00	1.00	1.00			1.00	1.00			1.00	1.00		1.00		1.00	1.00		1.00		1.00		
Initial Bse:	0	445	413			275	338			0	0		0		0	320		0		249		
User Adj:	1.00	1.00	1.00			1.00	1.00			1.00	1.00		1.00		1.00	1.00		1.00		1.00		
PHF Adj:	0.95	0.95	0.95			0.95	0.95			0.95	0.95		0.95		0.95	0.95		0.95		0.95		
PHF Volume:	0	468	435			289	356			0	0		0		0	337		0		262		
Reduct Vol:	0	0	0			0	0			0	0		0		0	0		0		0		
FinalVolume:	0	468	435			289	356			0	0		0		0	337		0		262		
Critical Gap Module:																						
Critical Gp:	xxxxx	xxxx	xxxxx			4.1	xxxx	xxxxx			xxxxx	xxxx	xxxxx			6.4	xxxx			6.2		
FollowUpTim:	xxxxx	xxxx	xxxxx			2.2	xxxx	xxxxx			xxxxx	xxxx	xxxxx			3.5	xxxx			3.3		
Capacity Module:																						
Cnflict Vol:	xxxx	xxxx	xxxxx			903	xxxx	xxxxx			xxxx	xxxx	xxxxx			1403	xxxx			468		
Potent Cap.:	xxxx	xxxx	xxxxx			761	xxxx	xxxxx			xxxx	xxxx	xxxxx			156	xxxx			599		
Move Cap.:	xxxx	xxxx	xxxxx			761	xxxx	xxxxx			xxxx	xxxx	xxxxx			110	xxxx			599		
Volume/Cap:	xxxx	xxxx	xxxx			0.38	xxxx	xxxx			xxxx	xxxx	xxxx			3.08	xxxx			0.44		
Level Of Service Module:																						
2Way95thQ:	xxxx	xxxx	xxxxx			1.8	xxxx	xxxxx			xxxx	xxxx	xxxxx			32.3	xxxx			2.2		
Control Del:	xxxxx	xxxx	xxxxx			12.6	xxxx	xxxxx			xxxxx	xxxx	xxxxx			1018	xxxx			15.6		
LOS by Move:	*	*	*			B	*	*			*	*	*			F	*			C		
Movement:	LT	-	LTR	-	RT	LT	-	LTR	-	RT	LT	-	LTR	-	RT	LT	-	LTR	-	RT		
Shared Cap.:	xxxx	xxxx	xxxxx			xxxx	xxxx	xxxxx			xxxx	xxxx	xxxxx			xxxx	xxxx	xxxxx				
SharedQueue:	xxxxx	xxxx	xxxxx			xxxxx	xxxx	xxxxx			xxxxx	xxxx	xxxxx			xxxxx	xxxx	xxxxx				
Shrd ConDel:	xxxxx	xxxx	xxxxx			xxxxx	xxxx	xxxxx			xxxxx	xxxx	xxxxx			xxxxx	xxxx	xxxxx				
Shared LOS:	*	*	*			*	*	*			*	*	*			*	*	*				
ApproachDel:	xxxxxx					xxxxxx					xxxxxx					579.5						
ApproachLOS:	*					*					*					F						

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #8 Palihiolo St/Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	1.905
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	213.3
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Palihiolo St						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Prot+Permit			Permitted		
Rights:	Include			Include			Include			Ignore		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 1	0 0	1	1	0 0	1 0	1	0 0	1 0	1	0 1	0 1
Volume Module:												
Base Vol:	4	19	26	2	4	611	506	752	13	49	1357	23
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	4	19	26	2	4	611	506	752	13	49	1357	23
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.00
PHF Volume:	4	20	27	2	4	643	533	792	14	52	1428	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	4	20	27	2	4	643	533	792	14	52	1428	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
FinalVolume:	4	20	27	2	4	643	533	792	14	52	1428	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.67	0.67	0.85	0.75	0.85	0.85	0.21	1.00	1.00	0.95	1.00	1.00
Lanes:	0.17	0.83	1.00	1.00	0.01	0.99	1.00	0.98	0.02	1.00	1.00	1.00
Final Sat.:	222	1053	1615	1423	11	1606	405	1862	32	1805	1900	1900
Capacity Analysis Module:												
Vol/Sat:	0.02	0.02	0.02	0.00	0.40	0.40	1.31	0.43	0.43	0.03	0.75	0.00
Crit Moves:					****		****					
Green/Cycle:	0.25	0.25	0.25	0.25	0.25	0.25	0.61	0.61	0.61	0.04	0.47	0.00
Volume/Cap:	0.08	0.08	0.07	0.01	1.61	1.61	1.31	0.70	0.70	0.70	1.61	0.00
Uniform Del:	28.7	28.7	28.7	28.2	37.6	37.6	9.8	13.2	13.2	47.3	26.6	0.0
IncremntDel:	0.1	0.1	0.1	0.0	285	285.0	155.3	1.9	1.9	25.2	279	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Delay/Veh:	28.9	28.9	28.8	28.3	323	322.5	165.1	15.1	15.1	72.6	306	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	28.9	28.9	28.8	28.3	323	322.5	165.1	15.1	15.1	72.6	306	0.0
LOS by Move:	C	C	C	C	F	F	F	B	B	E	F	A
HCM2kAvgQ:	1	1	1	0	51	51	34	17	17	3	110	0

Note: Queue reported is the number of cars per lane.

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                      Level Of Service Computation Report
            2000 HCM Unsignalized Method (Base Volume Alternative)
******************************************************************************
Intersection #10 Palani Rd / Uluaoa St
******************************************************************************
Average Delay (sec/veh):     11.7       Worst Case Level Of Service: F[237.4]
******************************************************************************
Street Name:            Palani Rd                         Uluaoa St
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:           Include          Include          Include          Include
Lanes:        0  1  0  0  0    0  0  0  1  0    1  0  0  0  1    0  0  0  0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:      29  761     0     0 1056   177    71    0    32     0    0     0
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:   29  761     0     0 1056   177    71    0    32     0    0     0
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.95
PHF Volume:    31  801     0     0 1112   186    75    0    34     0    0     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:   31  801     0     0 1112   186    75    0    34     0    0     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:  4.1 xxxx xxxxx xxxxx xxxx xxxxx   6.4 xxxx   6.2 xxxxx xxxx xxxxx
FollowUpTim:  2.2 xxxx xxxxx xxxxx xxxx xxxxx   3.5 xxxx   3.3 xxxxx xxxx xxxxx
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: 1298 xxxx xxxxx  xxxx xxxx xxxxx  2067 xxxx  1205  xxxx xxxx xxxxx
Potent Cap.:  541 xxxx xxxxx  xxxx xxxx xxxxx    61 xxxx   226  xxxx xxxx xxxxx
Move Cap.:    541 xxxx xxxxx  xxxx xxxx xxxxx    58 xxxx   226  xxxx xxxx xxxxx
Volume/Cap:  0.06 xxxx  xxxx  xxxx xxxx  xxxx  1.29 xxxx  0.15  xxxx xxxx  xxxx
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:    0.2 xxxx xxxxx  xxxx xxxx xxxxx   6.5 xxxx   0.5  xxxx xxxx xxxxx
Control Del: 12.1 xxxx xxxxx xxxxx xxxx xxxxx 333.8 xxxx  23.7 xxxxx xxxx xxxxx
LOS by Move:   B    *     *     *    *     *     F    *     C     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
SharedQueue:  0.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel: 12.1 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:    B    *     *     *    *     *     *    *     *     *    *     *
ApproachDel:    xxxxxx           xxxxxx            237.4           xxxxxx
ApproachLOS:        *                *                F                *
******************************************************************************
Note: Queue reported is the number of cars per lane.
******************************************************************************
```

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #11 Queen Kaahumanu Hwy / Kealakehe Pkwy

Cycle (sec):	100	Critical Vol./Cap.(X):	0.826
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	26.1
Optimal Cycle:	78	Level Of Service:	C

Street Name:	Queen Kaahumanu Hwy						Kaalakehe Pkwy					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Prot+Permit			Permitted			Permitted		
Rights:		Ovl			Ovl			Ovl			Ovl	
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	2 0	1	1 0	2 0	1	0 1	0 0	1	0 1	0 0	1
Volume Module:												
Base Vol:	66	1097	239	193	1066	232	106	97	67	242	66	167
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	66	1097	239	193	1066	232	106	97	67	242	66	167
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	69	1155	252	203	1122	244	112	102	71	255	69	176
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	69	1155	252	203	1122	244	112	102	71	255	69	176
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	69	1155	252	203	1122	244	112	102	71	255	69	176
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	0.95	0.85	0.95	0.95	0.85	0.53	0.53	0.85	0.55	0.55	0.85
Lanes:	1.00	2.00	1.00	1.00	2.00	1.00	0.52	0.48	1.00	0.79	0.21	1.00
Final Sat.:	1805	3610	1615	1805	3610	1615	528	483	1615	820	224	1615
Capacity Analysis Module:												
Vol/Sat:	0.04	0.32	0.16	0.11	0.31	0.15	0.21	0.21	0.04	0.31	0.31	0.11
Crit Moves:		****		****							****	
Green/Cycle:	0.45	0.39	0.39	0.55	0.47	0.47	0.38	0.38	0.43	0.38	0.38	0.51
Volume/Cap:	0.32	0.83	0.40	0.63	0.67	0.32	0.56	0.56	0.10	0.83	0.83	0.21
Uniform Del:	17.3	27.6	22.2	20.2	20.7	16.8	24.7	24.7	16.7	28.2	28.2	13.3
IncremntDel:	0.8	4.2	0.4	4.1	1.0	0.3	1.9	1.9	0.1	13.4	13.4	0.1
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	18.1	31.8	22.7	24.3	21.7	17.1	26.6	26.6	16.8	41.6	41.6	13.5
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	18.1	31.8	22.7	24.3	21.7	17.1	26.6	26.6	16.8	41.6	41.6	13.5
LOS by Move:	B	C	C	C	C	B	C	C	B	D	D	B
HCM2kAvgQ:	2	19	6	5	15	5	6	6	1	12	12	3

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #12 Ane Keohokalole Hwy / Kealakehe Pkwy

Average Delay (sec/veh): OVERFLOW Worst Case Level Of Service: F[xxxxx]

Street Name:	Ane Keohokalole Hwy						Kealakehe Pkwy					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	1 0 1	0 1		1 0	0 1	0	1 0	1	1 0	1 0	1	0 1
Volume Module:												
Base Vol:	220	395	0	50	349	369	165	194	260	5	128	23
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	220	395	0	50	349	369	165	194	260	5	128	23
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	232	416	0	53	367	388	174	204	274	5	135	24
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	232	416	0	53	367	388	174	204	274	5	135	24
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1224	858	239	803	971	135	159	xxxx	xxxxx	478	xxxx	xxxxx
Potent Cap.:	157	297	805	304	255	920	1433	xxxx	xxxxx	1095	xxxx	xxxxx
Move Cap.:	0	259	805	0	223	920	1433	xxxx	xxxxx	1095	xxxx	xxxxx
Volume/Cap:	xxxx	1.60	0.00	xxxx	1.65	0.42	0.12	xxxx	xxxx	0.00	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	25.6	xxxxx	xxxx	xxxx	xxxxx	0.4	xxxx	xxxxx	0.0	xxxx	xxxxx
Control Del:	xxxxx	323	xxxxx	xxxxx	xxxx	xxxxx	7.9	xxxx	xxxxx	8.3	xxxx	xxxxx
LOS by Move:	*	F	*	*	*	*	A	*	*	A	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	365	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	54.1	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	514.6	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	*	*	*	*	F	*	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			xxxxxx			xxxxxx		
ApproachLOS:	F			F			*			*		

Note: Queue reported is the number of cars per lane.

CUMULATIVE PLUS PROJECT CONDITIONS – CONCEPT C

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #1 Queen Kaahumanu Hwy / Henry St

Cycle (sec):	100	Critical Vol./Cap.(X):	0.887
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	29.3
Optimal Cycle:	99	Level Of Service:	C

Street Name:	Queen Kaahumanu Hwy						Henry St					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Prot+Permit			Prot+Permit			Prot+Permit		
Rights:	Ovl			Ovl			Ovl			Ovl		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0 2 0 1			1 0 3 0 1			1 0 2 0 1			1 1 1 0 1		
Volume Module:												
Base Vol:	320	801	923	130	584	132	76	415	25	642	716	99
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	320	801	923	130	584	132	76	415	25	642	716	99
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	337	843	972	137	615	139	80	437	26	676	754	104
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	337	843	972	137	615	139	80	437	26	676	754	104
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	337	843	972	137	615	139	80	437	26	676	754	104
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	0.95	0.85	0.95	0.91	0.85	0.95	0.95	0.85	0.93	0.93	0.85
Lanes:	1.00	2.00	1.00	1.00	3.00	1.00	1.00	2.00	1.00	1.42	1.58	1.00
Final Sat.:	1805	3610	1615	1805	5187	1615	1805	3610	1615	2501	2789	1615
Capacity Analysis Module:												
Vol/Sat:	0.19	0.23	0.60	0.08	0.12	0.09	0.04	0.12	0.02	0.27	0.27	0.06
Crit Moves:			****	****				****		****		
Green/Cycle:	0.48	0.37	0.68	0.26	0.18	0.24	0.20	0.14	0.42	0.46	0.38	0.46
Volume/Cap:	0.58	0.63	0.89	0.52	0.66	0.36	0.39	0.89	0.04	0.70	0.71	0.14
Uniform Del:	17.4	25.6	13.0	29.3	38.3	31.6	33.6	42.4	17.3	20.4	26.4	15.3
IncremntDel:	1.5	0.9	9.0	1.9	1.8	0.6	1.2	17.5	0.0	1.1	1.2	0.1
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	18.9	26.5	22.0	31.2	40.1	32.1	34.8	59.9	17.3	21.5	27.7	15.4
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	18.9	26.5	22.0	31.2	40.1	32.1	34.8	59.9	17.3	21.5	27.7	15.4
LOS by Move:	B	C	C	C	D	C	C	E	B	C	C	B
HCM2kAvgQ:	8	12	28	4	8	4	3	10	0	13	14	2

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #2 Queen Kaahumanu Hwy / Alli Dr

Cycle (sec):	100	Critical Vol./Cap.(X):	0.915
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	35.0
Optimal Cycle:	114	Level Of Service:	D

Street Name:	Queen Kaahumanu Hwy						Alli Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Prot+Permit			Prot+Permit			Prot+Permit		
Rights:		Ovl			Ovl			Ovl			Ovl	
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	2 0	1	1 0	2 0	1	1 0	1 0	1	1 0	1 0	1
Volume Module:												
Base Vol:	97	807	72	191	655	372	193	144	99	107	658	98
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	97	807	72	191	655	372	193	144	99	107	658	98
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	102	849	76	201	689	392	203	152	104	113	693	103
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	102	849	76	201	689	392	203	152	104	113	693	103
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	102	849	76	201	689	392	203	152	104	113	693	103
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	0.95	0.85	0.95	0.95	0.85	0.95	1.00	0.85	0.95	1.00	0.85
Lanes:	1.00	2.00	1.00	1.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Sat.:	1805	3610	1615	1805	3610	1615	1805	1900	1615	1805	1900	1615
Capacity Analysis Module:												
Vol/Sat:	0.06	0.24	0.05	0.11	0.19	0.24	0.11	0.08	0.06	0.06	0.36	0.06
Crit Moves:		****		****			****				****	
Green/Cycle:	0.34	0.26	0.49	0.40	0.29	0.42	0.42	0.29	0.38	0.54	0.40	0.52
Volume/Cap:	0.40	0.92	0.10	0.68	0.65	0.58	0.68	0.27	0.17	0.16	0.92	0.12
Uniform Del:	23.6	36.1	13.9	23.3	31.0	22.6	22.7	27.2	20.6	11.2	28.5	12.3
IncremntDel:	1.0	13.4	0.1	6.5	1.5	1.3	6.3	0.3	0.1	0.1	15.7	0.1
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	24.7	49.5	13.9	29.8	32.4	23.9	29.0	27.5	20.7	11.3	44.2	12.4
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	24.7	49.5	13.9	29.8	32.4	23.9	29.0	27.5	20.7	11.3	44.2	12.4
LOS by Move:	C	D	B	C	C	C	C	C	C	B	D	B
HCM2kAvgQ:	3	17	1	6	11	10	6	4	2	2	24	2

Note: Queue reported is the number of cars per lane.

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                      Level Of Service Computation Report
            2000 HCM Unsignalized Method (Base Volume Alternative)
******************************************************************************
Intersection #3 Kamakaeha Ave / Palani Rd
******************************************************************************
Average Delay (sec/veh):      1.4       Worst Case Level Of Service: D[ 31.7]
******************************************************************************
Street Name:          Kamakaeha Ave                       Palani Rd
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Stop Sign        Stop Sign       Uncontrolled     Uncontrolled
Rights:           Include          Include          Include          Ignore
Lanes:        0  0  0  0  0    1  0  0  0  1    0  0  1  0  0    0  0  1  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0    0     0    47    0    15     0  406     0     0  896   240
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:    0    0     0    47    0    15     0  406     0     0  896   240
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.00
PHF Volume:     0    0     0    49    0    16     0  427     0     0  943     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    0    0     0    49    0    16     0  427     0     0  943     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx   6.4 xxxx   6.2 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
FollowUpTim:xxxxx xxxx xxxxx   3.5 xxxx   3.3 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx  1371 xxxx   943  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Potent Cap.: xxxx xxxx xxxxx   163 xxxx   321  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Move Cap.:   xxxx xxxx xxxxx   163 xxxx   321  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Volume/Cap:  xxxx xxxx  xxxx  0.30 xxxx  0.05  xxxx xxxx  xxxx  xxxx xxxx  xxxx
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx   1.2 xxxx   0.2  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx  36.5 xxxx  16.8 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:   *    *     *     E    *     C     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:    *    *     *     *    *     *     *    *     *     *    *     *
ApproachDel:    xxxxxx             31.7           xxxxxx           xxxxxx
ApproachLOS:        *                D               *                *
******************************************************************************
Note: Queue reported is the number of cars per lane.
******************************************************************************
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Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Henry St / Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	1.726
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	236.5
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Henry St						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Prot+Permit		
Rights:	Ovl			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	0 1	0	1 0	0 1	0	1 0	0 1	0	1 0	0 1	0
Volume Module:												
Base Vol:	122	408	454	124	577	338	239	185	37	947	810	90
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	122	408	454	124	577	338	239	185	37	947	810	90
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	128	429	478	131	607	356	252	195	39	997	853	95
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	128	429	478	131	607	356	252	195	39	997	853	95
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	128	429	478	131	607	356	252	195	39	997	853	95
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.08	0.92	0.92	0.08	0.95	0.95	0.95	0.98	0.98	0.77	0.99	0.99
Lanes:	1.00	0.47	0.53	1.00	0.63	0.37	1.00	0.83	0.17	1.00	0.90	0.10
Final Sat.:	150	828	922	150	1132	663	1805	1544	309	1458	1684	187
Capacity Analysis Module:												
Vol/Sat:	0.86	0.52	0.52	0.87	0.54	0.54	0.14	0.13	0.13	0.68	0.51	0.51
Crit Moves:				****						****		
Green/Cycle:	0.51	0.51	0.83	0.51	0.51	0.51	0.09	0.07	0.07	0.31	0.31	0.31
Volume/Cap:	1.69	1.03	0.63	1.72	1.06	1.06	1.64	1.72	1.72	1.76	1.64	1.64
Uniform Del:	24.7	24.7	3.1	24.7	24.7	24.7	45.7	46.3	46.3	34.8	34.5	34.5
IncremntDel:	361.5	36.9	0.9	373.2	47.4	47.4	314.0	353	353.0	349.8	294	294.3
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	386.2	61.7	4.0	397.9	72.1	72.1	359.8	399	399.4	384.6	329	328.9
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	386.2	61.7	4.0	397.9	72.1	72.1	359.8	399	399.4	384.6	329	328.9
LOS by Move:	F	E	A	F	E	E	F	F	F	F	F	F
HCM2kAvgQ:	12	37	11	12	42	42	21	21	21	84	75	75

Note: Queue reported is the number of cars per lane.

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------------------------------------------------------------------------------
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                      Level Of Service Computation Report
            2000 HCM Unsignalized Method (Base Volume Alternative)
******************************************************************************
Intersection #5 Gate 2/Palani
******************************************************************************
Average Delay (sec/veh):      1.7       Worst Case Level Of Service: F[100.7]
******************************************************************************
Street Name:              Gate 2                          /Palani Rd
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Stop Sign       Yield Sign       Uncontrolled     Uncontrolled
Rights:           Include          Include          Include          Include
Lanes:        0  0  0  0  0    0  0  0  0  1    0  0  1  0  0    0  0  0  1  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0    0     0     0    0    47     0  763     0     0 1800    97
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:    0    0     0     0    0    47     0  763     0     0 1800    97
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.95
PHF Volume:     0    0     0     0    0    49     0  803     0     0 1895   102
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    0    0     0     0    0    49     0  803     0     0 1895   102
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx xxxxx xxxx   6.2 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
FollowUpTim:xxxxx xxxx xxxxx xxxxx xxxx   3.3 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx  xxxx xxxx  1946  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Potent Cap.: xxxx xxxx xxxxx  xxxx xxxx    82  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Move Cap.:   xxxx xxxx xxxxx  xxxx xxxx    82  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Volume/Cap:  xxxx xxxx  xxxx  xxxx xxxx  0.60  xxxx xxxx  xxxx  xxxx xxxx  xxxx
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx  xxxx xxxx   2.7  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx xxxxx xxxx 100.7 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:   *    *     *     *    *     F     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:    *    *     *     *    *     *     *    *     *     *    *     *
ApproachDel:    xxxxxx            100.7           xxxxxx           xxxxxx
ApproachLOS:        *                F               *                *
******************************************************************************
Note: Queue reported is the number of cars per lane.
******************************************************************************
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Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu Hwy / Makala Blvd

Cycle (sec):	100	Critical Vol./Cap.(X):	0.668
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	22.0
Optimal Cycle:	50	Level Of Service:	C

Street Name:	Queen Kaahumanu Hwy						Makala Blvd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Prot+Permit			Prot+Permit			Prot+Permit		
Rights:	Ovl			Ovl			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0 2 0 1			1 0 2 0 1			1 0 0 1 0			1 0 0 1 0		
Volume Module:												
Base Vol:	10	949	30	68	905	200	309	72	32	7	21	143
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	10	949	30	68	905	200	309	72	32	7	21	143
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	11	999	32	72	953	211	325	76	34	7	22	151
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	11	999	32	72	953	211	325	76	34	7	22	151
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	11	999	32	72	953	211	325	76	34	7	22	151
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	0.95	0.85	0.95	0.95	0.85	0.95	0.95	0.95	0.95	0.87	0.87
Lanes:	1.00	2.00	1.00	1.00	2.00	1.00	1.00	0.69	0.31	1.00	0.13	0.87
Final Sat.:	1805	3610	1615	1805	3610	1615	1805	1255	558	1805	211	1440
Capacity Analysis Module:												
Vol/Sat:	0.01	0.28	0.02	0.04	0.26	0.13	0.18	0.06	0.06	0.00	0.10	0.10
Crit Moves:		****		****			****				****	
Green/Cycle:	0.42	0.41	0.44	0.49	0.46	0.73	0.45	0.40	0.40	0.18	0.16	0.16
Volume/Cap:	0.06	0.67	0.04	0.33	0.57	0.18	0.55	0.15	0.15	0.03	0.67	0.67
Uniform Del:	17.6	23.7	15.9	16.4	19.6	4.1	18.9	19.2	19.2	33.5	39.7	39.7
IncremntDel:	0.1	1.2	0.0	0.9	0.5	0.1	1.1	0.1	0.1	0.0	6.6	6.6
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	17.7	24.9	15.9	17.4	20.0	4.2	20.0	19.3	19.3	33.5	46.3	46.3
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	17.7	24.9	15.9	17.4	20.0	4.2	20.0	19.3	19.3	33.5	46.3	46.3
LOS by Move:	B	C	B	B	C	A	B	B	B	C	D	D
HCM2kAvgQ:	0	14	1	2	11	2	8	2	2	0	6	6

Note: Queue reported is the number of cars per lane.

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                      Level Of Service Computation Report
            2000 HCM Unsignalized Method (Base Volume Alternative)
******************************************************************************
Intersection #7 Ane Keohokahole/Main Gate
******************************************************************************
Average Delay (sec/veh):    279.9       Worst Case Level Of Service: F[858.8]
******************************************************************************
Street Name:       Ane Keohokahole Hwy                    Main Gate
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:           Include          Include          Include          Include
Lanes:        0  0  1  0  1    1  0  1  0  0    0  0  0  0  0    1  0  0  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0  447   291   194  620     0     0    0     0   420    0   327
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:    0  447   291   194  620     0     0    0     0   420    0   327
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.95
PHF Volume:     0  471   306   204  653     0     0    0     0   442    0   344
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    0  471   306   204  653     0     0    0     0   442    0   344
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx   4.1 xxxx xxxxx xxxxx xxxx xxxxx   6.4 xxxx   6.2
FollowUpTim:xxxxx xxxx xxxxx   2.2 xxxx xxxxx xxxxx xxxx xxxxx   3.5 xxxx   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx   777 xxxx xxxxx  xxxx xxxx xxxxx  1532 xxxx   471
Potent Cap.: xxxx xxxx xxxxx   849 xxxx xxxxx  xxxx xxxx xxxxx   130 xxxx   597
Move Cap.:   xxxx xxxx xxxxx   849 xxxx xxxxx  xxxx xxxx xxxxx   106 xxxx   597
Volume/Cap:  xxxx xxxx  xxxx  0.24 xxxx  xxxx  xxxx xxxx  xxxx  4.18 xxxx  0.58
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx   0.9 xxxx xxxxx  xxxx xxxx xxxxx  45.7 xxxx   3.7
Control Del:xxxxx xxxx xxxxx  10.6 xxxx xxxxx xxxxx xxxx xxxxx  1513 xxxx  18.9
LOS by Move:   *    *     *     B    *     *     *    *     *     F    *     C
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:    *    *     *     *    *     *     *    *     *     *    *     *
ApproachDel:    xxxxxx           xxxxxx           xxxxxx            858.8
ApproachLOS:        *                *                *                F
******************************************************************************
Note: Queue reported is the number of cars per lane.
******************************************************************************
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Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #8 Palihiolo St/Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	1.644
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	188.2
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Palihiolo St						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Prot+Permit			Permitted		
Rights:	Include			Include			Include			Ignore		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 1	0 0	1	1	0 0	1 0	1	0 0	1 0	1	0 1	0 1
Volume Module:												
Base Vol:	5	20	32	10	15	553	438	569	6	20	1319	56
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	5	20	32	10	15	553	438	569	6	20	1319	56
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.00
PHF Volume:	5	21	34	11	16	582	461	599	6	21	1388	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	5	21	34	11	16	582	461	599	6	21	1388	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
FinalVolume:	5	21	34	11	16	582	461	599	6	21	1388	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.64	0.64	0.85	0.75	0.85	0.85	0.22	1.00	1.00	0.95	1.00	1.00
Lanes:	0.20	0.80	1.00	1.00	0.03	0.97	1.00	0.99	0.01	1.00	1.00	1.00
Final Sat.:	244	977	1615	1419	43	1580	415	1878	20	1805	1900	1900
Capacity Analysis Module:												
Vol/Sat:	0.02	0.02	0.02	0.01	0.37	0.37	1.11	0.32	0.32	0.01	0.73	0.00
Crit Moves:					****		****					
Green/Cycle:	0.24	0.24	0.24	0.24	0.24	0.24	0.63	0.63	0.63	0.02	0.49	0.00
Volume/Cap:	0.09	0.09	0.09	0.03	1.51	1.51	1.21	0.50	0.50	0.50	1.51	0.00
Uniform Del:	29.1	29.1	29.1	28.7	37.8	37.8	8.6	9.9	9.9	48.3	25.7	0.0
IncremntDel:	0.1	0.1	0.1	0.0	240	240.1	114.9	0.3	0.3	9.6	233	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Delay/Veh:	29.3	29.3	29.2	28.8	278	277.9	123.5	10.3	10.3	57.8	259	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	29.3	29.3	29.2	28.8	278	277.9	123.5	10.3	10.3	57.8	259	0.0
LOS by Move:	C	C	C	C	F	F	F	B	B	E	F	A
HCM2kAvgQ:	1	1	1	0	44	44	27	10	10	1	100	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #10 Palani Rd / Uluaoa St

Average Delay (sec/veh): 46.4 Worst Case Level Of Service: F[251.1]

Street Name:	Palani Rd						Uluaoa St					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	0 1 0 0 0			0 0 0 1 0			1 0 0 0 1			0 0 0 0 0		
Volume Module:												
Base Vol:	58	515	0	0	788	311	176	0	200	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	58	515	0	0	788	311	176	0	200	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	61	542	0	0	829	327	185	0	211	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	61	542	0	0	829	327	185	0	211	0	0	0
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.4	xxxx	6.2	xxxxx	xxxx	xxxxx
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	xxxx	3.3	xxxxx	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1157	xxxx	xxxxx	xxxx	xxxx	xxxxx	1657	xxxx	993	xxxx	xxxx	xxxxx
Potent Cap.:	611	xxxx	xxxxx	xxxx	xxxx	xxxxx	109	xxxx	300	xxxx	xxxx	xxxxx
Move Cap.:	611	xxxx	xxxxx	xxxx	xxxx	xxxxx	100	xxxx	300	xxxx	xxxx	xxxxx
Volume/Cap:	0.10	xxxx	xxxx	xxxx	xxxx	xxxx	1.85	xxxx	0.70	xxxx	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	0.3	xxxx	xxxxx	xxxx	xxxx	xxxxx	15.2	xxxx	4.9	xxxx	xxxx	xxxxx
Control Del:	11.5	xxxx	xxxxx	xxxxx	xxxx	xxxxx	489.9	xxxx	40.8	xxxxx	xxxx	xxxxx
LOS by Move:	B	*	*	*	*	*	F	*	E	*	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	0.3	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	11.5	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	B	*	*	*	*	*	*	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			251.1			xxxxxx		
ApproachLOS:	*			*			F			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #11 Queen Kaahumanu Hwy / Kealakehe Pkwy

Cycle (sec):	100	Critical Vol./Cap.(X):	0.834
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	28.1
Optimal Cycle:	80	Level Of Service:	C

Street Name:	Queen Kaahumanu Hwy						Kaalakehe Pkwy					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Prot+Permit			Permitted			Permitted		
Rights:		Ovl			Ovl			Ovl			Ovl	
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0 2 0 1			1 0 2 0 1			0 1 0 0 1			0 1 0 0 1		
Volume Module:												
Base Vol:	115	1042	422	268	975	249	81	107	10	231	61	221
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	115	1042	422	268	975	249	81	107	10	231	61	221
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	121	1097	444	282	1026	262	85	113	11	243	64	233
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	121	1097	444	282	1026	262	85	113	11	243	64	233
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	121	1097	444	282	1026	262	85	113	11	243	64	233
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	0.95	0.85	0.95	0.95	0.85	0.61	0.61	0.85	0.56	0.56	0.85
Lanes:	1.00	2.00	1.00	1.00	2.00	1.00	0.43	0.57	1.00	0.79	0.21	1.00
Final Sat.:	1805	3610	1615	1805	3610	1615	495	654	1615	837	221	1615
Capacity Analysis Module:												
Vol/Sat:	0.07	0.30	0.28	0.16	0.28	0.16	0.17	0.17	0.01	0.29	0.29	0.14
Crit Moves:		****		****							****	
Green/Cycle:	0.47	0.36	0.36	0.58	0.45	0.45	0.35	0.35	0.45	0.35	0.35	0.54
Volume/Cap:	0.38	0.83	0.75	0.68	0.64	0.36	0.49	0.49	0.01	0.83	0.83	0.27
Uniform Del:	16.0	29.0	27.9	23.3	21.4	18.3	25.7	25.7	15.0	29.9	29.9	12.6
IncremntDel:	0.8	4.7	5.5	4.6	0.9	0.3	1.0	1.0	0.0	15.0	15.0	0.2
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	16.8	33.8	33.4	27.9	22.3	18.6	26.6	26.6	15.0	44.9	44.9	12.8
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	16.8	33.8	33.4	27.9	22.3	18.6	26.6	26.6	15.0	44.9	44.9	12.8
LOS by Move:	B	C	C	C	C	B	C	C	B	D	D	B
HCM2kAvgQ:	3	19	14	7	13	5	5	5	0	11	11	4

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #12 Ane Keohokalole Hwy / Kealakehe Pkwy

Average Delay (sec/veh): OVERFLOW Worst Case Level Of Service: F[xxxxx]

Street Name:	Ane Keohokalole Hwy						Kealakehe Pkwy					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	1 0	1 0	1	1 0	0 1	0	1 0	1 1	0	1 0	1 0	1
Volume Module:												
Base Vol:	311	460	3	12	360	45	369	94	452	2	115	50
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	311	460	3	12	360	45	369	94	452	2	115	50
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	327	484	3	13	379	47	388	99	476	2	121	53
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	327	484	3	13	379	47	388	99	476	2	121	53
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1478	1292	287	1194	1477	121	174	xxxx	xxxxx	575	xxxx	xxxxx
Potent Cap.:	105	165	756	165	127	936	1415	xxxx	xxxxx	1008	xxxx	xxxxx
Move Cap.:	0	119	756	0	92	936	1415	xxxx	xxxxx	1008	xxxx	xxxxx
Volume/Cap:	xxxx	4.06	0.00	xxxx	4.11	0.05	0.27	xxxx	xxxx	0.00	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	49.3	0.0	xxxx	xxxx	xxxxx	1.1	xxxx	xxxxx	0.0	xxxx	xxxxx
Control Del:	xxxxx	1453	9.8	xxxxx	xxxx	xxxxx	8.5	xxxx	xxxxx	8.6	xxxx	xxxxx
LOS by Move:	*	F	A	*	*	*	A	*	*	A	*	*
Movement:	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	102	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	44.1	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	1508	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	*	*	*	*	F	*	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			xxxxxx			xxxxxx		
ApproachLOS:	F			F			*			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #1 Queen Kaahumanu Hwy / Henry St

Cycle (sec):	100	Critical Vol./Cap.(X):	0.931
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	31.9
Optimal Cycle:	123	Level Of Service:	C

Street Name:	Queen Kaahumanu Hwy						Henry St					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Prot+Permit			Prot+Permit			Prot+Permit		
Rights:	Ovl			Ovl			Ovl			Ovl		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0 2 0 1			1 0 3 0 1			1 0 2 0 1			1 1 1 0 1		
Volume Module:												
Base Vol:	282	542	836	183	731	121	76	639	107	565	604	211
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	282	542	836	183	731	121	76	639	107	565	604	211
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	297	571	880	193	769	127	80	673	113	595	636	222
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	297	571	880	193	769	127	80	673	113	595	636	222
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	297	571	880	193	769	127	80	673	113	595	636	222
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	0.95	0.85	0.95	0.91	0.85	0.95	0.95	0.85	0.93	0.93	0.85
Lanes:	1.00	2.00	1.00	1.00	3.00	1.00	1.00	2.00	1.00	1.45	1.55	1.00
Final Sat.:	1805	3610	1615	1805	5187	1615	1805	3610	1615	2554	2731	1615
Capacity Analysis Module:												
Vol/Sat:	0.16	0.16	0.54	0.11	0.15	0.08	0.04	0.19	0.07	0.23	0.23	0.14
Crit Moves:			****	****				****		****		
Green/Cycle:	0.47	0.34	0.59	0.33	0.21	0.29	0.27	0.20	0.44	0.47	0.38	0.49
Volume/Cap:	0.59	0.47	0.93	0.51	0.70	0.28	0.28	0.93	0.16	0.64	0.62	0.28
Uniform Del:	18.1	26.2	18.9	25.3	36.3	27.7	27.7	39.3	17.1	20.0	25.2	14.9
IncremntDel:	1.9	0.3	15.3	1.2	2.0	0.3	0.5	18.7	0.1	0.8	0.6	0.2
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	20.0	26.5	34.2	26.4	38.3	28.1	28.3	58.0	17.2	20.7	25.8	15.1
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	20.0	26.5	34.2	26.4	38.3	28.1	28.3	58.0	17.2	20.7	25.8	15.1
LOS by Move:	B	C	C	C	D	C	C	E	B	C	C	B
HCM2kAvgQ:	7	7	29	5	9	3	2	15	2	11	11	4

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #2 Queen Kaahumanu Hwy / Alli Dr

Cycle (sec):	100	Critical Vol./Cap.(X):	1.033
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	46.4
Optimal Cycle:	180	Level Of Service:	D

Street Name:	Queen Kaahumanu Hwy						Alli Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Prot+Permit			Prot+Permit			Prot+Permit		
Rights:	Ovl			Ovl			Ovl			Ovl		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0 2 0 1			1 0 2 0 1			1 0 1 0 1			1 0 1 0 1		
Volume Module:												
Base Vol:	38	706	98	304	707	358	269	293	219	144	732	110
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	38	706	98	304	707	358	269	293	219	144	732	110
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	40	743	103	320	744	377	283	308	231	152	771	116
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	40	743	103	320	744	377	283	308	231	152	771	116
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	40	743	103	320	744	377	283	308	231	152	771	116
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	0.95	0.85	0.79	0.95	0.85	0.70	1.00	0.85	0.95	1.00	0.85
Lanes:	1.00	2.00	1.00	1.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Sat.:	1805	3610	1615	1498	3610	1615	1332	1900	1615	1805	1900	1615
Capacity Analysis Module:												
Vol/Sat:	0.02	0.21	0.06	0.21	0.21	0.23	0.21	0.16	0.14	0.08	0.41	0.07
Crit Moves:		****		****			****				****	
Green/Cycle:	0.23	0.20	0.38	0.38	0.33	0.48	0.50	0.35	0.39	0.56	0.39	0.55
Volume/Cap:	0.22	1.05	0.17	0.84	0.63	0.49	0.82	0.46	0.37	0.26	1.05	0.13
Uniform Del:	30.3	40.2	20.6	22.6	28.3	17.7	14.7	25.0	21.8	11.6	30.7	10.7
IncremntDel:	0.6	47.9	0.1	15.8	1.1	0.5	14.3	0.5	0.4	0.2	47.3	0.1
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	30.9	88.1	20.8	38.5	29.4	18.2	29.0	25.5	22.2	11.8	78.0	10.7
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	30.9	88.1	20.8	38.5	29.4	18.2	29.0	25.5	22.2	11.8	78.0	10.7
LOS by Move:	C	F	C	D	C	B	C	C	C	B	E	B
HCM2kAvgQ:	1	19	2	12	11	8	10	7	5	3	34	2

Note: Queue reported is the number of cars per lane.

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                      Level Of Service Computation Report
            2000 HCM Unsignalized Method (Base Volume Alternative)
******************************************************************************
Intersection #3 Kamakaeha Ave / Palani Rd
******************************************************************************
Average Delay (sec/veh):     19.7       Worst Case Level Of Service: F[187.6]
******************************************************************************
Street Name:          Kamakaeha Ave                       Palani Rd
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Stop Sign        Stop Sign       Uncontrolled     Uncontrolled
Rights:           Include          Include          Include          Ignore
Lanes:        0  0  0  0  0    1  0  0  0  1    0  0  1  0  0    0  0  1  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0    0     0   127    0    63     0  695     0     0  923   281
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:    0    0     0   127    0    63     0  695     0     0  923   281
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.00
PHF Volume:     0    0     0   134    0    66     0  732     0     0  972     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    0    0     0   134    0    66     0  732     0     0  972     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx   6.4 xxxx   6.2 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
FollowUpTim:xxxxx xxxx xxxxx   3.5 xxxx   3.3 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx  1703 xxxx   972  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Potent Cap.: xxxx xxxx xxxxx   102 xxxx   309  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Move Cap.:   xxxx xxxx xxxxx   102 xxxx   309  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Volume/Cap:  xxxx xxxx  xxxx  1.31 xxxx  0.21  xxxx xxxx  xxxx  xxxx xxxx  xxxx
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx   9.3 xxxx   0.8  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx 270.9 xxxx  19.8 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:   *    *     *     F    *     C     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:    *    *     *     *    *     *     *    *     *     *    *     *
ApproachDel:    xxxxxx            187.6           xxxxxx           xxxxxx
ApproachLOS:        *                F               *                *
******************************************************************************
Note: Queue reported is the number of cars per lane.
******************************************************************************
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Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Henry St / Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	1.326
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	190.8
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Henry St						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Prot+Permit		
Rights:	Ovl			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	0 1	0	1 0	0 1	0	1 0	0 1	0	1 0	0 1	0
Volume Module:												
Base Vol:	110	445	394	89	362	212	345	416	129	870	927	93
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	110	445	394	89	362	212	345	416	129	870	927	93
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	116	468	415	94	381	223	363	438	136	916	976	98
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	116	468	415	94	381	223	363	438	136	916	976	98
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	116	468	415	94	381	223	363	438	136	916	976	98
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.11	0.93	0.93	0.11	0.95	0.95	0.95	0.96	0.96	0.80	0.99	0.99
Lanes:	1.00	0.53	0.47	1.00	0.63	0.37	1.00	0.76	0.24	1.00	0.91	0.09
Final Sat.:	212	937	830	212	1132	663	1805	1398	434	1512	1703	171
Capacity Analysis Module:												
Vol/Sat:	0.55	0.50	0.50	0.44	0.34	0.34	0.20	0.31	0.31	0.61	0.57	0.57
Crit Moves:	****							****		****		
Green/Cycle:	0.36	0.36	0.69	0.36	0.36	0.36	0.14	0.21	0.21	0.40	0.40	0.40
Volume/Cap:	1.52	1.39	0.72	1.23	0.94	0.94	1.43	1.52	1.52	1.35	1.43	1.43
Uniform Del:	32.0	32.0	9.4	32.0	30.9	30.9	43.0	39.7	39.7	29.3	30.0	30.0
IncremntDel:	289.2	185	2.1	176.8	21.0	21.0	216.1	247	246.7	166.8	203	202.6
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	321.3	217	11.5	208.8	51.9	51.9	259.1	286	286.4	196.1	233	232.6
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	321.3	217	11.5	208.8	51.9	51.9	259.1	286	286.4	196.1	233	232.6
LOS by Move:	F	F	B	F	D	D	F	F	F	F	F	F
HCM2kAvgQ:	10	59	17	7	23	23	27	43	43	59	73	73

Note: Queue reported is the number of cars per lane.

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------------------------------------------------------------------------------
                      Level Of Service Computation Report
            2000 HCM Unsignalized Method (Base Volume Alternative)
******************************************************************************
Intersection #5 Gate 2/Palani
******************************************************************************
Average Delay (sec/veh):      1.2       Worst Case Level Of Service: F[ 98.2]
******************************************************************************
Street Name:              Gate 2                          /Palani Rd
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Stop Sign       Yield Sign       Uncontrolled     Uncontrolled
Rights:           Include          Include          Include          Include
Lanes:        0  0  0  0  0    0  0  0  0  1    0  0  1  0  0    0  0  0  1  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0    0     0     0    0    36     0  899     0     0 1853   146
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:    0    0     0     0    0    36     0  899     0     0 1853   146
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.95
PHF Volume:     0    0     0     0    0    38     0  946     0     0 1951   154
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    0    0     0     0    0    38     0  946     0     0 1951   154
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx xxxxx xxxx   6.2 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
FollowUpTim:xxxxx xxxx xxxxx xxxxx xxxx   3.3 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx  xxxx xxxx  2027  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Potent Cap.: xxxx xxxx xxxxx  xxxx xxxx    73  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Move Cap.:   xxxx xxxx xxxxx  xxxx xxxx    73  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Volume/Cap:  xxxx xxxx  xxxx  xxxx xxxx  0.52  xxxx xxxx  xxxx  xxxx xxxx  xxxx
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx  xxxx xxxx   2.2  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx xxxxx xxxx  98.2 xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:   *    *     *     *    *     F     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:    *    *     *     *    *     *     *    *     *     *    *     *
ApproachDel:    xxxxxx             98.2           xxxxxx           xxxxxx
ApproachLOS:        *                F               *                *
******************************************************************************
Note: Queue reported is the number of cars per lane.
******************************************************************************
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Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #6 Queen Kaahumanu Hwy / Makala Blvd

Cycle (sec):	100	Critical Vol./Cap.(X):	0.801
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	24.8
Optimal Cycle:	72	Level Of Service:	C

Street Name:	Queen Kaahumanu Hwy						Makala Blvd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Prot+Permit			Prot+Permit			Prot+Permit		
Rights:	Ovl			Ovl			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0 2 0 1			1 0 2 0 1			1 0 0 1 0			1 0 0 1 0		
Volume Module:												
Base Vol:	14	735	80	86	1245	294	417	126	41	21	71	104
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	14	735	80	86	1245	294	417	126	41	21	71	104
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	15	774	84	91	1311	309	439	133	43	22	75	109
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	15	774	84	91	1311	309	439	133	43	22	75	109
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	15	774	84	91	1311	309	439	133	43	22	75	109
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	0.95	0.85	0.95	0.95	0.85	0.95	0.96	0.96	0.95	0.91	0.91
Lanes:	1.00	2.00	1.00	1.00	2.00	1.00	1.00	0.75	0.25	1.00	0.41	0.59
Final Sat.:	1805	3610	1615	1805	3610	1615	1805	1380	449	1805	702	1029
Capacity Analysis Module:												
Vol/Sat:	0.01	0.21	0.05	0.05	0.36	0.19	0.24	0.10	0.10	0.01	0.11	0.11
Crit Moves:	****				****		****				****	
Green/Cycle:	0.39	0.38	0.42	0.48	0.45	0.76	0.46	0.39	0.39	0.18	0.13	0.13
Volume/Cap:	0.16	0.57	0.12	0.30	0.80	0.25	0.71	0.25	0.25	0.09	0.80	0.80
Uniform Del:	21.9	24.8	17.4	15.7	23.5	3.7	19.9	20.8	20.8	33.9	42.1	42.1
IncremntDel:	0.8	0.6	0.1	0.6	2.9	0.1	3.7	0.2	0.2	0.2	17.9	17.9
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	22.7	25.4	17.5	16.3	26.4	3.8	23.6	21.0	21.0	34.0	60.0	60.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	22.7	25.4	17.5	16.3	26.4	3.8	23.6	21.0	21.0	34.0	60.0	60.0
LOS by Move:	C	C	B	B	C	A	C	C	C	C	E	E
HCM2kAvgQ:	0	10	2	2	20	3	12	4	4	1	8	8

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #7 Ane Keohokahole/Main Gate

Average Delay (sec/veh): 186.4 Worst Case Level Of Service: F[667.6]

Street Name:	Ane Keohokahole Hwy									Main Gate												
Approach:	North Bound					South Bound					East Bound					West Bound						
Movement:	L	-	T	-	R	L	-	T	-	R	L	-	T	-	R	L	-	T	-	R		
Control:	Uncontrolled					Uncontrolled					Stop Sign					Stop Sign						
Rights:	Include					Include					Include					Include						
Lanes:	0	0	1	0	1	1	0	1	0	0	0	0	0	0	0	1	0	0	0	1		
Volume Module:																						
Base Vol:	0	445	438	292	338	0	0	0	0	325	0	253										
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00										
Initial Bse:	0	445	438	292	338	0	0	0	0	325	0	253										
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00										
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95										
PHF Volume:	0	468	461	307	356	0	0	0	0	342	0	266										
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0										
FinalVolume:	0	468	461	307	356	0	0	0	0	342	0	266										
Critical Gap Module:																						
Critical Gp:	xxxxx	xxxx	xxxxx	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.4	xxxx	6.2										
FollowUpTim:	xxxxx	xxxx	xxxxx	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	xxxx	3.3										
Capacity Module:																						
Cnflict Vol:	xxxx	xxxx	xxxxx	929	xxxx	xxxxx	xxxx	xxxx	xxxxx	1439	xxxx	468										
Potent Cap.:	xxxx	xxxx	xxxxx	744	xxxx	xxxxx	xxxx	xxxx	xxxxx	148	xxxx	599										
Move Cap.:	xxxx	xxxx	xxxxx	744	xxxx	xxxxx	xxxx	xxxx	xxxxx	100	xxxx	599										
Volume/Cap:	xxxx	xxxx	xxxx	0.41	xxxx	xxxx	xxxx	xxxx	xxxx	3.41	xxxx	0.44										
Level Of Service Module:																						
2Way95thQ:	xxxx	xxxx	xxxxx	2.0	xxxx	xxxxx	xxxx	xxxx	xxxxx	34.0	xxxx	2.3										
Control Del:	xxxxx	xxxx	xxxxx	13.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	1175	xxxx	15.7										
LOS by Move:	*	*	*	B	*	*	*	*	*	F	*	C										
Movement:	LT	-	LTR	-	RT	LT	-	LTR	-	RT	LT	-	LTR	-	RT	LT	-	LTR	-	RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx										
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx										
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx										
Shared LOS:	*	*	*	*	*	*	*	*	*	*	*	*										
ApproachDel:	xxxxxx			xxxxxx			xxxxxx			667.6												
ApproachLOS:	*			*			*			F												

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #8 Palihiolo St/Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	1.914
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	215.1
Optimal Cycle:	180	Level Of Service:	F

Street Name:	Palihiolo St						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Prot+Permit			Permitted		
Rights:	Include			Include			Include			Ignore		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 1	0 0	1	1	0 0	1 0	1	0 0	1 0	1	0 1	0 1
Volume Module:												
Base Vol:	4	19	26	2	4	614	506	753	13	49	1362	23
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	4	19	26	2	4	614	506	753	13	49	1362	23
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.00
PHF Volume:	4	20	27	2	4	646	533	793	14	52	1434	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	4	20	27	2	4	646	533	793	14	52	1434	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
FinalVolume:	4	20	27	2	4	646	533	793	14	52	1434	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.67	0.67	0.85	0.75	0.85	0.85	0.21	1.00	1.00	0.95	1.00	1.00
Lanes:	0.17	0.83	1.00	1.00	0.01	0.99	1.00	0.98	0.02	1.00	1.00	1.00
Final Sat.:	222	1055	1615	1423	10	1606	404	1862	32	1805	1900	1900
Capacity Analysis Module:												
Vol/Sat:	0.02	0.02	0.02	0.00	0.40	0.40	1.32	0.43	0.43	0.03	0.75	0.00
Crit Moves:					****		****					
Green/Cycle:	0.25	0.25	0.25	0.25	0.25	0.25	0.61	0.61	0.61	0.04	0.47	0.00
Volume/Cap:	0.08	0.08	0.07	0.01	1.61	1.61	1.31	0.70	0.70	0.70	1.61	0.00
Uniform Del:	28.7	28.7	28.7	28.2	37.5	37.5	9.8	13.3	13.3	47.3	26.6	0.0
IncremntDel:	0.1	0.1	0.1	0.0	287	287.3	156.8	1.9	1.9	25.5	281	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Delay/Veh:	28.8	28.8	28.7	28.2	325	324.8	166.7	15.2	15.2	72.8	308	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	28.8	28.8	28.7	28.2	325	324.8	166.7	15.2	15.2	72.8	308	0.0
LOS by Move:	C	C	C	C	F	F	F	B	B	E	F	A
HCM2kAvgQ:	1	1	1	0	51	51	34	17	17	3	110	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #10 Palani Rd / Uluaoa St

Average Delay (sec/veh): 11.8 Worst Case Level Of Service: F[241.5]

Street Name:	Palani Rd						Uluaoa St					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	0 1 0 0 0			0 0 0 1 0			1 0 0 0 1			0 0 0 0 0		
Volume Module:												
Base Vol:	29	762	0	0	1061	177	71	0	32	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	29	762	0	0	1061	177	71	0	32	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	31	802	0	0	1117	186	75	0	34	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	31	802	0	0	1117	186	75	0	34	0	0	0
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.4	xxxx	6.2	xxxxx	xxxx	xxxxx
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	xxxx	3.3	xxxxx	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1303	xxxx	xxxxx	xxxx	xxxx	xxxxx	2073	xxxx	1210	xxxx	xxxx	xxxxx
Potent Cap.:	538	xxxx	xxxxx	xxxx	xxxx	xxxxx	60	xxxx	225	xxxx	xxxx	xxxxx
Move Cap.:	538	xxxx	xxxxx	xxxx	xxxx	xxxxx	57	xxxx	225	xxxx	xxxx	xxxxx
Volume/Cap:	0.06	xxxx	xxxx	xxxx	xxxx	xxxx	1.30	xxxx	0.15	xxxx	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	0.2	xxxx	xxxxx	xxxx	xxxx	xxxxx	6.5	xxxx	0.5	xxxx	xxxx	xxxxx
Control Del:	12.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	339.7	xxxx	23.8	xxxxx	xxxx	xxxxx
LOS by Move:	B	*	*	*	*	*	F	*	C	*	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	0.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	12.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	B	*	*	*	*	*	*	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			241.5			xxxxxx		
ApproachLOS:	*			*			F			*		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #11 Queen Kaahumanu Hwy / Kealakehe Pkwy

Cycle (sec):	100	Critical Vol./Cap.(X):	0.832
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	26.3
Optimal Cycle:	80	Level Of Service:	C

Street Name:	Queen Kaahumanu Hwy						Kaalakehe Pkwy					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Prot+Permit			Prot+Permit			Permitted			Permitted		
Rights:		Ovl			Ovl			Ovl			Ovl	
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	2 0	1	1 0	2 0	1	0 1	0 0	1	0 1	0 0	1
Volume Module:												
Base Vol:	66	1097	239	201	1071	232	106	97	67	242	66	168
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	66	1097	239	201	1071	232	106	97	67	242	66	168
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	69	1155	252	212	1127	244	112	102	71	255	69	177
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	69	1155	252	212	1127	244	112	102	71	255	69	177
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	69	1155	252	212	1127	244	112	102	71	255	69	177
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	0.95	0.85	0.95	0.95	0.85	0.53	0.53	0.85	0.55	0.55	0.85
Lanes:	1.00	2.00	1.00	1.00	2.00	1.00	0.52	0.48	1.00	0.79	0.21	1.00
Final Sat.:	1805	3610	1615	1805	3610	1615	526	481	1615	818	223	1615
Capacity Analysis Module:												
Vol/Sat:	0.04	0.32	0.16	0.12	0.31	0.15	0.21	0.21	0.04	0.31	0.31	0.11
Crit Moves:		****		****							****	
Green/Cycle:	0.44	0.38	0.38	0.56	0.47	0.47	0.37	0.37	0.43	0.37	0.37	0.52
Volume/Cap:	0.32	0.83	0.41	0.64	0.67	0.32	0.57	0.57	0.10	0.83	0.83	0.21
Uniform Del:	17.4	27.8	22.4	20.8	20.6	16.7	24.8	24.8	16.9	28.4	28.4	13.2
IncremntDel:	0.8	4.4	0.4	4.2	1.0	0.3	2.0	2.0	0.1	14.1	14.1	0.1
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	18.2	32.3	22.9	25.1	21.6	16.9	26.9	26.9	16.9	42.5	42.5	13.3
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	18.2	32.3	22.9	25.1	21.6	16.9	26.9	26.9	16.9	42.5	42.5	13.3
LOS by Move:	B	C	C	C	C	B	C	C	B	D	D	B
HCM2kAvgQ:	2	19	6	6	15	5	6	6	1	12	12	3

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #12 Ane Keohokalole Hwy / Kealakehe Pkwy

Average Delay (sec/veh): OVERFLOW Worst Case Level Of Service: F[xxxxx]

Street Name:	Ane Keohokalole Hwy						Kealakehe Pkwy					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Stop Sign			Stop Sign			Uncontrolled			Uncontrolled		
Rights:	Include			Include			Include			Include		
Lanes:	1 0	1 0	1	1 0	0 1	0	1 0	1 1	0	1 0	1 0	1
Volume Module:												
Base Vol:	222	396	0	50	354	369	165	194	271	5	128	23
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	222	396	0	50	354	369	165	194	271	5	128	23
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	234	417	0	53	373	388	174	204	285	5	135	24
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	234	417	0	53	373	388	174	204	285	5	135	24
Critical Gap Module:												
Critical Gp:	7.1	6.5	6.2	7.1	6.5	6.2	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx
FollowUpTim:	3.5	4.0	3.3	3.5	4.0	3.3	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	1232	864	245	803	982	135	159	xxxx	xxxxx	489	xxxx	xxxxx
Potent Cap.:	155	294	799	304	251	920	1433	xxxx	xxxxx	1084	xxxx	xxxxx
Move Cap.:	0	257	799	0	220	920	1433	xxxx	xxxxx	1084	xxxx	xxxxx
Volume/Cap:	xxxx	1.62	0.00	xxxx	1.70	0.42	0.12	xxxx	xxxx	0.00	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	26.0	xxxxx	xxxx	xxxx	xxxxx	0.4	xxxx	xxxxx	0.0	xxxx	xxxxx
Control Del:	xxxxx	330	xxxxx	xxxxx	xxxx	xxxxx	7.9	xxxx	xxxxx	8.3	xxxx	xxxxx
LOS by Move:	*	F	*	*	*	*	A	*	*	A	*	*
Movement:	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	359	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	55.4	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	537.2	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	*	*	*	*	F	*	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			xxxxxx			xxxxxx		
ApproachLOS:	F			F			*			*		

Note: Queue reported is the number of cars per lane.

CUMULATIVE PLUS PROJECT CONDITIONS WITH MITIGATION – CONCEPT A

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #3 Kamakaeha Ave / Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	0.558
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	4.8
Optimal Cycle:	40	Level Of Service:	A

Street Name:	Kamakaeha Ave						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Ignore		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0 0 0 0			1 0 0 0 1			0 0 1 0 0			0 0 1 0 1		
Volume Module:												
Base Vol:	0	0	0	47	0	15	0	404	0	0	846	240
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	0	0	47	0	15	0	404	0	0	846	240
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.00
PHF Volume:	0	0	0	49	0	16	0	425	0	0	891	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	49	0	16	0	425	0	0	891	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
FinalVolume:	0	0	0	49	0	16	0	425	0	0	891	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	1.00	0.77	1.00	0.85	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00	1.00	1.00
Final Sat.:	0	0	0	1461	0	1615	0	1900	0	0	1900	1900
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.03	0.00	0.01	0.00	0.22	0.00	0.00	0.47	0.00
Crit Moves:				****							****	
Green/Cycle:	0.00	0.00	0.00	0.06	0.00	0.06	0.00	0.84	0.00	0.00	0.84	0.00
Volume/Cap:	0.00	0.00	0.00	0.56	0.00	0.16	0.00	0.27	0.00	0.00	0.56	0.00
Uniform Del:	0.0	0.0	0.0	45.7	0.0	44.6	0.0	1.7	0.0	0.0	2.4	0.0
IncremntDel:	0.0	0.0	0.0	7.7	0.0	0.8	0.0	0.1	0.0	0.0	0.4	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00	1.00	0.00
Delay/Veh:	0.0	0.0	0.0	53.4	0.0	45.3	0.0	1.8	0.0	0.0	2.9	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	0.0	0.0	53.4	0.0	45.3	0.0	1.8	0.0	0.0	2.9	0.0
LOS by Move:	A	A	A	D	A	D	A	A	A	A	A	A
HCM2kAvgQ:	0	0	0	2	0	1	0	3	0	0	9	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Henry St / Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	0.833
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	32.4
Optimal Cycle:	76	Level Of Service:	C

Street Name:	Henry St						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Prot+Permit		
Rights:	Ovl			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1	1 0	1 0	1	1 0	1 0	0	1 0	2 0	1	1 0
Volume Module:												
Base Vol:	122	404	454	86	492	288	237	185	37	927	810	90
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	122	404	454	86	492	288	237	185	37	927	810	90
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	128	425	478	91	518	303	249	195	39	976	853	95
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	128	425	478	91	518	303	249	195	39	976	853	95
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	128	425	478	91	518	303	249	195	39	976	853	95
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.20	0.87	0.87	0.17	0.90	0.90	0.95	0.98	0.98	0.92	0.94	0.94
Lanes:	1.00	1.00	1.00	1.00	1.26	0.74	1.00	0.83	0.17	2.00	1.80	0.20
Final Sat.:	386	1662	1662	321	2152	1260	1805	1544	309	3502	3200	356
Capacity Analysis Module:												
Vol/Sat:	0.33	0.26	0.29	0.28	0.24	0.24	0.14	0.13	0.13	0.28	0.27	0.27
Crit Moves:	****						****			****		
Green/Cycle:	0.41	0.41	0.75	0.41	0.41	0.41	0.17	0.15	0.15	0.33	0.33	0.33
Volume/Cap:	0.82	0.63	0.39	0.69	0.59	0.59	0.82	0.82	0.82	0.85	0.82	0.82
Uniform Del:	26.4	23.7	4.5	24.6	23.2	23.2	40.1	41.0	41.0	31.6	31.0	31.0
IncremntDel:	27.7	0.9	0.1	15.0	0.7	0.7	15.9	16.9	16.9	6.1	4.7	4.7
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	54.1	24.6	4.6	39.5	23.9	23.9	56.0	57.9	57.9	37.6	35.8	35.8
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	54.1	24.6	4.6	39.5	23.9	23.9	56.0	57.9	57.9	37.6	35.8	35.8
LOS by Move:	D	C	A	D	C	C	E	E	E	D	D	D
HCM2kAvgQ:	6	12	6	4	11	11	10	9	9	17	16	16

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #7 Ane Keohokahole/Main Gate

Cycle (sec):	100	Critical Vol./Cap.(X):	0.579
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	15.9
Optimal Cycle:	42	Level Of Service:	B

Street Name:	Ane Keohokahole Hwy						Main Gate					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	1 0	1	1 0	1 0	0	0 0	0 0	0	1 0	0 0	1
Volume Module:												
Base Vol:	0	447	284	189	620	0	0	0	0	246	0	191
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	447	284	189	620	0	0	0	0	246	0	191
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	471	299	199	653	0	0	0	0	259	0	201
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	471	299	199	653	0	0	0	0	259	0	201
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	0	471	299	199	653	0	0	0	0	259	0	201
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	0.85	0.41	1.00	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	1900	1615	783	1900	0	0	0	0	1461	0	1615
Capacity Analysis Module:												
Vol/Sat:	0.00	0.25	0.19	0.25	0.34	0.00	0.00	0.00	0.00	0.18	0.00	0.12
Crit Moves:					****					****		
Green/Cycle:	0.00	0.59	0.59	0.59	0.59	0.00	0.00	0.00	0.00	0.31	0.00	0.31
Volume/Cap:	0.00	0.42	0.31	0.43	0.58	0.00	0.00	0.00	0.00	0.58	0.00	0.41
Uniform Del:	0.0	11.0	10.1	11.1	12.6	0.0	0.0	0.0	0.0	29.2	0.0	27.5
IncremntDel:	0.0	0.3	0.2	0.6	0.8	0.0	0.0	0.0	0.0	1.9	0.0	0.5
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	11.2	10.3	11.7	13.3	0.0	0.0	0.0	0.0	31.1	0.0	28.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	11.2	10.3	11.7	13.3	0.0	0.0	0.0	0.0	31.1	0.0	28.0
LOS by Move:	A	B	B	B	B	A	A	A	A	C	A	C
HCM2kAvgQ:	0	8	5	4	13	0	0	0	0	7	0	5

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #8 Palihiolo St/Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	0.982
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	33.2
Optimal Cycle:	173	Level Of Service:	C

Street Name:	Palihiolo St						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Prot+Permit			Permitted		
Rights:	Include			Ovl			Include			Ignore		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 1	0 0	1	1	0 0	1 0	2	0 0	1 0	1	0 1	1 0
Volume Module:												
Base Vol:	5	20	32	10	15	553	438	531	6	20	1317	56
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	5	20	32	10	15	553	438	531	6	20	1317	56
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.00
PHF Volume:	5	21	34	11	16	582	461	559	6	21	1386	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	5	21	34	11	16	582	461	559	6	21	1386	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
FinalVolume:	5	21	34	11	16	582	461	559	6	21	1386	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.90	0.90	0.85	0.75	0.85	0.85	0.92	1.00	1.00	0.95	0.95	0.95
Lanes:	0.20	0.80	1.00	1.00	0.03	0.97	2.00	0.99	0.01	1.00	2.00	0.00
Final Sat.:	341	1365	1615	1419	43	1580	3502	1875	21	1805	3610	0
Capacity Analysis Module:												
Vol/Sat:	0.02	0.02	0.02	0.01	0.37	0.37	0.13	0.30	0.30	0.01	0.38	0.00
Crit Moves:					****		****				****	
Green/Cycle:	0.38	0.38	0.38	0.38	0.38	0.51	0.51	0.51	0.51	0.02	0.39	0.00
Volume/Cap:	0.04	0.04	0.06	0.02	0.98	0.72	0.37	0.59	0.59	0.59	0.98	0.00
Uniform Del:	19.8	19.8	19.9	19.7	30.9	19.1	14.1	17.4	17.4	48.6	30.1	0.0
IncremntDel:	0.0	0.0	0.0	0.0	31.9	3.2	0.2	1.0	1.0	23.5	19.8	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Delay/Veh:	19.9	19.9	20.0	19.7	62.8	22.3	14.3	18.4	18.4	72.1	49.9	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	19.9	19.9	20.0	19.7	62.8	22.3	14.3	18.4	18.4	72.1	49.9	0.0
LOS by Move:	B	B	B	B	E	C	B	B	B	E	D	A
HCM2kAvgQ:	1	1	1	0	24	15	5	12	12	2	29	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #10 Palani Rd / Uluaoa St

Cycle (sec):	100	Critical Vol./Cap.(X):	0.757
Loss Time (sec):	0 (Y+R=4.0 sec)	Average Delay (sec/veh):	13.9
Optimal Cycle:	59	Level Of Service:	B

Street Name:	Palani Rd						Uluaoa St					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 1	0 0	0	0 0	0 1	0	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	58	477	0	0	786	311	176	0	200	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	58	477	0	0	786	311	176	0	200	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	61	502	0	0	827	327	185	0	211	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	61	502	0	0	827	327	185	0	211	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	61	502	0	0	827	327	185	0	211	0	0	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.81	0.81	1.00	1.00	0.96	0.96	0.78	1.00	0.85	1.00	1.00	1.00
Lanes:	0.11	0.89	0.00	0.00	0.72	0.28	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	167	1376	0	0	1310	518	1480	0	1615	0	0	0
Capacity Analysis Module:												
Vol/Sat:	0.37	0.37	0.00	0.00	0.63	0.63	0.13	0.00	0.13	0.00	0.00	0.00
Crit Moves:					****		****					
Green/Cycle:	0.83	0.83	0.00	0.00	0.83	0.83	0.17	0.00	0.17	0.00	0.00	0.00
Volume/Cap:	0.44	0.44	0.00	0.00	0.76	0.76	0.76	0.00	0.79	0.00	0.00	0.00
Uniform Del:	2.2	2.2	0.0	0.0	3.7	3.7	39.8	0.0	40.1	0.0	0.0	0.0
IncremntDel:	0.2	0.2	0.0	0.0	2.2	2.2	12.7	0.0	14.5	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	2.4	2.4	0.0	0.0	5.9	5.9	52.5	0.0	54.5	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	2.4	2.4	0.0	0.0	5.9	5.9	52.5	0.0	54.5	0.0	0.0	0.0
LOS by Move:	A	A	A	A	A	A	D	A	D	A	A	A
HCM2kAvgQ:	5	5	0	0	17	17	7	0	8	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #12 Ane Keohokalole Hwy / Kealakehe Pkwy

Cycle (sec):	100	Critical Vol./Cap.(X):	0.686
Loss Time (sec):	0 (Y+R=4.0 sec)	Average Delay (sec/veh):	18.5
Optimal Cycle:	46	Level Of Service:	B

Street Name:	Ane Keohokalole Hwy						Kealakehe Pkwy					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	1	1 0	0 1	0	1 0	1 1	0	1 0	1 0	1
Volume Module:												
Base Vol:	233	402	3	12	358	45	369	94	449	2	115	50
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	233	402	3	12	358	45	369	94	449	2	115	50
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	245	423	3	13	377	47	388	99	473	2	121	53
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	245	423	3	13	377	47	388	99	473	2	121	53
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	245	423	3	13	377	47	388	99	473	2	121	53
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.37	1.00	0.85	0.37	0.98	0.98	0.62	0.83	0.83	0.36	1.00	0.85
Lanes:	1.00	1.00	1.00	1.00	0.89	0.11	1.00	1.00	1.00	1.00	1.00	1.00
Final Sat.:	694	1900	1615	695	1659	209	1170	1581	1581	676	1900	1615
Capacity Analysis Module:												
Vol/Sat:	0.35	0.22	0.00	0.02	0.23	0.23	0.33	0.06	0.30	0.00	0.06	0.03
Crit Moves:	****						****					
Green/Cycle:	0.52	0.52	0.52	0.52	0.52	0.52	0.48	0.48	0.48	0.48	0.48	0.48
Volume/Cap:	0.69	0.43	0.00	0.04	0.44	0.44	0.69	0.13	0.62	0.01	0.13	0.07
Uniform Del:	18.1	15.1	11.7	11.9	15.2	15.2	19.9	14.2	19.0	13.3	14.2	13.8
IncremntDel:	5.5	0.3	0.0	0.0	0.3	0.3	3.5	0.0	1.3	0.0	0.1	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	23.6	15.4	11.7	12.0	15.5	15.5	23.4	14.2	20.3	13.4	14.3	13.8
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	23.6	15.4	11.7	12.0	15.5	15.5	23.4	14.2	20.3	13.4	14.3	13.8
LOS by Move:	C	B	B	B	B	B	C	B	C	B	B	B
HCM2kAvgQ:	7	8	0	0	8	8	10	2	12	0	2	1

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #3 Kamakaeha Ave / Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	0.652
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	10.3
Optimal Cycle:	48	Level Of Service:	B

Street Name:	Kamakaeha Ave						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Ignore		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0 0 0 0			1 0 0 0 1			0 0 1 0 0			0 0 1 0 1		
Volume Module:												
Base Vol:	0	0	0	127	0	63	0	618	0	0	894	281
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	0	0	127	0	63	0	618	0	0	894	281
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.00
PHF Volume:	0	0	0	134	0	66	0	651	0	0	941	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	134	0	66	0	651	0	0	941	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
FinalVolume:	0	0	0	134	0	66	0	651	0	0	941	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	1.00	0.77	1.00	0.85	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00	1.00	1.00
Final Sat.:	0	0	0	1461	0	1615	0	1900	0	0	1900	1900
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.09	0.00	0.04	0.00	0.34	0.00	0.00	0.50	0.00
Crit Moves:				****							****	
Green/Cycle:	0.00	0.00	0.00	0.14	0.00	0.14	0.00	0.76	0.00	0.00	0.76	0.00
Volume/Cap:	0.00	0.00	0.00	0.65	0.00	0.29	0.00	0.45	0.00	0.00	0.65	0.00
Uniform Del:	0.0	0.0	0.0	40.7	0.0	38.5	0.0	4.4	0.0	0.0	5.7	0.0
IncremntDel:	0.0	0.0	0.0	7.3	0.0	0.7	0.0	0.2	0.0	0.0	1.1	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00	1.00	0.00
Delay/Veh:	0.0	0.0	0.0	48.0	0.0	39.3	0.0	4.6	0.0	0.0	6.8	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	0.0	0.0	48.0	0.0	39.3	0.0	4.6	0.0	0.0	6.8	0.0
LOS by Move:	A	A	A	D	A	D	A	A	A	A	A	A
HCM2kAvgQ:	0	0	0	5	0	2	0	7	0	0	14	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Henry St / Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	0.926
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	32.9
Optimal Cycle:	120	Level Of Service:	C

Street Name:	Henry St						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Prot+Permit		
Rights:	Ovl			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1	1 0	1 0	1	1 0	1 0	0 1	0	2 0	1	1 0
Volume Module:												
Base Vol:	110	329	394	67	314	183	268	416	129	859	927	93
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	110	329	394	67	314	183	268	416	129	859	927	93
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	116	346	415	71	331	193	282	438	136	904	976	98
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	116	346	415	71	331	193	282	438	136	904	976	98
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	116	346	415	71	331	193	282	438	136	904	976	98
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.30	0.87	0.87	0.14	0.90	0.90	0.95	0.96	0.96	0.92	0.94	0.94
Lanes:	1.00	1.00	1.00	1.00	1.26	0.74	1.00	0.76	0.24	2.00	1.82	0.18
Final Sat.:	569	1657	1657	269	2155	1256	1805	1398	434	3502	3235	325
Capacity Analysis Module:												
Vol/Sat:	0.20	0.21	0.25	0.26	0.15	0.15	0.16	0.31	0.31	0.26	0.30	0.30
Crit Moves:				****				****		****		
Green/Cycle:	0.28	0.28	0.56	0.28	0.28	0.28	0.21	0.34	0.34	0.41	0.41	0.41
Volume/Cap:	0.72	0.74	0.45	0.93	0.54	0.54	0.74	0.93	0.93	0.67	0.74	0.74
Uniform Del:	32.3	32.5	12.8	34.8	30.4	30.4	36.9	31.9	31.9	23.7	25.2	25.2
IncremntDel:	14.5	2.9	0.2	78.1	0.6	0.6	7.7	20.1	20.1	1.3	2.1	2.1
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	46.8	35.3	13.0	113.0	31.0	31.0	44.6	52.0	52.0	25.1	27.3	27.3
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	46.8	35.3	13.0	113.0	31.0	31.0	44.6	52.0	52.0	25.1	27.3	27.3
LOS by Move:	D	D	B	F	C	C	D	D	D	C	C	C
HCM2kAvgQ:	5	12	8	5	8	8	10	21	21	12	16	16

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #7 Ane Keohokahole/Main Gate

Cycle (sec):	100	Critical Vol./Cap.(X):	0.455
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	16.4
Optimal Cycle:	34	Level Of Service:	B

Street Name:	Ane Keohokahole Hwy						Main Gate					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	1 0	1	1 0	1 0	0	0 0	0 0	0	1 0	0 0	1
Volume Module:												
Base Vol:	0	445	244	163	338	0	0	0	0	226	0	176
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	445	244	163	338	0	0	0	0	226	0	176
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	468	257	172	356	0	0	0	0	238	0	185
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	468	257	172	356	0	0	0	0	238	0	185
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	0	468	257	172	356	0	0	0	0	238	0	185
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	0.85	0.39	1.00	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	1900	1615	743	1900	0	0	0	0	1461	0	1615
Capacity Analysis Module:												
Vol/Sat:	0.00	0.25	0.16	0.23	0.19	0.00	0.00	0.00	0.00	0.16	0.00	0.11
Crit Moves:		****								****		
Green/Cycle:	0.00	0.54	0.54	0.54	0.54	0.00	0.00	0.00	0.00	0.36	0.00	0.36
Volume/Cap:	0.00	0.45	0.29	0.43	0.35	0.00	0.00	0.00	0.00	0.45	0.00	0.32
Uniform Del:	0.0	13.9	12.5	13.6	12.9	0.0	0.0	0.0	0.0	24.6	0.0	23.3
IncremntDel:	0.0	0.3	0.2	0.7	0.2	0.0	0.0	0.0	0.0	0.6	0.0	0.3
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	14.2	12.7	14.4	13.1	0.0	0.0	0.0	0.0	25.2	0.0	23.6
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	14.2	12.7	14.4	13.1	0.0	0.0	0.0	0.0	25.2	0.0	23.6
LOS by Move:	A	B	B	B	B	A	A	A	A	C	A	C
HCM2kAvgQ:	0	9	4	4	6	0	0	0	0	6	0	4

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #8 Palihiolo St/Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	1.023
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	40.7
Optimal Cycle:	180	Level Of Service:	D

Street Name:	Palihiolo St						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Prot+Permit			Permitted		
Rights:	Include			Ovl			Include			Ignore		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 1	0 0	1	1	0 0	1 0	2	0 0	1 0	1	0 1	1 0
Volume Module:												
Base Vol:	4	19	26	2	4	592	506	731	13	49	1319	23
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	4	19	26	2	4	592	506	731	13	49	1319	23
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.00
PHF Volume:	4	20	27	2	4	623	533	769	14	52	1388	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	4	20	27	2	4	623	533	769	14	52	1388	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
FinalVolume:	4	20	27	2	4	623	533	769	14	52	1388	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.89	0.89	0.85	0.75	0.85	0.85	0.91	1.00	1.00	0.95	0.95	0.95
Lanes:	0.17	0.83	1.00	1.00	0.01	0.99	2.00	0.98	0.02	1.00	2.00	0.00
Final Sat.:	293	1394	1615	1423	11	1606	3445	1861	33	1805	3610	0
Capacity Analysis Module:												
Vol/Sat:	0.01	0.01	0.02	0.00	0.39	0.39	0.15	0.41	0.41	0.03	0.38	0.00
Crit Moves:					****		****				****	
Green/Cycle:	0.38	0.38	0.38	0.38	0.38	0.53	0.49	0.49	0.49	0.03	0.37	0.00
Volume/Cap:	0.04	0.04	0.04	0.00	1.03	0.74	0.42	0.85	0.85	0.85	1.03	0.00
Uniform Del:	19.6	19.6	19.7	19.4	31.1	18.4	15.4	22.3	22.3	48.1	31.3	0.0
IncremntDel:	0.0	0.0	0.0	0.0	43.6	3.4	0.2	7.3	7.3	63.7	31.8	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Delay/Veh:	19.7	19.7	19.7	19.4	74.7	21.8	15.7	29.6	29.6	111.8	63.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	19.7	19.7	19.7	19.4	74.7	21.8	15.7	29.6	29.6	111.8	63.0	0.0
LOS by Move:	B	B	B	B	E	C	B	C	C	F	E	A
HCM2kAvgQ:	0	0	1	0	27	16	6	23	23	3	31	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #10 Palani Rd / Uluaoa St

Cycle (sec):	100	Critical Vol./Cap.(X):	0.725
Loss Time (sec):	0 (Y+R=4.0 sec)	Average Delay (sec/veh):	4.6
Optimal Cycle:	52	Level Of Service:	A

Street Name:	Palani Rd						Uluaoa St					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 1	0 0	0	0 0	0 1	0	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	29	740	0	0	1018	177	71	0	32	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	29	740	0	0	1018	177	71	0	32	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	31	779	0	0	1072	186	75	0	34	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	31	779	0	0	1072	186	75	0	34	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	31	779	0	0	1072	186	75	0	34	0	0	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.93	0.93	1.00	1.00	0.98	0.98	0.79	1.00	0.85	1.00	1.00	1.00
Lanes:	0.04	0.96	0.00	0.00	0.85	0.15	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	67	1700	0	0	1586	276	1503	0	1615	0	0	0
Capacity Analysis Module:												
Vol/Sat:	0.46	0.46	0.00	0.00	0.68	0.68	0.05	0.00	0.02	0.00	0.00	0.00
Crit Moves:					****		****					
Green/Cycle:	0.93	0.93	0.00	0.00	0.93	0.93	0.07	0.00	0.07	0.00	0.00	0.00
Volume/Cap:	0.49	0.49	0.00	0.00	0.73	0.73	0.73	0.00	0.30	0.00	0.00	0.00
Uniform Del:	0.4	0.4	0.0	0.0	0.7	0.7	45.6	0.0	44.3	0.0	0.0	0.0
IncremntDel:	0.2	0.2	0.0	0.0	1.6	1.6	22.5	0.0	1.6	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	0.7	0.7	0.0	0.0	2.3	2.3	68.1	0.0	45.9	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.7	0.7	0.0	0.0	2.3	2.3	68.1	0.0	45.9	0.0	0.0	0.0
LOS by Move:	A	A	A	A	A	A	E	A	D	A	A	A
HCM2kAvgQ:	4	4	0	0	10	10	4	0	1	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #12 Ane Keohokalole Hwy / Kealakehe Pkwy

Cycle (sec):	100	Critical Vol./Cap.(X):	0.583
Loss Time (sec):	0 (Y+R=4.0 sec)	Average Delay (sec/veh):	15.0
Optimal Cycle:	35	Level Of Service:	B

Street Name:	Ane Keohokalole Hwy						Kealakehe Pkwy					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	1	1 0	0 1	0	1 0	1 1	0	1 0	1 0	1
Volume Module:												
Base Vol:	179	363	0	50	311	369	165	194	185	5	128	23
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	179	363	0	50	311	369	165	194	185	5	128	23
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	188	382	0	53	327	388	174	204	195	5	135	24
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	188	382	0	53	327	388	174	204	195	5	135	24
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	188	382	0	53	327	388	174	204	195	5	135	24
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.28	1.00	1.00	0.47	0.92	0.92	0.53	0.88	0.88	0.37	1.00	0.85
Lanes:	1.00	1.00	1.00	1.00	0.46	0.54	1.00	1.02	0.98	1.00	1.00	1.00
Final Sat.:	528	1900	1900	899	799	948	1001	1713	1634	707	1900	1615
Capacity Analysis Module:												
Vol/Sat:	0.36	0.20	0.00	0.06	0.41	0.41	0.17	0.12	0.12	0.01	0.07	0.01
Crit Moves:					****		****					
Green/Cycle:	0.70	0.70	0.00	0.70	0.70	0.70	0.30	0.30	0.30	0.30	0.30	0.30
Volume/Cap:	0.51	0.29	0.00	0.08	0.58	0.58	0.58	0.40	0.40	0.03	0.24	0.05
Uniform Del:	6.9	5.5	0.0	4.7	7.5	7.5	29.9	28.0	28.0	24.9	26.6	25.1
IncremntDel:	1.2	0.1	0.0	0.1	0.7	0.7	2.9	0.3	0.3	0.0	0.2	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	8.0	5.7	0.0	4.8	8.2	8.2	32.8	28.3	28.3	24.9	26.8	25.1
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	8.0	5.7	0.0	4.8	8.2	8.2	32.8	28.3	28.3	24.9	26.8	25.1
LOS by Move:	A	A	A	A	A	A	C	C	C	C	C	C
HCM2kAvgQ:	3	4	0	1	11	11	5	5	5	0	3	1

Note: Queue reported is the number of cars per lane.

CUMULATIVE PLUS PROJECT CONDITIONS WITH MITIGATION – CONCEPT B

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #3 Kamakaeha Ave / Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	0.582
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	4.9
Optimal Cycle:	42	Level Of Service:	A

Street Name:	Kamakaeha Ave						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Ignore		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0 0 0 0			1 0 0 0 1			0 0 1 0 0			0 0 1 0 1		
Volume Module:												
Base Vol:	0	0	0	47	0	15	0	410	0	0	885	240
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	0	0	47	0	15	0	410	0	0	885	240
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.00
PHF Volume:	0	0	0	49	0	16	0	432	0	0	932	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	49	0	16	0	432	0	0	932	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
FinalVolume:	0	0	0	49	0	16	0	432	0	0	932	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	1.00	0.77	1.00	0.85	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00	1.00	1.00
Final Sat.:	0	0	0	1461	0	1615	0	1900	0	0	1900	1900
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.03	0.00	0.01	0.00	0.23	0.00	0.00	0.49	0.00
Crit Moves:				****							****	
Green/Cycle:	0.00	0.00	0.00	0.06	0.00	0.06	0.00	0.84	0.00	0.00	0.84	0.00
Volume/Cap:	0.00	0.00	0.00	0.58	0.00	0.17	0.00	0.27	0.00	0.00	0.58	0.00
Uniform Del:	0.0	0.0	0.0	45.9	0.0	44.8	0.0	1.6	0.0	0.0	2.5	0.0
IncremntDel:	0.0	0.0	0.0	9.9	0.0	0.9	0.0	0.1	0.0	0.0	0.6	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00	1.00	0.00
Delay/Veh:	0.0	0.0	0.0	55.8	0.0	45.6	0.0	1.7	0.0	0.0	3.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	0.0	0.0	55.8	0.0	45.6	0.0	1.7	0.0	0.0	3.0	0.0
LOS by Move:	A	A	A	E	A	D	A	A	A	A	A	A
HCM2kAvgQ:	0	0	0	2	0	1	0	3	0	0	9	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Henry St / Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	0.899
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	36.8
Optimal Cycle:	97	Level Of Service:	D

Street Name:	Henry St						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Prot+Permit		
Rights:	Ovl			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 1	0	1 0	1 1	0	1 0	0 1	0	2 0	1 1	0
Volume Module:												
Base Vol:	122	414	454	116	558	327	243	185	37	942	810	90
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	122	414	454	116	558	327	243	185	37	942	810	90
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	128	436	478	122	587	344	256	195	39	992	853	95
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	128	436	478	122	587	344	256	195	39	992	853	95
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	128	436	478	122	587	344	256	195	39	992	853	95
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.18	0.88	0.88	0.18	0.90	0.90	0.95	0.98	0.98	0.92	0.94	0.94
Lanes:	1.00	1.00	1.00	1.00	1.26	0.74	1.00	0.83	0.17	2.00	1.80	0.20
Final Sat.:	334	1664	1664	348	2151	1261	1805	1544	309	3502	3200	356
Capacity Analysis Module:												
Vol/Sat:	0.38	0.26	0.29	0.35	0.27	0.27	0.14	0.13	0.13	0.28	0.27	0.27
Crit Moves:	****						****			****		
Green/Cycle:	0.44	0.44	0.76	0.44	0.44	0.44	0.16	0.14	0.14	0.30	0.30	0.30
Volume/Cap:	0.88	0.60	0.38	0.81	0.63	0.63	0.88	0.88	0.88	0.92	0.88	0.88
Uniform Del:	25.9	21.6	4.1	24.5	21.9	21.9	41.0	42.0	42.0	33.9	33.1	33.1
IncremntDel:	41.8	0.7	0.1	26.2	0.9	0.9	24.9	27.1	27.1	13.0	8.5	8.5
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	67.6	22.3	4.2	50.7	22.8	22.8	65.9	69.1	69.1	46.9	41.6	41.6
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	67.6	22.3	4.2	50.7	22.8	22.8	65.9	69.1	69.1	46.9	41.6	41.6
LOS by Move:	E	C	A	D	C	C	E	E	E	D	D	D
HCM2kAvgQ:	6	11	5	5	12	12	11	10	10	20	18	18

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #7 Ane Keohokahole/Main Gate

Cycle (sec):	100	Critical Vol./Cap.(X):	0.687
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	21.0
Optimal Cycle:	52	Level Of Service:	C

Street Name:	Ane Keohokahole Hwy						Main Gate					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	1 0	1	1 0	1 0	0	0 0	0 0	0	1 0	0 0	1
Volume Module:												
Base Vol:	0	447	299	200	620	0	0	0	0	381	0	296
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	447	299	200	620	0	0	0	0	381	0	296
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	471	315	211	653	0	0	0	0	401	0	312
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	471	315	211	653	0	0	0	0	401	0	312
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	0	471	315	211	653	0	0	0	0	401	0	312
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	0.85	0.37	1.00	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	1900	1615	694	1900	0	0	0	0	1461	0	1615
Capacity Analysis Module:												
Vol/Sat:	0.00	0.25	0.19	0.30	0.34	0.00	0.00	0.00	0.00	0.27	0.00	0.19
Crit Moves:					****					****		
Green/Cycle:	0.00	0.50	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.40	0.00	0.40
Volume/Cap:	0.00	0.50	0.39	0.61	0.69	0.00	0.00	0.00	0.00	0.69	0.00	0.48
Uniform Del:	0.0	16.6	15.5	17.9	19.0	0.0	0.0	0.0	0.0	24.8	0.0	22.3
IncremntDel:	0.0	0.4	0.3	3.1	2.1	0.0	0.0	0.0	0.0	3.4	0.0	0.6
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	17.0	15.8	21.0	21.1	0.0	0.0	0.0	0.0	28.2	0.0	22.9
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	17.0	15.8	21.0	21.1	0.0	0.0	0.0	0.0	28.2	0.0	22.9
LOS by Move:	A	B	B	C	C	A	A	A	A	C	A	C
HCM2kAvgQ:	0	10	6	6	16	0	0	0	0	11	0	7

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #8 Palihiolo St/Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	0.984
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	33.5
Optimal Cycle:	175	Level Of Service:	C

Street Name:	Palihiolo St						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Prot+Permit			Permitted		
Rights:	Include			Ovl			Include			Ignore		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 1	0 0	1	1	0 0	1 0	2	0 0	1 0	1	0 1	1 0
Volume Module:												
Base Vol:	5	20	32	10	15	554	438	561	6	20	1321	56
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	5	20	32	10	15	554	438	561	6	20	1321	56
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.00
PHF Volume:	5	21	34	11	16	583	461	591	6	21	1391	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	5	21	34	11	16	583	461	591	6	21	1391	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
FinalVolume:	5	21	34	11	16	583	461	591	6	21	1391	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.90	0.90	0.85	0.75	0.85	0.85	0.92	1.00	1.00	0.95	0.95	0.95
Lanes:	0.20	0.80	1.00	1.00	0.03	0.97	2.00	0.99	0.01	1.00	2.00	0.00
Final Sat.:	340	1362	1615	1419	43	1580	3502	1876	20	1805	3610	0
Capacity Analysis Module:												
Vol/Sat:	0.02	0.02	0.02	0.01	0.37	0.37	0.13	0.31	0.31	0.01	0.39	0.00
Crit Moves:					****		****				****	
Green/Cycle:	0.37	0.37	0.37	0.37	0.37	0.51	0.51	0.51	0.51	0.02	0.39	0.00
Volume/Cap:	0.04	0.04	0.06	0.02	0.98	0.73	0.36	0.62	0.62	0.62	0.98	0.00
Uniform Del:	19.8	19.8	19.9	19.7	31.0	19.1	14.0	17.8	17.8	48.7	30.1	0.0
IncremntDel:	0.0	0.0	0.0	0.0	32.4	3.2	0.2	1.3	1.3	30.7	20.2	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Delay/Veh:	19.9	19.9	20.0	19.7	63.4	22.4	14.2	19.1	19.1	79.4	50.4	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	19.9	19.9	20.0	19.7	63.4	22.4	14.2	19.1	19.1	79.4	50.4	0.0
LOS by Move:	B	B	B	B	E	C	B	B	B	E	D	A
HCM2kAvgQ:	1	1	1	0	25	15	5	14	14	2	29	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #10 Palani Rd / Uluaoa St

Cycle (sec):	100	Critical Vol./Cap.(X):	0.759
Loss Time (sec):	0 (Y+R=4.0 sec)	Average Delay (sec/veh):	13.8
Optimal Cycle:	60	Level Of Service:	B

Street Name:	Palani Rd						Uluaoa St					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 1	0 0	0	0 0	0 1	0	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	58	507	0	0	790	311	176	0	200	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	58	507	0	0	790	311	176	0	200	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	61	534	0	0	832	327	185	0	211	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	61	534	0	0	832	327	185	0	211	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	61	534	0	0	832	327	185	0	211	0	0	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.82	0.82	1.00	1.00	0.96	0.96	0.78	1.00	0.85	1.00	1.00	1.00
Lanes:	0.10	0.90	0.00	0.00	0.72	0.28	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	160	1395	0	0	1312	516	1480	0	1615	0	0	0
Capacity Analysis Module:												
Vol/Sat:	0.38	0.38	0.00	0.00	0.63	0.63	0.13	0.00	0.13	0.00	0.00	0.00
Crit Moves:					****		****					
Green/Cycle:	0.84	0.84	0.00	0.00	0.84	0.84	0.16	0.00	0.16	0.00	0.00	0.00
Volume/Cap:	0.46	0.46	0.00	0.00	0.76	0.76	0.76	0.00	0.79	0.00	0.00	0.00
Uniform Del:	2.2	2.2	0.0	0.0	3.7	3.7	39.9	0.0	40.1	0.0	0.0	0.0
IncremntDel:	0.3	0.3	0.0	0.0	2.3	2.3	12.9	0.0	14.7	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	2.5	2.5	0.0	0.0	6.0	6.0	52.8	0.0	54.8	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	2.5	2.5	0.0	0.0	6.0	6.0	52.8	0.0	54.8	0.0	0.0	0.0
LOS by Move:	A	A	A	A	A	A	D	A	D	A	A	A
HCM2kAvgQ:	5	5	0	0	17	17	7	0	8	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #12 Ane Keohokalole Hwy / Kealakehe Pkwy

Cycle (sec):	100	Critical Vol./Cap.(X):	0.760
Loss Time (sec):	0 (Y+R=4.0 sec)	Average Delay (sec/veh):	20.2
Optimal Cycle:	60	Level Of Service:	C

Street Name:	Ane Keohokalole Hwy						Kealakehe Pkwy					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	1	1 0	0 1	0	1 0	1 1	0	1 0	1 0	1
Volume Module:												
Base Vol:	293	447	3	12	362	45	369	94	456	2	115	50
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	293	447	3	12	362	45	369	94	456	2	115	50
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	308	471	3	13	381	47	388	99	480	2	121	53
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	308	471	3	13	381	47	388	99	480	2	121	53
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	308	471	3	13	381	47	388	99	480	2	121	53
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.38	1.00	0.85	0.35	0.98	0.98	0.61	0.83	0.83	0.34	1.00	0.85
Lanes:	1.00	1.00	1.00	1.00	0.89	0.11	1.00	1.00	1.00	1.00	1.00	1.00
Final Sat.:	730	1900	1615	667	1661	207	1153	1581	1581	638	1900	1615
Capacity Analysis Module:												
Vol/Sat:	0.42	0.25	0.00	0.02	0.23	0.23	0.34	0.06	0.30	0.00	0.06	0.03
Crit Moves:	****						****					
Green/Cycle:	0.56	0.56	0.56	0.56	0.56	0.56	0.44	0.44	0.44	0.44	0.44	0.44
Volume/Cap:	0.76	0.44	0.00	0.03	0.41	0.41	0.76	0.14	0.68	0.01	0.14	0.07
Uniform Del:	17.0	13.1	9.9	10.0	12.8	12.8	23.4	16.5	22.2	15.5	16.5	16.0
IncremntDel:	8.1	0.3	0.0	0.0	0.3	0.3	6.5	0.0	2.3	0.0	0.1	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	25.1	13.4	9.9	10.1	13.0	13.0	29.9	16.5	24.6	15.6	16.6	16.1
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	25.1	13.4	9.9	10.1	13.0	13.0	29.9	16.5	24.6	15.6	16.6	16.1
LOS by Move:	C	B	A	B	B	B	C	B	C	B	B	B
HCM2kAvgQ:	9	8	0	0	8	8	12	2	13	0	2	1

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #3 Kamakaeha Ave / Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	0.669
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	10.3
Optimal Cycle:	50	Level Of Service:	B

Street Name:	Kamakaeha Ave						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Ignore		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0 0 0 0			1 0 0 0 1			0 0 1 0 0			0 0 1 0 1		
Volume Module:												
Base Vol:	0	0	0	127	0	63	0	685	0	0	921	281
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	0	0	127	0	63	0	685	0	0	921	281
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.00
PHF Volume:	0	0	0	134	0	66	0	721	0	0	969	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	134	0	66	0	721	0	0	969	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
FinalVolume:	0	0	0	134	0	66	0	721	0	0	969	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	1.00	0.77	1.00	0.85	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00	1.00	1.00
Final Sat.:	0	0	0	1461	0	1615	0	1900	0	0	1900	1900
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.09	0.00	0.04	0.00	0.38	0.00	0.00	0.51	0.00
Crit Moves:				****							****	
Green/Cycle:	0.00	0.00	0.00	0.14	0.00	0.14	0.00	0.76	0.00	0.00	0.76	0.00
Volume/Cap:	0.00	0.00	0.00	0.67	0.00	0.30	0.00	0.50	0.00	0.00	0.67	0.00
Uniform Del:	0.0	0.0	0.0	41.0	0.0	38.8	0.0	4.5	0.0	0.0	5.7	0.0
IncremntDel:	0.0	0.0	0.0	8.4	0.0	0.8	0.0	0.3	0.0	0.0	1.2	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00	1.00	0.00
Delay/Veh:	0.0	0.0	0.0	49.4	0.0	39.6	0.0	4.8	0.0	0.0	6.9	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	0.0	0.0	49.4	0.0	39.6	0.0	4.8	0.0	0.0	6.9	0.0
LOS by Move:	A	A	A	D	A	D	A	A	A	A	A	A
HCM2kAvgQ:	0	0	0	5	0	2	0	9	0	0	15	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Henry St / Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	1.009
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	40.6
Optimal Cycle:	180	Level Of Service:	D

Street Name:	Henry St						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Prot+Permit		
Rights:	Ovl			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1	1 0	1 0	1	1 0	1 0	0 1	0	2 0	1	1 0
Volume Module:												
Base Vol:	110	430	394	88	359	210	335	416	129	870	927	93
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	110	430	394	88	359	210	335	416	129	870	927	93
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	116	453	415	93	378	221	353	438	136	916	976	98
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	116	453	415	93	378	221	353	438	136	916	976	98
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	116	453	415	93	378	221	353	438	136	916	976	98
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.29	0.88	0.88	0.14	0.90	0.90	0.95	0.96	0.96	0.92	0.94	0.94
Lanes:	1.00	1.04	0.96	1.00	1.26	0.74	1.00	0.76	0.24	2.00	1.82	0.18
Final Sat.:	552	1748	1602	275	2152	1259	1805	1398	434	3501	3235	325
Capacity Analysis Module:												
Vol/Sat:	0.21	0.26	0.26	0.34	0.18	0.18	0.20	0.31	0.31	0.26	0.30	0.30
Crit Moves:				****				****		****		
Green/Cycle:	0.33	0.33	0.59	0.33	0.33	0.33	0.22	0.31	0.31	0.34	0.34	0.34
Volume/Cap:	0.63	0.78	0.44	1.01	0.53	0.53	0.88	1.01	1.01	0.76	0.88	0.88
Uniform Del:	28.2	30.0	11.3	33.4	27.0	27.0	37.5	34.5	34.5	29.2	30.8	30.8
IncremntDel:	6.9	3.6	0.2	97.7	0.5	0.5	18.9	41.1	41.1	2.9	7.4	7.4
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	35.1	33.6	11.5	131.1	27.5	27.5	56.4	75.7	75.7	32.1	38.1	38.1
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	35.1	33.6	11.5	131.1	27.5	27.5	56.4	75.7	75.7	32.1	38.1	38.1
LOS by Move:	D	C	B	F	C	C	E	E	E	C	D	D
HCM2kAvgQ:	4	14	8	6	8	8	14	25	25	14	20	20

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #7 Ane Keohokahole/Main Gate

Cycle (sec):	100	Critical Vol./Cap.(X):	0.679
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	18.6
Optimal Cycle:	51	Level Of Service:	B

Street Name:	Ane Keohokahole Hwy						Main Gate					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	1 0	1	1 0	1 0	0	0 0	0 0	0	1 0	0 0	1
Volume Module:												
Base Vol:	0	445	413	275	338	0	0	0	0	320	0	249
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	445	413	275	338	0	0	0	0	320	0	249
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	468	435	289	356	0	0	0	0	337	0	262
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	468	435	289	356	0	0	0	0	337	0	262
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	0	468	435	289	356	0	0	0	0	337	0	262
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	0.85	0.40	1.00	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	1900	1615	760	1900	0	0	0	0	1461	0	1615
Capacity Analysis Module:												
Vol/Sat:	0.00	0.25	0.27	0.38	0.19	0.00	0.00	0.00	0.00	0.23	0.00	0.16
Crit Moves:				****						****		
Green/Cycle:	0.00	0.56	0.56	0.56	0.56	0.00	0.00	0.00	0.00	0.34	0.00	0.34
Volume/Cap:	0.00	0.44	0.48	0.68	0.33	0.00	0.00	0.00	0.00	0.68	0.00	0.48
Uniform Del:	0.0	12.8	13.2	15.6	11.9	0.0	0.0	0.0	0.0	28.4	0.0	26.1
IncremntDel:	0.0	0.3	0.4	4.4	0.2	0.0	0.0	0.0	0.0	3.8	0.0	0.7
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	13.1	13.6	20.0	12.1	0.0	0.0	0.0	0.0	32.2	0.0	26.7
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	13.1	13.6	20.0	12.1	0.0	0.0	0.0	0.0	32.2	0.0	26.7
LOS by Move:	A	B	B	B	B	A	A	A	A	C	A	C
HCM2kAvgQ:	0	8	8	8	6	0	0	0	0	10	0	7

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #8 Palihiolo St/Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	1.045
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	44.9
Optimal Cycle:	180	Level Of Service:	D

Street Name:	Palihiolo St						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Prot+Permit			Permitted		
Rights:	Include			Ovl			Include			Ignore		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 1	0 0	1	1	0 0	1 0	2	0 0	1 0	1	0 1	1 0
Volume Module:												
Base Vol:	4	19	26	2	4	611	506	752	13	49	1357	23
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	4	19	26	2	4	611	506	752	13	49	1357	23
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.00
PHF Volume:	4	20	27	2	4	643	533	792	14	52	1428	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	4	20	27	2	4	643	533	792	14	52	1428	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
FinalVolume:	4	20	27	2	4	643	533	792	14	52	1428	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.86	0.86	0.85	0.75	0.85	0.85	0.89	1.00	1.00	0.95	0.95	0.95
Lanes:	0.17	0.83	1.00	1.00	0.01	0.99	2.00	0.98	0.02	1.00	2.00	0.00
Final Sat.:	284	1350	1615	1423	11	1606	3396	1862	32	1805	3610	0
Capacity Analysis Module:												
Vol/Sat:	0.01	0.01	0.02	0.00	0.40	0.40	0.16	0.43	0.43	0.03	0.40	0.00
Crit Moves:					****		****				****	
Green/Cycle:	0.38	0.38	0.38	0.38	0.38	0.52	0.49	0.49	0.49	0.03	0.38	0.00
Volume/Cap:	0.04	0.04	0.04	0.00	1.05	0.76	0.43	0.87	0.87	0.87	1.05	0.00
Uniform Del:	19.5	19.5	19.5	19.2	31.0	18.9	15.5	22.9	22.9	48.2	31.2	0.0
IncremntDel:	0.0	0.0	0.0	0.0	51.2	4.1	0.2	9.2	9.2	73.0	39.9	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Delay/Veh:	19.5	19.5	19.6	19.2	82.2	23.0	15.7	32.0	32.0	121.2	71.1	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	19.5	19.5	19.6	19.2	82.2	23.0	15.7	32.0	32.0	121.2	71.1	0.0
LOS by Move:	B	B	B	B	F	C	B	C	C	F	E	A
HCM2kAvgQ:	0	0	1	0	29	17	6	25	25	4	33	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #10 Palani Rd / Uluaoa St

Cycle (sec):	100	Critical Vol./Cap.(X):	0.746
Loss Time (sec):	0 (Y+R=4.0 sec)	Average Delay (sec/veh):	4.8
Optimal Cycle:	57	Level Of Service:	A

Street Name:	Palani Rd						Uluaoa St					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 1	0 0	0	0 0	0 1	0	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	29	761	0	0	1056	177	71	0	32	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	29	761	0	0	1056	177	71	0	32	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	31	801	0	0	1112	186	75	0	34	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	31	801	0	0	1112	186	75	0	34	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	31	801	0	0	1112	186	75	0	34	0	0	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.93	0.93	1.00	1.00	0.98	0.98	0.79	1.00	0.85	1.00	1.00	1.00
Lanes:	0.04	0.96	0.00	0.00	0.86	0.14	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	65	1700	0	0	1596	268	1501	0	1615	0	0	0
Capacity Analysis Module:												
Vol/Sat:	0.47	0.47	0.00	0.00	0.70	0.70	0.05	0.00	0.02	0.00	0.00	0.00
Crit Moves:					****		****					
Green/Cycle:	0.93	0.93	0.00	0.00	0.93	0.93	0.07	0.00	0.07	0.00	0.00	0.00
Volume/Cap:	0.50	0.50	0.00	0.00	0.75	0.75	0.75	0.00	0.31	0.00	0.00	0.00
Uniform Del:	0.4	0.4	0.0	0.0	0.7	0.7	45.8	0.0	44.5	0.0	0.0	0.0
IncremntDel:	0.3	0.3	0.0	0.0	1.8	1.8	26.0	0.0	1.7	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	0.7	0.7	0.0	0.0	2.5	2.5	71.8	0.0	46.1	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.7	0.7	0.0	0.0	2.5	2.5	71.8	0.0	46.1	0.0	0.0	0.0
LOS by Move:	A	A	A	A	A	A	E	A	D	A	A	A
HCM2kAvgQ:	4	4	0	0	11	11	4	0	1	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #12 Ane Keohokalole Hwy / Kealakehe Pkwy

Cycle (sec):	100	Critical Vol./Cap.(X):	0.634
Loss Time (sec):	0 (Y+R=4.0 sec)	Average Delay (sec/veh):	16.1
Optimal Cycle:	39	Level Of Service:	B

Street Name:	Ane Keohokalole Hwy						Kealakehe Pkwy					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	1	1 0	0 1	0	1 0	1 1	0	1 0	1 0	1
Volume Module:												
Base Vol:	220	395	0	50	349	369	165	194	260	5	128	23
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	220	395	0	50	349	369	165	194	260	5	128	23
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	232	416	0	53	367	388	174	204	274	5	135	24
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	232	416	0	53	367	388	174	204	274	5	135	24
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	232	416	0	53	367	388	174	204	274	5	135	24
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.27	1.00	1.00	0.46	0.92	0.92	0.52	0.87	0.87	0.30	1.00	0.85
Lanes:	1.00	1.00	1.00	1.00	0.49	0.51	1.00	1.00	1.00	1.00	1.00	1.00
Final Sat.:	507	1900	1900	868	852	901	979	1650	1650	561	1900	1615
Capacity Analysis Module:												
Vol/Sat:	0.46	0.22	0.00	0.06	0.43	0.43	0.18	0.12	0.17	0.01	0.07	0.01
Crit Moves:	****						****					
Green/Cycle:	0.72	0.72	0.00	0.72	0.72	0.72	0.28	0.28	0.28	0.28	0.28	0.28
Volume/Cap:	0.63	0.30	0.00	0.08	0.60	0.60	0.63	0.44	0.59	0.03	0.25	0.05
Uniform Del:	7.2	5.0	0.0	4.2	6.9	6.9	31.5	29.6	31.1	26.2	27.9	26.3
IncremntDel:	3.6	0.1	0.0	0.1	0.8	0.8	4.8	0.3	1.2	0.1	0.3	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	10.8	5.1	0.0	4.2	7.7	7.7	36.3	29.9	32.3	26.3	28.2	26.4
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	10.8	5.1	0.0	4.2	7.7	7.7	36.3	29.9	32.3	26.3	28.2	26.4
LOS by Move:	B	A	A	A	A	A	D	C	C	C	C	C
HCM2kAvgQ:	5	5	0	1	12	12	6	6	8	0	3	1

Note: Queue reported is the number of cars per lane.

CUMULATIVE PLUS PROJECT CONDITIONS WITH MITIGATION – CONCEPT C

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #3 Kamakaeha Ave / Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	0.589
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	5.0
Optimal Cycle:	43	Level Of Service:	A

Street Name:	Kamakaeha Ave						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Ignore		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0 0 0 0			1 0 0 0 1			0 0 1 0 0			0 0 1 0 1		
Volume Module:												
Base Vol:	0	0	0	47	0	15	0	406	0	0	896	240
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	0	0	47	0	15	0	406	0	0	896	240
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.00
PHF Volume:	0	0	0	49	0	16	0	427	0	0	943	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	49	0	16	0	427	0	0	943	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
FinalVolume:	0	0	0	49	0	16	0	427	0	0	943	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	1.00	0.77	1.00	0.85	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00	1.00	1.00
Final Sat.:	0	0	0	1461	0	1615	0	1900	0	0	1900	1900
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.03	0.00	0.01	0.00	0.22	0.00	0.00	0.50	0.00
Crit Moves:				****							****	
Green/Cycle:	0.00	0.00	0.00	0.06	0.00	0.06	0.00	0.84	0.00	0.00	0.84	0.00
Volume/Cap:	0.00	0.00	0.00	0.59	0.00	0.17	0.00	0.27	0.00	0.00	0.59	0.00
Uniform Del:	0.0	0.0	0.0	46.0	0.0	44.9	0.0	1.6	0.0	0.0	2.5	0.0
IncremntDel:	0.0	0.0	0.0	10.5	0.0	0.9	0.0	0.1	0.0	0.0	0.6	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00	1.00	0.00
Delay/Veh:	0.0	0.0	0.0	56.5	0.0	45.7	0.0	1.7	0.0	0.0	3.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	0.0	0.0	56.5	0.0	45.7	0.0	1.7	0.0	0.0	3.0	0.0
LOS by Move:	A	A	A	E	A	D	A	A	A	A	A	A
HCM2kAvgQ:	0	0	0	2	0	1	0	3	0	0	10	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Henry St / Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	0.923
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	38.7
Optimal Cycle:	109	Level Of Service:	D

Street Name:	Henry St						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Prot+Permit		
Rights:	Ovl			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1	1 0	1 0	1	1 0	1 0	0 1	0	2 0	1	1 0
Volume Module:												
Base Vol:	122	408	454	124	577	338	239	185	37	947	810	90
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	122	408	454	124	577	338	239	185	37	947	810	90
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	128	429	478	131	607	356	252	195	39	997	853	95
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	128	429	478	131	607	356	252	195	39	997	853	95
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	128	429	478	131	607	356	252	195	39	997	853	95
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.17	0.87	0.87	0.19	0.90	0.90	0.95	0.98	0.98	0.92	0.94	0.94
Lanes:	1.00	1.00	1.00	1.00	1.26	0.74	1.00	0.83	0.17	2.00	1.80	0.20
Final Sat.:	316	1662	1662	356	2151	1260	1805	1544	309	3502	3200	356
Capacity Analysis Module:												
Vol/Sat:	0.41	0.26	0.29	0.37	0.28	0.28	0.14	0.13	0.13	0.28	0.27	0.27
Crit Moves:	****						****			****		
Green/Cycle:	0.45	0.45	0.76	0.45	0.45	0.45	0.16	0.14	0.14	0.30	0.30	0.30
Volume/Cap:	0.91	0.58	0.38	0.82	0.63	0.63	0.90	0.91	0.91	0.95	0.90	0.90
Uniform Del:	25.7	20.6	4.0	24.1	21.3	21.3	41.4	42.4	42.4	34.6	33.7	33.7
IncremntDel:	49.0	0.5	0.1	27.4	0.9	0.9	28.8	32.8	32.8	16.6	10.2	10.2
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	74.7	21.1	4.1	51.5	22.1	22.1	70.2	75.3	75.3	51.2	43.8	43.8
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	74.7	21.1	4.1	51.5	22.1	22.1	70.2	75.3	75.3	51.2	43.8	43.8
LOS by Move:	E	C	A	D	C	C	E	E	E	D	D	D
HCM2kAvgQ:	7	11	5	6	12	12	11	11	11	20	18	18

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #7 Ane Keohokahole/Main Gate

Cycle (sec):	100	Critical Vol./Cap.(X):	0.718
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	22.4
Optimal Cycle:	57	Level Of Service:	C

Street Name:	Ane Keohokahole Hwy						Main Gate					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0 1	0 1		1 0 1	0 0		0 0 0	0 0		1 0 0	0 1	
Volume Module:												
Base Vol:	0	447	291	194	620	0	0	0	0	420	0	327
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	447	291	194	620	0	0	0	0	420	0	327
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	471	306	204	653	0	0	0	0	442	0	344
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	471	306	204	653	0	0	0	0	442	0	344
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	0	471	306	204	653	0	0	0	0	442	0	344
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	0.85	0.35	1.00	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	1900	1615	669	1900	0	0	0	0	1461	0	1615
Capacity Analysis Module:												
Vol/Sat:	0.00	0.25	0.19	0.31	0.34	0.00	0.00	0.00	0.00	0.30	0.00	0.21
Crit Moves:					****					****		
Green/Cycle:	0.00	0.48	0.48	0.48	0.48	0.00	0.00	0.00	0.00	0.42	0.00	0.42
Volume/Cap:	0.00	0.52	0.40	0.64	0.72	0.00	0.00	0.00	0.00	0.72	0.00	0.51
Uniform Del:	0.0	18.1	16.8	19.6	20.7	0.0	0.0	0.0	0.0	24.0	0.0	21.3
IncremntDel:	0.0	0.5	0.3	4.3	2.8	0.0	0.0	0.0	0.0	4.1	0.0	0.6
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	18.6	17.1	23.8	23.5	0.0	0.0	0.0	0.0	28.1	0.0	21.9
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	18.6	17.1	23.8	23.5	0.0	0.0	0.0	0.0	28.1	0.0	21.9
LOS by Move:	A	B	B	C	C	A	A	A	A	C	A	C
HCM2kAvgQ:	0	10	6	6	17	0	0	0	0	12	0	8

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #8 Palihiolo St/Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	0.983
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	33.3
Optimal Cycle:	174	Level Of Service:	C

Street Name:	Palihiolo St						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Prot+Permit			Permitted		
Rights:	Include			Ovl			Include			Ignore		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 1	0 0	1	1	0 0	1 0	2	0 0	1 0	1	0 1	1 0
Volume Module:												
Base Vol:	5	20	32	10	15	553	438	569	6	20	1319	56
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	5	20	32	10	15	553	438	569	6	20	1319	56
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.00
PHF Volume:	5	21	34	11	16	582	461	599	6	21	1388	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	5	21	34	11	16	582	461	599	6	21	1388	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
FinalVolume:	5	21	34	11	16	582	461	599	6	21	1388	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.90	0.90	0.85	0.75	0.85	0.85	0.92	1.00	1.00	0.95	0.95	0.95
Lanes:	0.20	0.80	1.00	1.00	0.03	0.97	2.00	0.99	0.01	1.00	2.00	0.00
Final Sat.:	341	1363	1615	1419	43	1580	3502	1878	20	1805	3610	0
Capacity Analysis Module:												
Vol/Sat:	0.02	0.02	0.02	0.01	0.37	0.37	0.13	0.32	0.32	0.01	0.38	0.00
Crit Moves:					****		****				****	
Green/Cycle:	0.37	0.37	0.37	0.37	0.37	0.51	0.51	0.51	0.51	0.02	0.39	0.00
Volume/Cap:	0.04	0.04	0.06	0.02	0.98	0.72	0.36	0.63	0.63	0.63	0.98	0.00
Uniform Del:	19.8	19.8	20.0	19.7	30.9	19.1	14.0	17.9	17.9	48.7	30.1	0.0
IncremntDel:	0.0	0.0	0.0	0.0	32.1	3.2	0.2	1.3	1.3	32.6	19.9	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Delay/Veh:	19.9	19.9	20.0	19.7	63.0	22.3	14.2	19.2	19.2	81.4	50.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	19.9	19.9	20.0	19.7	63.0	22.3	14.2	19.2	19.2	81.4	50.0	0.0
LOS by Move:	B	B	B	B	E	C	B	B	B	F	D	A
HCM2kAvgQ:	1	1	1	0	24	15	5	14	14	2	29	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #10 Palani Rd / Uluaoa St

Cycle (sec):	100	Critical Vol./Cap.(X):	0.758
Loss Time (sec):	0 (Y+R=4.0 sec)	Average Delay (sec/veh):	13.8
Optimal Cycle:	60	Level Of Service:	B

Street Name:	Palani Rd						Uluaoa St					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 1	0 0	0	0 0	0 1	0	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	58	515	0	0	788	311	176	0	200	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	58	515	0	0	788	311	176	0	200	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	61	542	0	0	829	327	185	0	211	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	61	542	0	0	829	327	185	0	211	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	61	542	0	0	829	327	185	0	211	0	0	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.82	0.82	1.00	1.00	0.96	0.96	0.78	1.00	0.85	1.00	1.00	1.00
Lanes:	0.10	0.90	0.00	0.00	0.72	0.28	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	158	1402	0	0	1311	517	1480	0	1615	0	0	0
Capacity Analysis Module:												
Vol/Sat:	0.39	0.39	0.00	0.00	0.63	0.63	0.13	0.00	0.13	0.00	0.00	0.00
Crit Moves:					****		****					
Green/Cycle:	0.83	0.83	0.00	0.00	0.83	0.83	0.17	0.00	0.17	0.00	0.00	0.00
Volume/Cap:	0.46	0.46	0.00	0.00	0.76	0.76	0.76	0.00	0.79	0.00	0.00	0.00
Uniform Del:	2.2	2.2	0.0	0.0	3.7	3.7	39.8	0.0	40.1	0.0	0.0	0.0
IncremntDel:	0.3	0.3	0.0	0.0	2.3	2.3	12.8	0.0	14.6	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	2.5	2.5	0.0	0.0	6.0	6.0	52.7	0.0	54.7	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	2.5	2.5	0.0	0.0	6.0	6.0	52.7	0.0	54.7	0.0	0.0	0.0
LOS by Move:	A	A	A	A	A	A	D	A	D	A	A	A
HCM2kAvgQ:	5	5	0	0	17	17	7	0	8	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #12 Ane Keohokalole Hwy / Kealakehe Pkwy

Cycle (sec):	100	Critical Vol./Cap.(X):	0.779
Loss Time (sec):	0 (Y+R=4.0 sec)	Average Delay (sec/veh):	20.6
Optimal Cycle:	65	Level Of Service:	C

Street Name:	Ane Keohokalole Hwy						Kealakehe Pkwy					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	1	1 0	0 1	0	1 0	1 1	0	1 0	1 0	1
Volume Module:												
Base Vol:	311	460	3	12	360	45	369	94	452	2	115	50
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	311	460	3	12	360	45	369	94	452	2	115	50
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	327	484	3	13	379	47	388	99	476	2	121	53
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	327	484	3	13	379	47	388	99	476	2	121	53
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	327	484	3	13	379	47	388	99	476	2	121	53
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.39	1.00	0.85	0.35	0.98	0.98	0.60	0.83	0.83	0.33	1.00	0.85
Lanes:	1.00	1.00	1.00	1.00	0.89	0.11	1.00	1.00	1.00	1.00	1.00	1.00
Final Sat.:	743	1900	1615	659	1660	208	1148	1581	1581	635	1900	1615
Capacity Analysis Module:												
Vol/Sat:	0.44	0.25	0.00	0.02	0.23	0.23	0.34	0.06	0.30	0.00	0.06	0.03
Crit Moves:	****						****					
Green/Cycle:	0.57	0.57	0.57	0.57	0.57	0.57	0.43	0.43	0.43	0.43	0.43	0.43
Volume/Cap:	0.78	0.45	0.00	0.03	0.40	0.40	0.78	0.14	0.69	0.01	0.15	0.08
Uniform Del:	16.9	12.7	9.5	9.6	12.2	12.2	24.2	17.1	22.9	16.0	17.1	16.5
IncremntDel:	9.0	0.3	0.0	0.0	0.3	0.3	7.7	0.0	2.5	0.0	0.1	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	25.9	13.0	9.5	9.7	12.5	12.5	31.9	17.1	25.4	16.1	17.2	16.6
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	25.9	13.0	9.5	9.7	12.5	12.5	31.9	17.1	25.4	16.1	17.2	16.6
LOS by Move:	C	B	A	A	B	B	C	B	C	B	B	B
HCM2kAvgQ:	10	9	0	0	7	7	12	2	13	0	2	1

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #3 Kamakaeha Ave / Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	0.670
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	10.3
Optimal Cycle:	50	Level Of Service:	B

Street Name:	Kamakaeha Ave						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Ignore		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0 0 0 0			1 0 0 0 1			0 0 1 0 0			0 0 1 0 1		
Volume Module:												
Base Vol:	0	0	0	127	0	63	0	695	0	0	923	281
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	0	0	127	0	63	0	695	0	0	923	281
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.00
PHF Volume:	0	0	0	134	0	66	0	732	0	0	972	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	134	0	66	0	732	0	0	972	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
FinalVolume:	0	0	0	134	0	66	0	732	0	0	972	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	1.00	0.77	1.00	0.85	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00	1.00	1.00
Final Sat.:	0	0	0	1461	0	1615	0	1900	0	0	1900	1900
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.09	0.00	0.04	0.00	0.39	0.00	0.00	0.51	0.00
Crit Moves:				****							****	
Green/Cycle:	0.00	0.00	0.00	0.14	0.00	0.14	0.00	0.76	0.00	0.00	0.76	0.00
Volume/Cap:	0.00	0.00	0.00	0.67	0.00	0.30	0.00	0.50	0.00	0.00	0.67	0.00
Uniform Del:	0.0	0.0	0.0	41.0	0.0	38.9	0.0	4.6	0.0	0.0	5.7	0.0
IncremntDel:	0.0	0.0	0.0	8.5	0.0	0.8	0.0	0.3	0.0	0.0	1.2	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00	1.00	0.00
Delay/Veh:	0.0	0.0	0.0	49.5	0.0	39.6	0.0	4.8	0.0	0.0	7.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	0.0	0.0	49.5	0.0	39.6	0.0	4.8	0.0	0.0	7.0	0.0
LOS by Move:	A	A	A	D	A	D	A	A	A	A	A	A
HCM2kAvgQ:	0	0	0	5	0	2	0	9	0	0	15	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #4 Henry St / Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	1.014
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	41.6
Optimal Cycle:	180	Level Of Service:	D

Street Name:	Henry St						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Prot+Permit		
Rights:	Ovl			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 1	0	1 0	1 1	0	1 0	0 1	0	2 0	1 1	0
Volume Module:												
Base Vol:	110	445	394	89	362	212	345	416	129	870	927	93
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	110	445	394	89	362	212	345	416	129	870	927	93
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	116	468	415	94	381	223	363	438	136	916	976	98
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	116	468	415	94	381	223	363	438	136	916	976	98
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	116	468	415	94	381	223	363	438	136	916	976	98
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.29	0.88	0.88	0.14	0.90	0.90	0.95	0.96	0.96	0.92	0.94	0.94
Lanes:	1.00	1.06	0.94	1.00	1.26	0.74	1.00	0.76	0.24	2.00	1.82	0.18
Final Sat.:	554	1781	1577	273	2151	1260	1805	1398	434	3503	3235	325
Capacity Analysis Module:												
Vol/Sat:	0.21	0.26	0.26	0.34	0.18	0.18	0.20	0.31	0.31	0.26	0.30	0.30
Crit Moves:				****				****		****		
Green/Cycle:	0.34	0.34	0.59	0.34	0.34	0.34	0.23	0.31	0.31	0.34	0.34	0.34
Volume/Cap:	0.62	0.78	0.44	1.02	0.53	0.53	0.89	1.02	1.02	0.77	0.89	0.89
Uniform Del:	27.8	29.9	11.2	33.2	26.7	26.7	37.6	34.6	34.6	29.8	31.4	31.4
IncremntDel:	6.3	3.6	0.2	99.5	0.5	0.5	21.2	43.2	43.2	3.1	8.7	8.7
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	34.1	33.4	11.4	132.7	27.2	27.2	58.7	77.8	77.8	33.0	40.1	40.1
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	34.1	33.4	11.4	132.7	27.2	27.2	58.7	77.8	77.8	33.0	40.1	40.1
LOS by Move:	C	C	B	F	C	C	E	E	E	C	D	D
HCM2kAvgQ:	4	15	8	6	8	8	14	25	25	15	20	20

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #7 Ane Keohokahole/Main Gate

Cycle (sec):	100	Critical Vol./Cap.(X):	0.706
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	18.9
Optimal Cycle:	55	Level Of Service:	B

Street Name:	Ane Keohokahole Hwy						Main Gate					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	1 0	1	1 0	1 0	0	0 0	0 0	0	1 0	0 0	1
Volume Module:												
Base Vol:	0	445	438	292	338	0	0	0	0	325	0	253
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	445	438	292	338	0	0	0	0	325	0	253
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	468	461	307	356	0	0	0	0	342	0	266
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	468	461	307	356	0	0	0	0	342	0	266
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	0	468	461	307	356	0	0	0	0	342	0	266
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	0.85	0.40	1.00	1.00	1.00	1.00	1.00	0.77	1.00	0.85
Lanes:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Final Sat.:	0	1900	1615	766	1900	0	0	0	0	1461	0	1615
Capacity Analysis Module:												
Vol/Sat:	0.00	0.25	0.29	0.40	0.19	0.00	0.00	0.00	0.00	0.23	0.00	0.16
Crit Moves:				****						****		
Green/Cycle:	0.00	0.57	0.57	0.57	0.57	0.00	0.00	0.00	0.00	0.33	0.00	0.33
Volume/Cap:	0.00	0.43	0.50	0.71	0.33	0.00	0.00	0.00	0.00	0.71	0.00	0.50
Uniform Del:	0.0	12.4	13.0	15.6	11.5	0.0	0.0	0.0	0.0	29.2	0.0	26.8
IncremntDel:	0.0	0.3	0.4	5.2	0.2	0.0	0.0	0.0	0.0	4.7	0.0	0.7
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Delay/Veh:	0.0	12.6	13.5	20.8	11.6	0.0	0.0	0.0	0.0	33.9	0.0	27.5
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	12.6	13.5	20.8	11.6	0.0	0.0	0.0	0.0	33.9	0.0	27.5
LOS by Move:	A	B	B	C	B	A	A	A	A	C	A	C
HCM2kAvgQ:	0	8	9	8	6	0	0	0	0	10	0	7

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #8 Palihiolo St/Palani Rd

Cycle (sec):	100	Critical Vol./Cap.(X):	1.048
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	45.6
Optimal Cycle:	180	Level Of Service:	D

Street Name:	Palihiolo St						Palani Rd					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Prot+Permit			Permitted		
Rights:	Include			Ovl			Include			Ignore		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 1	0 0	1	1	0 0	1 0	2	0 0	1 0	1	0 1	1 0
Volume Module:												
Base Vol:	4	19	26	2	4	614	506	753	13	49	1362	23
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	4	19	26	2	4	614	506	753	13	49	1362	23
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.00
PHF Volume:	4	20	27	2	4	646	533	793	14	52	1434	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	4	20	27	2	4	646	533	793	14	52	1434	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
FinalVolume:	4	20	27	2	4	646	533	793	14	52	1434	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.85	0.85	0.85	0.75	0.85	0.85	0.89	1.00	1.00	0.95	0.95	0.95
Lanes:	0.17	0.83	1.00	1.00	0.01	0.99	2.00	0.98	0.02	1.00	2.00	0.00
Final Sat.:	282	1340	1615	1423	10	1606	3389	1862	32	1805	3610	0
Capacity Analysis Module:												
Vol/Sat:	0.01	0.01	0.02	0.00	0.40	0.40	0.16	0.43	0.43	0.03	0.40	0.00
Crit Moves:					****		****				****	
Green/Cycle:	0.38	0.38	0.38	0.38	0.38	0.52	0.49	0.49	0.49	0.03	0.38	0.00
Volume/Cap:	0.04	0.04	0.04	0.00	1.06	0.77	0.43	0.87	0.87	0.87	1.06	0.00
Uniform Del:	19.5	19.5	19.5	19.2	31.0	18.9	15.5	22.9	22.9	48.2	31.2	0.0
IncremntDel:	0.0	0.0	0.0	0.0	52.4	4.3	0.2	9.3	9.3	73.7	41.1	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Delay/Veh:	19.5	19.5	19.5	19.2	83.3	23.2	15.8	32.2	32.2	121.8	72.4	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	19.5	19.5	19.5	19.2	83.3	23.2	15.8	32.2	32.2	121.8	72.4	0.0
LOS by Move:	B	B	B	B	F	C	B	C	C	F	E	A
HCM2kAvgQ:	0	0	1	0	30	17	6	25	25	4	34	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #10 Palani Rd / Uluaoa St

Cycle (sec):	100	Critical Vol./Cap.(X):	0.749
Loss Time (sec):	0 (Y+R=4.0 sec)	Average Delay (sec/veh):	4.9
Optimal Cycle:	57	Level Of Service:	A

Street Name:	Palani Rd						Uluaoa St					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 1	0 0	0	0 0	0 1	0	1 0	0 0	1	0 0	0 0	0
Volume Module:												
Base Vol:	29	762	0	0	1061	177	71	0	32	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	29	762	0	0	1061	177	71	0	32	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	31	802	0	0	1117	186	75	0	34	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	31	802	0	0	1117	186	75	0	34	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	31	802	0	0	1117	186	75	0	34	0	0	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.93	0.93	1.00	1.00	0.98	0.98	0.79	1.00	0.85	1.00	1.00	1.00
Lanes:	0.04	0.96	0.00	0.00	0.86	0.14	1.00	0.00	1.00	0.00	0.00	0.00
Final Sat.:	65	1699	0	0	1597	266	1501	0	1615	0	0	0
Capacity Analysis Module:												
Vol/Sat:	0.47	0.47	0.00	0.00	0.70	0.70	0.05	0.00	0.02	0.00	0.00	0.00
Crit Moves:					****		****					
Green/Cycle:	0.93	0.93	0.00	0.00	0.93	0.93	0.07	0.00	0.07	0.00	0.00	0.00
Volume/Cap:	0.51	0.51	0.00	0.00	0.75	0.75	0.75	0.00	0.31	0.00	0.00	0.00
Uniform Del:	0.4	0.4	0.0	0.0	0.7	0.7	45.9	0.0	44.5	0.0	0.0	0.0
IncremntDel:	0.3	0.3	0.0	0.0	1.8	1.8	26.5	0.0	1.7	0.0	0.0	0.0
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00
Delay/Veh:	0.7	0.7	0.0	0.0	2.6	2.6	72.4	0.0	46.2	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.7	0.7	0.0	0.0	2.6	2.6	72.4	0.0	46.2	0.0	0.0	0.0
LOS by Move:	A	A	A	A	A	A	E	A	D	A	A	A
HCM2kAvgQ:	4	4	0	0	11	11	4	0	1	0	0	0

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #12 Ane Keohokalole Hwy / Kealakehe Pkwy

Cycle (sec):	100	Critical Vol./Cap.(X):	0.640
Loss Time (sec):	0 (Y+R=4.0 sec)	Average Delay (sec/veh):	16.3
Optimal Cycle:	40	Level Of Service:	B

Street Name:	Ane Keohokalole Hwy						Kealakehe Pkwy					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	1	1 0	0 1	0	1 0	1 1	0	1 0	1 0	1
Volume Module:												
Base Vol:	222	396	0	50	354	369	165	194	271	5	128	23
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	222	396	0	50	354	369	165	194	271	5	128	23
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	234	417	0	53	373	388	174	204	285	5	135	24
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	234	417	0	53	373	388	174	204	285	5	135	24
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	234	417	0	53	373	388	174	204	285	5	135	24
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.27	1.00	1.00	0.46	0.92	0.92	0.51	0.87	0.87	0.28	1.00	0.85
Lanes:	1.00	1.00	1.00	1.00	0.49	0.51	1.00	1.00	1.00	1.00	1.00	1.00
Final Sat.:	505	1900	1900	868	860	896	977	1648	1648	542	1900	1615
Capacity Analysis Module:												
Vol/Sat:	0.46	0.22	0.00	0.06	0.43	0.43	0.18	0.12	0.17	0.01	0.07	0.01
Crit Moves:	****						****					
Green/Cycle:	0.72	0.72	0.00	0.72	0.72	0.72	0.28	0.28	0.28	0.28	0.28	0.28
Volume/Cap:	0.64	0.30	0.00	0.08	0.60	0.60	0.64	0.45	0.62	0.03	0.26	0.05
Uniform Del:	7.2	4.9	0.0	4.1	6.8	6.8	31.7	29.8	31.5	26.3	28.1	26.5
IncremntDel:	3.8	0.1	0.0	0.1	0.8	0.8	5.1	0.3	1.6	0.1	0.3	0.1
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	11.0	5.1	0.0	4.2	7.6	7.6	36.8	30.1	33.1	26.4	28.3	26.5
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	11.0	5.1	0.0	4.2	7.6	7.6	36.8	30.1	33.1	26.4	28.3	26.5
LOS by Move:	B	A	A	A	A	A	D	C	C	C	C	C
HCM2kAvgQ:	5	5	0	1	12	12	6	6	9	0	3	1

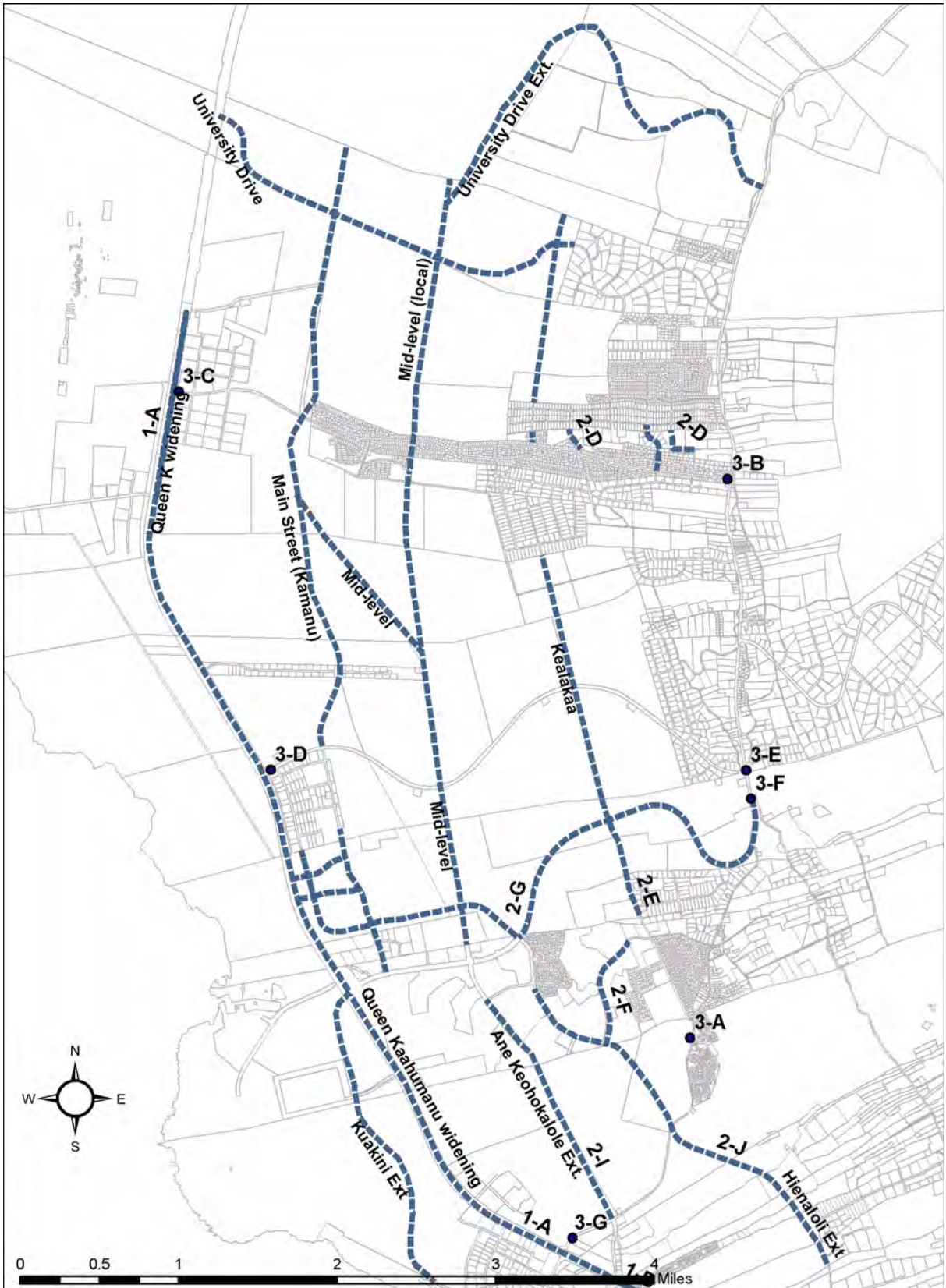
Note: Queue reported is the number of cars per lane.

APPENDIX D

EXCERPTS FROM

KEAHOLE TO HONAUNAU REGIONAL CIRCULATION PLAN
COUNTY ACTION PLAN
(County of Hawaii Planning Department, August 14, 2006)

FIGURE 4. Projects Map-- North of Palani Road



- Funding/Status: private

1-A Kuakini Highway improvements. The purpose of this improvement is to widen this road from 2 to 4 lanes to improve the traffic flow in downtown Kailua-Kona, as well as add sidewalks and bicycle lanes. The project will be done in two phases: Phase I (Palani to Hualalai) and Phase II (Hualalai to Alii Parkway). Eventually, there will be a Phase III widening from Alii Parkway to the Hawaii Belt Road.

- Lead Responsible: Department of Public Works
- Funding/Status

•Phase I :

Planning/Design: Completed.

Construction: STIP 2004-06 80% federal-aid ($10.4M) and 20% County CIP ($2.6M). Construction underway with estimated completion in October 2006.

•Phase II:

Planning: STIP 2004-06 ($0.33M total, $0.24M Federal, $0.306M County). Underway.

Design: STIP 2004-06 $0.5M County

Construction: Estimated $5M, not programmed

4.1.2 Strategy #2: Improve connectivity with a road network that spreads the traffic rather than funneling all the traffic to the major arterials.

2-A Lako Street Extension. The extension of Lako Street would provide a mauka-makai connection from Kuakini Highway to Alii Highway to Alii Drive. Lako Street will serve as the northern terminus of the Alii Highway Southern Phase.

- Lead Responsible: County Department of Public Works
- Funding/Status

•Planning: EA completed, but stuck in litigation

•Design/ROW: CIP appropriated, but cannot start until litigation resolved

•Construction: CIP appropriated

2-B Lako Street Mauka Connection. Mauka of Kuakini Highway, a private developer is constructing a connection of Lako Street to complete a continuous route from Kuakini to Hualalai.

- Lead Responsible: Private developer
- Funding/Status

•Planning/Design/ROW: Completed; privately funded

•Construction: Privately funded. Estimated completion is September 2006.

2-C Laaloa Avenue Extension. The extension of Laaloa Avenue would provide another mauka-makai connection from Kuakini Highway to Alii Highway to Alii Drive. Besides improving overall traffic circulation, these mauka-makai connectors provide alternative evacuation routes from coastal areas. A private developer is funding the preliminary engineering and EA in satisfaction of rezoning and SMA permit conditions.

- Lead Responsible: County Department of Public Works
- Funding/Status

•Planning: Private developer

•Design/ROW/Construction: County CIP appropriated ($3.6 million), with County commitment for additional funding as needed to complete construction

2-D Kalaoa Connector Roads. Between two major subdivisions in Kalaoa (Kona Palisades and Coastview), internal roads extend to the subdivision boundaries in anticipation of connection, but have never been connected, thereby forcing traffic onto Mamalahoa Highway. Through a combination of private development and County action, four connections will be established to Kaiminani Drive: Nana-Holoholo, Ahiahi-Kauhale, Holu-Keokeo, and Iliili-Kiekie.

- Lead Responsible: County Department of Public Works
- Funding/Status

•Planning/ROW: Condemnation is necessary for Ahiahi-Kauhale, Holu-Keokeo, and Iliili-Kiekie. Appraisals and title reports have been completed. Awaiting resolution of condemnation issues. Fair share contribution funds are being used to fund this phase.

•Design/ROW/Construction: Nana/Holoholo has been completed by a private developer, dedicated to the County, and opened. Appropriated $0.5 million CIP funds to design and construct Ahiahi-Kauhale. Holu-Keokeo is an existing road that meets County standards. A private developer will construct Iliili-Kiekie.

2-E Kealakaa Street Extension. The extension of Kealakaa Street would connect to Kealakehe Parkway (as extended, see 2-G below), Hina Lani Street, and Holoholo Street thereby providing an essential link to the Kealakehe elementary, middle, and high school without having to use the main highways (Mamalahoa, Palani, and Queen Kaahumanu).

- Lead Responsible: Planning Department (planning phase)
- Funding/Status

•Planning: The Planning Department has been holding meetings with the affected landowners to determine available information, potential alternative alignments, and issues. The Planning Department will procure a consultant for project coordination and environmental studies. CIP funds have been appropriated ($1.5 million).

•Design/ROW: Funding sources to be determined upon negotiations with affected landowners.

•Construction: Funding sources to be determined upon negotiations with affected landowners.

2-F Keanalehu/Manawalea Street Extension. The connection of Manawalea to Keanalehu would provide another link between the Kealakehe elementary, middle and high schools for the residents of Laiopua and Kealakehe (in the vicinity of the elementary and middle schools). These roads are nearly "construction-ready" since the EIS has been completed, and the design is almost complete. The County will advance the funds and DHHL will reimburse the County its proportionate share.

- Lead Responsible: County Department of Public Works (with Department of Hawaiian Home Lands)
- Funding/Status

•Planning: Completed.

•Design/ROW/Construction: Design is 80% complete, with estimated bid date of February 2007. DHHL will convey (by license) the rights-of-way to the County. The County will use appropriated CIP funds to complete design ($0.5 million).

•Construction: The County has appropriated $7.6M.

2-G Kealakehe Parkway Extension (to Kealakaa). Kealakehe Parkway, a State road, currently dead-ends just mauka of Kealakehe High School. The connection of the parkway to the extended Kealakaa Street would complete a vital link to enable traffic to flow from Hina Lani to Queen Kaahumanu.

- Lead Responsible: DOT
- Funding/Status

  •Planning: The EIS has been completed.

  •Design/ROW: 2006-08 STIP HS-20, Design ($0.5 million), Right-of-Way ($1 million)

  •Construction: Not programmed.

2-H Kamanu Street Extension. Kamanu Street currently dead-ends in Kaloko Industrial Park just mauka of Costco. This project will extend Kamanu to connect with Kealakehe Parkway. As a north-south road parallel to Queen Kaahumanu Highway, Kamanu Street will partially relieve Queen Kaahumanu of some traffic for that segment.

- Lead Responsible: County Department of Public Works
- Funding/Status

  •Planning: EIS complete (by private landowner)

  •Design/ROW: Currently underway by private developer as fulfillment of rezoning condition

  •Construction: County will advance funds with proportionate reimbursement by landowner. Appropriated CIP funds available ($3 million), with County commitment to supplement as necessary.

2-I Ane Keohokalole Extension (aka Henry Street Extension or Mid-Level Road). This project will extend Henry Street from Palani Road to the existing terminus of Ane Keohokalole makai of Kealakehe High School. The 2006 State legislature appropriated $6 million for this project. Once constructed, this road will enable someone to drive from Kailua Village to the Kaloko Industrial Park via Henry Street and the Kamanu Street Extension, without having to drive on Queen Kaahumanu Highway.

- Lead Responsible: Planning Department (planning phase), Department of Public Works (design and construction)
- Funding/Status

  •Planning/Design/ROW: $6M State CIP funds appropriated.

  •Construction: Not programmed.

2-J Hienaloli Street Extension. This project will extend Hienaloli Street to connect with Palani Road. At the intersection with Palani, the motorist will have a choice to turn onto Palani or to continue straight through onto the extended Keanalehu Street. Keanalehu Street will eventually connect with the planned Mid-Level Road. The ultimate plan is to enable residents in the area mauka of Kuakini and south of Palani to access Palani Road, Kealakehe High School, Kaloko Industrial Park, and eventually the West Hawaii University campus and the airport without having to load onto Kuakini or Queen Kaahumanu.

- Lead Responsible: Planning Department (planning phase)
- Funding/Status

  •Planning: CIP funds appropriated (($1.7 million) for preliminary engineering and environmental studies.

  •Design/ROW: Not programmed.

  •Construction: Not programmed.

2-K Nani Kailua Extension. The existing makai terminus of Nani Kailua Drive is Hualalai Road. There are two segments to extend this road to Alii Drive: Hualalai to Kuakini, (mauka segment), and Hualalai to Alii Drive (makai segment). The proposed extension would connect Nani Kailua to Alii Drive to provide another mauka-makai route closer to Kailua Village. The initial priority is to construct the makai segment.

- Lead Responsible: Planning Department (planning phase); DPW (makai segment design and construction phases)
- Funding/Status

  •Planning/ROW/Design: CIP-appropriated funds ($1.5 million) (makai segment)

  •Construction: Construction funding to be determined among County and private parties.

2-L Puapuanui Street. This road is entirely privately funded and will provide a more direct mauka-makai connector (compared to Hualalai) from the mauka segments of Hualalai Road to Queen Kaahumanu through the Pualani Estates subdivision. A traffic signal at that intersection will enable crossing Queen Kaahumanu through a proposed commercial area to connect with Kuakini.

- Lead Responsible: Private
- Funding/Status

  •Planning/Design/Construction: Private. Mauka segment from Queen Kaahumanu to Hualalai nearly complete.

4.1.3 Strategy #3: Use existing roadways more efficiently by improving traffic flow and turning movements.

3-A Palani Street Safety Improvments. This project will realign Kealakaa to intersect Palani Road at Palihiolo Street to create a new and safer signalized intersection.

- Lead Responsible: County Department of Public Works
- Funding/Status

  •Planning/Design/Construction: CIP funds ($1 million) with federal matching ($4 million); EA and design nearly complete. Estimated construction start is March 2007.

3-B Kaiminani right turn lane to Mamalahoa Highway. The right turn lane improvements will increase the capacity of that intersection.

- Lead Responsible: County Department of Public Works
- Funding/Status

  •Planning/Design/Construction: Design and construction inhouse by DPW staff. Awaiting utility relocation by HELCO and Oceanic to complete construction, with estimated completion in June 2007.

3-C Kaiminani right turn lane to Queen Kaahumanu Highway

- Lead Responsible: County Department of Public Works
- Funding/Status

  •Planning/Design/Construction: Design completed inhouse by DPW staff. CIP funds of $0.4 million appropriated for construction.

3-D Hina Lani right turn lane to Queen Kaahumanu Highway. This improvement will increase the capacity of this intersection.

- Lead Responsible: County Department of Public Works
- Funding/Status

  •Planning/Design/Construction: Design and construction completed inhouse by DPW staff.

3-E Traffic signal at Hina Lani/Mamalahoa. This traffic signal will improve the safety of left turns at this intersection.

- Lead Responsible: County Department of Public Works
- Funding/Status

  •Planning/Design/Construction: Design completed inhouse by DPW staff. CIP funds of $0.3 million appropriated for construction. Construction completed in June 2006.

3-F Palani Junction left turn pocket to Mamalahoa Highway. This project will provide capacity improvements by allowing makai-bound traffic to flow more efficiently through this intersection.

- Lead Responsible: County Department of Public Works
- Funding/Status

  •Planning/Design/Construction: Design completed inhouse by DPW staff. CIP funds of $1 million appropriated for construction. Estimated completion by November 2006.

3-G Palani left turn pocket to Kamakaeha. This project will provide capacity improvements to mauka-bound traffic on Palani Road.

- Lead Responsible: County Department of Public Works
- Funding/Status

  •Planning/Design/Construction: Design completed inhouse by DPW staff. CIP funds of $1 million appropriated for construction. Estimated construction start by January 2007 and estimated completion by January 2008.

3-H Mamalahoa Highway, Honalo to Captain Cook. The County will consult and work closely with the community to develop workable solutions. Suggested improvements to date include left turn pockets, peak-period onstreet parking restrictions, designated bus stop pull-outs, County parking lot, coordination of traffic signal timing, park & ride facility, and roundabouts.

- Lead Responsible: County Department of Public Works
- Funding/Status

  •Planning/Design/Construction: CIP funds of $12 million appropriated for design, right-of-way acquisition, and construction.

APPENDIX E

SIGNAL WARRANT ANALYSIS

TRAFFIC SIGNAL WARRANTS
FOUR HOUR VEHICULAR VOLUME (MUTCD Warrant 2, Caltrans Warrant 9)
PEAK HOUR VEHICULAR VOLUME (MUTCD Warrant 3, Caltrans Warrant 11)

Major Street: Palani Road
Minor Street: Kamakaeha Avenue
Scenario: FUTURE(CUM+PROJ: CONCEPT A) WEEKDAY - P.M. PEAK HOUR (2020)
Urban/Rural: u (U=urban, R=rural [a])

FOUR HOUR VOLUME (MUTCD Warrant 2, Caltrans Warrant 9)

Number of Lanes on Each Approach

Major Street:	1
Minor Street:	2

Vehicles Per Hour (4th Highest Hour)

Major Street (Approach 1):	760	Major Street Left Turn (see note [b]):	0
Major Street (Approach 2):	525	Minor Street (Higher Volume App.):	162
Major Street Total (Both Approaches):	1,285	Minor Street Total:	162
Minimum Volume on Major Street to Satisfy Warrant (see note [c]):	390	Minimum Volume on Minor Street to Satisfy Warrant (see note [c]):	115

FOUR HOUR VOLUME WARRANT SATISFIED? **YES**

PEAK HOUR VOLUME (MUTCD Warrant 3, Caltrans Warrant 11)

Number of Lanes on Each Approach

Major Street:	1
Minor Street:	2

Vehicles Per Hour (Peak Hour)

Major Street (Approach 1):	894	Major Street Left Turn (see note [b]):	0
Major Street (Approach 2):	618	Minor Street (Higher Volume App.):	190
Major Street Total (Both Approaches):	1,512	Minor Street Total:	190
Minimum Volume on Major Street to Satisfy Warrant (see note [d]):	510	Minimum Volume on Minor Street to Satisfy Warrant (see note [d]):	150

PEAK HOUR VOLUME WARRANT SATISFIED? **YES**

Notes:

a. May be used when the major-street speed exceeds 40 mph or in an isolated community with a population of less than 10,000.

b. Heavier left-turn movement from the major street may be included with minor street volume if a separate signal phase is proposed for left-turn movements.

c. From: USDOT, FHWA, "Manual on Uniform Traffic Control Devices," 2001, Figure 4C-1.

d. From: USDOT, FHWA, "Manual on Uniform Traffic Control Devices," 2001, Figure 4C-3.

Adopted from: U.S. Department of Transportation, Federal Highway Administration, "Manual on Uniform Traffic Control Devices, Millennium Edition," 2001; and Caltrans, "Traffic Manual," 2002.

TRAFFIC SIGNAL WARRANTS
FOUR HOUR VEHICULAR VOLUME (MUTCD Warrant 2, Caltrans Warrant 9)
PEAK HOUR VEHICULAR VOLUME (MUTCD Warrant 3, Caltrans Warrant 11)

Major Street: ANE KEOHOKALOLE HIGHWAY
Minor Street: MAJOR SITE ACCESSS ROAD
Scenario: FUTURE(CUM+PROJ: CONCEPT A) WEEKDAY - A.M. PEAK HOUR (2020)
Urban/Rural: U (U=urban, R=rural [a])

FOUR HOUR VOLUME (MUTCD Warrant 2, Caltrans Warrant 9)

Number of Lanes on Each Approach
Major Street: 2
Minor Street: 2

Vehicles Per Hour (4th Highest Hour)

Major Street (Approach 1):	527	Major Street Left Turn (see note [b]):	161
Major Street (Approach 2):	380	Minor Street (Higher Volume App.):	209
Major Street Total (Both Approaches):	907	Minor Street Total:	370
Minimum Volume on Major Street to Satisfy Warrant (see note [c]):	470	Minimum Volume on Minor Street to Satisfy Warrant (see note [c]):	230

FOUR HOUR VOLUME WARRANT SATISFIED? **YES**

PEAK HOUR VOLUME (MUTCD Warrant 3, Caltrans Warrant 11)

Number of Lanes on Each Approach
Major Street: 2
Minor Street: 2

Vehicles Per Hour (Peak Hour)

Major Street (Approach 1):	620	Major Street Left Turn (see note [b]):	189
Major Street (Approach 2):	447	Minor Street (Higher Volume App.):	246
Major Street Total (Both Approaches):	1,067	Minor Street Total:	435
Minimum Volume on Major Street to Satisfy Warrant (see note [d]):	620	Minimum Volume on Minor Street to Satisfy Warrant (see note [d]):	340

PEAK HOUR VOLUME WARRANT SATISFIED? **YES**

Notes:

a. May be used when the major-street speed exceeds 40 mph or in an isolated community with a population of less than 10,000.

b. Heavier left-turn movement from the major street may be included with minor street volume if a separate signal phase is proposed for left-turn movements.

c. From: USDOT, FHWA, "Manual on Uniform Traffic Control Devices," 2001, Figure 4C-1.

d. From: USDOT, FHWA, "Manual on Uniform Traffic Control Devices," 2001, Figure 4C-3.

Adopted from: U.S. Department of Transportation, Federal Highway Administration, "Manual on Uniform Traffic Control Devices, Millennium Edition," 2001; and Caltrans, "Traffic Manual," 2002.

TRAFFIC SIGNAL WARRANTS
FOUR HOUR VEHICULAR VOLUME (MUTCD Warrant 2, Caltrans Warrant 9)
PEAK HOUR VEHICULAR VOLUME (MUTCD Warrant 3, Caltrans Warrant 11)

Major Street: ULUAOA STREET
Minor Street: PALANI ROAD
Scenario: FUTURE(CUM+PROJ: CONCEPT A) WEEKDAY - P.M. PEAK HOUR (2020)
Urban/Rural: u (U=urban, R=rural [a])

FOUR HOUR VOLUME (MUTCD Warrant 2, Caltrans Warrant 9)

Number of Lanes on Each Approach

Major Street:	1
Minor Street:	1

Vehicles Per Hour (4th Highest Hour)

Major Street (Approach 1):	865	Major Street Left Turn (see note [b]):	25
Major Street (Approach 2):	629	Minor Street (Higher Volume App.):	170
Major Street Total (Both Approaches):	1,494	Minor Street Total:	195
Minimum Volume on Major Street to Satisfy Warrant (see note [c]):	380	Minimum Volume on Minor Street to Satisfy Warrant (see note [c]):	80

FOUR HOUR VOLUME WARRANT SATISFIED? **YES**

PEAK HOUR VOLUME (MUTCD Warrant 3, Caltrans Warrant 11)

Number of Lanes on Each Approach

Major Street:	1
Minor Street:	1

Vehicles Per Hour (Peak Hour)

Major Street (Approach 1):	1,018	Major Street Left Turn (see note [b]):	29
Major Street (Approach 2):	740	Minor Street (Higher Volume App.):	200
Major Street Total (Both Approaches):	1,758	Minor Street Total:	229
Minimum Volume on Major Street to Satisfy Warrant (see note [d]):	450	Minimum Volume on Minor Street to Satisfy Warrant (see note [d]):	100

PEAK HOUR VOLUME WARRANT SATISFIED? **YES**

Notes:

a. May be used when the major-street speed exceeds 40 mph or in an isolated community with a population of less than 10,000.

b. Heavier left-turn movement from the major street may be included with minor street volume if a separate signal phase is proposed for left-turn movements.

c. From: USDOT, FHWA, "Manual on Uniform Traffic Control Devices," 2001, Figure 4C-1.

d. From: USDOT, FHWA, "Manual on Uniform Traffic Control Devices," 2001, Figure 4C-3.

Adopted from: U.S. Department of Transportation, Federal Highway Administration, "Manual on Uniform Traffic Control Devices, Millennium Edition," 2001; and Caltrans, "Traffic Manual," 2002.

TRAFFIC SIGNAL WARRANTS
FOUR HOUR VEHICULAR VOLUME (MUTCD Warrant 2, Caltrans Warrant 9)
PEAK HOUR VEHICULAR VOLUME (MUTCD Warrant 3, Caltrans Warrant 11)

Major Street: KEALAKEHE PARKWAY
Minor Street: ANE KEOHOKALOLE HIGHWAY
Scenario: FUTURE(CUM+PROJ: CONCEPT A) WEEKDAY - A.M. PEAK HOUR (2020)
Urban/Rural: U (U=urban, R=rural [a])

FOUR HOUR VOLUME (MUTCD Warrant 2, Caltrans Warrant 9)

Number of Lanes on Each Approach
Major Street: 3
Minor Street: 3

Vehicles Per Hour (4th Highest Hour)

Major Street (Approach 1):	342	Major Street Left Turn (see note [b]):	198
Major Street (Approach 2):	304	Minor Street (Higher Volume App.):	382
Major Street Total (Both Approaches):	646	Minor Street Total:	580
Minimum Volume on Major Street to Satisfy Warrant (see note [c]):	470	Minimum Volume on Minor Street to Satisfy Warrant (see note [c]):	360

FOUR HOUR VOLUME WARRANT SATISFIED? **YES**

PEAK HOUR VOLUME (MUTCD Warrant 3, Caltrans Warrant 11)

Number of Lanes on Each Approach
Major Street: 3
Minor Street: 3

Vehicles Per Hour (Peak Hour)

Major Street (Approach 1):	402	Major Street Left Turn (see note [b]):	233
Major Street (Approach 2):	358	Minor Street (Higher Volume App.):	449
Major Street Total (Both Approaches):	760	Minor Street Total:	682
Minimum Volume on Major Street to Satisfy Warrant (see note [d]):	620	Minimum Volume on Minor Street to Satisfy Warrant (see note [d]):	500

PEAK HOUR VOLUME WARRANT SATISFIED? **YES**

Notes:

a. May be used when the major-street speed exceeds 40 mph or in an isolated community with a population of less than 10,000.

b. Heavier left-turn movement from the major street may be included with minor street volume if a separate signal phase is proposed for left-turn movements.

c. From: USDOT, FHWA, "Manual on Uniform Traffic Control Devices," 2001, Figure 4C-1.

d. From: USDOT, FHWA, "Manual on Uniform Traffic Control Devices," 2001, Figure 4C-3.

Adopted from: U.S. Department of Transportation, Federal Highway Administration, "Manual on Uniform Traffic Control Devices, Millennium Edition," 2001; and Caltrans, "Traffic Manual," 2002.

F-2

August 2008

FEHR & PEERS
TRANSPORTATION CONSULTANTS

TECHNICAL MEMORANDUM

Date: August 8, 2008

To: Lee Sichter, Belt Collins

From: Netai Basu and Natalie Porter

Subject: ***Planning Level Cost Estimates and Fair-Share Cost Contribution Calculations for Off-Site Mitigation Measures for the Keahuolu Affordable Housing Master Plan Project***

LA07-2145

The *Traffic Study for the Keahuolu Affordable Housing Master Plan North Kona, Island of Hawaii, Hawaii* (Fehr & Peers/Kaku Associates, January 2008), included as Appendix F to the *Keahuolu Affordable Housing Project Kailua-Kona, Hawaii Draft Environmental Impact Statement* (DEIS) (Belt Collins, February 2008), identified seven study intersections and three roadway segments that would be significantly impacted under cumulative plus project conditions in 2020. Analysis of an alternative future scenario, which assumed that the future street network in the vicinity of the project would be slightly more developed, was also conducted and is documented in a separate technical memorandum (*Analysis of an Alternative Future Scenario - Addendum to the Traffic Study for the Keahuolu Affordable Housing Master Plan, North Kona, Island of Hawaii*, Hawaii [Fehr & Peers, May 21, 2008]). Mitigation measures were developed for each location to achieve acceptable level of service conditions. Two of the three impacted street segments lie adjacent to impacted intersections on Palani Road (State Route [SR] 190) and the intersection-level mitigation measures would also mitigate the segment-level impacts there. Thus, the recommended improvement program includes improvements at seven intersections and one street segment. Each improvement is described below. The purpose of this technical memorandum is to document planning level cost estimates and the fair-share contribution calculations that have been prepared for each improvement.

INTERSECTIONS

- Intersection 3: Kamakaeha Avenue & Palani Road (SR 190) – Install traffic signal and interconnect/coordinate with adjacent intersections of Queen Kaahumanu Highway and Henry Street/Ane Keohokalole Highway.

- Intersection 4: Henry Street/Ane Keohokalole Highway & Palani Road (SR 190) – Widen makai-bound approach to provide two left-turn lanes, one through lane and one shared through/right-turn lane; widen the northbound approach to

provide one left-turn lane, one through lane and one shared through/right-turn lane and construct the southbound approach with one left-turn lane, one through lane and one shared through/right-turn lane. A signal modification will be needed to accommodate the change in lane configurations.

- Intersection 5: Palani Road (SR 190) & Minor Site Access Road – Add makai-bound deceleration lane into the project site and a makai-bound acceleration lane out from the project, separated by a raised island to channelize traffic. A second makai-bound lane would be added to receive traffic exiting the project site.

- Intersection 7: Ane Keohokalole Highway & Major Site Access Road – Install a traffic signal and have the future lane configuration provide one left-turn lane and one right-turn lane on the makai-bound approach, one through lane and one right-turn lane on the northbound approach, and one left-turn lane and one through lane on the southbound approach. Under the alternative future scenario, which assumed that the future street network in the vicinity of the project would be slightly more developed, the intersection would be signalized with a future lane configuration of one left-turn lane, one through lane and one right-turn lane on the northbound approach, one left-turn lane and one shared through/right-turn lane on the southbound approach and one left-turn lane and one shared through/right-turn lane on both the eastbound (mauka-bound) and westbound (makai-bound) approaches.

- Intersection 8: Kealakaa Street/Pahiliholo Street & Palani Road (SR 190) – Widen Palani Road to provide one left-turn lane, one through lane and one shared through/right-turn lane on the southbound approach and two left-turn lanes and one shared through/right-turn lane on the northbound approach. The southbound departure would be widened to two lanes and merge into a single lane downstream of the intersection.

- Intersection 10: Uluaoa Street & Palani Road (SR 190) – Install a traffic signal.

- Intersection 12: Kealakehe Parkway & Ane Keohokalole Highway – Install a traffic signal.

ROADWAY SEGMENTS

- Roadway Segment 2: Palani Road (SR 190) makai (west) of Henry Street – Widen makai-direction to provide two lanes. This location lies between Intersections 3 and 4.

- Roadway Segment 3: Palani Road (SR 190) mauka (east) of Henry Street – Widen makai-direction to provide two lanes. This location lies between Intersections 4 and 5 and the improvements at those intersections described

above would provide an additional makai-bound lane on this segment of Palani Road.

- Roadway Segment 10: Palani Road (SR 190) south of Mamalahoa Highway – Widen southbound direction to provide two lanes between Mamalahoa Highway (State Route 180) and Hao Kuni Street.

Planning-level cost estimates have been prepared for the recommended improvements at each location. Where possible, the cost estimates included in the DEIS (*Appendix G Civil Infrastructure)* were used. Staff at the County of Hawaii Planning and Public Works Departments provided assistance in determining the appropriate parameters of these estimates.

General assumptions for the cost estimates include:

1. No utility conflicts, except for the power line relocation along Palani Road widening
2. Right-of-way costs were not included in the estimates
3. The improvements are constructible
4. Added travel lanes will be 12' wide, carried to the nearest upstream or downstream intersection as applicable
5. Palani Road (SR 190) will have 10' wide shoulders, but no sidewalks or curb & gutter
6. Mobilization is 5% of the roadwork construction costs
7. Traffic control is assumed to be 10% of the roadwork construction cost
8. Removing of existing striping and pavement legends will be by grinding (striping details as referenced are per State DOT Standard Plans)
9. Additional environmental documentation will be required for off-site improvements not covered in the EIS for this project or for the separate Ane Keohokalole Highway project These costs were calculated as a percentage of the estimated construction costs where applicable
10. Cost estimates from Appendix G of the DEIS were used as a reference, as well as the updated *Civil Infrastructure, Keahuolu Affordable Housing Project,* dated June 2008 by Belt Collins Hawaii Ltd. for Hawaii Housing Finance & Development Corporation
11. Design speed was assumed to be 5 m.p.h. higher than the posted speed limit
12. All costs are in 2007 dollars to correlate with the DEIS

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The specific parameters for each location are summarized below and detailed in Attachments A through G. Additional information and excerpts from Appendix G of the DEIS are included in Attachment H. Future lane configurations are shown in Attachment I.

Intersection 3: Kamakaeha Avenue & Palani Road (SR 190)

1. The existing lane configuration will be maintained.
2. Interconnect with the adjacent intersections include trenching & conduit.
3. Fog seal the intersection after signal installation.
4. The intersection will be re-striped after signal installation.
5. The cost to prepare and file a simple environmental document for the construction was included at 10% of construction costs.
6. See Attachment A for cost summary.

Intersection 4: Henry Street/Ane Keohokalole Highway & Palani Road (SR 190)

1. The widening of the makai-bound direction will extend to Intersection 3 (Kamakaeha Avenue & Palani Road).
2. The costs of fog seal are included in the roadwork lump sum.
3. Additional signal modification and relocation of the loops will be required as additional lanes are added to mitigate the increase in traffic.
4. Remainder of construction of the approach westbound lanes is included.
5. Existing pavement is adequate and an overlay or restructure of existing pavement is not required.
6. The intersection will be re-striped after the widening and signal modification.
7. The cost estimate of improvements on Ane Keohokalole Highway are a separate cost for a 40' wide road, as shown in Appendix G of the DEIS and the subsequent (June 2008) *Civil Infrastructure, Keahuolu Affordable Housing Project*. The cost of widening the roadway to a 60' cross-section is required.
8. See Attachment B for cost summary.

Intersection 5: Palani Road (SR 190) & Minor Site Access Road

1. The cost estimate for this improvement is drawn from Appendix G of the DEIS. No additional costs have been identified.

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Intersection 7: Ane Keohokalole Highway & Major Site Access Road

1. The cost estimate of improvements on Ane Keohokalole Highway are a separate cost, as shown in Appendix G of the DEIS and the updated Belt Collins report. The additional 20' pavement width on Ane Keohokalole Highway for 300' on the north and south legs are included in this cost estimate.

2. The cost estimate for the makai bound approach (east leg of the intersection) is included in the on-site costs portion of the DEIS.

3. Based on the draft EIS analysis, the improvement needed at this location to achieve LOS D would signalize the intersection and result in one through lane and one right-turn lane on the northbound approach, one left-turn lane and one through lane on the southbound approach and separate left-turn and right-turn lanes on the makai-bound approach.

4. The alternative future scenario that was analyzed assumes that Makala Boulevard will be extended to Ane Keohokalole Highway as a baseline condition. The improvement needed at this location to achieve LOS D would signalize the intersection and result in one left-turn lane, one through lane and one right-turn lane on the northbound approach, one left-turn lane and one shared through/right-turn lane on the southbound approach and one left-turn lane and one shared through/right-turn lane on both the eastbound (mauka-bound) and westbound (makai-bound) approaches.

5. See Attachment C for cost summaries of the additional improvements at this location.

Intersection 8: Kealakaa Street/Pahiliholo Street & Palani Road (SR 190)

1. Fog seal the intersection after civil improvements are complete.

2. Existing pavement is adequate and an overlay or restructure of existing pavement is not required.

3. The intersection will be re-striped after the widening is complete.

4. The cost to prepare and file an environmental document for the construction was included at 1% of construction costs.

5. See Attachment D for cost summary.

Intersection 10: Uluaoa Street & Palani Road (SR 190)

1. The existing lane configuration will be maintained.

2. Fog seal the intersection after signal installation.

3. The intersection will be re-striped after signal installation.

4. The cost to prepare and file a simple environmental document for the construction was included at 10% of construction costs.

5. See Attachment E for cost summary.

Intersection 12: Kealakehe Parkway & Ane Keohokalole Highway

1. The existing lane configuration will be maintained.

2. Fog seal the intersection after signal installation.

3. The intersection will be re-striped after signal installation.

4. See Attachment F for cost summary.

Street Segment 10: Palani Road (SR 190) south of Mamalahoa Highway

1. The costs of fog seal are included in the roadwork lump sum.

2. Existing pavement is adequate and an overlay or restructure of existing pavement is not required.

3. The street segment will be re-striped after the widening is complete.

4. Adjust three private driveways.

5. The total cost per linear foot of $500.00/LF for 22' (12' travel lane, 10' shoulder) was used following discussions with Belt Collins staff.

6. The cost to prepare and file an environmental document for the construction was included at 1% of construction costs.

7. Cost to relocate the power lines was provided by Steve Sakai, Ronald NS Ho & Associates. This cost did not include relocation of fiber optic lines or potential right-of-way costs, if needed.

8. See Attachment G for cost summary.

The planning level cost estimates for the mitigation measures are listed in Table 1.

PROJECT CONTRIBUTION AND FAIR-SHARE COSTS

The project's fair-share contribution to the estimated cost for each of the traffic mitigation measures identified in the traffic impact analysis and discussed above is presented in Tables 2 through 7. Tables 2, 3 and 4 present these calculations based on the traffic impact analysis in the draft EIS while Tables 5, 6 and 7 are calculated on the basis of the traffic impact analysis of the alternative future scenario.

The project's fair-share contribution to the cost of the improvements at each location where the project would contribute to an identified cumulative impact is based on the proportion of project peak hour traffic contributed to each location relative to the estimated total growth in peak hour traffic volumes through the year 2020. Calculations have been made for both the AM and the PM peak hours and the maximum project contribution identified. The project would be responsible for 100% of the cost of improvements at the two locations where project-specific impacts have been identified.

As shown in Tables 2, 3 and 4, the project's fair share of identified intersection and roadway segment improvement costs ranges from $5,366,461 (under development concept A, with 1,020 dwelling units) to $6,185,004 (under development concept B, with 1,840 dwelling units) to $6,295,451 (under development concept C, with 2,330 dwelling units). Under the alternative future scenario, the project's fair-share contribution costs for the identified traffic improvements range from $6,397,526 (under development concept A) to $7,217,940 (under development concept B, with 1,840 dwelling units) to $7,332,387 (under development concept C). It should be noted that these totals include the estimated cost shown in Appendix G to the Draft EIS ($1,306,000) to construct the minor site access intersection on Palani Road. The primary reason that the estimated share of the improvement costs attributable to the project is higher under the alternative future scenario is that the total estimated traffic growth on Palani Road (SR 190) south of Mamalahoa Highway is lower, due to the assumed extension of Keanalehu Drive between Manawale'a Street and Palani Road, which results in a greater proportion of the estimated traffic growth there that can be attributed to the Keahuolu Affordable Housing Master Plan project.

SUMMARY AND CONCLUSIONS

Fehr & Peers/Kaku Associates prepared detailed planning-level cost estimates for the traffic mitigation measures at the seven intersections and one street segment that were identified in the traffic impact analyses for the proposed Keahuolu Affordable Housing Master Plan project (while the traffic impact analyses identified impacts on three street segments, two of the three impacted street segments lie adjacent to impacted intersections on Palani Road and the intersection-level mitigation measures would also mitigate the segment-level impacts there). Three development concepts for the project were assessed, each including 197,000 square feet of commercial/retail space, 25 acres of neighborhood parks, a seven-acre archeological preserve, a 12-acre site reserved for a school and between 1,020 and 2,330 housing units.

Two future scenarios were evaluated for each development concept: the traffic impact analysis report in the draft EIS assumed that the street network in the surrounding area would be expanded as described in *Keahole to Honaunau Regional Circulation Plan* (County of Hawaii Planning Department, August 2006), while the traffic impact analysis documented in a separate subsequent technical memorandum assumed that certain additional street segments would be in place by the study horizon year of 2020.

The overall estimated cost of the identified traffic improvements necessary to achieve LOS D or better under the draft EIS scenario is $15,227,000. Based on the total forecast traffic growth at each location and the portion of that growth that can be attributed to traffic related to the proposed project, the project's "fair-share" contribution to these improvements is estimated to vary from $5,366,461 (under development concept A, with 1,020 dwelling units) to $6,185,004 (under development concept B, with 1,840 dwelling units) to $6,295,451 (under development concept C, with 2,330 dwelling units).

Under the alternative future scenario, the total cost of the identified traffic improvements is $15,416,000. The project's "fair-share" contribution to these improvements is estimated to vary from $6,397,526 (under development concept A) to $7,217,940 (under development concept B, with 1,840 dwelling units) to $7,332,387 (under development concept C).

TABLE 1 COST ESTIMATES FOR RECOMMENDED MITIGATION MEASURES		
Intersection/Road Segment	**Proposed Improvement**	**Cost Estimate for the Mitigation Measures**
Locations on State Highways		
IS 12: Ane Keohokalole Hwy/ Kealakehe Pkwy	Install traffic signal	$836,000
Subtotal		**$836,000**
Locations on Hawaii County Roads		
IS 3: Kamakaeha Ave/Palani Rd (SR 190)	Install traffic signal & interconnect	$831,000
IS 4: Henry St/Ane Keohokalole Hwy/Palani Rd (SR 190)[1]	Add NB through lane, 2nd WB left-turn lane, WB through lane, SB thru lane, signal modification	$4,535,000
IS 5: Palani Rd (SR 190)/Minor Site Access Rd [2]	Add makai deceleration lane, makai acceleration lane, raised island, 2nd makai receiving lane	$1,306,000
IS 8: Kealakaa St/Pahiliholo St/Palani Rd (SR 190)	Add SB thru lane, add NB left-turn lane	$1,863,000
IS 10: Uluaoa St/Palani Rd (SR 190)	Install traffic signal	$763,000
RS 10: Palani Rd (SR 190) s/o Mamalahoa Hwy	Widen SB to 2 lanes to Hao Kuni St.	$4,403,000
IS 7: Ane Keohokalole Hwy/Major Site Access Road [1,3]	Build and install traffic signal	$690,000
Subtotal		**$14,391,000**
Grand Total		**$15,227,000**[1,2]

Notes:
[1]Does not include the cost to construct Ane Keohokalole Highway along the project frontage for $14,083,000.00, as presented in Appendix G, Draft EIS *Keahuolu Affordable Housing Project,* February 2008.
[2] The cost for this improvement is drawn from Appendix G to the Draft EIS.
[3] The estimated cost to construct Ane Keohokalole Highway with a 40' roadway along the project frontage is included in Appendix G to the Draft EIS. The costs shown here represent the additional estimated cost to construct the mitigation measures that were identified for each future scenario. Under the Alternative Future Scenario that was analyzed, Makala Boulevard between Ane Keohokalole Highway and its current terminus is assumed to be constructed as a two-lane roadway for the baseline condition. The mitigation required under this scenario would provide separate left-turn lanes on the mauka-bound and northbound approaches to this intersection, increasing the overall cost for the improvements at this intersection to $ 879,000. The estimated overall cost of the traffic improvements would increase to $15,416,000 in the alternative future scenario that was analyzed. Further detail is provided in Attachment D.

TABLE 2

2020 PROJECT FAIR SHARE INTERSECTION TRAFFIC CONTRIBUTION

SCENARIO A

Int # or Seg #	Intersection	AM Peak Hour					PM Peak Hour					Maximum Contribution	Cost Estimate for the Mitigation Measures	Keahuolu Fair Share
		Existing Traffic	2020 with Project Traffic	Project Traffic	Total New Traffic	Project % of New Traffic	Existing Traffic	2020 with Project Traffic	Project Traffic	Total New Traffic	Project % of New Traffic			
Mitigation on State Highways														
12	Ane Keohokahole Hwy & Kealakehe Parkway	589	2,132	380	1,543	24.6%	372	1,972	339	1,600	21.2%	24.6%	$836,000	$205,885
												Subtotal	*$836,000*	*$205,885*
Mitigation on County Roads														
3	Kamakaeha Av & Palani Rd (SR 190)	894	1,552	185	658	28.1%	1,323	1,983	163	660	24.7%	28.1%	$831,000	$233,640
4	Henry St & Palani Rd (SR 190)	1,943	4,132	557	2,189	25.4%	2,105	4,089	496	1,984	25.0%	25.4%	$4,535,000	$1,153,949
5	Minor Site Access Rd & Palani Rd (SR 190)	1,784	2,647	177	863	20.5%	1,846	2,836	156	990	15.8%	100.0**%	$1,306,000	$1,306,000
7	Ane Keohokahole Hwy & Major Site Access Rd	0	1,977	910	1,977	46.0%	0	1,592	809	1,592	50.8%	100.0**%	$690,000	$690,000
8*	Kealakaa St/Palihiolo St & Palani Rd (SR 190)	1,915	3,003	150	1,088	13.8%	1,930	3,288	131	1,358	9.6%	13.8%	$1,863,000	$256,847
10	Palani Rd (SR 190) & Uluaoa St	1,595	2,008	118	413	28.6%	1,616	2,067	104	451	23.1%	28.6%	$763,000	$218,000
10	Palani Rd (SR 190) south of Mamalahoa Highway	1,479	1,878	118	399	29.6%	1,588	2,033	104	445	23.4%	29.6%	$4,403,000	$1,302,140
												Subtotal	*$14,391,000*	*$5,160,576*
TOTAL													**$15,227,000**	**$5,366,461**

Notes:

* Volumes are recalculated to reflect the 4-legged intersections by combining intersection 8 and 9.

** The cumulative impact at this location is also identified as a project specific impact. The cost for the improvement at Intersection 5 is drawn from Appendix G of the draft EIS.

TABLE 3

2020 PROJECT FAIR SHARE INTERSECTION TRAFFIC CONTRIBUTION

SCENARIO B

Int # or Seg #	Intersection	AM Peak Hour					PM Peak Hour					Maximum Contribution	Cost Estimate for the Mitigation Measures	Keahuolu Fair Share
		Existing Traffic	2020 with Project Traffic	Project Traffic	Total New Traffic	Project % of New Traffic	Existing Traffic	2020 with Project Traffic	Project Traffic	Total New Traffic	Project % of New Traffic			
Mitigation on State Highways														
12	Ane Keohokahole Hwy & Kealakehe Parkway	589	2,248	496	1,659	29.9%	372	2,158	525	1,786	29.4%	29.9%	$836,000	$249,943
												Subtotal	*$836,000*	*$249,943*
Mitigation on County Roads														
3	Kamakaeha Av & Palani Rd (SR 190)	894	1,597	230	703	32.7%	1,323	2,077	257	754	34.1%	34.1%	$831,000	$283,245
4	Henry St & Palani Rd (SR 190)	1,943	4,298	723	2,355	30.7%	2,105	4,361	768	2,256	34.0%	34.0%	$4,535,000	$1,543,830
5	Minor Site Access Rd & Palani Rd (SR 190)	1,784	2,697	227	913	24.9%	1,846	2,925	245	1,079	22.7%	100.0**%	$1,306,000	$1,306,000
7	Ane Keohokahole Hwy & Major Site Access Rd	0	2,243	1,176	2,243	52.4%	0	2,040	1,257	2,040	61.6%	100.0**%	$690,000	$690,000
8*	Kealakaa St/Palihiolo St & Palani Rd (SR 190)	1,915	3,038	185	1,123	16.5%	1,930	3,366	209	1,436	14.6%	16.5%	$1,863,000	$306,906
10	Palani Rd (SR 190) & Uluaoa St	1,595	2,042	152	447	34.0%	1,616	2,126	163	510	32.0%	34.0%	$763,000	$259,454
10	Palani Rd (SR 190) south of Mamalahoa Highway	1,479	1,912	152	433	35.1%	1,588	2,092	163	504	32.3%	35.1%	$4,403,000	$1,545,626
												Subtotal	*$14,391,000*	*$5,935,061*
TOTAL													**$15,227,000**	**$6,185,004**

Notes:

* Volumes are recalculated to reflect the 4-legged intersections by combining intersection 8 and 9.

** The cumulative impact at this location is also identified as a project specific impact. The cost for the improvement at Intersection 5 is drawn from Appendix G of the draft EIS.

TABLE 4

2020 PROJECT FAIR SHARE INTERSECTION TRAFFIC CONTRIBUTION

SCENARIO C

Int # or Seg #	Intersection	AM Peak Hour					PM Peak Hour					Maximum Contribution	Cost Estimate for the Mitigation Measures	Keahuolu Fair Share
		Existing Traffic	2020 with Project Traffic	Project Traffic	Total New Traffic	Project % of New Traffic	Existing Traffic	2020 with Project Traffic	Project Traffic	Total New Traffic	Project % of New Traffic			
Mitigation on State Highways														
12	Ane Keohokahole Hwy & Kealakehe Parkway	589	2,273	521	1,684	30.9%	372	2,177	544	1,805	30.1%	30.9%	$836,000	$258,644
												Subtotal	*$836,000*	*$258,644*
Mitigation on County Roads														
3	Kamakaeha Av & Palani Rd (SR 190)	894	1,604	237	710	33.4%	1,323	2,089	269	766	35.1%	35.1%	$831,000	$291,826
4	Henry St & Palani Rd (SR 190)	1,943	4,331	756	2,388	31.7%	2,105	4,392	799	2,287	34.9%	34.9%	$4,535,000	$1,584,375
5	Minor Site Access Rd & Palani Rd (SR 190)	1,784	2,707	237	923	25.7%	1,846	2,934	254	1,088	23.3%	100.0**%	$1,306,000	$1,306,000
7	Ane Keohokahole Hwy & Major Site Access Rd	0	2,299	1,232	2,299	53.6%	0	2,091	1,308	2,091	62.6%	100.0**%	$690,000	$690,000
8*	Kealakaa St/Palihiolo St & Palani Rd (SR 190)	1,915	3,043	190	1,128	16.8%	1,930	3,375	218	1,445	15.1%	16.8%	$1,863,000	$313,803
10	Palani Rd (SR 190) & Uluaoa St	1,595	2,048	158	453	34.9%	1,616	2,132	169	516	32.8%	34.9%	$763,000	$266,124
10	Palani Rd (SR 190) south of Mamalahoa Highway	1,479	1,918	158	439	36.0%	1,588	2,098	169	510	33.1%	36.0%	$4,403,000	$1,584,679
												Subtotal	*$14,391,000*	*$6,036,807*
TOTAL													**$15,227,000**	**$6,295,451**

Notes:

* Volumes are recalculated to reflect the 4-legged intersections by combining intersection 8 and 9.

** The cumulative impact at this location is also identified as a project specific impact. The cost for the improvement at Intersection 5 is drawn from Appendix G of the draft EIS.

TABLE 5

2020 PROJECT FAIR SHARE INTERSECTION TRAFFIC CONTRIBUTION

ALTERNATIVE SCENARIO A

Int # or Seg #	Intersection	AM Peak Hour					PM Peak Hour					Maximum Contribution	Cost Estimate for the Mitigation Measures	Keahuolu Fair Share
		Existing Traffic	2020 with Project Traffic	Project Traffic	Total New Traffic	Project % of New Traffic	Existing Traffic	2020 with Project Traffic	Project Traffic	Total New Traffic	Project % of New Traffic			
Mitigation on State Highways														
12	Ane Keohokahole Hwy & Kealakehe Parkway	589	2,017	215	1,428	15.1%	372	1,864	191	1,492	12.8%	15.1%	$836,000	$125,868
												Subtotal	*$836,000*	*$125,868*
Mitigation on County Roads														
3	Kamakaeha Av & Palani Rd (SR 190)	894	1,488	173	594	29.1%	1,323	1,944	152	621	24.5%	29.1%	$831,000	$242,025
4	Henry St & Palani Rd (SR 190)	1,943	3,975	474	2,032	23.3%	2,105	3,981	421	1,876	22.4%	23.3%	$4,535,000	$1,057,869
5	Minor Site Access Rd & Palani Rd (SR 190)	1,784	2,605	192	821	23.4%	1,846	2,844	171	998	17.1%	100.0**%	$1,306,000	$1,306,000
7	Ane Keohokahole Hwy & Major Site Access Rd	0	1,608	169	1,608	10.5%	0	2,223	150	2,223	6.7%	100.0**%	$879,000	$879,000
8*	Kealakaa St/Palihiolo St & Palani Rd (SR 190)	1,915	2,888	201	973	20.7%	1,930	3,249	177	1,319	13.4%	20.7%	$1,863,000	$384,854
10	Palani Rd (SR 190) & Uluaoa St	1,595	2,035	177	440	40.2%	1,616	2,073	156	457	34.1%	40.2%	$763,000	$306,934
10	Palani Rd (SR 190) south of Mamalahoa Highway	1,479	1,851	177	372	47.6%	1,588	2,007	156	419	37.2%	47.6%	$4,403,000	$2,094,976
												Subtotal	*$14,580,000*	*$6,271,658*
TOTAL													**$15,416,000**	**$6,397,526**

Notes:

* Volumes are recalculated to reflect the 4-legged intersections by combining intersection 8 and 9.

** The cumulative impact at this location is also identified as a project specific impact. The cost for the improvement at Intersection 5 is drawn from Appendix G of the draft EIS.

TABLE 6

2020 PROJECT FAIR SHARE INTERSECTION TRAFFIC CONTRIBUTION

ALTERNATIVE SCENARIO B

Int # or Seg #	Intersection	AM Peak Hour					PM Peak Hour					Maximum Contribution	Cost Estimate for the Mitigation Measures	Keahuolu Fair Share
		Existing Traffic	2020 with Project Traffic	Project Traffic	Total New Traffic	Project % of New Traffic	Existing Traffic	2020 with Project Traffic	Project Traffic	Total New Traffic	Project % of New Traffic			
Mitigation on State Highways														
12	Ane Keohokahole Hwy & Kealakehe Parkway	589	2,086	284	1,497	19.0%	372	1,970	297	1,598	18.6%	19.0%	$836,000	$158,600
												Subtotal	*$836,000*	*$158,600*
Mitigation on County Roads														
3	Kamakaeha Av & Palani Rd (SR 190)	894	1,530	215	636	33.8%	1,323	2,033	241	710	33.9%	33.9%	$831,000	$282,072
4	Henry St & Palani Rd (SR 190)	1,943	4,118	617	2,175	28.4%	2,105	4,215	655	2,110	31.0%	31.0%	$4,535,000	$1,407,784
5	Minor Site Access Rd & Palani Rd (SR 190)	1,784	2,665	252	881	28.6%	1,846	2,939	266	1,093	24.3%	100.0**%	$1,306,000	$1,306,000
7	Ane Keohokahole Hwy & Major Site Access Rd	0	1,663	1,190	1,663	71.6%	0	2,304	231	2,304	10.0%	100.0**%	$879,000	$879,000
8*	Kealakaa St/Palihiolo St & Palani Rd (SR 190)	1,915	2,942	255	1,027	24.8%	1,930	3,352	280	1,422	19.7%	24.8%	$1,863,000	$462,575
10	Palani Rd (SR 190) & Uluaoa St	1,595	2,085	227	490	46.3%	1,616	2,162	245	546	44.9%	46.3%	$763,000	$353,471
10	Palani Rd (SR 190) south of Mamalahoa Highway	1,479	1,901	227	422	53.8%	1,588	2,096	245	508	48.2%	53.8%	$4,403,000	$2,368,438
												Subtotal	*$14,580,000*	*$7,059,340*
TOTAL													**$15,416,000**	**$7,217,940**

Notes:

* Volumes are recalculated to reflect the 4-legged intersections by combining intersection 8 and 9.

** The cumulative impact at this location is also identified as a project specific impact. The cost for the improvement at Intersection 5 is drawn from Appendix G of the draft EIS.

TABLE 7

2020 PROJECT FAIR SHARE INTERSECTION TRAFFIC CONTRIBUTION

ALTERNATIVE SCENARIO C

Int # or Seg #	Intersection	AM Peak Hour					PM Peak Hour					Maximum Contribution	Cost Estimate for the Mitigation Measures	Keahuolu Fair Share
		Existing Traffic	2020 with Project Traffic	Project Traffic	Total New Traffic	Project % of New Traffic	Existing Traffic	2020 with Project Traffic	Project Traffic	Total New Traffic	Project % of New Traffic			
Mitigation on State Highways														
12	Ane Keohokahole Hwy & Kealakehe Parkway	589	2,101	299	1,512	19.8%	372	1,980	307	1,608	19.1%	19.8%	$836,000	$165,320
												Subtotal	*$836,000*	*$165,320*
Mitigation on County Roads														
3	Kamakaeha Av & Palani Rd (SR 190)	894	1,537	222	643	34.5%	1,323	2,044	252	721	35.0%	35.0%	$831,000	$290,447
4	Henry St & Palani Rd (SR 190)	1,943	4,148	647	2,205	29.3%	2,105	4,239	679	2,134	31.8%	31.8%	$4,535,000	$1,442,955
5	Minor Site Access Rd & Palani Rd (SR 190)	1,784	2,677	264	893	29.6%	1,846	2,949	276	1,103	25.0%	100.0**%	$1,306,000	$1,306,000
7	Ane Keohokahole Hwy & Major Site Access Rd	0	1,676	237	1,676	14.1%	0	2,311	238	2,311	10.3%	100.0**%	$879,000	$879,000
8*	Kealakaa St/Palihiolo St & Palani Rd (SR 190)	1,915	2,952	265	1,037	25.6%	1,930	3,362	290	1,432	20.3%	25.6%	$1,863,000	$476,080
10	Palani Rd (SR 190) & Uluaoa St	1,595	2,095	237	500	47.4%	1,616	2,171	254	555	45.8%	47.4%	$763,000	$361,662
10	Palani Rd (SR 190) south of Mamalahoa Highway	1,479	1,910	236	431	54.8%	1,588	2,105	254	517	49.1%	54.8%	$4,403,000	$2,410,923
												Subtotal	*$14,580,000*	*$7,167,067*
TOTAL													**$15,416,000**	**$7,332,387**

Notes:

* Volumes are recalculated to reflect the 4-legged intersections by combining intersection 8 and 9.

** The cumulative impact at this location is also identified as a project specific impact. The cost for the improvement at Intersection 5 is drawn from Appendix G of the draft EIS.

ATTACHMENT A

KAMAKAEHA AVENUE & PALANI ROAD (SR 190)

FEHR & PEERS
Transportation Consultants

PRELIMINARY COST ESTIMATE

SHEET 1 OF 1
DATE July 29, 2008
LOCATION I/S3:Kamakaeha/Palani
Project No. LA07-2145

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
	ROAD CONSTRUCTION COSTS				
	Fog Seal Finish ($1.5/SF)	LS	Lump Sum	$39,000.00	$39,000.00
	Signing & Striping (Install & remove)	LS	Lump Sum	$12,000.00	$12,000.00
	Mobilization (for Road portion)	LS	Lump Sum	$5,000.00	$5,000.00
	Water Pollution & Erosion Control Measures	LS	Lump Sum	$2,000.00	$2,000.00
	20% Contingencies[1]			$11,600.00	$11,600.00
				SUB-TOTAL :	**$69,600.00**
	Traffic Control (10% of Road Constr Costs)	LS	Lump Sum	$6,960.00	$6,960.00
	Design & Constr Services (15% of Road Constr Costs)[1]	LS	Lump Sum	$10,440.00	$10,440.00
	Environmental Document (10% of Road Constr Costs)	LS	Lump Sum	$6,960.00	$6,960.00
				SUB-TOTAL :	**$24,360.00**
	TRAFFIC SIGNAL COSTS				
	Signal Installation[2]	LS	Lump Sum	$500,000.00	$500,000.00
	Traffic Signal Interconnect (@$15/LF)	LS	Lump Sum	$34,000.00	$34,000.00
	20% Contingencies[1]			$106,800.00	$106,800.00
				SUB-TOTAL :	**$640,800.00**
	Design & Constr Services (15% of Signal Costs)[1]	LS	Lump Sum	$96,120.00	$96,120.00
				SUB-TOTAL :	**$96,120.00**

Notes : [1]Per Appendix G of DEIS; [2]Per R.Thiel, Hawaii County Department of Public Works, Traffic Division

TOTAL : $830,880.00

Estimated by : Natalie K. Porter

FEHR & PEERS
TRANSPORTATION CONSULTANTS

BY NKP DATE 7-25-08 CLIENT KEAHUOLU AHMP SHEET NO. 1 OF 12
ATTACHMENT A
CHECKED _____ DATE _____ JOB _____ JOB NO. LA07-2145

I/S 3: KAMAKAEHA AVE. / PALANI RD. (SR190)

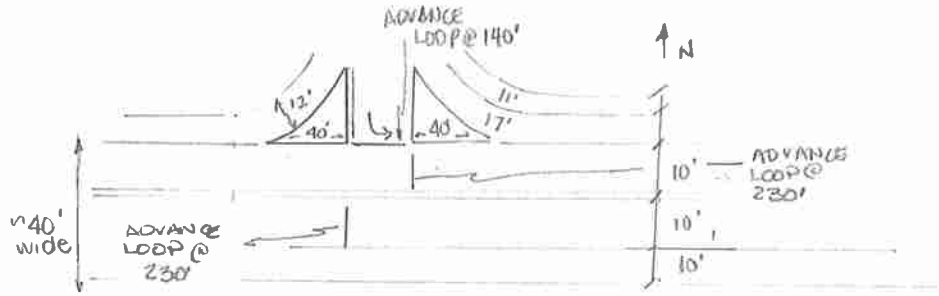
- INSTALL TRAFFIC SIGNAL + INTERCONNECT TO ADJ I/S'

TRAFFIC SIGNAL (PER R. THIEL)	$500,000.00
INTERCONNECT $15/FT x (750+1,500) (TRENCHING & CONDUIT)	33,750.00
SEAL COAT ($1.5/SF) (FOR I/S ONLY)	39,000.00
RESTRIPING	6,000.00
REMOVE STRIPING	6,000.00

DESIGN SPEED → ASSUME 5 MPH HIGHER THAN POSTED SPEED LIMIT

PALANI RD: DESIGN SPEED = 40 MPH
ADVANCE LOOP AT 230' FROM LIMIT LINE

KAMAKAEHA AVE: DESIGN SPEED = 30 MPH
ADVANCE LOOP AT 140' FROM LIMITLINE



SEAL COAT = W leg Palani = 190'(40') + 190'(12')(0.5) + 40'(30') = 9,940 sq. ft.
E leg Palani = 190'(30') + 190'(28')(0.5) + 40'(30') = 9,560 sq. ft.
Kamakaeha = 140'(45') = 6,300 sq. ft.
25,800
SAY 26,000 sq. ft.

26,000 x $1.5/SF = $39,000.00

STRIPING:
2 ARROWS @ 42 SQFT/EA = 84 SQFT.
DBL YELLOW = 500' ON PALANI + 140' ON Kamakaeha = 640' x 2 = 1,280'
4" white edgeline = (230' x 4) + (140 x 2) = 1,200'
STOP BAR = 12'
TOTAL = 2,492 SAY 2,500'

2,500 x $2/LF = $5,000

REMOVE STRIPING (ASSUME GRINDING) = COST STRIPING INSTALL
LEGEND @ $6.00/SQFT 84 x 6 = $504
STRIPING $5,000 + $504 = $5,504 → SAY $6,000.00

ATTACHMENT B

HENRY STREET/ANE KEOHOKALOLE HIGHWAY & PALANI ROAD (SR 190)

FEHR & PEERS
Transportation Consultants

PRELIMINARY COST ESTIMATE

SHEET 1 OF 1
DATE July 29, 2008
LOCATION IS4:Henry/AKH/Palani
Project No. LA07-2145

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
	ROAD CONSTRUCTION COSTS				
	Roadwork[1]	LS	Lump Sum	$2,799,000.00	$2,799,000.00
	Signing & Striping (Install & Remove)	LS	Lump Sum	$64,000.00	$64,000.00
	Mobilization (for Road portion)	LS	Lump Sum	$140,000.00	$140,000.00
	Water Pollution & Erosion Control Measures	LS	Lump Sum	$20,000.00	$20,000.00
	20% Contingencies[2]			$604,600.00	$604,600.00
				SUB-TOTAL :	$3,627,600.00
	Traffic Control (10% of Road Constr Costs)	LS	Lump Sum	$362,760.00	$362,760.00
	Design & Constr Services (15% of Road Constr Costs)[2]	LS	Lump Sum	$544,140.00	$544,140.00
				SUB-TOTAL :	$906,900.00

Notes : [1]Per Appendix G pro-rated - roadwork also includes fog-seal of existing pvmt, [2]Per Appendix G of DEIS

TOTAL : $4,534,500.00

Estimated by : Natalie K. Porter

FEHR & PEERS
TRANSPORTATION CONSULTANTS

BY NKP DATE 7-25-08 CLIENT KAHMP ATTACHMENT B SHEET NO. 2 OF 12

CHECKED ____ DATE ____ JOB ____ JOB NO. LA07-2145

I/S 4: HENRY ST. / ANE KEOHOKALOLE HWY & PALANI RD. (SR. 190)

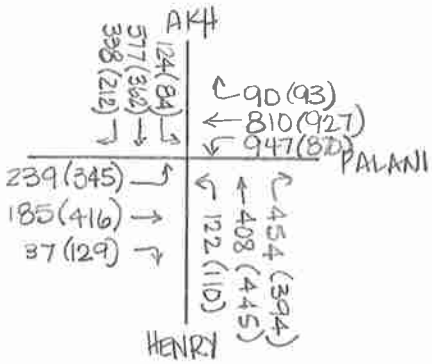
- WIDENING MAKAI-BOUND APPROACH
- ADD NB THRU (12')
- ADD 2nd LTL WB (MAKAI)
- ADD THRU WB (MAKAI) LANE
- ADD SB THRU (12')
- SIGNAL MODIFICATION

LEFT TURN POCKETS = ALL STORAGE + DECEL + TAPER (IN POCKET)

TAPER = 26' TO 49' LONGITUDINALLY AASHTO
3' TRAVERSELY

DESIGN SPEED: PALANI RD (SR 190) = 40 MPH
DECEL LENGTHS = 275' PER 2004 AASHTO, p. 714 (A. KATO)

CTP VOLUMES SCENARIO



STORAGE: ASSUME 120 SEC CYCLE

— MAKAI-BOUND LEFT TURN STORAGE
947 VEHICLES (AM PK HR)
= 15.8 VEHICLES / MINUTE OR 32 VEHICLES IN 120 S.
2 LANES = 16 VEHICLES / LANE / CYCLE x 1.5 = 24 VEHICLES / LANE / CYCLE
ASSUME 25' PER VEHICLE = 600' STORAGE REQ'D

MAKAI - LEFT TURN POCKET LENGTHS

STORAGE PER LANE = 600'
+ DECEL FOR 40 MPH = 275'
+ TAPER FOR DUAL = 150'
15:1 [L:T] 1,025' HAVE 1,250' TO I/S 5

APPROX (330' x 12') + (300' of taper) included in Palani est.
include 395' of 30' + 300' of taper

FEHR & PEERS
TRANSPORTATION CONSULTANTS

BY NKP DATE 7-25-08 CLIENT KAHMP - ATTACH B SHEET NO. 3 OF 12

CHECKED _____ DATE _____ JOB _____ JOB NO. LAD7-2145

I/S 4 (CON'T)

MAUKA LEFT TURN POCKET

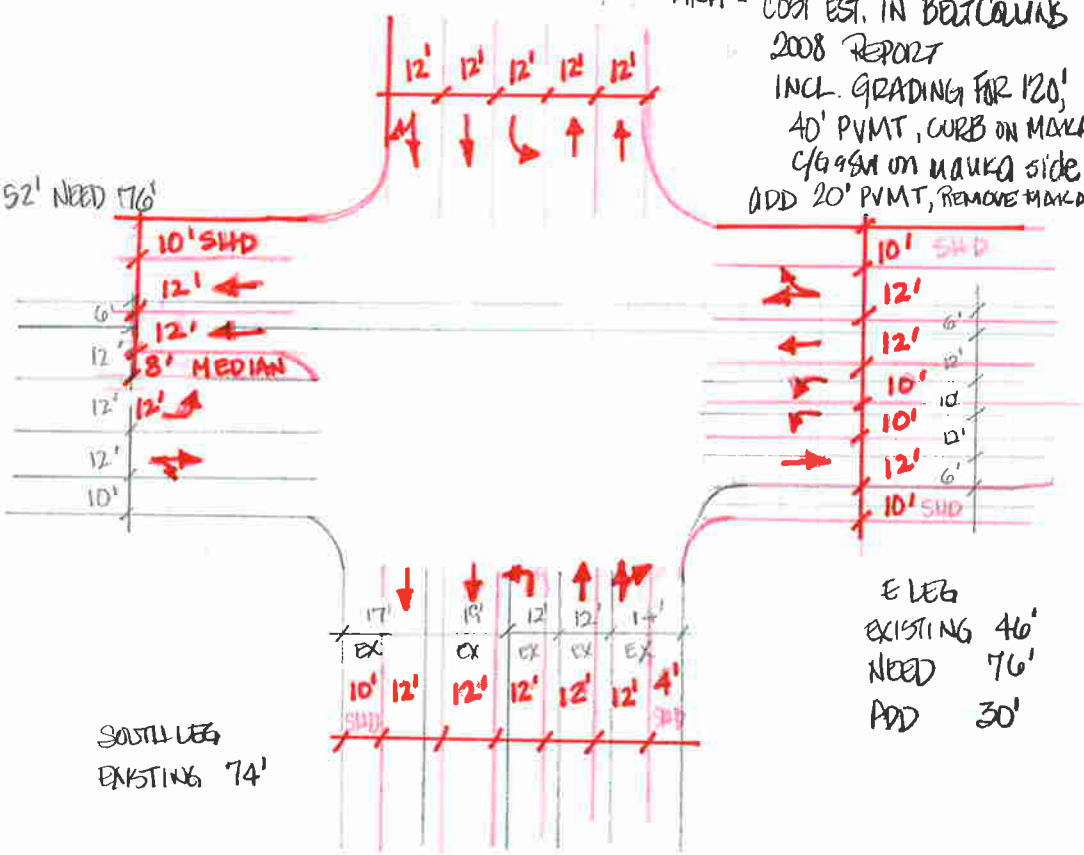
STORAGE REQ'D 345 VEHICLES (PM PK HR)
= 5.75 VEH/MIN OR 11.5 VEH IN 120 SEC.
USE 12 VEH/CYCLE x 1.5 = 18 veh/cycle
ASSUME 25' PER VEHICLE = 450' STORAGE REQ'D

STORAGE = 450'
+ DECEL = 275'
+ TAPER 8:1 = 100'
825'

HAVE 1,400' TO I/S 3

AKH - COST EST. IN BELTCOLLINS 2008 REPORT
INCL. GRADING FOR 120', 40' PVMT, CURB ON MAUKA C/G & SW ON MAUKA SIDE
ADD 20' PVMT, REMOVE MAUKA CURB

ON PALANI RD:
W LEG EXISTING 52' NEED 76'
ADD 24'



E LEG
EXISTING 46'
NEED 76'
ADD 30'

SOUTH LEG
EXISTING 74'

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BY NKP DATE 7-29-08 CLIENT KAHUP ATTACHMENT B SHEET NO. 4 OF 12

CHECKED _____ DATE _____ JOB _____ JOB NO. LA07-2145

I/S 4 (CON'T)

NORTH LEG - AKI highway

NEED 60', 40' PVMT INCLUDED IN BELT COLLINS EST

ADD 20' PVMT BTW. I/S 4 AND I/S 7 = 2,750'

PER BELT COLLINS REPT DATED JUNE 2008
ANE KEOHOKALOLE HWY EST ASSUMED 120' GRADING,
40' PVMT, CURB ON MAKAI, C/G & SW ON MAUKA FOR 4,670'
ROAD CONST. COSTS = $9,878,836.00 or $2,115.00/LF

USING COSTS TO PRORATE FOR 40' GRADING, 40' PVMT
$5,803,103.00 or $1,243.00/LF

FOR NEW SECTION - NO ADDITIONAL GRADING OR 4670 OF
CONCRETE CURB, ADD REMOVAL OF CONCRETE CURB
ON MAKAI SIDE (@ $1/LF)
$5,621,806.00 or $1,204.00/LF

$\frac{20}{40} \times 1{,}204.00 = \$602.00/LF$

$2{,}750' \times \$602/LF = \$1{,}655{,}500.00$ ←

WEST LEG

FOR PALANI RD. PER BELT COLLINS REPT DATED JUNE 2008
EST ASSUMED FOR 1,410 LF - 12' MED W/AC CURBS
10' AC PAVED SHLD (FULL DEPTH)
8' AC PAVED SWALE
360' ACCEL LANE
300' TAPER
275' DECEL
90' STORAGE
150' TAPER

$946,200.00 ÷ 1,410 LF =
$671.00/LF

subtract signing, marking, signs
traffic control
mobilization
water pollution and erosion
control measures
(<$264,500.00>)

= $681,700.00 ÷ 1,410 LF
= $483.48/LF use $500/LF

$\frac{24'}{22'} \times \$500/LF \times 825' = \$450{,}000.00$

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TRANSPORTATION CONSULTANTS

BY NLP DATE 7-29-08 CLIENT KAHMP SHEET NO. 5 OF 12

CHECKED _____ DATE _____ JOB _____ JOB NO. LA07-2145

I/S4 (CON'T)

EAST LEG $\left(\frac{30'}{22} \times \$500^{00}/LF \times 395\ LF\right) + 300 \times \frac{(12 \times 0.5)}{22} \times \$500^{00}/LF$ (269,318 / 40,909)

= $310,227

SOUTH LEG RESTRIPING ONLY SAY $311,000^{00}$

STORAGE REQ'MT = 454 VEH RT IN AM PK HR
= 7.6 VEH/MIN x 1.5 = 11.4 VEH/MIN
25' PER VEH = 285' STORAGE
DECEL FOR 35 MPH = 222'
507'

SUBTOTAL ROAD COSTS = $1,655,500^{00} + \$450,000^{00} + \$311,000^{00}$
= $2,416,500^{00}$
FOG SEAL - SEE NEXT SHEET $382,500^{00}$ } $2,799,000^{00}$

STRIPING

MED ISLAND (DBL-DBL YELLOW)

WLEG	825'	POCKET	INCL DECEL & TAPER (150')
ELEG	1,025'	POCKET	" " " (100')
HENRY	507'	POCKET	W/DECEL
	2,357'		

CROSS-WALK
HENRY 75'
WLEG 80'
ELEG 80'
} 235'

FOG LINE 4" WHITE 2(1,400) + 2(1,250) + 2(507') = 6,314'
LEADLINES 7(50') = 350'
} 6,664'

CHANNELIZING LANE (8") 300' + 2(300') + 200' = 1100'

4" LANE LINES 300' + 1,400' + 1,250' = 2,950'

LEGENDS
TYPE III ARROWS 4 LEFT x 42 SQFT = 168 SF
TYPE II ARROWS 4 ↑↑ x 45 SQFT = 180 SF
TYPE I ARROW 2 ↑ x 25 SQFT = 50 SF
} 398 SQFT

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BY NKP DATE 7-25-08 CLIENT KAHMP - ATTACHB SHEET NO. 6 OF 12

CHECKED _____ DATE _____ JOB _____ JOB NO. LA07-2145

I/S 1 (CON'T)

13,071 LF OF PAINT x $2/LF = $26,142.00
633 SQFT OF PAINT LEGENDS x $6/SF = $3,798.00 } $31,740 SAY $32,000.00

SIGNS ⇒ ASSUME 9 @ $200/SIGN = $1800.00

REMOVE STRIPING BY GRINDING = COST OF INSTALL

FOG SEAL

W LEG 80' x 1,400 = 112,000 SF
E LEG 80' x 1,250 = 100,000 SF
HENRY 80' x 507 = 40,560 SF } 252,560 SF
SAY 255,000 SF @ $1.50/SF
= $382,500.00

ATTACHMENT C

ANE KEOHOKALOLE HIGHWAY & MAJOR SITE ACCESS ROAD

FEHR & PEERS
Transportation Consultants

PRELIMINARY COST ESTIMATE

SHEET 1 OF 1
DATE July 29, 2008
LOCATION IS7:AKHwy/MajAcc
Project No. LA07-2145

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
	ROAD CONSTRUCTION COSTS				
				SUB-TOTAL :	
				SUB-TOTAL :	
	TRAFFIC SIGNAL COSTS				
	Traffic signal installation[1]	LS	Lump Sum	$500,000.00	$500,000.00
	20% Contingencies[2]			$100,000.00	$100,000.00
				SUB-TOTAL :	$600,000.00
	Design & Constr Services (15% of Signal Costs)[2]	LS	Lump Sum	$90,000.00	$90,000.00
				SUB-TOTAL :	$90,000.00

Notes : [1]Per R.Thiel, Hawaii County Department of Public Works, Traffic Division;[2]Per Appendix G

TOTAL : $690,000.00

Estimated by : Natalie K. Porter

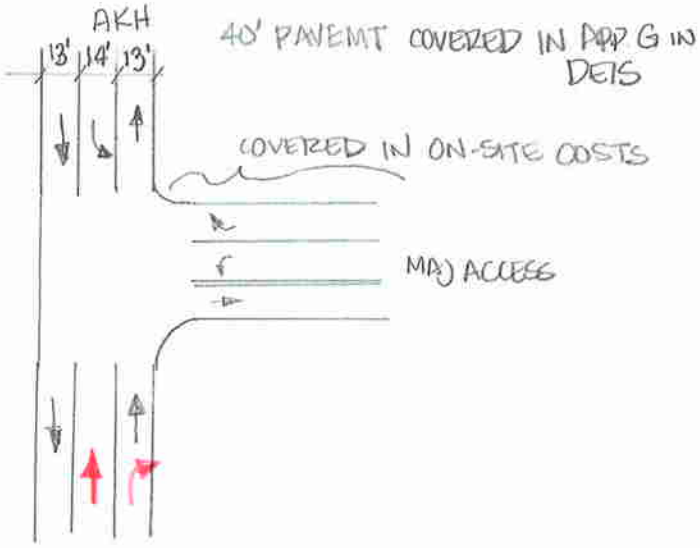
FEHR & PEERS
TRANSPORTATION CONSULTANTS

BY NKP DATE 7-29-08 CLIENT KAHMP ATTACH C SHEET NO. 7 OF 12

CHECKED _____ DATE _____ JOB _____ JOB NO. LA07-2145

I/S 7: ANE KEOHOKALOLE HWY & MAJOR SITE ACCESS RD.

SIGNALIZE



FEHR & PEERS
Transportation Consultants

PRELIMINARY COST ESTIMATE

SHEET 1 OF 1
DATE July 29, 2008
LOCATION IS7:AKHwy/MajAcc2
Project No. LA07-2145

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
	ROAD CONSTRUCTION COSTS				
	Mobilization	LS	Lump Sum	$6,000.00	$6,000.00
	Additional left-turn lanes	LS	Lump Sum	$126,000.00	$126,000.00
	Additional signing and striping	LS	Lump Sum	$4,500.00	$4,500.00
	20% Contingencies[1]			$27,300.00	$27,300.00
				SUB-TOTAL :	**$163,800.00**
	Design & Constr Services (15% of Road Constr Costs)[1]	LS	Lump Sum	$24,570.00	$24,570.00
				SUB-TOTAL :	**$24,570.00**
	TRAFFIC SIGNAL COSTS				
	Traffic signal installation[2]	LS	Lump Sum	$500,000.00	$500,000.00
	20% Contingencies[1]			$100,000.00	$100,000.00
				SUB-TOTAL :	**$600,000.00**
	Design & Constr Services (15% of Signal Costs)[1]	LS	Lump Sum	$90,000.00	$90,000.00
				SUB-TOTAL :	**$90,000.00**

Notes : [1]Per Appendix G; [2]Per R.Thiel, Hawaii County Department of Public Works, Traffic Division. **Alternative Future Scenario**

TOTAL : $878,370.00

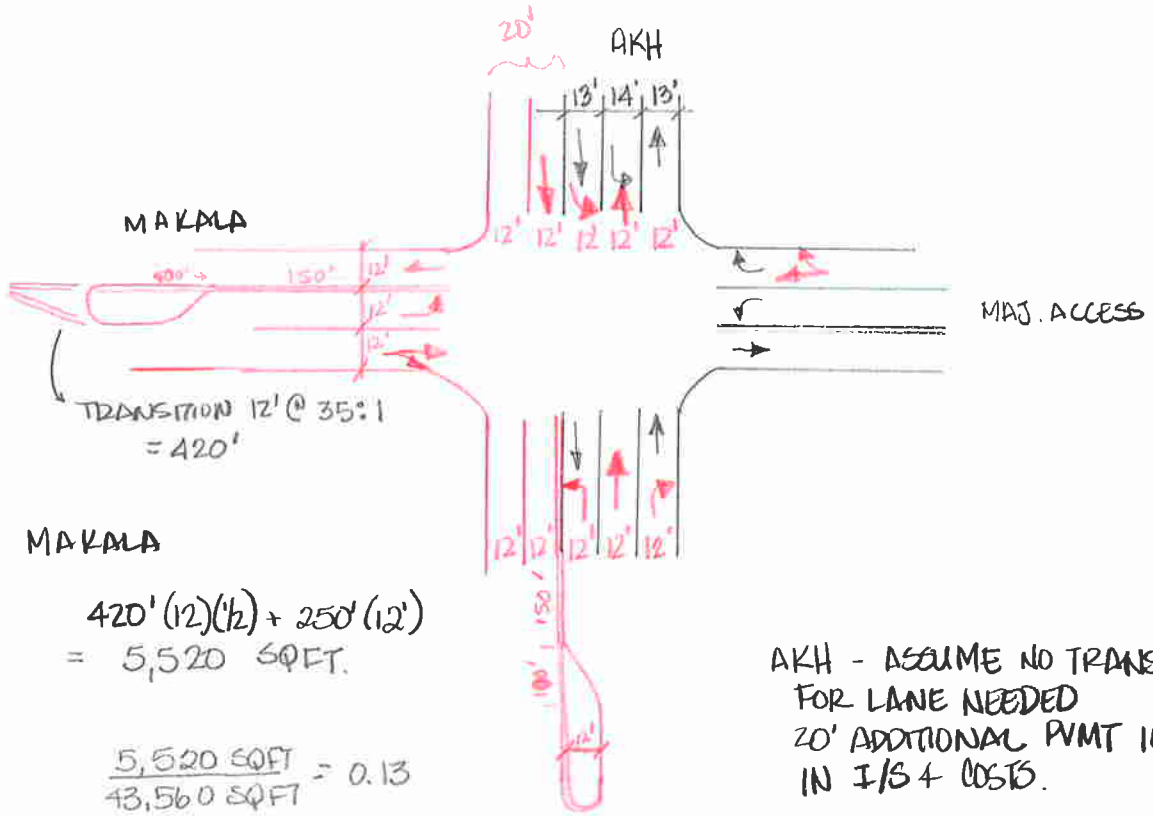
Estimated by : Natalie K. Porter

FEHR & PEERS
TRANSPORTATION CONSULTANTS

BY NKP DATE 7-29-08 CLIENT KALIMP ATTACH C SHEET NO. 8 OF 12

CHECKED _____ DATE _____ JOB _____ JOB NO. LA07-2145

I/S 7: ANE KEOHOKALOLE HWY & MAJOR SITE ACCESS / MAKALA BLVD
SIGNALIZE +
ADD: 150' LEFT TURN POCKET + 100' CURVE TRANSITION TAPER
ON NB AKH AND MAUKA BOUND MAKALA BLVD



420' (12)(½) + 250' (12')
= 5,520 SQFT.

$\frac{5,520 \text{ SQFT}}{43,560 \text{ SQFT}} = 0.13$

AKH - ASSUME NO TRANSITION
FOR LANE NEEDED
20' ADDITIONAL PVMT INCLUDED
IN I/S 4 COSTS.

$\frac{12'}{22'} \times \$500^{00}/LF \; (250 + (420 \cdot 0.5))$ = $125,454^{55} SAY $126,000^{00}
460

STRIPING DBL YELLOW 250' + 250' + 100' + 100' + 12' + 12' + 420' + 420' = 1,564'

CHANNELIZATION LANE 8" WHITE = 150' + 150' = 300'
1864' @ $2/LF = $3,728^{00}

2 TYPE III ARROWS @ 42 SQFT = 84 SQFT
@ $6/SQFT = $504

$4,232 SAY $4,500^{00}

ATTACHMENT D

PALANI ROAD (SR 190) & KEALAKAA STREET/PAHILIHOLO STREET

FEHR & PEERS
Transportation Consultants

PRELIMINARY COST ESTIMATE

SHEET 1 OF 1
DATE July 29, 2008
LOCATION IS8:Kealakaa/Palani
Project No. LA07-2145

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
	ROAD CONSTRUCTION COSTS				
	Roadwork[1]	LS	Lump Sum	$1,160,000.00	$1,160,000.00
	Signing & Striping (Install & Removal)	LS	Lump Sum	$9,100.00	$9,100.00
	Mobilization (for Road portion)	LS	Lump Sum	$58,000.00	$58,000.00
	Water Pollution & Erosion Control Measures	LS	Lump Sum	$5,000.00	$5,000.00
	20% Contingencies[2]			$246,420.00	$246,420.00
				SUB-TOTAL :	**$1,478,520.00**
	Traffic Control (10% of Road Constr Costs)	LS	Lump Sum	$147,852.00	$147,852.00
	Design & Constr Services (15% of Road Constr Costs)[2]	LS	Lump Sum	$221,778.00	$221,778.00
	Environmental Document (1% of Road Constr Costs)[3]	LS	Lump Sum	$14,785.20	$14,785.20
				SUB-TOTAL :	**$384,415.20**

Notes : [1]Per Appendix G: pro-rated, [2]Per Appendix G of DEIS, [3]Per N.Basu/A.Kato

TOTAL : $1,862,935.20

Estimated by : Natalie K. Porter

FEHR & PEERS
TRANSPORTATION CONSULTANTS

BY NKP DATE 7-25-08 CLIENT KAHMP ATTACH D SHEET NO. 9 OF 12

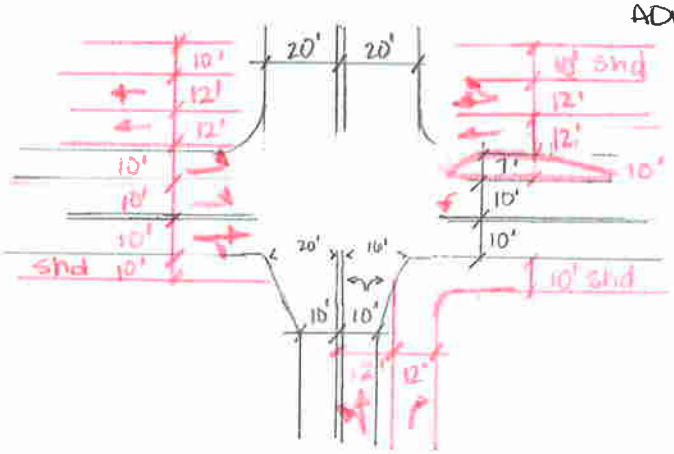
CHECKED _____ DATE _____ JOB _____ JOB NO. LA07-2145

I/S 8 KEALAKAA ST. / PAHILIHOLO ST & PALANI RD (SR 190)

WEST LEG EXIST 27' WIDE

ADD 47'

PAHILIHOLO & KEALAKAA ST
POST SPEED LIMIT 25 MPH
USE 30 MPH DESIGN SPEED
ADVANCE LOOPS @ 140'



EAST LEG
EXIST 27' WIDE
ADD 47'

STRIPING

CHANNELIZING (8") = 300' + 150' + 150' + 150' = 170'
EB WB NB SB

LIMIT LINE = 24' + 30' + 20' + 24' = 98'
EDGELINE = 600 × 2 = 1200'
DBL YELLOW ℄ = 150' + 150' + 285' + 600' = 1185'

ARROWS TYPE III × 5 = 210
TYPE II × 4 = 180 } 390 + 98 = 488 SF

PAINT = 2555' × $1.50/LF = $3,832.50
LEGEND = 488' × $6.0/SF = $2,928.00 } $6,760.50
SAY $6,800.00

REMOVAL OF STRIPING VIA GRINDING = COST TO INSTALL STRIPING
INCLUDED IN UNIT COST OF $671/LF

FEHR & PEERS
TRANSPORTATION CONSULTANTS

BY NKP DATE 7-25-08 CLIENT KAHMP ATTACH'D SHEET NO. 10 OF 12

CHECKED _____ DATE _____ JOB _____ JOB NO. LA07-2145

I/S 8 (CON'T)

W LEG EXIST = 27' NEED 74' ADD 47'

$\frac{47}{22}$ x \$500/LF x 585' = \$624,886.36

STORAGE 506 VEH / PM PK HR
= 8.4 VEH/MIN = 4.2 VEH/MIN/LANE
4.2 x 1.5 = 6.3 veh x 25'/veh = 158
decel for 40 mph = 275
Taper = 150
583
USE 585'

E LEG EXIST 27' WIDE NEED 74' ADD 47'

STORAGE 49 veh/pm pk hr = 0.8 veh/min
0.8 x 1.5 = 1.2 veh/min x 25'/veh = 30'
decel = 275'
taper = 100'
405'
use 410'

$\frac{47}{22}$ x \$500/LF x 410' = \$437,954.55

S LEG 20' EXIST NEED 34' ADD 14'

STORAGE 32 veh/pk hr
= 0.53 veh/min x 1.5 x 25'/veh = 19.9 = 20'
decel for 30 mph = 170'
taper = 100'
290'
use 300'

$\frac{14}{22}$ x \$500.00 x 300' = \$95,454.55

TOTAL ROADWORK = \$1,158,295.46

SAY \$1,160,000.00

ATTACHMENT E

ULUAOA STREET & PALANI ROAD (SR 190)

FEHR & PEERS
Transportation Consultants

PRELIMINARY COST ESTIMATE

SHEET 1 OF 1
DATE July 29, 2008
LOCATION IS10:Uluaoa/Palani
Project No. LA07-2145

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
	ROAD CONSTRUCTION COSTS				
	Fog Seal Finish ($1.5/SF)	LS	Lump Sum	$32,000.00	$32,000.00
	Signing & Striping (Install & Removal)	LS	Lump Sum	$9,000.00	$9,000.00
	Mobilization (for Road portion)	LS	Lump Sum	$2,000.00	$2,000.00
	Water Pollution & Erosion Control Measures	LS	Lump Sum	$2,000.00	$2,000.00
	20% Contingencies[1]			$9,000.00	$9,000.00
				SUB-TOTAL :	$54,000.00
	Traffic Control (10% of Road Constr Costs)	LS	Lump Sum	$5,400.00	$5,400.00
	Design & Constr Services (15% of Road Constr Costs)[1]	LS	Lump Sum	$8,100.00	$8,100.00
	Environmental Document (10% of Road Constr Costs)	LS	Lump Sum	$5,400.00	$5,400.00
				SUB-TOTAL :	$18,900.00
	TRAFFIC SIGNAL COSTS				
	Signal Installation[2]	LS	Lump Sum	$500,000.00	$500,000.00
	20% Contingencies[1]			$100,000.00	$100,000.00
				SUB-TOTAL :	$600,000.00
	Design & Constr Services (15% of Signal Costs)[1]	LS	Lump Sum	$90,000.00	$90,000.00
				SUB-TOTAL :	$90,000.00

Notes : [1]Per Appendix G of DEIS; [2]Per R.Thiel, Hawaii County Department of Public Works, Traffic Division

TOTAL : $762,900.00

Estimated by : Natalie K. Porter

FEHR & PEERS
TRANSPORTATION CONSULTANTS

BY NKP DATE 7-25-08 CLIENT KAHMP ATTACH E&F SHEET NO. 11 OF 12

CHECKED _____ DATE _____ JOB _____ JOB NO. LA07-2145

I/S 10: ULUAOA ST & PALANI RD (SR 190)
SIGNALIZE
RESTRIPE
FOGSEAL

ULUAOA @ 30 MPH DESIGN SPEED = 140' FOR ADV. LOOPS
PALANI @ 40 MPH D.S. = 230' FOR ADV. LOOPS

PALANI (230' + 40' + 230') x 30' = 15,000 SQFT
I/S
ULUAOA (140' + 20') x 36' = 5,760 SQFT
} 20,760 SQFT.

20,760 SQ.FT. x $1.50 /SQFT = $31,140.00 SAY $32,000.00

STRIPING: DBL YELLOW (230' + 230' + 205') = 665'
LIMIT LINE 18' + 10' + 10' = 38'
EDGE LINE 230' x 4 = 920'

1585' x $2/LF = $3,170
38 SF x $6/SQFT = 228
} $4,398 SAY $4,500.00
ASSUME 5 SIGNS @ $200/SIGN
REMOVE EXISTING STRIPING BY GRINDING = COST TO INSTALL

I/S 12: ANE KEOHOKALOLE HWY & KEALAKEHE PKWY
SIGNALIZE, RESTRIPE, FOGSEAL

AKH @ 35 mph D.S = 185' ADV LOOPS
KEALAKEHE @ 40 mph DS = 230' ADV LOOPS

FOGSEAL AKH (185' + 48' + 185') x 60' = 25,080 SF
KEALAKEHE (230' + 60' + 230') x 48' = 24,960 SF

50,040 SF x $1.50/SF
= $75,060 SAY $76,000.00

STRIPING: DBL YELLOW (230 x 2) + (185 x 2) = 830'
EDGE LINE (230 x 4) + (185 x 4) = 1660'
} 2,490 x $2/LF = $4,980.00

LIMIT LINE = 30 + 30 + 24 + 24 = 108'
ARROWS 4 x TYPE III x 42 = 168
2 x TYPE II x 45 = 90
} 366 SF x $6/LF = $2,196.00

$7,176
SAY $7,500

REMOVE EXISTING STRIPING BY GRINDING = COST TO INSTALL

ATTACHMENT F

ANE KEOHOKALOLE HIGHWAY & KEALAKEHE PARKWAY

FEHR & PEERS
Transportation Consultants

PRELIMINARY COST ESTIMATE

SHEET 1 OF 1
DATE July 29, 2008
LOCATION IS12:Kealakehe/AKH
Project No. LA07-2145

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
	ROAD CONSTRUCTION COSTS				
	Fog Seal Finish ($1.5/SF)	LS	Lump Sum	$76,000.00	$76,000.00
	Signing & Striping	LS	Lump Sum	$15,000.00	$15,000.00
	Mobilization (for Road portion)	LS	Lump Sum	$4,000.00	$4,000.00
	Water Pollution & Erosion Control Measures	LS	Lump Sum	$2,000.00	$2,000.00
	20% Contingencies[1]			$19,400.00	$19,400.00
				SUB-TOTAL :	$116,400.00
	Traffic Control (10% of Road Constr Costs)	LS	Lump Sum	$11,640.00	$11,640.00
	Design & Constr Services (15% of Road Constr Costs)[1]	LS	Lump Sum	$17,460.00	$17,460.00
				SUB-TOTAL :	$29,100.00
	TRAFFIC SIGNAL COSTS				
	Signal Installation[2]	LS	Lump Sum	$500,000.00	$500,000.00
	20% Contingencies[1]			$100,000.00	$100,000.00
				SUB-TOTAL :	$600,000.00
	Design & Constr Services (15% of Signal Costs)[1]	LS	Lump Sum	$90,000.00	$90,000.00
				SUB-TOTAL :	$90,000.00

Notes : [1]Per Appendix G of DEIS; [2]Per R.Thiel, Hawaii County Department of Public Works, Traffic Division

TOTAL : $835,500.00

Estimated by : Natalie K. Porter

FEHR & PEERS
TRANSPORTATION CONSULTANTS

BY NKP DATE 7-25-08 CLIENT KAHMP ATTACH E&F SHEET NO. 11 OF 12

CHECKED _____ DATE _____ JOB _____ JOB NO. LA07-2145

I/S 10: ULUAOA ST & PALANI RD (SR 190)
SIGNALIZE
RESTRIPE
FOGSEAL

ULUAOA @ 30 MPH DESIGN SPEED = 140' FOR ADV. LOOPS
PALANI @ 40 MPH D.S. = 230' FOR ADV. LOOPS

PALANI (230' + 40' I/S + 230') x 30' = 15,000 SQFT.
ULUAOA (140' + 20') x 36' = 5,760 SQFT
} 20,760 SQFT.

20,760 SQ.FT. x $1.50 /SQFT = $31,140.00 SAY $32,000.00

STRIPING: DBL YELLOW (230' + 230' + 205') = 665'
LIMIT LINE 18' + 10' + 10' = 38'
EDGE LINE 230' x 4 = 920'

1585' x $2/LF = $3,170
38 SF x $6/SQFT = 228
} $4,398 SAY $4,500.00
ASSUME 5 SIGNS @ $200/SIGN
REMOVE EXISTING STRIPING BY GRINDING = COST TO INSTALL

I/S 12: ANE KEOHOKALOLE HWY & KEALAKEHE PKWY
SIGNALIZE, RESTRIPE, FOGSEAL

AKH @ 35 mph D.S = 185' ADV LOOPS
KEALAKEHE @ 40 mph DS = 230' ADV LOOPS

FOGSEAL AKH (185' + 48' + 185') x 60' = 25,080 SF
KEALAKEHE (230' + 60' + 230') x 48' = 24,960 SF

50,040 SF x $1.50/SF
= $75,060 SAY $76,000.00

STRIPING: DBL YELLOW (230 x 2) + (185 x 2) = 830'
EDGE LINE (230 x 4) + (185 x 4) = 1660'
} 2,490 x $2/LF = $4,980.00

LIMIT LINE = 30 + 30 + 24 + 24 = 108'
ARROWS 4 x TYPE III x 42 = 168
2 x TYPE II x 45 = 90
} 366 SF x $6/LF = $2,196.00

$7,176
SAY $7,500

REMOVE EXISTING STRIPING BY GRINDING = COST TO INSTALL

ATTACHMENT G

PALANI ROAD (SR 190) SOUTH OF MAMALAHOA HIGHWAY

FEHR & PEERS
Transportation Consultants

PRELIMINARY COST ESTIMATE

SHEET 1 OF 1
DATE July 29, 2008
LOCATION SS10:Palani Rd
Project No. LA07-2145

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
	ROAD CONSTRUCTION COSTS				
	Roadwork[1]	LF	3000	$500.00	$1,500,000.00
	Adjust Private Driveways	EA	3	$3,000.00	$9,000.00
	Traffic Control	LS	Lump Sum	$10,000.00	$10,000.00
	Mobilization (for Road portion)	LS	Lump Sum	$500,000.00	$500,000.00
	Relocate Power Line[3]	LF	3000	$296.00	$888,000.00
	Water Pollution & Erosion Control Measures	LS	Lump Sum	$5,000.00	$5,000.00
	20% Contingencies[2]			$582,400.00	$582,400.00
				SUB-TOTAL :	**$3,494,400.00**
	Traffic Control (10% of Road Constr Costs)	LS	Lump Sum	$349,440.00	$349,440.00
	Design & Constr Services (15% of Road Constr Costs)[2]	LS	Lump Sum	$524,160.00	$524,160.00
	Environmental Document (1% of Road Constr Costs)[4]	LS	Lump Sum	$34,944.00	$34,944.00
				SUB-TOTAL :	**$908,544.00**

Notes : [1]Per Appendix G, pro-rated, [2]Per Appendix G of DEIS, [3]Per Steve Sakai (6-12-08), [4]Following consultation with Alan Kato (6-16-08)

TOTAL : $4,402,944.00

Estimated by : Natalie K. Porter

FEHR & PEERS
TRANSPORTATION CONSULTANTS

BY NKP DATE 6-17-08 CLIENT SHEET NO. ~~9~~ 12 OF ~~9~~ 12 REV.

CHECKED DATE JOB JOB NO. LA 07-2145

PALANI ROAD WIDENING SOUTH OF MAMALAHOA HWY
~ 3,000' to HAO KUNI ST.

① USE ~~$1,000~~ 500 /LF FOR WIDENING PALANI ROAD by 22' (12' LANE, 10' SHOULDER) PER ALAN KATO VIA E-MAIL (6-13-08)

② ADJUST 3 DWYS @ $3,000/EA = $9,000.00

③ RELOCATE POWERLINE: COST PER STEVE SAKAI via email (6-12-08)
ESCALATED COST TO 2007 INSTEAD OF 2009 FOR CONSISTANCY W/A
15% CONTINGENCY

COST DOES NOT INCLUDE FIBER OPTIC CABLES ON THE POLES OR ROW COSTS.

USE $296 /LF

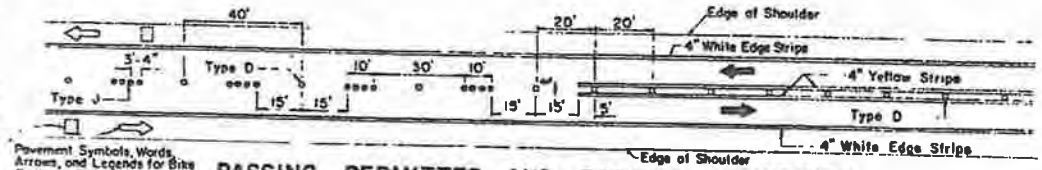
ATTACHMENT H

ADDITIONAL INFORMATION &

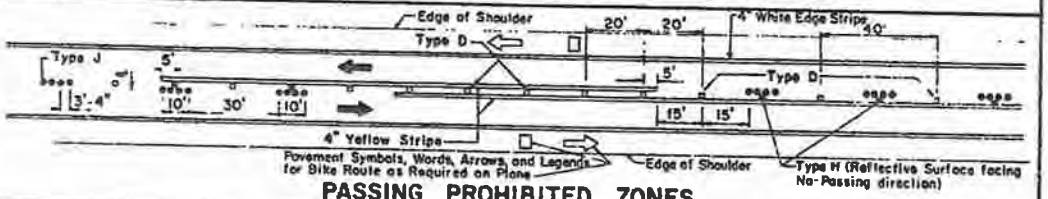
EXCERPTS FROM APPENDIX G OF

KEAHUOLU AFFORDABLE HOUSING PROJECT, DRAFT EIS

FEBRUARY 2008

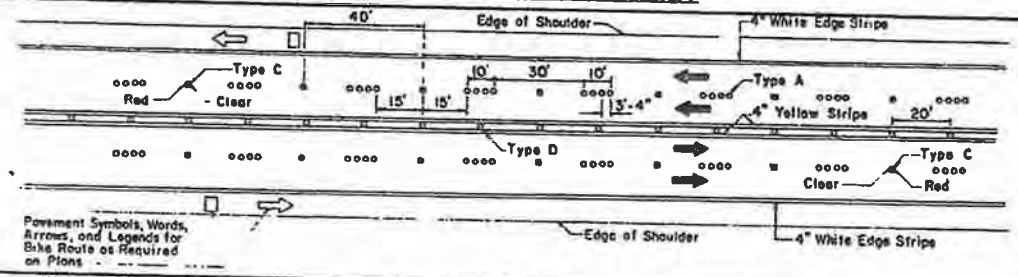


PASSING PERMITTED AND PASSING PROHIBITED

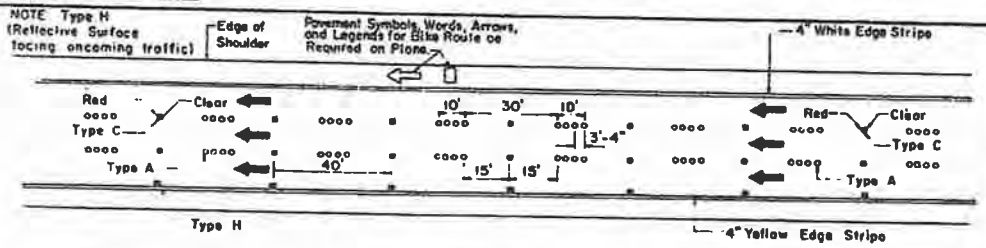


PASSING PROHIBITED ZONES

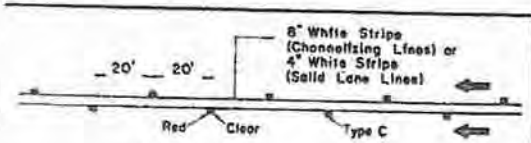
TWO - LANE



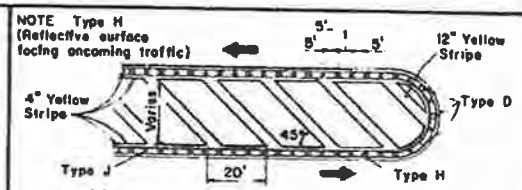
MULTI - LANE



DIVIDED HIGHWAY AND FREEWAY



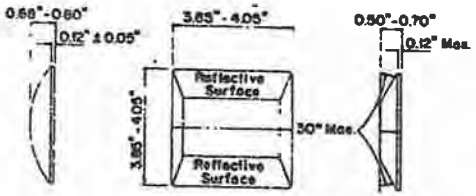
CHANNELIZING LINES OR SOLID LANE LINES



MEDIAN NOSE DELINEATION

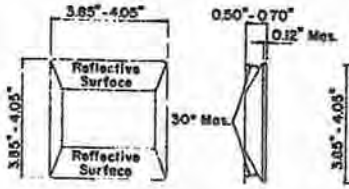
MISCELLANEOUS

TYPE A
NON-REFLECTIVE WHITE MARKER

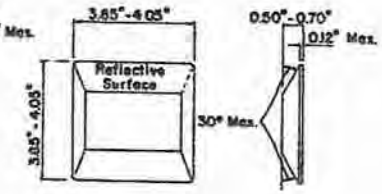


TYPE C
RED - CLEAR REFLECTIVE MARKER

TYPE J
NON-REFLECTIVE YELLOW MARKER



TYPE D
TWO - WAY YELLOW REFLECTIVE MARKER



TYPE H
ONE - WAY YELLOW REFLECTIVE MARKER

GENERAL NOTES

1. Pavement marking and striping shall conform to the latest "Manual on Uniform Traffic Control Devices for Streets and Highways," and as amended
2. Layout and installation of pavement marking and striping shall be done by the Contractor. The Contractor shall check the layouts with the Engineer prior to performing work.
3. Edge lines shall not be continued through intersections and shall not be broken for driveways unless otherwise shown or directed

LEGEND

- ○ Type A
- ▣ Type C
- □ Type D
- ■ Type H
- ● Type J

DATE	REVISION	APP'D.

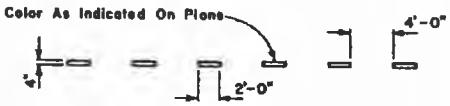
STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

STANDARD PLAN TE-30

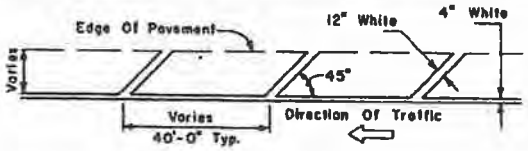
RAISED PAVEMENT MARKERS AND STRIPING

Eric Tanaka — APPROVED — 1/21/86 DATE

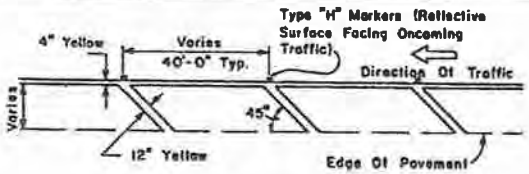
STANDARD PLAN TE-30 07/01/86



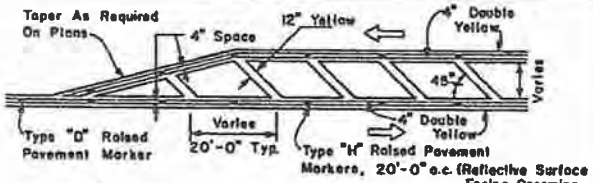
INTERSECTION GUIDE LINE



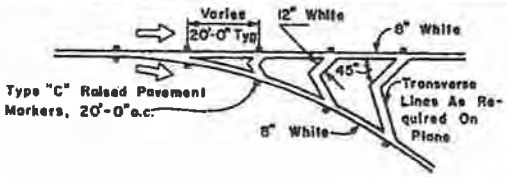
TRANSVERSE RIGHT SHOULDER MARKING



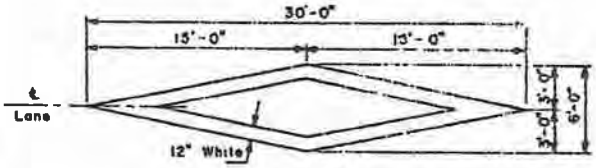
TRANSVERSE LEFT SHOULDER MARKING



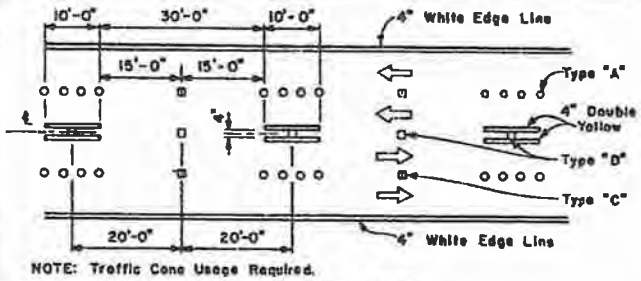
TRANSVERSE MEDIAN MARKING



CHANNELIZING ISLAND

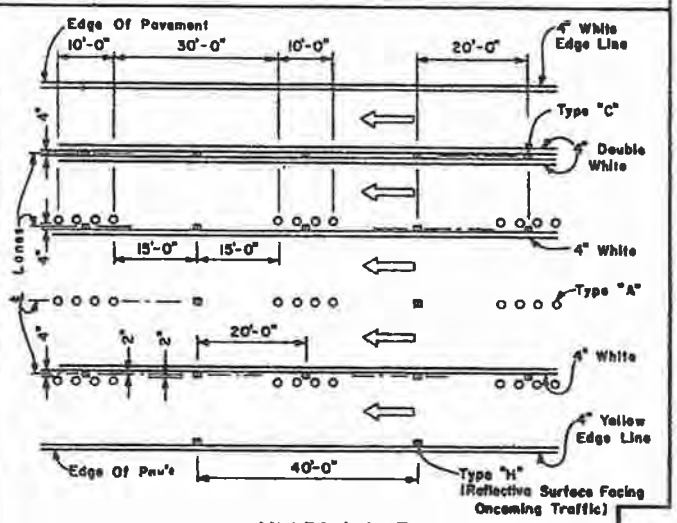


PAVEMENT DIAMOND



NOTE: Traffic Cone Usage Required.

MULTI-LANE REVERSIBLE LANES



MULTI-LANE LANE CHANGE RESTRICTION ZONES

GENERAL NOTES:

1. Pavement marking and striping shall conform to the latest edition of the "Manual on Uniform Traffic Control Devices for Streets and Highways," by the FHWA, and as amended.
2. Layout of pavement markings and striping shall be done by the Contractor. The Contractor shall check layout of markings and striping with the Engineer prior to performing work.
3. For additional pavement marking details, see Standard Plan TE-30.

DATE	REVISION	APP'D

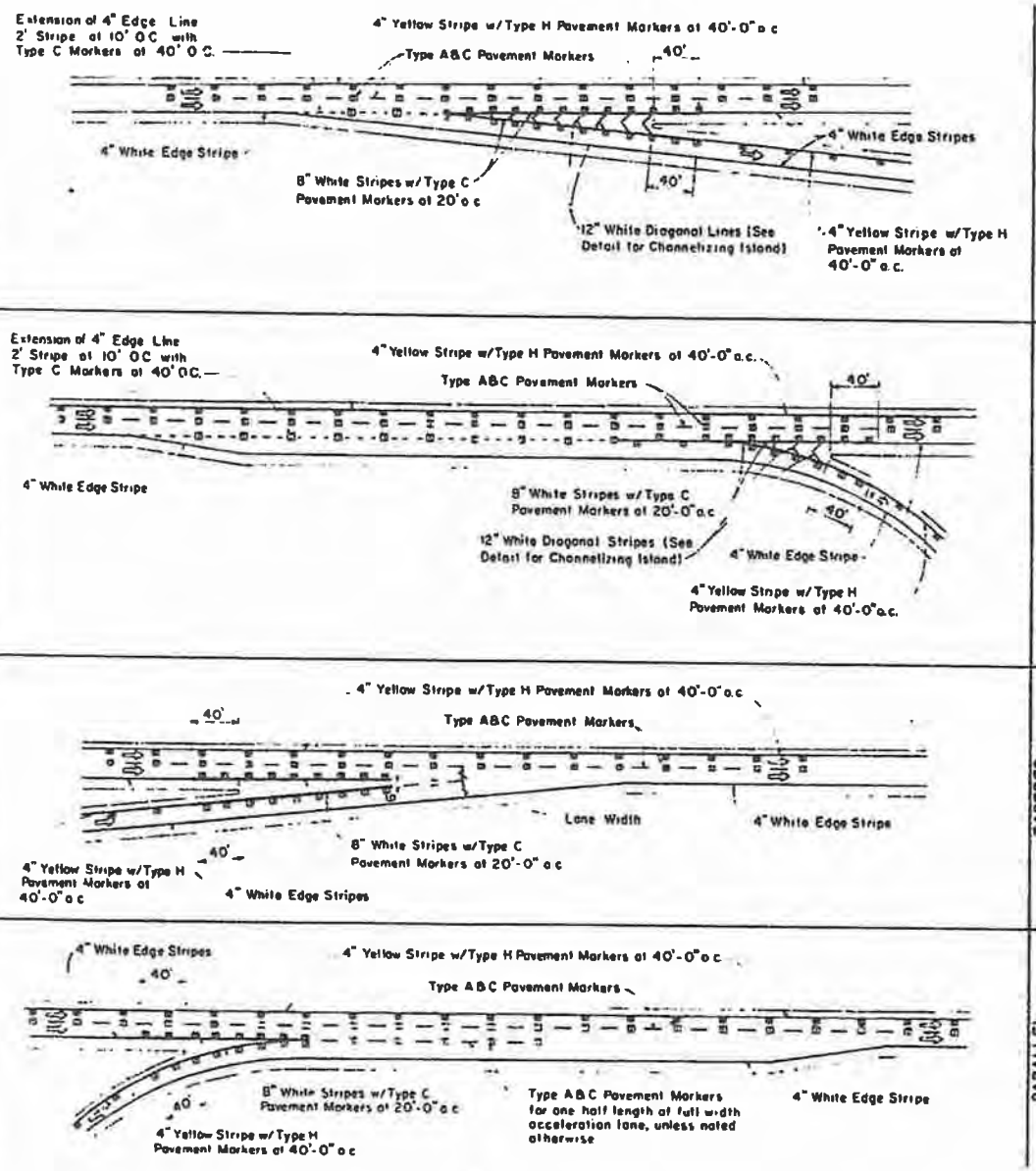
STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

STANDARD PLAN TE-31

MISCELLANEOUS PAVEMENT MARKINGS

APPROVED — DATE

STANDARD PLAN TE-31 07/01/86



GENERAL NOTES:

1. Pavement Markings and Striping shall conform to the latest edition of the "Manual on Uniform Traffic Control Devices for Streets and Highways," by the FHWA, and as amended.
2. Layout of Pavement Markings and Striping shall be done by the Contractor. The Contractor shall check layout of markings and striping with the Engineer prior to performing work
3. For additional details, see Standard Plan TE-30.

DATE	REVISION	APP'D
7/1/87	Revised Parallel Deceleration Lane Markings.	RK

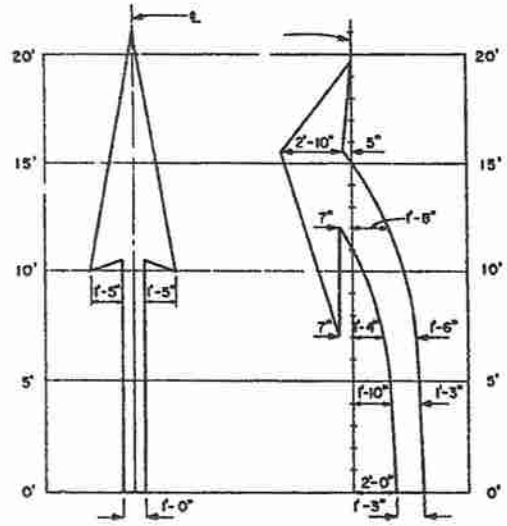
STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

STANDARD PLAN TE-32

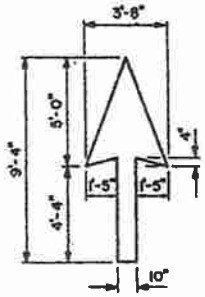
MISCELLANEOUS PAVEMENT MARKINGS

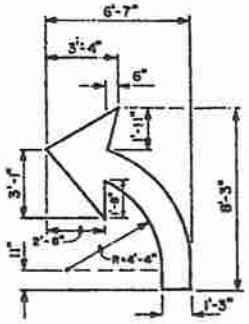
APPROVED — DATE

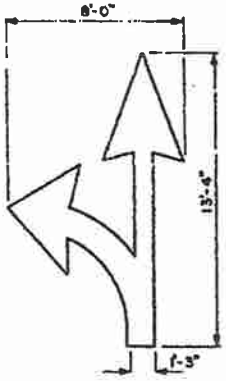
STANDARD PLAN TE-32 r09/01/87



ELONGATED

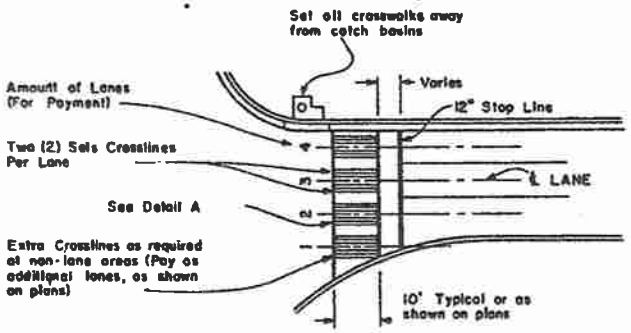




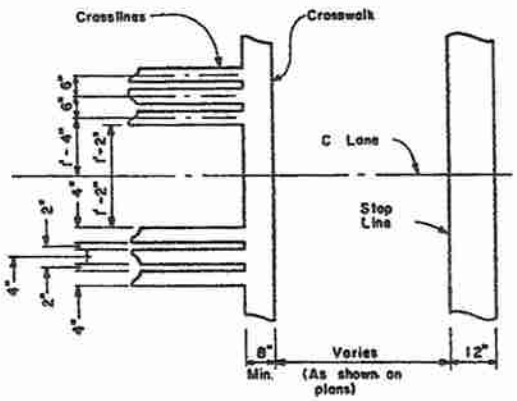


STANDARD

PAVEMENT ARROWS



PLAN



DETAIL "A"

CROSSWALK & STOP LINE

GENERAL NOTES:

1. Pavement marking and striping shall conform to the latest edition of the "Manual on Uniform Traffic Control Devices for Streets and Highways," by the FHWA, and as amended.
2. Layout of pavement markings and striping shall be done by the Contractor. The Contractor shall check layout of markings and striping with the Engineer prior to performing work.
3. For additional pavement marking details, see Standard Plan TE-30.

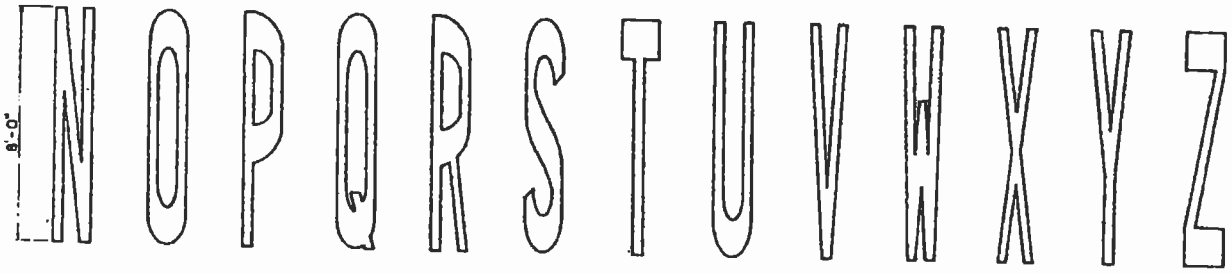
DATE	REVISION	APP'D.

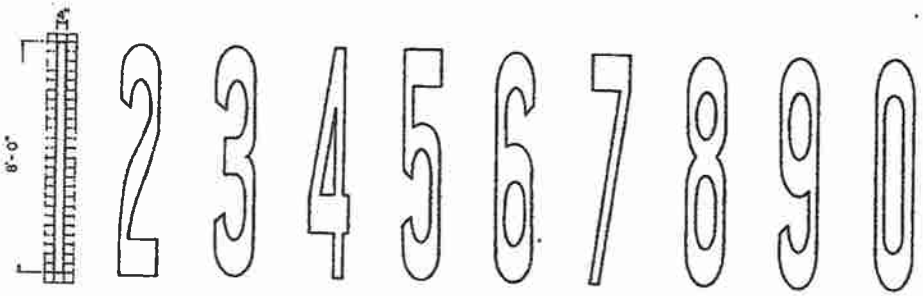
STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

STANDARD PLAN TE-33

MISCELLANEOUS PAVEMENT MARKINGS

Einoli Tanaka — APPROVED
1/31/86 — DATE





GENERAL NOTES

1. Pavement Alphabets, Numbers and Symbols shall conform to the latest edition of the FHWA publication, "Manual on Uniform Traffic Control Devices for Streets and Highways" and its amendments
2. The characters are based on a 24x4 (height x width) grid system to facilitate enlarging. Horizontal strokes are 4 units high and verticle strokes are 1 unit wide
3. Unless otherwise noted, the typical height and width of each character shall respectively be 8'-0" and 1'-4". The horizontal strokes shall be 16" high and the vertical strokes shall be 4" wide
4. All pavement messages and symbols shall be laid out by the Contractor and and approved by the Engineer prior to installation

DATE	REVISION	APP'D.

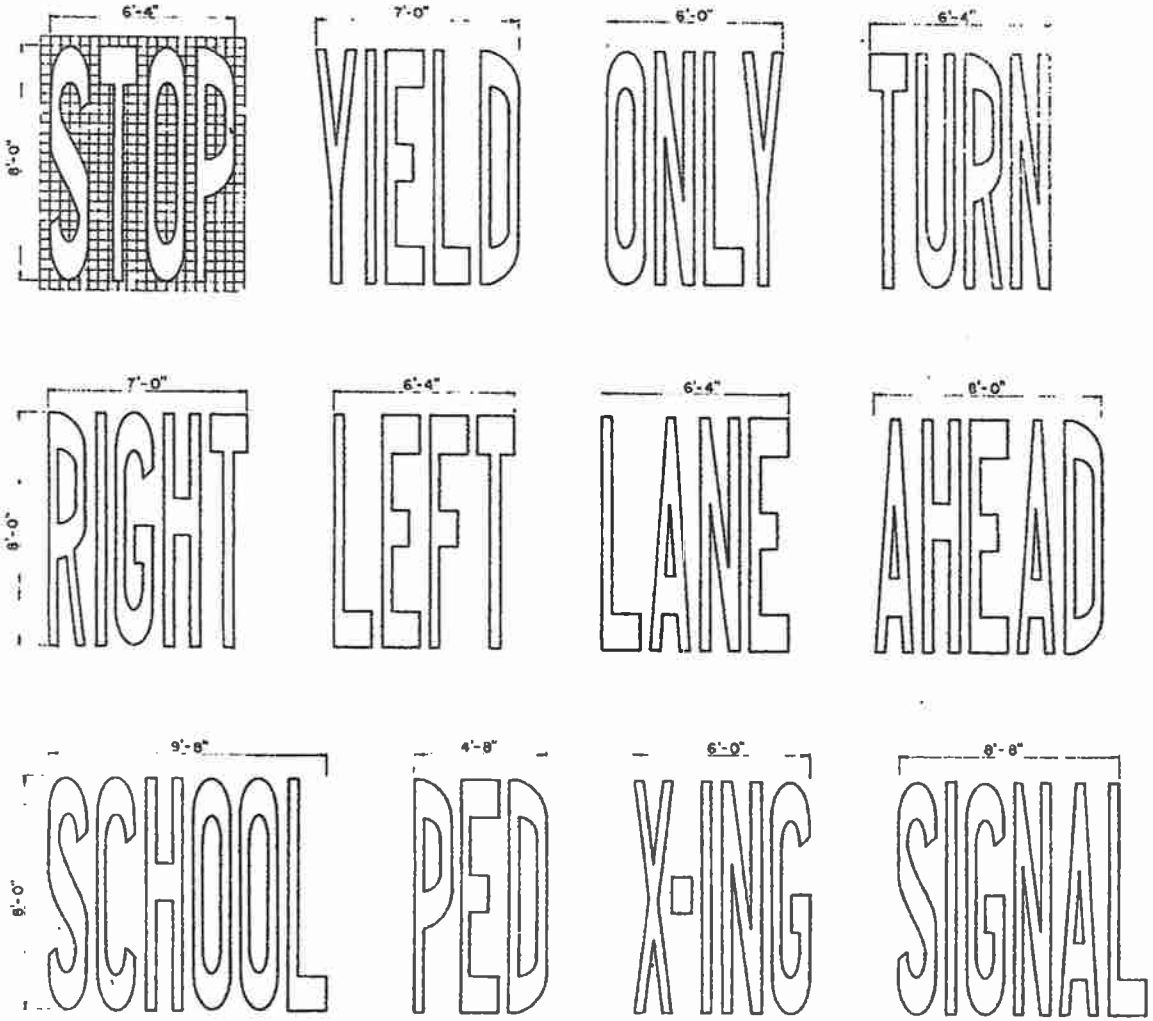
STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

STANDARD PLAN TE-35

PAVEMENT ALPHABETS NUMBERS & SYMBOLS

APPROVED 1/31/86 DATE

STANDARD PLAN TE-35 07/01/86



GENERAL NOTES

1. All messages not shown must be approved by the Engineer prior to installation.
2. The space between characters in a message shall be 1 grid unit unless otherwise shown or directed.
3. All pavement messages shall be white in color.

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

STANDARD PLAN TE-36

PAVEMENT ALPHABETS, NUMBERS & SYMBOLS

APPROVED — DATE

DATE	REVISION	APP'D.

STANDARD PLAN TE-36 07/01/86

CIVIL INFRASTRUCTURE

KEAHUOLU AFFORDABLE HOUSING PROJECT

KAILUA-KONA, HAWAII
TMK: (3) 7-4-021: 20

PREPARED FOR:

Hawaii Housing Finance & Development Corporation
677 Queen Street, Suite 300
Honolulu, Hawaii 96813

PREPARED BY:

BeltCollins

Belt Collins Hawaii Ltd.
2153 North King Street, Suite 200
Honolulu, Hawaii 96819

June 2008

3.1 ROADWAYS AND TRAFFIC

The County of Hawaii's proposed Ane Keohokalole Highway is key to full buildout of the Keahuolu project. Without Ane Keohakolole Highway, vehicular access to the site would be limited to access on Keanalehu Drive, and one possible connection to Palani Road. See Figure 3-1: Road System, following the text of this report.

Ane Keohokalole Highway would be a minor arterial with a 120-foot-wide right-of-way and posted speed limit of 35 miles per hour. Two lanes are proposed in each direction. The County plans to designate the highway as a bus transit corridor. A regional bus transit stop at the Ane Keohokalole Highway/Makala Boulevard intersection fronting the Keahuolu project is proposed. Bus stops are also proposed on Ane Keohokalole Highway for local circulators serving the *mauka* and *makai* neighborhoods.

Landowners with frontage to Ane Keohokalole Highway would be expected to share in the cost of constructing the highway. The projected order-of-magnitude cost of the portion fronting the project property, including one lane in each direction plus a middle turn lane with drainage but excluding other utilities, would be $13,633,000. For planning purposes, the project would be allocated responsibility for half of this off-site road improvement cost, or $6,816,500. This estimate would be the same for Concepts A, B and C. For details on the road cost, see Appendix A. (Note: All costs presented in this report are in 2007 dollars.)

A right in/right out intersection is proposed along Palani Road. To minimize impacts on traffic along Palani Road, the intersection would include deceleration and acceleration lanes and a raised median to prevent vehicles from attempting to make left turn movements. The order-of-magnitude cost for the Palani Road intersection would be $1,306,000.

Keahuolu's internal roadways would be pedestrian friendly streets, which accommodate cars, bicycles and pedestrians. The roadways would be designed to County of Hawaii Department of Public Works standards for dedication to the County. The layout of the internal roads would be determined by the developer to coordinate with the development concept. An order-of-magnitude cost for the internal roadways, including water, sewer, drainage, electric, telephone and cable television utilities, based on the concept plan is $122,725,000.

Existing traffic conditions are assessed in a separate report.

3.2 SITE GRADING AND EROSION CONTROL

The project does not propose major grading of the site. The existing topography would be altered only to the extent necessary for construction of the proposed improvements. It is anticipated that grading would occur on a localized scale and that cut and fill quantities would generally balance as construction progresses. Grading permits, approved by the State Department of Land and Natural Resources Historic Preservation Division, the County Planning Department and the County Department of Public Works would be required for all grading activities.

During all phases of construction, erosion control practices would comply with State, County and Federal regulations. National Pollutant Discharge Elimination System (NPDES) general permit coverage authorizing discharges of storm water associated with construction activities would be required for the project from the State Department of Health, Environmental Management Division,

Appendix A
Roads

HHFDC Keahuolu Lands
Off-Site Road System Costs

OFF-SITE ROAD SYSTEM

Item No.	Estimated Quantity	Description	Unit Price	Total	
Ane Keohokalole Highway					
1- 1	1	Lump Sum, Clearing and Grubbing	$ 40,000.00	$ 40,000	
1- 2	1	Lump Sum, Water Pollution and Erosion Control Measures	$ 200,000.00	$ 200,000	
1- 3	83,000	Cu. Yds., Excavation	$ 43.00	$ 3,569,000	1,189,667
1- 4	83,000	Cu. Yds., Embankment	$ 29.00	$ 2,407,000	802,333
1- 5	17.2	Acres, Grading	$ 8,000.00	$ 137,600	45,867
1- 6	186,800	Sq. Ft., AC Pavement for Roadways	$ 8.00	$ 1,494,400	
1- 7	4,670	Lin. Ft., Concrete Curb	$ 30.00	$ 140,100	
1- 8	4,670	Lin. Ft., Concrete Curb and Gutter	$ 60.00	$ 280,200	
1- 9	44,365	Sq. Ft., 4" Concrete Sidewalk with Base Course	$ 12.70	$ 563,436	
1- 10	6	Each, Centerline Monuments	$ 600.00	$ 3,600	
1- 11	1	Lump Sum, Striping and Marking	$ 20,000.00	$ 20,000	
1- 11	30	Each, Sign, Post and Footing	$ 450.00	$ 13,500	
1- 11	1	Lump Sum, Traffic Signal Modification	$ 200,000.00	$ 200,000	
1- 11	16	Each, Catch Basin with Dry Well	$ 20,000.00	$ 320,000	
1- 11	16	Each, Dry Well	$ 12,000.00	$ 192,000	
1- 11	16	Each, Drain Inlet and piping	$ 8,000.00	$ 128,000	
1- 11	1	Lump Sum, Traffic Control	$ 30,000.00	$ 30,000	
1- 11	1	Lump Sum, Construction Surveys	$ 40,000.00	$ 40,000	
1- 12	1	Lump Sum, Mobilization/Demobilization	$ 100,000.00	$ 100,000	
		Subtotal for Ane Keohokalole Highway		$ 9,878,836	
		Contingency (20%)		$ 1,975,767	
		Subtotal		$ 11,854,603	
		Design and Construction Services (15%)		$ 1,778,190	
		Total		$ 13,632,793	
		SAY		**$ 13,633,000**	

Note: 4,670 Linear feet of Ane Keohokalole Highway.
Half Section: 40 feet of pavement = One lane in each direction +
^Mauka middle turn lane. curb on makai side, cg & sidewalk on mauka side
For water and sewer improvements, see separate costs.

$9,878,836 ÷ 4,670 LF = $2,115.38/LF

FOR 40' grading & 40' paved Rd
cost = 1/3 excavation & embankment or $1,992,000.00
assume other costs are representative
subtotal = $5,803,103.00 or $1,243.00/LF
subtotal w/o any grading, 4,670 LF of concrete curb = $5,617,136.00 or $1,203.00/LF
add curb removal-makai @ $1/LF = $5,621,806.00 or $1,204.00/LF

HHFDC Keahuolu Lands
Off-Site Road System Costs

OFF-SITE ROAD SYSTEM

Item No.	Estimated Quantity	Description	Unit Price	Total
Palani Road Intersection				
1- 1	1	Lump Sum, Clearing and Grubbing	$ 7,000.00	$ 7,000
1- 2	1	Lump Sum, Water Pollution and Erosion Control Measures	$ 15,000.00	$ 15,000
1- 3	0	Cu. Yds., Excavation	$ 43.00	$ 0
1- 4	1,700	Cu. Yds., Embankment	$ 29.00	$ 49,300
1- 5	1.7	Acres, Grading	$ 8,000.00	$ 13,600
1- 6	59,500	Sq. Ft., AC Pavement for Roadways	$ 8.00	$ 476,000
1- 7	2,000	Lin. Ft., AC Curb	$ 20.00	$ 40,000
1- 8	3	Each, Centerline Monuments	$ 600.00	$ 1,800
1- 9	1	Lump Sum, Striping and Marking	$ 15,000.00	$ 15,000
1- 10	10	Each, Sign, Post and Footing	$ 450.00	$ 4,500
1- 11	7	Each, Dry Well	$ 12,000.00	$ 84,000
1- 12	1	Lump Sum, Traffic Control	$ 150,000.00	$ 150,000
1- 13	1	Lump Sum, Construction Surveys	$ 10,000.00	$ 10,000
1- 14	1	Lump Sum, Mobilization/Demobilization	$ 80,000.00	$ 80,000
		Subtotal for Palani Road Intersection		$ 946,200
		Contingency (20%)		$ 189,240
		Subtotal		$ 1,135,440
		Design and Construction Services (15%)		$ 170,316
		Total		$ 1,305,756
		SAY		**$ 1,306,000**

Notes: 1,410 Linear Feet of new Acceleration and Deceleration Lanes with
12' Median with AC curbs
10' AC paved shoulder
8' AC paved swale
Taper = 150', Deceleration = 275', Storage = 50'
Curve Radius = 150'
Acceleration = 360', Taper = 300'

$946,200 ÷ 1,410 ≅ $671.00/LF

HHFDC Keahuolu Lands
On-Site Road System Costs

ON-SITE ROADS

Item No.	Estimated Quantity	Description	Unit Price	Total
On-Site Roads				
1- 1	5,600	Lin. Ft., 80' Right-of-Way Roads	$ 2,250.00	$ 12,600,000
1- 2	24,200	Lin. Ft., 60' Right-of-Way Roads	$ 1,930.00	$ 46,706,000
1- 3	16,550	Lin. Ft., 50' Right-of-Way Roads	$ 1,790.00	$ 29,624,500
		Subtotal for On-Site Roads		$ 88,930,500
		Contingency (20%)		$ 17,786,100
		Subtotal		$ 106,716,600
		Design and Construction Services (15%)		$ 16,007,490
		Total		$ 122,724,090
		SAY		**$ 122,725,000**

Notes: Lengths of On-Site Roads based on Keahuolu Land Use Plan Concept, dated June 2007.
Cost is 2007 dollars

HHFDC Keahuolu Lands
On-Site Road System Costs

Item No.	Estimated Quantity	Description	Unit Price	Total
80' Right-of-Way Roads				
2- 1	1	Lin. Ft., Clearing and Grubbing	$ 32.14	$ 32.14
2- 2	1	Lin. Ft., Erosion Control Measures	$ 48.21	$ 48.21
2- 3	1	Lin. Ft., Roadway Excavation/Embankment	$ 200.00	$ 200.00
2- 4	1	Lin. Ft., Roadway Pavement	$ 480.00	$ 480.00
2- 5	1	Lin. Ft., Concrete Curb and Gutter	$ 60.00	$ 60.00
2- 6	1	Lin. Ft., Concrete Sidewalk	$ 133.50	$ 133.50
2- 7	1	Lin. Ft., Signing, Striping and Marking	$ 8.08	$ 8.08
2- 8	1	Lin. Ft., Catch Basin with Sediment Trap	$ 200.00	$ 200.00
2- 9	1	Lin. Ft., Dry Well	$ 233.33	$ 233.33
2- 10	1	Lin. Ft., Sewer System	$ 202.67	$ 202.67
2- 11	1	Lin. Ft., Water System	$ 201.29	$ 201.29
2- 12	1	Lin. Ft., Construction Surveys, Testing, Field Office	$ 200.00	$ 200.00
2- 13	1	Lin. Ft., Electrical System	$ 250.00	$ 250.00
		Subtotal		$ 2,249.21
		SAY		**$ 2,250.00**
60' Right-of-Way Roads				
3- 1	1	Lin. Ft., Clearing and Grubbing	$ 25.71	$ 25.71
3- 2	1	Lin. Ft., Erosion Control Measures	$ 38.57	$ 38.57
3- 3	1	Lin. Ft., Roadway Excavation/Embankment	$ 128.00	$ 128.00
3- 4	1	Lin. Ft., Roadway Pavement	$ 336.00	$ 336.00
3- 5	1	Lin. Ft., Concrete Curb and Gutter	$ 60.00	$ 60.00
3- 6	1	Lin. Ft., Concrete Sidewalk	$ 115.70	$ 115.70
3- 7	1	Lin. Ft., Signing, Striping and Marking	$ 8.08	$ 8.08
3- 8	1	Lin. Ft., Catch Basin with Sediment Trap	$ 166.67	$ 166.67
3- 9	1	Lin. Ft., Dry Well	$ 194.44	$ 194.44
3- 10	1	Lin. Ft., Sewer System	$ 202.67	$ 202.67
3- 11	1	Lin. Ft., Water System	$ 201.29	$ 201.29
3- 12	1	Lin. Ft., Construction Surveys, Testing, Field Office	$ 200.00	$ 200.00
3- 13	1	Lin. Ft., Electrical System	$ 250.00	$ 250.00
		Subtotal		$ 1,927.12
		SAY		**$ 1,930.00**
50' Right-of-Way Roads				
4- 1	1	Lin. Ft., Clearing and Grubbing	$ 22.50	$ 22.50
4- 2	1	Lin. Ft., Erosion Control Measures	$ 33.75	$ 33.75
4- 3	1	Lin. Ft., Roadway Excavation/Embankment	$ 98.00	$ 98.00
4- 4	1	Lin. Ft., Roadway Pavement	$ 256.00	$ 256.00
4- 5	1	Lin. Ft., Concrete Curb and Gutter	$ 60.00	$ 60.00
4- 6	1	Lin. Ft., Concrete Sidewalk	$ 115.70	$ 115.70
4- 7	1	Lin. Ft., Signing, Striping and Marking	$ 8.08	$ 8.08
4- 8	1	Lin. Ft., Catch Basin with Sediment Trap	$ 157.89	$ 157.89
4- 9	1	Lin. Ft., Dry Well	$ 184.21	$ 184.21
4- 10	1	Lin. Ft., Sewer System	$ 202.67	$ 202.67
4- 11	1	Lin. Ft., Water System	$ 196.29	$ 196.29
4- 12	1	Lin. Ft., Construction Surveys, Testing, Field Office	$ 200.00	$ 200.00
4- 13	1	Lin. Ft., Electrical System	$ 250.00	$ 250.00
		Subtotal		$ 1,785.08
		SAY		**$ 1,790.00**

Infrastructure for the proposed project would be built over an approximately 12-year period as the project site is developed. Construction is anticipated to begin in 2008/2009 and provide the required infrastructure for the initial stages of development in 2010. From 2010 until 2020, the infrastructure would be expanded to accommodate the entire project. Construction of the proposed development is anticipated to be completed by 2020.

4.8.1 Roadway System

4.8.1.1 Existing Conditions

Palani Road is the only existing road bordering the project, along the southern boundary. The proposed Ane Keohokalole Highway would border the project along the makai boundary, and the proposed Keanalehu Drive would border the project along the mauka boundary. Keanalehu Drive and Manawale‘a Street, along the northern-mauka tip of the project, are currently under construction with a projected completion date of late 2008.

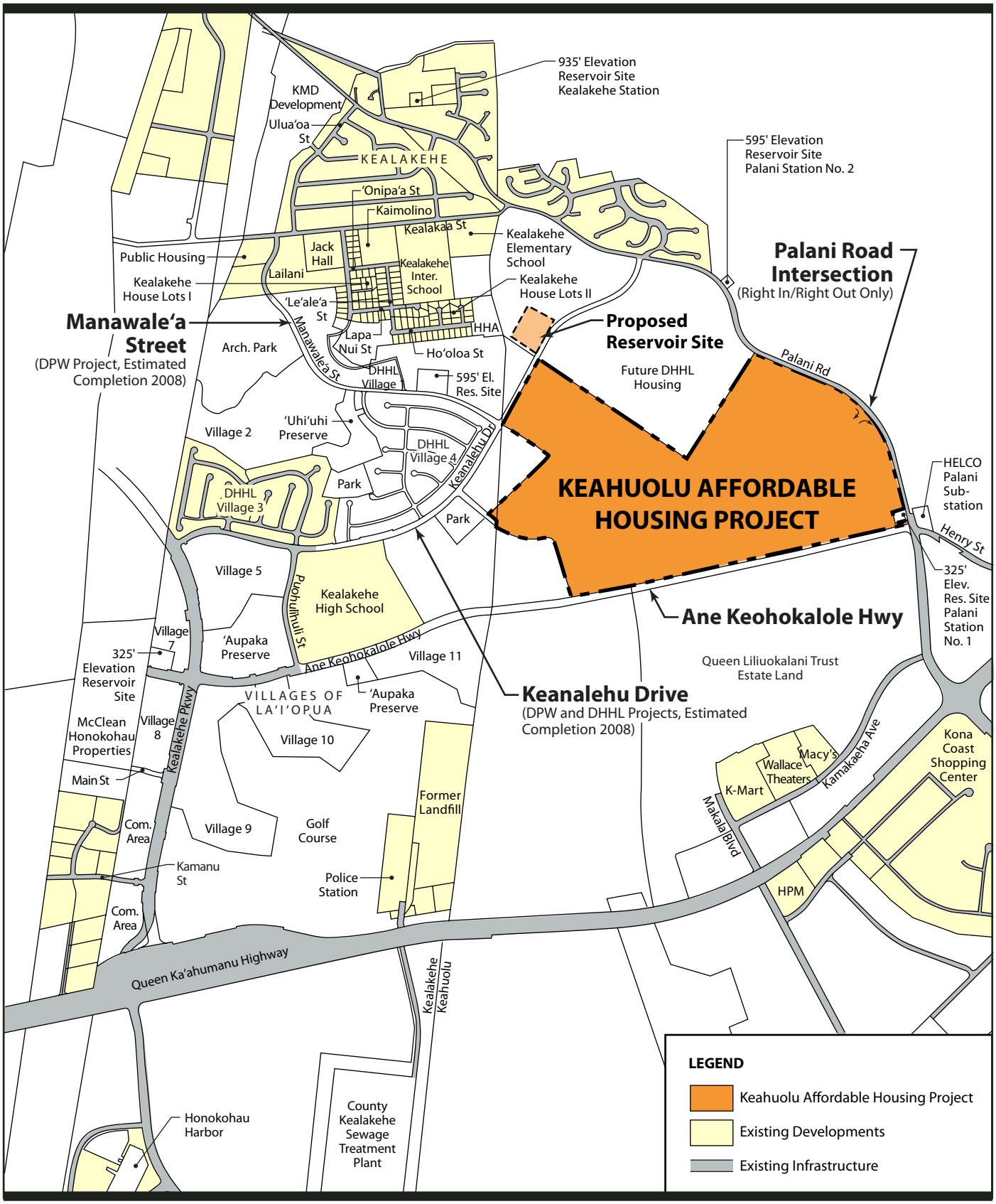
4.8.1.2 Proposed Roadway System, Potential Impacts, and Mitigation Measures

Off-Site Roadway System

The County’s proposed Ane Keohokalole Highway is key to full buildout of the Keahuolu project. Without Ane Keohokalole Highway, vehicular access to the site would be limited to Keanalehu Drive and one possible connection to Palani Road. See Figure 4-13.

Ane Keohokalole Highway would be a minor arterial with a 120-foot-wide ROW and posted speed limit of 35 miles per hour. Two lanes are proposed in each direction. The County plans to designate the highway as a bus transit corridor. A regional bus transit stop at the Ane Keohokalole Highway/Makala Boulevard intersection fronting the Keahuolu project is proposed. Bus stops are also proposed on Ane Keohokalole Highway for local circulators serving the mauka and makai neighborhoods.

©2008 Belt Collins Hawaii Ltd. 2006.70.0900/024-2 d2.11.08 1



BeltCollins

NORTH

0 600 1200 1800

SCALE IN FEET

Figure 4-13
ROAD SYSTEM

HHFDC Keahuolu Affordable Housing Project
Environmental Impact Statement
February 2008

Landowners with frontage to Ane Keohokalole Highway would be expected to share in the cost of constructing the highway. The projected order-of-magnitude cost of the portion fronting the project property, including one lane in each direction plus a middle turn lane with drainage but excluding other utilities, would be $13,633,000. For planning purposes, the project would be allocated responsibility for half of this off-site road improvement cost, or $6,816,500. This estimate would be the same for Concepts A, B, and C. For details on the road cost, see the civil infrastructure report in Appendix G.

A right-in/right-out intersection is proposed along Palani Road. To minimize impacts on traffic along Palani Road, the intersection would include deceleration and acceleration lanes and a raised median to prevent vehicles from attempting to make left turn movements. The order-of-magnitude cost for the Palani Road intersection would be $1,306,000.

Internal Road System

Keahuolu's internal roadways would be pedestrian friendly streets, which accommodate cars, bicycles, and pedestrians. The roadways would be designed to County DPW standards for dedication to the County. The layout of the internal roads would be determined by the developer to coordinate with the development concept. Based on the concept plan, an order-of-magnitude cost for the internal roadways, including water, sewer, drainage, electric, telephone and cable television utilities is $122,725,000.

Potential Short-Term and Long-Term Impacts and Mitigative Measures

No significant short-term environmental impacts are anticipated from the development of the roadways associated with this project. Construction will be carried out in compliance with applicable regulations to minimize impacts, including best management practices. The long-term impacts of the proposed roads would not be significant. The traffic impacts associated with the Keahuolu Affordable Housing project are assessed in Section 4.4 of this document.

Table 4-25: Estimated Project Roadway Improvement Costs

Concept	Ane Keohokalole Hwy	Palani Road Intersection	Internal Roadways	Total Roadways Costs
A	$6,816,500 *	$1,306,000	$122,725,000	$130,847,500
B	$6,816,500 *	$1,306,000	$122,725,000	$130,847,500
C	$6,816,500 *	$1,306,000	$122,725,000	$130,847,500

* Assumes a 50 percent share in the cost of off-site road improvements of Ane Keohokalole Highway along the project site's frontage. All costs in 2007 dollars.

4.8.2 Drainage Facilities

4.8.2.1 Existing Conditions

There are currently no existing drainage facilities and no defined natural drainage ways on-site. The high permeability of the existing soils is evident by the absence of any natural storm water channels or gullies in the project area.

4.8.2.2 Proposed Drainage System, Potential Impacts, and Mitigation Measures

Storm water runoff from the site would be collected through swales, ditches, gutters, inlets, and catch basins, and transported through pipes to dry wells, seepage wells, or infiltration areas for disposal. Infiltration areas, seepage wells, and dry wells would be located in open spaces and parking lots, where practical. Dry wells would be located within the roadway right-of-way as needed. A UIC permit is required by the State DOH to construct and operate the dry wells. It is recommended that BMPs be included in the design of the drainage system, such as vegetated swales, bioretention areas, and storm drain filtration devices to capture sediments and prevent pollutants from entering the groundwater.

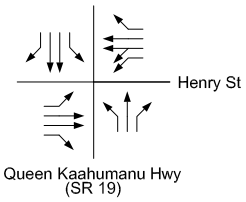
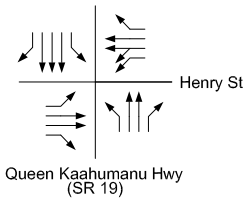
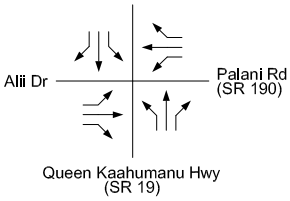
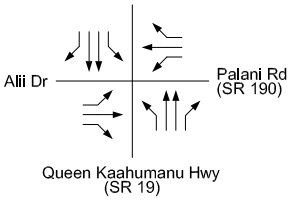
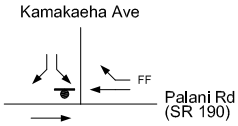
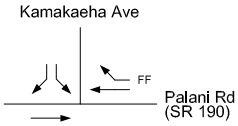
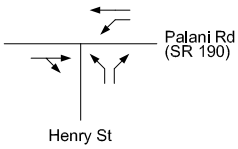
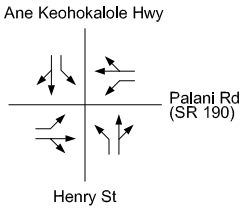
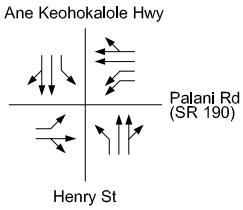
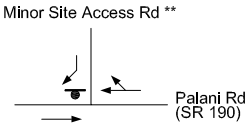
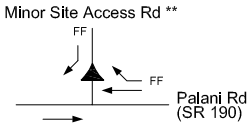
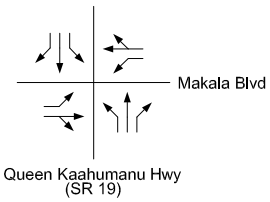
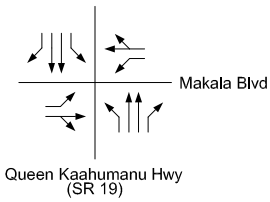
Potential Short-Term Impacts and Mitigation Measures

During grading activities, portions of the site would be disturbed and the potential for site erosion would increase. The contractor would be required to comply with Chapter 10 – Erosion

ATTACHMENT I

INTERSECTION LANE CONFIGURATIONS – WITH PROPOSED IMPROVEMENTS

INTERSECTION LANE CONFIGURATIONS

	EXISTING CONDITIONS	FUTURE CONDITIONS	FUTURE CONDITIONS WITH MITIGATION
1. Queen Kaahumanu Hwy (SR 19) & Henry St			Same As Future Conditions
*2. Queen Kaahumanu Hwy (SR 19) & Palini Rd (SR 190)/Alii Dr			Same As Future Conditions
*3. Kamakaeha Ave & Palani Rd (SR 190)		Same As Existing Conditions	
*4. Henry St/Ane Keohokalole Hwy & Palani Rd (SR 190)			
*5. Minor Site Access Rd & Palani Rd (SR 190)	Intersection Does Not Currently Exist		
6. Queen Kaahumanu Hwy (SR 19) & Makala Blvd			Same As Future Conditions

LEGEND

- Stop Controlled
- FF Free Flow
- * See third page of this attachment for additional detail
- ** The proposed project would construct the new road

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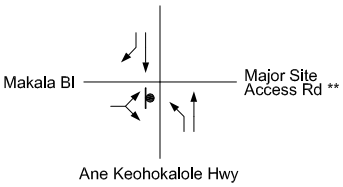
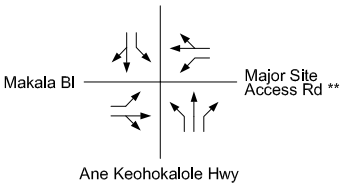
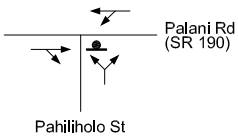
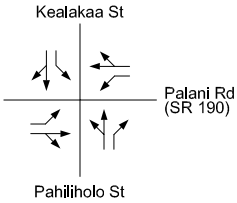
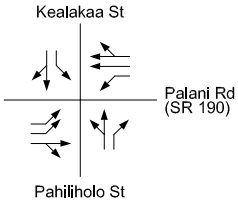
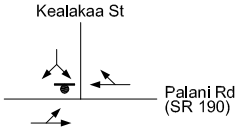
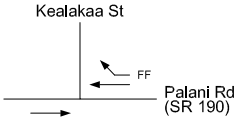
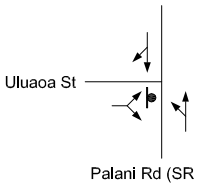
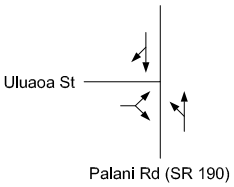
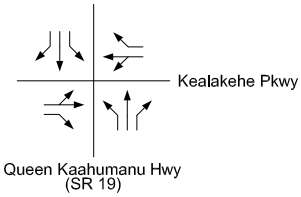
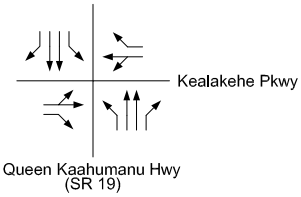
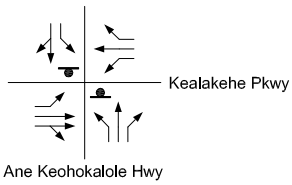
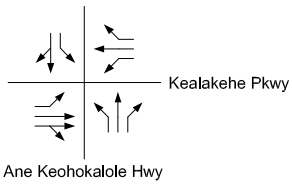
KAKU ASSOCIATES

INTERSECTION LANE CONFIGURATIONS

	EXISTING CONDITIONS	FUTURE CONDITIONS	FUTURE CONDITIONS WITH MITIGATION
7. Ane Keohokalole Hwy & Makala Bl/ Major Site Access Rd	Intersection Does Not Currently Exist		
8. Pahiliholo St & Palani Rd (SR 190)			
9. Kealakaa St & Palani Rd (SR 190)			Same As Future Conditions
		See Also Intersection 8	
10. Palani Rd (SR 190) & Uluaoa St		Same As Existing Conditions	
11. Queen Kaahumanu Hwy (SR 19) & Kealakehe Pkwy			Same As Future Conditions
12. Ane Keohokalole Hwy & Kealakehe Pkwy		Same As Existing Conditions	

LEGEND

- Stop Controlled
- FF Free Flow
- ** The proposed project would construct the new road

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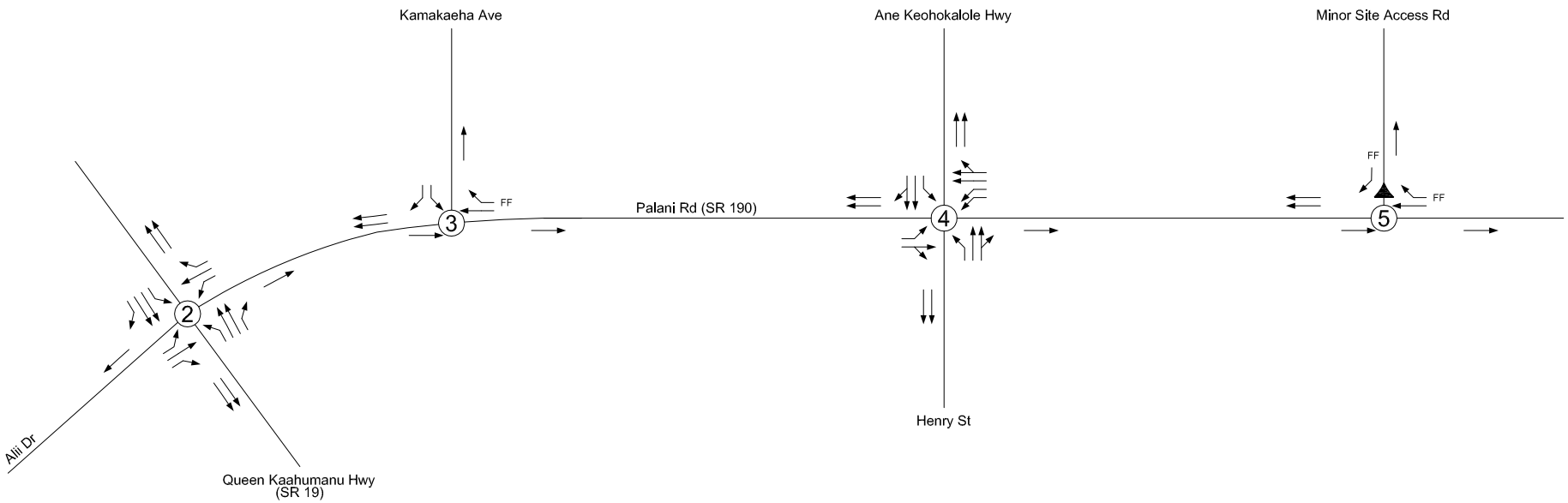
CONFIGURATION OF PALANI ROAD (SR 190) - FUTURE WITH MITIGATION FROM PROJECT SITE TO QUEEN KAAHUMANU HIGHWAY

NOT TO SCALE



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Appendix G

CIVIL INFRASTRUCTURE

KEAHUOLU AFFORDABLE HOUSING PROJECT

KAILUA-KONA, HAWAII
TMK: (3) 7-4-021: 20

PREPARED FOR:

Hawaii Housing Finance & Development Corporation
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Honolulu, Hawaii 96813

PREPARED BY:

Belt Collins Hawaii Ltd.
2153 North King Street, Suite 200
Honolulu, Hawaii 96819

December 2007

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1.0 PROJECT DESCRIPTION

The proposed Keahuolu Affordable Housing project is a master planned community of 1,020 to 2,330 dwelling units (single-family and multi-family residences) on approximately 272 acres of land located at Tax Map Key: (3) 7-4-021: 20 in North Kona, Hawaii. See Figure 1-1: Location Map, and Figure 1-2: Area Map, following the text of this report.

The land use elements of the master planned community includes residential units, commercial/retail space, school facilities, neighborhood parks, archaeological preserves, landscape buffers, open space and associated infrastructure. Infrastructure facilities required to support the development include roads, drainage facilities, potable water system, wastewater collection system, electrical system, telephone system and cable television system.

Three preliminary development plan concepts with varying dwelling unit densities and the projected timeline are summarized in Tables 1-1A, 1-1B and 1-1C.

Table 1-1A: Preliminary Development Plan – Concept A

Year	Land Use		
	Residential Units (multifamily/single family)	Commercial/Retail (SF)	School (SF)
2010	200 / 100		
2011	200 / 100		
2012	200 / 100		
2013	20 / 100		8,700
2014			
2015			
2016			
2017			
2018		100,000	
2019			
2020		97,000	
Total	1,020	197,000	8,700

Table 1-1B: Preliminary Development Plan – Concept B

Year	Land Use		
	Residential Units (multifamily/single family)	Commercial/Retail (SF)	School (SF)
2010	200 / 100		
2011	200 / 100		
2012	200 / 100		
2013	200 / 100		8,700
2014	200 / 100		
2015	200 / 100		
2016	40 / 0		
2017			
2018		100,000	
2019			
2020		97,000	
Total	1,840	197,000	8,700

Table 1-1C: Preliminary Development Plan – Concept C

Year	Land Use		
	Residential Units (multifamily)	Commercial/Retail (SF)	School (SF)
2010	300		
2011	300		
2012	300		
2013	300		8,700
2014	300		
2015	300		
2016	300		
2017	230		
2018		100,000	
2019			
2020		97,000	
Total	2,330	197,000	8,700

The three concepts include a variety of high and medium density multifamily units and low density single-family units. The residential units are located on approximately 162 acres in all three concepts. Table 1-2 provides a breakdown of the units and densities.

Table 1-2: Alternative Concepts

	Alternative Concepts		
	A	B	C
Residential Units			
High density – multifamily	400	800	800
Medium density - multifamily	220	440	1,530
Low density – single-family	400	600	0
Total	1,020	1,840	2,330
Density (dwelling units per acre)			
High density – multifamily	12	24	24
Medium density – multifamily	8	16	12
Low density – single-family	4	6	n/a
Commercial/retail	197,000 SF	197,000 SF	197,000 SF

2.0 EXISTING CONDITIONS

2.1 ROADWAYS AND TRAFFIC

Palani Road is the only existing road bordering the project, along the southern boundary. The proposed Ane Keohokalole Highway would border the project along the *makai* boundary and the proposed Keanalehu Drive would border the project along the *mauka* boundary. Keanalehu Drive and Manawale`a Street, along the northern-*mauka* tip of the project are currently under construction with a projected completion date of late 2008.

2.2 DRAINAGE FACILITIES

There are currently no existing drainage facilities and no defined natural drainage ways onsite. The high permeability of the existing soils is evident by the absence of any natural storm water channels or gullies in the project area.

2.3 WATER SUPPLY

No water is available from the County for new developments in the Kona area. New source well(s) would be required to support the project. There is no existing water system within the project site.

The majority of the project site is within the 595-foot elevation Kealakehe High School reservoir's service zone which extends from the 495-foot elevation to the 225-foot elevation. A portion of the site, along the extension of Keanalehu Drive, above the 495-foot elevation would have to be serviced from the 935-foot reservoir system, to provide adequate water pressure. See Figure 2-1: Water Supply, following the text of this report.

There is existing water system infrastructure around the project area, which connects to existing well sites above Mamalahoa Highway. An existing 16-inch water line in Manawale`a Street from the 595-foot elevation Kealakehe High School reservoir stubs out to the project site, and services the 495 to 225-foot elevation water service pressure zone. A 12-inch water line is under construction in Manawale`a Street as part of the road construction project to provide water service above the 495-foot elevation. There is an existing 16-inch water line in Palani Road along the project site.

A 1.0 million gallon (MG) reservoir exists at the 595-foot elevation Kealakehe High School reservoir site. The site is designed for a second 1.0 MG reservoir. The *Villages of La`i`opua Water Master Plan* (approved October 26, 2006 by the Department of Water Supply) prepared by Akinaka & Associates, Ltd. for the Department of Hawaiian Home Lands allocated 472,800 gallons from the two 1.0 MG reservoirs to the Keahuolu project.

2.4 WASTEWATER COLLECTION, TREATMENT, AND DISPOSAL

Hawaii County's Kealakehe Sewage Treatment Plant (STP) is located *makai* of Queen Ka`ahumanu Highway. There is no sewer service in the immediate project area. Regional sewer in the area connects to an existing 30-inch sewer line which crosses Queen Ka`ahumanu Highway near the police station. The County has reserved 431,360 gallons per day (gpd) capacity at the Kealakehe STP for the Keahuolu project.

3.0 PROPOSED CIVIL INFRASTRUCTURE

Infrastructure for the proposed project would be built over an approximately 12-year period as the project site is developed. Construction is anticipated to begin in 2008 and provide the required infrastructure for the initial stages of development in 2010. From 2010 until 2020, the infrastructure system would be expanded to accommodate the entire project. Construction of the proposed development is anticipated to be completed by 2020.

3.1 ROADWAYS AND TRAFFIC

The County of Hawaii's proposed Ane Keohokalole Highway is key to full buildout of the Keahuolu project. Without Ane Keohakolole Highway, vehicular access to the site would be limited to access on Keanalehu Drive, and one possible connection to Palani Road. See Figure 3-1: Road System, following the text of this report.

Ane Keohokalole Highway would be a minor arterial with a 120-foot-wide right-of-way and posted speed limit of 35 miles per hour. Two lanes are proposed in each direction. The County plans to designate the highway as a bus transit corridor. A regional bus transit stop at the Ane Keohokalole Highway/Makala Boulevard intersection fronting the Keahuolu project is proposed. Bus stops are also proposed on Ane Keohokalole Highway for local circulators serving the *mauka* and *makai* neighborhoods.

Landowners with frontage to Ane Keohokalole Highway would be expected to share in the cost of constructing the highway. The projected order-of-magnitude cost of the portion fronting the project property, including drainage but excluding other utilities, would be $13,633,000. For planning purposes, the project would be allocated responsibility for half of this off-site road improvement cost, or $6,816,500. This estimate would be the same for Concepts A, B and C. For details on the road cost, see Appendix A. (Note: All costs presented in this report are in 2007 dollars.)

A right in/right out intersection is proposed along Palani Road. To minimize impacts on traffic along Palani Road, the intersection would include deceleration and acceleration lanes and a raised median to prevent vehicles from attempting to make left turn movements. The order-of-magnitude cost for the Palani Road intersection would be $1,306,000.

Keahuolu's internal roadways would be pedestrian friendly streets, which accommodate cars, bicycles and pedestrians. The roadways would be designed to County of Hawaii Department of Public Works standards for dedication to the County. The layout of the internal roads would be determined by the developer to coordinate with the development concept. An order-of-magnitude cost for the internal roadways, including water, sewer, drainage, electric, telephone and cable television utilities, based on the concept plan is $122,725,000.

Existing traffic conditions are assessed in a separate report.

3.2 SITE GRADING AND EROSION CONTROL

The project does not propose major grading of the site. The existing topography would be altered only to the extent necessary for construction of the proposed improvements. It is anticipated that grading would occur on a localized scale and that cut and fill quantities would generally balance as construction progresses. Grading permits, approved by the State Department of Land and Natural Resources Historic Preservation Division, the County Planning Department and the County Department of Public Works would be required for all grading activities.

During all phases of construction, erosion control practices would comply with State, County and Federal regulations. National Pollutant Discharge Elimination System (NPDES) general permit coverage authorizing discharges of storm water associated with construction activities would be required for the project from the State Department of Health, Environmental Management Division, Clean Water Branch. Best management practices to control erosion during construction would be a component of the NPDES permit.

3.3 DRAINAGE FACILITIES

Storm water runoff from the site would be collected through swales, ditches, gutters, inlets and catch basins, and transported through pipes to dry wells, seepage wells or infiltration areas for disposal. Infiltration areas, seepage wells and dry wells would be located in open spaces and parking lots, where practical. Dry wells would be located within the roadway right-of-way as needed. An underground injection control (UIC) permit is required by the State Department of Health to construct and operate the dry wells. It is recommended to include best management practices in the design of the drainage system, such as vegetated swales and storm drain filtration devices to capture sediments and prevent pollutants from entering the groundwater.

3.4 WATER SYSTEM

The proposed water system would be developed in accordance with the 2002 State of Hawaii Water System Standards and revisions to the standards per discussions with Department of Water Supply staff. For details of the water system criteria, see Appendix B. The design and construction of the proposed offsite water system and onsite water system within the road right-of-way would meet County Standards for dedication to the Department of Water Supply.

The projected average water daily demand generated by the proposed development plan concepts and reservoir storage requirements are summarized in Table 3-1. Water system calculations are provided in Appendix B.

Table 3-1: Water Requirements

Development Plan	Average Daily Demand (gallons per day)	Reservoir * (million gallons)
Concept A	745,820	1.0
Concept B	1,158,680	1.5
Concept C	1,114,680	1.5

* Reservoir calculations utilize 472,800 gallons of capacity in the Kealakehe High School reservoir site allocated for the project parcels in the existing and proposed 1.0 MG reservoirs.

3.4.1 OFFSITE

3.4.1.1 WELL SITES

Two source wells, numbered 3 and 4 in the *Villages of La`i`opua Water Master Plan* (October 26, 2006), have been identified for the project. See Figure 3-2: Offsite Water System, following the text of this report. The Hawaii Housing Finance and Development Corporation (HHFDC) and the Department of Hawaiian Home Lands (DHHL) have discussed HHFDC's development of well numbers 3 and 4 to provide source water for the project.

The proposed wells are within the Keauhou aquifer system and would tap into high-level ground water, based on *A Study of the Ground-Water Conditions in North and South Kona and South Kohala Districts, Island of Hawaii, 1991-2002* (September 2003) by Glenn R. Bauer. Ground water occurs in Hawaii as both a thin basal lens and as high-level aquifers. The extent of the high-level ground water and the nature of the confining hydrogeologic structure are not completely known. Data from the aquifer suggests that the Keopu area is the "drain"

for the ground-water flow system from the high water aquifer to the basal aquifer along the coastline. The effects of withdrawal of ground water from the high level aquifer are not known and monitoring of the existing and future wells will be continued by the Commission on Water Resource Management. Based on the *State Water Projects Plan, Volume 2 SWPP for Island of Hawaii,* February 2003 by Fukunaga and Associates, the Keauhou aquifer system has a sustainable yield of 38 million gallons per day (MGD). The total Keauhou aquifer demand from the State Water Projects Plan in 2018 is 4.98749 MGD, which added to the highest project demand of 1.16 MGD would be below the sustainable yield of the aquifer. A portion of the project is allocated in the State Water Projects Plan as part of the Department of Hawaiian Home Lands La`i`opua development.

The Department of Water Supply's allows a project 50-percent of the yield for one developed well and 67-percent of the yield for two developed wells. Well site number 4 with a projected 2.0 MGD anticipated yield could provide the Keahuolu project with 1.0 MGD of water to meet the requirements for Concept A, which would be 0.7 MGD. Well site number 4 would not be able to support development Concepts B and C water demands, which exceed 1.0 MGD. Development of well site number 3, in addition to well site number 4, would be required for development Concepts B and C. The projected yield for well site number 3 would be 1.0 MGD. With the development of the two well sites 3 and 4, the total anticipated yield would be 3.0 MGD. The project would be allowed 67-percent of the 3.0 MGD, or 2.0 MGD to meet the requirements for Concepts B and C, which are 1.2 and 1.1 MGD, respectively.

Well site number 4 would required for Concepts A, B and C. Well site number 3 would be required in addition to well site number 4 for Concepts B or C.

The well site(s), reservoir(s), water lines and appurtenant structures would be dedicated to the Department of Water Supply. Construction of the well site(s) would require well permits pump installation permits, grading permits, NPDES general permit coverage authorizing discharges of storm water associated with construction activities, and building permits for the structures. An engineering report, including chemical analysis, would be required by the State Department of Health Safe Drinking Water Branch in the well permitting process for development of the production wells. If dry wells are constructed at the sites, an Underground Injection Control permit would also be required for the project.

3.4.1.1.1 WELL SITE NUMBER 4 AND RESERVOIR

Well site number 4, located at Tax Map Key: 7-5-13:22, is identified as Keopu Well, State Well No. 3957-03 in the Water Master Plan. See Figure 3-3: Well Site Number 4 Aerial Photograph and Figure 3-4: Well Site Number 4 Tax Map with Contours, following the text of this report. The parcel is owned by the State of Hawaii, and it is located approximately 3 miles south of Palani Junction along Mamalahoa Highway. The well site parcel is located *mauka* of Mamalahoa Highway with elevations ranging from approximately 1,490 feet to 2,440 feet. A negative declaration of the Final Environmental Assessment for an exploratory well, Keopu-HFDC Exploratory Well No. 1, was published in the September 23, 1994 Office of Environmental Quality Control Bulletin. The exploratory well at well site number 4, Keopu State Well No. 3957-05, was drilled at an elevation of 1,600.6 feet starting in August 2000 to a depth of 1,800 feet (-199 feet, mean sea level). The water level in the well was measured at 56.5 feet mean sea level. The well was pump tested in July and August 2002. The report *Results of Drilling & Testing Keopu-State Well (3957-05) North Kona, Hawaii* (Revised September 2007) by Water Resource Associates

indicates well number 4 is capable of yielding at least 2 million gallons per day of potable water. The daily chlorides ranged from 7 to 9 milligrams per liter, indicating excellent potable water quality.

Development of well site number 4 would require outfitting the well with a pump, installation of a well control building with a chlorination system and backup generator, a reservoir, and appurtenant structures. The reservoir would be sized to the average daily production rate of the well, or 2 million gallons (MG) based on the anticipated yield for the well. The reservoir would be located in cut, at the 1,683-foot elevation. The standard size for a 2.0 MG reservoir is approximately 145 feet in diameter, however, it could be constructed with a smaller footprint. A new access road would be required from Mamalahoa Highway to the well, well control building and reservoir. A new 16-inch water line would extend from the new reservoir to Mamalahoa Highway and extend approximately 7,000 linear feet north along Mamalahoa Highway to the existing Keahuolu (QLT #1) State Well No. 4057-01 well site.

3.4.1.1.2 WELL SITE NUMBER 3 AND RESERVOIR

Well site number 3, located at Tax Map Key: 7-5-01:55, is identified as North Keopu Well, State Well No. 3957-02 in the Water Master Plan. See Figure 3-5: Well Site Number 3 Aerial Photograph and Figure 3-6: Well Site Number 3 Tax Map with Contours, following the text of this report. The parcel is owned by the State of Hawaii and is adjacent to parcel 117 which is owned by the Department of Water Supply. The site is located approximately 2.25 miles south of Palani Junction along Mamalahoa Highway. Parcels 55 and 117 are located *mauka* of Mamalahoa Highway, with elevations ranging from 1,580 feet to 1,620 feet. Access to the well site is through an easement on parcel 31, which is privately owned. The projected yield from well site number 3 is 1 MG. A monitor well, USGS Well #3957-02 or also known as the Kailua Observation Well or the USGS Komo Observation well was drilled in 1991 on parcel 117. The well was drilled at the 1,600 feet elevation to a depth below ground of 1,622.5 feet. A 12-inch diameter hole was drilled and a 4-inch diameter casing installed. The water level in the well has been measured at around 42 feet mean sea level. There is no data available on water quality or quantity for this well. An existing 50,000 gallon Department of Water Supply water tank, which is not in service, is located on parcel 55. The site is known as the Moeauoa Tank Station.

Development of well site number 3 would require drilling of a new production well, installation of a pump, testing of the well for quality and capacity, installation of a well control building with chlorination system and backup generator, a reservoir, and appurtenant structures. However, well site number 3, with a total land area of 31,799 square feet for both parcels 55 and 117, is not large enough to accommodate all the structures required for a well site. Additional adjacent private lands would have to be obtained to operate the well. A new 1.0 MG reservoir, located in cut around the 1,683-foot elevation, would be required for the well. A 1.0 MG reservoir is approximately 95 feet in diameter. A new access road would be required from Mamalahoa Highway to the well, well control building and reservoir. A new 16-inch water line would extend from the reservoir to Mamalahoa Highway and connect to the new 16-inch water line between well site number 4 and the existing QLT well site.

3.4.1.2 RESERVOIR ON DHHL KEAHUOLU PROPERTY

Either a new 1.0 MG reservoir for Concept A or 1.5 MG reservoir for Concepts B or C would be required for project water storage in addition to the 472,800 gallon reserve capacity within the existing Kealakehe Reservoir site. HHFDC and DHHL have discussed a new 595-foot elevation reservoir site located on the DHHL Keahuolu property at Tax Map Key: 7-4-21: portion of 21. See Figure 3-7: Reservoir on DHHL Keahuolu Property, following the text of this report. The site would be off the future extension of Keanalehu Drive, and a temporary access road with two 16-inch water lines would be required within the Keanalehu Drive right-of-way until Keanalehu Drive is built-out. The access road would be over Tax Map Key: 7-4-21: portions of 20 and 21, and grading for the access road on Tax Map Key: 7-4-21: portion of 21.

Construction of the reservoir site would require a grading permit, NPDES general permit coverage authorizing discharges of storm water associated with construction activities, and building permits for the reservoir structure. If dry wells are constructed at the reservoir site, an Underground Injection Control permit would also be required for the reservoir construction.

3.4.1.3 WATER LINES

The *Villages of La`i`opua Water Master Plan* identified transmission deficiencies in the offsite water system. Approximately 3,200 linear feet of 8-inch water line in Kealakaa Street, from Palani Road to Manawale`a Street, would require upsizing to a 12-inch water line. Approximately 800 linear feet of new 12-inch water line would be required in the existing Manawale`a Street. Approximately 2,820 linear feet of 12-inch water line would also be required in Ane Keohokalole Highway, between Palani Road and Makala Boulevard. The water line improvements are shown in Figure 3-2. Upon finalization of the development concept, the Department of Water Supply requested the developer update the *Villages of La`i`opua Water Master Plan* to determine whether there are any other system deficiencies and required improvements.

3.4.1.4 WATER SYSTEM COSTS

Order-of-magnitude costs for the off-site water system improvements would be as follows. For details on the water system costs, see Appendix B.

Off-site Wells and Appurtenances (Well Site Number 4 required for all concepts, and Well Site Number 3 would be required in addition to Well Site Number 4 for Concepts B or C.

Well Site Number 4	$11,296,000
Well Site Number 3	$7,175,000

Reservoir on DHHL Keahuolu property: one would be required.

1.0 MG Reservoir – Concept A	$7,403,000
1.5 MG Reservoir – Concept B or C	$8,385,000

Water Line: upgrades required for all concepts.

3,200 linear foot (LF) of 12" in Kealaka`a Street	$873,000
800 LF in Manawale`a Street	$287,000
2,820 LF in Ane Keohokalole Highway	$798,000

Additional off-site water system improvements or water line size upgrades may be required with the update of the *Villages of La`i`opua Water Master Plan*.

3.4.2 ONSITE

The onsite water system would consist of water lines within the roadway network. The system would be connected to the existing water system at Keanalehu Drive and Manawale`a Street and at Palani Road and Ane Keohokalole Highway, forming a looped water system. The Keahuolu water system network would have a minimum pipe size of 8-inches in diameter and a maximum pipe size of 16-inches in diameter, based on the proposed roadway layout and development layout and densities. The water lines would be sized to meet the maximum daily demand plus fire flow with a residual pressure of 20 pounds per square inch (psi) at the critical fire hydrant or the peak hour demand with a residual pressure of 40 psi.

3.5 WASTEWATER SYSTEM

The proposed sewer system would be developed in accordance with the Hawaii County Department of Environmental Management criteria. For details of the sewer system criteria, see Appendix C. The design and construction of the proposed offsite sewer system and onsite sewer system would meet County Standards for dedication to the County Department of Environmental Management.

The projected sewer flows are summarized in Table 3-2. Sewer system calculations are provided in Appendix C.

Table 3-2: Sewer Requirements

Development Plan	Design Average Flow (gallons per day)	Design Peak Flow (gallons per day)
Concept A	430,598	1,915,899
Concept B	665,436	2,568,875
Concept C	720,856	2,710,213

The project has reserved 431,360 gpd capacity at the Kealakehe Sewage Treatment Plant (STP). Additional capacity at the STP would be required to accommodate Concepts B and C, which are projected to exceed the reserved capacity. The Department of Environmental Management would have to expand the STP and are currently undertaking a master plan to review options to upgrade the STP. Two improvement projects to the STP are planned which include 1) sludge removal: $4,600,000 (County of Hawaii FY 07-08 budget) and 2) aeration upgrade: $1,500,000 (County of Hawaii FY 07-08 budget). The two improvement projects will allow the STP to continue to operate at the present capacity and allow for future capacity upgrades.

R-2 Water (disinfected secondary recycled water) from the Kealakehe STP is discharged to a pond in the lava fields *makai* of Queen Kaahumanu Highway in the DHHL/Villages of La`i`opua. R-2 Water is not suitable for irrigation use for the project. The County would have to further treat the effluent to R-1 Water (significant reduction in viral and bacterial pathogens) before the effluent would be suitable for irrigation use on the project site. The County has no plans to upgrade the STP to produce R-1 Water. In addition, a pump system, storage and transmission lines for the recycled effluent system would be required, but there are no plans by the County for a system to the project area.

3.5.1 OFFSITE

Sewer lines from the project site to the STP would be routed either through Queen Liliuokalani Trust (QLT) lands or through DHHL/Villages of La`i`opua lands. Figures 3-8 and 3-9 show the QLT route for the offsite sewer system for development concept A and concepts B and C, respectively. Figures 3-10 and 3-11 show the La`i`opua route for the offsite sewer system for development concept A and concepts B and C, respectively. Sewer lines would be sized to accommodate sewer flows from the project site, lands immediately *mauka* of the project, and the *makai* lands adjacent to the sewer line alignment. The sewer line alignment and sizes are subject to change based on the final development concept.

Based on the design flows, a new 30-inch sewer line would be required to convey sewer flows from the project site, across Queen Kaahumanu Highway to the STP for either route. A sewer line through the QLT route can convey wastewater flows from the entire project site to the STP. A sewer line through the Villages of La`i`opua route can convey the majority of the flows from the site. A low-elevation portion, approximately 40 acres of the project parcel near Palani Road could be developed with activities not requiring sewer service, such as parking lots, open spaces, preserve areas, and playfields and parks with restroom facilities located outside the low area. If sewer service is required for the low area, either a pump station would be required or a sewer line would have to be constructed through QLT land to convey flows from the low area. Figures 3-9 and 3-10 show the proposed sewer line to service the project low area through the QLT lands.

The following order-of-magnitude costs for sewer system construction assume that the low area would be developed with sewage-generating facilities. For details on the sewer system costs, see Appendix C.

Through QLT Lands:		
	Concept A	$6,381,000
	Concept B or C	$6,663,000
Through the DHHL / Villages of La`i`opua:		
	Concept A	
	Through La`i`opua	$5,983,000
	Through QLT Lands	$4,297,000
	Total	$10,280,000
	Concept B or C	
	Through La`i`opua	$5,983,000
	Through QLT Lands	$4,543,000
	Total	$10,526,000

These cost estimates are based on the best available information on DHHL and QLT plans for future development of their properties. QLT is in preliminary planning, and actual routing and sewer flows may change.

3.5.2 ONSITE

The onsite sewer system would consist of sewer lines within the roadway network. The system would connect to sewer line routed through either the DHHL/Villages of La`i`opua lands or the QLT lands. The sewer system would have a minimum pipe size of 8-inches in diameter and a maximum pipe size of 21-inches in diameter for the DHHL/Villages of La`i`opua route or 15-inches in

diameter for the QLT route. The sewer lines would be sized to convey the design peak flow from the upstream tributary areas.

3.6 SOLID WASTE

The County of Hawai`i requires all solid waste (also known as rubbish), to be removed from all buildings and premises and disposed of at an approved solid waste disposal facility. All solid waste generated from the project would be taken to the West Hawai`i Landfill in Pu`uanahulu, a County transfer station, or recycled.

Quantities of solid waste were estimated for both construction and occupancy phases of the Keahuolu project. The "construction phase" of development is anticipated to begin in 2008 with construction of approximately 300 housing units per year. The school facilities, with 550 students and 70 faculty and staff, are projected for construction between 2011 and 2012. The commercial / retail spaces are projected for approximately 100,000 square feet of construction in 2016 and 2017, and 97,000 square feet of construction in 2018 and 2019. The "occupancy phase" of development refers to the time at which the facilities have been constructed and are open for use. The construction and occupancy phases are expected to overlap, as construction of later portions of the Keahuolu project would continue while earlier portions are completed and occupied. The project is estimated to be completed and occupied in 2020. The average amounts of solid waste generated by construction activities and occupancy are summarized in Table 3-3.

Table 3-3: Solid Waste

Year	Concept A		Concept B		Concept C	
	Construction Waste (tons/year)	Occupancy Waste (tons/year)	Construction Waste (tons/year)	Occupancy Waste (tons/year)	Construction Waste (tons/year)	Occupancy Waste (tons/year)
2008	525 - 910	0	525 – 910	0	450 – 780	0
2009	1,050 – 1,820	0	1,050 – 1,820	0	900 – 1,560	0
2010	1,050 – 1,820	1,086	1,050 – 1,820	1,086	900 – 1,560	950
2011	658 – 1,141	2,172	1,063 – 1,843	2,172	913 – 1,583	1,901
2012	358 – 621	3,259	1,063 – 1,843	3,259	913 – 1,583	2,851
2013	0	4,069	1,050 – 1,820	4,639	900 – 1,560	4,096
2014	0	4,069	585 – 1,014	5,725	900 – 1,560	5,046
2015	0	4,069	60 – 104	6,812	795 – 1,378	5,997
2016	150 – 260	4,069	150 – 260	6,938	495 – 858	6,947
2017	150 – 260	4,069	150 – 260	6,938	150 – 260	7,676
2018	146 – 252	4,730	146 – 252	7,599	146 – 252	8,337
2019	146 – 252	4,730	146 – 252	7,599	146 – 252	8,337
2020 and Beyond	0	5,370	0	8,240	0	8,977

A preliminary solid waste management plan is provided in Appendix D.

4.0 PROBABLE IMPACTS AND PROPOSED MITIGATION

4.1 POTENTIAL SHORT-TERM IMPACTS

4.1.1 ROADS

No significant short-term environmental impacts are anticipated from the development of the roadways within the project site. Regional traffic impacts are assessed in a separate report.

4.1.2 GRADING, DRAINAGE AND EROSION CONTROL

During grading activities, portions of the site would be disturbed and the potential for site erosion would increase. The contractor would be required to comply with Chapter 10 – Erosion and Sedimentation Control of the County Code, the Department of Public Works Storm Drainage Standard, and the NPDES permit requirements, including the best management practices (BMP) plan to contain and control site erosion and to prevent the discharge of sediment from the site. Based on the requirement for construction activities to comply with the County requirements and the approved NPDES permit, the short-term environmental impacts from grading activities are anticipated to be mitigated and insignificant.

The increase of impermeable surfaces resulting from site development would have the effect of increasing storm water runoff quantities on the site. To comply with the County's Storm Drainage Standard, runoff flow rates and volume would not be increased from the site. The runoff would be collected and discharged to on-site seepage areas, seepage wells and drywells for percolation into the ground. Thus, precipitation falling on the site would discharge into the ground as it does under pre-development conditions, and off-site runoff would not increase as a result of the proposed development. It is recommended that the drainage systems also include storm drain filtration devices to mitigate potential the impacts from potential pollutants. Filtration devices may include vegetated swales, bioretention areas, sand or organic filtering systems or commercially available proprietary products such as catch basin inserts and hydrodynamic devices. The method of filtration would be determined based on available technology and integrated with the system design.

4.1.3 WATER ENVIRONMENT

4.1.3.1 SURFACE WATER

There are no surface water bodies on or near the project site. The developer would be required to comply with the NPDES permit requirements, including the BMP plan, and Chapter 10 – Erosion and Sedimentation Control of the County Code during construction and prevent the discharge of sediment from the site. As areas of the site are developed, drainage systems would collect runoff and discharge it to the subsurface. The project would be designed to comply with the County's Storm Drainage Standard such that runoff volumes and rates would not increase as a result of site development. The project would have no significant short-term effects on surface waters because there would be no increase of runoff from the site.

4.1.3.2 GROUNDWATER

Precipitation on the site currently percolates to the underlying groundwater. This would continue to be the case during and after site development. The NPDES permit requirements,

including the BMP plan would require the contractors to manage materials to prevent the discharge of pollutants to the ground. It is recommended that during and after development, landscape management practices would be applied in public and private areas to minimize the use of fertilizers and pesticides that could potentially enter the groundwater. The developer and his contractor would be required to conform with the NPDES permit requirements during construction. Best management practices, such as storm drainage filtration devices, are recommended to mitigate pollutants from entering the groundwater. It is anticipated that short-term impacts upon the local groundwater quality would not be significant.

4.1.4 WATER SUPPLY

Water supply infrastructure, including source wells, storage reservoirs and distribution lines would be constructed as required and approved by the County of Hawaii Department of Water Supply. Construction activities would be required to conform to the applicable environmental requirements for storm water protection and mitigation of potential noise and dust impacts. Short-term localized water system shut-downs and road closures may be required as the new water infrastructure is connected to the existing water system. No short-term detrimental impacts on the existing water supply system are anticipated as a result of the proposed project.

4.1.5 WASTEWATER

Extension of the sewer system to serve the proposed development would not have significant short-term impacts on the environment. Construction activities would be required to conform to the applicable environmental requirements for storm water protection and mitigation of potential noise and dust impacts. County fees associated with permission to connect would be applied by the County to upgrade the existing treatment and disposal facilities on an as-needed basis.

4.1.6 SOLID WASTE

Emphasis for the management of solid wastes generated by the Keahuolu project would be placed on waste diversion and recycling. Solid wastes would be managed in conformance with the applicable Department of Health and County requirements. The landfill nearest to the Keahuolu project is the West Hawaii Landfill at Pu`uanahulu. Since the County of Hawaii does not provide waste collection services, recycle and disposal of construction and occupancy waste would be hauled by private contractors or individuals. Specific arrangements for construction and occupancy wastes would be made closer to the project beginning. Recyclables and wastes would be managed in either a centralized system or by private individuals, and hauled directly to recycling centers, transfer stations and the landfill. The average amounts of solid waste diverted through minimization and recycling, and landfilled are summarized in Table 3-4.

Table 3-4: Summary of Solid Waste Diverted and Landfilled

Year	Concept A		Concept B		Concept C	
	Diverted Waste (tons/year)	Landfilled Waste (tons/year)	Diverted Waste (tons/year)	Landfilled Waste (tons/year)	Diverted Waste (tons/year)	Landfilled Waste (tons/year)
2008	263-455	262-455	263-455	262-455	225-390	225-390
2009	525-910	525-910	525-910	525-910	450-780	450-780
2010	805-1,190	1,331-1,716	805-1,190	1,331-1,716	695-1,025	1,155-1,485
2011	889-1,131	1,941-2,182	1,092-1,482	2,143-2,533	947-1,282	1,867-2,202
2012	1,020-1,152	2,597-2,728	1,373-1,763	2,949-3,339	1,193-1,528	2,571-2,906
2013	1,050	3,019	1,722-2,107	3,967-4,352	1,507-1,837	3,489-3,819
2014	1,050	3,019	1,770-1,984	4,540-4,755	1,752-2,082	4,194-4,524
2015	1,050	3,019	1,787-1,809	5,085-5,107	1,945-2,236	4,847-5,139
2016	1,125-1,180	3,094-3,149	1,865-1,920	5,223-5,278	2,040-2,221	5,402-5,584
2017	1,125-1,180	3,094-3,149	1,865-1,920	5,223-5,278	2,055-2,110	5,771-5,826
2018	1,293-1,346	3,583-3,636	2,034-2,087	5,711-5,764	2,224-2,277	6,259-6,312
2019	1,293-1,346	3,583-3,636	2,034-2,087	5,711-5,764	2,224-2,277	6,259-6,312
2020 and Beyond	1,385	3,985	2,126	6,114	2,316	6,661

Although the project site is located in an area where the annual precipitation does not often exceed the amount of evapotranspiration (water lost to the atmosphere by evaporation and transpiration), all waste should avoid contact with water as best as possible. Waste that comes into contact with water before being hauled to the landfill may result in leachate (liquid produced when water percolates through any permeable material) at the landfill. Leachate could contaminate both ground and surface water, which may lead to various environmental and health problems as well as the degradation of local amenities. It can best be managed by daily covering of all waste.

According to the 2002 Updated Integrated Solid Waste Management Plan for the County of Hawaii, the Pu`uanahulu Landfill is estimated to have 12 million cubic yards of air space which is enough to accommodate the waste generated by West Hawaii for approximately the next 40 years.

No significant short-term impacts on the existing solid waste collection and disposal systems or the environment are anticipated as a result of the proposed development.

4.2 POTENTIAL LONG-TERM IMPACTS

4.2.1 ROADS

No significant long-term environmental impacts are anticipated from the development of roadways within the project site. Regional traffic impacts are assessed in a separate report.

4.2.2 DRAINAGE AND EROSION CONTROL

Site drainage in the long term would be collected and discharged to on-site seepage areas, seepage wells and drywells for percolation into the ground. Precipitation falling on the site would discharge into the ground as it does under pre-development conditions, and off-site runoff would not increase as a result of the proposed developments required compliance with the County's Storm Drainage Standard. Storm drainage filtration devices are recommended to mitigate pollutants from entering the groundwater. After completion of the project construction, ground surfaces would be stabilized with landscape and hardscape, and the potential for erosion would be minimal. Long-term impacts of the project on drainage and erosion are not anticipated to be significant.

4.2.3 WATER ENVIRONMENT

4.2.3.1 SURFACE WATER

Rainfall runoff from the developed site would be collected in the drainage systems and percolated into the ground in the on-site seepage areas, seepage wells and dry wells. Runoff volumes and rates would not increase as a result of site development in compliance with the County's Storm Drainage Standard, and the project would have no significant long-term effects on surface waters.

4.2.3.2 GROUNDWATER

The source wells would draw the high-level groundwater from the Keauhou aquifer system. The projected sustainable yield from the Keauhou aquifer is 38 MGD, while the projected 2018 demand is 4.98749 MGD. The project would add approximately 0.7 to 1.2 MGD demand on the aquifer, which is within the sustainable yield of the aquifer.

The full build-out water demands of the Keauhou aquifer based on the Hawaii County General Plan is 170.8 MGD without agricultural demands and 245.4 MGD with agricultural demands. Based on the County Zoning, the full build-out water demands of the Keauhou aquifer is 39.1 MGD without agricultural demands and 111.6 MGD with agricultural demands. In the long-term, water demands in the Keauhou aquifer would exceed the sustainable yield of the aquifer and alternate water resource enhancement measures would be required to meet the water demands. Alternative water resource enhancement measures that have been identified in the *Draft Report Hawaii County Water Use and Development Plan Update*, December 2006, by Fukunaga and Associates, would include rainwater catchment systems in the areas *mauka* of Mamalahoa Highway, wastewater reclamation for use within close proximity of the waster treatment facilities and desalination from brackish wells between Queen Kaahumanu Highway and Mamalahoa Highway. Future reduction in development density, development of water conservation programs by the Department of Water Supply and continued monitoring of the aquifer have also been identified in the *Draft Report Hawaii County Water Use and Development Plan Update* to mitigate the long term impacts on the Keauhou aquifer.

It is recommended the developer implement measures to reduce the amount of pollutants from entering the groundwater by including best management practices such as storm drain filtration devices, ground stabilization with landscape and hardscape, educational warning signs on the drainage systems with wording such as "DUMP NO WASTES. GOES TO GROUNDWATER AND OCEAN. HELP PROTECT HAWAI`I'S ENVIRONMENT.", and

coordinating environmental educational programs for the project area residents with the Department of Health Clean Water Branch.

4.2.4 WATER SUPPLY

The long-term impacts of the project on the DWS water source, storage and transmission system would be an improvement of the existing system. The additional source well(s) for the project would increase water available to the region, as DWS only allocates a portion of the well yield to the project. As previously noted, DWS allows a project 50-percent of the yield for one developed well and 67-percent of the yield for two developed wells for a project. The project would add storage reservoirs and improve the area water transmission system, as required to provide water service from the source well(s) down to the site. No long-term detrimental impacts on the existing water supply system are anticipated as a result of the project.

4.2.5 WASTEWATER

The long-term impacts of the project on the sewer system would be the construction of new sewer lines through either the DHHL/Villages of La`i`opua lands or the QLT lands to the Kealakehe STP. The impact would be an increase in daily flows to the STP of 430,598 GPD, 665,436 GPD or 720,856 GPD for concepts A, B or C, respectively. Concepts B or C would require the County to upgrade the Kealakehe STP. The new sewer lines *makai* of the project would also allow the potential development of the DHHL/Villages of La`i`opua lands or the QLT lands adjacent to the new sewer line, depending on the ultimate route of the new line. The construction of new sewer lines through the Keahuolu project would also provide potential sewer service to lands *mauka* of the project site. No long-term detrimental impacts on the existing sewer lines are anticipated as a result of the project, since all new sewer lines from the project site to the STP would be constructed. Adequate treatment and disposal capacity has been reserved at the Kealakehe STP for project concept A, and no long-term detrimental impacts to the STP are anticipated. Concepts B and C would require the County to upgrade the STP to handle the added sewage flows and to mitigate any long-term detrimental impacts to the STP. The Department of Environmental Management is undertaking a master plan for the STP to determine the appropriate system upgrades to increase the STP capacity. Until the master plan assessment is completed, the County does not know the type and costs of the STP upgrades.

4.2.6 SOLID WASTE

Emphasis for the management of solid wastes generated by the Keahuolu project would be placed on waste diversion and recycling. According to the 2002 Updated Integrated Solid Waste Management Plan for the County of Hawaii, the Pu`uanahulu Landfill is estimated to have 12 million cubic yards of air space which is enough to accommodate the waste generated by West Hawaii for approximately the next 40 years. The plan also notes that the County is also looking into waste reduction facilities for the island, using either a waste-to-energy incinerator, a thermal gasification plant (produces heat from waste), or an anaerobic digestion plant (breaks refuse into its molecular components). The project's full-build out annual occupancy landfill waste percentage of the annual West Hawaii Landfill waste would be estimated to be 4.43%, 6.79% or 7.40% for the development concepts A, B or C, respectively. The project's waste stream is a small fraction of the waste that would go to the landfill.

No significant long-term impacts on the solid waste collection and disposal system or the environment are anticipated as a result of the proposed development.

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NORTH

0 3 6 12
SCALE IN MILES

Figure 1-1
LOCATION MAP

Keahuolu Affordable Housing
Civil Infrastructure
December 2007

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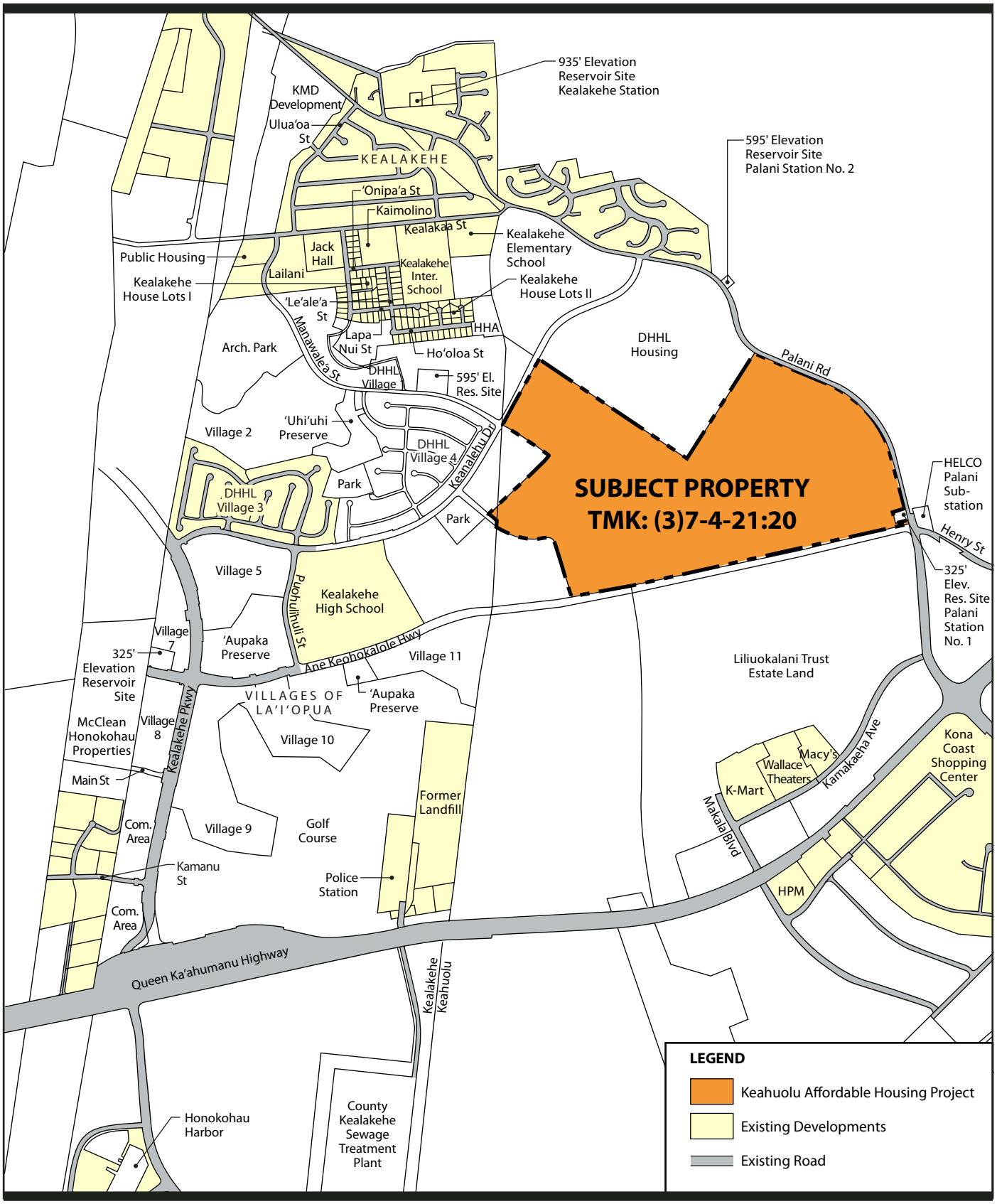

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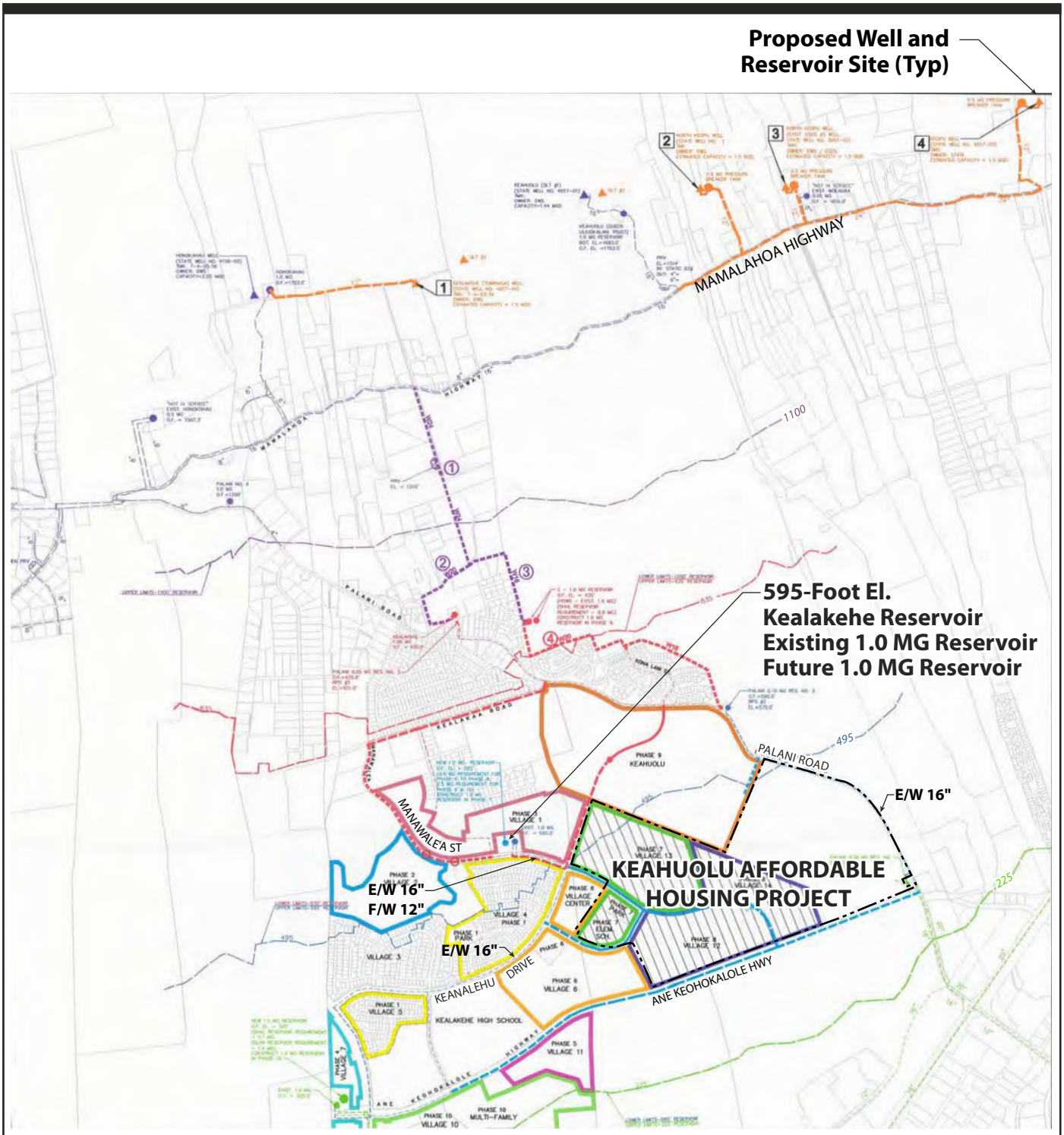
NORTH

0 600 1200 1800
SCALE IN FEET

Figure 1-2
AREA MAP

Keahuolu Affordable Housing
Civil Infrastructure
December 2007



Source:
Akinaka & Associates, Ltd. *Villages of La'i'opua Water Master Plan*. October 26, 2006.

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NORTH

0 600 1200 2400
SCALE IN FEET

Figure 2-1
WATER SUPPLY

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Civil Infrastructure
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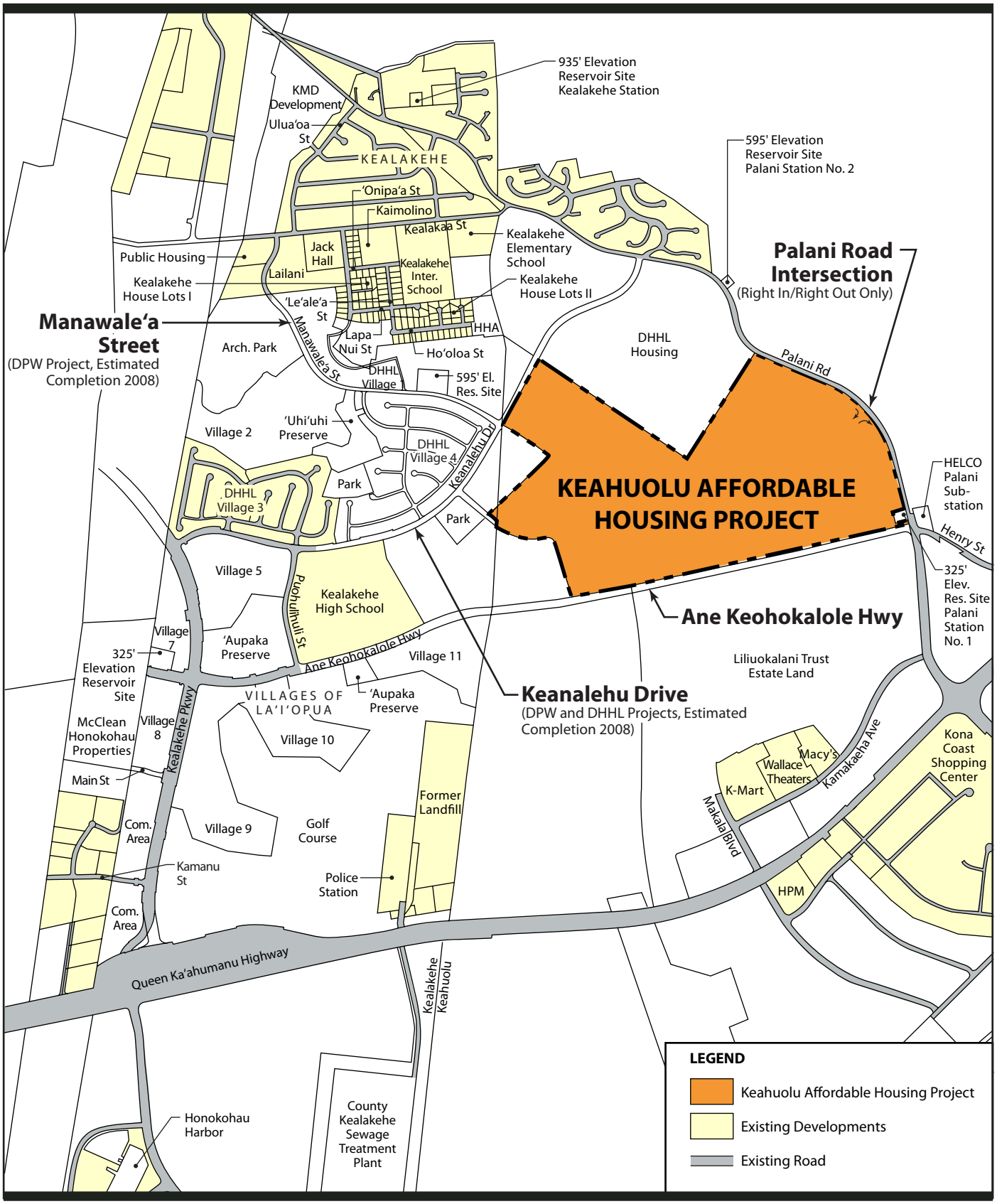

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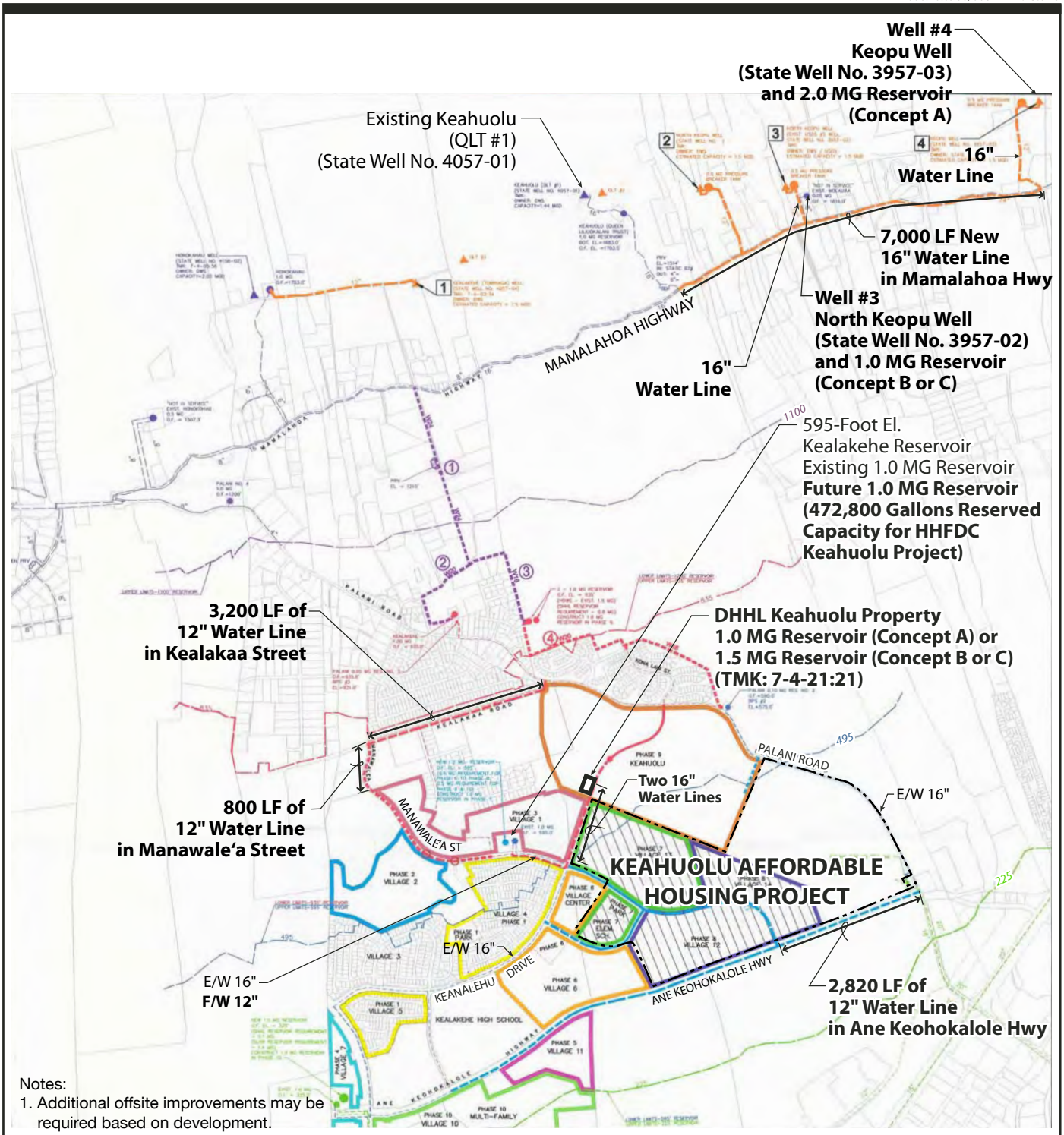
NORTH

0 600 1200 1800

SCALE IN FEET

Figure 3-1
ROAD SYSTEM

Keahuolu Affordable Housing
Civil Infrastructure
December 2007



Notes:
1. Additional offsite improvements may be required based on development.
2. Onsite water system will follow the roadway network. Roadway network may not be as shown.

Source:
Akinaka & Associates, Ltd. *Villages of La'i'opua Water Master Plan*. October 26, 2006.

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NORTH

0 600 1200 2400
SCALE IN FEET

Figure 3-2
OFFSITE WATER SYSTEM

Keahuolu Affordable Housing
Civil Infrastructure
December 2007

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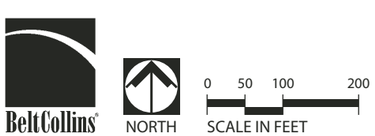

Figure 3-3
WELL SITE NUMBER 4
AERIAL PHOTOGRAPH

Keahuolu Affordable Housing
Civil Infrastructure
December 2007

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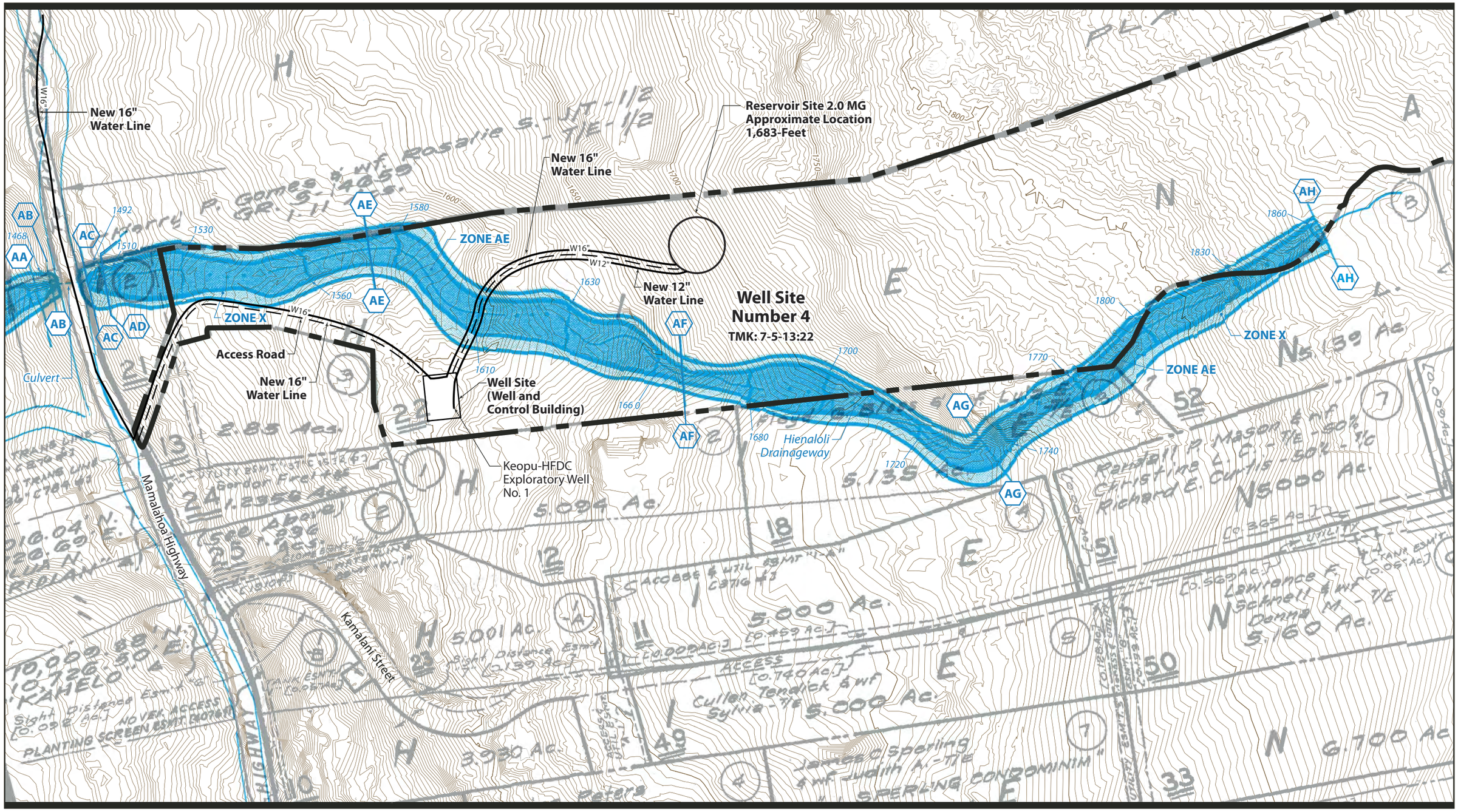

LEGEND

- Access Road
- W12" 12" Water Line
- W16" 16" Water Line

NORTH

0 50 100 200 SCALE IN FEET

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Figure 3-4
WELL SITE NUMBER 4
TAX MAP WITH CONTOURS

Keahuolu Affordable Housing
Civil Infrastructure
December 2007

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LEGEND

Well Parcel

Parcels

NORTH

0 25 50 100
SCALE IN FEET

Figure 3-5
WELL SITE NUMBER 3
AERIAL PHOTOGRAPH

Keahuolu Affordable Housing
Civil Infrastructure
December 2007

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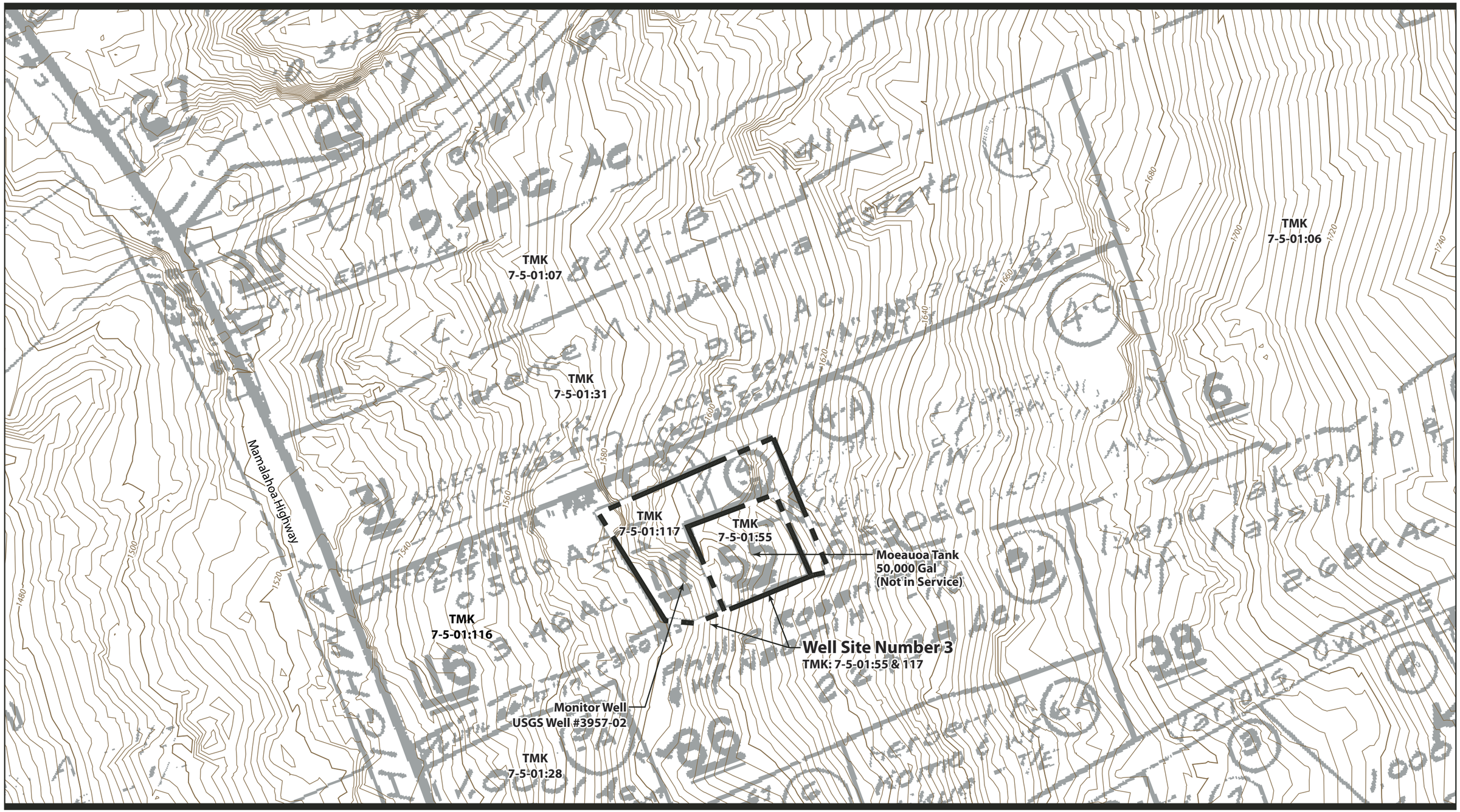

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NORTH

0 25 50 100
SCALE IN FEET

LEGEND

Well Parcel

Parcels

Figure 3-6
WELL SITE NUMBER 3
TAX MAP WITH CONTOURS

Keahuolu Affordable Housing
Civil Infrastructure
December 2007

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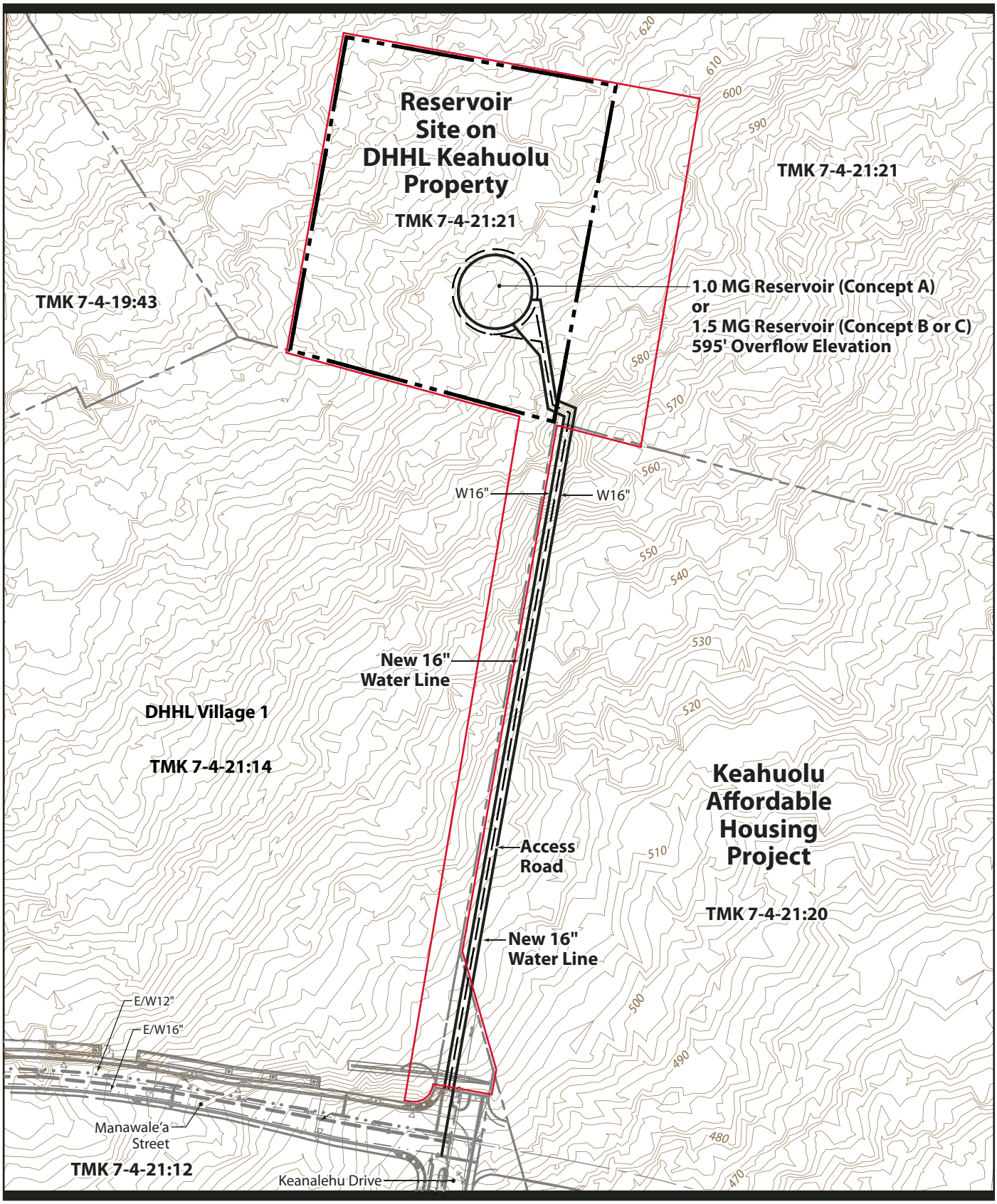

Figure 3-7
RESERVOIR ON DHHL KEAHUOLU PROPERTY

Keahuolu Affordable Housing
Civil Infrastructure
January 2008

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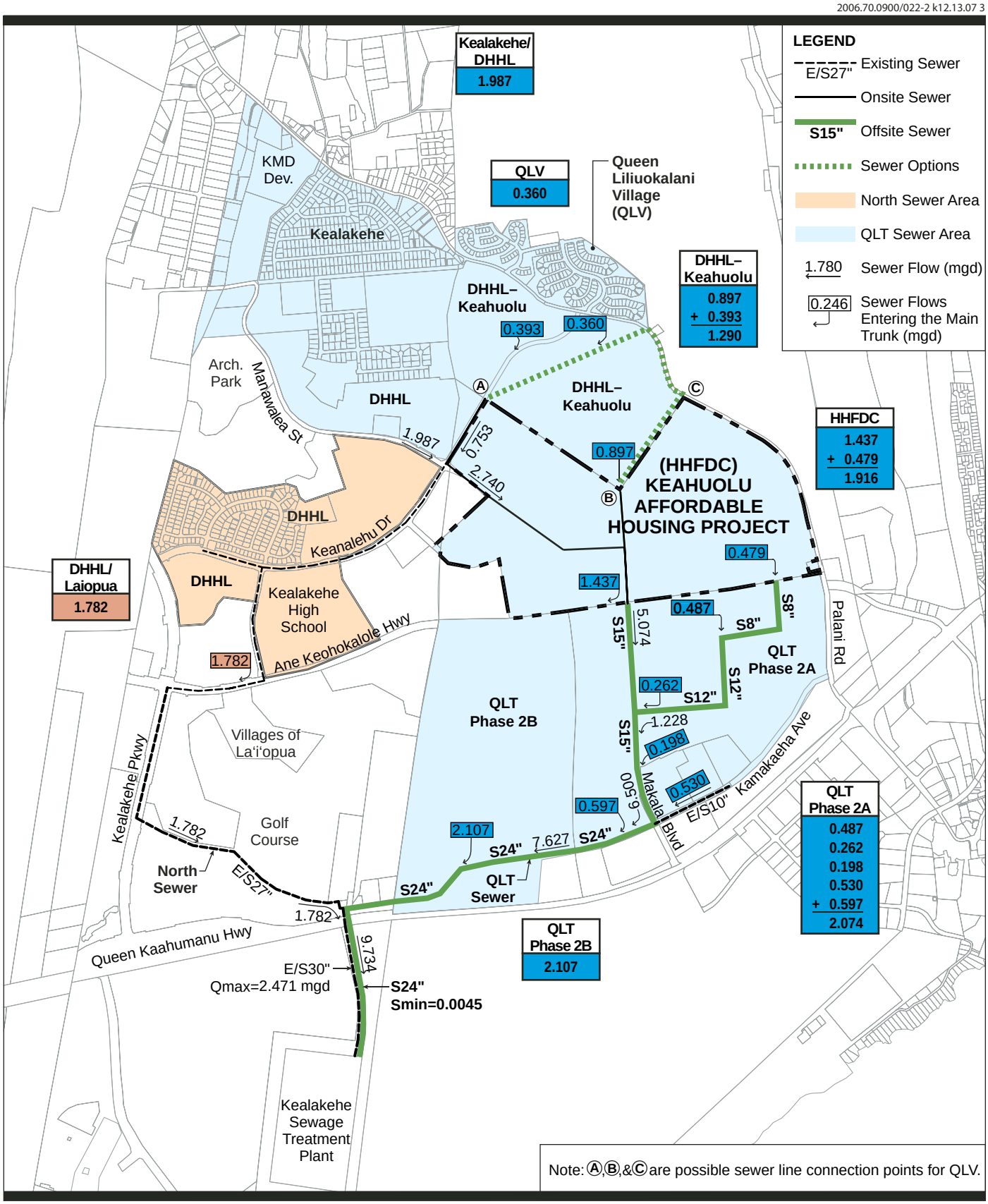
NORTH

0 50 100 200
SCALE IN FEET

LEGEND

- Proposed Reservoir Site
- Access Road
- W16" 16" Water Line
- Limits of Archaeological and Botanical Surveys



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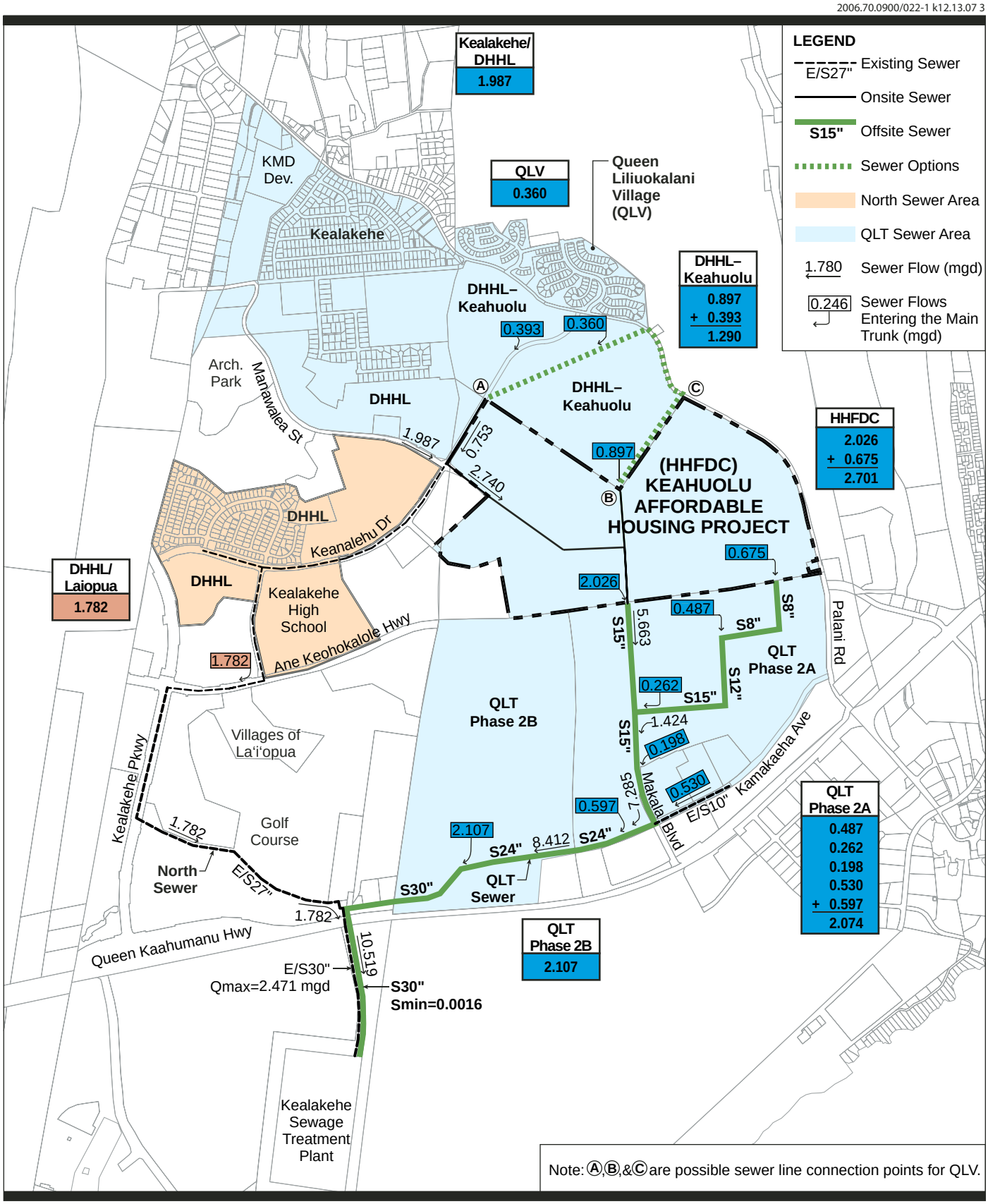
NORTH

0 500 1000 2000
SCALE IN FEET

Figure 3-8
OFFSITE SEWER SYSTEM CONCEPT A—QLT ROUTE

Keahuolu Affordable Housing
Civil Infrastructure
December 2007



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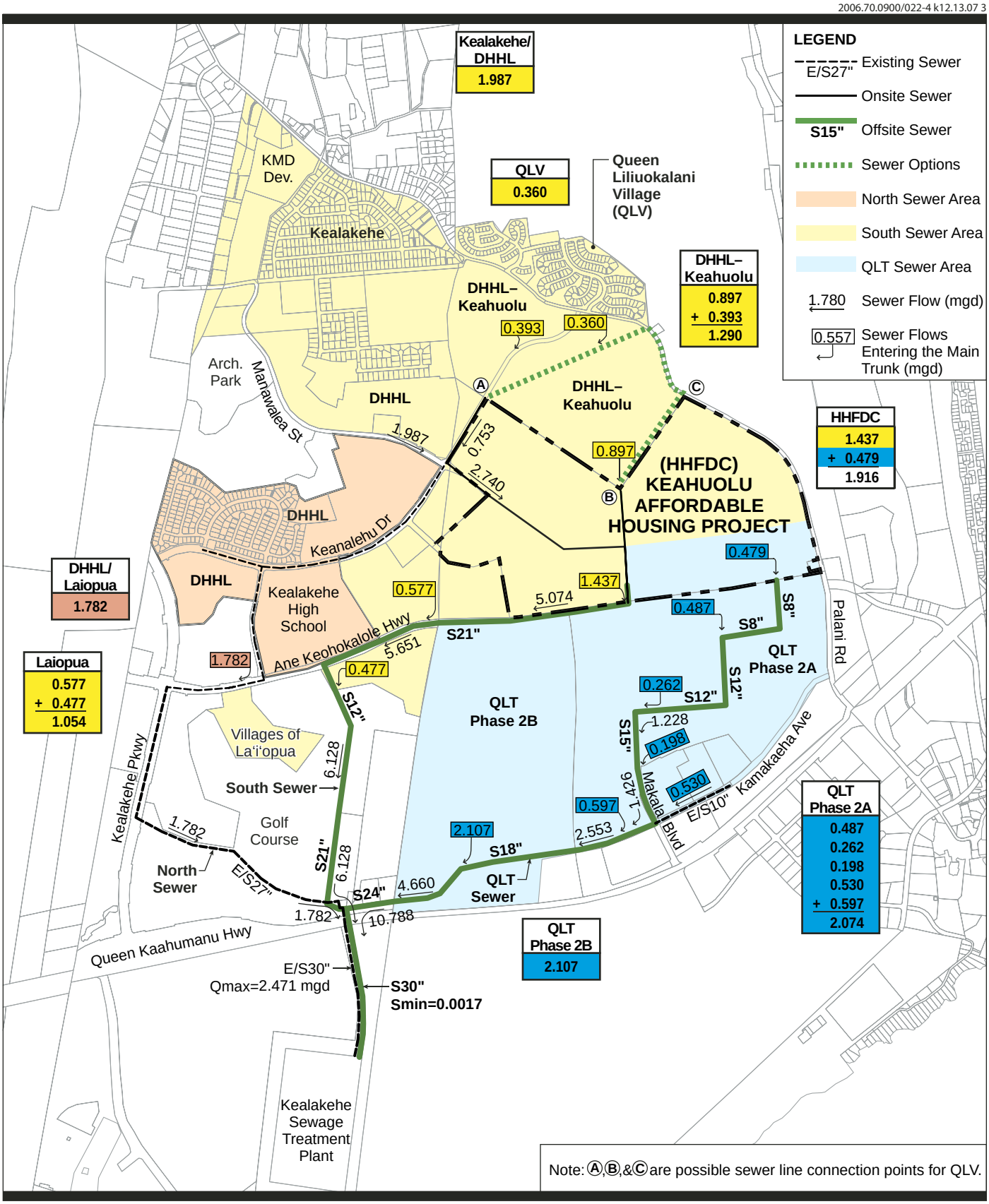
NORTH

0 500 1000 2000
SCALE IN FEET

Figure 3-9
OFFSITE SEWER SYSTEM CONCEPTS B & C—QLT ROUTE

Keahuolu Affordable Housing
Civil Infrastructure
December 2007



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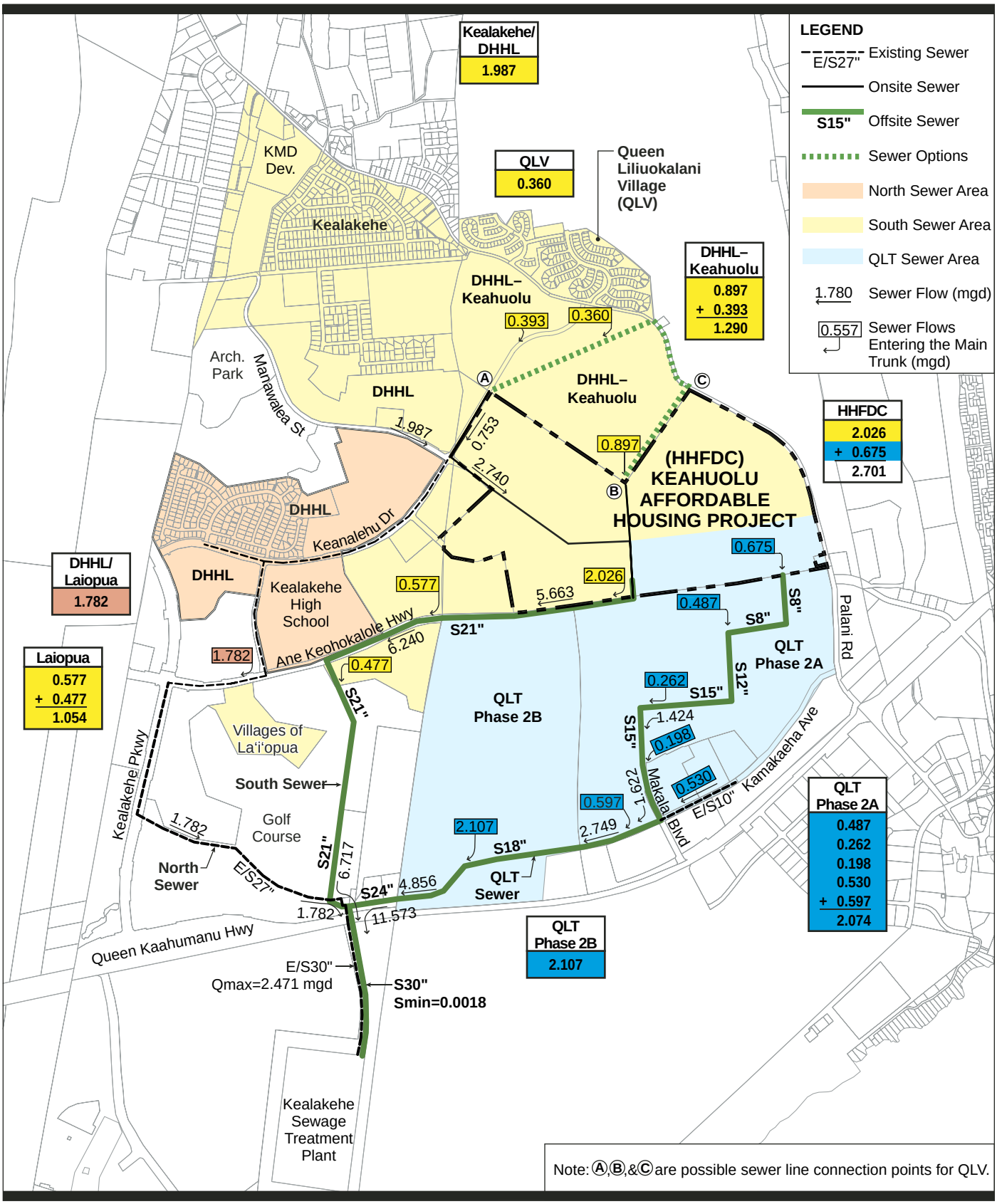
NORTH

0 500 1000 2000
SCALE IN FEET

Figure 3-10
OFFSITE SEWER SYSTEM
CONCEPT A—LA'I'OPUA ROUTE

Keahuolu Affordable Housing
Civil Infrastructure
December 2007



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NORTH

0 500 1000 2000
SCALE IN FEET

Figure 3-11
OFFSITE SEWER SYSTEM
CONCEPTS B & C—LA'I'OPUA ROUTE

Keahuolu Affordable Housing
Civil Infrastructure
December 2007

Appendix A
Roads

HHFDC Keahuolu Lands
Off-Site Road System Costs

OFF-SITE ROAD SYSTEM

Item No.	Estimated Quantity	Description	Unit Price	Total
Ane Keohokalole Highway				
1- 1	1	Lump Sum, Clearing and Grubbing	$ 40,000.00	$ 40,000
1- 2	1	Lump Sum, Water Pollution and Erosion Control Measures	$ 200,000.00	$ 200,000
1- 3	83,000	Cu. Yds., Excavation	$ 43.00	$ 3,569,000
1- 4	83,000	Cu. Yds., Embankment	$ 29.00	$ 2,407,000
1- 5	17.2	Acres, Grading	$ 8,000.00	$ 137,600
1- 6	186,800	Sq. Ft., AC Pavement for Roadways	$ 8.00	$ 1,494,400
1- 7	4,670	Lin. Ft., Concrete Curb	$ 30.00	$ 140,100
1- 8	4,670	Lin. Ft., Concrete Curb and Gutter	$ 60.00	$ 280,200
1- 9	44,365	Sq. Ft., 4" Concrete Sidewalk with Base Course	$ 12.70	$ 563,436
1- 10	6	Each, Centerline Monuments	$ 600.00	$ 3,600
1- 11	1	Lump Sum, Striping and Marking	$ 20,000.00	$ 20,000
1- 11	30	Each, Sign, Post and Footing	$ 450.00	$ 13,500
1- 11	1	Lump Sum, Traffic Signal Modification	$ 200,000.00	$ 200,000
1- 11	16	Each, Catch Basin with Dry Well	$ 20,000.00	$ 320,000
1- 11	16	Each, Dry Well	$ 12,000.00	$ 192,000
1- 11	16	Each, Drain Inlet and piping	$ 8,000.00	$ 128,000
1- 11	1	Lump Sum, Traffic Control	$ 30,000.00	$ 30,000
1- 11	1	Lump Sum, Construction Surveys	$ 40,000.00	$ 40,000
1- 12	1	Lump Sum, Mobilization/Demobilization	$ 100,000.00	$ 100,000
		Subtotal for Ane Keohokalole Highway		$ 9,878,836
		Contingency (20%)		$ 1,975,767
		Subtotal		$ 11,854,603
		Design and Construction Services (15%)		$ 1,778,190
		Total		$ 13,632,793
		SAY		**$ 13,633,000**

Note: 4,670 Linear feet of Ane Keohokalole Highway.
For water and sewer improvements, see separate costs.

HHFDC Keahuolu Lands
Off-Site Road System Costs

OFF-SITE ROAD SYSTEM

Item No.	Estimated Quantity	Description	Unit Price	Total
Palani Road Intersection				
1- 1	1	Lump Sum, Clearing and Grubbing	$ 7,000.00	$ 7,000
1- 2	1	Lump Sum, Water Pollution and Erosion Control Measures	$ 15,000.00	$ 15,000
1- 3	0	Cu. Yds., Excavation	$ 43.00	$ 0
1- 4	1,700	Cu. Yds., Embankment	$ 29.00	$ 49,300
1- 5	1.7	Acres, Grading	$ 8,000.00	$ 13,600
1- 6	59,500	Sq. Ft., AC Pavement for Roadways	$ 8.00	$ 476,000
1- 7	2,000	Lin. Ft., AC Curb	$ 20.00	$ 40,000
1- 8	3	Each, Centerline Monuments	$ 600.00	$ 1,800
1- 9	1	Lump Sum, Striping and Marking	$ 15,000.00	$ 15,000
1- 10	10	Each, Sign, Post and Footing	$ 450.00	$ 4,500
1- 11	7	Each, Dry Well	$ 12,000.00	$ 84,000
1- 12	1	Lump Sum, Traffic Control	$ 150,000.00	$ 150,000
1- 13	1	Lump Sum, Construction Surveys	$ 10,000.00	$ 10,000
1- 14	1	Lump Sum, Mobilization/Demobilization	$ 80,000.00	$ 80,000
		Subtotal for Palani Road Intersection		$ 946,200
		Contingency (20%)		$ 189,240
		Subtotal		$ 1,135,440
		Design and Construction Services (15%)		$ 170,316
		Total		$ 1,305,756
		SAY		**$ 1,306,000**

Notes: 1,410 Linear Feet of new Acceleration and Deceleration Lanes with
12' Median with AC curbs
10' AC paved shoulder
8' AC paved swale
Taper = 150', Deceleration = 275', Storage = 50'
Curve Radius = 150'
Acceleration = 360', Taper = 300'

HHFDC Keahuolu Lands
On-Site Road System Costs

ON-SITE ROADS

Item No.	Estimated Quantity	Description	Unit Price	Total
On-Site Roads				
1- 1	5,600	Lin. Ft., 80' Right-of-Way Roads	$ 2,250.00	$ 12,600,000
1- 2	24,200	Lin. Ft., 60' Right-of-Way Roads	$ 1,930.00	$ 46,706,000
1- 3	16,550	Lin. Ft., 50' Right-of-Way Roads	$ 1,790.00	$ 29,624,500
		Subtotal for On-Site Roads		$ 88,930,500
		Contingency (20%)		$ 17,786,100
		Subtotal		$ 106,716,600
		Design and Construction Services (15%)		$ 16,007,490
		Total		$ 122,724,090
		SAY		**$ 122,725,000**

Notes: Lengths of On-Site Roads based on Keahuolu Land Use Plan Concept, dated June 2007.
Cost is 2007 dollars

HHFDC Keahuolu Lands
On-Site Road System Costs

Item No.	Estimated Quantity	Description	Unit Price	Total
80' Right-of-Way Roads				
2- 1	1	Lin. Ft., Clearing and Grubbing	$ 32.14	$ 32.14
2- 2	1	Lin. Ft., Erosion Control Measures	$ 48.21	$ 48.21
2- 3	1	Lin. Ft., Roadway Excavation/Embankment	$ 200.00	$ 200.00
2- 4	1	Lin. Ft., Roadway Pavement	$ 480.00	$ 480.00
2- 5	1	Lin. Ft., Concrete Curb and Gutter	$ 60.00	$ 60.00
2- 6	1	Lin. Ft., Concrete Sidewalk	$ 133.50	$ 133.50
2- 7	1	Lin. Ft., Signing, Striping and Marking	$ 8.08	$ 8.08
2- 8	1	Lin. Ft., Catch Basin with Sediment Trap	$ 200.00	$ 200.00
2- 9	1	Lin. Ft., Dry Well	$ 233.33	$ 233.33
2- 10	1	Lin. Ft., Sewer System	$ 202.67	$ 202.67
2- 11	1	Lin. Ft., Water System	$ 201.29	$ 201.29
2- 12	1	Lin. Ft., Construction Surveys, Testing, Field Office	$ 200.00	$ 200.00
2- 13	1	Lin. Ft., Electrical System	$ 250.00	$ 250.00
		Subtotal		$ 2,249.21
		SAY		**$ 2,250.00**
60' Right-of-Way Roads				
3- 1	1	Lin. Ft., Clearing and Grubbing	$ 25.71	$ 25.71
3- 2	1	Lin. Ft., Erosion Control Measures	$ 38.57	$ 38.57
3- 3	1	Lin. Ft., Roadway Excavation/Embankment	$ 128.00	$ 128.00
3- 4	1	Lin. Ft., Roadway Pavement	$ 336.00	$ 336.00
3- 5	1	Lin. Ft., Concrete Curb and Gutter	$ 60.00	$ 60.00
3- 6	1	Lin. Ft., Concrete Sidewalk	$ 115.70	$ 115.70
3- 7	1	Lin. Ft., Signing, Striping and Marking	$ 8.08	$ 8.08
3- 8	1	Lin. Ft., Catch Basin with Sediment Trap	$ 166.67	$ 166.67
3- 9	1	Lin. Ft., Dry Well	$ 194.44	$ 194.44
3- 10	1	Lin. Ft., Sewer System	$ 202.67	$ 202.67
3- 11	1	Lin. Ft., Water System	$ 201.29	$ 201.29
3- 12	1	Lin. Ft., Construction Surveys, Testing, Field Office	$ 200.00	$ 200.00
3- 13	1	Lin. Ft., Electrical System	$ 250.00	$ 250.00
		Subtotal		$ 1,927.12
		SAY		**$ 1,930.00**
50' Right-of-Way Roads				
4- 1	1	Lin. Ft., Clearing and Grubbing	$ 22.50	$ 22.50
4- 2	1	Lin. Ft., Erosion Control Measures	$ 33.75	$ 33.75
4- 3	1	Lin. Ft., Roadway Excavation/Embankment	$ 98.00	$ 98.00
4- 4	1	Lin. Ft., Roadway Pavement	$ 256.00	$ 256.00
4- 5	1	Lin. Ft., Concrete Curb and Gutter	$ 60.00	$ 60.00
4- 6	1	Lin. Ft., Concrete Sidewalk	$ 115.70	$ 115.70
4- 7	1	Lin. Ft., Signing, Striping and Marking	$ 8.08	$ 8.08
4- 8	1	Lin. Ft., Catch Basin with Sediment Trap	$ 157.89	$ 157.89
4- 9	1	Lin. Ft., Dry Well	$ 184.21	$ 184.21
4- 10	1	Lin. Ft., Sewer System	$ 202.67	$ 202.67
4- 11	1	Lin. Ft., Water System	$ 196.29	$ 196.29
4- 12	1	Lin. Ft., Construction Surveys, Testing, Field Office	$ 200.00	$ 200.00
4- 13	1	Lin. Ft., Electrical System	$ 250.00	$ 250.00
		Subtotal		$ 1,785.08
		SAY		**$ 1,790.00**

Appendix B
Water

Appendix - Water System

Criteria

The water system criteria for the HHFDC Keahuolu Lands follows the Hawaii County Department of Water Supply's Standards dated 2002 and revised per discussions with the Department of Water Supply. The applicable criteria are shown below:

1. Water Consumption

Land Use	Average Daily Demand
Single Family (market)	800 gallons per day (gpd) per unit
Single Family (affordable)	400 gpd per unit
Multi-Family	400 gpd per unit
Commercial	3,000 gpd per acre
Schools	4,000 gpd per acre
Parks	4,000 gpd per acre

Notes:
Analysis utilizes the single family (market) consumption of 800 gpd per unit.
DWS indicated that market homes have a higher average daily demand than affordable.
DWS indicated that the project should minimize the use of water for landscaping.

2. Demand Factors:

   a. Maximum daily demand = 1.5 x average daily demand
   b. Peak hour demand = 5.0 x average daily demand

3. Fire Flow Requirements:

   a. 500 gallons per minute (gpm) for two hours for single family homes with a lot size of 10,000 square feet or larger.
   b. 1,000 gpm for one hour for single family homes with a lot size of 10,000 square feet or less.
   c. 1,500 gpm for one hour for multi-family
   d. 2,000 gpm for two hours for schools.

4. Pipeline sizing:

   a. Maximum daily demand plus fire flow with a residual pressure of 20 pounds per square inch (psi) at critical fire hydrant.
   b. Peak hour demand with a residual pressure of 40 psi.
   c. In determining the carrying capacity of the mains, the "C" values to be applied are:

Pipe Diameter	"C"
8", 12"	110
16", 20"	120
24" and larger	130

d. Maximum velocity in distribution main (without fire flow) is 6 feet per second.
e. Maximum velocity in distribution main (with fire flow) is 10 feet per second.
f. Maximum static or pumping pressure, whichever is greater, shall not exceed 125 psi.

5. Reservoirs

Reservoirs shall be sized as follows:

a. Meet maximum day consumption. Reservoir full at the beginning of the 24-hour period with no source input to the reservoir.
b. Meet maximum day rate plus fire flow for duration of the fire. Reservoir ¾ full at start of fire, with credit for incoming flow from pumps, one maximum size pump out of service.
c. Standard size of reservoir is 1.0 million gallons (MG) and in increments of 0.5 MG above 1.0 MG.

6. Wells

a. Yield:

For 2 wells drilled, each producing 1,000,000 gallons per day, each well will provide approximately two-thirds the production or 670,000 gallons per day for the project. The total available water for the project will be 1,340,000 gallons per day.

For 1 well drilled, producing 2,000,000 gallons per day, the well will provide approximately half the production or 1,000,000 gallons per day for the project.

b. Contact reservoir:

Provide a contact reservoir for the well equal to the daily production capacity of the well.

7. Service Zone

The majority of the site is within the service zone of the 595-foot Reservoir. The 595-foot Reservoir service zone extends from the 495-foot elevation to the 225-foot elevation. The portion of the site, along the mauka extension of Keanalehu Drive, above the 495-foot elevation has to be serviced from the 935-foot Reservoir, to provide adequate water pressure. Water lines from both reservoir service zones are designed to stub to the project site along Manawale`a Street.

Hawaii Housing Finance and Development Corporation December 2007
Keahuolu Affordable Housing Master Plan Prepared by: Belt Collins Hawaii Ltd.

Water - Daily Demands

Single Family Residential =	800	gallons/unit	(see note 1.)
Multi-family Residential =	400	gallons/unit	(see note 2.)
Commercial =	3,000	gallons/acre	per DWS Table 100-18
Schools (550 students) =	60	gallons/student	per DWS Table 100-18
(12 Acre School Site) Use	4,000	gallons/acre	per DHHL Water Master Plan
Parks =	4,000	gallons/acre	per DWS Table 100-18

Development	Units	Daily Demand (gallons/unit)	Average Demand (Gallons)
Concept A - LOW			
Single Family	400	800	320,000
Mult-Family	620	400	248,000
Commercial	9.7	3,000	29,100
Schools	12	4,000	48,000
Parks	25.18	4,000	100,720
Total			745,820

Reservoir Sizing:

1) Meet maximum daily consumption (1.5 x Average Day). Reservoir full at the beginning of the 24-hour period with no source input to the reservoir.

1.5 x 745,820 1,118,730 gallons

2) Meet maximum day rate plus fire flow for duration of fire. Reservoir 3/4 full at start of fire, with credit for incoming flow from pumps, one maximum size pump out of service.

Fire Flow (Worst Case is Schools) = 2000 gpm for 2 hours
240,000 gallons
Max Day Rate 93,228
Storage = 444,303 gallons

Condition 1 governs.
Existing 595' elevation reservoir has approximately 482,095 gallons capacity.
Will need to construct new 1.0 MG reservoir. (1.5 MG > 1.1 MG)

Wells:
Well Site No. 4 estimated yield = 2.0 MGD, Well Site No. 3 estimated yield = 1.0 MGD.
One 2.0 MGD yield well can provide approximately 1,000,000 gallons per day.
One 1.0 MGD yield well can provide approximately 500,000 gallons per day.
Two 1.0 MGD yield wells can provide approximately 1,340,000 gallons per day.
Two wells, one 2.0 MGD and one 1.0 MGD well can provide approximately 2,010,000 gallons per day.
Will need to construct 1 well, with 2 MGD yield. (1.0 MGD > 0.75 MGD)

Notes:
1. Per phone conversation 4/16/07 with Kurt Inaba at the Department of Water Supply, water use varies between 400 gpd (1 unit) to 800 gpd (2 units) based on size of lot.
HHFDC anticipates the single family homes to be market units and require 800 gpd (2 units).
2. Per phone conversation 4/16/07 with Kurt Inaba at the Department of Water Supply, water use for the multifamily (affordable) units can be set at 400 gpd (1 unit).

Water - Daily Demands

Development	Units	Daily Demand (gallons/unit)	Average Demand (Gallons)
Concept B - MED			
Single Family	600	800	480,000
Mult-Family	1240	400	496,000
Commercial	11.32	3,000	33,960
Schools	12	4,000	48,000
Parks	25.18	4,000	100,720
Total			1,158,680

Reservoir Sizing:

1) Meet maximum daily consumption (1.5 x Average Day). Reservoir full at the beginning of the 24-hour period with no source input to the reservoir.

1.5 x 1,158,680 1,738,020 gallons

2) Meet maximum day rate plus fire flow for duration of fire. Reservoir 3/4 full at start of fire, with credit for incoming flow from pumps, one maximum size pump out of service.

Fire Flow (Worst Case is Schools) = 2000 gpm for 2 hours
240,000 gallons
Max Day Rate 144,835
Storage = 513,113 gallons

Condition 1 governs.
Existing 595' elevation reservoir has approximately 482,095 gallons capacity.
Will need to construct new 1.5 MG reservoir. (2.0 MG > 1.7 MG)

Wells:
Well Site No. 4 estimated yield = 2.0 MGD, Well Site No. 3 estimated yield = 1.0 MGD.
One 2.0 MGD yield well can provide approximately 1,000,000 gallons per day.
One 1.0 MGD yield well can provide approximately 500,000 gallons per day.
Two 1.0 MGD yield wells can provide approximately 1,340,000 gallons per day.
Two wells, one 2.0 MGD and one 1.0 MGD well can provide approximately 2,010,000 gallons per day.
Will need to construct 2 wells. (2.01 MGD > 1.16 MGD)

Water - Daily Demands

Development	Units	Daily Demand (gallons/unit)	Average Demand (Gallons)
Concept C - HIGH			
Single Family	0	800	0
Mult-Family	2330	400	932,000
Commercial	11.32	3,000	33,960
Schools	12	4,000	48,000
Parks	25.18	4,000	100,720
Total			1,114,680

Reservoir Sizing:

1) Meet maximum daily consumption (1.5 x Average Day). Reservoir full at the beginning of the 24-hour period with no source input to the reservoir.

1.5 x 1,114,680 1,672,020 gallons

2) Meet maximum day rate plus fire flow for duration of fire. Reservoir 3/4 full at start of fire, with credit for incoming flow from pumps, one maximum size pump out of service.

Fire Flow (Worst Case is Schools) = 2000 gpm for 2 hours
240,000 gallons
Max Day Rate 139,335
Storage = 505,780 gallons

Condition 1 governs.
Existing 595' elevation reservoir has approximately 482,095 gallons capacity.
Will need to construct new 1.5 MG reservoir. (2.0 MG > 1.67 MG)

Wells:
Well Site No. 4 estimated yield = 2.0 MGD, Well Site No. 3 estimated yield = 1.0 MGD.
One 2.0 MGD yield well can provide approximately 1,000,000 gallons per day.
One 1.0 MGD yield well can provide approximately 500,000 gallons per day.
Two 1.0 MGD yield wells can provide approximately 1,340,000 gallons per day.
Two wells, one 2.0 MGD and one 1.0 MGD well can provide approximately 2,010,000 gallons per day.
Will need to construct 2 wells. (2.01 MGD > 1.11 MGD)

HHFDC Keahuolu Lands
Off-Site Water System Costs

OFF-SITE WATER SYSTEM

Item No.	Estimated Quantity	Description		Unit Price		Total
12-inch Water Line in Kealakaa Street						
1- 1	1,040	Cu. Yds., Unclassified Trench Excavation	$	130.00	$	135,200
1- 2	3,200	Lin. Ft., 12-inch Water Line	$	85.00	$	272,000
1- 3	330	Lin. Ft., 6-inch Water Line	$	60.00	$	19,800
1- 4	7,000	Lbs, Fittings	$	8.00	$	56,000
1- 5	30	Each, Concrete Reaction Blocks	$	500.00	$	15,000
1- 6	11	Fire Hydrant	$	4,000.00	$	44,000
1- 7	6	12" Butterfly Valve and Box	$	3,070.00	$	18,420
1- 8	11	6" Gate Valve and Box	$	1,800.00	$	19,800
1- 9	2	1" Air Relief Valve and Manhole	$	3,100.00	$	6,200
1- 10	2	Each, Connect to existing water line	$	3,000.00	$	6,000
1- 11	1	Lump Sum, Water line testing	$	10,000.00	$	10,000
1- 12	1	Lump Sum, Traffic Control	$	30,000.00	$	30,000
		Subtotal for 12-inch Water Line in Kealakaa Street			$	632,420
		Contingency (20%)			$	126,484
		Construction Total			$	758,904
		Design and Construction Services (15%)			$	113,836
		Total			$	872,740
		SAY			**$**	**873,000**
12-inch Water Line in Manawale'a Street						
2- 1	270	Cu. Yds., Unclassified Trench Excavation	$	130.00	$	35,100
2- 2	800	Lin. Ft., 12-inch Water Line	$	85.00	$	68,000
2- 3	100	Lin. Ft., 6-inch Water Line	$	60.00	$	6,000
2- 4	3,000	Lbs, Fittings	$	8.00	$	24,000
2- 5	12	Each, Concrete Reaction Blocks	$	500.00	$	6,000
2- 6	3	Fire Hydrant	$	4,000.00	$	12,000
2- 7	4	12" Butterfly Valve and Box	$	3,070.00	$	12,280
2- 8	3	6" Gate Valve and Box	$	1,800.00	$	5,400
2- 9	1	1" Air Relief Valve and Manhole	$	3,100.00	$	3,100
2- 10	2	Each, Connect to existing water line	$	3,000.00	$	6,000
2- 11	1	Lump Sum, Water line testing	$	10,000.00	$	10,000
2- 12	1	Lump Sum, Traffic Control	$	20,000.00	$	20,000
		Subtotal for 12-inch Water Line in Manawale'a Street			$	207,880
		Contingency (20%)			$	41,576
		Construction Total			$	249,456
		Design and Construction Services (15%)			$	37,418
		Total			$	286,874
		SAY			**$**	**287,000**

HHFDC Keahuolu Lands
Off-Site Water System Costs

Item No.	Estimated Quantity	Description		Unit Price		Total
12-inch Water Line in Ane Keohokalole Highway						
3- 1	910	Cu. Yds., Unclassified Trench Excavation	$	130.00	$	118,300
3- 2	2,820	Lin. Ft., 12-inch Water Line	$	85.00	$	239,700
3- 3	280	Lin. Ft., 6-inch Water Line	$	60.00	$	16,800
3- 4	7,000	Lbs, Fittings	$	8.00	$	56,000
3- 5	29	Each, Concrete Reaction Blocks	$	500.00	$	14,500
3- 6	10	Fire Hydrant	$	4,000.00	$	40,000
3- 7	7	12" Butterfly Valve and Box	$	3,070.00	$	21,490
3- 8	10	6" Gate Valve and Box	$	1,800.00	$	18,000
3- 9	2	2" Cleanout and Manhole	$	2,000.00	$	4,000
3- 10	3	1" Air Relief Valve and Manhole	$	3,100.00	$	9,300
3- 11	1	Each, Connect to existing water line	$	5,000.00	$	5,000
3- 12	1	Lump Sum, Water line testing	$	15,000.00	$	15,000
3- 13	1	Lump Sum, Traffic Control	$	20,000.00	$	20,000
		Subtotal for 12-inch Water Line in Ane Keohokalole Highway			$	578,090
		Contingency (20%)			$	115,618
		Construction Total			$	693,708
		Design and Construction Services (15%)			$	104,056
		Total			$	797,764
		SAY			**$**	**798,000**

HHFDC Keahuolu Lands
Off-Site Water System Costs

Item No.	Estimated Quantity	Description	Unit Price	Total
Wells				
4- 1	1	Well Site No. 4		
		Construction		
		Clearing, Grading and Access Road	$ 706,000.00	$ 706,000
		Well and Facilities	$ 607,000.00	$ 607,000
		2.0 MG Reservoir	$ 2,588,000.00	$ 2,588,000
		Reservoir Grading	$ 20,000.00	$ 20,000
		Reservoir Excavation	$ 1,376,000.00	$ 1,376,000
		Control Building	$ 656,000.00	$ 656,000
		Water Lines and Valve Stations		
		16" Water Line (1,330 LF)	$ 222,110.00	$ 222,110
		12" Water Line (550 LF)	$ 70,950.00	$ 70,950
		Valve Station	$ 66,000.00	$ 66,000
		Site Electrical	$ 146,000.00	$ 146,000
		Off-Site 16" Water Line (7,000 LF)	$ 1,726,200.00	$ 1,726,200
		Construction Subtotal		$ 8,184,260
		Contingency (20%)		$ 1,636,852
		Construction Total		$ 9,821,112
		Planning and Design (15%)		$ 1,474,000
		Total		$ 11,295,112
		SAY		**$ 11,296,000**
4- 2	1	Well Site No. 3		
		Construction		
		Clearing, Grading and Access Road	$ 700,000.00	$ 700,000
		Well and Facilities	$ 900,000.00	$ 900,000
		1.0 MG Reservoir	$ 2,070,000.00	$ 2,070,000
		Reservoir Grading	$ 8,000.00	$ 8,000
		Reservoir Excavation	$ 421,400.00	$ 421,400
		Control Building	$ 656,000.00	$ 656,000
		Water Lines and Valve Stations		
		16" Water Line (1,000 LF)	$ 167,000.00	$ 167,000
		12" Water Line (500 LF)	$ 64,500.00	$ 64,500
		Valve Station	$ 66,000.00	$ 66,000
		Site Electrical	$ 146,000.00	$ 146,000
		Construction Subtotal		$ 5,198,900
		Contingency (20%)		$ 1,039,780
		Construction Total		$ 6,238,680
		Planning and Design (15%)		$ 936,000
		Total		$ 7,174,680
		SAY		**$ 7,175,000**

Note: Cost for Well Site No. 3 does not include land acquisition cost for reservoir site.

HHFDC Keahuolu Lands
Off-Site Water System Costs

Item No.	Estimated Quantity	Description	Unit Price	Total
595' OF Elevation Reservoir on DHHL Keahuolu Property				
5- 1		1.0 MG Reservoir		
	1	Reservoir Construction	$ 2,070,000.00	$ 2,070,000
	39,000	Cu. Yds, Earthwork	$ 43.00	$ 1,677,000
	1.7	Acres, Grading	$ 8,000.00	$ 13,600
	100	Lin. Ft., Reservoir 16" Water Line	$ 167.00	$ 16,700
	2	Valve Stations	$ 66,000.00	$ 132,000
	1,770	Lin. Ft., Chain Link Fencing, PVC Coated	$ 40.00	$ 70,800
	5,500	Sq. Ft., AC Pavement	$ 8.00	$ 44,000
	14,400	Sq. Ft., Access Road Pavement	$ 8.00	$ 115,200
	22,000	Cu. Yds, Access Road Earthwork	$ 36.00	$ 792,000
	4	Acres, Access Road Grading	$ 8,000.00	$ 32,000
	2,400	Lin. Ft., Access Road 16" Water Line	$ 167.00	$ 400,800
		Subtotal		$ 5,364,100
		Contingency (20%)		$ 1,072,820
		Construction Total		$ 6,436,920
		Planning and Design (15%)		$ 966,000
		Total		$ 7,402,920
		SAY		**$ 7,403,000**
5- 2		1.5 MG Reservoir		
	1	Reservoir Construction	$ 2,300,000.00	$ 2,300,000
	50,000	Cu. Yds, Earthwork	$ 43.00	$ 2,150,000
	2.0	Acres, Grading	$ 8,000.00	$ 16,000
	100	Lin. Ft., Reservoir 16" Water Line	$ 167.00	$ 16,700
	2	Valve Stations	$ 66,000.00	$ 132,000
	1,770	Lin. Ft., Chain Link Fencing, PVC Coated	$ 40.00	$ 70,800
	6,200	Sq. Ft., AC Pavement	$ 8.00	$ 49,600
	14,400	Sq. Ft., Access Road Pavement	$ 8.00	$ 115,200
	22,000	Cu. Yds, Access Road Earthwork	$ 36.00	$ 792,000
	4	Acres, Access Road Grading	$ 8,000.00	$ 32,000
	2,400	Lin. Ft., Access Road 16" Water Line	$ 167.00	$ 400,800
		Subtotal		$ 6,075,100
		Contingency (20%)		$ 1,215,020
		Construction Total		$ 7,290,120
		Planning and Design (15%)		$ 1,094,000
		Total		$ 8,384,120
		SAY		**$ 8,385,000**

Notes: 1) Reservoir construction costs are based on estimates from DYK Inc. and adjusted (1.15) as a subcontractor to a general site contractor.

2) Reservoir construction costs do not include land acquisition from DHHL.

Appendix C
Sewer

Appendix - Sewer System

Criteria

The sewer system criteria for the HHFDC Keahuolu Lands follows the Hawaii County Department of Environmental Managements criteria as shown below:

1. Quantity of Wastewater

   Average Sewer Flow = 80 gallons per capita per day
   School / Park Sewer Flow = 25 gallons per capita per day

Land Use	Densities
Single Family	4 persons per unit
Multi-Family	2.8 persons per unit
Commercial	140 capita per acre
Schools	550 students
Parks	100 capita per 5 acres

2. Pipeline sizing:

   a. Size pipes to convey the design peak flow.
   b. Minimum size of pipe is 8-inches for mains in roadway areas.
   c. Minimum velocity in the sewer line flowing full is 2.0 feet per second.
   d. Maximum velocity in the sewer line flowing full is 10 feet per second.
   e. Minimum and maximum slopes for sewer lines flowing full:

Pipe Diameter	Minimum Slope	Maximum Slope
8”	0.00444	0.1110
10”	0.00331	0.0827
12”	0.00259	0.0648
15”	0.00192	0.0479
18”	0.00160	0.0377
21”	0.00092	0.0231
24”	0.00077	0.0193
27”	0.00066	0.0165
30”	0.00057	0.0143

3. Manhole Spacing:

   a. 350 feet – pipes up to and including 30 inches in diameter in street areas.
   b. 250 feet – pipes up to and including 18 inches in diameter in easement areas.
   c. 350 feet – pipes larger than 18 inches and up to and including 30 inches in diameter in easement areas.

4. Drop Manholes:

   A drop manhole or shallow drop manhole should be provided where a sewer enters a manhole at a height of 18 inches or more above the manhole invert.

5. Sewer Treatment Plant Capacity:

   The sewer treatment plant capacity is based on the design average flow from the development.

Hawaii Housing Finance and Development Corporation June 12, 2007
Keahuolu Affordable Housing Master Plan Prepared by: Belt Collins Hawaii Ltd.

Sewer Flows - Keahuolu Lands - Concept A

Average Sewer Flows	80	gallons/capita per day
School / Park Sewer Flows	25	gallons/capita per day
Single Family Residential =	4	persons/unit
Multi-family Residential =	2.8	persons/unit
Commercial =	140	capita/acre
Schools =	550	students
Parks =	100	persons/5 acres

Development	Units	capita/unit	capita	sewer flow (gallons/day)	average flow (gallons)
Concept A - LOW					
Single Family	400	4	1,600	80	128,000
Mult-Family	620	2.8	1,736	80	138,880
Commercial	9.7	140	1,358	80	108,640
Schools	1	550	550	25	13,750
Parks	25.18	100	504	25	12,590
Total			5,748		401,860

Average Wastewater Flow:	401,860	gallons/day	
Maximum Wastewater Flow:	1,547,161	gallons/day	(Flow Factor = 3.85)
Dry Weather Infiltration/Inflow:	28,738	gallons/day	
Design Average Flow:	**430,598**	gallons/day	**<-- Capacity Required at Plant**
Design Maximum Flow:	1,575,899	gallons/day	
Wet Weather Infiltration/Inflow:	340,000	gallons/day	
Design Peak Flow:	1,915,899	gallons/day	

Capacity at the Wastewater Treatment Plant = 431,360 gallons/day
Therefore, adequate capacity at the treatment plant.

Sewer Flows - Keahuolu Lands - Concept B

Average Sewer Flows	80	gallons/capita per day
School / Park Sewer Flows	25	gallons/capita per day
Single Family Residential =	4	persons/unit
Multi-family Residential =	2.8	persons/unit
Commercial =	140	capita/acre
Schools =	550	students
Parks =	100	persons/5 acres

Development	Units	capita/unit	capita	sewer flow (gallons/day)	average flow (gallons)
Concept B - MED					
Single Family	600	4	2,400	80	192,000
Mult-Family	1240	2.8	3,472	80	277,760
Commercial	11.32	140	1,585	80	126,784
Schools	1	550	550	25	13,750
Parks	25.18	100	504	25	12,590
Total			8,510		622,884

Average Wastewater Flow:	622,884	gallons/day	
Maximum Wastewater Flow:	2,186,323	gallons/day	(Flow Factor = 3.51)
Dry Weather Infiltration/Inflow:	42,552	gallons/day	
Design Average Flow:	**665,436**	gallons/day	**<-- Capacity Required at Plant**
Design Maximum Flow:	2,228,875	gallons/day	
Wet Weather Infiltration/Inflow:	340,000	gallons/day	
Design Peak Flow:	2,568,875	gallons/day	

Capacity at the Wastewater Treatment Plant = 431,360 gallons/day
Additional Capacity Required at the Treatment Plant = 234,076 gallons/day

Sewer Flows - Keahuolu Lands - Concept C

Average Sewer Flows	80	gallons/capita per day
School / Park Sewer Flows	25	gallons/capita per day
Single Family Residential =	4	persons/unit
Multi-family Residential =	2.8	persons/unit
Commercial =	140	capita/acre
Schools =	550	students
Parks =	100	persons/5 acres

Development	Units	capita/unit	capita	sewer flow (gallons/day)	average flow (gallons)
Concept C - HIGH					
Single Family	0	4	0	80	0
Mult-Family	2330	2.8	6,524	80	521,920
Commercial	11.32	140	1,585	80	126,784
Schools	1	550	550	25	13,750
Parks	25.18	100	504	25	12,590
Total			9,162		675,044

Average Wastewater Flow:	675,044	gallons/day	
Maximum Wastewater Flow:	2,315,401	gallons/day	(Flow Factor = 3.43)
Dry Weather Infiltration/Inflow:	45,812	gallons/day	
Design Average Flow:	**720,856**	gallons/day	**<-- Capacity Required at Plant**
Design Maximum Flow:	2,361,213	gallons/day	
Wet Weather Infiltration/Inflow:	340,000	gallons/day	
Design Peak Flow:	2,701,213	gallons/day	

Capacity at the Wastewater Treatment Plant = 431,360 gallons/day
Additional Capacity Required at the Treatment Plant = 289,496 gallons/day

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Sewer Flows - Queen Liliuokalani Trust (QLT), Phases 2A & 2B

Average Sewer Flows	80	gallons/capita per day
School / Park Sewer Flows	25	gallons/capita per day
Single Family Residential =	4	persons/unit
Multi-family Residential =	2.8	persons/unit
Commercial =	140	capita/acre
Schools =	550	students
Parks =	100	persons/5 acres

Development	Units	capita/unit	capita	sewer flow (gallons/day)	average flow (gallons)
QLT - Phase 2A					
Single Family	587	4	2,348	80	187,840
Mult-Family	332	2.8	930	80	74,368
Commercial	5.9	140	823	80	65,856
Schools	1.0	550	550	25	13,750
Parks	13.2	100	264	25	6,600
Total			4,915		348,414

Note: Development units referenced from JZMK Partners Preliminary Residential Program, April 25, 2007.

Total Area:	246	acres
Average Wastewater Flow:	348,414	gallons/day
Flow Factor:	5.00	(See note below)
Maximum Wastewater Flow:	1,742,070	gallons/day
Dry Weather Infiltration/Inflow:	24,574	gallons/day
Design Average Flow:	372,988	gallons/day
Design Maximum Flow:	1,766,644	gallons/day
Wet Weather Infiltration/Inflow:	307,500	gallons/day
Design Peak Flow:	2,074,144	gallons/day

Development	Area (acres)	average flow (gallons/day)	design peak flow (gallons/day)
QLT Phase 2A	218.0	348,414	2,074,144
QLT Phase 2B*	221.5	353,994	2,107,363

*QLT Phase 2B sewer flows are interpolated from Phase 2A. The Phase 2A area used for interpolating was reduced by 28.0 acres (archaeological preserve) in order to match future densities.

Note: Flow factor of 5.00 used to determine a conservative design peak flow.

Sewer Flows - Villages of Laiopua
Existing Village 3 and High School, Proposed Villages 4, 5 and Park

Average Sewer Flows	80	gallons/capita per day
School / Park Sewer Flows	25	gallons/capita per day
Single Family Residential =	4	persons/unit
Multi-family Residential =	2.8	persons/unit
Commercial =	140	capita/acre
Schools =	550	students
Parks =	100	persons/5 acres

Development	Units	capita/unit	capita	sewer flow (gallons/day)	average flow (gallons)
Villages of Laiopua (Existing and Proposed)					
Single Family	362	4	1,448	80	115,840
Mult-Family	680	2.8	1,904	80	152,320
Commercial	0.00	140	0	80	0
Schools	1	1400	1,400	25	35,000
Parks	5	100	100	25	2,500
Total			4,852		305,660

Note: Development units and flows referenced from Villages of Laiopua Planned Community Sewer System Master Plan, August 1994 by Belt Collins Hawaii.

Total Area:	183.2	acres
Average Wastewater Flow:	305,660	gallons/day
Flow Factor:	5.00	(See note below)
Maximum Wastewater Flow:	1,528,300	gallons/day
Dry Weather Infiltration/Inflow:	24,260	gallons/day
Design Average Flow:	329,920	gallons/day
Design Maximum Flow:	1,552,560	gallons/day
Wet Weather Infiltration/Inflow:	229,000	gallons/day
Design Peak Flow:	1,781,560	gallons/day

Note: Flow factor of 5.00 used to determine a conservative design peak flow.

Sewer Flows - Villages of Laiopua
Future Villages 6, 10, 11, Park & Village Center

Average Sewer Flows	80	gallons/capita per day
School / Park Sewer Flows	25	gallons/capita per day
Single Family Residential =	4	persons/unit
Multi-family Residential =	2.8	persons/unit
Commercial =	140	capita/acre
Schools =	550	students
Parks =	100	persons/5 acres

Development	Units	capita/unit	capita	sewer flow (gallons/day)	average flow (gallons)
Villages of Laiopua (Future)					
Single Family	329	4	1,316	80	105,280
Mult-Family	116	2.8	325	80	25,984
Commercial	14.50	40	580	80	46,400
Parks	4.5	100	90	25	2,250
Total			2,311		179,914

Note: Development units and flows referenced from Villages of Laiopua Planned Community Sewer System Master Plan, August 1994 by Belt Collins Hawaii.

Total Area:	114.2	acres
Average Wastewater Flow:	179,914	gallons/day
Flow Factor:	5.00	(See note below)
Maximum Wastewater Flow:	899,570	gallons/day
Dry Weather Infiltration/Inflow:	11,554	gallons/day
Design Average Flow:	191,468	gallons/day
Design Maximum Flow:	911,124	gallons/day
Wet Weather Infiltration/Inflow:	142,750	gallons/day
Design Peak Flow:	1,053,874	gallons/day

Note: Flow factor of 5.00 used to determine a conservative design peak flow.

Miscellaneous Sewer Design Flows

Development	Design Peak Flow (mgd)	Reference
Kealakehe/DHHL	1.987	Villages of Laiopua Planned Community, Sewer System Master Plan, August 1994 by Belt Collins Hawaii.
Queen Liliuokalani Village (QLV)	0.360	Department of Environmental Management
DHHL-Keahuolu	1.290	Villages of Laiopua Planned Community, Sewer System Master Plan, August 1994 by Belt Collins Hawaii. Makalapua Development Sewer System Master Plan, February 1994 (Revised August 1994) by Belt Collins Hawaii.

Note: Design Peak Flows are those shown on the Off-Site Sewer System Figures.

HHFDC Keahuolu Lands
Off-Site Sewer System Costs

SEWER SYSTEM - Through QLT (Concept A)

Item No.	Estimated Quantity	Description	Unit Price	Total
Sewer System				
1- 1	19,300	Cu. Yds., Unclassified Trench Excavation	$ 150.00	$ 2,895,000
1- 2	1,700	Lin. Ft., 8-inch PVC sewer pipe (ave. 6' cover)	$ 23.00	$ 39,100
1- 3	2,340	Lin. Ft., 12-inch PVC sewer pipe (ave. 8' cover)	$ 37.00	$ 86,580
1- 4	3,320	Lin. Ft., 15-inch PVC sewer pipe, (ave. 9' cover)	$ 47.00	$ 156,040
1- 5	6,850	Lin. Ft., 24-inch PVC sewer pipe (ave. 8' cover)	$ 110.00	$ 753,500
1- 6	45	Each, Sewer manhole, PVC lined (6-12' deep)	$ 11,000.00	$ 495,000
1- 7	5	Each, Shallow drop sewer manhole, PVC lined (10' to 13' deep)	$ 18,000.00	$ 90,000
1- 8	2	Each, Deep drop sewer manhole, PVC lined (13' to 16')	$ 26,000.00	$ 52,000
1- 9	1	Each, Connect to existing sewer lines	$ 3,000.00	$ 3,000
1- 10	1	Each, Connect to existing sewer manholes	$ 4,000.00	$ 4,000
1- 11	1	Lump Sum, Sewer line testing	$ 30,000.00	$ 30,000
1- 12	1	Lump Sum, Traffic Control	$ 20,000.00	$ 20,000
		Subtotal for Sewer System - Through QLT		$ 4,624,220
		Contingency (20%)		$ 924,844
		Subtotal		$ 5,549,064
		Design and construction Services (15%)		$ 832,360
		Total		$ 6,381,424
		SAY		**$ 6,381,000**

HHFDC Keahuolu Lands
Off-Site Sewer System Costs

SEWER SYSTEM - Through QLT (Concepts B and C)

Item No.	Estimated Quantity	Description		Unit Price		Total
Sewer System						
1- 1	21,000	Cu. Yds., Unclassified Trench Excavation	$	150.00	$	3,150,000
1- 2	1,700	Lin. Ft., 8-inch PVC sewer pipe (ave. 6' cover)	$	23.00	$	39,100
1- 3	1,000	Lin. Ft., 12-inch PVC sewer pipe (ave. 8' cover)	$	37.00	$	37,000
1- 4	4,660	Lin. Ft., 15-inch PVC sewer pipe, (ave. 9' cover)	$	47.00	$	219,020
1- 5	3,630	Lin. Ft., 24-inch PVC sewer pipe (ave. 8' cover)	$	110.00	$	399,300
1- 6	3,220	Lin. Ft., 30-inch HDPE sewer pipe, (ave. 8' cover)	$	90.00	$	289,800
1- 7	45	Each, Sewer manhole, PVC lined (6-12' deep)	$	11,000.00	$	495,000
1- 8	5	Each, Shallow drop sewer manhole, PVC lined (10' to 13' deep)	$	18,000.00	$	90,000
1- 9	2	Each, Deep drop sewer manhole, PVC lined (13' to 16')	$	26,000.00	$	52,000
1- 10	1	Each, Connect to existing sewer lines	$	3,000.00	$	3,000
1- 11	1	Each, Connect to existing sewer manholes	$	4,000.00	$	4,000
1- 12	1	Lump Sum, Sewer line testing	$	30,000.00	$	30,000
1- 13	1	Lump Sum, Traffic Control	$	20,000.00	$	20,000
		Subtotal for Sewer System - Through QLT			$	4,828,220
		Contingency (20%)			$	965,644
		Subtotal			$	5,793,864
		Design and construction Services (15%)			$	869,080
		Total			$	6,662,944
		SAY			**$**	**6,663,000**

HHFDC Keahuolu Lands
Off- Site Sewer System Costs

SEWER SYSTEM - Through Laiopua (Concept A)

Item No.	Estimated Quantity	Description		Unit Price		Total
Sewer System through Laiopua only						
1- 1	19,330	Cu. Yds., Unclassified Trench Excavation	$	150.00	$	2,899,500
1- 2	8,255	Lin. Ft., 21-inch PVC sewer pipe, (ave. 10' cover)	$	85.00	$	701,675
1- 3	2,470	Lin. Ft., 30-inch HDPE sewer pipe, (ave. 8' cover)	$	90.00	$	222,300
1- 4	22	Each, Sewer manhole, PVC lined (ave 9' deep)	$	11,000.00	$	242,000
1- 6	2	Each, Deep drop sewer manhole, PVC lined (14' deep)	$	19,000.00	$	38,000
1- 7	7	Each, Deep drop sewer manhole, PVC lined (20 - 25' deep)	$	25,000.00	$	175,000
1- 8	1	Each, Connect to existing sewer lines	$	3,000.00	$	3,000
1- 9	1	Each, Connect to existing sewer manholes	$	4,000.00	$	4,000
1- 10	1	Lump Sum, Sewer line testing	$	30,000.00	$	30,000
1- 11	1	Lump Sum, Traffic Control	$	20,000.00	$	20,000
		Subtotal for Laiopua sewer only			$	4,335,475
		Contingency (20%)			$	867,095
		Subtotal			$	5,202,570
		Design and construction Services (15%)			$	780,386
		Total			$	5,982,956
		SAY			**$**	**5,983,000**
Sewer through QLT only						
2- 1	13,400	Cu. Yds., Unclassified Trench Excavation	$	150.00	$	2,010,000
2- 2	1,700	Lin. Ft., 8-inch PVC sewer pipe (ave. 6' cover)	$	23.00	$	39,100
2- 3	2,340	Lin. Ft., 12-inch PVC sewer pipe (ave. 8' cover)	$	37.00	$	86,580
2- 4	1,700	Lin. Ft., 15-inch PVC sewer pipe, (ave. 9' cover)	$	47.00	$	79,900
2- 5	2,450	Lin. Ft., 18-inch PVC sewer pipe, (ave. 9' cover)	$	60.00	$	147,000
2- 6	2,290	Lin. Ft., 24-inch PVC sewer pipe, (ave. 10' cover)	$	110.00	$	251,900
2- 7	33	Each, Sewer manhole, PVC lined (ave 9' deep)	$	11,000.00	$	363,000
2- 8	8	Each, Shallow drop sewer manhole, PVC lined (10' to 13' deep)	$	17,000.00	$	136,000
		Subtotal for QLT sewer only			$	3,113,480
		Contingency (20%)			$	622,696
		Subtotal			$	3,736,176
		Design and construction Services (15%)			$	560,426
		Total			$	4,296,602
		SAY			**$**	**4,297,000**
		TOTAL FOR SEWER SYSTEM - THROUGH LAIOPUA				**10,280,000**

HHFDC Keahuolu Lands
Off- Site Sewer System Costs

SEWER SYSTEM - Through Laiopua (Concepts B and C)

Item No.	Estimated Quantity	Description		Unit Price		Total
Sewer System through Laiopua only						
1- 1	19,330	Cu. Yds., Unclassified Trench Excavation	$	150.00	$	2,899,500
1- 2	8,255	Lin. Ft., 21-inch PVC sewer pipe, (ave. 10' cover)	$	85.00	$	701,675
1- 3	2,470	Lin. Ft., 30-inch HDPE sewer pipe, (ave. 8' cover)	$	90.00	$	222,300
1- 4	22	Each, Sewer manhole, PVC lined (ave 9' deep)	$	11,000.00	$	242,000
1- 6	2	Each, Deep drop sewer manhole, PVC lined (14' deep)	$	19,000.00	$	38,000
1- 7	7	Each, Deep drop sewer manhole, PVC lined (20 - 25' deep)	$	25,000.00	$	175,000
1- 8	1	Each, Connect to existing sewer lines	$	3,000.00	$	3,000
1- 9	1	Each, Connect to existing sewer manholes	$	4,000.00	$	4,000
1- 10	1	Lump Sum, Sewer line testing	$	30,000.00	$	30,000
1- 11	1	Lump Sum, Traffic Control	$	20,000.00	$	20,000
		Subtotal for Laiopua sewer only			$	4,335,475
		Contingency (20%)			$	867,095
		Subtotal			$	5,202,570
		Design and construction Services (15%)			$	780,386
		Total			$	5,982,956
		SAY			**$**	**5,983,000**
Sewer through QLT only						
2- 1	14,500	Cu. Yds., Unclassified Trench Excavation	$	150.00	$	2,175,000
2- 2	1,700	Lin. Ft., 8-inch PVC sewer pipe (ave. 6' cover)	$	23.00	$	39,100
2- 3	1,000	Lin. Ft., 12-inch PVC sewer pipe (ave. 8' cover)	$	37.00	$	37,000
2- 4	3,040	Lin. Ft., 15-inch PVC sewer pipe, (ave. 9' cover)	$	47.00	$	142,880
2- 5	2,450	Lin. Ft., 18-inch PVC sewer pipe, (ave. 10' cover)	$	60.00	$	147,000
2- 5	2,290	Lin. Ft., 24-inch PVC sewer pipe, (ave. 10' cover)	$	110.00	$	251,900
2- 6	33	Each, Sewer manhole, PVC lined (ave 9' deep)	$	11,000.00	$	363,000
2- 7	8	Each, Shallow drop sewer manhole, PVC lined (10' to 13' deep)	$	17,000.00	$	136,000
		Subtotal for QLT sewer only			$	3,291,880
		Contingency (20%)			$	658,376
		Subtotal			$	3,950,256
		Design and construction Services (15%)			$	592,538
		Total			$	4,542,794
		SAY			**$**	**4,543,000**
		TOTAL FOR SEWER SYSTEM - THROUGH LAIOPUA				**10,526,000**

Appendix D
Solid Waste Management Plan

SOLID WASTE MANAGEMENT PLAN

FOR THE

KEAHUOLU AFFORDABLE HOUSING PROJECT

Prepared for

Hawaii Housing Finance & Development Corporation
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Honolulu, Hawai`i 96813

Prepared by

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This work was prepared by me or under my supervision.
Expiration Date of License: April 30, 2008

December 2007

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INTRODUCTION

The purpose of this Solid Waste Management Plan (SWMP) is to develop a plan for the management of solid waste generated during the construction and occupancy of the Keahuolu Affordable Housing project.

The Keahuolu Affordable Housing project would be located on approximately 272 acres of land located at Tax Map Key: (3) 7-4-021:20 in North Kona, Hawai'i. (Figure 1 – Location Map). Nearby developments include the Kealakehe High School, Department of Hawaiian Home Lands Village 3 and the existing Kealakehe community. (Figure 2 – Area Map)

The proposed Keahuolu Affordable Housing project is a master planned community of 1,020 to 2,330 dwelling units (single-family and multi-family residences), 197,000 square feet of commercial/retail space, 11.82 acres of school facilities (550 students and 70 faculty and staff with 8,700 square feet of buildings), neighborhood parks, archaeological preserves, landscape buffers, open space and associated infrastructure.

Three preliminary development plan concepts with varying dwelling unit densities and the projected timeline are summarized in Tables 1-1A, 1-1B and 1-1C.

TABLE 1-1A: PRELIMINARY DEVELOPMENT PLAN – CONCEPT A

Year	Land Use		
	Residential Units (multifamily / single family)	Commercial/Retail (SF)	School (SF)
2010	200 / 100		
2011	200 / 100		
2012	200 / 100		
2013	20 / 100		8,700
2014			
2015			
2016			
2017			
2018		100,000	
2019			
2020		97,000	
Total	**1,020**	**197,000**	**8,700**

TABLE 1-1B: PRELIMINARY DEVELOPMENT PLAN – CONCEPT B

Year	Land Use		
	Residential Units (multifamily / single family)	Commercial/Retail (SF)	School (SF)
2010	200 / 100		
2011	200 / 100		
2012	200 / 100		
2013	200 / 100		8,700
2014	200 / 100		
2015	200 / 100		
2016	40 / 0		
2017			
2018		100,000	
2019			
2020		97,000	
Total	**1,840**	**197,000**	**8,700**

TABLE 1-1C: PRELIMINARY DEVELOPMENT PLAN – CONCEPT C

Year	Land Use		
	Residential Units (multifamily)	Commercial/Retail (SF)	School (SF)
2010	300		
2011	300		
2012	300		
2013	300		8,700
2014	300		
2015	300		
2016	300		
2017	230		
2018		100,000	
2019			
2020		97,000	
Total	**2,330**	**197,000**	**8,700**

The three concepts include a variety of high and medium density multifamily units and low density single-family units. The residential units would be located on approximately 162 acres in all three development concepts. Table 1-2 provides a breakdown of the units and densities.

TABLE 1-2: ALTERNATIVE DEVELOPMENT PLAN CONCEPTS

	Alternative Concepts		
	A	B	C
Residential Units			
High density – multifamily	400	800	800
Medium density - multifamily	220	440	1,530
Low density – single-family	400	600	0
Total	**1,020**	**1,840**	**2,330**
Density (dwelling units per acre)			
High density – multifamily	12	24	24
Medium density – multifamily	8	16	12
Low density – single-family	4	6	n/a
Commercial/retail	**197,000 SF**	**197,000 SF**	**197,000 SF**
School	**8,700 SF**	**8,700 SF**	**8,700 SF**

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NORTH

0 3 6 12
SCALE IN MILES

Figure 1
LOCATION MAP

Keahuolu Affordable Housing
Solid Waste Management Plan
December 2007

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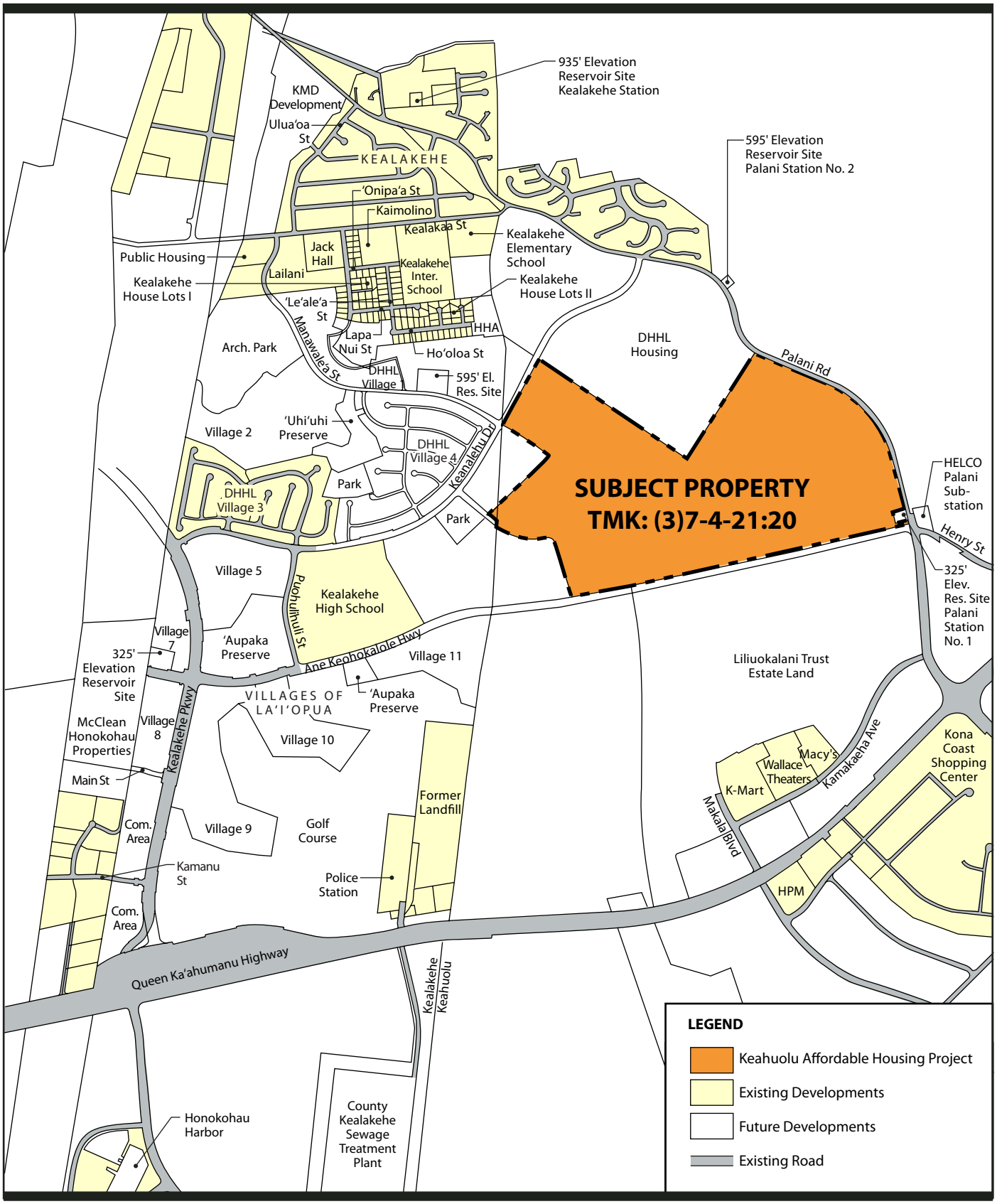

BeltCollins

NORTH

0 600 1200 1800

SCALE IN FEET

Figure 2
AREA MAP

Keahuolu Affordable Housing
Solid Waste Management Plan
December 2007

This report addresses reduction and recycling of solid wastes generated during the Keahuolu Affordable Housing project construction and occupancy. Occupancy waste collection would involve a centralized system, likely provided by one or more private contractors, where recyclables and wastes from residences, commercial/retail buildings and the school would be collected and taken directly to recycling centers or other licensed solid waste facilities. Waste that is not recycled would be taken directly to the closest landfill, which is the West Hawai'i Landfill in Pu'uanahulu, managed by Waste Management of Hawai'i, Inc. The shortest driving distance from the proposed development to the West Hawai'i Landfill is approximately 22 miles (See Figure 3 – Public Facilities - Landfills / Transfer Stations).

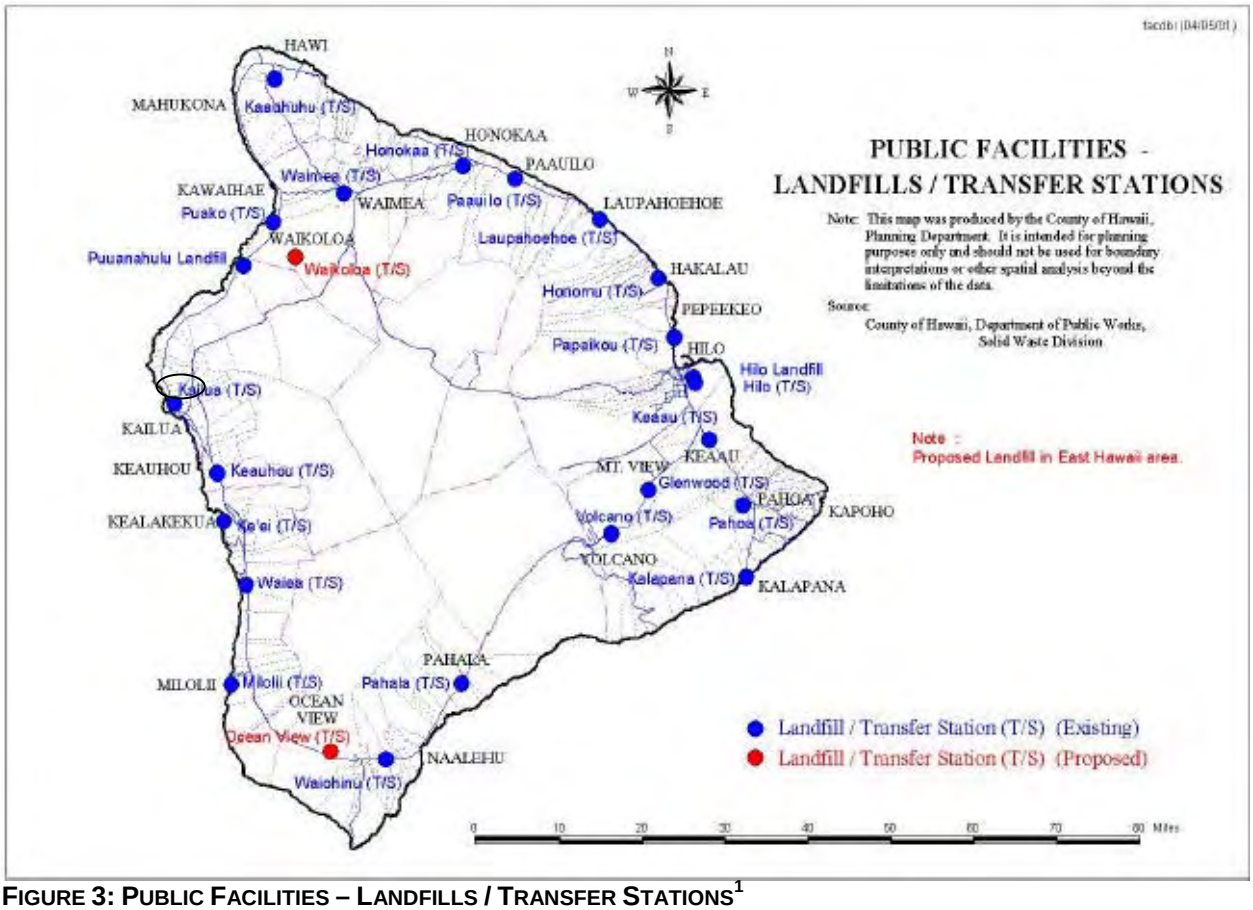

FIGURE 3: PUBLIC FACILITIES – LANDFILLS / TRANSFER STATIONS[1]

Notes:
1. Referenced from the 2002 Updated Integrated Solid Waste Management Plan for the County of Hawai'i.

Arrangements for construction waste recycling and disposal would be formalized once the planned development's construction scheduled is finalized. Likewise, arrangements for operations waste recycling and disposal would be formalized when the planned development is constructed and occupied.

SOLID WASTE GENERATION

According to the Hawai'i County Code, solid waste (also known as rubbish) is defined as "any rejected material including paper and cardboard cartons, straw, excelsior, rags, clothes, shoes….and any other material of similar character". If not properly managed, solid waste can have serious negative effects on the environment which could potentially lead to various public health problems. The County of Hawai'i therefore requires solid waste to be removed from any building or premise and disposed of at an approved solid waste disposal facility.

Quantities of solid waste were estimated for both construction and occupancy phases of the planned development. The "construction phase" of development is anticipated to begin in 2008 and completed in 2020. The "occupancy phase" of development refers to the time at which all facilities have been constructed and are open for use. The construction and occupancy phases are expected to overlap, as construction of later portions of the Keahuolu Affordable Housing project would continue while earlier portions are completed and occupied.

CONSTRUCTION PHASE

The construction of the proposed project is anticipated to start in 2008 and continue for 12 years until 2020. Projected building floor areas were used to estimate the amount of solid waste generated during construction (Tables 2-1 and 2-2). A range of 3.0 to 5.2 pounds (lbs) of construction waste per square foot (ft^2) of building floor area was used to estimate the amount of solid waste generated by construction activities.

TABLE 2-1: BUILDING FLOOR AREA

Building	Area (ft^2)
Multifamily	400 – 1,500 Use Average: 1,000
Single-family	1,000 – 2,000 Use Average: 1,500
Commercial/retail	197,000
School	8,700

TABLE 2-2: CONSTRUCTION WASTE GENERATION PROJECTIONS

Year	Construction Waste (tons/year)		
	Concept A	Concept B	Concept C
2008	525 – 910	525 – 910	450 – 780
2009	1,050 – 1,820	1,050 – 1,820	900 – 1,560
2010	1,050 – 1,820	1,050 – 1,820	900 – 1,560
2011	658 – 1,141	1,063 – 1,843	913 – 1,583
2012	358 – 621	1,063 – 1,843	913 – 1,583
2013	0	1,050 – 1,820	900 – 1,560
2014	0	585 – 1,014	900 – 1,560
2015	0	60 – 104	795 – 1,378
2016	150 – 260	150 – 260	495 – 858
2017	150 – 260	150 – 260	150 – 260
2018	146 – 252	146 – 252	146 – 252
2019	146 – 252	146 – 252	146 – 252
2020	0	0	0

Note:
1. All calculations are based on (3.0 lbs/ft^2) x (area of building) x (number of buildings constructed/year) to (5.2 lbs/ft^2) x (area of building) x (number of buildings constructed/year).
2. Pounds were multiplied by 5 x 10 $^{-4}$ (or 1/2000) to convert to tons.
3. See Appendix A for supporting calculations.

Shown below in Table 2-3 is an estimate of the components of construction waste based upon its typical composition. Tables 2-4A, 2-4B and 2-4C are estimates of the construction waste for the development plan concepts, the composition of construction waste is an estimate as the waste composition would vary according to the material selected for construction (See Appendix A for supporting calculations).

TABLE 2-3: CONSTRUCTION WASTE COMPOSITION

Waste Type	Percent of of Total Waste [1]	100 Percent of Total Waste [2]
Wood	40.4-43.3	41.9
Drywall	23.1-33.3	28.2
Cardboard	3.3-9.6	6.5
Metal	0.7-2.5	1.6
Other [4]	16.7-25.0	21.9
Total	84.2-113.7	100

Notes:
1. HABiT, 2000.
2. Converted "Percent of Total Waste" to 100 percent by taking the average of the range.
3. Calculations based on annual waste generated. See Appendix A for supporting calculations.
4. Composed of plastics, shingles, ceramic, etc.

TABLE 2-4A: CONSTRUCTION WASTE COMPOSITION – CONCEPT A

Year	Construction Waste Type (tons/year)					
	Wood	Drywall	Cardboard	Metal	Other [1]	Total
2008	220 - 381	148 - 257	34 - 59	8 - 15	115 - 199	525 – 910
2009	440 - 763	296 - 513	68 - 118	17 - 29	230 - 399	1,050 – 1,820
2010	440 - 763	296 - 513	68 - 118	17 - 29	230 - 399	1,050 – 1,820
2011	276 - 478	186 - 322	43 - 74	11 - 18	144 - 250	658 – 1,141
2012	150 - 260	101 - 175	23 - 40	6 - 10	78 - 136	358 – 621
2013	0	0	0	0	0	0
2014	0	0	0	0	0	0
2015	0	0	0	0	0	0
2016	63 - 109	42 - 73	10 - 17	2 - 4	33 - 57	150 – 260
2017	63 - 109	42 - 73	10 - 17	2 - 4	33 - 57	150 – 260
2018	61 - 106	41 - 71	9 - 16	2 - 4	32 - 55	146 - 252
2019	61 - 106	41 - 71	9 - 16	2 - 4	32 - 55	146 - 252
2020	0	0	0	0	0	0

TABLE 2-4B: CONSTRUCTION WASTE COMPOSITION – CONCEPT B

Year	Construction Waste Type (tons/year)					
	Wood	Drywall	Cardboard	Metal	Other [1]	Total
2008	220 - 381	148 - 257	34 - 59	8 - 15	115 - 199	525 – 910
2009	440 - 763	296 - 513	68 - 118	17 - 29	230 - 399	1,050 – 1,820
2010	440 - 763	296 - 513	68 - 118	17 - 29	230 - 399	1,050 – 1,820
2011	445 - 772	300 - 520	69 - 120	17 - 29	233 - 404	1,063 – 1,843
2012	445 - 772	300 - 520	69 - 120	17 - 29	233 - 404	1,063 – 1,843
2013	440 - 763	296 - 513	68 - 118	17 - 29	230 - 399	1,050 – 1,820
2014	245 - 425	165 - 286	38 - 66	9 - 16	28 – 222	585 – 1,014
2015	25 - 44	17 - 29	4 - 7	1 - 2	13 - 23	60 - 104
2016	63 - 109	42 - 73	10 - 17	2 - 4	33 - 57	150 – 260
2017	63 - 109	42 - 73	10 - 17	2 - 4	33 - 57	150 – 260
2018	61 - 106	41 - 71	9 - 16	2 - 4	32 - 55	146 - 252
2019	61 - 106	41 - 71	9 - 16	2 - 4	32 - 55	146 - 252
2020	0	0	0	0	0	0

Notes:
1. Composed of plastics, shingles, ceramic, etc.
2 See Appendix A for supporting calculations.

TABLE 2-4C: CONSTRUCTION WASTE COMPOSITION – CONCEPT C

Year	Construction Waste Type (tons/year)					
	Wood	Drywall	Cardboard	Metal	Other [1]	Total
2008	189 - 327	127 - 220	29 - 51	7 - 12	99 - 71	450 - 780
2009	377 - 654	254 - 440	59 - 101	14 - 25	197 - 342	900 – 1,560
2010	377 - 654	254 - 440	59 - 101	14 - 25	197 - 342	900 – 1,560
2011	383 - 663	257 - 446	59 - 103	15 - 25	200 - 347	913 – 1,583
2012	383 - 663	257 - 446	59 - 103	15 - 25	200 - 347	913 – 1,583
2013	377 - 654	254 - 440	59 - 101	14 - 25	197 - 342	900 – 1,560
2014	377 - 654	254 - 440	59 - 101	14 - 25	197 - 342	900 – 1,560
2015	333 - 577	224 - 389	52 - 90	13 - 22	174 - 302	795 – 1,378
2016	207 - 360	140 - 242	32 - 56	8 - 14	108 – 188	495 - 858
2017	63 - 109	42 - 73	10 - 17	2 - 4	33 - 57	150 – 260
2018	61 - 106	41 - 71	9 - 16	2 - 4	32 - 55	146 - 252
2019	61 - 106	41 - 71	9 - 16	2 - 4	32 - 55	146 - 252
2020	0	0	0	0	0	0

Notes:
1. Composed of plastics, shingles, ceramic, etc.
2 See Appendix A for supporting calculations.

OCCUPANCY PHASE

The Keahuolu Affordable Housing project is anticipated to begin its occupancy phase in 2010 and increase continuously until full occupancy is achieved in 2020. During the occupancy phase, solid waste quantities are a function of population. Therefore, the population during the occupancy phase was estimated based upon the following considerations:

- An average of 4 persons per single family unit.
- An average of 2.8 persons per multifamily unit
- 620 students, faculty and staff at the school facility
  - Students, faculty and staff are at the school only 42% of the day
  - Daily population = 260 persons
- 197,000 square feet of commercial / retail
  - 30 to 60 square feet / person for stores (per 1997 Uniform Building Code)
  - 100 square feet / person for office (per 1997 Uniform Building Code)
  - Use 72 square feet / person with 42% occupancy during the day
  - 100,000 square feet daily population = 583 persons
  - 97,000 square feet daily population = 566 persons
- Solid waste generation rate of 6.2 pounds per person per day.

Shown below in Tables 2-5A, 2-5B or 2-5C are population estimates as well as the anticipated amount of solid waste generated during the operations phase for development concepts A, B or C, respectively.

TABLE 2-5A: POPULATIONS AND WASTE GENERATION RATES – CONCEPT A

Year	Average Daily Population	Daily Waste Generated (lbs/day) [1]	Annual Waste Generated (tons/year) [2]
2010	960	5,952	1,086
2011	1,920	11,904	2,172
2012	2,880	17,856	3,259
2013	3,596	22,295	4,069
2014	3,596	22,295	4,069
2015	3,596	22,295	4,069
2016	3,596	22,295	4,069
2017	3,596	22,295	4,069
2018	4,180	25,916	4,730
2019	4,180	25,916	4,730
2020 and Beyond	4,746	29,425	5,370

Notes:
1. Calculation based on (6.2 lbs./person/day) x (total average per day population). See Appendix A for supporting calculations.
2. Calculation based on (daily waste generation) x (365 days) x (1/2000 tons/lb.). See Appendix A for supporting calculations.

TABLE 2-5B: POPULATIONS AND WASTE GENERATION RATES – CONCEPT B

Year	Average Daily Population	Daily Waste Generated (lbs/day) [1]	Annual Waste Generated (tons/year) [2]
2010	960	5,952	1,086
2011	1,920	11,904	2,172
2012	2,880	17,856	3,259
2013	4,100	25,420	4,639
2014	5,060	31,372	5,725
2015	6,020	37,324	6,812
2016	6,132	38,018	6,938
2017	6,132	38,018	6,938
2018	6,716	41,639	7,599
2019	6,716	41,639	7,599
2020 and Beyond	7,282	45,148	8,240

TABLE 2-5C: POPULATIONS AND WASTE GENERATION RATES – CONCEPT C

Year	Average Daily Population	Daily Waste Generated (lbs/day) [1]	Annual Waste Generated (tons/year) [2]
2010	840	5,208	950
2011	1,680	10,416	1,901
2012	2,520	15,624	2,851
2013	3,620	22,444	4,096
2014	4,460	27,652	5,046
2015	5,300	32,860	5,997
2016	6,140	38,068	6,947
2017	6,784	42,061	7,676
2018	7,368	45,682	8,337
2019	7,368	45,682	8,337
2020 and Beyond	7,934	49,191	8,977

Notes:
1. Calculation based on (6.2 lbs./person/day) x (total average per day population). See Appendix A for supporting calculations.
2. Calculation based on (daily waste generation) x (365 days) x (1/2000 tons/lb.). See Appendix A for supporting calculations.

The composition of wastes generated during the occupancy phase of the Keahuolu Affordable Housing project is based upon the 1993 Hawai'i Integrated Solid Waste Management Plan as well as a 2003 Oahu Waste Composition Study. Table 2-6 includes waste composition proportions and Tables 2-7A, 2-7B or 2-7C provides a yearly breakdown of the waste composition anticipated at the Keahuolu project for development concepts A, B or C, respectively. Management of these wastes is discussed in the following section.

TABLE 2-6: OCCUPANCY WASTE COMPOSITION

Waste Type	Percent of Total Waste[1]
Paper	16.7
Yard Waste	12.5
Food Waste	8.4
Plastic	4.4
Other Organic	21.5
Metals	13.1
Glass	1.6
Other Inorganic	21.8
Total	**100.0**

Notes:
1. 1993 County of Hawai'i Integrated Solid Waste Management Plan, 2003 Oahu Waste Composition Study

TABLE 2-7A: OCCUPANCY WASTE COMPOSITION – CONCEPT A

Year	Occupancy Waste (tons/year)								
	Paper	Yard	Food	Plastic	Other Organic	Metals	Glass	Other Inorganic	Total
2010	181	136	91	48	233	142	17	237	**1,086**
2011	363	272	182	96	467	285	35	473	**2,172**
2012	544	407	274	143	701	427	52	710	**3,259**
2013	680	509	342	179	875	533	65	887	**4,069**
2014	680	509	342	179	875	533	65	887	**4,069**
2015	680	509	342	179	875	533	65	887	**4,069**
2016	680	509	342	179	875	533	65	887	**4,069**
2017	680	509	342	179	875	533	65	887	**4,069**
2018	790	591	397	208	1,017	620	76	1,031	**4,730**
2019	790	591	397	208	1,017	620	76	1,031	**4,730**
2020	897	671	451	236	1,155	703	86	1,171	**5,370**

Notes:
1. Calculation based on (annual waste generated from Table 2-5A) x ("Percent of Total Waste" from Table 2-6).

TABLE 2-7B: OCCUPANCY WASTE COMPOSITION – CONCEPT B

Year	Occupancy Waste (tons/year)								
	Paper	Yard	Food	Plastic	Other Organic	Metals	Glass	Other Inorganic	Total
2010	181	136	91	48	233	142	17	237	**1,086**
2011	363	272	182	96	467	285	35	473	**2,172**
2012	544	407	274	143	701	427	52	710	**3,259**
2013	775	580	390	204	997	608	74	1,011	**4,639**
2014	956	716	481	252	1,231	750	92	1,248	**5,725**
2015	1,138	852	572	300	1,465	892	109	1,485	**6,812**
2016	1,159	867	583	305	1,492	909	111	1,512	**6,938**
2017	1,159	867	583	305	1,492	909	111	1,512	**6,938**
2018	1,269	950	638	334	1,634	995	122	1,657	**7,599**
2019	1,269	950	638	334	1,634	995	122	1,657	**7,599**
2020	1,376	1,030	692	363	1,772	1,079	132	1,796	**8,240**

Notes:
1. Calculation based on (annual waste generated from Table 2-5B) x ("Percent of Total Waste" from Table 2-6).

TABLE 2-7C: OCCUPANCY WASTE COMPOSITION – CONCEPT C

Year	Occupancy Waste (tons/year)								
	Paper	Yard	Food	Plastic	Other Organic	Metals	Glass	Other Inorganic	Total
2010	159	119	80	42	204	124	15	207	**950**
2011	317	238	160	84	409	249	30	414	**1,901**
2012	476	356	239	125	613	373	46	622	**2,851**
2013	684	512	344	180	881	537	66	893	**4,096**
2014	843	631	424	222	1,085	661	81	1,100	**5,046**
2015	1,001	750	504	264	1,289	786	96	1,307	**5,997**
2016	1,160	868	584	306	1,494	910	111	1,514	**6,947**
2017	1,282	960	645	338	1,650	1,006	123	1,673	**7,676**
2018	1,392	1,042	700	367	1,792	1,092	133	1,817	**8,337**
2019	1,392	1,042	700	367	1,792	1,092	133	1,817	**8,337**
2020	1,499	1,122	754	395	1,930	1,176	144	1,957	**8,977**

Notes:
1. Calculation based on (annual waste generated from Table 2-5C) x ("Percent of Total Waste" from Table 2-6).

SOLID WASTE MANAGEMENT

Emphasis for the management of solid wastes generated by the Keahuolu Affordable Housing project would be placed on waste diversion and recycling. Solid wastes would be managed in conformance with the applicable Department of Health and County requirements. The landfill nearest to the Keahuolu project is the West Hawai'i Landfill at Pu'uanahulu. Since the County of Hawai'i does not provide waste collection services, recycle and disposal of construction and occupancy wastes generated would be hauled by private contractors or individuals. Specific arrangements for construction and occupancy wastes would be made closer to the project beginning. Recyclables and wastes would be managed in a centralized system or by private individuals, and hauled directly to recycling centers, transfer stations and the landfill.

Although West Hawai'i is located in an area where the annual precipitation does not often exceed the amount of evapotranspiration (water lost to the atmosphere by evaporation and transpiration), all waste should avoid contact with water as best as possible. Waste that comes into contact with water before being hauled to the landfill may result in leachate (liquid produced when water percolates through any permeable material) at the landfill. Leachate could contaminate both ground and surface water, which may lead to various environmental and health problems as well as the degradation of local amenities. It can best be managed by daily covering of all waste to minimize the amount of water percolation.

CONSTRUCTION PHASE

As shown in Table 2-2, approximately 146 – 1,820 tons/year, 60 – 1,843 tons/year or 146 – 1,583 ton/year of construction waste would be generated for development concepts A, B or C, respectively, during the construction of the Keahuolu Affordable Housing project from 2008 to 2019.

The primary method of reducing (or mitigating) the amount of construction waste to be hauled offsite would be recycling. The following items or materials would be recycled to the extent practicable: green waste (processed and used on site), wood waste (processed with green waste when practical, depending on type of wood and ability to chip, and used on site), cardboard (recycled off site), and metals (recycled off site). The remaining categories of wastes (i.e., drywall, other) may be recycled if a local recycling vendor is available. Otherwise, these non-recyclable wastes would be hauled to the landfill. The construction waste composition that may be diverted or recycled is shown in Table 3-1 and Tables 3-2A, 3-2B or 3-2C provides a yearly breakdown of the waste composition for the development concepts, A, B or C, respectively. According to the estimated waste composition information, approximately 73 – 910 tons/year, 30 – 922 tons/year or 73 – 792 tons/year of construction wastes could be recycled for development concepts A, B or C, respectively. The remaining 50% would likely be hauled to the landfill.

TABLE 3-1: WASTE COMPOSITION
DIVERTED OR RECYCLED CONSTRUCTION WASTE

Waste Type	Percent of Total Waste[1]	100 Percent of Total Waste[2]
Wood	40.4-43.3	41.9
Cardboard	3.3-9.6	6.5
Metal	0.7-2.5	1.6
Total	44.4-55.4	49.9

Notes:
1. *HABiT, 2000.*
2. *Converted "Percent of Total Waste" to 100 percent by taking the average of the range.*

TABLE 3-2A: DIVERTED OR RECYCLED CONSTRUCTION WASTE COMPOSITION – CONCEPT A

Year	Diverted or Recycled Construction Waste (tons/year)			
	Wood	Cardboard	Metal	Total
2008	220 - 381	34 - 59	8 - 15	**263 – 455**
2009	440 - 763	68 - 118	17 - 29	**525 – 910**
2010	440 - 763	68 - 118	17 - 29	**525 – 910**
2011	276 - 478	43 - 74	11 - 18	**329 – 571**
2012	150 - 260	23 - 40	6 - 10	**179 – 311**
2013	0	0	0	**0**
2014	0	0	0	**0**
2015	0	0	0	**0**
2016	63 - 109	10 - 17	2 - 4	**75 – 130**
2017	63 - 109	10 - 17	2 - 4	**75 – 130**
2018	61 - 106	9 - 16	2 - 4	**73 – 126**
2019	61 - 106	9 - 16	2 - 4	**73 – 126**
2020	0	0	0	**0**

Notes:
1. *See Table 2-4A and Appendix A for supporting calculations.*

TABLE 3-2B: DIVERTED OR RECYCLED CONSTRUCTION WASTE COMPOSITION – CONCEPT B

Year	Diverted or Recycled Construction Waste (tons/year)			
	Wood	Cardboard	Metal	Total
2008	220 - 381	34 - 59	8 - 15	**263 – 455**
2009	440 - 763	68 - 118	17 - 29	**525 – 910**
2010	440 - 763	68 - 118	17 - 29	**525 – 910**
2011	445 - 772	69 - 120	17 - 29	**532 – 922**
2012	445 - 772	69 - 120	17 - 29	**532 – 922**
2013	440 - 763	68 - 118	17 - 29	**525 – 910**
2014	245 - 425	38 - 66	9 - 16	**293 – 507**
2015	25 - 44	4 - 7	1 - 2	**30 – 52**
2016	63 - 109	10 - 17	2 - 4	**75 – 130**
2017	63 - 109	10 - 17	2 - 4	**75 – 130**
2018	61 - 106	9 - 16	2 - 4	**73 – 126**
2019	61 - 106	9 - 16	2 - 4	**73 – 126**
2020	0	0	0	**0**

Notes:
1. See Table 2-4B and Appendix A for supporting calculations.

TABLE 3-2C: DIVERTED OR RECYCLED CONSTRUCTION WASTE COMPOSITION – CONCEPT C

Year	Diverted or Recycled Construction Waste (tons/year)			
	Wood	Cardboard	Metal	Total
2008	189 - 327	29 - 51	7 - 12	**225 – 390**
2009	377 - 654	59 - 101	14 - 25	**450 – 780**
2010	377 - 654	59 - 101	14 - 25	**450 – 780**
2011	383 - 663	59 - 103	15 - 25	**457 – 792**
2012	383 - 663	59 - 103	15 - 25	**457 – 792**
2013	377 - 654	59 - 101	14 - 25	**450 – 780**
2014	377 - 654	59 - 101	14 - 25	**450 – 780**
2015	333 - 577	52 - 90	13 - 22	**398 – 689**
2016	207 - 360	32 - 56	8 - 14	**248 – 429**
2017	63 - 109	10 - 17	2 - 4	**75 – 130**
2018	61 - 106	9 - 16	2 - 4	**73 – 126**
2019	61 - 106	9 - 16	2 - 4	**73 – 126**
2020	0	0	0	**0**

Notes:
1. See Table 2-4C and Appendix A for supporting calculations.

OCCUPANCY PHASE

The primary method of reducing (or mitigating) the amount of occupancy waste to be hauled offsite is recycling. To the extent practicable, the planned development would arrange for green waste (e.g., yard waste) generated during grounds keeping be collected and processed for use as soil amendment on the site. Wastes that cannot be incorporated into green waste processing on site would be minimized, and recycled or hauled to the landfill as appropriate. Future arrangements for recycling collection (aluminum, paper, newspaper, glass, and plastic containers) in building areas, and waste hauling for the remainder of waste that is not readily recyclable, would be made. The wastes associated with commercial / retail activities would also be recycled (likely to include cardboard, paper, glass, and plastic containers). Specialized materials associated with grounds keeping (e.g., pesticides and fertilizers) would be used according to accepted practices (i.e., pesticide rinsate would be used as product, and fertilizer would be used up or incorporated into green waste processing at the site). Specialized materials associated with maintenance and industrial activities (e.g., motor oil and solvents) would be recycled when possible or disposed according to accepted practices for the County of Hawai'i.

The anticipated recycled waste composition for the occupancy is shown in Table 3-3 and Tables 3-4A, 3-4B or 3-4C provides a yearly breakdown of the recycled waste for the development concepts, A, B or C, respectively. Hawai'i County's recycling rate is approximately 25.8 percent (County of Hawai'i – Solid Waste Disposal Summary 2006 - 2006). Based on the Keahuolu Affordable Housing project having a recycling rate equivalent to that measured by Hawai'i County, 1,385 tons, 2,126 tons or 2,316 tons of the total occupancy waste would be diverted or recycled for development concepts A, B or C, respectively. All other organic and inorganic categories of waste would likely be hauled to the landfill. Contracts with private recyclers and waste haulers would be developed to achieve these ends. In addition, green waste would be processed and used on site as soil amendment to the extent practical. Processing of green waste may involve chipping and passive composting of organic waste, resulting in soil amendment for use at the Keahuolu Affordable Housing project.

TABLE 3-3: WASTE COMPOSITION
DIVERTED OR RECYCLED OCCUPANCY WASTE

Waste Type	Percent of Total Waste[1]
Paper	16.7
Yard Waste	12.5
Plastic	4.4
Metals	13.1
Glass	1.6
Total Recyclable	**48.3**
Total Diverted Waste	**25.8**

Notes:
1. 1993 County of Hawai'i Integrated Solid Waste Management Plan, 2003 Oahu Waste Composition Study

TABLE 3-4A: DIVERTED OR RECYCLED OCCUPANCY WASTE COMPOSITION – CONCEPT A

Year	Occupancy Waste (tons/year)						
	Paper	Yard	Plastic	Metals	Glass	Total Recyclable	Total Diverted Waste [2]
2010	181	136	48	142	17	525	**280**
2011	363	272	96	285	35	1,049	**560**
2012	544	407	143	427	52	1,574	**841**
2013	680	509	179	533	65	1,965	**1,050**
2014	680	509	179	533	65	1,965	**1,050**
2015	680	509	179	533	65	1,965	**1,050**
2016	680	509	179	533	65	1,965	**1,050**
2017	680	509	179	533	65	1,965	**1,050**
2018	790	591	208	620	76	2,285	**1,220**
2019	790	591	208	620	76	2,285	**1,220**
2020	897	671	236	703	86	2,594	**1,385**

Notes:
1. Occupancy waste type (paper, yard, plastic, metals and glass) are referenced from Table 2-7A.
2. Calculation based on (annual waste generated from Table 2-7A) x (25.8 percent recycle rate).

TABLE 3-4B: DIVERTED OR RECYCLED OCCUPANCY WASTE COMPOSITION – CONCEPT B

Year	Occupancy Waste (tons/year)						
	Paper	Yard	Plastic	Metals	Glass	Total Recyclable	Total Diverted Waste [2]
2010	181	136	48	142	17	525	**280**
2011	363	272	96	285	35	1,049	**560**
2012	544	407	143	427	52	1,574	**841**
2013	775	580	204	608	74	2,241	**1,197**
2014	956	716	252	750	92	2,765	**1,477**
2015	1,138	852	300	892	109	3,290	**1,757**
2016	1,159	867	305	909	111	3,351	**1,790**
2017	1,159	867	305	909	111	3,351	**1,790**
2018	1,269	950	334	995	122	3,670	**1,961**
2019	1,269	950	334	995	122	3,670	**1,961**
2020	1,376	1,030	363	1,079	132	3,980	**2,126**

Notes:
1. Occupancy waste type (paper, yard, plastic, metals and glass) are referenced from Table 2-7B.
2. Calculation based on (annual waste generated from Table 2-7B) x (25.8 percent recycle rate).

TABLE 3-4C: DIVERTED OR RECYCLED OCCUPANCY WASTE COMPOSITION – CONCEPT C

Year	Occupancy Waste (tons/year)						
	Paper	Yard	Plastic	Metals	Glass	Total Recyclable	Total Diverted Waste [2]
2010	159	119	42	124	15	459	**245**
2011	317	238	84	249	30	918	**490**
2012	476	356	125	373	46	1,377	**736**
2013	684	512	180	537	66	1,978	**1,057**
2014	843	631	222	661	81	2,437	**1,302**
2015	1,001	750	264	786	96	2,897	**1,547**
2016	1,160	868	306	910	111	3,355	**1,792**
2017	1,282	960	338	1,006	123	3,708	**1,980**
2018	1,392	1,042	367	1,092	133	4,027	**2,151**
2019	1,392	1,042	367	1,092	133	4,027	**2,151**
2020	1,499	1,122	395	1,176	144	4,336	**2,316**

Notes:
1. Occupancy waste type (paper, yard, plastic, metals and glass) are referenced from Table 2-7C.
2. Calculation based on (annual waste generated from Table 2-7C) x (25.8 percent recycle rate).

SUMMARY

Based on the estimated waste generation rates for construction and occupancy at the Keahuolu Affordable Housing project and the solid waste management plans for waste diversion through minimization and recycling of materials, estimated waste diversion and landfilling generation are shown in Tables 4-1A, 4-1B or 4-1C for development concepts A, B or C, respectively.

TABLE 4-1A: SUMMARY OF WASTE DIVERTED AND LANDFILLED – CONCEPT A

Year	Construction Waste				Occupancy Waste				Total Diverted Waste (tons/yr)	Total Landfilled Waste (tons/yr)
	Diverted		Landfilled		Diverted		Landfilled			
	Waste[1] (tons/yr)	# Trucks per week[2]	Waste[3] (tons/yr)	# Trucks per week[2]	Waste[4] (tons/yr)	# Trucks per week[2]	Waste[5] (tons/yr)	# Trucks per week[2]		
2008	263-455	0.5-0.9	262-455	0.5-0.9	0	0	0	0	**263-455**	**262-455**
2009	525-910	1.0-1.8	525-910	1.0-1.8	0	0	0	0	**525-910**	**525-910**
2010	525-910	1.0-1.8	525-910	1.0-1.8	280	0.5	806	1.6	**805-1,190**	**1,331-1,716**
2011	329-571	0.6-1.1	329-570	0.6-1.1	560	1.1	1,612	3.1	**889-1,131**	**1,941-2,182**
2012	179-311	0.3-0.6	179-310	0.3-0.6	841	1.6	2,418	4.7	**1,020-1,152**	**2,597-2,728**
2013	0	0	0	0	1,050	2.0	3,019	5.8	**1,050**	**3,019**
2014	0	0	0	0	1,050	2.0	3,019	5.8	**1,050**	**3,019**
2015	0	0	0	0	1,050	2.0	3,019	5.8	**1,050**	**3,019**
2016	75-130	0.1-0.3	75-130	0.1-0.3	1,050	2.0	3,019	5.8	**1,125-1,180**	**3,094-3,149**
2017	75-130	0.1-0.3	75-130	0.1-0.3	1,050	2.0	3,019	5.8	**1,125-1,180**	**3,094-3,149**
2018	73-126	0.1-0.2	73-126	0.1-0.2	1,220	2.3	3,510	6.8	**1,293-1,346**	**3,583-3,636**
2019	73-126	0.1-0.2	73-126	0.1-0.2	1,220	2.3	3,510	6.8	**1,293-1,346**	**3,583-3,636**
2020 +	0	0	0	0	1,385	2.7	3,985	7.7	**1,385**	**3,985**

Notes:

1. *Diverted waste (tons/year) is waste that would be recycled. Values from total diverted construction waste (Table 3-2A).*
2. *Calculation based on 10-ton capacity for trucks that pick up waste.*
3. *Calculation based on total construction waste (Table 2-4A) – total diverted construction waste (Table 3-2A).*
4. *Diverted waste is waste that would be recycled. Values from total diverted occupancy waste (Table 3-4A).*
5. *Calculation based on total occupancy waste (Table 2-7A) – total diverted occupancy waste (Table 3-4A).*
6. *See Appendix A for supporting calculations.*

TABLE 4-1B: SUMMARY OF WASTE DIVERTED AND LANDFILLED – CONCEPT B

Year	Construction Waste				Occupancy Waste				Total Diverted Waste (tons/yr)	Total Landfilled Waste (tons/yr)
	Diverted		Landfilled		Diverted		Landfilled			
	Waste[1] (tons/yr)	# Trucks per week[2]	Waste[3] (tons/yr)	# Trucks per week[2]	Waste[4] (tons/yr)	# Trucks per week[2]	Waste[5] (tons/yr)	# Trucks per week[2]		
2008	263-455	0.5-0.9	262-455	0.5-0.9	0	0	0	0	**263-455**	**262-455**
2009	525-910	1.0-1.8	525-910	1.0-1.8	0	0	0	0	**525-910**	**525-910**
2010	525-910	1.0-1.8	525-910	1.0-1.8	280	0.5	806	1.6	**805-1,190**	**1,331-1,716**
2011	532-922	1.0-1.8	531-921	1.0-1.8	560	1.1	1,612	3.1	**1,092-1,482**	**2,143-2,533**
2012	532-922	1.0-1.8	531-921	1.0-1.8	841	1.6	2,418	4.7	**1,373-1,763**	**2,949-3,339**
2013	525-910	1.0-1.8	525-910	1.0-1.8	1,197	2.3	3,442	6.6	**1,722-2,107**	**3,967-4,352**
2014	293-507	0.6-1.0	292-507	0.6-1.0	1,477	2.8	4,248	8.2	**1,770-1,984**	**4,540-4,755**
2015	30-52	0.1-0.1	30-52	0.1-0.1	1,757	3.4	5,055	9.7	**1,787-1,809**	**5,085-5,107**
2016	75-130	0.1-0.3	75-130	0.1-0.3	1,790	3.4	5,148	9.9	**1,865-1,920**	**5,223-5,278**
2017	75-130	0.1-0.3	75-130	0.1-0.3	1,790	3.4	5,148	9.9	**1,865-1,920**	**5,223-5,278**
2018	73-126	0.1-0.2	73-126	0.1-0.2	1,961	3.8	5,638	10.8	**2,034-2,087**	**5,711-5,764**
2019	73-126	0.1-0.2	73-126	0.1-0.2	1,961	3.8	5,638	10.8	**2,034-2,087**	**5,711-5,764**
2020 +	0	0	0	0	2,126	4.1	6,114	11.8	**2,126**	**6,114**

Notes:

1. *Diverted waste (tons/year) is waste that would be recycled. Values from total diverted construction waste (Table 3-2B).*
2. *Calculation based on 10-ton capacity for trucks that pick up waste.*
3. *Calculation based on total construction waste (Table 2-4B) – total diverted construction waste (Table 3-2B).*
4. *Diverted waste is waste that would be recycled. Values from total diverted occupancy waste (Table 3-4B).*
5. *Calculation based on total occupancy waste (Table 2-7B) – total diverted occupancy waste (Table 3-4B).*
6. *See Appendix A for supporting calculations.*

TABLE 4-1C: SUMMARY OF WASTE DIVERTED AND LANDFILLED – CONCEPT C

Year	Construction Waste				Occupancy Waste				Total Diverted Waste (tons/yr)	Total Landfilled Waste (tons/yr)
	Diverted		Landfilled		Diverted		Landfilled			
	Waste[1] (tons/yr)	# Trucks per week[2]	Waste[3] (tons/yr)	# Trucks per week[2]	Waste[4] (tons/yr)	# Trucks per week[2]	Waste[5] (tons/yr)	# Trucks per week[2]		
2008	225-390	0.4-0.8	225-390	0.4-0.8	0	0	0	0	**225-390**	**225-390**
2009	450-780	0.9-1.5	450-780	0.9-1.5	0	0	0	0	**450-780**	**450-780**
2010	450-780	0.9-1.5	450-780	0.9-1.5	245	0.5	705	1.4	**695-1,025**	**1,155-1,485**
2011	457-792	0.9-1.5	456-791	0.9-1.5	490	0.9	1,411	2.7	**947-1,282**	**1,867-2,202**
2012	457-792	0.9-1.5	456-791	0.9-1.5	736	1.4	2,115	4.1	**1,193-1,528**	**2,571-2,906**
2013	450-780	0.9-1.5	450-780	0.9-1.5	1,057	2.0	3,039	5.8	**1,507-1,837**	**3,489-3,819**
2014	450-780	0.9-1.5	450-780	0.9-1.5	1,302	2.5	3,744	7.2	**1,752-2,082**	**4,194-4,524**
2015	398-689	0.8-1.3	397-689	0.8-1.3	1,547	3.0	4,450	8.6	**1,945-2,236**	**4,847-5,139**
2016	248-429	0.5-0.8	247-429	0.5-0.8	1,792	3.4	5,155	9.9	**2,040-2,221**	**5,402-5,584**
2017	75-130	0.1-0.3	75-130	0.1-0.3	1,980	3.8	5,696	11.0	**2,055-2,110**	**5,771-5,826**
2018	73-126	0.1-0.2	73-126	0.1-0.2	2,151	4.1	6,186	11.9	**2,224-2,277**	**6,259-6,312**
2019	73-126	0.1-0.2	73-126	0.1-0.2	2,151	4.1	6,186	11.9	**2,224-2,277**	**6,259-6,312**
2020 +	0	0	0	0	2,316	4.5	6,661	12.8	**2,316**	**6,661**

Notes:

1. *Diverted waste (tons/year) is waste that would be recycled. Values from total diverted construction waste (Table 3-2C).*
2. *Calculation based on 10-ton capacity for trucks that pick up waste.*
3. *Calculation based on total construction waste (Table 2-4C) – total diverted construction waste (Table 2-2C).*
4. *Diverted waste is waste that would be recycled. Values from total diverted occupancy waste (Table 3-4C).*
5. *Calculation based on total occupancy waste (Table 2-7C) – total diverted occupancy waste (Table 3-4C).*
6. *See Appendix A for supporting calculations.*

Trucks would most likely be used to haul construction and occupancy waste to either a local recycling vendor, for diverted waste, or to the West Hawai'i Landfill, for landfilled waste. For construction waste the number of trucks is expected to be on an on-call basis, meaning that less than one truck per week to three trucks per week would be required for both diverted and landfilled waste. For occupancy waste the number of trucks is expected to be a set schedule varying from two to about 18 trucks per week for both diverted and landfilled waste. The truck route to the West Hawai'i Landfill would most likely be from the project down Kealakehe Parkway and along Queen Kaahumanu Highway. The truck route to the local recycling vendor (anticipated to be Atlas Recycling Center in Kona town) would most likely be from the project down Kealakehe Parkway to Queen Kaahumanu Highway, Malakala Boulevard, Luhia Street, Kaiwi Street and Pawai Place.

According to the 2002 Updated Integrated Solid Waste Management Plan for the County of Hawai'i, the Pu'uanahulu Landfill is estimated to have 12 million cubic yards of air space which is enough to accommodate the waste generated by West Hawaii for approximately the next 40 years. In 2000, approximately 90,000 tons of waste was deposited at this landfill. Using this quantity of waste, the annual percent waste increase to the West Hawai'i Landfill from the Keahuolu Affordable Housing project were estimated in Table 4-2. The full-build out annual occupancy landfill waste percentage of the annual West Hawaii Landfill waste would be estimated to be 4.43%, 6,79% or 7.40% for the development concepts A, B or C, respectively.

TABLE 4-2: KEAHUOLU AFFORDABLE HOUSING PROJECT WASTE GENERATION IMPACT ON WEST HAWAI`I LANDFILL

Year	Percent Annual Waste Increase to Landfill[1]		
	Concept A	Concept B	Concept C
2008	0.29 – 0.51	0.29 – 0.51	0.25 – 0.43
2009	0.58 – 1.01	0.58 – 1.01	0.50 – 0.87
2010	1.48 – 1.91	1.48 – 1.91	1.28 – 1.65
2011	2.16 – 2.42	2.38 – 2.81	2.07 – 2.45
2012	2.89 – 3.03	3.28 – 3.71	2.86 – 3.23
2013	3.35	4.41 – 4.84	3.88 – 4.24
2014	3.35	5.04 – 5.28	4.66 – 5.03
2015	3.35	5.65 – 5.67	5.39 – 5.71
2016	3.44 – 3.50	5.80 – 5.86	6.00 – 6.20
2017	3.44 – 3.50	5.80 – 5.86	6.41 – 6.47
2018	3.98 – 4.04	6.35 – 6.40	6.95 – 7.01
2019	3.98 – 4.04	6.35 – 6.40	3.95 – 7.01
2020	4.43	6.79	7.40

Notes:
Calculation based on [(total Landfilled Waste from Tables 4-1A, 4-1B or 4-1C) / (90,000 tons/year)] x 100 percent.

It should be noted that the objectives for waste diversion for both construction and operations at the Keahuolu Affordable Housing project are based upon the assumption that private companies in the vicinity of the development can be contracted to either directly recycle materials on the island of Hawai'i or to economically ship materials to recycling markets elsewhere in Hawai'i, the U.S. mainland, or international countries. If recycling vendors are not immediately available for all materials intended to be recycled, some of these materials may be hauled to the landfill.

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APPENDIX A – CALCULATIONS

Construction Waste Generation - Concept A

Year	Building Type	Number	Building Area (sf)	Construction Waste (tons/year)	
2008	Multifamily	200	200,000	525	min.
	Single Family	100	150,000	910	max.
2009	Multifamily	400	400,000	1,050	min.
	Single Family	200	300,000	1,820	max.
2010	Multifamily	400	400,000	1,050	min.
	Single Family	200	300,000	1,820	max.
2011	Multifamily	400	400,000	658	min.
	Single Family	20	30,000	1,141	max.
	School		8,700		
2012	Multifamily	200	200,000	358	min.
	Single Family	20	30,000	621	max.
	School		8,700		
2013					
2014					
2015					
2016	Commercial/Retail		100,000	150	min.
				260	max.
2017	Commercial/Retail		100,000	150	min.
				260	max.
2018	Commercial/Retail		97,000	146	min.
				252	max.
2019	Commercial/Retail		97,000	146	min.
				252	max.
2020					

Multifamily	1000	square feet	
Single Family	1500	square feet	
Construction Waste	3	lbs / ft^2	min.
Construction Waste	5.2	lbs / ft^2	max.

Construction Waste Generation - Concept B

Year	Building Type	Number	Building Area (sf)	Construction Waste (tons/year)	
2008	Multifamily	200	200,000	525	min.
	Single Family	100	150,000	910	max.
2009	Multifamily	400	400,000	1,050	min.
	Single Family	200	300,000	1,820	max.
2010	Multifamily	400	400,000	1,050	min.
	Single Family	200	300,000	1,820	max.
2011	Multifamily	400	400,000	1,063	min.
	Single Family	200	300,000	1,843	max.
	School		8,700		
2012	Multifamily	400	400,000	1,063	min.
	Single Family	200	300,000	1,843	max.
	School		8,700		
2013	Multifamily	400	400,000	1,050	min.
	Single Family	200	300,000	1,820	max.
2014	Multifamily	240	240,000	585	min.
	Single Family	100	150,000	1,014	max.
2015	Multifamily	40	40,000	60	min.
	Single Family	0	0	104	max.
2016	Commercial/Retail		100,000	150	min.
				260	max.
2017	Commercial/Retail		100,000	150	min.
				260	max.
2018	Commercial/Retail		97,000	146	min.
				252	max.
2019	Commercial/Retail		97,000	146	min.
				252	max.
2020					

Multifamily	1000	square feet	
Single Family	1500	square feet	
Construction Waste	3	lbs / ft^2	min.
Construction Waste	5.2	lbs / ft^2	max.

Notes:

All calculations are based on (3.0 lbs/ft^2) x (area of building) x (number of buildings constructed/year). Pounds were multiplied by 5 x 10^{-4} (or 1/2000) to convert to tons.

Construction Waste Generation - Concept C

Year	Building Type	Number	Building Area (sf)	Construction Waste (tons/year)	
2008	Multifamily	300	300,000	450	min.
	Single Family	0	0	780	max.
2009	Multifamily	600	600,000	900	min.
	Single Family	0	0	1,560	max.
2010	Multifamily	600	600,000	900	min.
	Single Family	0	0	1,560	max.
2011	Multifamily	600	600,000	913	min.
	Single Family	0	0	1,583	max.
	School		8,700		
2012	Multifamily	600	600,000	913	min.
	Single Family	0	0	1,583	max.
	School		8,700		
2013	Multifamily	600	600,000	900	min.
	Single Family	0	0	1,560	max.
2014	Multifamily	600	600,000	900	min.
	Single Family	0	0	1,560	max.
2015	Multifamily	530	530,000	795	min.
	Single Family	0	0	1,378	max.
2016	Multifamily	230	230,000	495	min.
	Single Family	0	0	858	max.
	Commercial/Retail		100,000		
2017	Commercial/Retail		100,000	150	min.
				260	max.
2018	Commercial/Retail		97,000	146	min.
				252	max.
2019	Commercial/Retail		97,000	146	min.
				252	max.
2020					

Multifamily	1000	square feet	
Single Family	1500	square feet	
Construction Waste	3	lbs / ft^2	min.
Construction Waste	5.2	lbs / ft^2	max.

Notes:

All calculations are based on (3.0 lbs/ft^2) x (area of building) x (number of buildings constructed/year). Pounds were multiplied by 5 x 10^{-4} (or 1/2000) to convert to tons.

Construction Waste Composition - Concept A

Year	Construction Waste (tons/year)	Wood (tons/year)	Drywall (tons/year)	Cardboard (tons/year)	Metal (tons/year)	Other (tons/year)
2008	525	220	148	34	8	115
	910	381	257	59	15	199
2009	1,050	440	296	68	17	230
	1,820	763	513	118	29	399
2010	1,050	440	296	68	17	230
	1,820	763	513	118	29	399
2011	658	276	186	43	11	144
	1,141	478	322	74	18	250
2012	358	150	101	23	6	78
	621	260	175	40	10	136
2013	0	0	0	0	0	0
	0	0	0	0	0	0
2014	0	0	0	0	0	0
	0	0	0	0	0	0
2015	0	0	0	0	0	0
	0	0	0	0	0	0
2016	150	63	42	10	2	33
	260	109	73	17	4	57
2017	150	63	42	10	2	33
	260	109	73	17	4	57
2018	146	61	41	9	2	32
	252	106	71	16	4	55
2019	146	61	41	9	2	32
	252	106	71	16	4	55
2020						

	Wood	Drywall	Cardboard	Metal	Other
Waste Composition:	41.9%	28.2%	6.5%	1.6%	21.9%

Construction Waste Composition - Concept B

Year	Construction Waste (tons/year)	Wood (tons/year)	Drywall (tons/year)	Cardboard (tons/year)	Metal (tons/year)	Other (tons/year)
2008	525	220	148	34	8	115
	910	381	257	59	15	199
2009	1,050	440	296	68	17	230
	1,820	763	513	118	29	399
2010	1,050	440	296	68	17	230
	1,820	763	513	118	29	399
2011	1,063	445	300	69	17	233
	1,843	772	520	120	29	404
2012	1,063	445	300	69	17	233
	1,843	772	520	120	29	404
2013	1,050	440	296	68	17	230
	1,820	763	513	118	29	399
2014	585	245	165	38	9	128
	1,014	425	286	66	16	222
2015	60	25	17	4	1	13
	104	44	29	7	2	23
2016	150	63	42	10	2	33
	260	109	73	17	4	57
2017	150	63	42	10	2	33
	260	109	73	17	4	57
2018	146	61	41	9	2	32
	252	106	71	16	4	55
2019	146	61	41	9	2	32
	252	106	71	16	4	55
2020						

	Wood	Drywall	Cardboard	Metal	Other
Waste Composition:	41.9%	28.2%	6.5%	1.6%	21.9%

Construction Waste Composition - Concept C

Year	Construction Waste (tons/year)	Wood (tons/year)	Drywall (tons/year)	Cardboard (tons/year)	Metal (tons/year)	Other (tons/year)
2008	450	189	127	29	7	99
	780	327	220	51	12	171
2009	900	377	254	59	14	197
	1,560	654	440	101	25	342
2010	900	377	254	59	14	197
	1,560	654	440	101	25	342
2011	913	383	257	59	15	200
	1,583	663	446	103	25	347
2012	913	383	257	59	15	200
	1,583	663	446	103	25	347
2013	900	377	254	59	14	197
	1,560	654	440	101	25	342
2014	900	377	254	59	14	197
	1,560	654	440	101	25	342
2015	795	333	224	52	13	174
	1,378	577	389	90	22	302
2016	495	207	140	32	8	108
	858	360	242	56	14	188
2017	150	63	42	10	2	33
	260	109	73	17	4	57
2018	146	61	41	9	2	32
	252	106	71	16	4	55
2019	146	61	41	9	2	32
	252	106	71	16	4	55
2020						

	Wood	Drywall	Cardboard	Metal	Other
Waste Composition:	41.9%	28.2%	6.5%	1.6%	21.9%

Occupancy Waste Generation - Concept A

Year	Building Type	Number	Population	Waste Generated	
				Daily (lbs/day)	Annual (tons/yr)
2010	Multifamily	200	560	3,472	1,086
	Single Family	100	400	2,480	
	Total		960	5,952	
2011	Multifamily	400	1,120	6,944	2,172
	Single Family	200	800	4,960	
	Total		1,920	11,904	
2012	Multifamily	600	1,680	10,416	3,259
	Single Family	300	1,200	7,440	
	Total		2,880	17,856	
2013	Multifamily	620	1,736	10,763	4,069
	Single Family	400	1,600	9,920	
	School	1	260	1,612	
	Total		3,596	22,295	
2014	Multifamily	620	1,736	10,763	4,069
	Single Family	400	1,600	9,920	
	School	1	260	1,612	
	Total		3,596	22,295	
2015	Multifamily	620	1,736	10,763	4,069
	Single Family	400	1,600	9,920	
	School	1	260	1,612	
	Total		3,596	22,295	
2016	Multifamily	620	1,736	10,763	4,069
	Single Family	400	1,600	9,920	
	School	1	260	1,612	
	Total		3,596	22,295	
2017	Multifamily	620	1,736	10,763	4,069
	Single Family	400	1,600	9,920	
	School	1	260	1,612	
	Total		3,596	22,295	
2018	Multifamily	620	1,736	10,763	4,730
	Single Family	400	1,600	9,920	
	School	1	260	1,612	
	Commercial/Retail	100,000	584	3,621	
	Total		4,180	25,916	
2019	Multifamily	620	1,736	10,763	4,730
	Single Family	400	1,600	9,920	
	School	1	260	1,612	
	Commercial/Retail	100,000	584	3,621	
	Total		4,180	25,916	
2020	Multifamily	620	1,736	10,763	5,370
	Single Family	400	1,600	9,920	
	School	1	260	1,612	
	Commercial/Retail	197,000	1,150	7,130	
	Total		4,746	29,425	

Multifamily		2.8	persons / unit
Single Family		4	persons / unit
School	620 students/faculty/staff at the school for 42% of the day		
		260	persons
Commercial/Retail	30 to 60 sf/person for stores (per 1997 UBC)		
	100 sf/person for office (per 1997 UBC)		
	Use 72 sf/person for 42% of the day		
		0.005833	persons/sf
Waste Generation		6.2	lbs/person/day

Occupancy Waste Generation - Concept B

Year	Building Type	Number	Population	Waste Generated	
				Daily (lbs/day)	Annual (tons/yr)
2010	Multifamily	200	560	3,472	1,086
	Single Family	100	400	2,480	
	Total		960	5,952	
2011	Multifamily	400	1,120	6,944	2,172
	Single Family	200	800	4,960	
	Total		1,920	11,904	
2012	Multifamily	600	1,680	10,416	3,259
	Single Family	300	1,200	7,440	
	Total		2,880	17,856	
2013	Multifamily	800	2,240	13,888	4,639
	Single Family	400	1,600	9,920	
	School	1	260	1,612	
	Total		4,100	25,420	
2014	Multifamily	1,000	2,800	17,360	5,725
	Single Family	500	2,000	12,400	
	School	1	260	1,612	
	Total		5,060	31,372	
2015	Multifamily	1,200	3,360	20,832	6,812
	Single Family	600	2,400	14,880	
	School	1	260	1,612	
	Total		6,020	37,324	
2016	Multifamily	1,240	3,472	21,526	6,938
	Single Family	600	2,400	14,880	
	School	1	260	1,612	
	Total		6,132	38,018	
2017	Multifamily	1,240	3,472	21,526	6,938
	Single Family	600	2,400	14,880	
	School	1	260	1,612	
	Total		6,132	38,018	
2018	Multifamily	1,240	3,472	21,526	7,599
	Single Family	600	2,400	14,880	
	School	1	260	1,612	
	Commercial/Retail	100,000	584	3,621	
	Total		6,716	41,639	
2019	Multifamily	1,240	3,472	21,526	7,599
	Single Family	600	2,400	14,880	
	School	1	260	1,612	
	Commercial/Retail	100,000	584	3,621	
	Total		6,716	41,639	
2020	Multifamily	1,240	3,472	21,526	8,240
	Single Family	600	2,400	14,880	
	School	1	260	1,612	
	Commercial/Retail	197,000	1,150	7,130	
	Total		7,282	45,148	

Multifamily		2.8	persons / unit
Single Family		4	persons / unit
School	620 students/faculty/staff at the school for 42% of the day		
		260	persons
Commercial/Retail	30 to 60 sf/person for stores (per 1997 UBC)		
	100 sf/person for office (per 1997 UBC)		
	Use 72 sf/person for 42% of the day		
		0.005833	persons/sf
Waste Generation		6.2	lbs/person/day

Occupancy Waste Generation - Concept C

Year	Building Type	Number	Population	Waste Generated	
				Daily (lbs/day)	Annual (tons/yr)
2010	Multifamily	300	840	5,208	950
	Single Family	0	0	0	
	Total		840	5,208	
2011	Multifamily	600	1,680	10,416	1,901
	Single Family	0	0	0	
	Total		1,680	10,416	
2012	Multifamily	900	2,520	15,624	2,851
	Single Family	0	0	0	
	Total		2,520	15,624	
2013	Multifamily	1,200	3,360	20,832	4,096
	Single Family	0	0	0	
	School	1	260	1,612	
	Total		3,620	22,444	
2014	Multifamily	1,500	4,200	26,040	5,046
	Single Family	0	0	0	
	School	1	260	1,612	
	Total		4,460	27,652	
2015	Multifamily	1,800	5,040	31,248	5,997
	Single Family	0	0	0	
	School	1	260	1,612	
	Total		5,300	32,860	
2016	Multifamily	2,100	5,880	36,456	6,947
	Single Family	0	0	0	
	School	1	260	1,612	
	Total		6,140	38,068	
2017	Multifamily	2,330	6,524	40,449	7,676
	Single Family	0	0	0	
	School	1	260	1,612	
	Total		6,784	42,061	
2018	Multifamily	2,330	6,524	40,449	8,337
	Single Family	0	0	0	
	School	1	260	1,612	
	Commercial/Retail	100,000	584	3,621	
	Total		7,368	45,682	
2019	Multifamily	2,330	6,524	40,449	8,337
	Single Family	0	0	0	
	School	1	260	1,612	
	Commercial/Retail	100,000	584	3,621	
	Total		7,368	45,682	
2020	Multifamily	2,330	6,524	40,449	8,977
	Single Family	0	0	0	
	School	1	260	1,612	
	Commercial/Retail	197,000	1,150	7,130	
	Total		7,934	49,191	

Multifamily		2.8	persons / unit
Single Family		4	persons / unit
School	620 students/faculty/staff at the school for 42% of the day		
		260	persons
Commercial/Retail	30 to 60 sf/person for stores (per 1997 UBC)		
	100 sf/person for office (per 1997 UBC)		
	Use 72 sf/person for 42% of the day		
		0.005833	persons/sf
Waste Generation		6.2	lbs/person/day

Occupancy Waste Composition - Concept A

Year	Occupancy Waste (tons/year)								
	Paper	Yard	Food	Plastic	Other Organic	Metals	Glass	Inorganic	Total
2010	181	136	91	48	233	142	17	237	1,086
2011	363	272	182	96	467	285	35	473	2,172
2012	544	407	274	143	701	427	52	710	3,259
2013	680	509	342	179	875	533	65	887	4,069
2014	680	509	342	179	875	533	65	887	4,069
2015	680	509	342	179	875	533	65	887	4,069
2016	680	509	342	179	875	533	65	887	4,069
2017	680	509	342	179	875	533	65	887	4,069
2018	790	591	397	208	1,017	620	76	1,031	4,730
2019	790	591	397	208	1,017	620	76	1,031	4,730
2020	897	671	451	236	1,155	703	86	1,171	5,370

Waste Composition								
16.7%	12.5%	8.4%	4.4%	21.5%	13.1%	1.6%	21.8%	100.0%

Occupancy Waste Composition - Concept B

Year	Occupancy Waste (tons/year)								
	Paper	Yard	Food	Plastic	Other Organic	Metals	Glass	Inorganic	Total
2010	181	136	91	48	233	142	17	237	1,086
2011	363	272	182	96	467	285	35	473	2,172
2012	544	407	274	143	701	427	52	710	3,259
2013	775	580	390	204	997	608	74	1,011	4,639
2014	956	716	481	252	1,231	750	92	1,248	5,725
2015	1,138	852	572	300	1,465	892	109	1,485	6,812
2016	1,159	867	583	305	1,492	909	111	1,512	6,938
2017	1,159	867	583	305	1,492	909	111	1,512	6,938
2018	1,269	950	638	334	1,634	995	122	1,657	7,599
2019	1,269	950	638	334	1,634	995	122	1,657	7,599
2020	1,376	1,030	692	363	1,772	1,079	132	1,796	8,240

Waste Composition								
16.7%	12.5%	8.4%	4.4%	21.5%	13.1%	1.6%	21.8%	100.0%

Occupancy Waste Composition - Concept C

Year	Occupancy Waste (tons/year)								
	Paper	Yard	Food	Plastic	Other Organic	Metals	Glass	Inorganic	Total
2010	159	119	80	42	204	124	15	207	950
2011	317	238	160	84	409	249	30	414	1,901
2012	476	356	239	125	613	373	46	622	2,851
2013	684	512	344	180	881	537	66	893	4,096
2014	843	631	424	222	1,085	661	81	1,100	5,046
2015	1,001	750	504	264	1,289	786	96	1,307	5,997
2016	1,160	868	584	306	1,494	910	111	1,514	6,947
2017	1,282	960	645	338	1,650	1,006	123	1,673	7,676
2018	1,392	1,042	700	367	1,792	1,092	133	1,817	8,337
2019	1,392	1,042	700	367	1,792	1,092	133	1,817	8,337
2020	1,499	1,122	754	395	1,930	1,176	144	1,957	8,977

Waste Composition								
16.7%	12.5%	8.4%	4.4%	21.5%	13.1%	1.6%	21.8%	100.0%

Construction Waste - Diverted or Recycled - Concept A

Year	Construction Waste (tons/year)	Wood (tons/year)	Cardboard (tons/year)	Metal (tons/year)	Total (tons/year)
2008	525	220	34	8	263
	910	381	59	15	455
2009	1,050	440	68	17	525
	1,820	763	118	29	910
2010	1,050	440	68	17	525
	1,820	763	118	29	910
2011	658	276	43	11	329
	1,141	478	74	18	571
2012	358	150	23	6	179
	621	260	40	10	311
2013	0	0	0	0	0
	0	0	0	0	0
2014	0	0	0	0	0
	0	0	0	0	0
2015	0	0	0	0	0
	0	0	0	0	0
2016	150	63	10	2	75
	260	109	17	4	130
2017	150	63	10	2	75
	260	109	17	4	130
2018	146	61	9	2	73
	252	106	16	4	126
2019	146	61	9	2	73
	252	106	16	4	126
2020					

	Wood	Cardboard	Metal	Other
Waste Composition:	41.9%	6.5%	1.6%	49.9%

Construction Waste - Diverted or Recycled - Concept B

Year	Construction Waste (tons/year)	Wood (tons/year)	Cardboard (tons/year)	Metal (tons/year)	Total (tons/year)
2008	525	220	34	8	263
	910	381	59	15	455
2009	1,050	440	68	17	525
	1,820	763	118	29	910
2010	1,050	440	68	17	525
	1,820	763	118	29	910
2011	1,063	445	69	17	532
	1,843	772	120	29	922
2012	1,063	445	69	17	532
	1,843	772	120	29	922
2013	1,050	440	68	17	525
	1,820	763	118	29	910
2014	585	245	38	9	293
	1,014	425	66	16	507
2015	60	25	4	1	30
	104	44	7	2	52
2016	150	63	10	2	75
	260	109	17	4	130
2017	150	63	10	2	75
	260	109	17	4	130
2018	146	61	9	2	73
	252	106	16	4	126
2019	146	61	9	2	73
	252	106	16	4	126
2020					

		Wood	Cardboard	Metal	Total
Recycled Waste	Waste Composition:	41.9%	6.5%	1.6%	49.9%

Construction Waste - Diverted or Recycled - Concept C

Year	Construction Waste (tons/year)	Wood (tons/year)	Cardboard (tons/year)	Metal (tons/year)	Total (tons/year)
2008	450	189	29	7	225
	780	327	51	12	390
2009	900	377	59	14	450
	1,560	654	101	25	780
2010	900	377	59	14	450
	1,560	654	101	25	780
2011	913	383	59	15	457
	1,583	663	103	25	792
2012	913	383	59	15	457
	1,583	663	103	25	792
2013	900	377	59	14	450
	1,560	654	101	25	780
2014	900	377	59	14	450
	1,560	654	101	25	780
2015	795	333	52	13	398
	1,378	577	90	22	689
2016	495	207	32	8	248
	858	360	56	14	429
2017	150	63	10	2	75
	260	109	17	4	130
2018	146	61	9	2	73
	252	106	16	4	126
2019	146	61	9	2	73
	252	106	16	4	126
2020					

	Wood	Cardboard	Metal	Other
Waste Composition:	41.9%	6.5%	1.6%	21.9%

Occupancy Waste Composition - Diverted or Recycled - Concept A

Year	Occupancy Waste (tons/year)							
	Paper	Yard	Plastic	Metals	Glass	Total Recyclable	Total Diverted	Total Waste
2010	181	136	48	142	17	525	280	1,086
2011	363	272	96	285	35	1,049	560	2,172
2012	544	407	143	427	52	1,574	841	3,259
2013	680	509	179	533	65	1,965	1,050	4,069
2014	680	509	179	533	65	1,965	1,050	4,069
2015	680	509	179	533	65	1,965	1,050	4,069
2016	680	509	179	533	65	1,965	1,050	4,069
2017	680	509	179	533	65	1,965	1,050	4,069
2018	790	591	208	620	76	2,285	1,220	4,730
2019	790	591	208	620	76	2,285	1,220	4,730
2020	897	671	236	703	86	2,594	1,385	5,370

Waste Composition

16.7%	12.5%	4.4%	13.1%	1.6%	48.3%	25.8%

Occupancy Waste Composition - Diverted or Recycled - Concept B

Year	Occupancy Waste (tons/year)							
	Paper	Yard	Plastic	Metals	Glass	Total Recyclable	Total Diverted	Total Waste
2010	181	136	48	142	17	525	280	1,086
2011	363	272	96	285	35	1,049	560	2,172
2012	544	407	143	427	52	1,574	841	3,259
2013	775	580	204	608	74	2,241	1,197	4,639
2014	956	716	252	750	92	2,765	1,477	5,725
2015	1,138	852	300	892	109	3,290	1,757	6,812
2016	1,159	867	305	909	111	3,351	1,790	6,938
2017	1,159	867	305	909	111	3,351	1,790	6,938
2018	1,269	950	334	995	122	3,670	1,961	7,599
2019	1,269	950	334	995	122	3,670	1,961	7,599
2020	1,376	1,030	363	1,079	132	3,980	2,126	8,240

Waste Composition

16.7%	12.5%	4.4%	13.1%	1.6%	48.3%	25.8%

Occupancy Waste Composition - Diverted or Recycled - Concept C

Year	Occupancy Waste (tons/year)							
	Paper	Yard	Plastic	Metals	Glass	Total Recyclable	Total Diverted	Total Waste
2010	159	119	42	124	15	459	245	950
2011	317	238	84	249	30	918	490	1,901
2012	476	356	125	373	46	1,377	736	2,851
2013	684	512	180	537	66	1,978	1,057	4,096
2014	843	631	222	661	81	2,437	1,302	5,046
2015	1,001	750	264	786	96	2,897	1,547	5,997
2016	1,160	868	306	910	111	3,355	1,792	6,947
2017	1,282	960	338	1,006	123	3,708	1,980	7,676
2018	1,392	1,042	367	1,092	133	4,027	2,151	8,337
2019	1,392	1,042	367	1,092	133	4,027	2,151	8,337
2020	1,499	1,122	395	1,176	144	4,336	2,316	8,977

Waste Composition

16.7%	12.5%	4.4%	13.1%	1.6%	48.3%	25.8%

Summary of Waste Diverted and Landfilled - Concept A

Year	Construction Waste				Occupancy Waste				Total Diverted Waste (tons/year)	Total Landfilled Waste (tons/yr)
	Diverted		Landfilled		Diverted		Landfilled			
	Waste (tons/yr)	# Trucks per week	Waste (tons/yr)	# Trucks per week	Waste (tons/yr)	# Trucks per week	Waste (tons/yr)	# Trucks per week		
2008	263	0.5	262	0.5	0	0.0	0	0.0	263	262
	455	0.9	455	0.9					455	455
2009	525	1.0	525	1.0	0	0.0	0	0.0	525	525
	910	1.8	910	1.8					910	910
2010	525	1.0	525	1.0	280	0.5	806	1.6	805	1,331
	910	1.8	910	1.8					1,190	1,716
2011	329	0.6	329	0.6	560	1.1	1,612	3.1	889	1,941
	571	1.1	570	1.1					1,131	2,182
2012	179	0.3	179	0.3	841	1.6	2,418	4.7	1,020	2,597
	311	0.6	310	0.6					1,152	2,728
2013	0	0.0	0	0.0	1,050	2.0	3,019	5.8	1,050	3,019
	0	0.0	0	0.0					1,050	3,019
2014	0	0.0	0	0.0	1,050	2.0	3,019	5.8	1,050	3,019
	0	0.0	0	0.0					1,050	3,019
2015	0	0.0	0	0.0	1,050	2.0	3,019	5.8	1,050	3,019
	0	0.0	0	0.0					1,050	3,019
2016	75	0.1	75	0.1	1,050	2.0	3,019	5.8	1,125	3,094
	130	0.3	130	0.3					1,180	3,149
2017	75	0.1	75	0.1	1,050	2.0	3,019	5.8	1,125	3,094
	130	0.3	130	0.3					1,180	3,149
2018	73	0.1	73	0.1	1,220	2.3	3,510	6.8	1,293	3,583
	126	0.2	126	0.2					1,346	3,636
2019	73	0.1	73	0.1	1,220	2.3	3,510	6.8	1,293	3,583
	126	0.2	126	0.2					1,346	3,636
2020	0	0.0	0	0.0	1,385	2.7	3,985	7.7	1,385	3,985
	0	0.0	0	0.0					1,385	3,985

Company Pacific Waste **Phone:** **(808) 882-7295** **Contact Info:** Rich Truax (Sales Manager)
Construction Truck Volume: 20'x8'x7' (LxWxH) = 41.5 CY (Max Load is 10 tons) email: richtruax@pacificwasteinc.com
Operations Bin Volume: 72"x43"x45" (LxWxH) = 3 CY Use Truck Capacity: 10 tons / truck

Summary of Waste Diverted and Landfilled - Concept B

Year	Construction Waste				Occupancy Waste				Total Diverted Waste (tons/year)	Total Landfilled Waste (tons/yr)
	Diverted		Landfilled		Diverted		Landfilled			
	Waste (tons/yr)	# Trucks per week	Waste (tons/yr)	# Trucks per week	Waste (tons/yr)	# Trucks per week	Waste (tons/yr)	# Trucks per week		
2008	263	0.5	262	0.5	0	0.0	0	0.0	263	262
	455	0.9	455	0.9					455	455
2009	525	1.0	525	1.0	0	0.0	0	0.0	525	525
	910	1.8	910	1.8					910	910
2010	525	1.0	525	1.0	280	0.5	806	1.6	805	1,331
	910	1.8	910	1.8					1,190	1,716
2011	532	1.0	531	1.0	560	1.1	1,612	3.1	1,092	2,143
	922	1.8	921	1.8					1,482	2,533
2012	532	1.0	531	1.0	841	1.6	2,418	4.7	1,373	2,949
	922	1.8	921	1.8					1,763	3,339
2013	525	1.0	525	1.0	1,197	2.3	3,442	6.6	1,722	3,967
	910	1.8	910	1.8					2,107	4,352
2014	293	0.6	292	0.6	1,477	2.8	4,248	8.2	1,770	4,540
	507	1.0	507	1.0					1,984	4,755
2015	30	0.1	30	0.1	1,757	3.4	5,055	9.7	1,787	5,085
	52	0.1	52	0.1					1,809	5,107
2016	75	0.1	75	0.1	1,790	3.4	5,148	9.9	1,865	5,223
	130	0.3	130	0.3					1,920	5,278
2017	75	0.1	75	0.1	1,790	3.4	5,148	9.9	1,865	5,223
	130	0.3	130	0.3					1,920	5,278
2018	73	0.1	73	0.1	1,961	3.8	5,638	10.8	2,034	5,711
	126	0.2	126	0.2					2,087	5,764
2019	73	0.1	73	0.1	1,961	3.8	5,638	10.8	2,034	5,711
	126	0.2	126	0.2					2,087	5,764
2020	0	0.0	0	0.0	2,126	4.1	6,114	11.8	2,126	6,114
	0	0.0	0	0.0					2,126	6,114

Company Pacific Waste **Phone:** **(808) 882-7295** **Contact Info:** Rich Truax (Sales Manager)
Construction Truck Volume: 20'x8'x7' (LxWxH) = 41.5 CY (Max Load is 10 tons) email: richtruax@pacificwasteinc.com
Operations Bin Volume: 72"x43"x45" (LxWxH) = 3 CY Use Truck Capacity: 10 tons / truck

Summary of Waste Diverted and Landfilled - Concept C

Year	Construction Waste				Occupancy Waste				Total Diverted Waste (tons/year)	Total Landfilled Waste (tons/yr)
	Diverted		Landfilled		Diverted		Landfilled			
	Waste (tons/yr)	# Trucks per week	Waste (tons/yr)	# Trucks per week	Waste (tons/yr)	# Trucks per week	Waste (tons/yr)	# Trucks per week		
2008	225	0.4	225	0.4	0	0.0	0	0.0	225	225
	390	0.8	390	0.8					390	390
2009	450	0.9	450	0.9	0	0.0	0	0.0	450	450
	780	1.5	780	1.5					780	780
2010	450	0.9	450	0.9	245	0.5	705	1.4	695	1,155
	780	1.5	780	1.5					1,025	1,485
2011	457	0.9	456	0.9	490	0.9	1,411	2.7	947	1,867
	792	1.5	791	1.5					1,282	2,202
2012	457	0.9	456	0.9	736	1.4	2,115	4.1	1,193	2,571
	792	1.5	791	1.5					1,528	2,906
2013	450	0.9	450	0.9	1,057	2.0	3,039	5.8	1,507	3,489
	780	1.5	780	1.5					1,837	3,819
2014	450	0.9	450	0.9	1,302	2.5	3,744	7.2	1,752	4,194
	780	1.5	780	1.5					2,082	4,524
2015	398	0.8	397	0.8	1,547	3.0	4,450	8.6	1,945	4,847
	689	1.3	689	1.3					2,236	5,139
2016	248	0.5	247	0.5	1,792	3.4	5,155	9.9	2,040	5,402
	429	0.8	429	0.8					2,221	5,584
2017	75	0.1	75	0.1	1,980	3.8	5,696	11.0	2,055	5,771
	130	0.3	130	0.3					2,110	5,826
2018	73	0.1	73	0.1	2,151	4.1	6,186	11.9	2,224	6,259
	126	0.2	126	0.2					2,277	6,312
2019	73	0.1	73	0.1	2,151	4.1	6,186	11.9	2,224	6,259
	126	0.2	126	0.2					2,277	6,312
2020	0	0.0	0	0.0	2,316	4.5	6,661	12.8	2,316	6,661
	0	0.0	0	0.0					2,316	6,661

Company Pacific Waste **Phone:** **(808) 882-7295** **Contact Info:** Rich Truax (Sales Manager)

Construction Truck Volume: 20'x8'x7' (LxWxH) = 41.5 CY (Max Load is 10 tons) email: richtruax@pacificwasteinc.com

Operations Bin Volume: 72"x43"x45" (LxWxH) = 3 CY Use Truck Capacity: 10 tons / truck

Summary of Waste Diverted and Landfilled - Concept A

Year	Construction Waste		Occupancy Waste		Total Diverted Waste (tons/year)	Total Landfilled Waste (tons/yr)	Percent Annual Waste Increase to Landfill
	Diverted Waste (tons/yr)	Landfilled Waste (tons/yr)	Diverted Waste (tons/yr)	Landfilled Waste (tons/yr)			
2008	263	262	0	0	263	262	0.29%
	455	455			455	455	0.51%
2009	525	525	0	0	525	525	0.58%
	910	910			910	910	1.01%
2010	525	525	280	806	805	1,331	1.48%
	910	910			1,190	1,716	1.91%
2011	329	329	560	1,612	889	1,941	2.16%
	571	570			1,131	2,182	2.42%
2012	179	179	841	2,418	1,020	2,597	2.89%
	311	310			1,152	2,728	3.03%
2013	0	0	1,050	3,019	1,050	3,019	3.35%
	0	0			1,050	3,019	3.35%
2014	0	0	1,050	3,019	1,050	3,019	3.35%
	0	0			1,050	3,019	3.35%
2015	0	0	1,050	3,019	1,050	3,019	3.35%
	0	0			1,050	3,019	3.35%
2016	75	75	1,050	3,019	1,125	3,094	3.44%
	130	130			1,180	3,149	3.50%
2017	75	75	1,050	3,019	1,125	3,094	3.44%
	130	130			1,180	3,149	3.50%
2018	73	73	1,220	3,510	1,293	3,583	3.98%
	126	126			1,346	3,636	4.04%
2019	73	73	1,220	3,510	1,293	3,583	3.98%
	126	126			1,346	3,636	4.04%
2020	0	0	1,385	3,985	1,385	3,985	4.43%
	0	0			1,385	3,985	4.43%

Company Pacific Waste Phone: Rich Truax (Sales Manager)
Construction email: richtruax@pacificwasteinc.com
Operations Use Truck Capacity: 10 tons / truck

Summary of Waste Diverted and Landfilled - Concept B

Year	Construction Waste		Occupancy Waste		Total Diverted Waste (tons/year)	Total Landfilled Waste (tons/yr)	Percent Annual Waste Increase to Landfill
	Diverted Waste (tons/yr)	Landfilled Waste (tons/yr)	Diverted Waste (tons/yr)	Landfilled Waste (tons/yr)			
2008	263	262	0	0	263	262	0.29%
	455	455			455	455	0.51%
2009	525	525	0	0	525	525	0.58%
	910	910			910	910	1.01%
2010	525	525	280	806	805	1,331	1.48%
	910	910			1,190	1,716	1.91%
2011	532	531	560	1,612	1,092	2,143	2.38%
	922	921			1,482	2,533	2.81%
2012	532	531	841	2,418	1,373	2,949	3.28%
	922	921			1,763	3,339	3.71%
2013	525	525	1,197	3,442	1,722	3,967	4.41%
	910	910			2,107	4,352	4.84%
2014	293	292	1,477	4,248	1,770	4,540	5.04%
	507	507			1,984	4,755	5.28%
2015	30	30	1,757	5,055	1,787	5,085	5.65%
	52	52			1,809	5,107	5.67%
2016	75	75	1,790	5,148	1,865	5,223	5.80%
	130	130			1,920	5,278	5.86%
2017	75	75	1,790	5,148	1,865	5,223	5.80%
	130	130			1,920	5,278	5.86%
2018	73	73	1,961	5,638	2,034	5,711	6.35%
	126	126			2,087	5,764	6.40%
2019	73	73	1,961	5,638	2,034	5,711	6.35%
	126	126			2,087	5,764	6.40%
2020	0	0	2,126	6,114	2,126	6,114	6.79%
	0	0			2,126	6,114	6.79%

Company Pacific Waste Phone: Rich Truax (Sales Manager)
Construction email: richtruax@pacificwasteinc.com
Operations Use Truck Capacity: 10 tons / truck

Summary of Waste Diverted and Landfilled - Concept C

Year	Construction Waste		Occupancy Waste		Total Diverted Waste (tons/year)	Total Landfilled Waste (tons/yr)	Percent Annual Waste Increase to Landfill
	Diverted Waste (tons/yr)	Landfilled Waste (tons/yr)	Diverted Waste (tons/yr)	Landfilled Waste (tons/yr)			
2008	225	225	0	0	225	225	0.25%
	390	390			390	390	0.43%
2009	450	450	0	0	450	450	0.50%
	780	780			780	780	0.87%
2010	450	450	245	705	695	1,155	1.28%
	780	780			1,025	1,485	1.65%
2011	457	456	490	1,411	947	1,867	2.07%
	792	791			1,282	2,202	2.45%
2012	457	456	736	2,115	1,193	2,571	2.86%
	792	791			1,528	2,906	3.23%
2013	450	450	1,057	3,039	1,507	3,489	3.88%
	780	780			1,837	3,819	4.24%
2014	450	450	1,302	3,744	1,752	4,194	4.66%
	780	780			2,082	4,524	5.03%
2015	398	397	1,547	4,450	1,945	4,847	5.39%
	689	689			2,236	5,139	5.71%
2016	248	247	1,792	5,155	2,040	5,402	6.00%
	429	429			2,221	5,584	6.20%
2017	75	75	1,980	5,696	2,055	5,771	6.41%
	130	130			2,110	5,826	6.47%
2018	73	73	2,151	6,186	2,224	6,259	6.95%
	126	126			2,277	6,312	7.01%
2019	73	73	2,151	6,186	2,224	6,259	6.95%
	126	126			2,277	6,312	7.01%
2020	0	0	2,316	6,661	2,316	6,661	7.40%
	0	0			2,316	6,661	7.40%

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Operations Use Truck Capacity: 10 tons / truck