FOR BLNR REVIEW

VOLUME III OF III

~~Draft~~Final Environmental Impact Statement

DLNR INDUSTRIAL AND BUSINESS PARK
(TMK (2)3-8-008:001 (por.))

Prepared for:

State of Hawai'i
Department of Land and Natural Resources

Accepting Authority:

Governor
State of Hawai'i

~~May 2018~~February 2019

MUNEKIYO HIRAGA

Planning. Project Management. Sustainable Solutions.

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VOLUME III OF III

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ARCHAEOLOGICAL INVENTORY SURVEY

APPENDIX G

SCS Project Number 1801 AIS-5

ARCHAEOLOGICAL INVENTORY SURVEY OF 280-ACRES FOR THE DLNR BUSINESS PARK

PU`UNENE AND PŪLEHUNUI AHUPUA`A
WAILUKU DISTRICT
ISLAND OF MAUI, HAWAI`I

TMK: (2) 3-8-008:001

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May 2017
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ABSTRACT

Scientific Consultant Services, Inc. (SCS) conducted Archaeological Inventory Survey of 280 acres of undeveloped land in Pu`unēnē, Pūlehunui Ahupua`a, Wailuku District, Island of Maui, Hawai`i [TMK: (2) 3-8-008:001]. The entire project area, owned by the State of Hawaii (DLNR) was formerly used for sugar cane cultivation. Both pedestrian survey and representative testing of the project area revealed the presence of a single site: a Historic-period irrigation ditch associated with sugar cane cultivation. A majority of the features composing State Site 50-50-04-8481 were mechanically impacted, abandoned, and neglected.

The project area is located adjacent to the former Pu`unēnē Airport, which served as the Army and Navy Headquarters on Maui during World War II. The area has a pre-war history of agricultural use. Following World War II, the majority of the project site returned to sugarcane cultivation until December 2016, when HC&S harvested its last crop and ended sugarcane operations. Surrounding the project area currently is the Maui Raceway Park, Maui Army National Guard Armory, and Hawaiian Cement quarrying and concrete production operations.

State Site 50-50-04-8481, a Historic-era irrigation ditch, is assessed herein as significant under Criterion D. No further archaeological work is recommended for the project.

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INTRODUCTION

Scientific Consultant Services, Inc. (SCS) conducted Archaeological Inventory Survey (AIS) for the proposed State of Hawai`i, Department of Land and Natural Resources (DLNR) Business Park over 280 acres in Pulehunui, Pūlehunui Ahupua`a, Wailuku District, Island of Maui, Hawai`i [TMK: (2) 3-8-008:001 (Figures 1 through 3). The land is owned by the DLNR. Cumulatively, pedestrian survey and representative testing of the project area revealed the presence of a single site. Site 50-50-04-8481 consists of a Historic-period irrigation ditch associated with sugar cane cultivation.

Fieldwork was conducted intermittently between November 18, 2015 and January 27, 2017 by SCS archaeologists Ian Bassford, B.A., Penelope Baggs, B.A., Ikaika Kapu, B.A., and Cort Wasson, B.A., under the direction of Michael F. Dega, Ph.D., Principal Investigator. Fieldwork was intermittent due to SCS following harvesting schedules as dictated by HC&S. AIS was performed to investigate the presence/absence of historic properties in the project area and if found, to assess site function, construction methods, associated cultural deposits, and significance. Recommendations for further mitigation in the project area are offered herein as well.

The proposed project area is located in recently harvested sugar cane lands, adjacent to the former Pu'unēnē Airport, the latter which served as the Army and Navy Headquarters on Maui during World War II. The area has a pre-war history of agricultural use (sugar cane). Following World War II, the majority of the project area returned to sugarcane cultivation until December 2016, when HC&S harvested its last crop and ended sugarcane operations on Maui. Surrounding the project area currently is the Maui Raceway Park, Maui Army National Guard Armory, and Hawaiian Cement quarrying and concrete production operations.

The AIS was performed in order to identify and document historic properties, to gather sufficient information on these properties, to evaluate the significance of any newly identified historic properties, to determine the project effect on these properties, and to make mitigation recommendations to address possible adverse impacts to identified historic properties, pursuant to Hawaii Administrative Rules (HAR) § 13-275.

GEOGRAPHIC SETTING

The island of Maui ranks second in size of the eight main islands in the Hawaiian Archipelago. Pu'u Kukui, forming the west end of the island (1,215 m above mean sea level), is composed of large, heavily eroded amphitheater valleys that contain well-developed permanent stream systems that watered fertile agricultural lands extending to the coast. The deep valleys of West Maui and their associated coastal regions have been witness to many battles in ancient times and were coveted productive landscapes. These are joined together by an isthmus containing dry, open country (*kula*), and the land of Pūlehunui , among others.

PROJECT AREA

The project area is located in Pūlehunui Ahupua'a, on the southwestern side of Maui in the modern district of Wailuku. The proposed project area would have been partially within the Traditional District (*moku*) of Kula. As such, the proposed project area's traditional and historic settings will be highlighted with events that occurred in the traditional District of Kula rather than in the modern District of Wailuku.

The project area is composed of approximately 280 acres and is situated approximately 2.0 miles inland from the Kihei coastline, between *c.* 80 to 120 feet (24 to 37 meters) above mean sea level (amsl), on the lower west slope of Haleakalā. The north flank is bounded by Kamaaina Road, the east flank by fire break roads, the west by Mokulele Highway, and the southern flank by Maui Raceway Park, the Maui Army National Guard Armory, and Hawaiian Cement quarrying and concrete production operations.

A majority of the project area exhibits slightly undulated terrain amongst large swaths of flat terrain. There is no overstory or understory of vegetation in the project area, just harvested sugar cane and fallow sugar cane. Large portions of the project area have been mechanically altered, on the surface and in subsurface contexts, due to decades of industrial-level sugar cane cultivation. During fieldwork for the project, SCS worked only in portions of the fields that had been harvested for the final time, thus the "break" in fieldwork dates for the project noted above. Visibility of the mechanically-altered ground surface was excellent, as represented in Figure 4.

SOILS

The USDA soil analysis is included below (NRCSS 2017). These sediments were confirmed during subsurface testing, with minor variations, the predominance of silty clay being common in each excavation unit. Loam, composed of clay and sand, was not common in the soil profiles for the project area.

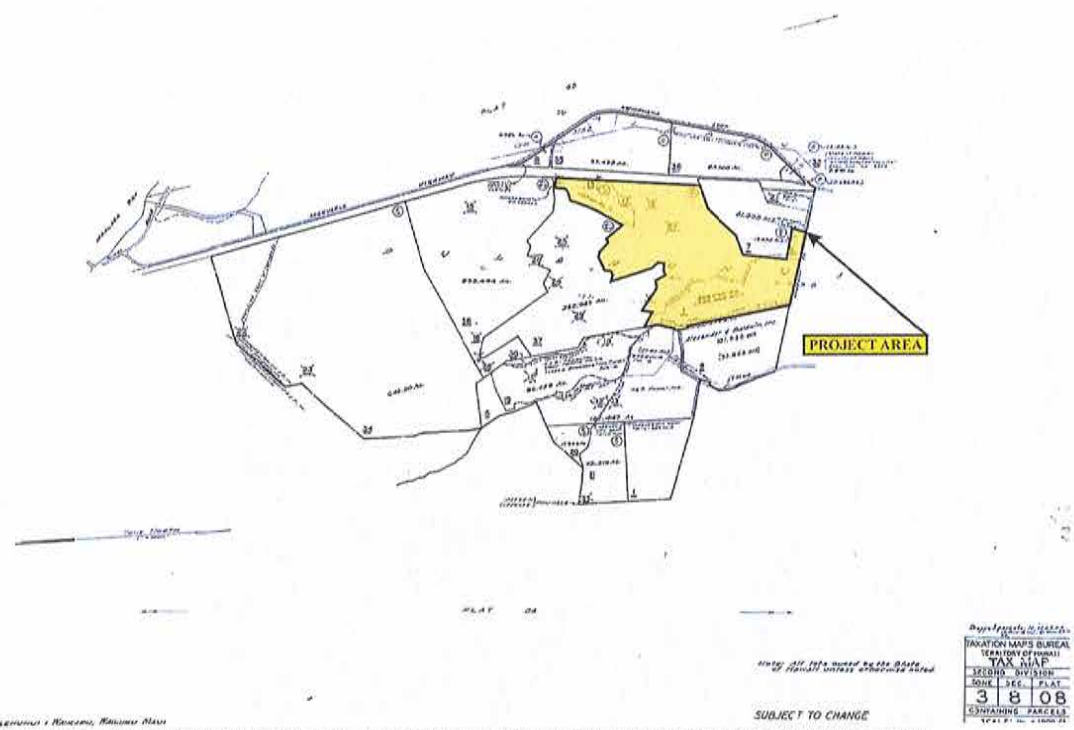

Figure 2: Tax Map Key [TMK: (2) 3-8-008:001] Showing Proposed Project Location (USGS 1955 topographic composite).

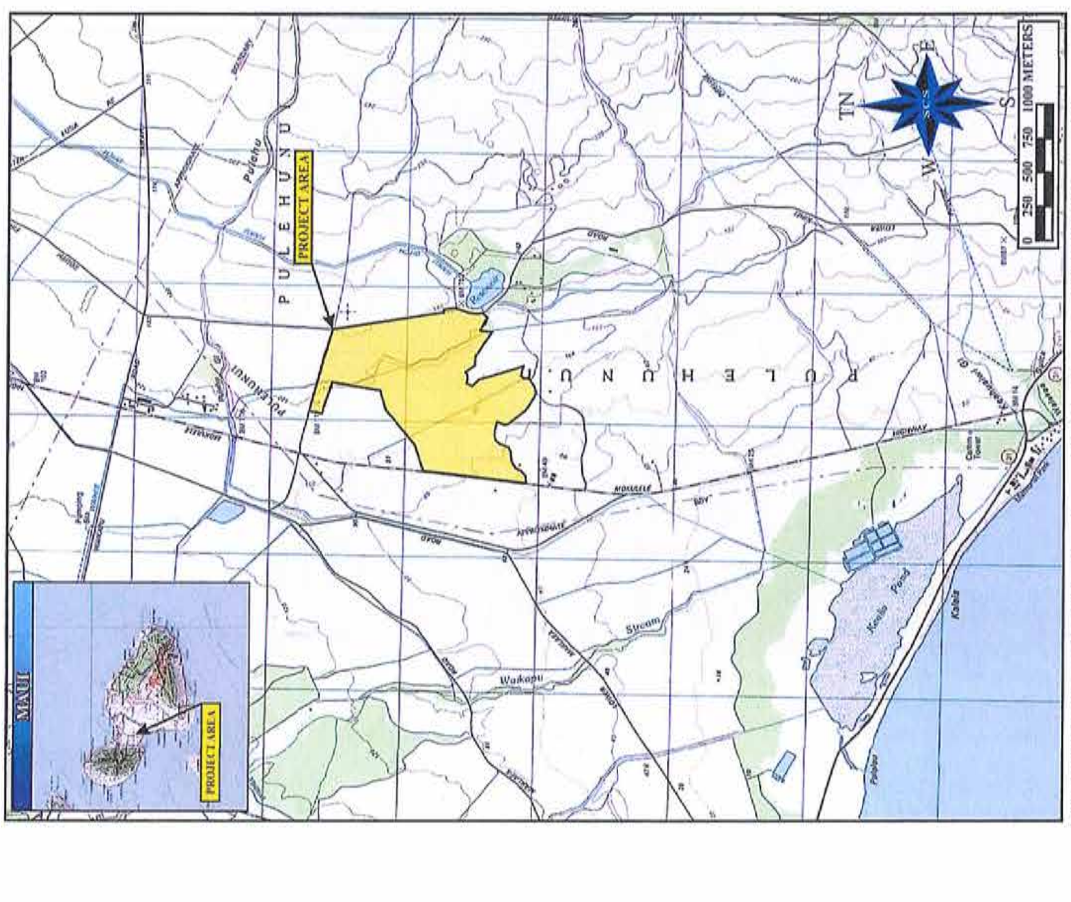

Figure 1: Quadrangle Map Showing Proposed Project Location (USGS 1955 topographic composite).

Figure 4: Photograph of Project Area, Post-Harvest. View to West.

Figure 3: Google Earth Image Showing Location of the Proposed Project Location.

Island of Maui, Hawaii

EaA—Ewa silty clay loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: hq7d
Elevation: 0 to 150 feet
Mean annual precipitation: 15 to 30 inches
Mean annual air temperature: 73 to 75 degrees F
Frost-free period: 365 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Ewa and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ewa

Setting

Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Linear

Typical profile

H1 - 0 to 18 inches: silty clay loam
H2 - 18 to 60 inches: silty clay loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: B

EcA—Ewa cobbly silty clay loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: hq7f
Elevation: 0 to 150 feet
Mean annual precipitation: 15 to 30 inches

Mean annual air temperature: 73 to 75 degrees F
Frost-free period: 365 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Ewa, cobbly, and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ewa, Cobbly

Setting

Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Linear

Typical profile

H1 - 0 to 18 inches: cobbly silty clay loam
H2 - 18 to 60 inches: silty clay loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.4 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: B

EcB—Ewa cobbly silty clay loam, 3 to 7 percent slopes

Map Unit Setting

National map unit symbol: hq7g
Elevation: 0 to 150 feet
Mean annual precipitation: 15 to 30 inches
Mean annual air temperature: 73 to 75 degrees F
Frost-free period: 365 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Ewa, cobbly, and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ewa, Cobbly

Setting

Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Linear

Typical profile

H1 - 0 to 18 inches: cobbly silty clay loam
H2 - 18 to 60 inches: silty clay loam

Properties and qualities

Slope: 3 to 7 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.4 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: B

VEGETATION

With the exception of few plant native species around the perimeter of the project area, such as *`ilima* (*Sida fallax*) and *`uhaloa* (*Waltheria americana*), vegetation in the proposed project area was composed of sugar cane that was to be harvested. Fieldwork was conducted post-harvest.

CLIMATE

The project area lies near the dry, arid region of Maui's southwest coast. Rainfall indicators, according to Price (1983:62), show that the project area receives no more than five inches per year, with accumulations occurring mostly during the months of December and January. Unlike lower, coastal elevations, higher elevations of Pūlehunui Ahupua`a receive more precipitation due to fog drip and lower temperature climates. The frequency of the project

area receiving upland wash is based on the amount of water accumulated upslope and the available water drainages created within or near the project area.

Given the lack of constant water resources within the proposed project area, Traditional-type (*i.e.,* pre-1778 A.D.) crops such as dryland sweet potato may have been the only feasible subsistence resource planted in the area prior to the advent of large-scale plantation-type irrigation systems. Of the 148 stratigraphic trenches excavated during the current survey, only eight (8) trenches revealed no more than a single soil layer. The windy conditions of the proposed project area suggest soils within the proposed project area may have been adversely affected. Upland, gravitational wash also may have contributed to soil movement through the proposed project area environs during the Traditional-Period.

TRADITIONAL AND HISTORIC SETTING

Traditionally, the division of Maui Island into districts (*moku*) and sub-districts was performed by a *kahuna* (priest, expert) named Kalaiha'ōhia, during the time of the *ali'i* Kaka'alaneo (Beckwith 1940:383). Fornander (1917-19, Vol. 6:248) places Kaka'alaneo at the end of the 15th century or the beginning of the 16th century. Land was considered the property of the king or *ali'i 'ai moku* (the *ali'i* who eats the island/district), which he held in trust for the gods. The title of *ali'i 'ai moku* ensured rights and responsibilities pertaining to the land, but did not confer absolute ownership. The king kept the parcels he wanted, his higher chiefs received large parcels from him and, in turn, distributed smaller parcels to lesser chiefs. The *maka'āinana* (commoners) worked the individual plots of land.

In general, several terms, such as *moku*, *ahupua'a*, *'ili* or *'ili 'āina* were used to delineate various land sections. A district (*moku*) contained smaller land divisions (*ahupua'a*), which customarily continued inland from the ocean and upland into the mountains. Extended household groups living within the *ahupua'a* were therefore, able to harvest from both the land and the sea. Ideally, this situation allowed each *ahupua'a* to be self-sufficient by supplying needed resources from different environmental zones (Lyons 1875:111). The *'ili 'āina* or *'ili* were smaller land divisions next to importance to the *ahupua'a* and were administered by the chief who controlled the *ahupua'a* in which it was located (Ibid:33; Lucas 1995:40). The *mo'o'āina* were narrow strips of land within an *'ili*. The land holding of a tenant or *hoa 'āina* residing in a *ahupua'a* was called a *kuleana* (Lucas 1995:61). The project area is located in the lands of Pūlehunui which translated literally means "large pūlehu," but since *pūlehu* means "broiled", it might refer to the degree of broiling one could receive from the sun in this area (Pukui et al. 1974:193).

SETTLEMENT PATTERNS

The Hawaiian economy was based on agricultural production and marine exploitation, as well as raising livestock and collecting wild plants and birds. Extended household groups settled in various *ahupua'a*. During the pre-Contact Period, there were primarily two types of agriculture, wetland and dry land, both of which were dependent upon geography and physiography. River valleys provided ideal conditions for wetland *kalo* (*Colocasia esculenta*) agriculture that incorporated pond fields and irrigation canals. Other cultigens, such as *kō* (sugar cane, *Saccharum officinaruma*) and *mai'a* (banana, *Musa* sp.), were also grown and, where appropriate, such crops as *'uala* (sweet potato, *Ipomoea batatas*) were produced. This was the typical agricultural pattern seen during traditional times on all the Hawaiian Islands (Kirch and Sahlins 1992, Vol. 1:5, 119; Kirch 1985). It must be noted that Handy (1940:105) stated that,

> "... the bounds of cultivation ... were strictly drawn by limitation of water for irrigation." The word "*kula*" meant "open country, or plain", according to Handy and Handy, and was often used to differentiate between dry, or *kula* land, and wet-taro land. The height and size of Haleakalā to the east, prevents moisture from reaching its southern and western flanks, causing and desert-like conditions throughout the region (Handy and Handy 1972:486).

Handy and Handy (1972: 105), further state that:

> [This is an essential characteristic of Kula, the central plain of Maui which is practically devoid of streams. Kula was always an arid region, throughout its long, low seashore, vast stony *kula* lands, and broad uplands [Ibid:510]

As to the occupation of this vast plain, Handy and Handy (1972: 511) stated:

> Both on the coast, where fishing was good, and on the lower westward slopes of Haleakala a considerable population existed. So far as we could learn Kula supported no Hawaiian taro, and the fishermen in this section must have depended for vegetable food mainly on *poi* brought from the wet lands of Waikapu and Wailuku to westward across the plain to supplement their usual sweet-potato diet.

An early witness to its lack of productivity was George Vancouver. During Vancouver's second visit to Hawai'i in 1793, as a Captain, he anchored in Mā'alaea Bay. Vancouver (1984:852) provided the following descriptive over-view of the southern coast of Maui:

> The appearance of this side of Mowee was scarcely less forbidding than that of its southern parts, which we had passed the preceding day. The shores, however, were not so steep and rocky, and were mostly composed of a sandy beach; the land did not rise so very abruptly from the sea towards the mountains, not was its surface so much broken with hills and deep chasms; yet the soil had little appearance of fertility, and no cultivation was to be seen. A few habitations were promiscuously scattered near the water side, and the inhabitants who came off to us, like those seen the day before, had little to dispose of.

Not much had changed 24 years later (1817) when Peter Corney sailed this way, bound for O'ahu. Corney (1965:70-71) made special reference to Keālia Pond (now the Keālia Pond and Wildlife Refuge), a short distance southwest of the project area:

> . . . Next morning we passed Morokenee (Molokini), and made sail up Mackerey (Maalaea) bay. . . This bay is very deep and wide, and nearly divides the island, there being but a narrow neck of land and very low, keeping the two parts of the island together. . . On this neck of land are their principal salt-pans, where they make most excellent salt.

EARLY HISTORY

Wailuku District was a center of political power often at war with its rival in Hana. Between 1775 and 1779, there was almost continual fighting between Kahekili, chief of Maui, and Kalani'ōpu'ū, chief from Hawai'i Island, who was often in residence at Hana (Kamakau 1961). After several skirmishes in which Kalani'ōpu'ū had been defeated by the warriors of Kahekili, Kalani'ōpu'ū retired to Hawai'i Island. He spent the next year gathering men from each of the six districts on the island, forming six divisions of warriors. His prize troops consisted of chiefs from his own group of attendants, which were named the 'Ālapa and Pi'ipi'i. Leaving nothing to chance, Kalani'ōpu'ū then built *heiau* for his war gods, assuring success, and when all was ready (1776), he and his men returned to Maui (Kamakau 1961).

Rather than landing at Hana on the east side, the warriors came around the southern coast of Maui. They first landed at Keone'ō'io Bay and ravaged the country side giving Kahekili notice and time to prepare his fighting men (Ibid.). Kalani'ōpu'ū's men traveled up the coast by sea and landed at Kīhei-puko'a at Keālia, confident that the victory was to be theirs (Ibid.). The 800 'Ālapa and Pi'ipi'i warriors marched across the plain to Wailuku where Kahekili and his warriors were waiting. Kamakau (1961:85-89) stated:

> They slew the Alapa on the sand hills at the southeast of Kalua. There the dead lay in heaps strewn like *kukui* branches; corpses lay heaped in death; they were slain like fish enclosed in a net....

An interesting anecdote is recounted by George W. Bates (in *Sandwich Island Notes*, 309) during his journey from Wailuku to Kahului in 1854 states:

> Leaving Wai-lu-ku [town], and passing along toward the village Kahului, a distance of three miles, the traveler passes over the old battle-ground named after the village. It is distinctly marked by moving sand-hills, which owe their formation to the action of the northeast trades. Here these winds blow almost with the violence of a sirocco, and clouds of sand are carried across the northern side of the isthmus to a height of several hundred feet. These sand-hills constitute a huge "Golgotha" for thousands of warriors who fell in ancient battles. In places laid bare by the action of the winds, there were human skeletons projecting, as if in the act of struggling for resurrection from their lurid sepulchers. In many portions of the plain who cart-loads were exposed in this way. Judging of the numbers of the dead, the contest of the old Hawaiians must have been exceedingly bloody. . . .

The 1776 encounter between Kahekili and Kalaniʻōpuʻū resulted in a temporary truce which was broken in 1790 by the battle of Kepaniwai, when Kamehameha I consolidated his control over Maui Island.

THE MĀHELE

In the 1840s, traditional land tenure shifted drastically with the introduction of private land ownership based on western law. Many scholars believe that in order to protect Hawaiian sovereignty from foreign powers, Kauikeaouli (Kamehameha III) was forced to establish laws changing the traditional Hawaiian economy to that of a market economy (Kameʻeleihiwa 1992:169-70, 176; Kelly 1983:45, 1998:4; Daws 1962:111; Kuykendall 1938 Vol. I:145). The Māhele of 1848 divided Hawaiian lands between the king, the chiefs, the government, and began the process of private ownership of lands. The subsequently awarded parcels were called Land Commission Awards (LCAs). Once lands were thus made available and private ownership was instituted, the *makaʻāinana* (commoners) were able to claim the plots on which they had been cultivating and living. These claims did not include any previously cultivated but presently fallow land, *ʻokipū* (on Oʻahu), stream fisheries, or many other resources necessary for traditional survival (Kelly 1983; Kameʻeleihiwa 1992:295; Kirch and Sahlins 1992). If occupation could be established through the testimony of two witnesses, the petitioners were awarded the claimed LCA and issued a Royal Patent after which they could take possession of the property (Chinen 1961:16).

The *ahupuaʻa* of Pūlehunui extended across the Kula plain to the edge of Haleakalā and would have included fruitful sections, not just the arid plains (Figure 5). There were 13 *kuleana* claimed in the *ahupuaʻa* of Pūlehunui . According to the Waihona ʻAina Database (2017), LCA 05230 (Royal Land Patent No. 8140), consisting of the *ahupuaʻa* of Pūlehunui (16,687.78 acres), in its entirety, was claimed by, and awarded to, Keaweamahi. Land Commission Award 5230 occurs across a wide swath of land, almost entirely enclusive of Pūlehu Ahupua`a (Figure

6), and extends from the coastline to the uplands. LCA 5230 was awarded to Emilia Keaweamahi in 1843 by King Kauikeaouli (Kamehameha III). The land is patent grant 8140 and merely describes that the entire ahupua`a was awarded to E. Keaweamahi. According to testimony (Waihona `Aina 2017), there were many Hawaiians living on the land. The boundaries of Pulehu were established as Haleakala, Makawao, Oma`opio (*mauka*) and the ocean, and Honua`ula, Pulehu iki (*makai*). Pulehu Gulch, Kamehame Gulch, and Kealahou Gulch, near the project area, are referred to as "creeks" or "streams" in the boundary documents.

HISTORIC LAND USE

As the sugar industry developed in the mid-1800s, more and more land was leased or purchased for what had become an intensely profitable endeavor. Water was an issue, but in 1876, the Hamakua Ditch Company (Alexander and Baldwin) was formed and within two years was bringing water from the streams of Haleakalā to four plantations in East Maui (Dorrance and Morgan 2000:180).

Also in 1876, the Reciprocity Treaty's ratification notice arrived by steamer, along with Claus Spreckles, California's sugar magnate, who viewed the sugar situation and decided two years later to turn the dry plains of Maui into a garden of cultivated cane (Van Dyke 2008). By various questionable means, he was able to acquire half interest in 16,000 acres of land in Waikapū commons and was able to lease 24,000 acres of Crown Lands on the Wailuku plains in central Maui for $1,000 (Dorrance and Morgan 2000:180). Figure 4 above, shows the survey line of the property extending across Pūlehunui , Claus Spreckles obtained from Henry Cornwell.

Having seen the success of the recently completed Hamakua Ditch now bringing mountain water to the otherwise dry, and unproductive East Maui fields, and having lost his battle to control this ditch water, Spreckles formed the Hawaiian Commercial Company and decided to construct a ditch system of his own on East Maui above the Hamakua Ditch, for his newly acquired land (Wilcox 1996). Spreckles' Haiku Ditch extended 30 miles, from Honomanu Stream to the Kīhei boundary and the water was used to irrigate his cane lands in the central Maui plains (Ibid.). Presently, the Haiku Ditch ends at the Haiku reservoir abutting the project area to the north (see Figure 1).

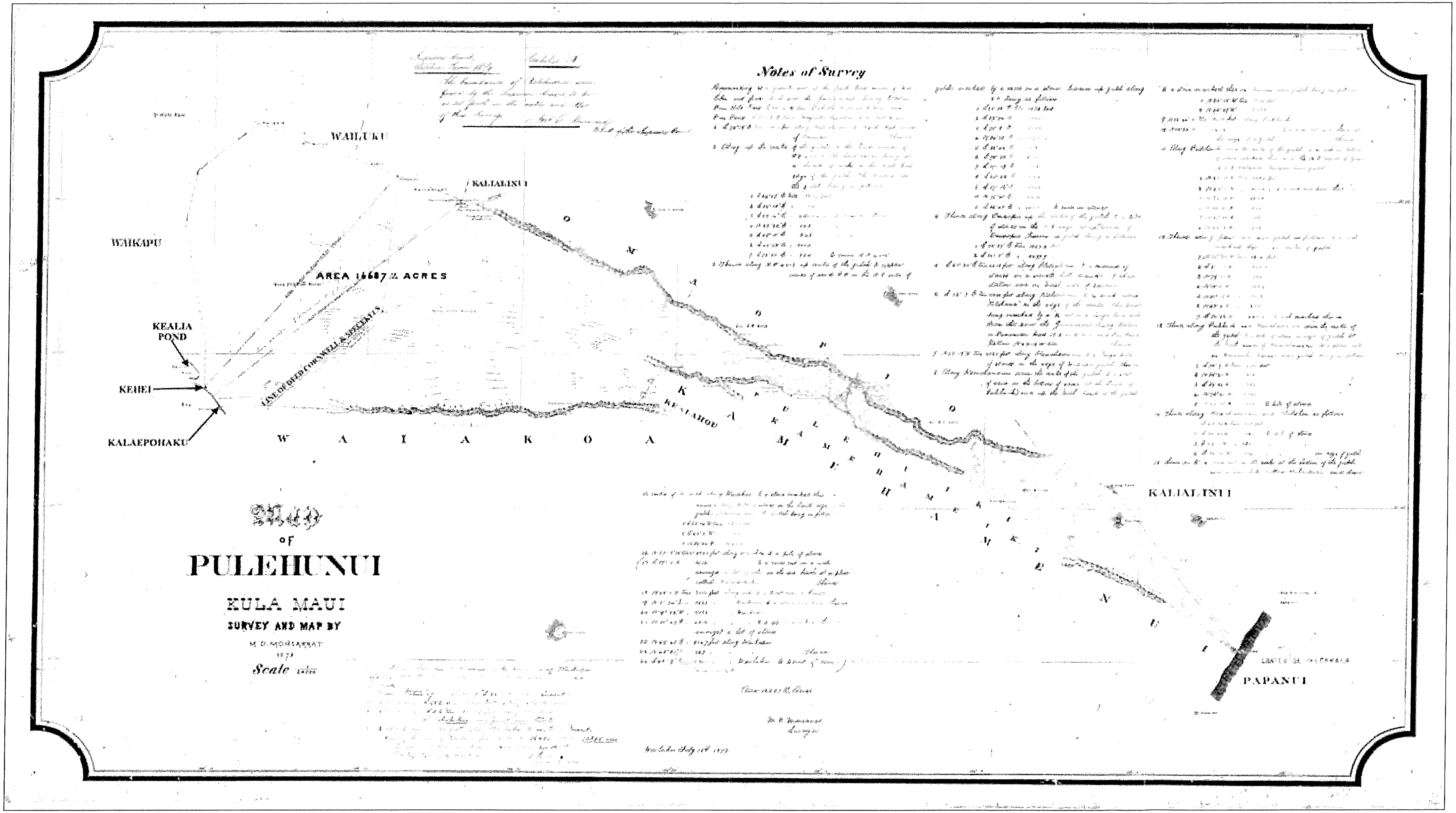

Figure 5: Modified "Pulehenui Kula Maui, Survey and Map By M.D. Monsarrat 1879", Showing *Ahupua'a* Meets and Bounds and Boundary of Spreckles Kula Land (State Survey Office, Reg. Map #1770).

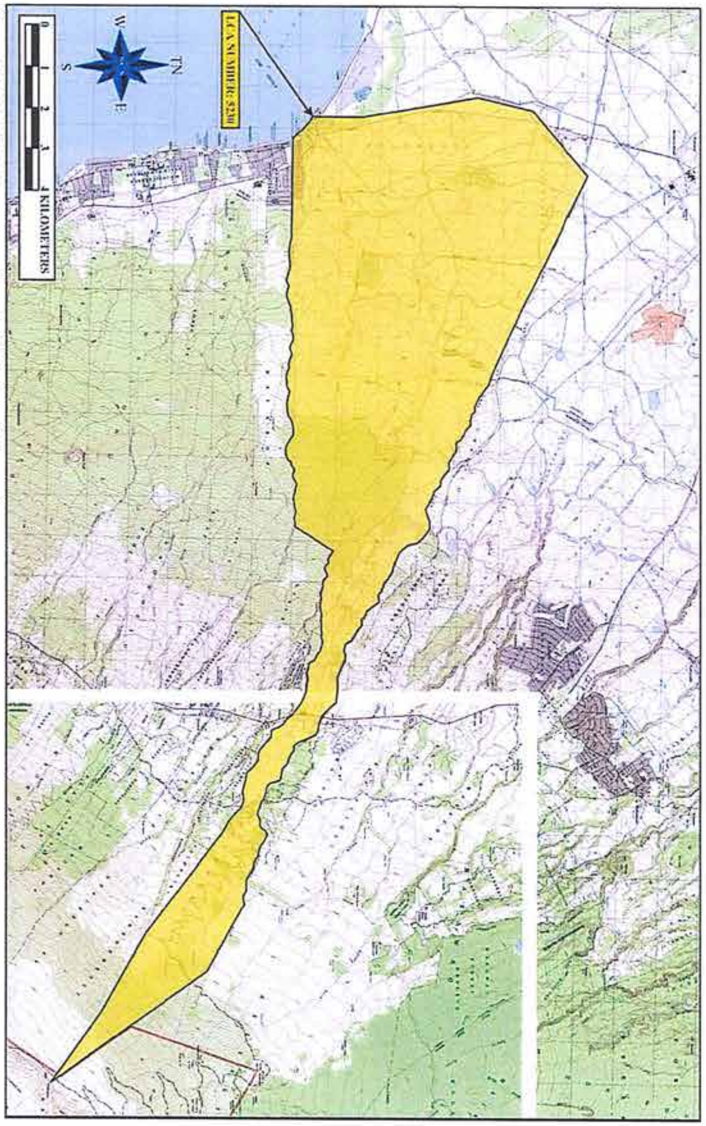

Figure 6: LCA 5230, Encompassing all of Pūlehunui Ahupua'a.

In 1882, Spreckles reorganized his company into a California corporation, called Hawaiian Commercial and Sugar Company, or HC&S (Wilcox 1996). Later he constructed another water system known as the Waihee Ditch in West Maui. It brought water from 15 miles away, starting at an elevation of 435 feet, to Kalua where it emptied into HC&S Waiale reservoir (Ibid.).

The ensuing years brought trials and tribulations between Spreckles, his associates, and the Maui sugar planters, resulting finally in the 1898 sale of his HC&S stock, at an all-time low, to James Castle in partnership with Alexander and Baldwin, and the departure of Claus Spreckles from Hawai'i (Dorrance and Morgan 2000; Wilcox 1996).

Henry Baldwin and Lorrin Thurston formed the Kihei Sugar Company in 1899, to grow cane on their ranch lands in south central Maui, which included the project area (Dorrance and Morgan 2000). It was sent to the mill at Pu'unēnē to be ground, but, although production was high, it was not enough to cover the costs (Ibid.).

After the annexation in 1898, some of the planters on Maui, including Alexander and Baldwin, had decided to combine plantations to reap maximum profit. They formed the Maui Agricultural Company, a co-partnership that initially encompassed seven plantations and two mills. In 1904, five new plantations became part of the Maui Agricultural Company, as Kula Plantation Company, Makawao Plantation Company, Pulehu Plantation Company, Kailua Plantation and Kalianui Plantation Company were newly formed by carving up the unprofitable Kihei Plantation land (Dorrance and Morgan 2000). Figure 7 shows the lands in Kula, previously Kihei Plantation Company, which became the "five companies" of the Maui Agricultural Company surveyed in 1904 by Arthur Alexander. The newly formed Makawao Plantation is shown in Figure 8. Maui Agricultural Company merged with HC&S in 1948 (Dorrance and Morgan 2000).

WORLD WAR II

A portion of the cane fields adjacent to the project area was turned into a civil airfield for the Territory of Hawai'i in 1937, as the one located at Ma'alaea had become too small to accommodate. Two years later, Inter-Island Airways began service to Maui, landing at Puunene Airport. As war loomed on the horizon (1940), the Navy began using the airport, along with a small Army Air Corps support base at the airfield. At this time, the air station was being used to support Squadron VU-3, to tow targets and operate drones for the fleet. Shortly after the United

States entered WWII, land in the area of the airport was condemned (1942), including the project parcel listed as parcel 2-C in the Declaration of Taking filed with the District Court of the United States for the District of Hawaii (on file Bureau of Conveyances, Honolulu). The airport was expanded and commissioned as Naval Air Station Maui (NAS). The Navy lengthened and widened the runways and added Link trainers, as well as changing its name to NAS Puunene. One hundred and six squadrons and carrier groups passed through the NAS during WWII. By 1945, the base consisted of a total of 2,202 acres, supporting over 3,300 personnel, and 271 aircraft. There were two paved runways, taxiways, ramps, hangers, and auxiliary buildings (Freeman 2017).

The airfield was released by the Navy back to the Territory of Hawai'i in 1947 and was apparently used as the official inter-island Airport until at least 1952 when the Kahului Airport was available for civil use. However, the Maui/Pu'unēnē airstrip, as it was known, serviced crop-dusters and other smaller aircraft and wasn't abandoned as a landing strip until sometime between 1961 and 1977. Over-grown military facilities were left in the area, including bunkers, revetments, and other bits and pieces. This is when the old airstrips were used for impromptu racing. All the land, except 222 acres, was sold back to HC&S by the State of Hawai'i. The 222 acres were deeded to the Maui County and the 2002 master plan for this land, included a raceway park, county fairgrounds, Hawai'i National Guard, the proposed Maui Correctional Center, and at the northeast end of the drag strip, acres set aside for a naval memorial park. Management is provided by the County Parks and Recreation Department and a portion of the airstrip is presently being used by the Maui Raceway Park Drag Strip, the Paradise Speedway Dirt Track, and the Maui Remote Airplane Club (2016).

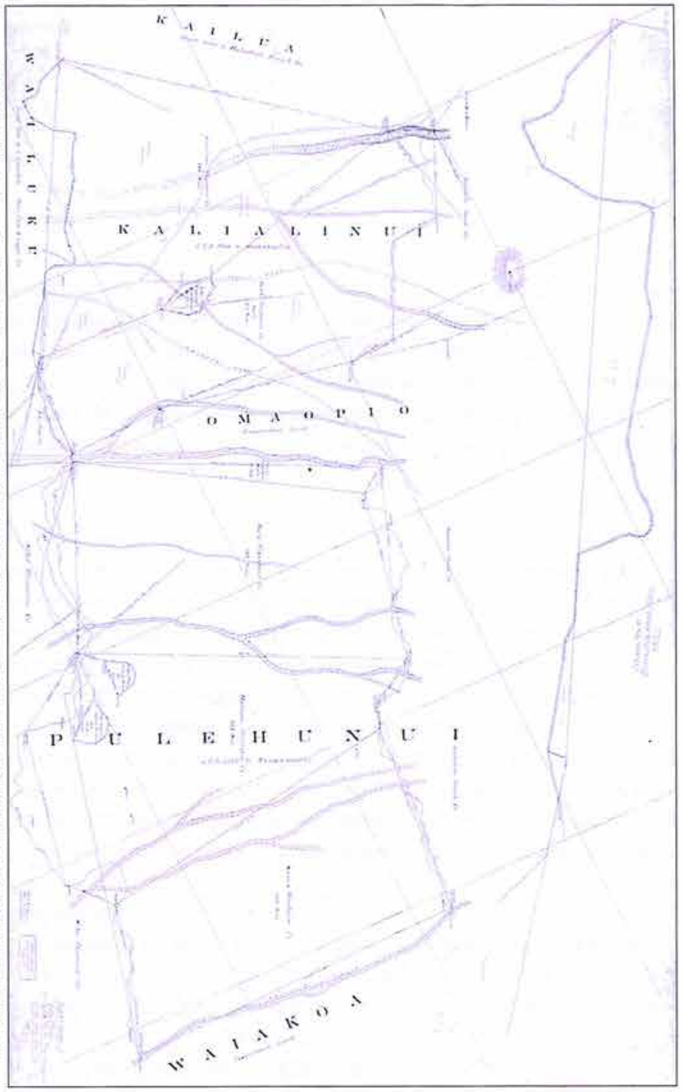

Figure 7: "Kihei Plantation Co. [crossed out], Map of Lands in Kula, Maui Belonging to the "Five Companies" of the Maui Ag. Co., July 1904" (State Survey Office, Reg. Map #1770).

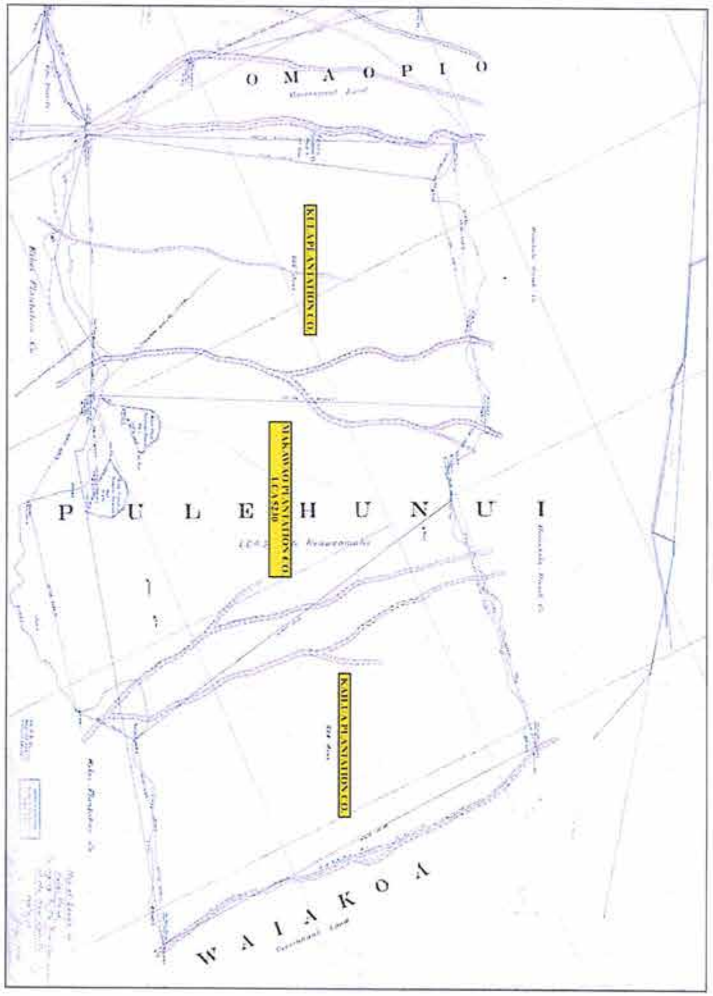

Figure 8: Close-up of Makawao Plantation Lands in Pūlehunui Ahupua'a (State Survey Office, Reg. Map #1770).

PREVIOUS ARCHAEOLOGY IN GENERAL AREA

Archaeological studies in the greater area began in the early 20th Century by T. Thrum (1909), J. Stokes (1909–1916), and W. M. Walker (1931). These surveys included areas of leeward Maui and inventoried both coastal and upland sites of the Kula District. In the *ahupua'a* of Pūlehunui Walker (1933 in Sterling 1998:253) listed two sites identified as Haleokane Heiau and Nininiwai Heiau.

Archival research indicates few archaeological projects have been conducted near the proposed project area. Although these projects occurred some distance from the subject parcel they are directly relevant. These studies provide background information to the current study area. The reader is also referred to Tomonari-Tuggle et al. (2001:61-63) which provides a succinct summary of these studies. The locations of selected previous archaeological projects conducted in the vicinity of the current project area are presented in Figure 9.

Kennedy (1988) conducted a visual inspection of TMK: (2) 3-8-004:029 that did not identify archaeological sites. The absence of sites was attributed to prior development of the area for a construction baseyard with an installation of a large concrete culvert. In 1991 the Bishop Museum conducted an Archaeological Inventory Survey for the Kai Makani project that produced negative findings on the ground surface or subsurface contexts (Rotunno-Hazuka (1991).

In 1992 Aki Sinoto Consulting conducted an Archaeological Inventory Survey of the proposed location for the Kihei Gateway Complex which led to the identification of State Site 50-50-09-31, a remnant, historic concrete bridge (crossing Waiakoa Stream. It was suggested that the bridge was probably related to a narrow gauge cane railroad that operated through the area and may have serviced Kihei Camp 1 (Sinoto and Pantaleo 1992).

Between 1995 and 1999 Scientific Consultant Services, Inc. conducted an Archaeological Inventory Survey (followed by two addendums) for the Puunene Bypass/ Mokulele Highway Improvements Corridor located in TMK: (2) 3-8:-04, 05, 06, and 079 (Burgett and Spear 1997; Chaffee et al. 1999). No additional archaeological sites were identified. However, one previously recorded site was relocated and identified as the Naval Air Station Puunene Dump Site (State Site 50-50-09-4164). Scientific Consultant Services, Inc. conducted an Archaeological Inventory Survey of TMK: (2) 3-9-041:027, which included excavation of nine stratigraphic trenches. No new sites were identified (Pestana and Dega 2002).

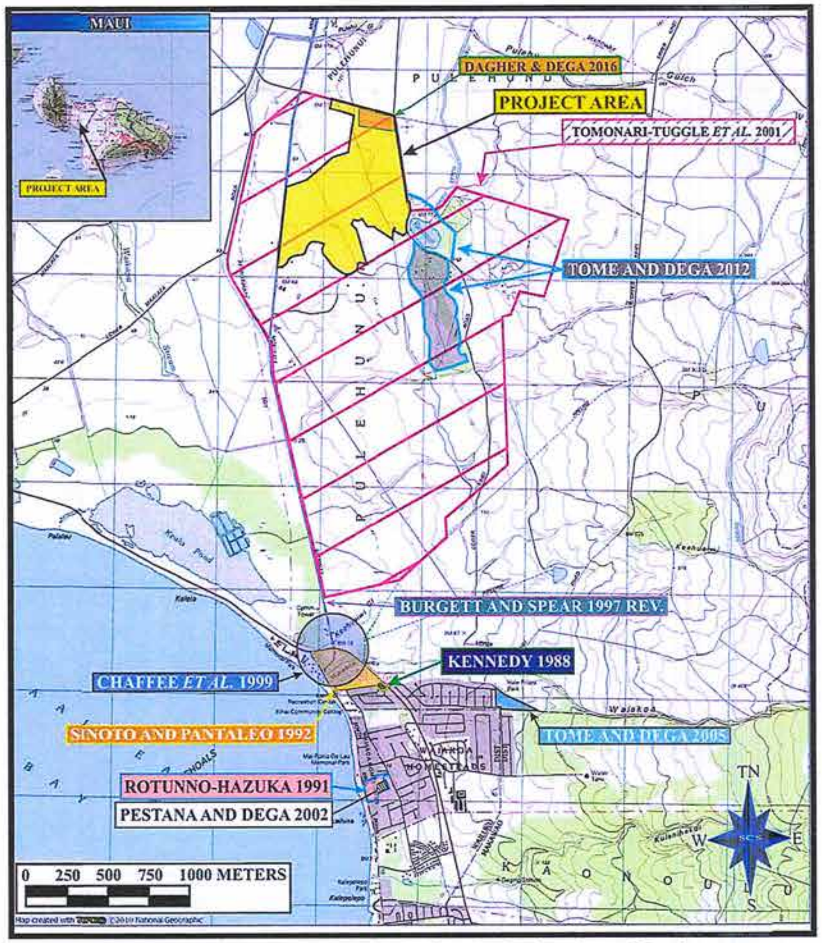

Figure 9: USGS (Puu O Kali 1992) Quadrangle Map Showing the Locations of Previous Archaeological Projects in the Vicinity of the Current Project Area.

International Archaeological Research Institute Inc. (IARII) conducted an Archaeological Inventory Survey of the former Naval Air Station located in Puunene, Pūlehunui Ahupua'a Former Naval Air Station Puunene, State Site 50-50-09-4164 (Tomonari-Tuggle et al. 2001). During the survey 3 sites were identified (State Site 50-50-09-4800 through State Site 50-80-09-4802). State Site 50-50-09-4800 consisted of seven features associated with the Plantation-Era and two complexes of corrals, fences, troughs associated with Post-World War II ranching. State Site 50-50-09-4801 consisted of a post-World War II cattle ranching site. State Site 50-50-09-4802 consisted of the Old Kihei Railroad Bed (State Site 50-50-09-4802 and 5 features associated with the Haiku Ditch and Reservoir. The current project area was included in this larger study previously conducted by International Archaeological Research Institute Inc. (Tomonari-Tuggle et al. 2001).

In 2005 Scientific Consultant Services, Inc. conducted an Archaeological Inventory Survey, including limited subsurface testing, was conducted on a 9.289-acre property in North Kīhei, Maui, Hawai'i [TMK: (2) 3-8-004:028] (Tome and Dega 2005). The project area, located immediately adjacent and abutting the southern boundary of the Hale Piilani Park, had been partially modified by illegal dumping, utilization as an informal dirt bike course, and ranching activities. Two archaeological sites comprising four structural features were newly identified during this Inventory Survey. The sites were interpreted respectively as a World War II-related site (State Site 50-50-09-5801, WW II training site) and a traditional Hawaiian site (State Site No. 50-50-09-5802, pre-Contact agricultural/habitation complex). The two sites date utilization of the subject parcel from the pre-Contact Period (*i.e.,* pre-1778) to the United States Marine Corps' 4th U.S. Marine Division training during the closing years of World War II.

In 2011 Scientific Consultant Services, Inc. (SCS), conducted an Archaeological Inventory Survey for the Puunene Heavy Industrial Subdivision Project on an approximately 917 meter (3,007.8 feet) long alternate access road [TMK: (2) 3-8-008: pors. 005 and 006] and on 86.029-acres of land [TMK: (2) 3-8-008: 019] within Pūlehunui Ahupua'a, Wailuku District, Island of Maui, Hawai'i (Tome and Dega 2012). A portion of the Puunene Naval Air Station was located within the project area. Thus, portions of the former Puunene Naval Air Station (State Site 50-50-09-4164) and a post-World War II cattle ranching site (State Site 50-50-09-4801) were re-located during the survey.

Finally, Scientific Consultant Services, Inc. (SCS; Dagher and Dega 2016) conducted Archaeological Inventory Survey-level study of a 20.3-acre property in Pu'unēnē, Pūlehunui Ahupua'a, Wailuku District, Island of Maui, Hawai'i [TMK: (2) 3-8-008:001 por.]. The project area is owned by the State of Hawai'i, Department of Land and Natural Resources and is directly adjacent to the current project area. The former project is part of this larger 280 acre parcel of current study. Full pedestrian survey was conducted of the 20 acre area, as well as a total of twenty (20) stratigraphic trenches (ST-1 through ST-20) having been mechanically excavated. No historic properties were identified on the ground surface or in subsurface contexts during the study. Stratigraphy was identical to what was identified during the current project, which is not surprising given both properties were adjacent to each other. No further archaeological work was recommended for the 20 acre parcel.

SETTLEMENT PATTERN

Multiple settlement pattern models for the traditional districts of Wailuku and Honua`ula, and its Kula extent, such as the proposed project area, have been proposed by researchers, including those by Kirch (1970), Barrera (1974), Cleghorn (1975), Cordy (1977), Cordy and Athens (1988), and Gosser *et al.* (1993), and Gosser *et al.*1995). Parallels may be drawn between the studies above with the project area based on physiographic and archaeological characteristics.

Cordy and Athens (1988) suggested that although the traditional district of Honua`ula and the Wailuku District extent at the base of the hills, on the isthmus, seems to have had a fairly harsh environment; people settled in this district and coped successfully with the elements, both on the coast and inland. Early surveys labeled the region between the coast and inland farming areas the 'barren zone,' alluding to temporary or seasonal habitation and agriculture. Cordy and Athens (1998) agreed that major land use patterns, initially generated by archaeologists in the 1970s, indicated that inland areas where rainfall was adequate were primarily farming zone. Permanent habitation and intensity of settlement correlated to rainfall amounts (Cordy and Athens 1988:23–24, 100–103; Gosser *et al.* 1993). The term 'barren zone' has indeed been replaced through time, with permanent settlement known to have occurred in these areas, stretching from Honua`ula through the lower Kula extent of Wailuku District, in late pre-Contact times (Perzinski *et al.* 2015). The area was also used extensively during Historic times, from ranching endeavors to potato cultivation and military use (WWII).

During pre-Contact times, crops in the inland areas were dryland taro, sweet potato, and banana (Barrera 1974; Cordy and Athens 1988:18). More relevant to the proposed project area is Handy and Handy's description of environmental conditions on the leeward side of Haleakala.

> The great bulk and altitude of Haleakala makes its southern flank practically a water less desert, and the southeast and west flanks relatively dry, so that there were no lo`i (pond

> fields) cultivation at all. The arid country below the west and south slopes of Haleakala, including Kula, Honua`ula, Kahikinui, and Kaupo, were dependent on sweet potato (Handy and Handy 1972:488).

Irish potato became an important crop in the mid-1800s due to the Gold Rush in Calfornia, the potatoes having been cultivated on Maui and sent to the Bay area. Ranching became a significant enterprise in the uplands during historic times and continued into recent times. Archaeological sites related to agriculture (planters, terraces, modified outcrops and ranching (walls, large enclosures) are common in this formerly labeled 'barren zone' area.

Based on a synthesis of previous archaeological work in this dry environmental zone of the Kula District, the landscape was expected to contain possible prehistoric sites, such as scattered temporary or seasonal habitations and associated dryland agricultural sites. Site density in this area is likely very low. Farther inland in this region sites might include field shelters and special activity areas represented by small C-shaped structures, terraces, platforms, rock mounds, and caves. Construction of these features is expected to be less formal and more random than those along the coast (see Gosser *et al.* 1993). Historic-period features have been recorded with perhaps more frequency in this zone, given limited habitation through time, making this an ideal training area. Historic period sites may include features related to WW II training such as C-shaped structures and concrete encasements/foundations, among others. Walls and enclosures representing the ranching era were also thought possible. Finally, the arid area would have required much water for sugar cane cultivation. There is the possibility that aquaducts or other cane-related historic infrastructure may be present in the project area.

METHODOLOGY

FIELD METHODOLOGY

Multiple field tasks were completed during the archaeological study. First, pedestrian survey was conducted in order to identify the presence/absence of archaeological sites and assess project area geographical/physiographical features. Transect spacing of a variable ten to twenty meter intervals was employed as surface visibility was high; one could view the entirety of the project area surface from any one location. One surface site was identified and mapped vis a handheld Garmin GPS Map 60 CSx global positioning system (GPS) unit. The datum and coordinate system used for the GPS unit was NAD83 and UTM (Universal Transverse Mercator). True north compass orientation was also employed. All measurements were recorded in metric. The boundary of the historic site was determined by its visible extent.

Mechanically excavated stratigraphic trenches were utilized to assess the presence/absence of subsurface cultural deposits. A total of 148 trenches were excavated throughout the project area. No cultural materials were identified in any of the trenches. Stratigraphy was documented utilizing metric graph paper and United States Department of Agriculture (USDA) Munsell soil color charts. Given the homogeneity in stratigraphic profiles throughout the project area, only a representative number of profiles are provided below.

LABORATORY METHODOLOGY

Laboratory work primarily involved digitizing maps, illustrating stratigraphic profiles, and reporting. Representative stratigraphic profiles have been drafted for presentation within this report. All field notes, digital photographs, and collected archaeological materials were curated at the SCS laboratory in Honolulu.

INVENTORY SURVEY RESULTS

SCS conducted AIS for the proposed State of Hawai`i, Department of Land and Natural Resources (DLNR) Business Park over 280 acres in Pulehunui, Pūlehunui Ahupua`a, Wailuku District, Island of Maui, Hawai`i [TMK: (2) 3-8-008:001] (see Figures 1, 2, and 3). Pedestrian survey revealed the presence of a single site. Site 50-50-04-8481 consists of a Historic-period irrigation ditch associated with sugar cane cultivation. Representative testing vis 148 trenches did not lead to the identification of cultural materials from any time period other than modern times.

STATE SITE NO: 50-50-04-8481

SCS Temporary Site: TS-1
GPS Coordinates: Enters property at East 764707/ North 2304475 and Terminates at East 764262/North 2305660
Previous Archaeological Recordation: None
Features: 1
Feature Type: Water Irrigation Ditch
Feature Function: Irrigation
Feature Structural Integrity: Fair to Good
Feature Age Association: Historic irrigation ditch associated with sugarcane cultivation
Criterion Significance: D
Recommendations: No further work

The site consists of a water irrigation ditch composed of concrete. The ditch has concrete walls and a concrete flooring, with gates and other small pipes entering the long ditch at locations to control water flow in the ditch. The presence of the aggregate concrete and use places the site to the Historic era of sugarcane cultivation practices (Figures 10 through 14).

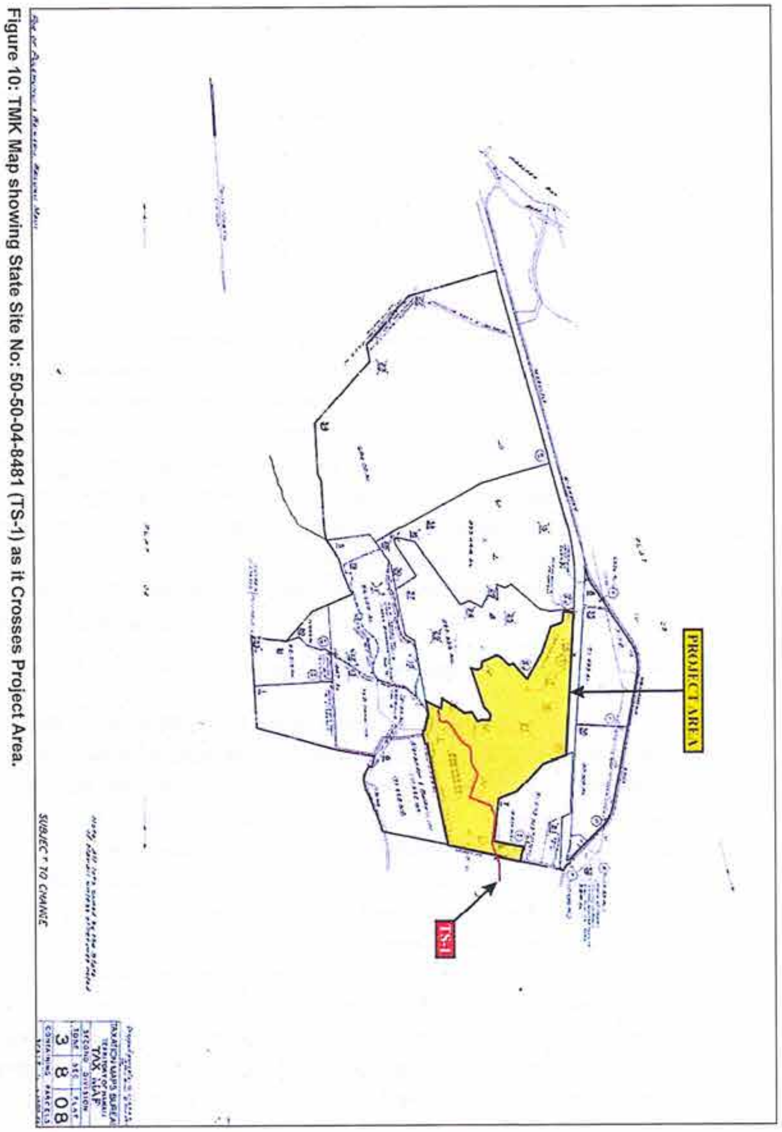

Figure 10: TMK Map showing State Site No: 50-50-04-8481 (TS-1) as it Crosses Project Area.

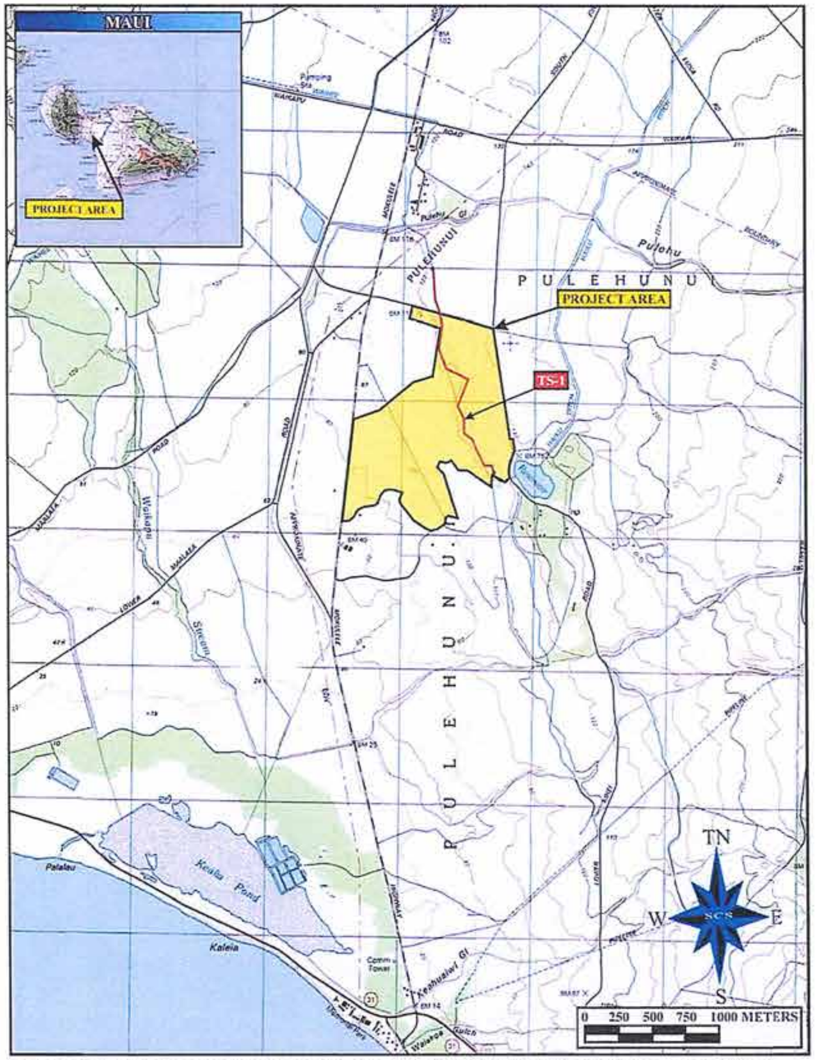

Figure 11: USGS Map showing State Site No: 50-50-04-8481 (TS-1) as it Crosses Project Area.

Figure 12: Photograph of Site -8481. View to Southwest.

Figure 13: Photograph of Site -8481. View to Southeast.

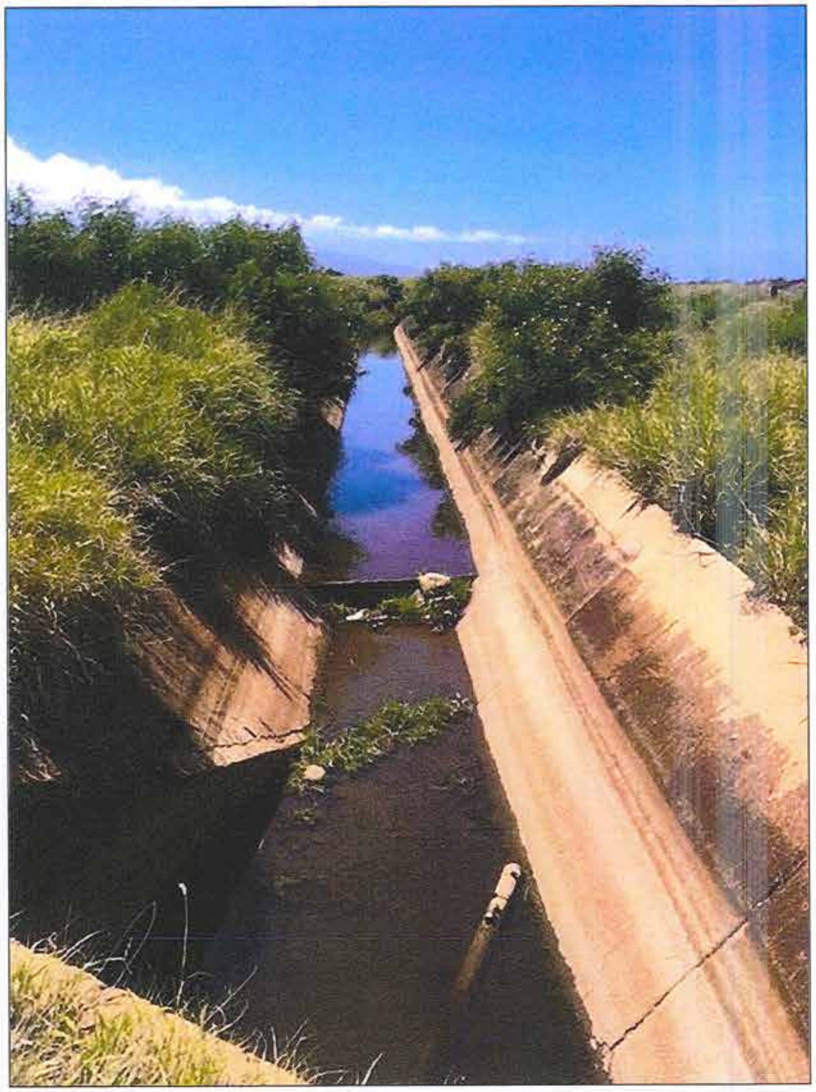

Figure 14: Photograph of Site -8481. View to South/Southeast.

Located on relatively flat terrain amongst dried grasses and former cane-harvested land, the site measured approximately 0.8 miles (1,287.48 m) long and traverses across the project area from the southeastern corner (from a large reservoir location outside the project area) to the northeastern corner of the project area, where it continues northward and then west to Mokulele Highway. From that point, it proceeds under the highway and continue for c. 750 m to another reservoir (see Figure 11). The ditch itself is "U" shaped, as shown in Figures 12-14, and contains a concrete deck and side walls. The ditch is 2.0 m wide and 1.5 m deep at greatest depth. During fieldwork and on all viewed occasions, the ditch contained water that flowed rather rapidly through the drainage. The water levels were not high, however, usually only slighter higher than in the above photographs.

STRATIGRAPHIC TESTING

A total 148 stratigraphic trenches were mechanically excavated across the project area to provide a concise view of subterranean contexts throughout the 235 acres (Table 1; Figure 15). Appendix A provides a representative sample of 67 stratigraphic profile descriptions, with drafted stratigraphic profiles presented within the sample and at the end of the descriptive text. Photographs of representative trenches are also presented. All 148 trenches were culturally sterile. As shown in Table 1, the trenches were variable in size, with maximums of 7.3 m long, 1.3 m wide, and 2.7 m below surface (mbs).

Figure 15: Aerial Photograph Showing Stratigraphic Trench Locations. Note: NE Corner Area was excavated previously for a different project (Dagher and Dega 2016).

Table 1: Stratigraphic Trenches.

Stratigraphic Trench Number	GPS (east)	GPS (west)	Long Axis Orientation (True North)	Dimensions (meters; L x W x Max. Depth)	Cultural Material Observed in Strata
ST-1	764383	2304167	60/240°	5.6 x 0.6 x 1.6	No
ST-2	764290	2304107	70/250°	4.2 x 0.6 x 1.1	No
ST-3	764227	2304137	70/250°	5.0 x 0.6 x 1.4	No
ST-4	764117	2304142	68/248°	5.0 x 0.6 x 1.4	No
ST-5	Missing Profiles/info		n/a	n/a	No
ST-6			n/a	n/a	No
ST-7	764332	2304195	58/238°	5.0 x 0.6 x 1.6	No
ST-8	764336	2304255	68/248°	5.0 x 0.6 x 1.6	No
ST-9	764295	2304230	80/260°	5.0 x 0.6 x 1.5	No
ST-10	764260	2304205	60/240°	5.0 x 0.6 x 1.7	No
ST-11	764055	2304199	60/240°	5.0 x 0.6 x 0.9	No
ST-12	764102	2304223	60/240°	5.0 x 0.6 x 1.5	No
ST-13	764154	2304255	60/240°	5.0 x 0.6 x 1.4	No
ST-14	764248	2304320	60/240°	5.0 x 0.6 x 2.0	No
ST-15	764320	2304365	54/234°	5.0 x 0.6 x 4.5	No
ST-16	764596	2304513	60/240°	5.0 x 0.6 x 1.8	No
ST-17	764530	2304592	70/250°	5.0 x 0.6 x 1.6	No
ST-18	764460	2304649	74/254°	5.0 x 0.6 x 1.2	No
ST-19	764347	2304630	54/234°	5.0 x 0.6 x 1.9	No
ST-20	764254	2304567	68/248°	5.0 x 0.6 x 2.0	No
ST-21	764169	2304522	64/244°	5.0 x 0.6 x 2.0	No
ST-22	764053	2304416	90/270°	5.0 x 0.6 x 1.4	No
ST-23	763844	2304377	76/256°	5.0 x 0.6 x 1.7	No
ST-24	763694	2304265	58/238°	5.0 x 0.6 x 1.4	No
ST-25	763693	2304397	62/242°	5.0 x 0.6 x 0.9	No
ST-26	763816	2304485	56/236°	5.0 x 0.6 x 0.9	No
ST-27	764030	2304609	70/250°	5.0 x 0.6 x 1.6	No
ST-28	764127	2304656	68/248°	5.0 x 0.6 x 1.9	No
ST-29	764127	2304656	70/250°	5.0 x 0.6 x 1.8	No
ST-30	764412	2304755	70/250°	5.0 x 0.6 x 1.2	No
ST-31	764412	2304898	68/248°	5.0 x 0.6 x 1.8	No
ST-32	764334	2304487	78/264	5.0 x 0.6 x 1.6	No
ST-33	764258	2304854	70/250°	5.0 x 0.6 x 1.8	No
ST-34	764159	2304827	70/250°	5.0 x 0.6 x 1.7	No
ST-35	764060	2304808	70/250°	5.0 x 0.6 x 1.7	No
ST-36	763955	2304775	340/160°	5.0 x 0.6 x 1.9	No

Stratigraphic Trench Number	GPS (east)	GPS (west)	Long Axis Orientation (True North)	Dimensions (meters; L x W x Max. Depth)	Cultural Material Observed in Strata
ST-37	763905	2304711	170/350°	5.0 x 0.6 x 1.9	No
ST-38	763832	2304715	20/200°	5.0 x 0.6 x 1.7	No
ST-39	763764	2304636	156/336°	5.0 x 0.6 x 1.5	No
ST-40	763694	2304602	110/290°	5.0 x 0.6 x 1.8	No
ST-41	763711	2304732	92/2752°	5.0 x 0.6 x 1.8	No
ST-42	763744	2304775	30/210°	5.0 x 0.6 x 1.6	No
ST-43	763817	2304790	58/238°	5.0 x 0.6 x 1.1	No
ST-44	763874	2304845	52/238°	5.0 x 0.6 x 1.4	No
ST-45	763940	2304914	22/202°	5.0 x 0.6 x 1.7	No
ST-46	764277	2304462	10/190°	5.0 x 0.6 x 1.3	No
ST-47	764208	2304451	90/250°	5.0 x 0.6 x 1.0	No
ST-48	764150	2304417	130/310°	5.0 x 0.6 x 1.6	No
ST-49	764076	2304381	110/290°	5.0 x 0.6 x 1.5	No
ST-50	764033	2304315	270/90°	5.0 x 0.6 x 1.6	No
ST-51	763990	2304882	38/218°	5.0 x 0.6 x 1.6	No
ST-52	764062	2304934	50/230°	5.0 x 0.6 x 1.4	No
ST-53	764133	2304922	110/290°	5.0 x 0.6 x 1.6	No
ST-54	764175	2304997	30/210°	5.0 x 0.6 x 1.8	No
ST-55	764246	2304960	110/290°	5.0 x 0.6 x 1.6	No
ST-56	764269	2305032	18/198°	5.0 x 0.6 x 1.8	No
ST-57	764341	2304985	118/298°	5.0 x 0.6 x 1.8	No
ST-58	764335	2305050	36/216°	5.0 x 0.6 x 1.8	No
ST-59	764324	2305120	14/194°	5.0 x 0.6 x 1.6	No
ST-60	764287	2305202	14/194°	5.0 x 0.6 x 1.6	No
ST-61	764237	2305217	92/272°	5.0 x 0.6 x 1.4	No
ST-62	764216	2305092	46/226°	5.0 x 0.6 x 0.9	No
ST-63	764118	2305174	70/250°	5.0 x 0.6 x 1.6	No
ST-64	764080	2305039	60/240°	5.0 x 0.6 x 1.3	No
ST-65	763938	2305118	96/276°	5.0 x 0.6 x 1.4	No
ST-66	763896	2305010	60/240°	5.0 x 0.6 x 1.5	No
ST-67	763792	2305063	50/230°	5.0 x 0.6 x 1.5	No
ST-68	763730	2304949	64/244°	5.0 x 0.6 x 1.6	No
ST-69	763737	2305129	100/280°	5.0 x 0.6 x 1.6	No
ST-70	763777	2305240	34/214°	5.0 x 0.6 x 1.6	No
ST-71	763796	2305355	10/190°	5.0 x 0.6 x 1.3	No
ST-72	763869	2305339	50/230°	5.0 x 0.6 x 1.6	No
ST-73	763921	2305209	50/203°	5.0 x 0.6 x 1.6	No

Stratigraphic Trench Number	GPS (east)	GPS (west)	Long Axis Orientation (True North)	Dimensions (meters; L x W x Max. Depth)	Cultural Material Observed in Strata
ST-74	763948	2305299	34/214°	5.0 x 0.6 x 1.6	No
ST-75	764021	2305205	74/254°	5.0 x 0.6 x 1.8	No
ST-76	764039	2305328	50/230°	5.0 x 0.6 x 1.6	No
ST-77	764134	2305255	70/250°	5.0 x 0.6 x 1.6	No
ST-78	764168	2305351	84/264°	5.0 x 0.6 x 1.3	No
ST-79	764234	2305268	60/240°	5.0 x 0.6 x 1.3	No
ST-80	764233	2305358	64/244°	5.0 x 0.6 x 1.4	No
ST-81	764229	2305414	64/244°	5.0 x 0.6 x 1.5	No
ST-82	764227	2305494	102/282°	5.0 x 0.6 x 0.8	No
ST-83	764158	2305494	52/232°	5.0 x 0.6 x 1.2	No
ST-84	764152	2305512	68/248°	5.0 x 0.6 x 1.4	No
ST-85	764090	2305562	70/250°	5.0 x 0.6 x 1.6	No
ST-86	764075	2305481	104/284°	5.0 x 0.6 x 1.2	No
ST-87	764070	2305393	70/230°	5.0 x 0.6 x 1.4	No
ST-88	764004	2305374	64/244°	5.0 x 0.6 x 1.4	No
ST-89	763972	2305474	74/252°	5.0 x 0.6 x 1.7	No
ST-90	763969	2305568	30/210°	5.0 x 0.6 x 1.4	No
ST-91	763969	2305684	52/232°	5.0 x 0.6 x 1.8	No
ST-92	763916	2305700	96/276°	5.0 x 0.6 x 1.4	No
ST-93	763897	2305625	100/280°	5.0 x 0.6 x 1.7	No
ST-94	763871	2305505	100/280°	5.0 x 0.6 x 1.5	No
ST-95	763869	2305403	68/248°	5.0 x 0.6 x 1.8	No
ST-96	763802	2305427	40/220°	5.0 x 0.6 x 1.0	No
ST-97	763803	2305494	60/240	5.0 x 0.6 x 1.0	No
ST-98	763800	2305568	14/194°	5.0 x 0.6 x 1.2	No
ST-99	763803	2305633	54/234°	5.0 x 0.6 x 1.4	No
ST-100	763813	2305720	150/230°	5.0 x 0.6 x 1.1	No
ST-101	764708	2305252	160/340°	7.3 x 1.3 x 1.6	No
ST-102	764692	2305245	160/340°	7.2 x 1.3 x 1.6	No
ST-103	764680	2305241	170/350°	7.2 x 1.3 x 1.8	No
ST-104	764628	2305235	70/250°	7.2 x 1.3 x 2.1	No
ST-105	764581	2305227	80/260°	7.2 x 1.3 x 2.0	No
ST-106	764541	2305223	165/345°	7.3 x 1.3 x 1.6	No
ST-107	764499	2305205	160/340°	7.2 x 1.3 x 2.0	No
ST-108	764449	2305219	100/280°	7.3 x 1.3 x 2.0	No
ST-109	764505	2305190	160/340°	7.2 x 1.3 x 2.1	No
ST-110	764553	2305195	60/240°	7.2 x 1.3 x 2.1	No

Stratigraphic Trench Number	GPS (east)	GPS (west)	Long Axis Orientation (True North)	Dimensions (meters; L x W x Max. Depth)	Cultural Material Observed in Strata
ST-111	764588	2305212	170/350°	7.2 x 1.3 x 2.0	No
ST-112	764628	2305218	70/250°	7.2 x 1.3 x 2.2	No
ST-113	764672	2305221	160/340°	7.2 x 1.3 x 1.9	No
ST-114	764706	2305220	80/260°	7.2 x 1.3 x 2.2	No
ST-115	764722	2305181	170/350°	7.2 x 1.3 x 2.0	No
ST-116	764685	2305180	80/260°	7.3 x 1.3 x 1.4	No
ST-117	764642	2305163	170/350°	7.2 x 1.3 x 1.9	No
ST-118	764585	2305145	60/240°	7.2 x 1.3 x 2.2	No
ST-119	764510	2305131	170/350°	7.2 x 1.3 x 2.4	No
ST-120	764499	2305080	80/260°	8.5 x 1.3 x 1.2	No
ST-121	764570	2305100	140/320°	7.2 x 1.3 x 2.5	No
ST-122	764627	2305112	60/240°	7.2 x 1.3 x 2.5	No
ST-123	764666	2305124	80/260°	7.2 x 1.3 x 2.4	No
ST-124	764722	2305139	80/260°	7.2 x 1.3 x 2.7	No
ST-125	764731	2305091	160/340°	7.2 x 1.3 x 2.0	No
ST-126	764667	2305067	40/220°	7.2 x 1.3 x 2.2	No
ST-127	764607	2305031	150/330°	7.2 x 1.3 x 2.2	No
ST-128	764538	2304991	60/240°	7.2 x 1.3 x 2.0	No
ST-129	764474	2304963	60/240°	7.2 x 1.3 x 2.5	No
ST-130	764470	2305010	60/240°	7.2 x 1.3 x 1.9	No
ST-131	764465	2304913	80/260°	7.2 x 1.3 x 2.2	No
ST-132	764546	2304940	150/330°	7.2 x 1.3 x 1.9	No
ST-133	764632	2304974	60/240°	7.2 x 1.3 x 1.0	No
ST-134	764733	2304978	170/350°	7.2 x 1.3 x 1.3	No
ST-135	764732	2304924	70/250°	7.2 x 1.3 x 2.0	No
ST-136	764652	2304862	160/340°	7.2 x 1.3 x 1.2	No
ST-137	764495	2304811	170/350°	7.2 x 1.3 x 2.3	No
ST-138	764550	2304723	60/240°	7.2 x 1.3 x 2.0	No
ST-139	764601	2304658	160/340°	7.3 x 1.3 x 1.6	No
ST-140	764652	2304589	160/340°	7.3 x 1.3 x 2.0	No
ST-141	764755	2304496	90/270°	7.3 x 1.3 x 2.3	No
ST-142	764738	2304565	170/350°	7.3 x 1.3 x 2.2	No
ST-143	764717	2304634	70/250°	7.3 x 1.3 x 1.9	No
ST-144	764660	2304790	80/260°	7.3 x 1.3 x 1.8	No
ST-145	764673	2304723	160/340°	7.3 x 1.3 x 2.0	No
ST-146	764775	2304667	160/340°	7.3 x 1.3 x 2.3	No
ST-147	764763	2304747	70/250°	7.3 x 1.3 x 2.5	No

Stratigraphic Trench Number	GPS (east)	GPS (west)	Long Axis Orientation (True North)	Dimensions (meters; L x W x Max. Depth)	Cultural Material Observed in Strata
ST-148	764749	2304823	160/340°	7.3 x 1.3 x 1.7	No

STRATIGRAPHY

The predominant sediment series documented on the parcel was silty clay. This is somewhat at odds with the USDA soil survey (see above) which had listed silty clay loam as the dominant series of the area. Given the generalness of the USDA survey and the fact that they did not excavate 148 trenches in the project area, the results or somewhat similar, besides the loam component. All trenches excavated for this project yielded upper levels of silty clay, all natural sediments derived from the *in situ* decomposition of igneous rock (see Appendix A). The profiles varied in depth but all silty clay strata (I through III) overlay saprolitic rock, which is decomposing bedrock. The till zone, given the sugar cane cultivation in the area for decades, was not deep, extending only into Layer I. In all, sediment homogeneity was high in the project area.

DISCUSSION AND CONCLUSION

Scientific Consultant Services, Inc. conducted Archaeological Inventory Survey for the proposed State of Hawai`i, Department of Land and Natural Resources (DLNR) Business Park over 280 acres in Pulehunui, Pūlehunui Ahupua`a, Wailuku District, Island of Maui, Hawai`i [TMK: (2) 3-8-008:001]. Both pedestrian survey and representative testing of the project area revealed the presence of a single site. Site 50-50-04-8481 consists of a Historic-period irrigation ditch associated with sugar cane cultivation. Mechanical excavation of 148 trenches did not yield any significant historic properties. All of the trenches were sterile and composed of silt and silty clay overlying saprolitic bedrock. Sugar cane harvesting of the project area occurred until very recently, as being one of the final harvests of sugar on Maui. The till zone was heavy in the upper stratigraphy, which was caused by the saprolitic bedrock being close to the surface.

Given the extent of historic and modern land use in the area, it is likely that any traditional/early historic sites that may have existed, albeit likely few in number, would have been severely impact by the industrial-level production of sugar cane. In fact, the only remnant of the project area's history is related to sugar cane cultivation.

SIGNIFICANCE ASSESSMENTS AND RECOMMENDATIONS

Site 50-50-04-8481 was assessed for significance as outlined in Hawai'i Administrative Rules §13-275-6. To be assessed as significant, a site must be characterized by one or more of the following five criteria:

a. It must be associated with events that have made a significant contribution to the broad patterns of our history, or be considered a traditional cultural property.

b. It must be associated with the lives of persons significant in the past.

c. It must embody distinctive characteristics of a type, period, or method of construction, or represent a significant and distinguishable entity whose components may lack individual distinction.

d. It must have yielded or may be likely to yield, information important in prehistory or history.

e. Have important value to native Hawaiian people or other ethnicities in the state, due to associations with cultural practices and traditional beliefs that were, or still are, carried out.

Site 50-50-04-8481 is significant under Criterion d. This Historic-era water transport channel was the only historic property identified on the large parcel. The parcel has been under sugar cane cultivation for decades. In addition, given the large number of trenches excavated across the 235-acre project area, and the lack of any cultural findings, it appears highly unlikely that there would be an inadvertent discovery of any significant historic properties during proposed land use. Thus, no further work is recommended for this project.

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APPENDIX A: STRATIGRAPHIC TRENCH INFORMATION

(Note: Sixty-Seven stratigraphic trench profiles are presented below in text, as representative of the population of 148 total trenches. Please refer to Figure 14 above for their location. Seven of the profile descriptions have accompanying trench profiles. This text is followed by 13 stratigraphic profiles from other portions of the project area.).

STRATIGRAPHIC TRENCH 1 (ST-1)

Stratigraphic Trench 1 (ST-1) (5.6 m long x 0.60 m wide x 1.6 m deep) was located on a northeast/southwest axis at 60°/240°. ST-1 contained three stratigraphic layers: Note: cmbs=centimeters below surface).

Layer I (0-48 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, silty clay. No rootlets or stones were present throughout Layer I. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (49-130 cmbs) consisted of red (2.5YR 4/8) dry, non-granular, non-plastic, loosely compacted silty clay. The stratum was structureless. No roots were present throughout Layer II. The lower boundary was clear and abrupt.

Layer III (131-160 cmbs) consisted of dusky red (7.5 YR 3/2) dry, non-plastic, saprolitic rock. The stratum was structureless. The excavation was terminated due to the instability of the soil.

STRATIGRAPHIC TRENCH 8 (ST-8)

Stratigraphic Trench 8 (ST-8) (5.0 x 0.60 x 1.6 m) was located on a northeast/southwest axis (68°/248°). ST-8 contained three stratigraphic layers.

Layer I (0-40 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, silty clay. No roots were present throughout Layer I. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (41-130 cmbs) consisted of red (2.5YR 3/8) dry, non-granular, non-plastic, loosely compacted silty clay. The stratum was structureless. No roots were present throughout Layer II. The lower boundary was clear and abrupt. The excavation was terminated due to the instability of the soil.

Layer III (131-160 cmbs) consisted of dusky red (7.5 YR 3/2) dry, non-plastic, saprolitic rock. The stratum was structureless. No Traditional or Historic artifacts were present in Layer II. The excavation was terminated due to the instability of the soil.

STRATIGRAPHIC TRENCH 9 (ST-9)

Stratigraphic Trench 9 (ST-9) (5.0 x 0.60 x 1.5 m) was located on an east/west axis (80°/260°). ST-9 contained three stratigraphic layers.

Layer I (0-49 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (50-120 cmbs) consisted of red (2.5YR 3/8) dry, non-granular, non-plastic, loosely compacted silty clay. The stratum was structureless. No roots or stones were present throughout Layer II. The lower boundary was clear and abrupt.

Layer III (121-150 cmbs) consisted of dusky red (7.5 YR 3/2) dry, non-plastic, saprolitic rock. The stratum was structureless. The excavation was terminated due to the instability of the soil.

STRATIGRAPHIC TRENCH 10 (ST-10)

Stratigraphic Trench 10 (ST-10) (5.0 x 0.60 x 1.7 m) was located on a northeast/southwest axis (60°/240°). ST-10 contained three stratigraphic layers.

Layer I (0-45 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. Layer I contained rootlets within the first 20 cmbs. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (46-120 cmbs) consisted of red (2.5YR 4/8) dry, non-granular, non-plastic, loosely compacted silty clay. The stratum was structureless. No roots or stones were present throughout Layer II. The lower boundary was clear and abrupt. No Traditional or Historic artifacts were present in Layer II.

Layer III (121-170 cmbs) consisted of dusky red (7.5 YR 3/2) dry, non-plastic, saprolitic rock. No rootlets were present in Layer III. The stratum was structureless. The excavation was terminated due to the instability of the soil.

STRATIGRAPHIC TRENCH 11 (ST-11)

Stratigraphic Trench 11 (ST-11) (5.0 x 0.60 x 0.90 m) was located on a northeast/southwest axis (60°/240°). ST-11 contained two stratigraphic layers.

Layer I (0-40 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. Layer I contained rootlets within the first 20 cmbs. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (41-90 cmbs) consisted of dusky red (7.5 YR 3/2) dry, non-plastic, saprolitic rock. No rootlets were present in Layer II. The stratum was structureless. The excavation was terminated due to the instability of the soil.

STRATIGRAPHIC TRENCH 12 (ST-12)

Stratigraphic Trench 12 (ST-12) (5.0 x 0.60 x 1.55 m) was located on a northeast/southwest axis (60°/240°). ST-12 contained three stratigraphic layers.

Layer I (0-59 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. Layer I contained rootlets within the first 20 cmbs, but contained no stones. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (60-100 cmbs) consisted of red (2.5YR 4/8) dry, non-granular, non-plastic, loosely compacted silty clay. The stratum was structureless. No roots or stones were present throughout Layer II. The lower boundary was clear and abrupt.

Layer III (101-155 cmbs) consisted of dusky red (7.5 YR 3/2) dry, non-plastic, saprolitic rock. No rootlets were present in Layer III. The stratum was structureless. The excavation was terminated due to the instability of the soil.

STRATIGRAPHIC TRENCH 14 (ST-14)

Stratigraphic Trench 14 (ST-14) (5.0 x 0.60 x 2.0 m) was located on a northeast/southwest axis (60°/240°). ST-14 contained two stratigraphic layers.

Layer I (0-73 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No rootlets or stones were present in Layer 1. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (43-140 cmbs) consisted of dusky red (2.5 YR 4/8) dry, non-plastic, saprolitic rock. No rootlets were present in Layer II. The stratum was structureless. The excavation was terminated due to the instability of the soil.

STRATIGRAPHIC TRENCH 15 (ST-15)

Stratigraphic Trench 15 (ST-15) (5.0 x 0.60 x 1.50 m) was located on a northwest/southwest axis (54°/234°). ST-15 contained three stratigraphic layers:

Layer I (0-43 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No rootlets or stones were present throughout Layer I. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (44-120 cmbs) consisted of red (2.5YR 4/8) dry, non-granular, non-plastic, loosely compacted silty clay. The stratum was structureless. No roots or stones were present throughout Layer II. The lower boundary was clear and abrupt.

Layer III (101-155 cmbs) consisted of dusky red (7.5 YR 3/2) dry, non-plastic, saprolitic rock. No rootlets were present in Layer III. The stratum was structureless. The excavation was terminated due to the instability of the soil.

STRATIGRAPHIC TRENCH 16 (ST-16)

Stratigraphic Trench 16 (ST-16) (5.0 x 0.60 x 1.6 m) was located on a northwest/southwest axis (60°/240°). ST-16 contained two stratigraphic layers.

Layer I (0-40 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No rootlets or stones were present in Layer 1. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse. No Traditional or Historic artifacts were present in Layer I.

Layer II (41-160 cmbs) consisted of strong brown (7.5 YR 4/6) dry, non-plastic, saprolitic rock. No rootlets were present in Layer II. The stratum was structureless. The excavation was terminated due to the instability of the soil.

STRATIGRAPHIC TRENCH 17 (ST-17)

Stratigraphic Trench 17 (ST-17) (5.0 x 0.60 x 1.6 m) was located on a northeast/southwest axis (70°/250°). ST-17 contained two stratigraphic layers.

Layer I (0-110 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No rootlets or stones were present in Layer 1. Layer I contained rootlets within the first 20 cmbs. Small patches of cinder were identified and mixed within the soil of Layer I. The stratum was structureless. The lower boundary was wavy and diffuse.

Layer II (111-160 cmbs) consisted of strong brown (7.5 YR 4/6) dry, non-plastic, saprolitic rock. No rootlets were present in Layer II. The stratum was structureless. The excavation was terminated due to the instability of the soil.

STRATIGRAPHIC TRENCH 18 (ST-18)

Stratigraphic Trench 18 (ST-18) (5.0 x 0.60 x 1.2 m) was located on a northeast/southwest axis (70°/250°). ST-18 contained two stratigraphic layers. Layer II contained a possible cement slab at 160 cmbs, which ended the excavation.

Layer I (0-110 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No rootlets or stones were present in Layer 1. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (111-160 cmbs) consisted of dark reddish brown (5 YR 3/4) dry, non-plastic fill. No rootlets were present in Layer II. The stratum was structureless. The excavation was terminated due to a possible cement slab that was discovered at 160 cmbs.

STRATIGRAPHIC TRENCH 19 (ST-19)

Stratigraphic Trench 19 (ST-19) (5.0 x 0.60 x 1.9 m) was located on a northeast/southwest axis (54°/234°). ST-19 contained four stratigraphic layers. Layer IV contained waterworn rock.

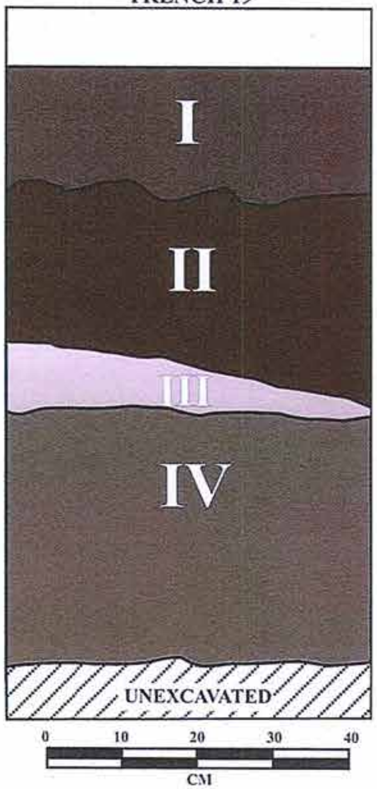
Layer I (0-60 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. Rootlets were present within the first 20 cm, but no stones were present in Layer 1. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (61-100 cmbs) consisted of dark reddish brown (5 YR 3/4) dry, non-plastic silty clay. No rootlets or stones were present in Layer II. The stratum was structureless. The lower boundary was wavy and abrupt.

Layer III (101-120 cmbs) consisted of reddish brown (5YR 4/3) mottled with white (5YR 8/1). Layer III was non-plastic, granular, silty clay. The layer contained many pebbles, and basalt water-worn stones. The lower boundary was wavy and abrupt.

Layer IV (121-190 cmbs) consisted of dark reddish brown (5 YR 3/4) dry, non-plastic silt. No rootlets were present in Layer IV, but the layer did contain a mix of cinder, pebbles, and olivine. The excavation was terminated due to the instability of the soil.

TRENCH 19



KEY

- I - LAYER I: DUSKY RED (10R 3/4, DRY) SILTY CLAY
- II - LAYER II: DARK REDDISH BROWN (5YR 3/4, DRY)SILTY CLAY
- III - LAYER III: REDDISH BROWN (5YR 4/3) SILTY CLAY MOTTLED WITH WHITE (5YR 8/1) (CRUSHED CORAL) SILTY CLAY
- IV - LAYER IV: REDDISH BROWN (5YR 4/3) SILTY CLAY

Stratigraphic Profile of ST-19

STRATIGRAPHIC TRENCH 20 (ST-20)

Stratigraphic Trench 20 (ST-20) (5.0 x 0.60 x 2.0 m) was located on a northeast/southwest axis (68°/248°). ST-20 contained three stratigraphic layers.

Layer I (0-50 cmbs) consisted of dusky red (10R) dry, non-plastic, non-granular, loosely compacted silty clay. No rootlets or stones were present throughout Layer I. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (51-120 cmbs) consisted of dark reddish brown (5 YR 3/4) dry, non-plastic silt. No rootlets or stones were present in Layer II. The lower boundary was wavy and abrupt. The stratum was structureless.

Layer III (121-200 cmbs) consisted of strong brown (7.5YR 3/4) dry, non-granular, silt. The stratum was structureless. Layer III did not contain rootlets or stones. The excavation was terminated due to the instability of the soil.

STRATIGRAPHIC TRENCH 21 (ST-21)

Stratigraphic Trench 21 (ST-21) (5.0 x 0.60 x 2.0 m) was located on a northeast/southwest axis (64°/244°). ST-21 contained four stratigraphic layers.

Layer I (0-50 cmbs) consisted of dusky red (10R) dry, non-plastic, non-granular, loosely compacted silty clay. No stones were present throughout Layer I, but the first 20 cm did contain rootlets. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (51-80 cmbs) consisted of strong brown (7.5YR 4/6) dry, non-plastic, nongranular, silt. No rootlets or stones were present in Layer II. The lower boundery was wavy and abrupt. The stratum was structureless.

Layer III (91-108 cmbs) consisted of black cinder mixed with pebbles and olivine. The stratum was structureless. Layer III did not contain rootlets.

Layer IV (109-200 cmbs) consisted of dark reddish brown (5YR 3/4) dry, non-plastic silt. No rootlets were present in Layer IV, but the layer did contain some pebbles. The excavation was terminated due to the instability of the soil.

STRATIGRAPHIC TRENCH 22 (ST-22)

Stratigraphic Trench 22 (ST-22) (5.0 x 0.60 x 1.4 m) was located on an east/west axis (90°/270°). ST-22 contained two stratigraphic layers.

Layer I (0-42 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones or rootlets were present throughout Layer I. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (43-140 cmbs) consisted of dusky red (2.5YR 4/8) dry, non-plastic, nongranular, silt. No rootlets or stones were present in Layer II. The lower boundary was wavy and abrupt. The stratum was structureless. The excavation was terminated at 140 cm due to the instability of the silt.

STRATIGRAPHIC TRENCH 23 (ST-23)

Stratigraphic Trench 23 (ST-23) (5.0 x 0.60 x 1.7 m) was located on a northeast/southwest axis (90°/270°). ST-23 contained three stratigraphic layers.

Layer I (0-80 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones were present, although rootlets were located within the first 20 cm of Layer I. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (81-130 cmbs) consisted of red (2.5YR 4/8) dry, non-plastic, compacted, nongranular, silt. No rootlets or stones were present in Layer II. The lower boundary was wavy and abrupt. The stratum was structureless. The excavation was terminated at 140 cm due to the instability of the silt.

Layer III (130-170 cmbs) consisted of strong brown (7.5YR 4/6) dry, compacted, non-plastic, nongranular, silt. No rootlets or stones were present in Layer II. The lower boundary was wavy and abrupt. The stratum was structureless. The excavation was terminated at 170 cm due to the instability of the soil.

STRATIGRAPHIC TRENCH 24 (ST-24)

Stratigraphic Trench 24 (ST-24) (5.0 x 0.60 x 1.4 m) was located on a northeast/southwest axis (58°/238°). ST-24 contained two stratigraphic layers.

Layer I (0-42 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones or rootlets were present throughout Layer I. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (43-140 cmbs) consisted of dusky red (5YR 3/4) dry, non-plastic, nongranular, compacted silt. No rootlets or stones were present in Layer II. The lower boundary was wavy and abrupt. The stratum was structureless. The excavation was terminated due to decomposing bedrock.

STRATIGRAPHIC TRENCH 25 (ST-25)

Stratigraphic Trench 25 (ST-25) (5.0 x 0.60 x .9 m) was located on a northeast/southwest axis (62°/242°). ST-25 contained two stratigraphic layers.

Layer I (0-40 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silt. No stones or rootlets were present throughout Layer I. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (41-90 cmbs) consisted of dusky red (5YR 3/4) dry, non-plastic, nongranular, compacted silt. No rootlets or stones were present in Layer II. The lower boundary was wavy and abrupt. The stratum was structureless. The excavation was terminated at 140 cm due to decomposing bedrock.

STRATIGRAPHIC TRENCH 26 (ST-26)

Stratigraphic Trench 26 (ST-26) (5.0 x 0.60 x .9 m) was located on a northeast/southwest axis (56°/236°). ST-25 contained two stratigraphic layers.

Layer I (0-42 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones or rootlets were present throughout Layer I. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (43-140 cmbs) consisted of dusky red (5YR 3/4) dry, non-plastic, nongranular, compacted silty clay. No rootlets or stones were present in Layer II. The lower boundary was wavy and abrupt. The stratum was structureless. The excavation was terminated due to decomposing bedrock.

STRATIGRAPHIC TRENCH 27 (ST-27)

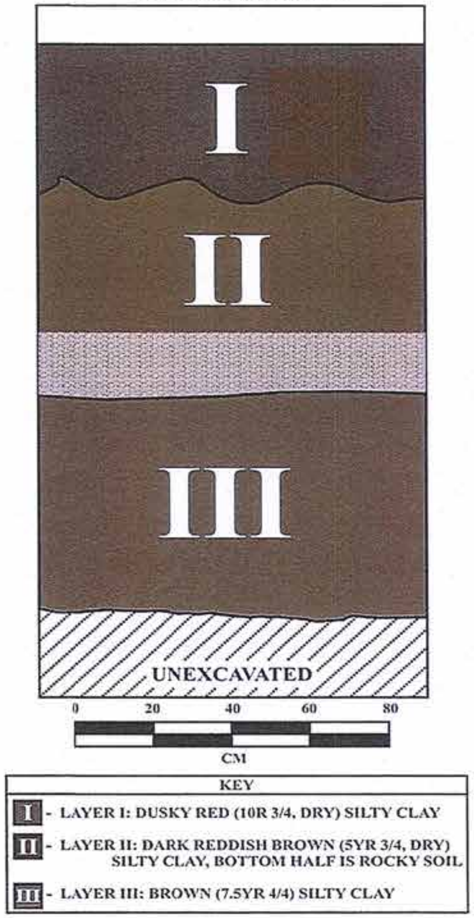
Stratigraphic Trench 27 (ST-27) (5.0 x 0.60 x 1.6 m) was located on a northeast/southwest axis (70°/250°). ST-27 contained three stratigraphic layers.

Layer I (0-40 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones present, but rootlets were contained in the first 20 cm of Layer I. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (41-100 cmbs) consisted of strong brown (7.5YR 4/6) dry, compacted, non-plastic, nongranular, silty clay. No rootlets were present in Layer II. Stones were present in the last 20 cm of Layer II. The lower boundary was wavy and abrupt.

Layer III (101-160) consisted of brown (7.5YR 4/4) dry, non-plastic, nongranular, loosely compacted silty clay. No rootlets or stones were present in Layer III. The lower boundary was wavy and abrupt. The stratum was structureless. The excavation was terminated due to encountered bedrock.

TRENCH 27 PROFILE



Stratigraphic Profile of ST-27

STRATIGRAPHIC TRENCH 28 (ST-28)

Stratigraphic Trench 28 (ST-28) (5.0 x 0.60 x 1.9 m) was located on a northeast/southwest axis 68°/248°). ST-28 contained three stratigraphic layers.

Layer I (0-38 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones or rootlets were present throughout Layer I. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (39-60 cmbs) consisted of multiple small waterworn pebbles. The lower boundary was wavy and abrupt.

Layer III (61-190) consisted of brown (7.5YR 4/4) dry, non-plastic, cinder mixed with course, granular sand. No rootlets were present in Layer III. The lower boundary was wavy and abrupt. The stratum was structureless. The excavation was terminated due to the instability of the soil.

STRATIGRAPHIC TRENCH 29 (ST-29)

Stratigraphic Trench 29 (ST-29) (5.0 x 0.60 x 1.8 m) was located on a northeast/southwest axis (70°/250°). ST-29 contained three stratigraphic layers.

Layer I (0-40 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones or rootlets were present throughout of Layer I. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (41-80 cmbs) consisted of strong brown (5YR 3/4) dry, loosely compacted, non-plastic, nongranular, silt. No rootlets or stones were present in Layer II. The lower boundary was wavy and abrupt.

Layer III (81-180) consisted of strong brown (7.5YR 4/6) dry, non-plastic, nongranular, loosely compacted silty clay. No rootlets or stones were present in Layer III. The lower boundary was wavy and abrupt. The stratum was structureless. The excavation was terminated due to encountered bedrock.

STRATIGRAPHIC TRENCH 30 (ST-30)

Stratigraphic Trench 30 (ST-30) (5.0 x 0.60 x 1.2 m) was located on a northeast/southwest axis (70°/250°). ST-30 contained three stratigraphic layers.

Layer I (0-40 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones or rootlets were present throughout of Layer I. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (41-61 cmbs) consisted of strong brown (7.5YR 4/6) dry, loosely compacted, non-plastic, granular, saprolitic rock. No rootlets were present in Layer II. The lower boundary was wavy and abrupt.

Layer III (62-120) consisted of dark reddish brown (5YR 3/4) dry, non-plastic, nongranular, loosely compacted silty clay. No rootlets or stones were present in Layer III. The lower boundary was wavy and abrupt. The stratum was structureless. The excavation was terminated due to decomposing bedrock.

STRATIGRAPHIC TRENCH 31 (ST-31)

Stratigraphic Trench 31 (ST-31) (5.0 x 0.60 x 1.8 m) was located on a northeast/southwest axis (68°/248°). ST-31 contained two stratigraphic layers.

Layer I (0-63 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones or rootlets were present throughout Layer I. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (64-180 cmbs) consisted of dark yellowish brown (10R 3/6) dry, non-plastic, nongranular, compacted silty clay. No rootlets or stones were present in Layer II. The lower boundary was wavy and abrupt. The stratum was structureless. Excavation was terminated at 180 cmbs due to decomposing bedrock.

STRATIGRAPHIC TRENCH 32 (ST-32)

Stratigraphic Trench 32 (ST-32) (5.0 x 0.60 x 1.6 m) was located on a east/west axis (78°/264°). ST-32 contained three stratigraphic layers.

Layer I (0-50 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones or rootlets were present throughout Layer I. The stratum had been previously tilled and was structureless. The lower boundary was clear and abrupt.

Layer II (51-110 cmbs) consisted of dark reddish brown (5YR 3/4) dry, loosely compacted, semi-plastic silt. No rootlets or stones were present in Layer II. The lower boundary was wavy and abrupt.

Layer III (111-160) consisted of strong brown (7.5YR 4/6) dry, non-plastic, nongranular, loosely compacted silt. No rootlets or stones were present in Layer III. The stratum was structureless. The excavation was terminated due to the presence of decomposing bedrock.

STRATIGRAPHIC TRENCH 33 (ST-33)

Stratigraphic Trench 33 (ST-33) (5.0 x 0.60 x 1.8 m) was located on a northeast/southwest axis (70°/250°). ST-33 contained two stratigraphic layers.

Layer I (0-45 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones or rootlets were present throughout Layer I. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (46-180 cmbs) consisted of strong brown (7.5YR 4/6) dry, non-plastic, nongranular, loosely compacted silty clay. No rootlets or stones were present in Layer II. The stratum was structureless. The excavation was terminated due to instability of the soil.

STRATIGRAPHIC TRENCH 34 (ST-34)

Stratigraphic Trench 33 (ST-34) (5.0 x 0.60 x 1.7 m) was located on a northeast/southwest axis (70°/250°). ST-34 contained two stratigraphic layers.

Layer I (0-45 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. Stones and rootlets were present within the first 20 cm of Layer I. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (46-170 cmbs) consisted of strong brown (7.5YR 4/6) dry, non-plastic, nongranular, loosely compacted silty clay. No rootlets were present in Layer II. Scattered stones were present throughout the layer. The stratum was structureless. The excavation was terminated due to instability of the soil.

STRATIGRAPHIC TRENCH 35 (ST-35)

Stratigraphic Trench 35 (ST-35) (5.0 x 0.60 x 1.7 m) was located on a northeast/southwest axis (70°/250°). ST-35 contained four stratigraphic layers.

Layer I (0-40 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. Rootlets were present within the first 20 cm, but no stones were present in Layer 1. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (41-70 cmbs) consisted of strong brown (7.5YR 4/6) dry, non-plastic, nongranular, loosely compacted silty clay. No stones or rootlets were present in Layer II. The stratum was structureless. The lower boundary was clear and abrupt.

Layer III (70-80 cmbs) consisted of reddish gray (2.5YR 5/1) dry, non-plastic, non-granular silty clay. Layer III contained no rootlets or stones. The lower boundary was clear and abrupt.

Layer IV (81-170 cmbs) consisted of dark reddish brown (5 YR 3/4) dry, non-plastic loosely compacted silt. No rootlets or stones were present in Layer IV. The excavation was terminated due to the instability of the soil.

STRATIGRAPHIC TRENCH 36 (ST-36)

Stratigraphic Trench 36 (ST-26) (5.0 x 0.60 x 1.9 m) was located on a northwest/southeast axis (340°/160°). ST-36 contained two stratigraphic layers.

Layer I (0-41 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones were present throughout Layer I. Rootlets were present within the first 20 cm of the stratum. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (42-190 cmbs) consisted of dark reddish brown (5YR 3/4) dry, non-plastic, nongranular, densely compacted silty clay. No rootlets were present in Layer II. Stones were scattered throughout the stratum. Layer II was structureless. The excavation was terminated due to decomposing bedrock.

STRATIGRAPHIC TRENCH 37 (ST-37)

Stratigraphic Trench 37 (ST-37) (5.0 x 0.60 x 1.9 m) was located on a north/south axis (170°/350°). ST-37 contained two stratigraphic layers.

Layer I (0-42 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No rootlets or stones were present throughout Layer I. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (43-190 cmbs) consisted of red (2.5YR 4/8) dry, non-plastic, nongranular, densely compacted silty clay. No stones or rootlets were present in Layer II. Layer II was structureless. The excavation was terminated due to the instability of the soil.

STRATIGRAPHIC TRENCH 38 (ST-38)

Stratigraphic Trench 38 (ST-38) (5.0 x 0.60 x 1.7 m) was located on a north/south axis (20°/200°). ST-38 contained two stratigraphic layers.

Layer I (0-39 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. Rootlets were present throughout the first 20 cm, but no stones were present throughout Layer I. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (40-170 cmbs) consisted of red (2.5YR 4/8) dry, non-plastic, nongranular, densely compacted silty clay. No stones or rootlets were present in Layer II. Layer II was structureless. The excavation was terminated due to the instability of the soil.

STRATIGRAPHIC TRENCH 39 (ST-39)

Stratigraphic Trench 39 (ST-39) (5.0 x 0.60 x 1.5 m) was located on a southeast/northwest axis (156°/336°). ST-39 contained two stratigraphic layers.

Layer I (0-40 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No rootlets or stones were present throughout Layer I. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (43-150 cmbs) consisted of red (2.5YR 4/8) dry, non-plastic, nongranular, densely compacted silty clay. No stones or rootlets were present in Layer II. The stratum was structureless. The excavation was terminated due to the instability of the soil.

STRATIGRAPHIC TRENCH 40 (ST-40)

Stratigraphic Trench 40 (ST-40) (5.0 x 0.60 x 1.8 m) was located on a north/south axis (170°/350°). ST-40 contained two stratigraphic layers.

Layer I (0-44 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No rootlets or stones were present throughout Layer I. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (45-180 cmbs) consisted of red (2.5YR 4/8) dry, non-plastic, nongranular, densely compacted silty clay. No rootlets or stones were present in Layer II. Layer II was structureless. The excavation was terminated due to the instability of the soil.

STRATIGRAPHIC TRENCH 41 (ST-41)

Stratigraphic Trench 41 (ST-41) (5.0 x 0.60 x 1.8 m) was located on a east/west axis (92°/272°). ST-41 contained two stratigraphic layers.

Layer I (0-49 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No rootlets or stones were present throughout Layer I. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

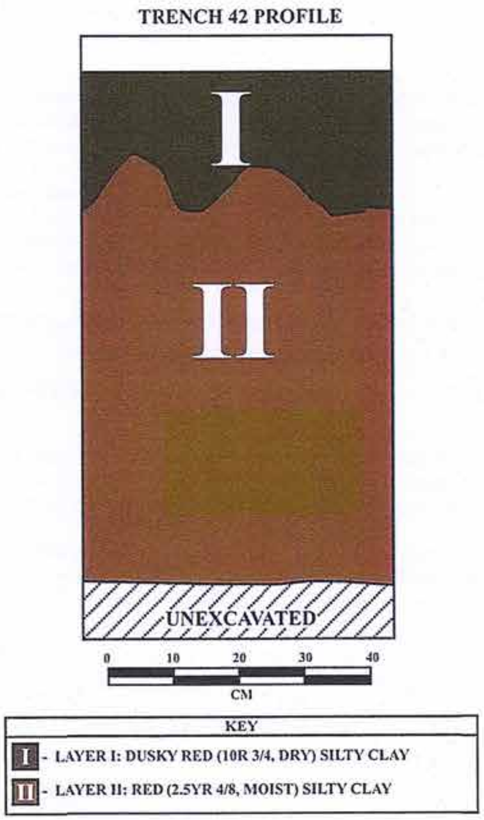
Layer II (50-180 cmbs) consisted of red (2.5YR 4/8) dry, non-plastic, nongranular, densely compacted silty clay. No rootlets were present in Layer II, but the stratum was motted with saprolitic rock.. Layer II was structureless. The excavation was terminated due to the instability of the soil.

STRATIGRAPHIC TRENCH 42 (ST-42)

Stratigraphic Trench 42 (ST-42) (5.0 x 0.60 x 1.6 m) was located on a northeast/southwest axis (30°/210°). ST-42 contained two stratigraphic layers.

Layer I (0-44 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones were present, although rootlets were located within the first 20 cm of Layer I. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (45-160 cmbs) consisted of red (2.5YR 4/8) moist, non-plastic, non-granular, densely compacted silty clay. No rootlets or stones were present in Layer II. Layer II was structureless. The excavation was terminated due to the instability of the soil.



Stratigraphic Profile of ST-42

STRATIGRAPHIC TRENCH 43 (ST-43)

Stratigraphic Trench 43 (ST-43) (5.0 x 0.60 x 1.1 m) was located on a northeast/southwest axis (58°/238°). ST-43 contained three stratigraphic layers.

Layer I (0-40 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones or rootlets were present throughout Layer I. The stratum had been previously tilled and was structureless. The lower boundary was clear and abrupt.

Layer II (41-81 cmbs) consisted of dark reddish brown (5YR 3/4) dry, loosely compacted, semi-plastic silty clay. No rootlets or stones were present in Layer II. The lower boundary was wavy and abrupt.

Layer III (82-110) consisted of strong brown (7.5YR 4/6) dry, non-plastic, nongranular, loosely compacted silty clay. No rootlets or stones were present in Layer III. The stratum was structureless. The excavation was terminated due to decomposing bedrock.

STRATIGRAPHIC TRENCH 44 (ST-44)

Stratigraphic Trench 44 (ST-44) (5.0 x 0.60 x 1.4 m) was located on a northeast/southwest axis (58°/238°). ST-44 contained three stratigraphic layers.

Layer I (0-40 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones were present throughout Layer I. The first 20 cm contained rootlets. The stratum had been previously tilled and was structureless. The lower boundary was clear and abrupt.

Layer II (41-110 cmbs) consisted of dark reddish brown (5YR 3/4) dry, densely compacted, semi-plastic silty clay. No rootlets or stones were present in Layer II. The lower boundary was wavy and abrupt.

Layer III (82-110) consisted of strong brown (7.5YR 4/6) dry, non-plastic, nongranular, densely compacted silty clay. No rootlets or stones were present in Layer III. The stratum was structureless. The excavation was terminated due to decomposing bedrock.

STRATIGRAPHIC TRENCH 45 (ST-45)

Stratigraphic Trench 45 (ST-45) (5.0 x 0.60 x 1.7 m) was located on a north/south axis (22°/202°). ST-45 contained two stratigraphic layers.

Layer I (0-38 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No rootlets were present. Stones were scattered throughout Layer I. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (39-170 cmbs) consisted of strong brown (7.5YR 4/6) moist, non-plastic, nongranular, densely compacted silty clay. No rootlets or stones were present in Layer II. Layer II was structureless. The excavation was terminated due to the instability of the soil.

STRATIGRAPHIC TRENCH 46 (ST-46)

Stratigraphic Trench 46 (ST-46) (5.0 x 0.60 x 1.3 m) was located on a north/south axis (10°/190°). ST-46 contained three stratigraphic layers.

Layer I (0-22 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones were present throughout Layer I. The first 20 cm contained rootlets. The stratum had been previously tilled and was structureless. The lower boundary was clear and abrupt.

Layer II (23-80 cmbs) consisted of dark reddish brown (5YR 3/4) dry, densely compacted, semi-plastic silty clay. No rootlets or stones were present in Layer II. The lower boundary was clear and abrupt.

Layer III (81-130) consisted of strong brown (7.5YR 4/6) dry, non-plastic, nongranular, densely compacted silty clay. No rootlets or stones were present in Layer III. The stratum was structureless. The excavation was terminated due to decomposing bedrock.

STRATIGRAPHIC TRENCH 47 (ST-47)

Stratigraphic Trench 47 (ST-47) (5.0 x 0.60 x 1.0 m) was located on an east/west axis (90°/270°). ST-47 contained three stratigraphic layers.

Layer I (0-30 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones were present throughout Layer I. The first 20 cm contained rootlets. The stratum had been previously tilled and was structureless. The lower boundary was wavy and abrupt.

Layer II (31-46 cmbs) consisted of dark reddish brown (5YR 3/4) dry, densely compacted, non-plastic silty clay. No rootlets or stones were present in Layer II. The lower boundary was clear and abrupt.

Layer III (47-100) consisted of strong brown (7.5YR 4/6) dry, non-plastic, nongranular, densely compacted silty clay. No rootlets or stones were present in Layer III. The stratum was structureless. The excavation was terminated due to decomposing bedrock.

STRATIGRAPHIC TRENCH 48 (ST-48)

Stratigraphic Trench 48 (ST-48) (5.0 x 0.60 x 1.6 m) was located on a southeast/northwest axis (130°/310°). ST-48 contained two stratigraphic layers.

Layer I (0-50 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones were present, although rootlets were located within the first 20 cm of Layer I. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (51-160 cmbs) consisted of red (2.5YR 4/8) moist, non-plastic, nongranular, densely compacted silty clay. No rootlets or stones were present in Layer II. Layer II was structureless. The excavation was terminated due to the instability of the soil.

STRATIGRAPHIC TRENCH 49 (ST-49)

Stratigraphic Trench 49 (ST-49) (5.0 x 0.60 x 1.5 m) was located on a southeast/northwest axis (130°/310°). ST-49 contained two stratigraphic layers.

Layer I (0-47 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones or rootlets were present within Layer I. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (48-150 cmbs) consisted of red (2.5YR 4/8) moist, non-plastic, nongranular, densely compacted silty clay. No rootlets or stones were present in Layer II. Layer II was structureless. The excavation was terminated due to the instability of the soil.

STRATIGRAPHIC TRENCH 50 (ST-50)

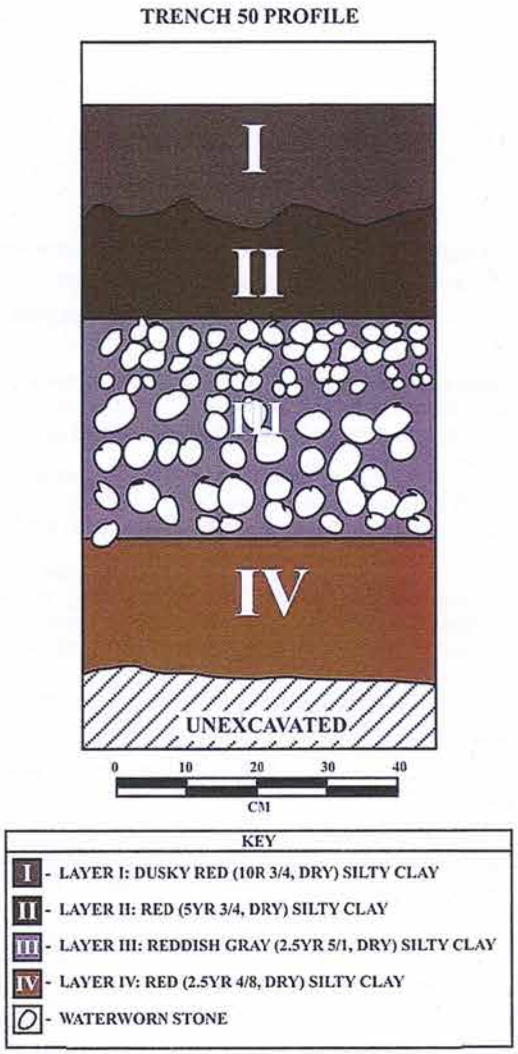
Stratigraphic Trench 50 (ST-50) (5.0 x 0.60 x 1.6 m) was located on a west/east axis (270°/90°). ST-50 contained four stratigraphic layers.

Layer I (0-30 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. Rootlets were present within the first 20 cm, but no stones were present throughout Layer I. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (31-56 cmbs) consisted of dark reddish brown (5YR 3/4) dry, non-plastic, nongranular, loosely compacted silty clay. No stones or rootlets were present in Layer II. The stratum was structureless. The lower boundary was clear and abrupt.

Layer III (57-120 cmbs) consisted of reddish gray (2.5YR 5/1) dry, non-plastic, non-granular silty clay mixed with large water worn stones and pebbles. Layer III contained no rootlets. The lower boundary was clear and abrupt.

Layer IV (121-160 cmbs) consisted of dark reddish brown (5 YR 3/4) dry, non-plastic loosely compacted silty clay. No rootlets or stones were present in Layer IV. The excavation was terminated due to the decomposing bedrock.



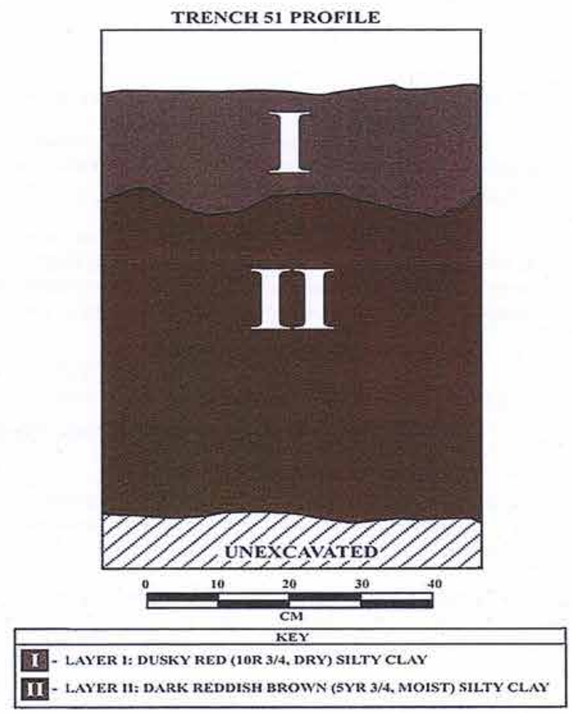
Stratigraphic Profile of ST-50

STRATIGRAPHIC TRENCH 51 (ST-51)

Stratigraphic Trench 51 (ST-51) (5.0 x 0.60 x 1.6 m) was located on a northeast/southwest axis (38°/218°). ST-51 contained two stratigraphic layers.

Layer I (0-40 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones or rootlets were present within Layer I. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (41-160 cmbs) consisted of dark reddish brown (5YR 3/4) moist, non-plastic, non-granular, densely compacted silty clay. No rootlets or stones were present in Layer II. Layer II was structureless. The excavation was terminated due to the instability of the soil.



Stratigraphic Profile of ST-51

STRATIGRAPHIC TRENCH 52 (ST-52)

Stratigraphic Trench 52 (ST-52) (5.0 x 0.60 x 1.4 m) was located on a northeast/southwest axis (50°/230°). ST-52 contained two stratigraphic layers.

Layer I (0-40 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones were present within Layer I. The first 20 cm of the stratum contained rootlets. The stratum had been previously tilled (sugar cane) and was structureless. The lower boundary was wavy and diffuse.

Layer II (41-140 cmbs) consisted of dark reddish brown (5YR 3/4) dry, non-plastic, non-granular, densely compacted silty clay. No rootlets or stones were present in Layer II. Layer II was structureless. The excavation was terminated due large amounts of basalt boulders and bedrock.

STRATIGRAPHIC TRENCH 53 (ST-53)

Stratigraphic Trench 53 (ST-53) (5.0 x 0.60 x 1.6 m) was located on a east/west axis (100°/290°). ST-53 contained three stratigraphic layers.

Layer I (0-44 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones or rootlets were present throughout Layer I. The stratum had been previously tilled and was structureless. The lower boundary was wavy and abrupt.

Layer II (45-95 cmbs) consisted of dark reddish brown (5YR 3/4) dry, densely compacted, non-plastic silty clay. No rootlets or stones were present in Layer II. The lower boundary was clear and abrupt.

Layer III (96-160) consisted of strong brown (7.5YR 4/6) dry, non-plastic, non-granular, densely compacted silty clay that contained large amounts of stones. No rootlets were present in Layer III. The stratum was structureless. The excavation was terminated due to basalt boulders and bedrock.

STRATIGRAPHIC TRENCH 54 (ST-54)

Stratigraphic Trench 54 (ST-54) (5.0 x 0.60 x 1.8 m) was located on a northeast/southwest axis (50°/230°). ST-54 contained two stratigraphic layers.

Layer I (0-76 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones were present within Layer I. The first 20 cm of the stratum contained rootlets. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (77-180 cmbs) consisted of dark reddish brown (5YR 3/4) dry, non-plastic, non-granular, densely compacted silt. No rootlets or stones were present in Layer II. Layer II was structureless. The excavation was terminated due to decomposing bedrock.

STRATIGRAPHIC TRENCH 55 (ST-55)

Stratigraphic Trench 55 (ST-55) (5.0 x 0.60 x 1.6 m) was located on a southwest/northeast axis (110°/290°). ST-55 contained two stratigraphic layers.

Layer I (0-44 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones or rootlets were present within Layer I. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (45-160 cmbs) consisted of dark reddish brown (5YR 3/4) dry, non-plastic, non-granular, densely compacted silty clay. No rootlets or stones were present in Layer II. Layer II was structureless. The excavation was terminated due to decomposing bedrock.

STRATIGRAPHIC TRENCH 56 (ST-56)

Stratigraphic Trench 56 (ST-56) (5.0 x 0.60 x 1.8 m) was located on a northeast/southwest axis (18°/198°). ST-56 contained four stratigraphic layers.

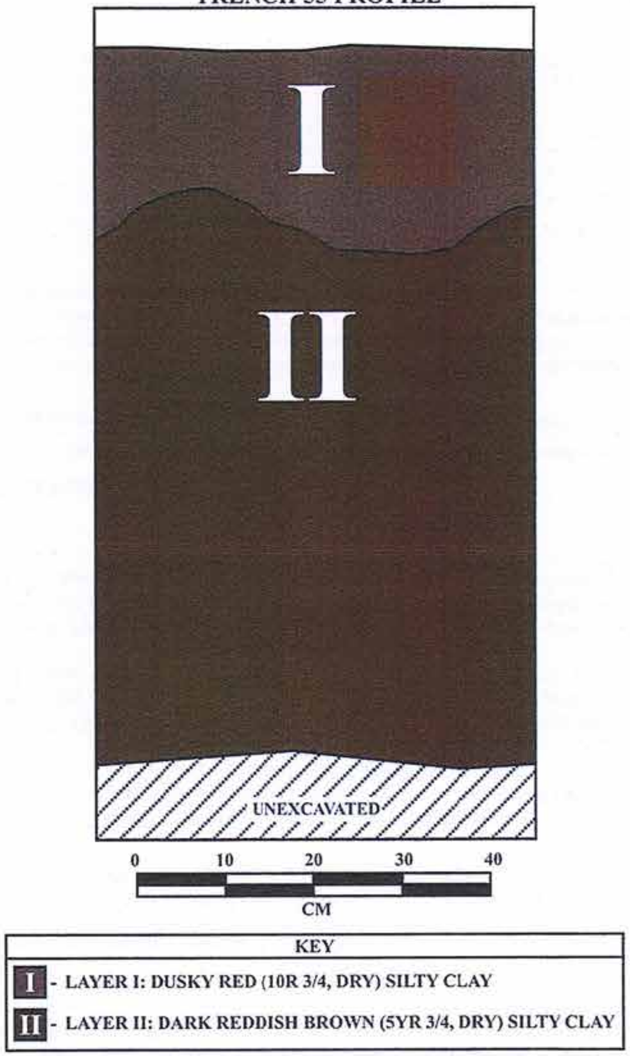
Layer I (0-47 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. Rootlets were present within the first 20 cm, but no stones were present throughout Layer I. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (48-80 cmbs) consisted of dark reddish brown (5YR 3/4) dry, non-plastic, nongranular, loosely compacted silty clay. No rootlets were present, but Layer II did contain waterworn stones. The stratum was structureless. The lower boundary was clear and abrupt.

Layer III (81-96 cmbs) consisted of reddish gray (2.5YR 5/1) dry, non-plastic, non-granular silty clay containing cinder. Layer III contained no rootlets. The lower boundary was clear and abrupt.

Layer IV (97-180 cmbs) consisted of dark reddish brown (5 YR 3/4) dry, non-plastic loosely compacted silty clay. No rootlets or stones were present in Layer IV. The excavation was terminated due to the decomposing bedrock.

TRENCH 55 PROFILE



Stratigraphic Profile of ST-55

STRATIGRAPHIC TRENCH 57 (ST-57)

Stratigraphic Trench 57 (ST-57) (5.0 x 0.60 x 1.8 m) was located on a southeast/northwest axis (118°/298°). ST-57 contained three stratigraphic layers.

Layer I (0-38 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones or rootlets were present throughout Layer I. The stratum had been previously tilled and was structureless. The lower boundary was wavy and abrupt.

Layer II (39-119 cmbs) consisted of consisted of reddish gray (2.5YR 5/1) dry, non-plastic, nongranular, loosely compacted silty clay. No rootlets were present, but Layer II did contain waterworn stones and cinder. The stratum was structureless. The lower boundary was clear and abrupt.

Layer III (120-180) consisted of dark reddish brown (5YR 3/4) dry, non-plastic, nongranular, densely compacted silty clay. No rootlets or stones were present in Layer III. The stratum was structureless. The excavation was terminated due to the instability of the soil.

STRATIGRAPHIC TRENCH 58 (ST-58)

Stratigraphic Trench 58 (ST-58) (5.0 x .60 x 1.8 m) was located on a northeast/southwest axis (36°/216°). ST-58 contained three stratigraphic layers.

Layer I (0-40 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones were present throughout Layer I, but the first 20 cm contained rootlets. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (40-120 cmbs) consisted of dark reddish brown (5YR 3/4) dry, non-plastic, nongranular, densely compacted silty clay. No rootlets or stones were present in Layer II. The stratum was structureless. The lower boundary was clear and abrupt.

Layer III (121-180) consisted of consisted of reddish gray (2.5YR 5/1) dry, non-plastic, nongranular, loosely compacted silty clay containing saprolitic rock. No rootlets were present. The stratum was structureless. The excavation was terminated due to the instability of the soil.

STRATIGRAPHIC TRENCH 59 (ST-59)

Stratigraphic Trench 59 (ST-59) (5.0 x 0.60 x 1.6 m) was located on a northeast/southwest axis (14°/194°). ST-59 contained three stratigraphic layers.

Layer I (0-61 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones or rootlets were present throughout Layer I. The stratum had been previously tilled and was structureless. The lower boundary was wavy and abrupt.

Layer II (62-120 cmbs) consisted of dark reddish brown (5YR 3/4) dry, densely compacted, non-plastic silty clay. No rootlets or stones were present in Layer II. The lower boundary was clear and abrupt.

Layer III (121-180) consisted of weak red (2.5YR 5/2) dry, non-plastic, non-granular, densely compacted silt that contained saprolitic rock. No rootlets were present in Layer III. The stratum was structureless. The excavation was terminated due to the instability of the soil.

STRATIGRAPHIC TRENCH 60 (ST-60)

Stratigraphic Trench 60 (ST-60) (5.0 x 0.60 x 1.6 m) was located on a north/south axis (14°/194°). ST-60 contained two stratigraphic layers.

Layer I (0-60 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones were present within Layer I. The top 20 cm of Layer I contained rootlets. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (61-160 cmbs) consisted of dark reddish brown (5YR 3/4) dry, non-plastic, non-granular, densely compacted saprolitic rock. No rootlets were present in Layer II. Layer II was structureless. The excavation was terminated due to decomposing bedrock.

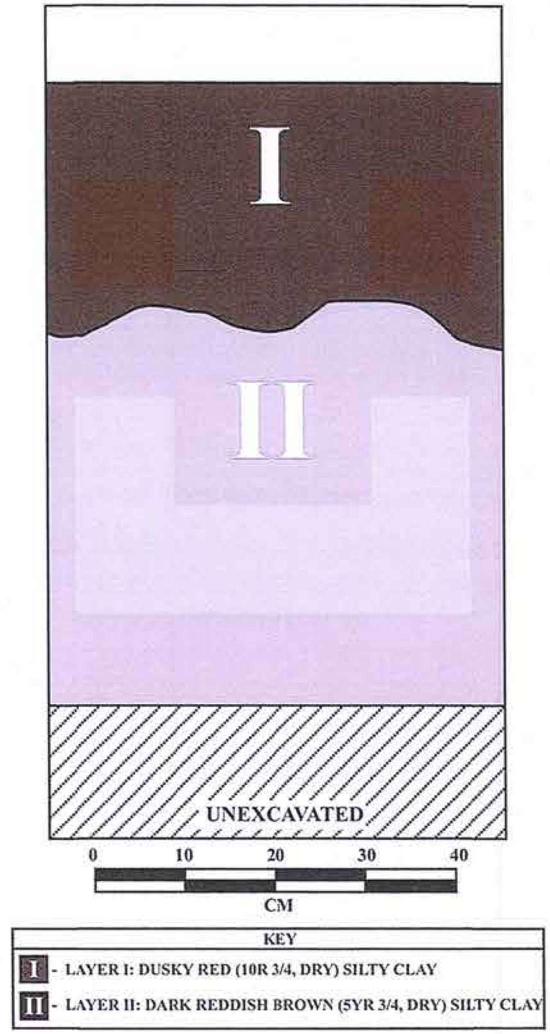
STRATIGRAPHIC TRENCH 61 (ST-61)

Stratigraphic Trench 61 (ST-61) (5.0 x 0.60 x 1.4 m) was located on an east/west axis (92°/272°). ST-61 contained two stratigraphic layers.

Layer I (0-60 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. Stones were present between 50-60 cmbs. The top 20 cm of Layer I contained rootlets. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (61-160 cmbs) consisted of dark reddish brown (5YR 3/4) dry, non-plastic, non-granular, densely compacted silty clay. No rootlets or stones were present in Layer II. Layer II was structureless. The excavation was terminated due to instability of the soil.

TRENCH 60 PROFILE



Stratigraphic Profile of ST-60

STRATIGRAPHIC TRENCH 62 (ST-62)

Stratigraphic Trench 62 (ST-62) (5.0 x 0.60 x .90 m) was located on a northeast/southwest axis (45°/225°). ST-62 contained two stratigraphic layers.

Layer I (0-45 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones were present within Layer I. The top 20 cm of Layer I contained rootlets. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (46-90 cmbs) consisted of dark reddish brown (5YR 3/4) dry, non-plastic, non-granular, densely compacted saprolitic rock. No rootlets were present in Layer II. Layer II was structureless. The excavation was terminated due to encountered bedrock.

STRATIGRAPHIC TRENCH 63 (ST-63)

Stratigraphic Trench 63 (ST-63) (5.0 x 0.60 x 1.6 m) was located on a northeast/southwest axis (70°/250°). ST-63 contained two stratigraphic layers.

Layer I (0-71 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones were present in Layer I. The top 20 cm of Layer I contained rootlets. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (72-160 cmbs) consisted of dark reddish brown (5YR 3/4) dry, non-plastic, non-granular, densely compacted silty clay. No rootlets or stones were present in Layer II. The stratum was structureless. The excavation was terminated due to instability of the soil.

STRATIGRAPHIC TRENCH 64 (ST-64)

Stratigraphic Trench 64 (ST-64) (5.0 x 0.60 x 1.3 m) was located on a northeast/southwest axis (60°/240°). ST-64 contained two stratigraphic layers.

Layer I (0-30 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones were present in Layer I. The top 20 cm of Layer I contained rootlets. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (31-130 cmbs) consisted of dark reddish brown (5YR 3/4) dry, non-plastic, non-granular, densely compacted silty clay. No rootlets were present in Layer II. Layer II contained stones and saprolitic rock. The stratum was structureless. The excavation was terminated due to encountered bedrock.

STRATIGRAPHIC TRENCH 65 (ST-65)

Stratigraphic Trench 65 (ST-65) (5.0 x 0.60 x 1.4 m) was located on an east/west axis (96°/276°). ST-65 contained two stratigraphic layers.

Layer I (0-42 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones were present in Layer I. The top 20 cm of Layer I contained rootlets. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (43-140 cmbs) consisted of dark reddish brown (5YR 3/4) dry, non-plastic, non-granular, densely compacted silty clay. No rootlets or stones were present in Layer II. The stratum was structureless. The excavation was terminated due to the instability of the soil.

STRATIGRAPHIC TRENCH 66 (ST-66)

Stratigraphic Trench 66 (ST-66) (5.0 x 0.60 x 1.5 m) was located on a northeast/southwest axis (60°/240°). ST-66 contained two stratigraphic layers.

Layer I (0-42 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones or rootlets were present in Layer I. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

Layer II (43-140 cmbs) consisted of dark reddish brown (5YR 3/4) dry, non-plastic, non-granular, densely compacted silty clay. No rootlets or stones were present in Layer II. The stratum was structureless. The excavation was terminated due to the instability of the soil.

STRATIGRAPHIC TRENCH 67 (ST-67)

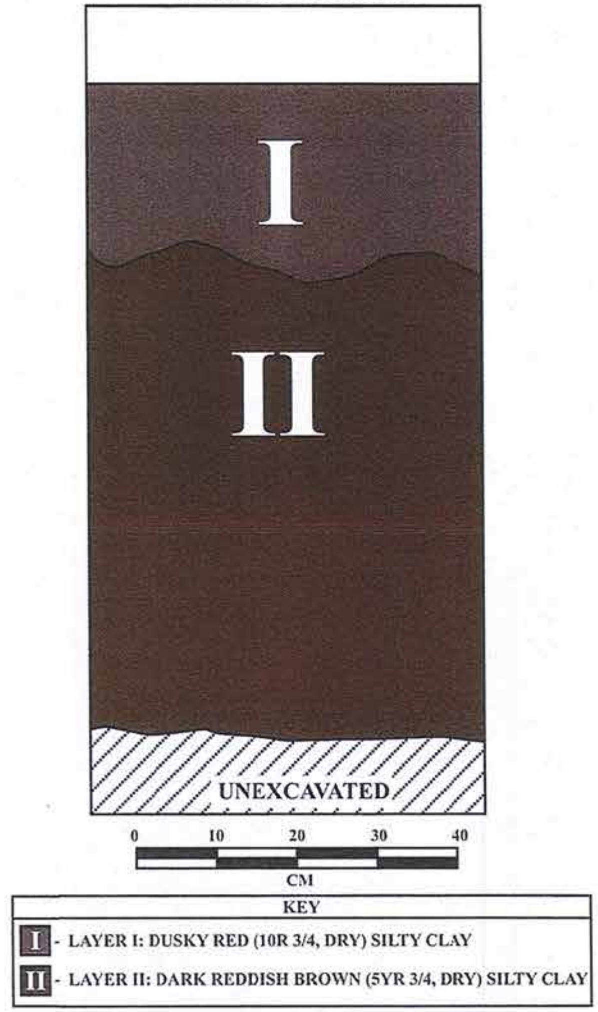
Stratigraphic Trench 67 (ST-67) (5.0 x 0.60 x 1.5 m) was located on a northeast/southwest axis (50°/230°). ST-67 contained two stratigraphic layers.

Layer I (0-49 cmbs) consisted of dusky red (10R 3/4) dry, non-plastic, non-granular, loosely compacted silty clay. No stones were present in Layer I. Rootlets were present 0-20 cmbs. The stratum had been previously tilled and was structureless. The lower boundary was wavy and diffuse.

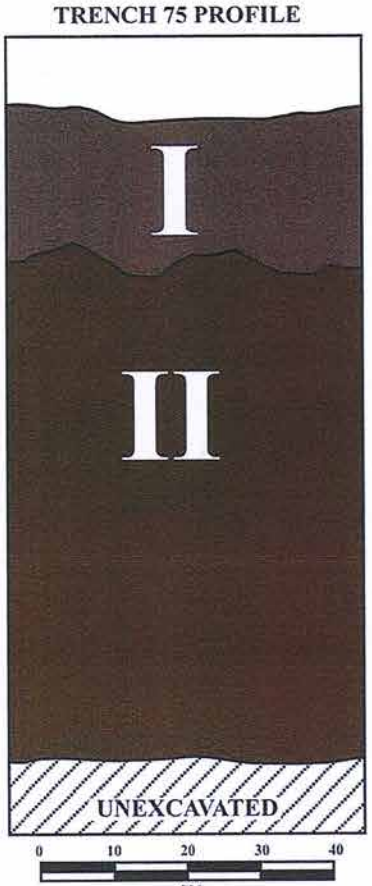
Layer II (50-150 cmbs) consisted of dark reddish brown (5YR 3/4) dry, non-plastic, non-granular, densely compacted silty clay. No rootlets or stones were present in Layer II. The stratum was structureless. The excavation was terminated due to the instability of the soil.

APPENDIX B: ADDITIONAL REPRESENTATIVE SOIL PROFILES

TRENCH 69 PROFILE

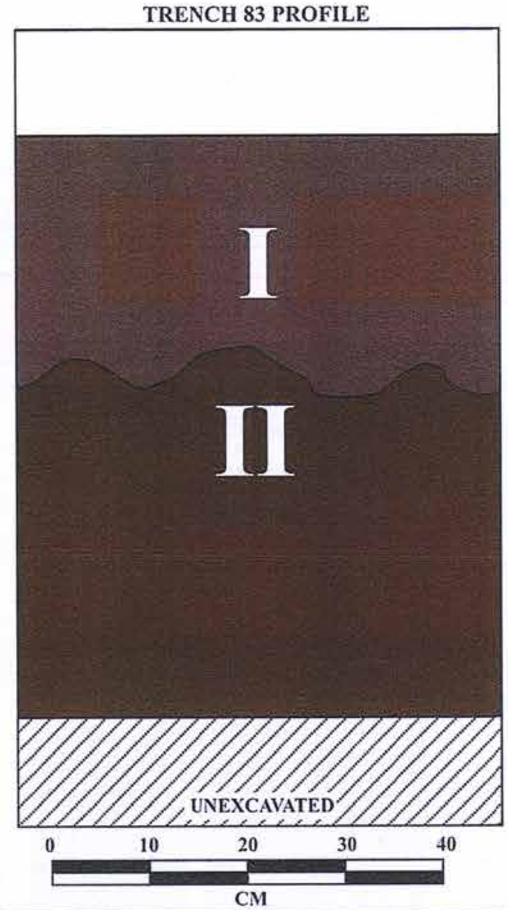


Stratigraphic Profile of ST-69



KEY
I - LAYER I: DUSKY RED (10R 3/4, DRY) SILTY CLAY
II - LAYER II: DARK REDDISH BROWN (5YR 3/4, MOIST) SILTY CLAY

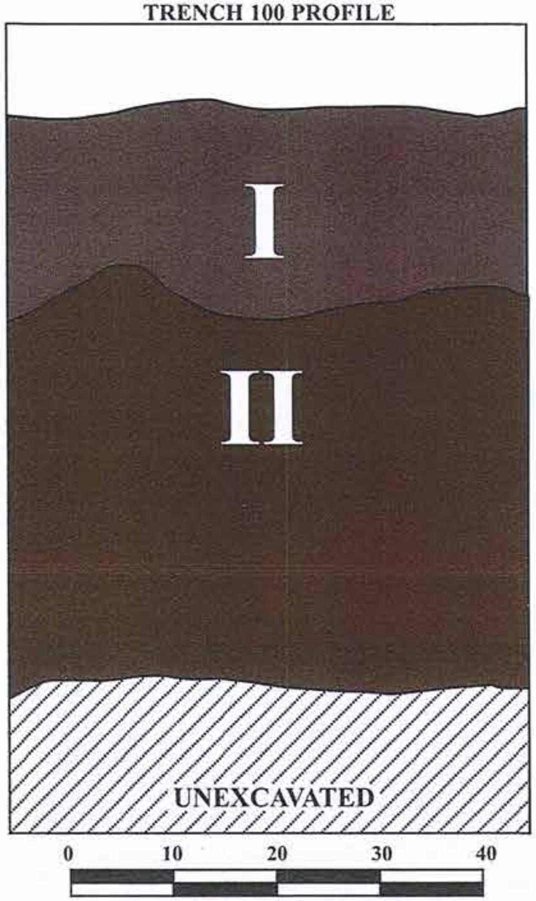
Stratigraphic Profile of ST-75



KEY
I - LAYER I: DUSKY RED (10R 3/4, DRY) SILTY CLAY
II - LAYER II: DARK REDDISH BROWN (5YR 3/4, DRY) SILTY CLAY

Stratigraphic Profile of ST-83

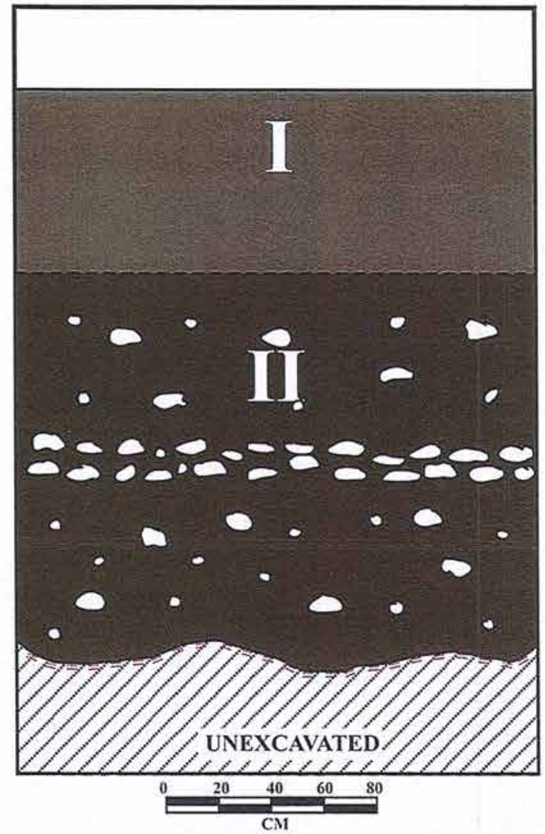
TRENCH 100 PROFILE



KEY
I - LAYER I: DUSKY RED (10R 3/4, DRY) SILTY CLAY
II - LAYER II: DARK REDDISH BROWN (5YR 3/4, DRY) SILTY CLAY

Stratigraphic Profile of ST-100

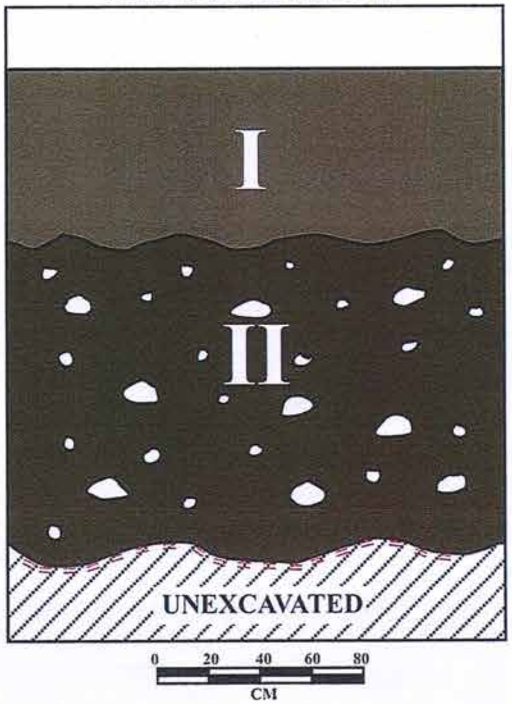
TRENCH 109 PROFILE



KEY
I - LAYER I: BROWN (10R 4/3) SILTY CLAY
II - LAYER II: DARK BROWN (10YR 3/3) SILTY CLAY
- BASALT STONE
- BEDROCK

Stratigraphic Profile of ST-109

TRENCH 113 PROFILE

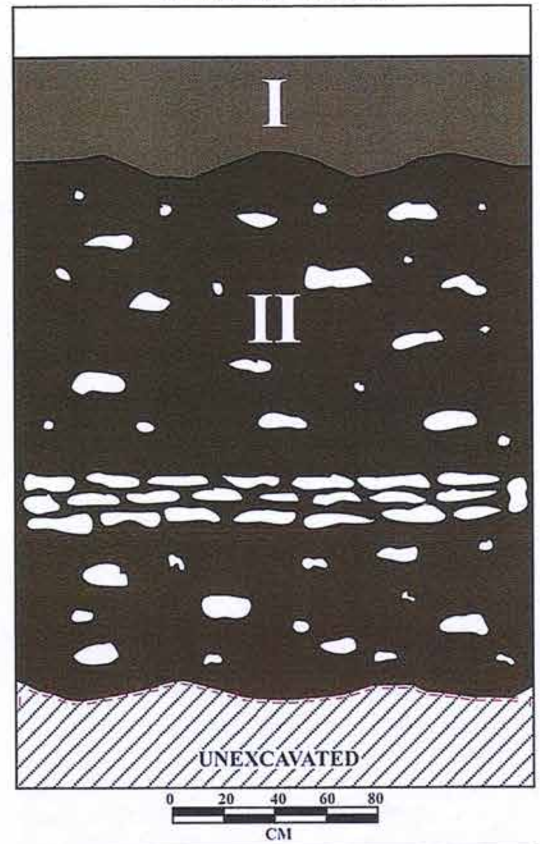


KEY

- I - LAYER I: BROWN (10R 4/3) SILTY CLAY.
- II - LAYER II: DARK BROWN (10YR 3/3) SILTY CLAY.
- - BASALT PEBBLES AND COBBLE STONE
- - BEDROCK

Stratigraphic Profile of ST-113

TRENCH 122 PROFILE

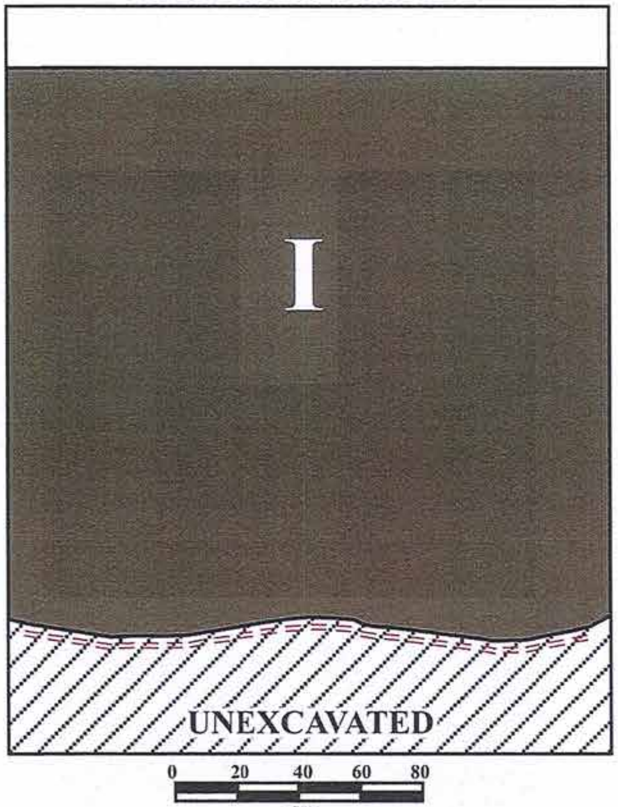


KEY

- I - LAYER I: BROWN (10R 4/3) SILTY CLAY.
- II - LAYER II: DARK BROWN (10YR 3/3) SILTY CLAY.
- - BASALT PEBBLES AND COBBLE STONE
- - BEDROCK

Stratigraphic Profile of ST-122

TRENCH 130 PROFILE



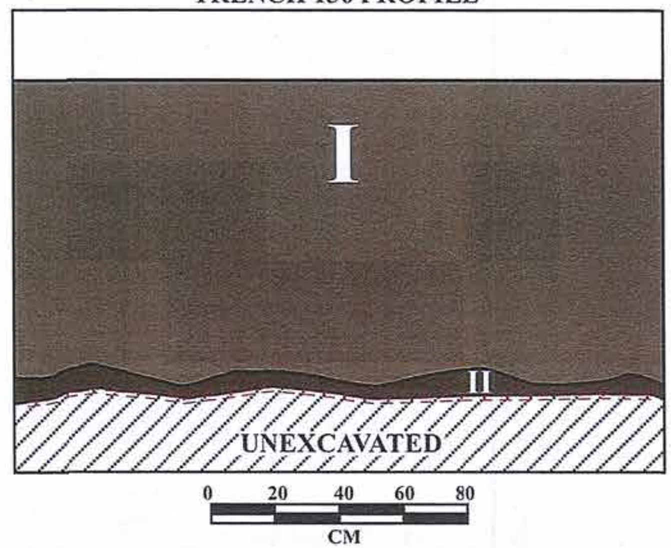
KEY

I - LAYER I: BROWN (10R 4/3) SILTY CLAY.

- BEDROCK

Stratigraphic Profile of ST-130

TRENCH 136 PROFILE



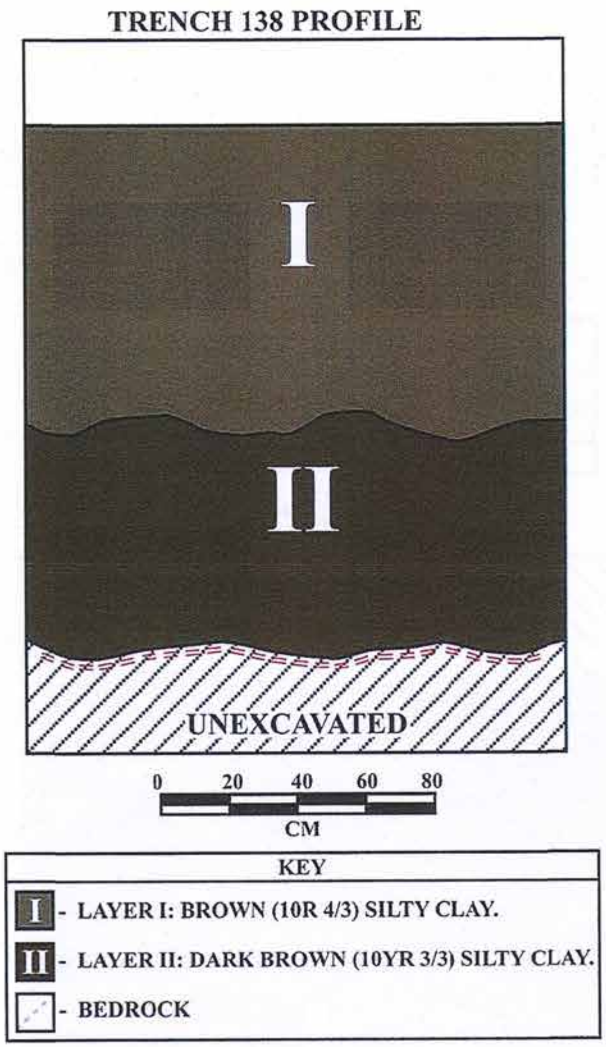
KEY

I - LAYER I: BROWN (10R 4/3) SILTY CLAY.

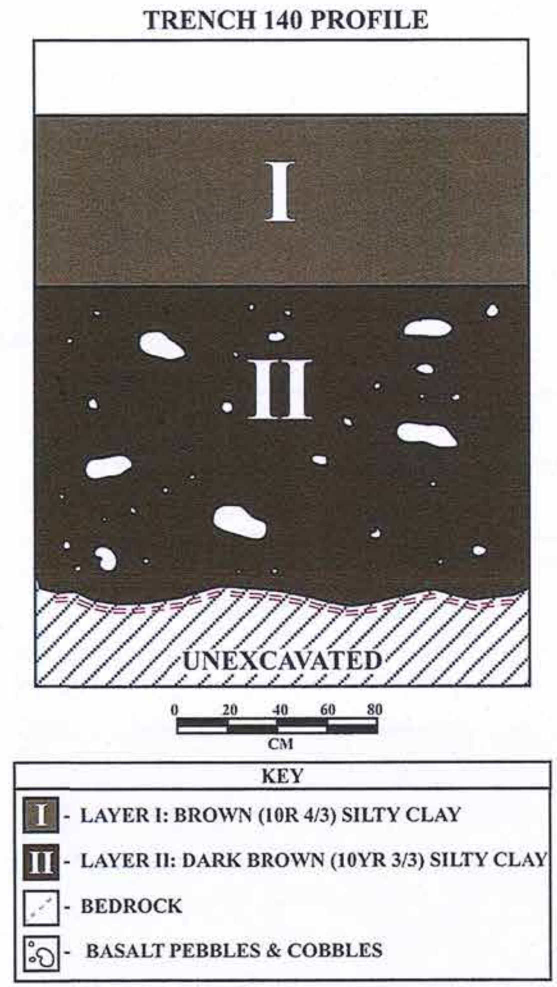
II - LAYER II: DARK BROWN (10YR 3/3) SILTY CLAY.

- BEDROCK

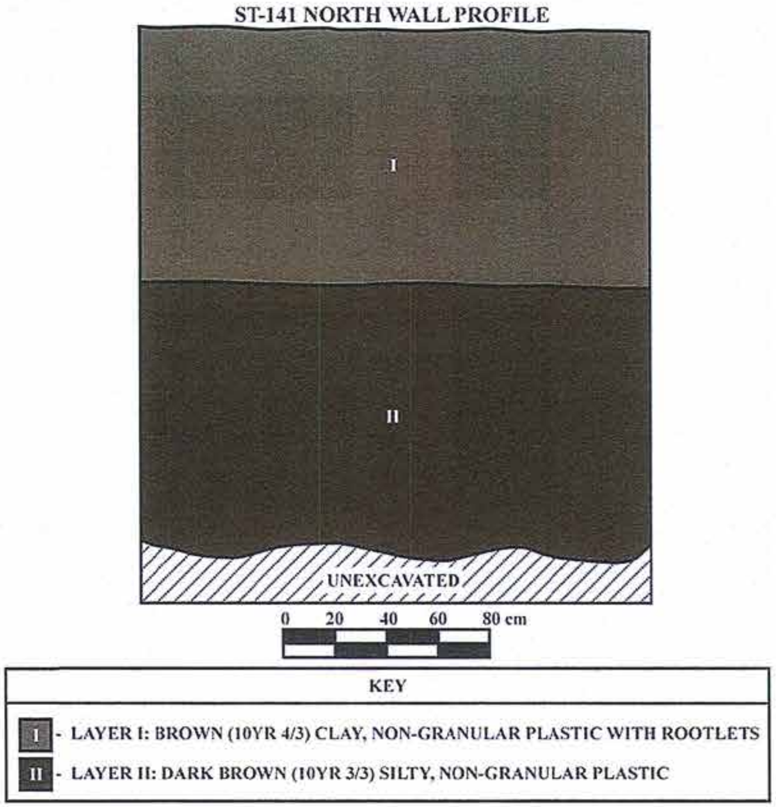
Stratigraphic Profile of ST-136



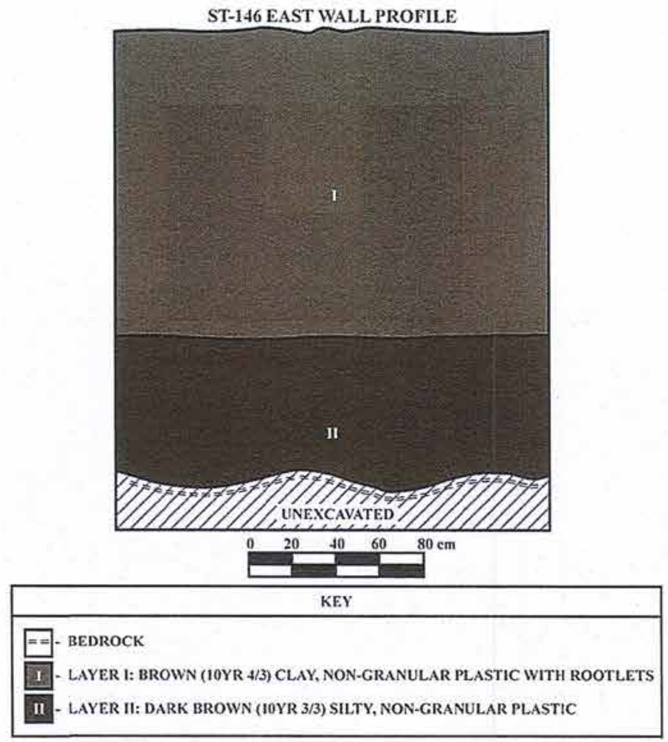
Stratigraphic Profile of ST-138



Stratigraphic Profile of ST-140

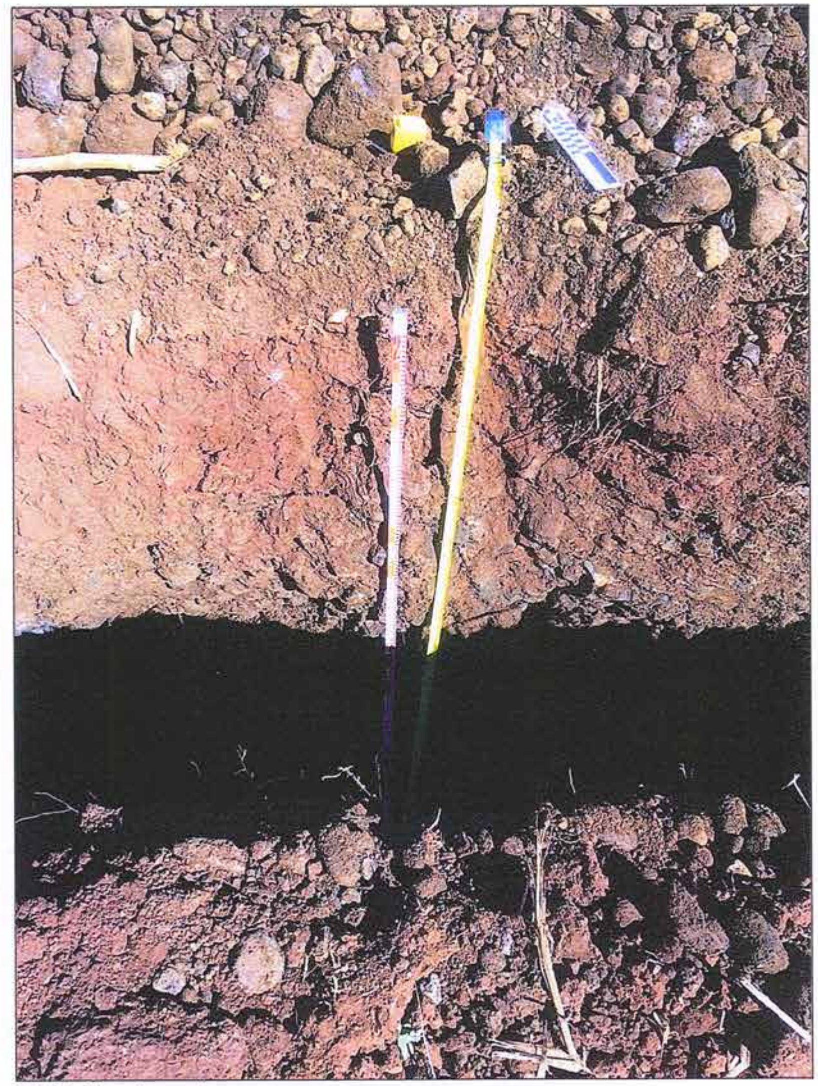


Stratigraphic Profile of ST-141

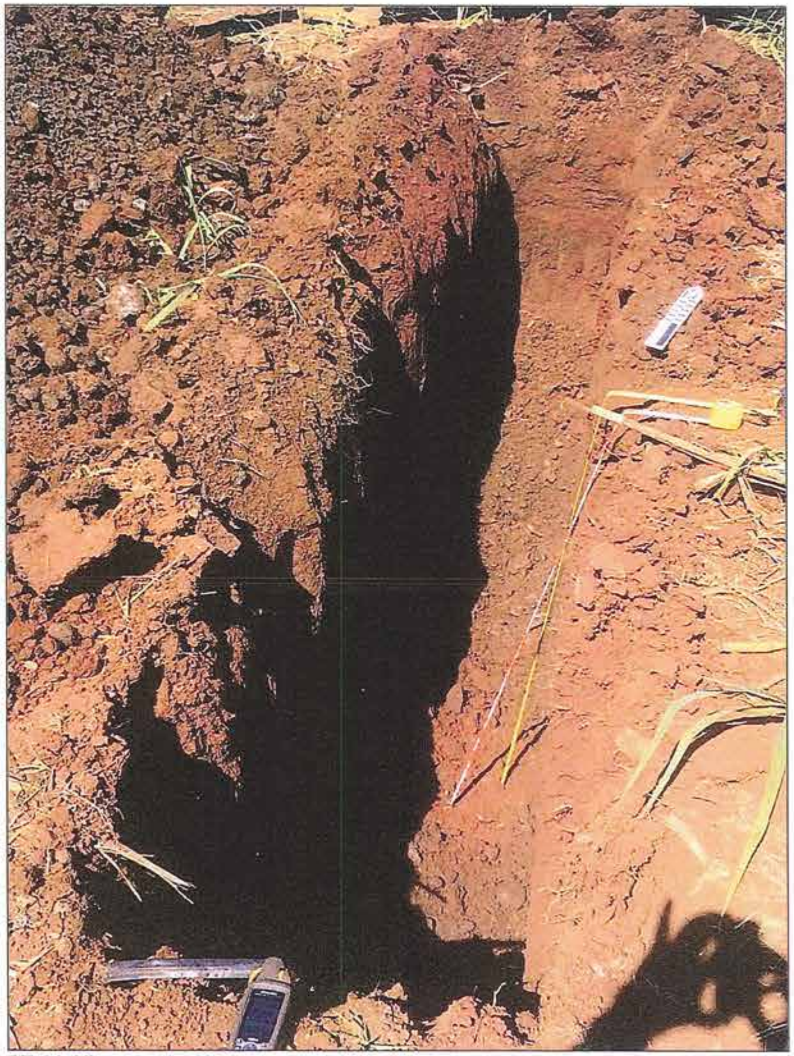


Stratigraphic Profile of ST-146

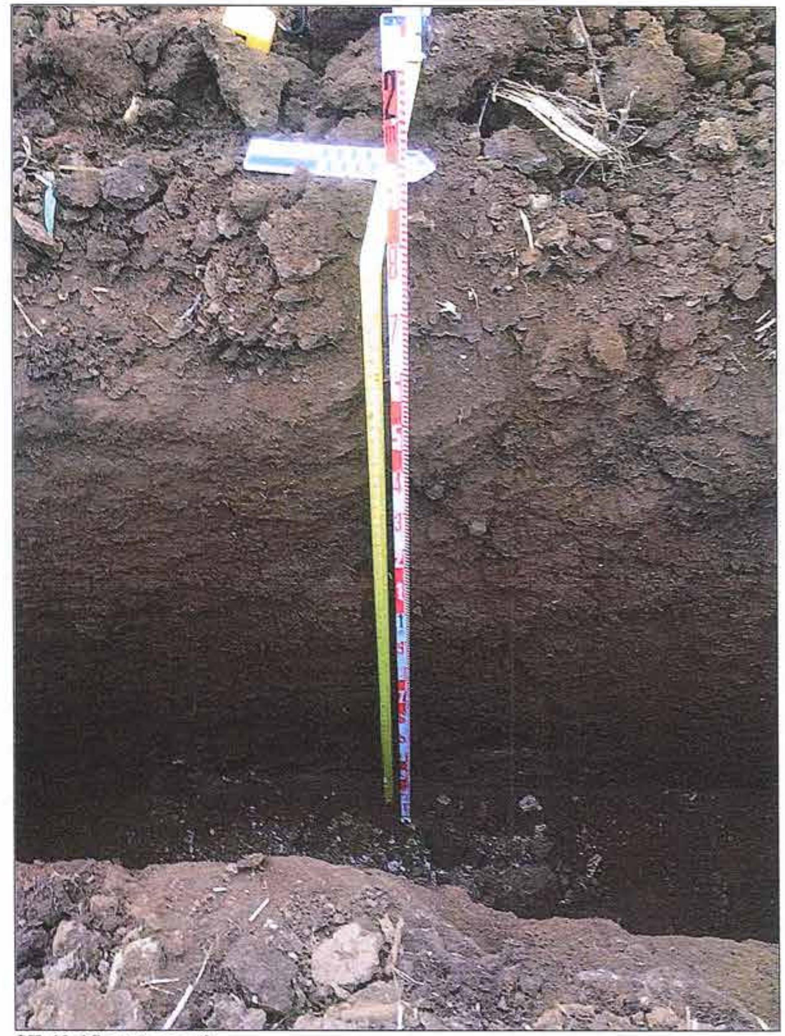
APPENDIX C: REPRESENTATIVE STRATIGRAPHIC TRENCH PHOTOGRAPHS



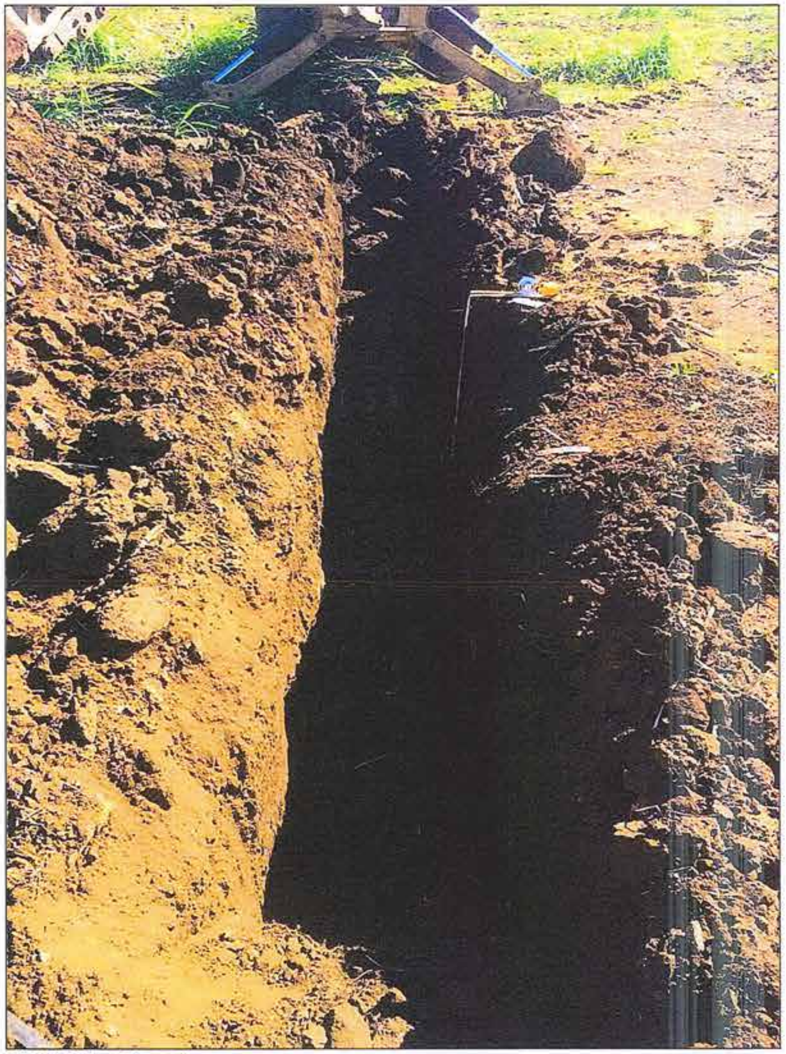
ST-12. View to east.



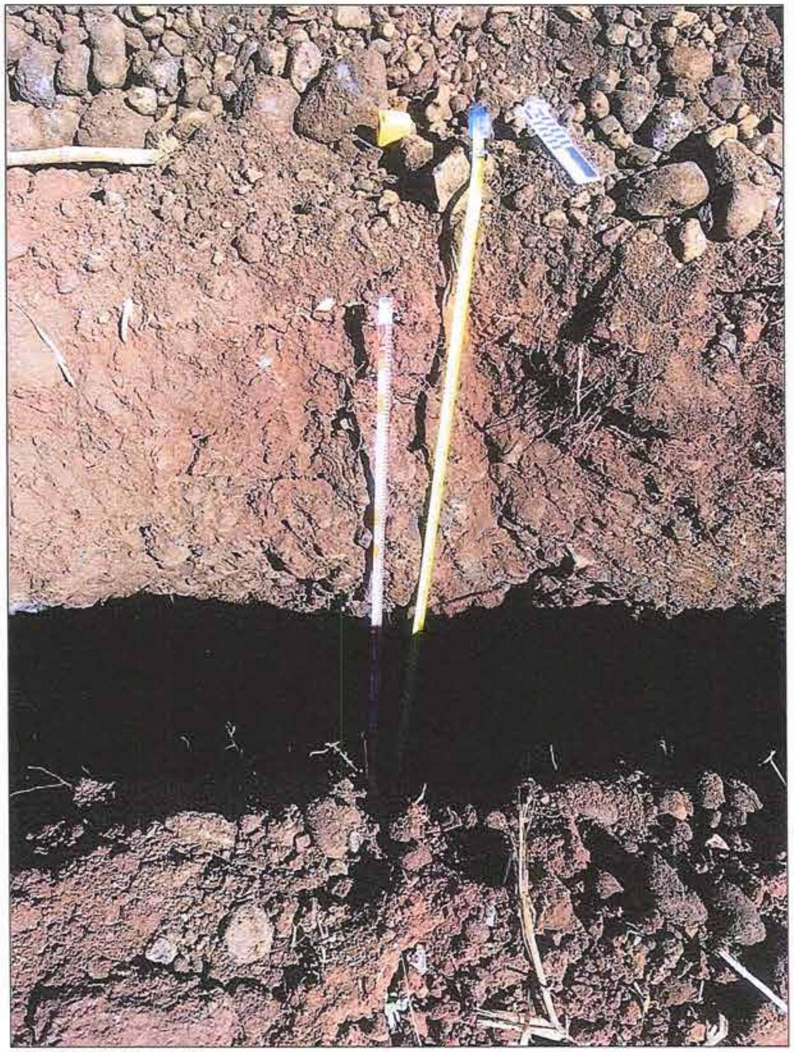
ST-21. View to west.



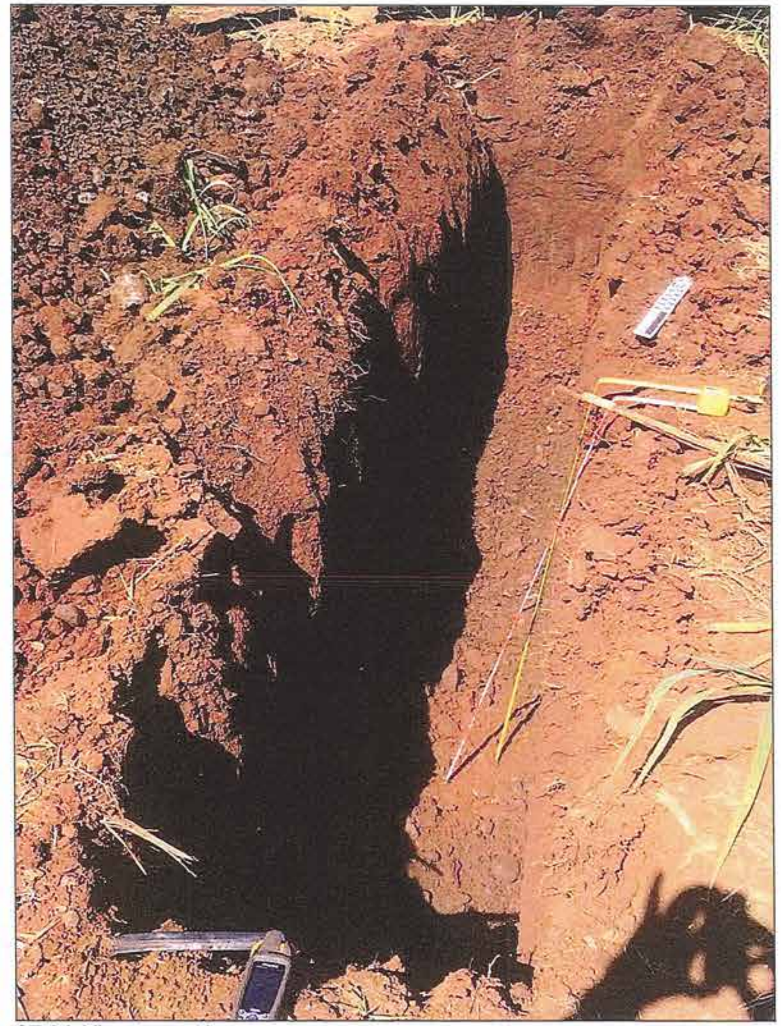
ST-46. View to south.


ST-53. View to east.

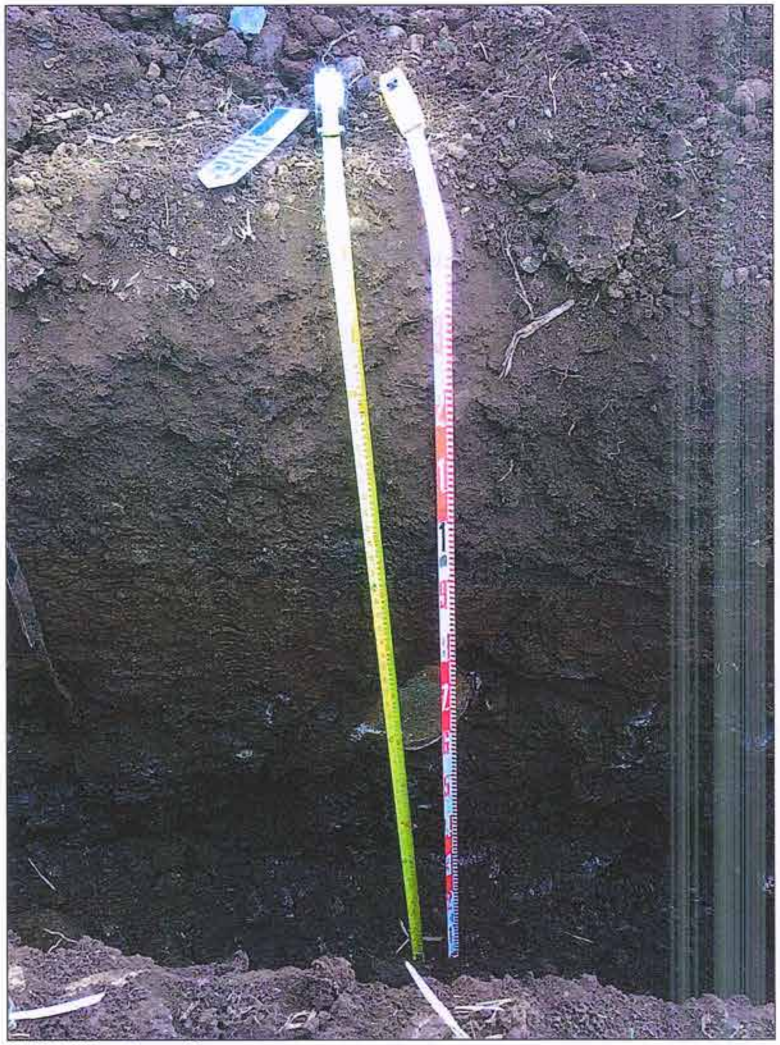

ST-71. View to west.

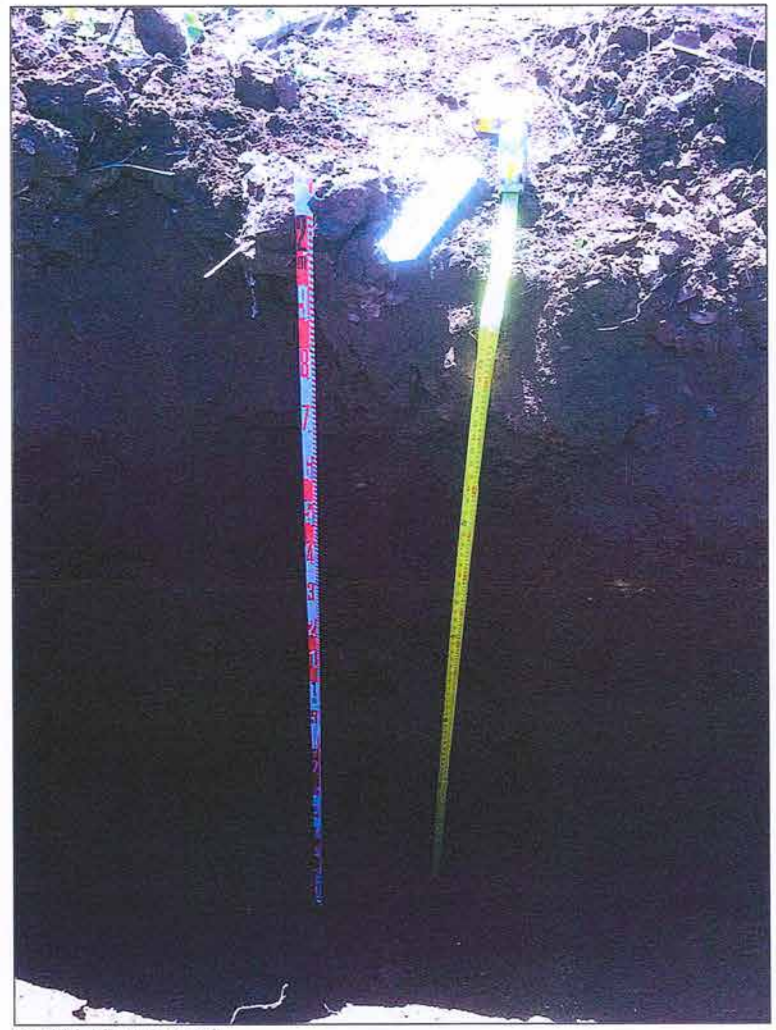


ST-79. View to east.



ST-84. View to south.


ST-99. View to north.


ST-111. View to north.


ST-141. View to west.

CULTURAL IMPACT ASSESSMENT

APPENDIX H

SCS Project Number 1802-CIA-Final

A CULTURAL IMPACT ASSESSMENT REPORT IN ADVANCE OF THE PROPOSED DLNR INDUSTIRAL AND BUSINESS PARK PŪLEHU NUI AHUPUA'A, WAILUKU DISTRICT ISLAND OF MAUI, HAWAI'I

[TMK: (2) 3-8-008:001]

Prepared by:
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August 2017

FINAL

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INTRODUCTION

At the request of Tessa Ng, Vice President of Munekiyo Hiraga, Scientific Consultant Services (SCS), Inc., has prepared a Cultural Impact Assessment (CIA) in advance of the proposed Department of Natural Resources (DLNR) Industrial and Business Park. The proposed project will be located on 280 acres of land owned by the State of Hawai'i in Pūlehu Nui Ahupua'a, Wailuku (Kula) District, Island of Maui, Hawai'i [TMK: (2) 3-8-008:001 por.; Figures 1 through 3].

The Hawaii State Office of Environmental Quality Control (OEQC 1997:11) states that "an environmental assessment of cultural impacts" gathers information about cultural practices and cultural features that may be affected by significant environmental effects:

> Cultural impacts differ from other types of impacts assessed in environmental assessments or environmental impact statements. A cultural impact assessment includes information relating to the practices and beliefs of a particular cultural or ethnic group or groups.

The purpose of a Cultural Impact Assessment is to identify the possibility of previous and current cultural practices and resources within a project area and ahupua'a, and then to assess the potential for impacts to these cultural resources.

PROJECT DESCRIPTION

The proposed DLNR Industrial and Business Park development will be a mixture of light-industrial/commercial and public/quasi-public uses, including the provision of required infrastructure systems. Key components of the plan include development of small, medium, and large lots for light industrial, commercial, government, and nonprofit uses to meet varying needs of future tenants. Lots within the proposed project will be leased and developed by the individual lessees. Lease revenue generated at DLNR Industrial and Business Park will provide a long-term revenue stream to support a wide range of DLNR programs including managing sensitive natural, cultural, and recreational resource areas, coastal lands and waters, water resources, conservation and forestry lands, historic sites, small boat harbors, parks and recreational facilities.

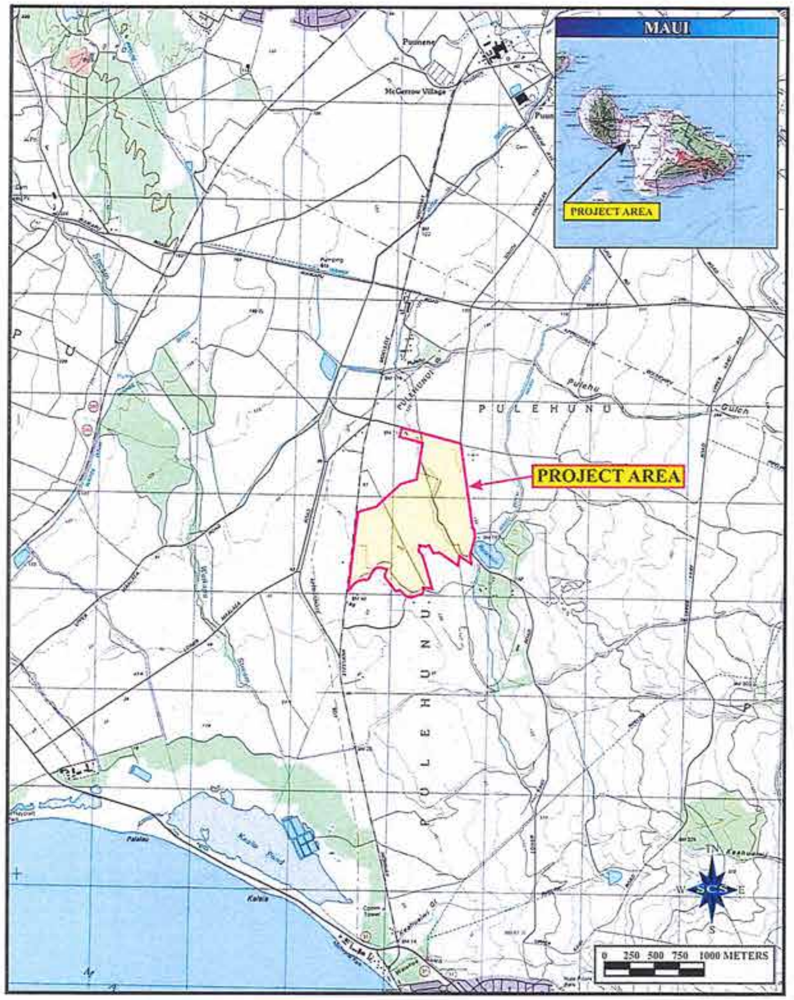

Figure 1: USGS Quadrangle (Maalaea, HI 1996; 1:24,000) Map Showing Project Area Location.

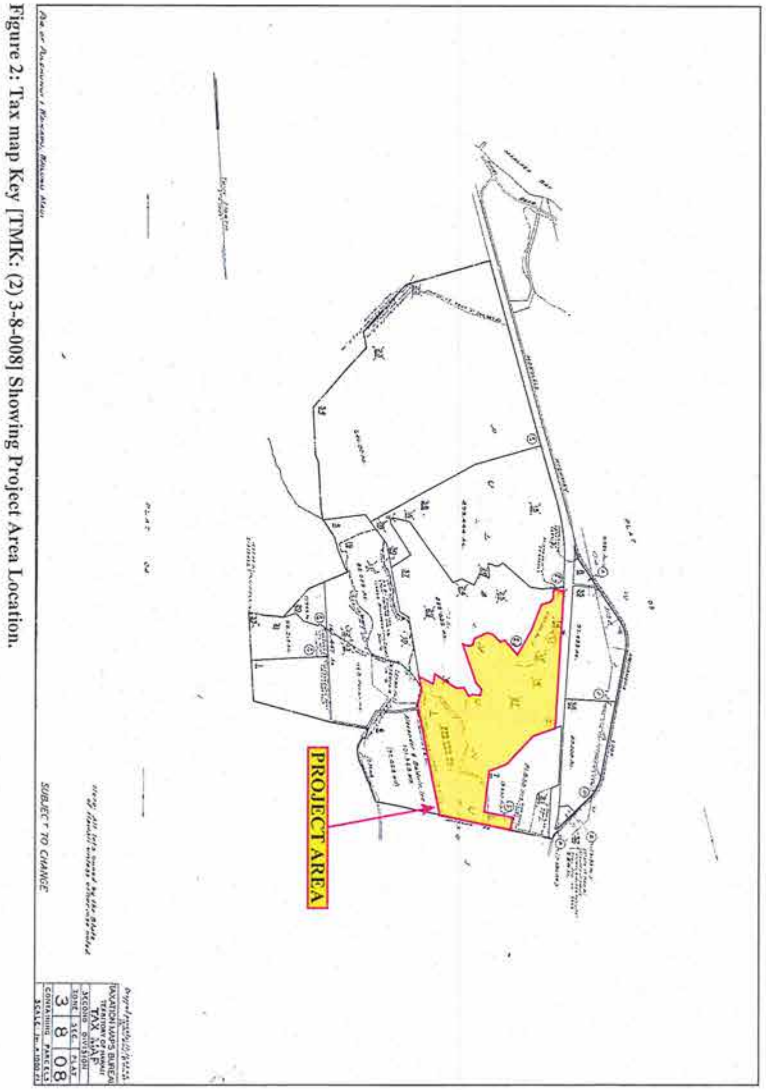

Figure 2: Tax map Key [TMK: (2) 3-8-008] Showing Project Area Location.

Figure 3: Google Earth Image (2016; Imagery Date 1/13/2013) Showing Project Area Location.

CULTURAL IMPACT ASSESSMENT METHODOLOGY

The Constitution of the State of Hawai'i clearly states the duty of the State and its agencies is to preserve, protect, and prevent interference with the traditional and customary rights of native Hawaiians. Article XII, Section 7 (2000) requires the State to "protect all rights, customarily and traditionally exercised for subsistence, cultural and religious purposes and possessed by *ahupua'a* tenants who are descendants of native Hawaiians who inhabited the Hawaiian Islands prior to 1778." Additionally, Article IX and XII, of the state constitution, other state laws, and the courts of the State, impose on government agencies a duty to promote and protect cultural beliefs and practices, and resources of Native Hawaiians as well as other ethnic groups.

Kamehameha III (Kauikeaouli) preserved the peoples traditional right to subsistence. As a result, in 1850, the Hawaiian Government confirmed the traditional access rights to native Hawaiian *ahupua'a* tenants to gather specific natural resources for customary uses from undeveloped private property and waterways under the Hawaiian Revised Statutes (HRS) 7-1. In 1992, the State of Hawai'i Supreme Court, reaffirmed HRS 7-1 and expanded it to include, "native Hawaiian rights...may extend beyond the *ahupua'a* in which a native Hawaiian resides where such rights have been customarily and traditionally exercised in this manner" [Pele Defense Fund v. Paty, 73 Haw.578, 620, 837 P.2d 1247, 1272 (1992)].

Act 50, enacted by the Legislature of the State of Hawai'i (2000) with House Bill (HB) 2895, relating to Environmental Impact Statements, proposes that:

> ...there is a need to clarify that the preparation of environmental assessments or environmental impact statements should identify and address effects on Hawaii's culture, and traditional and customary rights... [H.B. NO. 2895].
>
> Act 50 also requires state agencies and other developers to assess the effects of proposed land use or shoreline developments on the "cultural practices of the community and State" as part of the HRS Chapter 343 (2001) environmental review process.

It also re-defined the definition of "significant effect" to include "the sum of effects on the quality of the environment including actions that impact a natural resource, limit the range of beneficial uses of the environment, that are contrary to the State's environmental policies, or adversely affect the economic welfare, social welfare or cultural practices of the community and

State." Cultural resources can include a broad range of often overlapping categories, including places, behaviors, values, beliefs, objects, records, stories, etc. (H.B. 2895, Act 50, 2000).

The purpose of a CIA is to identify the possibility of on-going cultural activities and resources within a project area, or its vicinity, and then assessing the potential for impacts on these cultural resources. The CIA is not intended to be a document of in depth archival-historical land research, or a record of oral family histories, unless these records contain information about specific cultural resources that might be impacted by a proposed project.

GEOGRAPHICAL EXTENT

As defined by the Hawaii State Office of Environmental Quality Control (OEQC 1997:11), the geographical extent should be greater than the area over which the proposed project will take place in order to ensure that cultural practices that occur outside of the project area, but which may still be affected, are included in the assessment. For example, a project that may not, itself, physically impact traditional gathering practices, but may block access to those locations would be included within the assessment. The concept of geographical expansion is recognized by using, as an example, "the broad geographical area, e.g. district or *ahupua'a*." In some cases, the geographical extent could extend beyond the *ahupua'a* if cultural practices do so as well.

OEQC GUIDELINES FOR ASSESSING CULTURAL IMPACTS

According to the Guidelines for Assessing Cultural Impacts established by the Hawaii State Office of Environmental Quality Control (OEQC 1997:12):

> The types of cultural practices and beliefs subject to assessment may include subsistence, commercial, residential, agricultural, access-related, recreational, and religions and spiritual customs. The types of cultural resources subject to assessment may include traditional cultural properties or other types of historic sites, both man made and natural, which support such cultural beliefs.

The meaning of "traditional" was explained by in *National Register Bulletin*:

> 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. . . . [Parker and King 1998:1]

This CIA was prepared as much as possible in accordance with the suggested methodology and content protocol in the Guidelines for Assessing Cultural Impacts (OEQC 1997:11-13). In outlining the "Cultural Impact Assessment Methodology", the OEQC (1997:11) states that:

> "...information may be obtained through scoping community meetings, ethnographic interviews and oral histories..."

This Cultural Impact Assessment was prepared in accordance with the Guidelines for Assessing Cultural Impacts (OEQC 1997:11-13). The Guidelines recommend that preparers of assessments analyzing cultural impacts adopt the following protocol:

1. Identify and consult with individuals and organizations with expertise concerning the types of cultural resources, practices and beliefs found within the broad geographical area, e.g., district or ahupua'a;
2. Identify and consult with individuals and organizations with knowledge of the area potentially affected by the proposed action;
3. Receive information from or conduct ethnographic interviews and oral histories with persons having knowledge of the potentially affected area;
4. Conduct ethnographic, historical, anthropological, sociological, and other culturally related documentary research;
5. Identify and describe the cultural resources, practices and beliefs located within the potentially affected area; and
6. Assess the impact of the proposed action. alternatives to the proposed action, and mitigation measures, on the cultural resources, practices and beliefs identified.

CULTURAL IMPACT ASSESSMENT CONTENTS

The Guidelines state that an assessment of cultural impacts should address, but not be limited to:

A. Discussion of the methods applied and results of consultation with individuals and organizations identified by the preparer as being familiar with cultural practices and features associated with the project area, including any constraints or limitations which might have affected the quality of the information obtained.

B. Description of methods adopted by the preparer to identify, locate, and select the persons interviewed, including a discussion of the level of effort undertaken.

C. Ethnographic and oral history interview procedures, including the circumstances under which the interviews were conducted, and any constraints or limitations which might have affected the quality of the information obtained.

D. Biographical information concerning the individuals and organizations consulted their particular expertise and their historical and genealogical relationship to the project area, as well as information concerning the persons submitting information or interviewed their particular knowledge and cultural expertise, if any, and their historical and genealogical relationship to the project area.

E. Discussion concerning historical and cultural source materials consulted, the institutions and repositories searched and the level of effort undertaken. This discussion should include, if appropriate, the particular perspective of the authors, any opposing views, and any other relevant constraints, limitations or biases.

F. Discussion concerning the cultural resources, practices and beliefs identified, and, for resources and practices, their location within the broad geographical area in which the proposed action is located, as well as their direct or indirect significance or connection to the project site.

G. Discussion concerning the nature of the cultural practices and beliefs, and the significance of the cultural resources within the project area affected directly or indirectly by the proposed project.

H. Explanation of confidential information that has been withheld from public disclosure in the assessment.

I. Discussion concerning any conflicting information in regard to identified cultural resources, practices and beliefs.

J. Analysis of the potential effect of any proposed physical alteration on cultural resources, practices or beliefs; the potential of the proposed action to isolate cultural resources, practices or beliefs from their setting; and the potential of the proposed action to introduce elements which may alter the setting in which cultural practices take place.

K. A bibliography of references, and attached records of interviews which were allowed to be disclosed.

If on-going cultural activities and/or resources are identified within the project area, assessments of the potential effects on the cultural resources in the project area and recommendations for mitigation of these effects can be proposed.

PROJECT METHODOLOGY

This report contains archival and documentary research, as well as communication with organizations and individuals having knowledge of the project area, its cultural resources, and its practices and beliefs. An example of the initial letter of inquiry is presented in Appendix A, copies of the posted newspaper notice and affidavit are presented in Appendix B, an example of the follow up letter is presented in Appendix C. Previously conducted interviews, which were included in an earlier CIA prepared for the proposed DOFAW Baseyard project, and included in the Final Environmental Assessment for the proposed DOFAW Baseyard project (published in the Office of Environmental Quality Control's Environmental Notice on October 8, 2016), are included herein as Appendix D. The information contained in the interview summaries is considered to be relevant to the proposed project as well because the DOFAW Baseyard project site is located with the 280 acre DLNR Industrial and Business Park site. The signed information release forms associated with the current SCS CIA are presented in Appendix E. This Cultural Impact Assessment was prepared in accordance with the suggested methodology and content protocol provided in the Guidelines for Assessing Cultural Impacts (OEQC 1997:13), whenever possible. The assessment concerning cultural impacts may include, but not be limited to:

ARCHIVAL RESEARCH

Archival research focused on a historical documentary study involving both published and unpublished sources. These included legendary accounts of native and early foreign writers; early historical journals and narratives; historic maps, land records, such as Land Commission Awards, Royal Patent Grants, and Boundary Commission records; historic accounts, and previous archaeological reports.

Historical and cultural source materials were extensively used and can be found listed in the References Cited portion of this report. Such scholars as Samuel Kamakau, Martha Beckwith, Jon J. Chinen, Lilikalā Kame'eleihiwa, R. S. Kuykendall, Marion Kelly, E. S. C. Handy and E.G. Handy, John Papa 'Ī'ī, Gavin Daws, A. Grove Day, and Elspeth P. Sterling and Catherine C. Summers, and Mary Kawena Puku'i and Samuel H. Elbert continue to contribute to our knowledge and understanding of Hawai'i, past and present. The works of these and other authors were consulted and incorporated in this report where appropriate. Land use document research was supplied by the

Waihona 'Aina (2017) Database and the County of Maui Real Property Assessment and Tax Billing Information website.

INTERVIEWS

Interviews are conducted in accordance with Federal and State laws and guidelines when knowledgeable individuals are able to identify cultural practices in, or in close proximity to, the project area. If they have knowledge of traditional stories, practices and beliefs associated with a project area or if they know of historical properties within the project area, they are sought out for additional consultation and interviews. Individuals who have particular knowledge of traditions passed down from preceding generations and a personal familiarity with the project area are invited to share their relevant information concerning particular cultural resources. Often people are recommended for their expertise, and indeed, organizations, such as Hawaiian Civic Clubs, the Island Branch of Office of Hawaiian Affairs (OHA), historical societies, Island Trail clubs, and Planning Commissions are depended upon for their recommendations of suitable informants. These groups are invited to contribute their input and suggest further avenues of inquiry, as well as specific individuals to interview. It should be stressed again that this process does not include formal or in-depth ethnographic interviews or oral histories as described in the OEQC's *Guidelines for Assessing Cultural Impacts* (1997). The assessments are intended to identify potential impacts to ongoing cultural practices, or resources, within a project area or in its close vicinity.

If knowledgeable individuals are identified, personal interviews are sometimes taped and then summarized. These draft summaries are returned to each of the participants for their review and comments. After corrections are made, each individual is to sign an information release form, making the interview available for this study. When telephone interviews occur, a summary of the information is also sent for correction and approval, or dictated by the informant and then incorporated into the document. If no cultural resource information is forthcoming and no knowledgeable informants are suggested for further inquiry, interviews are not conducted.

ENVIRONMENTAL SETTING

The island of Maui ranks second in size of the eight main islands in the Hawaiian Archipelago. The Island was formed by two volcanoes, Mount Kukui in the west and Haleakalā

in the east. Pu'u Kukui, forming the west end of the island (1,215 m above mean sea level), is composed of large, heavily eroded amphitheater valleys that contain well-developed permanent stream systems that watered fertile agricultural lands extending to the coast. The deep valleys of West Maui and their associated coastal regions have been witness to many battles in ancient times and were coveted productive landscapes. These are joined together by an isthmus containing dry, open country (*kula*), and the land of Pūlehu Nui, among others. The current project area is located in the *ahupua'a* of Pūlehu Nui. Pūlehu Nui extended across the Kula plain up through Makawao, to the edge of Haleakalā and would have included fruitful sections, not just the arid plains.

PROJECT AREA

The project area is located in the land of Pūlehu Nui Ahupua'a, approximately 2.5 miles inland from Mā'alaea Bay at approximately 86 feet above mean sea level (amsl.). The proposed project area is bound on the north by Kamaaina Road, on the east by Firebreak Road, on the west by Mokulele Highway, and on the southeast by the National Guard Amory, with the remainder of the eastern portion of the project area bounded by commercial agriculture (see Figures 1 through 3).

SOILS

According to Foote *et al.* (1972: Sheet Numbers 100, 101, 105, 106; Figure 4) five soil types representing three Soil Series (*i.e.*, Ewa Soil Series, Pulehu Soil Series, and Waiakoa Series) are present within the project area. Soils of the Ewa Series are prevalent throughout the project area, while soils of the Pulehu series are present in the southwest portion of the project area and soils of the Waiakoa Series are present in the southeastern portion of the project area.

Ewa Soil Series

Foote *et al.* (1972:29) describes the well-drained volcanic soils of the Ewa Series occur in basins and alluvial fans on the islands of Maui and O'ahu. Typically, these soils can be found between sea level and 150 feet amsl in areas receiving 10 to 30 inches of annual rainfall and are used for the cultivation of sugarcane, vegetables, and as ranchlands.

Ewa silty clay loam, 0 to 3 percent slopes (EaA) is present in the northern portion of the project area. These soils exhibit very slow runoff and a very slight erosion hazard and are used for the commercial production of sugarcane and as residential areas (Foote *et al.* 1972:30).

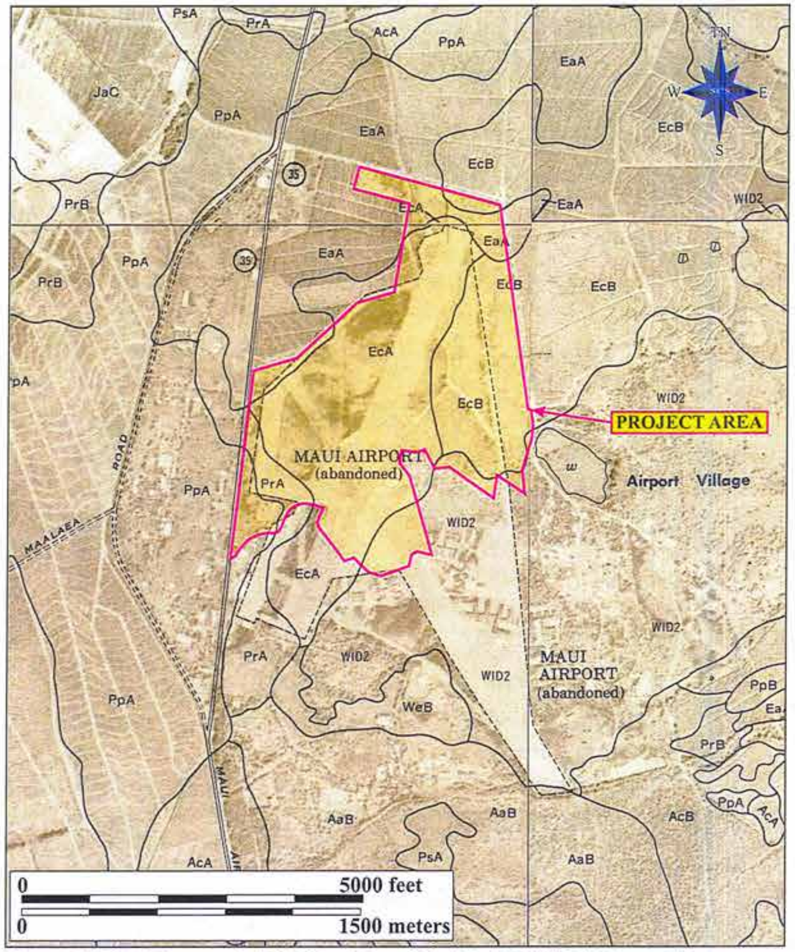

Figure 4: USDA (Foote *et al.* 1972: Sheet Maps 100, 101, 105, 106) Soil Survey Map Showing Soil Types within Project Area.

Ewa cobbly silty clay loam, 0 to 3 percent slopes (EcA) is present in the central portion of the project area. The EcA soils exhibits a cobbly surface, slow runoff, and a slight erosion hazard. These soils are primarily used form the cultivation of sugarcane and smaller properties are used as ranchlands (Foote *et al.* 1972:30).

Ewa cobbly silty clay loam, 3 to 7 percent slopes (EcB) is present in the eastern portion of the project and exhibits a cobbly surface. These soils are primarily used for the cultivation of sugarcane and smaller properties are used as ranchlands (Foote *et al.* 1972:30).

Pulehu Soil Series

Soils of the Pulehu Series, specifically Pulehu cobbly silt loam, 0 to 3 percent slopes (PrA) soils are located in the southwestern portion of the project area. Soils of the Pulehu series are of volcanic origin and well drained. Pulehu soils occur on alluvial fans, stream terraces, and in basins between sea level and 300 feet amsl in areas receiving 10 to 35 inches of annual rainfall (Foote *et al.* 1972:115). The PrA soils exhibit a very cobbly surface and are primarily used for the cultivation of sugarcane and smaller properties are used as ranchlands (Foote *et al.* 1972: 116).

Pulehu silt loam, 0 to 3 percent slopes (PpA) soils are located in the southwestern corner of the project area. According to Foote *et al.* (1972: 116), with the exception of the textures, the PpA soils are similar to the Pulehu clay loam, 0 to 3 percent slope soils (PsA)." The PpA soils exhibit moderate permeability, slow runoff, and a very slight erosion hazard. Larger acreages of PpA soils are used for the cultivation of sugarcane, while smaller properties are used as residential areas.

Waiakoa Soil Series

Soils of the Waiakoa Series, specifically Waiakoa extremely stony silty clay loam, 3 to 25 percent slopes (WID2), is located in the southeastern portion of the project area. The well-drained soils of the Waiakoa Series occur on the upland slopes of the island of Maui, between 100 to 1,000 feet amsl, in areas receiving 12 to 20 inches of annual rainfall (Foote *et al.* 1972: 126). The WID2 soils exhibit an eroded ground surface with stones covering 3 to 15 percent of the ground surface, medium runoff, and a severe erosion hazard. Areas comprised of WID2 soils are used for ranchlands and as habitats for wildlife (Foote *et al.* 1972:127).

CLIMATE

The project area lies near the dry, arid region of Maui's southwest coast. Rainfall indicators, according to Price (1983:62), show that the project area receives no more than five inches per year, with accumulations occurring mostly during the months of December and January. Unlike lower, coastal elevations, higher elevations of Pūlehu Nui Ahupua'a receives more precipitation due to fog drip and lower temperature climates. The frequency of the project area receiving upland wash is based on the amount of water accumulated upslope and the available water drainages created within or near the project area.

Given the lack of constant water resources within the proposed project area, Traditional-type (*i.e.,* pre-1778 A.D.) crops such as dryland sweet potato may have been the only feasible subsistence resource planted in the area prior to the advent of large-scale plantation-type irrigation systems.

CULTURAL HISTORICAL CONTEXT

Pūlehu Nui Ahupua'a is located on the southwestern side of Maui in the modern districts of both Wailuku and Makawao. Prior to being named the District of Makawao, the same district was traditionally known as Kula District. The proposed project area would have been partially within the traditional District of Kula. As such, the proposed project area's traditional and historic settings will be highlighted with events that occurred in the traditional District of Kula rather than in the modern District of Wailuku.

The proposed project area is situated near the leeward coast that is located on the lower, western slope of Maui's largest volcano, Haleakala, the latter which rises to over 3,048 meters (10,000 ft.) amsl.

PAST POLITICAL BOUNDARIES

Traditionally, the division of Maui Island into districts (*moku*) and sub-districts was performed by a *kahuna* (priest, expert) named Kalaiha'ōhia, during the time of the *ali'i* Kaka'alaneo (Beckwith 1940:383; Fornander places Kaka'alaneo at the end of the 15th century or the beginning of the 16th century [Fornander 1919-20, Vol. 6:248]). Land was considered the property of the king or *ali'i 'ai moku* (the *ali'i* who eats the island/district), which he held in trust for the gods. The title of *ali'i 'ai moku* ensured rights and responsibilities pertaining to the land, but did not confer absolute ownership. The king kept the parcels he wanted, his higher chiefs

received large parcels from him and, in turn, distributed smaller parcels to lesser chiefs. The *maka'āinana* (commoners) worked the individual plots of land.

In general, several terms, such as *moku*, *ahupua'a*, *'ili* or *'ili 'āina* were used to delineate various land sections. A district (*moku*) contained smaller land divisions (*ahupua'a*) which customarily continued inland from the ocean and upland into the mountains. Extended household groups living within the *ahupua'a* were therefore, able to harvest from both the land and the sea. Ideally, this situation allowed each *ahupua'a* to be self-sufficient by supplying needed resources from different environmental zones (Lyons 1875:111). The *'ili 'āina* or *'ili* were smaller land divisions next to importance to the *ahupua'a* and were administered by the chief who controlled the *ahupua'a* in which it was located (Lyons 1875:33; Lucas 1995:40). The *mo'o 'āina* were narrow strips of land within an *'ili*. The land holding of a tenant or *hoa 'āina* residing in an *ahupua'a* was called a *kuleana* (Lucas 1995:61). The project area is located in the lands of Pūlehu Nui, which translated literally means "large pūlehu" (Pukui *et al.* (1974:193; Figure 5). As Pukui *et al.* (1974:193) interpret "*pūlehu*" as meaning "broiled," perhaps the name of this *ahupua'a* may refer to the intense heat of the sun in this area. Pukui and Elbert (1986:353) provide a slightly different interpretation of "*pūlehu*" (to broil, as sweet potatoes, or breadfruit, placed on hot embers), suggesting the area had an abundance of food resources.

TRADITIONAL SETTLEMENT PATTERNS

The Hawaiian economy was based on agricultural production and marine exploitation, as well as raising livestock and collecting wild plants and birds. Extended household groups settled in various *ahupua'a*. During the pre-Contact Period, there were primarily two types of agriculture, wetland and dry land, both of which were dependent upon geography and physiography. River valleys provided ideal conditions for wetland *kalo* (*Colocasia esculenta*) agriculture that incorporated pond fields and irrigation canals. Other cultigens, such as *kō* (sugar cane, *Saccharum officinaruma*) and *mai'a* (banana, *Musa* sp.), were also grown and, where appropriate, such crops as *'uala* (sweet potato, *Ipomoea batatas*) were produced. This was the traditional agricultural pattern seen on all the Hawaiian Islands (Kirch and Sahlins 1992, Vol. 1:5, 119; Kirch 1985). It must be noted that Handy (1940:105 stated that, ". . . the bounds of cultivation . . . were strictly drawn by limitation of water for irrigation." The word "*kula*" meant "open country, or plain", according to Handy and Handy, and was often used to differentiate between dry, or *kula* land, and wet-taro land. The height and size of Haleakalā to the east, prevents moisture from reaching its southern and western flanks, causing and desert-like conditions throughout the region (Handy and Handy 1972:510). Handy and Handy (1972:510) further state:

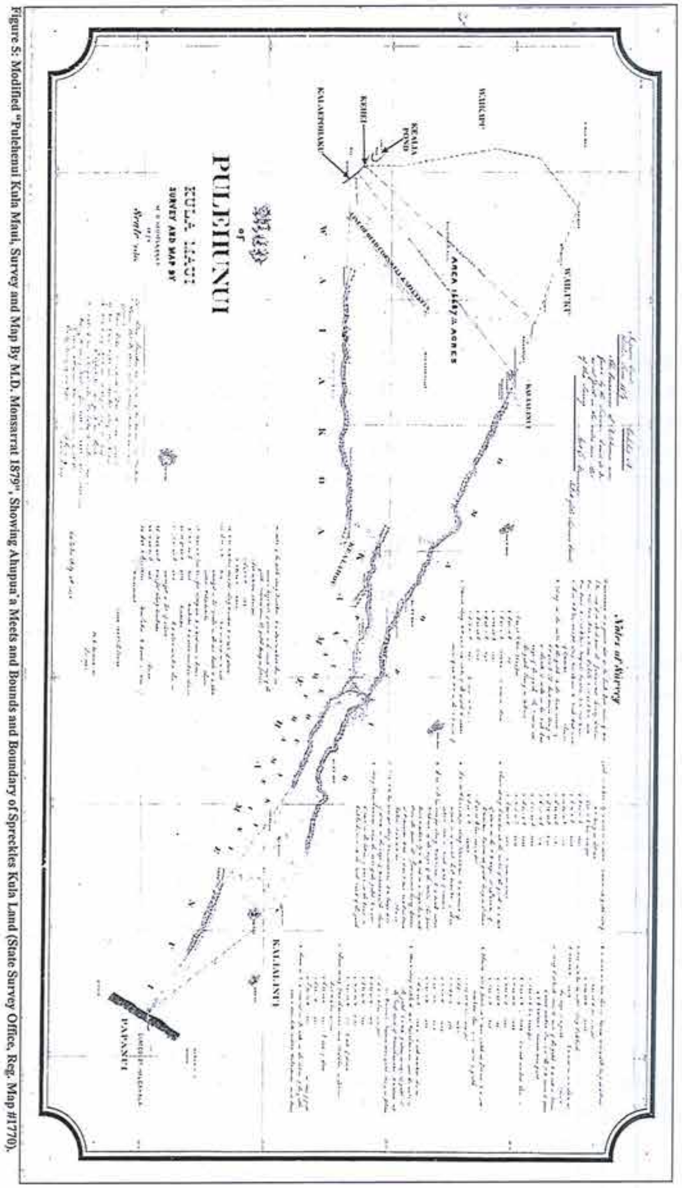

Figure 5: Modified "Pulehunui Kula Maui, Survey and Map By M.D. Monsarrat 1879", Showing Ahupua'a Meets and Bounds and Boundary of Spreckles Kula Land (State Survey Office, Reg. Map #1770).

> This is an essential characteristic of Kula, the central plain of Maui which is practically devoid of streams. Kula was always an arid region, throughout its long, low seashore, vast stony *kula* lands, and broad uplands.

As to the occupation of this vast plain, Handy and Handy (1972:511) stated:

> Both on the coast, where fishing was good, and on the lower westward slopes of Haleakala a considerable population existed. So far as we could learn Kula supported no Hawaiian taro, and the fishermen in this section must have depended for vegetable food mainly on *poi* brought from the wet lands of Waikapu and Wailuku to westward across the plain to supplement their usual sweet-potato diet.

An early witness to its lack of productivity was George Vancouver. During his second visit to Hawai'i in 1793 as a Captain, Vancouver anchored in Mā'alaea Bay, which he describes as follows (Vancouver 1984:852):

> The appearance of this side of Mowee was scarcely less forbidding than that of its southern parts, which we had passed the preceding day. The shores, however, were not so steep and rocky, and were mostly composed of a sandy beach; the land did not rise so very abruptly from the sea towards the mountains, not was its surface so much broken with hills and deep chasms; yet the soil had little appearance of fertility, and no cultivation was to be seen. A few habitations were promiscuously scattered near the water side, and the inhabitants who came off to us, like those seen the day before, had little to dispose of.

Not much had changed 24 years later (1817) when Peter Corney sailed this way, bound for O'ahu. He made special reference to Keālia Pond (now the Keālia Pond and Wildlife Refuge), a short distance southwest of the project area:

> . . . Next morning we passed Morokenee (Molokini), and made sail up Mackerey (Maalaea) bay. . . This bay is very deep and wide, and nearly divides the island, there being but a narrow neck of land and very low, keeping the two parts of the island together. . . On this neck of land are their principal salt-pans, where they make most excellent salt [Corney 1965:70-71].

WAHI PANA (LEGENDARY PLACES)

Wailuku District was a center of political power often at war with its rival in Hāna. Between 1775 and 1779, there was almost continual fighting between Kahekili, chief of Maui, and Kalani'ōpu'ū, chief from Hawai'i Island, who was often in residence at Hāna (Kamakau

1961). After several skirmishes in which Kalani'ōpu'ū had been defeated by the warriors of Kahekili, Kalani'ōpu'ū retired to Hawai'i Island. He spent the next year gathering men from each of the six districts on the island, forming six divisions of warriors. His prize troops consisted of chiefs from his own group of attendants, which were named the 'Ālapa and Pi'ipi'i. Leaving nothing to chance, Kalani'ōpu'ū then built *heiau* for his war gods, assuring success, and when all was ready (1776), he and his men returned to Maui (Kamakau 1961).

Rather than landing at Hāna on the east side, the warriors came around the southern coast of Maui. They first landed at Keone'ō'io Bay and ravaged the countryside giving Kahekili notice and time to prepare his fighting men (Kamakau 1961). Kalani'ōpu'ū's men traveled up the coast by sea and landed at Kīheipuko'a at Keālia, confident that the victory was to be theirs (Kamakau 1961).The 800 'Ālapa and Pi'ipi'i warriors marched across the plain (in which is the project area) to Wailuku where Kahekili and his warriors were waiting. Kamakau (1961:85-89) said:

> They slew the Alapa on the sand hills at the southeast of Kalua. There the dead lay in heaps strewn like *kukui* branches; corpses lay heaped in death; they were slain like fish enclosed in a net...

An interesting anecdote is recounted by George W. Bates (1854: 309), during his journey from Wailuku to Kahului in 1854:

> Leaving Wai-lu-ku [town], and passing along toward the village Kahului, a distance of three miles, the traveler passes over the old battle-ground named after the village. It is distinctly marked by moving sand-hills, which owe their formation to the action of the northeast trades. Here these winds blow almost with the violence of a sirocco, and clouds of sand are carried across the northern side of the isthmus to a height of several hundred feet. These sand-hills constitute a huge "Golgotha" for thousands of warriors who fell in ancient battles. In places laid bare by the action of the winds, there were human skeletons projecting, as if in the act of struggling for resurrection from their lurid sepulchers. In many portions of the plain who cart-loads were exposed in this way. Judging of the numbers of the dead, the contest of the old Hawaiians must have been exceedingly bloody. . . .

The1776 encounter between Kahekili and Kalani'ōpu'ū resulted in a temporary truce which was broken in 1790 by the battle of Kepaniwai, when Kamehameha I consolidated his control over Maui Island.

Fornander (cited in Sterling (1998:253), recounted another invasion of Maui by Alapaninui, an ali'i from the Island of Hawai'i:

> When all of the preparations for the invasion of Maui had been completed, Alapainui set sail with his fleet and landed at Mokululau, in the district of Kaupo on Maui. He met no resistance, but learned that Kekaulike had died but a short while previous, that his body had been removed to the sepulcher of Iao in Wailuku, and that Kamehamehanui, the son of Kekaulike and Kikuiapoiwa, had by order of the late king, succeeded him as Moi of Maui. On hearing this news Alapainui's anger relented, and moved by feelings of affection for his sister Kikuiapoiwa and his nephew Kamehamehanui, he refrained from acts of hostility, and met the young moi and his mother with the rest of the royal family at Kiheipukoa [between Kalepolepo and Mā'alaea (Sterling 1998:257)], where peace was concluded and festive reunions took place of warlike encounters."

THE MĀHELE

In the 1840s, traditional land tenure shifted drastically with the introduction of private land ownership based on western law. While it is a complex issue, many scholars believe that in order to protect Hawaiian sovereignty from foreign powers, Kauikeaouli (Kamehameha III) was forced to establish laws changing the traditional Hawaiian economy to that of a market economy (Kame'eleihiwa 1992:169-70, 176; Kelly 1983:45, 1998:4; Daws 1962:111; Kuykendall 1938 Vol. I:145). The Māhele of 1848 divided Hawaiian lands between the king, the chiefs, the government, and began the process of private ownership of lands. The subsequently awarded parcels were called Land Commission Awards (LCAs). With the passage of the Kuleana Act of 1850, lands were made available and private ownership was instituted, the *maka'āinana* could claim parcels. These claims did not include any previously cultivated but presently fallow land, *'okipū* (on O'ahu), stream fisheries, or many other resources necessary for traditional survival (Kelly 1983; Kame'eleihiwa 1992:295; Kirch and Sahlins 1992). If occupation could be established through the testimony of two witnesses, the petitioners were awarded the claimed LCA and issued a Royal Patent after which they could take possession of the property (Chinen 1961:16).

In 1848, the Hawaiian population was around 88,000, of which 29,220 were males over the age of 18. There were only 14,195 applications for LCA awards submitted by *maka'āinana*. Of these claims, only 8,421 were awarded to less than 30 percent of the eligible males. The land received by the *maka'āinana* was less than one percent of all the total land in Hawai'i (Kame'eleihiwa 1992).

There were 13 *kuleana* claimed in the *ahupua'a* of Pūlehu Nui. The Land Commission awarded the *ahupua'a* of Pūlehu Nui, comprising 16687.78 acres, to Keaweamahi, under Land Commission Award (LCA) 5230/Royal Patent 8140 (Figure 6). Keaweamahi claimed 5 *apana* (land portions), 7 *lo'i* (wet taro) and 2 *kula* (pastures). Saltwater-associated geography (*i.e.*, shore and dunes) was also claimed by Keaweamahi as part of LCA 5230 (Waihona 'Aina Database 2017; Appendix F).

HISTORIC LAND USE

SUGAR YEARS

As the sugar industry developed in the mid-1800s, more and more land was leased or purchased for what had become an intensely profitable endeavor. Water was an issue, but in 1876, the Hamakua Ditch Company (Alexander and Baldwin) was formed and within two years was bringing water from the streams of Haleakalā to four plantations in East Maui (Dorrance and Morgan 2000).

Also in 1876, the Reciprocity Treaty's ratification notice arrived by steamer, along with Claus Spreckles, California's sugar magnate, who viewed the sugar situation and decided two years later to turn the dry plains of Maui into a garden of cultivated cane (Van Dyke 2008). By various questionable means, he was able to acquire half interest in 16,000 acres of land in Waikapū commons and was able to lease 24,000 acres of Crown Lands on the Wailuku plains in central Maui for $1,000 (Van Dyke 2008). Figure 5 above, shows the survey line of the property extending across Pūlehu Nui, Claus Spreckles obtained from Henry Cornwell.

Having seen the success of the recently completed Hamakua Ditch now bringing mountain water to the otherwise dry, and unproductive East Maui fields, and having lost his battle to control this ditch water, Spreckles formed the Hawaiian Commercial Company and decided to construct a ditch system of his own on East Maui above the Hamakua Ditch, for his newly acquired land (Wilcox 1996). Spreckles' Haiku Ditch extended 30 miles, from Honomanu Stream to the Kīhei boundary and the water was used to irrigate his cane lands in the central Maui plains (Wilcox 1996). Presently, the Haiku Ditch ends at the Haiku reservoir abutting the project area to the north (see Figure 1).

In 1882, Spreckles reorganized his company into a California corporation, called Hawaiian Commercial and Sugar Company, or HC&S (Wilcox 1996). Later he constructed

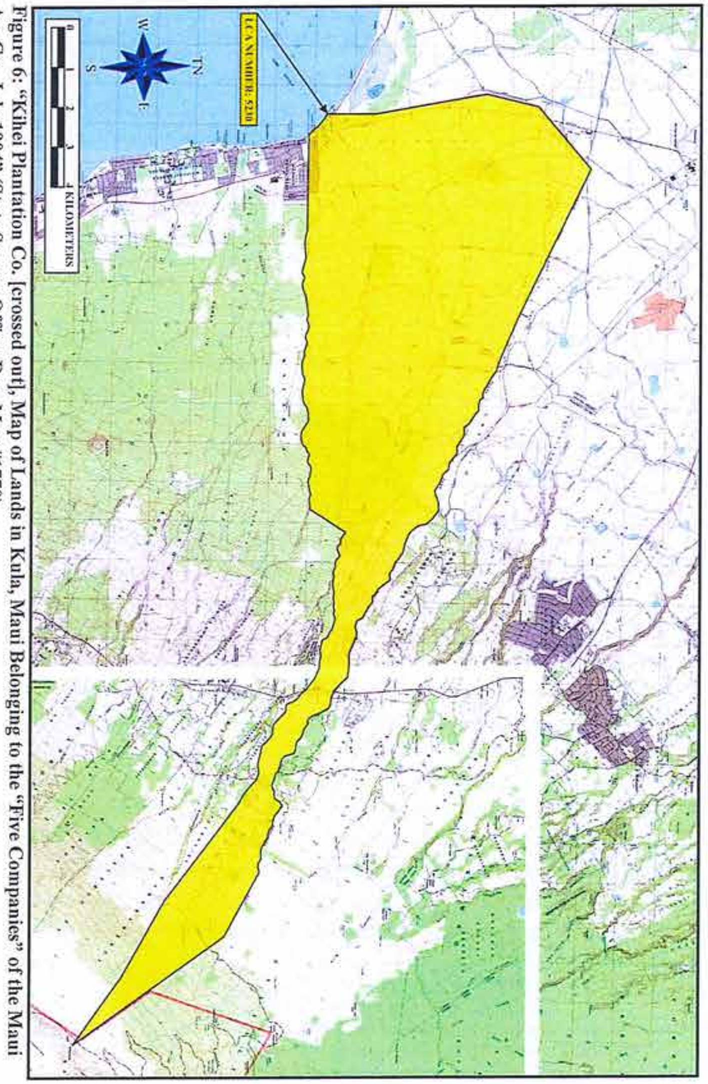

Figure 6: "Kihei Plantation Co. [crossed out], Map of Lands in Kula, Maui Belonging to the "Five Companies" of the Maui Ag. Co., July 1904" (State Survey Office, Reg. Map #1770).

another water system known as the Waihee Ditch in West Maui. It brought water from 15 miles away, starting at an elevation of 435 feet, to Kalua where it emptied into HC&S Waiale reservoir (Wilcox 1996).

The ensuing years brought trials and tribulations between Spreckles, his associates, and the Maui sugar planters, resulting finally in the 1898 sale of his HC&S stock, at an all-time low, to James Castle in partnership with Alexander and Baldwin, and the departure of Claus Spreckles from Hawai'i (Dorrance and Morgan 2000; Wilcox 1996).

Henry Baldwin and Lorrin Thurston formed the Kihei Sugar Company in 1899, to grow cane on their ranch lands in south central Maui, which included the project area (Dorrance and Morgan 2000). It was sent to the mill at Pu'unēnē to be ground, but, although production was high, it was not enough to cover the costs (Dorrance and Morgan 2000).

After the annexation in 1898, some of the planters on Maui, including Alexander and Baldwin, had decided to combine plantations to reap maximum profit. They formed the Maui Agricultural Company, a co-partnership that initially encompassed seven plantations and two mills. In 1904, five new plantations became part of the Maui Agricultural Company, as Kula Plantation Company, Makawao Plantation Company, Pulehu Plantation Company, Kailua Plantation and Kalianui Plantation Company were newly formed by carving up the unprofitable Kihei Plantation land (Dorrance and Morgan 2000). Maui Agricultural Company merged with HC&S in 1948 (Dorrance and Morgan 2000). Figure 7 shows the lands in Kula, previously Kihei Plantation Company, which became the "five companies" of the Maui Agricultural Company surveyed in 1904 by Arthur Alexander. The newly formed Makawao Plantation is shown in Figure 8. Maui Agricultural Company merged with HC&S in 1948 (Dorrance and Morgan 2000).

WORLD WAR II

A portion of the cane fields within the project area were turned into a civil airfield for the Territory of Hawai'i in 1937, as the one located at Ma'alaea had become too small to accommodate. Two years later, Inter-Island Airways began service to Maui, conveniently landing at Puunene Airport. As war loomed on the horizon (1940), the Navy began using the airport, along with a small Army Air Corps support base at the airfield. At this time, the air station was being used to support Squadron VU-3, to tow targets and operate drones for the fleet. Shortly after the United States entered WWII, land in the area of the airport was condemned (1942), including the project parcel listed as parcel 2-C in the Declaration of Taking filed with

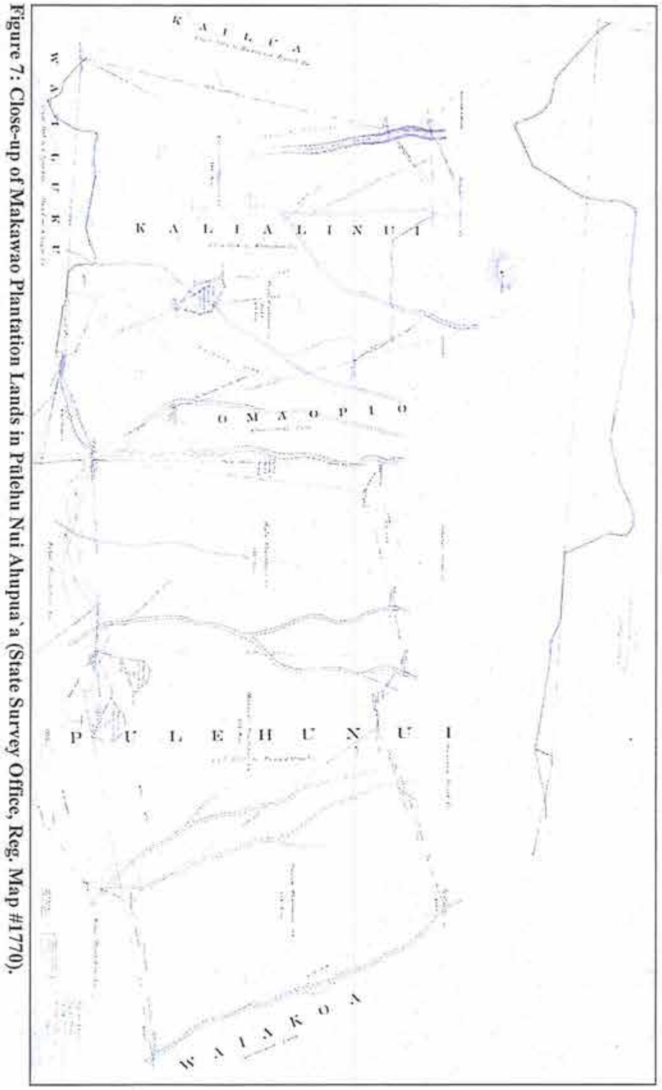

Figure 7: Close-up of Makawao Plantation Lands in Pulehu Nui Ahupua'a (State Survey Office, Reg. Map #1770).

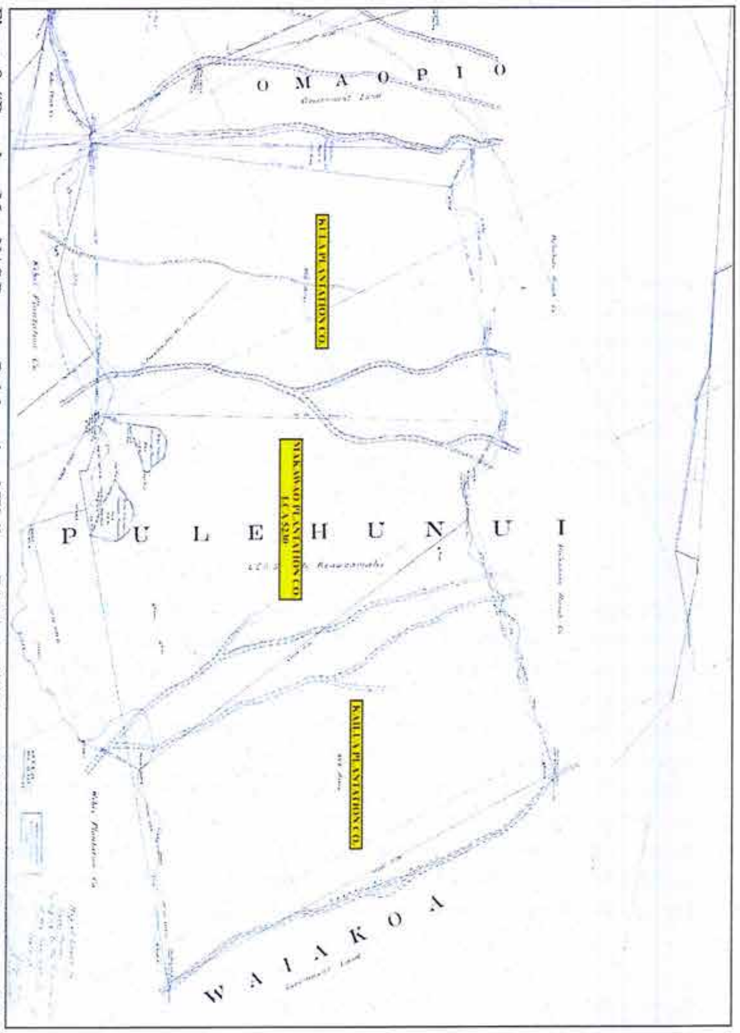

Figure 8: "Boundary Map NAS Puunene Pulehunui and Waikapu Districts of Kula and Wailuku Maui T.H. June 1944," Showing Project Area (14th Naval District, Pearl Harbor, T.H.; Courtesy of Hugh Starr).

the District Court of the United States for the District of Hawaii (on file Bureau of Conveyances, Honolulu). The airport was expanded and commissioned as Naval Air Station Maui (NAS). One hundred and six squadrons and carrier groups passed through the NAS during WWII. By 1945, the base consisted of a total of 2,202 acres, supporting over 3,300 personnel, and 271 aircraft. There were two paved runways, taxiways, ramps, hangers, and auxiliary buildings (Freeman 2016).

The airfield was released by the Navy back to the Territory of Hawai'i in 1947 and was apparently used as the official inter-island Airport until at least 1952 when the Kahului Airport was available for civil use (Freeman 2016). However, the Maui/Pu'unēnē airstrip, as it was known, serviced crop-dusters and other smaller aircraft and wasn't abandoned as a landing strip until sometime between 1961 and 1977(Freeman 2016). Over-grown military facilities were left in the area, including bunkers, revetments, and other bits and pieces. This is when the old airstrips were used for impromptu racing.

PREVIOUS ARCHAEOLOGY

Archaeological studies in the greater area began in the early 20th Century by T. Thrum (1909), J. Stokes (1909–1916), and W. M. Walker (1931), under the auspice of the Bernice Pauahi Bishop Museum. These surveys included areas of leeward Maui and inventoried both coastal and upland sites of the Kula District. In the *ahupua'a* of Pūlehu Nui Walker (1933 cited in Sterling 1998:253) listed two sites identified as Haleokane Heiau and Nininiwai Heiau.

Walker (1933 cited in Sterling 1998:253) described Haleokane Heiau (Walker Site 221) as located "[a]t Poonahoahoa above the main road one hundred and fifty yards, and beyond the end of the side road. Walker (1933 cited in Sterling 1998:253) further described Haleokane Heiau (Walker Site 221) as:

> A small heiau platform 22 by 30 feet…In spite of its small size the natives attach considerable importance to it and report the noise of drums on the nights of Kane. The name Haleokane was given by the old woman on whose property the heiau stands but the other kamaainas did not regard her information as very accurate.

Walker (1933 cited in Sterling 1998:253) described Nininiwai Heiau (Walker Site 222 and 223) as located "on the mauka side of the main road near the branch road. The other heiau is located on a hill in the mist of the cactus a mile and a half below the main road and near the branch road." Walker (1933 cited in Sterling 1998:253) further described Nininiwai Heiau (Walker Site 222 and 223) as:

> A medium-sized wall heiau, 50 x 50 feet. It is double-terraced on the north side and the wall here is 10 feet thick. Elsewhere it is 6 feet thick. There is a small enclosure in one corner. Cattle are continually trampling over this heiau and will in a short time reduce it to a shapeless pile of rocks.

Archival research indicates few archaeological projects have been conducted near the proposed project area. Although these projects occurred some distance from the subject parcel they are directly relevant. These studies provide background information to the current study area. The reader is also referred to Tomonari-Tuggle et al. (2001:61-63) which provides a succinct summary of these studies. The locations of selected previous archaeological projects conducted in the vicinity of the current project area are presented in Figure 9.

Kennedy (1988) conducted a visual inspection of TMK: (2) 3-8-004:029 that did not identify archaeological sites. The absence of sites was attributed to prior development of the area for a construction baseyard with an installation of a large concrete culvert. In 1991 the Bishop Museum conducted an Archaeological Inventory Survey for the Kai Makani project that produced negative findings on the ground surface or subsurface contexts (Rotunno-Hazuka (1991).

In 1992 Aki Sinoto Consulting conducted an Archaeological Inventory Survey of the proposed location for the Kihei Gateway Complex which led to the identification of State Site 50-50-09-31, a remnant, historic concrete bridge (crossing Waiakoa Stream. It was suggested that the bridge was probably related to a narrow gauge cane railroad that operated through the area and may have serviced Kihei Camp 1 (Sinoto and Pantaleo 1992).

Between 1995 and 1999 Scientific Consultant Services, Inc. conducted an Archaeological Inventory Survey (followed by two addendums) for the Puunene Bypass/ Mokulele Highway Improvements Corridor located in TMK: (2) 3-8-004, 05, 06, and 079 (Burgett and Spear 1997; Chaffee *et al.* 1999). No additional archaeological sites were identified. However, one previously recorded site was relocated and identified as the Naval Air Station Puunene Dump Site (State Site 50-50-09-4164). Scientific Consultant Services, Inc. conducted an Archaeological Inventory Survey of TMK: (2) 3-9-041:027, which included excavation of nine stratigraphic trenches. No new sites were identified (Pestana and Dega 2002).

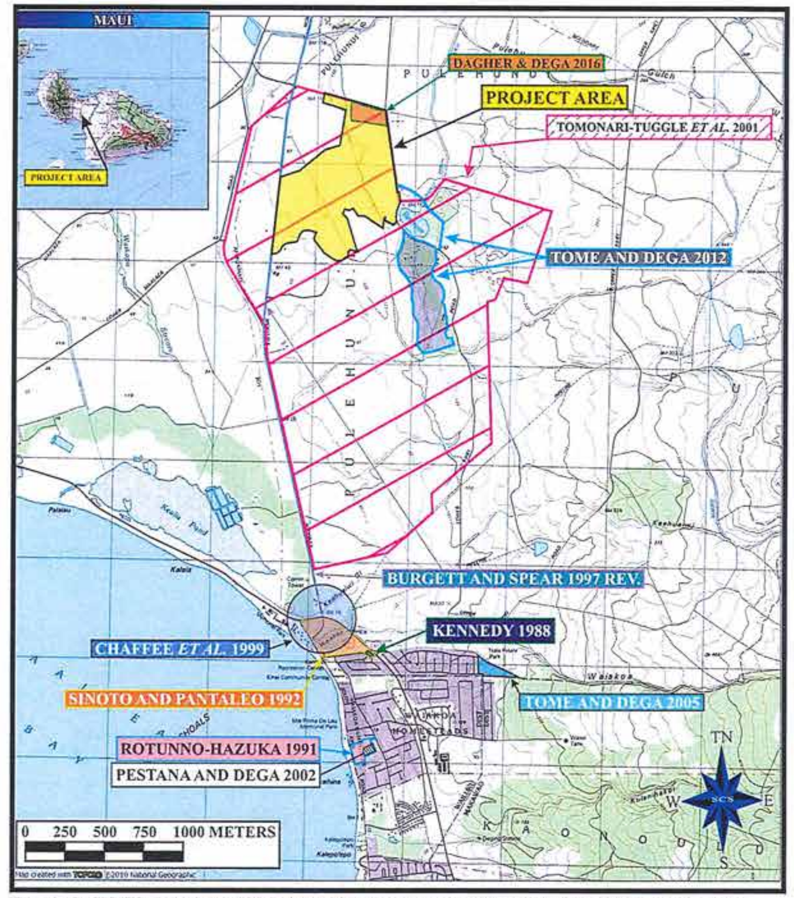

Figure 9: USGS (Maalaea 1996; 1:24,000) Quadrangle Map Showing the Locations of Previous Archaeological Projects in the Vicinity of the Current Project Area.

International Archaeological Research Institute Inc. (IARII) conducted an Archaeological Inventory Survey of the former Naval Air Station located in Puunene, Pūlehu Nui Ahupua'a Former Naval Air Station Puunene, State Site 50-50-09-4164 (Tomonari-Tuggle *et al.* 2001). During the survey 3 sites were identified (State Site 50-50-09-4800 through State Site 50-80-09-4802). State Site 50-50-09-4800 consisted of seven features associated with the Plantation-Era and two complexes of corrals, fences, troughs associated with Post-World War II ranching. State Site 50-50-09-4801 consisted of a post-World War II cattle ranching site. State Site 50-50-09-4802 consisted of the Old Kihei Railroad Bed (State Site 50-50-09-4802 and 5 features associated with the Haiku Ditch and Reservoir. The current project area was included in this larger study previously conducted by International Archaeological Research Institute Inc. (Tomonari-Tuggle *et al.* 2001).

In 2005 Scientific Consultant Services, Inc. conducted an Archaeological Inventory Survey, including limited subsurface testing, was conducted on a 9.289-acre property in North Kīhei, Maui, Hawai'i [TMK: (2) 3-8-004:028] (Tome and Dega 2005). The project area, located immediately adjacent and abutting the southern boundary of the Hale Piilani Park, had been partially modified by illegal dumping, utilization as an informal dirt bike course, and ranching activities. Two archaeological sites comprising four structural features were newly identified during this Inventory Survey. The sites were interpreted respectively as a World War II-related site (State Site 50-50-09-5801, WW II training site) and a traditional Hawaiian site (State Site No. 50-50-09-5802, pre-Contact agricultural/habitation complex). The two sites date utilization of the subject parcel from the pre-Contact Period (*i.e.,* pre-1778) to the United States Marine Corps' 4th U.S. Marine Division training during the closing years of World War II.

In 2011, Scientific Consultant Services, Inc. (SCS), conducted an Archaeological Inventory Survey for the Puunene Heavy Industrial Subdivision Project on an approximately 917 meter (3,007.8 feet) long alternate access road [TMK: (2) 3-8-008: pors. 005 and 006] and on 86.029-acres of land [TMK: (2) 3-8-008: 019] within Pūlehu Nui Ahupua'a, Wailuku District, Island of Maui, Hawai'i (Tome and Dega 2012). A portion of the Puunene Naval Air Station was located within the project area. Thus, portions of the former Puunene Naval Air Station (State Site 50-50-09-4164) and a post-World War II cattle ranching site (State Site 50-50-09-4801) were re-located during the survey.

Scientific Consultant Services, Inc. (Dagher and Dega 2016) conducted Archaeological Inventory Survey-level study of a 20.3-acre property in Pu'unēnē, Pūlehu Nui Ahupua'a,

Wailuku District, Island of Maui, Hawai'i [TMK: (2) 3-8-008:001 por.]. The project area is owned by the State of Hawai'i, Department of Land and Natural Resources and is directly adjacent to the current project area. The former project shares a northeastern border with the current project. Full pedestrian survey was conducted of the 20-acre area, as well as a total of twenty (20) stratigraphic trenches (ST-1 through ST-20) having been mechanically excavated. No historic properties were identified on the ground surface or in subsurface contexts during the study. Stratigraphy was identical to what was identified during the current project, which is not surprising given both properties were adjacent to each other. No further archaeological work was recommended for the 20-acre parcel.

Scientific Consultant Services, Inc. (Andricci and Dega 2017, in review) conducted an Archaeological Inventory Survey of 285-acres for the DLNR Industrial and Business Park in Puunene, Pūlehu Nui Ahupua'a, Wailuku District, Island of Maui, Hawai'i [TMK: (2) 3-8-008: 001] (*i.e.,* the current project area). Pedestrian survey led to the identification of one historic property, which was interpreted as an Historic Period irrigation ditch associated with sugar cane cultivation (State Site 50-50-04-8481). Mechanically conducted subsurface testing of 148 stratigraphic trenches did not lead to the identification of traditional or historic cultural materials.

CONSULTATION

During the consultation process, SCS reached out to 21 individuals and organizations in an effort to obtain information that might contribute to the knowledge of traditional cultural activities that were, or are currently, conducted in the vicinity of the proposed DLNR Industrial and Business Park Project. Consultation was conducted via telephone, e-mail, and the U.S. Postal Service. Consultation was sought from:

1. Dr. Kamana'opono M. Crabbe, Office of Hawaiian Affairs;
2. Chris (Ikaika) Nakahashi, Cultural Historian; State Historic Preservation Division;
3. Roy Newton, Office of Hawaiian Affairs;
4. Thelma Shimaoka, Community Outreach Coordinator III, Office of Hawaiian Affairs;
5. Ke'eaumoku Kapu. CEO, Aha Moku o Maui, Inc.;
6. William Ho'ohuli, community member;
7. Lui K. Hokoana, Central Maui Hawaiian Civic Club;
8. Leimana DaMate, Executive Director, Aha Moku Advisory Committee;
9. Albert Perez, Executive Director, Maui Tomorrow Foundation;

10. Lucienne de Naie, President, Maui Tomorrow Foundation;
11. Maui Sierra Club;
12. Hale Mahaolu;
13. Andrew K. Phillips, Burial Sites Specialist, State Historic Preservation Division;
14. Kapulani Antonio, Chair, Maui/ Lana'i Island Burial Council;
15. Kahele Dukelow, Maui /Lana'i Island Burial Council;
16. P. Kaanohi Kaleikini, President, Hui Malama I Na Kupuna o Hawaii Nei and cultural descendant;
17. Basil Oshiro, Kula Makai Representative, Aha Moku o Maui;
18. Timothy Bailey, Kula Mauka Moku, Aha Moku Council;
19. Henry Nakamura; community member;
20. Randall J. Moore, worked at HC&S from 1974 to 2012; and
21. Lui K. Hokoana, Central Maui Hawaiian Civic Club

A Cultural Impact Assessment Notice was published on February 22, 23, and 26, 2017, in *The Honolulu Star-Advertiser* and in *The Maui News*, which published on the same dates on Maui, and the March 2017issue of the OHA newspaper, *Ka Wai Ola* (see Appendix B). These notices requested information of cultural resources or activities conducted within or near the proposed project area, stated locational information, including the *ahupua'a*, district, island, Tax Map Key (TMK) number, and where to respond with pertinent information.

WRITTEN RESPONSES

Analysis of the potential effect of the project on cultural resources, practices or beliefs, the potential to isolate cultural resources, maintain practices or beliefs in their original setting, and the potential of the project to introduce elements that may alter the setting in which cultural practices take place is a requirement of the OEQC (1997:13). As stated earlier, this includes the cultural resources of the different groups comprising the multi-ethnic community of Hawai`i.

Based on the responses, an assessment of the potential effects on cultural resources in the project area and recommendations for mitigation of these effects can be proposed. The consultation process resulted in the receipt of seven written responses. These responses are presented below:

Andrew K. Phillips, Burial Sites Specialist, State Historic Preservation Division
In an e-mail dated February 22, 2017, Andrew K. Phillips, Burial Sites Specialist, State Historic Preservation Division, stated:

I would consult with two members of the Maui Lanai Island burial council and the CEO for Aha Moku o Maui Inc.

- Kapulani Antonio, Chair
- Kahele Dukelow
- Keeaumoku Kapu

Concerns: None. The individuals listed above were contacted by SCS (see list under Consultation discussion) and two of them did provide responses.

P. Kaanohi Kaleikini, President, Hui Malama I Na Kupuna o Hawaii Nei and cultural descendant:

In a series of three e-mails dated March 4, 2017, Ms. Kaleikini provided the following comments:

The ahupuaa of Pulehunui contained 16,687 78/1000 acres, more or less. It was awarded to Keaweamahi and his heirs and assigns forever in fee simple on Land Commission Award 5230, Royal Patent 8140 that was signed by the governor of the Territory of Hawaii, Sanford B. Dole, on July 8, 1902. All kamaaina were living on Pulehunui; most were 'ohana to Keaweamahi.

[No.5230 - KEAWEAMAHI Lahaina, 29 January 1848 Page 252

Greetings to you, the Land Commissioners, William L. Lee, J.S. Smith, Z. Kaauwai, John Ii, and N. Namauu:

I hereby state to you my claim for land on Maui. Its name is Pulehu, it is a land at Kula, and I am the one with the right there, forever.]

After the death of Keaweamahi, his heir, Governor W.L. Moehonua, became the owner of Pulehunui. What happened to the land after the death of W.L. Moehonua is noted in western history books and in documents at the State of Hawaii offices.

I am a State of Hawaii recognized lineal descendant of Keaweamahi and William Luther Moehonua.

This State of Hawaii, Department of Land and Natural Resources project, is planned to be in an area on approximately 285 acres of land on ahupuaa Pulehunui.

In September 2008, human remains were documented during excavations of an archaeological inventory survey of an 1,800 acre land parcel in Pulehunui [TMK: (2) 2-3-002:004]. Many kamaaina lived on Pulehunui and where they lived is where they were buried. Many more human remains and cultural sites have not yet been disturbed by development and should remain undisturbed.

I also would like to add that the kamaaina on the land cultivated heavily. Of course they lived on the land; there were many house sites; kula sites, lo'i sites, pauku sites. There were streams close by for water. Kamaaina complained of the best land for cultivation being lost to foreigners. See Appendix E for Ms. Kaleikini's signed information release form.

Concerns: Ms. Kaleikini stated that, "more human remains and cultural sites have not yet been disturbed by development and should remain undisturbed."

Ke'eaumoku Kapu, CEO, Aha Moku o Maui, Inc.
In an e-mail dated March 4, 2017, Ke'eaumoku Kapu. CEO, Aha Moku o Maui, Inc., stated:

I included Basil Oshiro to this link he is the moku representative for the Kula Makai moku and Timothy Bailey of Kula Mauka area. Sorry if I took so long with answering back. Please go to our website for more information and moku.

Concerns: None

Chris (Ikaika) Nakahashi, Cultural Historian; State Historic Preservation Division
In an e-mail dated March 6, 2017, Chris (Ikaika) Nakahashi, Cultural Historian; State Historic Preservation Division, stated:

Mahalo for contacting me regarding this project.
The people listed at the bottom of your March 3, 2017 letter are appropriate to contact regarding the traditional cultural practices in Pūlehunui, Maui.

Concerns: None

Kapulani Antonio, Chair, Maui/ Lana'i Island Burial Council
In an e-mail dated March 6, 2017, Kapulani Antonio, Chair, Maui/ Lana'i Island Burial Council, stated:
I do not have any information for you regarding the CIA. I'm not sure if you also sent this information to the rest of the Burial Council but will make sure that it get to them since we are not meeting this month.

Concerns: None

Basil Oshiro, Kula Makai Representative, Aha Moku o Maui
In an e-mail dated April 5, 2017, Mr. Oshiro provided the following comments:

I am having a hard time to contact our experts and lineal at this time. I took a look at the area, but could not find anything looking from the highway without accessing the area to the South West.

Looking at the reports, findings of FONSI was reported. Trying to look for how the Military used the area is not really mentioned. Growing up, in the mid and late forties and early fifties, I can remember flying out of the old Puunene airport. Piston engine, propeller air craft (Aloha and Hawaiian at the time). I can remember at time that the Air strip would get flooded with rains in the area. and till this day the drag strip gets flooded. I also remember the old Mokulele would flood also and we used the Mehameha Loop, known as the by-pass road to us at that time. I also remember the Military Housing Barracks also, between the Mukulele Highway and Mehamaha Loop. Yes, Military Housing in the area, before it got plowed under for sugar cane. My dad used the Red wood sidings to build his church (Rin Zai Zen Mission, in Paia, next the the Paia Baldwin Park)

I tried looking for Old Photos of the area, but the contact has not responded to my request as of yet. I hope to send these photos as soon as I acquire them.

I would like to mention that: The report I have in hand is Highly Sugar Coated to make it seem like a great idea for DLNR to proceed with this project.

Concerns and Recommendations: Mr. Oshiro expressed the following environmental concerns and made the following recommendations in regards to the proposed undertaking:

Air quality: will measures be taken to mitigate the effects of the wind, which can get very strong at times, creating actual dust storms and dust devil occur in the open fields and housing areas?

Water: How much water per-day will be needed to supply this development? From where will this water be obtained? Do we have enough Water to supply all the development that is happening on Maui?

Hazardous Materials: There is the possibility of unexploded ordinance buried in the area. Was a study or search done? The military was known to bury unwanted or discarded ordinance or equipment.

Economy: Who will benefit from this project? Will it be outside of Maui, Mainland outfits, or will it be affordable for the average local business owner? Rumors are that the cost is too high for a local business to afford.? (rent or buy)

Solid waste: Will the exiting landfills be able to accommodate the solid waste or hazardous waste the development, when in full operation, generate in the near future, not 20 years from now, a 100 or more years in the future? Mr. Oshiro suggested including operations to handle, or companies to maintain, these waste products. Are there any plans in place to ensure these waste product, or hazardous waste don't contaminate our 'āina"

Warming of the Area: Mr. Oshiro recommended considering the effect colors have on the environment, in an effort to cut down on the amount of heat going into the ground. He suggested the use of lighter colors to reflect back into space instead of being absorbed in the ground. Can there be a solution, using plants (need water) and lighter colors?

Randall J. Moore, worked at HC&S from 1974 to 2012
Randall J. Moore worked at HC&S from 1974 to 2012. In an e-mail dated April 20, 2017, and in a subsequent telephone conversation, Randall J. Moore stated that he understood that HC&S Camp 6 was located in this area near Mokulele Highway and Kama'aina Road (Figure 10). The camp was re-located when the U.S. Military controlled the Naval Air Station (c. 1942). See link below for some of the airport history:
http://www.airfields-freeman.com/HI/Airfields_HI_Maui.htm#puunene

Concerns: None.

PREVIOUSLY CONDUCTED INTERVIEWS

In addition, to the above responses, previously conducted interviews, which were included in an earlier CIA prepared for the proposed DOFAW Baseyard project, and included in the Final Environmental Assessment for the proposed DOFAW Baseyard project (published in the Office of Environmental Quality Control's Environmental Notice on October 8, 2016), are included herein as Appendix D. The information contained in the interview summaries is considered to be relevant to the proposed project as well because the DOFAW Baseyard project site is located with the 280-acre DLNR Industrial and Business Park site.

CULTURAL IMPACT ASSESSMENT SUMMARY

This Cultural Impact Assessment was prepared in accordance with the Guidelines for Assessing Cultural Impacts (OEQC 1997:11-13). The Guidelines recommend that a CIA consult relevant individuals/organizations, conduct ethnographic interviews and archival and historical research, identify cultural resources and practices located within the project area or in proximity and, finally, assess the impact of the proposed action and its mitigation measures on the cultural practices or resources identified.

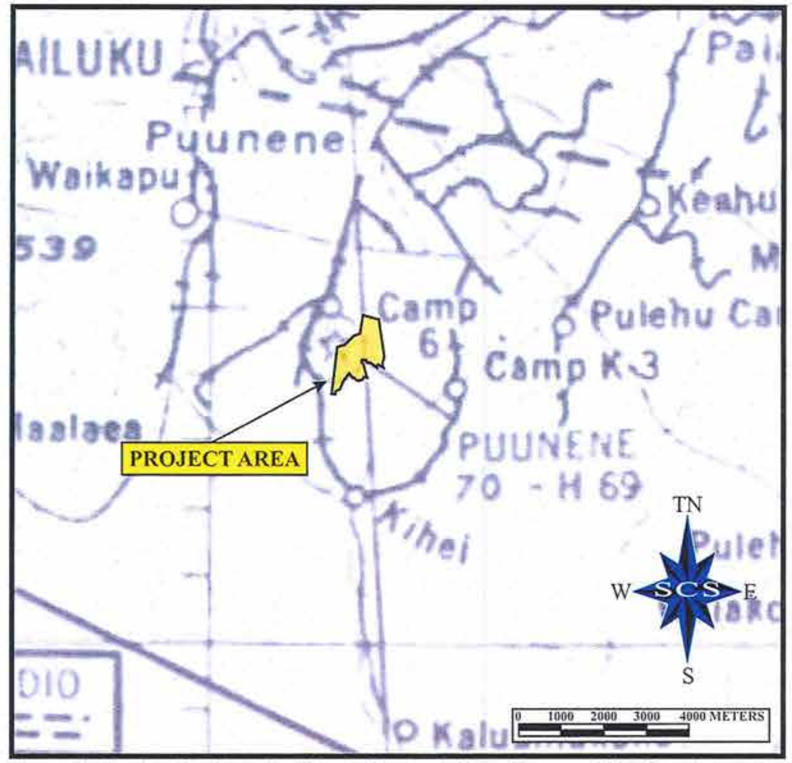

Figure 10: Portion 1947 Hawaiian Islands Sectional Chart (Freeman 2016) Showing Plantation-Era Camps in the Vicinity of the Project Area.

IDENTIFED CULTURAL PRACTICES

Letters of inquiry were sent to twenty-one individuals and organizations that may have knowledge or information pertaining to the collection of cultural resources and/or practices currently, or previously, conducted in the vicinity of the proposed project area. The consultation process resulted in SCS receiving responses from nine individuals. Concerns expressed pertained to impacts to remnants of traditional Native Hawaiian activities previously conducted in the area and to impacts to the environment. No on-going traditional cultural practices were identified.

ARCHAEOLOGICAL RESOURCES AND NATIVE HAWAIIAN BURIAL INTERNMENT

During the consultation process, one individual expressed concerns that historic properties, including traditional Native Hawaiian habitation, agricultural, and burial sites may be present within the proposed project area.

IMPACT ASSESSMENT

The Cultural Impact Assessment has reviewed historical research and suggestions from the community and organizations, and analyzed the potential effect of the project on cultural resources, practices or beliefs, its potential to isolate cultural resources, practices or beliefs from their setting, and the potential of the project to introduce elements which may alter the setting in which cultural practices take place, as required by the OEQC (1997). Based upon this review and analysis, no traditional cultural practices are currently known to be practiced within the proposed project area.

The Land Use Commission (LUC) is required to apply the analytical framework set forth by the Hawaii Supreme Court in Ka Pa'akai O Ka'Aina v. Land Use Comm'n, State of Hawai'i, 94 Hawai'i 31, 7 P.3d 1068 (2000) (hereinafter, "***Ka Pa'akai***"). In this case, a coalition of native Hawaiian community organizations challenged an administrative decision by the Land Use Commission (the "***LUC***") to reclassify nearly 1,010 acres of land from conservation to urban use, to allow for the development of a luxury project including upscale homes, a golf course, and other amenities. The native Hawaiian community organizations appealed, arguing that their native Hawaiian members would be adversely affected by the LUC's decision because the proposed development would infringe upon the exercise of their traditional and customary rights. Noting that "[a]rticle XII, section 7 of the Hawaii Constitution obligates the LUC to protect the reasonable exercise of customarily and traditionally exercised rights of native Hawaiians to the extent feasible when granting a petition for reclassification of district boundaries," the Hawai'i Supreme Court held that the LUC did not provide a sufficient basis to determine "whether [the agency] fulfilled its obligation to preserve and protect customary and traditional rights of native

Hawaiians" and, therefore, the LUC "failed to satisfy its statutory and constitutional obligations." Ka Pa'akai, 94 Hawai'i at 46, 53, 7 P.3d at 1083, 1090.

The Hawai'i Supreme Court in Ka Pa'akai provided an analytical framework in an effort to effectuate the State's obligation to protect native Hawaiian customary and traditional practices while reasonably accommodating competing private interests. In order to fulfill its duty to preserve and protect customary and traditional native Hawaiian rights to the extent feasible, the LUC must—at a minimum—make specific findings and conclusions as to the following:

(1) the identity and scope of "valued cultural, historical, or natural resources" in the petition area, including the extent to which traditional and customary native Hawaiian rights are exercised in the petition area;

(2) the extent to which those resources--including traditional and customary native Hawaiian rights--will be affected or impaired by the proposed action; and

(3) the feasible action, if any, to be taken by the LUC to reasonably protect native Hawaiian rights if they are found to exist.

See Ka Pa'akai, 94 Hawai'i at 47, 7 P.3d at 1084.

The Cultural Impact Assessment has reviewed historical research and suggestions from the community and organizations, and analyzed the potential effect of the project on cultural resources, practices or beliefs, its potential to isolate cultural resources, practices or beliefs from their setting, and the potential of the project to introduce elements which may alter the setting in which cultural practices take place, as required by the OEQC Guidelines (1997). Based upon this review and analysis, no traditional cultural practices are currently known to be conducted within the proposed project area. However, information provided by the community and presented in the current CIA, suggests the proposed undertaking may have an impact on existing traditional Native Hawaiian sites, including burials, and the integrity of the environment.

As noted, SCS recently conducted an Archaeological Inventory Survey (Andricci and Dega 2017, in review), which included the mechanical excavation of 148 stratigraphic trenches, of the project area. During the survey, State Site 50-50-04-8481, an Historic-era irrigation ditch associated with sugar cane cultivation, was newly identified. However, no traditional or historic cultural materials were identified in subsurface contexts. State Site 50-50-04-8481, an Historic Period irrigation ditch associated with sugar cane cultivation, was evaluated for significance as outlined in Hawai'i Administrative Rules §13-275-6 and found to be significant under Criterion d, for information content. The State Historic Preservation Division is in the process of reviewing the archaeological inventory survey report (Andricci and Dega 2017, in review), and will address issues related to historic properties in the proposed project area, and recommend appropriate mitigation measures, if necessary.

The Environmental Impact Statement will address what efforts have been taken or are proposed to mitigate impacts to the environment within the proposed DLNR Industrial and Business Park, Pūlehu Nui Ahupua'a, Wailuku (Kula) District, Island of Maui, Hawai'i [TMK: (2) 3-8-008:001 por.] project area.

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APPENDIX A: EXAMPLE LETTER OF INQUIRY

Scientific Consultant Services, Inc.
1347 Kapiolani Blvd., Suite 408 Honolulu, Hawai'i 96814

Aloha kāua:

On behalf of the State of Hawai'i, Department of Land and Natural Resources (DLNR), Scientific Consulting Services (SCS) is conducting a Cultural Impact Assessment (CIA) in advance of the proposed DLNR Business Park. The DLNR Business Park will be located on 285 acre of lands owned by the State of Hawa'i in Pūlehunui Ahupua'a, Wailuku (Kula) District, Island of Maui, Hawai'i [TMK: (2) 3-8-008:001 por.].

The DLNR Business Park development is proposed to be a mixture of light-industrial/commercial and public/quasi-public uses, including the provision of required infrastructure systems. Key components of the plan include development of small, medium, and large lots for light industrial, commercial, government, and nonprofit uses to meet varying needs of future tenants. Lots within the proposed project will be leased and developed by the individual lessees. Lease revenue generated at DLNR Business Park will provide a long-term revenue stream to support a wide range of DLNR programs

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including managing sensitive natural, cultural, and recreational resource areas, coastal lands and waters, water resources, conservation and forestry lands, historic sites, small boat harbors, parks and recreational facilities.

The purpose of this Cultural Impact Assessment (CIA) is to identify and understand the importance of any traditional Hawaiian and/or historic cultural resources or traditional cultural practices associated with the proposed project area and the surrounding *ahupua`a*. In an effort to promote responsible decision-making, the CIA will gather information about the project area and its surroundings through research and interviews with individuals that are knowledgeable about the area in order to assess potential impacts to the cultural resources, cultural practices and beliefs identified as a result of the proposed Project. We are seeking your *kōkua* and guidance regarding the following aspects of our study:

- General history as well as present and past land use of the project area
- Knowledge of cultural resources which may be impacted by future development of the project area (*i.e.* historic and archaeological sites, as well as burials)
- Knowledge of traditional gathering practices in the project area, both past and ongoing
- Cultural associations of the project area, such as legends, traditional uses and beliefs
- Referrals of *kūpuna* or elders and *kama`āina* who might be willing to share their cultural knowledge of the project area and the surrounding *ahupua`a*
- Due to the sensitive nature regarding *iwi kūpuna* or ancestral remains discovered, *mana`o* regarding *nā iwi kūpuna* will be greatly appreciated
- Any other cultural concerns the community has related to Hawaiian cultural practices within or in the vicinity of the project area.

Enclosed are maps showing the proposed project area. I invite you to contact me at the Scientific Consultant Services, Honolulu, office at (808) 597-1182 or send me an email at

cathy@scshawaii.com with any information or recommendations concerning this Cultural Impact Assessment. I would greatly appreciate hearing from you!

Mahalo and Aloha,

Cathleen Dagher
Senior Archaeologist

Enclosures (3)

Cc:

APPENDIX B: NEWSPAPER NOTICE AND AFFIDAVIT

AFFIDAVIT OF PUBLICATION

STATE OF HAWAII, } ss.
County of Maui. }

Rhonda M. Kurohara being duly sworn deposes and says, that she is in Advertising Sales of the Maui Publishing Co., Ltd., publishers of THE MAUI NEWS, a newspaper published in Wailuku, County of Maui, State of Hawaii; that the ordered publication as to Scientific Consultant Services, Inc. (SCS)

of which the annexed is a true and correct printed notice, was published 3 times in THE MAUI NEWS, aforesaid, commencing on the 21st day of February, 2017, and ending on the 26th day of February, 2017, (three days inclusive), to-wit: on February 21, 23, 26, 2017

and that affiant is not a party to or in any way interested in the above entitled matter.

This 1 page Scientific Consultant Services, Inc., dated February 21, 23, 26, 2017, was subscribed and sworn to before me this 27th day of February, 2017, in the Second Circuit of the State of Hawaii, by Rhonda M. Kurohara

Notary Public, Second Judicial Circuit, State of Hawaii
BETTY E. UEHARA
My Commission expires 09-26-2019

BETTY E. UEHARA NOTARY PUBLIC No. 83-344 STATE OF HAWAII

Scientific Consultant Services, Inc. (SCS) is seeking information on cultural resources and traditional cultural activities, previously or on-going, within or near the proposed Department of Land and Natural Resources (DLNR) Business Park. The DLNR Business Park will be located on 285 acres of land owned by the State of Hawai'i, in Pūlehunui Ahupua'a, Wailuku (Kula) District, Island of Maui, Hawai'i [TMK: (2) 3-8-008:001 por.]. Please respond within 30 days to Cathleen Dagher at (808) 597-1182.
(MN: Feb. 22, 23, 26, 2017)

APPENDIX C: RESPONSES

SCIENTIFIC CONSULTANT SERVICES, Inc.
1347 Kapiolani Blvd., Suite 408 Honolulu, Hawai'i 96814

Aloha kāua:

This is our follow-up letter to our February 16, 2017 letter which was in compliance with the statutory requirements of the State of Hawai`i Revised Statute (HRS) Chapter 343 Environmental Impact Statements Law, and in accordance with the State of Hawai`i Department of Health's Office of Environmental Quality Control (OEQC) Guidelines for Assessing Cultural Impacts as adopted by the Environmental Council, State of Hawai`i, on November 19, 1997.

On behalf of the State of Hawai'i, Department of Land and Natural Resources (DLNR), Scientific Consulting Services (SCS) is conducting a Cultural Impact Assessment (CIA) in advance of the proposed DLNR Business Park. The DLNR Business Park will be located on 285 acre of lands owned by the State of Hawa'i in Pūlehunui Ahupua'a, Wailuku (Kula) District, Island of Maui, Hawai'i [TMK: (2) 3-8-008:001 por.].

The DLNR Business Park development is proposed to be a mixture of light-industrial/commercial and public/quasi-public uses, including the provision of required infrastructure systems. Key components of the plan include development of small, medium, and large lots for light industrial, commercial, government, and nonprofit uses to meet varying needs of future tenants. Lots within the proposed project will be leased and developed by the individual lessees. Lease revenue generated at DLNR Business Park will provide a long-term revenue stream to support a wide range of DLNR programs including managing sensitive natural, cultural, and recreational resource areas, coastal lands and waters, water resources, conservation and forestry lands, historic sites, small boat harbors, parks and recreational facilities,

The purpose of this Cultural Impact Assessment (CIA) is to identify and understand the importance of any traditional Hawaiian and/or historic cultural resources or traditional cultural practices associated with the proposed project area and the surrounding *ahupua`a*. In an effort to promote responsible decision-making, the CIA will gather information about the project area and its surroundings through research and interviews with individuals that are knowledgeable about the area in order to assess potential impacts to the cultural resources, cultural practices and beliefs identified as a result of the proposed Project. We are seeking your *kōkua* and guidance regarding the following aspects of our study:

Ph: 808-597-1182 SCS... SERVING ALL YOUR *ARCHAEOLOGICAL* NEEDS Fax: 808-597-1193
Neighbor Island Offices • Hawai'i Island • Maui • Kaua'i

- General history as well as present and past land use of the project area
- Knowledge of cultural resources which may be impacted by future development of the project area (*i.e.* historic and archaeological sites, as well as burials)
- Knowledge of traditional gathering practices in the project area, both past and ongoing
- Cultural associations of the project area, such as legends, traditional uses and beliefs
- Referrals of *kūpuna* or elders and *kama`āina* who might be willing to share their cultural knowledge of the project area and the surrounding *ahupua`a*
- Due to the sensitive nature regarding *iwi kūpuna* or ancestral remains discovered, *mana`o* regarding *nā iwi kūpuna* will be greatly appreciated
- Any other cultural concerns the community has related to Hawaiian cultural practices within or in the vicinity of the project area.

I invite you to contact me at the Scientific Consultant Services, Honolulu, office at (808) 597-1182 or send me an email at cathy@scshawaii.com with any information or recommendations concerning this Cultural Impact Assessment. I would greatly appreciate hearing from you!

Mahalo and Aloha,

Cath Dagher

Cathleen Dagher
Senior Archaeologist

Cc:

APPENDIX D: DOFAW BASEYARD INTERVIEW SUMMARIES

Interview with: *Blossom Feiteira*

Interview Date: *March 26, 2015*

Interviewed By: *Cheryl K. Okuma, Senior Associate*
Munekiyo Hiraga

The interview with Blossom Feiteira took place at the offices of Munekiyo Hiraga on March 26, 2015. Ms. Feiteira is a native Hawaiian and beneficiary of the Department of Hawaiian Home Lands who was born in 1959. She was raised in Lahaina on Dickenson Street across from the Maria Lanakila Church. She currently lives in Wailuku. She is married to Matthew Feiteira and has four (4) children, three (3) boys and one (1) girl.

Her father was John Ah Heen Yap whose father, Siu Choi Yap, emigrated from China in 1895. Her father's Hawaiian mother was Mary Kuhia who was born in Hana. Her mother was Theresa Kaaiawahia whose father was Albert Kaaiawahia who originally came from Kaupo. In 1800 her grandfather (Albert Kaaiawahia) moved to Lahaina to work for AmFac to run the water system.

Ms. Feiteira has an interest in Hawaiian culture and serves as President of the Association of Hawaiians for Homestead Lands and Secretary of Na Poe Kokua.

Ms. Feiteira has no lineal connection to Pulehunui. But, she indicated that she conducted some research of the area and found that there was a case in the Supreme Court of the Hawaiian Kingdom in which a person who bought land in the area requested a court judgment on the metes and bounds description of the property. At that time three (3) men testified, who were the last generation to live in Pulehunui.

According to Ms. Feiteira the area originally belonged to the Ali'i. In the Great Mahele this *ahupua'a* was kept separate. Originally the area was to be developed as homestead lands. After the last families left the area it was actively used for sugar cane cultivation. Due to the former sugar cane cultivation, artifacts that may have once been on the property were probably destroyed.

Ms. Feiteira notes that here family utilizes the Maui Raceway Park located south of the project site. She is not aware of any traditional cultural practices remaining in the area and expressed she has no concerns of adverse impacts by the project. No remnants of the Hawaiian culture remain since the area was used for sugar cane, the military (airport) and back to sugar cane.

She supports the proposed project and suggested that DOFAW conduct community consultation and meetings regarding the proposed project. Ms. Feiteira expressed a desire for a Master Plan effort for the general region.

PROPOSED DIVISION OF FORESTRY AND WILDLIFE BASEYARD AT PULEHUNUI

Interview with: *Kehau Filimoeatu*

Interview Date: *March 26, 2015*

Interviewed By: *Cheryl K. Okuma, Senior Associate*
Munekiyo Hiraga

The interview with Kehau Filimoeatu took place at the offices of Munekiyo Hiraga on March 26, 2015. Ms. Filimoeatu is a native Hawaiian and beneficiary of the Department of Hawaiian Home Lands who was born in 1947 at the old hospital originally located on Baldwin Avenue in Paia, Maui. Her parents were Quang Gee Lum Ho who retired as a police officer for the Maui Police Department and Irene May Lum Ho (born Wahinekona) who was a kupuna who taught at Lihikai School for 20 years. Ms. Filimoeatu has a brother, Nathan who is an entertainer and a sister, Ada Lum Ho. She also has two (2) sons and a daughter.

Ms. Filimoeatu was educated mainly on Maui where she attended Kaunoa School which was an English standard school located in Spreckelsville and Baldwin High School. When she was 12-years old she attended one (1) year at Kamehameha School on Oahu as a boarder. She did not enjoy the school and being away from her family and returned to Maui.

Ms. Filimoeatu is a board member of the advocacy group, Hui Kako'o 'Aina Ho'opulapula which advocates the interest of applicants and native Hawaiians on the Hawaiian Home Lands wait list.

Because Ms. Filimoeatu is younger than many of our elders or kupuna she has very little memory or knowledge of the ancient aspects of the area. She does remember that as a police officer her father patrolled the general area. As a child she remembers standing near the airport chain link fence to watch the planes on the old runway just south of the project area. She also remembers the area was always far out from Kahului and North Kihei with nothing but the former airport and dry grasses. Besides being barren the area was also verywindy.

Ms. Filimoeatu has very little knowledge of the airport area. She can't explain why but she had an uncomfortable feeling about the place name, Pu'unene (also known as Pulehunui) for the area. She and other beneficiaries visited the site to obtain spiritual guidance and a feeling for the place. According to Ms. Filimoeatu she learned that Pu'u on nene is actually in Spreckelsville and indicated there needs to be further research as to what actually was there before the war when the airport was constructed. She is not

aware of any traditional or cultural practices and uses past or present in the project area due to disturbance (e.g. sugar cane cultivation) and other uses.

She expressed support for the project recognizing Division of Forestry and Wildlife's (DOFAW) need and noted that the general area is an ideal site for the project given the nearby infrastructure and its distance away from Mokulele Highway. Ms. Filimoeatu mentioned that there are economies of scale if the other divisions' operational needs are also addressed. She expressed a desire that there be a Master Plan for the region.

Ms. Filimoeatuwondered about the reason DOFAW chose the project site and if staffing is increasing. She concluded the interview by stating that she did not feel there will be adverse impacts in the area from the proposed project.

PROPOSED DIVISION OF FORESTRY AND WILDLIFE (DOFAW) BASEYARD AT PULEHUNUI

Interview with: *Randall Moore*

Interview Date: *April 10, 2015*

Interviewed By: *Cheryl K. Okuma, Senior Associate*
Munekiyo Hiraga

The interview with Randall Moore took place at his home in Kula on April 10, 2015. Mr. Moore was born in Texas and moved to Puunene, Maui in 1974. After a couple of years of residing in the Puunene area, he moved to Kula where he built his home and currently resides. For 38 years, Mr. Moore was employed by Hawaiian Commercial & Sugar Company (HC&S) until he retired. As an agricultural engineer, Mr. Moore's expertise included work on drip irrigation systems (e.g. irrigation installation and operations), knowledge of ditches, reservoirs, pumps and water resources on the island, including the Pulehunui area. While at HC&S, Mr. Moore was involved in land and property issues for the company on Maui, and he developed his knowledge of the proposed baseyard property as he worked in this area. During his years with HC&S, Mr. Moore dealt with the Department of Land and Natural Resources (DLNR), an agency which had a long term lease with HC&S until it expired. He notes that some land was transferred to Department of Hawaiian Home Lands and the area of the drag strip was conveyed to the County of Maui and that adjacent to the property is the Department of Agriculture cattle quarantine station. The proposed baseyard is under DLNR control and HC&S is farming the area under a revocable permit.

Mr. Moore noted that although the proposed baseyard would have good access via Kamaaina Road from a signalized intersection at Mokulele Highway, the main cane haul road (S. Firebreak Road) is a public road which experiences traffic from the quarry on State DLNR and Alexander & Baldwin Inc. land. This cane road also experiences HC&S traffic during cane harvesting and year-round hauling of large trucks carrying heavy equipment, fertilizer, and weed control products. Kamaaina Road is State owned and is currently maintained by Hawaiian Cement and he expressed concern as to who will maintain and improve the substandard roads.

Mr. Moore supports DOFAW's proposed baseyard project, but noted that the surrounding area is cultivated by sugar cane and is characterized by occasional smoke during cane harvesting, the threat of unscheduled fires in the fields, and dust and wind noise from 24-hour operations (harvest plowing and planting). As the proposed location has been in cane cultivation, he expressed a preference for a location that is on unproductive land, closer to the existing Kahului DOFAW baseyard, or in the vicinity of the Hawaii Army National Guard Armory and drag strip.

As the subject property has been in sugar production for nearly 100 years and has a military history as a naval air station with bunkers during World War II, Mr. Moore is not aware of cultural practices in the area.

Interview with: *Mona Kapaku*

Interview Date: *May 2, 2016*

Interviewed By: *Colleen Suyama, Senior Associate*
Munekiyo Hiraga

Mona Kapaku is of pure Hawaiian decent and was born in Lahaina, Maui. Ms. Kapaku belongs to the Maui Native Hawaiian Chamber of Commerce and is Vice President of the Board of Directors for Hui Loke Ola Pono, which promotes Hawaiian health. Her interests include seeking agreement from various family members in finding productive ways to utilize the many family kuleana lands of her father's family.

As the Maui operation manager of DHHL she is most familiar with the nearby DHHL lands located near the Maui Humane Society site and on the east side of Mokulele Highway south of the Maui Motor Sports Park and Hawai'i Army National Guard. DHHL lands have been in sugar cane cultivation for several years and include structures from World War II (WWII) built during the time the military operated an airport in Pulehunui (Maui Motor Sports Park site). With the demise of sugar cane cultivation at the end of 2016, DHHL concerns relate to removal of the WWII structures on their property and environmental concerns from the use of pesticides of DHHL lands. DHHL supports the Department of Land and Natural Resources (DLNR) efforts to master plan State lands and the proposed Pulehunui Baseyard.

Ms. Kapaku's knowledge of the area is third person received from beneficiaries of Hawaiian Home Lands (HHL) and she cannot confirm the authenticity of the information being provided. She has been told that there was once a fishing village in the area and that a historic battle on Maui was fought in the area. She has been told by beneficiaries that they can feel the battle that once was fought in the area. Other than the limited knowledge of the area, Ms. Kapaku is not aware of any cultural use of the area.

INTERVIEW SUMMARY

Interview with: *Henry Nakamura*

Interview Date: *May 9, 2016*

Interviewed By: *Colleen Suyama, Senior Associate*
Munekiyo Hiraga

Mr. Henry Nakamura was born on December 30, 1928 at the Pu'unene Hospital that was once located between Hansen Road and POlehu Road in Hospital Camp. Hospital Camp was near the intersection of Hansen Road and Hana Highway and was occupied by Japanese families who worked for Hawaiian Commercial & Sugar Company (HC&S). His parents were Taisuke and Yoshiko (maiden name Shimada) Nakamura. His father was born in Ha'iku, Maui and worked for HC&S, while his mother was born in McGerrow Camp, Pu'unene, Maui. Mr. Nakamura has a sister Lillian Sodetani and a brother, Paul Nakamura. Mr. Nakamura is married to the former Jeanette Midori Ito and has a daughter.

Mr. Nakamura worked for HC&S from 1949 until he retired in 1993. He started as a grass cutter and was promoted into several jobs with HC&S. When Mr. Nakamura retired he worked with the HC&S Budget Office.

Mr. Nakamura was raised at McGerrow Camp, Pu'unene, Maui located north of the Pulehunui area near the Pu'unene Mill. McGerrow Camp was the largest plantation camp on Maui and contained homes for the "haole" bosses who lived near the post office in the Camp and mostly Japanese families, as well as, Filipino and Portuguese families, and one (1) Russian family.

During Mr. Nakamura's childhood, Mokulele Highway was lower than today and there were railroad tracks along the highway from the Pu'unene Mill to KThei. Mr. Nakamura remembers sitting on benches in the train cars and riding the train to KThei with other plantation families for a plantation-sponsored picnic with their picnic lunch. The plantation supplied the juice made of Malolo syrup and water.

Mr. Nakamura remembers that during World War II they would pick kiawe seeds near Pulehunui and the Navy pilots would wave to them as they flew into the Navy Air Station Kahului (NASKA) at Pu'unene. There would be torpedo planes and later corsairs flying into the airport. Camp Six was located near the air station and during World War II the camp was relocated for security reasons because it was home to several Japanese families. John Arisumi's family was one of the families who lived in the Camp.

Mr. Nakamura remembers that during his childhood there would be many birds that congregated along the train tracks. He remembe rs an incident where he and about ten
(10) of his friends lay in wait below the highway with their sling shots waiting to shoot the birds. A convoy of military trucks were traveling on Mokulele Highway when the lead truck stopped. When he and his friends stood up they began shooting their sling shots and hit several birds. The soldiers in the convey then began clapping.

There are several bunkers built during the war that are still in the area. HC&S left the bunkers in the fields because the walls are thick and too hard to demolish.

Regarding the area near the existing DOFAW baseyard near the Kahului Airport, Mr. Nakamura is only aware that his father was the pump supervisor for the area during the war when he worked for HC&S. During World War II, due to security concerns, the bosses at HC&S vouched for him.

Mr. Nakamura is familiar with the area from his experience living in McGerrow Camp and working for HC&S. Mr. Nakamura is unaware of any cultural sites or practices in both the Pulehunui and Kahului airport areas.

APPENDIX E: SIGNED INFORMATION RELEASE FORMS

INFORMATION RELEASE FORM

I, the undersigned, provided written testimony, via e-mail, to Cathleen Dagher from Scientific Consultant Services, Inc., on April 6, of the year 2017.

I understand that the information I have provided to Scientific Consultant Services, Inc., shall be submitted as part of a Cultural Impact Assessment (CIA) report prepared in advance of the proposed DLNR Business Park. The DLNR Business Park will be located on 285 acre of lands owned by the State of Hawai'i, in Pūlehunui Ahupua'a, Wailuku (Kula) District, Island of Maui, Hawai'i [TMK: (2) 3-8-008:001 por.].

I have read the summary of my testimony and the information is true and accurate to the best of my knowledge. By signing this release form, I am providing my approval for the release of the information to Scientific Consultant Services, Inc., for the purpose outlined above (*i.e.*, making the contents of this interview available for publication to the general public).

Print Name: Basil Oshiro

Signature: [signature]

Received by CD on this date

Release Dated: 6/12/2017

INFORMATION RELEASE FORM

I, the undersigned, provided written testimony, via e-mail, to Cathleen Dagher from Scientific Consultant Services, Inc., on March 4, of the year 2017.

I understand that the information I have provided to Scientific Consultant Services, Inc., shall be submitted as part of a Cultural Impact Assessment (CIA) report prepared in advance of the proposed DLNR Business Park. The DLNR Business Park will be located on 285 acre of lands owned by the State of Hawai'i, in Pūlehunui Ahupua'a, Wailuku (Kula) District, Island of Maui, Hawai'i [TMK: (2) 3-8-008:001 por.].

I have read the summary of my testimony and the information is true and accurate to the best of my knowledge. By signing this release form, I am providing my approval for the release of the information to Scientific Consultant Services, Inc., for the purpose outlined above (*i.e.*, making the contents of this interview available for publication to the general public).

Print Name: Paulette Kaanohi Kaleikini

Signature: [signature]

Release Dated: April 3, 2017

APPENDIX F: LAND COMMISSION AWARD 5230

Number: 05230

Claim Number:	**05230**
Claimant:	**Keaweamahi**
Other claimant:	
Other name:	
Island:	**Maui**
District:	**Kula,Lahaina**
Ahupuaa:	**Pulehunui, Polaiki**
Ili:	

Apana:	5	Awarded:	1
Loi:	7	FR:	
Plus:		NR:	**252v6**
Mala Taro:		FT:	**181v7**
Kula:	2	NT:	**63v5**
House lot:		RP:	**8140, 8252**
Kihapai/Pakanu:		Number of Royal Patents:	2
Salt lands:		Koele/Poalima:	No
Wauke:		Loko:	No
Olona:		Lokoia:	No
Noni:		Fishing Rights:	No
Hala:		Sea/Shore/Dunes:	Yes
Sweet Potatoes:		Auwai/Ditch:	No
Irish Potatoes:		Other Edifice:	No
Bananas:		Spring/Well:	No
Breadfruit:		Pigpen:	No
Coconut:		Road/Path:	No
Coffee:		Burial/Graveyard:	No
Oranges:		Wall/Fence:	No
Bitter Melon/Gourd:		Stream/Muliwai/River:	No
Sugar Cane:		Pali:	No
Tobacco:		Disease:	No
Koa/Kou Trees:		Claimant Died:	No
Other Plants:		Other Trees:	

Other Mammals:	No	Miscellaneous:	Kula and Lahaina

No. 5230, Keaweamahi, Lahaina, 29 January 2848
N.R. 252v6

Greetings to you, the Land Commissioners, William L. Lee, J.S. Smith, Z. Kaauwai, John Ii, and N. Namaau: I hereby state to you may claim for land on Maui. Its name is Pulehu, it is a land at Kula, and I am the one with the right there, forever.

Also, at Lahaina are seven mo`o. One lo`i is in this land. Kanaina is the one who has the land and we are the people on the land.

There is a pauku of land inland, named Puuopapai. the mo`os are there with this pauku of land. The land in Lahaina, is at Polanui. That is where the aforesaid things are.
KEAWEAMAHI

F.T. 181-182v7
Cl. 5230, Keaweamahi

Kaiakeakua, sworn - Nothing intelligible could be got out of this witness.

Paulo Kauhihope, sworn, The claimant has 3 pieces of lands in "Polanui," Lahaina and one piece of kula called Pulehu which I do not well know.

No. 1 is a pauku of land.
No. 2 consists of 7 moos.
No. 3 is one loi.

The claimant received these lands from Kakaulia in 1837 and his title has never been disputed.

No. 1 is bounded:
Mauka by Malaekahana's land
Olowalu by "Kamani"
Makai by Rabati J. White's land
Kaanapali by "Kooka."

No. 2 is bounded:
Mauka by Kuhalake's land
Olowalu by "Kamani"
Makai by Rabati J. White's land
Kaanapali by "Kooka."

No. 3 is bounded:
Mauka by Kui's land
Olowalu and Makai sides by the same

Kaanapali by "Kooka."

Z. Kaauwai, sworn, I know the claimant's kula Pulehu in East Maui. I have always understood that the claimant received this from the King in 1843 and I never heard his title disputed (he, Keoni Ana and the King in reference to this land)

It is bounded:
Mauka by the "Haleakala" mountains
Honuaula by "Palehuiki"
Makai by the sea shore
Makawao by Omaopio.

There are a great many natives on this land.

N.T. 63-64v5
No. 5230, Keaweamahi

Kaiakekaua, sworn, this witness was unaware of the inaccuracy of his statement, he has been sworn again as indicated below.

P. Kauhihape, sworn, He has seen 3 sections in the Polanui ahupuaa which were from Makaulia in 1837, no objections to the present time.

No. 2 - Pasture.
Mauka by Kuhalake's land
Olowalu by Kamani land
Makai by Polaiki land
Kaanapali by Kooka land.

No. 3 - Patch.
Mauka, Olowalu and Makai Kini's land
Kaanapali by Kooka land.

No. 1 - A patch and pasture.
Mauka by Malae Kahana's land
Olowalu by Kahaia
Makai by Kaalokai
Kaanapali by Wainee 2 land.

SEE 316, vol. 10.

Z. Kaauwai, sworn, he has seen the Pulehu ahupuaa in Kula, Maui, Keaweamahi had received it in 1843, no one had objected to him.

The boundaries of that ahupuaa are:

Mauka by Haleakala mountain
Honuaula by Pulehu iki ahupuaa
Makai by Kekai
Makawao by Omaopio ahupuaa.

Many people live in here.

N.T. 316v10
No. 5230, Keaweamahi, 28 September 1853

Keaweamahei's land in the Book of the Mahele.
Pulehu ahupuaa, Kula, Maui.
True Copy
A.G. Thruston, Clerk, Interior Department
28 September 1853

[Award 5230; Land Patent 8140 Pulehunui Kula; 1 ap. (ahupua`a; Ap. 2); 1668.78 Acs; Land Patent 8252; Polanui Lahaina; 4 ap.1 Ac. 1 rods]

APPENDIX

AIR QUALITY STUDY

I

AIR QUALITY STUDY

FOR THE PROPOSED

DLNR INDUSTRIAL AND BUSINESS PARK PROJECT

PUUNENE, MAUI, HAWAII

Prepared for:

Munekiyo Hiraga

December 2018

B.D. NEAL & ASSOCIATES

Applied Meteorology • Air Quality • Computer Science

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1.0 SUMMARY

The Department of Land and Natural Resources is proposing the Maui Industrial and Business Park at Puunene on the island of Maui. The proposed project will provide lots for a mixture of commercial and light industrial use on an approximately 280-acre site near Puunene. The project is expected to be developed over a period of about 20 years and be fully developed by 2038. This study examines the potential short- and long-term air quality impacts that could occur as a result of construction and use of the proposed facilities and suggests mitigative measures to reduce any potential air quality impacts where possible and appropriate.

Both federal and state standards have been established to maintain ambient air quality. At the present time, seven parameters are regulated including: particulate matter, sulfur dioxide, hydrogen sulfide, nitrogen dioxide, carbon monoxide, ozone and lead. Hawaii air quality standards are comparable to the national standards except those for nitrogen dioxide and carbon monoxide which are more stringent than the national standards.

Regional and local climate together with the amount and type of human activity generally dictate the air quality of a given location. The climate of the project area is very much affected by its elevation near sea level and by nearby mountains. The predominant trade winds tend to be channeled through the area by the mountains to the east and west. Temperatures in the project area are generally very consistent and warm with average daily temperatures ranging from about 63°F to 86°F. Rainfall in the

project area is minimal with an average of about 13 inches per year.

Except for periodic impacts from volcanic emissions (vog) and possibly occasional localized impacts from traffic congestion and local agricultural sources, the present air quality of the project area is believed to be relatively good. There is very little air quality monitoring data from the Department of Health for the project area, but the limited data that are available suggest that concentrations are generally within state and national air quality standards. The recent cessation of sugarcane cultivation in the project area likely has resulted in improved air quality.

If the proposed project is given the necessary approvals to proceed, there may be some short- and/or long-term impacts on air quality that may occur either directly or indirectly as a consequence of project construction and use. Short-term impacts from fugitive dust could occur during the project construction phases. To a lesser extent, exhaust emissions from stationary and mobile construction equipment, from the minor disruption of traffic, and from workers' vehicles may also affect air quality during the period of construction. State air pollution control regulations require that there be no visible fugitive dust emissions at the property line. Hence, an effective dust control plan must be implemented to ensure compliance with state regulations. Fugitive dust emissions can be controlled to a large extent by watering of active work areas, using wind screens, keeping adjacent paved roads clean, and by covering of open-bodied trucks. Other dust control measures to consider include limiting the area that is disturbed at any given time and/or mulching or chemically stabilizing inactive areas that have been worked. Paving and landscaping of project areas early in the construction schedule will also reduce dust emissions. Exhaust emissions can be mitigated by moving construction equipment and workers to and from the project site during off-peak traffic hours.

To assess the potential long-term impact of emissions from project-related motor vehicle traffic operating on roadways in the project area after construction is completed, a computerized air quality modeling study was undertaken. The air quality modeling study estimated current worst-case concentrations of carbon monoxide at intersections in the project vicinity and predicted future levels both with and without the proposed project. During worst-case conditions, model results indicated that present 1-hour and 8-hour worst-case carbon monoxide concentrations are well within both the state and the national ambient air quality standards. In the year 2038 without the project, worst-case carbon monoxide concentrations were predicted to decrease (improve) despite an increase in traffic, and concentrations would remain well within standards. This is because emissions from the increase in traffic will be more than offset by the retirement of older, more-polluting vehicles over time. With the project in the year 2038 and with proposed roadway improvements, estimated worst-case carbon monoxide concentrations indicated only minimal or no impact compared to the without project case. Through the year 2038, it is predicted that with or without the project carbon monoxide concentrations in the project area will be lower (better) than existing concentrations, and concentrations would remain well within standards. Due to the negligible impact the project is expected to have, implementing mitigation measures for long-term traffic-related air quality impacts is probably unnecessary and unwarranted.

At this time, the specific tenants of the commercial/industrial area associated with the project have not been identified, but the types of facilities that are expected to locate there are not significant sources of air pollution. Before any air pollution sources can be built anywhere in the state, an application must be submitted to the Department of Health for a permit to construct the facility, and detailed information concerning any air pollution emissions will need to be provided in the application.

2.0 INTRODUCTION

The Hawaii Department of Land and Natural Resources (DLNR) is proposing the Maui Industrial and Business Park Project at Puunene the island of Maui (see Figure 1 for project location). The project site is located on approximately 280.4 acres of vacant land of which about 200.9 acres would be developed for a mix of light industrial and commercial use. Approximately 70% (140.6 acres) would be dedicated for light industrial use and the remaining 30% (60.3 acres) would be targeted for commercial use. The project site is located in Puunene to the east of Maui Veterans Highway. Access to the northern portion of the project will be provided along the existing Kamaaina Road via the Maui Veterans Highway. A new signalized intersection along Maui Veterans Highway between Kamaaina Road and Mehameha Loop (South)/Maui Raceway Park Access Road will provide primary access to the project and adjacent areas. The project will also provide access via the Maui Raceway Park Access Road on the south side of the project. Secondary eastern project access will be provided via South Firebreak Road. It is anticipated that the project will be developed over a period of about 20 years with full occupation reached by the year 2038.

The purpose of this study is to describe existing air quality in the project area and to assess the potential short- and long-term direct and indirect air quality impacts that could result from construction and use of the proposed facilities as planned. Measures to mitigate project impacts are suggested where possible and appropriate.

3.0 AMBIENT AIR QUALITY STANDARDS

Ambient concentrations of air pollution are regulated by both national and state ambient air quality standards (AAQS). National AAQS are specified in Section 40, Part 50 of the Code of Federal Regulations (CFR), while State of Hawaii AAQS are defined in Chapter 11-59 of the Hawaii Administrative Rules. Table 1 summarizes both the national and the state AAQS that are specified in the cited documents. As indicated in the table, national and state AAQS have been established for particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone and lead. The state has also set a standard for hydrogen sulfide. National AAQS are stated in terms of both primary and secondary standards for most of the regulated air pollutants. National primary standards are designed to protect the public health with an "adequate margin of safety". National secondary standards, on the other hand, define levels of air quality necessary to protect the public welfare from "any known or anticipated adverse effects of a pollutant". Secondary public welfare impacts may include such effects as decreased visibility, diminished comfort levels, or other potential injury to the natural or man-made environment, e.g., soiling of materials, damage to vegetation or other economic damage. In contrast to the national AAQS, Hawaii State AAQS

are given in terms of a single standard that is designed "to protect public health and welfare and to prevent the significant deterioration of air quality".

Each of the regulated air pollutants has the potential to create or exacerbate some form of adverse health effect or to produce environmental degradation when present in sufficiently high concentration for prolonged periods of time. The AAQS specify a maximum allowable concentration for a given air pollutant for one or more averaging times to prevent harmful effects. Averaging times vary from one hour to one year depending on the pollutant and type of exposure necessary to cause adverse effects. In the case of the short-term (i.e., 1- to 24-hour) AAQS, both national and state standards allow a specified number of exceedances each year.

The Hawaii AAQS are in some cases considerably more stringent than the comparable national AAQS. In particular, the Hawaii 1-hour AAQS for carbon monoxide is four times more stringent than the comparable national limit.

The national AAQS are reviewed periodically, and multiple revisions have occurred over the past 30 years. In general, the national AAQS have become more stringent with the passage of time and as more information and evidence become available concerning the detrimental effects of air pollution. Changes to the Hawaii AAQS over the past several years have tended to follow revisions to the national AAQS, making several of the Hawaii AAQS the same as the national AAQS.

4.0 REGIONAL AND LOCAL CLIMATOLOGY

Regional and local climatology significantly affect the air quality of a given location. Wind, temperature, atmospheric turbulence, mixing height and rainfall all influence air quality. Although the climate of Hawaii is relatively moderate throughout most of the state, significant differences in these parameters may occur from one location to another. Most differences in regional and local climates within the state are caused by the mountainous topography.

The topography of Maui is dominated by the great volcanic masses of Haleakala (10,023 feet) and the West Maui Mountains (5,788 feet). The island consists entirely of the slopes of these mountains and of a connecting isthmus. Haleakala is still considered to be an active volcano and last erupted about 1790. The project site is located at an elevation of about 110 feet above sea level, near the middle of the valley between Haleakala and the West Maui Mountains.

Maui lies well within the belt of northeasterly trade winds generated by the semi-permanent Pacific high-pressure cell to the north and east. Because the project site is located in the valley between Haleakala and the West Maui Mountains, the predominant trade wind flow tends to be channeled through the area from north to south by the terrain to the east and west. Local winds such as land/sea breezes and/or upslope/downslope winds also influence the wind pattern for the area when the trade winds are weak or absent. During winter, occasional strong winds from the south or southwest occur in association with the passage of winter storm systems.

Air pollution emissions from motor vehicles, the formation of photochemical smog and smoke plume rise all depend in part on air temperature. Warmer temperatures tend to result in higher emissions of carbon monoxide from automobiles and higher concentrations of photochemical smog. In Hawaii, the annual and daily variation of temperature depends to a large degree on elevation above sea level, distance inland and exposure to the trade winds. Average temperatures at locations near sea level generally are warmer than those at higher elevations. Areas exposed to the trade winds tend to have the least temperature variation, while inland and leeward areas often have the most. The project site's lower elevation and near-windward location results in relatively even temperatures compared with many other parts of the island. Average daily minimum and maximum temperatures at the nearby old Puunene Airport are 63°F and 86°F, respectively [1]. Temperatures at the project site can be expected to be similar to this.

Small scale, random motions in the atmosphere (turbulence) cause air pollutants to be dispersed as a function of distance or time from the point of emission. Turbulence is caused by both mechanical and thermal forces in the atmosphere. It is often measured and described in terms of Pasquill-Gifford stability class. Stability class 1 is the most turbulent and class 6 is the least. Thus, air pollution dissipates the best during stability class 1 conditions and the worst when stability class 6 prevails. In the Kahului area, stability classes 5 or 6 typically occur during the nighttime or early morning hours when temperature inversions form due to radiational cooling or to drainage flow from the nearby mountains. Stability classes 1 through 4 occur during the daytime, depending mainly on the amount of cloud cover and incoming solar radiation and the prevailing wind conditions.

Mixing height is defined as the height above the surface through which relatively vigorous vertical mixing occurs. Low mixing heights can result in high ground-level air pollution concentrations because contaminants emitted from or near the surface can become trapped within the mixing layer. In Hawaii, minimum mixing heights tend to be high because of mechanical mixing caused by the trade winds and because of the temperature moderating effect of the surrounding ocean. Low mixing heights may sometimes occur, however, at inland locations and even at times along coastal areas early in the morning following a clear, cool, windless night. Coastal areas also may experience low mixing levels during sea breeze conditions when cooler ocean air rushes in over warmer land. Mixing heights in Hawaii typically are above 3,000 feet (1,000 meters).

Rainfall can have a beneficial effect on the air quality of an area in that it helps to suppress fugitive dust emissions, and it also may "washout" gaseous contaminants that are water soluble. Rainfall in Hawaii is highly variable depending on elevation and on location with respect to the trade wind. The climate of the project area is moderately dry due to the low elevation. Historical records from the nearby old Puunene Airport show that this area of Maui averages about 13 inches of precipitation per year with the summer months being the driest [1].

5.0 PRESENT AIR QUALITY

Present air quality in the project area is mostly affected by air pollutants from vehicular, industrial, natural and/or agricultural sources. Table 2 presents an air pollutant emission summary for the island of Maui for calendar year 1993. This is the most recent year for which an island-wide emission inventory is available, and emissions today are probably somewhat different. The emission rates shown in the table pertain to manmade emissions only, i.e., emissions from natural sources are not included. As suggested in the table, most of the manmade particulate and sulfur oxides emissions on Maui originate from point sources, such as power plants and other fuel-burning industries. Nitrogen oxides emissions are roughly equally divided between point sources and area sources (mostly motor vehicle traffic). The majority of carbon monoxide emissions occur from area sources (motor vehicle traffic and agriculture), while hydrocarbons are emitted mainly from point sources. Emissions today from agriculture, primarily particulate and carbon monoxide, are probably lower than those shown in the table with the recent cessation of sugarcane cultivation.

The largest sources of air pollution in the immediate project area are most likely airport operations and automobile traffic using local roadways. Emissions from these sources consist primarily of particulate, hydrocarbons, carbon monoxide and nitrogen oxides. Kahului Power Plant, which is located about 4 miles to the north, and Maalaea Power Plant, which is situated about 4 miles to the south, emit mostly sulfur dioxide, nitrogen oxides and particulate. Volcanic emissions from distant natural sources on the Big Island also affect the air quality at times during kona wind conditions. By the time the volcanic emissions reach the project area, they consist mostly of fine particulate sulfate.

The State Department of Health operates a network of air quality monitoring stations at various locations around the state, but only very limited data are available for Maui Island. The only air quality data for the island of Maui consists of particulate measurements collected at Kihei, which is about 6 miles to the south, and beginning in 2013 at Paia about 8 miles to the northeast. Table 3 summarizes the data from these two monitoring stations. At Kihei, the annual 24-hour 98th percentile PM-2.5 particulate concentrations (which are most relevant to the air quality standards) ranged from 10 to 13 µg/m^3 between 2011 and 2015. Average annual concentrations ranged from 4 to 6 µg/m^3. No values above 35 µg/m^3 (which relates to the national standard) were recorded during this period. Concentrations at Paia for the period 2013 to 2015 were similar.

Given the limited air pollution sources in the area, it is likely that air pollution concentrations are near natural background levels most of the time, except possibly for locations adjacent to agricultural operations or near traffic-congested intersections. With the cessation of sugarcane cultivation in 2017, it is likely that air quality has improved. Present concentrations of carbon monoxide in the project area are estimated later in this study based on computer modeling of motor vehicle emissions.

6.0 SHORT-TERM IMPACTS OF PROJECT

Short-term direct and indirect impacts on air quality could potentially occur due to project construction. For a project of this nature, there are two potential types of air pollution emissions that could directly result in short-term air quality impacts during project construction: (1) fugitive dust from vehicle movement and soil excavation activities; and (2) exhaust emissions from on-site construction equipment. Indirectly, there also could be short-term impacts from slow-moving construction equipment traveling to and from the project site, from a temporary increase in local traffic caused by commuting construction workers, and from the disruption of normal traffic flow caused by roadway lane closures.

Fugitive dust emissions may arise from the grading and dirt-moving activities associated with site clearing and preparation work. The emission rate for fugitive dust emissions from construction activities is difficult to estimate accurately. This is because of its elusive nature of emission and because the potential for its generation varies greatly depending upon the type of soil at the construction site, the amount and type of dirt-disturbing activity taking place, the moisture content of exposed soil in work areas, and the wind speed. The EPA [2] has provided a rough estimate for uncontrolled fugitive dust emissions from construction activity of 1.2 tons per acre per month under conditions of "medium" activity, moderate soil silt content (30%), and precipitation/evaporation (P/E) index of 50. Uncontrolled fugitive dust emissions at the project site could be somewhere near that level, depending on the amount of rainfall that occurs. In any case, State of Hawaii Air Pollution Control Regulations [3] prohibit visible emissions of fugitive dust from construction activities at the property line. Thus, an effective dust control plan for the project construction phase is essential.

Adequate fugitive dust control can usually be accomplished by the establishment of a frequent watering program to keep bare-dirt surfaces in construction areas from becoming significant sources of dust. In dust-prone or dust-sensitive areas, other control measures such as limiting the area that can be disturbed at any given time, applying chemical soil stabilizers, mulching and/or using wind screens may be necessary. Control regulations further stipulate that open-bodied trucks be covered at all times when in motion if they are transporting materials that could become airborne. Haul trucks tracking dirt onto paved streets from unpaved areas is often a significant source of dust in construction areas. Some means to alleviate this problem, such as road cleaning or tire washing, may be appropriate. Paving of parking areas and/or establishment of landscaping as early in the construction schedule as possible can also lower the potential for fugitive dust emissions.

On-site mobile and stationary construction equipment also will emit air pollutants from engine exhausts. The largest of this equipment is usually diesel-powered. Nitrogen oxides emissions from diesel engines can be relatively high compared to gasoline-powered equipment, but the annual standard for nitrogen dioxide is not likely to be violated by short-term construction equipment emissions. Also, the new short-term (1-hour) standard for nitrogen dioxide is based on a three-year average; thus it is unlikely that relatively short-term construction emissions would exceed the standard. Carbon monoxide emissions from diesel

engines are low and should be relatively insignificant compared to vehicular emissions on nearby roadways.

Project construction activities could obstruct the normal flow of traffic for short periods of times such that overall vehicular emissions in the project area could temporarily increase. The only means to alleviate this problem will be to attempt to keep roadways open during peak traffic hours and to move heavy construction equipment and workers to and from construction areas during periods of low traffic volume. Thus, most potential short-term air quality impacts from project construction can be mitigated.

7.0 LONG-TERM IMPACTS OF PROJECT

7.1 Roadway Traffic

After construction is completed, use of the proposed facilities may result in increased motor vehicle traffic in the project area, potentially causing long-term impacts on ambient air quality. Motor vehicles with gasoline-powered engines are significant sources of carbon monoxide. They also emit nitrogen oxides and other contaminates.

Federal air pollution control regulations require that new motor vehicles be equipped with emission control devices that reduce emissions significantly compared to a few years ago. In 1990, the President signed into law the Clean Air Act Amendments. This legislation required further emission reductions, which have been phased in since 1994. More recently, additional restrictions were signed into law during the Clinton administration, and these began to take effect during the next decade. The added restrictions on emissions from new motor vehicles will lower average emissions each year as more and more older vehicles leave the state's roadways.

To evaluate the potential long-term ambient air quality impact of motor vehicle traffic using the proposed new roadway facilities, computerized emission and atmospheric dispersion models can be used to estimate ambient carbon monoxide concentrations along roadways within the project area. Carbon monoxide is selected for modeling because it is both the most stable and the most abundant of the pollutants generated by motor vehicles. Furthermore, carbon monoxide air pollution is generally considered to be a microscale problem that can be addressed locally to some extent, whereas nitrogen oxides air pollution most often is a regional issue that cannot be addressed by a single project.

For this project, three scenarios were selected for the carbon monoxide modeling study: (1) year 2017 with present conditions, (2) year 2038 without the project, and (3) year 2038 with the project. The year 2038 is when the project is expected to fully occupied. To begin the modeling study of the three scenarios, critical receptor areas in the vicinity of the project were identified for analysis. Generally speaking, roadway intersections are the primary concern because of traffic congestion and because of the increase in vehicular emissions associated with traffic queuing. For this study, the five key intersections identified in the traffic study [4] were selected for air quality analysis. These included the following intersections:

- Veterans Highway at Nakii Road
- Veterans Highway at Mehameha Loop North
- Veterans Highway at DHHL/DLNR Access Road
- Veterans Highway at Mehameha Loop South
- Veterans Highway at North Kihei Road.

The traffic study describes the existing and projected future traffic conditions and laneage configurations of the study intersections in detail. In performing the air quality impact analysis, it was assumed that all traffic mitigation measures included in the traffic study would be implemented.

The main objective of the modeling study was to estimate maximum 1-hour average carbon monoxide concentrations for each of the three scenarios studied. To evaluate the significance of the estimated concentrations, a comparison of the predicted values for each scenario can be made. Comparison of the estimated values to the national and state AAQS was also used to provide another measure of significance.

Maximum carbon monoxide concentrations typically coincide with peak traffic periods. The traffic impact assessment report evaluated weekday morning and afternoon peak traffic periods and also Saturday midday traffic. The air quality study was restricted to weekday morning and afternoon peak-traffic periods, but the Saturday midday traffic was not substantially different from the weekday peak traffic periods.

Vehicular carbon monoxide emissions for each year studied were calculated using EPA's Motor Vehicle Emission Simulator (MOVES) computer model [5]. MOVES was configured for a project-level analysis specifically for Hawaii. Assumptions included an urban, unrestricted road type, default fuel supply and fuel formulation, default vehicle age distribution and morning and afternoon ambient temperatures of 70°F and 90°F, respectively. MOVES emission factors were generated both for idling and for moving traffic.

After computing vehicular carbon monoxide emissions through the use of MOVES, these data were then input to an atmospheric dispersion model. EPA air quality modeling guidelines [6] currently recommend that the computer model CAL3QHC [7] be used to assess carbon monoxide concentrations at roadway intersections, or in areas where its use has previously been established, CALINE4 [8] may be used. Until a few years ago, CALINE4 was used extensively in Hawaii to assess air quality impacts at roadway intersections. In December 1997, the California Department of Transportation recommended that the intersection mode of CALINE4 no longer be used because it was thought the model had become outdated. Studies have shown that CALINE4 may tend to over-predict maximum concentrations in some situations. Therefore, CAL3QHC was used for the subject analysis.

CAL3QHC was developed for the U.S. EPA to simulate vehicular movement, vehicle queuing and atmospheric dispersion of vehicular emissions near roadway intersections. It is designed to predict 1-hour average pollutant concentrations near roadway intersections based on input traffic and emission data, roadway/receptor geometry and meteorological conditions.

Input peak-hour traffic data were obtained from the traffic study cited previously. This included vehicle approach volumes, saturation capacity estimates, intersection laneage and signal timings. All emission factors that were input to CAL3QHC for free-flow traffic on roadways were obtained from MOVES based on assumed free-flow vehicle speeds corresponding to the posted or design speed limits.

Model roadways were set up to reflect roadway geometry, physical dimensions and operating characteristics. Concentrations predicted by air quality models generally are not considered valid within the roadway-mixing zone. The roadway-mixing zone is usually taken to include 3 meters on either side of the traveled portion of the roadway and the turbulent area within 10 meters of a cross street. Model receptor sites were thus located at the edges of the mixing zones near all intersections that were studied for all three scenarios. This acknowledges that pedestrian sidewalks already exist or may exist in the future in these locations. All receptor heights were placed at 1.8 meters above ground to simulate levels within the normal human breathing zone.

Input meteorological conditions for this study were defined to provide "worst-case" results. One of the key meteorological inputs is atmospheric stability category. For these analyses, atmospheric stability category 6 was assumed for the morning cases, while atmospheric stability category 4 was assumed for the afternoon cases. These are the most conservative stability categories that are generally used for estimating worst-case pollutant dispersion within suburban areas for these periods. A surface roughness length of 100 cm and a mixing height of 1000 meters were used in all cases. Worst-case wind conditions were defined as a wind speed of 1 meter per second with a wind direction resulting in the highest predicted concentration. Concentration estimates were calculated at wind directions of every 5 degrees.

Existing background concentrations of carbon monoxide in the project vicinity are believed to be at low levels. Thus, background contributions of carbon monoxide from sources or roadways not directly considered in the analysis were accounted for by adding a background concentration of 0.5 ppm to all predicted concentrations for 2017. Although increased traffic is expected to occur within the project area within the next several years with or without the project, background carbon monoxide concentrations may not change significantly since individual emissions from motor vehicles are forecast to decrease with time. Hence, a background value of 0.5 ppm was assumed to persist for the future scenarios studied.

Predicted Worst-Case 1-Hour Concentrations

Table 4 summarizes the final results of the modeling study in the form of the estimated worst-case 1-hour morning and afternoon ambient carbon monoxide concentrations. These results can be compared directly to the state and the national AAQS. Estimated worst-case carbon monoxide concentrations are presented in the table for three scenarios: year 2017 with existing traffic, year 2038 without the project and year 2038 with the project. The locations of these estimated worst-case 1-hour concentrations all occurred at or very near the indicated intersections.

As indicated in the table, the highest estimated 1-hour concentration within the project vicinity for the present (2017) case was 1.7 ppm. This was projected to occur during both the morning peak traffic hour and the afternoon peak traffic hour at the intersection of Veterans Highway at North Kihei Road. Worst-case 1-hour concentrations at the other locations studied ranged between 1.2 and 1.3 ppm. Predicted worst-case 1-hour concentrations at all locations studied for the 2017 scenario were well within both the national AAQS of 35 ppm and the state standard of 9 ppm.

In the year 2038 without the proposed project, the highest worst-case 1-hour carbon monoxide concentration in the project area was predicted to reach 0.9 ppm. This occurred at four of the five intersections studied. Compared to the existing case, predicted worst-case concentrations for the year 2038 without the project decreased (improved) at all locations, and worst-case concentrations remained well within the state and national standards. This suggests that emissions from higher traffic volumes and increased traffic congestion in the future will be more than offset by the retirement of older, more-polluting vehicles over time.

Predicted 1-hour worst-case concentrations for the 2038 with project scenario remained nearly unchanged at the study intersections. Forecast worst-case concentrations at all locations studied remained well within the state and federal standards.

Predicted Worst-Case 8-Hour Concentrations

Worst-case 8-hour carbon monoxide concentrations were estimated by multiplying the worst-case 1-hour values by a persistence factor of 0.5. This accounts for two factors: (1) traffic volumes averaged over eight hours are lower than peak 1-hour values, and (2) meteorological conditions are more variable (and hence more favorable for dispersion) over an 8-hour period than they are for a single hour. Based on monitoring data, 1-hour to 8-hour persistence factors for most locations generally vary from 0.4 to 0.8 with 0.6 being the most typical. One study based on modeling [9] concluded that 1-hour to 8-hour persistence factors could typically be expected to range from 0.4 to 0.5. EPA guidelines [10] recommend using a value of 0.7 unless a locally derived persistence factor is available. Recent monitoring data for locations on Oahu reported by the Department of Health [11] suggest that this factor may range between about 0.2 and 0.6 depending on location and traffic variability. Considering the location of the project and the traffic pattern for the area, a 1-hour to 8-hour persistence factor of 0.5 will likely yield reasonable estimates of worst-case 8-hour concentrations.

The resulting estimated worst-case 8-hour concentrations are indicated in Table 5. For the 2017 scenario, the estimated worst-case 8-hour carbon monoxide concentrations for the four locations studied ranged from 0.6 to 0.8 ppm. The estimated worst-case concentrations for the existing case were well within both the state standard of 4.4 ppm and the national limit of 9 ppm.

For the year 2038 without project scenario, predicted worst-case concentration at all five intersections studied was 0.4 ppm, decreasing (improving) compared to the existing scenario. All predicted concentrations were within the standards.

For the 2038 with project scenario, worst-case concentrations remained nearly unchanged compared to the without project case, indicating minimal project impact. All predicted 8-hour concentrations for this scenario were well within both the national and the state AAQS.

Conservativeness of Estimates

The results of this study reflect several assumptions that were made concerning both traffic movement and worst-case meteorological conditions. One such assumption concerning worst-case meteorological conditions is that a wind speed of 1 meter per second with a steady direction for 1 hour will occur. A steady wind of 1 meter per second blowing from a single direction for an hour is extremely unlikely and may occur only once a year or less. With wind speeds of 2 meters per second, for example, computed carbon monoxide concentrations would be only about half the values given above. The 8-hour estimates are also conservative in that it is unlikely that anyone would occupy the assumed receptor sites (within 3 m of the roadways) for a period of 8 hours.

7.2 Commercial/Industrial Emissions

Air pollution emissions from industrial sources locating within the proposed project could potentially result in direct impacts on air quality. While the specific industrial residents of the proposed project have not yet been identified, it is expected these will not have the potential to emit significant amounts of air pollution. Land uses within the DLNR Industrial and Business Park will be consistent with the M-1 Light Industrial district (Chapter 19.24 of the Maui County Code) and may include warehousing and distribution businesses as well as retailing, light manufacturing, research facilities, offices, and other uses.

Without specific information concerning stack heights and stack gas temperatures, exit velocities and emission rates, air quality impacts from the potential light industrial facilities locating within the proposed industrial park cannot be quantitatively estimated. At the present time, such detailed information is not available. However, Hawaii air pollution control rules [2] require that any activity that causes air pollution must obtain written approval from the director of the Hawaii Department of Health. This written approval generally involves applying for both a permit to construct and a permit to operate. At the time of application, detailed information must be provided by the applicant concerning the type and nature of any air pollution emissions and the emission control technology that would be utilized. Depending on the magnitudes of the project emissions and other factors, air quality impact analyses and/or air quality monitoring may be required before the application to construct/operate is approved. Thus, even though an assessment of potential direct impacts from project air pollution emissions

cannot be done at this time, state rules may require that such analyses be performed at a later date when specific businesses apply to locate at the proposed industrial park.

8.0 CONCLUSIONS AND RECOMMENDATIONS

Although very little ambient air quality data are available to characterize existing conditions, it is likely that state and federal ambient air quality standards are currently being met in the project area. The recent cessation of sugarcane cultivation in the project area likely has resulted in improved air quality.

Project-related short-term impacts on air quality may occur from the emission of fugitive dust during construction phases. Uncontrolled fugitive dust emissions from construction activities could amount to about 1.2 tons per acre per month, depending on rainfall. To control dust, active work areas and any temporary unpaved work roads should be watered at least twice daily on days without rainfall. Use of wind screens and/or limiting the area that is disturbed at any given time will also help to contain fugitive dust emissions. Wind erosion of inactive areas of the site that have been disturbed could be controlled by mulching or by the use of chemical soil stabilizers. Dirt-hauling trucks should be covered when traveling on roadways to prevent windage. A routine road cleaning and/or tire washing program will also help to reduce fugitive dust emissions that may occur as a result of trucks tracking dirt onto paved roadways in the project area. Establishment of landscaping early in the construction schedule will also help to control dust.

During construction phases, emissions from engine exhausts (primarily consisting of carbon monoxide and nitrogen oxides) will also occur both from on-site construction equipment and from vehicles used by construction workers and from trucks traveling to and from the project. Increased vehicular emissions due to disruption of traffic by construction equipment and/or commuting construction workers can be alleviated by moving equipment and personnel to the site during off-peak traffic hours.

After the proposed project is completed, any long-term impacts on air quality in the project area due to emissions from project-related motor vehicle traffic should be negligible. Worst-case concentrations of carbon monoxide should remain well within both the state and the national ambient air quality standards. In the year 2038, it is predicted that with or without the project carbon monoxide concentrations in the project area will be lower (better) than existing concentrations. Implementing any air quality mitigation measures for long-term traffic-related impacts is probably unnecessary and unwarranted.

At this time, sufficient detail is not available describing the facilities that may be located within the commercial/industrial area included in the project to perform any quantitative impact assessments. However, the types of facilities currently being considered do not emit significant amounts of air pollution. In any case, before any air pollution sources can be built anywhere in the state, an application must be submitted to the Department of Health for a permit to construct the facility, and detailed information concerning any air pollution emissions will need to be provided in the application. If deemed necessary, the Department

of Health may require the applicant to assess the air quality impact of the proposed emissions.

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5. User Guide for Motor Vehicle Emission Simulator (MOVES), U.S. Environmental Protection Agency, Office of Transportation and Air Quality, Assessment and Standards Division, Ann Arbor, Michigan, July 2014, EPA-420-B-14-055.

6. Guideline on Air Quality Models (Revised), Including Supplements A and B, EPA-450/2-78-027R, U.S. Environmental Protection Agency, Research Triangle Park, NC, July 1986.

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9. "Persistence Factors for Mobile Source (Roadway) Carbon Monoxide Modeling", C. David Cooper, Journal of the Air & Waste Management Association, Volume 39, Number 5, May 1989.

10. Guideline for Modeling Carbon Monoxide from Roadway Intersections, U.S. Environmental Protection Agency, EPA-454/R-92-005, November 1992.

11. Annual Summaries, Hawaii Air Quality Data, 2006-2010, State of Hawaii Department of Health.

Figure 1 - Project Location

Table 1

SUMMARY OF STATE OF HAWAII AND NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Units	Averaging Time	Maximum Allowable Concentration		
			National Primary	National Secondary	State of Hawaii
Particulate Matter (<10 microns)	μg/m³	Annual	–	–	50
		24 Hours	150[a]	150[a]	150[b]
Particulate Matter (<2.5 microns)	μg/m³	Annual	15[c]	15[c]	–
		24 Hours	35[d]	35[d]	–
Sulfur Dioxide	ppm	Annual	–	–	0.03
		24 Hours	–	–	0.14[b]
		3 Hours	–	0.5[b]	0.5[b]
		1 Hour	0.075[e]	–	–
Nitrogen Dioxide	ppm	Annual	0.053	0.053	0.04
		1 Hour	0.100[f]	–	–
Carbon Monoxide	ppm	8 Hours	9[b]	–	4.4[b]
		1 Hour	35[b]	–	9[b]
Ozone	ppm	8 Hours	0.075[g]	0.075[g]	0.08[g]
Lead	μg/m³	3 Months	0.15[h]	0.15[h]	–
		Quarter	1.5[i]	1.5[i]	1.5[i]
Hydrogen Sulfide	ppm	1 Hour	–	–	0.025[b]

[a] Not to be exceeded more than once per year on average over three years.
[b] Not to be exceeded more than once per year.
[c] Three-year average of the weighted annual arithmetic mean.
[d] 98th percentile value of the 24-hour concentrations averaged over three years.
[e] Three-year average of annual fourth-highest daily 1-hour maximum.
[f] 98th percentile value of the daily 1-hour maximum averaged over three years.
[g] Three-year average of annual fourth-highest daily 8-hour maximum.
[h] Rolling 3-month average.
[i] Quarterly average.

Table 2

AIR POLLUTION EMISSIONS INVENTORY FOR ISLAND OF MAUI, 1993

Air Pollutant	Point Sources (tons/year)	Area Sources (tons/year)	Total (tons/year)
Particulate	63,275	7,030	70,305
Sulfur Oxides	6,419	nil	6,419
Nitrogen Oxides	7,312	8,618	15,930
Carbon Monoxide	4,612	20,050	24,662
Hydrocarbons	1,991	234	2,225

Source: Final Report, "Review, Revise and Update of the Hawaii Emissions Inventory Systems for the State of Hawaii", prepared for Hawaii Department of Health by J.L. Shoemaker & Associates, Inc., 1996

Table 3

ANNUAL SUMMARIES OF AIR QUALITY MEASUREMENTS FOR
MONITORING STATIONS NEAREST DLNR INDUSTRIAL AND BUSINESS PARK PROJECT

Parameter / Location	2011	2012	2013	2014	2015
Particulate (PM-2.5) / Paia					
24-Hour Averaging Period:					
No. of Samples	-	-	280	299	362
Highest Concentration (µg/m³)	-	-	18	50	19
98th Percentile Concentration (µg/m³)	-	-	16	13	14
No. of values greater than 35 µg/m³	-	-	0	0	0
Annual Average Concentration (µg/m³)	-	-	7	5	5
Particulate (PM-2.5) / Kihei					
24-Hour Averaging Period:					
No. of Samples	301	337	337	260	306
Highest Concentration (µg/m³)	15	18	18	14	23
98th Percentile Concentration (µg/m³)	13	14	14	10	13
No. of values greater than 35 µg/m³	0	0	0	0	0
Annual Average Concentration (µg/m³)	6	6	6	4	5

Source: State of Hawaii Department of Health, "Annual Summaries, Hawaii Air Quality Data, 2011 - 2015"

Table 4

ESTIMATED WORST-CASE 1-HOUR CARBON MONOXIDE CONCENTRATIONS
ALONG ROADWAYS NEAR DLNR INDUSTRIAL AND BUSINESS PARK PROJECT
(parts per million)

Roadway Intersection	Year/Scenario					
	2017/Present		2038/Without Project		2038/With Project	
	AM	PM	AM	PM	AM	PM
Veterans Highway at Nakii Road	1.3	1.3	0.9	0.9	1.0	0.9
Veterans Highway at Mehameha Loop North	1.3	1.3	0.9	0.8	0.9	0.9
Veterans Highway at DHHL/DLNR Access Rd	-	-	0.9	0.9	0.8	0.9
Veterans Highway at Mehameha Loop South	1.2	1.2	0.8	0.8	0.9	0.9
Veterans Highway at North Kihei Road	1.7	1.7	0.9	0.9	1.0	1.0

Hawaii State AAQS: 9
National AAQS: 35

Table 5

ESTIMATED WORST-CASE 8-HOUR CARBON MONOXIDE CONCENTRATIONS ALONG ROADWAYS NEAR DLNR INDUSTRIAL AND BUSINESS PARK PROJECT (parts per million)

Roadway Intersection	Year/Scenario		
	2017/Present	2038/Without Project	2038/With Project
Veterans Highway at Nakii Road	0.6	0.4	0.5
Veterans Highway at Mehameha Loop North	0.6	0.4	0.4
Veterans Highway at DHHL/DLNR Access Rd	-	0.4	0.4
Veterans Highway at Mehameha Loop South	0.6	0.4	0.4
Veterans Highway at North Kihei Road	0.8	0.4	0.5

Hawaii State AAQS: 4.4
National AAQS: 9

NOISE STUDY

APPENDIX J

ACOUSTIC STUDY FOR THE
DLNR INDUSTRIAL AND BUSINESS PARK
PUUNENE, MAUI, HAWAII

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NOVEMBER 2018

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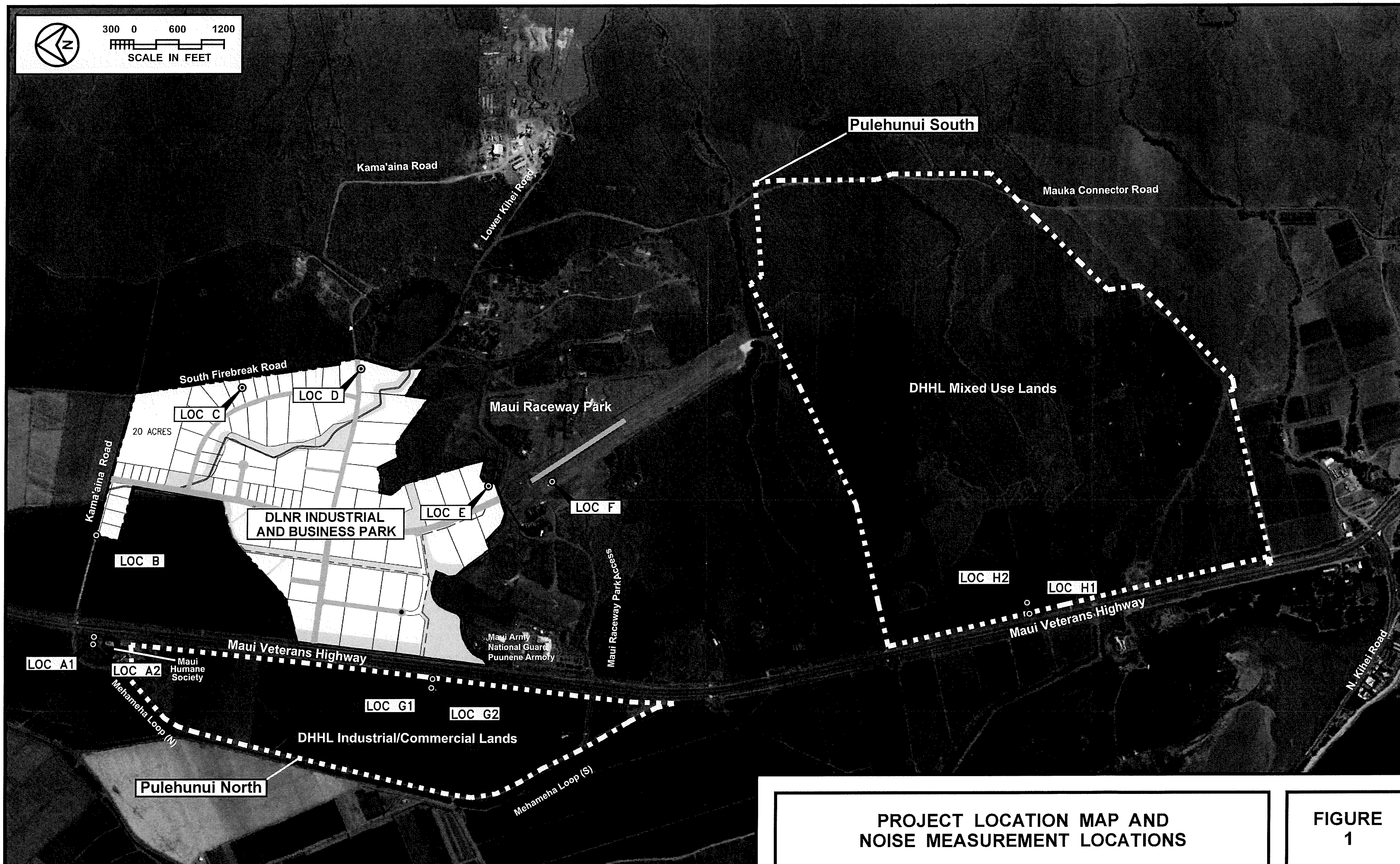
CHAPTER I. SUMMARY

The existing and future traffic noise levels in the vicinity of the proposed DLNR Industrial and Business Park at Puunene, Maui were evaluated for their potential impacts and their relationship to current FHA/HUD noise standards. The traffic noise level increases along the roadways servicing the project site (see Figure 1) were calculated. No significant increases in traffic noise levels are predicted to occur along Maui Veterans Highway as a result of project traffic following project build-out by CY 2038. Large increases of 8.6 DNL are expected to occur along Maui Raceway Park Access Road which will be one of three access roads used by project traffic from Maui Veterans Highway.

Along Maui Veterans Highway in the vicinity of the project site, traffic noise levels are expected to increase by approximately 2.3 to 3.0 DNL by CY 2038 as a result of project and non-project traffic. Of this increase, a 1.3 to 2.4 DNL increase is expected to occur from non-project traffic and roadway improvements by CY 2038. Project traffic will account for approximately 0.6 to 1.0 DNL units of noise increase along Maui Veterans Highway in the immediate vicinity of the project. Along Kamaaina Road between Maui Veterans Highway and the project site, traffic noise levels are expected to increase by 3.3 DNL by CY 2038 as a result of project traffic. This level of traffic noise increase resulting from project generated traffic along Kamaaina Road is considered to be moderate and similar to non-project traffic, which will cause a 4.6 DNL increase along this roadway. The 3.3 to 8.6 DNL predicted increase in project generated traffic noise levels are limited to the roadways used by project traffic between Maui Veterans Highway and the project site, and are not expected to generate adverse noise impacts by CY 2038 due to the absence of noise sensitive developments along these roadways.

The project site is located near an existing quarry and motor sports facility, with large buffer distances to the closest residential developments. The closest neighboring developments include the planned Puunene Heavy Industrial Subdivision to the southeast, a rock quarry, the Maui Humane Society, a motor sport raceway, an industrial subdivision to the north, and military office facilities. Predicted worst case noise emissions from operating equipment within the proposed DLNR Industrial and Business Park are not expected to exceed noise impact thresholds at the nearest noise sensitive developments. Compliance with State Department of Health noise regulations for fixed on-site equipment are recommended to minimize adverse noise impacts on adjacent and distant properties.

Adverse noise impacts are not expected to occur during construction of the proposed project due to the relatively large buffer distances to the nearest developed properties and due to the non-noise sensitive nature of the neighboring properties. Because construction activities may be audible within the project site and at nearby properties, the quality of the acoustic environment may be degraded to unacceptable levels during periods of construction. Mitigation measures to reduce construction noise



PROJECT LOCATION MAP AND
NOISE MEASUREMENT LOCATIONS

FIGURE
1

to inaudible levels will not be practical in all cases, but the use of quiet equipment and compliance with State Department of Health construction noise regulations are recommended as standard mitigation measures.

CHAPTER II. PURPOSE

The primary objective of this study was to describe the existing and future traffic noise environment in the environs of the proposed DLNR Industrial and Business Park at Puunene on the island of Maui. Traffic forecasts for 2038 were used. Traffic noise level increases and impacts associated with the proposed project were to be determined within the project site as well as along the public roadways which are expected to service the project traffic. A specific objective was to determine future traffic noise level increases associated with both project and non-project traffic, and the potential noise impacts associated with these increases.

Existing noise levels on the project site resulting from activities at the Maui Raceway Park, and potential noise impacts on project tenants were evaluated.

Noise impacts from on-site activities and short term construction noise at the project site were also included as noise study objectives. Recommendations for minimizing identified noise impacts were also to be provided as required.

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

The noise descriptor currently used by federal agencies (such as FHA/HUD) to assess environmental noise is the Day-Night Average Sound Level (DNL). This descriptor incorporates a 24-hour average of instantaneous A-Weighted Sound Levels as read on a standard Sound Level Meter. By definition, the minimum averaging period for the DNL descriptor is 24 hours. Additionally, sound levels which occur during the nighttime hours of 10:00 PM to 7:00 AM are increased by 10 decibels (dB) prior to computing the 24-hour average by the DNL descriptor. A more complete list of noise descriptors is provided in Appendix B to this report.

Table 1, derived from Reference 1, presents current federal noise standards and acceptability criteria for residential land uses. Table 2, also extracted from Reference 1, presents the general effects of noise on people in residential use situations. Land use compatibility guidelines for various levels of environmental noise as measured by the DNL descriptor system are shown in Figure 2 (from Reference 2). As a general rule, noise levels of 55 DNL or less occur in rural areas, or in areas which are removed from high volume roadways. In urbanized areas which are shielded from high volume streets, DNL levels generally range from 55 to 65 DNL, and are usually controlled by motor vehicle traffic noise. Residences which front major roadways are generally exposed to levels of 65 DNL, and as high as 75 DNL when the roadway is a high speed freeway. In the project area, existing traffic noise levels associated with Maui Veterans Highway are approximately 67 to 69 DNL along the Rights-of-Way due to the relatively large volume of traffic and high vehicle speeds on this thoroughfare.

For purposes of determining noise acceptability for funding assistance from federal agencies (FHA/HUD and VA), an exterior noise level of 65 DNL or less is considered acceptable for residences. This standard is applied nationally (Reference 3), including Hawaii. Because of our open-living conditions, the predominant use of naturally ventilated dwellings, and the relatively low exterior-to-interior sound attenuation afforded by these naturally ventilated structures, an exterior noise level of 65 DNL does not eliminate all risks of noise impacts. Because of these factors, and as recommended in Reference 4, a lower level of 55 DNL is considered as the "Unconditionally Acceptable" (or "Near-Zero Risk") level of exterior noise. However, after considering the cost and feasibility of applying the lower level of 55 DNL, government agencies such as FHA/HUD and VA have selected 65 DNL as a more appropriate regulatory standard.

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

On the island of Maui, the State Department of Health (DOH) regulates noise from construction activities through the issuance of permits for allowing excessive

TABLE 1

EXTERIOR NOISE EXPOSURE CLASSIFICATION (RESIDENTIAL LAND USE)

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

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

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

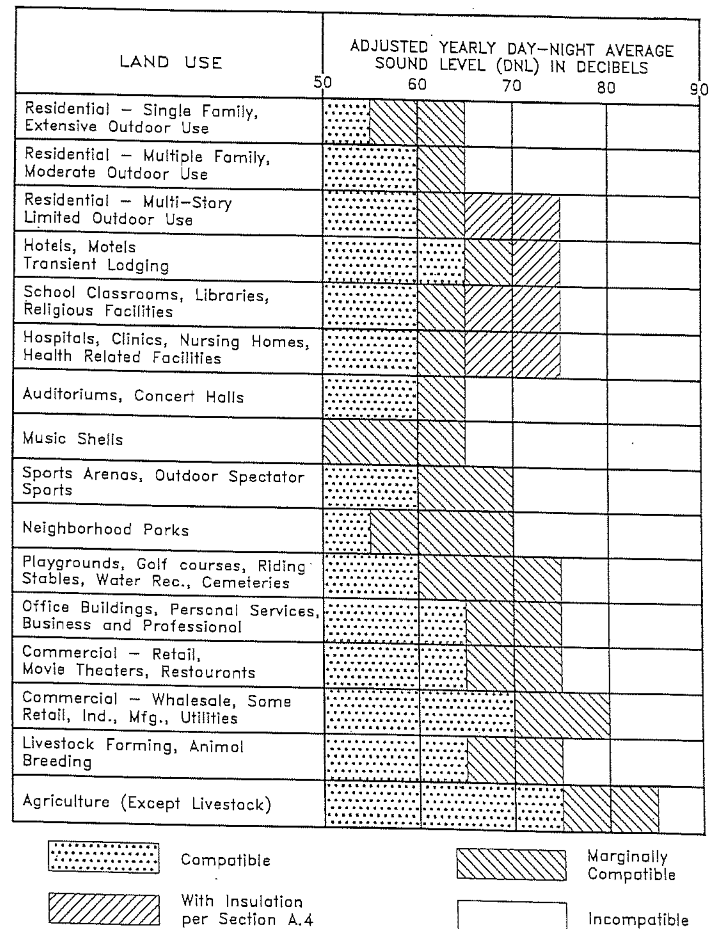
TABLE 2

EFFECTS OF NOISE ON PEOPLE
(Residential Land Uses Only)

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

1. "Speech Interference" data are drawn from the following tables in EPA's "Levels Document": Table 3, Fig. D-1, Fig. D-2, Fig. D-3. All other data from National Academy of Science 1977 report "Guidelines for Preparing Environmental Impact Statements on Noise, Report of Working Group 69 on Evaluation of Environmental Impact of Noise."
2. Depends on attitudes and other factors.
3. The percentages of people reporting annoyance to lesser extents are higher in each case. An unknown small percentage of people will report being "highly annoyed" even in the quietest surroundings. One reason is the difficulty all people have in integrating annoyance over a very long time.
4. Attitudes or other non-acoustic factors can modify this. Noise at low levels can still be an important problem, particularly when it intrudes into a quiet environment.

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



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

FIGURE 2

noise during limited time periods. State DOH noise regulations are expressed in maximum allowable property line noise limits rather than DNL (see Reference 5). Although they are not directly comparable to noise criteria expressed in DNL, State DOH noise limits for residential, commercial, and industrial lands equate to approximately 55, 60, and 76 DNL, respectively.

CHAPTER IV. GENERAL STUDY METHODOLOGY

Existing traffic noise levels were measured at three locations (A1, A2, and B) in the project environs in February 2017 and at four additional locations (G1, G2, H1, and H2) in July 2018 to provide a basis for developing the project's traffic noise contributions along the roadways which will service the proposed development. In addition, the noise levels of drag racing events at Maui Raceway Park were obtained at four locations (C, D, E, and F) in February 2017. The locations of the measurement sites are shown in Figure 1. The results of the traffic noise measurements were compared with calculations of existing traffic noise levels to validate the computer model used. The traffic noise measurement results, and their comparisons with computer model predictions of existing traffic noise levels are summarized in Table 3.

Traffic noise calculations for the existing conditions as well as noise predictions for the Year 2038 were performed using the Federal Highway Administration (FHWA) Traffic Noise Model (Reference 6). Traffic data entered into the noise prediction model were: roadway and receiver locations; hourly traffic volumes; average vehicle speeds; estimates of traffic mix; and "Hard and Loose Soil" propagation loss factors. The traffic data and forecasts for the project (Reference 7), plus the spot traffic counts obtained during the noise measurement periods were the primary sources of data inputs to the model. Appendix C summarizes the AM and PM peak hour traffic volumes for CY 2017 and 2038 which were used to model existing and future traffic noise along the roadways in the vicinity of the project site. For existing and future traffic along the roadways in the vicinity of the project site, it was assumed that the 24-hour DNL along those roadways were equal to the average noise levels, or Leq(h), during the PM peak traffic hour plus 1.0 dB. This assumption was based on computations of both the hourly Leq and the 24-hour DNL of traffic noise on Maui Veterans Highway (see Figure 3) using State of Hawaii hourly traffic counts from Reference 8.

Traffic noise calculations for both the existing and future conditions in the project environs were developed for ground level receptors with and without the benefit of shielding from natural terrain features or man made obstructions. Traffic noise levels were also calculated for future conditions with and without the proposed project. The forecasted changes in traffic noise levels over existing levels were calculated with and without the project, and noise impact risks evaluated. The relative contributions of non-project and project traffic to the total noise levels were also calculated, and an evaluation of possible traffic noise impacts was made.

Evaluations of potential noise impacts from on site noise sources were performed by predicting the noise levels from on site noise sources at the closest existing residential developments in Kihei (3.0 miles), Pukalani (6.8 miles), and Kahului (3.2 miles). These predictions assumed that each of the small and large lots of the industrial subdivision emitted the maximum sound level of 70 dBA as allowed for industrial properties by the State DOH noise regulations (Reference 5). A total of 83 subdivision lots, each with 70 dBA noise emitters located within each lot (for a total of

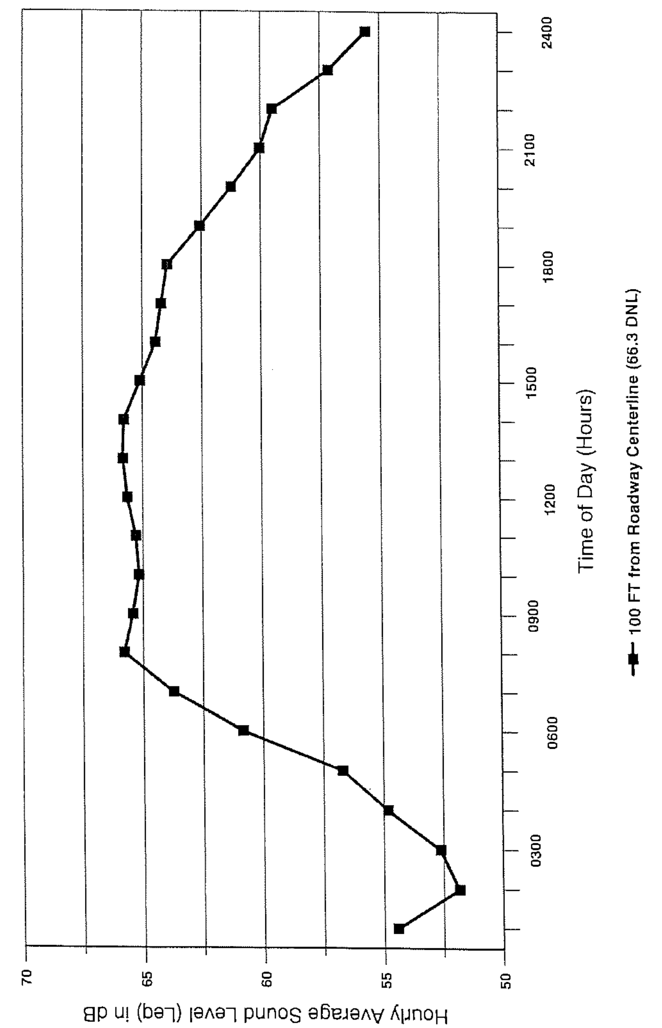
TABLE 3
TRAFFIC NOISE MEASUREMENT RESULTS

LOCATION	Time of Day (HRS)	Ave. Speed (MPH)	Hourly Traffic Volume AUTO	M.TRUCK	H.TRUCK	Measured Leq (dB)	Predicted Leq (dB)
A1. 96 FT from the center-line of Maui Veterans Hwy (2/24/17)	0700 TO 0800	50	2,221	43	88	70.3	69.8
A2. 196 FT from the center-line of Maui Veterans Hwy (2/24/17)	0700 TO 0800	50	2,221	43	88	64.8	65.4
B. 50 FT from the center-line of Kamaaina Rd. (2/24/17)	0832 TO 0932	35	16	2	21	59.0	58.9
A1. 96 FT from the center-line of Maui Veterans Hwy (2/23/17)	1545 TO 1645	50	2,853	34	38	68.6	68.3
A2. 196 FT from the center-line of Maui Veterans Hwy (2/23/17)	1545 TO 1645	50	2,853	34	38	63.5	63.8
G1. 120 FT from the center-line of Maui Veterans Hw (7/10/18)	1600 TO 1700	45	2,766	72	61	62.6	63.3
G2. 240 FT from the center-line of Maui Veterans Hwy (7/10/18)	1600 TO 1700	45	2,766	72	61	60.0	59.1

TABLE 3 (CONTINUED)
TRAFFIC NOISE MEASUREMENT RESULTS

LOCATION	Time of Day (HRS)	Ave. Speed (MPH)	Hourly Traffic Volume AUTO	M.TRUCK	H.TRUCK	Measured Leq (dB)	Predicted Leq (dB)
G1. 120 FT from the center-line of Maui Veterans Hwy (7/11/18)	0700 TO 0800	50	2,071	67	121	64.6	64.5
G2. 240 FT from the center-line of Maui Veterans Hwy (7/11/18)	0700 TO 0800	50	2,071	67	121	61.8	60.4
H1. 150 FT from the center-line of Maui Veterans Hwy (7/11/18)	1600 TO 1700	50	2,713	71	59	62.7	63.4
H2. 300 FT from the center-line of Maui Veterans Hwy (7/11/18)	1600 TO 1700	50	2,713	71	59	60.2	58.8
H1. 150 FT from the center-line of Maui Veterans Hwy (7/12/18)	0700 TO 0800	45	2,115	92	101	61.1	64.7
H2. 300 FT from the center-line of Maui Veterans Hwy (7/12/18)	0700 TO 0800	45	2,115	92	101	57.8	60.3

FIGURE 3
HOURLY TRAFFIC NOISE LEVELS VS. TIME OF DAY
STA. B74031100000, PUUNENE AVE - KUIHELANI HWY. TO MAUI VETERANS HWY.; 09/28/2011



83 continuous noise sources), was assumed for these noise modeling purposes. The worst case sound levels at the closest residential developments in Kihei, Pukalani, and Kahului resulting from this noise modeling assumption were then compared to existing background noise levels and noise impact criteria.

The noise levels during drag racing events at the adjacent Maui Raceway Park were measured and evaluated near the southern end of the project site. Potential noise impacts from Friday and Saturday drag racing events were evaluated and discussed.

Calculations of average exterior and interior noise levels from construction activities were performed for typical naturally ventilated and air conditioned buildings. Predicted noise levels were compared with existing background ambient noise levels, and the potential for noise impacts was assessed.

V. EXISTING ACOUSTICAL ENVIRONMENT

Traffic Noise. The existing background ambient noise levels within the project site are relatively low and less than 50 dBA, except during passbys of heavy motor vehicles on the cane field service roads or during flybys of aircraft operating at Kahului Airport. Traffic along Maui Veterans Highway control the background noise levels along the western boundary at the southwest section of the project site. Traffic on Kamaaina Road and South Firebreak Road controls the background noise levels along the north and east boundaries of the project site. The loudest noise sources at the project site are probably heavy trucks traveling along the roadways closest to the project site boundaries. During Saturdays and occasionally on Fridays, Sundays, and holidays, noise from activities at the Maui Raceway Park are probably the loudest noise sources at the south end of the project site.

Traffic noise measurements were obtained in February 2017 and July 2018 at seven locations (A1, A2, B, G1, G2, H1, and H2) in the project environs for validating the FHWA Traffic Noise Model (TNM, Version 2.5). These locations are shown in Figure 1. The results of the traffic and background ambient noise measurements are summarized in Table 3, with measurement locations identified in Figure 1. The measurement locations were all at approximately 5 feet above ground level. As shown in Table 3, correlation between measured and predicted traffic noise levels was satisfactory. The Traffic Noise Model's "Loose Soil" (along Kamaaina Road) and "Hard Soil" (along Maui Veterans Highway) propagation loss factors were used to obtain the good correlation.

Calculations of existing traffic noise levels during the PM peak traffic hour are presented in Table 4. The hourly Leq (or Equivalent Sound Level) contribution from each roadway section in the project environs was calculated for comparison with forecasted traffic noise levels with and without the project. In Table 4, the PM peak hour Leq values shown were assumed to be approximately 1.0 dB lower than the DNL values for the roadways shown. The existing setback distances from the roadways' centerlines to their associated 65 and 70 DNL contours were also calculated as shown in Table 5. The contour line setback distances do not take into account noise shielding effects or the additive contributions of traffic noise from intersecting street sections.

The existing traffic noise levels in the project environs along the Maui Veterans Highway Rights-of-Way are in the "Significant Exposure, Normally Unacceptable" category for residences, and at or greater than 65 DNL along the highway's Rights-of-Way. The existing traffic noise levels in the project environs along Maui Veterans Highway's Rights-of-Way are approximately 65 to 66 DNL on the east side and approximately 67 to 68 DNL on the west side. Existing traffic noise levels at the Maui Humane Society building closest to Maui Veterans Highway are approximately 65 to 66 DNL, which is considered to be acceptable for office buildings. Existing traffic noise levels at the Maui Army National Guard Puunene Armory is approximately 60 to 61 DNL, which is also considered to be acceptable for office buildings. Existing traffic

TABLE 4

EXISTING (CY 2017) TRAFFIC VOLUMES AND NOISE LEVELS
ALONG ROADWAYS IN PROJECT AREA
(PM PEAK HOUR)

LOCATION	SPEED (MPH)	TOTAL VPH	********* VOLUMES (VPH) ********* AUTOS	M TRUCKS	H TRUCKS	100' Leq	200' Leq	400' Leq
Maui Veterans Hwy. N. of Nakii Rd.	50	3,053	2,913	76	64	66.9	62.6	58.1
Maui Veterans Hwy. Between Nakii Rd. & Kamaaina Rd.	50	2,818	2,689	70	59	66.5	62.3	57.7
Maui Veterans Hwy. Between Kamaaina Rd. & DHHL Access Rd.	50	2,666	2,543	67	56	66.3	62.1	57.5
Maui Veterans Hwy. Btwn. DHHL Acc. Rd. & Mehameha Lp. (South)	50	2,666	2,543	67	56	66.3	62.1	57.5
Maui Veterans Hwy. Btwn. Mehameha Lp. (South) & DHHL S. Acc1.	50	2,692	2,568	67	57	66.3	62.1	57.5
Maui Veterans Hwy. Btwn. DHHL Acc.1 & DHHL South Acc.2	50	2,692	2,568	67	57	66.3	62.1	57.5
Maui Veterans Hwy. Btwn. DHHL Acc.1 & DHHL South Acc.3	50	2,692	2,568	67	57	66.3	62.1	57.5
Maui Veterans Hwy. Btwn. DHHL Acc.3 & N. Kihei Rd.	50	2,692	2,568	67	57	66.3	62.1	57.5
Maui Veterans Hwy. S. of N. Kihei Rd.	50	3,171	3,025	79	67	67.0	62.8	58.2
Mehameha Lp. (North) at Maui Veterans Hwy.	35	60	44	8	8	51.3	46.4	41.2
Kamaaina Rd. At Maui Veterans Hwy.	35	38	16	2	20	53.6	49.0	44.1
DHHL Access At Maui Veterans Hwy.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
DLNR Access At Maui Veterans Hwy.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Maui Raceway Park Access Rd. At Maui Veterans Hwy.	35	17	17	0	0	39.0	32.7	26.4
Mehameha Lp. (South) At Maui Veterans Hwy.	35	2	2	0	0	29.7	23.4	17.1
DHHL South Access1 Rd. At Maui Veterans Hwy.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
DHHL South Access2 Rd. At Maui Veterans Hwy.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
DHHL Souh Access3 Rd. At Maui Veterans Hwy.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

TABLE 5

EXISTING AND CY 2038 DISTANCES TO 65 AND 70 DNL CONTOURS

STREET SECTION	65 DNL SETBACK (FT) EXISTING	65 DNL SETBACK (FT) CY 2038	70 DNL SETBACK (FT) EXISTING	70 DNL SETBACK (FT) CY 2038
Maui Veterans Hwy. N. of Nakii Rd.	158	241	71	112
Maui Veterans Hwy. Between Nakii Rd. & Kamaaina Rd.	150	228	66	105
Maui Veterans Hwy. Between Kamaaina Rd. & DHHL Access Rd.	145	215	64	98
Maui Veterans Hwy. Btwn. DHHL Acc. Rd. & Mehameha Lp. (South)	145	212	64	97
Maui Veterans Hwy. Btwn. Mehameha Lp. (South) & DHHL S. Acc1.	145	224	64	103
Maui Veterans Hwy. Btwn. DHHL Acc.1 & DHHL South Acc.2	145	222	64	102
Maui Veterans Hwy. Btwn. DHHL Acc.1 & DHHL South Acc.3	145	224	64	102
Maui Veterans Hwy. Btwn. DHHL Acc.3 & N. Kihei Rd.	145	219	64	98
Maui Veterans Hwy. S. of N. Kihei Rd.	163	222	71	100
Mehameha Lp. (North) at Maui Veterans Hwy.	17	24	8	10
Kamaaina Rd. At Maui Veterans Hwy.	21	68	10	28
DHHL Access At Maui Veterans Hwy.	N/A	47	N/A	19
DLNR Access At Maui Veterans Hwy.	N/A	93	N/A	38
Maui Raceway Park Access Rd. At Maui Veterans Hwy.	6	36	4	14
Mehameha Lp. (South) At Maui Veterans Hwy.	2	32	1	13
DHHL South Access1 Rd. At Maui Veterans Hwy.	N/A	8	N/A	3
DHHL South Access2 Rd. At Maui Veterans Hwy.	N/A	37	N/A	15
DHHL Souh Access3 Rd. At Maui Veterans Hwy.	N/A	6	N/A	2

Notes:

(1) All setback distances are from the roadways' centerlines.
(2) See Tables 4 and 6 for traffic volume, speed, and mix assumptions.
(3) Setback distances are for ground level receptors.

noise levels at the industrial subdivision south of Nakii Road intersection with Maui Veterans Highway range from approximately 57 DNL to 65 DNL, which is also considered to be acceptable for industrial land uses.

Raceway Park Noise. Sound level measurements of noise during drag racing time trials at Maui Raceway Park were obtained on February 25, 2017 at Locations F, E, D, and C where shown in Figure 1. The purpose of these measurements was to determine if potential noise impacts are possible at future tenants of the project during similar drag racing events at Maui Raceway Park.

The sound levels of drag racing noise events were recorded at Location F and compared to sound levels recorded at Locations E, D, and C at the project site. The recordings at Location F were used to identify those noise events at Locations E, D, and C which time correlated with the drag racing events at Location F. Drag racing noise events recorded at Location F are shown in Figures 4 through 8, which depict the noise events as recurring, short duration, 90 to 117 dBA bursts of noise at 115 to 150 feet distance from the dual lane, drag strip.

Figures 9 and 10 depict the sound levels recorded at Locations D and C, respectively, with the "x" marks indicating the noise events which correlated with drag racing noise events measured at Location F. At Location D, 28 drag racing noise events (or approximately 74 percent of those recorded at Location F) were measured using both A-Weight and 1/3-Octave (centered at 315 Hz) filters, with corresponding noise levels ranging from 48 to 64 dBA. At Location C, 4 drag racing noise events (or approximately 40 percent of those recorded at Location F) were measured using both A-Weight and 1/3-Octave (centered at 315 Hz) filters, with corresponding noise levels ranging from 50 to 55 dBA. The noise associated with the drag racing events had a concentration of energy in the 250 to 500 Hz, 1/3-Octave frequency bands. The noise measurement results at Locations C and D were considered to be acceptable for the commercial and light industrial land uses planned for the project site, and not significantly or uniquely different or higher than noise levels measured alongside Kamaaina Road at Location B (see Figure 11).

Figures 12 through 14 depict the sound levels recorded at Location E, with the "x" marks indicating the noise events which correlated with drag racing noise events measured at Location F. At Location E, 95 drag racing noise events (or approximately 99 percent of those recorded at Location F) were measured using both A-Weight and 1/3-Octave filtering centered at 315 Hz, with corresponding noise levels ranging from 62 to 82 dBA. Average noise level at Location E, which was controlled by noise from Maui Raceway Park, ranged from 56.4 LAeq (between 1430 and 1530 hours) to 61.7 LAeq (between 1728 and 1812 hours). Average noise levels from Hawaii Raceway Park during a drag racing event day were approximately 3 to 7 dB less than those measured at Location A2 (196 feet from the centerline of Maui Veterans Highway) during the am and pm peak hours on February 23-24, 2017. So, while the noise from Hawaii Raceway Park controlled the background noise levels during the drag racing events at

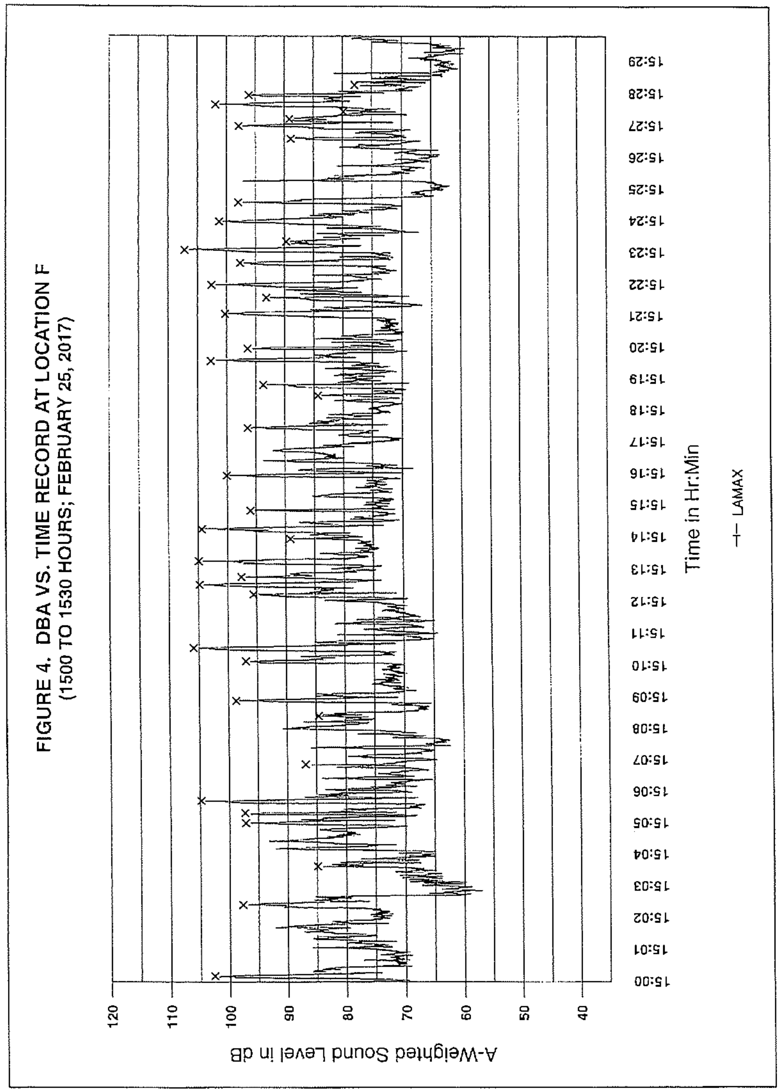


FIGURE 4. DBA VS. TIME RECORD AT LOCATION F
(1500 TO 1530 HOURS; FEBRUARY 25, 2017)

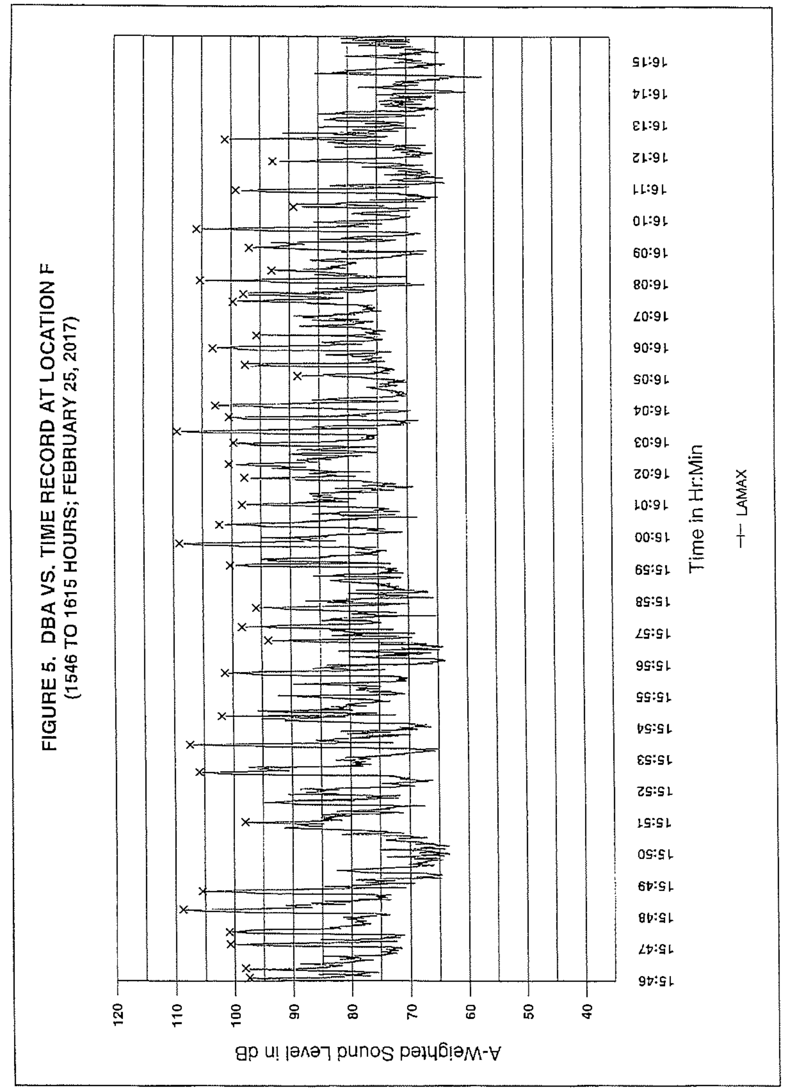


FIGURE 5. DBA VS. TIME RECORD AT LOCATION F
(1546 TO 1615 HOURS; FEBRUARY 25, 2017)

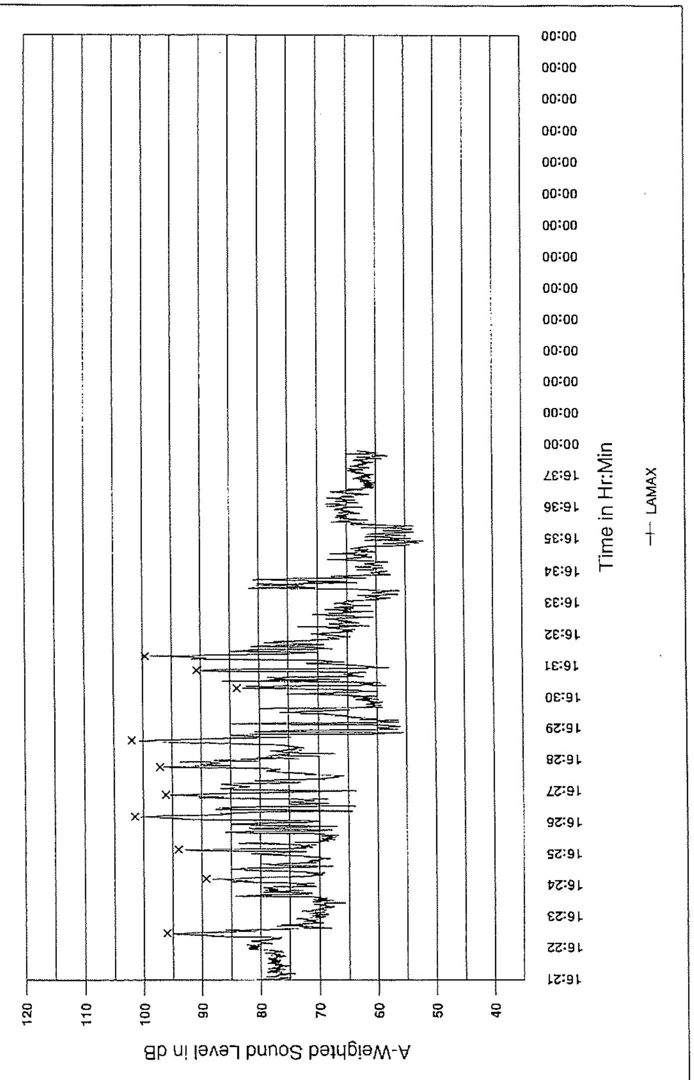


FIGURE 6. DBA VS. TIME RECORD AT LOCATION F
(1621 TO 1637 HOURS; FEBRUARY 25, 2017)

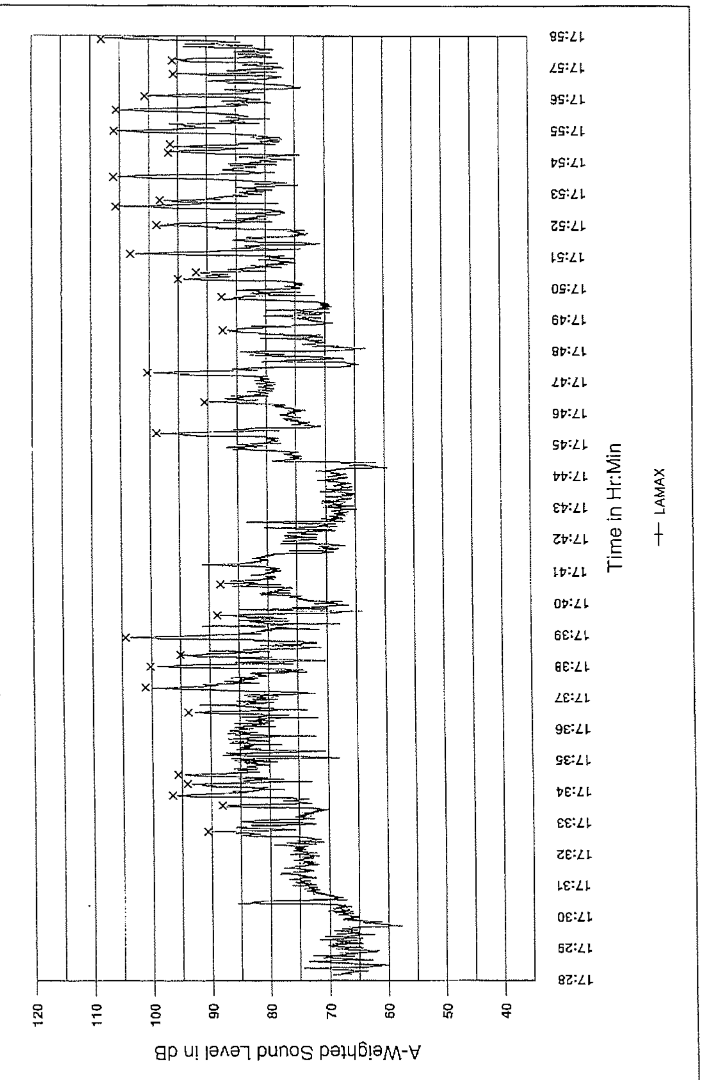


FIGURE 7. DBA VS. TIME RECORD AT LOCATION F
(1728 TO 1756 HOURS; FEBRUARY 25, 2017)

FIGURE 8. DBA VS. TIME RECORD AT LOCATION F
(1757 TO 1811 HOURS; FEBRUARY 25, 2017)

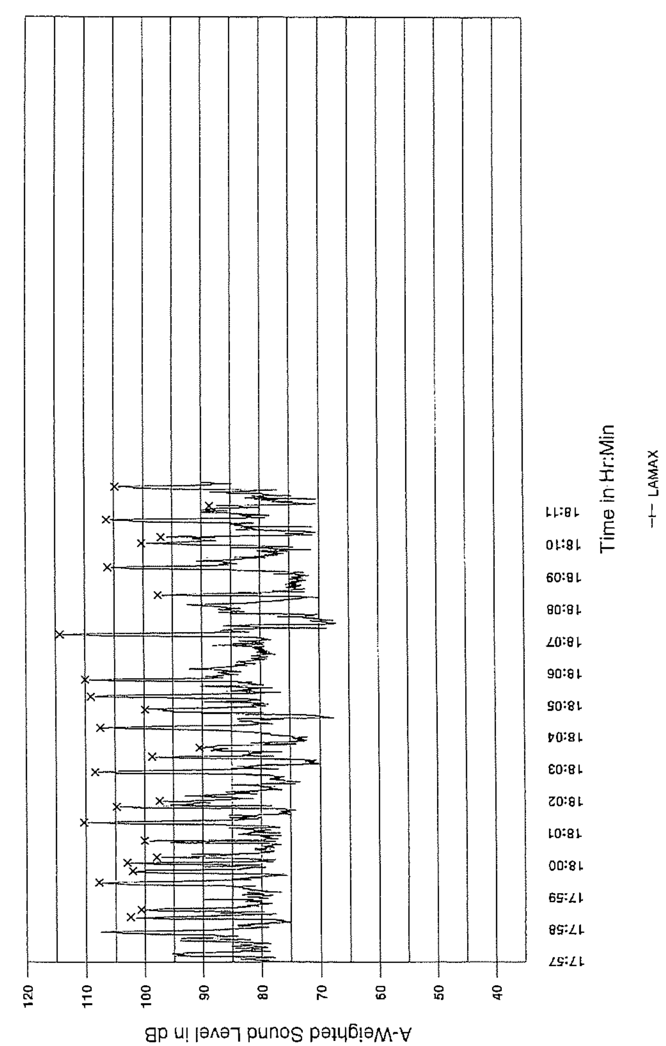


FIGURE 9. DBA VS. TIME RECORD AT LOCATION D
(1546 TO 1615 HOURS; FEBRUARY 25, 2017)

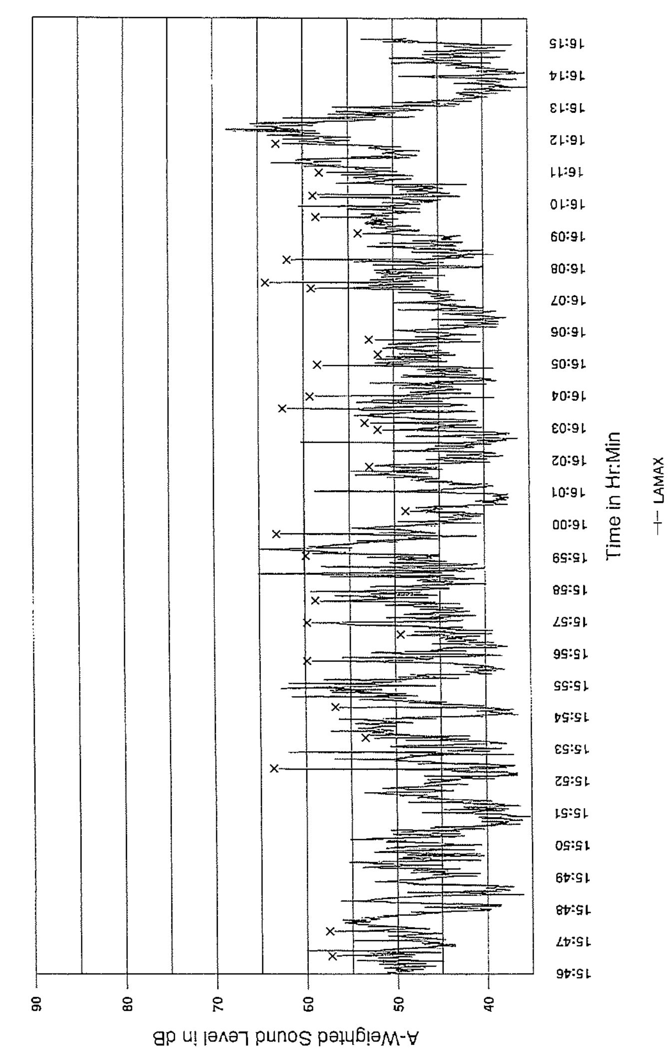


FIGURE 10. DBA VS. TIME RECORD AT LOCATION C
(1621 TO 1641 HOURS; FEBRUARY 25, 2017)

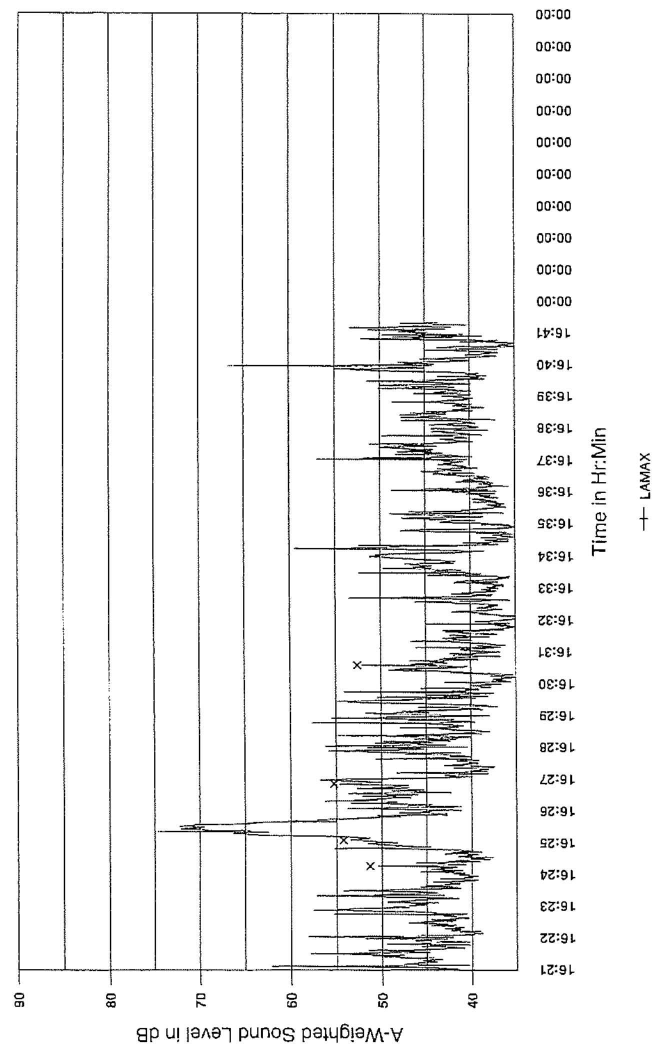


FIGURE 11. DBA VS. TIME RECORD OF KAMAAINA ROAD NOISE AT LOCATION A1
(0832 TO 0932 HOURS; FEBRUARY 24, 2017)

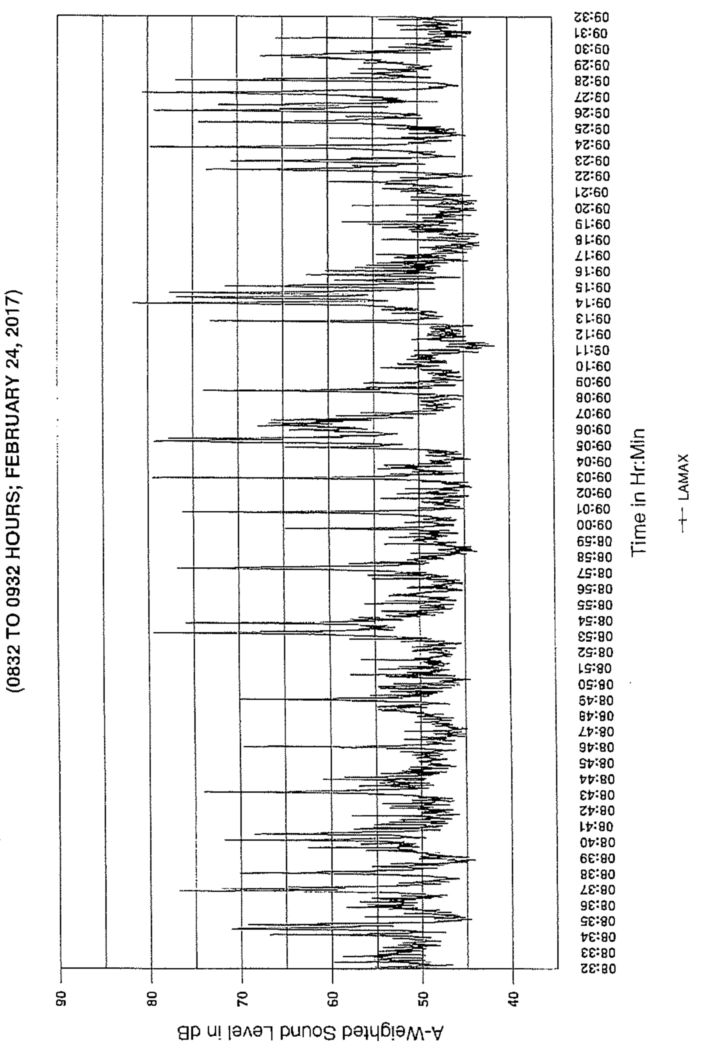


FIGURE 12. DBA VS. TIME RECORD AT LOCATION E
(1500 TO 1530 HOURS; FEBRUARY 25, 2017)

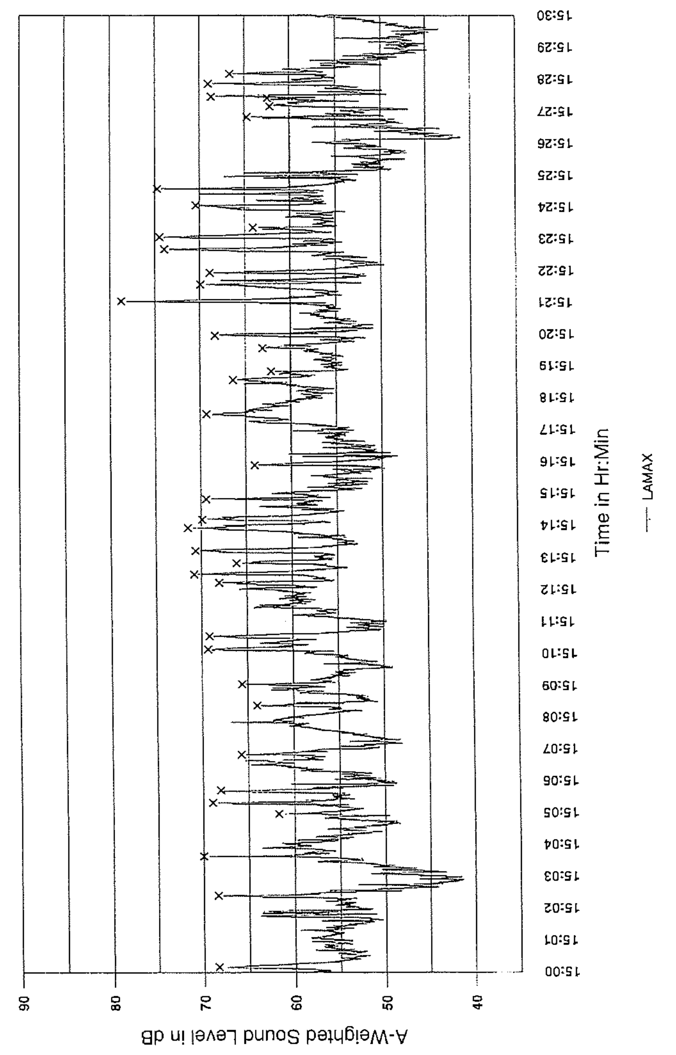


FIGURE 13. DBA VS. TIME RECORD AT LOCATION E
(1728 TO 1758 HOURS; FEBRUARY 25, 2017)

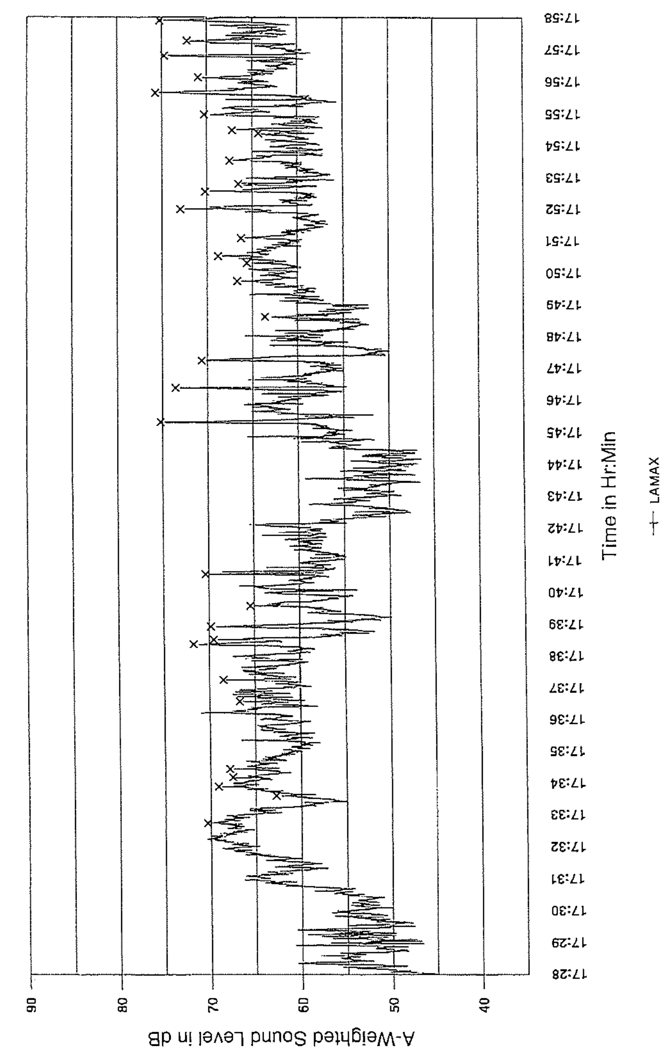
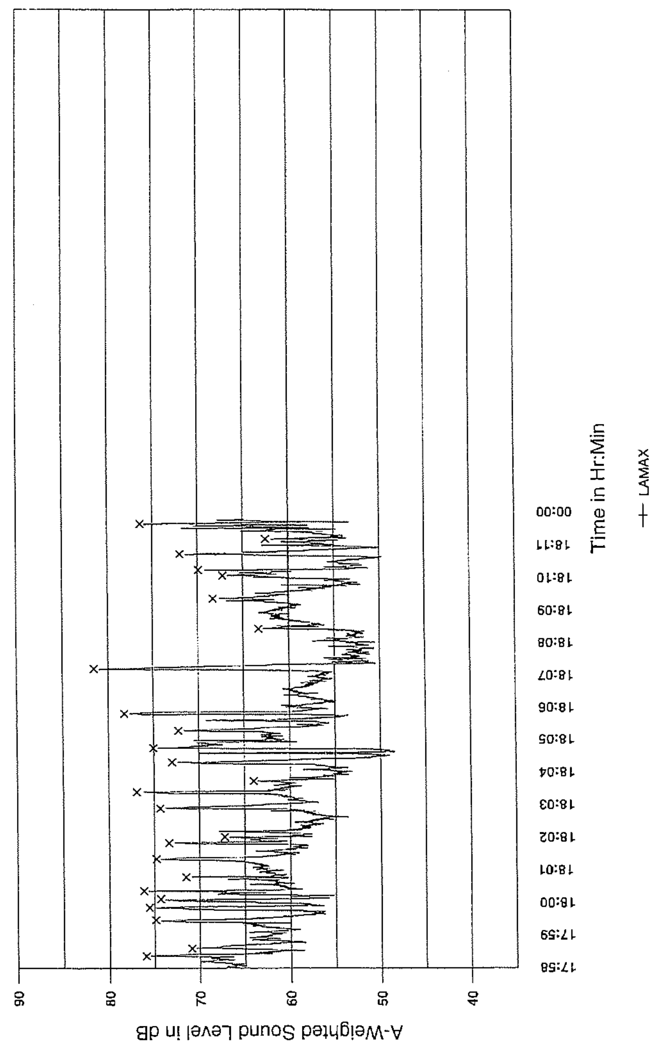


FIGURE 14. DBA VS. TIME RECORD AT LOCATION E
(1758 TO 1811 HOURS; FEBRUARY 25,2017)



Location E, average noise levels associated with these drag racing events were considered to be compatible (and less than 70 DNL) with the commercial and light industrial uses planned for the project.

CHAPTER VI. FUTURE NOISE ENVIRONMENT

Predictions of future traffic noise levels were made using the traffic volume assignments of Reference 7 for CY 2038 without and with the proposed project. Estimates of CY 2038 traffic volumes with and without the project were contained in Reference 7, and are summarized in Appendix C. The future projections of project plus non-project traffic noise levels on the roadways which would service the project are shown in Table 6 for the PM peak hour of traffic, and under the Build Alternative. Predicted increases in the setback distances to the 65 and 70 DNL contours are shown in Table 5. The separate non-project and project traffic noise contributions under the Build Alternative are shown in Table 7.

Small to moderate changes in traffic noise levels (0.6 to 1.0 DNL) are expected along Maui Veterans Highway in the project environs between CY 2017 and 2038 as a result of project traffic and anticipated roadway improvements. The growth in non-project traffic and anticipated roadway improvements by CY 2038 are predicted to result in a traffic noise level increase of 1.3 to 2.4 DNL along Maui Veterans Highway. By CY 2038, traffic noise levels in the project area along Maui Veterans Highway are expected to increase primarily due to the anticipated growth in non-project traffic, with small to moderate increases in future traffic noise of 0.6 to 1.0 DNL associated with the project traffic. The anticipated roadway improvements will also contribute to the traffic noise level increases by reducing the buffer distances from the travel lanes and the Rights-of-Way.

Along the planned project access road (DLNR Access at Maui Veterans Highway), a large traffic noise level increase is expected solely as a result of project traffic. This new access road will be located approximately 3,200 feet south of the existing Kamaaina Road intersection. Along the existing Maui Raceway Park Access Road, an increase of 7.3 DNL is anticipated from non-project traffic and an increase of 8.6 DNL is anticipated from project traffic. The increases in traffic noise levels due to non-project and project traffic are relatively high on these two roadways, primarily due to the very low or nonexistent traffic on these two roads during 2017.

The dominant traffic noise source in the project environs will continue to be traffic along Maui Veterans Highway, with the increases in future traffic noise levels from project generated traffic being relatively small along this roadway, and primarily associated with non-project traffic. Due to the planned large, 100 foot buffer distance to the highway's east Right-of-Way and 240 foot setback from the highway centerline, future traffic noise levels on the project site are predicted to not exceed 65 DNL by CY 2038, and will be controlled by traffic moving within the industrial subdivision and along Kamaaina and South Firebreak Roads. These future traffic noise levels within the industrial subdivision are not expected to exceed 70 DNL except within 28 feet of the centerline of Kamaaina and South Firebreak Roads, and should be acceptable for the planned commercial and light industrial land uses.

TABLE 6

FUTURE (CY 2038) TRAFFIC VOLUMES AND NOISE LEVELS
ALONG ROADWAYS IN PROJECT AREA
(PM PEAK HOUR, BUILD)

LOCATION	SPEED (MPH)	TOTAL VPH	********* VOLUMES (VPH) ********** AUTOS	M TRUCKS	H TRUCKS	100' Leq	200' Leq	400' Leq
Maui Veterans Hwy. N. of Nakii Rd.	50	7,075	6,749	177	149	69.7	65.3	60.5
Maui Veterans Hwy. Between Nakii Rd. & Kamaaina Rd.	50	6,573	6,271	164	138	69.3	64.9	60.2
Maui Veterans Hwy. Between Kamaaina Rd. & DHHL Access Rd.	50	5,918	5,646	148	124	68.9	64.5	59.8
Maui Veterans Hwy. Btwn. DHHL Acc. Rd. & Mehameha Lp. (South)	50	5,815	5,548	145	122	68.8	64.4	59.7
Maui Veterans Hwy. Btwn. Mehameha Lp. (South) & DHHL S. Acc1.	50	6,300	6,010	158	132	69.2	64.8	60.0
Maui Veterans Hwy. Btwn. DHHL Acc.1 & DHHL South Acc.2	50	6,228	5,941	156	131	69.1	64.7	60.0
Maui Veterans Hwy. Btwn. DHHL Acc.1 & DHHL South Acc.3	50	6,295	6,006	157	132	69.1	64.8	60.0
Maui Veterans Hwy. Btwn. DHHL Acc.3 & N. Kihei Rd.	50	6,330	6,039	158	133	68.9	64.6	60.0
Maui Veterans Hwy. S. of N. Kihei Rd.	50	6,470	6,172	162	136	69.0	64.7	60.1
Mehameha Lp. (North) at Maui Veterans Hwy.	35	255	249	3	3	55.7	51.7	47.8
Kamaaina Rd. At Maui Veterans Hwy.	35	1,055	1,028	13	14	61.8	57.9	53.3
DHHL Access At Maui Veterans Hwy.	35	665	648	8	9	59.8	55.9	51.3
DLNR Access At Maui Veterans Hwy.	35	1,600	1,560	19	21	63.6	59.7	55.1
Maui Raceway Park Access Rd. At Maui Veterans Hwy.	35	605	590	7	8	58.7	55.1	50.5
Mehameha Lp. (South) At Maui Veterans Hwy.	35	420	410	5	5	57.7	53.9	49.2
DHHL South Access1 Rd. At Maui Veterans Hwy.	35	80	78	1	1	50.1	46.2	41.7
DHHL South Access2 Rd. At Maui Veterans Hwy.	35	575	561	7	7	58.6	54.8	50.2
DHHL Souh Access3 Rd. At Maui Veterans Hwy.	35	50	48	1	1	48.6	44.8	40.3

TABLE 7

CALCULATIONS OF PROJECT AND NON-PROJECT TRAFFIC NOISE CONTRIBUTIONS (CY 2038) (DNL)

STREET SECTION	NOISE LEVEL INCREASE DUE TO: NON-PROJECT TRAFFIC	PROJECT TRAFFIC
Maui Veterans Hwy. N. of Nakii Rd.	2.2	0.7
Maui Veterans Hwy. Between Nakii Rd. & Kamaaina Rd.	1.4	1.0
Maui Veterans Hwy. Between Kamaaina Rd. & DHHL Access Rd.	1.3	1.0
Maui Veterans Hwy. Btwn. DHHL Acc. Rd. & Mehameha Lp. (South)	1.9	0.6
Maui Veterans Hwy. Btwn. Mehameha Lp. (South) & DHHL S. Acc1.	2.3	0.7
Maui Veterans Hwy. Btwn. DHHL Acc.1 & DHHL South Acc.2	2.3	0.7
Maui Veterans Hwy. Btwn. DHHL Acc.1 & DHHL South Acc.3	2.3	0.7
Maui Veterans Hwy. Btwn. DHHL Acc.3 & N. Kihei Rd.	2.4	0.6
Maui Veterans Hwy. S. of N. Kihei Rd.	1.8	0.7
Mehameha Lp. (North) at Maui Veterans Hwy.	4.7	0.7
Kamaaina Rd. At Maui Veterans Hwy.	4.6	3.3
DHHL Access At Maui Veterans Hwy.	59.9	0.3
DLNR Access At Maui Veterans Hwy.	N/A	55.1
Maui Raceway Park Access Rd. At Maui Veterans Hwy.	11.2	8.6
Mehameha Lp. (South) At Maui Veterans Hwy.	28.0	0.2
DHHL South Access1 Rd. At Maui Veterans Hwy.	50.1	0.0
DHHL South Access2 Rd. At Maui Veterans Hwy.	58.6	0.0
DHHL Souh Access3 Rd. At Maui Veterans Hwy.	48.6	0.0

CHAPTER VII. DISCUSSION OF PROJECT-RELATED NOISE IMPACTS AND POSSIBLE MITIGATION MEASURES

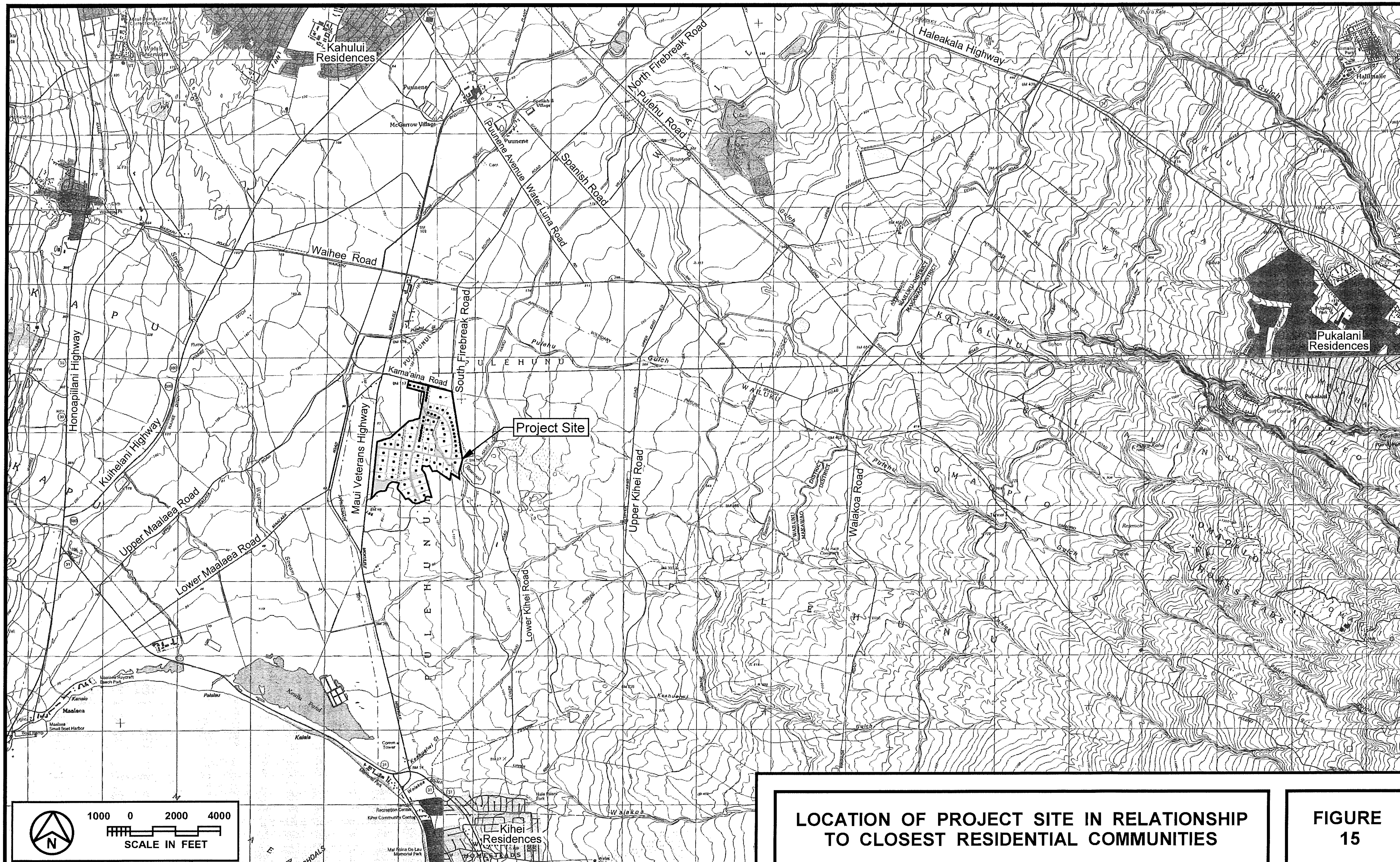
Traffic Noise. Existing traffic noise levels along Maui Veterans Highway are relatively high, and are expected to remain so through CY 2038. Risks of future traffic noise impacts along the highway should continue to be low due to the absence of noise sensitive receptors along the highway in the project environs.

Project related traffic along Maui Veterans Highway is not expected to cause significant increases in future traffic noise levels. The predicted increases of 0.6 to 1.0 DNL in project related traffic noise are small compared to the 1.3 to 2.4 DNL increases expected from non-project traffic. The inclusion of a 100 foot buffer along the highway's east Right-of-Way is a noise mitigation measure included in the project. Adverse traffic noise impacts resulting from project traffic are not expected along the highway. For these reasons, traffic noise mitigation measures should not be required.

On-Site Noise Sources. By existing State Department of Health regulations, fixed machinery on industrial lots may emit sound levels continuously during the day and night, as long as their sound levels do not exceed 70 dBA at or beyond the lots' property boundaries. Therefore, using the industrial subdivision plan shown in Figure 1, it was assumed that there could be a total of 83 noise sources, each emitting sound levels so as to not exceed 70 dBA at their respective lot boundary lines. This noise modeling assumption was assumed for determining the potential sound level emissions from on-site sources within the proposed commercial and light industrial subdivision. Under these hypothetical worst case conditions, the combined sound level from the 83 lots of the project subdivision would be approximately 45 dBA at 4,900 feet (0.93 mile) distance from the center of the subdivision in directions east, west, and south from the subdivision. In the north direction, a larger separation distance of 5,700 feet from the center of the subdivision would be required to not exceed 45 dBA. A continuous outdoor sound level of 45 dBA is considered to be acceptable by the State DOH and by all federal agencies for single family residences. Because there are no existing noise sensitive developments within 5,700 feet of the proposed commercial and light industrial subdivision (see Figure 15), risks of adverse noise impacts from on site noise sources at existing noise sensitive receptors are considered to be minimal.

Predicted noise levels under the hypothetical worst case condition described above were developed at the closest existing residential developments. These predicted hypothetical worst case levels were: 18 dBA in Kihei at Kaiolohia Street; 0 dBA in Pukalani at Akalani Loop; 17 dBA at Puunene near the Sugar Museum; and 17 dBA in Kahului at Makalii Street. These worst case levels are very low, and will be below existing nighttime background noise levels in these communities.

Predicted hypothetical worst case noise levels from the same DLNR project industrial sources were also developed at the planned DHHL Pulehunui South and



LOCATION OF PROJECT SITE IN RELATIONSHIP TO CLOSEST RESIDENTIAL COMMUNITIES

FIGURE 15

North parcels shown in Figure 1. As indicated in Reference 9, these worst case noise levels were 43 dBA at the closest Ag Homestead and Education lots of DHHL Pulehunui South, and 60 dBA at the eastern boundary of DHHL Pulehunui North. At these predicted worst case levels, risks of adverse noise impacts at the planned noise sensitive developments of the DHHL parcels resulting from the DNLR project are considered to be low.

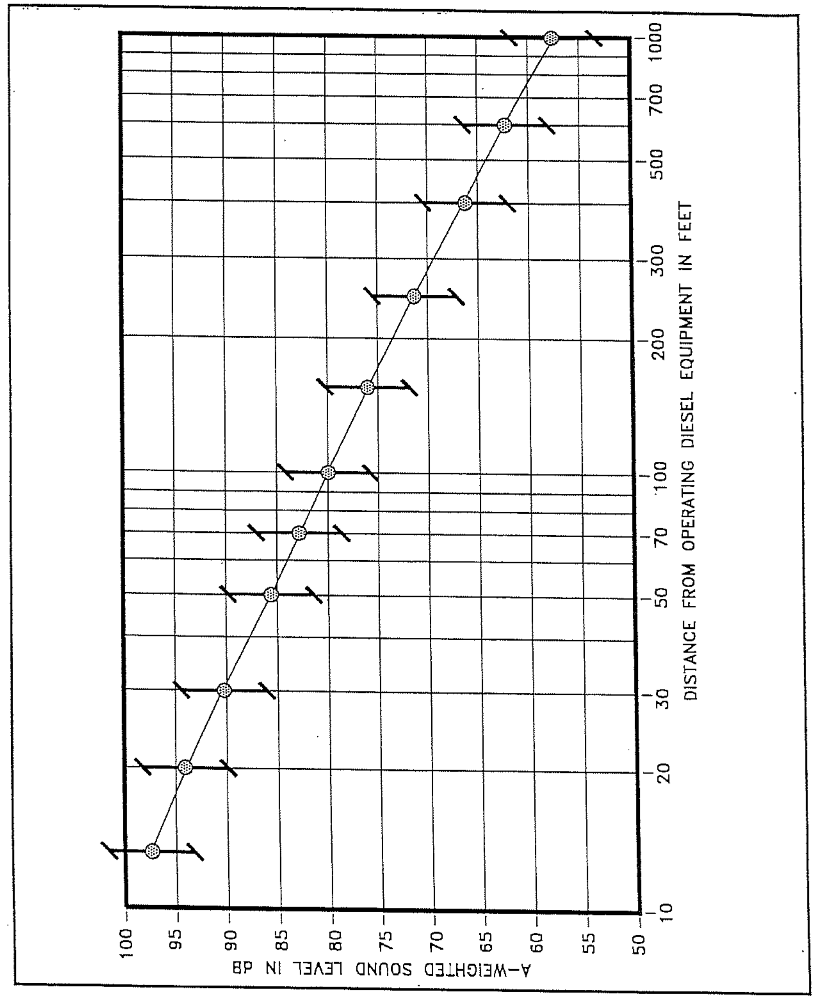
Noise mitigation measures which limit the noise from fixed mechanical equipment to those allowed by the State Department of Health (Reference 5) should be required of all tenants within the industrial subdivision.

General Construction Noise. Audible construction noise will probably be unavoidable during the entire project construction period. The total time period for construction is unknown, but it is anticipated that the actual work will be moving from one location on the project site to another during that period. Actual length of exposure to construction noise at any receptor location will probably be less than the total construction period for the entire project. Typical levels of exterior noise from construction activity (excluding pile driving activity) at various distances from the job site are shown in Figure 16. The impulsive noise levels of impact pile drivers are approximately 15 dB higher than the levels shown in Figure 16, while the intermittent noise levels of vibratory pile drivers are at the upper end of the noise level ranges depicted in the figure. Typical levels of construction noise inside naturally ventilated and air conditioned structures are approximately 10 and 20 dB less, respectively, than the levels shown in Figure 16.

The closest existing residences to the project site are well beyond the 1,000 feet separation distance shown in Figure 16, and for this reason, risks of adverse noise impacts from construction activity on the project site are expected to be very low. The noise from construction activities will decrease and be masked by traffic noise from Maui Veterans Highway at the Maui Humane Society and National Guard facilities.

Peak airborne noise levels from pile diving may be as much as 15 dBA greater than noise levels shown in Figure 16 for non-impulsive (steady) construction noise sources. Although the pile driving can produce more intense noise levels, each pulse is of short individual duration (less than one second). Therefore, its impact on speech communication is not as severe as that of a steady source of the same noise level.

Adverse noise impacts are more likely to occur following completion of initial site preparation and infrastructure construction activities and at the initial subdivision tenants who are exposed to building construction noise from neighboring or nearby lots of the same subdivision. Adverse noise impacts are not expected to occur inside air conditioned structures which are beyond 200 FT of a building construction site. Inside naturally ventilated structures, interior noise levels (with windows or doors opened) are estimated to range between 65 to 53 dBA at 200 FT to 600 FT distances from the



ANTICIPATED RANGE OF CONSTRUCTION NOISE LEVELS VS. DISTANCE

FIGURE 16

building construction site. Closure of all doors and windows facing the building construction site would generally reduce interior noise levels by an additional 5 to 10 dBA.

The use of properly muffled construction equipment should be required on all job sites. The incorporation of State Department of Health construction noise limits and curfew times, which are applicable throughout the State of Hawaii (Reference 5), is another noise mitigation measure which is normally applied to construction activities. Figure 17 depicts the normally permitted hours of noisy construction activities. Noisy construction activities are not allowed on Sundays and holidays, during the early morning, and during the late evening and nighttime periods under the DOH permit procedures.

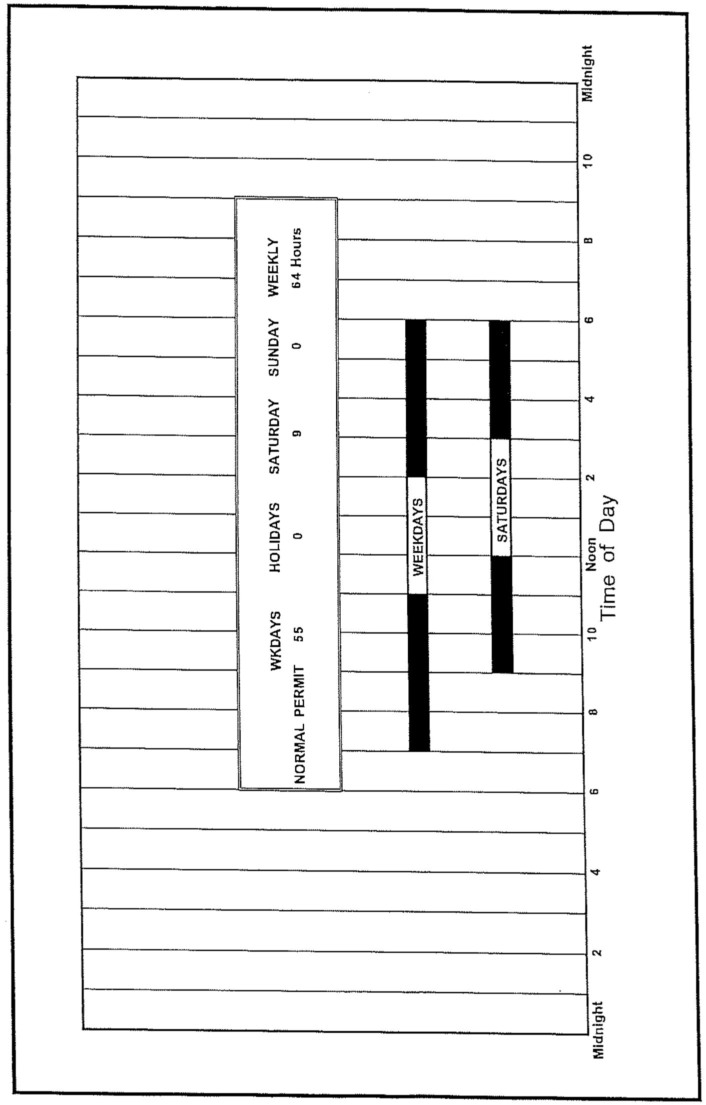


FIGURE 17

AVAILABLE WORK HOURS UNDER DOH PERMIT PROCEDURES FOR CONSTRUCTION NOISE

APPENDIX A. REFERENCES

(1) "Guidelines for Considering Noise in Land Use Planning and Control;" Federal Interagency Committee on Urban Noise; June 1980.

(2) American National Standard, "Sound Level Descriptors for Determination of Compatible Land Use," ANSI S12.9-1998/ Part 5; Acoustical Society of America.

(3) "Environmental Criteria and Standards, Noise Abatement and Control, 24 CFR, Part 51, Subpart B;" U.S. Department of Housing and Urban Development; July 12, 1979.

(4) "Information on Levels of Environmental Noise Requisite to Protect the Public Health and Welfare with an Adequate Margin of Safety;" U.S. Environmental Protection Agency; EPA 550/9-74- 004; March 1974.

(5) "Title 11, Administrative Rules, Chapter 46, Community Noise Control;" Hawaii State Department of Health; September 23, 1996.

(6) "FHWA Highway Traffic Noise Model User's Guide;" FHWA-PD-96-009, Federal Highway Administration; Washington, D.C.; January 1998 and Version 2.5 Upgrade (April 14, 2004).

(7) Final Draft "Traffic Impact Analysis Report; DLNR Industrial and Business Park;" Austin, Tsutsumi, & Associates, Inc.; November 12, 2018.

(8) Hourly Traffic Counts At Station B74031100000, Puunene Ave. - Kuihelani Hwy. to Maui Veterans Highway; Hawaii State Department of Transportation; September 28, 2011.

(9) "Acoustic Study for the DHHL North and South Parcels, Puunene, Maui, Hawaii;" Y. Ebisu & Associates; September 2018.

APPENDIX B

EXCERPTS FROM EPA'S ACOUSTIC TERMINOLOGY GUIDE

Descriptor Symbol Usage

The recommended symbols for the commonly used acoustic descriptors based on A-weighting are contained in Table I. As most acoustic criteria and standards used by EPA are derived from the A-weighted sound level, almost all descriptor symbol usage guidance is contained in Table I.

Since acoustic nomenclature includes weighting networks other than "A" and measurements other than pressure, an expansion of Table I was developed (Table II). The group adopted the ANSI descriptor-symbol scheme which is structured into three stages. The first stage indicates that the descriptor is a level (i.e., based upon the logarithm of a ratio), the second stage indicates the type of quantity (power, pressure, or sound exposure), and the third stage indicates the weighting network (A, B, C, D, E.....). If no weighting network is specified, "A" weighting is understood. Exceptions are the A-weighted sound level and the A-weighted peak sound level which require that the "A" be specified. For convenience in those situations in which an A-weighted descriptor is being compared to that of another weighting, the alternative column in Table II permits the inclusion of the "A". For example, a report on blast noise might wish to contrast the LCdn with the LAdn.

Although not included in the tables, it is also recommended that "Lpn" and "LepN" be used as symbols for perceived noise levels and effective perceived noise levels, respectively.

It is recommended that in their initial use within a report, such terms be written in full, rather than abbreviated. An example of preferred usage is as follows:

The A-weighted sound level (LA) was measured before and after the installation of acoustical treatment. The measured LA values were 85 and 75 dB respectively.

Descriptor Nomenclature

With regard to energy averaging over time, the term "average" should be discouraged in favor of the term "equivalent". Hence, Leq, is designated the "equivalent sound level". For Ld, Ln, and Ldn, "equivalent" need not be stated since the concept of day, night, or day-night averaging is by definition understood. Therefore, the designations are "day sound level", "night sound level", and "day-night sound level", respectively.

The peak sound level is the logarithmic ratio of peak sound pressure to a reference pressure and not the maximum root mean square pressure. While the latter is the maximum sound pressure level, it is often incorrectly labelled peak. In that sound level meters have "peak" settings, this distinction is most important.

"Background ambient" should be used in lieu of "background", "ambient", "residual", or "indigenous" to describe the level characteristics of the general background noise due to the contribution of many unidentifiable noise sources near and far.

With regard to units, it is recommended that the unit decibel (abbreviated dB) be used without modification. Hence, DBA, PNdB, and EPNdB are not to be used. Examples of this preferred usage are: the Perceived Noise Level (Lpn was found to be 75 dB. Lpn = 75 dB). This decision was based upon the recommendation of the National Bureau of Standards, and the policies of ANSI and the Acoustical Society of America, all of which disallow any modification of bel except for prefixes indicating its multiples or submultiples (e.g., deci).

Noise Impact

In discussing noise impact, it is recommended that "Level Weighted Population" (LWP) replace "Equivalent Noise Impact" (ENI). The term "Relative Change of Impact" (RCI) shall be used for comparing the relative differences in LWP between two alternatives.

Further, when appropriate, "Noise Impact Index" (NII) and "Population Weighed Loss of Hearing" (PHL) shall be used consistent with CHABA Working Group 69 Report Guidelines for Preparing Environmental Impact Statements (1977).

APPENDIX B (CONTINUED)

TABLE I

A-WEIGHTED RECOMMENDED DESCRIPTOR LIST

TERM	SYMBOL
1. A-Weighted Sound Level	L_A
2. A-Weighted Sound Power Level	L_{WA}
3. Maximum A-Weighted Sound Level	L_{max}
4. Peak A-Weighted Sound Level	L_{Apk}
5. Level Exceeded x% of the Time	L_x
6. Equivalent Sound Level	L_{eq}
7. Equivalent Sound Level over Time (T) (1)	$L_{eq(T)}$
8. Day Sound Level	L_d
9. Night Sound Level	L_n
10. Day-Night Sound Level	L_{dn}
11. Yearly Day-Night Sound Level	$L_{dn(Y)}$
12. Sound Exposure Level	L_{SE}

(1) Unless otherwise specified, time is in hours (e.g. the hourly equivalent level is $L_{eq(1)}$). Time may be specified in non-quantitative terms (e.g., could be specified a $L_{eq(WASH)}$ to mean the washing cycle noise for a washing machine).

SOURCE: EPA ACOUSTIC TERMINOLOGY GUIDE, BNA 8-14-78,

APPENDIX B (CONTINUED)

TABLE II

RECOMMENDED DESCRIPTOR LIST

TERM	A-WEIGHTING	ALTERNATIVE(1) A-WEIGHTING	OTHER(2) WEIGHTING	UNWEIGHTED
1. Sound (Pressure)(3) Level	L_A	L_{pA}	L_B, L_{pB}	L_p
2. Sound Power Level	L_{WA}		L_{WB}	L_W
3. Max. Sound Level	L_{max}	L_{Amax}	L_{Bmax}	L_{pmax}
4. Peak Sound (Pressure) Level	L_{Apk}		L_{Bpk}	L_{pk}
5. Level Exceeded x% of the Time	L_x	L_{Ax}	L_{Bx}	L_{px}
6. Equivalent Sound Level	L_{eq}	L_{Aeq}	L_{Beq}	L_{peq}
7. Equivalent Sound Level (4) Over Time(T)	$L_{eq(T)}$	$L_{Aeq(T)}$	$L_{Beq(T)}$	$L_{peq(T)}$
8. Day Sound Level	L_d	L_{Ad}	L_{Bd}	L_{pd}
9. Night Sound Level	L_n	L_{An}	L_{Bn}	L_{pn}
10. Day-Night Sound Level	L_{dn}	L_{Adn}	L_{Bdn}	L_{pdn}
11. Yearly Day-Night Sound Level	$L_{dn(Y)}$	$L_{Adn(Y)}$	$L_{Bdn(Y)}$	$L_{pdn(Y)}$
12. Sound Exposure Level	L_S	L_{SA}	L_{SB}	L_{Sp}
13. Energy Average Value Over (Non-Time Domain) Set of Observations	$L_{eq(e)}$	$L_{Aeq(e)}$	$L_{Beq(e)}$	$L_{peq(e)}$
14. Level Exceeded x% of the Total Set of (Non-Time Domain) Observations	$L_{x(e)}$	$L_{Ax(e)}$	$L_{Bx(e)}$	$L_{px(e)}$
15. Average L_x Value	L_x	L_{Ax}	L_{Bx}	L_{px}

(1) "Alternative" symbols may be used to assure clarity or consistency.

(2) Only B-weighting shown. Applies also to C,D,E,.....weighting.

(3) The term "pressure" is used only for the unweighted level.

(4) Unless otherwise specified, time is in hours (e.g., the hourly equivalent level is Leq(1). Time may be specified in non-quantitative terms (e.g., could be specified as Leq(WASH) to mean the washing cycle noise for a washing machine.

APPENDIX C

SUMMARY OF BASE YEAR AND YEAR 2038 TRAFFIC VOLUMES

ROADWAY LANES	**** CY 2017 ***** AM VPH	PM VPH	CY 2038 (NO BUILD) AM VPH	PM VPH	CY 2038 (BUILD) AM VPH	PM VPH
Maui Veterans Hwy. N. of Nakii Rd. (NB)	1,347	1,480	2,240	3,230	2,385	3,875
Maui Veterans Hwy. N. of Nakii Rd. (SB)	1,313	1,573	2,745	2,760	3,155	3,200
Two-Way	2,660	3,053	4,985	5,990	5,540	7,075
Maui Veterans Hwy. Between Nakii & Kamaaina (NB)	1,282	1,352	2,048	2,893	2,190	3,545
Maui Veterans Hwy. Between Nakii & Kamaaina (SB)	1,213	1,467	2,455	2,588	2,868	3,028
Two-Way	2,495	2,818	4,503	5,480	5,058	6,573
Maui Veterans Hwy. Between Kamaaina & DLNR Access (NB)	1,263	1,287	2,105	2,538	2,245	3,030
Maui Veterans Hwy. Between Kamaaina & DLNR Access (SB)	1,169	1,379	2,130	2,525	2,435	2,888
Two-Way	2,432	2,666	4,235	5,063	4,680	5,918
Maui Veterans Hwy. Btwn. DLNR Acc. & Mehameha Lp. (South) (NB)	1,263	1,287	2,143	2,433	2,448	2,798
Maui Veterans Hwy. Btwn. DLNR Acc. & Mehameha Lp. (South) (SB)	1,169	1,379	2,055	2,528	2,193	3,018
Two-Way	2,432	2,666	4,198	4,960	4,640	5,815
Maui Veterans Hwy. Btwn. Mehameha Lp. (South) & DHHL Acc1. (NB)	1,263	1,299	2,280	2,495	2,678	2,933
Maui Veterans Hwy. Btwn. Mehameha Lp. (South) & DHHL Acc1. (SB)	1,085	1,393	2,050	2,715	2,185	3,368
Two-Way	2,347	2,692	4,330	5,210	4,863	6,300
Maui Veterans Hwy. Btwn. DHHL Acc.1 & DHHL Acc.2 (NB)	1,263	1,299	2,255	2,425	2,665	2,863
Maui Veterans Hwy. Btwn. DHHL Acc.1 & DHHL Acc.2 (SB)	1,085	1,393	2,050	2,715	2,185	3,365
Two-Way	2,347	2,692	4,305	5,140	4,850	6,228
Maui Veterans Hwy. Btwn. DHHL Acc.2 & DHHL Acc.3 (NB)	1,263	1,299	2,380	2,370	2,793	2,810
Maui Veterans Hwy. Btwn. DHHL Acc.2 & DHHL Acc.3 (SB)	1,085	1,393	1,885	2,835	2,025	3,485
Two-Way	2,347	2,692	4,265	5,205	4,818	6,295
Maui Veterans Hwy. Btwn. DHHL Acc.3 & N. Kihei Rd. (NB)	1,263	1,299	2,443	2,388	2,855	2,828
Maui Veterans Hwy. Btwn. DHHL Acc.3 & N. Kihei Rd. (SB)	1,085	1,393	1,805	2,858	1,945	3,503
Two-Way	2,347	2,692	4,248	5,245	4,800	6,330
Maui Veterans Hwy. S. of N. Kihei Rd. (NB)	1,482	1,558	2,525	2,388	2,855	3,015
Maui Veterans Hwy. S. of N. Kihei Rd. (SB)	1,319	1,613	2,085	2,858	2,200	3,455
Two-Way	2,801	3,171	4,610	5,245	5,055	6,470
Mehameha Lp. (North) at Maui Veterans Hwy. (EB)	4	36	40	145	40	145
Mehameha Lp. (North) at Maui Veterans Hwy. (WB)	23	24	105	110	105	110
Two-Way	27	60	145	255	145	255
Kamaaina Rd. At Maui Veterans Hwy. (EB)	23	14	425	125	590	340
Kamaaina Rd. At Maui Veterans Hwy. (WB)	20	24	110	415	165	715
Two-Way	43	38	535	540	755	1,055
DHHL Access At Maui Veterans Hwy. (EB)	N/A	N/A	85	360	85	365
DHHL Access At Maui Veterans Hwy. (WB)	N/A	N/A	200	255	210	300
Two-Way	N/A	N/A	285	615	295	665

APPENDIX C (CONTINUED)

SUMMARY OF BASE YEAR AND YEAR 2038 TRAFFIC VOLUMES

ROADWAY LANES	**** CY 2017 ***** AM VPH	PM VPH	CY 2038 (NO BUILD) AM VPH	PM VPH	CY 2038 (BUILD) AM VPH	PM VPH
DLNR Access At Maui Veterans Hwy. (EB)	N/A	N/A	N/A	N/A	505	660
DLNRL Access At Maui Veterans Hwy. (WB)	N/A	N/A	N/A	N/A	180	940
Two-Way	N/A	N/A	N/A	N/A	685	1,600
Maui Raceway Park Access Rd. At Maui Veterans Hwy. (EB)	7	11	65	30	230	245
Maui Raceway Park Access Rd. At Maui Veterans Hwy. (WB)	4	6	55	55	110	360
Two-Way	11	17	120	85	340	605
Mehameha Lp. (South) At Maui Veterans Hwy. (EB)	0	0	60	260	60	260
Mehameha Lp. (South) At Maui Veterans Hwy. (WB)	2	2	190	160	190	160
Two-Way	2	2	250	420	250	420
DHHL Access1 Rd. At Maui Veterans Hwy. (EB)	N/A	N/A	25	5	25	5
DHHL Access1 Rd. At Maui Veterans Hwy. (WB)	N/A	N/A	50	75	50	75
Two-Way	N/A	N/A	75	80	75	80
DHHL Access2 Rd. At Maui Veterans Hwy. (EB)	N/A	N/A	485	200	485	200
DHHL Access2 Rd. At Maui Veterans Hwy. (WB)	N/A	N/A	195	375	200	375
Two-Way	N/A	N/A	680	575	685	575
DHHL Access3 Rd. At Maui Veterans Hwy. (EB)	N/A	N/A	75	25	75	25
DHHL Access3 Rd. At Maui Veterans Hwy. (WB)	N/A	N/A	15	25	15	25
Two-Way	N/A	N/A	90	50	90	50

APPENDIX K

DESIGN GUIDELINES

DLNR INDUSTRIAL AND BUSINESS PARK ARCHITECTURAL DESIGN GUIDELINES

GENERAL SITE CHARACTERISTICS

The Department of Land and Natural Resources (DLNR) Industrial and Business Park (hereby referred to as the "Project") is located in the Central Maui region, on Maui Veterans Highway at its intersection with Kama'āina Road. The project site consists of an approximately 280-acre of Tax Map Key (2)3-8-008:001, owned by the State of Hawai'i. The project site is currently undeveloped. It was most recently in sugarcane cultivation, however, commercial sugarcane production on Maui ceased at the end of 2016. Naturally occurring vegetation is primarily composed of low lying brush and ground cover with very few tall trees to provide shade. Views to the east and west are dominated by the mountain peaks of *Pu'u Kukui* to the west, and *Haleakalā* to the east, as shown in the image below.

Composite image of Project Site
Image: Composite from Google Earth

SURROUNDING NEIGHBORHOODS & USES

The Project is surrounded by agricultural lands owned by the Hawaiian Commercial & Sugar Company, the Department of Hawaiian Home Lands, and the DLNR. In addition, the Pulehunui Industrial Park, an 86-lot heavy industrial subdivision owned by CBMY 2011 Investments, LLC, is located to the southeast of the project site. Also located in proximity to the project site are the Maui Raceway Park and the Army National Guard Armory. Maui Veterans Highway, the main thoroughfare which connects the towns of Kahului and Kīhei, forms the western boundary of the project site. The nearest developed lots consist primarily of industrial and public/quasi-public uses.

Approximately four (4) miles to the north of the development is the city of Kahului, the island's largest mixed-use community where the airport, harbor, several malls and major department stores, and a concentration of residential neighborhoods are located. In Kahului the architectural scale varies, from large retail centers to smaller one and two-story residences.

Roughly five (5) miles south of the development is Kīhei, a small but densely populated mixed-use town geared towards the visitor industry with a large number of beach destinations, hotels, condos, retail stores, and residential neighborhoods. In Kīhei the architectural scale varies, with multi-story hotels in close proximity to one and two-story residences.

Approximately three (3) miles to the west of the project site is the residential neighborhood of Waikapū, where two (2) light industrial subdivisions, the Waikō Road Baseyard and Consolidated Baseyard are located. Approximately seven (7) miles to the east is Maui's upcountry region, where historical *paniolo* (Hawaiian word for "cowboy") plantation style one to three-story homes and sprawling farm lands

dominate the landscape; however smaller scale, higher-density residential neighborhoods are also located in the area. Primarily residential in use, upcountry Maui also hosts the island's three major ranches, Haleakalā, Erewhon, and 'Ulupalakua.

A number of light industrial developments located in proximity to the Project site have been identified, as shown in the image below. The Millyard and Maui Lani Village Center developments in particular have received positive response from the community and are noted as successful developments. Thus they serve as a point of reference to define strategies for creating well-designed, attractive, and functional light industrial and commercial development.

Light Industrial Developments in the vicinity of the proposed DLNR Industrial and Business Park development at Pulehunui

GENERAL DESIGN GUIDELINES

The anticipated uses of the DLNR Industrial and Business Park at Pulehunui are mainly light industrial, with some commercial. Per the County of Maui Code of Ordinances, the M-1 Light Industrial district is "designed to contain mostly warehousing and distribution types of activity".[1]

The intent of these guidelines is to encourage development that is well-designed, aesthetically pleasing, and complements the feel and character of its surrounding neighborhoods, while supporting the functions of its light-industrial and limited commercial usage.

Light Industrial Neighborhood with harmonious color palette at the Millyard, Wailuku Maui

Recommendations

- Create attractive, unified streetscapes with medium scale, one to two-story development that complements and reflect the design characteristics of similar developments, including scale, architectural style and character, and landscape design.
    1. Generally, transitions between buildings should be gradual. The height and mass should not abruptly change between buildings in close proximity.
    2. Building materials and color palettes should be complementary and create a harmonious character for the neighborhood.
- Development should not be overwhelmed by vehicles, roadways, or parking lots, and should be friendly to pedestrians and cyclists.
    1. Canopies are recommended to enhance pedestrian and bike friendly environments.
    2. Provide mid-block crosswalks to enhance pedestrian circulation.

[1] County of Maui: Section 19.24.010

3. Provide sidewalks of adequate widths.
    - The recommended minimum width is 5 feet, a width that allows two people to comfortably pass each other side by side, either walking or in wheelchairs.
    - When space allows, and especially on major arterial streets, the desirable width is 8 to 10 feet.[2]
    - Provide continuous sidewalk paths when feasible.

- Provide landscaping and greenery, at building setbacks and especially in public areas.
    1. Plant trees along major traffic corridors, pedestrian corridors, and public gathering areas.
    2. Desirable minimum buffer widths as measured from the edge of the of the road are[3]:
        - Local or collector streets – 2 to 4 feet.
        - Arterial or major streets – 5 to 6 feet.
    3. Landscape all parking lots that have street frontage.
    4. Setbacks treatments should create a positive, pleasant streetscape.

[2] Department of Transportation: 4-9

[3] Department of Transportation: 4-10.

Site Design Guidelines

Height, Mass and Scale

Definitions:

Height: The vertical distance from the average grade around the building to the uppermost portion of the building.

Mass: A building's physical size and bulk.

Scale: The size of a structure as it appears to the pedestrian.

A building's height, mass and scale define the character of an area and are key considerations in making a structure compatible with its surroundings.

Buildings that appear out-of-scale in context of its surroundings in Pearl City, O'ahu
Image: Google Earth

- Maximum height: Building height should conform to the limits defined in the Kihei-Makena Community Plan for new industrial and commercial buildings.
    - 35'-0" maximum.
    - Vent pipes, fans, chimneys, antennae and equipment used for small scale energy systems on roofs shall not exceed 70'-0" in total height. All rooftop equipment should be shielded from street view.

- The scale of a neighborhood takes precedence over the scale of an individual structure. Abrupt changes in scale are inappropriate. No structure or complex should significantly change the overall scale of the neighborhood.
- Structures more than two stories should be mitigated by means of stepping higher stories (3rd and above) back from the line of view from the street.
- Articulation of the façade is strongly recommended to reduce a structure's vertical emphasis and encourage pedestrian circulation.
- The contextual scale of large, new buildings may be mitigated by using vertical divisions and stepped roof lines.
- Windows, doors and other architectural details should be used to reduce the apparent mass of larger structures
- The mass and facades of large new buildings should be divided into several smaller "storefronts" to reduce the building's apparent scale.

Setback

Definition: The *setback* is the distance between the building and a reference line, usually a sidewalk or property line.

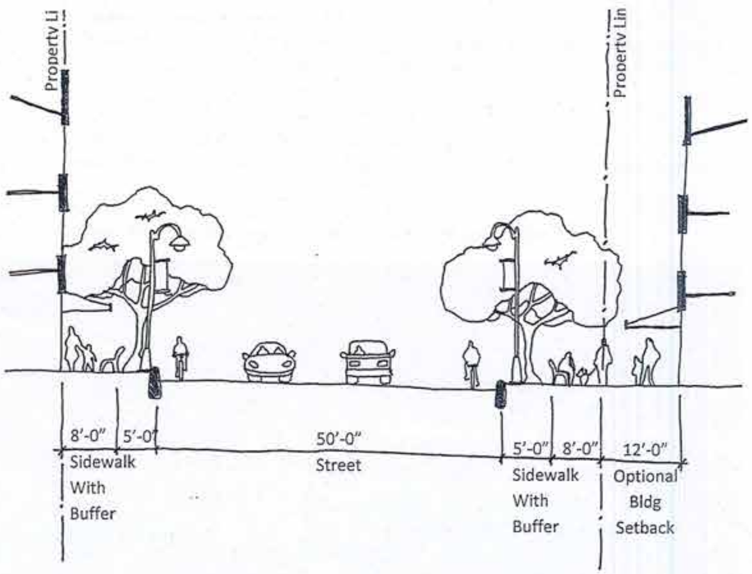
Buildings with various setbacks in Maui Lani Village Center

- Setbacks should conform to the limits defined in the County of Maui Code of Ordinances, for the "M-1 Light Industrial" zoning district.
    - Front: 0 feet or the same as the adjoining zoning category, whichever is greater. Where the setback of the adjoining non-industrial zoned parcel is less than 10 feet, a minimum setback of 10 feet shall be applied.
    - Side & rear: 0 feet or the same as the adjoining zoning category, whichever is greater. Where the setback of the adjoining non-industrial zoned parcel is less than 10 feet, a minimum setback of 10 feet shall be applied.

- Freestanding antenna or wind turbine structures: Setback 1 foot for every foot in height from all property lines.
- Accessory structures allowed within setback area: Boundary walls, parking area, trash enclosures, and ground signs.

- Setbacks are measured from the building's main façade. Canopies, awnings and balconies should not be used as reference points.

Ideal Example of Sidewalks with Landscape buffering and Building Setbacks



Parking

Off-street parking is a necessity of development, and often integral to the success of a commercial business. However, automobiles and the associated amenities should not overwhelm the development, compromise the architectural character, or require pedestrians and cyclists to put themselves in danger to circulate the site.

- Off-street parking should conform to the limits defined in the County of Maui Code of Ordinances.
  - Industrial or storage uses in M-1 and M-2 industrial zones: One parking space for every 600 square feet of floor area of building or 25% of the lot area, whichever is greater.

Parking Lot with Landscape Screening in the Millyard

  - General business buildings: One parking space for every 500 square feet of floor area, provided that the minimum shall be three parking spaces.
  - Location: every off-street parking space or area, or equivalent multi-deck, basement, roof or other parking facilities shall be located on the same lot it serves or within a distance of 400 feet of the nearest point of the lot and as approved by the planning director.
  - Refer to "Chapter 19.36A – Off Street Parking and Loading" of the County of Maui Code of Ordinances for minimum dimensions of parking spaces, aisle widths, and other guidelines required by code.
- On-site parking lots should not dominate the view of the site from the street. It is recommended to locate parking lots at the side or rear of the buildings. Design parking so pedestrians walk parallel to moving cars. Minimize the need for the pedestrian to cross parking aisles and landscape areas. These features may be integrated with accessibility requirements.
  - For lots fronting Maui Veterans Highway, on-site parking lots shall not be located along Maui Veterans Highway, so as not to be seen by passing motorists. For these lots, it is recommended to locate parking lots at the side of the buildings, or fronting an internal road within the development, and to minimize visibility from Maui Veterans Highway.
- Parking areas should be screened from the street with landscaping, walls and / or fences. Landscape strips separating a parking area from street view are recommended to be at least 4' wide. Hedges and other such vertical landscape buffers are recommended to be at least 3' high.
- Parking entrances should be designed to minimize interruptions in street patterns and the number of curb cuts. When possible, provide common driveways for access to more than one site or development which reduces the number of driveways and contributes to a continuous streetscape.

- On corner sites, parking areas located at the corner immediately adjacent to intersections are discouraged.
- Rooftop parking should be screened from public view by architectural features such as false fronts.
- Site accessories such as bicycle racks, trash receptacles, planters, benches, shade structures and lighting should be designed as an integral part of the project. The site accessories should be consistent with the overall project design.

Service & Loading Facilities

- When feasible, service yards are encouraged, to consolidate the location of services facilities such loading, trash bins, utility cabinets, utility meters, transformers, and other outdoor mechanical equipment, instead of dispersing them around the site.
- Loading and outdoor storage activities should be concentrated and located such that it minimizes nuisance for the surrounding areas.
- All service areas should be screened from street view. Screening may include walls, buildings, gates, landscaping, berming, or combinations of the aforementioned.
- Service area walls and other site elements should be compatible with the architecture, materials, and color palette of the main building.
- When possible, loading areas should not be visible from street view.
- Loading driveways should not spill into streets or landscaped setback areas.

Screened Trash Bin at the Millyard, Wailuku Maui

Landscaping

Especially in Hawai'i, where its natural beauty and tropical climate allows for almost year-round connection with the outdoors, landscaping is a key design feature to enhance the appeal of developments, and allows them to blend harmoniously with their surroundings. Landscaping is intended to soften the harsh appearance of pavement and concrete. Enhancing the landscape will not only beautify the Project, but also create a more pedestrian and bicycle-friendly environment.

- All landscape planting should conform to the Maui County Planting Plan.
- Landscaping should be used to enhance, but not hide, a building's site and complement its architecture, softening the appearance of structures, defining site functions, screening and buffering adjacent uses.
- Landscaping should be used to encourage pedestrian circulation by providing visual variety, color and shade.
- Parking lots should be landscaped with canopy shade trees and screened by hedges, walls, or fences from public view and adjacent buildings. As a rule of thumb, one canopy tree should be provided for every five (5) parking spaces.
- All open storage should be screened from public view by landscaping, a fence or wall.
- Landscaping should be used to accentuate a building entry when appropriate.
- For vertical landscaping, vines and climbing plants on buildings or trash enclosures, trellises, and perimeter walls are encouraged.
- For landscaping that abuts the public right-of-way, consider plant palettes that are compatible with neighboring landscapes.
- Combining landscaping and hardscaping, such as contrasting pavement colors or materials, banding or pathways interspersed with different paving material, is encouraged.

Street with a variety of landscaping in Millyard

Hazardous Wildlife Attractants

State law (Hawaii Revised Statutes, Chapter 262 – Airport Zoning Act) requires that the State and the Department of Transportation, Airports Division (DOT-A) act to prevent hazards and not allow proposed non-conforming uses that are in conflict with the FAA Hazardous Wildlife Attractants requirements. Inasmuch as the project site is located within five (5) nautical miles of the Kahului Airport, the following recommendations are offered to prevent wildlife hazards which can lead to a catastrophic event causing loss of life and property:

- Developments shall be designed and operated or otherwise conditioned or mitigated to meet the requirements of FAA *Advisory Circular Hazardous Wildlife Attractants on or Near Airports 150/5200-33B*.
- Any planned water detention ponds or basins and any related open drainage swales shall be designed, engineered, constructed, and maintained for a maximum 48-hour detention period after the design storm and remain completely dry between storms.
- Water detention basins shall be designed in accordance with Maui County Code. Refer to "Chapter 4 – Rules for the Design of Storm Drainage Facilities in the County of Maui" of the County of Maui Department of Public Works and Waste Management code for guidelines regarding the size, location, shape, drainage system and maintenance of water retention basins. If more than one acre of impervious surface is provided, refer to "Chapter 15-111 Rules for the Design of Storm Water Treatment Best Management Practices" for guidelines regarding water quality, discharge rates and such.
- Any landscaped areas should be planned and implemented to deter wildlife attraction.

DLNR Industrial and Business Park EIS Report
Job No. D00CM68A
Prepared by: Bowers + Kubota Consulting

Pedestrian Paths

Pedestrian paths should link commercial structures, streets, parking and activities, creating a pedestrian-friendly community.

- Pedestrian access should be provided by pathways that connect the municipal parking lots and adjacent streets. These paths may include open-air walkways, covered walkways or courtyards.
- Landscaping is encouraged for pathways.
- Pathways should be well lit, attractive and safe.

Pedestrian & bicycle friendly path with landscape buffering in Millyard

BK
13A6545.01
10/24/17

Architectural Design Guidelines

Facades

Definition: A *façade* is the principal exterior face of a building fronting a street. It is the architectural front, which is usually distinguished from other faces by elaboration of architectural details.

Building with articulated façade in Waipahu, Hawai'i
Image: Bowers + Kubota Auali'i Office & Warehouse

- Canopies or balconies should extend across the entire building façade.
- Recessed entries are encouraged
- Glass windows should be at least 18" above the sidewalk level. Use of larger sized, clear glass windows in compliance with the current Energy Code are encouraged to provide daylight and a modern feel.
- Architectural details should be incorporated to add interest to and break down the scale of monolithic walls. Blank walls adjacent to a publicly traveled way should be avoided. Canopies, wall variations such as insets and pop outs, and changes in wall material are recommended.
- New buildings with a façade over 50 feet wide and / or tall should use horizontal and vertical divisions in the facades to articulate the facade.
- Utility meters and mechanical equipment should be located away from public view.
- Primary site and building entry points are encouraged to create visual interest with design features such as decorative or textured paving, flowering landscape accent plant species, decorative accent lighting, monumental scale, accent wall finishes, water features, and such. Secondary entrances that face parking areas should have inviting facades.

Wall Finish

Wall finish materials serve a functional purpose and can also enhance a building's aesthetic appeal. Painted concrete masonry unit wall systems with or without stucco are commonly used for its cost and durability. Metal and composite paneling are also popular choices for light industrial developments.

Combinations of painted CMU with metal paneling may be used for durability as well as to create visual interest

Image: Allied Builders

- Durable but attractive materials of high quality should be used.
- Exterior building treatments, including colors, materials, and architectural detailing should be consistent throughout the building.
- Building materials reflecting natural elements, such as stone or wood, are encouraged.
- Wall Base
  - Base materials should be highly resistant to damage, defacement, and general wear and tear. Pre-case decorative concrete, stone masonry, brick, slate, and commercial grade ceramic tile are recommended. The use of anti-graffiti coating is encouraged.

Doors

Doors are often one of the first items replaced when buildings change owners or tenants. Ensure doors are complementary with the overall building design.

- Doors may be glazed as permitted by fire code.
- Doors should be made of commercial-grade, durable materials. Hollow metal and aluminum are cost efficient and durable exterior doors. Interior doors may be made of wood and / or finished with laminate surfacing.
- Large-sized delivery doors, barred metal doors, and aluminum doors should not be visible from the street where practicable.

Windows

- Larger window openings or curtain wall systems create a modern feel and increase worker productivity providing ample daylight.
- Operable windows are also encouraged for natural ventilation.
- Windows should be constructed with muntins, frames, sashes and sills.
- Frames should be of durable and commercial-grade material. Hollow metal or aluminum are recommended. Vinyl windows are cost effective, but are not recommended as they may crack or discolor from light exposure.

A mixture of small and large window openings may create a modern feel

Image: Bowers + Kubota Auali'i Office & Warehouse

Roofs

Roofs are an integral part of the building design and overall form.

- Roof design should have the appearance of a full roof reflecting traditional forms, such as hipped, gabled, flat, double hipped and such.
- Durable roof materials such as metal with unified or complimentary colors are highly encouraged.
- Parapet walls should be used to screen flat roofs and enhance a building's profile.

Metal roofs with complimentary colors at the Millyard

Parapets articulate roof line at Maui Lani Village Center

Photovoltaic Systems

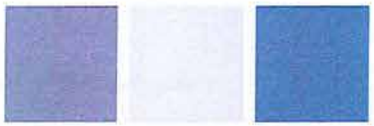
Because the project site is located in the vicinity if the Kahului Airport, the following recommendations are offered in regards to photovoltaic (PV) systems if they are to be installed on buildings within the project as PV systems located in or near the approach path of aircraft into an airport can create a hazardous condition for a pilot due to possible glint and glare reflected from the PV array.

- Prior to PV installation, a Glint and Glare Analysis shall be prepared. The website www.sandia.gov/glare may assist in preparation of the Glint and Glare Analysis.
- The highest rated non-glare material is recommended to be used in the PV system to mitigate potential hazard to the greatest degree possible.
- If glint or glare from the PV is found to create a hazardous condition for pilots, the owner of the PV system must be prepared to immediately mitigate the hazard, upon notification by the DOT-A or the Federal Aviation Administration (FAA).
- PV installations have been known to emit signals that create radio frequency interference (RFI) and disrupt air-to-ground communications. Tenants must ensure the installation does not create an RFI hazard.

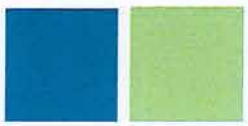
Color Palette

Exterior color is one of the most prominent visual aspects of a building. Color is also one of the easiest architectural details to change and can be an excellent method to quickly enhance a building's appearance and the streetscape. The majority of the building's skin is recommended to feature a neutral color palette. However brighter more vibrant colors may be used to create focal points & accents on limited portions of a building's exterior, such as the roof, feature walls, trims, and such.

- Traditional: Recommended colors include off-white, gray, light grey, gray-blue, or other similar colors.



- Accent: Recommended colors include blue-green & spring green.



- Color schemes should be compatible with adjacent buildings.
- Side and rear walls should be painted with the same color scheme as the main façade.
- Roof colors should coordinate with the rest of the building, if visible, and be compatible with colors of adjacent buildings.
- Buildings with multiple vertical divisions in the facades to create the appearance of separate storefronts may use different but complementary color schemes for each storefront section.

An accent color creates emphasis on a wall pop-out

Image: Home Design Ideas

Signage

Signs provide information and identify businesses, but also add interest and visual variety to the streetscape. While sign diversity is encouraged, individual signs must be compatible with the overall character of the island.

Attractive building signage in Honolulu, O'ahu

Image: Hawai'i Magazine

- Sign design should be compatible with a building's architecture style and colors, and should not overwhelm the façade or its architectural details.
- Signage should conform to Maui County's sign ordinance.
- Commercial establishments should have no more than two signs: a hanging / projecting sign or a wall sign, and a monument sign.
- Signs should be graphically simple, clearly legible, and present an appropriate level of detail without appearing cluttered. Information should be limited to the name and / or nature of the business.
- Sign material may be wood or non-reflective metal, on which the design can be carved, sandblasted or painted. In rare cases, other sign materials may be appropriate as permitted by the Maui County sign ordinance.
- The following are prohibited: flashing, blinking, rotating, plastic, inflatable, roof and detached freestanding signs.
- Use shielded or indirect external lighting to illuminate signs.

SUMMARY

The intent of these design guidelines is to encourage smart development that is compatible with surrounding developments of similar nature. Building materials and colors should be durable and functional yet attractive, aesthetically pleasing and unified. Parking and roadways should function to service the light-industrial and limited commercial uses, yet not overwhelm the development. Landscaping and greenery, adequate sidewalk and buffer widths, and architectural elements such a canopies support pedestrian and bike friendly environments and encourage a lively and friendly atmosphere for workers and visitors.

Text References:

County of Maui. *Code of Ordinances*. County of Maui. December 2016. Accessed 6 Feb 2017

Department of Transportation. *Hawaii Pedestrian Toolbox*. County of Maui. May 2013. Accessed 6 Feb 2017.

Maui County Planning Department. *Wailuku Redevelopment Area Design*. County of Maui. Jan 2006. Accessed 7 Feb 2017.

Image References:

Allied Builders: http://abshawaii.com/portfolio/yhata-chefzone/

Khon 2: http://khon2.com/2015/04/30/newly-renovated-haleiwa-store-lots-to-hold-grand-opening/

Home Design Ideas: http://www.thephotostation.net/images/superb-exterior-metal-panels-1-metal-exterior-panels-skirting-inspiration-house-photos-hgtv-1200-x-798.jpg

Hawaii Magazine:
http://www.hawaiimagazine.com/sites/default/files/sites/default/files/Screen%20Shot%202016-11-21%20at%202.28.12%20PM.png

Mapio: http://static.panoramio.com/photos/original/6850912.jpg

APPENDIX

L

VIEW ANALYSIS


Source: Bowers + Kubota Consulting

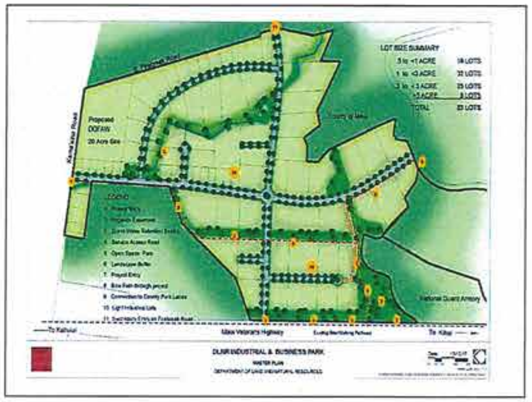

Source: Bowers + Kubota Consulting

Source: Bowers + Kubota Consulting

FINANCIAL FEASIBILITY ANALYSIS

APPENDIX M

FEASIBILITY ANALYSIS
OF
PROPOSED DLNR INDUSTRIAL AND BUSINESS PARK



Off Maui Veterans Highway
Wailuku, HI, 96793

As of
January 1, 2020

Prepared For
Tessa Munekiyo Ng, AICP
Vice President
MUNEKIYO HIRAGA
305 High Street, Suite 104
Wailuku, HI, 96793

Client File:
N/A

Prepared by
FUKUDA VALUATION & CONSULTING LLC
Shane M. Fukuda, MAI

File Name:
17-026C

FUKUDA
VALUATION & CONSULTING LLC

February 21, 2018

17-026C

Tessa Munekiyo Ng, AICP
Vice President
MUNEKIYO HIRAGA
305 High Street, Suite 104
Wailuku, HI 96793

Re: Feasibility Analysis for the Proposed DLNR Industrial and Business Park, Off Maui Veterans Highway, Wailuku, Maui County, HI, 96793

Tax Map Key: Division 2, Zone 3, Section 8, Plat 08, Parcel 001 (portion of)

Client File Number: N/A

Dear Ms. Munekiyo Ng:

Pursuant to the Scope of Work, I have prepared a feasibility analysis for the above referenced property, which is briefly described as follows:

The DLNR Industrial and Business Park (the "Proposed Project) is a planned light industrial subdivision of approximately 280 gross acres, situated east of Maui Veterans Highway. The irregular site has generally level to gently sloping topography, with mountain views.

The client is Munekiyo Hiraga. The intended users are Munekiyo Hiraga; State of Hawaii Department of Land and Natural Resources; and the appropriate State and County agencies involved in the proposed land use changes. The intended use of this appraisal is to provide real property information and real estate market data in support of an Environmental Impact Statement, a State Land Use District Boundary Amendment (Agricultural to Urban), Community Plan Amendment (Agricultural to Light Industrial), and a Change in Zoning (Agricultural District to M-1 Light Industrial District).. This report is not intended to serve any other intended use. Please reference page 5 of this report for important information regarding the scope of research and analysis for this appraisal, including property identification, inspection, highest and best use analysis and valuation methodology.

Your attention is directed to the Limiting Conditions and Assumptions section of this report (page 3). Acceptance of this report constitutes an agreement with these conditions and assumptions. In particular, I note the following:

Hypothetical Conditions:
There are no Hypothetical Conditions for this report.

Tessa Munekiyo Ng
February 21, 2018
Page 2

Extraordinary Assumptions:
Feasibility analysis utilizes numerous extraordinary assumptions relative to securing entitlements; accuracy of cost expenditures; timing of sales; market condition trends; and project construction in a workmanlike manner, as of the prospective date. This analysis is based on the Extraordinary Assumption that the land will be zoned M-1 Light Industrial District, as of the prospective date, January 1, 2020.

I certify that I have no present or contemplated future interest in the property beyond this concluded opinion of value. I have provided appraisal services regarding the property that is the subject of this report within the three-year period immediately preceding acceptance of this assignment.

This **Feasibility Analysis** complies with the reporting requirements set forth under Standards Rule 2-2(a) of the *Uniform Standards of Professional Appraisal Practice* for an Appraisal Report. As such, it provides sufficient information to enable the client and intended users to understand the rationale for the opinions and conclusions, including reconciliation of the data and approaches. The amount of detail varies with the significance of the information to the appraisal.

Determination of the feasibility of the proposed project entailed use of the Subdivision Development methodology. In this case, the scenarios are specific to a development by the State of Hawaii Department of Land and Natural Resources (DLNR). The results of this analysis represent Investment Value. Investment Value is defined as the value of a property to a particular investor or class of investors based on the investor's specific requirements. Investment value may be different from market value because it depends on a set of investment criteria that are not necessarily typical of the market. (*The Dictionary of Real Estate Appraisal*, 6th edition, The Appraisal Institute, 2015)

Based on the appraisal described in the accompanying report, subject to the Limiting Conditions and Assumptions, Extraordinary Assumptions and Hypothetical Conditions, I have concluded that the Proposed DLNR Industrial and Business Park, as specifically developed herein, is feasible as of the prospective date, January 1, 2020.

Respectfully submitted,

Fukuda Valuation & Consulting LLC

Shane M. Fukuda

Shane M. Fukuda, MAI
Certified General Appraiser
State of Hawaii, CGA-810
Expiration: December 31, 2017

TABLE OF CONTENTS

Summary of Important Facts and Conclusions

GENERAL

Subject: Proposed DLNR Industrial and Business Park
Off Maui Veterans Highway, Wailuku,
Maui County, HI, 96793

The DLNR Industrial and Business Park (the "Proposed Project) is a planned light industrial subdivision of approximately 280 gross acres, situated east of Maui Veterans Highway. The irregular site has generally level to gently sloping topography, with mountain views.

Tax Map Key: Division 2, Zone 3, Section 8, Plat 08, Parcel 001 (portion of)

Owner: State of Hawaii

Date of Report: February 21, 2018

Intended Use: The intended use is to provide real property information and real estate market data in support of an Environmental Impact Statement, a State Land Use District Boundary Amendment (Agricultural to Urban), Community Plan Amendment (Agricultural to Light Industrial), and a Change in Zoning (Agricultural District to M-1 Light Industrial District).

Intended Users: Munekiyo Hiraga; State of Hawaii Department of Land and Natural Resources; and the appropriate State and County agencies involved in the proposed land use changes.

Assessment (2017)

Real Estate Assessment and Taxes

Assessment Year	Land	Improvements	Exemptions	Total Assessment	County Rate	Taxes
2017	$130,300	$438,900	-$438,900	$130,300	$6.01	$783.10
2016	$130,300	$437,400	-$437,400	$130,300	$5.66	$737.50
2015	$1,634,600	$400,400	-$1,908,200	$126,800	$5.75	$729.10

Gross Land Areas: 280 acres

Zoning: Light Industrial District (Extraordinary Assumption, Page 6)

Highest and Best Use of the Site: Light industrial use (Extraordinary Assumption, Page 6)

Type of Value: Investment Value

Feasibility Analysis Conclusion: Subject to the Limiting Conditions and Assumptions, Extraordinary Assumptions and Hypothetical Conditions, I have concluded that the Proposed DLNR Industrial and Business Park, as specifically developed herein, is feasible as of the prospective date, January 1, 2020

Limiting Conditions and Assumptions

Acceptance of and/or use of this report constitutes acceptance of the following limiting conditions and assumptions; these can only be modified by written documents executed by both parties.

This appraisal is to be used only for the purpose stated herein. While distribution of this appraisal in its entirety is at the discretion of the client, individual sections shall not be distributed; this report is intended to be used in whole and not in part.

No part of this appraisal, its value estimates or the identity of the firm or the appraiser(s) may be communicated to the public through advertising, public relations, media sales, or other media.

All files, work papers and documents developed in connection with this assignment are the property of Fukuda Valuation & Consulting LLC. Information, estimates and opinions are verified where possible, but cannot be guaranteed. Plans provided are intended to assist the client in visualizing the property; no other use of these plans is intended or permitted.

No hidden or unapparent conditions of the property, subsoil or structure, which would make the property more or less valuable, were discovered by the appraiser(s) or made known to the appraiser(s). No responsibility is assumed for such conditions or engineering necessary to discover them. Unless otherwise stated, this appraisal assumes there is no existence of hazardous materials or conditions, in any form, on or near the subject property.

Unless otherwise stated in this report, the existence of hazardous substances, including without limitation asbestos, polychlorinated biphenyl, petroleum leakage, or agricultural chemicals, which may or may not be present on the property, was not called to the attention of the appraiser nor did the appraiser become aware of such during the appraiser's inspection. The appraiser has no knowledge of the existence of such materials on or in the property unless otherwise stated. The appraiser, however, is not qualified to test for such substances. The presence of such hazardous substances may affect the value of the property. The value opinion developed herein is predicated on the assumption that no such hazardous substances exist on or in the property or in such proximity thereto, which would cause a loss in value. No responsibility is assumed for any such hazardous substances, nor for any expertise or knowledge required to discover them.

Unless stated herein, the property is assumed to be outside of areas where flood hazard insurance is mandatory. Maps used by public and private agencies to determine these areas are limited with respect to accuracy. Due diligence has been exercised in interpreting these maps, but no responsibility is assumed for misinterpretation.

Good title, free of liens, encumbrances and special assessments is assumed. No responsibility is assumed for matters of a legal nature.

Necessary licenses, permits, consents, legislative or administrative authority from any local, state or Federal government or private entity are assumed to be in place or reasonably obtainable.

It is assumed there are no zoning violations, encroachments, easements or other restrictions which would affect the subject property, unless otherwise stated.

The appraiser(s) are not required to give testimony in Court in connection with this appraisal. If the appraisers are subpoenaed pursuant to a court order, the client agrees to pay the appraiser(s) Fukuda Valuation & Consulting LLC's regular per diem rate plus expenses.

Appraisals are based on the data available at the time the assignment is completed. Amendments/modifications to appraisals based on new information made available after the appraisal was completed will be made, as soon as reasonably possible, for an additional fee.

Americans with Disabilities Act (ADA) of 1990
A civil rights act passed by Congress guaranteeing individuals with disabilities equal opportunity in public accommodations, employment, transportation, government services, and telecommunications. Statutory deadlines become effective on various dates between 1990 and 1997. Fukuda Valuation & Consulting LLC has not made a determination regarding the subject's ADA compliance or non-compliance. **Non-compliance could have a negative impact on value, however this has not been considered or analyzed in this appraisal.**

Scope of Work

According to the *Uniform Standards of Professional Appraisal Practice*, it is the appraiser's responsibility to develop and report a scope of work that results in credible results that are appropriate for the appraisal problem and intended user(s). Therefore, the appraiser must identify and consider:

- the client and intended users;
- the intended use of the report;
- the type and definition of value;
- the effective date of value;
- assignment conditions;
- typical client expectations; and
- typical appraisal work by peers for similar assignments.

This appraisal is prepared for the client, Munekiyo Hiraga. The client contact is Tessa Munekiyo Ng, AICP, Vice President. The problem to be solved is determine the financial feasibility of the Proposed DLNR Industrial and Business Park. The intended use is to provide real property information and real estate market data in support of an Environmental Impact Statement, a State Land Use District Boundary Amendment (Agricultural to Urban), Community Plan Amendment (Agricultural to Light Industrial), and a Change in Zoning (Agricultural District to M-1 Light Industrial District). This appraisal is intended for the use of Munekiyo Hiraga; State of Hawaii Department of Land and Natural Resources; and the appropriate State and County agencies involved in the proposed land use changes.

SCOPE OF WORK	
Report Type:	This is an Appraisal Report as defined by *Uniform Standards of Professional Appraisal Practice* under Standards Rule 2-2(a). This format provides a summary or description of the appraisal process, subject and market data and valuation analyses.
Property Identification:	The subject has been identified by the legal description and the assessors' parcel number.
Inspection:	An inspection of the subject property has been made, and photographs taken.
Market Area and Analysis of Market Conditions:	A complete analysis of market conditions has been made. The appraiser maintains and has access to comprehensive databases for this market area and has reviewed the market for sales and listings relevant to this analysis.
Highest and Best Use Analysis:	A complete as vacant and as improved highest and best use analysis for the subject has been made. Physically possible, legally permissible and financially feasible uses were considered, and the maximally productive use was concluded.

Type of Value:	Investment Value
Definition of Value:	Investment Value is defined as the value of a property to a particular investor or class of investors based on the investor's specific requirements. Investment value may be different from market value because it depends on a set of investment criteria that are not necessarily typical of the market. (*The Dictionary of Real Estate Appraisal*, 6th edition, The Appraisal Institute, 2015)
Valuation Analyses	
Cost Approach:	A cost approach was not applied as the development costs are specific to the build-out of the proposed DLNR Industrial and Business Park.
Sales Comparison Approach:	A sales approach was applied as there is adequate market sales data to establish the fee simple individual fee simple market values for the overall project site and proposed leasable lots.
Income Approach:	An income approach was not applied as the site is vacant and not revenue-generating.
Subdivision Development:	A subdivision development analysis was applied as project-specific costs have been provided and there is sufficient industrial lease data.
Hypothetical Conditions:	• There are no Hypothetical Conditions for this report.
Extraordinary Assumptions:	Extraordinary Assumption is defined as an assumption, directly related to a specific assignment, as of the effective date of the assignment results, which, if found to be false, could alter the appraiser's opinions or conclusions. (*The Dictionary of Real Estate Appraisal*, 6th edition, The Appraisal Institute, 2015) • Feasibility analysis utilizes numerous extraordinary assumptions relative to securing entitlements; accuracy of cost expenditures; timing of sales; market condition trends; and project construction in a workmanlike manner, as of the prospective date. • This analysis is based on the Extraordinary Assumption that the land will be zoned M-1 Light Industrial District, as of the prospective date, January 1, 2020.

Information Not Available: • None

Comments

Construction schedule and cost estimates are based on documents by Austin, Tsutsumi & Associates, Inc. The documents stipulate various assumptions that may have an impact on the results of this feasibility analysis (See Addenda).

Market Area Analysis

Boundaries

The subject's Pulehunui location is within the District of Wailuku, but part of the Kihei-Makena Community Plan.

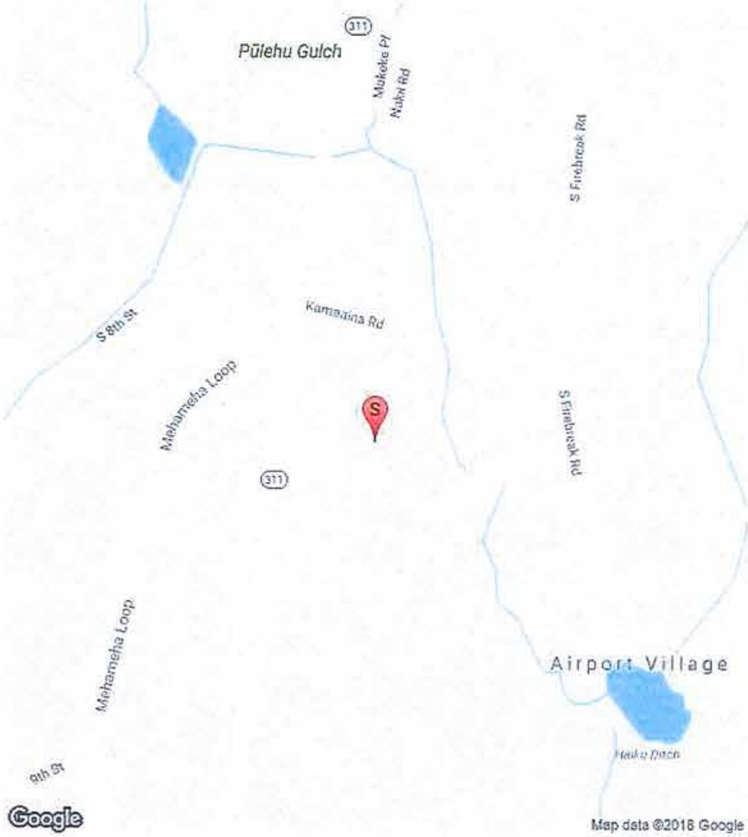
The boundaries of the Kihei-Makena area extend along the western shoreline of east Maui at the foot of Haleakala. The boundaries of the Kihei-Makena planning region begin at the shore where Kapuni Gulch enters the ocean. Starting at this point, the boundary travels mauka to the Kahikinui forest reserve, then in the westerly direction along the unimproved Piilani Highway to the Kula Highway at Ulupalakua, then along the highway to the jeep trail running through the center of the Kamaole Ahupua'a, then makai along the jeep trail to the unimproved portion of Waiakoa Road, then in a northerly direction along the unimproved improved portions of Waiakoa Road to its intersection with Spanish Road north of Pulehu Gulch. The boundary then extends along Spanish and Waikapu Roads which traverse the length of the island's isthmus to a point just east of Waikapu at Waikapu Stream, then in a southwesterly direction to Honoapiilani Highway, and finally along the highway to Pohakea Gulch. The boundary then goes mauka along the centerline of the gulch to the ridgeline, and then makai along the centerline of Manawainui Gulch to the shoreline. The region is comprised of four communities: Maalaea, Kihei, Wailea, and Makena. Community form in the planning region consists of a small shoreline-oriented community at Maalaea and a linear pattern of urbanization extending from the south end of Kealia Pond to Makena. This consists of Kihei proper, extending from Kilohana Drive, and the planned resort destination areas at Wailea and Makena.

Environs

The DLNR Industrial and Business Park (the "Proposed Project) is a planned light industrial subdivision of approximately 280 gross acres, situated east of Maui Veterans Highway, District of Wailuku, Island and County of Maui. Maui Veterans Highway is the primary roadway connecting Kahului to Kihei and runs in a generally north-south direction. It is an asphalt-paved four-lane thoroughfare with two lanes in each direction, divided by a median. Maui Veterans Highway has street lights, as well as overhead and underground utilities. A dedicated bicycle and pedestrian path is situated along the eastern side of the roadway.

Puunene is primarily an agricultural area between the Central Maui and South Maui regions. Most of the surrounding land has historically been utilized for commercial sugar cane production. Maui Raceway Park, the Hawaiian Cement quarry, the Maui Army National Guard Armory, and the Maui Humane Society are located nearby. To the southeast of the Proposed Project is the Pulehunui Industrial Park, an 86-acre heavy industrial subdivision currently under development. Central Maui Baseyard, a light/heavy industrial yard storage development, is situated approximately one mile to the north. Although the immediate area is unpopulated, the Proposed Project will be conveniently located with respect to its many supporting facilities, such as shopping, schools, employment, residential and recreational areas in both Central Maui and South Maui.

Location Map



Property Description

SITE	
Location:	The subject property is located off Maui Veterans Highway in Pulehunui, District of Wailuku, Island and County of Maui, State of Hawaii
Owner of Record:	State of Hawaii
Census Tract:	307.05
Legal Description:	The subject's legal description has been included in the Addendum section of this report
Tax Map Key:	Division 2, Zone 3, Section 8, Plat 08, Parcel 001 (portion of)
Property Descriptions	The DLNR Industrial and Business Park (the "Proposed Project) is a planned light industrial subdivision of approximately 280 gross acres, situated east of Maui Veterans Highway. The irregular site has generally level to gently sloping topography, with mountain views.
Visibility:	Average
Soil Conditions:	Appears stable
Utilities:	Electricity: Public electricity Sewer: Private sewer Water: Public water Underground Utilities: No Adequacy: Adequate
Off-Site Improvements:	Street Lighting: Yes Sidewalks: No Curbs and Gutter: -- Landscaping: Typical subdivision
Flood Zone:	The subject is in an area mapped by the Federal Emergency Management Agency (FEMA). The subject is in FEMA Flood Zone X, which is not classified as a flood hazard area. FEMA Map Number: 150003 0580F/150003 0557F FEMA Map Date: September 19, 2012 Flood Zone X identifies areas determined to be outside the 0.2 percent annual chance floodplain. Flood insurance is not required.
Wetlands/Watershed:	None noted

Environmental Issues:	None noted
Current Use of the Property:	Vacant land
Site Comments:	There are no notable physical characteristics that would prevent efficient development of the subject site.
Sale History:	There have been no conveyances of the subject property within the three years prior to the effective date.
Listing History:	There have been no listings of the subject property within the three years prior to the effective date.

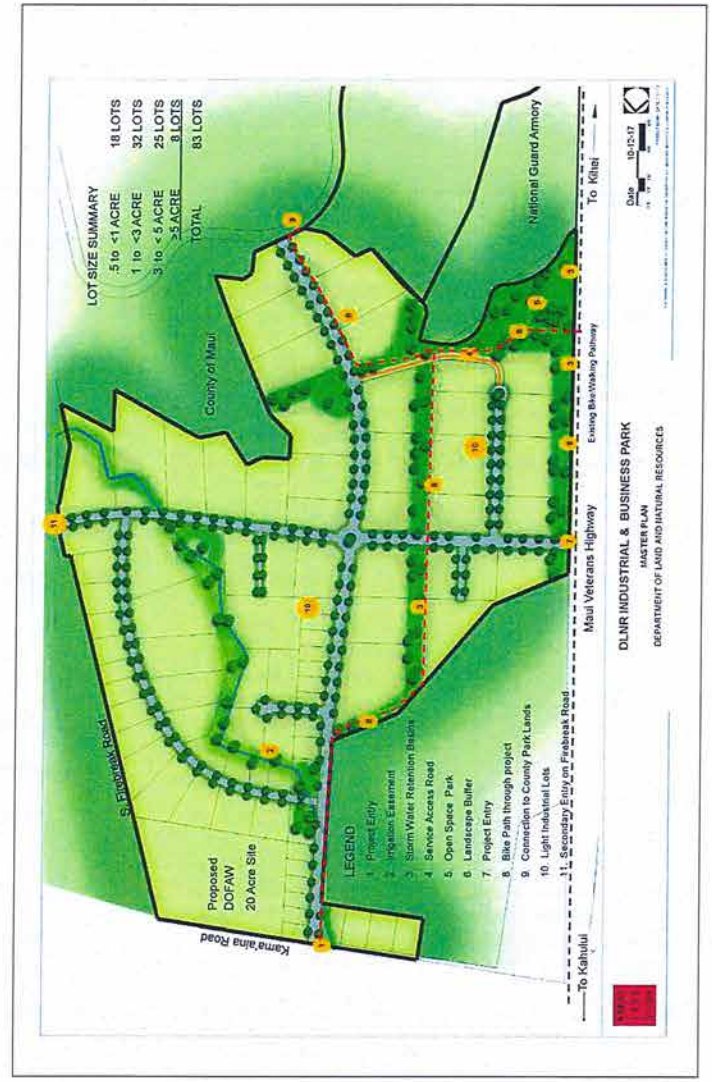
Americans With Disabilities Act

Please reference the Limiting Conditions and Assumptions section of this report on page 4.

Hazardous Substances

Please reference the Limiting Conditions and Assumptions section of this report on page 4.

Master Plan Map



Assessment and Taxes

Taxing Authority County of Maui

Assessment Year 2017

Real Estate Assessment and Taxes						
Assessment Year	Land	Improvements	Exemptions	Total Assessment	County Rate	Taxes
2017	$130,300	$438,900	-$438,900	$130,300	$6.01	$783.10
2016	$130,300	$437,400	-$437,400	$130,300	$5.66	$737.50
2015	$1,634,600	$400,400	-$1,908,200	$126,800	$5.75	$729.10

Comments
Properties in the State of Hawaii are assessed annually at 100 percent of fee simple market value using the cost and market approaches to value. Real property taxes are calculated by multiplying assessed values less any exemptions by the appropriate tax rate. As of the effective date, the subject's 280 acres has not received final subdivision approval; therefore, only the large lot, TMK (2) 3-8-08-001, is being assessed. For 2017-2018, the taxable assessments for Parcel 001 is $130,300 because of its dedicated agriculture status. Furthermore, the $438,900 building assessment is fully-exempt. The 2017-2018 County of Maui tax rate for the Agricultural class is $6.01 per $1,000 assessment. Based on this rate, the 2017-2018 real property tax for larger Parcel 001 is $783.10 ($130,300 ÷ $1,000 x $6.01). The real property tax office market land assessment is $7,656,700. Without the agricultural dedication, the land real property tax for larger Parcel 001 would be $46,016.77.

As indicated on the County of Maui Real Property Tax website, the subject is current on its tax payments, as of the effective date. There are no known special assessments of record.

Zoning

Land Use Controls

State Land Use District	Urban (Extraordinary Assumption)
Land Use District Comment	The State Land Use Law (Chapter 205, Hawaii Revised Statutes) was adopted in 1961, establishing a framework of land use management and regulation in which all lands in the State of Hawaii are classified into one of four land use districts. The Urban District generally includes lands characterized by "city-like" concentrations of people, structures and services. This District also includes vacant areas for future development. Jurisdiction of this district lies primarily with the respective counties. Generally, lot sizes and uses permitted in the district area are established by the respective county through ordinances or rules.
Zoning Description	Light Industrial District (Extraordinary Assumption, Page 6)
Zoning Comments	The M-1 Light Industrial District is designed to contain mostly warehousing and distribution types of activity, and permits most compounding, assembly, or treatment of articles or materials with the exception of heavy manufacturing and processing of raw materials. Residential uses are excluded except for dwelling units located above or below the first floor and apartments. Commercial uses are also allowed, since the M-1 Light Industrial District encompasses the B-3, B-2 and B-1 Business Districts.
Zoning Density/FAR	No maximum
Current Use Legally Conforming	The subject is legal and conforming use
Zoning Change Likely	A zoning change from M-1 Light Industrial District is unlikely
Zoning Change Description	Not applicable
Set Back Distance	None or the same as the adjoining zoning category, whichever is greater
Side Yard Distance	None or the same as the adjoining zoning category, whichever is greater

Kihei-Makena Community Plan	Light Industrial (Extraordinary Assumption)
Community Plan Comments	The Kihei-Makena Community Plan, one of nine (9) community plans for Maui County, reflects current and anticipated conditions in the Kihei-Makena region and advances planning goals, objectives, policies, and implementation considerations to guide decision-making in the region through the year 2010. The Kihei-Makena Community Plan provides specific recommendations to address the goals, objectives, and policies contained in the General Plan, while recognizing the values and unique attributes of the Kihei-Makena area in order to enhance the region's overall living environment. The Maui County General Plan, first adopted in 1980 and updated in 1990, sets forth goals, directions and strategies for meeting the long-term social, economic, environmental and land use needs of the County. Similarly, the Kihei-Makena Community Plan, first adopted by Ordinance No. 1490 in 1985, was updated in 1997. The Light Industrial area is for warehousing, light assembly, service and craft-type industrial operations.
Special Management Area	Not within
Special Management Area Comments	An article was adopted by the Maui County Planning Commission in December of 1979 for the purpose of "preserving" and "protecting", and where possible, restoring the natural resources of the coastal zone of Hawaii. The rules and regulations in the article are known as the "Special Management Area Rules and Regulations of the County of Maui". The rules and regulations contained in the article were established pursuant to Chapter 205A, Hawaii Revised Statutes, as amended by Acts 176, 188 and 200, Session Laws of Hawaii 1975, 1977 and 1979, respectively.

Highest and Best Use

Highest and best use may be defined as the reasonably probable and legal use of vacant land or improved property, which is physically possible, appropriately supported, financially feasible, and that results in the highest value.

1. **Legally Permissible:** What uses are permitted by zoning and other legal restrictions?
2. **Physically Possible:** To what use is the site physically adaptable?
3. **Financially Feasible:** Which possible and permissible use will produce any net return to the owner of the site?
4. **Maximally Productive.** Among the feasible uses which use will produce the highest net return, (i.e., the highest present worth)?

Highest and Best Use of the Site

Legally Permissible
For the purpose of this analysis, the project site is presumed to be zoned Light Industrial District. The M-1 Light Industrial District is designed to contain mostly warehousing and distribution types of activity, and permits most compounding, assembly, or treatment of articles or materials with the exception of heavy manufacturing and processing of raw materials. Residential uses are excluded except for dwelling units located above or below the first floor and apartments. Commercial uses allowed in the B-3, B-2 and B-1 Business Districts are also allowed under the M-1 Light Industrial District.

Physically Possible
Soil or other engineering studies have not been provided to determine the load-bearing capacity of the subject parcels. However, based on the development of other properties in the immediate vicinity, the subject site is presumed to have stable soil conditions and no apparent drainage problems. The project site is irregular in shape with topography being generally level to gently sloping. The portion of larger Parcel 001 slated for the proposed project is 280 gross acres in size. The subject site exhibits no physical characteristics that would prevent efficient development. A wide variety of light industrial and commercial uses are physically possible.

Financially Feasible
The test of financial feasibility involves an analysis of the likelihood of the use producing an income, or return, greater than the combined income needed to satisfy operating expenses, financial expenses, and capital amortization. All uses that are expected to produce a positive net income or rate of return are considered financially feasible.

The Central Maui and South Maui region have historically experienced good demand for industrial lots. This is primarily due to the fact that the areas are proximate to goods and service providers. The island's primary shipping and transportation venues are in Kahului. Most of the existing light industrial inventory is in Central Maui. Ongoing developments and proposed projects are planned for Central Maui and South Maui. These new and upcoming developments provide circumstantial evidence of market demand.

Maximally Productive
The maximally productive use of the site is that use among all financially feasible uses that provides the highest rate of return, or value. In the final analysis, a determination must be made as to which feasible use is the highest and best use of the parcels as if vacant. Based on the current zoning, locational and physical attributes of the subject site, coupled with the long-term demand for industrial uses in the region, it is maximally productive for the subject site to be developed for such utilization.

The highest and best use of the subject site as vacant is for a light industrial subdivision. The timing of development is immediate. The State of Hawaii is required to retain ownership; however, there is potential for development by a sublessor.

Valuation Methodology

Three basic approaches may be used to arrive at an estimate of market value. They are:

1. The Cost Approach
2. The Income Approach
3. The Sales Comparison Approach
4.

Cost Approach

The Cost Approach is summarized as follows:

Cost New
- Depreciation
+ Land Value
= Value

Income Approach

The Income Approach converts the anticipated flow of future benefits (income) to a present value estimate through a capitalization and or a discounting process.

Sales Comparison Approach

The Sales Comparison Approach compares sales of similar properties with the subject property. Each comparable sale is adjusted for its inferior or superior characteristics. The values derived from the adjusted comparable sales form a range of value for the subject. By process of correlation and analysis, a final indicated value is derived.

Final Reconciliation

The appraisal process concludes with the Final Reconciliation of the values derived from the approaches applied for a single estimate of market value. Different properties require different means of analysis and lend themselves to one approach over the others.

Analyses Applied

The **Cost Approach** was considered and was not developed because the development costs are specific to the build-out of the proposed DLNR Industrial and Business Park.

The **Sales Comparison Approach** was considered and was developed because there is adequate market sales data to establish the fee simple individual fee simple market values for the overall project site and proposed leasable lots.

The **Income Approach** was considered and was not developed because the site is vacant and not revenue-generating.

The **Subdivision Development** was considered and was developed because project-specific costs have been provided and there is sufficient industrial lease data.

Subdivision Development

This methodology, generally employed in the absence of comparable market data, provides a practical and realistic approach to the valuation of raw land which demonstrates strong development potential. Essentially, this procedure simulates a typical development of a site for subdivision purposes. Analysis of the income and expenses is conducted, and, through utilization of a discounted cash flow procedure, this approach measures the residual present value attributable to the land. In other words, this residual value represents the cash price that an investor/developer could rationally pay for a bulk site, given its development potential; the anticipated demand over time for leased industrial lot properties; and the cost to produce and carry the subdivided inventory until fully absorbed, including sufficient allowances for financing, overhead expenses, and an incentive profit margin.

Valuation assumes land development scenarios specific to the proposed DLNR Industrial and Business Park, reflecting an estimated construction schedule and development costs. Due to perpetual ownership by a government agency, certain line-item expenses are not applicable. These include, but may not be limited to: entrepreneurial incentive; extensive marketing; leasing commissions; private project management and maintenance; etc.

Revenue Projections

Revenue projections from this project are expressed in terms of "lots leased" over the determined absorption period. The proposed DLNR Industrial and Business Park is slated for 83 subdivided lots. There will be three alternatives presented in the feasibility analysis: Alternative 1- Connect to Offsite Water System; Alternative 2- Brackish R0 Water System; and Alternative 3- Surface Water System. For all three scenarios, Lot 11 will be the Department of Forestry and Wildlife base yard and Lot 63 is depicted as the subdivision's sewer treatment plant site. In the case of Alternative 2, Lot 13 houses the brackish water treatment facility. Meanwhile, for Alternative 3, Lot 26 is a raw water storage reservoir and Lot 62 is a surface water treatment facility. To establish the average annual rent for each of the leasable lots in each scenario, six steps were necessary:

(1) Research recent recorded sales of competing industrial lots;

(2) Select the "benchmark" lots that are characteristic of the leasable lots;

(3) Value each of the benchmark lots;

(4) Apply and compare the value of each benchmark to the appropriate remaining lots, applying premiums or discounts when necessary;

(5) Derive an aggregate retail value for the leasable lots based on their individual appraised values;

(6) Establish the average lot value and apply a market-based rate of return to determine the average annual ground rent per leasable lot.

Selection of the Benchmark Lots

The leasable lots range in size from 0.4159 to 5.9078 acres. Some of the lots have easement areas that are considered non-buildable and reduce their utility. The impacted lots are identified in the following table, which has a summary of the proposed project lots.

Lot	Gross Land Area		Easement Area		Net Land Area			
No.	Sq. Ft.	Acres	Sq. Ft.	Acres	Sq. Ft.	Acres	Location	Shape
1	48,983	1.1245	22,589	0.5186	26,394	0.6059	Entrance road	Rectangular
2	48,983	1.1245	0	0.0000	48,983	1.1245	Entrance road	Rectangular
3	48,983	1.1245	0	0.0000	48,983	1.1245	Entrance road	Rectangular
4	48,983	1.1245	19,806	0.4547	29,177	0.6698	Entrance road	Rectangular
5	24,791	0.5691	0	0.0000	24,791	0.5691	Entrance road	Rectangular
6	24,791	0.5691	0	0.0000	24,791	0.5691	Entrance road	Rectangular
7	24,791	0.5691	0	0.0000	24,791	0.5691	Entrance road	Rectangular
8	24,791	0.5691	0	0.0000	24,791	0.5691	Entrance road	Rectangular
9	24,791	0.5691	0	0.0000	24,791	0.5691	Entrance road	Rectangular
10	24,791	0.5691	0	0.0000	24,791	0.5691	Entrance road	Rectangular
12	77,988	1.7903	0	0.0000	77,988	1.7903	Interior	Generally rectangular
13	88,293	2.0269	0	0.0000	88,293	2.0269	Interior	Generally rectangular
14	95,117	2.1836	0	0.0000	95,117	2.1836	Interior	Generally rectangular
15	134,284	3.0827	12,557	0.2883	121,727	2.7945	Interior	Generally rectangular
16	98,715	2.2662	25,255	0.5798	73,461	1.6864	Interior	Generally rectangular
17	65,045	1.4932	17,145	0.3936	47,899	1.0996	Interior	Generally rectangular
18	57,917	1.3296	16,499	0.3788	41,417	0.9508	Interior	Generally rectangular
19	47,911	1.0999	14,699	0.3375	33,212	0.7624	Interior	Generally rectangular
20	38,200	0.8770	12,306	0.2825	25,894	0.5945	Interior	Generally rectangular
21	47,774	1.0967	15,735	0.3612	32,039	0.7355	Interior	Generally rectangular
22	45,943	1.0547	14,286	0.3280	31,657	0.7267	Interior	Generally rectangular
23	63,589	1.4598	18,415	0.4228	45,174	1.0371	Interior	Generally rectangular
24	77,643	1.7824	19,091	0.4383	58,551	1.3442	Interior	Generally rectangular
25	94,982	2.1805	27,292	0.6265	67,690	1.5539	Interior	Generally rectangular
26	256,918	5.8980	145,823	3.3476	111,095	2.5504	Interior	Generally rectangular
27	213,512	4.9015	0	0.0000	213,512	4.9015	Interior	Generally rectangular
28	225,429	5.1751	0	0.0000	225,429	5.1751	Interior	Generally rectangular
29	179,067	4.1108	0	0.0000	179,067	4.1108	Interior	Generally rectangular
30	129,412	2.9709	0	0.0000	129,412	2.9709	Interior	Generally rectangular
31	78,614	1.8047	0	0.0000	78,614	1.8047	Interior	Generally rectangular
32	57,768	1.3262	7,904	0.1815	49,864	1.1447	Interior	Generally rectangular
33	48,723	1.1185	13,500	0.3099	35,223	0.8086	Interior	Generally rectangular
34	37,782	0.8674	12,556	0.2882	25,226	0.5791	Interior	Generally rectangular
35	41,560	0.9541	13,252	0.3042	28,308	0.6499	Interior	Generally rectangular
36	71,498	1.6414	0	0.0000	71,498	1.6414	Interior	Generally rectangular
37	79,943	1.8352	0	0.0000	79,943	1.8352	Interior	Generally rectangular
38	84,701	1.9445	0	0.0000	84,701	1.9445	Interior	Generally rectangular
39	88,663	2.0354	0	0.0000	88,663	2.0354	Interior	Generally rectangular
40	33,463	0.7682	0	0.0000	33,463	0.7682	Interior	Generally rectangular
41	34,154	0.7841	0	0.0000	34,154	0.7841	Interior	Generally rectangular

Lot	Gross Land Area		Easement Area		Net Land Area			
No.	Sq. Ft.	Acres	Sq. Ft.	Acres	Sq. Ft.	Acres	Location	Shape
42	21,560	0.4949	0	0.0000	21,560	0.4949	Interior	Generally rectangular
43	25,793	0.5921	0	0.0000	25,793	0.5921	Interior	Generally rectangular
44	25,826	0.5929	0	0.0000	25,826	0.5929	Interior	Generally rectangular
45	25,993	0.5967	0	0.0000	25,993	0.5967	Interior	Generally rectangular
46	29,748	0.6829	0	0.0000	29,748	0.6829	Interior	Generally rectangular
47	31,246	0.7173	0	0.0000	31,246	0.7173	Interior	Generally rectangular
48	31,500	0.7231	0	0.0000	31,500	0.7231	Interior	Generally rectangular
49	145,750	3.3460	0	0.0000	145,750	3.3460	Interior	Generally rectangular
50	113,979	2.6166	0	0.0000	113,979	2.6166	Interior	Generally rectangular
51	121,888	2.7982	0	0.0000	121,888	2.7982	Interior	Generally rectangular
52	295,182	6.7764	58,414	1.3410	236,768	5.4354	Interior	Generally rectangular
53	18,118	0.4159	0	0.0000	18,118	0.4159	Interior	Generally rectangular
54	175,481	4.0285	0	0.0000	175,481	4.0285	Interior	Irregular
55	153,446	3.5226	0	0.0000	153,446	3.5226	Interior	Generally rectangular
56	108,613	2.4934	0	0.0000	108,613	2.4934	Interior	Generally rectangular
57	161,257	3.7019	0	0.0000	161,257	3.7019	Interior	Generally rectangular
58	180,815	4.1509	0	0.0000	180,815	4.1509	Interior	Irregular
59	194,206	4.4584	28,262	0.6488	165,944	3.8096	Interior	Generally rectangular
60	192,756	4.4251	26,659	0.6120	166,097	3.8131	Interior	Generally rectangular
61	166,378	3.8195	26,570	0.6100	139,808	3.2096	Interior	Irregular
62	103,414	2.3741	0	0.0000	103,414	2.3741	Interior	Generally rectangular
64	267,879	6.1497	123,308	2.8308	144,571	3.3189	Interior	Irregular
65	170,961	3.9247	0	0.0000	170,961	3.9247	Interior	Generally rectangular
66	155,598	3.5720	0	0.0000	155,598	3.5720	Interior	Generally rectangular
67	113,787	2.6122	0	0.0000	113,787	2.6122	Interior	Generally rectangular
68	162,982	3.7416	0	0.0000	162,982	3.7416	Interior	Generally rectangular
69	157,409	3.6136	0	0.0000	157,409	3.6136	Interior	Generally rectangular
70	306,474	7.0357	49,130	1.1279	257,344	5.9078	Interior	Generally rectangular
71	97,409	2.2362	0	0.0000	97,409	2.2362	Interior	Generally rectangular
72	89,546	2.0557	0	0.0000	89,546	2.0557	Interior	Generally rectangular
73	144,032	3.3065	0	0.0000	144,032	3.3065	Interior	Generally rectangular
74	211,897	4.8645	0	0.0000	211,897	4.8645	Interior	Generally rectangular
75	152,470	3.5002	0	0.0000	152,470	3.5002	Interior	Generally rectangular
76	104,170	2.3914	0	0.0000	104,170	2.3914	Interior	Generally rectangular
77	165,202	3.7925	60,946	1.3991	104,256	2.3934	Highway	Generally rectangular
78	160,660	3.6882	59,595	1.3681	101,065	2.3201	Highway	Generally rectangular
79	229,813	5.2758	85,087	1.9533	144,726	3.3225	Highway	Generally rectangular
80	159,233	3.6555	58,841	1.3508	100,392	2.3047	Highway	Generally rectangular
81	160,095	3.6753	44,830	1.0291	115,265	2.6461	Highway	Generally rectangular
82	189,760	4.3563	0	0.0000	189,760	4.3563	Interior	Irregular
83	197,214	4.5274	0	0.0000	197,214	4.5274	Interior	Generally rectangular

The following benchmark lots have been utilized for the corresponding size ranges:

Lot 35, 0.6499 net acres	Smaller than 1 acre
Lot 39, 2.0354 net acres	1 acre to less than 3 acres
Lot 29, 4.1108 net acres	3 acres or larger

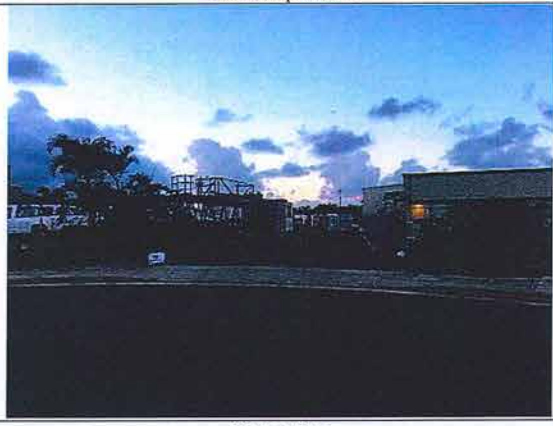
Selection of the Comparable Transactions

The Sales Comparison Approach is based on the premise that a buyer would pay no more for a specific property than the cost of obtaining a property with the same quality, utility, and perceived benefits of ownership. It is based on the principles of supply and demand, balance, substitution and externalities. The following steps describe the applied process of the Sales Comparison Approach.

- The market in which the subject property competes is investigated; comparable sales, contracts for sale and current offerings are reviewed.
- The most pertinent data is further analyzed and the quality of the transaction is determined.
- The most meaningful unit of value for the subject property is determined.
- Each comparable sale is analyzed and where appropriate, adjusted to equate with the subject property.
- The value indication of each comparable sale is analyzed and the data reconciled for a final indication of value via the Sales Comparison Approach.

To develop market value opinions for the benchmarks, comparable industrial lot sales are considered. Four conveyances from Central Maui subdivisions were utilized. The land sales are documented on the following pages, followed by a location map and analysis grid. All sales have been researched through numerous sources, inspected and verified by a party to the transaction.

Land Comparable 1



Transaction

ID	34	**Date**	12/1/2015
Address	121 West Ahuliu Way	**Price**	$1,510,000
City	Wailuku	**Price Per Land SF**	$28.49
State	HI	**Financing**	Cash
Tax ID	(2) 3-8-94-012-0001&0002	**Property Rights**	Fee Simple
Grantor	Cons BY Lot 12, LLC & 121 West Ahuliu, LLC	**Days on Market**	371
Grantee	The Chock Lun Lee Limited Partnership	**Verification**	Ben Walin- Commercial Properties of Maui

Site

Land SF	53,005	**Topography**	Level to gently sloping
Acres	1.2168	**Zoning**	M-1
Road Frontage	West Ahuliu Way	**Flood Zone**	Zone X
Shape	Flag	**Encumbrance or Easement**	Landscape/water system
Utilities	Elec/pvt wtr/pvt swr	**Environmental Issues**	None noted

Comments

Flag-shape lot with non-buildable easements and access driveway encumbering approximately 20 percent of gross land area. Condominium Property Regime, lease and licensing agreement in place at time of sale. As verified by seller representative, sale price based on fee simple vacant land. There are no sales of this property within the three years prior to this transaction.

Land Comparable 2

Transaction

ID	35	**Date**	5/15/2015
Address	Units 36D&E, Pulehu Place	**Price**	$4,421,970
City	Kahului	**Price Per Land SF**	$42.00
State	HI	**Financing**	Conventional
Tax ID	(2) 3-8-101-036-0004&0005	**Property Rights**	Fee Simple
Grantor	Alexander & Baldwin, LLC	**Days on Market**	N/A
Grantee	5521 LLC	**Verification**	Appraisal

Site

Land SF	105,285	**Topography**	Level to gently sloping
Acres	2.4170	**Zoning**	M-1
Road Frontage	Pulehu Place	**Flood Zone**	Zone X
Shape	Generally rectangular	**Encumbrance or Easement**	None noted
Utilities	Elec/pvt wtr & swr	**Environmental Issues**	None noted

Comments

Transaction involves two adjacent land condominium units in Maui Business Park II, South Increment. Buyer verified no discount for property rights, as seller will bear remaining costs to complete subdivision to identically sized parcel. Conveyance as land condo units also allowed buyer to immediately commence with construction of owner-user industrial retail facility (pictured) rather than wait for final subdivision approval. Assigned TMK (2) 3-8-101-043-0000 after subdivision approval. Unit 36C is visible to left of dust screen and is typical of vacant land units. Located on subdivision interior roadway. There are no conveyances of these properties within the three years prior to this transaction.

Land Comparable 3

Transaction			
ID	103	**Date**	11/29/2013
Address	138 Maa Street	**Price**	$4,173,870
City	Kahului	**Price Per Land SF**	$51.89
State	HI	**Financing**	Conventional
Tax ID	(2) 3-8-097-037	**Property Rights**	Fee Simple
Grantor	Maui Lani Village Center,	**Days on Market**	1751
Grantee	Pa'a Properties LLC/Kula Produce Company Ltd	**Verification**	Seller

Site			
Land SF	80,434	**Topography**	Level to gently sloping
Acres	1.8465	**Zoning**	VMX-C/R
Road Frontage	Maa Street	**Flood Zone**	Zone X
Shape	Generally rectangular	**Encumbrance or Easement**	Drainage
Utilities	All public utilities	**Environmental Issues**	None noted

Comments

Public records do not indicate any conveyance of this property within the previous three years. This property is currently not listed for sale. It was purchased by Kula Produce with the intent of building a new wholesale distribution facility. The $4,173,870 net sale price paid by the buyer represents the $4,423,870 recorded price less a $250,000 credit upon closing. According to the seller, the price paid is the aggregate retail of six adjoining lots which were consolidated prior to closing and no bulk discount was considered.

Land Comparable 4

Transaction			
ID	33	**Date**	11/26/2013
Address	230 Imi Kala Street	**Price**	$2,012,460
City	Wailuku	**Price Per Land SF**	$30.05
State	HI	**Financing**	Cash
Tax ID	(2) 3-4-20-078	**Property Rights**	Fee Simple
Grantor	Bicara Ltd.	**Days on Market**	N/A
Grantee	Tamura Enterprises, Inc.	**Verification**	Grant Howe- Commercial Properties of Maui

Site			
Land SF	66,979.0	**Topography**	Level to gently sloping
Acres	1.538	**Zoning**	M-2
Road Frontage	Imi Kala Street	**Flood Zone**	Zone X
Shape	Generally rectangular	**Encumbrance or**	Landscape/sewer
Utilities	All public utilities	**Environmental Issues**	None noted

Comments

The intent of the buyer is to build a retail facility. Parcel is located next to the Wailuku Post Office. There are no conveyances of this property within the three years prior to this transaction.

Comparables Map

Analysis Grid

The utilized sales have been analyzed and compared with the appropriate benchmark lot. I have considered adjustments in the areas of:

- Property Rights Sold
- Financing
- Conditions of Sale
- Market Trends
- Location
- Physical Characteristics

On the following pages are sales comparison grids displaying the benchmark lots, the comparables and the adjustments applied.

		LAND TRANSACTIONS			
	Subject	1	2	3	4
Tax Map Key, Division II	DLNR Pulenunui Lot 35	3-8-94-012-0001&0002	3-8-101-036-0004&0005	3-8-97-037 to 039, 048 to 050	3-4-20-078-0000
Address	Off Mokulele Highway	121 West Ahuliu Way	82 Pulehu Place	138 Maa Street	230 Imi Kala Street
City	Pulehunui	Waikapu	Kahului	Kahului	Wailuku
County Zoning	Presumed M-1	M-1	M-1	VMX-C/R	M-2
Community Plan	Light Industrial	Light Industrial	Light Industrial	Light Industrial	Light Industrial
Land Tenure	Fee Simple	Fee Simple	Fee Simple	Fee Simple	Fee Simple
Flood Status	Zone X	Zone X	Zone X	Zone X	Zone X
Encumbrances	None noted (Net Usable)	Landscape/water system	None noted	Drain	Landscape/sewer
Parcel Configuration	Generally rectangular	Flag-shaped	Generally rectangular	Irregular	Generally rectangular
Topography	Level to gently sloping	Level to gently sloping	Level to gently sloping	Level to gently sloping	Level to gently sloping
Utilities	Electricity/water	Electricity/private water	Electricity/private water	Electricity/water	Electricity/water
Gross Land Area in Avg Acres	0.9541	1.2168	2.4170	1.8465	1.5376
Estimated Net Usable Acres	0.6499	0.9735	2.4170	1.7245	1.3593
Transaction Date		December 1, 2015	May 15, 2015	November 29, 2013	November 26, 2013
Grantor		Cons BY Lot 12, LLC	Alexander & Baldwin, LLC	Maui Lani Village Center, Inc.	Bicara Ltd.
Grantee		Chock Lun Lee Ltd Partnership	5521 LLC	Paa Properties LLC/Kula Produce	Tamura Enterprises, Inc.
Conveyance Document		Deed/Cash	Deed/Conventional	Deed/Conventional	Deed/Cash
Document No.		58130240	56130353 & 56130354	50810199	50780661
Transaction Price		$1,510,000	$4,421,970	$4,423,870	$2,012,460
Financing/Conditions of Sale Adjustment		$0	$0	$0	$0
Adjusted Transaction Price		$1,510,000	$4,421,970	$4,423,870	$2,012,460
Indicated Transaction Price per Usable Acre		$1,551,168	$1,829,528	$2,565,246	$1,480,490
Market Conditions Adjustment (Time)		1.00	1.00	1.00	1.00
Market Conditions Adjusted Unit Price		$1,551,168	$1,829,528	$2,565,246	$1,480,490
ADJUSTMENTS					
Zoning and Community Plan		0%	0%	-10%	0%
Location		-10%	-30%	-30%	-30%
Flood Status		0%	0%	0%	0%
Views		0%	0%	0%	0%
Easements/Restrictions		0%	0%	0%	0%
Physical Characteristics		0%	0%	0%	0%
Utilities		0%	0%	0%	0%
Net Adjustments		-10%	-30%	-40%	-30%
Adjusted Unit Price		$1,396,051	$1,280,670	$1,539,148	$1,036,343
Size Adjustment		1.01	1.05	1.03	1.03
Final Size Adjusted Unit Price		$1,410,012	$1,344,703	$1,585,322	$1,067,433

Range of Final Adj. Values: $1,067,443 to $1,585,322 per Net Usable Acre
Median Unit Value: $1,377,358 per Net Usable Acre
Mean Unit Value: $1,351,868 per Net Usable Acre
Weighted Unit Value: $1,345,965 per Net Usable Acre

Estimated Value of the Land, Fee Simple: $1,345,000 per Net Usable Acre

Indicated Site Value: $1,345,000 x 0.6499 Acres = $874,062 $20.93 per gross square foot

Rounded to $870,000 $30.73 per net usable square foot

	Subject	LAND TRANSACTIONS 1	2	3	4
Tax Map Key, Division II	DLNR Pulehunui Lot 29	3-8-94-012-0001&0002	3-8-101-036-0004&0005	3-8-97-037 to 039, 048 to 050	3-4-20-078-0000
Address	Off Mokulele Highway	121 West Ahuliu Way	82 Pulehu Place	138 Maa Street	230 Imi Kala Street
City	Pulehunui	Waikapu	Kahului	Kahului	Wailuku
County Zoning	Presumed M-1	M-1	M-1	VMX-C/R	M-2
Community Plan	Light Industrial	Light Industrial	Light Industrial	Light Industrial	Light Industrial
Land Tenure	Fee Simple	Fee Simple	Fee Simple	Fee Simple	Fee Simple
Flood Status	Zone X	Zone X	Zone X	Zone X	Zone X
Encumbrances	None noted (Net Usable)	Landscape/water system	None noted	Drain	Landscape/sewer
Parcel Configuration	Generally rectangular	Flag-shaped	Generally rectangular	Irregular	Generally rectangular
Topography	Level to gently sloping	Level to gently sloping	Level to gently sloping	Level to gently sloping	Level to gently sloping
Utilities	Electricity/water	Electricity/private water	Electricity/private water	Electricity/water	Electricity/water
Gross Land Area in Avg Acres	4.1108	1.21683	2.4170	1.8465	1.5376
Estimated Net Usable Acres	4.1108	0.9735	2.4170	1.7245	1.3593
Transaction Date		December 1, 2015	May 15, 2015	November 29, 2013	November 26, 2013
Grantor		Cons BY Lot 12, LLC	Alexander & Baldwin, LLC	Maui Lani Village Center, Inc.	Bicara Ltd.
Grantee		Chock Lun Lee Ltd Partnership	5521 LLC	Paa Properties LLC/Kula Produce	Tamura Enterprises, Inc.
Conveyance Document		Deed/Cash	Deed/Conventional	Deed/Conventional	Deed/Cash
Document No.		58130240	56130353 & 56130354	50810199	50780661
Transaction Price		$1,510,000	$4,421,970	$4,423,870	$2,012,460
Financing/Conditions of Sale Adjustment		$0	$0	$0	$0
Adjusted Transaction Price		$1,510,000	$4,421,970	$4,423,870	$2,012,460
Indicated Transaction Price per Usable Acre		$1,551,168	$1,829,528	$2,565,246	$1,480,490
Market Conditions Adjustment (Time)		1.00	1.00	1.00	1.00
Market Conditions Adjusted Unit Price		$1,551,168	$1,829,528	$2,565,246	$1,480,490
ADJUSTMENTS					
Zoning and Community Plan		0%	0%	-10%	0%
Location		-10%	-30%	-30%	-30%
Flood Status		0%	0%	0%	0%
Views		0%	0%	0%	0%
Easements/Restrictions		0%	0%	0%	0%
Physical Characteristics		0%	0%	0%	0%
Utilities		0%	0%	0%	0%
Net Adjustments		-10%	-30%	-40%	-30%
Adjusted Unit Price		$1,396,051	$1,280,670	$1,539,148	$1,036,343
Size Adjustment		0.89	0.96	0.93	0.92
Final Size Adjusted Unit Price		$1,242,486	$1,229,443	$1,431,407	$953,436

Range of Final Adj. Values: $953,436 to $1,431,407 per Net Usable Acre
Median Unit Value: $1,235,964 per Net Usable Acre
Mean Unit Value: $1,214,193 per Net Usable Acre
Weighted Unit Value: $1,200,959 per Net Usable Acre
Estimated Value of the Land, Fee Simple: $1,200,000 per Net Usable Acre

Indicated Site Value: $1,200,000 x 4.1108 Acres = $4,932,960 — $27.53 per gross square foot
Rounded to $4,930,000 — $27.53 per net usable square foot

	Subject	LAND TRANSACTIONS 1	2	3	4
Tax Map Key, Division II	DLNR Pulenunui Lot 39	3-8-94-012-0001&0002	3-8-101-036-0004&0005	3-8-97-037 to 039, 048 to 050	3-4-20-078-0000
Address	Off Mokulele Highway	121 West Ahuliu Way	82 Pulehu Place	138 Maa Street	230 Imi Kala Street
City	Pulehunui	Waikapu	Kahului	Kahului	Wailuku
County Zoning	Presumed M-1	M-1	M-1	VMX-C/R	M-2
Community Plan	Light Industrial	Light Industrial	Light Industrial	Light Industrial	Light Industrial
Land Tenure	Fee Simple	Fee Simple	Fee Simple	Fee Simple	Fee Simple
Flood Status	Zone X	Zone X	Zone X	Zone X	Zone X
Encumbrances	None noted (Net Usable)	Landscape/water system	None noted	Drain	Landscape/sewer
Parcel Configuration	Generally rectangular	Flag-shaped	Generally rectangular	Irregular	Generally rectangular
Topography	Level to gently sloping	Level to gently sloping	Level to gently sloping	Level to gently sloping	Level to gently sloping
Utilities	Electricity/water	Electricity/private water	Electricity/private water	Electricity/water	Electricity/water
Gross Land Area in Avg Acres	2.0354	1.21683	2.4170	1.8465	1.5376
Estimated Net Usable Acres	2.0354	0.9735	2.4170	1.7245	1.3593
Transaction Date		December 1, 2015	May 15, 2015	November 29, 2013	November 26, 2013
Grantor		Cons BY Lot 12, LLC	Alexander & Baldwin, LLC	Maui Lani Village Center, Inc.	Bicara Ltd.
Grantee		Chock Lun Lee Ltd Partnership	5521 LLC	Paa Properties LLC/Kula Produce	Tamura Enterprises, Inc.
Conveyance Document		Deed/Cash	Deed/Conventional	Deed/Conventional	Deed/Cash
Document No.		58130240	56130353 & 56130354	50810199	50780661
Transaction Price		$1,510,000	$4,421,970	$4,423,870	$2,012,460
Financing/Conditions of Sale Adjustment		$0	$0	$0	$0
Adjusted Transaction Price		$1,510,000	$4,421,970	$4,423,870	$2,012,460
Indicated Transaction Price per Usable Acre		$1,551,168	$1,829,528	$2,565,246	$1,480,490
Market Conditions Adjustment (Time)		1.00	1.00	1.00	1.00
Market Conditions Adjusted Unit Price		$1,551,168	$1,829,528	$2,565,246	$1,480,490
ADJUSTMENTS					
Zoning and Community Plan		0%	0%	-10%	0%
Location		-10%	-30%	-30%	-30%
Flood Status		0%	0%	0%	0%
Views		0%	0%	0%	0%
Easements/Restrictions		0%	0%	0%	0%
Physical Characteristics		0%	0%	0%	0%
Utilities		0%	0%	0%	0%
Net Adjustments		-10%	-30%	-40%	-30%
Adjusted Unit Price		$1,396,051	$1,280,670	$1,539,148	$1,036,343
Size Adjustment		1.00	1.00	1.00	1.00
Final Size Adjusted Unit Price		$1,396,051	$1,280,670	$1,539,148	$1,036,343

Range of Final Adj. Values: $1,036,343 to $1,539,148 per Net Usable Acre
Median Unit Value: $1,338,361 per Net Usable Acre
Mean Unit Value: $1,313,053 per Net Usable Acre
Weighted Unit Value: $1,315,343 per Net Usable Acre
Estimated Value of the Land, Fee Simple: $1,315,000 per Net Usable Acre

Indicated Site Value: $1,315,000 x 2.0354 Acres = $2,676,551 — $30.23 per gross square foot
Rounded to $2,680,000 — $30.23 per net usable square foot

Comparable Sale Adjustments

Property Rights

The rights that are related to the ownership of the real estate. These include the right to develop or not to develop the land, to lease it to others, to sell it, to give it away, to farm it, to mine it, to alter its topography, to subdivide it, to assemble it, to use it for waste disposal, or to choose to exercise none of these rights. Comparable sales can be adjusted for the effect of differences in the real property right (fee simple, leased fee, leasehold, easements, or other encumbrances, etc.) involved in the transactions being compared.

The benchmark lots are valued as Fee Simple properties and all the comparable sales conveyed as Fee Simple estates.

Financing

Each transaction is analyzed as to financing terms to reflect the impact of non-institutional methods of financing. Any special or creative financing were considered in terms of cash equivalency. Each improved property was purchased with cash or conventional financing.

Conditions of Sale

Sale conditions and buyer expenditures that occur immediately after closing need to be considered. All the comparable sales are verified as being arm's length transactions. There are no sale conditions or expenditures immediately after sale.

Economic Trends

This category is considered to compensate for changes in real property values over time, if any, in the market area. The comparable improved transactions occurred between November 2013 and December 2015. Unit prices for Central Maui industrial land do not show a consistent trend from which a market conditions adjustment can be derived.

Zoning

The zoning adjustment considers the potential higher uses of the property with respect to current zoning classifications. The benchmark lots are zoned M-1 Light Industrial District. Land Transactions 1, 2, and 4 are zoned for industrial use. Land Transaction 3 is zoned PD-WK/1 Wailuku-Kahului Project District 1, with a sub-district zoning of VMX-C/R. The additional flexibility and partial entitlements that come with project district zoning are superior to the benchmark lots. A negative 10 percent adjustment is issued to Land Transaction 3.

Location

The location adjustment considers the overall desirability of the immediate neighborhood, proximity to complementary services and vehicular traffic patterns. It also considers the overall desirability of the site with respect to its highest and best use. As previously described, the benchmark lots will be located within the DLNR Industrial and Business Park. While having convenient distance of Central Maui and South Maui, this proposed subdivision is not within the urban cores. The comparable lot sales are all within organized industrial subdivisions in Central Maui. Negative adjustments of between 10 and 30 percent are appropriate for the superior location of the land transactions.

Flood Zone

Being located within a Flood Hazard Area requires a property owner to purchase flood insurance. In addition, a Flood Development Permit must be obtained from the County of Maui for construction and renovation. These factors increase development cost and risk and must be accounted for. The benchmark lots and comparable sales are all located within Flood Zone X, an area minimal flooding. Flood insurance and flood development permits are not required.

Easements/Restrictions

This adjustment considers the impact of encumbrances with respect to development potential. It is commonly recognized that unencumbered sites are easier to efficiently build upon compared to lots with non-buildable easement areas. The benchmark lots will be within a subdivision that has encumbrances deemed typical for large development tracts. The land sales also have typical encumbrances.

Physical Characteristics

Properties with quadrilateral configurations and generally level topography are less costly to develop than those that have irregular shapes and/or are heavily sloped. In cases of extreme irregularity and/or topography variations, such as large drainage swales or gulches, the affected land area can be considered non-buildable. The benchmark lots are generally rectangular with minimal slope. The comparable land sales are rated similar with regard to physical characteristics.

Utilities

Utilities, or the lack thereof, have an impact to value for real property in Hawaii; especially potable water. The inability to connect to a public system or the means to develop an adequate private source can be detrimental to building potential. In this case, the benchmark lots and land transactions all have adequate utility provision.

Size

The size factor typically reflects market-recognized economies of scale, where larger parcels have lower unit values and smaller parcels have higher unit values; all other factors being equal. Adjustments ranging from negative 11 percent to positive 5 percent are issued, based on market evidence and a size curve sensitivity analysis.

Conclusion of Benchmark Values

After careful consideration of the competitive transactions and adjustments to reflect the differences in the properties, the concluded unit values of the benchmarks, as of the prospective date, January 1, 2020, are:

Lot 35, 0.6499 net acres	$1,345,000 per net acre
Lot 39, 2.0354 net acres	$1,315,000 per net acre
Lot 29, 4.1108 net acres	$1,200,000 per net acre

Feasibility Analysis Alternative Scenarios

The Proposed DLNR Industrial and Business Park is preliminarily planned to be serviced by an on-site private wastewater treatment facility. There are three potential potable water alternatives under consideration. Alternative 1 would have the proposed project connect to an off-site water system. Alternative 2 features an on-site brackish R0 water treatment system. Alternative 3 would consist of an on-site surface water treatment system. For all three scenarios, Lot 11 will be the Department of Forestry and Wildlife base yard and Lot 63 is depicted as the subdivision's sewer treatment plant site. Lots 11 and 63 are deemed non-buildable lots. As such, Alternative 1 is slated to have 81 leasable lots. In the case of Alternative 2, Lot 13 houses the brackish water treatment facility and is non-buildable, resulting in 80 leasable lots. Meanwhile, for Alternative 3, Lot 26 is a raw water storage reservoir and Lot 62 is a surface water treatment facility. These two non-buildable lots reduce the leasable lots to 79 lots for Alternative 3.

Alternative 1 – Connect to Offsite Water System

Valuation of the Remaining Leasable Lots

For this alternative, there are 81 leasable lots, including the three previously-valued benchmark lots. To establish the market values of the remaining 78 leasable lots, each is rated and compared against the appropriate benchmark lot. Considerations are made for differences in lot size, location and shape. Premiums or discounts are applied to each property based on these differences.

Lot Size

The same considerations and size curve sensitivity analysis conducted for the valuation of the benchmarks is utilized for the remaining lots.

Location

A slight premium is issued to lots located along the primary Kamaaina Road subdivision entrance, as well as the lots along Maui Veterans Highway. It is anticipated that these parcels will have increased exposure to commuter traffic.

Shape

Similar to the valuation of the benchmark lots, the irregular configurations of some of the remaining lots is not expected to detract from efficient development, especially in light of their net acreage.

Conclusion of Aggregate Retail

Based on the foregoing factors, the remaining leasable industrial lots assigned final values. Application of the respective adjustments to the benchmark lots results in an aggregate retail of $222,917,383 for the 81 leasable lots, as of the prospective date of January 1, 2020. The average lot value is $2,752,066.

Historical rates of return for ground rent calculation in Central Maui have generally congregated between 8.0 and 8.5 percent. It is recognized that in cases where a "prevailing" rate of return is specified for ground rent renegotiations; 8.0 percent is the predominant agreed-to rate. The nearby Central Maui Baseyard is also a leasehold development. Ground rent is being established using an 8.0 percent rate of return. In light of this evidence, an 8.0 percent rate of return is utilized in determining the $220,165 average annual rent per leasable lot.

Lot No	Net Land Area (Acres)	Location	Shape	Benchmark Unit Value	Unit Premiums and Discounts: Lot Size	Location	Shape	Net Adjustments	Adjusted Unit Value	Market Values
53	0.4159	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$559,429
42	0.4949	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$665,698
5	0.5691	Entrance road	Rectangular	$1,345,000	$0	$33,625	$0	$33,625	$1,412,250	$803,734
6	0.5691	Entrance road	Rectangular	$1,345,000	$0	$33,625	$0	$33,625	$1,412,250	$803,734
7	0.5691	Entrance road	Rectangular	$1,345,000	$0	$33,625	$0	$33,625	$1,412,250	$803,734
8	0.5691	Entrance road	Rectangular	$1,345,000	$0	$33,625	$0	$33,625	$1,412,250	$803,734
9	0.5691	Entrance road	Rectangular	$1,345,000	$0	$33,625	$0	$33,625	$1,412,250	$803,734
10	0.5691	Entrance road	Rectangular	$1,345,000	$0	$33,625	$0	$33,625	$1,412,250	$803,734
34	0.5791	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$778,902
43	0.5921	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$796,400
44	0.5929	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$797,428
20	0.5945	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$799,540
45	0.5967	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$802,585
1	0.6059	Entrance road	Rectangular	$1,345,000	$0	$33,625	$0	$33,625	$1,412,250	$855,718
35	**0.6499**	**Interior**	**Generally rectangular**	**$1,345,000**		**BENCHMARK**		$0	$1,345,000	$874,065
4	0.6698	Entrance road	Rectangular	$1,345,000	$0	$33,625	$0	$33,625	$1,412,250	$945,945
46	0.6829	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$918,524
47	0.7173	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$964,769
48	0.7231	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$972,612
22	0.7267	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$977,465
21	0.7355	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$989,257
19	0.7624	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$1,025,482
40	0.7682	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$1,033,235
41	0.7841	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$1,054,571
33	0.8086	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$1,087,579
18	0.9508	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$1,278,840
23	1.0371	Interior	Generally rectangular	$1,315,000	$13,150	$0	$0	$13,150	$1,341,300	$1,390,998
17	1.0996	Interior	Generally rectangular	$1,315,000	$13,150	$0	$0	$13,150	$1,341,300	$1,474,919
2	1.1245	Entrance road	Rectangular	$1,315,000	$13,150	$32,875	$0	$46,025	$1,407,050	$1,582,234
3	1.1245	Entrance road	Rectangular	$1,315,000	$13,150	$32,875	$0	$46,025	$1,407,050	$1,582,234
32	1.1447	Interior	Generally rectangular	$1,315,000	$13,150	$0	$0	$13,150	$1,341,300	$1,535,413
24	1.3442	Interior	Generally rectangular	$1,315,000	$13,150	$0	$0	$13,150	$1,341,300	$1,802,915
25	1.5539	Interior	Generally rectangular	$1,315,000	$13,150	$0	$0	$13,150	$1,341,300	$2,084,311
36	1.6414	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$2,158,390
16	1.6864	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$2,217,647
12	1.7903	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$2,354,306
31	1.8047	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$2,373,219
37	1.8352	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$2,413,342
38	1.9445	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$2,556,972
13	2.0269	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$2,665,423
39	**2.0354**	**Interior**	**Generally rectangular**	**$1,315,000**		**BENCHMARK**		$0	$1,315,000	$2,676,587
72	2.0557	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$2,703,237
14	2.1836	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$2,871,418
71	2.2362	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$2,940,607
80	2.3047	Highway	Generally rectangular	$1,315,000	$0	$32,875	$0	$32,875	$1,380,750	$3,182,191
78	2.3201	Highway	Generally rectangular	$1,315,000	$0	$32,875	$0	$32,875	$1,380,750	$3,203,524
62	2.3741	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$3,121,887
76	2.3914	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$3,144,710
77	2.3934	Highway	Generally rectangular	$1,315,000	$0	$32,875	$0	$32,875	$1,380,750	$3,304,671
56	2.4934	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$3,278,836
26	2.5504	Interior	Generally rectangular	$1,315,000	($26,300)	$0	$0	($26,300)	$1,262,400	$3,219,613
67	2.6122	Interior	Generally rectangular	$1,315,000	($26,300)	$0	$0	($26,300)	$1,262,400	$3,297,629
50	2.6166	Interior	Generally rectangular	$1,315,000	($26,300)	$0	$0	($26,300)	$1,262,400	$3,303,199
81	2.6461	Highway	Generally rectangular	$1,315,000	($26,300)	$32,875	$0	$6,575	$1,328,150	$3,514,445
15	2.7945	Interior	Generally rectangular	$1,315,000	($26,300)	$0	$0	($26,300)	$1,262,400	$3,527,747
51	2.7982	Interior	Generally rectangular	$1,315,000	($26,300)	$0	$0	($26,300)	$1,262,400	$3,532,396
30	2.9709	Interior	Generally rectangular	$1,315,000	($26,300)	$0	$0	($26,300)	$1,262,400	$3,750,452
61	3.2096	Interior	Irregular	$1,200,000	$24,000	$0	$0	$24,000	$1,248,000	$4,005,518
73	3.3065	Interior	Generally rectangular	$1,200,000	$24,000	$0	$0	$24,000	$1,248,000	$4,126,537
64	3.3189	Interior	Irregular	$1,200,000	$24,000	$0	$0	$24,000	$1,248,000	$4,141,991
79	3.3225	Highway	Generally rectangular	$1,200,000	$24,000	$30,000	$0	$54,000	$1,308,000	$4,345,767
49	3.3460	Interior	Generally rectangular	$1,200,000	$24,000	$0	$0	$24,000	$1,248,000	$4,175,763
75	3.5002	Interior	Generally rectangular	$1,200,000	$12,000	$0	$0	$12,000	$1,224,000	$4,284,281
55	3.5226	Interior	Generally rectangular	$1,200,000	$12,000	$0	$0	$12,000	$1,224,000	$4,311,706
66	3.5720	Interior	Generally rectangular	$1,200,000	$12,000	$0	$0	$12,000	$1,224,000	$4,372,172
69	3.6136	Interior	Generally rectangular	$1,200,000	$12,000	$0	$0	$12,000	$1,224,000	$4,423,071
57	3.7019	Interior	Generally rectangular	$1,200,000	$12,000	$0	$0	$12,000	$1,224,000	$4,531,180
68	3.7416	Interior	Generally rectangular	$1,200,000	$12,000	$0	$0	$12,000	$1,224,000	$4,579,671
59	3.8096	Interior	Generally rectangular	$1,200,000	$12,000	$0	$0	$12,000	$1,224,000	$4,662,889
60	3.8131	Interior	Generally rectangular	$1,200,000	$12,000	$0	$0	$12,000	$1,224,000	$4,667,188
65	3.9247	Interior	Generally rectangular	$1,200,000	$0	$0	$0	$0	$1,200,000	$4,709,669
54	4.0285	Interior	Irregular	$1,200,000	$0	$0	$0	$0	$1,200,000	$4,834,179
29	**4.1108**	**Interior**	**Generally rectangular**	**$1,200,000**		**BENCHMARK**		$0	$1,200,000	$4,932,961
58	4.1509	Interior	Irregular	$1,200,000	$0	$0	$0	$0	$1,200,000	$4,981,129
82	4.3563	Interior	Irregular	$1,200,000	$0	$0	$0	$0	$1,200,000	$5,227,543
83	4.5274	Interior	Generally rectangular	$1,200,000	($12,000)	$0	$0	($12,000)	$1,176,000	$5,324,229
74	4.8645	Interior	Generally rectangular	$1,200,000	($12,000)	$0	$0	($12,000)	$1,176,000	$5,720,633
27	4.9015	Interior	Generally rectangular	$1,200,000	($12,000)	$0	$0	($12,000)	$1,176,000	$5,764,222
28	5.1751	Interior	Generally rectangular	$1,200,000	($24,000)	$0	$0	($24,000)	$1,152,000	$5,961,745
52	5.4354	Interior	Generally rectangular	$1,200,000	($24,000)	$0	$0	($24,000)	$1,152,000	$6,261,636
70	5.9078	Interior	Generally rectangular	$1,200,000	($24,000)	$0	$0	($24,000)	$1,152,000	$6,805,781

81 No. of Leasable Lots

Aggregate Retail Lot Values:	$222,917,383
Average Lot Value:	$2,752,066
Rate of Return:	8.00%
Average Annual Rent Per Lot:	$220,165

Absorption Revenue

Pursuant to the scope of work, two feasibility scenarios have been conducted. The first assumes the entire project is leased to one sublessor who would rent the individual lots to long-term leasehold owners. The second scenario assumes that DLNR will lease the individual lots directly to long-term leasehold owners.

For the Sublessor scenario, the ground lease for the entire project would initiate upon release of the first increment lots. At that point in time, the development would be 100 percent vacant and the burden of lease-up expenses is on the sublessor. According to a sublessor of a similar leasehold project, it would be challenging to attract a market participant unless the master lease ground rent is discounted while initial tenants are being secured. For this analysis, initial ground rent is based on a 3.0 percent rate of return against the release of lots at 25 percent increments over the first four years. The rates of return are ramped up to 6.0 percent beginning Year 10 of the master lease, coinciding with the project achieving stabilized occupancy. The aggregate retail lot values are increased by 5 percent every five years.

In the scenario where DLNR leases the individual lots to leasehold owners, 77 lots are rented over a 10-year period, at which point the project will be at 95 percent stabilized occupancy. This absorption timeframe is based on the results of a project market study by ACM Consultants, Inc. For this analysis, ground rent is based on an 8.0 percent rate of return. Year 1 lot values for new leases consider a 2.0 percent increase from the previous year and increased by 5.0 percent every five years.

Development Expenses

Direct construction schedules and cost estimates for the proposed subdivision were reviewed. Austin Tsutsumi & Associates, Inc., who provided the preliminary figures, specifies the estimates are an opinion of probable cost. They have been utilized herein under the extraordinary assumption they are accurate for valuation purposes. Direct costs amount to $70,3800,000, inclusive of 15 percent contingency. Discussions with local developers and review of similar projects supports a reasonable range for indirect costs, *inclusive of contingency*, from 15 to 25 percent of the sum of direct and indirect construction costs. A 20 percent indirect cost assumption has been made for this analysis. However, since $9,180,000 in contingency is already included with the $70,380,000 direct costs provided, the remaining indirect costs are only $6,120,000. Financing expenses for the $76,500,000 in construction costs are $38,250,000, based on a 10-year bond at 5 percent interest. Total development cost is forecasted to be $114,750,000.

The State of Hawaii is exempt from paying real property tax. For the scenario where DLNR leases directly to the individual leasehold owners, operating expenses consist of employing a DLNR project manager. Salary information, as well as typical pay increase rates, were provided by DLNR.

Remaining project operating expenses, such as real property tax; fire/liability insurance; utilities; repair and maintenance; etc. will either be paid directly by the individual leasehold owners or recovered through common area maintenance fees collected from lessees. These are deemed pass-through expenses that do not need to be accounted for in the cash flow.

A separate line-item for entrepreneurial incentive is not addressed in either scenario. The primary benefit sought by DLNR is not profit from the actual development of the project; rather, the

perpetual receipt of ground lease revenue. Other typical market expenses that have been excluded are: extensive marketing and leasing commissions.

Discount Rate

The residual annual net rental revenue is discounted to a present value at a rate which represents both the time value of money at a safe investment rate, and the risks associated with this specific project. Basic to discounted cash flow analysis is the idea that future income or benefits are worth less than the same income or benefits today; and the value decreases systematically as time for their receipt is deferred further into the future. This process involves the application of a specific market-derived discount rate to the anticipated future income flows to develop a present worth estimate.

The two most common ways to handle entrepreneurial incentive with respect to the discount rate include: (1) to include profit in the discount rate or (2) to use a bifurcated or "dual" rate after deducting a line item for entrepreneurial incentive. Considering DLNR ownership of the project, a line-item deduction for entrepreneurial incentive is not made. The discount rate employed is intended to focus solely on the investor's preference for funds sooner as opposed to later.

This rate typically reflects acceptable expectations of yields to be achieved by investors currently dealing in the marketplace. Interviews with several developers on Maui and Oahu indicate that subdivision developers generally expect internal rates of return of 10.0 to 15.0 percent.

The consensus is that the appropriate discount rate for net cash flows, after a deduction for entrepreneurial incentive, ranges from 9.0 to 15.0 percent. Typically, raw land development risks encompass entitlement, development and market conditions. However, in the case of the subject, the project site is analyzed under the extraordinary assumption that entitlements are secured as of the prospective date. Furthermore, the property owner is the State of Hawaii, which limits financing risk. Construction risk is not as notable for a vacant lot subdivision utilizing land that has been previously tilled for commercial agriculture. As such, a discount rate of 6.0 percent has been considered for the Sublessor scenario. Meanwhile, an 8.0 percent discount rate is reasonable for the DLNR direct lease scenario. The 2.0 percentage point margin is primarily attributed to the need to secure rent from only one entity in the Sublessor scenario, rather than having to manage and collect rent from 80 individual owners in the case of the DLNR direct lease scenario. Both discount rates also account for the historically-strong true industrial market. These users are the primary targets for the proposed project, rather than industrial retail users that may be attracted to available fee simple lots in Maui Business Park II or Maui Lani Village Center.

Conclusion of Subdivision Development Feasibility Analysis, Alternative 1

Based on the forecasts presented in the preceding sections, as of the prospective date, January 1, 2020, the Sublessor scenario will produce a positive result in 2041. The DLNR direct lease scenario would actually have a positive return by 2040; however, the cash flow is extended to 2041 for the purpose of comparison.

Long-term ground leases typically exceed 20 years, with 50-year and 60-year ground leases commonly found in the market. As such, both 22-year cash flows support the conclusion that the proposed DLNR Industrial and Business Park is financially feasible, as of the prospective date, January 1, 2020.

PERIOD	2020 Year 1	2021 Year 2	2022 Year 3	2023 Year 4	2024 Year 5	2025 Year 6	2026 Year 7	2027 Year 8	2028 Year 9	2029 Year 10	2030 Year 11
ABSORPTION											
Lots Leased- 2024	0	0	0	0	8	8	8	8	8	8	8
Avg Rent per Lot, 8% Rate of Return- 2024	$0	$0	$0	$0	$220,165	$220,165	$220,165	$220,165	$220,165	$231,174	$231,174
Rent for Lots Leased- 2024	$0	$0	$0	$0	$1,761,323	$1,761,323	$1,761,323	$1,761,323	$1,761,323	$1,849,389	$1,849,389
Lots Leased- 2025	0	0	0	0	0	8	8	8	8	8	8
Avg Rent per Lot, 8% Rate of Return- 2025	$0	$0	$0	$0	$0	$224,569	$224,569	$224,569	$224,569	$224,569	$235,797
Rent for Lots Leased- 2025	$0	$0	$0	$0	$0	$1,796,549	$1,796,549	$1,796,549	$1,796,549	$1,796,549	$1,886,376
Lots Leased- 2026	0	0	0	0	0	0	8	8	8	8	8
Avg Rent per Lot, 8% Rate of Return- 2026	$0	$0	$0	$0	$0	$0	$229,060	$229,060	$229,060	$229,060	$229,060
Rent for Lots Leased- 2026	$0	$0	$0	$0	$0	$0	$1,832,480	$1,832,480	$1,832,480	$1,832,480	$1,832,480
Lots Leased- 2027	0	0	0	0	0	0	0	8	8	8	8
Avg Rent per Lot, 8% Rate of Return- 2027	$0	$0	$0	$0	$0	$0	$0	$233,641	$233,641	$233,641	$233,641
Rent for Lots Leased- 2027	$0	$0	$0	$0	$0	$0	$0	$1,869,130	$1,869,130	$1,869,130	$1,869,130
Lots Leased- 2028	0	0	0	0	0	0	0	0	8	8	8
Avg Rent per Lot, 8% Rate of Return- 2028	$0	$0	$0	$0	$0	$0	$0	$0	$238,314	$238,314	$238,314
Rent for Lots Leased- 2028	$0	$0	$0	$0	$0	$0	$0	$0	$1,906,512	$1,906,512	$1,906,512
Lots Leased- 2029	0	0	0	0	0	0	0	0	0	8	8
Avg Rent per Lot, 8% Rate of Return- 2029	$0	$0	$0	$0	$0	$0	$0	$0	$0	$243,080	$243,080
Rent for Lots Leased- 2029	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,944,642	$1,944,642
Lots Leased- 2030	0	0	0	0	0	0	0	0	0	0	8
Avg Rent per Lot, 8% Rate of Return- 2030	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$247,942
Rent for Lots Leased- 2030	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,983,535
Lots Leased- 2031	0	0	0	0	0	0	0	0	0	0	0
Avg Rent per Lot, 8% Rate of Return- 2031	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Rent for Lots Leased- 2031	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Lots Leased- 2032	0	0	0	0	0	0	0	0	0	0	0
Avg Rent per Lot, 8% Rate of Return- 2032	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Rent for Lots Leased- 2032	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Lots Leased- 2033	0	0	0	0	0	0	0	0	0	0	0
Avg Rent per Lot, 8% Rate of Return- 2033	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Rent for Lots Leased- 2033	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Cumulative Lots Leased	0	0	0	0	8	16	24	32	40	48	56
Lots Available w/5% Stabilized Vacancy	77	77	77	77	69	61	53	45	37	29	21
REVENUE											
Total Rent per Period	$0	$0	$0	$0	$1,761,323	$3,557,872	$5,390,351	$7,259,481	$9,165,993	$11,198,702	$13,272,064
Other Income	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Gross Rental Revenue	$0	$0	$0	$0	$1,761,323	$3,557,872	$5,390,351	$7,259,481	$9,165,993	$11,198,702	$13,272,064
DEVELOPMENT EXPENSES											
Direct Costs	$0	$0	$25,374,665	$28,075,137	$15,990,524	$939,674	$0	$0	$0	$0	$0
Indirect Costs	$612,000	$612,000	$918,000	$918,000	$612,000	$612,000	$306,000	$306,000	$306,000	$306,000	$306,000
	$612,000	$612,000	$26,292,665	$28,993,137	$16,602,524	$1,551,674	$306,000	$306,000	$306,000	$306,000	$306,000
FINANCING EXPENSES											
10-Year Bond @ 5.00%	$0	$0	$3,506,250	$3,825,000	$3,825,000	$3,825,000	$3,825,000	$3,825,000	$3,825,000	$3,825,000	$3,825,000
	$0	$0	$3,506,250	$3,825,000	$3,825,000	$3,825,000	$3,825,000	$3,825,000	$3,825,000	$3,825,000	$3,825,000
HOLDING EXPENSES											
DLNR Project Management	$95,000	$97,850	$100,786	$103,809	$106,923	$114,536	$117,972	$121,512	$125,157	$128,912	$138,090
RP Tax (Exempt)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	$95,000	$97,850	$100,786	$103,809	$106,923	$114,536	$117,972	$121,512	$125,157	$128,912	$138,090
TOTAL EXPENSES	$707,000	$709,850	$29,899,701	$32,921,946	$20,534,448	$5,491,210	$4,248,972	$4,252,512	$4,256,157	$4,259,912	$4,269,090
NET RENTAL REVENUE	($707,000)	($709,850)	($29,899,701)	($32,921,946)	($18,773,125)	($1,933,339)	$1,141,379	$3,006,969	$4,909,836	$6,938,790	$9,002,974
Discount Period	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11
Present Value Factor @ 8.00%	0.925926	0.857339	0.793832	0.735030	0.680583	0.630170	0.583490	0.540269	0.500249	0.463193	0.428883
DISCOUNTED VALUE PER PERIOD	($654,630)	($608,582)	($23,735,346)	($24,198,613)	($12,776,673)	($1,218,331)	$665,984	$1,624,572	$2,456,141	$3,214,002	$3,861,221

PERIOD	2020 Year 1	2021 Year 2	2022 Year 3	2023 Year 4	2024 Year 5	2025 Year 6	2026 Year 7	2027 Year 8	2028 Year 9	2029 Year 10	2030 Year 11
ABSORPTION											
Aggregate Retail Lot Values	$0	$0	$0	$0	$55,729,346	$111,458,691	$167,188,037	$222,917,383	$222,917,383	$234,063,252	$234,063,252
Rate of Return	0%	0%	0%	0%	3%	3%	3%	3%	3.5%	4%	4.5%
REVENUE											
Total Rent per Period	$0	$0	$0	$0	$1,671,880	$3,343,761	$5,015,641	$6,687,521	$7,802,108	$9,362,530	$10,532,846
Other Income	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Gross Rental Revenue	$0	$0	$0	$0	$1,671,880	$3,343,761	$5,015,641	$6,687,521	$7,802,108	$9,362,530	$10,532,846
DEVELOPMENT EXPENSES											
Direct Costs	$0	$0	$25,374,665	$28,075,137	$15,990,524	$939,674	$0	$0	$0	$0	$0
Indirect Costs	$612,000	$612,000	$918,000	$918,000	$612,000	$612,000	$306,000	$306,000	$306,000	$306,000	$306,000
	$612,000	$612,000	$26,292,665	$28,993,137	$16,602,524	$1,551,674	$306,000	$306,000	$306,000	$306,000	$306,000
FINANCING EXPENSES											
10-Year Bond @ 5.00%	$0	$0	$3,506,250	$3,825,000	$3,825,000	$3,825,000	$3,825,000	$3,825,000	$3,825,000	$3,825,000	$3,825,000
	$0	$0	$3,506,250	$3,825,000	$3,825,000	$3,825,000	$3,825,000	$3,825,000	$3,825,000	$3,825,000	$3,825,000
HOLDING EXPENSES											
RP Tax (Exempt)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL EXPENSES	$612,000	$612,000	$29,798,915	$32,818,137	$20,427,524	$5,376,674	$4,131,000	$4,131,000	$4,131,000	$4,131,000	$4,131,000
NET RENTAL REVENUE	($612,000)	($612,000)	($29,798,915)	($32,818,137)	($18,755,644)	($2,032,913)	$884,641	$2,556,521	$3,671,108	$5,231,530	$6,401,846
Discount Period	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11
Present Value Factor @ 6.00%	0.943396	0.889996	0.839619	0.792094	0.747258	0.704961	0.665057	0.627412	0.591898	0.558395	0.526788
DISCOUNTED VALUE PER PERIOD	($577,358)	($544,678)	($25,019,744)	($25,995,038)	($14,015,308)	($1,433,124)	$588,337	$1,603,993	$2,172,923	$2,921,259	$3,372,413

PERIOD	2031 Year 12	2032 Year 13	2033 Year 14	2034 Year 15	2035 Year 16	2036 Year 17	2037 Year 18	2038 Year 19	2039 Year 20	2040 Year 21	2041 Year 22	TOTALS
ABSORPTION												
Aggregate Retail Lot Values	$234,063,252	$234,063,252	$234,063,252	$245,766,415	$245,766,415	$245,766,415	$245,766,415	$245,766,415	$258,054,735	$258,054,735	$258,054,735	
Rate of Return	5%	5.5%	6%	6%	6%	6%	6%	6%	6%	6%	6%	
REVENUE												
Total Rent per Period	$11,703,163	$12,873,479	$14,043,795	$14,745,985	$14,745,985	$14,745,985	$14,745,985	$14,745,985	$15,483,284	$15,483,284	$15,483,284	$203,216,502
Other Income	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Gross Rental Revenue	$11,703,163	$12,873,479	$14,043,795	$14,745,985	$14,745,985	$14,745,985	$14,745,985	$14,745,985	$15,483,284	$15,483,284	$15,483,284	$203,216,502
DEVELOPMENT EXPENSES												
Direct Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$70,380,000
Indirect Costs	$306,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$6,120,000
	$306,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$76,500,000
FINANCING EXPENSES												
10-Year Bond @ 5.00%	$3,825,000	$318,750	$0	$0	$0	$0	$0	$0	$0	$0	$0	$38,250,000
	$3,825,000	$318,750	$0	$0	$0	$0	$0	$0	$0	$0	$0	$38,250,000
HOLDING EXPENSES												
RP Tax (Exempt)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL EXPENSES	$4,131,000	$318,750	$0	$0	$0	$0	$0	$0	$0	$0	$0	$114,750,000
NET RENTAL REVENUE	$7,572,163	$12,554,729	$14,043,795	$14,745,985	$14,745,985	$14,745,985	$14,745,985	$14,745,985	$15,483,284	$15,483,284	$15,483,284	$88,466,502
Discount Period	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	
Present Value Factor @ 6.00%	0.496969	0.468839	0.442301	0.417265	0.393646	0.371364	0.350344	0.330513	0.311805	0.294155	0.277505	
DISCOUNTED VALUE PER PERIOD	$3,763,133	$5,886,147	$6,211,584	$6,152,984	$5,804,702	$5,476,134	$5,166,164	$4,873,740	$4,827,761	$4,554,492	$4,296,690	$87,207
											Rounded	$90,000

PERIOD	2031 Year 12	2032 Year 13	2033 Year 14	2034 Year 15	2035 Year 16	2036 Year 17	2037 Year 18	2038 Year 19	2039 Year 20	2040 Year 21	2041 Year 22	TOTALS
ABSORPTION												
Lots Leased- 2024	8	8	8	8	8	8	8	8	8	8	8	
Avg Rent per Lot, 8% Rate of Return- 2024	$231,174	$231,174	$231,174	$242,732	$242,732	$242,732	$242,732	$242,732	$254,869	$254,869	$254,869	
Rent for Lots Leased- 2024	$1,849,389	$1,849,389	$1,849,389	$1,941,858	$1,941,858	$1,941,858	$1,941,858	$1,941,858	$2,038,951	$2,038,951	$2,038,951	
Lots Leased- 2025	8	8	8	8	8	8	8	8	8	8	8	
Avg Rent per Lot, 8% Rate of Return- 2025	$235,797	$235,797	$235,797	$235,797	$247,587	$247,587	$247,587	$247,587	$247,587	$259,966	$259,966	
Rent for Lots Leased- 2025	$1,886,376	$1,886,376	$1,886,376	$1,886,376	$1,980,695	$1,980,695	$1,980,695	$1,980,695	$1,980,695	$2,079,730	$2,079,730	
Lots Leased- 2026	8	8	8	8	8	8	8	8	8	8	8	
Avg Rent per Lot, 8% Rate of Return- 2026	$240,513	$240,513	$240,513	$240,513	$240,513	$252,539	$252,539	$252,539	$252,539	$252,539	$265,166	
Rent for Lots Leased- 2026	$1,924,104	$1,924,104	$1,924,104	$1,924,104	$1,924,104	$2,020,309	$2,020,309	$2,020,309	$2,020,309	$2,020,309	$2,121,325	
Lots Leased- 2027	8	8	8	8	8	8	8	8	8	8	8	
Avg Rent per Lot, 8% Rate of Return- 2027	$233,641	$245,323	$245,323	$245,323	$245,323	$245,323	$257,589	$257,589	$257,589	$257,589	$257,589	
Rent for Lots Leased- 2027	$1,869,130	$1,962,586	$1,962,586	$1,962,586	$1,962,586	$1,962,586	$2,060,715	$2,060,715	$2,060,715	$2,060,715	$2,060,715	
Lots Leased- 2028	8	8	8	8	8	8	8	8	8	8	8	
Avg Rent per Lot, 8% Rate of Return- 2028	$238,314	$238,314	$250,230	$250,230	$250,230	$250,230	$250,230	$262,741	$262,741	$262,741	$262,741	
Rent for Lots Leased- 2028	$1,906,512	$1,906,512	$2,001,838	$2,001,838	$2,001,838	$2,001,838	$2,001,838	$2,101,930	$2,101,930	$2,101,930	$2,101,930	
Lots Leased- 2029	8	8	8	8	8	8	8	8	8	8	8	
Avg Rent per Lot, 8% Rate of Return- 2029	$243,080	$243,080	$243,080	$255,234	$255,234	$255,234	$255,234	$255,234	$267,996	$267,996	$267,996	
Rent for Lots Leased- 2029	$1,944,642	$1,944,642	$1,944,642	$2,041,875	$2,041,875	$2,041,875	$2,041,875	$2,041,875	$2,143,968	$2,143,968	$2,143,968	
Lots Leased- 2030	8	8	8	8	8	8	8	8	8	8	8	
Avg Rent per Lot, 8% Rate of Return- 2030	$247,942	$247,942	$247,942	$247,942	$260,339	$260,339	$260,339	$260,339	$260,339	$273,356	$273,356	
Rent for Lots Leased- 2030	$1,983,535	$1,983,535	$1,983,535	$1,983,535	$2,082,712	$2,082,712	$2,082,712	$2,082,712	$2,082,712	$2,186,848	$2,186,848	
Lots Leased- 2031	7	7	7	7	7	7	7	7	7	7	7	
Avg Rent per Lot, 8% Rate of Return- 2031	$252,901	$252,901	$252,901	$252,901	$252,901	$265,546	$265,546	$265,546	$265,546	$265,546	$278,823	
Rent for Lots Leased- 2031	$1,770,305	$1,770,305	$1,770,305	$1,770,305	$1,770,305	$1,858,820	$1,858,820	$1,858,820	$1,858,820	$1,858,820	$1,951,761	
Lots Leased- 2032	0	7	7	7	7	7	7	7	7	7	7	
Avg Rent per Lot, 8% Rate of Return- 2032	$0	$257,959	$257,959	$257,959	$257,959	$257,959	$270,857	$270,857	$270,857	$270,857	$270,857	
Rent for Lots Leased- 2032	$0	$1,805,711	$1,805,711	$1,805,711	$1,805,711	$1,805,711	$1,895,997	$1,895,997	$1,895,997	$1,895,997	$1,895,997	
Lots Leased- 2033	0	0	7	7	7	7	7	7	7	7	7	
Avg Rent per Lot, 8% Rate of Return- 2033	$0	$0	$263,118	$263,118	$263,118	$263,118	$263,118	$276,274	$276,274	$276,274	$276,274	
Rent for Lots Leased- 2033	$0	$0	$1,841,826	$1,841,826	$1,841,826	$1,841,826	$1,841,826	$1,933,917	$1,933,917	$1,933,917	$1,933,917	
Cumulative Lots Leased	63	70	77	77	77	77	77	77	77	77	77	
Lots Available w/5% Stabilized Vacancy	14	7	0	0	0	0	0	0	0	0	0	
REVENUE												
Total Rent per Period	$15,133,994	$17,033,161	$18,970,313	$19,160,014	$19,353,510	$19,538,230	$19,726,645	$19,918,828	$20,118,015	$20,321,185	$20,515,142	$261,394,822
Other Income	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Gross Rental Revenue	$15,133,994	$17,033,161	$18,970,313	$19,160,014	$19,353,510	$19,538,230	$19,726,645	$19,918,828	$20,118,015	$20,321,185	$20,515,142	$261,394,822
DEVELOPMENT EXPENSES												
Direct Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$70,380,000
Indirect Costs	$306,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$6,120,000
	$306,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$76,500,000
FINANCING EXPENSES												
10-Year Bond @ 5.00%	$3,825,000	$318,750	$0	$0	$0	$0	$0	$0	$0	$0	$0	$38,250,000
	$3,825,000	$318,750	$0	$0	$0	$0	$0	$0	$0	$0	$0	$38,250,000
HOLDING EXPENSES												
DLNR Project Management	$142,233	$146,500	$150,895	$155,422	$166,488	$171,482	$176,627	$181,926	$187,383	$200,725	$206,747	$3,136,973
RP Tax (Exempt)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	$142,233	$146,500	$150,895	$155,422	$166,488	$171,482	$176,627	$181,926	$187,383	$200,725	$206,747	$3,136,973
TOTAL EXPENSES	$4,273,233	$465,250	$150,895	$155,422	$166,488	$171,482	$176,627	$181,926	$187,383	$200,725	$206,747	$117,886,973
NET RENTAL REVENUE	$10,860,761	$16,567,912	$18,819,418	$19,004,592	$19,187,022	$19,366,748	$19,550,018	$19,736,903	$19,930,631	$20,120,460	$20,308,395	$143,507,849
Discount Period	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	
Present Value Factor @ 8.00%	0.397114	0.367698	0.340461	0.315242	0.291890	0.270269	0.250249	0.231712	0.214548	0.198656	0.183941	
DISCOUNTED VALUE PER PERIOD	$4,312,958	$6,091,987	$6,407,279	$5,991,040	$5,600,509	$5,234,231	$4,892,373	$4,573,278	$4,276,081	$3,997,045	$3,735,536	$3,742,061
											Rounded	$3,740,000

Alternative 2 – Brackish R0 Water System

Valuation of the Remaining Leasable Lots

For this alternative, there are 80 leasable lots, including the three previously-valued benchmark lots. To establish the market value of the remaining 77 leasable lots, each is rated and compared against the appropriate benchmark lot. Considerations are made for differences in lot size, location and shape. Premiums or discounts are applied to each property based on these differences.

Lot Size
The same considerations and size curve sensitivity analysis conducted for the valuation of the benchmarks is utilized for the remaining lots.

Location
A slight premium is issued to lots located along the primary Kamaaina Road subdivision entrance, as well as the lots along Maui Veterans Highway. It is anticipated that these parcels will have increased exposure to commuter traffic.

Shape
Similar to the valuation of the benchmark lots, the irregular configurations of some of the remaining lots is not expected to detract from efficient development, especially in light of their net acreage.

Conclusion of Aggregate Retail

Based on the foregoing factors, the remaining leasable industrial lots assigned final values. Application of the respective adjustments to the benchmark lots results in an aggregate retail of $220,251,960 for the 80 leasable lots, as of the prospective date of January 1, 2020. The average lot value is $2,753,150.

Historical rates of return for ground rent calculation in Central Maui have generally congregated between 8.0 and 8.5 percent. It is recognized that in cases where a "prevailing" rate of return is specified for ground rent renegotiations; 8.0 percent is the predominant agreed-to rate. The nearby Central Maui Baseyard is also a leasehold development. Ground rent is being established using an 8.0 percent rate of return. In light of this evidence, an 8.0 percent rate of return is utilized in determining the $220,252 average annual rent per leasable lot.

Lot No	Net Land Area (Acres)	Location	Shape	Benchmark Unit Value	Unit Premiums and Discounts Lot Size	Location	Shape	Net Adjustments	Adjusted Unit Value	Market Values
53	0.4159	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$559,429
42	0.4949	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$665,698
5	0.5691	Entrance road	Rectangular	$1,345,000	$0	$33,625	$0	$33,625	$1,412,250	$803,734
6	0.5691	Entrance road	Rectangular	$1,345,000	$0	$33,625	$0	$33,625	$1,412,250	$803,734
7	0.5691	Entrance road	Rectangular	$1,345,000	$0	$33,625	$0	$33,625	$1,412,250	$803,734
8	0.5691	Entrance road	Rectangular	$1,345,000	$0	$33,625	$0	$33,625	$1,412,250	$803,734
9	0.5691	Entrance road	Rectangular	$1,345,000	$0	$33,625	$0	$33,625	$1,412,250	$803,734
10	0.5691	Entrance road	Rectangular	$1,345,000	$0	$33,625	$0	$33,625	$1,412,250	$803,734
34	0.5791	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$778,902
43	0.5921	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$796,400
44	0.5929	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$797,428
20	0.5945	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$799,540
45	0.5967	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$802,585
1	0.6059	Entrance road	Rectangular	$1,345,000	$0	$33,625	$0	$33,625	$1,412,250	$855,718
35	**0.6499**	**Interior**	**Generally rectangular**	**$1,345,000**		**BENCHMARK**		**$0**	**$1,345,000**	**$874,065**
4	0.6698	Entrance road	Rectangular	$1,345,000	$0	$33,625	$0	$33,625	$1,412,250	$945,945
46	0.6829	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$918,524
47	0.7173	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$964,769
48	0.7231	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$972,612
22	0.7267	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$977,465
21	0.7355	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$989,257
19	0.7624	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$1,025,482
40	0.7682	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$1,033,235
41	0.7841	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$1,054,571
33	0.8086	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$1,087,579
18	0.9508	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$1,278,840
23	1.0371	Interior	Generally rectangular	$1,315,000	$13,150	$0	$0	$13,150	$1,341,300	$1,390,998
17	1.0996	Interior	Generally rectangular	$1,315,000	$13,150	$0	$0	$13,150	$1,341,300	$1,474,919
2	1.1245	Entrance road	Rectangular	$1,315,000	$13,150	$32,875	$0	$46,025	$1,407,050	$1,582,234
3	1.1245	Entrance road	Rectangular	$1,315,000	$13,150	$32,875	$0	$46,025	$1,407,050	$1,582,234
32	1.1447	Interior	Generally rectangular	$1,315,000	$13,150	$0	$0	$13,150	$1,341,300	$1,535,413
24	1.3442	Interior	Generally rectangular	$1,315,000	$13,150	$0	$0	$13,150	$1,341,300	$1,802,915
25	1.5539	Interior	Generally rectangular	$1,315,000	$13,150	$0	$0	$13,150	$1,341,300	$2,084,311
36	1.6414	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$2,158,390
16	1.6864	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$2,217,647
12	1.7903	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$2,354,306
31	1.8047	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$2,373,219
37	1.8352	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$2,413,342
38	1.9445	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$2,556,972
39	**2.0354**	**Interior**	**Generally rectangular**	**$1,315,000**		**BENCHMARK**		**$0**	**$1,315,000**	**$2,676,587**
72	2.0557	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$2,703,237
14	2.1836	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$2,871,418
71	2.2362	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$2,940,607
80	2.3047	Highway	Generally rectangular	$1,315,000	$0	$32,875	$0	$32,875	$1,380,750	$3,182,191
78	2.3201	Highway	Generally rectangular	$1,315,000	$0	$32,875	$0	$32,875	$1,380,750	$3,203,524
62	2.3741	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$3,121,887
76	2.3914	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$3,144,710
77	2.3934	Highway	Generally rectangular	$1,315,000	$0	$32,875	$0	$32,875	$1,380,750	$3,304,671
56	2.4934	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$3,278,836
26	2.5504	Interior	Generally rectangular	$1,315,000	($26,300)	$0	$0	($26,300)	$1,262,400	$3,219,613
67	2.6122	Interior	Generally rectangular	$1,315,000	($26,300)	$0	$0	($26,300)	$1,262,400	$3,297,629
50	2.6166	Interior	Generally rectangular	$1,315,000	($26,300)	$0	$0	($26,300)	$1,262,400	$3,303,199
81	2.6461	Highway	Generally rectangular	$1,315,000	($26,300)	$32,875	$0	$6,575	$1,328,150	$3,514,445
15	2.7945	Interior	Generally rectangular	$1,315,000	($26,300)	$0	$0	($26,300)	$1,262,400	$3,527,747
51	2.7982	Interior	Generally rectangular	$1,315,000	($26,300)	$0	$0	($26,300)	$1,262,400	$3,532,396
30	2.9709	Interior	Generally rectangular	$1,315,000	($26,300)	$0	$0	($26,300)	$1,262,400	$3,750,452
61	3.2096	Interior	Irregular	$1,200,000	$24,000	$0	$0	$24,000	$1,248,000	$4,005,518
73	3.3065	Interior	Generally rectangular	$1,200,000	$24,000	$0	$0	$24,000	$1,248,000	$4,126,537
64	3.3189	Interior	Irregular	$1,200,000	$24,000	$0	$0	$24,000	$1,248,000	$4,141,991
79	3.3225	Highway	Generally rectangular	$1,200,000	$24,000	$30,000	$0	$54,000	$1,308,000	$4,345,767
49	3.3460	Interior	Generally rectangular	$1,200,000	$24,000	$0	$0	$24,000	$1,248,000	$4,175,763
75	3.5002	Interior	Generally rectangular	$1,200,000	$12,000	$0	$0	$12,000	$1,224,000	$4,284,281
55	3.5226	Interior	Generally rectangular	$1,200,000	$12,000	$0	$0	$12,000	$1,224,000	$4,311,706
66	3.5720	Interior	Generally rectangular	$1,200,000	$12,000	$0	$0	$12,000	$1,224,000	$4,372,172
69	3.6136	Interior	Generally rectangular	$1,200,000	$12,000	$0	$0	$12,000	$1,224,000	$4,423,071
57	3.7019	Interior	Generally rectangular	$1,200,000	$12,000	$0	$0	$12,000	$1,224,000	$4,531,180
68	3.7416	Interior	Generally rectangular	$1,200,000	$12,000	$0	$0	$12,000	$1,224,000	$4,579,671
59	3.8096	Interior	Generally rectangular	$1,200,000	$12,000	$0	$0	$12,000	$1,224,000	$4,662,889
60	3.8131	Interior	Generally rectangular	$1,200,000	$12,000	$0	$0	$12,000	$1,224,000	$4,667,188
65	3.9247	Interior	Generally rectangular	$1,200,000	$0	$0	$0	$0	$1,200,000	$4,709,669
54	4.0285	Interior	Irregular	$1,200,000	$0	$0	$0	$0	$1,200,000	$4,834,179
29	**4.1108**	**Interior**	**Generally rectangular**	**$1,200,000**		**BENCHMARK**		**$0**	**$1,200,000**	**$4,932,961**
58	4.1509	Interior	Irregular	$1,200,000	$0	$0	$0	$0	$1,200,000	$4,981,129
82	4.3563	Interior	Irregular	$1,200,000	$0	$0	$0	$0	$1,200,000	$5,227,543
83	4.5274	Interior	Generally rectangular	$1,200,000	($12,000)	$0	$0	($12,000)	$1,176,000	$5,324,229
74	4.8645	Interior	Generally rectangular	$1,200,000	($12,000)	$0	$0	($12,000)	$1,176,000	$5,720,633
27	4.9015	Interior	Generally rectangular	$1,200,000	($12,000)	$0	$0	($12,000)	$1,176,000	$5,764,222
28	5.1751	Interior	Generally rectangular	$1,200,000	($24,000)	$0	$0	($24,000)	$1,152,000	$5,961,745
52	5.4354	Interior	Generally rectangular	$1,200,000	($24,000)	$0	$0	($24,000)	$1,152,000	$6,261,636
70	5.9078	Interior	Generally rectangular	$1,200,000	($24,000)	$0	$0	($24,000)	$1,152,000	$6,805,781
80 No. of Leasable Lots									Aggregate Retail Lot Values:	$220,251,960
									Average Lot Value:	$2,753,150
									Rate of Return:	8.00%
									Average Annual Rent Per Lot:	$220,252

Absorption Revenue

Pursuant to the scope of work, two feasibility scenarios have been conducted. The first assumes the entire project is leased to one sublessor who would rent the individual lots to long-term leasehold owners. The second scenario assumes that DLNR will lease the individual lots directly to long-term leasehold owners.

For the Sublessor scenario, the ground lease for the entire project would initiate upon release of the first increment lots. At that point in time, the development would be 100 percent vacant and the burden of lease-up expenses is on the sublessor. According to a sublessor of a similar leasehold project, it would be challenging to attract a market participant unless the master lease ground rent is discounted while initial tenants are being secured. For this analysis, initial ground rent is based on a 3.0 percent rate of return against the release of lots at 25 percent increments over the first four years. The rates of return are ramped up to 6.0 percent beginning Year 10 of the master lease, coinciding with the project achieving stabilized occupancy. The aggregate retail lot values are increased by 5 percent every five years.

In the scenario where DLNR leases the individual lots to leasehold owners, 76 lots are rented over a 10-year period, at which point the project will be at 95 percent stabilized occupancy. This absorption timeframe is based on the results of a project market study by ACM Consultants, Inc. For this analysis, ground rent is based on an 8.0 percent rate of return. Year 1 lot values for new leases consider a 2.0 percent increase from the previous year and increased by 5.0 percent every five years.

Development Expenses

Direct construction schedules and cost estimates for the proposed subdivision were reviewed. Austin Tsutsumi & Associates, Inc., who provided the preliminary figures, specifies the estimates are an opinion of probable cost. They have been utilized herein under the extraordinary assumption they are accurate for valuation purposes. Direct costs amount to $79,555,850, inclusive of 15 percent contingency. Discussions with local developers and review of similar projects supports a reasonable range for indirect costs, *inclusive of contingency*, from 15 to 25 percent of the sum of direct and indirect construction costs. A 20 percent indirect cost assumption has been made for this analysis. However, since $10,376,850 in contingency is already included with the $79,555,850 direct costs provided, the remaining indirect costs are only $6,917,900. Financing expenses for the $76,500,000 in construction costs are $43,236,870, based on a 10-year bond at 5 percent interest. Total development cost is forecasted to be $129,710,620.

The State of Hawaii is exempt from paying real property tax. For the scenario where DLNR leases directly to the individual leasehold owners, operating expenses consist of employing a DLNR project manager. Salary information, as well as typical pay increase rates, were provided by DLNR.

Remaining project operating expenses, such as real property tax; fire/liability insurance; utilities; repair and maintenance; etc. will either be paid directly by the individual leasehold owners or recovered through common area maintenance fees collected from lessees. These are deemed pass-through expenses that do not need to be accounted for in the cash flow.

A separate line-item for entrepreneurial incentive is not addressed in either scenario. The primary benefit sought by DLNR is not profit from the actual development of the project; rather, the perpetual receipt of ground lease revenue. Other typical market expenses that have been excluded are: extensive marketing and leasing commissions.

Discount Rate

The residual annual net rental revenue is discounted to a present value at a rate which represents both the time value of money at a safe investment rate, and the risks associated with this specific project. Basic to discounted cash flow analysis is the idea that future income or benefits are worth less than the same income or benefits today; and the value decreases systematically as time for their receipt is deferred further into the future. This process involves the application of a specific market-derived discount rate to the anticipated future income flows to develop a present worth estimate.

The two most common ways to handle entrepreneurial incentive with respect to the discount rate include: (1) to include profit in the discount rate or (2) to use a bifurcated or "dual" rate after deducting a line item for entrepreneurial incentive. Considering DLNR ownership of the project, a line-item deduction for entrepreneurial incentive is not made. The discount rate employed is intended to focus solely on the investor's preference for funds sooner as opposed to later.

This rate typically reflects acceptable expectations of yields to be achieved by investors currently dealing in the marketplace. Interviews with several developers on Maui and Oahu indicate that subdivision developers generally expect internal rates of return of 10.0 to 15.0 percent.

The consensus is that the appropriate discount rate for net cash flows, after a deduction for entrepreneurial incentive, ranges from 9.0 to 15.0 percent. Typically, raw land development risks encompass entitlement, development and market conditions. However, in the case of the subject, the project site is analyzed under the extraordinary assumption that entitlements are secured as of the prospective date. Furthermore, the property owner is the State of Hawaii, which limits financing risk. Construction risk is not as notable for a vacant lot subdivision utilizing land that has been previously tilled for commercial agriculture. As such, a discount rate of 6.0 percent has been considered for the Sublessor scenario. Meanwhile, an 8.0 percent discount rate is reasonable for the DLNR direct lease scenario. The 2.0 percentage point margin is primarily attributed to the need to secure rent from only one entity in the Sublessor scenario, rather than having to manage and collect rent from 80 individual owners in the case of the DLNR direct lease scenario. Both discount rates also account for the historically-strong true industrial market. These users are the primary targets for the proposed project, rather than industrial retail users that may be attracted to available fee simple lots in Maui Business Park II or Maui Lani Village Center.

Conclusion of Subdivision Development Feasibility Analysis, Alternative 2

Based on the forecasts presented in the preceding sections, as of the prospective date, January 1, 2020, the Sublessor scenario will produce a positive result in 2044. The DLNR direct lease scenario would actually have a positive return by 2043; however, the cash flow is extended to 2044 for the purpose of comparison.

Long-term ground leases typically exceed 20 years, with 50-year and 60-year ground leases commonly found in the market. As such, both 25-year cash flows support the conclusion that the proposed DLNR Industrial and Business Park is financially feasible, as of the prospective date, January 1, 2020.

PERIOD	2020 Year 1	2021 Year 2	2022 Year 3	2023 Year 4	2024 Year 5	2025 Year 6	2026 Year 7	2027 Year 8	2028 Year 9	2029 Year 10	2030 Year 11	2031 Year 12	2032 Year 13
ABSORPTION													
Aggregate Retail Lot Values	$0	$0	$0	$0	$55,062,990	$110,125,980	$165,188,970	$220,251,960	$220,251,960	$231,264,558	$231,264,558	$231,264,558	$231,264,558
Rate of Return	0%	0%	0%	0%	3%	3%	3%	3%	3.5%	4%	4.5%	5%	5.5%
REVENUE													
Total Rent per Period	$0	$0	$0	$0	$1,651,890	$3,303,779	$4,955,669	$6,607,559	$7,708,819	$9,250,582	$10,406,905	$11,563,228	$12,719,551
Other Income	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Gross Rental Revenue	$0	$0	$0	$0	$1,651,890	$3,303,779	$4,955,669	$6,607,559	$7,708,819	$9,250,582	$10,406,905	$11,563,228	$12,719,551
DEVELOPMENT EXPENSES													
Direct Costs	$0	$0	$23,655,500	$29,519,350	$21,022,000	$5,359,000	$0	$0	$0	$0	$0	$0	$0
Indirect Costs	$691,790	$691,790	$1,037,685	$1,037,685	$691,790	$691,790	$345,895	$345,895	$345,895	$345,895	$345,895	$345,895	$0
	$691,790	$691,790	$24,693,185	$30,557,035	$21,713,790	$6,050,790	$345,895	$345,895	$345,895	$345,895	$345,895	$345,895	$0
FINANCING EXPENSES													
10-Year Bond @ 5.00%	$0	$0	$3,963,380	$4,323,687	$4,323,687	$4,323,687	$4,323,687	$4,323,687	$4,323,687	$4,323,687	$4,323,687	$4,323,687	$360,307
	$0	$0	$3,963,380	$4,323,687	$4,323,687	$4,323,687	$4,323,687	$4,323,687	$4,323,687	$4,323,687	$4,323,687	$4,323,687	$360,307
HOLDING EXPENSES													
RP Tax (Exempt)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL EXPENSES	$691,790	$691,790	$28,656,565	$34,880,722	$26,037,477	$10,374,477	$4,669,582	$4,669,582	$4,669,582	$4,669,582	$4,669,582	$4,669,582	$360,307
NET RENTAL REVENUE	($691,790)	($691,790)	($28,656,565)	($34,880,722)	($24,385,587)	($7,070,698)	$286,087	$1,937,977	$3,039,237	$4,581,000	$5,737,323	$6,893,646	$12,359,244
Discount Period	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13
Present Value Factor @ 6.00%	0.943396	0.889996	0.839619	0.792094	0.747258	0.704961	0.665057	0.627412	0.591898	0.558395	0.526788	0.496969	0.468839
DISCOUNTED VALUE PER PERIOD	($652,632)	($615,691)	($24,060,605)	($27,628,799)	($18,222,329)	($4,984,563)	$190,264	$1,215,911	$1,798,919	$2,558,007	$3,022,350	$3,425,931	$5,794,496

PERIOD	2033 Year 14	2034 Year 15	2035 Year 16	2036 Year 17	2037 Year 18	2038 Year 19	2039 Year 20	2040 Year 21	2041 Year 22	2042 Year 23	2043 Year 24	2044 Year 25	TOTALS
ABSORPTION													
Aggregate Retail Lot Values	$231,264,558	$242,827,786	$242,827,786	$242,827,786	$242,827,786	$242,827,786	$254,969,175	$254,969,175	$254,969,175	$254,969,175	$254,969,175	$267,717,634	
Rate of Return	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	
REVENUE													
Total Rent per Period	$13,875,873	$14,569,667	$14,569,667	$14,569,667	$14,569,667	$14,569,667	$15,298,151	$15,298,151	$15,298,151	$15,298,151	$15,298,151	$16,063,058	$247,446,002
Other Income	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Gross Rental Revenue	$13,875,873	$14,569,667	$14,569,667	$14,569,667	$14,569,667	$14,569,667	$15,298,151	$15,298,151	$15,298,151	$15,298,151	$15,298,151	$16,063,058	$247,446,002
DEVELOPMENT EXPENSES													
Direct Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$79,555,850
Indirect Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$6,917,900
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$86,473,750
FINANCING EXPENSES													
10-Year Bond @ 5.00%	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$43,236,870
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$43,236,870
HOLDING EXPENSES													
RP Tax (Exempt)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL EXPENSES	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$129,710,620
NET RENTAL REVENUE	$13,875,873	$14,569,667	$14,569,667	$14,569,667	$14,569,667	$14,569,667	$15,298,151	$15,298,151	$15,298,151	$15,298,151	$15,298,151	$16,063,058	$117,735,382
Discount Period	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25	
Present Value Factor @ 6.00%	0.442301	0.417265	0.393646	0.371364	0.350344	0.330513	0.311805	0.294155	0.277505	0.261797	0.246979	0.232999	
DISCOUNTED VALUE PER PERIOD	$6,137,312	$6,079,413	$5,735,295	$5,410,656	$5,104,392	$4,815,465	$4,770,036	$4,500,034	$4,245,315	$4,005,014	$3,778,315	$3,742,671	$165,176
												Rounded	$170,000

PERIOD	2033 Year 14	2034 Year 15	2035 Year 16	2036 Year 17	2037 Year 18	2038 Year 19	2039 Year 20	2040 Year 21	2041 Year 22	2042 Year 23	2043 Year 24	2044 Year 25	TOTALS
ABSORPTION													
Lots Leased- 2024	8	8	8	8	8	8	8	8	8	8	8	8	
Avg Rent per Lot, 8% Rate of Return- 2024	$231,265	$242,828	$242,828	$242,828	$242,828	$242,828	$254,969	$254,969	$254,969	$254,969	$254,969	$267,718	
Rent for Lots Leased- 2024	$1,850,116	$1,942,622	$1,942,622	$1,942,622	$1,942,622	$1,942,622	$2,039,753	$2,039,753	$2,039,753	$2,039,753	$2,039,753	$2,141,741	
Lots Leased- 2025	8	8	8	8	8	8	8	8	8	8	8	8	
Avg Rent per Lot, 8% Rate of Return- 2025	$235,890	$235,890	$247,684	$247,684	$247,684	$247,684	$247,684	$260,069	$260,069	$260,069	$260,069	$260,069	
Rent for Lots Leased- 2025	$1,887,119	$1,887,119	$1,981,475	$1,981,475	$1,981,475	$1,981,475	$1,981,475	$2,080,548	$2,080,548	$2,080,548	$2,080,548	$2,080,548	
Lots Leased- 2026	8	8	8	8	8	8	8	8	8	8	8	8	
Avg Rent per Lot, 8% Rate of Return- 2026	$240,608	$240,608	$240,608	$252,638	$252,638	$252,638	$252,638	$252,638	$265,270	$265,270	$265,270	$265,270	
Rent for Lots Leased- 2026	$1,924,861	$1,924,861	$1,924,861	$2,021,104	$2,021,104	$2,021,104	$2,021,104	$2,021,104	$2,122,159	$2,122,159	$2,122,159	$2,122,159	
Lots Leased- 2027	8	8	8	8	8	8	8	8	8	8	8	8	
Avg Rent per Lot, 8% Rate of Return- 2027	$245,420	$245,420	$245,420	$245,420	$257,691	$257,691	$257,691	$257,691	$257,691	$270,575	$270,575	$270,575	
Rent for Lots Leased- 2027	$1,963,358	$1,963,358	$1,963,358	$1,963,358	$2,061,526	$2,061,526	$2,061,526	$2,061,526	$2,061,526	$2,164,603	$2,164,603	$2,164,603	
Lots Leased- 2028	8	8	8	8	8	8	8	8	8	8	8	8	
Avg Rent per Lot, 8% Rate of Return- 2028	$250,328	$250,328	$250,328	$250,328	$250,328	$262,845	$262,845	$262,845	$262,845	$262,845	$275,987	$275,987	
Rent for Lots Leased- 2028	$2,002,626	$2,002,626	$2,002,626	$2,002,626	$2,002,626	$2,102,757	$2,102,757	$2,102,757	$2,102,757	$2,102,757	$2,207,895	$2,207,895	
Lots Leased- 2029	8	8	8	8	8	8	8	8	8	8	8	8	
Avg Rent per Lot, 8% Rate of Return- 2029	$243,176	$255,335	$255,335	$255,335	$255,335	$255,335	$268,101	$268,101	$268,101	$268,101	$268,101	$281,507	
Rent for Lots Leased- 2029	$1,945,408	$2,042,678	$2,042,678	$2,042,678	$2,042,678	$2,042,678	$2,144,812	$2,144,812	$2,144,812	$2,144,812	$2,144,812	$2,252,053	
Lots Leased- 2030	7	7	7	7	7	7	7	7	7	7	7	7	
Avg Rent per Lot, 8% Rate of Return- 2030	$248,039	$248,039	$260,441	$260,441	$260,441	$260,441	$260,441	$273,464	$273,464	$273,464	$273,464	$273,464	
Rent for Lots Leased- 2030	$1,736,276	$1,736,276	$1,823,090	$1,823,090	$1,823,090	$1,823,090	$1,823,090	$1,914,245	$1,914,245	$1,914,245	$1,914,245	$1,914,245	
Lots Leased- 2031	7	7	7	7	7	7	7	7	7	7	7	7	
Avg Rent per Lot, 8% Rate of Return- 2031	$253,000	$253,000	$253,000	$265,650	$265,650	$265,650	$265,650	$265,650	$278,933	$278,933	$278,933	$278,933	
Rent for Lots Leased- 2031	$1,771,002	$1,771,002	$1,771,002	$1,859,552	$1,859,552	$1,859,552	$1,859,552	$1,859,552	$1,952,530	$1,952,530	$1,952,530	$1,952,530	
Lots Leased- 2032	7	7	7	7	7	7	7	7	7	7	7	7	
Avg Rent per Lot, 8% Rate of Return- 2032	$258,060	$258,060	$258,060	$258,060	$270,963	$270,963	$270,963	$270,963	$270,963	$284,511	$284,511	$284,511	
Rent for Lots Leased- 2032	$1,806,422	$1,806,422	$1,806,422	$1,806,422	$1,896,743	$1,896,743	$1,896,743	$1,896,743	$1,896,743	$1,991,580	$1,991,580	$1,991,580	
Lots Leased- 2033	7	7	7	7	7	7	7	7	7	7	7	7	
Avg Rent per Lot, 8% Rate of Return- 2033	$263,221	$263,221	$263,221	$263,221	$263,221	$276,383	$276,383	$276,383	$276,383	$276,383	$290,202	$290,202	
Rent for Lots Leased- 2033	$1,842,550	$1,842,550	$1,842,550	$1,842,550	$1,842,550	$1,934,678	$1,934,678	$1,934,678	$1,934,678	$1,934,678	$2,031,412	$2,031,412	
Cumulative Lots Leased	76	76	76	76	76	76	76	76	76	76	76	76	
Lots Available w/5% Stabilized Vacancy	0	0	0	0	0	0	0	0	0	0	0	0	
REVENUE													
Total Rent per Period	$18,729,739	$18,919,515	$19,100,685	$19,285,478	$19,473,967	$19,666,226	$19,865,491	$20,055,719	$20,249,752	$20,447,665	$20,649,537	$20,858,765	$320,364,326
Other Income	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Gross Rental Revenue	$18,729,739	$18,919,515	$19,100,685	$19,285,478	$19,473,967	$19,666,226	$19,865,491	$20,055,719	$20,249,752	$20,447,665	$20,649,537	$20,858,765	$320,364,326
DEVELOPMENT EXPENSES													
Direct Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$79,555,850
Indirect Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$6,917,900
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$86,473,750
FINANCING EXPENSES													
10-Year Bond @ 5.00%	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$43,236,870
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$43,236,870
HOLDING EXPENSES													
DLNR Project Management	$150,895	$155,422	$166,488	$171,482	$176,627	$181,926	$187,383	$200,725	$206,747	$212,949	$219,338	$225,918	$3,795,177
RP Tax (Exempt)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	$150,895	$155,422	$166,488	$171,482	$176,627	$181,926	$187,383	$200,725	$206,747	$212,949	$219,338	$225,918	$3,795,177
TOTAL EXPENSES	$150,895	$155,422	$166,488	$171,482	$176,627	$181,926	$187,383	$200,725	$206,747	$212,949	$219,338	$225,918	$133,505,797
NET RENTAL REVENUE	$18,578,844	$18,764,093	$18,934,197	$19,113,995	$19,297,340	$19,484,300	$19,678,107	$19,854,994	$20,043,005	$20,234,716	$20,430,199	$20,632,847	$186,858,529
Discount Period	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25	
Present Value Factor @ 8.00%	0.340461	0.315242	0.291890	0.270269	0.250249	0.231712	0.214548	0.198656	0.183941	0.170315	0.157699	0.146018	
DISCOUNTED VALUE PER PERIOD	$6,325,373	$5,915,225	$5,526,712	$5,165,920	$4,829,141	$4,514,747	$4,221,903	$3,944,309	$3,686,720	$3,446,281	$3,221,829	$3,012,765	$3,261,286
												Rounded	$3,260,000

PERIOD	2020 Year 1	2021 Year 2	2022 Year 3	2023 Year 4	2024 Year 5	2025 Year 6	2026 Year 7	2027 Year 8	2028 Year 9	2029 Year 10	2030 Year 11	2031 Year 12	2032 Year 13
ABSORPTION													
Lots Leased- 2024	0	0	0	0	8	8	8	8	8	8	8	8	8
Avg Rent per Lot, 8% Rate of Return- 2024	$0	$0	$0	$0	$220,252	$220,252	$220,252	$220,252	$220,252	$231,265	$231,265	$231,265	$231,265
Rent for Lots Leased- 2024	$0	$0	$0	$0	$1,762,016	$1,762,016	$1,762,016	$1,762,016	$1,762,016	$1,850,116	$1,850,116	$1,850,116	$1,850,116
Lots Leased- 2025	0	0	0	0	0	8	8	8	8	8	8	8	8
Avg Rent per Lot, 8% Rate of Return- 2025	$0	$0	$0	$0	$0	$224,657	$224,657	$224,657	$224,657	$224,657	$235,890	$235,890	$235,890
Rent for Lots Leased- 2025	$0	$0	$0	$0	$0	$1,797,256	$1,797,256	$1,797,256	$1,797,256	$1,797,256	$1,887,119	$1,887,119	$1,887,119
Lots Leased- 2026	0	0	0	0	0	0	8	8	8	8	8	8	8
Avg Rent per Lot, 8% Rate of Return- 2026	$0	$0	$0	$0	$0	$0	$229,150	$229,150	$229,150	$229,150	$229,150	$240,608	$240,608
Rent for Lots Leased- 2026	$0	$0	$0	$0	$0	$0	$1,833,201	$1,833,201	$1,833,201	$1,833,201	$1,833,201	$1,924,861	$1,924,861
Lots Leased- 2027	0	0	0	0	0	0	0	8	8	8	8	8	8
Avg Rent per Lot, 8% Rate of Return- 2027	$0	$0	$0	$0	$0	$0	$0	$233,733	$233,733	$233,733	$233,733	$233,733	$245,420
Rent for Lots Leased- 2027	$0	$0	$0	$0	$0	$0	$0	$1,869,865	$1,869,865	$1,869,865	$1,869,865	$1,869,865	$1,963,358
Lots Leased- 2028	0	0	0	0	0	0	0	0	8	8	8	8	8
Avg Rent per Lot, 8% Rate of Return- 2028	$0	$0	$0	$0	$0	$0	$0	$0	$238,408	$238,408	$238,408	$238,408	$238,408
Rent for Lots Leased- 2028	$0	$0	$0	$0	$0	$0	$0	$0	$1,907,262	$1,907,262	$1,907,262	$1,907,262	$1,907,262
Lots Leased- 2029	0	0	0	0	0	0	0	0	0	8	8	8	8
Avg Rent per Lot, 8% Rate of Return- 2029	$0	$0	$0	$0	$0	$0	$0	$0	$0	$243,176	$243,176	$243,176	$243,176
Rent for Lots Leased- 2029	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,945,408	$1,945,408	$1,945,408	$1,945,408
Lots Leased- 2030	0	0	0	0	0	0	0	0	0	0	7	7	7
Avg Rent per Lot, 8% Rate of Return- 2030	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$248,039	$248,039	$248,039
Rent for Lots Leased- 2030	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,736,276	$1,736,276	$1,736,276
Lots Leased- 2031	0	0	0	0	0	0	0	0	0	0	0	7	7
Avg Rent per Lot, 8% Rate of Return- 2031	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$253,000	$253,000
Rent for Lots Leased- 2031	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,771,002	$1,771,002
Lots Leased- 2032	0	0	0	0	0	0	0	0	0	0	0	0	7
Avg Rent per Lot, 8% Rate of Return- 2032	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$258,060
Rent for Lots Leased- 2032	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,806,422
Lots Leased- 2033	0	0	0	0	0	0	0	0	0	0	0	0	0
Avg Rent per Lot, 8% Rate of Return- 2033	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Rent for Lots Leased- 2033	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Cumulative Lots Leased	0	0	0	0	8	16	24	32	40	48	55	62	69
Lots Available w/5% Stabilized Vacancy	76	76	76	76	68	60	52	44	36	28	21	14	7
REVENUE													
Total Rent per Period	$0	$0	$0	$0	$1,762,016	$3,559,272	$5,392,473	$7,262,338	$9,169,600	$11,203,109	$13,029,248	$14,891,910	$16,791,825
Other Income	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Gross Rental Revenue	$0	$0	$0	$0	$1,762,016	$3,559,272	$5,392,473	$7,262,338	$9,169,600	$11,203,109	$13,029,248	$14,891,910	$16,791,825
DEVELOPMENT EXPENSES													
Direct Costs	$0	$0	$23,655,500	$29,519,350	$21,022,000	$5,359,000	$0	$0	$0	$0	$0	$0	$0
Indirect Costs	$691,790	$691,790	$1,037,685	$1,037,685	$691,790	$691,790	$345,895	$345,895	$345,895	$345,895	$345,895	$345,895	$0
	$691,790	$691,790	$24,693,185	$30,557,035	$21,713,790	$6,050,790	$345,895	$345,895	$345,895	$345,895	$345,895	$345,895	$0
FINANCING EXPENSES													
10-Year Bond @ 5.00%	$0	$0	$3,963,380	$4,323,687	$4,323,687	$4,323,687	$4,323,687	$4,323,687	$4,323,687	$4,323,687	$4,323,687	$4,323,687	$360,307
	$0	$0	$3,963,380	$4,323,687	$4,323,687	$4,323,687	$4,323,687	$4,323,687	$4,323,687	$4,323,687	$4,323,687	$4,323,687	$360,307
HOLDING EXPENSES													
DLNR Project Management	$95,000	$97,850	$100,786	$103,809	$106,923	$114,536	$117,972	$121,512	$125,157	$128,912	$138,090	$142,233	$146,500
RP Tax (Exempt)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	$95,000	$97,850	$100,786	$103,809	$106,923	$114,536	$117,972	$121,512	$125,157	$128,912	$138,090	$142,233	$146,500
TOTAL EXPENSES	$786,790	$789,640	$28,757,351	$34,984,531	$26,144,400	$10,489,013	$4,787,554	$4,791,094	$4,794,739	$4,798,494	$4,807,672	$4,811,815	$506,807
NET RENTAL REVENUE	($786,790)	($789,640)	($28,757,351)	($34,984,531)	($24,382,385)	($6,929,742)	$604,918	$2,471,244	$4,374,861	$6,404,615	$8,221,576	$10,080,095	$16,285,018
Discount Period	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13
Present Value Factor @ 8.00%	0.925926	0.857339	0.793832	0.735030	0.680583	0.630170	0.583490	0.540269	0.500249	0.463193	0.428883	0.397114	0.367698
DISCOUNTED VALUE PER PERIOD	($728,509)	($676,989)	($22,828,512)	($25,714,675)	($16,594,241)	($4,366,913)	$352,964	$1,335,136	$2,188,520	$2,966,576	$3,526,093	$4,002,944	$5,987,967

Alternative 3 – Surface Water System

Valuation of the Remaining Leasable Lots

For this alternative, there are 79 leasable lots, including the three previously-valued benchmark lots. To establish the market value of the remaining 76 leasable lots, each is rated and compared against the appropriate benchmark lot. Considerations are made for differences in lot size, location and shape. Premiums or discounts are applied to each property based on these differences.

Lot Size

The same considerations and size curve sensitivity analysis conducted for the valuation of the benchmarks is utilized for the remaining lots.

Location

A slight premium is issued to lots located along the primary Kamaaina Road subdivision entrance, as well as the lots along Maui Veterans Highway. It is anticipated that these parcels will have increased exposure to commuter traffic.

Shape

Similar to the valuation of the benchmark lots, the irregular configurations of some of the remaining lots is not expected to detract from efficient development, especially in light of their net acreage.

Conclusion of Aggregate Retail

Based on the foregoing factors, the remaining leasable industrial lots assigned final values. Application of the respective adjustments to the benchmark lots results in an aggregate retail of $216,575,883 for the 79 leasable lots, as of the prospective date of January 1, 2020. The average lot value is $2,741,467.

Historical rates of return for ground rent calculation in Central Maui have generally congregated between 8.0 and 8.5 percent. It is recognized that in cases where a "prevailing" rate of return is specified for ground rent renegotiations; 8.0 percent is the predominant agreed-to rate. The nearby Central Maui Baseyard is also a leasehold development. Ground rent is being established using an 8.0 percent rate of return. In light of this evidence, an 8.0 percent rate of return is utilized in determining the $219,317 average annual rent per leasable lot.

Lot No.	Net Land Area (Acres)	Location	Shape	Benchmark Unit Value	Unit Premiums and Discounts: Lot Size	Location	Shape	Net Adjustments	Adjusted Unit Value	Market Values
53	0.4159	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$559,429
42	0.4949	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$665,698
5	0.5691	Entrance road	Rectangular	$1,345,000	$0	$33,625	$0	$33,625	$1,412,250	$803,734
6	0.5691	Entrance road	Rectangular	$1,345,000	$0	$33,625	$0	$33,625	$1,412,250	$803,734
7	0.5691	Entrance road	Rectangular	$1,345,000	$0	$33,625	$0	$33,625	$1,412,250	$803,734
8	0.5691	Entrance road	Rectangular	$1,345,000	$0	$33,625	$0	$33,625	$1,412,250	$803,734
9	0.5691	Entrance road	Rectangular	$1,345,000	$0	$33,625	$0	$33,625	$1,412,250	$803,734
10	0.5691	Entrance road	Rectangular	$1,345,000	$0	$33,625	$0	$33,625	$1,412,250	$803,734
34	0.5791	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$778,902
43	0.5921	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$796,400
44	0.5929	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$797,428
20	0.5945	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$799,540
45	0.5967	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$802,585
1	0.6059	Entrance road	Rectangular	$1,345,000	$0	$33,625	$0	$33,625	$1,412,250	$855,718
35	**0.6499**	**Interior**	**Generally rectangular**	**$1,345,000**		**BENCHMARK**		**$0**	**$1,345,000**	**$874,065**
4	0.6698	Entrance road	Rectangular	$1,345,000	$0	$33,625	$0	$33,625	$1,412,250	$945,945
46	0.6829	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$918,524
47	0.7173	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$964,769
48	0.7231	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$972,612
22	0.7267	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$977,465
21	0.7355	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$989,257
19	0.7624	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$1,025,482
40	0.7682	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$1,033,235
41	0.7841	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$1,054,571
33	0.8086	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$1,087,579
18	0.9508	Interior	Generally rectangular	$1,345,000	$0	$0	$0	$0	$1,345,000	$1,278,840
23	1.0371	Interior	Generally rectangular	$1,315,000	$13,150	$0	$0	$13,150	$1,341,300	$1,390,998
17	1.0996	Interior	Generally rectangular	$1,315,000	$13,150	$0	$0	$13,150	$1,341,300	$1,474,919
2	1.1245	Entrance road	Rectangular	$1,315,000	$13,150	$32,875	$0	$46,025	$1,407,050	$1,582,234
3	1.1245	Entrance road	Rectangular	$1,315,000	$13,150	$32,875	$0	$46,025	$1,407,050	$1,582,234
32	1.1447	Interior	Generally rectangular	$1,315,000	$13,150	$0	$0	$13,150	$1,341,300	$1,535,413
24	1.3442	Interior	Generally rectangular	$1,315,000	$13,150	$0	$0	$13,150	$1,341,300	$1,802,915
25	1.5539	Interior	Generally rectangular	$1,315,000	$13,150	$0	$0	$13,150	$1,341,300	$2,084,311
36	1.6414	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$2,158,390
16	1.6864	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$2,217,647
12	1.7903	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$2,354,306
31	1.8047	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$2,373,219
37	1.8352	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$2,413,342
38	1.9445	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$2,556,972
13	2.0269	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$2,665,423
39	**2.0354**	**Interior**	**Generally rectangular**	**$1,315,000**		**BENCHMARK**		**$0**	**$1,315,000**	**$2,676,587**
72	2.0557	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$2,703,237
14	2.1836	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$2,871,418
71	2.2362	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$2,940,607
80	2.3047	Highway	Generally rectangular	$1,315,000	$0	$32,875	$0	$32,875	$1,380,750	$3,182,191
78	2.3201	Highway	Generally rectangular	$1,315,000	$0	$32,875	$0	$32,875	$1,380,750	$3,203,524
76	2.3914	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$3,144,710
77	2.3934	Highway	Generally rectangular	$1,315,000	$0	$32,875	$0	$32,875	$1,380,750	$3,304,671
56	2.4934	Interior	Generally rectangular	$1,315,000	$0	$0	$0	$0	$1,315,000	$3,278,836
67	2.6122	Interior	Generally rectangular	$1,315,000	($26,300)	$0	$0	($26,300)	$1,262,400	$3,297,629
50	2.6166	Interior	Generally rectangular	$1,315,000	($26,300)	$0	$0	($26,300)	$1,262,400	$3,303,199
81	2.6461	Highway	Generally rectangular	$1,315,000	($26,300)	$32,875	$0	$6,575	$1,328,150	$3,514,445
15	2.7945	Interior	Generally rectangular	$1,315,000	($26,300)	$0	$0	($26,300)	$1,262,400	$3,527,747
51	2.7982	Interior	Generally rectangular	$1,315,000	($26,300)	$0	$0	($26,300)	$1,262,400	$3,532,396
30	2.9709	Interior	Generally rectangular	$1,315,000	($26,300)	$0	$0	($26,300)	$1,262,400	$3,750,452
61	3.2096	Interior	Irregular	$1,200,000	$24,000	$0	$0	$24,000	$1,248,000	$4,005,518
73	3.3065	Interior	Generally rectangular	$1,200,000	$24,000	$0	$0	$24,000	$1,248,000	$4,126,537
64	3.3189	Interior	Irregular	$1,200,000	$24,000	$0	$0	$24,000	$1,248,000	$4,141,991
79	3.3225	Highway	Generally rectangular	$1,200,000	$24,000	$30,000	$0	$54,000	$1,308,000	$4,345,767
49	3.3460	Interior	Generally rectangular	$1,200,000	$24,000	$0	$0	$24,000	$1,248,000	$4,175,763
75	3.5002	Interior	Generally rectangular	$1,200,000	$12,000	$0	$0	$12,000	$1,224,000	$4,284,281
55	3.5226	Interior	Generally rectangular	$1,200,000	$12,000	$0	$0	$12,000	$1,224,000	$4,311,706
66	3.5720	Interior	Generally rectangular	$1,200,000	$12,000	$0	$0	$12,000	$1,224,000	$4,372,172
69	3.6136	Interior	Generally rectangular	$1,200,000	$12,000	$0	$0	$12,000	$1,224,000	$4,423,071
57	3.7019	Interior	Generally rectangular	$1,200,000	$12,000	$0	$0	$12,000	$1,224,000	$4,531,180
68	3.7416	Interior	Generally rectangular	$1,200,000	$12,000	$0	$0	$12,000	$1,224,000	$4,579,671
59	3.8096	Interior	Generally rectangular	$1,200,000	$12,000	$0	$0	$12,000	$1,224,000	$4,662,889
60	3.8131	Interior	Generally rectangular	$1,200,000	$12,000	$0	$0	$12,000	$1,224,000	$4,667,188
65	3.9247	Interior	Generally rectangular	$1,200,000	$0	$0	$0	$0	$1,200,000	$4,709,669
54	4.0285	Interior	Irregular	$1,200,000	$0	$0	$0	$0	$1,200,000	$4,834,179
29	**4.1108**	**Interior**	**Generally rectangular**	**$1,200,000**		**BENCHMARK**		**$0**	**$1,200,000**	**$4,932,961**
58	4.1509	Interior	Irregular	$1,200,000	$0	$0	$0	$0	$1,200,000	$4,981,129
82	4.3563	Interior	Irregular	$1,200,000	$0	$0	$0	$0	$1,200,000	$5,227,543
83	4.5274	Interior	Generally rectangular	$1,200,000	($12,000)	$0	$0	($12,000)	$1,176,000	$5,324,229
74	4.8645	Interior	Generally rectangular	$1,200,000	($12,000)	$0	$0	($12,000)	$1,176,000	$5,720,633
27	4.9015	Interior	Generally rectangular	$1,200,000	($12,000)	$0	$0	($12,000)	$1,176,000	$5,764,222
28	5.1751	Interior	Generally rectangular	$1,200,000	($24,000)	$0	$0	($24,000)	$1,152,000	$5,961,745
52	5.4354	Interior	Generally rectangular	$1,200,000	($24,000)	$0	$0	($24,000)	$1,152,000	$6,261,636
70	5.9078	Interior	Generally rectangular	$1,200,000	($24,000)	$0	$0	($24,000)	$1,152,000	$6,805,781

79 No. of Leasable Lots

Aggregate Retail Lot Values:	$216,575,883
Average Lot Value:	$2,741,467
Rate of Return:	8.00%
Average Annual Rent Per Lot:	$219,317

Absorption Revenue

Pursuant to the scope of work, two feasibility scenarios have been conducted. The first assumes the entire project is leased to one sublessor who would rent the individual lots to long-term leasehold owners. The second scenario assumes that DLNR will lease the individual lots directly to long-term leasehold owners.

For the Sublessor scenario, the ground lease for the entire project would initiate upon release of the first increment lots. At that point in time, the development would be 100 percent vacant and the burden of lease-up expenses is on the sublessor. According to a sublessor of a similar leasehold project, it would be challenging to attract a market participant unless the master lease ground rent is discounted while initial tenants are being secured. For this analysis, initial ground rent is based on a 3.0 percent rate of return against the release of lots at 25 percent increments over the first four years. The rates of return are ramped up to 6.0 percent beginning Year 10 of the master lease, coinciding with the project achieving stabilized occupancy. The aggregate retail lot values are increased by 5 percent every five years.

In the scenario where DLNR leases the individual lots to leasehold owners, 75 lots are rented over a 10-year period, at which point the project will be at 95 percent stabilized occupancy. This absorption timeframe is based on the results of a project market study by ACM Consultants, Inc. For this analysis, ground rent is based on an 8.0 percent rate of return. Year 1 lot values for new leases consider a 2.0 percent increase from the previous year and increased by 5.0 percent every five years.

Development Expenses

Direct construction schedules and cost estimates for the proposed subdivision were reviewed. Austin Tsutsumi & Associates, Inc., who provided the preliminary figures, specifies the estimates are an opinion of probable cost. They have been utilized herein under the extraordinary assumption they are accurate for valuation purposes. Direct costs amount to $88,083,100, inclusive of 15 percent contingency. Discussions with local developers and review of similar projects supports a reasonable range for indirect costs, *inclusive of contingency*, from 15 to 25 percent of the sum of direct and indirect construction costs. A 20 percent indirect cost assumption has been made for this analysis. However, since $11,489,100 in contingency is already included with the $88,083,100 direct costs provided, the remaining indirect costs are only $7,659,400. Financing expenses for the $95,742,500 in construction costs are $47,871,250, based on a 10-year bond at 5 percent interest. Total development cost is forecasted to be $143,613,750.

The State of Hawaii is exempt from paying real property tax. For the scenario where DLNR leases directly to the individual leasehold owners, operating expenses consist of employing a DLNR project manager. Salary information, as well as typical pay increase rates, were provided by DLNR.

Remaining project operating expenses, such as real property tax; fire/liability insurance; utilities; repair and maintenance; etc. will either be paid directly by the individual leasehold owners or recovered through common area maintenance fees collected from lessees. These are deemed pass-through expenses that do not need to be accounted for in the cash flow.

A separate line-item for entrepreneurial incentive is not addressed in either scenario. The primary benefit sought by DLNR is not profit from the actual development of the project; rather, the

perpetual receipt of ground lease revenue. Other typical market expenses that have been excluded are: extensive marketing and leasing commissions.

Discount Rate

The residual annual net rental revenue is discounted to a present value at a rate which represents both the time value of money at a safe investment rate, and the risks associated with this specific project. Basic to discounted cash flow analysis is the idea that future income or benefits are worth less than the same income or benefits today; and the value decreases systematically as time for their receipt is deferred further into the future. This process involves the application of a specific market-derived discount rate to the anticipated future income flows to develop a present worth estimate.

The two most common ways to handle entrepreneurial incentive with respect to the discount rate include: (1) to include profit in the discount rate or (2) to use a bifurcated or "dual" rate after deducting a line item for entrepreneurial incentive. Considering DLNR ownership of the project, a line-item deduction for entrepreneurial incentive is not made. The discount rate employed is intended to focus solely on the investor's preference for funds sooner as opposed to later.

This rate typically reflects acceptable expectations of yields to be achieved by investors currently dealing in the marketplace. Interviews with several developers on Maui and Oahu indicate that subdivision developers generally expect internal rates of return of 10.0 to 15.0 percent.

The consensus is that the appropriate discount rate for net cash flows, after a deduction for entrepreneurial incentive, ranges from 9.0 to 15.0 percent. Typically, raw land development risks encompass entitlement, development and market conditions. However, in the case of the subject, the project site is analyzed under the extraordinary assumption that entitlements are secured as of the prospective date. Furthermore, the property owner is the State of Hawaii, which limits financing risk. Construction risk is not as notable for a vacant lot subdivision utilizing land that has been previously tilled for commercial agriculture. As such, a discount rate of 6.0 percent has been considered for the Sublessor scenario. Meanwhile, an 8.0 percent discount rate is reasonable for the DLNR direct lease scenario. The 2.0 percentage point margin is primarily attributed to the need to secure rent from only one entity in the Sublessor scenario, rather than having to manage and collect rent from 79 individual owners in the case of the DLNR direct lease scenario. Both discount rates also account for the historically-strong true industrial market. These users are the primary targets for the proposed project, rather than industrial retail users that may be attracted to available fee simple lots in Maui Business Park II or Maui Lani Village Center.

Conclusion of Subdivision Development Feasibility Analysis, Alternative 3

Based on the forecasts presented in the preceding sections, as of the prospective date, January 1, 2020, the Sublessor scenario will produce a positive result in 2048. The DLNR direct lease scenario also has a positive return by 2048.

Long-term ground leases typically exceed 20 years, with 50-year and 60-year ground leases commonly found in the market. As such, both 29-year cash flows support the conclusion that the proposed DLNR Industrial and Business Park is financially feasible, as of the prospective date, January 1, 2020.

PERIOD	2020 Year 1	2021 Year 2	2022 Year 3	2023 Year 4	2024 Year 5	2025 Year 6	2026 Year 7	2027 Year 8	2028 Year 9	2029 Year 10	2030 Year 11	2031 Year 12	2032 Year 13	2033 Year 14	2034 Year 15
ABSORPTION															
Lots Leased- 2024	0	0	0	0	8	8	8	8	8	8	8	8	8	8	8
Avg Rent per Lot, 8% Rate of Return- 2024	$0	$0	$0	$0	$219,317	$219,317	$219,317	$219,317	$219,317	$230,283	$230,283	$230,283	$230,283	$230,283	$241,797
Rent for Lots Leased- 2024	$0	$0	$0	$0	$1,754,539	$1,754,539	$1,754,539	$1,754,539	$1,754,539	$1,842,266	$1,842,266	$1,842,266	$1,842,266	$1,842,266	$1,934,379
Lots Leased- 2025	0	0	0	0	0	8	8	8	8	8	8	8	8	8	8
Avg Rent per Lot, 8% Rate of Return- 2025	$0	$0	$0	$0	$0	$223,704	$223,704	$223,704	$223,704	$223,704	$234,889	$234,889	$234,889	$234,889	$234,889
Rent for Lots Leased- 2025	$0	$0	$0	$0	$0	$1,789,630	$1,789,630	$1,789,630	$1,789,630	$1,789,630	$1,879,111	$1,879,111	$1,879,111	$1,879,111	$1,879,111
Lots Leased- 2026	0	0	0	0	0	0	8	8	8	8	8	8	8	8	8
Avg Rent per Lot, 8% Rate of Return- 2026	$0	$0	$0	$0	$0	$0	$228,178	$228,178	$228,178	$228,178	$228,178	$239,587	$239,587	$239,587	$239,587
Rent for Lots Leased- 2026	$0	$0	$0	$0	$0	$0	$1,825,422	$1,825,422	$1,825,422	$1,825,422	$1,825,422	$1,916,693	$1,916,693	$1,916,693	$1,916,693
Lots Leased- 2027	0	0	0	0	0	0	0	8	8	8	8	8	8	8	8
Avg Rent per Lot, 8% Rate of Return- 2027	$0	$0	$0	$0	$0	$0	$0	$232,741	$232,741	$232,741	$232,741	$232,741	$244,378	$244,378	$244,378
Rent for Lots Leased- 2027	$0	$0	$0	$0	$0	$0	$0	$1,861,931	$1,861,931	$1,861,931	$1,861,931	$1,861,931	$1,955,027	$1,955,027	$1,955,027
Lots Leased- 2028	0	0	0	0	0	0	0	0	8	8	8	8	8	8	8
Avg Rent per Lot, 8% Rate of Return- 2028	$0	$0	$0	$0	$0	$0	$0	$0	$237,396	$237,396	$237,396	$237,396	$237,396	$249,266	$249,266
Rent for Lots Leased- 2028	$0	$0	$0	$0	$0	$0	$0	$0	$1,899,169	$1,899,169	$1,899,169	$1,899,169	$1,899,169	$1,994,128	$1,994,128
Lots Leased- 2029	0	0	0	0	0	0	0	0	0	7	7	7	7	7	7
Avg Rent per Lot, 8% Rate of Return- 2029	$0	$0	$0	$0	$0	$0	$0	$0	$0	$242,144	$242,144	$242,144	$242,144	$242,144	$254,251
Rent for Lots Leased- 2029	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,695,009	$1,695,009	$1,695,009	$1,695,009	$1,695,009	$1,779,759
Lots Leased- 2030	0	0	0	0	0	0	0	0	0	0	7	7	7	7	7
Avg Rent per Lot, 8% Rate of Return- 2030	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$246,987	$246,987	$246,987	$246,987	$246,987
Rent for Lots Leased- 2030	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,728,909	$1,728,909	$1,728,909	$1,728,909	$1,728,909
Lots Leased- 2031	0	0	0	0	0	0	0	0	0	0	0	7	7	7	7
Avg Rent per Lot, 8% Rate of Return- 2031	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$251,927	$251,927	$251,927	$251,927
Rent for Lots Leased- 2031	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,763,487	$1,763,487	$1,763,487	$1,763,487
Lots Leased- 2032	0	0	0	0	0	0	0	0	0	0	0	0	7	7	7
Avg Rent per Lot, 8% Rate of Return- 2032	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$256,965	$256,965	$256,965
Rent for Lots Leased- 2032	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,798,757	$1,798,757	$1,798,757
Lots Leased- 2033	0	0	0	0	0	0	0	0	0	0	0	0	0	7	7
Avg Rent per Lot, 8% Rate of Return- 2033	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$262,105	$262,105
Rent for Lots Leased- 2033	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,834,732	$1,834,732
Cumulative Lots Leased	0	0	0	0	8	16	24	32	40	47	54	61	68	75	75
Lots Available w/5% Stabilized Vacancy	75	75	75	75	67	59	51	43	35	28	21	14	7	0	0
REVENUE															
Total Rent per Period	$0	$0	$0	$0	$1,754,539	$3,544,168	$5,369,591	$7,231,521	$9,130,690	$10,913,426	$12,731,816	$14,586,574	$16,478,427	$18,408,117	$18,584,981
Other Income	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Gross Rental Revenue	$0	$0	$0	$0	$1,754,539	$3,544,168	$5,369,591	$7,231,521	$9,130,690	$10,913,426	$12,731,816	$14,586,574	$16,478,427	$18,408,117	$18,584,981
DEVELOPMENT EXPENSES															
Direct Costs	$0	$0	$27,767,900	$36,020,300	$16,693,400	$7,601,500	$0	$0	$0	$0	$0	$0	$0	$0	$0
Indirect Costs	$765,940	$765,940	$1,148,910	$1,148,910	$765,940	$765,940	$382,970	$382,970	$382,970	$382,970	$382,970	$382,970	$0	$0	$0
	$765,940	$765,940	$28,916,810	$37,169,210	$17,459,340	$8,367,440	$382,970	$382,970	$382,970	$382,970	$382,970	$382,970	$0	$0	$0
FINANCING EXPENSES															
10-Year Bond @ 5.00%	$0	$0	$4,388,198	$4,787,125	$4,787,125	$4,787,125	$4,787,125	$4,787,125	$4,787,125	$4,787,125	$4,787,125	$4,787,125	$398,927	$0	$0
	$0	$0	$4,388,198	$4,787,125	$4,787,125	$4,787,125	$4,787,125	$4,787,125	$4,787,125	$4,787,125	$4,787,125	$4,787,125	$398,927	$0	$0
HOLDING EXPENSES															
DLNR Project Management	$95,000	$97,850	$100,786	$103,809	$106,923	$114,536	$117,972	$121,512	$125,157	$128,912	$138,090	$142,233	$146,500	$150,895	$155,422
RP Tax (Exempt)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	$95,000	$97,850	$100,786	$103,809	$106,923	$114,536	$117,972	$121,512	$125,157	$128,912	$138,090	$142,233	$146,500	$150,895	$155,422
TOTAL EXPENSES	$860,940	$863,790	$33,405,794	$42,060,144	$22,353,388	$13,269,101	$5,288,067	$5,291,607	$5,295,252	$5,299,007	$5,308,185	$5,312,328	$545,427	$150,895	$155,422
NET RENTAL REVENUE	($860,940)	($863,790)	($33,405,794)	($42,060,144)	($20,598,850)	($9,724,933)	$81,523	$1,939,915	$3,835,438	$5,614,419	$7,423,631	$9,274,246	$15,933,000	$18,257,223	$18,429,559
Discount Period	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15
Present Value Factor @ 8.00%	0.925926	0.857339	0.793832	0.735030	0.680583	0.630170	0.583490	0.540269	0.500249	0.463193	0.428883	0.397114	0.367698	0.340461	0.315242
DISCOUNTED VALUE PER PERIOD	($797,167)	($740,561)	($26,518,596)	($30,915,462)	($14,019,231)	($6,128,357)	$47,568	$1,048,076	$1,918,674	$2,600,562	$3,183,868	$3,682,931	$5,858,531	$6,215,873	$5,809,766

PERIOD	2020 Year 1	2021 Year 2	2022 Year 3	2023 Year 4	2024 Year 5	2025 Year 6	2026 Year 7	2027 Year 8	2028 Year 9	2029 Year 10	2030 Year 11	2031 Year 12	2032 Year 13	2033 Year 14	2034 Year 15
ABSORPTION															
Aggregate Retail Lot Values	$0	$0	$0	$0	$54,143,971	$108,287,941	$162,431,912	$216,575,883	$216,575,883	$227,404,677	$227,404,677	$227,404,677	$227,404,677	$227,404,677	$238,774,911
Rate of Return	0%	0%	0%	0%	3%	3%	3%	3%	3.5%	4%	4.5%	5%	5.5%	6%	6%
REVENUE															
Total Rent per Period	$0	$0	$0	$0	$1,624,319	$3,248,638	$4,872,957	$6,497,276	$7,580,156	$9,096,187	$10,233,210	$11,370,234	$12,507,257	$13,644,281	$14,326,495
Other Income	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Gross Rental Revenue	$0	$0	$0	$0	$1,624,319	$3,248,638	$4,872,957	$6,497,276	$7,580,156	$9,096,187	$10,233,210	$11,370,234	$12,507,257	$13,644,281	$14,326,495
DEVELOPMENT EXPENSES															
Direct Costs	$0	$0	$27,767,900	$36,020,300	$16,693,400	$7,601,500	$0	$0	$0	$0	$0	$0	$0	$0	$0
Indirect Costs	$765,940	$765,940	$1,148,910	$1,148,910	$765,940	$765,940	$382,970	$382,970	$382,970	$382,970	$382,970	$382,970	$0	$0	$0
	$765,940	$765,940	$28,916,810	$37,169,210	$17,459,340	$8,367,440	$382,970	$382,970	$382,970	$382,970	$382,970	$382,970	$0	$0	$0
FINANCING EXPENSES															
10-Year Bond @ 5.00%	$0	$0	$4,388,198	$4,787,125	$4,787,125	$4,787,125	$4,787,125	$4,787,125	$4,787,125	$4,787,125	$4,787,125	$4,787,125	$398,927	$0	$0
	$0	$0	$4,388,198	$4,787,125	$4,787,125	$4,787,125	$4,787,125	$4,787,125	$4,787,125	$4,787,125	$4,787,125	$4,787,125	$398,927	$0	$0
HOLDING EXPENSES															
RP Tax (Exempt)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL EXPENSES	$765,940	$765,940	$33,305,008	$41,956,335	$22,246,465	$13,154,565	$5,170,095	$5,170,095	$5,170,095	$5,170,095	$5,170,095	$5,170,095	$398,927	$0	$0
NET RENTAL REVENUE	($765,940)	($765,940)	($33,305,008)	($41,956,335)	($20,622,146)	($9,905,927)	($297,138)	$1,327,181	$2,410,061	$3,926,092	$5,063,115	$6,200,139	$12,108,330	$13,644,281	$14,326,495
Discount Period	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15
Present Value Factor @ 6.00%	0.943396	0.889996	0.839619	0.792094	0.747258	0.704961	0.665057	0.627412	0.591898	0.558395	0.526788	0.496969	0.468839	0.442301	0.417265
DISCOUNTED VALUE PER PERIOD	($722,585)	($681,684)	($27,963,527)	($33,233,347)	($15,410,067)	($6,983,287)	($197,613)	$832,600	$1,436,511	$2,192,309	$2,667,186	$3,081,279	$5,676,858	$6,034,878	$5,977,946

PERIOD	2035 Year 16	2036 Year 17	2037 Year 18	2038 Year 19	2039 Year 20	2040 Year 21	2041 Year 22	2042 Year 23	2043 Year 24	2044 Year 25	2045 Year 26	2046 Year 27	2047 Year 28	2048 Year 29	TOTALS
ABSORPTION															
Aggregate Retail Lot Values	$238,774,911	$238,774,911	$238,774,911	$238,774,911	$250,713,657	$250,713,657	$250,713,657	$250,713,657	$250,713,657	$263,249,339	$263,249,339	$263,249,339	$263,249,339	$263,249,339	
Rate of Return	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	
REVENUE															
Total Rent per Period	$14,326,495	$14,326,495	$14,326,495	$14,326,495	$15,042,819	$15,042,819	$15,042,819	$15,042,819	$15,042,819	$15,794,960	$15,794,960	$15,794,960	$15,794,960	$15,794,960	$306,495,888
Other Income	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Gross Rental Revenue	$14,326,495	$14,326,495	$14,326,495	$14,326,495	$15,042,819	$15,042,819	$15,042,819	$15,042,819	$15,042,819	$15,794,960	$15,794,960	$15,794,960	$15,794,960	$15,794,960	$306,495,888
DEVELOPMENT EXPENSES															
Direct Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$88,083,100
Indirect Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$7,659,400
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$95,742,500
FINANCING EXPENSES															
10-Year Bond @ 5.00%	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$47,871,250
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$47,871,250
HOLDING EXPENSES															
RP Tax (Exempt)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL EXPENSES	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$143,613,750
NET RENTAL REVENUE	$14,326,495	$14,326,495	$14,326,495	$14,326,495	$15,042,819	$15,042,819	$15,042,819	$15,042,819	$15,042,819	$15,794,960	$15,794,960	$15,794,960	$15,794,960	$15,794,960	$162,882,138
Discount Period	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25	Year 26	Year 27	Year 28	Year 29	
Present Value Factor @ 6.00%	0.393646	0.371364	0.350344	0.330513	0.311805	0.294155	0.277505	0.261797	0.246979	0.232999	0.219810	0.207368	0.195630	0.184557	
DISCOUNTED VALUE PER PERIOD	$5,639,571	$5,320,350	$5,019,198	$4,735,093	$4,690,422	$4,424,927	$4,174,459	$3,938,169	$3,715,254	$3,680,204	$3,471,891	$3,275,369	$3,089,970	$2,915,066	$787,491
														Rounded	$790,000

PERIOD	2035 Year 16	2036 Year 17	2037 Year 18	2038 Year 19	2039 Year 20	2040 Year 21	2041 Year 22	2042 Year 23	2043 Year 24	2044 Year 25	2045 Year 26	2046 Year 27	2047 Year 28	2048 Year 29	TOTALS
ABSORPTION															
Lots Leased- 2024	8	8	8	8	8	8	8	8	8	8	8	8	8	8	
Avg Rent per Lot, 8% Rate of Return- 2024	$241,797	$241,797	$241,797	$241,797	$253,887	$253,887	$253,887	$253,887	$253,887	$266,582	$266,582	$266,582	$266,582	$266,582	
Rent for Lots Leased- 2024	$1,934,379	$1,934,379	$1,934,379	$1,934,379	$2,031,098	$2,031,098	$2,031,098	$2,031,098	$2,031,098	$2,132,653	$2,132,653	$2,132,653	$2,132,653	$2,132,653	
Lots Leased- 2025	8	8	8	8	8	8	8	8	8	8	8	8	8	8	
Avg Rent per Lot, 8% Rate of Return- 2025	$246,633	$246,633	$246,633	$246,633	$246,633	$258,965	$258,965	$258,965	$258,965	$258,965	$271,913	$271,913	$271,913	$271,913	
Rent for Lots Leased- 2025	$1,973,067	$1,973,067	$1,973,067	$1,973,067	$1,973,067	$2,071,720	$2,071,720	$2,071,720	$2,071,720	$2,071,720	$2,175,306	$2,175,306	$2,175,306	$2,175,306	
Lots Leased- 2026	8	8	8	8	8	8	8	8	8	8	8	8	8	8	
Avg Rent per Lot, 8% Rate of Return- 2026	$239,587	$251,566	$251,566	$251,566	$251,566	$251,566	$264,144	$264,144	$264,144	$264,144	$264,144	$277,352	$277,352	$277,352	
Rent for Lots Leased- 2026	$1,916,693	$2,012,528	$2,012,528	$2,012,528	$2,012,528	$2,012,528	$2,113,154	$2,113,154	$2,113,154	$2,113,154	$2,113,154	$2,218,812	$2,218,812	$2,218,812	
Lots Leased- 2027	8	8	8	8	8	8	8	8	8	8	8	8	8	8	
Avg Rent per Lot, 8% Rate of Return- 2027	$244,378	$244,378	$256,597	$256,597	$256,597	$256,597	$256,597	$269,427	$269,427	$269,427	$269,427	$269,427	$282,899	$282,899	
Rent for Lots Leased- 2027	$1,955,027	$1,955,027	$2,052,778	$2,052,778	$2,052,778	$2,052,778	$2,052,778	$2,155,417	$2,155,417	$2,155,417	$2,155,417	$2,155,417	$2,263,188	$2,263,188	
Lots Leased- 2028	8	8	8	8	8	8	8	8	8	8	8	8	8	8	
Avg Rent per Lot, 8% Rate of Return- 2028	$249,266	$249,266	$249,266	$261,729	$261,729	$261,729	$261,729	$261,729	$274,816	$274,816	$274,816	$274,816	$274,816	$288,557	
Rent for Lots Leased- 2028	$1,994,128	$1,994,128	$1,994,128	$2,093,834	$2,093,834	$2,093,834	$2,093,834	$2,093,834	$2,198,526	$2,198,526	$2,198,526	$2,198,526	$2,198,526	$2,308,452	
Lots Leased- 2029	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
Avg Rent per Lot, 8% Rate of Return- 2029	$254,251	$254,251	$254,251	$254,251	$266,964	$266,964	$266,964	$266,964	$266,964	$280,312	$280,312	$280,312	$280,312	$280,312	
Rent for Lots Leased- 2029	$1,779,759	$1,779,759	$1,779,759	$1,779,759	$1,868,747	$1,868,747	$1,868,747	$1,868,747	$1,868,747	$1,962,184	$1,962,184	$1,962,184	$1,962,184	$1,962,184	
Lots Leased- 2030	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
Avg Rent per Lot, 8% Rate of Return- 2030	$259,336	$259,336	$259,336	$259,336	$259,336	$272,303	$272,303	$272,303	$272,303	$272,303	$285,918	$285,918	$285,918	$285,918	
Rent for Lots Leased- 2030	$1,815,354	$1,815,354	$1,815,354	$1,815,354	$1,815,354	$1,906,122	$1,906,122	$1,906,122	$1,906,122	$1,906,122	$2,001,428	$2,001,428	$2,001,428	$2,001,428	
Lots Leased- 2031	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
Avg Rent per Lot, 8% Rate of Return- 2031	$251,927	$264,523	$264,523	$264,523	$264,523	$264,523	$277,749	$277,749	$277,749	$277,749	$277,749	$291,637	$291,637	$291,637	
Rent for Lots Leased- 2031	$1,763,487	$1,851,661	$1,851,661	$1,851,661	$1,851,661	$1,851,661	$1,944,244	$1,944,244	$1,944,244	$1,944,244	$1,944,244	$2,041,456	$2,041,456	$2,041,456	
Lots Leased- 2032	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
Avg Rent per Lot, 8% Rate of Return- 2032	$256,965	$256,965	$269,813	$269,813	$269,813	$269,813	$269,813	$283,304	$283,304	$283,304	$283,304	$283,304	$297,469	$297,469	
Rent for Lots Leased- 2032	$1,798,757	$1,798,757	$1,888,694	$1,888,694	$1,888,694	$1,888,694	$1,888,694	$1,983,129	$1,983,129	$1,983,129	$1,983,129	$1,983,129	$2,082,286	$2,082,286	
Lots Leased- 2033	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
Avg Rent per Lot, 8% Rate of Return- 2033	$262,105	$262,105	$262,105	$275,210	$275,210	$275,210	$275,210	$275,210	$288,970	$288,970	$288,970	$288,970	$288,970	$303,419	
Rent for Lots Leased- 2033	$1,834,732	$1,834,732	$1,834,732	$1,926,468	$1,926,468	$1,926,468	$1,926,468	$1,926,468	$2,022,792	$2,022,792	$2,022,792	$2,022,792	$2,022,792	$2,123,931	
Cumulative Lots Leased	75	75	75	75	75	75	75	75	75	75	75	75	75	75	
Lots Available w/5% Stabilized Vacancy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
REVENUE															
Total Rent per Period	$18,765,382	$18,949,391	$19,137,080	$19,328,523	$19,514,230	$19,703,651	$19,896,861	$20,093,934	$20,294,949	$20,489,942	$20,688,834	$20,891,704	$21,098,631	$21,309,697	$398,896,660
Other Income	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Gross Rental Revenue	$18,765,382	$18,949,391	$19,137,080	$19,328,523	$19,514,230	$19,703,651	$19,896,861	$20,093,934	$20,294,949	$20,489,942	$20,688,834	$20,891,704	$21,098,631	$21,309,697	$398,896,660
DEVELOPMENT EXPENSES															
Direct Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$88,083,100
Indirect Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$7,659,400
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$95,742,500
FINANCING EXPENSES															
10-Year Bond @ 5.00%	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$47,871,250
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$47,871,250
HOLDING EXPENSES															
DLNR Project Management	$166,488	$171,482	$176,627	$181,926	$187,383	$200,725	$206,747	$212,949	$219,338	$225,918	$242,003	$249,263	$256,741	$264,443	$4,807,628
RP Tax (Exempt)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	$166,488	$171,482	$176,627	$181,926	$187,383	$200,725	$206,747	$212,949	$219,338	$225,918	$242,003	$249,263	$256,741	$264,443	$4,807,628
TOTAL EXPENSES	$166,488	$171,482	$176,627	$181,926	$187,383	$200,725	$206,747	$212,949	$219,338	$225,918	$242,003	$249,263	$256,741	$264,443	$148,421,378
NET RENTAL REVENUE	$18,598,894	$18,777,909	$18,960,454	$19,146,598	$19,326,847	$19,502,926	$19,690,114	$19,880,985	$20,075,612	$20,264,024	$20,446,831	$20,642,440	$20,841,890	$21,045,254	$250,475,282
Discount Period	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25	Year 26	Year 27	Year 28	Year 29	
Present Value Factor @ 8.00%	0.291890	0.270269	0.250249	0.231712	0.214548	0.198656	0.183941	0.170315	0.157699	0.146018	0.135202	0.125187	0.115914	0.107328	
DISCOUNTED VALUE PER PERIOD	$5,428,840	$5,075,086	$4,744,835	$4,436,498	$4,146,540	$3,874,368	$3,621,810	$3,386,036	$3,165,911	$2,958,910	$2,764,448	$2,584,161	$2,415,861	$2,258,735	$2,108,514
														Rounded	$2,110,000

Certification Statement

I certify that, to the best of my knowledge and belief:

- The statements of fact contained in this report are true and correct.
- The reported analyses, opinions and conclusions are limited only by the reported assumptions and limiting conditions, and are my personal, impartial, and unbiased professional analyses, opinions and conclusions.
- I have no present or prospective interest in the property that is the subject of this report and have no personal interest with respect to the parties involved.
- I have no bias with respect to the property that is the subject of this report or to the parties involved with this assignment.
- My engagement in this assignment was not contingent upon developing or reporting predetermined results.
- My compensation for completing this assignment is not contingent upon the development or reporting of a predetermined value or direction in value that favors the cause of the client, the amount of the value opinion, the attainment of a stipulated result, or the occurrence of a subsequent event directly related to the intended use of this appraisal.
- My analyses, opinions, and conclusions were developed, and this report has been prepared, in conformity with the *Uniform Standards of Professional Appraisal Practice.*
- I have made a personal inspection of the property that is the subject of this report.
- No one provided significant real property appraisal assistance to the person signing this certification.
- The reported analyses, opinions, and conclusions were developed, and this report has been prepared, in conformity with the Code of Professional Ethics and Standards of Professional Appraisal Practice of the Appraisal Institute.
- The use of this report is subject to the requirements of the Appraisal Institute relating to review by its duly authorized representatives.
- I have provided appraisal services regarding the property that is the subject of this report within the three-year period immediately preceding acceptance of this assignment.
- As of the date of this report, I have completed the continuing education program for Designated Members of the of the Appraisal Institute.

Shane M. Fukuda

Shane M. Fukuda, MAI
Certified General Appraiser
State of Hawaii, CGA-810
Expiration: December 31, 2017

Addenda

M-1 Light Industrial District Zoning Ordinance

Chapter 19.24 - M-1 LIGHT INDUSTRIAL DISTRICT
Sections:

FOOTNOTE(S):
1.

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- (6) ---
Editor's note— Sec. 2 of Ord. No. 3975, effective Sept. 24, 2012, amended ch. 19.24 in its entirety to read as herein set out. Former ch. 19.24 pertained to the same subject matter, consisted of §§ 19.24.010—19.24.050; and derived from § 8-1.12 of the prior code.

19.24.010 - Purpose and intent.
The M-1 light industrial district is designed to contain mostly warehousing and distribution types of activity, and permits most compounding, assembly, or treatment of articles or materials with the exception of heavy manufacturing and processing of raw materials. Residential uses are excluded except for dwelling units located above or below the first floor and apartments. (Ord. No. 3975, § 2, 2012)

19.24.020 - Permitted uses.
A. Within the M-1 light industrial district, no building, structure or premises shall be used and no building or structure hereafter erected, structurally altered, replaced, or enlarged except for one or more of the following uses:

Uses	Notes and Exceptions
Any use permitted in a B-1, B-2, or B-3 business district; provided, however, that no building, structure or portion thereof shall be hereafter erected, converted, or moved onto any lot in an M-1 district for dwelling purposes, including hotels and motels, except for dwelling units located above or below the first floor and apartments	
Animal kennels	
Apartment houses	
Assembly of electrical appliances, radios and phonographs including the manufacture of small parts such as coils, condensers crystal holders and the like	
Carpet cleaning plants	
Cold storage plants	
Commercial laundries	
Craft cabinet and furniture manufacturing	
Education, specialized	
Farm implement sales and service	
General food, fruit and vegetable processing and manufacturing plants	
Harbor facilities	
Ice cream and milk producing, manufacturing and storage	
Laboratories—experimental, photo or motion picture, film or testing	
Light and heavy equipment and product display rooms, storage and service	
Machine shop or other metal working shop	
Manufacture, compounding or treatment of articles or merchandise from the following previously prepared materials: aluminum, bone, cellophane, canvas, cloth, cork, feathers, felt, fiber, fur, glass, hair, horn, leather, plastics, precious or semi-precious metals or stones, shell, tobacco and wood	
Manufacture, compounding, processing, packing or treatment of such products as candy, cosmetics, drugs, perfumes, pharmaceutical, toiletries, and food products	Except the rendering or refining of fats and oils
Manufacture, dyeing and printing of cloth fabrics and wearing apparel	
Manufacture of musical instruments, toys, novelties and rubber and metal stamps	
Manufacture of pottery and figurines or other similar ceramic products	
Milk bottling or central distribution stations	
Mortuaries and morgues	
Plumbing shops	
Poultry or rabbit slaughter incidental to a retail business on the same premises	
Production facility, multimedia	
Radio transmitting and television stations; provided, that towers are of the self-sustaining type without guys	
Replating shop	
Retail lumber yard including mill and sash work	Mill and sash work shall be conducted within a completely enclosed building
Small boat building	
Soda water and soft drink bottling and distribution plants	
Tire repair operation including recapping and retreading	
Utility facilities, minor, and substations up to, and including, 69 kv transmission	
Warehouse, storage and loft buildings	
Wearing apparel manufacturing	
Wholesale business, storage buildings, nonexplosive goods and warehouses	

(Ord. No. 3975, § 2, 2012)

19.24.030 - Accessory uses and structures.
The following uses and structures, located on the same lot, are deemed accessory, customary, incidental, usual and necessary to the above permitted uses in the district:
Uses:
Energy systems small-scale
Fences, walls, patios, decks and other landscape features
Garages, porte-cochere, mailboxes, ground signs, and trash
enclosures Security/watchman or custodian outbuildings
Subordinate uses and structures which are determined the planning director to be clearly incidental and customary to the permitted uses listed herein (Ord. No. 3975, § 2, 2012)

19.24.040 - Reserved.

19.24.050 - Development standards.

	M-1	Notes and Exceptions
Minimum lot area (square feet)	7,500	Except for utility facilities minor, which shall have no minimum lot area
Minimum lot width (in feet)	65	
Maximum building height (in feet)	60	Except that vent pipes, fans, chimneys, antennae, and equipment used for small scale energy systems on roofs shall not exceed 70 feet in total height
Minimum yard setback (in feet)		

Front	0 or the same as the adjoining zoning category whichever is greater	Where the setback of the adjoining non-industrial zoned parcel is less than 10 feet, a minimum setback of 10 feet shall be applied
Side and rear	0 or the same as the adjoining zoning category whichever is greater	
Freestanding antenna or wind turbine structures height and setback	Maximum height of 75 feet and shall be setback 1 foot for every foot in height from all property lines	
Accessory structures allowed within setback area	Boundary walls, parking area, trash enclosures, and ground signs	
Enclosure requirement	All uses are to be conducted wholly within a completely enclosed building, or within an area	
	enclosed on all sides except the front of the lot, by a solid fence or wall or cyclone fence at least 6 feet in height	

(Ord. No. 3975, § 2, 2012)

19.24.060 - Rulemaking authority.
The planning director may adopt rules to implement this chapter. (Ord. No. 3975, § 2, 2012)

Chapter 19.20 - B-3 CENTRAL BUSINESS DISTRICT
Sections:

19.20.010 - Purpose and intent.
The B-3 central business district permits general business enterprises, particularly financial, governmental, commercial, and professional activities. Its distinguishing feature is the greater height limit permitted in the area. Manufacturing and nuisance industries are excluded from the zone.
(Ord. No. 4141, § 1, 2014)

19.20.020 - Permitted uses.
Within the B-3 central business district, the following uses shall be permitted:

Permitted uses	Criteria or limitations
Amusement and recreational activities	Conducted wholly within a completely enclosed building
Animal hospitals, including boarding	
Auditoriums, theaters, gymnasiums including fitness centers, private clubs, and dance halls	
Automobile services	No automobile repair
Baseball or football stadiums and other sport activities	
Building and premises used, owned, or operated by government agencies, including community centers	
Catering establishments	
Communication equipment, antennae or towers	
Day care facilities	
Drive-in restaurants	
Eating and drinking establishments	
Education, specialized	
Educational institutions	
Farmer's market	
General merchandising	Except for equipment rentals, sales yards, and plumbing shops
General office	
Libraries	
Marinas	
Multifamily dwellings, duplexes, and bungalow courts	
Museums	
Nursing and convalescent homes	
Parking structures and lots	
Parks and playgrounds	
Personal and business services	
Pet shops	
Recycling collection center	Conducted wholly within a completely enclosed building or within an area enclosed on all sides by a solid fence or wall at least six feet in height; and provided, that no goods, materials, or objects shall be stacked higher than the fence or walls so erected
Redemption center	

Religious, benevolent, or philanthropic societies, civic organizations, and quasi-public uses	
Sanitariums	
Service business residential ("SBR") service establishments	
Swap meets and open air markets	
Transient vacation rentals	Not exceeding twenty bedrooms; except on Molokai, where a special use permit shall be required
Other similar businesses or commercial enterprises or activities that are not detrimental to the welfare of the surrounding area	Provided, however, that such uses shall be approved by the appropriate planning commission as conforming to the intent of this article

(Ord. No. 4141, § 1, 2014)

19.20.030 - Accessory uses.

A. The following uses, located on the same lot, are deemed accessory, customary, incidental, usual, and necessary to the permitted uses in the B-3 central business district:

Accessory uses	Criteria or limitations
Dwelling units	One or more, located above or below the first floor of a permitted use
Energy systems, small-scale	Provided there will be no detrimental or nuisance effect upon neighbors
Fences	
Other uses that are determined by the director of planning to be clearly incidental and customary to a permitted use	

B. The following uses, located on a nearby lot, are also deemed accessory, customary, incidental, usual, and necessary to the permitted uses in the B-3 central business district:

Accessory uses	Criteria or limitations
Energy systems, small-scale	Provided the system is within a distance of four hundred feet of the nearest point of the lot it serves and there will be no detrimental or nuisance effect upon neighbors

(Ord. No. 4141, § 1, 2014)

19.20.040 - Special uses.

The following are special uses in the B-3 central business district, and approval of the appropriate planning commission shall be obtained, upon conformance with the intent of this article and subject to such terms and conditions as may be warranted and required:

Special uses	Criteria or limitations
Mortuaries	
Transient vacation rentals	Twenty-one to fifty bedrooms; except on Molokai, where the maximum number of bedrooms and use shall be determined by the planning commission

(Ord. No. 4141, § 1, 2014)

19.20.050 - Development standards.

The development standards in the B-3 central business district shall be as follows:

	B-3	Notes and exceptions
Minimum lot area (square feet)	6,000	
Minimum lot width (in feet)	60	
Maximum building height (in feet)	144	Except that vent pipes, fans, chimneys, antennae, and equipment used for small-scale energy systems on roofs shall not exceed 155 feet
Floor area ratio	400%	

Minimum yard setback (in feet)		
Front	None	
Side and rear	0 or the same as the adjoining zoning category whichever is	
	greater	
Maximum height and minimum setback for free-standing antennae or wind turbine structures	Maximum height of 50 feet; minimum setback of 1 foot for each foot in height, from all property lines	
Accessory structures within setback area	Mail boxes, trash enclosures, boundary walls, and ground signs	

(Ord. No. 4141, § 1, 2014)

19.20.060 - Rule making authority.

The director of planning may adopt rules to implement this chapter. (Ord. No. 4141, § 1, 2014)

Chapter 19.18 - B-2 COMMUNITY BUSINESS DISTRICT
Sections:

FOOTNOTE(S):
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Editor's note— Ord. No. 4088, § 7, adopted in 2013, amended former Ch. 19.18, §§ 19.18.010—19.18.050, in its entirety to read as herein set out. Former Ch. 19.18 pertained to similar subject matter and derived from the prior code, § 8.19; Ord. No. 1960, §§ 1, 2, 1990; Ord. No. 2609, § 6, 1997; Ord. No. 3941, § 8, 2012.

19.18.060 - Rule making authority.

19.18.010 - Purpose and intent.
A B-2 community business district is intended to provide all types of goods and services for the community, with the exception of those uses more generally associated with an industrial district, but at a lower intensity of use than in the B-3 central business district.
(Ord. No. 4088, § 7, 2013)

19.18.020 - Permitted uses.
Within the B-2 community business district, the following uses shall be permitted:

Permitted uses	Criteria or limitations
Amusement and recreational activities	
Animal hospitals including boarding	
Auditoriums, theaters, and gymnasiums including fitness centers, private clubs, and dance halls	
Automobile services	Provided all automobile repair operations are conducted wholly within a completely enclosed building; and provided further, that tire rebuilding or battery manufacturing shall not be permitted
Automobile upholstery shops	
Awning or canvas shops	
Baseball, football and other sports stadiums or activities	
Bed and breakfast homes, in a lawfully existing single-family dwelling	Subject to the restrictions and standards of section 19.64.030 of this code
Buildings and premises used, owned or operated by government agencies, including community centers	
Catering establishments	
Communication equipment, antenna or towers	
Day care facilities	
Drive-in restaurants	
Eating and drinking establishments	
Education, specialized	
Educational institutions	
Entertainment establishments	
Farmers markets	
General merchandising	
General office	
Ice cream and milk manufacturing plants	
Libraries	
Marinas	
Multifamily dwellings, duplexes, and bungalow courts	
Museums	
New and used car lots	Provided all repair and maintenance is conducted wholly within a completely enclosed building
Nursing and convalescent homes	
Nurseries (flower or plants)	Provided, that all incidental equipment and supplies, including fertilizers and empty cans, are kept within enclosed buildings
Parking structures or lots, which may include solar energy facilities that are installed on overhead canopies or structures, and may provide power to other lots	
Personal and business services	
Pet shops and boarding facilities	
Recycling collection center	Conducted wholly within a completely enclosed building or within an area enclosed on all sides by a solid fence or wall at least six feet in height; and provided, that no goods, materials, or objects shall be stacked higher than the fence or walls so erected
Redemption center	
Religious, benevolent, or philanthropic societies, civil organizations, and quasi-public uses	
Sanitariums	
Sign-painting shops	Conducted wholly within a completely enclosed building
Swap meet or open air market	
Taxicab, car rental, and U-drive stations and offices	
Transient vacation rentals	Not exceeding twenty bedrooms; except on Molokai, where a special use permit shall be required
Other similar businesses or commercial enterprises or activities that are not detrimental to the welfare of the surrounding area	Provided that such uses shall be approved by the appropriate planning commission as conforming to the intent of this article

(Ord. No. 4088, § 7, 2013)

19.18.030 Accessory uses.
The following uses, located on the same lot, are deemed accessory, customary, incidental, usual, and necessary to the permitted uses in the B-2 community business district.

Accessory uses	Criteria or limitations
Energy systems, small-scale	Provided there will be no detrimental or nuisance effect upon neighbors
Warehouses and yards	Conducted wholly within a completely enclosed building or within an area enclosed on all sides by a solid fence or wall at least six feet in height; and provided, that no goods, materials, or objects shall be stacked higher than the fence or walls so erected
One or more dwelling units	Located above or below the first floor of a permitted use
Other uses that are determined by the director of planning to be clearly incidental and customary to a permitted use	

(Ord. No. 4088, § 7, 2013)

19.18.040 - Special uses.
The following are special uses in the B-2 community business district, and approval of the appropriate planning commission shall be obtained, upon conformance with the intent of this article and subject to such terms and conditions as may be warranted and required:

Special uses	Criteria or limitations
Mortuaries	
Transient vacation rentals	Twenty-one to fifty bedrooms; except on Molokai, where the maximum number of bedrooms and use shall be
	determined by the planning commission
Other uses that are similar in character to permitted and special uses and that are not detrimental to the welfare of the surrounding area	

(Ord. No. 4088, § 7, 2013)

19.18.050 - Development standards.
The development standards in the B-2 community business district shall be as follows:

	B-2	Notes and exceptions
Minimum lot area (square feet)	6,000	
Minimum lot width (in feet)	60	
Maximum building height (in feet)	90	Except that vent pipes, fans, chimneys, antennae, and equipment used for small-scale energy systems on roofs shall not exceed one hundred feet
Floor area ratio	200%	
Minimum yard setback (in feet)		
Front	None	
Side and rear	0 or the same as the adjoining zoning category whichever is greater	
Maximum height and minimum setback for free-standing antennae or wind turbine structures	Maximum height of 50 feet; minimum setback of 1 foot for each foot in height, from all property lines	
Accessory structures within setback area	Mail boxes, trash enclosures, boundary walls, and ground signs	

(Ord. No. 4088, § 7, 2013)

19.18.060 - Rule making authority.
The director of planning may adopt rules to implement this chapter. (Ord. No. 4088, § 7, 2013)

Chapter 19.16 - B-1 NEIGHBORHOOD BUSINESS DISTRICT
Sections:

19.16.010 - Generally.
A neighborhood business district is one wherein retail businesses or service establishments supply commodities or perform services to meet the daily needs of the neighborhood.
(Prior code § 8-1.8(a))

19.16.20 - Permitted uses.
Within the B-1 district, the following uses shall be permitted:
A. Barber or beauty shops;
B. Baker goods stores;
C. Book, stationery, or gift stores;
D. Candy stores;
E. Churches;
F. Day care centers and nurseries;
G. Delicatessen stores;
H. Drugstores;
I. Florist shops;
J. Grocery stores and meat markets;
K. Ice cream or snack counters;
L. Laundromats;
M. Liquor stores (package only);
N. Gasoline retailing; provided that, it is owned and operated as an adjunct to a neighborhood store; and further provided that, no servicing, repairing, storing, washing, or maintenance of vehicles will be permitted on the premises;
O. Other similar retail businesses or service establishments that supply commodities or perform services primarily for residents of the surrounding neighborhood; provided that, such uses shall be approved by the commission as conforming to the intent of this title;
P. One single-family dwelling per lot; provided that, the lot is sufficiently large to provide a lot area six thousand square feet for the dwelling after the area for the business, parking, and other accessory areas for the business have been subtracted; or living and sleeping quarters for a single family constructed above the ground floor of the business building;
Q. Bed and breakfast homes, subject to the provisions of chapter 19.64 of this title;
R. Home occupations in single-family dwellings permitted pursuant to subsection P; and
S. Short-term rental homes, subject to the provisions of chapter 19.65 of this title.
(Ord. No. 3941, § 7, 2012; Ord. No. 3622, § 5, 2009; Ord. 2609 § 5, 1997: prior code § 8-1.8(b))

19.16.030 - Required conditions.
A. All business, services, or processing shall be conducted wholly within completely enclosed buildings, except for day care centers, nurseries, automobile parking, and/or off-street loading.
B. All goods produced on the premises, whether primary or incidental, shall be sold at retail and only on the premises where produced.
(Prior code § 8-1.8(c))

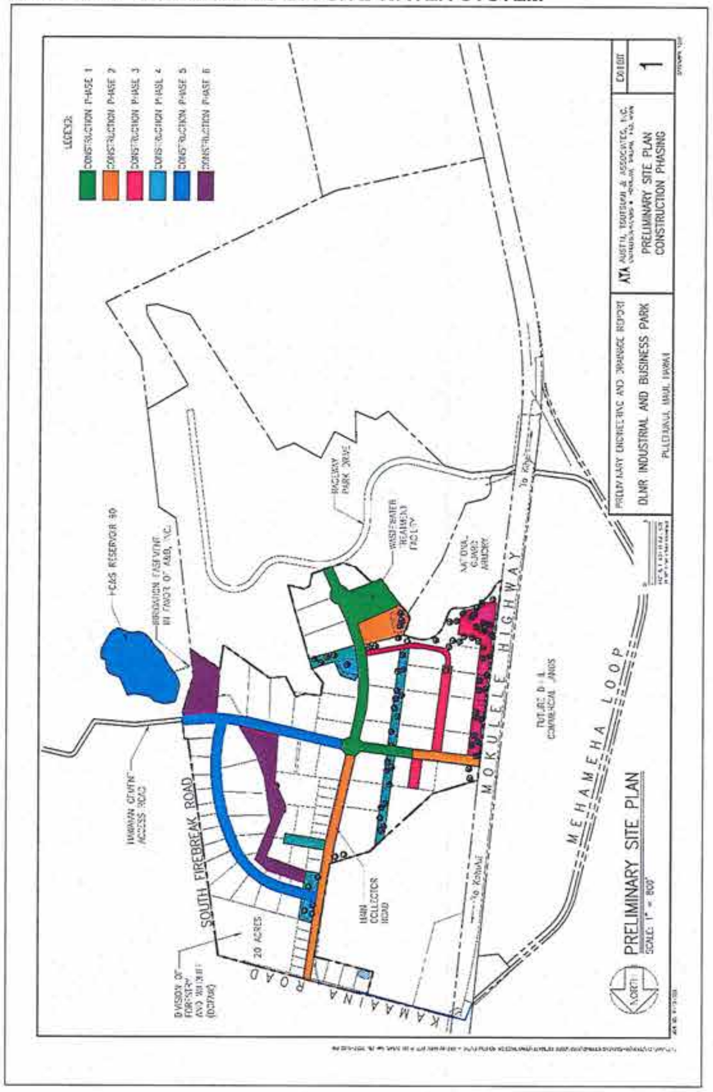
19.16.040 - Area regulations.
The minimum lot area shall be six thousand square feet and the minimum lot frontage shall be sixty feet. (Prior code § 8-1.8(d))

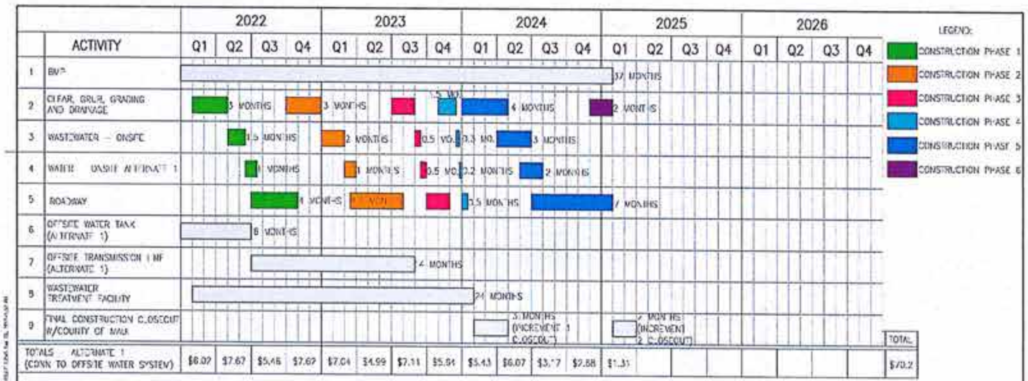
19.16.050 - Height regulations.
No building shall exceed two stories and thirty feet in height. (Prior code § 8-1.8(e))

19.16.060 - Yards.
There shall be a front yard of fifteen feet, side yard of six feet, and a rear yard of six feet; except that for any two-story building, a side yard of ten feet, and a rear yard of ten feet shall be required. (Prior code § 8- 1.8(f))

Preliminary Site Plan and Alternative Cost Opinions from ATA, Inc.

ALTERNATIVE 1 – CONNECT TO OFFSITE WATER SYSTEM





NOTE:

1. TOTALS REPRESENTED IN MILLIONS.
2. ASSUMES LAND ACQUISITION FOR TANK SITE IS COMPLETED.
3. ASSUMES ALL PERMITS AND USE AND OCCUPANCY AGREEMENT HAS BEEN APPROVED.
4. ACCOUNTS FOR 15 ACRE DISTURBED AREA PHASES AS COVERED BY THE GRADING AND GRUBBING PERMIT GENERAL PROVISIONS.
5. SCHEDULE ASSUMES MULTIPLE CREWS.
6. OFFSITE ROAD WIDENING/TRAFFIC LIGHTS NOT INCLUDED.
7. ASSUMES LOT MOWING IN LIEU OF CLEARING & GRUBBING. LOT MOWING NOT INCLUDED IN ESTIMATE.
8. ASSUMES HYDRO MULCH FOR BASIN AREAS.

PRELIMINARY ENGINEERING AND DRAINAGE REPORT
DLNR INDUSTRIAL AND BUSINESS PARK
PULEHUNUI, MAUI, HAWAII

ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC.

PRELIMINARY ESTIMATE BUILD OUT SCHEDULE

EXHIBIT 2

		2022				2023				2024				2025				2026				
	ACTIVITY	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	TOTAL
1	BMP	$0.46	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08	$0.06	$0.03								$1.40
2	GRADING AND DRAINAGE	$2.02	$0.99		$3.49			$1.80	$1.33	$3.60	$1.20		$0.54	$0.54								$15.6
3	WASTEWATER – ONSITE		$1.64			$1.98		$0.77	$0.28		$3.03											$7.70
4	WATER – ONSITE		$0.52	$0.52		$1.26		$0.49	$0.19		$0.96	$0.96										$4.90
5	ROADWAY			$1.62	$3.54	$0.20	$1.74	$0.58	$1.02	$0.38		$1.71	$1.71	$0.57								$10.1
6	OFFSITE WATER TANK	$1.40	$1.40																			$2.80
7	WATER OFFSITE TRANS			$0.49	$0.49	$0.49	$0.49	$0.33														$2.30
8	WASTEWATER TREATMENT FACILITY	$1.34	$2.03	$2.02	$2.03	$2.03	$2.03	$2.03	$2.03	$3.66												$16.2
TOTALS ALTERNATE 1 (CONN TO OFFSITE WATER SYSTEM)		$5.24	$6.67	$4.71	$6.63	$6.12	$4.34	$6.18	$4.91	$4.72	$5.28	$2.67	$2.33	$1.14								$61.0
TOTALS WITH 15% CONTINGENCY		$6.02	$7.67	$5.46	$7.62	$7.04	$4.99	$7.11	$5.64	$5.43	$6.07	$3.17	$2.68	$1.31								$70.2

NOTE:

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3. ASSUMES ALL PERMITS AND USE AND OCCUPANCY AGREEMENT HAS BEEN APPROVED.
4. ACCOUNTS FOR 15 ACRE DISTURBED AREA PHASES AS COVERED BY THE GRADING AND GRUBBING PERMIT GENERAL PROVISIONS.
5. SCHEDULE ASSUMES MULTIPLE CREWS.
6. OFFSITE ROAD WIDENING/TRAFFIC LIGHTS NOT INCLUDED.
7. ASSUMES LOT MOWING IN LIEU OF CLEARING & GRUBBING. LOT MOWING NOT INCLUDED IN ESTIMATE.
8. ASSUMES HYDRO MULCH FOR BASIN AREAS.

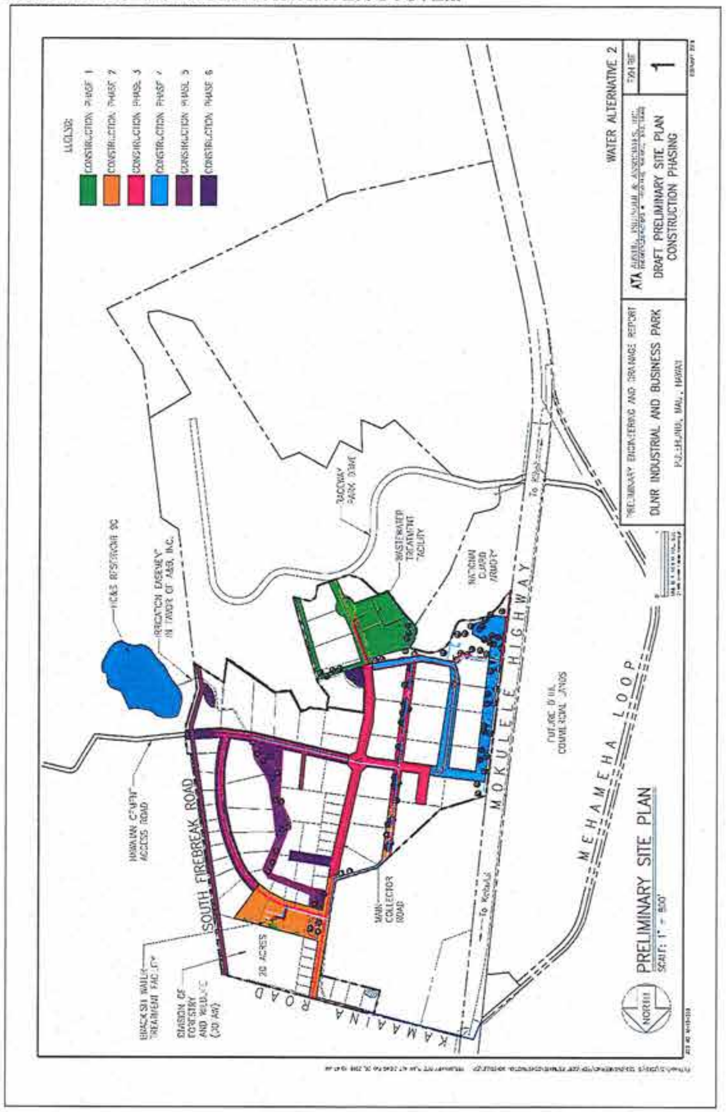
PRELIMINARY ENGINEERING AND DRAINAGE REPORT
DLNR INDUSTRIAL AND BUSINESS PARK
PULEHUNUI, MAUI, HAWAII

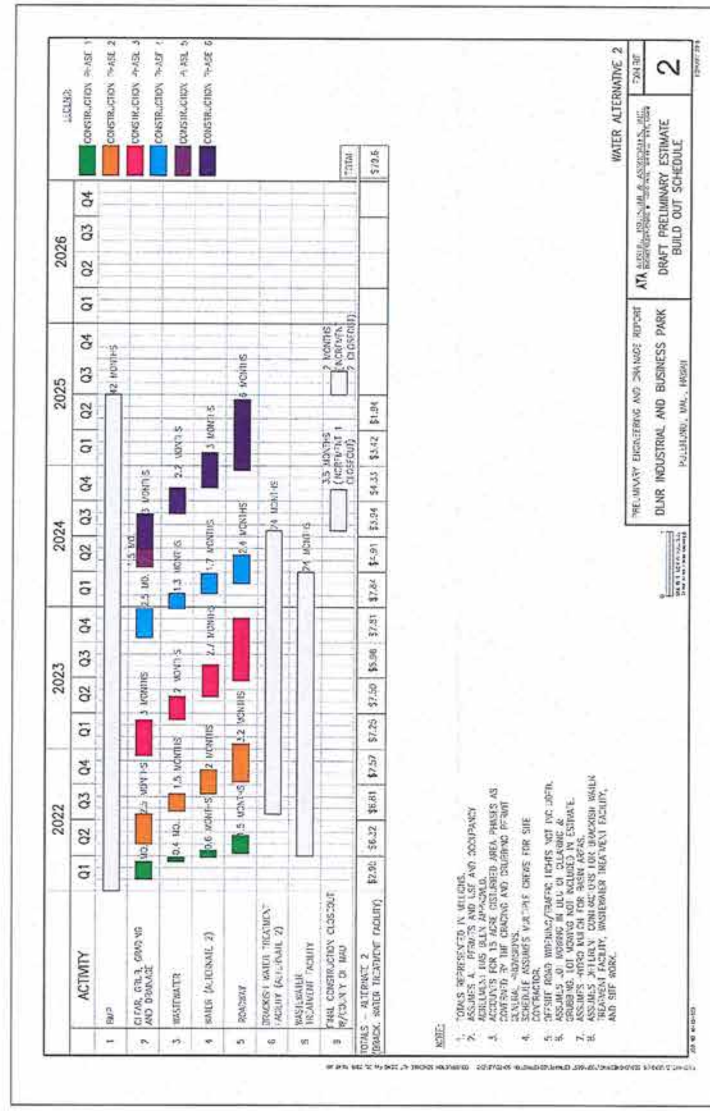
ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC.

PRELIMINARY COST BREAKDOWN WATER ALTERNATE 1

EXHIBIT 3

ALTERNATIVE 2 – BRACKISH R0 WATER SYSTEM





		2022				2023				2024				2025				2026				
	ACTIVITY	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	TOTAL
1	BMP	$0.65	$0.255	$0.255	$0.255	$0.255	$0.255	$0.255	$0.255	$0.255	$0.255	$0.255	$0.255	$0.255	$0.255							$4.00
2	GRADING AND DRAINAGE	$1.39	$1.86	$0.464	$0.539	$2.25			$2.32		$2.42	$1.66										$13.00
3	WASTEWATER	$0.422		$1.58		$0.611	$1.50		$0.126	$1.24		$1.16	$1.16									$7.80
4	WATER (ALTERNATE 2)	$0.107	$0.535	$0.824	$1.32		$1.69	$1.20		$1.82			$2.14	$1.07								$10.70
5	ROADWAY		$0.823		$1.52	$0.236	$0.126	$1.85	$1.14	$0.549	$0.768		$0.214	$1.65	$1.43							$10.10
6	BRACKISH WATER TREATMENT FACILITY			$3.771	$0.925	$0.925	$0.925	$0.925	$0.925	$0.925	$0.925	$0.154										$7.40
7	WASTEWATER TREATMENT FACILITY		$2.025	$2.025	$2.025	$2.025	$2.025	$2.025	$2.025	$2.025												$16.20
TOTALS - ALTERNATE 2 (BRACK. WATER TREATMENT FACILITY)		$2.57	$5.50	$5.92	$6.58	$6.40	$5.52	$6.08	$6.79	$6.81	$4.27	$3.43	$3.77	$2.98	$1.69							$69.2
TOTALS - WITH 15% CONTINGENCY		$2.95	$6.32	$6.81	$7.57	$7.25	$7.50	$6.96	$7.81	$7.84	$4.91	$3.94	$4.33	$3.42	$1.94							$79.6

NOTE:

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3. ACCOUNTS FOR 15 ACRE DISTURBED AREA PHASES AS COVERED BY THE GRADING AND GRUBBING PERMIT GENERAL PROVISIONS.
4. SCHEDULE ASSUMES MULTIPLE CREWS FOR SITE CONTRACTOR.
5. OFFSITE ROAD WIDENING/TRAFFIC LIGHTS NOT INCLUDED.
6. ASSUMES JOB MOWING IN LIEU OF CLEARING & GRUBBING. LOT MOWING NOT INCLUDED IN ESTIMATE.
7. ASSUMES HYDRO MULCH FOR BASIN AREAS.
8. ASSUMES DIFFERENT CONTRACTORS FOR BRACKISH WATER TREATMENT FACILITY, WASTEWATER TREATMENT FACILITY, AND SITE WORK.

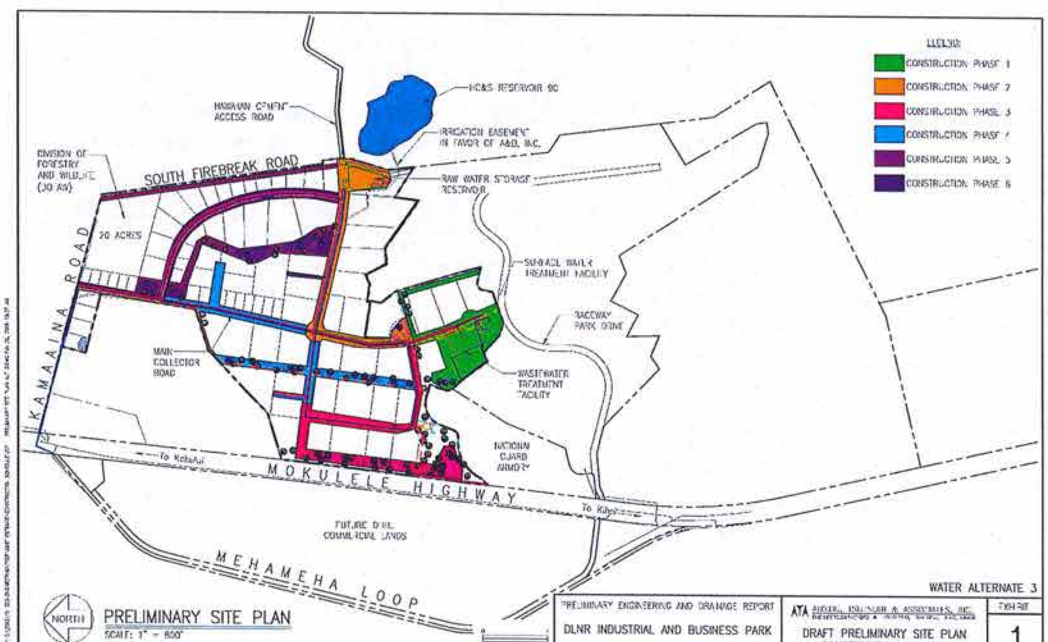
WATER ALTERNATIVE 2

PRELIMINARY ENGINEERING AND DRAINAGE REPORT
DLNR INDUSTRIAL AND BUSINESS PARK
PULEHUNUI, MAUI, HAWAII

ATA
DRAFT PRELIMINARY COST BREAKDOWN

EXHIBIT 3

ALTERNATIVE 3 – SURFACE WATER SYSTEM

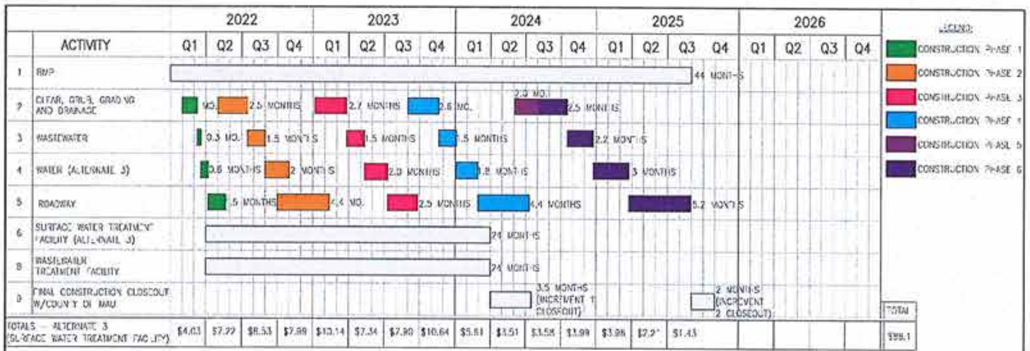


WATER ALTERNATE 3

PRELIMINARY ENGINEERING AND DRAINAGE REPORT
DLNR INDUSTRIAL AND BUSINESS PARK
PULEHUNUI, MAUI, HAWAII

ATA
DRAFT PRELIMINARY SITE PLAN CONSTRUCTION PHASING

EXHIBIT 1



NOTE:

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2. ASSUMES ALL PERMITS AND LSF AND OCCUPANCY AGREEMENT HAS BEEN APPROVED.
3. ACCOUNTS FOR 15 ACRE DISTURBED AREA PHASES AS CONFIRMED BY THE GRADING AND GRUBBING PERMIT GENERAL PROVISIONS.
4. SCHEDULE ASSUMES MULTIPLE CREWS FOR SITE CONTRACTOR.
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7. ASSUMES HYDRO MULCH FOR BASIN AREAS.
8. ASSUMES DIFFERENT CONTRACTORS FOR SURFACE WATER TREATMENT FACILITY, WASTEWATER TREATMENT FACILITY, AND SITE WORK.
9. ASSUMES LEGAL ENTITLEMENTS GRANTED FOR SURFACE WATER TREATMENT FACILITY.

WATER ALTERNATE 3

PRELIMINARY ENGINEERING AND DRAINAGE REPORT
DLNR INDUSTRIAL AND BUSINESS PARK
PULEHUNUI, MAUI, HAWAII

ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC.
DRAFT PRELIMINARY ESTIMATE BUILD OUT SCHEDULE

EXHIBIT 2

	ACTIVITY	2022 Q1	2022 Q2	2022 Q3	2022 Q4	2023 Q1	2023 Q2	2023 Q3	2023 Q4	2024 Q1	2024 Q2	2024 Q3	2024 Q4	2025 Q1	2025 Q2	2025 Q3	2025 Q4	2026 Q1	2026 Q2	2026 Q3	2026 Q4	TOTAL
1	BMP	$0.538	$0.243	$0.243	$0.243	$0.243	$0.243	$0.243	$0.243	$0.243	$0.243	$0.243	$0.243	$0.243	$0.243	$0.162						$4.00
2	GRADING AND DRAINAGE	$1.24	$1.91	$0.476		$2.58		$0.959	$1.53		$0.956	$2.67	$0.476									$13.00
3	WASTEWATER	$0.334		$1.67		$1.30	$0.305		$1.56	[illegible]			$2.45									$7.80
4	WATER (ALTERNATE 3)	$0.447	$0.223	$1.12	$1.12		$1.87	$0.367	$2.01				$0.302	$3.05								$10.50
5	ROADWAY	$0.842			$1.58	$0.786		$1.40		$0.617	$1.85			$0.152	$1.58	$1.28						$10.10
6	SURFACE WATER TREATMENT FACILITY (ALTERNATE 3)		$1.88	$1.88	$1.88	$1.88	$1.88	$1.88	$1.88	$1.88												$15.0
7	WASTEWATER TREATMENT FACILITY		$2.025	$2.025	$2.025	$2.025	$2.025	$2.025	$2.025	$2.025												$16.20
TOTALS ALTERNATE 3 (SURF. WATER TREATMENT FACILITY)		$3.50	$6.28	$7.42	$6.95	$8.81	$6.39	$6.87	$9.25	$4.88	$3.06	$3.11	$3.47	$3.45	$1.92	$1.24						$76.6
TOTALS – WITH 15% CONTINGENCY		$4.03	$7.22	$8.53	$7.99	$10.14	$7.34	$7.90	$10.64	$5.61	$3.51	$3.58	$3.99	$3.96	$2.21	$1.43						$88.1

NOTE:

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7. ASSUMES HYDRO MULCH FOR BASIN AREAS.
8. ASSUMES DIFFERENT CONTRACTORS FOR SURFACE WATER TREATMENT FACILITY, WASTEWATER TREATMENT FACILITY, AND SITE WORK.
9. ASSUMES LEGAL ENTITLEMENTS GRANTED FOR SURFACE WATER TREATMENT FACILITY.

WATER ALTERNATE 3

PRELIMINARY ENGINEERING AND DRAINAGE REPORT
DLNR INDUSTRIAL AND BUSINESS PARK
PULEHUNUI, MAUI, HAWAII

ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC.
DRAFT PRELIMINARY COST BREAKDOWN 3

EXHIBIT 3

Qualifications

PROFESSIONAL QUALIFICATIONS

Shane M. Fukuda, MAI

STATE LICENSING

State Certified General Appraiser
State of Hawaii, License No. CGA-810, July 1, 2007
Expiration: December 31, 2019

PROFESSIONAL AFFILIATIONS

Member – Appraisal Institute, MAI Designation
Affiliate Member – National Association of Realtors, Hawaii Association of Realtors, Realtors Association of Maui

EMPLOYMENT

Fukuda Valuation & Consulting LLC
January 2017 to Present
Managing Member

ACM Consultants, Inc.
November 2009 to December 2016
Vice President – Commercial Division
July 2007 to October 2009
Staff Appraiser
October 2004 to June 2007
Appraiser Assistant; Appraiser Trainee

GENERAL EDUCATION

Maui Community College, 1989-1991
Henry Perrine Baldwin High School, 1989

APPRAISAL EDUCATION

Appraisal Institute

Seminar	*Litigation Assignments for Residential Appraisers: Doing Expert Work on Atypical Cases* Honolulu, Hawaii – September 2017
Seminar	*Advanced Land Valuation: Sound Solutions to Perplexing Problems* Honolulu, Hawaii – September 2017
Seminar	*Analyzing Tenant Credit Risk and Commercial Lease Analysis* Honolulu, Hawaii – October 2016
Seminar	*Historic Lands* Wailuku, Hawaii – July 2016
Course	*7 Hour National USPAP Equivalent* Honolulu, Hawaii – April 2016
Course	*7 Hour National USPAP Equivalent* Online Course – November 2015
Course	*Supervisory Appraiser/Trainee Appraiser* Honolulu, Hawaii – May 2015
Seminar	*General Demonstration Report Writing* Online Seminar – July 2014

Professional Qualifications
Page 2

Course 503GD	*Advanced Concepts & Case Studies* Las Vegas, Nevada – April 2014
Course S500GD	*Advanced Market Analysis and Highest & Best Use* Synchronous Online Course– December 2013
Course	*7 Hour National USPAP Equivalent* Online Course – December 2013
Course 844	*Residential & Commercial Valuation of Solar* Honolulu, Hawaii – November 2013
Course 405G	*General Appraiser Report Writing and Case Studies* Online Course – August 2012
Course	*7 Hour National USPAP Equivalent* Online Course – December 2011
Course 501GD	*Advanced Income Capitalization* San Diego, California – June 2011
Seminar	*Hotel Valuation* Honolulu, Hawaii – February 2010
Seminar	*Subdivision Valuation* Online Seminar – December 2009
Seminar	*Business Practices and Ethics* Online Seminar – December 2009
Seminar	*Small Hotel/Motel Valuation* Online Seminar – December 2009
Course	*7 Hour National USPAP Equivalent* Online Course – December 2009
Seminar	*Hawaii Lands, Historical Review* Kahului, Hawaii – September 2009
Course 320	*General Applications* San Diego, California – July 2006
Course 310	*Basic Income Capitalization* San Diego, California – July 2006
Course 101	*Basic Appraisal Procedures* Denver, Colorado – April 2005
Course 100	*Basic Appraisal Principles* Denver, Colorado – April 2005

Lincoln Graduate Center

Course 405	*Residential Sales Comparison & Income Approaches* Honolulu, Hawaii – November 2006
Course 404	*Residential Appraiser Site Valuation & Cost Approach* Honolulu, Hawaii – November 2006
Course 403	*Residential Market Analysis & Highest & Best Use* Honolulu, Hawaii – November 2006
Course 772	*National USPAP Course* Honolulu, Hawaii – October 2006
Course 772	*National USPAP Course* Honolulu, Hawaii – January 2005

Professional Qualifications
Page 3

MISCELLANEOUS EDUCATION

CoreLogic- Marshall & Swift

Course	*Commercial Cost Approach Certification* Dallas, Texas – October 2017

REALM Business Solutions

Course	*Argus 12.0* Honolulu, Hawaii – July 2005

LICENSE NUMBER	EXPIRATION DATE
CGA - 810	12/31/2019

STATE OF HAWAII DEPARTMENT OF COMMERCE AND CONSUMER AFFAIRS
CERTIFIED GENERAL APPRAISER

SHANE M FUKUDA
270 HOOKAHI ST S
WAILUKU HI 96793

(SIGNATURE OF LICENSEE) Shane M. Fukuda

Glossary

This glossary contains the definitions of common words and phrases, used throughout the appraisal industry, as applied within this document. Please refer to the publications listed in the **Works Cited** section below for more information.

Works Cited:

- Appraisal Institute. *The Appraisal of Real Estate.* 14th ed. Chicago: Appraisal Institute, 2013. Print.
- Appraisal Institute. *The Dictionary of Real Estate Appraisal.* 6th ed. 2015. Print.

Band of Investment
A technique in which the capitalization rates attributable to components of an investment are weighted and combined to derive a weighted-average rate attributable to the total investment (i.e., debt and equity, land and improvements).
(Dictionary, 6th Edition)

Common Area
1. The total area within a property that is not designed for sale or rental but is available for common use by all owners, tenants, or their invitees, e.g., parking and its appurtenances, malls, sidewalks, landscaped areas, recreation areas, public toilets, truck and service facilities.
2. In a shopping center, the walkways and areas onto which the stores face and which conduct the flow of customer traffic. (ICSC) (Dictionary, 6th Edition)

Common Area Maintenance (CAM)
1. The expense of operating and maintaining common areas; may or may not include management charges and usually does not include capital expenditures on tenant improvements or other improvements to the property.
   - CAM can be a line-item expense for a group of items that can include maintenance of the parking lot and landscaped areas and sometimes the exterior walls of the buildings.
   - CAM can refer to all operating expenses.
   - CAM can refer to the reimbursement by the tenant to the landlord for all expenses reimbursable under the lease. Sometimes reimbursements have what is called an administrative load. An example would be a 15% addition to total operating expenses, which are then prorated among tenants. The administrative load, also called an administrative and marketing fee, can be a substitute for or an addition to a management fee.
2. The amount of money charged to tenants for their shares of maintaining a center's common area. The charge that a tenant pays for shared services and facilities such as electricity, security, and maintenance of parking lots. Items charged to common area maintenance may include cleaning services, parking lot sweeping and maintenances, snow removal, security, and upkeep. (ICSC) (Dictionary, 6th Edition)

Debt Coverage Ratio (DCR)
The ratio of net operating income to annual debt service (DCR = NOI/Im), which measures the relative ability of a property to meet its debt service out of net operating income; also called debt service coverage ratio (DSCR). A larger DCR indicates a greater ability for a property to withstand a downturn in revenue, providing an improved safety margin for a lender. (Dictionary, 6th Edition)

Discount Rate
A rate on return on capital used to convert future payments or receipts into present value; usually considered to be a synonym for yield rate. (Dictionary, 6th Edition)

Effective Age
The age of property that is based on the amount of observed deterioration and obsolescence it has sustained, which may be different from its chronological age. (Dictionary, 6th Edition)

Effective Date
1. The date on which the appraisal or review opinion applies. (SVP)
2. In a lease document, the date upon which the lease goes into effect.

Exposure Time
1. The time a property remains on the market.
2. The estimated length of time the property interest being appraised would have been offered on the market prior to the hypothetical consummation of a sale at market value on the effective date of the appraisal; a retrospective estimate based on an analysis of past events assuming a competitive and open market. (Dictionary, 6th Edition)

External Obsolescence
A type of depreciation; a diminution in value caused by negative externalities and generally incurable on the part of the owner, landlord, or tenant. The external influence may be either temporary or permanent (Dictionary, 6th Edition).

Extraordinary Assumption
An assumption, directly related to a specific assignment, as of the effective date of the assignment results, which, if found to be false, could alter the appraiser's opinion or conclusion. Comment: Extraordinary assumptions presume as fact otherwise uncertain information about physical, legal, or economic characteristics of the subject property; or about conditions external to the property, such as market conditions or trends; or about the integrity of data used in an analysis. (USPAP, 2016-2017 ed.) (Dictionary, 6th Edition)

Fee Simple Estate
Absolute ownership unencumbered by any other interest or estate, subject only to the limitations imposed by the governmental powers of taxation, eminent domain, police power, and escheat. (Dictionary, 6th Edition)

Functional Obsolescence
The impairment of functional capacity of a property according to market tastes and standards. (Dictionary, 6th Edition)

Functional Utility
The ability of a property or building to be useful and to perform the function for which it is intended according to current market tastes and standards; the efficiency of a building's use in terms of architectural style, design and layout, traffic patterns, and the size and type of rooms. (Dictionary, 6th Edition)

Gross Building Area (GBA)
Total floor area of a building, excluding unenclosed areas, measured from the exterior of the walls of the above grade area. (Dictionary, 6th Edition)

Gross Leasable Area (GLA)
Total floor area designed for the occupancy and exclusive use of tenants, including basements and mezzanines; measured from the center of joint partitioning to the outside wall surfaces. (Dictionary, 6th Edition)

Highest & Best Use
The reasonably probable use of property that results in the highest value. The four criteria that the highest and best legal use must meet are legal permissibility, physical possibility,

financial feasibility, and maximum productivity. (Dictionary, 6th Edition)

Hypothetical Condition
A condition, directly related to a specific assignment, which is contrary to what is known by the appraiser to exist on the effective date of the assignment results, but it is used for the purpose of analysis. Comment: Hypothetical conditions are contrary to known facts about physical, legal, or economic characteristics of the subject property; or about conditions external to the property, such as market conditions or trends; or about the integrity of data used in an analysis. (USPAP, 2016-2017 ed.) (Dictionary, 6th Edition)

Leased Fee Interest
The ownership interest held by the lessor, which includes the right to receive the contract rent specified in the lease plus the revisionary right when the lease expires. (Dictionary, 6th Edition)

Market Area
The geographic region from which a majority of demand comes in which the majority of competition is located. Depending on the market, a market area may be further subdivided into components such as primary, secondary, and tertiary market areas, or the competitive market area may be distinguished from the general market area. (Dictionary, 6th Edition)

Market Rent
The most probable rent that a property should bring in a competitive and open market reflecting the conditions and restrictions of a specified lease agreement, including the rental adjustment and reevaluation, permitted uses, use restrictions, expense obligations, term, concessions, renewal and purchase options, and tenant improvements (TIs). (Dictionary, 6th Edition)

Market Value
A type of value that is the major focus of most real property appraisal assignments. Both economic and legal definitions of market value have been developed and refined, such as the following:

1. The most widely accepted components of market value are incorporated in the following definition: The most probable price, as of a specified date, in cash, or in terms equivalent to cash, or in other precisely revealed terms, for which the specified property rights should sell after a reasonable exposure in a competitive market under all conditions requisite to a fair sale, with the buyer and seller each acting prudently, knowledgably, and for self-interest, and assuming that neither is under undue duress.
2. Market value is described, not defined, in the Uniform Standards of Professional Appraisal Practice (USPAP) as follows: A type of value, stated as an opinion, that presumes the transfer of a property (i.e., a right of ownership or a bundle of such rights), as of a certain date, under specific conditions set forth in the definition of the term identified by the appraiser as applicable in an appraisal.

   USPAP also requires that certain items be included in every appraisal report. Among these items, the following are directly related to the definition of market value:
   - Identification of the specific property rights to be appraised.
   - Statement of the effective date of the value opinion.
   - Specification as to whether cash, terms equivalent to cash, or other precisely described financing terms are assumed as the basis of the appraisal.
   - If the appraisal is conditioned upon financing or other terms, specification as to whether the financing or terms are at, below, or above market interest

   rates and/or contain unusual conditions or incentives. The terms of above—or below—market interest rates and/or other special incentives must be clearly set forth; their contribution to, or negative influence on, value must be described and estimated; and the market data supporting the opinion of value must be described and explained.
3. The following definition of market value is used by agencies that regulate federally insured financial institutions in the United States: The most probable price that a property should bring in a competitive and open market under all conditions requisite to a fair sale, the buyer and the seller each acting prudently and knowledgeably, and assuming the price is not affected by undue stimulus. Implicit in this definition is the consummation of a sale as of a specified date and the passing of title from seller to buyer under conditions whereby:
   - Buyer and seller are typically motivated;
   - Both parties are well informed or well advised, and acting in what they consider their best interests;
   - A reasonable time is allowed for exposure in the open market;
   - Payment is made in terms of cash in U.S. dollars or in terms of financial arrangements comparable thereto; and
   - The price represents the normal consideration for the property sold unaffected by special or creative financing or sales concessions granted by anyone associated with the sale.

   (12 C.F.R. Part 34.42(g); 55 Federal Register 34696, August 24, 1990, as amended at 57 Federal Register 12202, April 9, 1992; 59 Federal Register 29499, June 7, 1994)
4. The International Valuation Standards Council defines *market value* for the purpose of international standards as follows: The estimated amount for which an asset or liability should exchange on the valuation date between a willing buyer and a willing seller in an arm's length transaction, after proper marketing and where the parties had each acted knowledgably, prudently and without compulsion. (IVS)
5. The Uniform Standards for Federal Land Acquisitions defines *market value* as follows: Market value is the amount in cash, or on terms reasonably equivalent to cash, for which in all probability the property would have sold on the effective date for the appraisal, after a reasonable exposure time on the open competitive market, from a willing and reasonably knowledgeable buyer, with neither acting under any compulsion to buy or sell, giving due consideration to all available economic uses of the property at the time of the appraisal. (Uniform Standards for Federal Land Acquisitions) (Dictionary, 6th Edition)

Marketing Time
An opinion of the amount of time it might take to sell a real or personal property interest at the concluded market value level during the period immediately after the effective date of the appraisal. Marketing time differs from exposure time, which is always presumed to precede the effective date of an appraisal. (Advisory Opinion 7 of the Standards Board of The Appraisal Foundation and Statement on Appraisal Standards No. 6, "Reasonable Exposure Time in Real Property and Personal Property Market Value Opinions" address the determination of reasonable exposure and marketing time). (Dictionary, 6th Edition)

Net Operating Income (NOI)
The actual or anticipated net income that remains after all operating expenses are deducted from effective gross income but before mortgage debt service and book depreciation are deducted. Note: This

definition mirrors the convention used in corporate finance and business valuation for EBITDA (earnings before interest taxes, depreciation, and amortization) (Dictionary, 6th Edition)

Obsolescence
One cause of depreciation; an impairment of desirability and usefulness caused by new inventions, changes in design, improved processes for production, or external factors that make a property less desirable and valuable for a continued use; may be either functional or external. (Dictionary, 6th Edition)

Parking Ratio
A ratio of parking area or parking spaces to an economic or physical unit of comparison. Minimum required parking ratios of various land uses are often stated in zoning ordinances. (Dictionary, 6th Edition)

Rentable Area
For office buildings, the tenant's pro rata portion of the entire office floor, excluding elements of the building that penetrate through the floor to the areas below. The rentable area of a floor is computed by measuring to the inside finished surface of the dominant portion of the permanent building walls, excluding any major vertical penetrations of the floor. Alternatively, the amount of space on which the rent is based; calculated according to local practice. (Dictionary, 6th Edition)

Replacement Cost
The estimated cost to construct, at current prices as of the effective appraisal date, a substitute for the building being appraised, using modern materials and current standards, design, and layout. (Dictionary, 6th Edition)

Scope of Work
The type and extent of research and analyses in an appraisal or appraisal review assignment. (USPAP, 2016-2017 ed.)

Stabilized Occupancy
An expression of the average or typical occupancy that would be expected for a property over a specified projection period or over its economic life. (Dictionary, 6th Edition)

Tenant Improvements (TIs)
1. Fixed improvements to the land or structures installed and paid for use by a lessee.
2. The original installation of finished tenant space in a construction project; subject to periodic change for succeeding tenants. (Dictionary, 6th Edition)

Vacancy and Collection Loss
A deduction from potential gross income (PGI) made to reflect income reductions due to vacancies, tenant turnover, and non-payment of rent; also called vacancy and credit loss or vacancy and contingency loss. (Dictionary, 6th Edition)

ECONOMIC AND FISCAL IMPACT ANALYSIS REPORT

APPENDIX

N

Economic and Fiscal Impact Analysis Report

DLNR INDUSTRIAL AND BUSINESS PARK
(TMK (2)3-8-008:001 (por.))

Prepared for:

State of Hawai'i
Department of Land and Natural Resources

Revised
December 2018

MUNEKIYO HIRAGA

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INTRODUCTION

I. INTRODUCTION

A. PROJECT OVERVIEW

The State of Hawai'i, Department of Land and Natural Resources (DLNR) proposes to develop the DLNR Industrial and Business Park (the Project) on an approximately 280-acre site (the Project Area) in Pulehunui, Maui, Hawai'i. The DLNR Industrial and Business Park development is envisioned to be a mixture of light-industrial, public/quasi-public, and limited commercial uses, including the provision of required infrastructure systems. Key components of the proposed plan include the development of small, medium, and large lots for light industrial, commercial, government, and nonprofit uses to meet varying needs of future lessees. Lots within the proposed project will be leased by the DLNR and developed by individual tenants.

The DLNR Industrial and Business Park will provide a long-term revenue stream to support a wide range of DLNR programs. Lease revenues generated by the project will support divisions within the DLNR, including the Commission on Water Resource Management, Division of Forestry and Wildlife, State Parks, Office of Conservation and Coastal Lands, Engineering Division, and Land Division.

B. CONTENT AND PURPOSE

This report addresses the economic and fiscal benefits and impacts of the Project related to (1) construction and related activities, and (2) operations at full development of the Project. The economic impacts cover sales and expenditures, profits, employment, and payroll. Fiscal impacts address the impact of the Project on County and State revenues and expenditures. The material covers the increase in County and State tax revenues, the increase in government support expenditures, and the resulting net fiscal impact to the County and State. The report will also address long-term lease revenues to DLNR anticipated during project operation.

C. METHODOLOGY

An overview of the methodology used for the economic and fiscal impact analyses is provided below.

1. Economic Impact Assessment

The development and operational economic impacts of the proposed DLNR Industrial and Business Park were analyzed using the *Hawaii State Input-Output Study: 2012 Benchmark Report,* which was prepared by the State Department of Business, Economic Development, and Tourism (DBEDT) in August 2016. The Input-Output (I-O) analysis provides information on the relationships between

industries, final users, and factors of production within an economy to determine the role and relative importance of each sector. Specifically, the I-O analysis provides multipliers for direct, indirect, and induced effects for output, earnings, and employment resulting from an exogenous change in an industry's final demand. In this case, the changes in the economy that are analyzed are construction spending for development and spending at businesses at the project at full build-out. The multipliers measure the economic activity resulting from an industry spending an additional dollar.

The State Input-Output Study reports direct, indirect, and induced output (dollars), employment, and labor income. Direct, indirect, and induced effects are described below:

- **Direct effects** – Direct effects refer to immediate effects associated with a change in the economy. For example, direct effects could be the dollar value of a construction budget or the number of jobs associated with that construction budget.

- **Indirect effects** – Indirect effects relate to inter-industry spending or the secondary impacts of a change. These impacts occur when industries buy goods and services from other local industries. In the construction sector, for example, indirect effects would include contractor expenditures on construction materials such as wood or steel.

- **Induced effects** – Induced effects capture household spending impacts generated when people who benefit from direct or indirect impacts spend their income on local goods and services. For example, a construction industry employee may spend his or her income on groceries or eating out at a restaurant.

For the purposes of this analysis, indirect effects and induced effects are combined and referred to collectively as "indirect effects".

2. Fiscal Impact Assessment

Fiscal impacts were analyzed for the State of Hawai'i and County of Maui during both the construction period and at full build-out of the project. This analysis identifies the key revenues, namely taxes that the State and County would collect from the proposed project. For each major source, a dollar estimate of revenues is provided based on project characteristics and assumed occupancy patterns and market conditions. It is noted that this study is not intended to provide a comprehensive analysis of all revenue sources that would be impacted but rather focuses on the largest revenue sources, in terms of dollars collected.

The analysis of fiscal impacts to the State and County are based on fiscal year 2017-2018 budget and tax rates. The analysis assumes that the structure of tax revenues and government expenditures presented in the 2017-2018 budget remains the same. If taxation or spending policies are substantially changed in the future, the projected fiscal impacts of the proposed project would differ.

Throughout the report, dollar amounts are expressed in terms of 2018 purchasing power and market conditions. Dollar amounts after 2018 are not increased to account for inflation, appreciation in property values, changes in labor rates, changes in building costs, or other changes in market conditions.

Information pertaining to long-term lease revenues generated by the project at full build-out is derived from the Feasibility Analysis for the project prepared by Fukuda Valuation & Consulting, LLC (December 2017). Lease revenues will flow to the DLNR's Special Land Development Fund, which supports DLNR divisions such as the Commission on Water Resource Management, Division of Forestry and Wildlife, State Parks, Office of Conservation and Coastal Lands, Engineering Division, and Land Division.

D. ORGANIZATION OF THE REPORT

The material below gives the following information about the Project and its economic and fiscal impacts: a description of the Project, the economic impacts of construction and related activities, the economic impacts of Project operations at full development, and fiscal impacts to the County of Maui and State of Hawai'i.

The detailed assumptions, multipliers, and calculations are shown in five (5) tables presented in **Appendix "A"**. These tables cover the following:

- **Table 1:** Proposed Development
- **Table 2:** Economic Impacts of Development Activities
- **Table 3:** Economic Impacts of Operations at Full Development
- **Table 4:** Fiscal Impacts to the County of Maui
- **Table 5:** Fiscal Impacts to the State of Hawai'i

E. PROJECT DESCRIPTION

1. Project Location and Area

The DLNR Industrial and Business Park is located in the vicinity of the Old Pu'unēnē Airport, approximately five (5) miles south of Kahului, adjacent to the existing Maui Army National Guard Armory. The subject property at Pulehunui (also referred to as Pu'unēnē) comprising the project area is identified as Tax Map Key (TMK) No. (2)3-8-008:001 (por.). See **Figure 1**. The total combined acreage encompassing the project planning limits is approximately 280 acres.

2. Project Components

As shown in **Table 1**, the DLNR Industrial and Business Park will include the development of small, medium, and large lots for light industrial, commercial, government, and nonprofit uses to meet the varying needs of future lessees. See **Figure 2**. While the specific mix of the uses within the Project will be determined by tenant interest, it is anticipated that the lots will generally be distributed as follows:

a. DOFAW Baseyard

The Project includes a 20-acre site for the proposed Division of Forestry and Wildlife (DOFAW) administrative facilities and baseyard in the northeastern portion of the DLNR Industrial and Business Park. The 20-acre site would allow DOFAW to relocate its operations from its existing 3.0-acre baseyard facility in Kahului, which has limited potential for expansion.

b. Light Industrial Uses

Approximately 70 percent of the project area (exclusive of roads and infrastructure) are anticipated to be in light industrial use. In addition to the DOFAW Baseyard site, an estimated 139 acres would be in light industrial use. Assuming 17,000 sq. ft. of building floor space per acre, an estimated 2.3 million sq. ft. of light industrial space would be provided at the Project.[1] In addition to buildings, the lots would include parking, landscaping, storage areas for equipment, etc.

[1] This assumes a floor area ratio of approximately 40 percent.

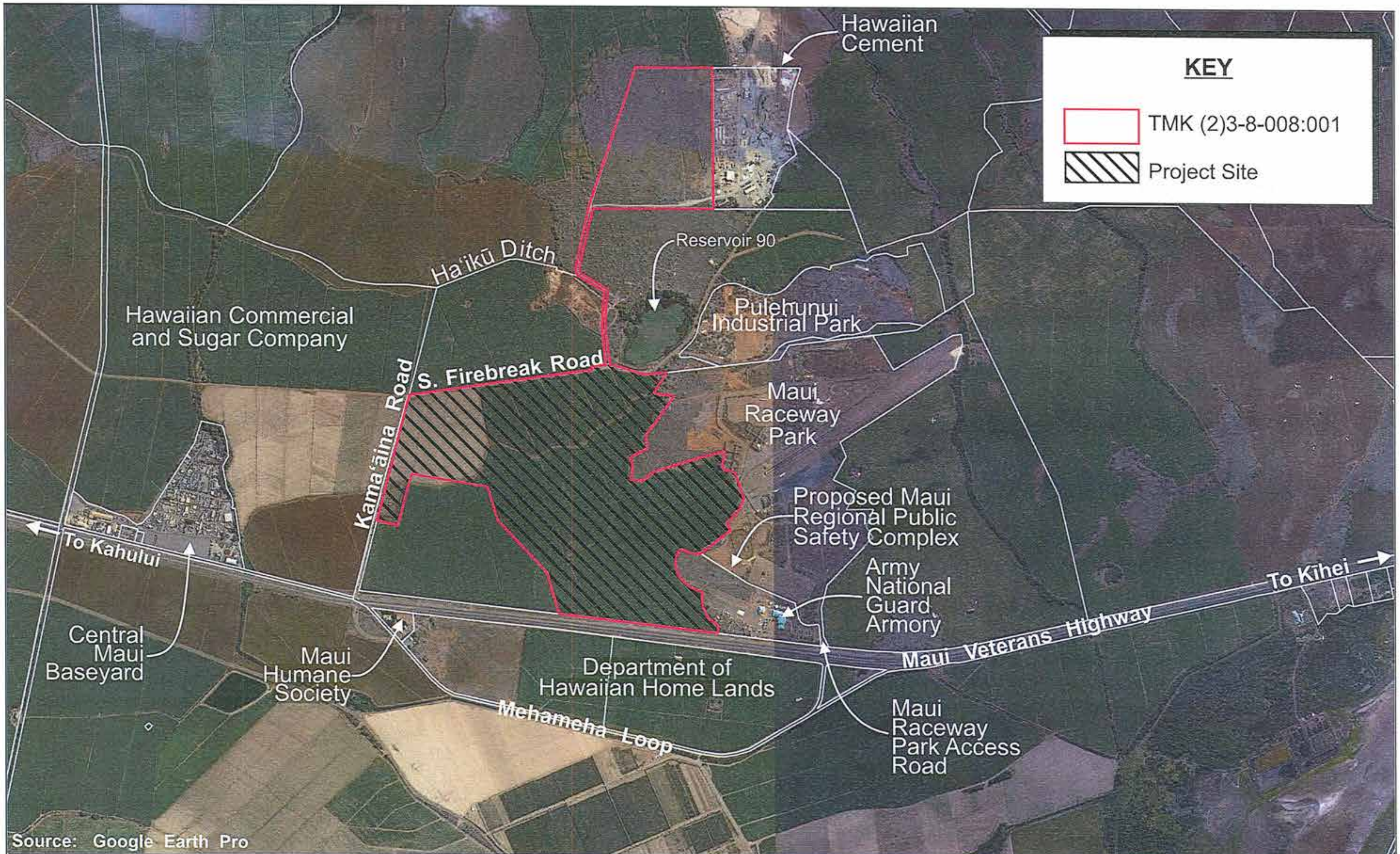

Figure 1 DLNR Industrial and Business Park
Property Location Map

Prepared for: State of Hawai'i, Department of Land and Natural Resources

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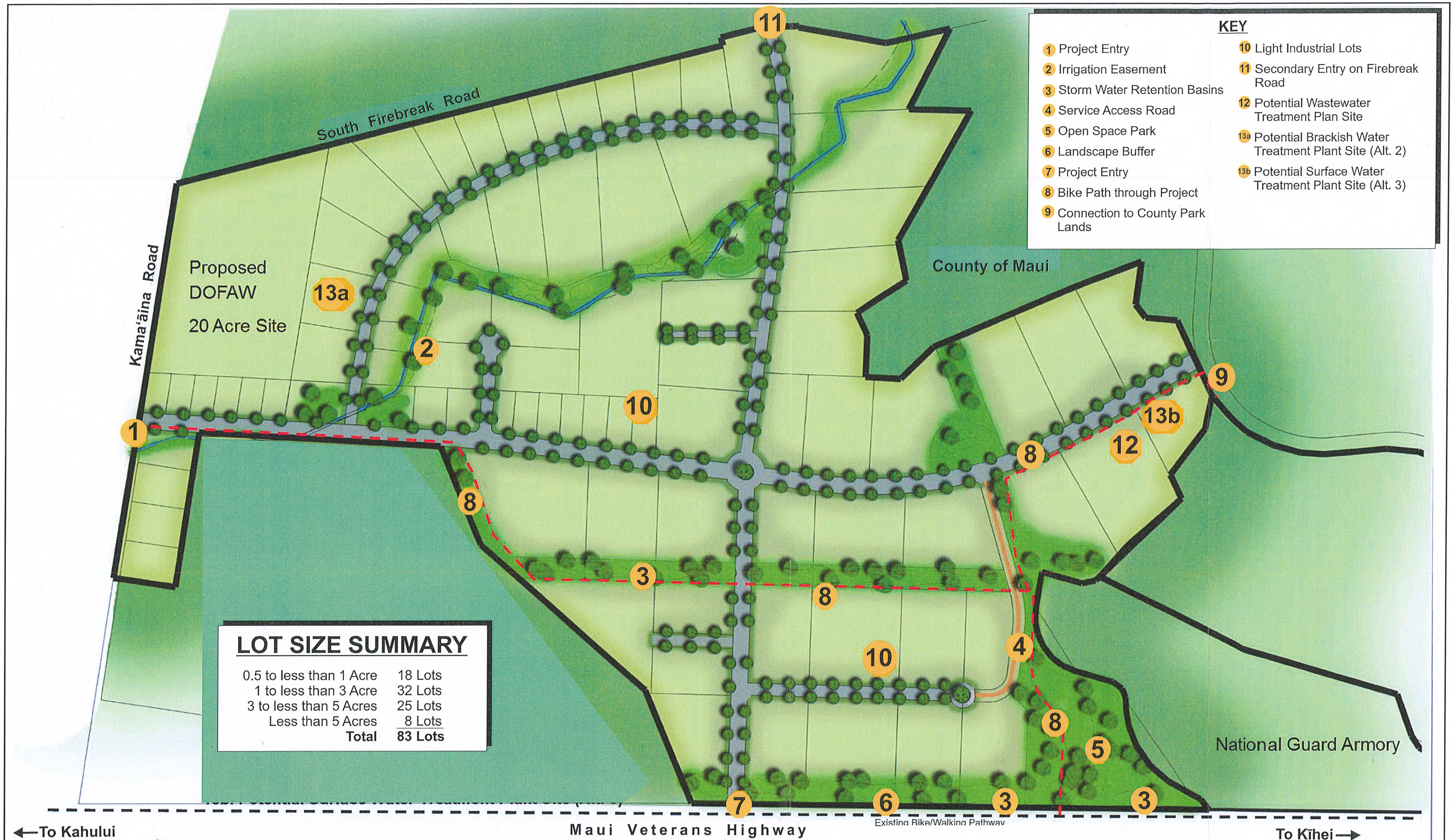

LOT SIZE SUMMARY

0.5 to less than 1 Acre	18 Lots
1 to less than 3 Acre	32 Lots
3 to less than 5 Acres	25 Lots
Less than 5 Acres	8 Lots
Total	83 Lots

Source: Hawaii Land Design

Figure 2

DLNR Industrial and Business Park

Conceptual Site Plan

NOT TO SCALE

Prepared for: State of Hawai'i, Department of Land and Natural Resources

MUNEKIYO HIRAGA

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c. **Commercial Uses**

Limited commercial uses are expected within the DLNR Industrial and Business Park, including business that would serve various light industrial businesses and their employees within the Project. It is estimated that 30 percent of the project area (exclusive of roads and infrastructure), or 68 acres, would be in commercial use. Assuming 17,000 sq. ft. building floor space per acre, an estimated 1.2 million sq. ft. of commercial space would be provided within the Project. The lots would also include parking, landscaping, and related improvements.

d. **Other Components**

Other Project components will include 30 acres of open space and 23 acres of roadways. It is noted that several different alternatives are being explored for the provision of infrastructure such as water and wastewater. Depending on the alternative selected, water and wastewater infrastructure requirements may require approximately 7 acres of land, which would reduce the amount of light industrial, commercial, and other government uses that may be developed within the Project.

ECONOMIC IMPACTS OF DEVELOPMENT ACTIVITIES

II

II. ECONOMIC IMPACTS OF DEVELOPMENT ACTIVITIES

The development of the Project will involve the following activities: (1) grading and other work to prepare the site for development; (2) construction of internal roads, water and wastewater infrastructure, drainage systems, utilities systems, etc.; (3) leasing of lots to lessees; (4) construction of buildings by individual lessees. **Table 2** summarizes the direct and indirect economic impacts of these development activities. The material in this table gives the development period, construction expenditures, indirect sales generated by the construction activity, profits, and employment and payroll.

A. DEVELOPMENT PERIOD

As indicated in **Table 2, Section 2.a**, the assumed development period is 16 years—from about 2022 to 2038. However, development could require more or less time, depending on future market conditions and lease absorption rates. According to the Feasibility Analysis prepared for the project by Fukuda Valuation & Consulting, LLC, Inc., the project is anticipated to reach stabilized occupancy in terms of lots leased around 2033. Additional time is assumed for completion of buildings by individual lessees.

B. CONSTRUCTION EXPENDITURES

Over the 16-year development period, total construction expenditures for the Project are estimated at about $882.4 million (see **Table 2, Section 2.b** for cost assumptions), including $79.6 million for direct infrastructure costs and $802.8 million for buildings. As the project sponsor, the State would bear the costs for infrastructure development while individual tenants would construct their buildings.

It is noted that direct infrastructure costs may vary depending on the particular infrastructure improvements that will be required. The cost estimate of $79.6 million assumes development of a private wastewater treatment plant and onsite brackish water wells with a reverse osmosis treatment facility. This estimate was selected for this analysis as it represents the mid-range infrastructure cost estimate. Costs may be lower if the project connects to the County Department of Water Supply system or higher if a surface water treatment plant is developed to treat water from irrigation ditches. Infrastructure costs may also be reduced if the DLNR is able to collaborate with other state agencies in the region on infrastructure.

The total construction cost of infrastructure and buildings translates into average construction expenditures of about $55.2 million per year. In practice, construction

expenditures will vary from year to year. In particular, infrastructure development is anticipated to occur in the first three years of project construction.

C. INDIRECT SALES GENERATED BY CONSTRUCTION ACTIVITY

In addition to construction expenditures, development activities will generate indirect sales associated with supplying goods and services to construction companies and to the families of construction workers.

Based on State economic multipliers, these indirect sales are expected to average about $25.7 million per year, of which about $16.7 million per year will be in Maui County and about $9.0 million on O'ahu (see **Table 2, Section 2.c**).

D. OTHER DEVELOPMENT COSTS

In addition to construction costs, other development costs will be incurred for planning, permitting, design, engineering, marketing, and leasing. These costs are estimated to be $6.9 million related to infrastructure and $200.7 million for buildings.

As noted earlier, the State would bear the cost of the infrastructure development for the project. Funding for the development of the infrastructure has not yet been allocated by the State and the specific funding mechanism has not been determined. The Feasibility Analysis for the project, prepared by Fukuda Valuation & Consulting, LLC, assumes that the State will finance the infrastructure development and related indirect costs. Financing expenses are assumed to be $43.3 million based on a 10-year bond at 5.0 percent interest. Financing costs for the buildings are not estimated as each tenant would be responsible for developing buildings.

E. LAND VALUES

At full development, the DLNR Industrial and Business Park is expected to have a land value of about $326.3 million and improvement value of approximately $802.8 million. Total property value for the DLNR Industrial and Business Park would be aproximately $1.1 billion (see **Table 2, Section 2.e**).

F. SUMMARY OF EXPENDITURES AND SALES

Table 2, Section 2.f summarizes anticipated expenditures and sales. As indicated, construction expenditures, and indirect sales related to construction, are expected to average about $80.8 million per year. About $65.0 million per year will be subject to the State 4 percent excise tax on final sales, while about $15.8 million per year will be subject to the 0.5 percent excise tax on intermediate sales. As previously noted, actual construction spending and associated tax revenue will vary year to year depending on the development and market conditions.

G. PROFITS

Profits associated with construction are estimated at about $10.8 million per year (see **Table 2, Section 2.g**).

H. EMPLOYMENT

During the Project's 16-year development period, construction employment is expected to average about 122 full-time equivalent (FTE) jobs per year (see **Table 2, Section 2.h**). These jobs will include supervisors, heavy-equipment operators (grading, roads, water mains, sewer lines, etc.), cement workers to lay foundations, metal workers, carpenters, plumbers, electricians, roofers, glass and window installers, cabinet makers, carpet and tile layers, painters, equipment installers, interior decorators, landscapers, etc. Other jobs related to construction will include architects, civil engineers, draftsmen, government inspectors, etc. These jobs will range over a variety of skill levels, including entry-level, semi-skilled, skilled, management, and professional positions.

As with indirect sales, development activities will generate indirect jobs associated with supplying goods and services to construction companies and to the families of construction workers. In turn, the companies supplying goods and services, and the families of their employees, will purchase goods and services from other companies, and so on. Indirect jobs will include those at companies supplying building materials; rent construction equipment; repair equipment; provide warehousing services; provide shipping and trucking services; etc. Other indirect jobs will include those involved with supplying goods and services to employees and their families. The jobs will range over a variety of skill levels, including entry-level, semi-skilled, skilled, and management positions.

Based on State employment multipliers, indirect employment related to Project development is expected to average about 112 FTE jobs in Maui County and 60 FTE jobs on O'ahu.

Thus, total direct and indirect employment associated with Project development activities will average about 294 FTE jobs, of which about 234 FTE jobs will be on Maui.

I. PAYROLL

Development activities are expected to generate a total payroll of about $117.9 million per year for the Project, of which about $9.9 million will be for construction workers, about $4.9 million for indirect employment on Maui, and about $3.1 million for indirect employment on O'ahu (see **Table 2, Section 2.i**). These estimates are based on the average number of direct and indirect jobs multiplied by average wages as reported by

the Department of Labor and Industrial Relations (DLIR), and adjusted for inflation to 2018 values.

J. SOURCES OF CONSTRUCTION WORKERS

As noted above, construction employment is expected to average about 122 FTE jobs during the Project's 16-year development period. This is about 3 percent of the County's 3,900 construction jobs in 2016 (DLIR). In view of this small percentage, it is expected that the construction jobs for the Project will be filled by workers already living on Maui. As other construction projects are completed on the island, the Maui construction workers will be hired to work on the various components of the Project infrastructure and building construction, then move on to other projects. Thus, the Project will help keep Maui's existing construction workers employed.

ECONOMIC IMPACTS OF OPERATIONS AT FULL DEVELOPMENT **III**

III. ECONOMIC IMPACTS OF OPERATIONS AT FULL DEVELOPMENT

Table 3 summarizes the estimates of economic activity generated at full development of the DLNR Industrial and Business Park.

A. ONSITE ECONOMIC ACTIVITIES

1. Revenues and Profit

At full development, onsite economic activities are expected to generate about $701.3 million per year in revenues from light industrial and commercial uses. Corresponding profits will amount to about $70.1 million per year at full development.

2. Employment and Payroll

Onsite operating employment is expected to total about 5,360 full-time equivalent (FTE) jobs, including jobs associated with the proposed Division of Forestry and Wildlife Baseyard and light industrial and commercial uses. While many of these jobs will be new, others may be jobs that have existed elsewhere on Maui. Factoring in jobs that may be relocating from elsewhere on Maui, net new employment resulting from the project is estimated at 3,180 FTE jobs.

The jobs will range over a variety of skill levels, including entry-level, semi-skilled, skilled, highly skilled professionals, and management positions. Based on DLIR data, wages are expected to average $44,000 for light industrial jobs and $57,000 for commercial jobs. Total payroll for onsite jobs is estimated at about $265.9 million per year. Payroll associated with net new jobs is estimated at $158.0 million.

3. Lease Revenue Paid to DLNR

The DLNR Industrial and Business Park will generate long-term lease revenue to support various DLNR programs. Lease revenues will be deposited into the Special Land Development Fund and will support various divisions within the DLNR, including the Commission on Water Resource Management, Division of Forestry and Wildlife, State Parks, Office of Conservation and Coastal Lands, Engineering Division, and Land Division.

Two (2) scenarios for the management of leases are being contemplated. Under the first scenario, the entire project would be leased to a master sublessor, who would manage the project and lease the individual lots to leasehold owners. The second scenario assumes that DLNR will lease the individual lots directly to long-term leasehold owners. According to a Feasibility Analysis prepared for the project by Fukuda Valuation & Consulting, LLC, the net annual lease rent revenue generated would be $13.9 million under the sublessor scenario, or $18.6 million under the direct lease scenario.

IMPACTS ON COUNTY REVENUES AND EXPENDITURES

IV

IV. IMPACTS ON COUNTY REVENUES AND EXPENDITURES

The impact of the Project on County finances is shown in **Table 4**. This table summarizes: (1) changes in the County's tax base which is used to calculate revenues; (2) revenues and expenditures related to development activities; and (3) revenues and expenditures related to operations at full development.

A. DEVELOPMENT ACTIVITIES

The County of Maui will collect one-time construction-related revenues from the proposed development in the form of building permit and related fees.

The County is not expected to bear any expenditures associated with the construction of the project. The State DLNR will provide the infrastructure and facilities to support the Project.

Construction activities require few onsite services from the County. Furthermore, construction companies will provide their own security, sanitation, transportation, etc.

Based on the foregoing, the construction of the proposed DLNR Industrial and Business Park is not anticipated to have a significant fiscal impact on the County during the development period.

B. OPERATIONS AT FULL DEVELOPMENT

The County of Maui will realize increased property tax revenues from the proposed project. At full development, the Project is expected to generate $7.1 million per year in net new property taxes for the County (see **Table 4, Section 4.c.**). Beyond property tax, the County will collect a nominal amount of other taxes and fees, including fuel taxes, motor vehicle weight taxes, and other licenses and fees. These revenues, however, would be minimal compared to real property tax.

The cost of providing government services is largely linked to the number of persons served. Generally, as the "service population" increases, there is a need to increase spending for services such as police and fire protection and other government functions. A common practice in fiscal impact analysis for mainland jurisdictions is to define a service population as 100 percent of residents residing in a jurisdiction plus 50 percent of employees. This reflects the fact that while residential population is generally considered to constitute a larger share of demand for services, local employees who may reside elsewhere contribute to a jurisdiction's daytime population, resulting in an increase in demand for government services. This methodology for defining service

population is appropriate for non-island economies. However, on Maui and in the State of Hawai'i, the residents and employees are generally one and the same. For the most part, employees do not reside outside of the State or County that they work in.

The DLNR Industrial and Business Park does not include a residential component and is expected to attract future employees from Maui's existing and future population base. Employment at the DLNR Industrial and Business Park is anticipated to draw from the natural projected population growth of the County. Inasmuch as the proposed project does not include a residential component and is not anticipated to result in a significant increase in the County's population, County expenditures in support of government functions is not anticipated to increase as a result of the DLNR Industrial and Business Park.

Based on the foregoing, the Project is projected to generate about $7.1 million per year in net revenues to the County at full development.

IMPACTS ON STATE REVENUES AND EXPENDITURES

V

V. IMPACTS ON STATE REVENUES AND EXPENDITURES

The impact of the Project on State finances is shown in **Table 5**. This table summarizes: (1) changes in the State's tax and expenditure base which is used to calculate revenues and expenditures; (2) revenues and expenditures related to development activities; and (3) revenues and expenditures related to operations at full development.

A. DEVELOPMENT ACTIVITIES

Unlike the County, the State derives substantial revenues from development activity. Over the 16-year development period, Project development activities are expected to generate about $58.3 million in tax revenues for the State, for an average of about $3.6 million per year (**Table 5, Section 5.b**). Most of the revenues will be derived from (1) excise taxes and (2) corporate and personal income taxes.

As the project sponsor, the State DLNR would cover the cost of developing the underlying infrastructure for the project, including grading, internal roadways, drainage, and utilities. The estimated infrastructure cost for the project is $79.6 million. As previously mentioned, the $79.6 million infrastructure cost assumes development of a private onsite wastewater treatment plant and onsite brackish wells and reverse osmosis plant. Actual infrastructure costs could be higher or lower depending on the water and wastewater infrastructure alternatives, however, this figure was selected based on likely infrastructure needs and because it represents a midpoint of the various infrastructure cost estimates.

In addition to direct infrastructure construction costs, State expenditures related to the project would include indirect development costs of $6.9 million for planning, permitting, design, engineering, marketing, and leasing and financing costs of $43.3 million. Together, the construction costs, indirect development costs, and financing costs total $129.8 million.

Tax revenue related to project development will partially offset State expenditures related to the project. Nevertheless, the project will represent a significant capital outlay for the State. As will be discussed further, following the development of the project, long-term lease revenue will flow to the State's Special Land Development Fund to support various DLNR programs. The upfront development costs for the project are viewed as an investment for future long-term revenue generation in the form of lease payments.

B. OPERATIONS AT FULL DEVELOPMENT

At full development, the Project will generate increased tax revenues to the State general fund of about $23.9 million per year (**Table 5, Section 5.c**). State revenues will include excise taxes, corporate and personal income taxes. Beyond these revenues, the State will collect nominal revenues for various licenses, permits, and services.

As was the case with the County of Maui, the proposed project is not anticipated to generate additional operational costs for the State's general fund because the project does not contain a residential component and is not expected to be a generator of a significant increase in population.

In addition to general fund revenues noted above, the State DLNR will collect lease revenue from the Project annually. The lease revenue will be deposited into the Special Land Development Fund, which supports a variety of DLNR land management, natural resource, and conservation programs. There are two (2) scenarios for the management of leases at the DLNR Industrial and Business Park. Under the first scenario, the entire project would be leased to one (1) master sublessor who would manage the project and lease the individual lots to leasehold owners. The second scenario assumes that DLNR would lease the individual lots to long-term leasehold owners. The Feasibility Study prepared for the project estimates that net annual lease rent revenue generated would be $13.9 million under the sublessor scenario or $18.6 million under the direct lease scenario. Refer to **Table 5, Section 5c**.

As noted previously, the State would bear the upfront development costs for the DLNR Industrial and Business Park. Total development costs are estimated at $129.8 million. Based on the estimated expenditures and anticipated lease revenues, the Feasibility Study estimated that the development of the project would yield positive results in 2044 in the master sublessor scenario and in 2043 in the direct lease scenario.

SUMMARY OF ANALYSIS VI

VI. SUMMARY OF ANALYSIS

The following is a summary of the economic and fiscal impacts associated with the project.

A. ECONOMIC IMPACTS

The proposed DLNR Industrial and Business Park will generate positive economic impacts during the 16-year construction period and at full build-out. Total construction expenditures, including infrastructure and buildings, is estimated at $882.4 million. Construction is anticipated to generate approximately 122 full-time equivalent (FTE) jobs on average per year with annual payroll of approximately $9.9 million. In addition to direct construction spending and employment, the project will generate indirect spending and employment related to supplying goods and services to construction companies and to the families of construction workers. Indirect sales are expected to average $25.7 million per year and generate 172 FTE indirect jobs per year.

At full development, onsite economic activities are expected to generate about $701.3 million per year in revenues from the light industrial and commercial businesses, with corresponding profits of about $70.1 million per year. Onsite operating employment is expected to total approximately 5,360 onsite FTE jobs, including jobs associated with the light industrial and commercial uses. Net new employment is estimated at 3,180 FTE jobs.

B. FISCAL IMPACTS

1. County of Maui

The DLNR Industrial and Business Park is not anticipated to have a significant impact on County revenues or expenditures during the construction period.

At full development, the County will realize increased property tax revenues from the proposed project. The project is expected to generate $7.1 million per year in net new property taxes for the County. The cost of providing government services is largely linked to the number of persons served. Because the project does not include a residential component and is expected to attract future employees from Maui's existing and future population base, County expenditures in support of government functions is not anticipated to increase as a result of the proposed project. As such, the DLNR Industrial and Business Park will have a positive fiscal impact for the County of Maui.

2. State of Hawai'i

During the 16-year development period, the State will collect an estimated $58.3 million in general excise tax and corporate and personal income taxes. As the project sponsor, the State DLNR would cover the cost of developing the underlying project infrastructure, including grading, internal roadways, drainage, and utilities. In addition to direct construction costs, project expenditures for the state would include indirect development costs, and financing costs, which together total $129.8 million. The project represents a significant capital outlay for the State as an investment for future long-term revenue generation in the form of lease payments.

At full development, the project will generate increased tax revenues for the State general fund of approximately $23.9 million per year in the form of general excise tax and corporate and personal income tax. As was the case with the County of Maui, the proposed project is not anticipated to generate additional operational costs for the State's general fund because the Project does not contain a residential component and is not anticipated to result in a significant population increase.

The DLNR Industrial and Business Park will generate long-term lease revenue for the Special Land Development Fund to support various DLNR programs. Two (2) scenarios for the management of leases are being contemplated. Under the first scenario, the entire Project would be leased to a master sublessor, who would manage the project and lease the individual lots to leasehold owners. The second scenario assumes that DLNR will lease the individual lots directly to long-term leasehold owners. The Feasibility Study prepared for the project estimates that the net annual lease rent revenue generated would be $13.9 million under the sublessor scenario or $18.6 million under the direct lease scenario.

Based on the anticipated expenditures and future lease revenues, the Feasibility Study estimated that the development of the project would yield positive results in 2044 in the master sublessor scenario and in 2043 in the direct lease scenario.

REFERENCES VII

VII. REFERENCES

ACM Consultants, Inc., A Market Study for the Proposed DLNR Industrial and Business Park, District of Wailuku, Island of Maui, Hawai'i, October 2017.

Fukuda Valuation & Consulting, LLC, Feasibility Analysis of Proposed DLNR Industrial and Business Park, December 2017.

State of Hawai'i, Department of Business, Economic Development & Tourism, The Hawai'i State Input-Output Study: 2012 Benchmark Report, August 2016.

State of Hawai'i, Department of Labor and Industrial Relations, Quarterly Census of Employment and Wages by Industry, 2016.

State of Hawai'i, Department of Labor and Industrial Relations, Job Count by Industry, 2016.

DETAILED TABLES

APPENDIX A

Table 1. Proposed Development
(Values in 2018 dollars)

Item	Source or Multiplier	Amount	Units
1.a. LAND AREA			
Business Park			
DOFAW Baseyard		20.0	acres
Light Industrial Uses		139.0	acres
Commercial Uses		68.0	acres
Open Space		30.0	acres
Roadways		23.0	acres
Total Area Developed		**280.0**	**acres**
1.b. BUILDING SQUARE FOOTAGE			
DOFAW Baseyard		75,000	sq. ft.
Light Industrial Uses	17,000 sq ft per acre	2,363,000	sq. ft.
Commercial Uses	17,000 sq ft per acre	1,156,000	sq. ft.
		3,594,000	**sq. ft.**

Table 2. Economic Impacts of Development Activities
(Values in 2018 dollars)

Item	Source or Multiplier	Amount	Units
2.a. DEVELOPMENT PERIOD			
First Year of Construction		2022	
Last Year of Construction		2038	
Duration of Construction		16	years
2.b. CONSTRUCTION EXPENDITURES			
Expenditures Over Development Period			
Infrastructure (State DLNR)			
Water	Engineering Report	$ 18,100,000	
Wastewater	Engineering Report	$ 24,000,000	
Grading and Drainage	Engineering Report	$ 13,000,000	
BMPs	Engineering Report	$ 4,000,000	
Roadways	Engineering Report	$ 10,100,000	
Contingency	15%	$ 10,400,000	
Total for Infrastructure		$ 79,600,000	
Industrial and Business Park (Buildings - Tenants)			
DOFAW Baseyard	DOFAW BY Final EA	$ 41,200,000	
Light Industrial Uses	$ 200 per sq. ft.	$ 472,600,000	
Commercial Uses	$ 250 per sq. ft.	$ 289,000,000	
Total Industrial and Business Park (Buildings)		$ 802,800,000	
Total Construction Expenditures		**$ 882,400,000**	
Annual Construction Expenditures (average)			
Infrastructure		$ 4,975,000	per year
Maui	55%	$ 2,736,250	per year
Imports	45%	$ 2,238,750	per year
Industrial/Business Park (Buildings)		$ 50,175,000	per year
Maui	55%	$ 27,596,250	per year
Imports	45%	$ 22,578,750	per year
Total Annual Construction Expenditures		**$ 55,150,000**	**per year**
Maui	55%	$ 30,332,500	per year
Imports	45%	$ 24,817,500	per year
2.c. INDIRECT SALES GENERATED BY CONSTRUCTION ACTIVITY			
Infrastructure	111% of Maui exp.	$ 3,037,238	per year
Industrial/Business Park (Buildings)	82% of Maui exp.	$ 22,628,925	per year
Total Indirect Sales		**$ 25,666,163**	**per year**
Maui	65%	$ 16,683,000	per year
Oahu	35%	$ 8,983,163	per year
2.d. OTHER DEVELOPMENT COSTS			
Indirect Dev. Costs (i.e., design, planning, permitting, etc.)			
Infrastructure	Feasibility Study	$ 6,900,000	
Industrial/Business Park (Buildings)	25% of const. exp.	$ 200,700,000	
Financing			
Infrastructure	5% 10 year bond	$ 43,250,000	
Industrial/Business Park (Buildings)		Not Estimated (n.e.)	see text
2.e. PROPERTY VALUES			
Land Value			
DOFAW Baseyard	$ 30.00 per sq. ft.	$ 26,136,000	
Light Industrial Uses	$ 30.00 per sq. ft.	$ 181,645,200	
Commercial Uses	$ 40.00 per sq. ft.	$ 118,483,200	
Total Land Value		**$ 326,264,400**	
Improvement Value			
DOFAW Baseyard	Section 2.b	$ 41,200,000	
Light Industrial Uses	Section 2.b	$ 472,600,000	
Commercial Uses	Section 2.b	$ 289,000,000	
Total Improvement Value		**$ 802,800,000**	
Total Property Value		**$ 1,129,064,400**	

Table 2. Economic Impacts of Development Activities
(Values in 2018 dollars)
(continued)

Item	Source or Multiplier	Amount	Units
2.f. SUMMARY OF EXPENDITURES & SALES			
Final Sales (taxed at 4%)			
Construction Expenditures	Section 2.b	$ 55,150,000	per year
Consumption	55% of payroll	$ 9,828,500	per year
Total Sales at 4%		**$ 64,978,500**	**per year**
Intermediate Sales (taxed at 0.5%)			
Indirect Sales Related to Construction	Section 2.c	$ 25,666,163	per year
Less Consumption	above	$ (9,828,500)	per year
Total Sales at 0.5%		**$ 15,837,663**	**per year**
Total Sales		**$ 80,816,163**	**per year**
2.g. PROFITS			
Profits on Total Expenditures & Sales	10.0%	$ 8,081,616	per year
Risk Premium for Construction	5.0%	$ 2,757,500	per year
Total Profit from Construction & Related Activity		**$ 10,839,116**	**per year**
2.h. EMPLOYMENT (on-site & off-site)			
Maui			
Construction Jobs(a)	4.48 x sales/$1 mil	122	FTE/year
Indirect Jobs Generated by Construction	1.41 x direct jobs x 65%	112	FTE/year
Total Maui Employment		**234**	**FTE/year**
Oahu			
Indirect Jobs Generated by Construction	1.41 x direct jobs x 35%	60	FTE/year
Total Employment		**294**	**FTE/year**
2.i. PAYROLL			
Maui			
Construction Payroll	$ 81,000 per FTE	$ 9,882,000	per year
Payroll for Indirect Employment	$ 44,000 per FTE	$ 4,928,000	per year
Total Maui Payroll		**$ 14,810,000**	**per year**
Oahu, Payroll for Indirect Employment	$ 51,000 per FTE	$ 3,060,000	per year
Total Payroll		**$ 17,870,000**	**per year**

Note: (a) FTE defined as 40 hours per week or 2,080 hours per week. Pursuant to Hawaii Workforce Info net data, average weekly hours worked per week in the construction industry was 36 hours. As such, a 0.9 adjustment was made to convert jobs to

Table 3. Economic Impacts of Operations at Full Development
(Values in 2018 dollars)

Item	Source or Multiplier	Amount	Units
3.a. ON-SITE ECONOMIC ACTIVITIES			
Revenues			
Industrial and Business Park Businesses			
Light Industrial	$ 150 per sq. ft.	$ 354,450,000	per year
Commercial	$ 300 per sq. ft.	$ 346,800,000	per year
Total Revenues (on-site)		$ 701,250,000	per year
Profit	10% onsite revenues	$ 70,125,000	per year
Employment, Onsite			
DOFAW Baseyard	DOFAW	100	FTE jobs
Light Industrial	800 sf per FTE	2,950	FTE jobs
Commercial	500 sf per FTE	2,310	FTE jobs
Total Employment		5,360	FTE jobs
Employment, Net New			
DOFAW Baseyard	DOFAW	20	FTE jobs
Light Industrial	60% new jobs	1,770	FTE jobs
Commercial	60% new jobs	1,390	FTE jobs
Total Employment		3,180	FTE jobs
Payroll, Onsite			
DOFAW Baseyard	$ 44,000 per job	$ 4,400,000	per year
Light Industrial	$ 44,000 per job	$ 129,800,000	per year
Commercial	$ 57,000 per job	$ 131,670,000	per year
Total Payroll		$ 265,870,000	per year
Payroll, Net New			
DOFAW Baseyard	$ 44,000 per job	$ 880,000	per year
Light Industrial	$ 44,000 per job	$ 77,880,000	per year
Commercial	$ 57,000 per job	$ 79,230,000	per year
Total Payroll		$ 157,990,000	per year
Lease Revenue (paid to DLNR Special Land Development Fund)			
Sublessor Scenario OR	Feasibility Study	$ 13,900,000	per year
Direct Lease Scenario	Feasibility Study	$ 18,600,000	per year

Table 4. Impacts on County Revenues and Expenditures
(Values in 2018 dollars)

Item	Source or Multiplier	Amount	Units
4.a. TAX & EXPENDITURE BASE			
Taxable Value			
Land		16	years
DOFAW Baseyard	Table 2, Section 2.e	$ 26,136,000	
Light Industrial Uses	Table 2, Section 2.e	$ 181,645,200	
Commercial Uses	Table 2, Section 2.e	$ 118,483,200	
Improvements			
DOFAW Baseyard	Table 2, Section 2.b	$ 41,200,000	
Light Industrial Uses	Table 2, Section 2.b	$ 472,600,000	
Commercial Uses	Table 2, Section 2.b	$ 289,000,000	
4.b. DEVELOPMENT ACTIVITY			
Revenues, Cumulative			
Total Revenues, Cumulative		n.e.	see text
Expenditures, Cumulative			
Improvements			
Infrastructure and Facilities [1]			
Total Expenditures		$ -	
Net Impact Cumulative		$ -	
4.c. OPERATIONS AT FULL DEVELOPMENT			
Revenues, Annual			
Property Taxes			
DOFAW Baseyard	State exemption	$ -	per year
Light Industrial	$ 6.69 per $1,000	$ 4,376,900	per year
Commercial	$ 6.60 per $1,000	$ 2,689,389	per year
Less Current Taxes	County	$ (519)	per year
Total Property Taxes		$ 7,065,770	per year
Expenditures, Annual			
Total Expenditures		n.e.	see text
Total Expenditures		$ -	
Net Revenues, Annual		$ 7,065,770	per year

[1] Infrastructure will be built by the project sponsor.

Table 5. Impacts on State Revenues and Expenditures
(Values in 2018 dollars)

Item	Source or Multiplier	Amount	Units
5.a. TAX & EXPENDITURE BASE			
Development Activities			
Duration	Table 2, Section 2.a	16	years
Final Sales			
Annual Average	Table 2, Section 2.f	$ 64,978,500	per year
Cumulative		$ 1,039,656,000	
Intermediate Sales			
Annual Average	Table 2, Section 2.f	$ 15,837,663	per year
Cumulative		$ 253,402,608	
Profits			
Annual Average	Table 2, Section 2.g	$ 10,839,116	per year
Cumulative		$ 173,425,856	
Payroll			
Annual Average	Table 2, Section 2.i	$ 17,870,000	per year
Cumulative		$ 285,920,000	
Operations at Full Development			
Sales Revenues			
Light Industrial	Table 3, Section 3.a	$ 354,450,000	per year
Commercial	Table 3, Section 3.a	$ 346,800,000	per year
Profits (on-site activities)	Table 3, Section 3.a	$ 70,125,000	per year
Employment	Table 3, Section 3.a	5,360	jobs/year
Payroll	Table 3, Section 3.a	$ 265,870,000	per year
5.b. DEVELOPMENT ACTIVITIES			
General Fund			
Revenues, Cumulative			
Excise Tax			
Final Sales	4.0% of sales	$ 41,586,240	
Intermediate Sales	0.5% of sales	$ 1,267,013	
Total Excise Tax		**$ 42,853,253**	
Corporate Income Taxes	1.0% of profits	$ 1,734,259	
Personal Income Taxes	4.8% of income	$ 13,724,160	
Total State Tax Revenues		**$ 58,311,672**	
Average Annual Revenues		**$ 3,644,480**	
Expenditures, Cumulative			
Project Infrastructure	Table 2, Section 2.b	$ (79,600,000)	
Indirect Dev. Costs (i.e., design, permitting, leasing, etc.)	Table 2, Section 2.d	$ (6,900,000)	
Financing	Table 2, Section 2.d	$ (43,250,000)	
Total Expenditures (State)		**$ (129,750,000)**	
Average Annual Expenditures		$ (8,109,375)	per year
Net Impact Cumulative		**$ (71,438,328)**	
Annual Average		$ (4,464,896)	per year

Table 5. Impacts on State Revenues and Expenditures
(Values in 2018 dollars)
(continued)

5.c. OPERATIONS AT FULL DEVELOPMENT			
General Fund			
Revenues, Annual			
Excise Tax			
Final Sales (Commercial Revenue)	4.0% of sales	$ 13,872,000	per year
Intermediate Sales (Light Industrial Revenue)	0.5% of sales	$ 1,772,250	per year
Corporate Income Tax	1.0% of profit	$ 701,250	per year
Personal Income Tax	4.8% of income	$ 7,583,520	per year
Total Tax Revenue		$ 23,929,020	
Expenditures, Annual			
Total Expenditures		n.e.	see text
Net Revenues, Annual		**$ 23,929,020**	**per year**
Special Land Development Fund			
Lease Revenue			
Sublessor Scenario OR	Table 3, Section 3.a	$ 13,900,000	per year
Direct Lease Scenario	Table 3, Section 3.a	$ 18,600,000	per year

TRAFFIC IMPACT ANALYSIS REPORT

APPENDIX

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TRAFFIC IMPACT ANALYSIS REPORT DLNR INDUSTRIAL AND BUSINESS PARK

Puunene, Maui, Hawaii

DRAFT FINAL

December 20, 2018

Prepared for:

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TRAFFIC IMPACT ANALYSIS REPORT
DLNR INDUSTRIAL AND BUSINESS PARK

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December 20, 2018

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AYA AUSTIN, TSUTSUMI & ASSOCIATES, INC. CIVIL ENGINEERS • SURVEYORS
CONTINUING THE ENGINEERING PRACTICE FOUNDED BY H. A. R. AUSTIN IN 1934

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TRAFFIC IMPACT ANALYSIS REPORT

DNLR INDUSTRIAL AND BUSINESS PARK

Puunene, Maui, Hawaii

1. INTRODUCTION

This report documents the findings of a traffic study conducted by Austin, Tsutsumi, and Associates, Inc. (ATA) to evaluate the traffic impacts resulting from the proposed DLNR Industrial and Business Park (hereinafter referred to as the "Project").

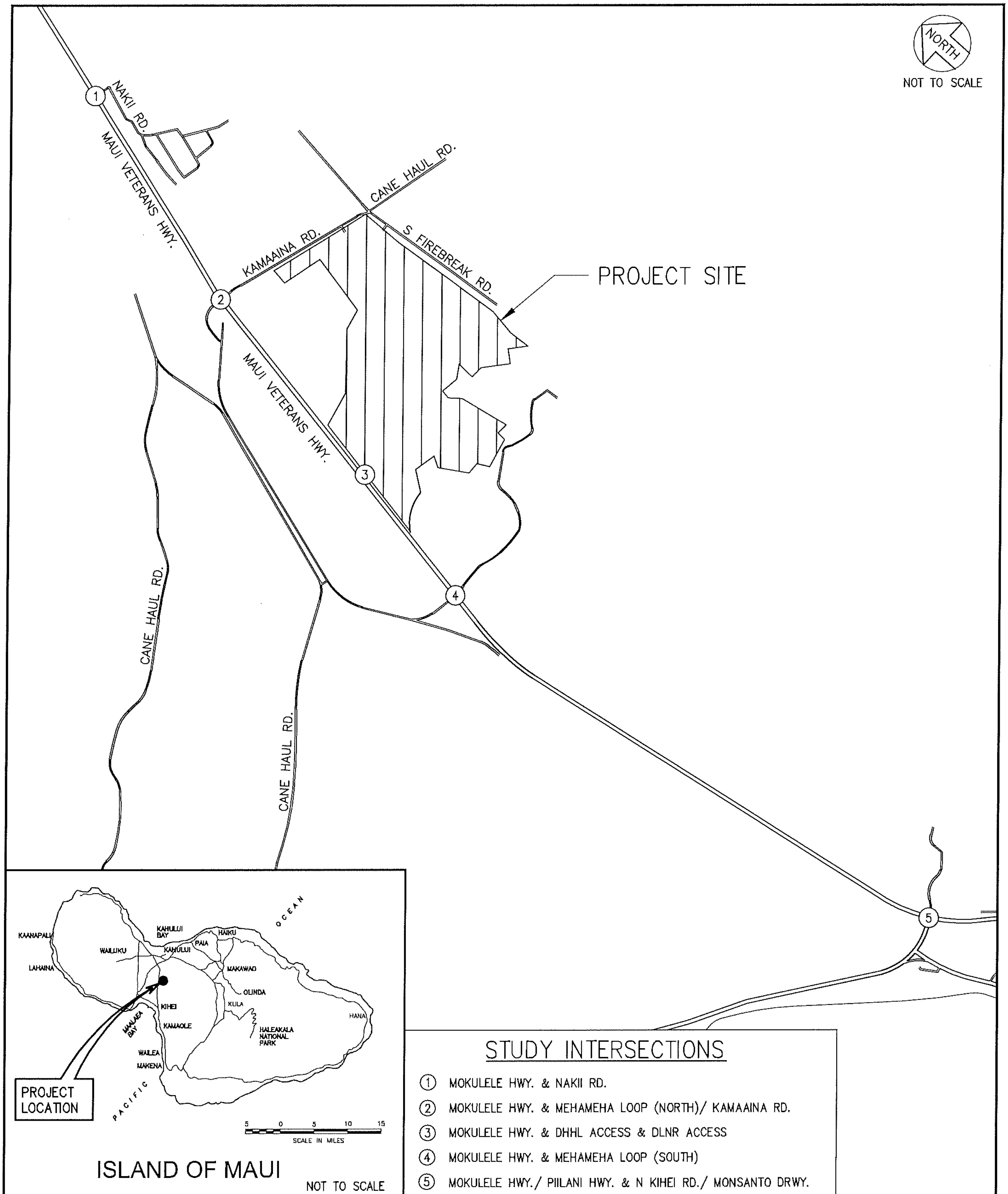
1.1 Location

The Project is located on an unoccupied parcel located to the east of Maui Veterans Highway, more specifically (2) 3-8-008:001. There are two (2) existing vehicle access points along Maui Veterans Highway; Kamaaina Road to the north across from Mehameha Loop (North), and the Maui Raceway Park Access Road which currently provides access to the Maui Raceway Park and Army National Guard Armory. See Figure 1.1 for the Project location.

1.2 Project Description

The Project proposes to develop approximately 280.4 acres of vacant land owned by the Department of Land and Natural Resources (DLNR) previously leased to Hawaiian Commercial & Sugar (HC&S) for agricultural use. Approximately 200.9 acres is estimated to be developable lands for a mix of light industrial and commercial use. For purposes of this study, approximately 70% (140.63 acres) was allocated to light industrial use and 30% (60.27 acres) allocated to commercial use.

Access to the northern site of the Project will be provided along the existing Kamaaina Road via the Maui Veterans Highway. Additionally, a new signalized intersection is proposed along Maui Veterans Highway, between Kamaaina Road and Mehameha Loop (South)/Maui Raceway Park Access Road to provide primary access to the Project and to the future Department of Hawaiian Home Lands (DHHL) North development located across the Project on the west side of Maui Veterans Highway. The Project will also provide access via the Maui Raceway Park Access Road on the south side of the Project. Secondary eastern Project access will also be provided via South Firebreak Road. See Figure 1.2 for the Project site plan.

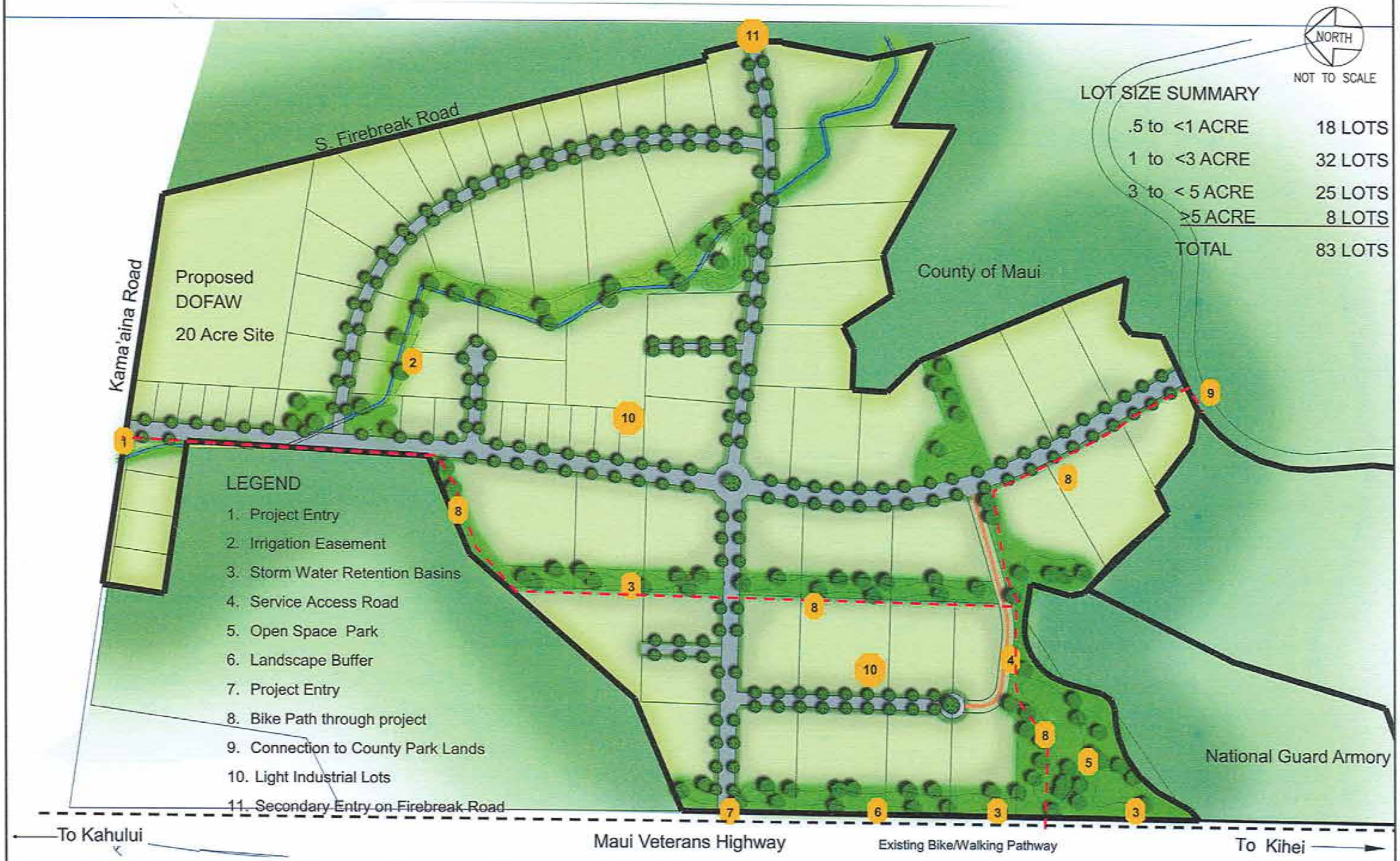


DLNR INDUSTRIAL AND BUSINESS PARK TIAR

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS, SURVEYORS • HONOLULU, HAWAII

LOCATION MAP

FIGURE 1.1



DLNR INDUSTRIAL AND BUSINESS PARK TIAR

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS, SURVEYORS • HONOLULU, HAWAII

SITE PLAN

FIGURE 1.2

2. METHODOLOGY

2.1 Study Methodology

This study will address the following:

- Assess existing traffic operating conditions at key intersections during the weekday morning (AM) and afternoon (PM) and weekend midday (WE) peak hours of traffic within the study area.
- Traffic projections for Base Year 2038 (without the Project) including traffic generated by other known developments in the vicinity of the Project in addition to an ambient growth rate. These other known developments are projects that are currently under construction or known new/future developments that are anticipated to affect traffic demand and operations within the study area.
- Trip generation and traffic assignment characteristics for the proposed Project.
- Traffic projections for Future Year 2038 (with the Project), which includes Base Year traffic volumes in addition to traffic volumes generated by the Project.
- Recommendations for Base Year and Future Year roadway improvements or other mitigative measures, as appropriate, to reduce or eliminate the adverse impacts resulting from traffic generated by know developments in the region or the Project.

2.2 Intersection Analysis

Level of Service (LOS) is a qualitative measure used to describe the conditions of traffic flow at intersections, with values ranging from free-flow conditions at LOS A to congested conditions at LOS F. The Highway Capacity Manual (HCM), dated 2010, methods for calculating volume to capacity ratios, delays and corresponding Levels of Service were utilized in this study. LOS definitions for signalized and unsignalized intersections are provided in Appendix B.

Analyses for the study intersections were performed using the traffic analysis software Synchro, which is able to prepare reports based on the methodologies described in the HCM. These reports contain control delay results as based on intersection lane geometry, signal timing, and hourly traffic volumes. Based on the vehicular delay at each intersection, a LOS is assigned to each approach and intersection movement as a qualitative measure of performance. These results, as confirmed or refined by field observations, constitute the technical analysis that will form the basis of the recommendations outlined in this report.

3. EXISTING TRAFFIC CONDITIONS

3.1 Roadway System

The following are brief descriptions of the existing roadways studied within the vicinity of the Project:

Maui Veterans Highway (formerly Mokulele Highway) is a regional, four-lane, two-way divided State highway facility that runs in the north-south direction. This roadway begins to the north transitioning from Puunene Avenue into Maui Veterans Highway at its intersection with Hookele Street and terminates to the south at its intersection with North Kihei Road, where it continues further south as Piilani Highway. The posted speed limit in the vicinity of the Project is 45 miles per hour (mph).

Nakii Road is a two-lane, two-way roadway that provides access to the Central Maui Baseyard from Maui Veterans Highway. The posted speed limit along this roadway is 15 mph.

Kamaaina Road is a roadway that runs in the east-west direction. Kamaaina Road begins to the west at its intersection with Maui Veterans Highway, and terminates to the east at an intersection with South Firebreak Road. Kamaaina Road primarily services traffic generated by the Hawaiian Cement Baseyard located further south of the roadway. Kamaaina Road is currently unstriped but was observed to provide enough width to service two-way traffic.

Mehameha Loop is a two-lane, two-way private roadway that generally runs parallel and to the west of Maui Veterans Highway. This roadway intersects with Maui Veterans Highway across from Kamaaina Road, forming the west leg of the signalized intersection (Mehameha Loop North) at the northern end. This roadway traverses south, providing access to the Maui Humane Society and is gated further south for private use. Mehameha Loop ultimately terminates across from the Maui Raceway Park Access Road forming the west leg of the unsignalized intersection (Mehameha Loop South) at the southern end. The roadway is gated just west of the unsignalized intersection across Mehameha Loop South. The posted speed limit along this roadway is 15 mph.

Piilani Highway is generally a four-lane, two-way State highway facility that runs in the north-south direction. This roadway begins to the north transitioning from Maui Veterans Highway at its intersection with North Kihei Road and terminates to the south in Wailea, where it transitions into Wailea Ike Drive. The posted speed limit along this roadway is 45 mph.

North Kihei Road is a two-lane, two-way State roadway that connects Honoapiilani Highway in Maalaea to Maui Veterans Highway/Piilani Highway in Kihei. The posted speed limit along this roadway is 30 mph.

South Firebreak Road is a local road that facilitates transport for Hawaiian Cement trucks in the north-south direction. South Firebreak Road begins to the south near the Hawaiian Cement Baseyard and travels north to Pulehu Road where it transitions into North Firebreak Road before it terminates about 1.25 miles north of Haleakala Highway. Various intersection approaches along South Firebreak Road are gated and previously provided access to HC&S sugar cane fields. In the vicinity of the Project, the roadway is currently unstriped but was observed to provide enough width to service two-way traffic.

Maui Raceway Park Access Road is an unstriped roadway that provides access to the Maui Raceway Park and Army National Guard Armory. The roadway begins to the west at its connection with Mehameha Loop (South) near the Maui Veterans Highway/Mehameha Loop (South) intersection and terminates as a dead end at the Maui Raceway Park. There is no posted speed limit along this roadway.

3.2 Existing Traffic Volumes

The weekday hourly traffic volume data utilized in this report were collected on Thursday, September 10 and Tuesday, September 15, 2015 as well as Thursday, January 19, 2017. The weekend hourly traffic volume data was collected on Saturday, August 12, 2017. Weekday PM traffic volumes taken in 2015 were adjusted to generally meet 2017 conditions. See the traffic count data provided in Appendix A for the existing intersections studied and their corresponding traffic count data. Based on the proximity to the proposed Project site, the following intersections were studied in the existing conditions scenario. Note that the Maui Veterans Highway/DHHL Access/DLNR Access intersection is proposed upon completion of the DHHL and DLNR projects and is not currently built out, and therefore, no traffic data was collected at this intersection. However, the intersection is included here for continuity within this report.

- [1] Maui Veterans Highway/Nakii Road (Signalized)
- [2] Maui Veterans Highway/Mehameha Loop (North)/Kamaaina Road (Signalized)
- [3] Maui Veterans Highway/DHHL Access/DLNR Access (Future Signalized)
- [4] Maui Veterans Highway/Mehameha Loop (South)/Maui Raceway Park Access Road (Unsignalized)
- [5] Maui Veterans Highway/Piilani Highway/North Kihei Road/Monsanto Driveway (Signalized)

Based on the traffic count data, the AM, PM and WE peak hours of traffic were determined to occur between 7:15 AM to 8:15 AM, 3:30 PM to 4:30 PM and 12:00 PM to 1:00 PM, respectively. The turning movement count data may be found in Appendix A.

3.3 Existing Traffic Conditions Analysis and Observations

3.3.1 Existing Intersection Analysis

The observations and analysis described below are based on prevailing observations during the time at which the data was collected. Hereinafter, observations that are expressed as ongoing and current shall represent conditions that prevailed at the time at which data was collected. It was observed that a number of vehicles accessing Nakii Road and Kamaaina Road consisted of heavy vehicle (HV) trucks generated by the Central Maui Baseyard and Hawaiian Cement Baseyard, respectively. Due to its potential impact on existing and future projections, HV trucks were accounted for and utilized in this analysis. The following shows the percentages of turning movement HV trucks utilized in the existing conditions analysis:

[1] Maui Veterans Highway/Nakii Road

- AM Peak (Enter Nakii Road) – 5% HV Trucks
- AM Peak (Exit Nakii Road) – 20% HV Trucks
- PM/WE Peak (Enter Nakii Road) – 7% HV Trucks
- PM/WE Peak (Exit Nakii Road) – 4% HV Trucks

[2] Maui Veterans Highway/Mehameha Loop (North)/Kamaaina Road

- AM Peak (Enter Kamaaina Road) – 35% HV Trucks
- AM Peak (Exit Kamaaina Road) – 90% HV Trucks
- PM Peak (Enter Kamaaina Road) – 71% HV Trucks
- PM Peak (Exit Kamaaina Road) – 21% HV Trucks
- WE Peak (Enter Kamaaina Road) – 25% HV Trucks
- WE Peak (Exit Kamaaina Road) – 11% HV Trucks

Traffic volumes along Maui Veterans Highway were generally similar in both directions during all peak hours of traffic. No significant delays or queuing were observed at the study intersections. All intersection movements generally operated adequately at LOS D or better. However, the following intersection movements operated at LOS E/F conditions:

[2] Maui Veterans Highway/Mehameha Loop (North)/Kamaaina Road

This intersection operated at overall LOS A with all movements generally operating at LOS D or better during all peak hours of traffic. However, the AM northbound left-turn and PM southbound left-turn operated at LOS E due to low volumes (≤ 10 vehicles) that resulted in lengthier delays.

[4] Maui Veterans Highway/Mehameha Loop (South)/Maui Raceway Park Access Road

During all peak hours of traffic, the westbound left-turn operated at LOS E/F due to delays from unsignalized conditions, but westbound left-turn movement was low with only two (2) vehicles during each peak hour. However, gaps in through traffic along Maui Veterans Highway help vehicles proceed onto Maui Veterans Highway.

[5] Maui Veterans Highway/Piilani Highway & N Kihei Road/Monsanto Driveway

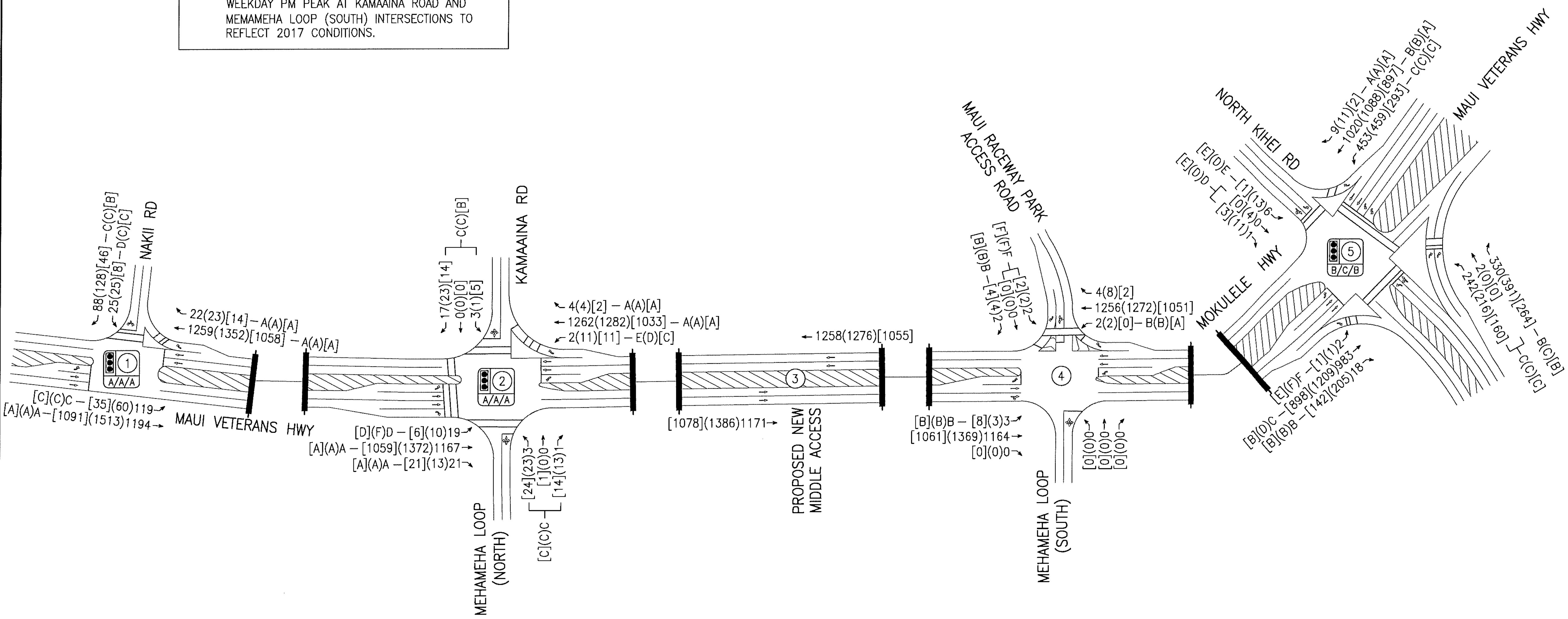
This intersection operated at overall LOS C or better during all peak hours of traffic. However, the southbound left-turn and various westbound movements operated at LOS E/F during the peak hours due to lengthier delays from low movement volumes of thirteen or fewer vehicles per peak hour.

Figure 3.1 illustrates the existing lane configuration, traffic volumes and LOS for each study intersection. Table 3.1 provides a summary of the existing conditions analysis. LOS worksheets are provided in Appendix C.

NORTH

NOT TO SCALE

NOTE:
1. THIS DRAWING IS FOR ILLUSTRATIVE PURPOSES ONLY. DO NOT USE FOR CONSTRUCTION.
2. SOUTHBOUND THROUGH VOLUME ADJUSTED FOR WEEKDAY PM PEAK AT KAMAAINA ROAD AND MEMAMEHA LOOP (SOUTH) INTERSECTIONS TO REFLECT 2017 CONDITIONS.



DATE OF COUNTS:
SEPTEMBER 10, 2015
SEPTEMBER 15, 2015
JANUARY 19, 2017
AUGUST 12, 2017

AM PEAK HOUR:
7:15 AM – 8:15 AM

PM PEAK HOUR:
3:30 PM – 4:30 PM

WE PEAK HOUR:
12:00 PM – 1:00 PM

LEGEND

##(##)[##] – AM(PM)[WE] PEAK HOUR OF TRAFFIC VOLUMES

(X) – UNSIGNALIZED INTERSECTION X

(Y) A/A/A – SIGNALIZED INTERSECTION Y, OVERALL AM/PM/WE LOS

A(A)[A] – AM(PM)[WE] LOS

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EXISTING LANE CONFIGURATION, VOLUMES AND MOVEMENT LOS

FIGURE 3.1

TABLE 3.1: LOS SUMMARY TABLE
EXISTING CONDITIONS

Intersection	Existing Conditions								
	AM			PM			WE		
	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
1: Maui Veterans Hwy & Nakii Rd									
NB TH	9.3	0.74	A	8.5	0.74	A	6.9	0.64	A
NB RT	5.3	0.01	A	4.5	0.02	A	4.5	0.01	A
WB LT	36.4	0.63	D	27.8	0.47	C	30.6	0.42	C
WB RT	21.6	0.02	C	21.7	0.02	C	18.9	0.05	B
SB LT	28.0	0.78	C	27.5	0.64	C	22.8	0.52	C
SB TH	2.8	0.50	A	3.4	0.64	A	2.8	0.48	A
OVERALL	7.5	-	A	6.5	-	A	5.2	-	A
2: Maui Veterans Hwy & Mehameha Lp North/Kamaaina Rd									
NB LT	69.3	0.40	E	36.7	0.43	D	30.6	0.43	C
NB TH	6.9	0.65	A	6.7	0.63	A	7.2	0.60	A
NB RT	4.1	0.00	A	3.9	0.01	A	4.7	0.00	A
EB LT/TH/RT	23.7	0.03	C	26.1	0.15	C	20.2	0.13	C
WB LT/TH/RT	23.7	0.03	C	25.3	0.01	C	19.7	0.03	B
SB LT	42.2	0.64	D	135.8	0.95	F	54.4	0.56	D
SB TH	5.9	0.58	A	7.1	0.68	A	7.5	0.62	A
SB RT	3.7	0.02	A	3.9	0.01	A	4.9	0.02	A
OVERALL	6.8	-	A	7.7	-	A	7.8	-	A
4: Maui Veterans Hwy & Mehameha Loop South									
NB LT	11.5	0.00	B	12.9	0.01	B	0.0	-	A
WB LT/TH	111.3	0.06	F	144.1	0.08	F	71.9	0.04	F
WB RT	14.1	0.01	B	14.3	0.01	B	12.7	0.01	B
SB LT	12.1	0.01	B	12.2	0.01	B	10.9	0.01	B
OVERALL	0.1	-	-	0.1	-	-	0.1	-	-
5: Piilani Hwy/Maui Veterans Hwy & N Kihei Rd/Monsanto Drwy									
NB LT	29.3	0.76	C	33.4	0.79	C	24.9	0.66	C
NB TH	10.5	0.56	B	11.0	0.58	B	9.5	0.53	A
NB RT	7.1	0.01	A	7.2	0.01	A	6.8	0.00	A
EB LT	30.6	0.59	C	33.4	0.51	C	25.6	0.50	C
EB RT	18.2	0.23	B	21.2	0.32	C	17.3	0.14	B
WB LT	57.2	0.48	E	49.2	0.46	D	60.0	0.26	E
WB TH/RT	37.4	0.08	D	41.2	0.16	D	68.9	0.29	E
SB LT	113.7	0.52	F	141.4	0.45	F	79.4	0.32	E
SB TH	22.9	0.81	C	35.1	0.94	D	16.2	0.73	B
SB RT	14.1	0.01	B	15.5	0.12	B	11.7	0.10	B
OVERALL	19.9	-	B	25.4	-	C	15.4	-	B

4. BASE YEAR 2038 WITHOUT PROJECT TRAFFIC CONDITIONS

The full build-out of the Project is anticipated to occur by Year 2038. The Base Year 2038 scenario represents the traffic conditions within the study area with no development on the Project site. Traffic projections were formulated by applying a defacto growth rate to the existing traffic count volumes as well as trips generated by known future developments in the vicinity of the Project.

Based on discussions with the State of Hawaii Department of Transportation (HDOT), it was requested that an iterative Base Year 2038 scenario be analyzed that excludes the three (3) proposed State Pulehunui developments; DHHL North and South Project, DLNR Industrial and Business Park, and Maui Regional Public Safety Complex (MRPSC). This scenario is described in greater detail in Appendix F.

4.1 Defacto Growth Rate

Projections for Base Year 2038 traffic were based upon a correlation between the existing traffic counts collected by ATA, the Maui Regional Travel Demand Model (MRTDM) growth for forecast years between 2007 and 2035, and nearby developments in the immediate vicinity of the Project. The overall annual growth rate along Maui Veterans Highway was determined to be approximately 2.06 percent per year.

4.2 Traffic Forecasts for Known Developments

By Year 2038, numerous developments are forecast to be completed within the vicinity of the Project and generate additional traffic along Maui Veterans Highway. The associated forecast traffic volumes for each known development traveling through the study intersections were added to the forecast Base Year 2038 traffic volumes. Based on an assessment of the MRTDM, the following developments were not part of the MRTDM model and were therefore included in addition to the ambient growth rate. These known developments are illustrated in Figure 4.1 & 4.2 and described below:

- Department of Hawaiian Home Lands (DHHL) Pulehunui North – This development encompasses approximately 184.4 acres of land located across the DLNR Industrial and Business Park Project on the west side of Maui Veterans Highway more specifically identified as TMK: (2) 3-8-008-008 & 3-8-008-035:036. This subdivision proposes to develop approximately 80 acres of industrial space, 16 acres of commercial space, a 5 acre hotel and 40 acres for a cultural center/visitor attraction space. Access to the Project will occur at the existing Mehameha Loop (North) and Mehameha Loop (South) roadways, accessible via the Maui Veterans Highway. In addition, the new proposed signalized intersection between Mehameha Loop (North)/Kamaaina Road and Mehameha Loop (South) is proposed and will service both the DHHL Pulehunui subdivision site and DLNR Industrial and Business Park site. Full buildout is anticipated to occur prior to 2038.
- DHHL Pulehunui South – This development encompasses approximately 646 acres of land, ¾ mile south of the DHHL Pulehunui North development, adjacent and east of Maui Veterans Highway and east of the Kealia Pond National Wildlife Refuge more specifically identified as TMK: (2) 3-8-008-034. This subdivision proposes to develop approximately 173 acres of agricultural space, 238 acres for agricultural homesteads, 33 acres for an education facility, 18 acres for a cultural and arts center and 105 acres for

industrial/agricultural processing space. Access to this development would occur directly from Maui Veterans Highway via three (3) existing accesses fronting DHHL Pulehunui South Parcel. Full buildout is anticipated to occur prior to 2038.

- Maui Regional Public Safety Complex (MRPSC) – This project is proposed to be located east of Maui Veterans Highway near the Army National Guard Armory and the Maui Raceway Park. Based on the MRPSC Environmental Impact Statement Preparation Notice, dated May 2010, the complex may include up to 843 beds when fully constructed. Although this project is currently on hold, it was assumed to be completed by Base Year 2038. It's anticipated to generate approximately 85(43)[43] trips during the AM(PM)[WE] peak hours. Primary vehicular access to the Project will be provided via the Maui Raceway Park Access Road at its intersection with Maui Veterans Highway.

- Puunene Heavy Industrial Subdivision – This project is proposed to be located approximately 1.4 miles east of Maui Veterans Highway and will include approximately 65.92 acres of heavy industrial space. This development is anticipated to generate approximately 472(471)[311] trips during the AM(PM)[WE] peak hours, 25 percent of which was anticipated to be heavy vehicle trucks, based on the Puunene Heavy Industrial Subdivision TIAR, dated January, 24, 2012, prepared by Phillip Rowell & Associates. Vehicular access to the Project from the main thoroughfare was assumed to occur via the Maui Veterans Highway/Mehameha Loop (North)/Kamaaina Road intersection. Internally, South Firebreak Road will be used to get to the site.

- Central Maui Baseyard Expansion – The existing Central Maui Baseyard is currently constructed and occupied. Based on the County of Maui's Long Range Plan, there is potential for expansion of the industrial park for an additional 100 acres. Traffic is anticipated to access the existing Maui Veterans Highway/Nakii Road intersection.

- Piilani Promenade – This proposed development will be located east of the Piilani Highway/Kaonoulu Street intersection. Based on the current status of this project, the proposed plan would provide approximately 530,000 square feet of commercial/retail space and 58,000 SF of light industrial space. This report conservatively assumes that the Piilani Promenade development will be 100 percent complete by the Year 2038.

- Maui Bay Villas (formerly Maui Lu) – This proposed project is located on the corner of the South Kihei Road/Kaonoulu Street intersection. This development proposes to construct 388 residential units and various service-related land uses. For purposes of this study, it was assumed that this project would be complete by Year 2020.

- Kihei High School - This proposed project will be located east of the Piilani Highway/Kulanihakoi Street intersection. The project is currently proposed to be completed in two phases based on the Kihei High School TIAR, dated September 2011, prepared by Wilson Okamoto Corporation. 704 public school students from the Kihei area currently attend high schools in Kahului and Wailuku; it is anticipated that these students will transfer to the proposed Kihei High School, producing a net increase of only 96 new students during phase 1. Since full enrollment of 1,650 students was expected by Year 2025, this TIAR conservatively assumes Phases 1 and 2 of Kihei High School will be completed by Year 2025.

In addition to the above developments, the following developments were assumed to be included in the ambient growth generated by the MRTDM: Maui Business Park Phase II, Kihei Residential, Kaiwahine Village, Kenolio Apartments, Maui Research & Technology Park, Krausz Downtown Kihei, Liloa Village, South Maui Community Park, Alahele Subdivision. The County of Maui Department of Parks & Recreation (DPR) is also master planning for a regional park in the area, but since no plans are available this Project was not included in this TIAR.

Table 4.1 shows the various trip rates/formulas used to generate vehicle trips for those newer developments where no TIAR's have previously been completed. Table 4.2 shows the total peak hour traffic volumes forecast to be generated by each of the developments discussed above. Of these known developments assumed to be completed by Base Year 2038, only the DHHL Pulehunui North & South Parcels, Puunene Heavy Industrial Subdivision and MRPSC developments are proposed to generate turning movement traffic that will directly impact the Project's adjacent study intersections. All other known developments are located further north and south of the Project and will only generate regional throughput traffic along Maui Veterans Highway.

4.3 Planned Roadway Improvements

[2] Maui Veterans Highway/Mehameha Loop (North)/Kamaaina Road

Based on the mitigation proposed in the Puunene Heavy Industrial Subdivision TIAR, dated January 24, 2012, the following roadway improvements were assumed to be implemented upon completion of the Puunene Heavy Industrial Subdivision and were included in the Base Year 2038 analysis:

- Lengthen the southbound left-turn storage lane by an additional 350 feet, in addition to taper.
- Modify/Widen Kamaaina Road to provide a separate channelized westbound right-turn lane.
- Provide an acceleration lane for the westbound right-turns from Kamaaina Road onto Maui Veterans Highway.

Maui Veterans Highway Widening from Kuihelani Highway to Piilani Highway [1]

The State of Hawaii Department of Transportation's (HDOT) *Federal Aid Highways 2035 Transportation Plan for the District of Maui* (Plan) dated July 2014 (hereinafter referred to as "HDOT 2035 Transportation Plan") estimated that by the year 2035, traffic volumes on Maui Veterans Highway will increase by over 80 percent due to nearby population and land development growth in the area. To increase highway capacity and accommodate this traffic growth, the HDOT 2035 Transportation Plan identified the widening of Maui Veterans Highway to construct two (2) additional travel lanes on Maui Veterans Highway from Kuihelani Highway in Kahului to Piilani Highway in Kihei as a potential need by Year 2035.

Full build-out of the DLNR Industrial and Business Park project is anticipated to occur after the 2035 estimated need for HDOT's Maui Veterans Highway widening improvement. HDOT's Maui Veterans Highway widening improvement is currently not a funded improvement and is not identified on the latest Statewide Transportation Improvement Program (STIP). Due to the uncertainty of HDOT's Maui Veterans Highway widening improvement, DLNR will coordinate with HDOT on its fair share of improvements. For purposes of this TIAR, widening

[1] This Maui Veterans Highway Widening improvement is currently not a DOT-funded or approved project and is only an identified roadway capacity solution for long range planning purposes. This TIAR does not assume the Maui Veterans Highway Widening improvement project will be implemented by Year 2038.

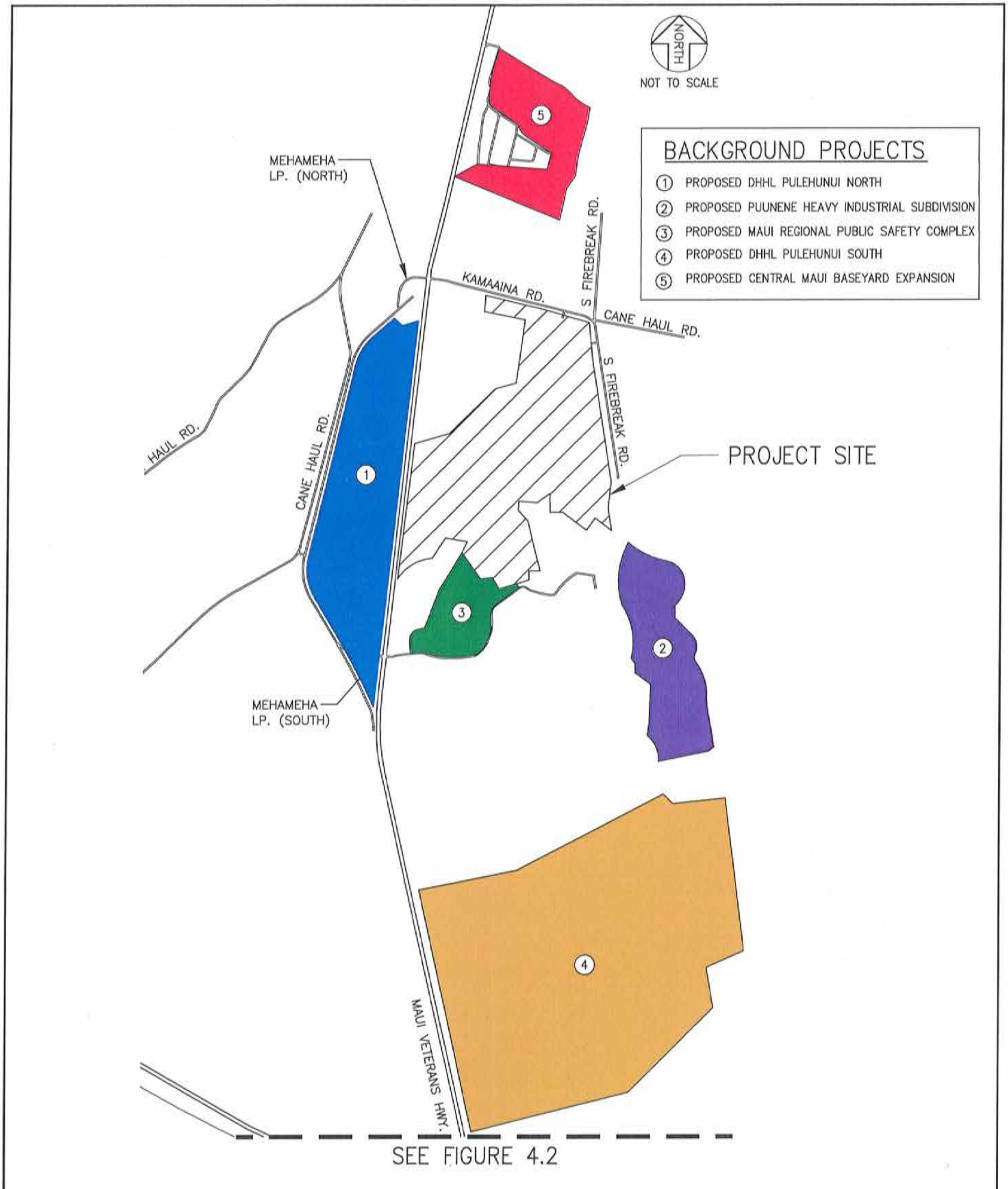
improvements along Maui Veterans Highway were recommended on the need at each study intersection based on LOS analysis for both Base Year 2038 and Future Year 2038 scenarios.

Upcountry-Kihei Corridor

The County of Maui's Maui Island Plan General Plan 2030 prepared by the County of Maui Planning Department Long Range Division dated December 28, 2012 conceptually identifies the Upcountry-Kihei Corridor as a new future bypass road that will provide a more direct connection between Kihei and Upcountry. Plans conceptually identify Kaonoulu Street as the western terminus and Haliimaile Road as the eastern terminus. The Upcountry-Kihei Corridor could significantly reduce north-south traffic along the length of Maui Veterans Highway, by allowing vehicles that travel between Upcountry and Kihei to bypass Maui Veterans Highway. To our knowledge, the Upcountry-Kihei Corridor is not a funded improvement on the latest STIP and no design plans have been prepared, so the Upcountry-Kihei Corridor was therefore not included in this TIAR.

Kihei Mauka Bypass Collector Road

The Maui Island Plan General Plan 2030 conceptually identifies the Kihei Mauka Bypass Collector Road as a new future bypass road that will generally run parallel to and mauka of Piilani Highway. Since this new roadway is currently only in the conceptual stage, the roadway alignment and northern and southern termination points are not defined, but could potentially extend as far south as Keonekai Road and terminate north at some point near the Kealia Pond National Wildlife Refuge. Based on discussions with the County of Maui Department of Public Works, the Kihei Mauka Bypass Collector Road is currently not an active Project being pursued at this time. To our knowledge, the Kihei Mauka Bypass Collector Road is not a funded improvement on the latest STIP and no design plans have been prepared, so the Kihei Mauka Bypass Collector Road was therefore not included in this TIAR.



DLNR INDUSTRIAL AND BUSINESS PARK TIAR

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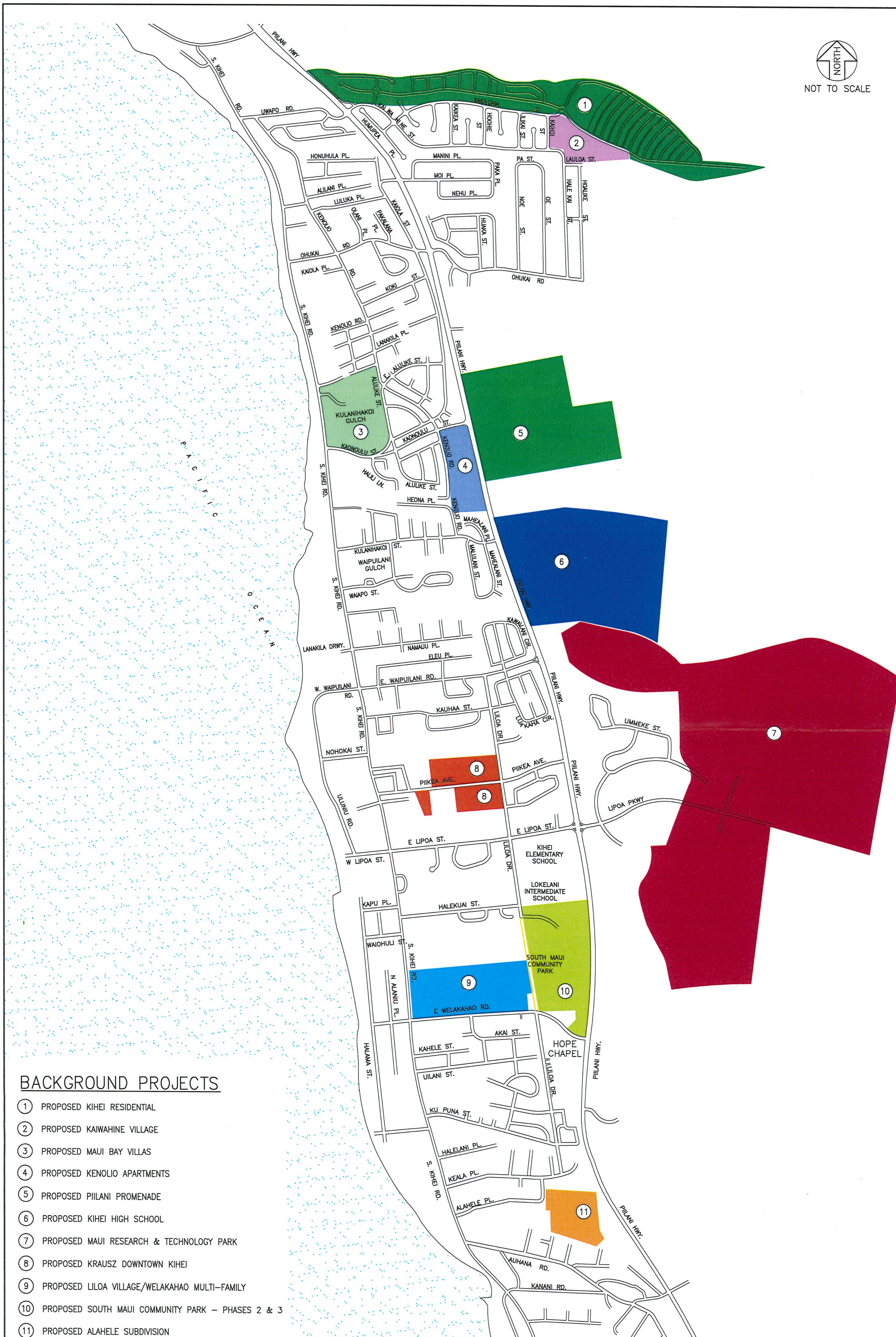
BACKGROUND DEVELOPMENTS PULEHUNUI

FIGURE 4.1



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BACKGROUND DEVELOPMENTS KIHEI

FIGURE 4.2

Table 4.1 Background Developments Trip Rates

Land Use (ITE Code)	Independent Variable	AM Peak Hour		PM Peak Hour		WE Peak Hour	
		Trip Rate	% Enter	Trip Rate	% Enter	Trip Rate	% Enter
Industrial Park (130)	Acres	[a]	83%	[b]	21%	4.71	32%
Shopping Center (820)	1,000 SF GLA	[c]	62%	[d]	48%	[e]	52%
Prison (571) [1]	Beds	0.10	54%	0.05	10%	0.05	10%
Agriculture [2]	Acres	0.16	83%	0.16	21%	0.16	21%

Notes:

[a] $LN(T) = 0.78LN(X)+2.82$

[b] $LN(T) = 0.72LN(X)+3.06$

[c] $LN(T) = 0.61LN(X)+2.24$

[d] $LN(T) = 0.67LN(X)+3.31$

[e] $LN(T) = 0.65LN(X)+3.78$

1. Due to a lack of available weekend data, ITE trip generation rates for the PM peak hour was used to estimate WE peak hour.

2. ITE Trip Generation 9th Edition does not provide trip rates for Agriculture land use. Trip generation rates from the San Diego Municipal Code, Land Development Code, Trip Generation Manual, dated May 2003 was used in lieu of ITE trip generation rates. Assumes peak hour trip rates are approximately 8% of total weekday daily trip rate of 2 trips/acre. Percent enter values taken from ITE 130 Industrial Park distribution.

Table 4.2 Background Developments Trip Generation

Land Use	Independent Variable (ITE Code)	Size	AM Peak Hour			PM Peak Hour			WE Peak Hour		
			Enter (vph)	Exit (vph)	Total (vph)	Enter (vph)	Exit (vph)	Total (vph)	Enter (vph)	Exit (vph)	Total (vph)
DHHL Pulehunui North [1]	DHHL North - Industrial Park (130)	80 acres	312	64	376	71	267	338	121	256	377
	DHHL North - Shopping Center (820)	174,200 SF	74	45	119	249	270	519	378	349	726
	DHHL North - Hotel (310)	200 rooms	63	43	106	61	59	120	80	63	143
	DHHL North - Cultural Center	40 acres	3	2	6	74	81	155	127	106	233
		Pass-by reduction				-65	-65	-130	-91	-91	-182
	Subtotal		452	154	606	390	612	1,002	615	683	1,298
DHHL Pulehunui South [1]	DHHL South - Industrial Park (130)	105 acres	410	84	493	93	350	443	158	336	495
	DHHL South - Agricultural	173 acres	23	5	28	6	22	28	9	19	28
	DHHL South - Single Family Residential (230)	110 Dwelling Units	22	65	87	72	43	115	58	49	107
	DHHL South - Private School K-12 (536)	400 students	164	164	328	29	39	68	-	-	-
	DHHL South - Recreational Community Center (495)	39,000 SF	53	27	80	38	39	77	23	19	42
	Subtotal		672	345	1,017	238	493	731	248	423	671
Maui Regional Public Safety Complex [2]	Prison (571)	843 beds	46	39	85	4	39	43	4	39	43
Puunene Heavy Industrial Subdivision [3]	Industrial Park (130)	65.92 acres	392	80	472	99	372	471	100	211	311
Central Maui Baseyard Expansion	Industrial Park (130)	100 acres	506	104	610	123	465	588	151	320	471
Piilani Promenade [4]	Retail/Commercial (820)	530,000 SF	268	164	432	703	777	1,480	1,096	993	2,089
	Outdoor Garden (818)	58,000 SF (5 Acres)									
Maui Bay Villas [3,4]	Timeshare (265)	388 Dwelling Units	210	110	60	319	136	183	319	136	183
	Beach Park (415)	12 Stalls									
Kihei High School [3,4]	High School (530)	946 students	270	127	397	58	65	123	116	66	182
Total NEW External Trips			2,816	1,123	3,679	1,934	2,959	4,621	2,649	2,871	5,248

Notes:

- SF = Square Feet of Gross Floor Area

1. Due to its close proximity with one another, trips were generated as a single aggregate for the total industrial and/or commercial component for the following three (3) developments. Trips generated by each development were then calculated based on a percentage of its size in relation to the derived aggregate total. Commercial SF calculated based on a 25% floor-area-ratio (FAR).
   a. DHHL Pulehunui North
   b. DHHL Pulehunui South
   c. DLNR Industrial & Business Park.

2. Due to a lack of available weekend data, ITE trip generation rates for the PM peak hour was used to estimate WE peak hour.

3. Trip generation taken from TIAR's prepared for each respective development.

4. Table 4.2 shows total new external trips generated by each development. However, due to its location further south in Kihei, only a portion of these trips traverse the study intersections along Maui Veterans Highway.

4.4 Base Year 2038 Without Project Analysis

By Year 2038 without the Project, traffic in the study area is expected to significantly increase due to trips generated by nearby developments and growth along Maui Veterans Highway. As a result of the increase in traffic volumes, several roadway improvements are recommended by Base Year 2038. All improvements are described below and summarized in Appendix D:

<u>[1] Maui Veterans Highway/Nakii Road</u>

- Widen Maui Veterans Highway to provide an additional northbound through lane, resulting in three northbound through lanes.
    - Northbound: Three (3) through lanes and one (1) right-turn lane.
    - Southbound: One (1) left-turn lane and Two (2) through lanes.
    - Westbound: One (1) left-turn lane and one (1) right-turn lane.

<u>[2] Maui Veterans Highway/Mehameha Loop (North)/Kamaaina Road</u>

- Implement planned roadway improvements listed in Section 4.3
- Provide additional widening improvements, resulting in the following lane configuration:
    - Northbound: One (1) left-turn lane, three (3) through lanes and one (1) right-turn lane.
    - Southbound: Two (2) left-turn lanes, two (2) through lanes and one (1) right-turn lane
    - Eastbound: One (1) left-turn lane, one (1) through and one (1) right-turn lane.
    - Westbound: One (1) shared left-turn/through lane and one (1) right-turn lane with acceleration lane.

<u>[3] Maui Veterans Highway/DHHL Access/DLNR Access</u>

- Provide a new signalized intersection along Maui Veterans Highway to serve the DHHL Pulehunui North development with the following lane configuration at the intersection:
    - Northbound: One (1) left-turn lanes and two (2) through lanes
    - Southbound: Three (3) through lanes and one (1) right-turn lane
    - Eastbound: Two (2) left-turn lanes and one (1) right-turn lane.

<u>[4] Maui Veterans Highway/Mehameha Loop (South)/Maui Raceway Park Access Road</u>

- Provide a traffic signal with the following lane configuration at the intersection:
    - Northbound: One (1) left-turn lane, two (2) through lanes and one (1) right-turn lane
    - Southbound: One (1) left-turn lane, three (3) through lanes and one (1) right-turn lane
    - Eastbound: One (1) shared left-turn/through lane and one (1) channelized right-turn lane with an acceleration lane.
    - Westbound: One (1) shared left-turn/through lane and one (1) right-turn lane

[5] Maui Veterans Highway/Piilani Highway/North Kihei Road/Monsanto Driveway

- Widen Maui Veterans Highway to provide an additional southbound through lane, resulting in resulting in three southbound through lanes.
  - Northbound: Two (2) left-turn lanes, two (2) through and one (1) right-turn lane.
  - Southbound: One (1) left-turn lane, three (3) through and one (1) right-turn lane.
  - Eastbound: One (1) left-turn lane, one (1) shared left-turn/through lane and two (2) right-turn lanes.
  - Westbound: One (1) left-turn lane and one (1) shared through/right-turn lane.

For the three (3) proposed DHHL South Parcel accesses, a traffic signal with exclusive left-turn and right-turn lanes are proposed at the middle DHHL South Access 2 intersection and right-in, right-out (RIRO) accesses are proposed for the northernmost DHHL South Access 1 and southernmost DHHL South Access 3 intersection.

In addition to the above improvements, the coordination of traffic signals at Maui Veterans Highway/Mehameha Loop (North)/Kamaaina Road, Maui Veterans Highway/DHHL Access/DLNR Access and Maui Veterans Highway/Mehameha Loop (South)/Maui Raceway Park Access Road intersections should be considered where feasible, and the signal timing plans should be optimized to improve throughput progression along Maui Veterans Highway.

As discussed in Section 4.3, for purposes of this TIAR, widening improvements along Maui Veterans Highway were recommended on the need at each study intersection based on LOS analysis for Base Year 2038.

4.4.1 Base Year 2038 Intersection Analysis

The signalization of the new Maui Veterans Highway/DHHL Access/DLNR Access intersection and Maui Veterans Highway/Mehameha Loop South intersection is recommended as the most feasible alternative at these intersections. Based on the mainline through volume along Maui Veterans Highway and turning movement traffic accessing the side streets, a signal would be warranted at each of these intersections. Traffic control that includes roundabouts, full movement two-way stop control and right-in, right-out (RIRO) access was not considered at these intersections since it would create lengthy delays and capacity issues. Signal warrants are shown in Appendix E.

If a single lane roundabout is implemented, Maui Veterans Highway will need to be reduced from its existing four-lane roadway to a two-lane roadway. Based on national guidance, the vehicular capacity for a single-lane roundabout is generally up to 25,000 vehicles/day. Maui Veterans Highway currently services between 30,000-35,000 vehicles/day. Therefore, a single-lane roundabout would likely operate over-capacity and cause lengthy delays and congestion.

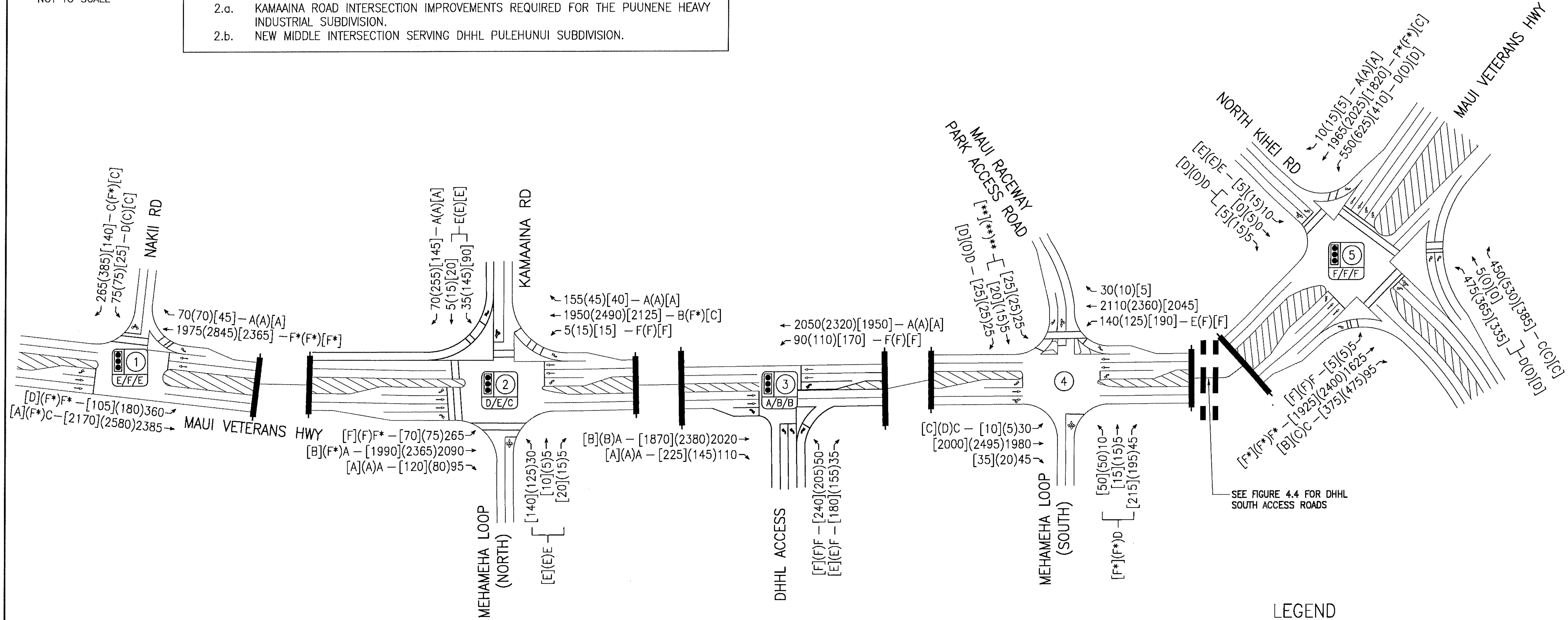
Based on national guidance, the vehicular capacity for a double-lane roundabout is generally up to 45,000 vehicles/day. Based on forecast traffic by 2038, average daily traffic may reach between 60,000-75,000 vehicles/day, likely making double-lane roundabouts infeasible. In addition, three lanes are forecast to be needed at various locations by Year 2038, so double lane roundabouts will not work.

With the recommended improvements at the study intersections, all intersections are forecast to operate at overall LOS D or better. Although the majority of left-turn and minor street movements are expected to operate at LOS E/F due to the long cycle lengths favoring the through movements along Maui Veterans Highway, all movements are anticipated to operate below capacity during all peak hours of traffic. Additionally, all mainline through movements along the highway are expected to operate at LOS D or better during all peak hours.

Figure 4.3 to 4.6 illustrate the lane configuration, forecast traffic volumes and movement LOS for Base Year 2038 with and without the recommended mitigation, respectively. Table 4.3 summarizes the Base Year 2038 LOS at the study intersections compared to existing conditions. LOS worksheets are provided in Appendix C.

NORTH
NOT TO SCALE

NOTE:
1. THIS DRAWING IS FOR ILLUSTRATIVE PURPOSES ONLY. DO NOT USE FOR CONSTRUCTION.
2. LANEAGE ONLY REFLECTS EXISTING CONDITIONS WITH PLANNED ROADWAY IMPROVEMENTS WITHOUT THE PROJECT:
   2.a. KAMAAINA ROAD INTERSECTION IMPROVEMENTS REQUIRED FOR THE PUUNENE HEAVY INDUSTRIAL SUBDIVISION.
   2.b. NEW MIDDLE INTERSECTION SERVING DHHL PULEHUNUI SUBDIVISION.



LEGEND

##(##)[##]	– AM(PM)[WE] PEAK HOUR OF TRAFFIC VOLUMES
(X)	– UNSIGNALIZED INTERSECTION X
(Y) A/A/A	– SIGNALIZED INTERSECTION Y, OVERALL AM/PM/WE LOS
A(A)[A]	– AM(PM)[WE] LOS
**	– LOS NOT COMPUTED

DLNR INDUSTRIAL AND BUSINESS PARK TIAR

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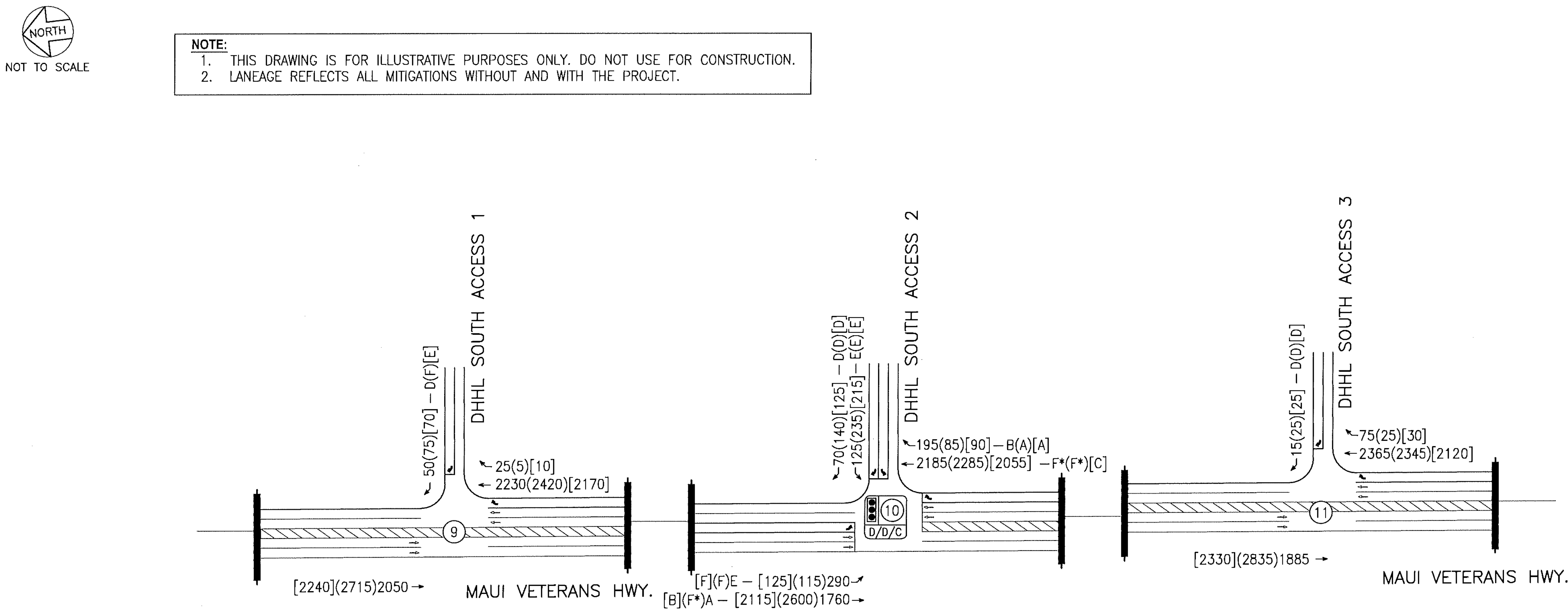
BASE YEAR 2038 WITHOUT PROJECT (WITHOUT MITIGATION) LANE CONFIGURATION, VOLUMES AND MOVEMENT LOS

FIGURE 4.3

NOTE:
1. THIS DRAWING IS FOR ILLUSTRATIVE PURPOSES ONLY. DO NOT USE FOR CONSTRUCTION.
2. LANEAGE REFLECTS ALL MITIGATIONS WITHOUT AND WITH THE PROJECT.



LEGEND

##(##)[##] – AM(PM)[WE] PEAK HOUR OF TRAFFIC VOLUMES

(X) – UNSIGNALIZED INTERSECTION X

(Y) A/A/A – SIGNALIZED INTERSECTION Y, OVERALL AM/PM/WE LOS

A(A)[A] – AM(PM)[WE] LOS

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BASE YEAR 2038 WITHOUT PROJECT (WITHOUT MITIGATION) LANE CONFIGURATION, VOLUMES AND MOVEMENT LOS - CONTINUATION

FIGURE 4.4

NOTE:
1. THIS DRAWING IS FOR ILLUSTRATIVE PURPOSES ONLY. DO NOT USE FOR CONSTRUCTION.
2. LANEAGE REFLECTS THE FOLLOWING TWO (2) PLANNED ROADWAY IMPROVEMENTS PLUS ADDITIONAL MITIGATION NECESSARY FOR ADEQUATE INTERSECTION OPERATIONS FROM TRAFFIC INCREASES FROM AMBIENT GROWTH AND BACKGROUND DEVELOPMENTS (EXCLUDING THE PROJECT):
 2.a. KAMAAINA ROAD INTERSECTION IMPROVEMENTS REQUIRED FOR THE PUUNENE HEAVY INDUSTRIAL SUBDIVISION.
 2.b. NEW MIDDLE INTERSECTION SERVING DHHL PULEHUNUI SUBDIVISION.

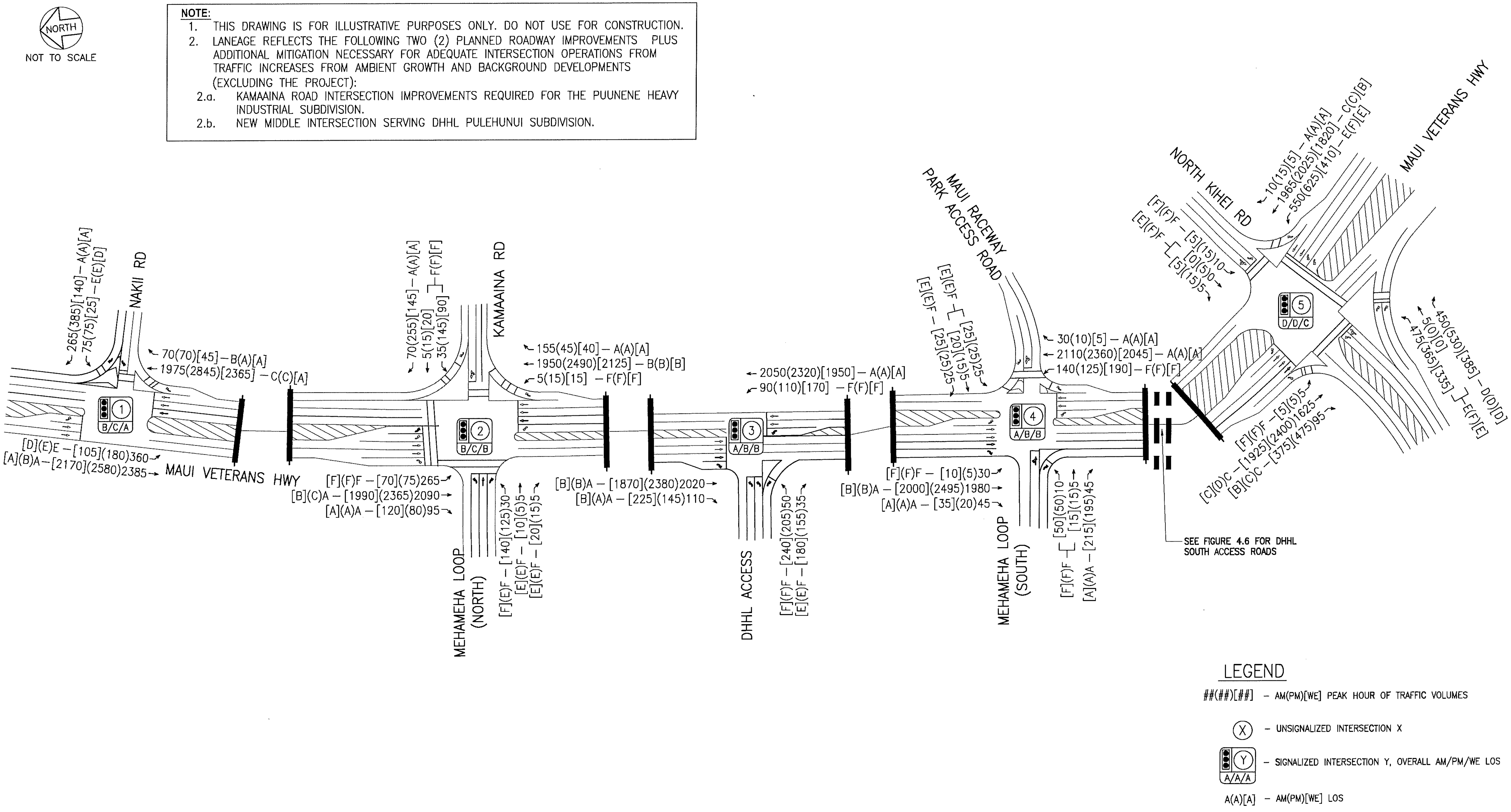

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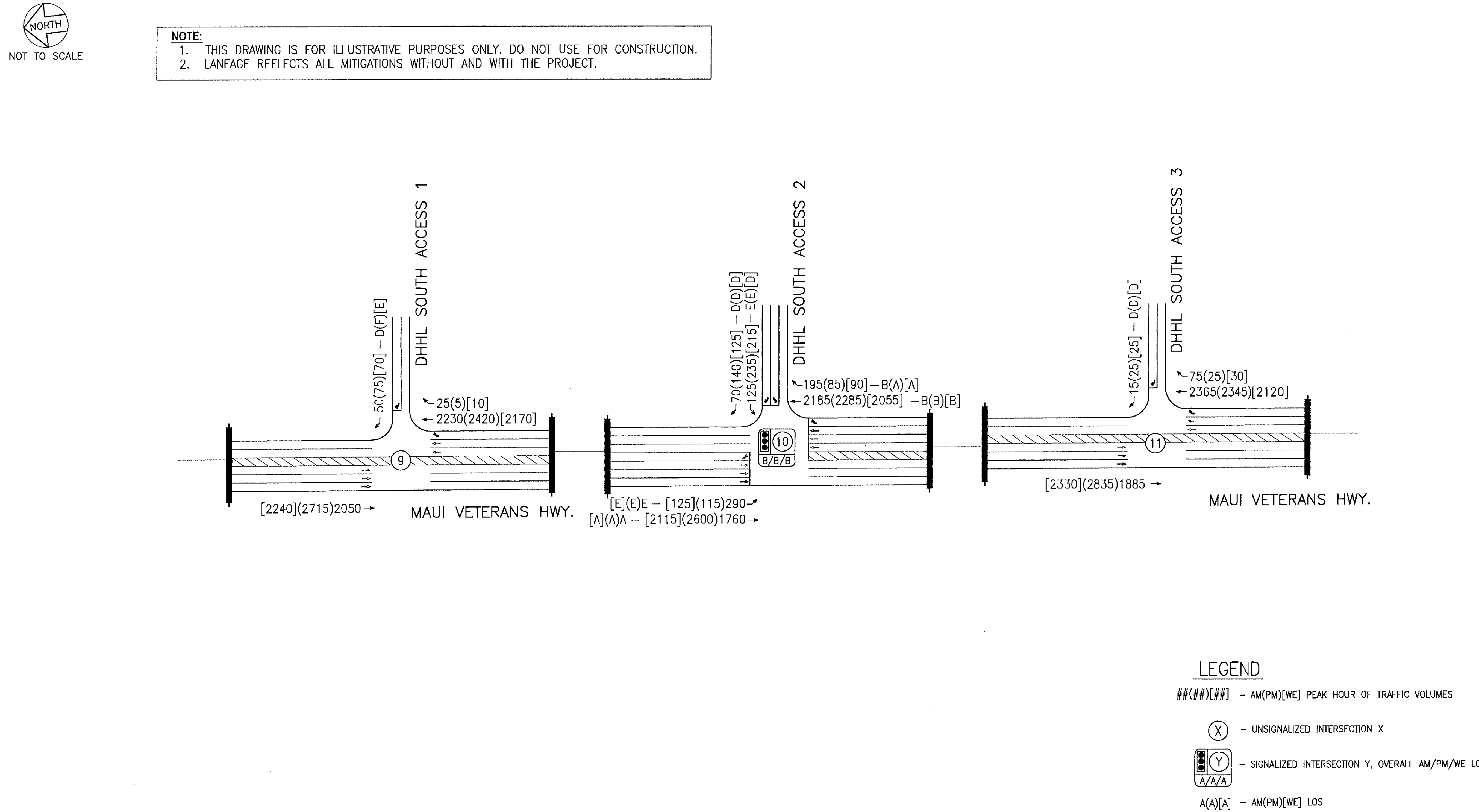
FIGURE 4.5

BASE YEAR 2038 WITHOUT PROJECT (WITH MITIGATION) LANE CONFIGURATION, VOLUMES AND MOVEMENT LOS

NOTE:
1. THIS DRAWING IS FOR ILLUSTRATIVE PURPOSES ONLY. DO NOT USE FOR CONSTRUCTION.
2. LANEAGE REFLECTS ALL MITIGATIONS WITHOUT AND WITH THE PROJECT.



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BASE YEAR 2038 WITHOUT PROJECT (WITH MITIGATION) LANE CONFIGURATION, VOLUMES AND MOVEMENT LOS - CONTINUATION

FIGURE 4.6

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TABLE 4.3: LOS SUMMARY TABLE
EXISTING, BASE YEAR 2038 AND BASE YEAR 2038 WITH MITIGATION CONDITIONS

Existing Conditions

Intersection	AM HCM Delay	AM v/c Ratio	AM LOS	PM HCM Delay	PM v/c Ratio	PM LOS	WE HCM Delay	WE v/c Ratio	WE LOS
1: Maui Veterans Hwy & Nakii Rd									
NB TH	9.3	0.74	A	8.5	0.74	A	6.9	0.64	A
NB RT	5.3	0.01	A	4.5	0.02	A	4.5	0.01	A
WB LT	36.4	0.63	D	27.8	0.47	C	30.6	0.42	C
WB RT	21.6	0.02	C	21.7	0.02	C	18.9	0.05	B
SB LT	28.0	0.78	C	27.5	0.64	C	22.8	0.52	C
SB TH	2.8	0.50	A	3.4	0.64	A	2.8	0.48	A
OVERALL	7.5	-	A	6.5	-	A	5.2	-	A
2: Maui Veterans Hwy & Mehameha Lp North/Kamaaina Rd									
NB LT	69.3	0.40	E	36.7	0.43	D	30.6	0.43	C
NB TH	6.9	0.65	A	6.7	0.63	A	7.2	0.60	A
NB RT	4.1	0.00	A	3.9	0.01	A	4.7	0.00	A
EB LT	-	-	-	-	-	-	-	-	-
EB TH	-	-	-	-	-	-	-	-	-
EB LT/TH/RT	23.7	0.03	C	26.1	0.15	C	20.2	0.13	C
EB RT	-	-	-	-	-	-	-	-	-
WB LT/TH	-	-	-	-	-	-	-	-	-
WB LT/TH/RT	23.7	0.03	C	25.3	0.01	C	19.7	0.03	B
WB RT	-	-	-	-	-	-	-	-	-
SB LT	42.2	0.64	D	135.8	0.95	F	54.4	0.56	D
SB TH	5.9	0.58	A	7.1	0.68	A	7.5	0.62	A
SB RT	3.7	0.02	A	3.9	0.01	A	4.9	0.02	A
OVERALL	6.8	-	A	7.7	-	A	7.8	-	A
3: Maui Veterans Hwy & DHHL Access									
NB LT	-	-	-	-	-	-	-	-	-
NB TH	-	-	-	-	-	-	-	-	-
EB LT	-	-	-	-	-	-	-	-	-
EB RT	-	-	-	-	-	-	-	-	-
SB TH	-	-	-	-	-	-	-	-	-
SB RT	-	-	-	-	-	-	-	-	-
OVERALL									

Base Year 2038 Conditions

Intersection	AM HCM Delay	AM v/c Ratio	AM LOS	PM HCM Delay	PM v/c Ratio	PM LOS	WE HCM Delay	WE v/c Ratio	WE LOS
1: Maui Veterans Hwy & Nakii Rd									
NB TH	95.5	1.17	F*	277.9	1.58	F*	116.0	1.22	F*
NB RT	7.1	0.04	A	6.3	0.05	A	4.8	0.03	A
WB LT	43.1	0.70	D	27.4	0.47	C	31.4	0.45	C
WB RT	31.6	0.55	C	394.4	1.76	F*	26.8	0.11	C
SB LT	350.8	1.68	F*	224.5	1.35	F*	49.9	0.80	D
SB TH	23.4	0.99	C	60.7	1.10	F*	7.7	0.87	A
OVERALL	77.0	-	E	182.6	-	F	63.3	-	E
2: Maui Veterans Hwy & Mehameha Lp North/Kamaaina Rd									
NB LT	82.9	0.43	F	84.6	0.54	F	81.7	0.53	F
NB TH	17.8	0.87	B	105.5	1.17	F*	33.2	0.97	C
NB RT	6.6	0.13	A	8.9	0.04	A	7.7	0.03	A
EB LT	-	-	-	-	-	-	-	-	-
EB TH	-	-	-	-	-	-	-	-	-
EB LT/TH/RT	56.7	0.28	E	58.3	0.51	E	62.4	0.71	E
EB RT	-	-	-	-	-	-	-	-	-
WB LT/TH	58.2	0.38	E	64.1	0.72	E	58.6	0.51	E
WB LT/TH/RT	-	-	-	-	-	-	-	-	-
WB RT	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A
SB LT	464.0	1.86	F*	95.8	0.85	F	83.9	0.83	F
SB TH	8.8	0.80	A	45.2	1.02	F*	16.9	0.85	B
SB RT	2.7	0.06	A	6.4	0.05	A	5.9	0.07	A
OVERALL	39.9	-	D	74.5	-	E	28.1	-	C
3: Maui Veterans Hwy & DHHL Access									
NB LT	113.7	0.85	F	121.8	0.87	F	97.9	0.90	F
NB TH	2.6	0.68	A	8.1	0.82	A	5.7	0.69	A
EB LT	93.8	0.62	F	87.2	0.82	F	86.2	0.83	F
EB RT	85.6	0.02	F	78.8	0.30	E	74.9	0.04	E
SB TH	7.6	0.74	A	19.9	0.95	B	17.5	0.79	B
SB RT	2.8	0.08	A	5.6	0.12	A	8.3	0.19	A
OVERALL	8.3	-	A	19.5	-	B	18.8	-	B

Base Year 2038 with Mitigation Conditions

Intersection	AM HCM Delay	AM v/c Ratio	AM LOS	PM HCM Delay	PM v/c Ratio	PM LOS	WE HCM Delay	WE v/c Ratio	WE LOS
1: Maui Veterans Hwy & Nakii Rd									
NB TH	20.5	0.81	C	21.4	0.93	C	8.7	0.74	A
NB RT	11.2	0.04	B	6.5	0.04	A	4.1	0.03	A
WB LT	57.8	0.81	E	59.3	0.77	E	47.4	0.57	D
WB RT	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A
SB LT	62.5	0.93	E	73.8	0.88	E	44.1	0.79	D
SB TH	9.8	0.90	A	14.3	0.95	B	4.4	0.80	A
OVERALL	18.9	-	B	20.2	-	C	7.7	-	A
2: Maui Veterans Hwy & Mehameha Lp North/Kamaaina Rd									
NB LT	115.0	0.45	F	105.7	0.58	F	105.7	0.58	F
NB TH	12.0	0.57	B	15.9	0.73	B	11.1	0.60	B
NB RT	7.6	0.12	A	7.1	0.04	A	5.9	0.03	A
EB LT	84.6	0.29	F	74.9	0.52	E	83.6	0.73	F
EB TH	82.0	0.05	F	67.7	0.02	E	71.5	0.05	E
EB LT/TH/RT	-	-	-	-	-	-	-	-	-
EB RT	81.6	0.01	F	67.6	0.01	E	71.1	0.01	E
WB LT/TH	88.3	0.46	F	83.4	0.75	F	83.3	0.67	F
WB LT/TH/RT	-	-	-	-	-	-	-	-	-
WB RT	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A
SB LT	90.7	0.89	F	95.0	0.75	F	94.5	0.72	F
SB TH	7.8	0.76	A	31.0	0.96	C	14.2	0.79	B
SB RT	2.4	0.06	A	5.9	0.05	A	5.0	0.07	A
OVERALL	15.7	-	B	27.3	-	C	18.1	-	B
3: Maui Veterans Hwy & DHHL Access									
NB LT	101.6	0.84	F	102.1	0.87	F	91.5	0.90	F
NB TH	2.1	0.68	A	6.3	0.81	A	5.2	0.69	A
EB LT	92.9	0.60	F	87.1	0.81	F	86.2	0.83	F
EB RT	85.7	0.02	F	79.5	0.30	E	74.9	0.04	E
SB TH	4.8	0.52	A	10.6	0.66	B	12.3	0.55	B
SB RT	2.8	0.08	A	5.4	0.11	A	8.1	0.14	A
OVERALL	6.5	-	A	14.0	-	B	16.2	-	B

TABLE 4.3: LOS SUMMARY TABLE
EXISTING, BASE YEAR 2038 AND BASE YEAR 2038 WITH MITIGATION CONDITIONS

	Existing Conditions									Base Year 2038 Conditions									Base Year 2038 with Mitigation Conditions								
	AM			PM			WE			AM			PM			WE			AM			PM			WE		
Intersection	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
4: Maui Veterans Hwy & Mehameha Loop South																											
NB LT	11.5	0.00	B	12.9	0.01	B	0.0	-	A	47.2	0.67	E	119.0	0.94	F	77.4	0.89	F	86.5	0.88	F	89.6	0.87	F	94.5	0.91	F
NB TH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.9	0.74	A	10.0	0.86	A	8.0	0.75	A
NB RT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.5	0.02	A	2.3	0.01	A	2.6	0.00	A
EB LT/TH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	88.5	0.26	F	87.6	0.57	F	87.5	0.57	F
EB LT/TH/RT	-	-	-	-	-	-	-	-	-	33.5	0.34	D	556.0	2.06	F*	285.3	1.49	F*	-	-	-	-	-	-	-	-	-
EB RT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A
WB LT/TH	111.3	0.06	F	144.1	0.08	F	71.9	0.04	F	**	**	**	**	**	**	**	**	**	88.6	0.36	F	79.0	0.27	E	78.8	0.29	E
WB RT	14.1	0.01	B	14.3	0.01	B	12.7	0.01	B	26.3	0.14	D	32.3	0.17	D	25.1	0.13	D	84.9	0.02	F	76.3	0.01	E	75.8	0.01	E
SB LT	12.1	0.01	B	12.2	0.01	B	10.9	0.01	B	23.9	0.15	C	26.2	0.03	D	20.8	0.05	C	108.9	0.77	F	105.0	0.45	F	102.1	0.52	F
SB TH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.8	0.53	A	11.9	0.70	B	13.3	0.60	B
SB RT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.8	0.03	A	5.3	0.01	A	7.5	0.02	A
OVERALL	0.1	-	-	0.1	-	-	0.1	-	-	143.0	-	-	29.9	-	-	20.5	-	-	9.9	-	A	14.4	-	B	16.3	-	B
5: Piilani Hwy/Maui Veterans Hwy & N Kihei Rd/Monsanto Drwy																											
NB LT	29.3	0.76	C	33.4	0.79	C	24.9	0.66	C	41.2	0.84	D	39.9	0.85	D	39.7	0.80	D	77.4	0.90	E	100.2	0.95	F	61.7	0.85	E
NB TH	10.5	0.56	B	11.0	0.58	B	9.5	0.53	A	57.9	1.05	F*	58.9	1.06	F*	23.4	0.92	C	23.8	0.88	C	20.5	0.84	C	15.1	0.80	B
NB RT	7.1	0.01	A	7.2	0.01	A	6.8	0.00	A	9.3	0.01	A	8.5	0.01	A	7.3	0.00	A	8.5	0.01	A	6.9	0.01	A	6.4	0.00	A
EB LT	30.6	0.59	C	33.4	0.51	C	25.6	0.50	C	39.8	0.75	D	39.3	0.66	D	39.0	0.70	D	76.2	0.86	E	98.7	0.84	F	60.8	0.77	E
EB RT	18.2	0.23	B	21.2	0.32	C	17.3	0.14	B	20.7	0.31	C	21.1	0.39	C	24.3	0.29	C	40.4	0.40	D	53.5	0.49	D	40.8	0.42	D
WB LT	57.2	0.48	E	49.2	0.46	D	60.0	0.26	E	70.1	0.54	E	58.3	0.49	E	72.0	0.45	E	111.4	0.61	F	124.1	0.64	F	98.1	0.47	F
WB TH/RT	37.4	0.08	D	41.2	0.16	D	68.9	0.29	E	50.2	0.06	D	49.8	0.18	D	49.9	0.10	D	84.2	0.06	F	103.9	0.24	F	73.6	0.11	E
SB LT	113.7	0.52	F	141.4	0.45	F	79.4	0.32	E	91.0	0.54	F	89.7	0.54	F	86.4	0.54	F	130.2	0.57	F	150.4	0.58	F	113.3	0.56	F
SB TH	22.9	0.81	C	35.1	0.94	D	16.2	0.73	B	192.1	1.35	F*	507.0	2.05	F*	173.9	1.32	F*	33.0	0.70	C	52.8	0.95	D	24.2	0.74	C
SB RT	14.1	0.01	B	15.5	0.12	B	11.7	0.10	B	20.3	0.05	C	25.1	0.49	C	16.3	0.28	B	22.0	0.06	C	29.7	0.48	C	17.6	0.35	B
OVERALL	19.9	-	B	25.4	-	C	15.4	-	B	94.9	-	F	226.3	-	F	84.3	-	F	39.0	-	D	48.7	-	D	27.3	-	C
9: Maui Veterans Hwy & DHHL Access Drwy 1																											
WB RT	-	-	-	-	-	-	-	-	-	34.8	0.31	D	55.7	0.55	F	38.0	0.42	E	34.8	0.31	D	55.7	0.55	F	38.0	0.42	E
OVERALL	-	-	-	-	-	-	-	-	-	0.4	-	-	0.8	-	-	0.6	-	-	0.4	-	-	0.8	-	-	0.6	-	-
10: Maui Veterans Hwy & DHHL Access Drwy 2																											
NB TH	-	-	-	-	-	-	-	-	-	80.0	1.11	F*	65.5	1.08	F*	29.8	0.95	C	18.6	0.79	B	15.7	0.77	B	13.3	0.71	B
NB RT	-	-	-	-	-	-	-	-	-	10.3	0.12	B	8.0	0.05	A	7.9	0.06	A	10.1	0.12	B	7.9	0.05	A	7.6	0.06	A
WB LT	-	-	-	-	-	-	-	-	-	63.6	0.83	E	73.8	0.90	E	78.8	0.90	E	58.0	0.82	E	61.1	0.88	E	53.1	0.86	D
WB RT	-	-	-	-	-	-	-	-	-	49.7	0.02	D	45.3	0.10	D	48.4	0.05	D	45.2	0.02	D	39.6	0.10	D	36.7	0.05	D
SB LT	-	-	-	-	-	-	-	-	-	73.6	0.92	E	84.4	0.83	F	82.8	0.85	F	64.3	0.91	E	70.6	0.82	E	56.1	0.81	E
SB TH	-	-	-	-	-	-	-	-	-	4.1	0.65	A	41.3	1.03	F*	10.6	0.82	B	2.8	0.45	A	7.9	0.73	A	5.5	0.59	A
OVERALL	-	-	-	-	-	-	-	-	-	47.6	-	D	53.8	-	D	24.5	-	C	16.2	-	B	15.1	-	B	12.7	-	B
11: Maui Veterans Hwy & DHHL Access Drwy 3																											
WB RT	-	-	-	-	-	-	-	-	-	30.9	0.11	D	32.5	0.17	D	27.0	0.14	D	30.9	0.11	D	32.5	0.17	D	27.0	0.14	D
OVERALL	-	-	-	-	-	-	-	-	-	0.1	-	-	0.2	-	-	0.1	-	-	0.1	-	-	0.2	-	-	0.1	-	-

* Denotes overcapacity condition, v/c ≥ 1.

** Value not computed in Synchro.

5. FUTURE YEAR 2038 TRAFFIC CONDITIONS

5.1 Background

The Project proposes to develop approximately 280.4 acres of vacant land owned by the Department of Land and Natural Resources (DLNR) previously leased to Hawaiian Commercial & Sugar (HC&S) for agricultural use. As discussed earlier, approximately 200.9 acres is estimated to be developable lands for a mix of light industrial and commercial use. For purposes of this study, approximately 70% (140.63 acres) was allocated to light industrial use and 30% (60.27 acres) allocated to commercial use. It should be noted that DLNR does not intend to construct a large densified shopping center on the 60.27 acres of commercial space. This space will primarily consist of smaller commercial parcels that are spread around the site to serve and complement the industrial uses.

Access to the northern site of the Project will be provided along the existing Kamaaina Road via the Maui Veterans Highway. Additionally, a new signalized intersection is proposed along Maui Veterans Highway, between Kamaaina Road and Mehameha Loop (South) to provide primary access to the Project and to the future DHHL Pulehunui North development located across the Project on the west side of Maui Veterans Highway. The Project will also provide access via the Maui Raceway Park Access Road on the south side of the Project. Secondary eastern Project access will also be provided via South Firebreak Road.

5.1.1 Travel Demand Estimations

The State of Hawaii Department of Transportation (HDOT) and Maui County provide various Transportation Demand Management (TDM) programs that promote the use of transit, walking, biking and alternative modes of transportation to reduce the use of single-occupant vehicles on roadways. These TDM measures have only been identified and conservatively assumed to yield NO vehicular reductions for Project generated traffic.

Maui County currently provides a bus system that offers several routes that connect the major areas in Maui. The Kihei Islander Route 10 provides transportation between Kihei and Kahului via Maui Veterans Highway. However, no stops are currently provided in the study area.

HDOT currently provides the Bike Plan Hawaii Master Plan, which identifies existing and proposed bicycle routes that could potentially be implemented in the future. Within the Project area, a shared use path and a signed shared roadway are currently provided along Maui Veterans Highway.

5.1.2 Trip Generation

The Institute of Transportation Engineers (ITE) publishes a book based upon empirical data compiled from a body of more than 4,250 trip generation studies submitted by public agencies, developers, consulting firms, and associations. This publication, titled Trip Generation Manual, 9th Edition, provides trip rates and/or formulae based on graphs that correlate vehicular trips with independent variables. The independent variables can range from Dwelling Units (DU) for single-family attached homes to Gross Floor Area (GFA) or Acres for commercial or industrial development. These trip rates/formulae and their associated directional distributions were used to estimate the increase in the number of vehicular trips generated by the proposed Project. The rates selected were based on the land use description.

As mentioned above in Section 5.1, DLNR does not intend to construct a large densified shopping center on the 60.27 acres of commercial space. This space will primarily consist of smaller commercial parcels that are spread around the site to serve and complement the industrial uses. However, in order to generate the most conservative trip generation estimate, the Shopping Center (ITE Code 820) was applied to the 60.27 acres of commercial space.

Pass-by trip reductions were applied to the Project-generated trips based upon information within the ITE Trip Generation Handbook. As a conservative measure, a pass-by rate of 20% was applied to the retail component for the PM and WE peak hours of traffic. No pass-by reductions were applied to the AM peak hour.

See Tables 5.1 and 5.2 for Trip Generation formulae/rates and projections for the Project.

5.1.3 Trip Distribution & Assignment

Trips generated by the Project were assigned throughout the study area generally based upon existing travel patterns and the proximity and convenience of access. The traffic generated by the Project was added to the forecast Base Year 2038 traffic volumes within the vicinity of the Project to constitute the traffic volumes for the Future Year 2038 traffic conditions. Figure 5.1 to 5.2 illustrates the Project-generated trip distribution.

Table 5.1: Trip Generation Rates

Land Use (ITE Code)	Independent Variable	AM Peak Hour		PM Peak Hour		WE Peak Hour	
		Trip Rate	% Enter	Trip Rate	% Enter	Trip Rate	% Enter
Industrial Park (130)	Acres	[a]	83%	[b]	21%	4.71	32%
Shopping Center (820)	1,000 SF GLA	[c]	62%	[d]	48%	[e]	52%

[a] LN(T) = 0.78LN(X)+2.82 [b] LN(T) = 0.72LN(X)+3.06

[c] LN(T) = 0.61LN(X)+2.24 [d] LN(T) = 0.67LN(X)+3.31 [e] LN(T) = 0.65LN(X)+3.78

Table 5.2: Project-Generated Trips

Land Use (ITE Code)	Independent Variable	AM Peak Hour			PM Peak Hour			WE Peak Hour		
		Enter (vph)	Exit (vph)	Total (vph)	Enter (vph)	Exit (vph)	Total (vph)	Enter (vph)	Exit (vph)	Total (vph)
Industrial Park (130)	140.6 Acres	549	112	661	125	469	594	212	450	662
Shopping Center (820)	656,300 SF	278	171	449	939	1,017	1,956	1,422	1,313	2,736
	Subtotal	827	283	1,110	1,064	1,486	2,550	1,634	1,763	3,398
	Pass-by (Retail)	0	0	0	-188	-188	-376	-263	-263	-526
Total NEW External Trips		**827**	**283**	**1,110**	**876**	**1,298**	**2,174**	**1,371**	**1,501**	**2,872**

Notes:
SF = Square Feet of Gross Floor Area
1. Due to its close proximity with one another, trips were generated as a single aggregate for the total industrial and/or commercial component for the following three (3) developments. Trips generated by each development were then calculated based on a percentage of its size in relation to the derived aggregate total. Commercial SF calculated based on a 25% floor-area-ratio (FAR) of the 60.27 acres of commercial space.
   a. DHHL Pulehunui North
   b. DHHL Pulehunui South
   c. DLNR Industrial & Business Park.
2. Table 5.2 shows trip generation for full build-out of the DLNR Industrial & Business Park. Note the total DLNR site encompasses approximately 227 acres, exclusive of internal roadways and open space. An additional 26.1 acres is estimated to be allocated for undevelopable drainage and easement space. Therefore, for traffic projection purposes, approximately 200.9 acres was used to forecast traffic based on anticipated available developable land.

5.2 Future Year 2038 Analysis

Upon completion of the Project, traffic in the study area is expected to significantly increase over Base Year 2038 conditions. As a result of the increase in traffic volumes, the following roadway improvements are recommended with the Project and are summarized in Appendix D:

[1] Maui Veterans Highway/Nakii Road

- Widen Maui Veterans Highway to provide an additional southbound through lane, resulting in three southbound through lanes.
  - Northbound: Three (3) through lanes and one (1) right-turn lane.
  - Southbound: Two (2) left-turn lanes and three (3) through lanes.
  - Westbound: One (1) left-turn lane and one (1) right-turn lane.

[2] Maui Veterans Highway/Mehameha Loop (North)/Kamaaina Road

- Provide the following lane configuration:
  - Northbound: One (1) left-turn, three (3) through lanes and one (1) right-turn lane.
  - Southbound: Two (2) left-turn, Three (3) through lanes and one (1) right-turn lane

- Eastbound: One (1) left-turn, one (1) through lane and one (1) right-turn lane.
- Westbound: Two (2) left-turn, one (1) through lane and one (1) right-turn lane with acceleration lane

[3] Maui Veterans Highway/DHHL Access/DLNR Access

- Modify the intersection to add an eastern leg to the intersection, widen Maui Veterans Highway to provide an additional northbound through lane and provide additional widening improvements with the following lane configuration:
    - Northbound: Two (2) left-turn, three (3) through lanes and one (1) right-turn lane
    - Southbound: Two (2) left-turn, three (3) through lanes and one (1) right-turn lane
    - Eastbound: Two (2) left-turn, one (1) through and one (1) right-turn lane.
    - Westbound: Two (2) left-turn, one (1) through lane and one (1) right-turn lane with an acceleration lane.

[4] Maui Veterans Highway/Mehameha Loop (South)/Maui Raceway Park Access Road

- Widen Maui Veterans Highway to provide an additional northbound through lane and widening along Mehameha Loop (South) and Maui Raceway Park Access Road. Provide the following lane configuration:
    - Northbound: One (1) left-turn, three (3) through lanes and one (1) right-turn lane
    - Southbound: One (1) left-turn, three (3) through lanes and one (1) right-turn lane
    - Eastbound: One (1) left-turn, one (1) through lane and one (1) right-turn lane with an acceleration lane.
    - Westbound: One (1) left-turn, one (1) through lane and one (1) right-turn lane.

[5] Maui Veterans Highway/Piilani Highway/North Kihei Road/Monsanto Driveway

- Widen Maui Veterans Highway to provide an additional northbound and southbound through lane, resulting in three through lanes northbound and four through lanes southbound along Maui Veterans Highway.
    - Northbound: Two (2) left-turn, three (3) through lanes and one (1) right-turn lane.
    - Southbound: One (1) left-turn, four (4) through lanes and one (1) right-turn lane.
    - Eastbound: One (1) left-turn, one (1) shared left-turn/through lane and two (2) right-turn lanes.
    - Westbound: One (1) left-turn and one (1) shared through/right-turn lane.

Kamaaina Road, South Firebreak Road & Maui Raceway Park Access Road

- Upgrade roadway to Maui County standards.

For the three (3) proposed DHHL South Parcel accesses, Base Year 2038 conditions recommends a traffic signal with exclusive left-turn and right-turn lanes at the middle DHHL South Access 2 intersection and right-in, right-out (RIRO) accesses a for the northernmost DHHL South Access 1 and southernmost DHHL South Access 3 intersection. In addition, northbound and southbound approaches should provide three (3) through lanes per direction along Piilani Highway.

The signal timing plans at Maui Veterans Highway/Mehameha Loop (North)/Kamaaina Road, Maui Veterans Highway/DHHL Access/DLNR Access and Maui Veterans Highway/Mehameha Loop (South)/Maui Raceway Park Access Road intersections should be optimized to provide favorable throughput progression along Maui Veterans Highway.

As discussed in Section 4.3, for purposes of this TIAR, widening improvements along Maui Veterans Highway were recommended on the need at each study intersection based on LOS analysis for Future Year 2038.

Full build-out of the DLNR Industrial and Business Park project is anticipated to occur after the 2035 estimated need for HDOT's Maui Veterans Highway widening improvement. HDOT's Maui Veterans Highway widening improvement is currently not a funded improvement and is not identified on the latest Statewide Transportation Improvement Program (STIP). Due to the uncertainty of HDOT's Maui Veterans Highway widening improvement, DLNR will coordinate with HDOT on its fair share of improvements. Based on a comparison of the Project traffic increase to total Future Year 2038 forecast traffic, the Project will constitute approximately 18% of all traffic, based on its composite average increase for the AM, PM and Saturday MD peak hours of traffic.

5.2.1 Future Year 2038 Intersection Analysis

As described in Section 4.4.1, the signalization of the new Maui Veterans Highway/DHHL Access/DLNR Access is recommended as the most feasible alternative over a roundabout, full movement two-way stop control and right-in, right-out (RIRO) access in order to produce adequate levels for both the main and minor street movements at the intersection.

With the recommended improvements at the study intersections, all intersections are forecast to continue operating at overall LOS D or better. Although the majority of left-turn and minor street movements are expected to operate at LOS E/F due to the long cycle lengths favoring the through movements along Maui Veterans Highway, all movements are anticipated to operate below capacity during all peak hours of traffic. Additionally, all mainline through movements along the highway are expected to operate at LOS D or better during all peak hours.

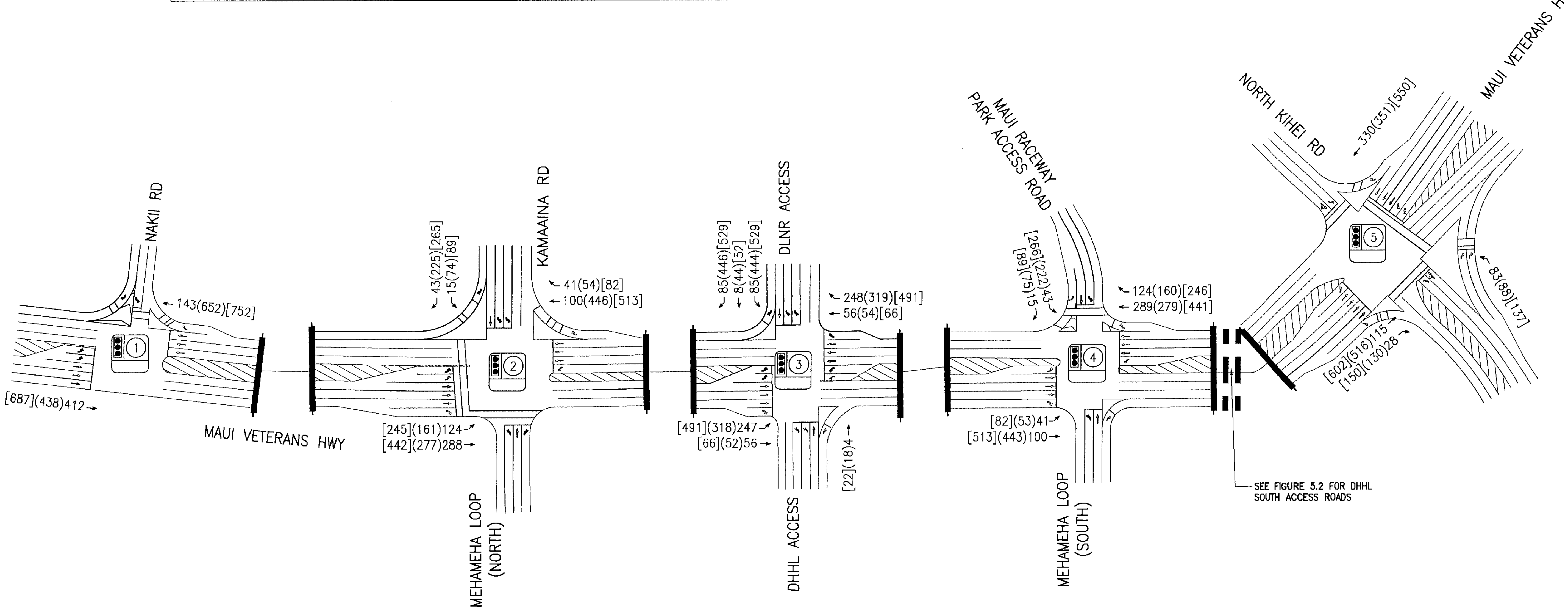
Based on A Policy on Geometric Design of Highways and Streets, by the American Association of State Highway and Transportation Officials, dated 2011 (hereinafter referred to as the "AASHTO Green Book"), left-turn storage lane lengths were determined for all intersections accessing the Project. Tables 5.3 to 5.7 show recommended storage lane lengths along Maui Veterans Highway at its four (4) intersections with Kamaaina Road, DHHL North/DLNR Access, Mehameha Loop South/Maui Raceway Park Road and DHHL South Driveway 2, respectively.

Figures 5.3 to 5.4 and Figures 5.5 to 5.6 illustrate the lane configuration, forecast traffic volumes and movement LOS for Future Year 2038 WITHOUT and WITH the recommended mitigation, respectively. Table 5.8 summarizes the Future Year 2038 LOS at the study intersections compared to Base Year 2038 with mitigation conditions. LOS worksheets are provided in Appendix C.

NORTH

NOT TO SCALE

NOTE:
1. THIS DRAWING IS FOR ILLUSTRATIVE PURPOSES ONLY. DO NOT USE FOR CONSTRUCTION.
2. LANEAGE REFLECTS ALL MITIGATIONS WITHOUT AND WITH THE PROJECT.



LEGEND

##(##)[##] – AM(PM)[WE] PEAK HOUR OF TRAFFIC VOLUMES

(X) – UNSIGNALIZED INTERSECTION X

(Y) – SIGNALIZED INTERSECTION Y

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PROJECT-GENERATED TRAFFIC

FIGURE 5.1

NORTH

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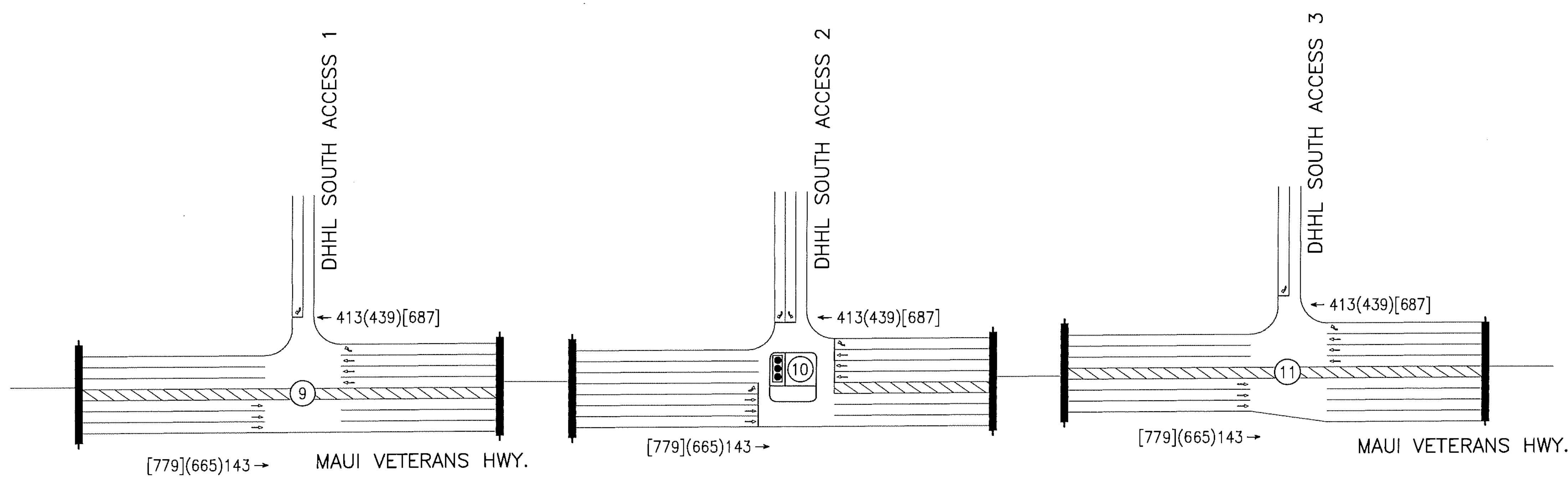

LEGEND

##(##)[##] – AM(PM)[WE] PEAK HOUR OF TRAFFIC VOLUMES

(X) – UNSIGNALIZED INTERSECTION X

(Y) – SIGNALIZED INTERSECTION Y

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PROJECT GENERATED TRAFFIC - CONTINUATION

FIGURE 5.2

Table 5.3 Future Year 2038
Left-Turn Storage Lane Length Calculations

Maui Veterans Highway & Nakii Road Intersection										
				AASHTO						
Movement [1]	Peak Hour	Passenger Car Volume (veh)	Heavy Vehicle Truck Volume (veh)	Cycle Length (sec)	Cycles per Hour	Average Veh. per Cycle per lane	Average HV per Cycle per lane [2]	Minimum Storage Length (1.5 Factor) [3]		Recommended storage length [4]
								Vehicle Equivalent	Ft	
Southbound Left-turn lane	AM	360	20	180	20	9	1	18	**450**	450 ft.
	PM	180	15	130	28	4	1	11	275	
	WE	105	10	180	20	3	1	9	225	
Westbound Left-turn lane	AM	75	20	180	20	4	1	11	**275**	275 ft.
	PM	75	5	180	20	4	1	11	275	
	WE	25	5	180	20	2	1	8	200	

Notes:

1. For double left-turns, assumes a 50/50 split between turning lanes when determing design volume per lane.

2. Includes heavy vehicle trucks; Assume 1 HV truck = 3 passenger car vehicles.

3. Minimum storage length is 1.5 times the average number of passenger car vehicles per cycle; assume 1 vehicle length = 25 ft.

4. Recommended storage length is exclusive of taper length or deceleration length. To be verified upon design.

Table 5.4: Future Year 2038
Left-Turn Storage Lane Length Calculations

Maui Veterans Highway & Kamaaina Road & Mehameha Loop (North) Intersection										
				AASHTO						
Movement [1]	Peak Hour	Passenger Car Volume (veh)	Heavy Vehicle Truck Volume (veh)	Cycle Length (sec)	Cycles per Hour	Average Veh. per Cycle per lane	Average HV per Cycle per lane [2]	Minimum Storage Length (1.5 Factor) [3]		Recommended storage length [4]
								Vehicle Equivalent	Ft	
Northbound Left-turn lane	AM	5	0	180	20	1	0	2	**50**	50 ft.
	PM	15	0	180	20	1	0	2	50	
	WE	15	0	180	20	1	0	2	50	
Southbound Left-turn lane	AM	390	95	180	20	10	3	29	**725**	725 ft.
	PM	235	25	180	20	6	1	14	350	
	WE	315	20	180	20	8	1	17	425	
Eastbound Left-turn lane	AM	30	5	180	20	2	1	8	200	375 ft.
	PM	125	5	180	20	7	1	15	375	
	WE	140	5	180	20	7	1	15	**375**	
Westbound Left-turn lane	AM	50	15	180	20	2	1	8	200	350 ft.
	PM	220	40	180	20	6	1	14	**350**	
	WE	175	15	180	20	5	1	12	300	

Notes:

1. For double left-turns, assumes a 50/50 split between turning lanes when determing design volume per lane.
2. Includes heavy vehicle trucks; Assume 1 HV truck = 3 passenger car vehicles.
3. Minimum storage length is 1.5 times the average number of passenger car vehicles per cycle; assume 1 vehicle length = 25 ft.
4. Recommended storage length is exclusive of taper length or deceleration length. To be verified upon design.

Table 5.5: Future Year 2038
Left-Turn Storage Lane Length Calculations

Maui Veterans Highway & DHHL Access & DLNR Access Intersection										
				AASHTO						
Movement [1]	Peak Hour	Passenger Car Volume (veh)	Heavy Vehicle Truck Volume (veh)	Cycle Length (sec)	Cycles per Hour	Average Veh. per Cycle per lane	Average HV per Cycle per lane [2]	Minimum Storage Length (1.5 Factor) [3]		Recommended storage length [4]
								Vehicle Equivalent	Ft	
Northbound Left-turn lane	AM	90	5	180	20	3	1	9	225	300 ft.
	PM	110	5	180	20	3	1	9	225	
	WE	170	5	180	20	5	1	12	**300**	
Southbound Left-turn lane	AM	250	10	180	20	7	1	15	375	600 ft.
	PM	320	5	180	20	8	1	17	425	
	WE	495	5	180	20	13	1	24	**600**	
Eastbound Left-turn lane	AM	45	5	180	20	2	1	8	200	350 ft
	PM	195	5	180	20	5	1	12	300	
	WE	225	5	180	20	6	1	14	**350**	
Westbound Left-turn lane	AM	85	10	180	20	3	1	9	225	650 ft.
	PM	445	10	180	20	12	1	23	575	
	WE	530	5	180	20	14	1	26	**650**	

Notes:

1. For double left-turns, assumes a 50/50 split between turning lanes when determing design volume per lane.
2. Includes heavy vehicle trucks; Assume 1 HV truck = 3 passenger car vehicles.
3. Minimum storage length is 1.5 times the average number of passenger car vehicles per cycle; assume 1 vehicle length = 25 ft.
4. Recommended storage length is exclusive of taper length or deceleration length. To be verified upon design.

Table 5.6: Future Year 2038
Left-Turn Storage Lane Length Calculations

Maui Veterans Highway & Mehameha Loop (South) Intersection										
				AASHTO						Recommended storage length [4]
Movement [1]	Peak Hour	Passenger Car Volume (veh)	Heavy Vehicle Truck Volume (veh)	Cycle Length (sec)	Cycles per Hour	Average Veh. per Cycle per lane	Average HV per Cycle per lane [2]	Minimum Storage Length (1.5 Factor) [3]		
								Vehicle Equivalent	Ft	
Northbound Left-turn lane	AM	140	5	180	20	7	1	15	375	500 ft
	PM	125	5	180	20	7	1	15	375	
	WE	190	5	180	20	10	1	20	**500**	
Southbound Left-turn lane	AM	70	5	180	20	4	1	11	275	300 ft
	PM	60	0	180	20	3	0	5	125	
	WE	95	5	180	20	5	1	12	**300**	
Eastbound Left-turn lane	AM	10	5	180	20	1	1	6	150	225 ft
	PM	50	5	180	20	3	1	9	225	
	WE	50	5	180	20	3	1	9	**225**	
Westbound Left-turn lane	AM	65	5	180	20	4	1	11	275	675 ft
	PM	245	5	180	20	13	1	24	600	
	WE	290	5	180	20	15	1	27	**675**	

Notes:

1. For double left-turns, assumes a 50/50 split between turning lanes when determing design volume per lane.
2. Includes heavy vehicle trucks; Assume 1 HV truck = 3 passenger car vehicles.
3. Minimum storage length is 1.5 times the average number of passenger car vehicles per cycle; assume 1 vehicle length = 25 ft.
4. Recommended storage length is exclusive of taper length or deceleration length. To be verified upon design.

Table 5.7: Future Year 2038
Left-Turn Storage Lane Length Calculations

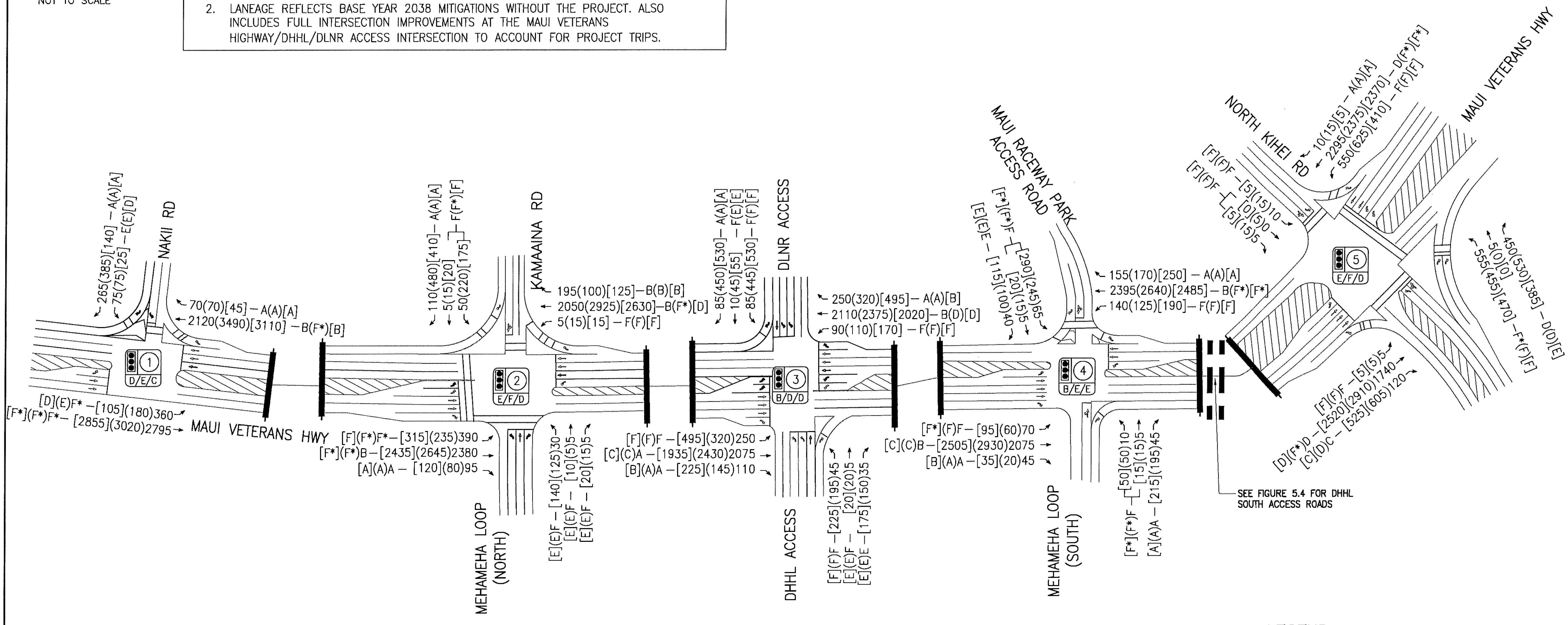
Maui Veterans Highway & DHHL South Driveway 2 Intersection										
				AASHTO						
Movement [1]	Peak Hour	Passenger Car Volume (veh)	Heavy Vehicle Truck Volume (veh)	Cycle Length (sec)	Cycles per Hour	Average Veh. per Cycle per lane	Average HV per Cycle per lane [2]	Minimum Storage Length (1.5 Factor) [3]		Recommended storage length [4]
								Vehicle Equivalent	Ft	
Southbound Left-turn lane	AM	290	15	180	20	15	1	27	**675**	675 ft
	PM	115	5	180	20	6	1	14	350	
	WE	125	10	180	20	7	1	15	375	
Westbound Left-turn lane	AM	130	10	180	20	7	1	15	375	575 ft
	PM	235	10	180	20	12	1	23	**575**	
	WE	215	10	180	20	11	1	21	525	

Notes:

1. Includes heavy vehicle trucks; Assume 1 HV truck = 3 passenger car vehicles.
2. Minimum storage length is 1.5 times the average number of passenger car vehicles per cycle; assume 1 vehicle length = 25 ft.
3. Recommended storage length is exclusive of taper length or deceleration length. To be verified upon design.

NORTH
NOT TO SCALE

NOTE:
1. THIS DRAWING IS FOR ILLUSTRATIVE PURPOSES ONLY. DO NOT USE FOR CONSTRUCTION.
2. LANEAGE REFLECTS BASE YEAR 2038 MITIGATIONS WITHOUT THE PROJECT. ALSO INCLUDES FULL INTERSECTION IMPROVEMENTS AT THE MAUI VETERANS HIGHWAY/DHHL/DLNR ACCESS INTERSECTION TO ACCOUNT FOR PROJECT TRIPS.



LEGEND

##(##)[##] – AM(PM)[WE] PEAK HOUR OF TRAFFIC VOLUMES

(X) – UNSIGNALIZED INTERSECTION X

(Y) A/A/A – SIGNALIZED INTERSECTION Y, OVERALL AM/PM/WE LOS

A(A)[A] – AM(PM)[WE] LOS

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FUTURE YEAR 2038 WITH PROJECT (WITHOUT MITIGATION) LANE CONFIGURATION, VOLUMES AND MOVEMENT LOS

FIGURE 5.3

NORTH

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NOTE:
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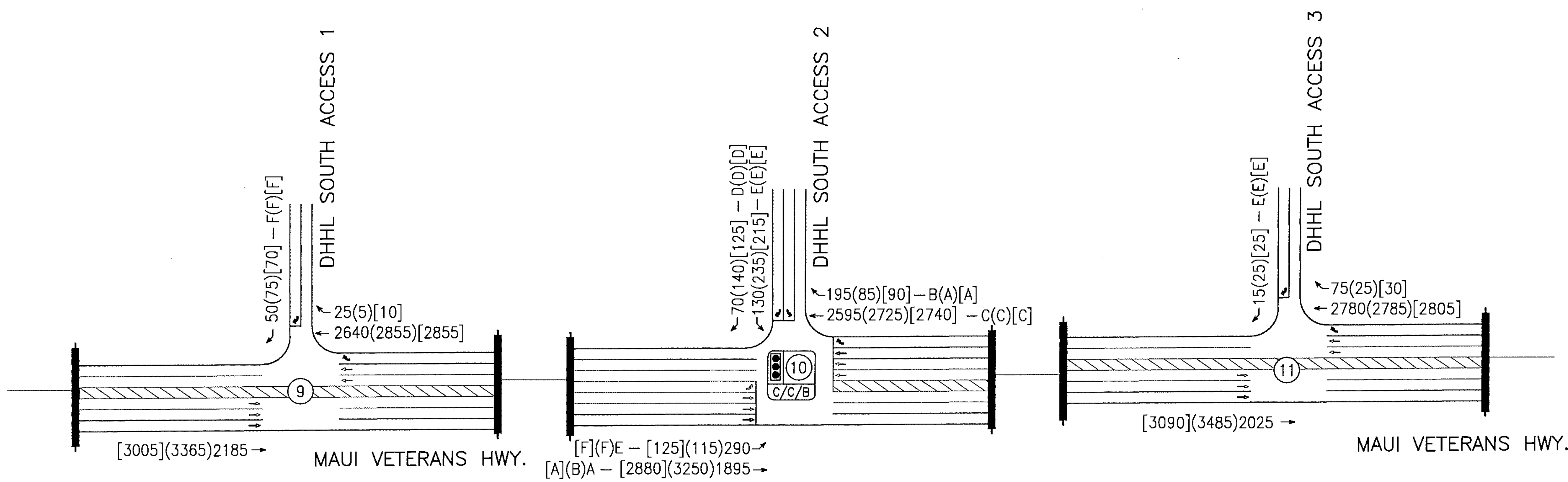

LEGEND

##(##)[##] – AM(PM)[WE] PEAK HOUR OF TRAFFIC VOLUMES

(X) – UNSIGNALIZED INTERSECTION X

(Y) A/A/A – SIGNALIZED INTERSECTION Y, OVERALL AM/PM/WE LOS

A(A)[A] – AM(PM)[WE] LOS

DLNR INDUSTRIAL AND BUSINESS PARK TIAR

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FUTURE YEAR 2038 WITH PROJECT (WITHOUT MITIGATION) LANE CONFIGURATION, VOLUMES AND MOVEMENT LOS - CONTINUATION

FIGURE 5.4

NORTH

NOT TO SCALE

NOTE:
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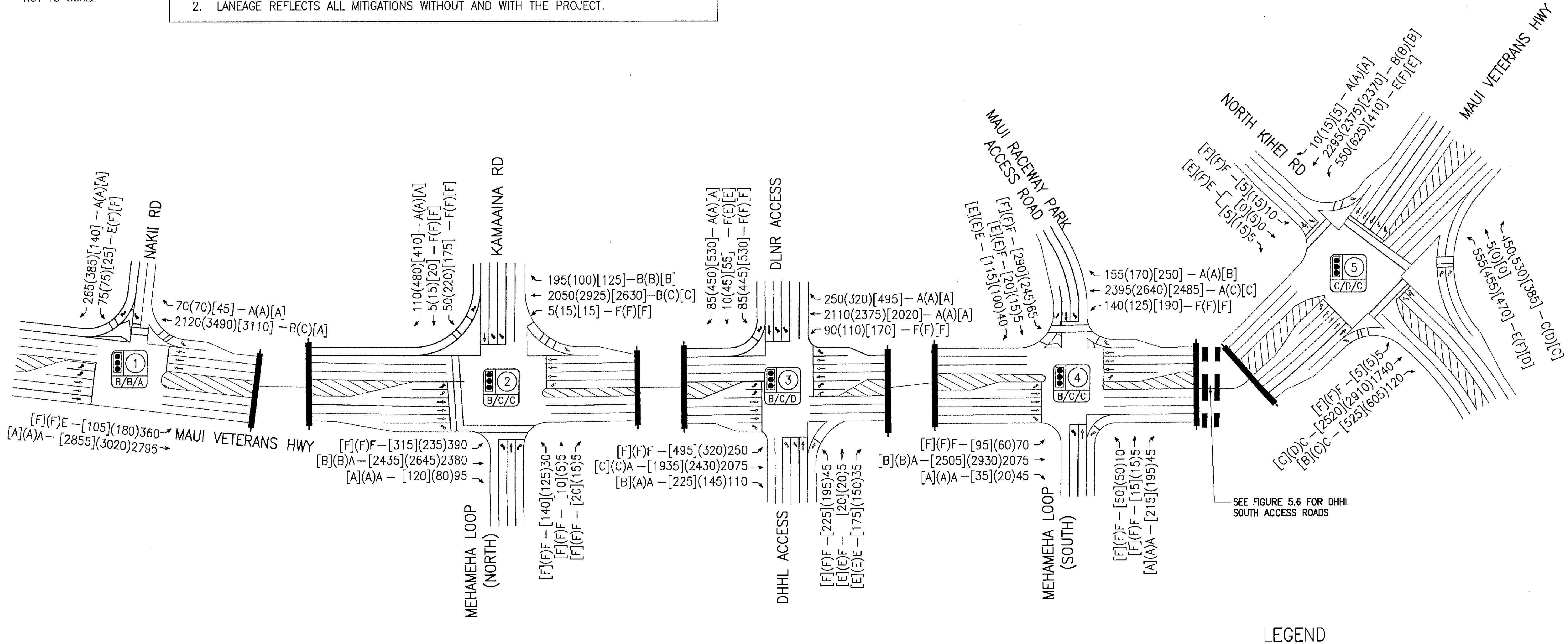


LEGEND

##(##)[##] – AM(PM)[WE] PEAK HOUR OF TRAFFIC VOLUMES

(X) – UNSIGNALIZED INTERSECTION X

(Y) A/A/A – SIGNALIZED INTERSECTION Y, OVERALL AM/PM/WE LOS

A(A)[A] – AM(PM)[WE] LOS

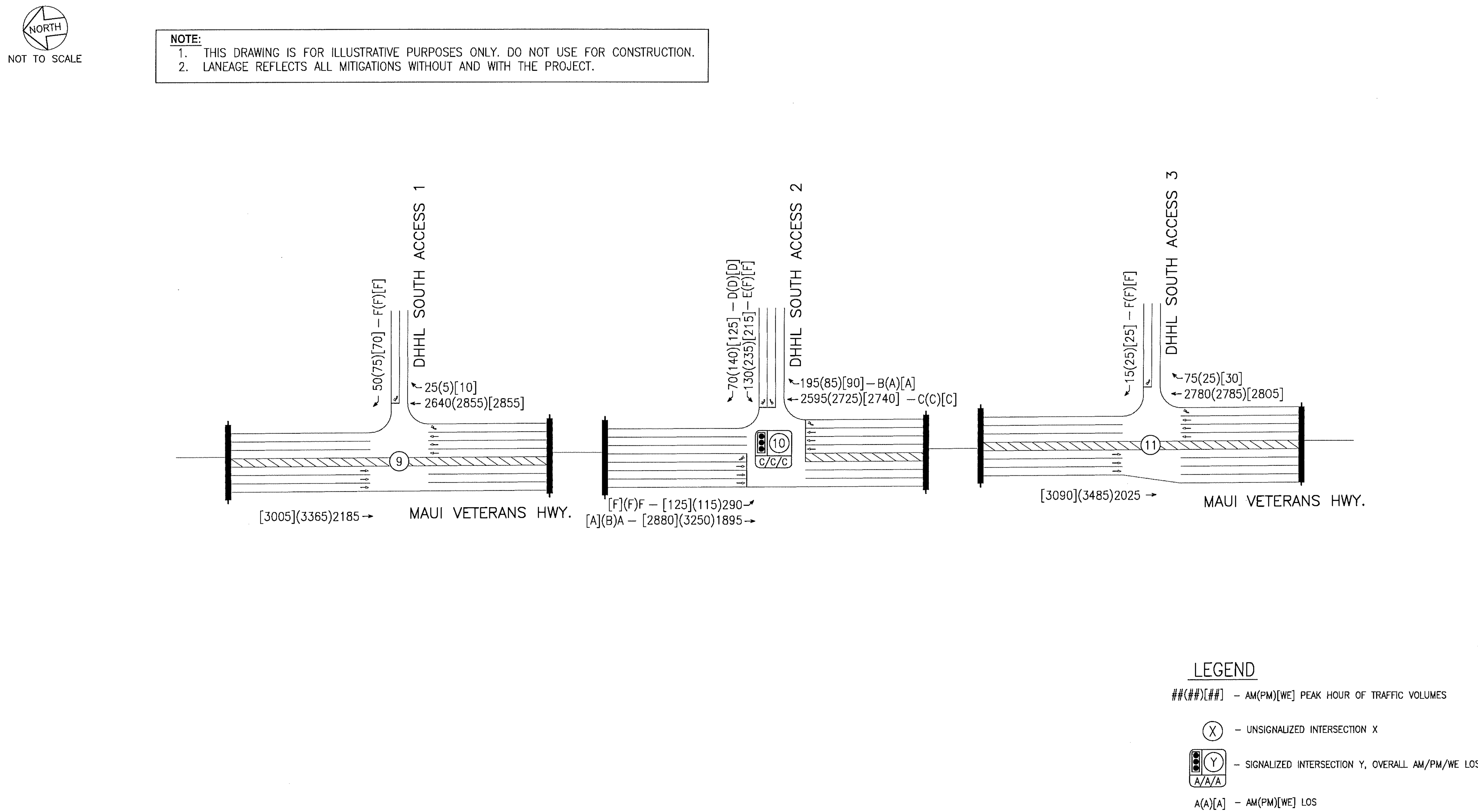
DLNR INDUSTRIAL AND BUSINESS PARK TIAR

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS, SURVEYORS • HONOLULU, HAWAII

FUTURE YEAR 2038 WITH PROJECT (WITH MITIGATION) LANE CONFIGURATION, VOLUMES AND MOVEMENT LOS

FIGURE 5.5

NOTE:
1. THIS DRAWING IS FOR ILLUSTRATIVE PURPOSES ONLY. DO NOT USE FOR CONSTRUCTION.
2. LANEAGE REFLECTS ALL MITIGATIONS WITHOUT AND WITH THE PROJECT.



DLNR INDUSTRIAL AND BUSINESS PARK TIAR

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS, SURVEYORS • HONOLULU, HAWAII

FUTURE YEAR 2038 WITH PROJECT (WITH MITIGATION) LANE CONFIGURATION, VOLUMES AND MOVEMENT LOS - CONTINUATION

FIGURE 5.6

TABLE 5.8: LOS SUMMARY TABLE
BASE YEAR 2038 WITH MITIGATION, FUTURE YEAR 2038 AND FUTURE YEAR 2038 WITH MITIGATION CONDITIONS

Intersection	Base Year 2038 with Mitigation Conditions									Future Year 2038 Conditions									Future Year 2038 with Mitigation Conditions								
	AM			PM			WE			AM			PM			WE			AM			PM			WE		
	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
1: Maui Veterans Hwy & Nakii Rd																											
NB TH	20.5	0.81	C	21.4	0.93	C	8.7	0.74	A	13.2	0.72	B	81.8	1.13	F*	15.3	0.92	B	14.0	0.69	B	22.5	0.94	C	8.2	0.81	A
NB RT	11.2	0.04	B	6.5	0.04	A	4.1	0.03	A	7.0	0.04	A	6.3	0.04	A	3.8	0.03	A	7.6	0.05	A	4.7	0.05	A	2.5	0.03	A
WB LT	57.8	0.81	E	59.3	0.77	E	47.4	0.57	D	56.2	0.78	E	59.4	0.77	E	54.3	0.56	D	74.0	0.84	E	111.1	0.83	F	92.8	0.72	F
WB RT	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A
SB LT	62.5	0.93	E	73.8	0.88	E	44.1	0.79	D	310.3	1.56	F*	72.3	0.87	E	51.0	0.79	D	56.6	0.83	E	101.9	0.84	F	82.8	0.73	F
SB TH	9.8	0.90	A	14.3	0.95	B	4.4	0.80	A	37.0	1.04	F*	62.5	1.11	F*	29.1	1.02	F*	4.4	0.71	A	4.5	0.72	A	2.2	0.67	A
OVERALL	18.9	-	B	20.2	-	C	7.7	-	A	45.9	-	D	72.3	-	E	22.4	-	C	12.7	-	B	17.5	-	B	7.0	-	A
2: Maui Veterans Hwy & Mehameha Lp North/Kamaaina Rd																											
NB LT	115.0	0.45	F	105.7	0.58	F	105.7	0.58	F	115.0	0.45	F	105.7	0.58	F	105.7	0.58	F	116.1	0.46	F	105.7	0.58	F	106.5	0.59	F
NB TH	12.0	0.57	B	15.9	0.73	B	11.1	0.60	B	19.3	0.66	B	50.1	1.00	F*	41.8	0.95	D	19.8	0.66	B	33.3	0.94	C	31.0	0.88	C
NB RT	7.6	0.12	A	7.1	0.04	A	5.9	0.03	A	12.8	0.22	B	13.6	0.07	B	16.1	0.09	B	12.2	0.16	B	10.8	0.07	B	12.7	0.08	B
EB LT	84.6	0.29	F	74.9	0.52	E	83.6	0.73	F	83.1	0.26	F	62.1	0.34	E	67.8	0.45	E	114.5	0.79	F	110.3	0.88	F	114.3	0.89	F
EB TH	82.0	0.05	F	67.7	0.02	E	71.5	0.05	E	80.8	0.05	F	57.0	0.01	E	61.2	0.03	E	86.9	0.11	F	86.1	0.10	F	81.7	0.11	F
EB RT	81.6	0.01	F	67.6	0.01	E	71.1	0.01	E	80.5	0.01	F	56.9	0.01	E	60.9	0.01	E	85.9	0.03	F	85.3	0.02	F	80.9	0.01	F
WB LT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	95.2	0.66	F	87.2	0.85	F	88.8	0.81	F
WB TH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	86.0	0.10	F	86.9	0.26	F	91.5	0.42	F
WB LT/TH	88.3	0.46	F	83.4	0.75	F	83.3	0.67	F	87.8	0.52	F	135.0	1.01	F*	86.1	0.80	F	-	-	-	-	-	-	-	-	-
WB RT	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A
SB LT	90.7	0.89	F	95.0	0.75	F	94.5	0.72	F	690.2	2.33	F*	224.8	1.24	F*	89.8	0.89	F	84.9	0.90	F	105.0	0.88	F	91.3	0.88	F
SB TH	7.8	0.76	A	31.0	0.96	C	14.2	0.79	B	12.3	0.87	B	119.3	1.19	F*	60.8	1.05	F*	6.9	0.62	A	15.5	0.76	B	14.1	0.70	B
SB RT	2.4	0.06	A	5.9	0.05	A	5.0	0.07	A	2.6	0.06	A	9.7	0.06	A	8.4	0.08	A	3.3	0.06	A	6.4	0.05	A	6.8	0.08	A
OVERALL	15.7	-	B	27.3	-	C	18.1	-	B	67.8	-	E	88.5	-	F	53.7	-	D	19.8	-	B	31.8	-	C	30.9	-	C
3: Maui Veterans Hwy & DHHL Access/DLNR Access																											
NB LT	101.6	0.84	F	102.1	0.87	F	91.5	0.90	F	92.4	0.72	F	91.8	0.75	F	98.3	0.83	F	87.1	0.73	F	84.7	0.76	F	86.1	0.83	F
NB TH	2.1	0.68	A	6.3	0.81	A	5.2	0.69	A	11.9	0.61	B	41.6	0.91	D	54.5	0.93	D	0.5	0.61	A	2.8	0.90	A	8.8	0.92	A
NB RT	-	-	-	-	-	-	-	-	-	5.5	0.18	A	9.2	0.22	A	16.6	0.39	B	0.2	0.17	A	0.2	0.22	A	2.1	0.38	A
EB LT	92.9	0.60	F	87.1	0.81	F	86.2	0.83	F	90.7	0.52	F	88.1	0.82	F	87.1	0.83	F	91.4	0.55	F	88.0	0.81	F	87.0	0.83	F
EB TH	-	-	-	-	-	-	-	-	-	86.3	0.10	F	78.9	0.16	E	76.2	0.13	E	86.3	0.10	F	79.0	0.16	E	76.2	0.13	E
EB RT	85.7	0.02	F	79.5	0.30	E	74.9	0.04	E	78.5	0.01	E	77.1	0.54	E	72.2	0.53	E	78.5	0.01	E	77.1	0.53	E	72.3	0.53	E
WB LT	-	-	-	-	-	-	-	-	-	92.0	0.70	F	90.5	0.91	F	95.0	0.94	F	92.0	0.70	F	89.4	0.91	F	93.6	0.94	F
WB TH	-	-	-	-	-	-	-	-	-	84.7	0.15	F	66.2	0.17	E	62.3	0.18	E	84.6	0.15	F	66.8	0.17	E	62.7	0.18	E
WB RT	-	-	-	-	-	-	-	-	-	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A
SB LT	-	-	-	-	-	-	-	-	-	94.7	0.87	F	98.9	0.90	F	92.3	0.93	F	93.3	0.86	F	98.5	0.90	F	91.7	0.92	F
SB TH	4.8	0.52	A	10.6	0.66	B	12.3	0.55	B	7.4	0.56	A	29.2	0.83	C	30.4	0.73	C	7.4	0.56	A	28.4	0.82	C	29.9	0.72	C
SB RT	2.8	0.08	A	5.4	0.11	A	8.1	0.14	A	3.2	0.07	A	9.0	0.10	A	12.5	0.16	B	3.2	0.07	A	8.7	0.10	A	12.3	0.16	B
OVERALL	6.5	-	A	14.0	-	B	16.2	-	B	17.6	-	B	44.6	-	D	53.1	-	D	12.4	-	B	29.3	-	C	36.3	-	D

TABLE 5.8: LOS SUMMARY TABLE
BASE YEAR 2038 WITH MITIGATION, FUTURE YEAR 2038 AND FUTURE YEAR 2038 WITH MITIGATION CONDITIONS (CONTINUED)

Intersection	Base Year 2038 with Mitigation Conditions									Future Year 2038 Conditions									Future Year 2038 with Mitigation Conditions								
	AM			PM			WE			AM			PM			WE			AM			PM			WE		
	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
4: Maui Veterans Hwy & Mehameha Loop South																											
NB LT	86.5	0.88	F	89.6	0.87	F	94.5	0.91	F	83.0	0.89	F	84.0	0.87	F	83.4	0.91	F	93.4	0.88	F	94.6	0.87	F	107.4	0.91	F
NB TH	4.9	0.74	A	10.0	0.86	A	8.0	0.75	A	14.1	0.91	B	68.5	1.10	F*	41.3	1.03	F*	9.7	0.65	A	20.2	0.80	C	25.7	0.81	C
NB RT	1.5	0.02	A	2.3	0.01	A	2.6	0.00	A	3.8	0.10	A	6.9	0.12	A	7.2	0.17	A	4.9	0.10	A	8.9	0.11	A	12.7	0.17	B
EB LT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	86.0	0.14	F	82.6	0.37	F	82.6	0.37	F
EB TH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	88.6	0.14	F	89.2	0.31	F	89.2	0.31	F
EB LT/TH	88.5	0.26	F	87.6	0.57	F	87.5	0.57	F	83.8	0.24	F	477.2	1.68	F*	477.2	1.68	F*	-	-	-	-	-	-	-	-	-
EB RT	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A
WB LT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	81.9	0.48	F	105.6	0.91	F	95.1	0.90	F
WB TH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	80.5	0.05	F	71.4	0.07	E	66.3	0.08	E
WB LT/TH	88.6	0.36	F	79.0	0.27	E	78.8	0.29	E	86.1	0.57	F	157.9	1.08	F*	235.5	1.29	F*	-	-	-	-	-	-	-	-	-
WB RT	84.9	0.02	F	76.3	0.01	E	75.8	0.01	E	77.8	0.01	E	67.1	0.20	E	68.0	0.27	E	71.7	0.01	E	64.0	0.04	E	56.6	0.05	E
SB LT	108.9	0.77	F	105.0	0.45	F	102.1	0.52	F	124.5	0.82	F	196.1	0.99	F	412.6	1.59	F*	105.7	0.82	F	96.5	0.80	F	122.1	0.91	F
SB TH	6.8	0.53	A	11.9	0.70	B	13.3	0.60	B	10.4	0.59	B	28.5	0.91	C	27.2	0.83	C	0.6	0.60	A	12.6	0.95	B	19.5	0.91	B
SB RT	3.8	0.03	A	5.3	0.01	A	7.5	0.02	A	5.6	0.03	A	9.1	0.01	A	11.7	0.02	B	0.0	0.03	A	3.8	0.01	A	8.2	0.02	A
OVERALL	9.9	-	A	14.4	-	B	16.3	-	B	17.0	-	B	57.9	-	E	56.7	-	E	10.7	-	B	22.8	-	C	31.2	-	C
5: Piilani Hwy/Maui Veterans Hwy & N Kihei Rd/Monsanto Drwy																											
NB LT	77.4	0.90	E	100.2	0.95	F	61.7	0.85	E	100.5	0.93	F	106.4	0.96	F	95.2	0.90	F	67.6	0.89	E	106.9	0.96	F	60.3	0.86	E
NB TH	23.8	0.88	C	20.5	0.84	C	15.1	0.80	B	45.6	0.99	D	49.6	1.01	F*	47.1	1.01	F*	19.3	0.76	B	17.4	0.70	B	18.1	0.79	B
NB RT	8.5	0.01	A	6.9	0.01	A	6.4	0.00	A	8.8	0.01	A	8.2	0.01	A	7.8	0.00	A	9.7	0.01	A	8.3	0.01	A	8.4	0.00	A
EB LT	76.2	0.86	E	98.7	0.84	F	60.8	0.77	E	120.7	1.00	F*	99.8	0.89	F	98.6	0.90	F	68.4	0.87	E	99.3	0.88	F	52.5	0.80	D
EB RT	40.4	0.40	D	53.5	0.49	D	40.8	0.42	D	49.9	0.41	D	51.3	0.48	D	55.9	0.40	E	32.2	0.30	C	51.9	0.48	D	32.3	0.34	C
WB LT	111.4	0.61	F	124.1	0.64	F	98.1	0.47	F	134.3	0.64	F	125.8	0.65	F	132.7	0.50	F	101.2	0.59	F	128.3	0.65	F	91.0	0.47	F
WB TH/RT	84.2	0.06	F	103.9	0.24	F	73.6	0.11	E	102.3	0.07	F	105.2	0.24	F	104.8	0.11	F	76.0	0.06	E	107.0	0.24	F	67.1	0.10	E
SB LT	130.2	0.57	F	150.4	0.58	F	113.3	0.56	F	151.3	0.58	F	151.9	0.58	F	149.1	0.58	F	120.7	0.56	F	153.9	0.58	F	105.9	0.55	F
SB TH	33.0	0.70	C	52.8	0.95	D	24.2	0.74	C	37.3	0.70	D	140.1	1.19	F*	43.2	0.92	D	32.2	0.65	C	54.4	0.95	D	31.2	0.87	C
SB RT	22.0	0.06	C	29.7	0.48	C	17.6	0.35	B	24.2	0.09	C	38.3	0.66	D	25.3	0.51	C	23.3	0.07	C	31.9	0.45	C	19.6	0.32	B
OVERALL	39.0	-	D	48.7	-	D	27.3	-	C	56.1	-	E	92.6	-	F	51.5	-	D	34.1	-	C	48.6	-	D	29.5	-	C
9: Maui Veterans Hwy & DHHL South Dwy 1																											
WB RT	34.8	0.31	D	55.7	0.55	F	38.0	0.42	E	55.6	0.44	F	116.5	0.80	F	106.1	0.75	F	73.7	0.53	F	173.7	0.96	F	156.5	0.90	F
OVERALL	0.4	-	-	0.8	-	-	0.6	-	-	0.6	-	-	1.4	-	-	1.3	-	-	0.8	-	-	2.1	-	-	1.8	-	-
10: Maui Veterans Hwy & DHHL Access Drwy 2																											
NB TH	18.6	0.79	B	15.7	0.77	B	13.3	0.71	B	26.6	0.92	C	22.0	0.90	C	21.2	0.88	C	30.5	0.94	C	24.9	0.92	C	23.3	0.90	C
NB RT	10.1	0.12	B	7.9	0.05	A	7.6	0.06	A	10.4	0.12	B	8.0	0.05	A	7.9	0.06	A	11.5	0.13	B	8.9	0.06	A	8.6	0.06	A
WB LT	58.0	0.82	E	61.1	0.88	E	53.1	0.86	D	64.0	0.83	E	72.7	0.90	E	78.0	0.90	E	67.7	0.84	E	80.4	0.92	F	83.7	0.91	F
WB RT	45.2	0.02	D	39.6	0.10	D	36.7	0.05	D	49.2	0.02	D	44.9	0.11	D	48.1	0.05	D	50.3	0.02	D	44.3	0.12	D	48.3	0.05	D
SB LT	64.3	0.91	E	70.6	0.82	E	56.1	0.81	E	73.1	0.92	E	83.3	0.83	F	82.0	0.84	F	84.8	0.95	F	87.3	0.84	F	88.5	0.86	F
SB TH	2.8	0.45	A	7.9	0.73	A	5.5	0.59	A	3.0	0.49	A	14.1	0.90	B	8.8	0.78	A	3.1	0.49	A	16.4	0.92	B	9.5	0.79	A
OVERALL	16.2	-	B	15.1	-	B	12.7	-	B	21.0	-	C	20.9	-	C	18.5	-	B	23.9	-	C	23.7	-	C	20.2	-	C
11: Maui Veterans Hwy & DHHL Access Drwy 3																											
WB RT	30.9	0.11	D	32.5	0.17	D	27.0	0.14	D	43.8	0.15	E	48.7	0.25	E	49.7	0.25	E	50.6	0.17	F	61.4	0.30	F	62.3	0.31	F
OVERALL	0.1	-	-	0.2	-	-	0.1	-	-	0.1	-	-	0.2	-	-	0.2	-	-	0.2	-	-	0.2	-	-	0.3	-	-

* Denotes overcapacity condition, v/c ≥ 1.

6. CONCLUSIONS

The Project proposes to develop approximately 280.4 acres of vacant land owned by the Department of Land and Natural Resources (DLNR) previously leased to Hawaiian Commercial & Sugar (HC&S) for agricultural use. As discussed earlier, approximately 200.9 acres is estimated to be developable lands for a mix of light industrial and commercial use. For purposes of this study, approximately 70% (140.63 acres) was allocated to light industrial use and 30% (60.27 acres) allocated to commercial use. It should be noted that DLNR does not intend to construct a large densified shopping center on the 60.27 acres of commercial space. This space will primarily consist of smaller commercial parcels that are spread around the site to serve and complement the industrial uses.

Access to the northern site of the Project will be provided along the existing Kamaaina Road via the Maui Veterans Highway. Additionally, a new signalized intersection is proposed along Maui Veterans Highway, between Kamaaina Road and Mehameha Loop (South) to provide primary access to the Project and to the future DHHL Pulehunui North development located across the Project on the west side of Maui Veterans Highway. The Project will also provide access via the Maui Raceway Park Access Road on the south side of the Project. Secondary eastern Project access will also be provided via South Firebreak Road.

6.1 Existing Conditions

No significant delays or queuing were observed at the study intersections. All intersection movements generally operated adequately at LOS D or better. However, various left-turn and minor street movements operated at LOS E/F during the peak hours of traffic generally due to low movement volumes of 10 or fewer vehicles per peak hour.

6.2 Base Year 2038

Projections for Base Year 2038 traffic included increases generated by a 2.1 percent annual growth rate along Maui Veterans Highway and numerous developments forecast to be completed within the vicinity of the Project. These nearby developments include the DHHL North & South Parcels, Maui Regional Public Safety Complex (MRPSC), Puunene Heavy Industrial Subdivision, Central Maui Baseyard Expansion, Piilani Promenade, Maui Bay Villas (formerly Maui Lu), Kihei High School, Maui Business Park Phase II, Kihei Residential, Kaiwahine Village, Kenolio Apartments, Maui Research & Technology Park, Krausz Downtown Kihei, Liloa Village, South Maui Community Park and Alahele Subdivision.

Various widening improvements are proposed at the Maui Veterans Highway/Mehameha Loop (North)/Kamaaina Road intersection as part of the development of the Puunene Heavy Industrial Subdivision. The State of Hawaii Department of Transportation's (HDOT) *Federal Aid Highways 2035 Transportation Plan for the District of Maui* (Plan) dated July 2014 (hereinafter referred to as "HDOT 2035 Transportation Plan") estimated that by the year 2035, traffic volumes on Maui Veterans Highway will increase by over 80 percent due to nearby population and land development growth in the area. To increase highway capacity and accommodate this traffic growth, the HDOT 2035 Transportation Plan identified the widening of Maui Veterans Highway to construct two (2) additional travel lanes on Maui Veterans Highway from Kuihelani Highway in Kahului to Piilani Highway in Kihei as a potential need by Year 2035. It should be noted that this Maui Veterans Highway Widening improvement is currently not a DOT-funded or approved project and is only an identified roadway capacity solution for long range planning purposes. This TIAR does not assume the Maui Veterans Highway Widening improvement project will be implemented by Year 2038. For purposes of this TIAR, widening improvements along Maui Veterans Highway were recommended on the need at each study intersection based on LOS analysis for both Base Year and Future Year scenarios.

By Base Year 2038 without the Project, traffic in the study area is expected to increase due to trips generated by nearby developments and growth along Maui Veterans Highway. As a result of the increase in traffic volumes, several roadway improvements are recommended to be completed by Base Year 2038 and are summarized in Appendix D.

The signalization of the new Maui Veterans Highway/DLNR Access intersection and Maui Veterans Highway/Mehameha Loop South intersection is recommended as the most feasible alternative at these intersections. Based on the mainline through volume along Maui Veterans Highway and turning movement traffic accessing the side streets, a signal would be warranted at each of these intersections. Traffic control that includes roundabouts and two-way stop control was not considered at these intersections since it would create lengthy delays and capacity issues.

The coordination of traffic signals at Maui Veterans Highway/Mehameha Loop (North)/Kamaaina Road and Maui Veterans Highway/DHHL North Access/DLNR Access intersections should be considered if feasible, and the signal timing plans should be optimized to improve throughput progression along Maui Veterans Highway

With the recommended improvements at the study intersections, all intersections are forecast to operate at overall LOS D or better. All movements will also operate under capacity, with vehicle to capacity (v/c) ratios below 1.0. Additionally, all mainline through movements along the highway are expected to operate at LOS D or better during all peak hours. The majority of left-turn and minor street movements are expected to operate at LOS E/F due to the long cycle lengths favoring the through movements along Maui Veterans Highway.

6.3 Future Year 2038

The Project proposes to develop approximately 280.4 acres of vacant land owned by the Department of Land and Natural Resources (DLNR) previously leased to Hawaiian Commercial & Sugar (HC&S) for agricultural use. As discussed earlier, approximately 200.9 acres is estimated to be developable lands for a mix of light industrial and commercial use. For purposes of this study, approximately 70% (140.63 acres) was allocated to light industrial use and 30% (60.27 acres) allocated to commercial use. It should be noted that DLNR does not intend to construct a large densified shopping center on the 60.27 acres of commercial space. This space will primarily consist of smaller commercial parcels that are spread around the site to serve and complement the industrial uses.

Upon completion of the Project, traffic in the study area is expected to increase over Base Year 2038 conditions. The Project is anticipated to generate approximately 1,110(2,174)[2,872] trips during the AM(PM)[WE] peak hours of traffic, respectively. As discussed in Section 4.3, for purposes of this TIAR, widening improvements along Maui Veterans Highway were recommended on the need at each study intersection based on LOS analysis for Future Year 2038. As a result of the increase in traffic volumes, several roadway improvements are recommended with the Project and described in greater detail in Section 7 and Appendix D. Left-turn storage lane lengths for the Project accesses are also shown in Tables 5.3 to 5.7.

The signal timing plans at Maui Veterans Highway/Mehameha Loop (North)/Kamaaina Road, Maui Veterans Highway/DHHL North Access/DLNR Access and Maui Veterans Highway/Mehameha Loop (South)/Maui Raceway Park Access Road intersections should be optimized to provide favorable throughput progression along Maui Veterans Highway.

Full build-out of the Project is anticipated to occur after the 2035 estimated need for HDOT's Maui Veterans Highway widening improvement. HDOT's Maui Veterans Highway widening improvement is currently not a funded improvement and is not identified on the latest Statewide Transportation Improvement Program (STIP). Due to the uncertainty of HDOT's Maui Veterans Highway widening improvement, DLNR will coordinate with HDOT on its fair share of improvements. Based on a comparison of the Project traffic increase to total Future Year 2038 forecast traffic, the Project will constitute approximately 18% of all traffic, based on its composite average increase for the AM, PM and Saturday MD peak hours of traffic.

7. RECOMMENDATIONS

Full Base Year 2038 and Future Year 2038 roadway improvements are summarized in Appendix D and discussed in more detail below.

In addition to the above improvements, the coordination of traffic signals at Maui Veterans Highway/Mehameha Loop (North)/Kamaaina Road, Maui Veterans Highway/DHHL Access/DLNR Access and Maui Veterans Highway/Mehameha Loop (South)/Maui Raceway Park Access Road intersections should be considered where feasible, and the signal timing plans should be optimized to improve throughput progression along Maui Veterans Highway for each scenario.

7.1 Planned Roadway Improvements

The following roadway improvements are based on the mitigation proposed in the Puunene Heavy Industrial Subdivision TIAR, dated January 24, 2012, and were assumed to be implemented upon completion of the Puunene Heavy Industrial Subdivision:

[2] Maui Veterans Highway/Mehameha Loop (North)/Kamaaina Road

- Lengthen the southbound left-turn storage lane by an additional 350 feet, in addition to taper.
- Modify/Widen Kamaaina Road to provide a separate channelized westbound right-turn lane.
- Provide an acceleration lane for the westbound right-turns from Kamaaina Road onto Maui Veterans Highway.

7.2 Base Year 2038

The following roadway improvements are proposed for Base Year 2038. For purposes of this TIAR, widening improvements along Maui Veterans Highway were recommended on the need at each study intersection based on LOS analysis for Base Year 2038.

[1] Maui Veterans Highway/Nakii Road

- Widen Maui Veterans Highway to provide an additional northbound through lane, resulting in three northbound through lanes.
    - Northbound: Three (3) through lanes and one (1) right-turn lane.
    - Southbound: One (1) left-turn lane and Two (2) through lanes.
    - Westbound: One (1) left-turn lane and one (1) right-turn lane.

[2] Maui Veterans Highway/Mehameha Loop (North)/Kamaaina Road

- Implement planned roadway improvements listed in Section 4.3
- Provide additional widening improvements, resulting in the following lane configuration:
    - Northbound: One (1) left-turn lane, three (3) through lanes and one (1) right-turn lane.

- Southbound: Two (2) left-turn lanes, two (2) through lanes and one (1) right-turn lane
- Eastbound: One (1) left-turn lane, one (1) through and one (1) right-turn lane.
- Westbound: One (1) shared left-turn/through lane and one (1) right-turn lane with acceleration lane.

[3] Maui Veterans Highway/DHHL Access/DLNR Access

- Provide a new signalized intersection along Maui Veterans Highway to serve the DHHL Pulehunui North development with the following lane configuration at the intersection:
  - Northbound: One (1) left-turn lanes and two (2) through lanes
  - Southbound: Three (3) through lanes and one (1) right-turn lane
  - Eastbound: Two (2) left-turn lanes and one (1) right-turn lane.

[4] Maui Veterans Highway/Mehameha Loop (South)/Maui Raceway Park Access Road

- Provide a traffic signal with the following lane configuration at the intersection:
  - Northbound: One (1) left-turn lane, two (2) through lanes and one (1) right-turn lane
  - Southbound: One (1) left-turn lane, three (3) through lanes and one (1) right-turn lane
  - Eastbound: One (1) shared left-turn/through lane and one (1) channelized right-turn lane with an acceleration lane.
  - Westbound: One (1) shared left-turn/through lane and one (1) right-turn lane

[5] Maui Veterans Highway/Piilani Highway/North Kihei Road/Monsanto Driveway

- Widen Maui Veterans Highway to provide an additional southbound through lane, resulting in resulting in three southbound through lanes.
  - Northbound: Two (2) left-turn lanes, two (2) through lanes and one (1) right-turn lane.
  - Southbound: One (1) left-turn lane, three (3) through lanes and one (1) right-turn lane.
  - Eastbound: One (1) left-turn lane, one (1) shared left-turn/through lane and two (2) right-turn lanes.
- Westbound: One (1) left-turn lane and one (1) shared through/right-turn lane.

For the three (3) proposed DHHL South Parcel accesses, a traffic signal with exclusive left-turn and right-turn lanes are proposed at the middle DHHL South Access 2 intersection and right-in, right-out (RIRO) accesses are proposed for the northernmost DHHL South Access 1 and southernmost DHHL South Access 3 intersection.

7.3 Future Year 2038

Upon completion of the Project, traffic in the study area is expected to significantly increase over Base Year 2038 conditions. As a result of the increase in traffic volumes, the following roadway improvements are recommended with the Project and are summarized in Appendix D.

[1] Maui Veterans Highway/Nakii Road

- Widen Maui Veterans Highway to provide an additional southbound through lane, resulting in three southbound through lanes.
  - Northbound: Three (3) through lanes and one (1) right-turn lane.
  - Southbound: Two (2) left-turn lanes and three (3) through lanes.
  - Westbound: One (1) left-turn lane and one (1) right-turn lane.

[2] Maui Veterans Highway/Mehameha Loop (North)/Kamaaina Road

- Provide the following lane configuration:
  - Northbound: One (1) left-turn lane, three (3) through lanes and one (1) right-turn lane.
  - Southbound: Two (2) left-turn lanes, Three (3) through lanes and one (1) right-turn lane
  - Eastbound: One (1) left-turn lane, one (1) through lane and one (1) right-turn lane.
  - Westbound: Two (2) left-turn lanes, one (1) through lane and one (1) right-turn lane with acceleration lane

[3] Maui Veterans Highway/DHHL Access/DLNR Access

- Modify the intersection to add an eastern leg to the intersection, widen Maui Veterans Highway to provide an additional northbound through lane and provide additional widening improvements with the following lane configuration:
  - Northbound: Two (2) left-turn lanes, three (3) through lanes and one (1) right-turn lane
  - Southbound: Two (2) left-turn lanes, three (3) through lanes and one (1) right-turn lane
  - Eastbound: Two (2) left-turn lanes, one (1) through and one (1) right-turn lane.
  - Westbound: Two (2) left-turn lanes, one (1) through lane and one (1) right-turn lane with an acceleration lane.

[4] Maui Veterans Highway/Mehameha Loop (South)/Maui Raceway Park Access Road

- Widen Maui Veterans Highway to provide an additional northbound through lane and widening along Mehameha Loop (South) and Maui Raceway Park Access Road. Provide the following lane configuration:
  - Northbound: One (1) left-turn lane, three (3) through lanes and one (1) right-turn lane

- Southbound: One (1) left-turn lanes, three (3) through lanes and one (1) right-turn lane
- Eastbound: One (1) left-turn lane, one (1) through lane and one (1) right-turn lane with an acceleration lane.
- Westbound: One (1) left-turn lane, one (1) through lane and one (1) right-turn lane.

[5] Maui Veterans Highway/Piilani Highway/North Kihei Road/Monsanto Driveway

- Widen Maui Veterans Highway to provide an additional northbound and southbound through lane, resulting in three through lanes northbound and four through lanes southbound along Maui Veterans Highway.
    - Northbound: Two (2) left-turn lanes, three (3) through lanes and one (1) right-turn lane.
    - Southbound: One (1) left-turn lane, four (4) through lanes and one (1) right-turn lane.
    - Eastbound: One (1) left-turn lane, one (1) shared left-turn/through lane and two (2) right-turn lanes.
    - Westbound: One (1) left-turn lane and one (1) shared through/right-turn lane.

Kamaaina Road, South Firebreak Road & Maui Raceway Park Access Road

- Upgrade roadway to Maui County standards.

For the three (3) proposed DHHL South Parcel accesses, Base Year 2038 conditions recommends a traffic signal with exclusive left-turn and right-turn lanes at the middle DHHL South Access 2 intersection and right-in, right-out (RIRO) accesses a for the northernmost DHHL South Access 1 and southernmost DHHL South Access 3 intersection. In addition, northbound and southbound approaches should provide three (3) through lanes per direction along Piilani Highway.

8. REFERENCES

1. American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highway and Streets, 2011.
2. Institute of Transportation Engineers, Trip Generation, 9th Edition, 2012.
3. Phillip Rowell & Associates, Piilani Promenade TIAR, June, 6, 2014.
4. Phillip Rowell & Associates, Puunene Heavy Industrial Subdivision TIAR, January, 24, 2012.
5. Transportation Research Board, Highway Capacity Manual, 2010.
6. Wilson Okamoto Corporation, Kihei High School TIAR, September 2011.
7. Wilson Okamoto Corporation, MRPSC Environmental Impact Statement Preparation Notice, May 2010.

APPENDICES

APPENDIX A

TRAFFIC COUNT DATA

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501 Sumner Street, Suite 521
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File Name : AM_Mokulele Hwy - Nakii Rd
Site Code : 00000000
Start Date : 1/19/2017
Page No : 1

Groups Printed- Unshifted

	MOKULELE HWY Southbound				NAKII RD Westbound				MOKULELE HWY Northbound				Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
06:30 AM	34	212	0	0	3	0	5	0	0	161	11	0	0	0	0	0	426
06:45 AM	47	198	0	0	4	0	20	0	0	258	14	0	0	0	0	0	541
Total	81	410	0	0	7	0	25	0	0	419	25	0	0	0	0	0	967
07:00 AM	40	235	0	0	5	0	10	0	0	260	12	0	0	0	0	0	562
07:15 AM	28	267	0	0	8	0	26	0	0	350	9	0	0	0	0	0	688
07:30 AM	26	280	0	0	3	0	20	0	0	371	4	0	0	0	0	0	704
07:45 AM	31	316	0	0	12	0	23	0	0	290	4	0	0	0	0	0	676
Total	125	1098	0	0	28	0	79	0	0	1271	29	0	0	0	0	0	2630
08:00 AM	34	331	0	0	2	0	19	0	0	248	5	0	0	0	0	0	639
08:15 AM	19	304	0	0	9	0	13	0	0	295	6	0	0	0	0	0	646
Grand Total	259	2143	0	0	46	0	136	0	0	2233	65	0	0	0	0	0	4882
Apprch %	10.8	89.2	0	0	25.3	0	74.7	0	0	97.2	2.8	0	0	0	0	0	
Total %	5.3	43.9	0	0	0.9	0	2.8	0	0	45.7	1.3	0	0	0	0	0	

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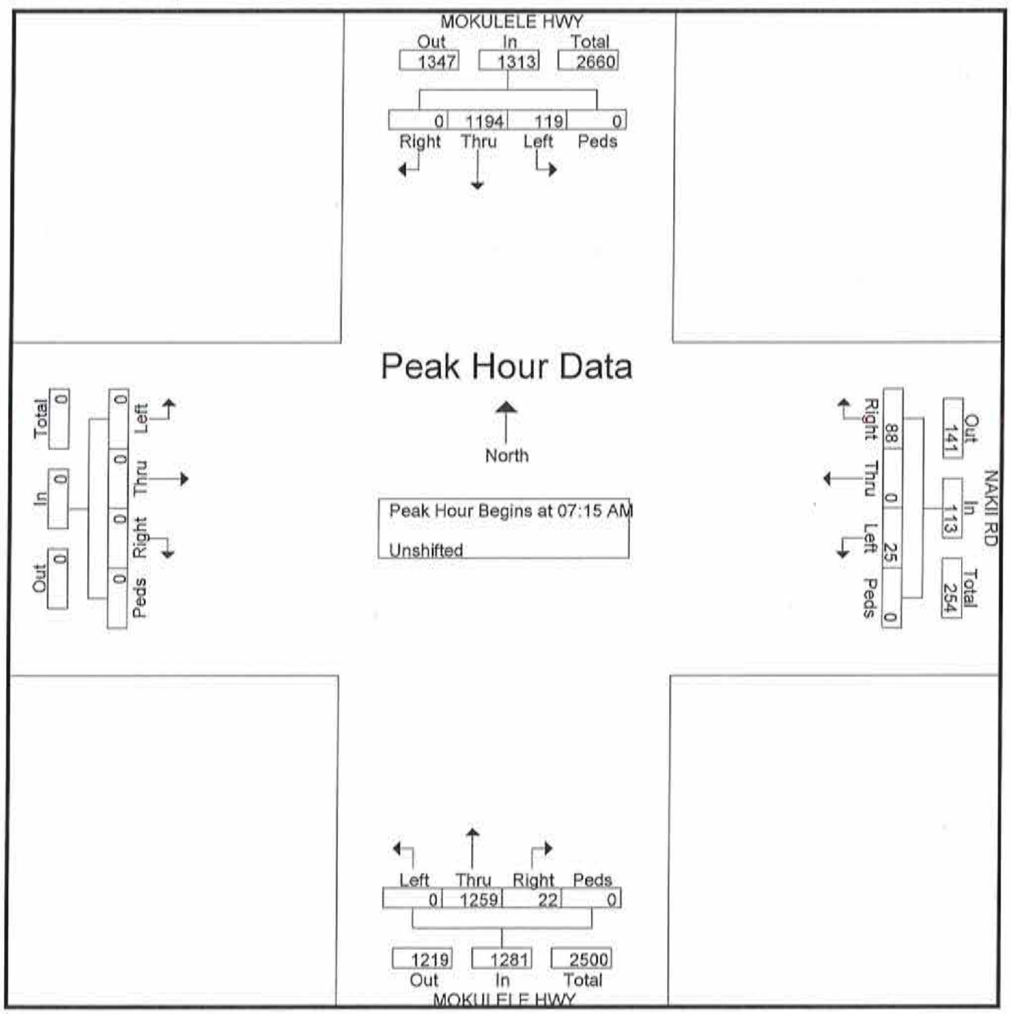
	MOKULELE HWY Southbound					NAKII RD Westbound					MOKULELE HWY Northbound					Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:30 AM to 08:15 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15 AM																					
07:15 AM	28	267	0	0	295	8	0	**26**	0	34	0	350	**9**	0	359	0	0	0	0	0	688
07:30 AM	26	280	0	0	306	3	0	20	0	23	0	**371**	4	0	**375**	0	0	0	0	0	**704**
07:45 AM	31	316	0	0	347	**12**	0	23	0	**35**	0	290	4	0	294	0	0	0	0	0	676
08:00 AM	**34**	**331**	0	0	**365**	2	0	19	0	21	0	248	5	0	253	0	0	0	0	0	639
Total Volume	119	1194	0	0	1313	25	0	88	0	113	0	1259	22	0	1281	0	0	0	0	0	2707
% App. Total	9.1	90.9	0	0		22.1	0	77.9	0		0	98.3	1.7	0		0	0	0	0		
PHF	.875	.902	.000	.000	.899	.521	.000	.846	.000	.807	.000	.848	.611	.000	.854	.000	.000	.000	.000	.000	.961



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File Name : AM_Mokulele Hwy - Mehameha Lp_Kamaaina Rd (N)
Site Code : 00000000
Start Date : 9/15/2015

Groups Printed- Unshifted

	MEHAMEHA LP Eastbound					KAMAAINA RD Westbound					MOKULELE HWY Northbound					MOKULELE HWY Southbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
06:30 AM	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
06:45 AM	1	0	1	0	2	0	0	3	0	3	1	267	0	0	268	9	223	4	0	236	509
Total	1	1	1	0	3	0	0	3	0	3	1	267	0	0	268	9	223	4	0	236	510
07:00 AM	1	0	1	0	2	4	0	1	0	5	0	300	6	0	306	3	258	1	0	262	575
07:15 AM	2	0	0	0	2	1	0	4	0	5	0	336	0	0	336	3	273	5	0	281	624
07:30 AM	0	0	1	0	1	0	0	2	1	3	1	373	0	0	374	8	316	1	0	325	703
07:45 AM	1	0	0	0	1	2	0	7	2	11	1	279	3	0	283	5	292	5	0	302	597
Total	4	0	2	0	6	7	0	14	3	24	2	1288	9	0	1299	19	1139	12	0	1170	2499
08:00 AM	0	0	0	0	0	0	0	4	0	4	0	274	1	0	275	3	286	10	0	299	578
08:15 AM	2	0	1	0	3	2	1	2	0	5	3	255	3	0	261	6	272	3	0	281	550
08:30 AM	2	0	0	0	2	0	0	2	1	3	2	260	2	0	264	2	246	6	0	254	523
Grand Total	9	1	4	0	14	9	1	25	4	39	8	2344	15	0	2367	39	2166	35	0	2240	4660
Apprch %	64.3	7.1	28.6	0		23.1	2.6	64.1	10.3		0.3	99	0.6	0		1.7	96.7	1.6	0		
Total %	0.2	0	0.1	0	0.3	0.2	0	0.5	0.1	0.8	0.2	50.3	0.3	0	50.8	0.8	46.5	0.8	0	48.1	

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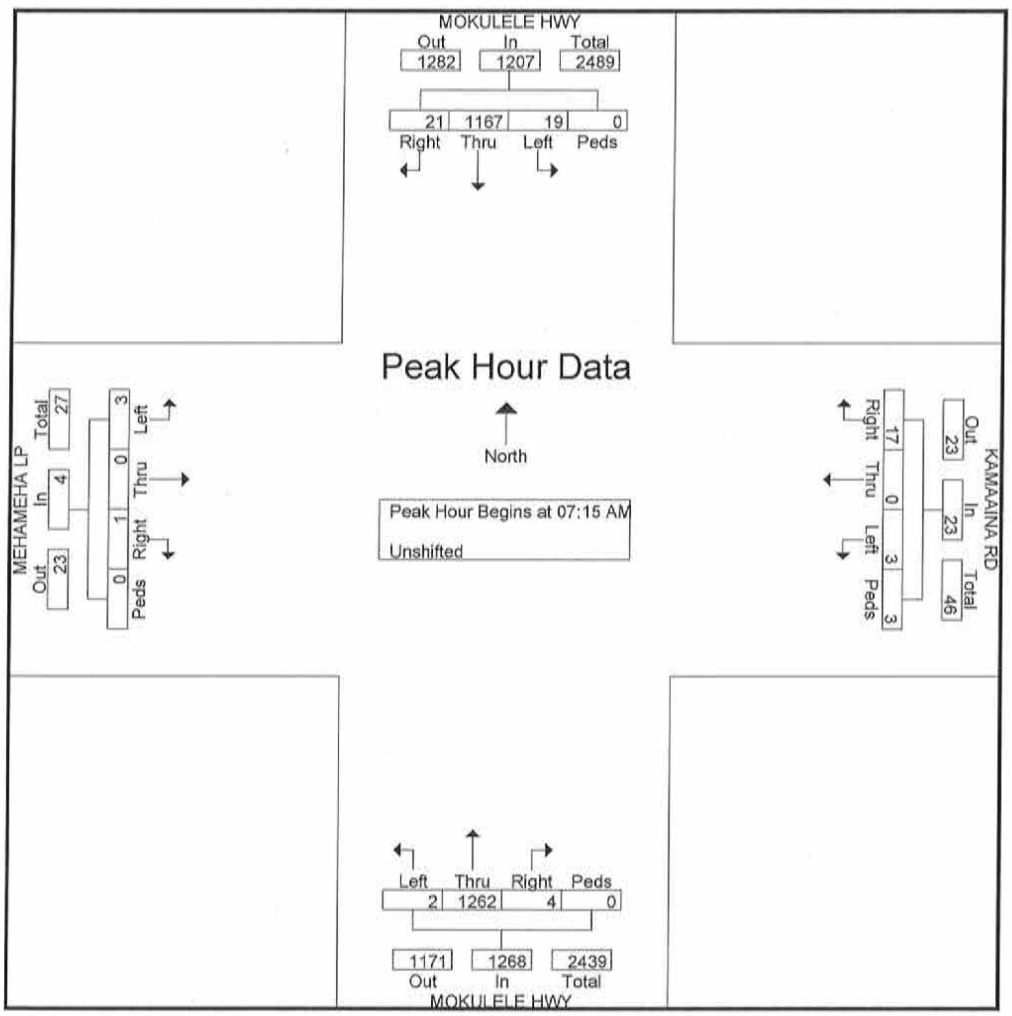
Site Code : 00000000
Start Date : 9/15/2015
Page No : 2

	MEHAMEHA LP Eastbound					KAMAAINA RD Westbound					MOKULELE HWY Northbound					MOKULELE HWY Southbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:30 AM to 08:15 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15 AM																					
07:15 AM	2	0	0	0	2	1	0	4	0	5	0	336	0	0	336	3	273	5	0	281	624
07:30 AM	0	0	1	0	1	0	0	2	1	3	1	373	0	0	374	8	316	1	0	325	703
07:45 AM	1	0	0	0	1	2	0	7	2	11	1	279	3	0	283	5	292	5	0	302	597
08:00 AM	0	0	0	0	0	0	0	4	0	4	0	274	1	0	275	3	286	10	0	299	578
Total Volume	3	0	1	0	4	3	0	17	3	23	2	1262	4	0	1268	19	1167	21	0	1207	2502
% App. Total	75	0	25	0		13	0	73.9	13		0.2	99.5	0.3	0		1.6	96.7	1.7	0		
PHF	.375	.000	.250	.000	.500	.375	.000	.607	.375	.523	.500	.846	.333	.000	.848	.594	.923	.525	.000	.928	.890



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Page No : 1

Groups Printed- Unshifted

	MEHAMEHA LP Eastbound					Westbound					MOKULELE HWY Northbound					MOKULELE HWY Southbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
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06:45 AM	0	0	2	0	2	0	0	0	0	0	0	266	1	0	267	0	223	0	0	223	492
Total	0	0	2	0	2	0	0	0	0	0	0	266	1	0	267	0	223	0	0	223	492
07:00 AM	0	0	0	0	0	0	0	0	0	0	1	299	0	0	300	0	258	0	0	258	558
07:15 AM	0	0	0	0	0	1	0	2	0	3	0	335	1	0	336	1	272	0	0	273	612
07:30 AM	0	0	0	0	0	0	0	0	1	1	1	372	0	0	373	1	315	0	0	316	690
07:45 AM	0	0	0	0	0	0	0	0	2	2	0	278	1	0	279	0	292	0	0	292	573
Total	0	0	0	0	0	1	0	2	3	6	2	1284	2	0	1288	2	1137	0	0	1139	2433
08:00 AM	0	0	0	0	0	1	0	0	0	1	1	271	2	0	274	1	285	0	0	286	561
08:15 AM	0	0	3	0	3	0	0	0	0	0	2	252	1	0	255	1	271	0	0	272	530
08:30 AM	0	2	0	0	2	0	3	0	1	4	7	252	1	0	260	1	245	0	0	246	512
Grand Total	0	2	5	0	7	2	3	2	4	11	12	2325	7	0	2344	5	2161	0	0	2166	4528
Apprch %	0	28.6	71.4	0		18.2	27.3	18.2	36.4		0.5	99.2	0.3	0		0.2	99.8	0	0		
Total %	0	0	0.1	0	0.2	0	0.1	0	0.1	0.2	0.3	51.3	0.2	0	51.8	0.1	47.7	0	0	47.8	

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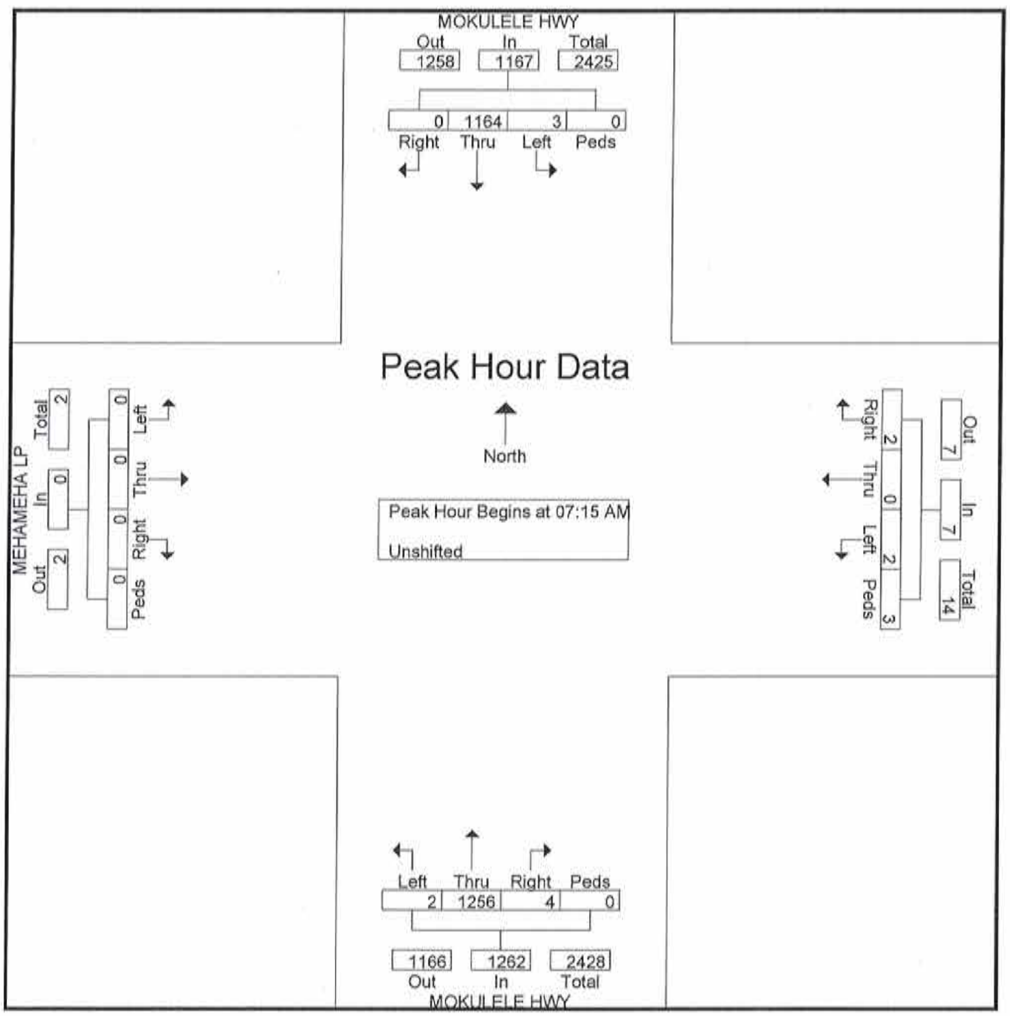
Site Code : 00000000
Start Date : 9/15/2015

	MEHAMEHA LP Eastbound					Westbound					MOKULELE HWY Northbound					MOKULELE HWY Southbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:30 AM to 08:15 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15 AM																					
07:15 AM	0	0	0	0	0	1	0	2	0	3	0	335	1	0	336	1	272	0	0	273	612
07:30 AM	0	0	0	0	0	0	0	0	1	1	1	372	0	0	373	1	315	0	0	316	690
07:45 AM	0	0	0	0	0	0	0	0	2	2	0	278	1	0	279	0	292	0	0	292	573
08:00 AM	0	0	0	0	0	1	0	0	0	1	1	271	2	0	274	1	285	0	0	286	561
Total Volume	0	0	0	0	0	2	0	2	3	7	2	1256	4	0	1262	3	1164	0	0	1167	2436
% App. Total	0	0	0	0		28.6	0	28.6	42.9		0.2	99.5	0.3	0		0.3	99.7	0	0		
PHF	.000	.000	.000	.000	.000	.500	.000	.250	.375	.583	.500	.844	.500	.000	.846	.750	.924	.000	.000	.923	.883



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Phone: (808) 533-3646 Fax: (808) 526-1267

File Name : AM_Mokulele_Piilani Hwy - Kihei Rd
Site Code : 00000000
Start Date : 1/19/2017

Groups Printed- Unshifted

	MOKULELE HWY Southbound				KIHEI RD Westbound				PIILANI HWY Northbound				KIHEI RD Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
06:30 AM	2	164	29	0	4	0	0	1	74	154	0	3	35	1	66	0	533
06:45 AM	3	157	23	0	1	0	0	2	88	235	6	0	40	4	48	0	607
Total	5	321	52	0	5	0	0	3	162	389	6	3	75	5	114	0	1140
07:00 AM	1	214	15	0	4	1	1	3	103	248	15	0	39	2	46	0	692
07:15 AM	0	222	21	0	3	0	1	1	134	292	5	0	51	0	72	0	802
07:30 AM	0	235	25	0	2	0	0	9	96	296	3	3	80	1	81	0	831
07:45 AM	2	268	41	0	0	0	0	3	132	242	0	0	47	1	95	0	831
Total	3	939	102	0	9	1	2	16	465	1078	23	3	217	4	294	0	3156
08:00 AM	0	258	31	0	1	0	0	4	91	190	1	0	64	0	82	0	722
08:15 AM	1	309	30	0	3	0	0	3	76	217	4	0	55	0	63	0	761
Grand Total	9	1827	215	0	18	1	2	26	794	1874	34	6	411	9	553	0	5779
Apprch %	0.4	89.1	10.5	0	38.3	2.1	4.3	55.3	29.3	69.2	1.3	0.2	42.2	0.9	56.8	0	
Total %	0.2	31.6	3.7	0	0.3	0	0	0.4	13.7	32.4	0.6	0.1	7.1	0.2	9.6	0	

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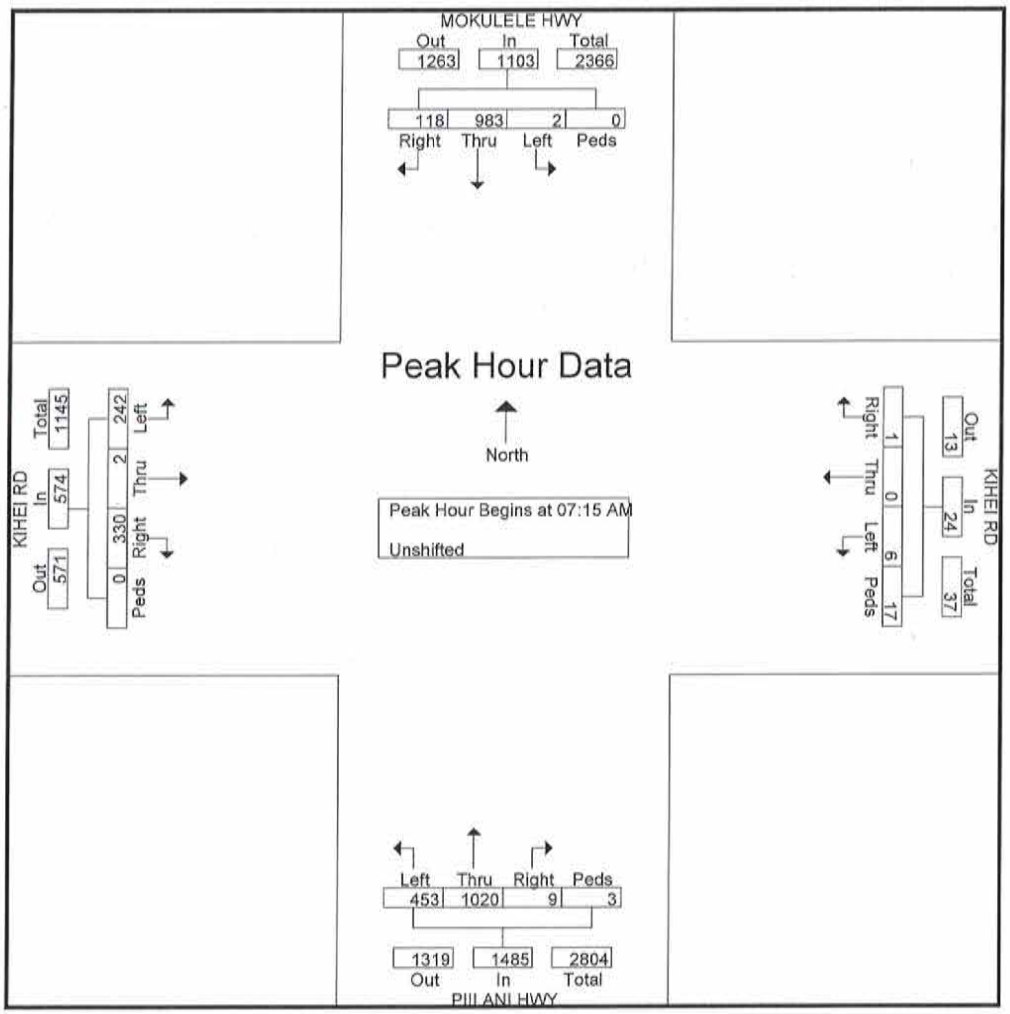
File Name : AM_Mokulele_Piilani Hwy - Kihei Rd
Site Code : 00000000
Start Date : 1/19/2017
Page No : 2

	MOKULELE HWY Southbound					KIHEI RD Westbound					PIILANI HWY Northbound					KIHEI RD Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:30 AM to 08:15 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15 AM																					
07:15 AM	0	222	21	0	243	**3**	0	**1**	1	5	**134**	292	**5**	0	**431**	51	0	72	0	123	802
07:30 AM	0	235	25	0	260	2	0	0	**9**	**11**	96	**296**	3	**3**	398	**80**	**1**	81	0	**162**	**831**
07:45 AM	**2**	**268**	**41**	0	**311**	0	0	0	3	3	132	242	0	0	374	47	1	**95**	0	143	831
08:00 AM	0	258	31	0	289	1	0	0	4	5	91	190	1	0	282	64	0	82	0	146	722
Total Volume	2	983	118	0	1103	6	0	1	17	24	453	1020	9	3	1485	242	2	330	0	574	3186
% App. Total	0.2	89.1	10.7	0		25	0	4.2	70.8		30.5	68.7	0.6	0.2		42.2	0.3	57.5	0		
PHF	.250	.917	.720	.000	.887	.500	.000	.250	.472	.545	.845	.861	.450	.250	.861	.756	.500	.868	.000	.886	.958



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File Name : PM_Mokulele Hwy - Nakii Rd
Site Code : 00000000
Start Date : 1/19/2017
Page No : 1

Groups Printed- Unshifted

	MOKULELE HWY Southbound				NAKII RD Westbound				MOKULELE HWY Northbound				Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
03:00 PM	16	364	0	0	4	0	29	0	4	301	10	0	0	0	0	0	728
03:15 PM	22	346	0	0	4	0	19	0	0	320	6	0	0	0	0	0	717
03:30 PM	17	396	0	0	6	0	32	0	0	365	2	0	0	0	0	0	818
03:45 PM	17	356	0	0	4	0	31	0	0	343	11	0	0	0	0	0	762
Total	72	1462	0	0	18	0	111	0	4	1329	29	0	0	0	0	0	3025
04:00 PM	17	365	0	0	11	0	35	0	0	324	5	0	0	0	0	0	757
04:15 PM	9	396	0	0	4	0	30	0	0	320	5	0	0	0	0	0	764
04:30 PM	10	355	0	0	2	0	13	0	0	339	5	0	0	0	0	0	724
04:45 PM	11	340	0	0	3	0	21	0	0	367	3	0	0	0	0	0	745
Total	47	1456	0	0	20	0	99	0	0	1350	18	0	0	0	0	0	2990
Grand Total	119	2918	0	0	38	0	210	0	4	2679	47	0	0	0	0	0	6015
Apprch %	3.9	96.1	0	0	15.3	0	84.7	0	0.1	98.1	1.7	0	0	0	0	0	
Total %	2	48.5	0	0	0.6	0	3.5	0	0.1	44.5	0.8	0	0	0	0	0	

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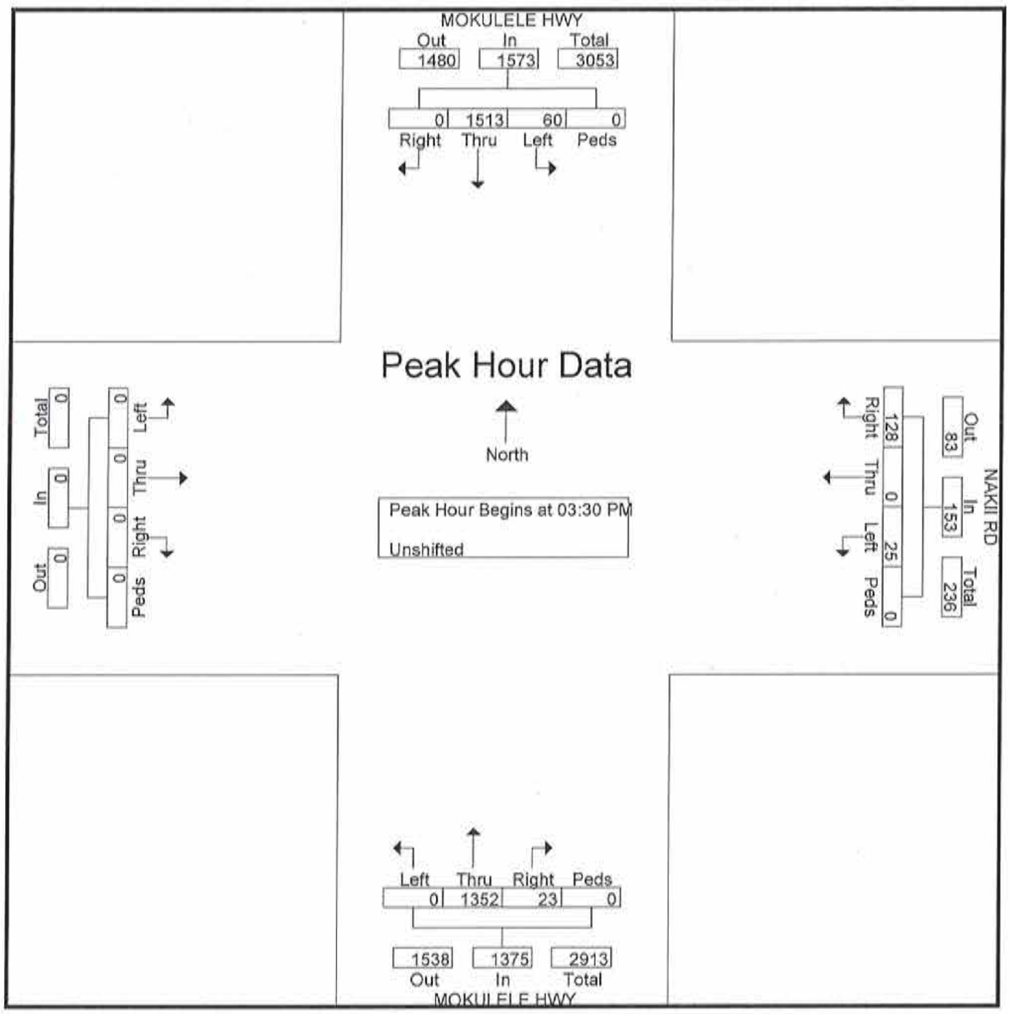
File Name : PM_Mokulele Hwy - Nakii Rd
Site Code : 00000000
Start Date : 1/19/2017
Page No : 2

	MOKULELE HWY Southbound					NAKII RD Westbound					MOKULELE HWY Northbound					Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 04:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 03:30 PM																					
03:30 PM	**17**	**396**	0	0	**413**	6	0	32	0	38	0	**365**	2	0	**367**	0	0	0	0	0	**818**
03:45 PM	17	356	0	0	373	4	0	31	0	35	0	343	**11**	0	354	0	0	0	0	0	762
04:00 PM	17	365	0	0	382	**11**	0	**35**	0	**46**	0	324	5	0	329	0	0	0	0	0	757
04:15 PM	9	396	0	0	405	4	0	30	0	34	0	320	5	0	325	0	0	0	0	0	764
Total Volume	60	1513	0	0	1573	25	0	128	0	153	0	1352	23	0	1375	0	0	0	0	0	3101
% App. Total	3.8	96.2	0	0		16.3	0	83.7	0		0	98.3	1.7	0		0	0	0	0		
PHF	.882	.955	.000	.000	.952	.568	.000	.914	.000	.832	.000	.926	.523	.000	.937	.000	.000	.000	.000	.000	.948



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File Name : PM_Mokulele Hwy - Mehameha Lp_Kamaaina Rd (N)
Site Code : 00000000
Start Date : 9/10/2015

Groups Printed- Unshifted

	MEHAMEHA LP Eastbound					KAMAAINA RD Westbound					MOKULELE HWY Northbound					MOKULELE HWY Southbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
02:30 PM	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1
02:45 PM	1	0	0	0	1	1	0	0	0	1	0	13	0	0	13	0	27	0	0	27	42
Total	1	0	0	0	1	1	0	1	0	2	0	13	0	0	13	0	27	0	0	27	43
03:00 PM	4	0	1	0	5	1	0	17	0	18	1	270	1	0	272	5	324	2	0	331	626
03:15 PM	0	0	2	0	2	2	1	4	0	7	4	294	1	0	299	2	297	2	0	301	609
03:30 PM	6	0	1	0	7	0	0	4	1	5	5	310	1	0	316	4	338	4	0	346	674
03:45 PM	6	0	2	0	8	1	0	7	0	8	2	327	2	0	331	1	274	5	0	280	627
Total	16	0	6	0	22	4	1	32	1	38	12	1201	5	0	1218	12	1233	13	0	1258	2536
04:00 PM	6	0	7	0	13	0	0	9	0	9	0	267	0	0	267	4	304	2	0	310	599
04:15 PM	5	1	3	0	9	0	0	3	0	3	4	378	1	0	383	1	306	2	0	309	704
04:30 PM	5	0	2	0	7	1	0	3	0	4	0	351	1	0	352	1	287	2	0	290	653
04:45 PM	0	0	1	0	1	1	0	5	0	6	0	284	1	0	285	2	300	1	0	303	595
Total	16	1	13	0	30	2	0	20	0	22	4	1280	3	0	1287	8	1197	7	0	1212	2551
Grand Total	33	1	19	0	53	7	1	53	1	62	16	2494	8	0	2518	20	2457	20	0	2497	5130
Apprch %	62.3	1.9	35.8	0		11.3	1.6	85.5	1.6		0.6	99	0.3	0		0.8	98.4	0.8	0		
Total %	0.6	0	0.4	0	1	0.1	0	1	0	1.2	0.3	48.6	0.2	0	49.1	0.4	47.9	0.4	0	48.7	

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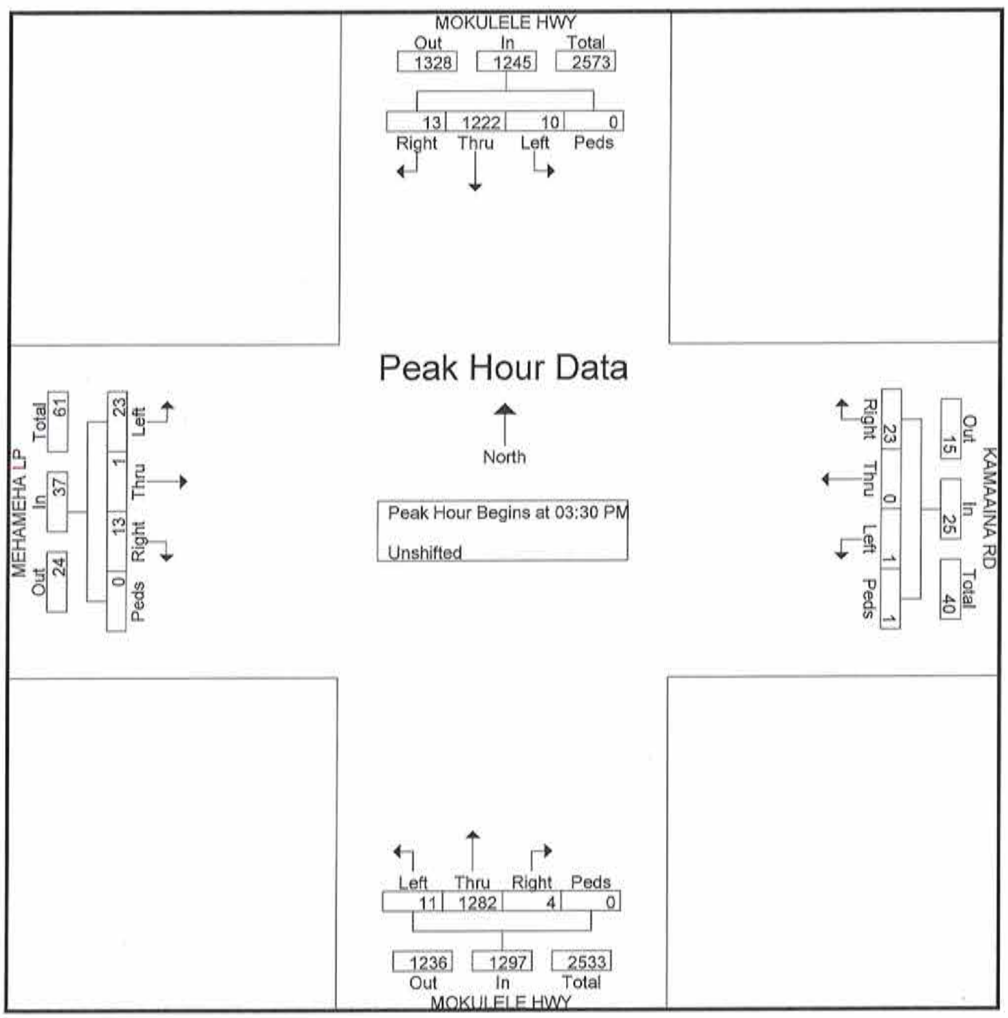
File Name : PM_Mokulele Hwy - Mehameha Lp_Kamaaina Rd (N)
Site Code : 00000000
Start Date : 9/10/2015

	MEHAMEHA LP Eastbound					KAMAAINA RD Westbound					MOKULELE HWY Northbound					MOKULELE HWY Southbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 02:30 PM to 04:15 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 03:30 PM																					
03:30 PM	6	0	1	0	7	0	0	4	1	5	5	310	1	0	316	4	338	4	0	346	674
03:45 PM	6	0	2	0	8	1	0	7	0	8	2	327	2	0	331	1	274	5	0	280	627
04:00 PM	6	0	7	0	13	0	0	9	0	9	0	267	0	0	267	4	304	2	0	310	599
04:15 PM	5	1	3	0	9	0	0	3	0	3	4	378	1	0	383	1	306	2	0	309	704
Total Volume	23	1	13	0	37	1	0	23	1	25	11	1282	4	0	1297	10	1222	13	0	1245	2604
% App. Total	62.2	2.7	35.1	0		4	0	92	4		0.8	98.8	0.3	0		0.8	98.2	1	0		
PHF	.958	.250	.464	.000	.712	.250	.000	.639	.250	.694	.550	.848	.500	.000	.847	.625	.904	.650	.000	.900	.925



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File Name : PM_Mokulele Hwy - Mehameha Lp (S)
Site Code : 00000000
Start Date : 9/10/2015

Groups Printed- Unshifted

	MEHAMEHA LP Eastbound					Westbound					MOKULELE HWY Northbound					MOKULELE HWY Southbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
02:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:45 PM	0	0	0	0	0	0	0	0	0	0	0	13	0	0	13	0	27	0	0	27	40
Total	0	0	0	0	0	0	0	0	0	0	0	13	0	0	13	0	27	0	0	27	40
03:00 PM	0	0	1	0	1	0	0	0	0	0	1	269	0	0	270	1	323	0	0	324	595
03:15 PM	0	0	4	0	4	0	0	0	0	0	1	293	0	0	294	2	295	0	0	297	595
03:30 PM	0	0	0	0	0	0	0	0	0	0	0	308	2	0	310	0	338	0	0	338	648
03:45 PM	0	0	0	0	0	0	0	0	0	0	1	324	2	0	327	1	273	0	0	274	601
Total	0	0	5	0	5	0	0	0	0	0	3	1194	4	0	1201	4	1229	0	0	1233	2439
04:00 PM	0	0	0	0	0	2	0	2	0	4	1	265	1	0	267	1	303	0	0	304	575
04:15 PM	0	0	0	0	0	0	0	2	0	2	0	375	3	0	378	1	305	0	0	306	686
04:30 PM	0	0	0	0	0	0	0	2	0	2	1	349	1	0	351	0	287	0	0	287	640
04:45 PM	0	0	0	0	0	0	0	2	0	2	0	282	2	0	284	2	298	0	0	300	586
Total	0	0	0	0	0	2	0	8	0	10	2	1271	7	0	1280	4	1193	0	0	1197	2487
Grand Total	0	0	5	0	5	2	0	8	0	10	5	2478	11	0	2494	8	2449	0	0	2457	4966
Apprch %	0	0	100	0		20	0	80	0		0.2	99.4	0.4	0		0.3	99.7	0	0		
Total %	0	0	0.1	0	0.1	0	0	0.2	0	0.2	0.1	49.9	0.2	0	50.2	0.2	49.3	0	0	49.5	

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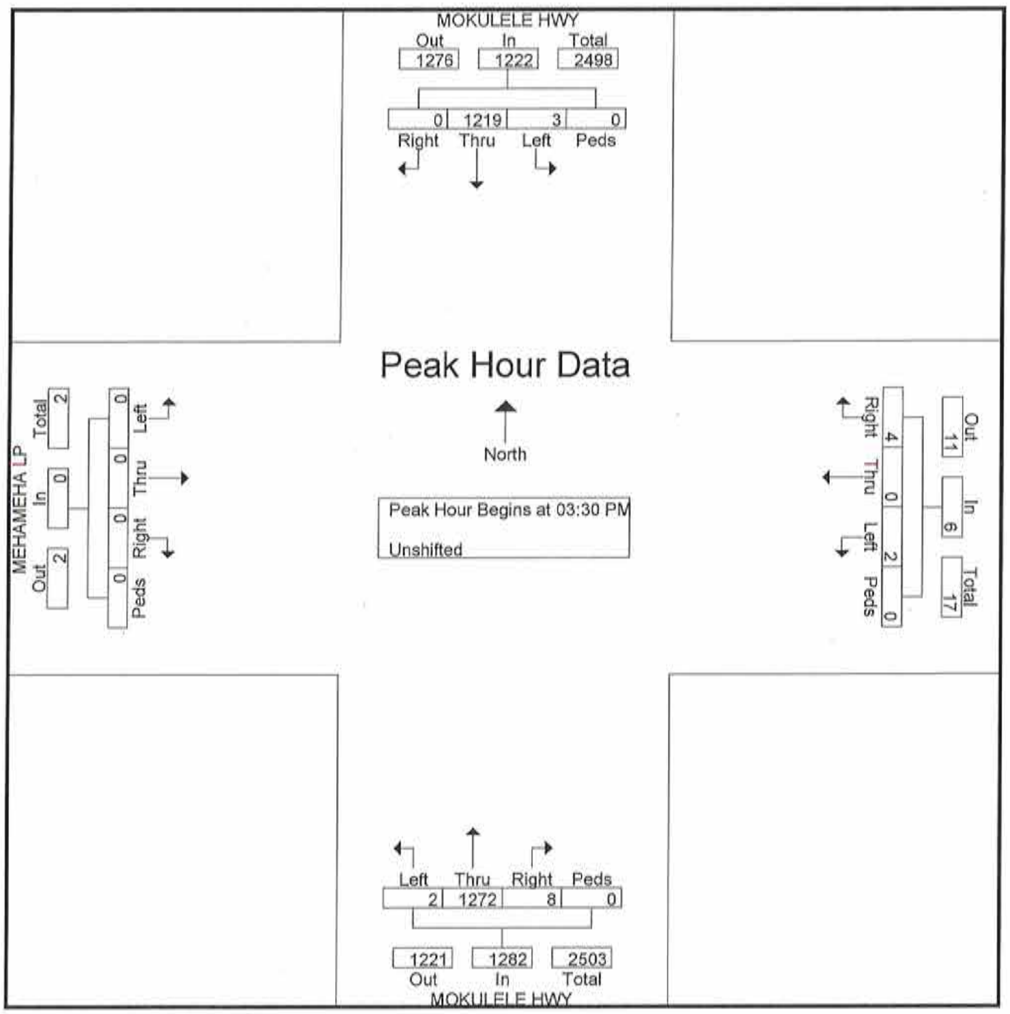
File Name : PM_Mokulele Hwy - Mehameha Lp (S)
Site Code : 00000000
Start Date : 9/10/2015

	MEHAMEHA LP Eastbound					Westbound					MOKULELE HWY Northbound					MOKULELE HWY Southbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 02:30 PM to 04:15 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 03:30 PM																					
03:30 PM	0	0	0	0	0	0	0	0	0	0	0	308	2	0	310	0	338	0	0	338	648
03:45 PM	0	0	0	0	0	0	0	0	0	0	1	324	2	0	327	1	273	0	0	274	601
04:00 PM	0	0	0	0	0	2	0	2	0	4	1	265	1	0	267	1	303	0	0	304	575
04:15 PM	0	0	0	0	0	0	0	2	0	2	0	375	3	0	378	1	305	0	0	306	686
Total Volume	0	0	0	0	0	2	0	4	0	6	2	1272	8	0	1282	3	1219	0	0	1222	2510
% App. Total	0	0	0	0		33.3	0	66.7	0		0.2	99.2	0.6	0		0.2	99.8	0	0		
PHF	.000	.000	.000	.000	.000	.250	.000	.500	.000	.375	.500	.848	.667	.000	.848	.750	.902	.000	.000	.904	.915



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File Name : PM_Mokulele_Piilani Hwy - Kihei Rd
Site Code : 00000000
Start Date : 1/19/2017
Page No : 1

Groups Printed- Unshifted

	MOKULELE HWY Southbound				KIHEI RD Westbound				PIILANI HWY Northbound				KIHEI RD Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
03:00 PM	0	323	52	0	2	1	3	0	111	233	2	0	49	0	107	0	883
03:15 PM	0	313	54	0	3	0	1	0	95	273	2	0	55	0	107	0	903
03:30 PM	0	268	51	0	7	0	5	0	132	294	2	0	60	0	80	7	906
03:45 PM	1	305	48	0	1	3	2	1	121	288	5	0	52	0	97	0	924
Total	1	1209	205	0	13	4	11	1	459	1088	11	0	216	0	391	7	3616
04:00 PM	0	351	61	0	2	0	0	0	96	227	1	0	33	0	94	2	867
04:15 PM	2	265	49	0	1	1	1	0	99	273	2	0	41	0	99	0	833
04:30 PM	1	310	49	0	1	1	5	0	112	287	1	0	39	0	94	0	900
04:45 PM	0	289	50	0	3	0	0	1	83	267	0	0	45	0	90	0	828
Total	3	1215	209	0	7	2	6	1	390	1054	4	0	158	0	377	2	3428
Grand Total	4	2424	414	0	20	6	17	2	849	2142	15	0	374	0	768	9	7044
Apprch %	0.1	85.3	14.6	0	44.4	13.3	37.8	4.4	28.2	71.3	0.5	0	32.5	0	66.7	0.8	
Total %	0.1	34.4	5.9	0	0.3	0.1	0.2	0	12.1	30.4	0.2	0	5.3	0	10.9	0.1	

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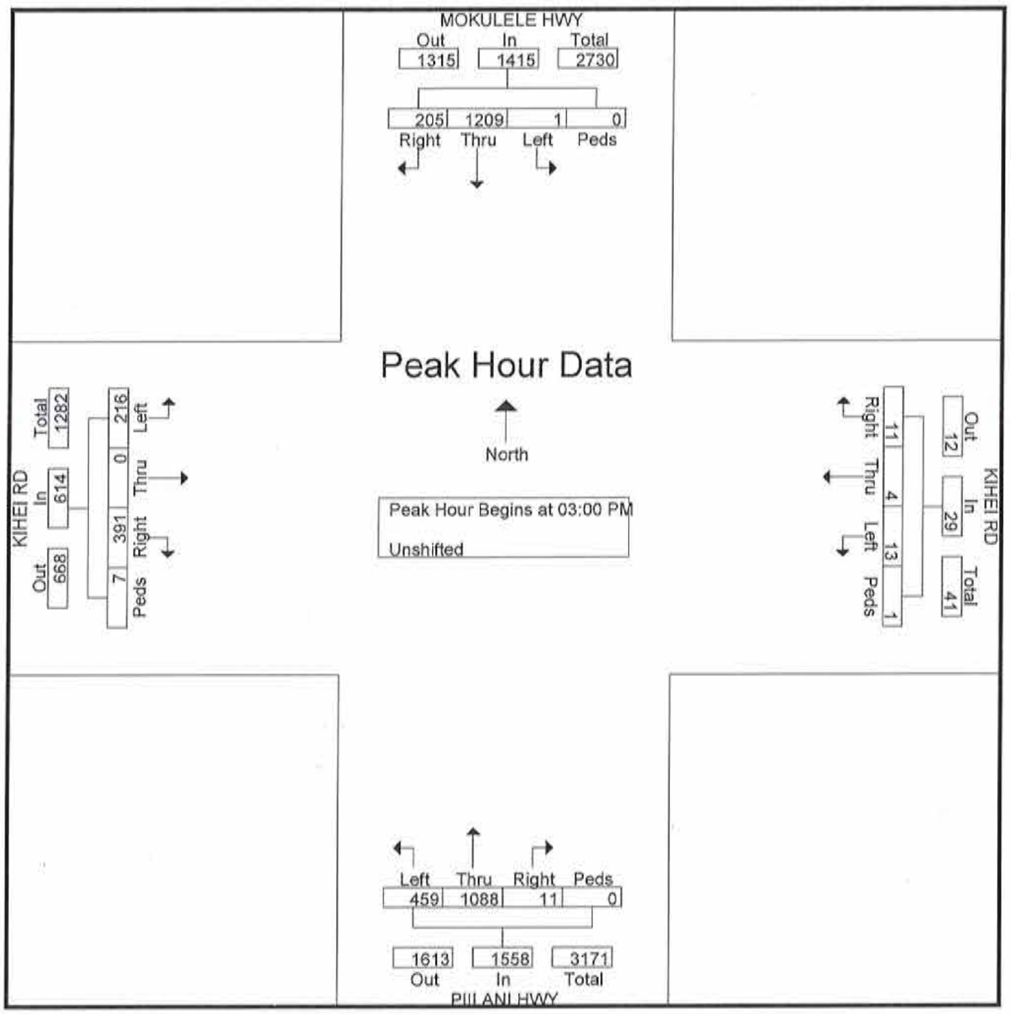
File Name : PM_Mokulele_Piilani Hwy - Kihei Rd
Site Code : 00000000
Start Date : 1/19/2017
Page No : 2

	MOKULELE HWY Southbound					KIHEI RD Westbound					PIILANI HWY Northbound					KIHEI RD Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 04:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 03:00 PM																					
03:00 PM	0	**323**	52	0	**375**	2	1	3	0	6	111	233	2	0	346	49	0	**107**	0	156	883
03:15 PM	0	313	**54**	0	367	3	0	1	0	4	95	273	2	0	370	55	0	107	0	**162**	903
03:30 PM	0	268	51	0	319	**7**	0	**5**	0	**12**	**132**	**294**	2	0	**428**	**60**	0	80	**7**	147	906
03:45 PM	**1**	305	48	0	354	1	**3**	2	**1**	7	121	288	**5**	0	414	52	0	97	0	149	**924**
Total Volume	1	1209	205	0	1415	13	4	11	1	29	459	1088	11	0	1558	216	0	391	7	614	3616
% App. Total	0.1	85.4	14.5	0		44.8	13.8	37.9	3.4		29.5	69.8	0.7	0		35.2	0	63.7	1.1		
PHF	.250	.936	.949	.000	.943	.464	.333	.550	.250	.604	.869	.925	.550	.000	.910	.900	.000	.914	.250	.948	.978



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File Name : WE_Mokulele Hwy - Nakii Rd
Site Code : 15-554 DLNR Industrial & Business Park
Start Date : 8/12/2017

Groups Printed- Motorcycles - Cars - Light Goods Vehicles - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

	MOKULELE HWY SOUTHBOUND				NAKII RD WESTBOUND				MOKULELE HWY NORTHBOUND				NAKII RD EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
11:00	6	220	0	0	2	0	6	2	0	288	3	0	0	0	0	0	527
11:15	7	249	0	0	0	0	4	1	0	299	0	0	0	0	0	0	560
11:30	12	275	0	0	3	0	8	1	0	278	0	0	0	0	0	0	577
11:45	9	252	0	0	2	0	16	0	0	274	3	0	0	0	0	0	556
Total	34	996	0	0	7	0	34	4	0	1139	6	0	0	0	0	0	2220
12:00	7	257	0	0	2	0	7	1	0	226	3	0	0	0	0	0	503
12:15	7	278	0	0	1	0	6	2	0	275	6	0	0	0	0	0	575
12:30	10	275	0	0	3	0	14	0	0	280	3	0	0	0	0	0	585
12:45	11	281	0	0	2	0	19	1	0	277	2	0	0	0	0	0	593
Total	35	1091	0	0	8	0	46	4	0	1058	14	0	0	0	0	0	2256
Grand Total	69	2087	0	0	15	0	80	8	0	2197	20	0	0	0	0	0	4476
Apprch %	3.2	96.8	0	0	14.6	0	77.7	7.8	0	99.1	0.9	0	0	0	0	0	
Total %	1.5	46.6	0	0	0.3	0	1.8	0.2	0	49.1	0.4	0	0	0	0	0	
Motorcycles	1	13	0	0	0	0	2	0	0	5	2	0	0	0	0	0	23
% Motorcycles	1.4	0.6	0	0	0	0	2.5	0	0	0.2	10	0	0	0	0	0	0.5
Cars	36	1611	0	0	7	0	43	0	0	1687	9	0	0	0	0	0	3393
% Cars	52.2	77.2	0	0	46.7	0	53.8	0	0	76.8	45	0	0	0	0	0	75.8
Light Goods Vehicles	26	439	0	0	7	0	34	0	0	468	7	0	0	0	0	0	981
% Light Goods Vehicles	37.7	21	0	0	46.7	0	42.5	0	0	21.3	35	0	0	0	0	0	21.9
Buses	1	5	0	0	0	0	0	0	0	11	0	0	0	0	0	0	17
% Buses	1.4	0.2	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0.4
Single-Unit Trucks	5	16	0	0	1	0	1	0	0	26	2	0	0	0	0	0	51
% Single-Unit Trucks	7.2	0.8	0	0	6.7	0	1.2	0	0	1.2	10	0	0	0	0	0	1.1
Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Road	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
% Bicycles on Road	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
Bicycles on Crosswalk	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	8
% Bicycles on Crosswalk	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	0.2
Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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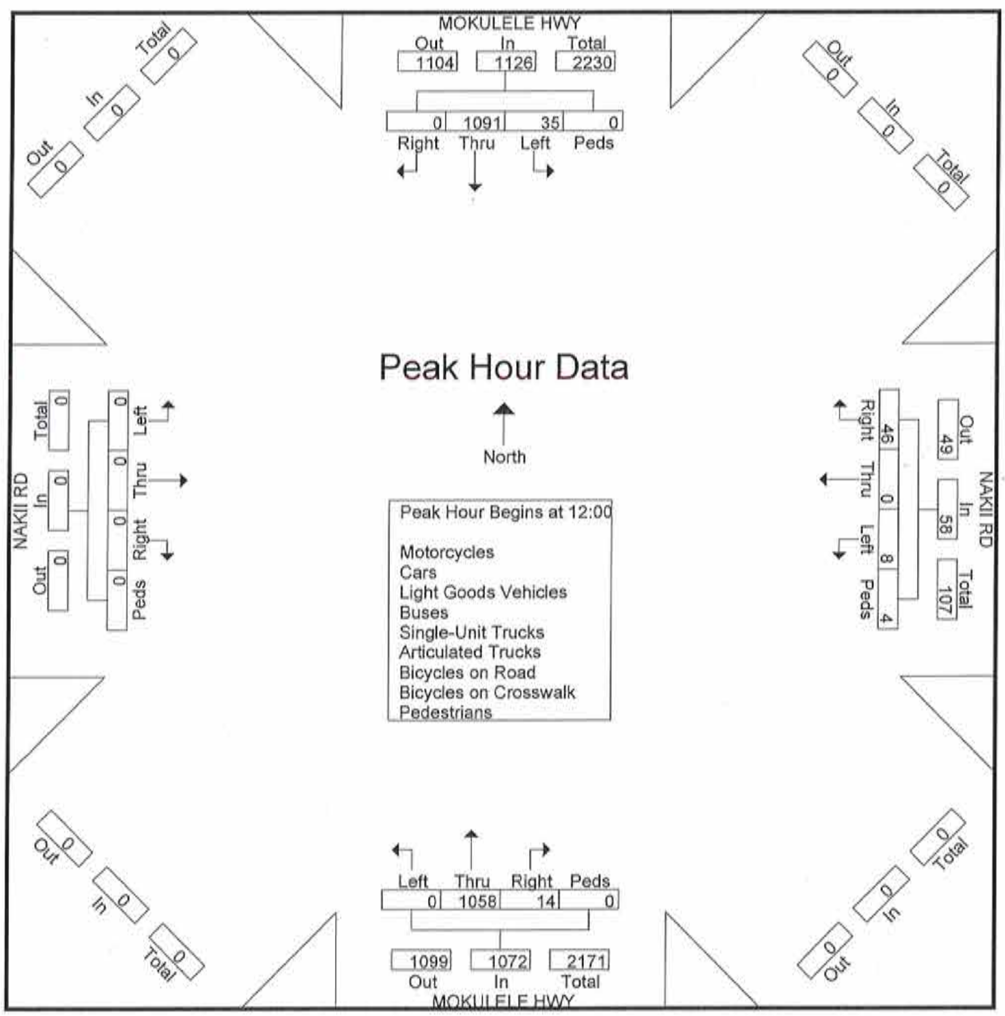
File Name : WE_Mokulele Hwy - Nakii Rd
Site Code : 15-554 DLNR Industrial & Business Park
Start Date : 8/12/2017

	MOKULELE HWY SOUTHBOUND					NAKII RD WESTBOUND					MOKULELE HWY NORTHBOUND					NAKII RD EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 11:00 to 12:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 12:00																					
12:00	7	257	0	0	264	2	0	7	1	10	0	226	3	0	229	0	0	0	0	0	503
12:15	7	278	0	0	285	1	0	6	**2**	9	0	275	**6**	0	281	0	0	0	0	0	575
12:30	10	275	0	0	285	**3**	0	14	0	17	0	**280**	3	0	**283**	0	0	0	0	0	585
12:45	**11**	**281**	0	0	**292**	2	0	**19**	1	**22**	0	277	2	0	279	0	0	0	0	0	**593**
Total Volume	35	1091	0	0	1126	8	0	46	4	58	0	1058	14	0	1072	0	0	0	0	0	2256
% App. Total	3.1	96.9	0	0		13.8	0	79.3	6.9		0	98.7	1.3	0		0	0	0	0		
PHF	.795	.971	.000	.000	.964	.667	.000	.605	.500	.659	.000	.945	.583	.000	.947	.000	.000	.000	.000	.000	.951



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File Name : WE_Mokulele Hwy - Kamaaina Rd Site
Code : 15-554 DLNR Industrial & Business Park
Start Date : 8/12/2017

Groups Printed- Unit Trucks

	MOKULELE HWY SOUTHBOUND				KAMAAINA RD WESTBOUND				MOKULELE HWY NORTHBOUND				KAMAAINA RD EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
11:00	0	1	0	0	0	0	0	0	0	3	1	0	0	0	0	0	5
11:15	1	2	0	0	0	0	1	0	0	4	0	0	0	0	0	0	8
11:30	1	2	0	0	1	0	1	0	0	4	2	0	0	0	0	0	11
11:45	0	0	0	0	0	0	0	0	0	4	1	0	0	0	0	0	5
Total	2	5	0	0	1	0	2	0	0	15	4	0	0	0	0	0	29
12:00	1	1	0	0	1	0	0	0	0	2	0	0	0	0	0	0	5
12:15	0	1	0	0	1	0	0	0	0	6	0	0	0	0	0	0	8
12:30	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
12:45	1	2	0	0	0	0	0	0	0	3	0	0	0	0	0	0	6
Total	2	6	0	0	2	0	0	0	0	11	0	0	0	0	0	0	21
Grand Total	4	11	0	0	3	0	2	0	0	26	4	0	0	0	0	0	50
Apprch %	26.7	73.3	0	0	60	0	40	0	0	86.7	13.3	0	0	0	0	0	
Total %	8	22	0	0	6	0	4	0	0	52	8	0	0	0	0	0	

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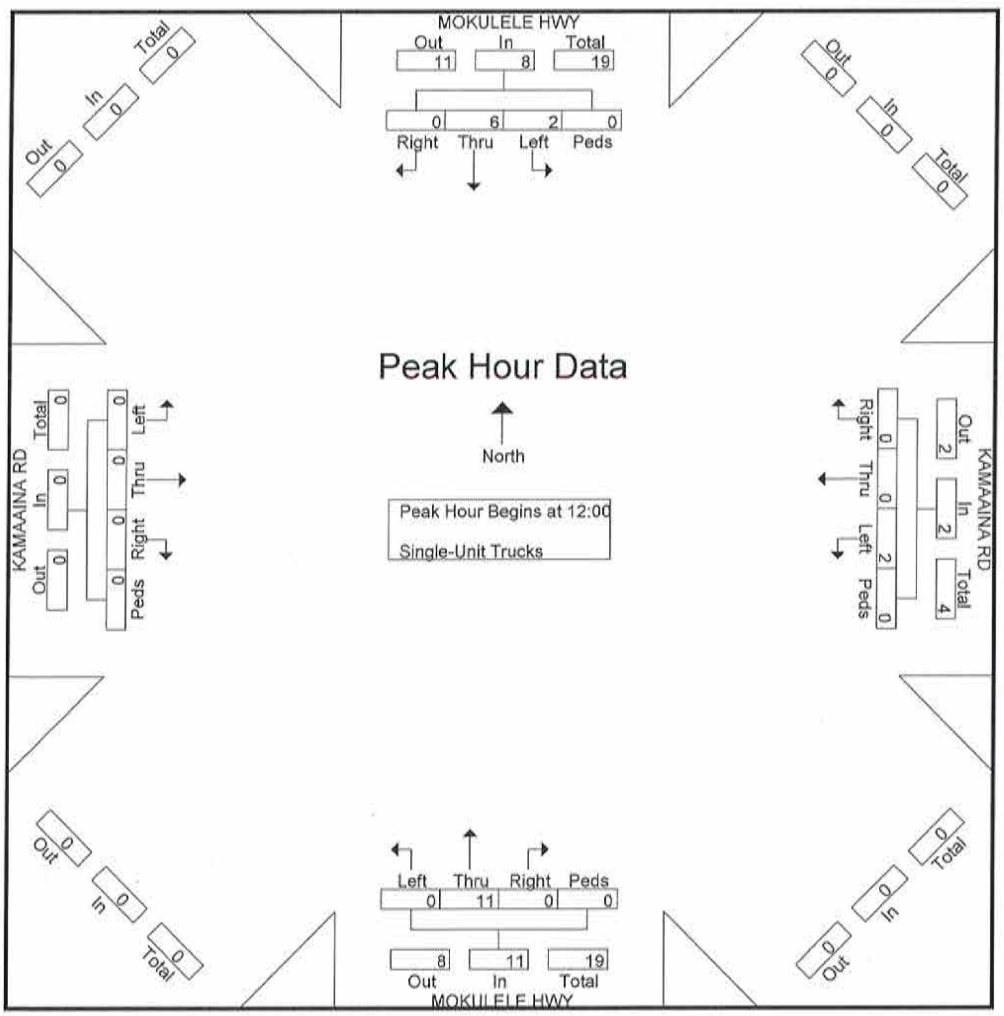
File Name : WE_Mokulele Hwy - Kamaaina Rd Site
Code : 15-554 DLNR Industrial & Business Park
Start Date : 8/12/2017
Page No : 2

	MOKULELE HWY SOUTHBOUND					KAMAAINA RD WESTBOUND					MOKULELE HWY NORTHBOUND					KAMAAINA RD EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 12:00 to 12:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 12:00																					
12:00	**1**	1	0	0	2	**1**	0	0	0	**1**	0	2	0	0	2	0	0	0	0	0	5
12:15	0	1	0	0	1	1	0	0	0	1	0	**6**	0	0	**6**	0	0	0	0	0	**8**
12:30	0	**2**	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
12:45	1	2	0	0	**3**	0	0	0	0	0	0	3	0	0	3	0	0	0	0	0	6
Total Volume	2	6	0	0	8	2	0	0	0	2	0	11	0	0	11	0	0	0	0	0	21
% App. Total	25	75	0	0		100	0	0	0		0	100	0	0		0	0	0	0		
PHF	.500	.750	.000	.000	.667	.500	.000	.000	.000	.500	.000	.458	.000	.000	.458	.000	.000	.000	.000	.000	.656



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File Name : WE_Mokulele Hwy - Mehameha Lp Site
Code : 15-554 DLNR Industrial & Business Park
Start Date : 8/12/2017
Page No : 1

Groups Printed- Motorcycles - Cars - Light Goods Vehicles - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

	MOKULELE HWY SOUTHBOUND				MEHAMEHA LP WESTBOUND				MOKULELE HWY NORTHBOUND				MEHAMEHA LP EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
11:00	2	198	0	0	0	0	1	3	0	269	2	0	0	0	0	0	475
11:15	1	252	0	0	0	0	2	0	0	294	1	0	0	0	0	0	550
11:30	2	275	0	0	0	0	2	0	0	280	0	0	0	0	0	0	559
11:45	2	256	0	0	0	0	1	0	0	274	1	0	0	0	0	0	534
Total	7	981	0	0	0	0	6	3	0	1117	4	0	0	0	0	0	2118
12:00	3	250	0	0	0	0	3	0	0	247	0	0	0	0	0	0	503
12:15	1	248	0	0	1	0	0	0	0	254	1	0	0	0	0	0	505
12:30	2	294	0	0	1	0	1	2	0	272	0	0	0	0	0	0	572
12:45	2	269	0	0	0	0	0	0	0	278	1	0	0	0	0	0	550
Total	8	1061	0	0	2	0	4	2	0	1051	2	0	0	0	0	0	2130
Grand Total	15	2042	0	0	2	0	10	5	0	2168	6	0	0	0	0	0	4248
Apprch %	0.7	99.3	0	0	11.8	0	58.8	29.4	0	99.7	0.3	0	0	0	0	0	
Total %	0.4	48.1	0	0	0	0	0.2	0.1	0	51	0.1	0	0	0	0	0	
Motorcycles	0	13	0	0	0	0	0	0	0	7	0	0	0	0	0	0	20
% Motorcycles	0	0.6	0	0	0	0	0	0	0	0.3	0	0	0	0	0	0	0.5
Cars	5	1665	0	0	2	0	2	0	0	1670	3	0	0	0	0	0	3347
% Cars	33.3	81.5	0	0	100	0	20	0	0	77	50	0	0	0	0	0	78.8
Light Goods Vehicles	8	339	0	0	0	0	8	0	0	449	3	0	0	0	0	0	807
% Light Goods Vehicles	53.3	16.6	0	0	0	0	80	0	0	20.7	50	0	0	0	0	0	19
Buses	0	6	0	0	0	0	0	0	0	12	0	0	0	0	0	0	18
% Buses	0	0.3	0	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0.4
Single-Unit Trucks	2	18	0	0	0	0	0	0	0	30	0	0	0	0	0	0	50
% Single-Unit Trucks	13.3	0.9	0	0	0	0	0	0	0	1.4	0	0	0	0	0	0	1.2
Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Road	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
% Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Crosswalk	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	5
% Bicycles on Crosswalk	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	0.1
Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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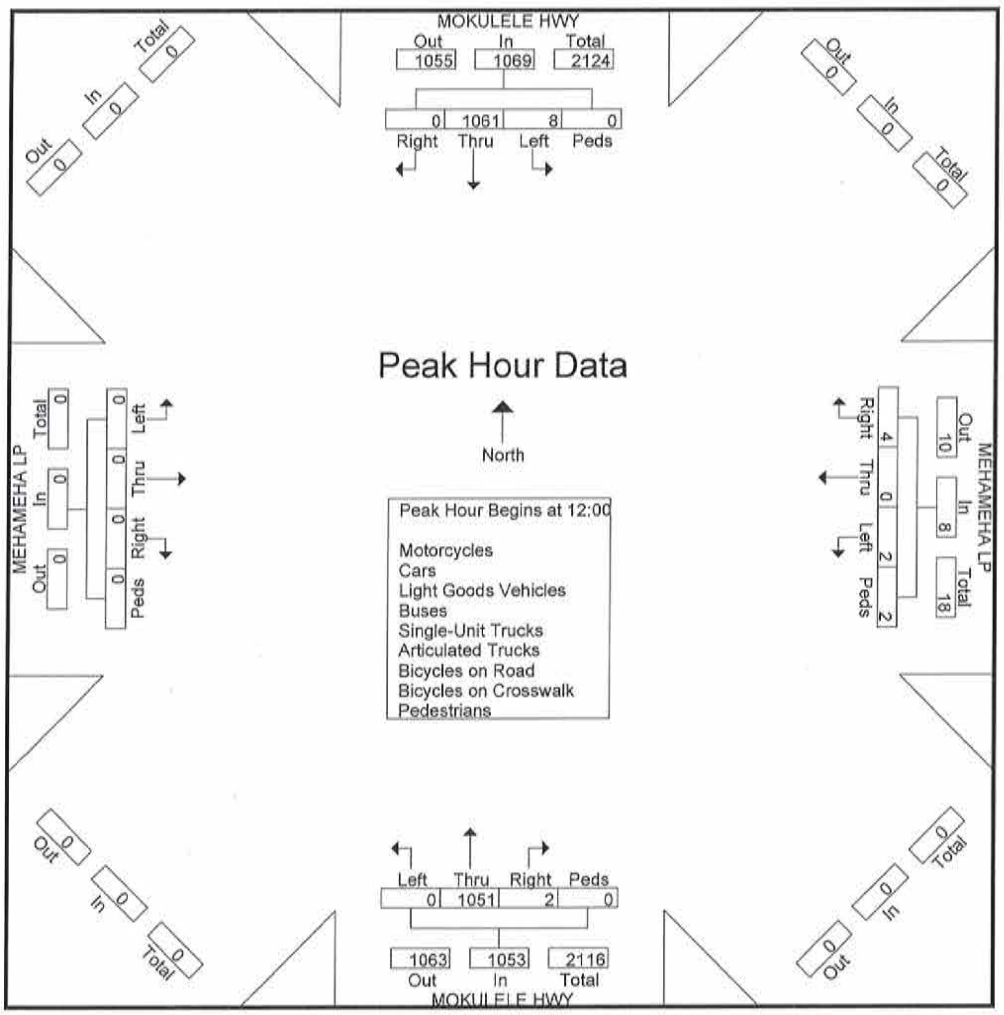
File Name : WE_Mokulele Hwy - Mehameha Lp Site
Code : 15-554 DLNR Industrial & Business Park
Start Date : 8/12/2017

	MOKULELE HWY SOUTHBOUND					MEHAMEHA LP WESTBOUND					MOKULELE HWY NORTHBOUND					MEHAMEHA LP EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 12:00 to 12:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 12:00																					
12:00	**3**	250	0	0	253	0	0	**3**	0	3	0	247	0	0	247	0	0	0	0	0	503
12:15	1	248	0	0	249	**1**	0	0	0	1	0	254	**1**	0	255	0	0	0	0	0	505
12:30	2	**294**	0	0	**296**	1	0	1	**2**	**4**	0	272	0	0	272	0	0	0	0	0	**572**
12:45	2	269	0	0	271	0	0	0	0	0	0	**278**	1	0	**279**	0	0	0	0	0	550
Total Volume	8	1061	0	0	1069	2	0	4	2	8	0	1051	2	0	1053	0	0	0	0	0	2130
% App. Total	0.7	99.3	0	0		25	0	50	25		0	99.8	0.2	0		0	0	0	0		
PHF	.667	.902	.000	.000	.903	.500	.000	.333	.250	.500	.000	.945	.500	.000	.944	.000	.000	.000	.000	.000	.931



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File Name : WE_Mokulele Hwy - Kihei Rd
Site Code : 15-554 DLNR Industrial & Business
Park Start Date : 8/12/2017
Page No : 1

Groups Printed- Motorcycles - Cars - Light Goods Vehicles - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

	MOKULELE HWY SOUTHBOUND				KIHEI RD WESTBOUND				MOKULELE HWY NORTHBOUND				KIHEI RD EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
11:00	0	164	33	0	0	0	0	2	78	248	0	2	43	0	55	0	625
11:15	0	208	30	0	0	0	0	1	48	245	0	0	44	0	60	0	636
11:30	0	230	32	0	1	0	0	0	62	231	0	0	50	0	58	0	664
11:45	0	215	46	0	0	0	0	0	75	205	0	0	55	0	56	0	652
Total	0	817	141	0	1	0	0	3	263	929	0	2	192	0	229	0	2577
12:00	0	209	29	0	1	0	1	0	70	201	0	0	42	0	69	0	622
12:15	1	216	31	0	0	0	2	1	74	235	1	0	39	0	61	0	661
12:30	0	235	39	0	0	0	0	2	81	224	1	2	41	0	72	2	699
12:45	0	238	43	1	0	0	0	0	68	237	0	0	38	0	62	0	687
Total	1	898	142	1	1	0	3	3	293	897	2	2	160	0	264	2	2669
Grand Total	1	1715	283	1	2	0	3	6	556	1826	2	4	352	0	493	2	5246
Apprch %	0.1	85.8	14.1	0.1	18.2	0	27.3	54.5	23.3	76.5	0.1	0.2	41.6	0	58.2	0.2	
Total %	0	32.7	5.4	0	0	0	0.1	0.1	10.6	34.8	0	0.1	6.7	0	9.4	0	
Motorcycles	0	8	3	0	0	0	0	0	2	8	0	0	0	0	0	0	21
% Motorcycles	0	0.5	1.1	0	0	0	0	0	0.4	0.4	0	0	0	0	0	0	0.4
Cars	0	1415	243	0	0	0	0	0	476	1416	0	0	274	0	459	0	4283
% Cars	0	82.5	85.9	0	0	0	0	0	85.6	77.5	0	0	77.8	0	93.1	0	81.6
Light Goods Vehicles	1	270	35	0	2	0	1	0	73	372	2	0	71	0	28	0	855
% Light Goods Vehicles	100	15.7	12.4	0	100	0	33.3	0	13.1	20.4	100	0	20.2	0	5.7	0	16.3
Buses	0	5	2	0	0	0	0	0	3	10	0	0	2	0	1	0	23
% Buses	0	0.3	0.7	0	0	0	0	0	0.5	0.5	0	0	0.6	0	0.2	0	0.4
Single-Unit Trucks	0	16	0	0	0	0	2	0	1	20	0	0	5	0	5	0	49
% Single-Unit Trucks	0	0.9	0	0	0	0	66.7	0	0.2	1.1	0	0	1.4	0	1	0	0.9
Articulated Trucks	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
% Articulated Trucks	0	0	0	0	0	0	0	0	0.2	0	0	0	0	0	0	0	0
Bicycles on Road	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
% Bicycles on Road	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Crosswalk	0	0	0	0	0	0	0	6	0	0	0	4	0	0	0	2	12
% Bicycles on Crosswalk	0	0	0	0	0	0	0	100	0	0	0	100	0	0	0	100	0.2
Pedestrians	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
% Pedestrians	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0

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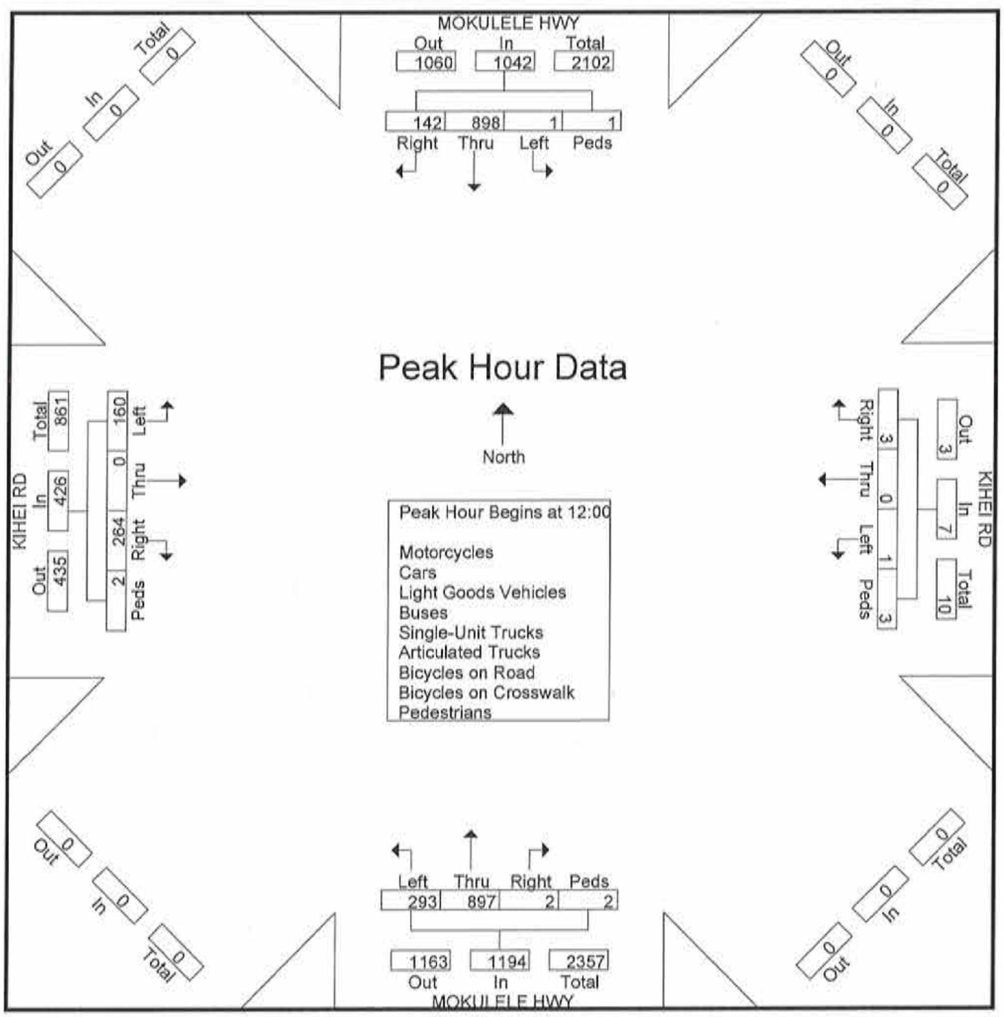
	MOKULELE HWY SOUTHBOUND					KIHEI RD WESTBOUND					MOKULELE HWY NORTHBOUND					KIHEI RD EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 11:00 to 12:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 12:00																					
12:00	0	209	29	0	238	**1**	0	1	0	2	70	201	0	0	271	**42**	0	69	0	111	622
12:15	**1**	216	31	0	248	0	0	**2**	1	**3**	74	235	**1**	0	**310**	39	0	61	0	100	661
12:30	0	235	39	0	274	0	0	0	**2**	2	**81**	224	1	**2**	308	41	0	**72**	**2**	**115**	**699**
12:45	0	**238**	**43**	**1**	**282**	0	0	0	0	0	68	**237**	0	0	305	38	0	62	0	100	687
Total Volume	1	898	142	1	1042	1	0	3	3	7	293	897	2	2	1194	160	0	264	2	426	2669
% App. Total	0.1	86.2	13.6	0.1		14.3	0	42.9	42.9		24.5	75.1	0.2	0.2		37.6	0	62	0.5		
PHF	.250	.943	.826	.250	.924	.250	.000	.375	.375	.583	.904	.946	.500	.250	.963	.952	.000	.917	.250	.926	.955



APPENDIX B

LEVEL OF SERVICE CRITERIA

APPENDIX B – LEVEL OF SERVICE (LOS) CRITERIA

VEHICULAR LEVEL OF SERVICE FOR SIGNALIZED INTERSECTIONS (HCM 2010)

Level of service for vehicles at signalized intersections is directly related to delay values and is assigned on that basis. Level of Service is a measure of the acceptability of delay values to motorists at a given intersection. The criteria are given in the table below.

Level-of Service Criteria for Signalized Intersections

Level of Service	Control Delay per Vehicle (sec./veh.)
A	< 10.0
B	>10.0 and ≤ 20.0
C	>20.0 and ≤ 35.0
D	>35.0 and ≤ 55.0
E	>55.0 and ≤ 80.0
F	> 80.0

Delay is a complex measure, and is dependent on a number of variables, including the quality of progression, the cycle length, the green ratio, and the v/c ratio for the lane group or approach in question.

VEHICULAR LEVEL OF SERVICE CRITERIA FOR UNSIGNALIZED INTERSECTIONS (HCM 2010)

The level of service criteria for vehicles at unsignalized intersections is defined as the average control delay, in seconds per vehicle.

LOS delay threshold values are lower for two-way stop-controlled (TWSC) and all-way stop-controlled (AWSC) intersections than those of signalized intersections. This is because more vehicles pass through signalized intersections, and therefore, drivers expect and tolerate greater delays. While the criteria for level of service for TWSC and AWSC intersections are the same, procedures to calculate the average total delay may differ.

Level of Service Criteria for Two-Way Stop-Controlled Intersections

Level of Service	Average Control Delay (sec/veh)
A	≤ 10
B	>10 and ≤15
C	>15 and ≤25
D	>25 and ≤35
E	>35 and ≤50
F	> 50

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Existing AM Peak

Movement	WBL	WBR	NBT	NBR	SBL	SBT	
Lane Configurations							
Traffic Volume (veh/h)	25	88	1259	22	119	1194	
Future Volume (veh/h)	25	88	1259	22	119	1194	
Initial Q (Qb), veh	0	0	0	0	0	0	
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00		
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	
Work Zone On Approach	No		No			No	
Adj Sat Flow, veh/h/ln	1366	1781	1870	1826	1826	1870	
Adj Flow Rate, veh/h	27	1	1368	12	129	1298	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	
Percent Heavy Veh, %	36	8	2	5	5	2	
Cap, veh/h	43	49	1856	808	165	2582	
Arrive On Green	0.03	0.03	0.52	0.52	0.09	0.73	
Sat Flow, veh/h	1301	1510	3647	1547	1739	3647	
Grp Volume(v), veh/h	27	1	1368	12	129	1298	
Grp Sat Flow(s),veh/h/ln	1301	1510	1777	1547	1739	1777	
Q Serve(g_s), s	0.9	0.0	13.7	0.2	3.3	7.2	
Cycle Q Clear(g_c), s	0.9	0.0	13.7	0.2	3.3	7.2	
Prop In Lane	1.00	1.00		1.00	1.00		
Lane Grp Cap(c), veh/h	43	49	1856	808	165	2582	
V/C Ratio(X)	0.63	0.02	0.74	0.01	0.78	0.50	
Avail Cap(c_a), veh/h	142	165	2411	1050	304	3422	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	
Uniform Delay (d), s/veh	21.8	21.4	8.5	5.3	20.2	2.7	
Incr Delay (d2), s/veh	14.5	0.2	0.9	0.0	7.8	0.2	
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	
%ile BackOfQ(50%),veh/ln	0.4	0.0	3.0	0.0	1.5	0.1	
Unsig. Movement Delay, s/veh							
LnGrp Delay(d),s/veh	36.4	21.6	9.3	5.3	28.0	2.8	
LnGrp LOS	D	C	A	A	C	A	
Approach Vol, veh/h	28		1380			1427	
Approach Delay, s/veh	35.8		9.3			5.1	
Approach LOS	D		A			A	
Timer - Assigned Phs	1	2				6	8
Phs Duration (G+Y+Rc), s	9.3	29.9				39.2	6.5
Change Period (Y+Rc), s	5.0	6.0				6.0	5.0
Max Green Setting (Gmax), s	8.0	31.0				44.0	5.0
Max Q Clear Time (g_c+I1), s	5.3	15.7				9.2	2.9
Green Ext Time (p_c), s	0.1	8.2				11.2	0.0
Intersection Summary							
HCM 6th Ctrl Delay			7.5				
HCM 6th LOS			A				

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	3	0	1	3	0	17	2	1262	4	19	1167	21
Future Volume (veh/h)	3	0	1	3	0	17	2	1262	4	19	1167	21
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1900	1900	1900	1900	1900	1900	1900	1870	1530	1352	1870	1900
Adj Flow Rate, veh/h	3	0	1	3	0	1	2	1372	3	21	1268	15
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	0	0	0	0	0	0	0	2	25	37	2	0
Cap, veh/h	143	0	4	143	0	4	5	2097	765	33	2177	986
Arrive On Green	0.01	0.00	0.01	0.01	0.00	0.01	0.00	0.59	0.59	0.03	0.61	0.61
Sat Flow, veh/h	1163	0	388	1163	0	388	1810	3554	1296	1287	3554	1610
Grp Volume(v), veh/h	4	0	0	4	0	0	2	1372	3	21	1268	15
Grp Sat Flow(s),veh/h/ln	1551	0	0	1551	0	0	1810	1777	1296	1287	1777	1610
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.0	0.1	12.4	0.0	0.8	10.3	0.2
Cycle Q Clear(g_c), s	0.1	0.0	0.0	0.1	0.0	0.0	0.1	12.4	0.0	0.8	10.3	0.2
Prop In Lane	0.75		0.25	0.75		0.25	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	147	0	0	147	0	0	5	2097	765	33	2177	986
V/C Ratio(X)	0.03	0.00	0.00	0.03	0.00	0.00	0.40	0.65	0.00	0.64	0.58	0.02
Avail Cap(c_a), veh/h	1145	0	0	1145	0	0	526	6942	2532	375	6942	3146
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	23.6	0.0	0.0	23.6	0.0	0.0	24.0	6.6	4.1	23.2	5.6	3.6
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.0	45.3	0.4	0.0	19.0	0.2	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.1	2.3	0.0	0.4	1.7	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	23.7	0.0	0.0	23.7	0.0	0.0	69.3	6.9	4.1	42.2	5.9	3.7
LnGrp LOS	C	A	A	C	A	A	E	A	A	D	A	A
Approach Vol, veh/h		4			4			1377			1304	
Approach Delay, s/veh		23.7			23.7			7.0			6.4	
Approach LOS		C			C			A			A	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	7.2	34.4		6.5	6.1	35.5		6.5
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	14.0	94.0		33.0	14.0	94.0		33.0
Max Q Clear Time (g_c+I1), s	2.8	14.4		2.1	2.1	12.3		2.1
Green Ext Time (p_c), s	0.0	14.0		0.0	0.0	12.2		0.0

Intersection Summary		
HCM 6th Ctrl Delay		6.8
HCM 6th LOS		A

Intersection												
Int Delay, s/veh	0.1											

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰↑↱			↰↑	↱	↰	↑↑	↱	↰	↑↑↱	
Traffic Vol, veh/h	0	0	0	2	0	2	2	1256	4	3	1164	0
Future Vol, veh/h	0	0	0	2	0	2	2	1256	4	3	1164	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	Stop	-	-	Yield	-	-	None
Storage Length	-	-	-	-	-	100	525	-	425	625	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	0	0	0	0	0	0	0	2	0	0	2	0
Mvmt Flow	0	0	0	2	0	2	2	1365	4	3	1265	0

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1958	2640	633	2008	2640	683	1265	0	0	1365	0	0
Stage 1	1271	1271	-	1369	1369	-	-	-	-	-	-	-
Stage 2	687	1369	-	639	1271	-	-	-	-	-	-	-
Critical Hdwy	7.5	6.5	6.9	7.5	6.5	6.9	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.5	5.5	-	6.5	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.5	5.5	-	6.5	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.5	4	3.3	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	39	24	427	36	24	396	556	-	-	510	-	-
Stage 1	181	241	-	157	216	-	-	-	-	-	-	-
Stage 2	408	216	-	436	241	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	38	24	427	36	24	396	556	-	-	510	-	-
Mov Cap-2 Maneuver	38	24	-	36	24	-	-	-	-	-	-	-
Stage 1	180	240	-	156	215	-	-	-	-	-	-	-
Stage 2	404	215	-	433	240	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0	62.7	0	0
HCM LOS	A	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	556	-	-	-	36	396	510	-	-
HCM Lane V/C Ratio	0.004	-	-	-	0.06	0.005	0.006	-	-
HCM Control Delay (s)	11.5	-	-	0	111.3	14.1	12.1	-	-
HCM Lane LOS	B	-	-	A	F	B	B	-	-
HCM 95th %tile Q(veh)	0	-	-	-	0.2	0	0	-	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	242	2	330	6	0	1	453	1020	9	2	983	18
Future Volume (veh/h)	242	2	330	6	0	1	453	1020	9	2	983	18
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	264	0	224	7	0	1	492	1109	6	2	1068	7
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	445	0	988	15	0	13	646	1972	879	4	1315	587
Arrive On Green	0.12	0.00	0.12	0.01	0.00	0.01	0.19	0.55	0.55	0.00	0.37	0.37
Sat Flow, veh/h	3563	0	3170	1781	0	1585	3456	3554	1585	1781	3554	1585
Grp Volume(v), veh/h	264	0	224	7	0	1	492	1109	6	2	1068	7
Grp Sat Flow(s),veh/h/ln	1781	0	1585	1781	0	1585	1728	1777	1585	1781	1777	1585
Q Serve(g_s), s	5.0	0.0	3.7	0.3	0.0	0.0	9.6	14.3	0.1	0.1	19.2	0.2
Cycle Q Clear(g_c), s	5.0	0.0	3.7	0.3	0.0	0.0	9.6	14.3	0.1	0.1	19.2	0.2
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	445	0	988	15	0	13	646	1972	879	4	1315	587
V/C Ratio(X)	0.59	0.00	0.23	0.48	0.00	0.08	0.76	0.56	0.01	0.52	0.81	0.01
Avail Cap(c_a), veh/h	1857	0	2245	126	0	112	1656	2854	1273	226	1602	715
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	29.4	0.0	18.1	35.0	0.0	34.9	27.4	10.2	7.1	35.4	20.1	14.1
Incr Delay (d2), s/veh	1.3	0.0	0.1	22.2	0.0	2.5	1.9	0.3	0.0	78.4	2.7	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.1	0.0	1.3	0.2	0.0	0.0	3.7	4.3	0.0	0.1	7.2	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	30.6	0.0	18.2	57.2	0.0	37.4	29.3	10.5	7.1	113.7	22.9	14.1
LnGrp LOS	C	A	B	E	A	D	C	B	A	F	C	B
Approach Vol, veh/h		488			8			1607			1077	
Approach Delay, s/veh		24.9			54.8			16.2			23.0	
Approach LOS		C			D			B			C	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.2	45.4		5.6	19.3	32.3		13.9				
Change Period (Y+Rc), s	6.0	6.0		5.0	6.0	6.0		5.0				
Max Green Setting (Gmax), s	9.0	57.0		5.0	34.0	32.0		37.0				
Max Q Clear Time (g_c+I1), s	2.1	16.3		2.3	11.6	21.2		7.0				
Green Ext Time (p_c), s	0.0	9.2		0.0	1.7	5.1		1.9				
Intersection Summary												
HCM 6th Ctrl Delay			19.9									
HCM 6th LOS			B									

Notes

User approved volume balancing among the lanes for turning movement.

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Existing PM Peak

Movement	WBL	WBR	NBT	NBR	SBL	SBT	
Lane Configurations							
Traffic Volume (veh/h)	25	128	1352	23	60	1513	
Future Volume (veh/h)	25	128	1352	23	60	1513	
Initial Q (Qb), veh	0	0	0	0	0	0	
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00		
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	
Work Zone On Approach	No		No			No	
Adj Sat Flow, veh/h/ln	1841	1856	1870	1648	1752	1870	
Adj Flow Rate, veh/h	27	1	1470	14	65	1645	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	
Percent Heavy Veh, %	4	3	2	17	10	2	
Cap, veh/h	57	51	1984	780	102	2588	
Arrive On Green	0.03	0.03	0.56	0.56	0.06	0.73	
Sat Flow, veh/h	1753	1572	3647	1397	1668	3647	
Grp Volume(v), veh/h	27	1	1470	14	65	1645	
Grp Sat Flow(s),veh/h/ln	1753	1572	1777	1397	1668	1777	
Q Serve(g_s), s	0.7	0.0	14.3	0.2	1.8	10.8	
Cycle Q Clear(g_c), s	0.7	0.0	14.3	0.2	1.8	10.8	
Prop In Lane	1.00	1.00		1.00	1.00		
Lane Grp Cap(c), veh/h	57	51	1984	780	102	2588	
V/C Ratio(X)	0.47	0.02	0.74	0.02	0.64	0.64	
Avail Cap(c_a), veh/h	229	205	2549	1002	181	3322	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	
Uniform Delay (d), s/veh	21.9	21.5	7.7	4.5	21.1	3.2	
Incr Delay (d2), s/veh	5.9	0.2	0.9	0.0	6.4	0.3	
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	
%ile BackOfQ(50%),veh/ln	0.4	0.0	2.9	0.0	0.7	0.1	
Unsig. Movement Delay, s/veh							
LnGrp Delay(d),s/veh	27.8	21.7	8.5	4.5	27.5	3.4	
LnGrp LOS	C	C	A	A	C	A	
Approach Vol, veh/h	28		1484			1710	
Approach Delay, s/veh	27.5		8.5			4.3	
Approach LOS	C		A			A	
Timer - Assigned Phs	1	2				6	8
Phs Duration (G+Y+Rc), s	7.8	31.7				39.5	6.5
Change Period (Y+Rc), s	5.0	6.0				6.0	5.0
Max Green Setting (Gmax), s	5.0	33.0				43.0	6.0
Max Q Clear Time (g_c+I1), s	3.8	16.3				12.8	2.7
Green Ext Time (p_c), s	0.0	9.3				15.0	0.0

Intersection Summary			
HCM 6th Ctrl Delay			6.5
HCM 6th LOS			A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	23	0	13	1	0	23	11	1282	4	10	1372	13
Future Volume (veh/h)	23	0	13	1	0	23	11	1282	4	10	1372	13
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1900	1900	1900	1900	1900	1900	1900	1870	788	863	1870	1900
Adj Flow Rate, veh/h	25	0	1	1	0	1	12	1393	3	11	1491	9
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	0	0	0	0	0	0	0	2	75	70	2	0
Cap, veh/h	176	0	2	127	0	27	28	2202	414	12	2198	996
Arrive On Green	0.03	0.00	0.03	0.03	0.00	0.03	0.02	0.62	0.62	0.01	0.62	0.62
Sat Flow, veh/h	1401	0	56	852	0	852	1810	3554	668	822	3554	1610
Grp Volume(v), veh/h	26	0	0	2	0	0	12	1393	3	11	1491	9
Grp Sat Flow(s),veh/h/ln	1457	0	0	1703	0	0	1810	1777	668	822	1777	1610
Q Serve(g_s), s	0.9	0.0	0.0	0.0	0.0	0.0	0.4	13.2	0.1	0.7	14.8	0.1
Cycle Q Clear(g_c), s	0.9	0.0	0.0	0.1	0.0	0.0	0.4	13.2	0.1	0.7	14.8	0.1
Prop In Lane	0.96		0.04	0.50		0.50	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	177	0	0	154	0	0	28	2202	414	12	2198	996
V/C Ratio(X)	0.15	0.00	0.00	0.01	0.00	0.00	0.43	0.63	0.01	0.95	0.68	0.01
Avail Cap(c_a), veh/h	1044	0	0	1066	0	0	471	6206	1167	214	6206	2812
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	25.7	0.0	0.0	25.3	0.0	0.0	26.3	6.4	3.9	26.5	6.7	3.9
Incr Delay (d2), s/veh	0.4	0.0	0.0	0.0	0.0	0.0	10.4	0.3	0.0	109.3	0.4	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.3	0.0	0.0	0.0	0.0	0.0	0.2	2.5	0.0	0.5	2.9	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	26.1	0.0	0.0	25.3	0.0	0.0	36.7	6.7	3.9	135.8	7.1	3.9
LnGrp LOS	C	A	A	C	A	A	D	A	A	F	A	A
Approach Vol, veh/h		26			2			1408			1511	
Approach Delay, s/veh		26.1			25.3			7.0			8.0	
Approach LOS		C			C			A			A	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.8	39.4		7.7	6.8	39.3		7.7				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	14.0	94.0		34.0	14.0	94.0		34.0				
Max Q Clear Time (g_c+I1), s	2.7	15.2		2.9	2.4	16.8		2.1				
Green Ext Time (p_c), s	0.0	14.4		0.1	0.0	16.4		0.0				

Intersection Summary		
HCM 6th Ctrl Delay		7.7
HCM 6th LOS		A

Intersection	
Int Delay, s/veh	0.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	0	0	0	2	0	4	2	1272	8	3	1369	0
Future Vol, veh/h	0	0	0	2	0	4	2	1272	8	3	1369	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	Stop	-	-	Yield	-	-	None
Storage Length	-	-	-	-	-	100	525	-	425	625	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	0	0	0	0	0	0	0	2	0	0	2	0
Mvmt Flow	0	0	0	2	0	4	2	1383	9	3	1488	0

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	2190	2881	744	2137	2881	692	1488	0	0	1383	0	0
Stage 1	1494	1494	-	1387	1387	-	-	-	-	-	-	-
Stage 2	696	1387	-	750	1494	-	-	-	-	-	-	-
Critical Hdwy	7.5	6.5	6.9	7.5	6.5	6.9	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.5	5.5	-	6.5	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.5	5.5	-	6.5	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.5	4	3.3	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	26	17	362	28	17	391	458	-	-	502	-	-
Stage 1	131	188	-	153	212	-	-	-	-	-	-	-
Stage 2	403	212	-	374	188	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	26	17	362	28	17	391	458	-	-	502	-	-
Mov Cap-2 Maneuver	26	17	-	28	17	-	-	-	-	-	-	-
Stage 1	130	187	-	152	211	-	-	-	-	-	-	-
Stage 2	397	211	-	372	187	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0	57.6	0	0
HCM LOS	A	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	458	-	-	-	28	391	502	-	-
HCM Lane V/C Ratio	0.005	-	-	-	0.078	0.011	0.006	-	-
HCM Control Delay (s)	12.9	-	-	0	144.1	14.3	12.2	-	-
HCM Lane LOS	B	-	-	A	F	B	B	-	-
HCM 95th %tile Q(veh)	0	-	-	-	0.2	0	0	-	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	216	0	391	13	4	11	459	1088	11	1	1209	205
Future Volume (veh/h)	216	0	391	13	4	11	459	1088	11	1	1209	205
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	235	0	320	14	4	1	499	1183	7	1	1314	75
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	461	0	993	31	25	6	635	2052	915	2	1403	626
Arrive On Green	0.13	0.00	0.13	0.02	0.02	0.02	0.18	0.58	0.58	0.00	0.39	0.39
Sat Flow, veh/h	3563	0	3170	1781	1444	361	3456	3554	1585	1781	3554	1585
Grp Volume(v), veh/h	235	0	320	14	0	5	499	1183	7	1	1314	75
Grp Sat Flow(s),veh/h/ln	1781	0	1585	1781	0	1805	1728	1777	1585	1781	1777	1585
Q Serve(g_s), s	4.9	0.0	6.2	0.6	0.0	0.2	11.0	16.9	0.2	0.0	28.4	2.4
Cycle Q Clear(g_c), s	4.9	0.0	6.2	0.6	0.0	0.2	11.0	16.9	0.2	0.0	28.4	2.4
Prop In Lane	1.00		1.00	1.00		0.20	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	461	0	993	31	0	31	635	2052	915	2	1403	626
V/C Ratio(X)	0.51	0.00	0.32	0.46	0.00	0.16	0.79	0.58	0.01	0.45	0.94	0.12
Avail Cap(c_a), veh/h	1646	0	2047	111	0	113	1467	2529	1128	200	1420	633
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	32.5	0.0	21.0	39.0	0.0	38.8	31.2	10.7	7.2	40.0	23.3	15.4
Incr Delay (d2), s/veh	0.9	0.0	0.2	10.2	0.0	2.4	2.2	0.3	0.0	101.4	11.8	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.1	0.0	2.2	0.4	0.0	0.1	4.4	5.3	0.0	0.1	12.6	0.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	33.4	0.0	21.2	49.2	0.0	41.2	33.4	11.0	7.2	141.4	35.1	15.5
LnGrp LOS	C	A	C	D	A	D	C	B	A	F	D	B
Approach Vol, veh/h		555			19			1689			1390	
Approach Delay, s/veh		26.3			47.1			17.6			34.1	
Approach LOS		C			D			B			C	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.1	52.3		6.4	20.7	37.6		15.4				
Change Period (Y+Rc), s	6.0	6.0		5.0	6.0	6.0		5.0				
Max Green Setting (Gmax), s	9.0	57.0		5.0	34.0	32.0		37.0				
Max Q Clear Time (g_c+I1), s	2.0	18.9		2.6	13.0	30.4		8.2				
Green Ext Time (p_c), s	0.0	10.0		0.0	1.7	1.2		2.2				
Intersection Summary												
HCM 6th Ctrl Delay			25.4									
HCM 6th LOS			C									

Notes

User approved volume balancing among the lanes for turning movement.

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Existing WE Peak

Movement	WBL	WBR	NBT	NBR	SBL	SBT	
Lane Configurations							
Traffic Volume (veh/h)	8	46	1058	14	35	1091	
Future Volume (veh/h)	8	46	1058	14	35	1091	
Initial Q (Qb), veh	0	0	0	0	0	0	
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00		
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	
Work Zone On Approach	No		No			No	
Adj Sat Flow, veh/h/ln	1707	1841	1870	1693	1767	1870	
Adj Flow Rate, veh/h	9	1	1150	8	38	1186	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	
Percent Heavy Veh, %	13	4	2	14	9	2	
Cap, veh/h	21	21	1811	731	74	2447	
Arrive On Green	0.01	0.01	0.51	0.51	0.04	0.69	
Sat Flow, veh/h	1626	1560	3647	1434	1682	3647	
Grp Volume(v), veh/h	9	1	1150	8	38	1186	
Grp Sat Flow(s),veh/h/ln	1626	1560	1777	1434	1682	1777	
Q Serve(g_s), s	0.2	0.0	8.7	0.1	0.8	5.8	
Cycle Q Clear(g_c), s	0.2	0.0	8.7	0.1	0.8	5.8	
Prop In Lane	1.00	1.00		1.00	1.00		
Lane Grp Cap(c), veh/h	21	21	1811	731	74	2447	
V/C Ratio(X)	0.42	0.05	0.64	0.01	0.52	0.48	
Avail Cap(c_a), veh/h	264	254	3178	1283	228	4141	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	
Uniform Delay (d), s/veh	18.1	18.0	6.6	4.5	17.3	2.7	
Incr Delay (d2), s/veh	12.5	1.0	0.4	0.0	5.5	0.1	
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	
%ile BackOfQ(50%),veh/ln	0.1	0.0	1.4	0.0	0.4	0.1	
Unsig. Movement Delay, s/veh							
LnGrp Delay(d),s/veh	30.6	18.9	6.9	4.5	22.8	2.8	
LnGrp LOS	C	B	A	A	C	A	
Approach Vol, veh/h	10		1158			1224	
Approach Delay, s/veh	29.4		6.9			3.5	
Approach LOS	C		A			A	
Timer - Assigned Phs	1	2				6	8
Phs Duration (G+Y+Rc), s	6.6	24.8				31.4	5.5
Change Period (Y+Rc), s	5.0	6.0				6.0	5.0
Max Green Setting (Gmax), s	5.0	33.0				43.0	6.0
Max Q Clear Time (g_c+I1), s	2.8	10.7				7.8	2.2
Green Ext Time (p_c), s	0.0	8.1				9.8	0.0
Intersection Summary							
HCM 6th Ctrl Delay			5.2				
HCM 6th LOS			A				

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣		↰	↑↑	↱	↰	↑↑	↱
Traffic Volume (veh/h)	24	1	14	5	0	14	11	1033	2	6	1059	21
Future Volume (veh/h)	24	1	14	5	0	14	11	1033	2	6	1059	21
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1900	1900	1900	1900	1900	1900	1900	1870	1900	1411	1870	1900
Adj Flow Rate, veh/h	26	1	1	5	0	1	12	1123	1	7	1151	13
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	0	0	0	0	0	0	0	2	0	33	2	0
Cap, veh/h	218	2	2	209	0	11	28	1871	848	13	1849	838
Arrive On Green	0.04	0.04	0.04	0.04	0.00	0.04	0.02	0.53	0.53	0.01	0.52	0.52
Sat Flow, veh/h	1380	53	53	1359	0	272	1810	3554	1610	1344	3554	1610
Grp Volume(v), veh/h	28	0	0	6	0	0	12	1123	1	7	1151	13
Grp Sat Flow(s),veh/h/ln	1486	0	0	1631	0	0	1810	1777	1610	1344	1777	1610
Q Serve(g_s), s	0.6	0.0	0.0	0.0	0.0	0.0	0.3	9.3	0.0	0.2	9.7	0.2
Cycle Q Clear(g_c), s	0.8	0.0	0.0	0.1	0.0	0.0	0.3	9.3	0.0	0.2	9.7	0.2
Prop In Lane	0.93		0.04	0.83		0.17	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	222	0	0	219	0	0	28	1871	848	13	1849	838
V/C Ratio(X)	0.13	0.00	0.00	0.03	0.00	0.00	0.43	0.60	0.00	0.56	0.62	0.02
Avail Cap(c_a), veh/h	1335	0	0	1338	0	0	598	7890	3575	444	7890	3575
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	19.9	0.0	0.0	19.6	0.0	0.0	20.7	6.9	4.7	20.9	7.2	4.9
Incr Delay (d2), s/veh	0.3	0.0	0.0	0.0	0.0	0.0	9.9	0.3	0.0	33.5	0.3	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.3	0.0	0.0	0.1	0.0	0.0	0.2	1.7	0.0	0.2	1.9	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	20.2	0.0	0.0	19.7	0.0	0.0	30.6	7.2	4.7	54.4	7.5	4.9
LnGrp LOS	C	A	A	B	A	A	C	A	A	D	A	A
Approach Vol, veh/h		28			6			1136			1171	
Approach Delay, s/veh		20.2			19.7			7.5			7.8	
Approach LOS		C			B			A			A	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.4	28.3		7.6	6.7	28.0		7.6				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	14.0	94.0		34.0	14.0	94.0		34.0				
Max Q Clear Time (g_c+I1), s	2.2	11.3		2.8	2.3	11.7		2.1				
Green Ext Time (p_c), s	0.0	9.8		0.1	0.0	10.3		0.0				

Intersection Summary			
HCM 6th Ctrl Delay			7.8
HCM 6th LOS			A

Intersection	
Int Delay, s/veh	0.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	0	0	0	2	0	4	0	1051	2	8	1061	0
Future Vol, veh/h	0	0	0	2	0	4	0	1051	2	8	1061	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	Stop	-	-	Yield	-	-	None
Storage Length	-	-	-	-	-	100	525	-	425	625	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	0	0	0	0	0	0	0	2	0	0	2	0
Mvmt Flow	0	0	0	2	0	4	0	1142	2	9	1153	0

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1742	2313	577	1737	2313	571	1153	0	0	1142	0	0
Stage 1	1171	1171	-	1142	1142	-	-	-	-	-	-	-
Stage 2	571	1142	-	595	1171	-	-	-	-	-	-	-
Critical Hdwy	7.5	6.5	6.9	7.5	6.5	6.9	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.5	5.5	-	6.5	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.5	5.5	-	6.5	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.5	4	3.3	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	57	38	465	57	38	469	613	-	-	619	-	-
Stage 1	208	269	-	217	278	-	-	-	-	-	-	-
Stage 2	478	278	-	463	269	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	56	37	465	56	37	469	613	-	-	619	-	-
Mov Cap-2 Maneuver	56	37	-	56	37	-	-	-	-	-	-	-
Stage 1	208	265	-	217	278	-	-	-	-	-	-	-
Stage 2	474	278	-	456	265	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0	32.4	0	0.1
HCM LOS	A	D		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	613	-	-	-	56	469	619	-	-
HCM Lane V/C Ratio	-	-	-	-	0.039	0.009	0.014	-	-
HCM Control Delay (s)	0	-	-	0	71.9	12.7	10.9	-	-
HCM Lane LOS	A	-	-	A	F	B	B	-	-
HCM 95th %tile Q(veh)	0	-	-	-	0.1	0	0	-	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	160	0	264	1	0	3	293	897	2	1	898	142
Future Volume (veh/h)	160	0	264	1	0	3	293	897	2	1	898	142
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	174	0	105	1	0	1	318	975	1	1	976	62
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	349	0	754	4	0	3	483	1829	816	3	1336	596
Arrive On Green	0.10	0.00	0.10	0.00	0.00	0.00	0.14	0.51	0.51	0.00	0.38	0.38
Sat Flow, veh/h	3563	0	3170	1781	0	1585	3456	3554	1585	1781	3554	1585
Grp Volume(v), veh/h	174	0	105	1	0	1	318	975	1	1	976	62
Grp Sat Flow(s),veh/h/ln	1781	0	1585	1781	0	1585	1728	1777	1585	1781	1777	1585
Q Serve(g_s), s	2.7	0.0	1.5	0.0	0.0	0.0	5.0	10.5	0.0	0.0	13.5	1.5
Cycle Q Clear(g_c), s	2.7	0.0	1.5	0.0	0.0	0.0	5.0	10.5	0.0	0.0	13.5	1.5
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	349	0	754	4	0	3	483	1829	816	3	1336	596
V/C Ratio(X)	0.50	0.00	0.14	0.26	0.00	0.29	0.66	0.53	0.00	0.32	0.73	0.10
Avail Cap(c_a), veh/h	2301	0	2491	155	0	138	2051	3536	1577	280	1985	885
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	24.5	0.0	17.2	28.5	0.0	28.5	23.3	9.3	6.8	28.6	15.4	11.6
Incr Delay (d2), s/veh	1.1	0.0	0.1	31.5	0.0	40.4	1.5	0.2	0.0	50.8	0.8	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.1	0.0	0.5	0.0	0.0	0.1	1.9	2.9	0.0	0.1	4.4	0.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	25.6	0.0	17.3	60.0	0.0	68.9	24.9	9.5	6.8	79.4	16.2	11.7
LnGrp LOS	C	A	B	E	A	E	C	A	A	E	B	B
Approach Vol, veh/h		279			2			1294			1039	
Approach Delay, s/veh		22.5			64.5			13.3			15.9	
Approach LOS		C			E			B			B	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.1	35.5		5.1	14.0	27.5		10.6				
Change Period (Y+Rc), s	6.0	6.0		5.0	6.0	6.0		5.0				
Max Green Setting (Gmax), s	9.0	57.0		5.0	34.0	32.0		37.0				
Max Q Clear Time (g_c+I1), s	2.0	12.5		2.0	7.0	15.5		4.7				
Green Ext Time (p_c), s	0.0	7.7		0.0	1.1	6.0		1.0				

Intersection Summary			
HCM 6th Ctrl Delay			15.4
HCM 6th LOS			B

Notes

User approved volume balancing among the lanes for turning movement.

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Base Year 2038 AM Peak

Movement	WBL	WBR	NBT	NBR	SBL	SBT	
Lane Configurations	↰	↱	↑↑	↱	↰	↑↑	
Traffic Volume (veh/h)	75	265	1975	70	360	2385	
Future Volume (veh/h)	75	265	1975	70	360	2385	
Initial Q (Qb), veh	0	0	0	0	0	0	
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00		
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	
Work Zone On Approach	No		No			No	
Adj Sat Flow, veh/h/ln	1515	1663	1870	1826	1826	1870	
Adj Flow Rate, veh/h	82	63	2147	36	391	2592	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	
Percent Heavy Veh, %	26	16	2	5	5	2	
Cap, veh/h	117	114	1841	802	232	2613	
Arrive On Green	0.08	0.08	0.52	0.52	0.13	0.74	
Sat Flow, veh/h	1443	1409	3647	1547	1739	3647	
Grp Volume(v), veh/h	82	63	2147	36	391	2592	
Grp Sat Flow(s),veh/h/ln	1443	1409	1777	1547	1739	1777	
Q Serve(g_s), s	3.3	2.6	31.0	0.7	8.0	42.7	
Cycle Q Clear(g_c), s	3.3	2.6	31.0	0.7	8.0	42.7	
Prop In Lane	1.00	1.00		1.00	1.00		
Lane Grp Cap(c), veh/h	117	114	1841	802	232	2613	
V/C Ratio(X)	0.70	0.55	1.17	0.04	1.68	0.99	
Avail Cap(c_a), veh/h	121	118	1841	802	232	2613	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	
Uniform Delay (d), s/veh	26.8	26.5	14.4	7.1	25.9	7.7	
Incr Delay (d2), s/veh	16.3	5.2	81.1	0.0	324.8	15.7	
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	
%ile BackOfQ(50%),veh/ln	1.6	1.0	29.3	0.2	23.9	9.8	
Unsig. Movement Delay, s/veh							
LnGrp Delay(d),s/veh	43.1	31.6	95.5	7.1	350.8	23.4	
LnGrp LOS	D	C	F	A	F	C	
Approach Vol, veh/h	145		2183			2983	
Approach Delay, s/veh	38.1		94.1			66.3	
Approach LOS	D		F			E	
Timer - Assigned Phs	1	2				6	8
Phs Duration (G+Y+Rc), s	13.0	37.0				50.0	9.8
Change Period (Y+Rc), s	5.0	6.0				6.0	5.0
Max Green Setting (Gmax), s	8.0	31.0				44.0	5.0
Max Q Clear Time (g_c+I1), s	10.0	33.0				44.7	5.3
Green Ext Time (p_c), s	0.0	0.0				0.0	0.0
Intersection Summary							
HCM 6th Ctrl Delay			77.0				
HCM 6th LOS			E				

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	30	5	5	35	5	70	5	1950	155	265	2090	95
Future Volume (veh/h)	30	5	5	35	5	70	5	1950	155	265	2090	95
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1826	1826	1826	1366	1366	1337	1900	1870	1530	1396	1870	1841
Adj Flow Rate, veh/h	33	5	1	38	5	0	5	2120	111	288	2272	79
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	5	5	5	36	36	38	0	2	25	34	2	4
Cap, veh/h	120	15	2	107	8		12	2432	887	155	2823	1239
Arrive On Green	0.05	0.05	0.05	0.05	0.05	0.00	0.01	0.68	0.68	0.12	0.79	0.79
Sat Flow, veh/h	1311	306	43	1015	154	1133	1810	3554	1296	1330	3554	1560
Grp Volume(v), veh/h	39	0	0	43	0	0	5	2120	111	288	2272	79
Grp Sat Flow(s),veh/h/ln	1660	0	0	1169	0	1133	1810	1777	1296	1330	1777	1560
Q Serve(g_s), s	0.0	0.0	0.0	1.6	0.0	0.0	0.3	56.1	3.6	14.0	43.8	1.3
Cycle Q Clear(g_c), s	2.6	0.0	0.0	4.2	0.0	0.0	0.3	56.1	3.6	14.0	43.8	1.3
Prop In Lane	0.85		0.03	0.88		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	137	0	0	114	0		12	2432	887	155	2823	1239
V/C Ratio(X)	0.28	0.00	0.00	0.38	0.00		0.43	0.87	0.13	1.86	0.80	0.06
Avail Cap(c_a), veh/h	458	0	0	353	0		211	2778	1013	155	2823	1239
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	55.5	0.0	0.0	56.2	0.0	0.0	59.5	14.8	6.5	53.1	7.0	2.7
Incr Delay (d2), s/veh	1.1	0.0	0.0	2.0	0.0	0.0	23.4	3.0	0.1	410.8	1.8	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.2	0.0	0.0	1.3	0.0	0.0	0.2	19.4	0.9	22.2	11.1	0.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	56.7	0.0	0.0	58.2	0.0	0.0	82.9	17.8	6.6	464.0	8.8	2.7
LnGrp LOS	E	A	A	E	A		F	B	A	F	A	A
Approach Vol, veh/h		39			43	A		2236			2639	
Approach Delay, s/veh		56.7			58.2			17.4			58.3	
Approach LOS		E			E			B			E	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	20.0	88.3		11.9	6.8	101.5		11.9
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	14.0	94.0		33.0	14.0	94.0		33.0
Max Q Clear Time (g_c+I1), s	16.0	58.1		4.6	2.3	45.8		6.2
Green Ext Time (p_c), s	0.0	24.2		0.1	0.0	32.1		0.2

Intersection Summary	
HCM 6th Ctrl Delay	39.9
HCM 6th LOS	D

Notes

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	50	35	90	2050	2020	110
Future Volume (veh/h)	50	35	90	2050	2020	110
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No	No	
Adj Sat Flow, veh/h/ln	1752	1767	1841	1870	1870	1856
Adj Flow Rate, veh/h	54	1	98	2228	2196	110
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	10	9	4	2	2	3
Cap, veh/h	87	40	116	3281	2957	1308
Arrive On Green	0.03	0.03	0.07	0.92	0.83	0.83
Sat Flow, veh/h	3237	1497	1753	3647	3647	1572
Grp Volume(v), veh/h	54	1	98	2228	2196	110
Grp Sat Flow(s),veh/h/ln	1618	1497	1753	1777	1777	1572
Q Serve(g_s), s	3.0	0.1	10.0	23.2	48.9	2.3
Cycle Q Clear(g_c), s	3.0	0.1	10.0	23.2	48.9	2.3
Prop In Lane	1.00	1.00	1.00			1.00
Lane Grp Cap(c), veh/h	87	40	116	3281	2957	1308
V/C Ratio(X)	0.62	0.02	0.85	0.68	0.74	0.08
Avail Cap(c_a), veh/h	908	420	141	3281	2957	1308
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	0.54	0.54
Uniform Delay (d), s/veh	86.7	85.3	83.1	1.4	6.6	2.7
Incr Delay (d2), s/veh	7.1	0.2	30.6	1.2	0.9	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.3	0.1	5.5	1.4	14.3	0.6
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	93.8	85.6	113.7	2.6	7.6	2.8
LnGrp LOS	F	F	F	A	A	A
Approach Vol, veh/h	55			2326	2306	
Approach Delay, s/veh	93.7			7.3	7.4	
Approach LOS	F			A	A	
Timer - Assigned Phs		2		4	5	6
Phs Duration (G+Y+Rc), s		170.7		9.3	16.4	154.3
Change Period (Y+Rc), s		4.5		4.5	4.5	4.5
Max Green Setting (Gmax), s		120.5		50.5	14.5	101.5
Max Q Clear Time (g_c+I1), s		25.2		5.0	12.0	50.9
Green Ext Time (p_c), s		43.1		0.2	0.0	31.7
Intersection Summary						
HCM 6th Ctrl Delay			8.3			
HCM 6th LOS			A			

Intersection	
Int Delay, s/veh	143

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	10	5	45	25	5	25	140	2110	30	30	1980	45
Future Vol, veh/h	10	5	45	25	5	25	140	2110	30	30	1980	45
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	Stop	-	-	Yield	-	-	None
Storage Length	-	-	-	-	-	100	525	-	425	625	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	23	0	13	0	0	0	4	2	0	0	2	5
Mvmt Flow	11	5	49	27	5	27	152	2293	33	33	2152	49

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	3696	4840	1101	3742	4864	1147	2201	0	0	2293	0	0
Stage 1	2243	2243	-	2597	2597	-	-	-	-	-	-	-
Stage 2	1453	2597	-	1145	2267	-	-	-	-	-	-	-
Critical Hdwy	7.96	6.5	7.16	7.5	6.5	6.9	4.18	-	-	4.1	-	-
Critical Hdwy Stg 1	6.96	5.5	-	6.5	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.96	5.5	-	6.5	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.73	4	3.43	3.5	4	3.3	2.24	-	-	2.2	-	-
Pot Cap-1 Maneuver	~ 1	~ 1	190	~ 2	~ 1	196	229	-	-	223	-	-
Stage 1	33	79	-	~ 26	52	-	-	-	-	-	-	-
Stage 2	113	52	-	216	77	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	0	0	190	~ 1	0	196	229	-	-	223	-	-
Mov Cap-2 Maneuver	0	0	-	~ 1	0	-	-	-	-	-	-	-
Stage 1	11	67	-	~ 9	17	-	-	-	-	-	-	-
Stage 2	22	17	-	126	66	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	33.5	$ 11404.2	2.9	0.3
HCM LOS	D	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	229	-	-	190	1	196	223	-	-
HCM Lane V/C Ratio	0.665	-	-	0.343	32.609	0.139	0.146	-	-
HCM Control Delay (s)	47.2	-	-	33.5	$ 20885.8	26.3	23.9	-	-
HCM Lane LOS	E	-	-	D	F	D	C	-	-
HCM 95th %tile Q(veh)	4.1	-	-	1.4	6	0.5	0.5	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	475	5	450	10	0	5	550	1965	10	5	1625	95
Future Volume (veh/h)	475	5	450	10	0	5	550	1965	10	5	1625	95
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	520	0	389	11	0	1	598	2136	6	5	1766	30
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	691	0	1266	20	0	18	710	2025	903	9	1313	586
Arrive On Green	0.19	0.00	0.19	0.01	0.00	0.01	0.21	0.57	0.57	0.01	0.37	0.37
Sat Flow, veh/h	3563	0	3170	1781	0	1585	3456	3554	1585	1781	3554	1585
Grp Volume(v), veh/h	520	0	389	11	0	1	598	2136	6	5	1766	30
Grp Sat Flow(s),veh/h/ln	1781	0	1585	1781	0	1585	1728	1777	1585	1781	1777	1585
Q Serve(g_s), s	13.8	0.0	8.4	0.6	0.0	0.1	16.6	57.0	0.2	0.3	37.0	1.2
Cycle Q Clear(g_c), s	13.8	0.0	8.4	0.6	0.0	0.1	16.6	57.0	0.2	0.3	37.0	1.2
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	691	0	1266	20	0	18	710	2025	903	9	1313	586
V/C Ratio(X)	0.75	0.00	0.31	0.54	0.00	0.06	0.84	1.05	0.01	0.54	1.35	0.05
Avail Cap(c_a), veh/h	1318	0	1824	89	0	79	1174	2025	903	160	1313	586
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	38.1	0.0	20.6	49.2	0.0	48.9	38.2	21.5	9.3	49.6	31.5	20.3
Incr Delay (d2), s/veh	1.7	0.0	0.1	20.9	0.0	1.3	3.0	36.4	0.0	41.4	160.5	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	6.1	0.0	3.1	0.4	0.0	0.0	7.0	30.0	0.1	0.2	43.8	0.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	39.8	0.0	20.7	70.1	0.0	50.2	41.2	57.9	9.3	91.0	192.1	20.3
LnGrp LOS	D	A	C	E	A	D	D	F	A	F	F	C
Approach Vol, veh/h		909			12			2740			1801	
Approach Delay, s/veh		31.6			68.4			54.1			188.9	
Approach LOS		C			E			D			F	

Timer - Assigned Phs	1	2	4	5	6	8
Phs Duration (G+Y+Rc), s	6.5	63.0	6.1	26.6	43.0	24.4
Change Period (Y+Rc), s	6.0	6.0	5.0	6.0	6.0	5.0
Max Green Setting (Gmax), s	9.0	57.0	5.0	34.0	32.0	37.0
Max Q Clear Time (g_c+I1), s	2.3	59.0	2.6	18.6	39.0	15.8
Green Ext Time (p_c), s	0.0	0.0	0.0	1.9	0.0	3.6

Intersection Summary	
HCM 6th Ctrl Delay	94.9
HCM 6th LOS	F

Notes

User approved volume balancing among the lanes for turning movement.

Intersection						
Int Delay, s/veh	0.4					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	50	2230	25	0	2050
Future Vol, veh/h	0	50	2230	25	0	2050
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	500	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	54	2424	27	0	2228

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	-	1212	0	0	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	6.94	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.32	-	-	-	-
Pot Cap-1 Maneuver	0	174	-	-	0	-
Stage 1	0	-	-	-	0	-
Stage 2	0	-	-	-	0	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	-	174	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	34.8	0	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBT
Capacity (veh/h)	-	-	174	-
HCM Lane V/C Ratio	-	-	0.312	-
HCM Control Delay (s)	-	-	34.8	-
HCM Lane LOS	-	-	D	-
HCM 95th %tile Q(veh)	-	-	1.3	-

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	125	70	2185	195	290	1760
Future Volume (veh/h)	125	70	2185	195	290	1760
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No		No			No
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	136	3	2375	115	315	1913
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	164	146	2143	956	343	2959
Arrive On Green	0.09	0.09	0.60	0.60	0.19	0.83
Sat Flow, veh/h	1781	1585	3647	1585	1781	3647
Grp Volume(v), veh/h	136	3	2375	115	315	1913
Grp Sat Flow(s),veh/h/ln	1781	1585	1777	1585	1781	1777
Q Serve(g_s), s	9.0	0.2	72.5	3.7	20.9	23.4
Cycle Q Clear(g_c), s	9.0	0.2	72.5	3.7	20.9	23.4
Prop In Lane	1.00	1.00		1.00	1.00	
Lane Grp Cap(c), veh/h	164	146	2143	956	343	2959
V/C Ratio(X)	0.83	0.02	1.11	0.12	0.92	0.65
Avail Cap(c_a), veh/h	274	244	2143	956	378	3030
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	53.6	49.6	23.9	10.2	47.6	3.6
Incr Delay (d2), s/veh	10.0	0.1	56.1	0.1	25.9	0.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.5	0.1	42.9	1.2	11.4	4.4
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	63.6	49.7	80.0	10.3	73.6	4.1
LnGrp LOS	E	D	F	B	E	A
Approach Vol, veh/h	139		2490			2228
Approach Delay, s/veh	63.3		76.8			13.9
Approach LOS	E		E			B

Timer - Assigned Phs	1	2				6	8
Phs Duration (G+Y+Rc), s	27.6	77.0				104.6	15.6
Change Period (Y+Rc), s	4.5	4.5				4.5	4.5
Max Green Setting (Gmax), s	25.5	72.5				102.5	18.5
Max Q Clear Time (g_c+I1), s	22.9	74.5				25.4	11.0
Green Ext Time (p_c), s	0.3	0.0				28.1	0.2

Intersection Summary		
HCM 6th Ctrl Delay		47.6
HCM 6th LOS		D

Intersection	
Int Delay, s/veh	0.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations		↱	↑↑	↱		↑↑
Traffic Vol, veh/h	0	15	2365	75	0	1885
Future Vol, veh/h	0	15	2365	75	0	1885
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	500	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	16	2571	82	0	2049

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	-	1286	0	0	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	6.94	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.32	-	-	-	-
Pot Cap-1 Maneuver	0	155	-	-	0	-
Stage 1	0	-	-	-	0	-
Stage 2	0	-	-	-	0	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	-	155	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	30.9	0	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBT
Capacity (veh/h)	-	-	155	-
HCM Lane V/C Ratio	-	-	0.105	-
HCM Control Delay (s)	-	-	30.9	-
HCM Lane LOS	-	-	D	-
HCM 95th %tile Q(veh)	-	-	0.3	-

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Base Year 2038 PM Peak

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	75	385	2845	70	180	2580
Future Volume (veh/h)	75	385	2845	70	180	2580
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No		No			No
Adj Sat Flow, veh/h/ln	1841	1856	1870	1648	1826	1870
Adj Flow Rate, veh/h	82	277	3092	39	196	2804
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	4	3	2	17	5	2
Cap, veh/h	175	157	1955	768	145	2547
Arrive On Green	0.10	0.10	0.55	0.55	0.08	0.72
Sat Flow, veh/h	1753	1572	3647	1397	1739	3647
Grp Volume(v), veh/h	82	277	3092	39	196	2804
Grp Sat Flow(s),veh/h/ln	1753	1572	1777	1397	1739	1777
Q Serve(g_s), s	2.6	6.0	33.0	0.8	5.0	43.0
Cycle Q Clear(g_c), s	2.6	6.0	33.0	0.8	5.0	43.0
Prop In Lane	1.00	1.00		1.00	1.00	
Lane Grp Cap(c), veh/h	175	157	1955	768	145	2547
V/C Ratio(X)	0.47	1.76	1.58	0.05	1.35	1.10
Avail Cap(c_a), veh/h	175	157	1955	768	145	2547
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	25.5	27.0	13.5	6.2	27.5	8.5
Incr Delay (d2), s/veh	1.9	367.4	264.4	0.0	197.0	52.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.2	18.2	80.3	0.2	9.8	23.7
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	27.4	394.4	277.9	6.3	224.5	60.7
LnGrp LOS	C	F	F	A	F	F
Approach Vol, veh/h	359		3131			3000
Approach Delay, s/veh	310.6		274.5			71.4
Approach LOS	F		F			E

Timer - Assigned Phs	1	2	6	8
Phs Duration (G+Y+Rc), s	10.0	39.0	49.0	11.0
Change Period (Y+Rc), s	5.0	6.0	6.0	5.0
Max Green Setting (Gmax), s	5.0	33.0	43.0	6.0
Max Q Clear Time (g_c+I1), s	7.0	35.0	45.0	8.0
Green Ext Time (p_c), s	0.0	0.0	0.0	0.0

Intersection Summary	
HCM 6th Ctrl Delay	182.6
HCM 6th LOS	F

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰↑↱			↰↑	↱	↰	↑↑	↱	↰	↑↑	↱
Traffic Volume (veh/h)	125	5	15	145	15	255	15	2490	45	75	2365	80
Future Volume (veh/h)	125	5	15	145	15	255	15	2490	45	75	2365	80
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1885	1885	1885	1530	1530	1589	1900	1870	1441	1426	1870	1885
Adj Flow Rate, veh/h	136	5	14	158	16	0	16	2707	28	82	2571	61
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	1	1	1	25	25	21	0	2	31	32	2	1
Cap, veh/h	272	8	23	223	18		30	2319	797	97	2513	1130
Arrive On Green	0.15	0.15	0.15	0.15	0.15	0.00	0.02	0.65	0.65	0.07	0.71	0.71
Sat Flow, veh/h	1487	55	153	1155	117	1346	1810	3554	1221	1358	3554	1598
Grp Volume(v), veh/h	155	0	0	174	0	0	16	2707	28	82	2571	61
Grp Sat Flow(s),veh/h/ln	1694	0	0	1272	0	1346	1810	1777	1221	1358	1777	1598
Q Serve(g_s), s	0.0	0.0	0.0	7.1	0.0	0.0	1.3	94.0	1.2	8.6	101.9	1.7
Cycle Q Clear(g_c), s	12.0	0.0	0.0	19.1	0.0	0.0	1.3	94.0	1.2	8.6	101.9	1.7
Prop In Lane	0.88		0.09	0.91		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	304	0	0	240	0		30	2319	797	97	2513	1130
V/C Ratio(X)	0.51	0.00	0.00	0.72	0.00		0.54	1.17	0.04	0.85	1.02	0.05
Avail Cap(c_a), veh/h	425	0	0	339	0		176	2319	797	132	2513	1130
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	57.0	0.0	0.0	59.6	0.0	0.0	70.3	25.0	8.9	66.1	21.1	6.4
Incr Delay (d2), s/veh	1.3	0.0	0.0	4.5	0.0	0.0	14.3	80.4	0.0	29.7	24.1	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.4	0.0	0.0	6.5	0.0	0.0	0.7	60.5	0.3	3.7	43.4	0.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	58.3	0.0	0.0	64.1	0.0	0.0	84.6	105.5	8.9	95.8	45.2	6.4
LnGrp LOS	E	A	A	E	A		F	F	A	F	F	A
Approach Vol, veh/h		155			174	A		2751			2714	
Approach Delay, s/veh		58.3			64.1			104.4			45.8	
Approach LOS		E			E			F			D	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	16.2	100.0		27.8	8.4	107.9		27.8				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	14.0	94.0		34.0	14.0	94.0		34.0				
Max Q Clear Time (g_c+I1), s	10.6	96.0		14.0	3.3	103.9		21.1				
Green Ext Time (p_c), s	0.0	0.0		0.8	0.0	0.0		0.7				

Intersection Summary	
HCM 6th Ctrl Delay	74.5
HCM 6th LOS	E

Notes

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	205	155	110	2320	2380	145
Future Volume (veh/h)	205	155	110	2320	2380	145
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No	No	
Adj Sat Flow, veh/h/ln	1752	1767	1841	1870	1870	1885
Adj Flow Rate, veh/h	223	38	120	2522	2587	143
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	10	9	4	2	2	1
Cap, veh/h	272	126	138	3077	2709	1218
Arrive On Green	0.08	0.08	0.08	0.87	0.76	0.76
Sat Flow, veh/h	3237	1497	1753	3647	3647	1598
Grp Volume(v), veh/h	223	38	120	2522	2587	143
Grp Sat Flow(s),veh/h/ln	1618	1497	1753	1777	1777	1598
Q Serve(g_s), s	12.2	4.3	12.2	59.0	114.5	4.2
Cycle Q Clear(g_c), s	12.2	4.3	12.2	59.0	114.5	4.2
Prop In Lane	1.00	1.00	1.00			1.00
Lane Grp Cap(c), veh/h	272	126	138	3077	2709	1218
V/C Ratio(X)	0.82	0.30	0.87	0.82	0.95	0.12
Avail Cap(c_a), veh/h	818	378	141	3077	2709	1218
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	0.09	0.09
Uniform Delay (d), s/veh	81.1	77.5	82.0	5.6	18.7	5.6
Incr Delay (d2), s/veh	6.1	1.3	39.8	2.6	1.2	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.4	3.7	7.0	14.8	40.0	1.3
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	87.2	78.8	121.8	8.1	19.9	5.6
LnGrp LOS	F	E	F	A	B	A
Approach Vol, veh/h	261			2642	2730	
Approach Delay, s/veh	85.9			13.3	19.1	
Approach LOS	F			B	B	

Timer - Assigned Phs		2		4	5	6
Phs Duration (G+Y+Rc), s		160.4		19.6	18.7	141.7
Change Period (Y+Rc), s		4.5		4.5	4.5	4.5
Max Green Setting (Gmax), s		125.5		45.5	14.5	106.5
Max Q Clear Time (g_c+I1), s		61.0		14.2	14.2	116.5
Green Ext Time (p_c), s		45.1		0.9	0.0	0.0

Intersection Summary		
HCM 6th Ctrl Delay		19.5
HCM 6th LOS		B

Intersection	
Int Delay, s/veh	29.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	50	15	195	25	15	25	125	2360	10	5	2495	20
Future Vol, veh/h	50	15	195	25	15	25	125	2360	10	5	2495	20
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	Stop	-	-	Yield	-	-	None
Storage Length	-	-	-	-	-	100	525	-	425	625	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	3	0	2	0	0	0	2	2	0	0	2	4
Mvmt Flow	54	16	212	27	16	27	136	2565	11	5	2712	22

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	4296	5570	1367	4211	5581	1283	2734	0	0	2565	0	0
Stage 1	2733	2733	-	2837	2837	-	-	-	-	-	-	-
Stage 2	1563	2837	-	1374	2744	-	-	-	-	-	-	-
Critical Hdwy	7.56	6.5	6.94	7.5	6.5	6.9	4.14	-	-	4.1	-	-
Critical Hdwy Stg 1	6.56	5.5	-	6.5	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.56	5.5	-	6.5	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.53	4	3.32	3.5	4	3.3	2.22	-	-	2.2	-	-
Pot Cap-1 Maneuver	~ 1	0	~ 137	~ 1	0	159	145	-	-	175	-	-
Stage 1	~ 20	44	-	~ 18	39	-	-	-	-	-	-	-
Stage 2	116	39	-	156	44	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	0	0	~ 137	-	0	159	145	-	-	175	-	-
Mov Cap-2 Maneuver	0	0	-	-	0	-	-	-	-	-	-	-
Stage 1	~ 1	43	-	~ 1	~ 2	-	-	-	-	-	-	-
Stage 2	-	~ 2	-	-	43	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	$ 556		6	0.1
HCM LOS	F	-		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	145	-	-	137	-	159	175	-	-
HCM Lane V/C Ratio	0.937	-	-	2.063	-	0.171	0.031	-	-
HCM Control Delay (s)	119	-	-	$ 556	-	32.3	26.2	-	-
HCM Lane LOS	F	-	-	F	-	D	D	-	-
HCM 95th %tile Q(veh)	6.6	-	-	22.8	-	0.6	0.1	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	365	0	530	15	5	15	625	2025	15	5	2400	475
Future Volume (veh/h)	365	0	530	15	5	15	625	2025	15	5	2400	475
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	397	0	490	16	5	1	679	2201	8	5	2609	280
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	598	0	1263	33	28	6	797	2073	925	9	1272	567
Arrive On Green	0.17	0.00	0.17	0.02	0.02	0.02	0.23	0.58	0.58	0.01	0.36	0.36
Sat Flow, veh/h	3563	0	3170	1781	1513	303	3456	3554	1585	1781	3554	1585
Grp Volume(v), veh/h	397	0	490	16	0	6	679	2201	8	5	2609	280
Grp Sat Flow(s),veh/h/ln	1781	0	1585	1781	0	1816	1728	1777	1585	1781	1777	1585
Q Serve(g_s), s	10.2	0.0	10.7	0.9	0.0	0.3	18.4	57.0	0.2	0.3	35.0	13.5
Cycle Q Clear(g_c), s	10.2	0.0	10.7	0.9	0.0	0.3	18.4	57.0	0.2	0.3	35.0	13.5
Prop In Lane	1.00		1.00	1.00		0.17	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	598	0	1263	33	0	33	797	2073	925	9	1272	567
V/C Ratio(X)	0.66	0.00	0.39	0.49	0.00	0.18	0.85	1.06	0.01	0.54	2.05	0.49
Avail Cap(c_a), veh/h	1349	0	1932	91	0	93	1203	2073	925	164	1272	567
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	38.1	0.0	20.9	47.5	0.0	47.2	36.0	20.4	8.5	48.5	31.4	24.5
Incr Delay (d2), s/veh	1.3	0.0	0.2	10.8	0.0	2.5	3.9	38.5	0.0	41.2	475.6	0.7
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.5	0.0	3.9	0.5	0.0	0.2	7.7	30.4	0.1	0.2	97.8	4.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	39.3	0.0	21.1	58.3	0.0	49.8	39.9	58.9	8.5	89.7	507.0	25.1
LnGrp LOS	D	A	C	E	A	D	D	F	A	F	F	C
Approach Vol, veh/h		887			22			2888			2894	
Approach Delay, s/veh		29.3			56.0			54.3			459.6	
Approach LOS		C			E			D			F	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.5	63.0		6.8	28.5	41.0		21.4				
Change Period (Y+Rc), s	6.0	6.0		5.0	6.0	6.0		5.0				
Max Green Setting (Gmax), s	9.0	57.0		5.0	34.0	32.0		37.0				
Max Q Clear Time (g_c+I1), s	2.3	59.0		2.9	20.4	37.0		12.7				
Green Ext Time (p_c), s	0.0	0.0		0.0	2.1	0.0		3.7				

Intersection Summary			
HCM 6th Ctrl Delay			226.3
HCM 6th LOS			F

Notes

User approved volume balancing among the lanes for turning movement.

Intersection						
Int Delay, s/veh	0.8					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	75	2420	5	0	2715
Future Vol, veh/h	0	75	2420	5	0	2715
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	500	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	82	2630	5	0	2951

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	-	1315	0	0	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	6.94	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.32	-	-	-	-
Pot Cap-1 Maneuver	0	148	-	-	0	-
Stage 1	0	-	-	-	0	-
Stage 2	0	-	-	-	0	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	-	148	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	55.7	0	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBT
Capacity (veh/h)	-	-	148	-
HCM Lane V/C Ratio	-	-	0.551	-
HCM Control Delay (s)	-	-	55.7	-
HCM Lane LOS	-	-	F	-
HCM 95th %tile Q(veh)	-	-	2.8	-

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	235	140	2285	85	115	2600
Future Volume (veh/h)	235	140	2285	85	115	2600
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No		No			No
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	255	26	2484	55	125	2826
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	284	253	2306	1029	150	2733
Arrive On Green	0.16	0.16	0.65	0.65	0.08	0.77
Sat Flow, veh/h	1781	1585	3647	1585	1781	3647
Grp Volume(v), veh/h	255	26	2484	55	125	2826
Grp Sat Flow(s),veh/h/ln	1781	1585	1777	1585	1781	1777
Q Serve(g_s), s	17.6	1.8	81.4	1.6	8.7	96.5
Cycle Q Clear(g_c), s	17.6	1.8	81.4	1.6	8.7	96.5
Prop In Lane	1.00	1.00		1.00	1.00	
Lane Grp Cap(c), veh/h	284	253	2306	1029	150	2733
V/C Ratio(X)	0.90	0.10	1.08	0.05	0.83	1.03
Avail Cap(c_a), veh/h	348	309	2306	1029	163	2733
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	51.8	45.1	22.0	8.0	56.6	14.5
Incr Delay (d2), s/veh	22.0	0.2	43.4	0.0	27.8	26.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	9.6	0.7	42.4	0.5	5.0	36.8
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	73.8	45.3	65.5	8.0	84.4	41.3
LnGrp LOS	E	D	F	A	F	F
Approach Vol, veh/h	281		2539			2951
Approach Delay, s/veh	71.1		64.2			43.1
Approach LOS	E		E			D

Timer - Assigned Phs	1	2	6	8
Phs Duration (G+Y+Rc), s	15.1	85.9	101.0	24.5
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	11.5	80.5	96.5	24.5
Max Q Clear Time (g_c+I1), s	10.7	83.4	98.5	19.6
Green Ext Time (p_c), s	0.0	0.0	0.0	0.4

Intersection Summary	
HCM 6th Ctrl Delay	53.8
HCM 6th LOS	D

Intersection						
Int Delay, s/veh	0.2					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	25	2345	25	0	2835
Future Vol, veh/h	0	25	2345	25	0	2835
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	500	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	27	2549	27	0	3082

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	-	1275	0	0	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	6.94	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.32	-	-	-	-
Pot Cap-1 Maneuver	0	158	-	-	0	-
Stage 1	0	-	-	-	0	-
Stage 2	0	-	-	-	0	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	-	158	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	32.5	0	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBT
Capacity (veh/h)	-	-	158	-
HCM Lane V/C Ratio	-	-	0.172	-
HCM Control Delay (s)	-	-	32.5	-
HCM Lane LOS	-	-	D	-
HCM 95th %tile Q(veh)	-	-	0.6	-

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Base Year 2038 WE Peak

Movement	WBL	WBR	NBT	NBR	SBL	SBT	
Lane Configurations	↰	↱	↑↑	↱	↰	↑↑	
Traffic Volume (veh/h)	25	140	2365	45	105	2170	
Future Volume (veh/h)	25	140	2365	45	105	2170	
Initial Q (Qb), veh	0	0	0	0	0	0	
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00		
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	
Work Zone On Approach	No		No			No	
Adj Sat Flow, veh/h/ln	1767	1841	1870	1648	1752	1870	
Adj Flow Rate, veh/h	27	6	2571	27	114	2359	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	
Percent Heavy Veh, %	9	4	2	17	10	2	
Cap, veh/h	60	56	2103	827	142	2725	
Arrive On Green	0.04	0.04	0.59	0.59	0.09	0.77	
Sat Flow, veh/h	1682	1560	3647	1397	1668	3647	
Grp Volume(v), veh/h	27	6	2571	27	114	2359	
Grp Sat Flow(s),veh/h/ln	1682	1560	1777	1397	1668	1777	
Q Serve(g_s), s	0.9	0.2	33.0	0.4	3.7	25.7	
Cycle Q Clear(g_c), s	0.9	0.2	33.0	0.4	3.7	25.7	
Prop In Lane	1.00	1.00		1.00	1.00		
Lane Grp Cap(c), veh/h	60	56	2103	827	142	2725	
V/C Ratio(X)	0.45	0.11	1.22	0.03	0.80	0.87	
Avail Cap(c_a), veh/h	181	168	2103	827	150	2740	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	
Uniform Delay (d), s/veh	26.3	26.0	11.4	4.7	25.0	4.5	
Incr Delay (d2), s/veh	5.1	0.8	104.6	0.0	24.9	3.2	
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	
%ile BackOfQ(50%),veh/ln	0.4	0.1	37.7	0.1	2.3	1.4	
Unsig. Movement Delay, s/veh							
LnGrp Delay(d),s/veh	31.4	26.8	116.0	4.8	49.9	7.7	
LnGrp LOS	C	C	F	A	D	A	
Approach Vol, veh/h	33		2598			2473	
Approach Delay, s/veh	30.6		114.8			9.6	
Approach LOS	C		F			A	
Timer - Assigned Phs	1	2				6	8
Phs Duration (G+Y+Rc), s	9.8	39.0				48.8	7.0
Change Period (Y+Rc), s	5.0	6.0				6.0	5.0
Max Green Setting (Gmax), s	5.0	33.0				43.0	6.0
Max Q Clear Time (g_c+I1), s	5.7	35.0				27.7	2.9
Green Ext Time (p_c), s	0.0	0.0				13.3	0.0
Intersection Summary							
HCM 6th Ctrl Delay			63.3				
HCM 6th LOS			E				

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	140	10	20	90	20	145	15	2125	40	70	1990	120
Future Volume (veh/h)	140	10	20	90	20	145	15	2125	40	70	1990	120
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1885	1885	1885	1618	1618	1574	1900	1870	1544	1515	1870	1870
Adj Flow Rate, veh/h	152	11	19	98	22	0	16	2310	26	76	2163	85
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	1	1	1	19	19	22	0	2	24	26	2	2
Cap, veh/h	221	13	22	199	34		30	2387	879	91	2553	1139
Arrive On Green	0.14	0.14	0.14	0.14	0.14	0.00	0.02	0.67	0.67	0.06	0.72	0.72
Sat Flow, veh/h	1281	93	160	1121	252	1334	1810	3554	1309	1443	3554	1585
Grp Volume(v), veh/h	182	0	0	120	0	0	16	2310	26	76	2163	85
Grp Sat Flow(s),veh/h/ln	1533	0	0	1373	0	1334	1810	1777	1309	1443	1777	1585
Q Serve(g_s), s	4.7	0.0	0.0	0.0	0.0	0.0	1.2	84.8	0.9	7.2	60.9	2.2
Cycle Q Clear(g_c), s	16.0	0.0	0.0	11.3	0.0	0.0	1.2	84.8	0.9	7.2	60.9	2.2
Prop In Lane	0.84		0.10	0.82		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	255	0	0	233	0		30	2387	879	91	2553	1139
V/C Ratio(X)	0.71	0.00	0.00	0.51	0.00		0.53	0.97	0.03	0.83	0.85	0.07
Avail Cap(c_a), veh/h	413	0	0	370	0		182	2403	885	145	2553	1139
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	58.7	0.0	0.0	56.8	0.0	0.0	67.8	21.4	7.6	64.4	14.1	5.8
Incr Delay (d2), s/veh	3.7	0.0	0.0	1.8	0.0	0.0	13.9	11.7	0.0	19.6	2.9	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	6.5	0.0	0.0	4.1	0.0	0.0	0.7	34.1	0.2	3.1	21.3	0.7
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	62.4	0.0	0.0	58.6	0.0	0.0	81.7	33.2	7.7	83.9	16.9	5.9
LnGrp LOS	E	A	A	E	A		F	C	A	F	B	A
Approach Vol, veh/h		182			120	A		2352			2324	
Approach Delay, s/veh		62.4			58.6			33.2			18.7	
Approach LOS		E			E			C			B	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	14.8	99.4		24.8	8.3	105.9		24.8				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	14.0	94.0		34.0	14.0	94.0		34.0				
Max Q Clear Time (g_c+I1), s	9.2	86.8		18.0	3.2	62.9		13.3				
Green Ext Time (p_c), s	0.1	6.6		0.8	0.0	22.3		0.6				

Intersection Summary			
HCM 6th Ctrl Delay			28.1
HCM 6th LOS			C

Notes

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	240	180	170	1950	1870	225
Future Volume (veh/h)	240	180	170	1950	1870	225
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No	No	
Adj Sat Flow, veh/h/ln	1885	1885	1885	1870	1870	1885
Adj Flow Rate, veh/h	261	6	185	2120	2033	219
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	1	1	1	2	2	1
Cap, veh/h	314	144	206	3056	2559	1151
Arrive On Green	0.09	0.09	0.11	0.86	0.72	0.72
Sat Flow, veh/h	3483	1598	1795	3647	3647	1598
Grp Volume(v), veh/h	261	6	185	2120	2033	219
Grp Sat Flow(s),veh/h/ln	1742	1598	1795	1777	1777	1598
Q Serve(g_s), s	13.3	0.6	18.3	37.3	67.3	8.0
Cycle Q Clear(g_c), s	13.3	0.6	18.3	37.3	67.3	8.0
Prop In Lane	1.00	1.00	1.00			1.00
Lane Grp Cap(c), veh/h	314	144	206	3056	2559	1151
V/C Ratio(X)	0.83	0.04	0.90	0.69	0.79	0.19
Avail Cap(c_a), veh/h	977	448	314	3056	2559	1151
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	0.37	0.37
Uniform Delay (d), s/veh	80.5	74.8	78.6	4.4	16.5	8.2
Incr Delay (d2), s/veh	5.7	0.1	19.3	1.3	1.0	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	6.3	0.6	9.5	9.7	25.1	2.7
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	86.2	74.9	97.9	5.7	17.5	8.3
LnGrp LOS	F	E	F	A	B	A
Approach Vol, veh/h	267			2305	2252	
Approach Delay, s/veh	86.0			13.1	16.6	
Approach LOS	F			B	B	

Timer - Assigned Phs		2		4	5	6
Phs Duration (G+Y+Rc), s		159.3		20.7	25.1	134.1
Change Period (Y+Rc), s		4.5		4.5	4.5	4.5
Max Green Setting (Gmax), s		120.5		50.5	31.5	84.5
Max Q Clear Time (g_c+I1), s		39.3		15.3	20.3	69.3
Green Ext Time (p_c), s		36.1		1.0	0.3	12.2

Intersection Summary		
HCM 6th Ctrl Delay		18.8
HCM 6th LOS		B

Intersection	
Int Delay, s/veh	20.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	50	15	215	25	20	25	190	2045	5	10	2000	35
Future Vol, veh/h	50	15	215	25	20	25	190	2045	5	10	2000	35
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	Stop	-	-	Yield	-	-	None
Storage Length	-	-	-	-	-	100	525	-	425	625	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	3	0	2	0	0	0	2	2	0	0	2	5
Mvmt Flow	54	16	234	27	22	27	207	2223	5	11	2174	38

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	3752	4852	1106	3754	4871	1112	2212	0	0	2223	0	0
Stage 1	2215	2215	-	2637	2637	-	-	-	-	-	-	-
Stage 2	1537	2637	-	1117	2234	-	-	-	-	-	-	-
Critical Hdwy	7.56	6.5	6.94	7.5	6.5	6.9	4.14	-	-	4.1	-	-
Critical Hdwy Stg 1	6.56	5.5	-	6.5	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.56	5.5	-	6.5	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.53	4	3.32	3.5	4	3.3	2.22	-	-	2.2	-	-
Pot Cap-1 Maneuver	~ 1	~ 1	~ 205	~ 2	~ 1	206	233	-	-	238	-	-
Stage 1	~ 44	82	-	~ 24	50	-	-	-	-	-	-	-
Stage 2	120	50	-	224	80	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	0	0	~ 205	-	0	206	233	-	-	238	-	-
Mov Cap-2 Maneuver	0	0	-	-	0	-	-	-	-	-	-	-
Stage 1	~ 5	78	-	~ 3	~ 6	-	-	-	-	-	-	-
Stage 2	-	~ 6	-	-	76	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	285.3		6.6	0.1
HCM LOS	F	-		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	233	-	-	205	-	206	238	-	-
HCM Lane V/C Ratio	0.886	-	-	1.485	-	0.132	0.046	-	-
HCM Control Delay (s)	77.4	-	-	285.3	-	25.1	20.8	-	-
HCM Lane LOS	F	-	-	F	-	D	C	-	-
HCM 95th %tile Q(veh)	7.3	-	-	18.6	-	0.4	0.1	-	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s   +: Computation Not Defined   *: All major volume in platoon

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	335	0	385	5	0	5	410	1820	5	5	1925	375
Future Volume (veh/h)	335	0	385	5	0	5	410	1820	5	5	1925	375
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	364	0	279	5	0	1	446	1978	3	5	2092	198
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	521	0	977	11	0	10	560	2142	956	9	1585	707
Arrive On Green	0.15	0.00	0.15	0.01	0.00	0.01	0.16	0.60	0.60	0.01	0.45	0.45
Sat Flow, veh/h	3563	0	3170	1781	0	1585	3456	3554	1585	1781	3554	1585
Grp Volume(v), veh/h	364	0	279	5	0	1	446	1978	3	5	2092	198
Grp Sat Flow(s),veh/h/ln	1781	0	1585	1781	0	1585	1728	1777	1585	1781	1777	1585
Q Serve(g_s), s	8.9	0.0	6.1	0.3	0.0	0.1	11.4	45.8	0.1	0.3	41.0	7.3
Cycle Q Clear(g_c), s	8.9	0.0	6.1	0.3	0.0	0.1	11.4	45.8	0.1	0.3	41.0	7.3
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	521	0	977	11	0	10	560	2142	956	9	1585	707
V/C Ratio(X)	0.70	0.00	0.29	0.45	0.00	0.10	0.80	0.92	0.00	0.54	1.32	0.28
Avail Cap(c_a), veh/h	1435	0	1791	97	0	86	1279	2205	984	175	1585	707
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	37.3	0.0	24.1	45.5	0.0	45.4	37.0	16.3	7.3	45.6	25.4	16.1
Incr Delay (d2), s/veh	1.7	0.0	0.2	26.5	0.0	4.5	2.6	7.0	0.0	40.8	148.5	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.0	0.0	2.3	0.2	0.0	0.0	4.8	16.7	0.0	0.2	47.8	2.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	39.0	0.0	24.3	72.0	0.0	49.9	39.7	23.4	7.3	86.4	173.9	16.3
LnGrp LOS	D	A	C	E	A	D	D	C	A	F	F	B
Approach Vol, veh/h		643			6			2427			2295	
Approach Delay, s/veh		32.6			68.3			26.4			160.1	
Approach LOS		C			E			C			F	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	6.5	61.4		5.6	20.9	47.0		18.4
Change Period (Y+Rc), s	6.0	6.0		5.0	6.0	6.0		5.0
Max Green Setting (Gmax), s	9.0	57.0		5.0	34.0	32.0		37.0
Max Q Clear Time (g_c+I1), s	2.3	47.8		2.3	13.4	43.0		10.9
Green Ext Time (p_c), s	0.0	7.6		0.0	1.5	0.0		2.5

Intersection Summary			
HCM 6th Ctrl Delay			84.3
HCM 6th LOS			F

Notes

User approved volume balancing among the lanes for turning movement.

Intersection	
Int Delay, s/veh	0.6

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations		↱	↑↑	↱		↑↑
Traffic Vol, veh/h	0	70	2170	10	0	2240
Future Vol, veh/h	0	70	2170	10	0	2240
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	500	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	76	2359	11	0	2435

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	-	1180	0	0	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	6.94	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.32	-	-	-	-
Pot Cap-1 Maneuver	0	183	-	-	0	-
Stage 1	0	-	-	-	0	-
Stage 2	0	-	-	-	0	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	-	183	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	38	0	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBT
Capacity (veh/h)	-	-	183	-
HCM Lane V/C Ratio	-	-	0.416	-
HCM Control Delay (s)	-	-	38	-
HCM Lane LOS	-	-	E	-
HCM 95th %tile Q(veh)	-	-	1.9	-

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	215	125	2055	90	125	2115
Future Volume (veh/h)	215	125	2055	90	125	2115
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No		No			No
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	234	11	2234	60	136	2299
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	261	232	2349	1048	161	2791
Arrive On Green	0.15	0.15	0.66	0.66	0.09	0.79
Sat Flow, veh/h	1781	1585	3647	1585	1781	3647
Grp Volume(v), veh/h	234	11	2234	60	136	2299
Grp Sat Flow(s),veh/h/ln	1781	1585	1777	1585	1781	1777
Q Serve(g_s), s	17.0	0.8	75.7	1.8	9.9	51.9
Cycle Q Clear(g_c), s	17.0	0.8	75.7	1.8	9.9	51.9
Prop In Lane	1.00	1.00		1.00	1.00	
Lane Grp Cap(c), veh/h	261	232	2349	1048	161	2791
V/C Ratio(X)	0.90	0.05	0.95	0.06	0.85	0.82
Avail Cap(c_a), veh/h	317	283	2385	1064	196	2897
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	55.3	48.4	20.4	7.9	59.1	8.6
Incr Delay (d2), s/veh	23.5	0.1	9.4	0.0	23.8	2.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	9.3	0.3	29.8	0.6	5.4	14.8
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	78.8	48.4	29.8	7.9	82.8	10.6
LnGrp LOS	E	D	C	A	F	B
Approach Vol, veh/h	245		2294			2435
Approach Delay, s/veh	77.4		29.3			14.6
Approach LOS	E		C			B

Timer - Assigned Phs	1	2	6	8
Phs Duration (G+Y+Rc), s	16.4	91.6	108.0	23.8
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	14.5	88.5	107.5	23.5
Max Q Clear Time (g_c+I1), s	11.9	77.7	53.9	19.0
Green Ext Time (p_c), s	0.1	9.4	34.4	0.3

Intersection Summary	
HCM 6th Ctrl Delay	24.5
HCM 6th LOS	C

Intersection						
Int Delay, s/veh	0.1					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	25	2120	30	0	2330
Future Vol, veh/h	0	25	2120	30	0	2330
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	500	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	27	2304	33	0	2533

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	-	1152	0	0	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	6.94	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.32	-	-	-	-
Pot Cap-1 Maneuver	0	191	-	-	0	-
Stage 1	0	-	-	-	0	-
Stage 2	0	-	-	-	0	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	-	191	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	27	0	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBT
Capacity (veh/h)	-	-	191	-
HCM Lane V/C Ratio	-	-	0.142	-
HCM Control Delay (s)	-	-	27	-
HCM Lane LOS	-	-	D	-
HCM 95th %tile Q(veh)	-	-	0.5	-

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Base Year 2038 AM Peak With Mitigation

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑↑↑	↱	↰	↑↑
Traffic Volume (veh/h)	75	265	1975	70	360	2385
Future Volume (veh/h)	75	265	1975	70	360	2385
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No		No			No
Adj Sat Flow, veh/h/ln	1515	1663	1870	1826	1826	1870
Adj Flow Rate, veh/h	82	0	2147	36	391	2592
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	26	16	2	5	5	2
Cap, veh/h	101		2654	804	420	2893
Arrive On Green	0.07	0.00	0.52	0.52	0.24	0.81
Sat Flow, veh/h	1443	1409	5274	1547	1739	3647
Grp Volume(v), veh/h	82	0	2147	36	391	2592
Grp Sat Flow(s),veh/h/ln	1443	1409	1702	1547	1739	1777
Q Serve(g_s), s	5.3	0.0	33.0	1.1	20.9	47.5
Cycle Q Clear(g_c), s	5.3	0.0	33.0	1.1	20.9	47.5
Prop In Lane	1.00	1.00		1.00	1.00	
Lane Grp Cap(c), veh/h	101		2654	804	420	2893
V/C Ratio(X)	0.81		0.81	0.04	0.93	0.90
Avail Cap(c_a), veh/h	411		2910	882	422	3075
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	43.5	0.0	18.8	11.2	35.2	6.1
Incr Delay (d2), s/veh	14.3	0.0	1.7	0.0	27.3	3.7
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.3	0.0	11.6	0.3	11.5	8.0
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	57.8	0.0	20.5	11.2	62.5	9.8
LnGrp LOS	E		C	B	E	A
Approach Vol, veh/h	82	A	2183			2983
Approach Delay, s/veh	57.8		20.4			16.7
Approach LOS	E		C			B

Timer - Assigned Phs	1	2				6	8
Phs Duration (G+Y+Rc), s	27.9	55.3				83.1	11.6
Change Period (Y+Rc), s	5.0	6.0				6.0	5.0
Max Green Setting (Gmax), s	23.0	54.0				82.0	27.0
Max Q Clear Time (g_c+I1), s	22.9	35.0				49.5	7.3
Green Ext Time (p_c), s	0.0	14.2				27.3	0.2

Intersection Summary	
HCM 6th Ctrl Delay	18.9
HCM 6th LOS	B

Notes

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱		↰↑	↱	↰	↑↑↑	↱	↰↰	↑↑	↱
Traffic Volume (veh/h)	30	5	5	35	5	70	5	1950	155	265	2090	95
Future Volume (veh/h)	30	5	5	35	5	70	5	1950	155	265	2090	95
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1752	1885	1900	1530	1530	1530	1900	1870	1441	1426	1870	1885
Adj Flow Rate, veh/h	33	5	1	38	5	0	5	2120	110	288	2272	82
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	10	1	0	25	25	25	0	2	31	32	2	1
Cap, veh/h	114	91	78	86	8		11	3720	889	324	3004	1351
Arrive On Green	0.05	0.05	0.05	0.05	0.05	0.00	0.01	0.73	0.73	0.12	0.85	0.85
Sat Flow, veh/h	1322	1885	1610	994	158	1296	1810	5106	1221	2634	3554	1598
Grp Volume(v), veh/h	33	5	1	43	0	0	5	2120	110	288	2272	82
Grp Sat Flow(s),veh/h/ln	1322	1885	1610	1152	0	1296	1810	1702	1221	1317	1777	1598
Q Serve(g_s), s	0.0	0.5	0.1	6.2	0.0	0.0	0.5	34.7	4.8	19.4	49.3	1.5
Cycle Q Clear(g_c), s	3.7	0.5	0.1	6.7	0.0	0.0	0.5	34.7	4.8	19.4	49.3	1.5
Prop In Lane	1.00		1.00	0.88		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	114	91	78	94	0		11	3720	889	324	3004	1351
V/C Ratio(X)	0.29	0.05	0.01	0.46	0.00		0.45	0.57	0.12	0.89	0.76	0.06
Avail Cap(c_a), veh/h	321	388	331	280	0		90	3720	889	483	3004	1351
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	83.2	81.7	81.5	84.8	0.0	0.0	89.1	11.3	7.3	77.7	6.0	2.3
Incr Delay (d2), s/veh	1.4	0.2	0.1	3.5	0.0	0.0	25.9	0.6	0.3	13.0	1.8	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.6	0.2	0.0	2.1	0.0	0.0	0.3	12.3	1.3	7.1	13.9	0.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	84.6	82.0	81.6	88.3	0.0	0.0	115.0	12.0	7.6	90.7	7.8	2.4
LnGrp LOS	F	F	F	F	A		F	B	A	F	A	A
Approach Vol, veh/h		39			43	A		2235			2642	
Approach Delay, s/veh		84.2			88.3			12.0			16.7	
Approach LOS		F			F			B			B	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	28.1	137.1		14.7	7.1	158.2		14.7				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	33.0	92.0		37.0	9.0	116.0		37.0				
Max Q Clear Time (g_c+I1), s	21.4	36.7		5.7	2.5	51.3		8.7				
Green Ext Time (p_c), s	0.8	28.5		0.1	0.0	38.5		0.2				

Intersection Summary		
HCM 6th Ctrl Delay		15.7
HCM 6th LOS		B

Notes

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	50	35	90	2050	2020	110
Future Volume (veh/h)	50	35	90	2050	2020	110
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No	No	
Adj Sat Flow, veh/h/ln	1885	1870	1885	1870	1870	1885
Adj Flow Rate, veh/h	54	1	98	2228	2196	104
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	1	2	1	2	2	1
Cap, veh/h	91	41	116	3284	4259	1333
Arrive On Green	0.03	0.03	0.06	0.92	0.83	0.83
Sat Flow, veh/h	3483	1585	1795	3647	5274	1598
Grp Volume(v), veh/h	54	1	98	2228	2196	104
Grp Sat Flow(s),veh/h/ln	1742	1585	1795	1777	1702	1598
Q Serve(g_s), s	2.8	0.1	9.7	23.0	22.5	2.1
Cycle Q Clear(g_c), s	2.8	0.1	9.7	23.0	22.5	2.1
Prop In Lane	1.00	1.00	1.00			1.00
Lane Grp Cap(c), veh/h	91	41	116	3284	4259	1333
V/C Ratio(X)	0.60	0.02	0.84	0.68	0.52	0.08
Avail Cap(c_a), veh/h	977	445	145	3284	4259	1333
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	0.57	0.57	1.00	1.00
Uniform Delay (d), s/veh	86.7	85.4	83.2	1.4	4.3	2.6
Incr Delay (d2), s/veh	6.1	0.2	18.4	0.7	0.4	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.3	0.1	5.1	1.0	6.3	0.6
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	92.9	85.7	101.6	2.1	4.8	2.8
LnGrp LOS	F	F	F	A	A	A
Approach Vol, veh/h	55			2326	2300	
Approach Delay, s/veh	92.7			6.2	4.7	
Approach LOS	F			A	A	

Timer - Assigned Phs		2		4	5	6
Phs Duration (G+Y+Rc), s		170.8		9.2	16.2	154.6
Change Period (Y+Rc), s		4.5		4.5	4.5	4.5
Max Green Setting (Gmax), s		120.5		50.5	14.5	101.5
Max Q Clear Time (g_c+I1), s		25.0		4.8	11.7	24.5
Green Ext Time (p_c), s		43.1		0.2	0.0	34.8

Intersection Summary			
HCM 6th Ctrl Delay			6.5
HCM 6th LOS			A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰↑	↱		↰↑	↱	↰	↑↑	↱	↰	↑↑↑	↱
Traffic Volume (veh/h)	10	5	45	25	5	25	140	2110	30	30	1980	45
Future Volume (veh/h)	10	5	45	25	5	25	140	2110	30	30	1980	45
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1900	1900	1870	1900	1900	1900	1870	1870	1900	1900	1870	1841
Adj Flow Rate, veh/h	11	5	0	27	5	1	152	2293	28	33	2152	36
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	0	0	2	0	0	0	2	2	0	0	2	4
Cap, veh/h	47	15		81	8	48	173	3096	1403	43	4075	1245
Arrive On Green	0.03	0.03	0.00	0.03	0.03	0.03	0.10	0.87	0.87	0.02	0.80	0.80
Sat Flow, veh/h	452	511	1585	1460	270	1610	1781	3554	1610	1810	5106	1560
Grp Volume(v), veh/h	16	0	0	32	0	1	152	2293	28	33	2152	36
Grp Sat Flow(s),veh/h/ln	963	0	1585	1730	0	1610	1781	1777	1610	1810	1702	1560
Q Serve(g_s), s	0.8	0.0	0.0	0.0	0.0	0.1	15.2	42.1	0.4	3.3	26.5	0.9
Cycle Q Clear(g_c), s	3.9	0.0	0.0	3.1	0.0	0.1	15.2	42.1	0.4	3.3	26.5	0.9
Prop In Lane	0.69		1.00	0.84		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	63	0		89	0	48	173	3096	1403	43	4075	1245
V/C Ratio(X)	0.26	0.00		0.36	0.00	0.02	0.88	0.74	0.02	0.77	0.53	0.03
Avail Cap(c_a), veh/h	253	0		272	0	246	302	3096	1403	65	4075	1245
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	0.82	0.82	0.82
Uniform Delay (d), s/veh	86.3	0.0	0.0	86.2	0.0	84.7	80.2	4.2	1.5	87.4	6.3	3.8
Incr Delay (d2), s/veh	2.1	0.0	0.0	2.4	0.0	0.2	13.6	1.6	0.0	21.5	0.4	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.8	0.0	0.0	1.5	0.0	0.0	7.6	10.0	0.1	1.8	8.2	0.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	88.5	0.0	0.0	88.6	0.0	84.9	93.8	5.8	1.5	108.9	6.8	3.8
LnGrp LOS	F	A		F	A	F	F	A	A	F	A	A
Approach Vol, veh/h		16	A		33			2473			2221	
Approach Delay, s/veh		88.5			88.5			11.2			8.2	
Approach LOS		F			F			B			A	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	8.8	161.3		9.9	21.9	148.1		9.9
Change Period (Y+Rc), s	4.5	4.5		4.5	4.5	4.5		4.5
Max Green Setting (Gmax), s	6.5	132.5		27.5	30.5	108.5		27.5
Max Q Clear Time (g_c+I1), s	5.3	44.1		5.9	17.2	28.5		5.1
Green Ext Time (p_c), s	0.0	45.2		0.0	0.3	32.9		0.1

Intersection Summary			
HCM 6th Ctrl Delay			10.6
HCM 6th LOS			B

Notes

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↰↑	↱↱	↰	↑↱		↰↰	↑↑	↱	↰	↑↑↑	↱
Traffic Volume (veh/h)	475	5	450	10	0	5	550	1965	10	5	1625	95
Future Volume (veh/h)	475	5	450	10	0	5	550	1965	10	5	1625	95
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	520	0	459	11	0	1	598	2136	7	5	1766	46
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	607	0	1147	18	0	16	661	2430	1084	9	2540	788
Arrive On Green	0.17	0.00	0.17	0.01	0.00	0.01	0.19	0.68	0.68	0.00	0.50	0.50
Sat Flow, veh/h	3563	0	3170	1781	0	1585	3456	3554	1585	1781	5106	1585
Grp Volume(v), veh/h	520	0	459	11	0	1	598	2136	7	5	1766	46
Grp Sat Flow(s),veh/h/ln	1781	0	1585	1781	0	1585	1728	1777	1585	1781	1702	1585
Q Serve(g_s), s	23.9	0.0	18.2	1.0	0.0	0.1	28.5	80.3	0.2	0.5	44.8	2.5
Cycle Q Clear(g_c), s	23.9	0.0	18.2	1.0	0.0	0.1	28.5	80.3	0.2	0.5	44.8	2.5
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	607	0	1147	18	0	16	661	2430	1084	9	2540	788
V/C Ratio(X)	0.86	0.00	0.40	0.61	0.00	0.06	0.90	0.88	0.01	0.57	0.70	0.06
Avail Cap(c_a), veh/h	740	0	1265	42	0	38	861	3057	1364	42	3241	1006
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	67.9	0.0	40.1	83.1	0.0	82.6	66.6	21.1	8.5	83.7	32.5	21.9
Incr Delay (d2), s/veh	8.3	0.0	0.2	28.3	0.0	1.6	10.7	2.7	0.0	46.5	0.5	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	11.7	0.0	7.3	0.6	0.0	0.1	13.4	31.0	0.1	0.3	18.1	1.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	76.2	0.0	40.4	111.4	0.0	84.2	77.4	23.8	8.5	130.2	33.0	22.0
LnGrp LOS	E	A	D	F	A	F	E	C	A	F	C	C
Approach Vol, veh/h		979			12			2741			1817	
Approach Delay, s/veh		59.4			109.1			35.5			33.0	
Approach LOS		E			F			D			C	

Timer - Assigned Phs	1	2	4	5	6	8
Phs Duration (G+Y+Rc), s	6.8	121.3	6.7	38.3	89.8	33.7
Change Period (Y+Rc), s	6.0	6.0	5.0	6.0	6.0	5.0
Max Green Setting (Gmax), s	4.0	145.0	4.0	42.0	107.0	35.0
Max Q Clear Time (g_c+I1), s	2.5	82.3	3.0	30.5	46.8	25.9
Green Ext Time (p_c), s	0.0	33.0	0.0	1.7	20.5	2.8

Intersection Summary	
HCM 6th Ctrl Delay	39.0
HCM 6th LOS	D

Notes

User approved volume balancing among the lanes for turning movement.

Intersection						
Int Delay, s/veh	0.4					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	50	2230	25	0	2050
Future Vol, veh/h	0	50	2230	25	0	2050
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	500	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	54	2424	27	0	2228

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	-	1212	0	0	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	6.94	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.32	-	-	-	-
Pot Cap-1 Maneuver	0	174	-	-	0	-
Stage 1	0	-	-	-	0	-
Stage 2	0	-	-	-	0	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	-	174	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	34.8	0	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBT
Capacity (veh/h)	-	-	174	-
HCM Lane V/C Ratio	-	-	0.312	-
HCM Control Delay (s)	-	-	34.8	-
HCM Lane LOS	-	-	D	-
HCM 95th %tile Q(veh)	-	-	1.3	-

Movement	WBL	WBR	NBT	NBR	SBL	SBT	
Lane Configurations							
Traffic Volume (veh/h)	125	70	2185	195	290	1760	
Future Volume (veh/h)	125	70	2185	195	290	1760	
Initial Q (Qb), veh	0	0	0	0	0	0	
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00		
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	
Work Zone On Approach	No		No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	
Adj Flow Rate, veh/h	136	3	2375	113	315	1913	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	
Percent Heavy Veh, %	2	2	2	2	2	2	
Cap, veh/h	167	148	3004	933	347	4209	
Arrive On Green	0.09	0.09	0.59	0.59	0.19	0.82	
Sat Flow, veh/h	1781	1585	5274	1585	1781	5274	
Grp Volume(v), veh/h	136	3	2375	113	315	1913	
Grp Sat Flow(s),veh/h/ln	1781	1585	1702	1585	1781	1702	
Q Serve(g_s), s	8.2	0.2	39.2	3.5	19.0	11.5	
Cycle Q Clear(g_c), s	8.2	0.2	39.2	3.5	19.0	11.5	
Prop In Lane	1.00	1.00		1.00	1.00		
Lane Grp Cap(c), veh/h	167	148	3004	933	347	4209	
V/C Ratio(X)	0.82	0.02	0.79	0.12	0.91	0.45	
Avail Cap(c_a), veh/h	301	268	3378	1048	414	4775	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	
Uniform Delay (d), s/veh	48.7	45.1	17.4	10.0	43.2	2.7	
Incr Delay (d2), s/veh	9.3	0.1	1.2	0.1	21.1	0.1	
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	
%ile BackOfQ(50%),veh/ln	4.1	0.1	13.6	1.1	10.0	1.8	
Unsig. Movement Delay, s/veh							
LnGrp Delay(d),s/veh	58.0	45.2	18.6	10.1	64.3	2.8	
LnGrp LOS	E	D	B	B	E	A	
Approach Vol, veh/h	139		2488			2228	
Approach Delay, s/veh	57.7		18.2			11.5	
Approach LOS	E		B			B	
Timer - Assigned Phs	1	2				6	8
Phs Duration (G+Y+Rc), s	25.9	69.0				94.8	14.8
Change Period (Y+Rc), s	4.5	4.5				4.5	4.5
Max Green Setting (Gmax), s	25.5	72.5				102.5	18.5
Max Q Clear Time (g_c+I1), s	21.0	41.2				13.5	10.2
Green Ext Time (p_c), s	0.4	23.3				25.6	0.2
Intersection Summary							
HCM 6th Ctrl Delay			16.2				
HCM 6th LOS			B				

Intersection						
Int Delay, s/veh	0.1					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations		↱	↑↑	↱		↑↑↑
Traffic Vol, veh/h	0	15	2365	75	0	1885
Future Vol, veh/h	0	15	2365	75	0	1885
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	500	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	16	2571	82	0	2049

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	-	1286	0	0	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	6.94	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.32	-	-	-	-
Pot Cap-1 Maneuver	0	155	-	-	0	-
Stage 1	0	-	-	-	0	-
Stage 2	0	-	-	-	0	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	-	155	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	30.9	0	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBT
Capacity (veh/h)	-	-	155	-
HCM Lane V/C Ratio	-	-	0.105	-
HCM Control Delay (s)	-	-	30.9	-
HCM Lane LOS	-	-	D	-
HCM 95th %tile Q(veh)	-	-	0.3	-

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Base Year 2038 PM Peak With Mitigation

Movement	WBL	WBR	NBT	NBR	SBL	SBT		
Lane Configurations								
Traffic Volume (veh/h)	75	385	2845	70	180	2580		
Future Volume (veh/h)	75	385	2845	70	180	2580		
Initial Q (Qb), veh	0	0	0	0	0	0		
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00		
Work Zone On Approach	No		No			No		
Adj Sat Flow, veh/h/ln	1841	1856	1870	1648	1752	1870		
Adj Flow Rate, veh/h	82	0	3092	40	196	2804		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92		
Percent Heavy Veh, %	4	3	2	17	10	2		
Cap, veh/h	106		3326	910	224	2962		
Arrive On Green	0.06	0.00	0.65	0.65	0.13	0.83		
Sat Flow, veh/h	1753	1572	5274	1397	1668	3647		
Grp Volume(v), veh/h	82	0	3092	40	196	2804		
Grp Sat Flow(s),veh/h/ln	1753	1572	1702	1397	1668	1777		
Q Serve(g_s), s	4.8	0.0	55.6	1.1	12.0	64.6		
Cycle Q Clear(g_c), s	4.8	0.0	55.6	1.1	12.0	64.6		
Prop In Lane	1.00	1.00		1.00	1.00			
Lane Grp Cap(c), veh/h	106		3326	910	224	2962		
V/C Ratio(X)	0.77		0.93	0.04	0.88	0.95		
Avail Cap(c_a), veh/h	371		3344	915	225	2978		
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00		
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00		
Uniform Delay (d), s/veh	48.1	0.0	16.0	6.5	44.1	6.8		
Incr Delay (d2), s/veh	11.2	0.0	5.4	0.0	29.7	7.5		
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0		
%ile BackOfQ(50%),veh/ln	2.4	0.0	18.7	0.3	6.6	11.3		
Unsig. Movement Delay, s/veh								
LnGrp Delay(d),s/veh	59.3	0.0	21.4	6.5	73.8	14.3		
LnGrp LOS	E		C	A	E	B		
Approach Vol, veh/h	82	A	3132			3000		
Approach Delay, s/veh	59.3		21.2			18.2		
Approach LOS	E		C			B		
Timer - Assigned Phs	1	2				6		8
Phs Duration (G+Y+Rc), s	18.9	73.6				92.5		11.3
Change Period (Y+Rc), s	5.0	6.0				6.0		5.0
Max Green Setting (Gmax), s	14.0	68.0				87.0		22.0
Max Q Clear Time (g_c+I1), s	14.0	57.6				66.6		6.8
Green Ext Time (p_c), s	0.0	10.0				18.9		0.1
Intersection Summary								
HCM 6th Ctrl Delay			20.2					
HCM 6th LOS			C					

Notes

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	125	5	15	145	15	255	15	2490	45	75	2365	80
Future Volume (veh/h)	125	5	15	145	15	255	15	2490	45	75	2365	80
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1900	1900	1900	1900	1530	1900	1870	1441	1426	1870	1885
Adj Flow Rate, veh/h	136	5	2	158	16	0	16	2707	32	82	2571	61
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	0	0	0	0	25	0	2	31	32	2	1
Cap, veh/h	263	255	216	213	18		28	3698	884	110	2667	1199
Arrive On Green	0.13	0.13	0.13	0.13	0.13	0.00	0.02	0.72	0.72	0.04	0.75	0.75
Sat Flow, veh/h	1397	1900	1610	1307	132	1296	1810	5106	1221	2634	3554	1598
Grp Volume(v), veh/h	136	5	2	174	0	0	16	2707	32	82	2571	61
Grp Sat Flow(s),veh/h/ln	1397	1900	1610	1439	0	1296	1810	1702	1221	1317	1777	1598
Q Serve(g_s), s	0.0	0.4	0.2	21.1	0.0	0.0	1.6	56.0	1.3	5.5	117.4	1.8
Cycle Q Clear(g_c), s	13.6	0.4	0.2	21.5	0.0	0.0	1.6	56.0	1.3	5.5	117.4	1.8
Prop In Lane	1.00		1.00	0.91		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	263	255	216	231	0		28	3698	884	110	2667	1199
V/C Ratio(X)	0.52	0.02	0.01	0.75	0.00		0.58	0.73	0.04	0.75	0.96	0.05
Avail Cap(c_a), veh/h	348	369	313	320	0		50	3698	884	190	2667	1199
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	73.4	67.7	67.6	77.0	0.0	0.0	88.0	14.6	7.0	85.3	20.2	5.8
Incr Delay (d2), s/veh	1.6	0.0	0.0	6.4	0.0	0.0	17.6	1.3	0.1	9.7	10.8	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	6.1	0.2	0.1	8.4	0.0	0.0	0.9	20.1	0.4	2.0	45.4	0.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	74.9	67.7	67.6	83.4	0.0	0.0	105.7	15.9	7.1	95.0	31.0	5.9
LnGrp LOS	E	E	E	F	A		F	B	A	F	C	A
Approach Vol, veh/h		143			174	A		2755			2714	
Approach Delay, s/veh		74.6			83.4			16.3			32.4	
Approach LOS		E			F			B			C	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	13.5	136.4		30.1	8.8	141.1		30.1
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	13.0	114.0		35.0	5.0	122.0		35.0
Max Q Clear Time (g_c+I1), s	17.5	58.0		15.6	3.6	119.4		23.5
Green Ext Time (p_c), s	0.1	41.1		0.3	0.0	2.5		0.6

Intersection Summary		
HCM 6th Ctrl Delay		27.3
HCM 6th LOS		C

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	205	155	110	2320	2380	145
Future Volume (veh/h)	205	155	110	2320	2380	145
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No	No	
Adj Sat Flow, veh/h/ln	1885	1870	1885	1870	1870	1885
Adj Flow Rate, veh/h	223	38	120	2522	2587	132
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	1	2	1	2	2	1
Cap, veh/h	276	125	138	3095	3925	1228
Arrive On Green	0.08	0.08	0.08	0.87	0.77	0.77
Sat Flow, veh/h	3483	1585	1795	3647	5274	1598
Grp Volume(v), veh/h	223	38	120	2522	2587	132
Grp Sat Flow(s),veh/h/ln	1742	1585	1795	1777	1702	1598
Q Serve(g_s), s	11.3	4.1	11.9	56.8	42.7	3.7
Cycle Q Clear(g_c), s	11.3	4.1	11.9	56.8	42.7	3.7
Prop In Lane	1.00	1.00	1.00			1.00
Lane Grp Cap(c), veh/h	276	125	138	3095	3925	1228
V/C Ratio(X)	0.81	0.30	0.87	0.81	0.66	0.11
Avail Cap(c_a), veh/h	880	401	145	3095	3925	1228
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	0.43	0.43	1.00	1.00
Uniform Delay (d), s/veh	81.5	78.2	82.1	5.2	9.8	5.2
Incr Delay (d2), s/veh	5.6	1.3	20.0	1.1	0.9	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.4	3.7	6.2	13.1	14.3	1.2
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	87.1	79.5	102.1	6.3	10.6	5.4
LnGrp LOS	F	E	F	A	B	A
Approach Vol, veh/h	261			2642	2719	
Approach Delay, s/veh	86.0			10.6	10.4	
Approach LOS	F			B	B	
Timer - Assigned Phs		2		4	5	6
Phs Duration (G+Y+Rc), s		161.3		18.7	18.4	142.9
Change Period (Y+Rc), s		4.5		4.5	4.5	4.5
Max Green Setting (Gmax), s		125.5		45.5	14.5	106.5
Max Q Clear Time (g_c+I1), s		58.8		13.3	13.9	44.7
Green Ext Time (p_c), s		46.1		0.9	0.0	42.1
Intersection Summary						
HCM 6th Ctrl Delay			14.0			
HCM 6th LOS			B			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	50	15	195	25	15	25	125	2360	10	5	2495	20
Future Volume (veh/h)	50	15	195	25	15	25	125	2360	10	5	2495	20
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1900	1900	1870	1900	1900	1900	1870	1870	1900	1900	1870	1841
Adj Flow Rate, veh/h	54	16	0	27	16	1	136	2565	9	5	2712	15
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	0	0	2	0	0	0	2	2	0	0	2	4
Cap, veh/h	100	23		106	56	128	156	2983	1352	11	3870	1182
Arrive On Green	0.08	0.08	0.00	0.08	0.08	0.08	0.09	0.84	0.84	0.01	0.76	0.76
Sat Flow, veh/h	811	289	1585	925	706	1610	1781	3554	1610	1810	5106	1560
Grp Volume(v), veh/h	70	0	0	43	0	1	136	2565	9	5	2712	15
Grp Sat Flow(s),veh/h/ln	1100	0	1585	1631	0	1610	1781	1777	1610	1810	1702	1560
Q Serve(g_s), s	7.8	0.0	0.0	0.0	0.0	0.1	13.6	75.0	0.2	0.5	49.4	0.4
Cycle Q Clear(g_c), s	12.1	0.0	0.0	4.3	0.0	0.1	13.6	75.0	0.2	0.5	49.4	0.4
Prop In Lane	0.77		1.00	0.63		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	123	0		162	0	128	156	2983	1352	11	3870	1182
V/C Ratio(X)	0.57	0.00		0.27	0.00	0.01	0.87	0.86	0.01	0.45	0.70	0.01
Avail Cap(c_a), veh/h	258	0		303	0	273	252	2983	1352	65	3870	1182
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	0.66	0.66	0.66
Uniform Delay (d), s/veh	83.5	0.0	0.0	78.2	0.0	76.3	81.1	8.3	2.3	89.1	11.2	5.3
Incr Delay (d2), s/veh	4.1	0.0	0.0	0.9	0.0	0.0	16.8	3.5	0.0	17.6	0.7	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	8.4	0.0	0.0	1.9	0.0	0.0	6.9	22.2	0.0	0.3	16.7	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	87.6	0.0	0.0	79.0	0.0	76.3	97.9	11.9	2.3	106.8	12.0	5.3
LnGrp LOS	F	A		E	A	E	F	B	A	F	B	A
Approach Vol, veh/h		70	A		44			2710			2732	
Approach Delay, s/veh		87.6			79.0			16.1			12.1	
Approach LOS		F			E			B			B	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	5.6	155.6		18.8	20.3	140.9		18.8				
Change Period (Y+Rc), s	4.5	4.5		4.5	4.5	4.5		4.5				
Max Green Setting (Gmax), s	6.5	129.5		30.5	25.5	110.5		30.5				
Max Q Clear Time (g_c+I1), s	2.5	77.0		14.1	15.6	51.4		6.3				
Green Ext Time (p_c), s	0.0	39.9		0.2	0.2	42.7		0.2				

Intersection Summary			
HCM 6th Ctrl Delay			15.6
HCM 6th LOS			B

Notes

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	365	0	530	15	5	15	625	2025	15	5	2400	475
Future Volume (veh/h)	365	0	530	15	5	15	625	2025	15	5	2400	475
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	397	0	531	16	5	1	679	2201	12	5	2609	408
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	473	0	1078	25	21	4	716	2631	1173	9	2746	852
Arrive On Green	0.13	0.00	0.13	0.01	0.01	0.01	0.21	0.74	0.74	0.00	0.54	0.54
Sat Flow, veh/h	3563	0	3170	1781	1513	303	3456	3554	1585	1781	5106	1585
Grp Volume(v), veh/h	397	0	531	16	0	6	679	2201	12	5	2609	408
Grp Sat Flow(s),veh/h/ln	1781	0	1585	1781	0	1816	1728	1777	1585	1781	1702	1585
Q Serve(g_s), s	22.1	0.0	27.0	1.8	0.0	0.7	39.4	86.0	0.4	0.6	98.2	32.6
Cycle Q Clear(g_c), s	22.1	0.0	27.0	1.8	0.0	0.7	39.4	86.0	0.4	0.6	98.2	32.6
Prop In Lane	1.00		1.00	1.00		0.17	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	473	0	1078	25	0	25	716	2631	1173	9	2746	852
V/C Ratio(X)	0.84	0.00	0.49	0.64	0.00	0.24	0.95	0.84	0.01	0.58	0.95	0.48
Avail Cap(c_a), veh/h	473	0	1078	61	0	62	748	2631	1173	35	2762	857
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	86.1	0.0	53.2	99.8	0.0	99.2	79.5	18.0	6.9	101.0	44.4	29.3
Incr Delay (d2), s/veh	12.7	0.0	0.3	24.3	0.0	4.7	20.7	2.5	0.0	49.4	8.3	0.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	11.1	0.0	11.0	1.0	0.0	0.4	19.5	33.1	0.1	0.4	42.3	12.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	98.7	0.0	53.5	124.1	0.0	103.9	100.2	20.5	6.9	150.4	52.8	29.7
LnGrp LOS	F	A	D	F	A	F	F	C	A	F	D	C
Approach Vol, veh/h		928			22			2892			3022	
Approach Delay, s/veh		72.9			118.6			39.2			49.8	
Approach LOS		E			F			D			D	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	7.0	156.6		7.8	48.2	115.4		32.0
Change Period (Y+Rc), s	6.0	6.0		5.0	6.0	6.0		5.0
Max Green Setting (Gmax), s	1.0	150.0		7.0	44.0	110.0		27.0
Max Q Clear Time (g_c+I1), s	2.6	88.0		3.8	41.4	100.2		29.0
Green Ext Time (p_c), s	0.0	34.8		0.0	0.7	9.1		0.0

Intersection Summary	
HCM 6th Ctrl Delay	48.7
HCM 6th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.

User approved volume balancing among the lanes for turning movement.

Intersection						
Int Delay, s/veh	0.8					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations		↱	↑↑	↱		↑↑↑
Traffic Vol, veh/h	0	75	2420	5	0	2715
Future Vol, veh/h	0	75	2420	5	0	2715
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	500	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	82	2630	5	0	2951

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	-	1315	0	0	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	6.94	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.32	-	-	-	-
Pot Cap-1 Maneuver	0	148	-	-	0	-
Stage 1	0	-	-	-	0	-
Stage 2	0	-	-	-	0	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	-	148	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	55.7	0	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBT
Capacity (veh/h)	-	-	148	-
HCM Lane V/C Ratio	-	-	0.551	-
HCM Control Delay (s)	-	-	55.7	-
HCM Lane LOS	-	-	F	-
HCM 95th %tile Q(veh)	-	-	2.8	-

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	235	140	2285	85	115	2600
Future Volume (veh/h)	235	140	2285	85	115	2600
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No		No			No
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	255	27	2484	54	125	2826
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	289	257	3216	998	153	3861
Arrive On Green	0.16	0.16	0.63	0.63	0.09	0.76
Sat Flow, veh/h	1781	1585	5274	1585	1781	5274
Grp Volume(v), veh/h	255	27	2484	54	125	2826
Grp Sat Flow(s),veh/h/ln	1781	1585	1702	1585	1781	1702
Q Serve(g_s), s	15.5	1.6	38.8	1.4	7.6	33.4
Cycle Q Clear(g_c), s	15.5	1.6	38.8	1.4	7.6	33.4
Prop In Lane	1.00	1.00		1.00	1.00	
Lane Grp Cap(c), veh/h	289	257	3216	998	153	3861
V/C Ratio(X)	0.88	0.10	0.77	0.05	0.82	0.73
Avail Cap(c_a), veh/h	395	351	3718	1154	185	4457
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	45.3	39.4	14.7	7.8	49.7	7.4
Incr Delay (d2), s/veh	15.9	0.2	0.9	0.0	20.9	0.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	8.1	0.6	12.9	0.4	4.2	8.5
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	61.1	39.6	15.7	7.9	70.6	7.9
LnGrp LOS	E	D	B	A	E	A
Approach Vol, veh/h	282		2538			2951
Approach Delay, s/veh	59.1		15.5			10.6
Approach LOS	E		B			B

Timer - Assigned Phs	1	2				6		8
Phs Duration (G+Y+Rc), s	14.0	74.1				88.1		22.5
Change Period (Y+Rc), s	4.5	4.5				4.5		4.5
Max Green Setting (Gmax), s	11.5	80.5				96.5		24.5
Max Q Clear Time (g_c+I1), s	9.6	40.8				35.4		17.5
Green Ext Time (p_c), s	0.0	28.9				46.1		0.5

Intersection Summary			
HCM 6th Ctrl Delay			15.1
HCM 6th LOS			B

Intersection						
Int Delay, s/veh	0.2					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	25	2345	25	0	2835
Future Vol, veh/h	0	25	2345	25	0	2835
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	500	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	27	2549	27	0	3082

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	-	1275	0	0	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	6.94	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.32	-	-	-	-
Pot Cap-1 Maneuver	0	158	-	-	0	-
Stage 1	0	-	-	-	0	-
Stage 2	0	-	-	-	0	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	-	158	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	32.5	0	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBT
Capacity (veh/h)	-	-	158	-
HCM Lane V/C Ratio	-	-	0.172	-
HCM Control Delay (s)	-	-	32.5	-
HCM Lane LOS	-	-	D	-
HCM 95th %tile Q(veh)	-	-	0.6	-

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Base Year 2038 WE Peak With Mitigation

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	25	140	2365	45	105	2170
Future Volume (veh/h)	25	140	2365	45	105	2170
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No		No			No
Adj Sat Flow, veh/h/ln	1767	1841	1870	1693	1767	1870
Adj Flow Rate, veh/h	27	0	2571	31	114	2359
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	9	4	2	14	9	2
Cap, veh/h	48		3474	976	144	2951
Arrive On Green	0.03	0.00	0.68	0.68	0.09	0.83
Sat Flow, veh/h	1682	1560	5274	1434	1682	3647
Grp Volume(v), veh/h	27	0	2571	31	114	2359
Grp Sat Flow(s),veh/h/ln	1682	1560	1702	1434	1682	1777
Q Serve(g_s), s	1.2	0.0	25.2	0.5	5.2	26.1
Cycle Q Clear(g_c), s	1.2	0.0	25.2	0.5	5.2	26.1
Prop In Lane	1.00	1.00		1.00	1.00	
Lane Grp Cap(c), veh/h	48		3474	976	144	2951
V/C Ratio(X)	0.57		0.74	0.03	0.79	0.80
Avail Cap(c_a), veh/h	648		3934	1105	302	3605
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	37.4	0.0	8.0	4.1	34.9	3.3
Incr Delay (d2), s/veh	10.1	0.0	0.7	0.0	9.2	1.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.6	0.0	6.0	0.1	2.4	0.9
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	47.4	0.0	8.7	4.1	44.1	4.4
LnGrp LOS	D		A	A	D	A
Approach Vol, veh/h	27	A	2602			2473
Approach Delay, s/veh	47.4		8.6			6.3
Approach LOS	D		A			A

Timer - Assigned Phs	1	2				6	8
Phs Duration (G+Y+Rc), s	11.7	59.0				70.7	7.2
Change Period (Y+Rc), s	5.0	6.0				6.0	5.0
Max Green Setting (Gmax), s	14.0	60.0				79.0	30.0
Max Q Clear Time (g_c+I1), s	7.2	27.2				28.1	3.2
Green Ext Time (p_c), s	0.1	25.7				34.6	0.0

Intersection Summary		
HCM 6th Ctrl Delay		7.7
HCM 6th LOS		A

Notes

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱		↰↑	↱	↰	↑↑↑	↱	↰↰	↑↑	↱
Traffic Volume (veh/h)	140	10	20	90	20	145	15	2125	40	70	1990	120
Future Volume (veh/h)	140	10	20	90	20	145	15	2125	40	70	1990	120
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1900	1900	1693	1693	1559	1900	1870	1441	1426	1870	1870
Adj Flow Rate, veh/h	152	11	2	98	22	0	16	2310	28	76	2163	90
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	0	0	14	14	23	0	2	31	32	2	2
Cap, veh/h	209	213	180	152	26		28	3820	913	105	2746	1225
Arrive On Green	0.11	0.11	0.11	0.11	0.11	0.00	0.02	0.75	0.75	0.04	0.77	0.77
Sat Flow, veh/h	1390	1900	1610	1035	232	1321	1810	5106	1221	2634	3554	1585
Grp Volume(v), veh/h	152	11	2	120	0	0	16	2310	28	76	2163	90
Grp Sat Flow(s),veh/h/ln	1390	1900	1610	1268	0	1321	1810	1702	1221	1317	1777	1585
Q Serve(g_s), s	0.9	0.9	0.2	16.0	0.0	0.0	1.6	37.4	1.1	5.1	63.6	2.5
Cycle Q Clear(g_c), s	17.7	0.9	0.2	16.9	0.0	0.0	1.6	37.4	1.1	5.1	63.6	2.5
Prop In Lane	1.00		1.00	0.82		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	209	213	180	178	0		28	3820	913	105	2746	1225
V/C Ratio(X)	0.73	0.05	0.01	0.67	0.00		0.58	0.60	0.03	0.72	0.79	0.07
Avail Cap(c_a), veh/h	339	391	331	303	0		90	3820	913	483	2746	1225
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	78.8	71.4	71.1	78.9	0.0	0.0	88.0	10.4	5.8	85.4	11.9	4.9
Incr Delay (d2), s/veh	4.8	0.1	0.0	4.4	0.0	0.0	17.6	0.7	0.1	9.0	2.4	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	7.3	0.5	0.1	5.7	0.0	0.0	0.9	13.0	0.3	1.9	22.5	0.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	83.6	71.5	71.1	83.3	0.0	0.0	105.7	11.1	5.9	94.5	14.2	5.0
LnGrp LOS	F	E	E	F	A		F	B	A	F	B	A
Approach Vol, veh/h		165			120	A		2354			2329	
Approach Delay, s/veh		82.7			83.3			11.7			16.5	
Approach LOS		F			F			B			B	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	13.2	140.7		26.2	8.8	145.1		26.2				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	33.0	92.0		37.0	9.0	116.0		37.0				
Max Q Clear Time (g_c+I1), s	7.1	39.4		19.7	3.6	65.6		18.9				
Green Ext Time (p_c), s	0.2	31.1		0.4	0.0	30.7		0.5				
Intersection Summary												
HCM 6th Ctrl Delay			18.1									
HCM 6th LOS			B									

Notes

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	240	180	170	1950	1870	225
Future Volume (veh/h)	240	180	170	1950	1870	225
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No	No	
Adj Sat Flow, veh/h/ln	1885	1885	1885	1870	1870	1885
Adj Flow Rate, veh/h	261	6	185	2120	2033	161
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	1	1	1	2	2	1
Cap, veh/h	314	144	206	3056	3677	1151
Arrive On Green	0.09	0.09	0.11	0.86	0.72	0.72
Sat Flow, veh/h	3483	1598	1795	3647	5274	1598
Grp Volume(v), veh/h	261	6	185	2120	2033	161
Grp Sat Flow(s),veh/h/ln	1742	1598	1795	1777	1702	1598
Q Serve(g_s), s	13.3	0.6	18.3	37.3	33.3	5.6
Cycle Q Clear(g_c), s	13.3	0.6	18.3	37.3	33.3	5.6
Prop In Lane	1.00	1.00	1.00			1.00
Lane Grp Cap(c), veh/h	314	144	206	3056	3677	1151
V/C Ratio(X)	0.83	0.04	0.90	0.69	0.55	0.14
Avail Cap(c_a), veh/h	977	448	314	3056	3677	1151
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	0.60	0.60	1.00	1.00
Uniform Delay (d), s/veh	80.5	74.8	78.6	4.4	11.7	7.8
Incr Delay (d2), s/veh	5.7	0.1	12.8	0.8	0.6	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	6.3	0.6	9.1	9.4	11.9	2.0
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	86.2	74.9	91.5	5.2	12.3	8.1
LnGrp LOS	F	E	F	A	B	A
Approach Vol, veh/h	267			2305	2194	
Approach Delay, s/veh	86.0			12.1	12.0	
Approach LOS	F			B	B	

Timer - Assigned Phs		2		4	5	6
Phs Duration (G+Y+Rc), s		159.3		20.7	25.1	134.1
Change Period (Y+Rc), s		4.5		4.5	4.5	4.5
Max Green Setting (Gmax), s		120.5		50.5	31.5	84.5
Max Q Clear Time (g_c+I1), s		39.3		15.3	20.3	35.3
Green Ext Time (p_c), s		36.1		1.0	0.3	25.5

Intersection Summary			
HCM 6th Ctrl Delay			16.2
HCM 6th LOS			B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰↑	↱		↰↑	↱	↰	↑↑	↱	↰	↑↑↑	↱
Traffic Volume (veh/h)	50	15	215	25	20	25	190	2045	5	10	2000	35
Future Volume (veh/h)	50	15	215	25	20	25	190	2045	5	10	2000	35
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1856	1856	1870	1900	1900	1900	1870	1870	1900	1900	1870	1826
Adj Flow Rate, veh/h	54	16	0	27	22	1	207	2223	4	11	2174	26
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	3	3	2	0	0	0	2	2	0	0	2	5
Cap, veh/h	99	24		97	71	133	227	2951	1337	21	3649	1106
Arrive On Green	0.08	0.08	0.00	0.08	0.08	0.08	0.13	0.83	0.83	0.01	0.71	0.71
Sat Flow, veh/h	764	285	1585	804	862	1610	1781	3554	1610	1810	5106	1547
Grp Volume(v), veh/h	70	0	0	49	0	1	207	2223	4	11	2174	26
Grp Sat Flow(s),veh/h/ln	1049	0	1585	1666	0	1610	1781	1777	1610	1810	1702	1547
Q Serve(g_s), s	7.9	0.0	0.0	0.0	0.0	0.1	20.6	51.0	0.1	1.1	38.1	0.9
Cycle Q Clear(g_c), s	12.7	0.0	0.0	4.8	0.0	0.1	20.6	51.0	0.1	1.1	38.1	0.9
Prop In Lane	0.77		1.00	0.55		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	122	0		169	0	133	227	2951	1337	21	3649	1106
V/C Ratio(X)	0.57	0.00		0.29	0.00	0.01	0.91	0.75	0.00	0.52	0.60	0.02
Avail Cap(c_a), veh/h	225	0		281	0	246	302	2951	1337	65	3649	1106
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	0.79	0.79	0.79
Uniform Delay (d), s/veh	83.4	0.0	0.0	77.9	0.0	75.8	77.5	6.9	2.6	88.4	12.8	7.5
Incr Delay (d2), s/veh	4.2	0.0	0.0	0.9	0.0	0.0	25.2	1.8	0.0	14.5	0.6	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.4	0.0	0.0	2.2	0.0	0.0	11.0	15.4	0.0	0.6	13.7	0.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	87.5	0.0	0.0	78.8	0.0	75.8	102.7	8.7	2.6	102.9	13.3	7.5
LnGrp LOS	F	A		E	A	E	F	A	A	F	B	A
Approach Vol, veh/h		70	A		50			2434			2211	
Approach Delay, s/veh		87.5			78.7			16.7			13.7	
Approach LOS		F			E			B			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	6.6	154.0		19.4	27.5	133.1		19.4
Change Period (Y+Rc), s	4.5	4.5		4.5	4.5	4.5		4.5
Max Green Setting (Gmax), s	6.5	132.5		27.5	30.5	108.5		27.5
Max Q Clear Time (g_c+I1), s	3.1	53.0		14.7	22.6	40.1		6.8
Green Ext Time (p_c), s	0.0	39.9		0.2	0.3	31.7		0.2

Intersection Summary	
HCM 6th Ctrl Delay	17.0
HCM 6th LOS	B

Notes

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	335	0	385	5	0	5	410	1820	5	5	1925	375
Future Volume (veh/h)	335	0	385	5	0	5	410	1820	5	5	1925	375
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	364	0	379	5	0	1	446	1978	4	5	2092	307
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	475	0	901	11	0	9	522	2478	1105	9	2816	874
Arrive On Green	0.13	0.00	0.13	0.01	0.00	0.01	0.15	0.70	0.70	0.01	0.55	0.55
Sat Flow, veh/h	3563	0	3170	1781	0	1585	3456	3554	1585	1781	5106	1585
Grp Volume(v), veh/h	364	0	379	5	0	1	446	1978	4	5	2092	307
Grp Sat Flow(s),veh/h/ln	1781	0	1585	1781	0	1585	1728	1777	1585	1781	1702	1585
Q Serve(g_s), s	13.7	0.0	13.5	0.4	0.0	0.1	17.5	52.8	0.1	0.4	43.3	15.0
Cycle Q Clear(g_c), s	13.7	0.0	13.5	0.4	0.0	0.1	17.5	52.8	0.1	0.4	43.3	15.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	475	0	901	11	0	9	522	2478	1105	9	2816	874
V/C Ratio(X)	0.77	0.00	0.42	0.47	0.00	0.11	0.85	0.80	0.00	0.56	0.74	0.35
Avail Cap(c_a), veh/h	897	0	1277	51	0	46	1044	3705	1653	51	3929	1220
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	58.2	0.0	40.4	68.9	0.0	68.8	57.5	14.4	6.4	69.0	23.7	17.3
Incr Delay (d2), s/veh	2.6	0.0	0.3	29.2	0.0	4.8	4.1	0.8	0.0	44.2	0.5	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	6.4	0.0	5.4	0.3	0.0	0.0	7.8	18.4	0.0	0.3	16.4	5.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	60.8	0.0	40.8	98.1	0.0	73.6	61.7	15.1	6.4	113.3	24.2	17.6
LnGrp LOS	E	A	D	F	A	E	E	B	A	F	C	B
Approach Vol, veh/h		743			6			2428			2404	
Approach Delay, s/veh		50.6			94.0			23.7			23.5	
Approach LOS		D			F			C			C	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.7	103.0		5.8	27.0	82.7		23.5				
Change Period (Y+Rc), s	6.0	6.0		5.0	6.0	6.0		5.0				
Max Green Setting (Gmax), s	4.0	145.0		4.0	42.0	107.0		35.0				
Max Q Clear Time (g_c+I1), s	2.4	54.8		2.4	19.5	45.3		15.7				
Green Ext Time (p_c), s	0.0	31.6		0.0	1.5	31.4		2.8				

Intersection Summary		
HCM 6th Ctrl Delay		27.3
HCM 6th LOS		C

Notes

User approved volume balancing among the lanes for turning movement.

Intersection	
Int Delay, s/veh	0.6

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	70	2170	10	0	2240
Future Vol, veh/h	0	70	2170	10	0	2240
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	500	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	76	2359	11	0	2435

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	-	1180	0	0	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	6.94	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.32	-	-	-	-
Pot Cap-1 Maneuver	0	183	-	-	0	-
Stage 1	0	-	-	-	0	-
Stage 2	0	-	-	-	0	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	-	183	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	38	0	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBT
Capacity (veh/h)	-	-	183	-
HCM Lane V/C Ratio	-	-	0.416	-
HCM Control Delay (s)	-	-	38	-
HCM Lane LOS	-	-	E	-
HCM 95th %tile Q(veh)	-	-	1.9	-

Movement	WBL	WBR	NBT	NBR	SBL	SBT	
Lane Configurations							
Traffic Volume (veh/h)	215	125	2055	90	125	2115	
Future Volume (veh/h)	215	125	2055	90	125	2115	
Initial Q (Qb), veh	0	0	0	0	0	0	
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00		
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	
Work Zone On Approach	No		No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	
Adj Flow Rate, veh/h	234	13	2234	56	136	2299	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	
Percent Heavy Veh, %	2	2	2	2	2	2	
Cap, veh/h	271	241	3168	983	167	3874	
Arrive On Green	0.15	0.15	0.62	0.62	0.09	0.76	
Sat Flow, veh/h	1781	1585	5274	1585	1781	5274	
Grp Volume(v), veh/h	234	13	2234	56	136	2299	
Grp Sat Flow(s),veh/h/ln	1781	1585	1702	1585	1781	1702	
Q Serve(g_s), s	13.0	0.7	29.9	1.4	7.6	20.0	
Cycle Q Clear(g_c), s	13.0	0.7	29.9	1.4	7.6	20.0	
Prop In Lane	1.00	1.00		1.00	1.00		
Lane Grp Cap(c), veh/h	271	241	3168	983	167	3874	
V/C Ratio(X)	0.86	0.05	0.71	0.06	0.81	0.59	
Avail Cap(c_a), veh/h	414	368	4466	1386	255	5425	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	
Uniform Delay (d), s/veh	41.8	36.7	13.0	7.6	45.0	5.4	
Incr Delay (d2), s/veh	11.2	0.1	0.3	0.0	11.1	0.1	
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	
%ile BackOfQ(50%),veh/ln	6.5	0.3	9.5	0.4	3.7	4.6	
Unsig. Movement Delay, s/veh							
LnGrp Delay(d),s/veh	53.1	36.7	13.3	7.6	56.1	5.5	
LnGrp LOS	D	D	B	A	E	A	
Approach Vol, veh/h	247		2290			2435	
Approach Delay, s/veh	52.2		13.1			8.3	
Approach LOS	D		B			A	
Timer - Assigned Phs	1	2				6	8
Phs Duration (G+Y+Rc), s	14.0	67.3				81.3	19.9
Change Period (Y+Rc), s	4.5	4.5				4.5	4.5
Max Green Setting (Gmax), s	14.5	88.5				107.5	23.5
Max Q Clear Time (g_c+I1), s	9.6	31.9				22.0	15.0
Green Ext Time (p_c), s	0.1	30.9				38.4	0.5
Intersection Summary							
HCM 6th Ctrl Delay			12.7				
HCM 6th LOS			B				

Intersection						
Int Delay, s/veh	0.1					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations		↱	↑↑	↱		↑↑↑
Traffic Vol, veh/h	0	25	2120	30	0	2330
Future Vol, veh/h	0	25	2120	30	0	2330
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	500	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	27	2304	33	0	2533

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	-	1152	0	0	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	6.94	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.32	-	-	-	-
Pot Cap-1 Maneuver	0	191	-	-	0	-
Stage 1	0	-	-	-	0	-
Stage 2	0	-	-	-	0	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	-	191	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	27	0	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBT
Capacity (veh/h)	-	-	191	-
HCM Lane V/C Ratio	-	-	0.142	-
HCM Control Delay (s)	-	-	27	-
HCM Lane LOS	-	-	D	-
HCM 95th %tile Q(veh)	-	-	0.5	-

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Future Year 2038 AM Peak

Movement	WBL	WBR	NBT	NBR	SBL	SBT	
Lane Configurations							
Traffic Volume (veh/h)	75	265	2120	70	360	2795	
Future Volume (veh/h)	75	265	2120	70	360	2795	
Initial Q (Qb), veh	0	0	0	0	0	0	
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00		
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	
Work Zone On Approach	No		No			No	
Adj Sat Flow, veh/h/ln	1722	1663	1870	1885	1811	1870	
Adj Flow Rate, veh/h	82	0	2304	41	391	3038	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	
Percent Heavy Veh, %	12	16	2	1	6	2	
Cap, veh/h	105		3186	997	251	2920	
Arrive On Green	0.06	0.00	0.62	0.62	0.15	0.82	
Sat Flow, veh/h	1640	1409	5274	1598	1725	3647	
Grp Volume(v), veh/h	82	0	2304	41	391	3038	
Grp Sat Flow(s),veh/h/ln	1640	1409	1702	1598	1725	1777	
Q Serve(g_s), s	4.7	0.0	29.7	1.0	14.0	79.0	
Cycle Q Clear(g_c), s	4.7	0.0	29.7	1.0	14.0	79.0	
Prop In Lane	1.00	1.00		1.00	1.00		
Lane Grp Cap(c), veh/h	105		3186	997	251	2920	
V/C Ratio(X)	0.78		0.72	0.04	1.56	1.04	
Avail Cap(c_a), veh/h	512		3186	997	251	2920	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00	
Uniform Delay (d), s/veh	44.3	0.0	12.4	7.0	41.1	8.6	
Incr Delay (d2), s/veh	11.8	0.0	0.8	0.0	269.2	28.4	
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	
%ile BackOfQ(50%),veh/ln	2.3	0.0	9.3	0.3	24.4	21.4	
Unsig. Movement Delay, s/veh							
LnGrp Delay(d),s/veh	56.2	0.0	13.2	7.0	310.3	37.0	
LnGrp LOS	E		B	A	F	F	
Approach Vol, veh/h	82	A	2345			3429	
Approach Delay, s/veh	56.2		13.1			68.1	
Approach LOS	E		B			E	
Timer - Assigned Phs	1	2				6	8
Phs Duration (G+Y+Rc), s	19.0	66.0				85.0	11.2
Change Period (Y+Rc), s	5.0	6.0				6.0	5.0
Max Green Setting (Gmax), s	14.0	60.0				79.0	30.0
Max Q Clear Time (g_c+I1), s	16.0	31.7				81.0	6.7
Green Ext Time (p_c), s	0.0	20.6				0.0	0.2
Intersection Summary							
HCM 6th Ctrl Delay			45.9				
HCM 6th LOS			D				

Notes

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	30	5	5	50	5	110	5	2050	195	390	2380	95
Future Volume (veh/h)	30	5	5	50	5	110	5	2050	195	390	2380	95
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1752	1870	1900	1870	1870	1441	1900	1870	1322	537	1870	1841
Adj Flow Rate, veh/h	33	5	1	54	5	0	5	2228	164	424	2587	83
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	10	2	0	2	2	31	0	2	39	92	2	4
Cap, veh/h	125	103	89	108	6		11	3378	741	182	2981	1308
Arrive On Green	0.06	0.06	0.06	0.06	0.06	0.00	0.01	0.66	0.66	0.18	0.84	0.84
Sat Flow, veh/h	1322	1870	1610	1257	116	1221	1810	5106	1120	991	3554	1560
Grp Volume(v), veh/h	33	5	1	59	0	0	5	2228	164	424	2587	83
Grp Sat Flow(s),veh/h/ln	1322	1870	1610	1374	0	1221	1810	1702	1120	496	1777	1560
Q Serve(g_s), s	0.0	0.5	0.1	7.3	0.0	0.0	0.5	47.2	10.4	33.0	77.7	1.6
Cycle Q Clear(g_c), s	3.6	0.5	0.1	7.7	0.0	0.0	0.5	47.2	10.4	33.0	77.7	1.6
Prop In Lane	1.00		1.00	0.92		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	125	103	89	114	0		11	3378	741	182	2981	1308
V/C Ratio(X)	0.26	0.05	0.01	0.52	0.00		0.45	0.66	0.22	2.33	0.87	0.06
Avail Cap(c_a), veh/h	324	384	331	331	0		90	3378	741	182	2981	1308
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	82.0	80.6	80.4	84.2	0.0	0.0	89.1	18.3	12.1	73.5	8.6	2.5
Incr Delay (d2), s/veh	1.1	0.2	0.0	3.6	0.0	0.0	25.9	1.0	0.7	616.7	3.7	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.5	0.2	0.0	2.9	0.0	0.0	0.3	18.0	2.7	19.7	23.1	0.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	83.1	80.8	80.5	87.8	0.0	0.0	115.0	19.3	12.8	690.2	12.3	2.6
LnGrp LOS	F	F	F	F	A		F	B	B	F	B	A
Approach Vol, veh/h		39			59	A		2397			3094	
Approach Delay, s/veh		82.8			87.8			19.1			105.0	
Approach LOS		F			F			B			F	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	39.0	125.1		15.9	7.1	157.0		15.9
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	33.0	92.0		37.0	9.0	116.0		37.0
Max Q Clear Time (g_c+I1), s	35.0	49.2		5.6	2.5	79.7		9.7
Green Ext Time (p_c), s	0.0	27.2		0.1	0.0	30.2		0.2

Intersection Summary			
HCM 6th Ctrl Delay			67.8
HCM 6th LOS			E

Notes

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	45	5	35	85	10	85	90	2110	250	250	2075	110
Future Volume (veh/h)	45	5	35	85	10	85	90	2110	250	250	2075	110
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1841	1870	1856	1796	1870	1796	1841	1870	1781	1781	1870	1841
Adj Flow Rate, veh/h	49	5	1	92	11	0	98	2293	207	272	2255	96
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	4	2	3	7	2	7	4	2	8	8	2	4
Cap, veh/h	94	50	105	131	72		136	3771	1175	313	4053	1281
Arrive On Green	0.03	0.03	0.03	0.04	0.04	0.00	0.04	0.74	0.74	0.10	0.79	0.79
Sat Flow, veh/h	3401	1870	1572	3319	1870	1522	3401	5106	1510	3291	5106	1560
Grp Volume(v), veh/h	49	5	1	92	11	0	98	2293	207	272	2255	96
Grp Sat Flow(s),veh/h/ln	1700	1870	1572	1659	1870	1522	1700	1702	1510	1646	1702	1560
Q Serve(g_s), s	2.6	0.5	0.1	4.9	1.0	0.0	5.1	38.4	6.3	14.7	29.4	2.1
Cycle Q Clear(g_c), s	2.6	0.5	0.1	4.9	1.0	0.0	5.1	38.4	6.3	14.7	29.4	2.1
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	94	50	105	131	72		136	3771	1175	313	4053	1281
V/C Ratio(X)	0.52	0.10	0.01	0.70	0.15		0.72	0.61	0.18	0.87	0.56	0.07
Avail Cap(c_a), veh/h	671	275	294	618	255		274	3771	1175	411	4053	1281
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	86.3	85.5	78.4	85.4	83.7	0.0	85.4	11.2	5.1	80.3	6.9	3.1
Incr Delay (d2), s/veh	4.4	0.9	0.0	6.6	1.0	0.0	7.0	0.7	0.3	14.4	0.6	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.2	0.2	0.0	2.3	0.5	0.0	2.4	13.4	2.1	6.8	9.3	0.7
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	90.7	86.3	78.5	92.0	84.7	0.0	92.4	11.9	5.5	94.7	7.4	3.2
LnGrp LOS	F	F	E	F	F		F	B	A	F	A	A
Approach Vol, veh/h		55			103	A		2598			2623	
Approach Delay, s/veh		90.1			91.2			14.4			16.3	
Approach LOS		F			F			B			B	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	21.6	137.4	11.6	9.3	11.7	147.4	9.5	11.4
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	22.5	79.5	33.5	26.5	14.5	87.5	35.5	24.5
Max Q Clear Time (g_c+I1), s	16.7	40.4	6.9	2.5	7.1	31.4	4.6	3.0
Green Ext Time (p_c), s	0.4	26.8	0.3	0.0	0.1	31.6	0.1	0.0

Intersection Summary	
HCM 6th Ctrl Delay	17.6
HCM 6th LOS	B

Notes

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰	↱		↰	↱	↰	↑↑	↱	↰	↑↑↑	↱
Traffic Volume (veh/h)	10	5	45	65	5	40	140	2395	155	70	2075	45
Future Volume (veh/h)	10	5	45	65	5	40	140	2395	155	70	2075	45
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1811	1856	1856	1885	1796	1870	1841	1885	1870	1856
Adj Flow Rate, veh/h	11	5	0	71	5	1	152	2603	128	76	2255	34
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	6	3	3	1	7	2	4	1	2	3
Cap, veh/h	49	16		128	6	113	172	2852	1252	93	3850	1186
Arrive On Green	0.07	0.07	0.00	0.07	0.07	0.07	0.10	0.80	0.80	0.05	0.75	0.75
Sat Flow, veh/h	219	233	1535	1265	89	1598	1711	3554	1560	1795	5106	1572
Grp Volume(v), veh/h	16	0	0	76	0	1	152	2603	128	76	2255	34
Grp Sat Flow(s),veh/h/ln	453	0	1535	1354	0	1598	1711	1777	1560	1795	1702	1572
Q Serve(g_s), s	0.8	0.0	0.0	0.0	0.0	0.1	15.8	97.3	3.2	7.5	35.0	1.0
Cycle Q Clear(g_c), s	10.8	0.0	0.0	10.0	0.0	0.1	15.8	97.3	3.2	7.5	35.0	1.0
Prop In Lane	0.69		1.00	0.93		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	66	0		134	0	113	172	2852	1252	93	3850	1186
V/C Ratio(X)	0.24	0.00		0.57	0.00	0.01	0.89	0.91	0.10	0.82	0.59	0.03
Avail Cap(c_a), veh/h	191	0		251	0	244	290	2852	1252	95	3850	1186
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	81.9	0.0	0.0	82.4	0.0	77.8	79.9	13.1	3.8	84.5	9.7	5.6
Incr Delay (d2), s/veh	1.9	0.0	0.0	3.7	0.0	0.0	15.7	5.8	0.2	40.0	0.7	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.8	0.0	0.0	3.7	0.0	0.0	7.7	33.0	0.9	4.5	12.0	0.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	83.8	0.0	0.0	86.1	0.0	77.8	95.7	18.9	4.0	124.5	10.4	5.6
LnGrp LOS	F	A		F	A	E	F	B	A	F	B	A
Approach Vol, veh/h		16	A		77			2883			2365	
Approach Delay, s/veh		83.8			86.0			22.2			14.0	
Approach LOS		F			F			C			B	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	13.8	149.0		17.2	22.6	140.2		17.2				
Change Period (Y+Rc), s	4.5	4.5		4.5	4.5	4.5		4.5				
Max Green Setting (Gmax), s	9.5	129.5		27.5	30.5	108.5		27.5				
Max Q Clear Time (g_c+I1), s	9.5	99.3		12.8	17.8	37.0		12.0				
Green Ext Time (p_c), s	0.0	26.1		0.0	0.3	34.8		0.3				
Intersection Summary												
HCM 6th Ctrl Delay			19.7									
HCM 6th LOS			B									

Notes

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	555	5	450	10	0	5	550	2295	10	5	1740	120
Future Volume (veh/h)	555	5	450	10	0	5	550	2295	10	5	1740	120
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	607	0	461	11	0	1	598	2495	8	5	1891	79
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	609	0	1130	17	0	15	641	2514	1121	9	2689	835
Arrive On Green	0.17	0.00	0.17	0.01	0.00	0.01	0.19	0.71	0.71	0.00	0.53	0.53
Sat Flow, veh/h	3563	0	3170	1781	0	1585	3456	3554	1585	1781	5106	1585
Grp Volume(v), veh/h	607	0	461	11	0	1	598	2495	8	5	1891	79
Grp Sat Flow(s),veh/h/ln	1781	0	1585	1781	0	1585	1728	1777	1585	1781	1702	1585
Q Serve(g_s), s	34.9	0.0	22.4	1.3	0.0	0.1	34.9	141.3	0.3	0.6	57.0	5.1
Cycle Q Clear(g_c), s	34.9	0.0	22.4	1.3	0.0	0.1	34.9	141.3	0.3	0.6	57.0	5.1
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	609	0	1130	17	0	15	641	2514	1121	9	2689	835
V/C Ratio(X)	1.00	0.00	0.41	0.64	0.00	0.07	0.93	0.99	0.01	0.58	0.70	0.09
Avail Cap(c_a), veh/h	609	0	1130	35	0	31	708	2515	1122	35	2689	835
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	84.9	0.0	49.7	101.1	0.0	100.6	82.2	29.5	8.8	101.8	36.5	24.2
Incr Delay (d2), s/veh	35.8	0.0	0.2	33.2	0.0	1.8	18.3	16.2	0.0	49.5	0.8	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	19.2	0.0	9.1	0.8	0.0	0.1	17.1	60.5	0.1	0.4	23.6	2.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	120.7	0.0	49.9	134.3	0.0	102.3	100.5	45.6	8.8	151.3	37.3	24.2
LnGrp LOS	F	A	D	F	A	F	F	D	A	F	D	C
Approach Vol, veh/h		1068			12			3101			1975	
Approach Delay, s/veh		90.2			131.7			56.1			37.1	
Approach LOS		F			F			E			D	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	7.0	150.9		7.0	44.0	113.9		40.0				
Change Period (Y+Rc), s	6.0	6.0		5.0	6.0	6.0		5.0				
Max Green Setting (Gmax), s	1.0	145.0		4.0	42.0	107.0		35.0				
Max Q Clear Time (g_c+I1), s	2.6	143.3		3.3	36.9	59.0		36.9				
Green Ext Time (p_c), s	0.0	1.6		0.0	1.1	21.8		0.0				

Intersection Summary		
HCM 6th Ctrl Delay		56.1
HCM 6th LOS		E

Notes

User approved volume balancing among the lanes for turning movement.

Intersection						
Int Delay, s/veh	0.6					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations		↱	↑↑	↱		↑↑↑
Traffic Vol, veh/h	0	50	2640	25	0	2185
Future Vol, veh/h	0	50	2640	25	0	2185
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	500	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	54	2870	27	0	2375

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	-	1435	0	0	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	6.94	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.32	-	-	-	-
Pot Cap-1 Maneuver	0	123	-	-	0	-
Stage 1	0	-	-	-	0	-
Stage 2	0	-	-	-	0	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	-	123	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	55.6	0	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBT
Capacity (veh/h)	-	-	123	-
HCM Lane V/C Ratio	-	-	0.442	-
HCM Control Delay (s)	-	-	55.6	-
HCM Lane LOS	-	-	F	-
HCM 95th %tile Q(veh)	-	-	1.9	-

Movement	WBL	WBR	NBT	NBR	SBL	SBT	
Lane Configurations	↰	↱	↑↑↑	↱	↰	↑↑↑	
Traffic Volume (veh/h)	130	70	2595	195	290	1895	
Future Volume (veh/h)	130	70	2595	195	290	1895	
Initial Q (Qb), veh	0	0	0	0	0	0	
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00		
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	
Work Zone On Approach	No		No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	
Adj Flow Rate, veh/h	141	3	2821	115	315	2060	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	
Percent Heavy Veh, %	2	2	2	2	2	2	
Cap, veh/h	170	151	3062	950	343	4236	
Arrive On Green	0.10	0.10	0.60	0.60	0.19	0.83	
Sat Flow, veh/h	1781	1585	5274	1585	1781	5274	
Grp Volume(v), veh/h	141	3	2821	115	315	2060	
Grp Sat Flow(s),veh/h/ln	1781	1585	1702	1585	1781	1702	
Q Serve(g_s), s	9.3	0.2	59.2	3.8	20.8	13.8	
Cycle Q Clear(g_c), s	9.3	0.2	59.2	3.8	20.8	13.8	
Prop In Lane	1.00	1.00		1.00	1.00		
Lane Grp Cap(c), veh/h	170	151	3062	950	343	4236	
V/C Ratio(X)	0.83	0.02	0.92	0.12	0.92	0.49	
Avail Cap(c_a), veh/h	275	245	3091	960	379	4370	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	
Uniform Delay (d), s/veh	53.2	49.1	21.5	10.4	47.4	2.9	
Incr Delay (d2), s/veh	10.7	0.1	5.2	0.1	25.7	0.1	
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	
%ile BackOfQ(50%),veh/ln	4.7	0.1	22.0	1.2	11.4	2.5	
Unsig. Movement Delay, s/veh							
LnGrp Delay(d),s/veh	64.0	49.2	26.6	10.4	73.1	3.0	
LnGrp LOS	E	D	C	B	E	A	
Approach Vol, veh/h	144		2936			2375	
Approach Delay, s/veh	63.7		26.0			12.3	
Approach LOS	E		C			B	
Timer - Assigned Phs	1	2				6	8
Phs Duration (G+Y+Rc), s	27.5	76.3				103.8	15.9
Change Period (Y+Rc), s	4.5	4.5				4.5	4.5
Max Green Setting (Gmax), s	25.5	72.5				102.5	18.5
Max Q Clear Time (g_c+I1), s	22.8	61.2				15.8	11.3
Green Ext Time (p_c), s	0.3	10.6				30.1	0.2
Intersection Summary							
HCM 6th Ctrl Delay			21.0				
HCM 6th LOS			C				

Intersection	
Int Delay, s/veh	0.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	15	2780	75	0	2025
Future Vol, veh/h	0	15	2780	75	0	2025
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	500	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	16	3022	82	0	2201

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	-	1511	0	0	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	6.94	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.32	-	-	-	-
Pot Cap-1 Maneuver	0	109	-	-	0	-
Stage 1	0	-	-	-	0	-
Stage 2	0	-	-	-	0	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	-	109	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	43.8	0	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBT
Capacity (veh/h)	-	-	109	-
HCM Lane V/C Ratio	-	-	0.15	-
HCM Control Delay (s)	-	-	43.8	-
HCM Lane LOS	-	-	E	-
HCM 95th %tile Q(veh)	-	-	0.5	-

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Future Year 2038 PM Peak

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑↑↑	↱	↰	↑↑
Traffic Volume (veh/h)	75	385	3490	70	180	3020
Future Volume (veh/h)	75	385	3490	70	180	3020
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No		No			No
Adj Sat Flow, veh/h/ln	1856	1856	1870	1841	1811	1870
Adj Flow Rate, veh/h	82	0	3793	40	196	3283
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	3	3	2	4	6	2
Cap, veh/h	106		3350	1023	225	2965
Arrive On Green	0.06	0.00	0.66	0.66	0.13	0.83
Sat Flow, veh/h	1767	1572	5274	1560	1725	3647
Grp Volume(v), veh/h	82	0	3793	40	196	3283
Grp Sat Flow(s),veh/h/ln	1767	1572	1702	1560	1725	1777
Q Serve(g_s), s	4.8	0.0	68.4	0.9	11.6	87.0
Cycle Q Clear(g_c), s	4.8	0.0	68.4	0.9	11.6	87.0
Prop In Lane	1.00	1.00		1.00	1.00	
Lane Grp Cap(c), veh/h	106		3350	1023	225	2965
V/C Ratio(X)	0.77		1.13	0.04	0.87	1.11
Avail Cap(c_a), veh/h	373		3350	1023	232	2965
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	48.3	0.0	17.9	6.3	44.5	8.6
Incr Delay (d2), s/veh	11.1	0.0	63.9	0.0	27.8	53.9
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.4	0.0	40.6	0.3	6.5	33.3
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	59.4	0.0	81.8	6.3	72.3	62.5
LnGrp LOS	E		F	A	E	F
Approach Vol, veh/h	82	A	3833			3479
Approach Delay, s/veh	59.4		81.0			63.1
Approach LOS	E		F			E

Timer - Assigned Phs	1	2	6	8
Phs Duration (G+Y+Rc), s	18.6	74.4	93.0	11.3
Change Period (Y+Rc), s	5.0	6.0	6.0	5.0
Max Green Setting (Gmax), s	14.0	68.0	87.0	22.0
Max Q Clear Time (g_c+I1), s	13.6	70.4	89.0	6.8
Green Ext Time (p_c), s	0.0	0.0	0.0	0.1

Intersection Summary	
HCM 6th Ctrl Delay	72.3
HCM 6th LOS	E

Notes

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	125	5	15	220	15	480	15	2925	100	235	2645	80
Future Volume (veh/h)	125	5	15	220	15	480	15	2925	100	235	2645	80
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1856	1900	1366	1366	922	1900	1870	1707	1544	1870	1885
Adj Flow Rate, veh/h	136	5	2	239	16	0	16	3179	67	255	2875	62
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	3	0	36	36	66	0	2	13	24	2	1
Cap, veh/h	400	381	331	238	13		28	3177	900	206	2413	1085
Arrive On Green	0.21	0.21	0.21	0.21	0.21	0.00	0.02	0.62	0.62	0.07	0.68	0.68
Sat Flow, veh/h	1397	1856	1610	969	65	781	1810	5106	1447	2853	3554	1598
Grp Volume(v), veh/h	136	5	2	255	0	0	16	3179	67	255	2875	62
Grp Sat Flow(s),veh/h/ln	1397	1856	1610	1034	0	781	1810	1702	1447	1427	1777	1598
Q Serve(g_s), s	0.0	0.4	0.2	36.6	0.0	0.0	1.6	112.0	3.3	13.0	122.2	2.3
Cycle Q Clear(g_c), s	12.0	0.4	0.2	37.0	0.0	0.0	1.6	112.0	3.3	13.0	122.2	2.3
Prop In Lane	1.00		1.00	0.94		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	400	381	331	251	0		28	3177	900	206	2413	1085
V/C Ratio(X)	0.34	0.01	0.01	1.01	0.00		0.58	1.00	0.07	1.24	1.19	0.06
Avail Cap(c_a), veh/h	400	381	331	251	0		50	3177	900	206	2413	1085
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	61.6	57.0	56.9	74.5	0.0	0.0	88.0	34.0	13.5	83.5	28.9	9.6
Incr Delay (d2), s/veh	0.5	0.0	0.0	60.5	0.0	0.0	17.6	16.1	0.2	141.3	90.5	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.5	0.2	0.1	16.1	0.0	0.0	0.9	47.7	1.1	8.8	77.3	0.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	62.1	57.0	56.9	135.0	0.0	0.0	105.7	50.1	13.6	224.8	119.3	9.7
LnGrp LOS	E	E	E	F	A		F	F	B	F	F	A
Approach Vol, veh/h		143			255	A		3262			3192	
Approach Delay, s/veh		61.8			135.0			49.6			125.6	
Approach LOS		E			F			D			F	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	19.0	118.0		43.0	8.8	128.2		43.0
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	13.0	112.0		37.0	5.0	120.0		37.0
Max Q Clear Time (g_c+I1), s	15.0	114.0		14.0	3.6	124.2		39.0
Green Ext Time (p_c), s	0.0	0.0		0.4	0.0	0.0		0.0

Intersection Summary		
HCM 6th Ctrl Delay		88.5
HCM 6th LOS		F

Notes

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑	↱	↰↰	↑	↱	↰↰	↑↑↑	↱	↰↰	↑↑↑	↱
Traffic Volume (veh/h)	195	20	150	445	45	450	110	2375	320	320	2430	145
Future Volume (veh/h)	195	20	150	445	45	450	110	2375	320	320	2430	145
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1856	1870	1856	1811	1870	1811	1885	1870	1856	1856	1870	1885
Adj Flow Rate, veh/h	212	22	100	484	49	0	120	2582	249	348	2641	112
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	3	2	3	6	2	6	1	2	3	3	2	1
Cap, veh/h	260	136	186	531	291		160	2837	1123	388	3180	1116
Arrive On Green	0.08	0.07	0.07	0.16	0.16	0.00	0.05	0.56	0.56	0.11	0.62	0.62
Sat Flow, veh/h	3428	1870	1572	3346	1870	1535	3483	5106	1572	3428	5106	1598
Grp Volume(v), veh/h	212	22	100	484	49	0	120	2582	249	348	2641	112
Grp Sat Flow(s),veh/h/ln	1714	1870	1572	1673	1870	1535	1742	1702	1572	1714	1702	1598
Q Serve(g_s), s	11.0	2.0	10.8	25.6	4.1	0.0	6.1	81.8	9.7	18.0	72.8	4.1
Cycle Q Clear(g_c), s	11.0	2.0	10.8	25.6	4.1	0.0	6.1	81.8	9.7	18.0	72.8	4.1
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	260	136	186	531	291		160	2837	1123	388	3180	1116
V/C Ratio(X)	0.82	0.16	0.54	0.91	0.17		0.75	0.91	0.22	0.90	0.83	0.10
Avail Cap(c_a), veh/h	676	275	304	623	291		281	2837	1123	429	3180	1116
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	81.9	78.3	74.7	74.5	65.9	0.0	84.9	36.0	8.7	78.8	26.5	8.8
Incr Delay (d2), s/veh	6.2	0.6	2.4	16.1	0.3	0.0	6.9	5.6	0.5	20.1	2.7	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.1	1.0	4.5	12.3	2.0	0.0	2.9	34.0	3.5	9.0	28.7	1.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	88.1	78.9	77.1	90.5	66.2	0.0	91.8	41.6	9.2	98.9	29.2	9.0
LnGrp LOS	F	E	E	F	E		F	D	A	F	C	A
Approach Vol, veh/h		334			533	A		2951			3101	
Approach Delay, s/veh		84.2			88.3			40.9			36.3	
Approach LOS		F			F			D			D	
Timer - Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	24.8	104.5	33.1	17.6	12.8	116.6	18.2	32.5				
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5				
Max Green Setting (Gmax), s	22.5	79.5	33.5	26.5	14.5	87.5	35.5	24.5				
Max Q Clear Time (g_c+I1), s	20.0	83.8	27.6	12.8	8.1	74.8	13.0	6.1				
Green Ext Time (p_c), s	0.3	0.0	1.0	0.3	0.2	11.6	0.7	0.1				

Intersection Summary	
HCM 6th Ctrl Delay	44.6
HCM 6th LOS	D

Notes

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	50	15	195	245	15	100	125	2640	170	60	2930	20
Future Volume (veh/h)	50	15	195	245	15	100	125	2640	170	60	2930	20
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1826	1856	1856	1885	1870	1870	1885	1900	1870	1885
Adj Flow Rate, veh/h	54	16	0	266	16	50	136	2870	137	65	3185	14
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	5	3	3	1	2	2	1	0	2	1
Cap, veh/h	35	6		248	13	244	156	2616	1176	65	3496	1094
Arrive On Green	0.15	0.15	0.00	0.15	0.15	0.15	0.09	0.74	0.74	0.04	0.68	0.68
Sat Flow, veh/h	0	40	1547	1368	82	1598	1781	3554	1598	1810	5106	1598
Grp Volume(v), veh/h	70	0	0	282	0	50	136	2870	137	65	3185	14
Grp Sat Flow(s),veh/h/ln	40	0	1547	1450	0	1598	1781	1777	1598	1810	1702	1598
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	4.9	13.6	132.5	4.5	6.5	94.1	0.5
Cycle Q Clear(g_c), s	27.5	0.0	0.0	27.5	0.0	4.9	13.6	132.5	4.5	6.5	94.1	0.5
Prop In Lane	0.77		1.00	0.94		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	42	0		260	0	244	156	2616	1176	65	3496	1094
V/C Ratio(X)	1.68	0.00		1.08	0.00	0.20	0.87	1.10	0.12	0.99	0.91	0.01
Avail Cap(c_a), veh/h	42	0		260	0	244	252	2616	1176	65	3496	1094
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	86.0	0.0	0.0	78.3	0.0	66.7	81.1	23.7	6.9	86.7	23.8	9.0
Incr Delay (d2), s/veh	391.3	0.0	0.0	79.6	0.0	0.4	16.8	50.4	0.2	109.4	4.7	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	6.5	0.0	0.0	18.0	0.0	2.1	6.9	66.0	1.5	5.0	36.0	0.2
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	477.2	0.0	0.0	157.9	0.0	67.1	97.9	74.2	7.1	196.1	28.5	9.1
LnGrp LOS	F	A		F	A	E	F	F	A	F	C	A
Approach Vol, veh/h		70	A		332			3143			3264	
Approach Delay, s/veh		477.2			144.2			72.3			31.8	
Approach LOS		F			F			E			C	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	11.0	137.0		32.0	20.3	127.7		32.0				
Change Period (Y+Rc), s	4.5	4.5		4.5	4.5	4.5		4.5				
Max Green Setting (Gmax), s	6.5	132.5		27.5	25.5	113.5		27.5				
Max Q Clear Time (g_c+I1), s	8.5	134.5		29.5	15.6	96.1		29.5				
Green Ext Time (p_c), s	0.0	0.0		0.0	0.2	16.6		0.0				
Intersection Summary												
HCM 6th Ctrl Delay			60.5									
HCM 6th LOS			E									

Notes

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	455	0	530	15	5	15	625	2375	15	5	2910	605
Future Volume (veh/h)	455	0	530	15	5	15	625	2375	15	5	2910	605
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	495	0	548	16	5	1	679	2582	12	5	3163	546
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	555	0	1141	25	21	4	705	2554	1139	9	2653	823
Arrive On Green	0.16	0.00	0.16	0.01	0.01	0.01	0.20	0.72	0.72	0.00	0.52	0.52
Sat Flow, veh/h	3563	0	3170	1781	1513	303	3456	3554	1585	1781	5106	1585
Grp Volume(v), veh/h	495	0	548	16	0	6	679	2582	12	5	3163	546
Grp Sat Flow(s),veh/h/ln	1781	0	1585	1781	0	1816	1728	1777	1585	1781	1702	1585
Q Serve(g_s), s	28.1	0.0	27.6	1.8	0.0	0.7	40.1	148.0	0.4	0.6	107.0	52.0
Cycle Q Clear(g_c), s	28.1	0.0	27.6	1.8	0.0	0.7	40.1	148.0	0.4	0.6	107.0	52.0
Prop In Lane	1.00		1.00	1.00		0.17	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	555	0	1141	25	0	25	705	2554	1139	9	2653	823
V/C Ratio(X)	0.89	0.00	0.48	0.65	0.00	0.24	0.96	1.01	0.01	0.58	1.19	0.66
Avail Cap(c_a), veh/h	605	0	1185	35	0	35	705	2554	1139	35	2653	823
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	85.2	0.0	51.0	101.0	0.0	100.5	81.2	29.0	8.2	102.3	49.5	36.3
Incr Delay (d2), s/veh	14.6	0.0	0.3	24.8	0.0	4.7	25.1	20.6	0.0	49.6	90.6	2.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	14.2	0.0	11.2	1.0	0.0	0.4	20.2	64.2	0.2	0.4	66.3	20.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	99.8	0.0	51.3	125.8	0.0	105.2	106.4	49.6	8.2	151.9	140.1	38.3
LnGrp LOS	F	A	D	F	A	F	F	F	A	F	F	D
Approach Vol, veh/h		1043			22			3273			3714	
Approach Delay, s/veh		74.4			120.2			61.2			125.1	
Approach LOS		E			F			E			F	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	7.0	154.0		7.9	48.0	113.0		37.1				
Change Period (Y+Rc), s	6.0	6.0		5.0	6.0	6.0		5.0				
Max Green Setting (Gmax), s	4.0	145.0		4.0	42.0	107.0		35.0				
Max Q Clear Time (g_c+I1), s	2.6	150.0		3.8	42.1	109.0		30.1				
Green Ext Time (p_c), s	0.0	0.0		0.0	0.0	0.0		2.0				
Intersection Summary												
HCM 6th Ctrl Delay			92.6									
HCM 6th LOS			F									

Notes

User approved volume balancing among the lanes for turning movement.

Intersection	
Int Delay, s/veh	1.4

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	75	2855	5	0	3365
Future Vol, veh/h	0	75	2855	5	0	3365
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	500	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	82	3103	5	0	3658

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	-	1552	0	0	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	6.94	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.32	-	-	-	-
Pot Cap-1 Maneuver	0	102	-	-	0	-
Stage 1	0	-	-	-	0	-
Stage 2	0	-	-	-	0	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	-	102	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	116.5	0	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBT
Capacity (veh/h)	-	-	102	-
HCM Lane V/C Ratio	-	-	0.799	-
HCM Control Delay (s)	-	-	116.5	-
HCM Lane LOS	-	-	F	-
HCM 95th %tile Q(veh)	-	-	4.4	-

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	235	140	2725	85	115	3250
Future Volume (veh/h)	235	140	2725	85	115	3250
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No		No			No
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	255	29	2962	55	125	3533
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	284	253	3306	1026	150	3921
Arrive On Green	0.16	0.16	0.65	0.65	0.08	0.77
Sat Flow, veh/h	1781	1585	5274	1585	1781	5274
Grp Volume(v), veh/h	255	29	2962	55	125	3533
Grp Sat Flow(s),veh/h/ln	1781	1585	1702	1585	1781	1702
Q Serve(g_s), s	17.5	1.9	60.5	1.6	8.6	64.8
Cycle Q Clear(g_c), s	17.5	1.9	60.5	1.6	8.6	64.8
Prop In Lane	1.00	1.00		1.00	1.00	
Lane Grp Cap(c), veh/h	284	253	3306	1026	150	3921
V/C Ratio(X)	0.90	0.11	0.90	0.05	0.83	0.90
Avail Cap(c_a), veh/h	351	312	3306	1026	165	3964
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	51.2	44.7	18.4	8.0	56.1	10.9
Incr Delay (d2), s/veh	21.5	0.2	3.6	0.0	27.3	3.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	9.5	0.8	21.4	0.5	4.9	18.2
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	72.7	44.9	22.0	8.0	83.3	14.1
LnGrp LOS	E	D	C	A	F	B
Approach Vol, veh/h	284		3017			3658
Approach Delay, s/veh	69.9		21.8			16.5
Approach LOS	E		C			B

Timer - Assigned Phs	1	2	6	8
Phs Duration (G+Y+Rc), s	15.0	85.0	100.0	24.3
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	11.5	80.5	96.5	24.5
Max Q Clear Time (g_c+I1), s	10.6	62.5	66.8	19.5
Green Ext Time (p_c), s	0.0	16.7	28.7	0.4

Intersection Summary	
HCM 6th Ctrl Delay	20.9
HCM 6th LOS	C

Intersection						
Int Delay, s/veh	0.2					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	25	2785	25	0	3485
Future Vol, veh/h	0	25	2785	25	0	3485
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	500	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	27	3027	27	0	3788

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	-	1514	0	0	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	6.94	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.32	-	-	-	-
Pot Cap-1 Maneuver	0	109	-	-	0	-
Stage 1	0	-	-	-	0	-
Stage 2	0	-	-	-	0	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	-	109	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	48.7	0	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBT
Capacity (veh/h)	-	-	109	-
HCM Lane V/C Ratio	-	-	0.249	-
HCM Control Delay (s)	-	-	48.7	-
HCM Lane LOS	-	-	E	-
HCM 95th %tile Q(veh)	-	-	0.9	-

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Future Year 2038 WE Peak

	↙	↖	↑	↗	↘	↓
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑↑↑	↱	↰	↑↑
Traffic Volume (veh/h)	25	140	3110	45	105	2855
Future Volume (veh/h)	25	140	3110	45	105	2855
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No		No			No
Adj Sat Flow, veh/h/ln	1870	1841	1870	1870	1856	1870
Adj Flow Rate, veh/h	27	0	3380	31	114	3103
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	4	2	2	3	2
Cap, veh/h	48		3668	1139	144	3035
Arrive On Green	0.03	0.00	0.72	0.72	0.08	0.85
Sat Flow, veh/h	1781	1560	5274	1585	1767	3647
Grp Volume(v), veh/h	27	0	3380	31	114	3103
Grp Sat Flow(s),veh/h/ln	1781	1560	1702	1585	1767	1777
Q Serve(g_s), s	1.4	0.0	51.0	0.5	5.9	79.0
Cycle Q Clear(g_c), s	1.4	0.0	51.0	0.5	5.9	79.0
Prop In Lane	1.00	1.00		1.00	1.00	
Lane Grp Cap(c), veh/h	48		3668	1139	144	3035
V/C Ratio(X)	0.56		0.92	0.03	0.79	1.02
Avail Cap(c_a), veh/h	578		3668	1139	267	3035
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	44.5	0.0	10.9	3.7	41.7	6.8
Incr Delay (d2), s/veh	9.8	0.0	4.5	0.0	9.3	22.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.7	0.0	13.8	0.1	2.8	11.6
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	54.3	0.0	15.3	3.8	51.0	29.1
LnGrp LOS	D		B	A	D	F
Approach Vol, veh/h	27	A	3411			3217
Approach Delay, s/veh	54.3		15.2			29.8
Approach LOS	D		B			C

Timer - Assigned Phs	1	2	6	8
Phs Duration (G+Y+Rc), s	12.5	72.5	85.0	7.5
Change Period (Y+Rc), s	5.0	6.0	6.0	5.0
Max Green Setting (Gmax), s	14.0	60.0	79.0	30.0
Max Q Clear Time (g_c+I1), s	7.9	53.0	81.0	3.4
Green Ext Time (p_c), s	0.1	6.9	0.0	0.0

Intersection Summary	
HCM 6th Ctrl Delay	22.4
HCM 6th LOS	C

Notes

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	140	10	20	175	20	410	15	2630	125	315	2435	120
Future Volume (veh/h)	140	10	20	175	20	410	15	2630	125	315	2435	120
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1900	1707	1707	1352	1900	1870	1737	1604	1870	1870
Adj Flow Rate, veh/h	152	11	4	190	22	0	16	2859	81	342	2647	90
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	0	13	13	37	0	2	11	20	2	2
Cap, veh/h	335	333	287	242	24		28	3024	872	384	2511	1120
Arrive On Green	0.18	0.18	0.18	0.18	0.18	0.00	0.02	0.59	0.59	0.13	0.71	0.71
Sat Flow, veh/h	1390	1870	1610	1143	132	1145	1810	5106	1472	2963	3554	1585
Grp Volume(v), veh/h	152	11	4	212	0	0	16	2859	81	342	2647	90
Grp Sat Flow(s),veh/h/ln	1390	1870	1610	1275	0	1145	1810	1702	1472	1481	1777	1585
Q Serve(g_s), s	0.0	0.9	0.4	28.7	0.0	0.0	1.6	93.4	4.3	20.4	127.2	3.2
Cycle Q Clear(g_c), s	14.8	0.9	0.4	29.6	0.0	0.0	1.6	93.4	4.3	20.4	127.2	3.2
Prop In Lane	1.00		1.00	0.90		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	335	333	287	265	0		28	3024	872	384	2511	1120
V/C Ratio(X)	0.45	0.03	0.01	0.80	0.00		0.58	0.95	0.09	0.89	1.05	0.08
Avail Cap(c_a), veh/h	373	384	331	301	0		90	3024	872	543	2511	1120
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	66.8	61.1	60.9	73.4	0.0	0.0	88.0	34.0	15.8	77.1	26.4	8.2
Incr Delay (d2), s/veh	1.0	0.0	0.0	12.7	0.0	0.0	17.6	7.8	0.2	12.7	34.4	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	6.5	0.4	0.2	10.7	0.0	0.0	0.9	38.7	1.5	8.4	59.6	1.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	67.8	61.2	60.9	86.1	0.0	0.0	105.7	41.8	16.1	89.8	60.8	8.4
LnGrp LOS	E	E	E	F	A		F	D	B	F	F	A
Approach Vol, veh/h		167			212	A		2956			3079	
Approach Delay, s/veh		67.2			86.1			41.5			62.5	
Approach LOS		E			F			D			E	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	29.3	112.6		38.1	8.8	133.2		38.1				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	33.0	92.0		37.0	9.0	116.0		37.0				
Max Q Clear Time (g_c+I1), s	22.4	95.4		16.8	3.6	129.2		31.6				
Green Ext Time (p_c), s	0.9	0.0		0.4	0.0	0.0		0.5				

Intersection Summary		
HCM 6th Ctrl Delay		53.7
HCM 6th LOS		D

Notes

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	225	20	175	530	55	530	170	2020	495	495	1935	225
Future Volume (veh/h)	225	20	175	530	55	530	170	2020	495	495	1935	225
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1856	1870	1870	1826	1870	1826	1870	1870	1841	1841	1870	1870
Adj Flow Rate, veh/h	245	22	128	576	60	0	185	2196	391	538	2103	166
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	3	2	2	5	2	5	2	2	4	4	2	2
Cap, veh/h	294	164	241	612	342		224	2350	1001	581	2892	1034
Arrive On Green	0.09	0.09	0.09	0.18	0.18	0.00	0.06	0.46	0.46	0.17	0.57	0.57
Sat Flow, veh/h	3428	1870	1585	3374	1870	1547	3456	5106	1560	3401	5106	1585
Grp Volume(v), veh/h	245	22	128	576	60	0	185	2196	391	538	2103	166
Grp Sat Flow(s),veh/h/ln	1714	1870	1585	1687	1870	1547	1728	1702	1560	1700	1702	1585
Q Serve(g_s), s	12.7	2.0	13.4	30.3	4.9	0.0	9.5	73.3	21.6	28.0	54.7	7.3
Cycle Q Clear(g_c), s	12.7	2.0	13.4	30.3	4.9	0.0	9.5	73.3	21.6	28.0	54.7	7.3
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	294	164	241	612	342		224	2350	1001	581	2892	1034
V/C Ratio(X)	0.83	0.13	0.53	0.94	0.18		0.83	0.93	0.39	0.93	0.73	0.16
Avail Cap(c_a), veh/h	676	275	336	628	342		278	2350	1001	633	2892	1034
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	81.0	75.8	70.4	72.7	62.1	0.0	83.2	46.0	15.4	73.5	28.8	12.2
Incr Delay (d2), s/veh	6.1	0.4	1.8	22.3	0.2	0.0	15.1	8.5	1.1	18.8	1.6	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.9	1.0	5.6	15.1	2.4	0.0	4.7	31.9	8.2	13.6	22.1	2.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	87.1	76.2	72.2	95.0	62.3	0.0	98.3	54.5	16.6	92.3	30.4	12.5
LnGrp LOS	F	E	E	F	E		F	D	B	F	C	B
Approach Vol, veh/h		395			636	A		2772			2807	
Approach Delay, s/veh		81.6			91.9			52.1			41.2	
Approach LOS		F			F			D			D	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	35.3	87.3	37.2	20.2	16.2	106.4	20.0	37.4
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	33.5	68.5	33.5	26.5	14.5	87.5	35.5	24.5
Max Q Clear Time (g_c+I1), s	30.0	75.3	32.3	15.4	11.5	56.7	14.7	6.9
Green Ext Time (p_c), s	0.7	0.0	0.3	0.3	0.2	20.4	0.8	0.2

Intersection Summary	
HCM 6th Ctrl Delay	53.1
HCM 6th LOS	D

Notes

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	50	15	215	290	20	115	190	2485	250	95	2505	35
Future Volume (veh/h)	50	15	215	290	20	115	190	2485	250	95	2505	35
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1826	1856	1856	1885	1841	1870	1870	1885	1870	1870
Adj Flow Rate, veh/h	54	16	0	315	22	66	207	2701	197	103	2723	23
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	5	3	3	1	4	2	2	1	2	2
Cap, veh/h	35	6		246	14	244	227	2616	1167	65	3282	1019
Arrive On Green	0.15	0.15	0.00	0.15	0.15	0.15	0.13	0.74	0.74	0.04	0.64	0.64
Sat Flow, veh/h	0	40	1547	1358	95	1598	1753	3554	1585	1795	5106	1585
Grp Volume(v), veh/h	70	0	0	337	0	66	207	2701	197	103	2723	23
Grp Sat Flow(s),veh/h/ln	40	0	1547	1453	0	1598	1753	1777	1585	1795	1702	1585
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	6.6	21.0	132.5	6.7	6.5	73.5	0.9
Cycle Q Clear(g_c), s	27.5	0.0	0.0	27.5	0.0	6.6	21.0	132.5	6.7	6.5	73.5	0.9
Prop In Lane	0.77		1.00	0.93		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	42	0		261	0	244	227	2616	1167	65	3282	1019
V/C Ratio(X)	1.68	0.00		1.29	0.00	0.27	0.91	1.03	0.17	1.59	0.83	0.02
Avail Cap(c_a), veh/h	42	0		261	0	244	297	2616	1167	65	3282	1019
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	86.0	0.0	0.0	78.3	0.0	67.4	77.3	23.7	7.2	86.8	24.6	11.7
Incr Delay (d2), s/veh	391.3	0.0	0.0	157.2	0.0	0.6	26.1	26.6	0.3	325.8	2.6	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	6.5	0.0	0.0	23.7	0.0	2.8	11.0	57.4	2.3	8.9	28.6	0.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	477.2	0.0	0.0	235.5	0.0	68.0	103.4	50.4	7.5	412.6	27.2	11.7
LnGrp LOS	F	A		F	A	E	F	F	A	F	C	B
Approach Vol, veh/h		70	A		403			3105			2849	
Approach Delay, s/veh		477.2			208.1			51.2			41.0	
Approach LOS		F			F			D			D	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	11.0	137.0		32.0	27.8	120.2		32.0
Change Period (Y+Rc), s	4.5	4.5		4.5	4.5	4.5		4.5
Max Green Setting (Gmax), s	6.5	132.5		27.5	30.5	108.5		27.5
Max Q Clear Time (g_c+I1), s	8.5	134.5		29.5	23.0	75.5		29.5
Green Ext Time (p_c), s	0.0	0.0		0.0	0.3	27.3		0.0

Intersection Summary	
HCM 6th Ctrl Delay	61.2
HCM 6th LOS	E

Notes

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	470	0	385	5	0	5	410	2370	5	5	2520	525
Future Volume (veh/h)	470	0	385	5	0	5	410	2370	5	5	2520	525
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	511	0	382	5	0	1	446	2576	4	5	2739	468
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	567	0	959	10	0	9	496	2562	1143	9	2973	923
Arrive On Green	0.16	0.00	0.16	0.01	0.00	0.01	0.14	0.72	0.72	0.00	0.58	0.58
Sat Flow, veh/h	3563	0	3170	1781	0	1585	3456	3554	1585	1781	5106	1585
Grp Volume(v), veh/h	511	0	382	5	0	1	446	2576	4	5	2739	468
Grp Sat Flow(s),veh/h/ln	1781	0	1585	1781	0	1585	1728	1777	1585	1781	1702	1585
Q Serve(g_s), s	28.3	0.0	19.2	0.6	0.0	0.1	25.5	145.0	0.1	0.6	97.2	35.2
Cycle Q Clear(g_c), s	28.3	0.0	19.2	0.6	0.0	0.1	25.5	145.0	0.1	0.6	97.2	35.2
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	567	0	959	10	0	9	496	2562	1143	9	2973	923
V/C Ratio(X)	0.90	0.00	0.40	0.50	0.00	0.11	0.90	1.01	0.00	0.58	0.92	0.51
Avail Cap(c_a), veh/h	620	0	1007	35	0	32	722	2562	1143	35	2973	923
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	83.0	0.0	55.6	99.7	0.0	99.5	84.7	28.1	7.8	99.9	37.8	24.9
Incr Delay (d2), s/veh	15.6	0.0	0.3	33.0	0.0	5.4	10.5	19.1	0.0	49.2	5.4	0.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	14.4	0.0	7.9	0.4	0.0	0.1	12.1	62.1	0.0	0.4	40.4	13.2
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	98.6	0.0	55.9	132.7	0.0	104.8	95.2	47.1	7.8	149.1	43.2	25.3
LnGrp LOS	F	A	E	F	A	F	F	F	A	F	D	C
Approach Vol, veh/h		893			6			3026			3212	
Approach Delay, s/veh		80.3			128.1			54.2			40.8	
Approach LOS		F			F			D			D	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	7.0	151.0		6.1	34.9	123.1		37.0
Change Period (Y+Rc), s	6.0	6.0		5.0	6.0	6.0		5.0
Max Green Setting (Gmax), s	4.0	145.0		4.0	42.0	107.0		35.0
Max Q Clear Time (g_c+I1), s	2.6	147.0		2.6	27.5	99.2		30.3
Green Ext Time (p_c), s	0.0	0.0		0.0	1.3	7.5		1.7

Intersection Summary		
HCM 6th Ctrl Delay		51.5
HCM 6th LOS		D

Notes

User approved volume balancing among the lanes for turning movement.

Intersection						
Int Delay, s/veh	1.3					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	70	2855	10	0	3005
Future Vol, veh/h	0	70	2855	10	0	3005
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	500	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	76	3103	11	0	3266

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	-	1552	0	0	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	6.94	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.32	-	-	-	-
Pot Cap-1 Maneuver	0	102	-	-	0	-
Stage 1	0	-	-	-	0	-
Stage 2	0	-	-	-	0	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	-	102	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	106.1	0	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBT
Capacity (veh/h)	-	-	102	-
HCM Lane V/C Ratio	-	-	0.746	-
HCM Control Delay (s)	-	-	106.1	-
HCM Lane LOS	-	-	F	-
HCM 95th %tile Q(veh)	-	-	4	-

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	215	125	2740	90	125	2880
Future Volume (veh/h)	215	125	2740	90	125	2880
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No		No			No
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	234	11	2978	60	136	3130
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	261	232	3370	1046	161	4007
Arrive On Green	0.15	0.15	0.66	0.66	0.09	0.78
Sat Flow, veh/h	1781	1585	5274	1585	1781	5274
Grp Volume(v), veh/h	234	11	2978	60	136	3130
Grp Sat Flow(s),veh/h/ln	1781	1585	1702	1585	1781	1702
Q Serve(g_s), s	16.9	0.8	62.3	1.8	9.8	44.7
Cycle Q Clear(g_c), s	16.9	0.8	62.3	1.8	9.8	44.7
Prop In Lane	1.00	1.00		1.00	1.00	
Lane Grp Cap(c), veh/h	261	232	3370	1046	161	4007
V/C Ratio(X)	0.90	0.05	0.88	0.06	0.84	0.78
Avail Cap(c_a), veh/h	320	285	3452	1072	197	4193
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	54.9	48.0	18.2	7.9	58.6	7.8
Incr Delay (d2), s/veh	23.1	0.1	3.0	0.0	23.4	1.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	9.3	0.3	22.0	0.6	5.4	11.8
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	78.0	48.1	21.2	7.9	82.0	8.8
LnGrp LOS	E	D	C	A	F	A
Approach Vol, veh/h	245		3038			3266
Approach Delay, s/veh	76.6		20.9			11.8
Approach LOS	E		C			B

Timer - Assigned Phs	1	2	6	8
Phs Duration (G+Y+Rc), s	16.3	90.9	107.2	23.7
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	14.5	88.5	107.5	23.5
Max Q Clear Time (g_c+I1), s	11.8	64.3	46.7	18.9
Green Ext Time (p_c), s	0.1	22.1	51.8	0.3

Intersection Summary	
HCM 6th Ctrl Delay	18.5
HCM 6th LOS	B

Intersection	
Int Delay, s/veh	0.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	25	2805	30	0	3090
Future Vol, veh/h	0	25	2805	30	0	3090
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	500	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	27	3049	33	0	3359

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	-	1525	0	0	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	6.94	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.32	-	-	-	-
Pot Cap-1 Maneuver	0	107	-	-	0	-
Stage 1	0	-	-	-	0	-
Stage 2	0	-	-	-	0	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	-	107	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	49.7	0	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBT
Capacity (veh/h)	-	-	107	-
HCM Lane V/C Ratio	-	-	0.254	-
HCM Control Delay (s)	-	-	49.7	-
HCM Lane LOS	-	-	E	-
HCM 95th %tile Q(veh)	-	-	0.9	-

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Future Year 2038 AM Peak With Mitigation

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	75	265	2120	70	360	2795
Future Volume (veh/h)	75	265	2120	70	360	2795
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No		No			No
Adj Sat Flow, veh/h/ln	1366	1663	1870	1826	1826	1870
Adj Flow Rate, veh/h	82	0	2304	46	391	3038
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	36	16	2	5	5	2
Cap, veh/h	98		3361	1019	470	4275
Arrive On Green	0.08	0.00	0.66	0.66	0.14	0.84
Sat Flow, veh/h	1301	1409	5274	1547	3374	5274
Grp Volume(v), veh/h	82	0	2304	46	391	3038
Grp Sat Flow(s),veh/h/ln	1301	1409	1702	1547	1687	1702
Q Serve(g_s), s	7.8	0.0	35.4	1.3	14.2	30.1
Cycle Q Clear(g_c), s	7.8	0.0	35.4	1.3	14.2	30.1
Prop In Lane	1.00	1.00		1.00	1.00	
Lane Grp Cap(c), veh/h	98		3361	1019	470	4275
V/C Ratio(X)	0.84		0.69	0.05	0.83	0.71
Avail Cap(c_a), veh/h	393		3409	1033	1126	5317
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	57.4	0.0	13.4	7.6	52.7	4.1
Incr Delay (d2), s/veh	16.6	0.0	0.6	0.0	3.9	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.0	0.0	11.9	0.4	6.1	5.5
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	74.0	0.0	14.0	7.6	56.6	4.4
LnGrp LOS	E		B	A	E	A
Approach Vol, veh/h	82	A	2350			3429
Approach Delay, s/veh	74.0		13.8			10.4
Approach LOS	E		B			B

Timer - Assigned Phs	1	2	6	8
Phs Duration (G+Y+Rc), s	22.5	88.8	111.3	14.5
Change Period (Y+Rc), s	5.0	6.0	6.0	5.0
Max Green Setting (Gmax), s	42.0	84.0	131.0	38.0
Max Q Clear Time (g_c+I1), s	16.2	37.4	32.1	9.8
Green Ext Time (p_c), s	1.3	29.0	73.3	0.2

Intersection Summary	
HCM 6th Ctrl Delay	12.7
HCM 6th LOS	B

Notes

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	30	5	5	50	5	110	5	2050	195	390	2380	95
Future Volume (veh/h)	30	5	5	50	5	110	5	2050	195	390	2380	95
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1752	1870	1870	1559	1870	1470	1870	1870	1604	1544	1870	1856
Adj Flow Rate, veh/h	33	5	1	54	5	0	5	2228	141	424	2587	78
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	10	2	2	23	2	29	2	2	20	24	2	3
Cap, veh/h	42	46	39	82	53		11	3357	894	469	4165	1283
Arrive On Green	0.03	0.02	0.02	0.03	0.03	0.00	0.01	0.66	0.66	0.16	0.82	0.82
Sat Flow, veh/h	1668	1870	1585	2881	1870	1246	1781	5106	1359	2853	5106	1572
Grp Volume(v), veh/h	33	5	1	54	5	0	5	2228	141	424	2587	78
Grp Sat Flow(s),veh/h/ln	1668	1870	1585	1440	1870	1246	1781	1702	1359	1427	1702	1572
Q Serve(g_s), s	3.5	0.5	0.1	3.3	0.5	0.0	0.5	47.7	7.1	26.3	34.1	1.7
Cycle Q Clear(g_c), s	3.5	0.5	0.1	3.3	0.5	0.0	0.5	47.7	7.1	26.3	34.1	1.7
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	42	46	39	82	53		11	3357	894	469	4165	1283
V/C Ratio(X)	0.79	0.11	0.03	0.66	0.10		0.46	0.66	0.16	0.90	0.62	0.06
Avail Cap(c_a), veh/h	190	156	132	616	343		49	3357	894	697	4165	1283
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	87.3	85.8	85.7	86.6	85.2	0.0	89.1	18.7	11.8	73.8	6.2	3.2
Incr Delay (d2), s/veh	27.2	1.0	0.3	8.7	0.8	0.0	26.9	1.1	0.4	11.1	0.7	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.9	0.2	0.0	1.4	0.2	0.0	0.3	17.9	2.3	10.2	9.8	0.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	114.5	86.9	85.9	95.2	86.0	0.0	116.1	19.8	12.2	84.9	6.9	3.3
LnGrp LOS	F	F	F	F	F		F	B	B	F	A	A
Approach Vol, veh/h		39			59	A		2374			3089	
Approach Delay, s/veh		110.2			94.4			19.5			17.5	
Approach LOS		F			F			B			B	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	35.6	124.3	9.6	10.4	7.1	152.8	9.0	11.1
Change Period (Y+Rc), s	6.0	6.0	4.5	6.0	6.0	6.0	4.5	6.0
Max Green Setting (Gmax), s	44.0	60.0	38.5	15.0	5.0	99.0	20.5	33.0
Max Q Clear Time (g_c+I1), s	28.3	49.7	5.3	2.5	2.5	36.1	5.5	2.5
Green Ext Time (p_c), s	1.3	8.7	0.2	0.0	0.0	40.8	0.0	0.0

Intersection Summary	
HCM 6th Ctrl Delay	19.8
HCM 6th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	45	5	35	85	10	85	90	2110	250	250	2075	110
Future Volume (veh/h)	45	5	35	85	10	85	90	2110	250	250	2075	110
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1752	1870	1767	1781	1870	1781	1841	1870	1856	1856	1870	1856
Adj Flow Rate, veh/h	49	5	1	92	11	0	98	2293	208	272	2255	96
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	10	2	9	8	2	8	4	2	3	3	2	3
Cap, veh/h	90	50	99	131	73		135	3786	1229	315	4053	1292
Arrive On Green	0.03	0.03	0.03	0.04	0.04	0.00	0.08	1.00	1.00	0.09	0.79	0.79
Sat Flow, veh/h	3237	1870	1497	3291	1870	1510	3401	5106	1572	3428	5106	1572
Grp Volume(v), veh/h	49	5	1	92	11	0	98	2293	208	272	2255	96
Grp Sat Flow(s),veh/h/ln	1618	1870	1497	1646	1870	1510	1700	1702	1572	1714	1702	1572
Q Serve(g_s), s	2.7	0.5	0.1	5.0	1.0	0.0	5.1	0.0	0.0	14.1	29.4	2.1
Cycle Q Clear(g_c), s	2.7	0.5	0.1	5.0	1.0	0.0	5.1	0.0	0.0	14.1	29.4	2.1
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	90	50	99	131	73		135	3786	1229	315	4053	1292
V/C Ratio(X)	0.55	0.10	0.01	0.70	0.15		0.73	0.61	0.17	0.86	0.56	0.07
Avail Cap(c_a), veh/h	638	275	280	613	255		274	3786	1229	429	4053	1292
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	0.00	0.71	0.71	0.71	1.00	1.00	1.00
Uniform Delay (d), s/veh	86.4	85.5	78.5	85.4	83.6	0.0	81.9	0.0	0.0	80.6	6.9	3.1
Incr Delay (d2), s/veh	5.1	0.9	0.0	6.7	1.0	0.0	5.2	0.5	0.2	12.7	0.6	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.2	0.2	0.0	2.3	0.5	0.0	2.2	0.2	0.1	6.7	9.3	0.7
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	91.4	86.3	78.5	92.0	84.6	0.0	87.1	0.5	0.2	93.3	7.4	3.2
LnGrp LOS	F	F	E	F	F		F	A	A	F	A	A
Approach Vol, veh/h		55			103	A		2599			2623	
Approach Delay, s/veh		90.7			91.2			3.8			16.2	
Approach LOS		F			F			A			B	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	21.1	138.0	11.7	9.3	11.6	147.4	9.5	11.5
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	22.5	79.5	33.5	26.5	14.5	87.5	35.5	24.5
Max Q Clear Time (g_c+I1), s	16.1	2.0	7.0	2.5	7.1	31.4	4.7	3.0
Green Ext Time (p_c), s	0.5	39.6	0.3	0.0	0.1	31.6	0.1	0.0

Intersection Summary		
HCM 6th Ctrl Delay		12.4
HCM 6th LOS		B

Notes

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	10	5	45	65	5	40	140	2395	155	70	2075	45
Future Volume (veh/h)	10	5	45	65	5	40	140	2395	155	70	2075	45
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1559	1870	1707	1826	1870	1856	1841	1870	1856	1885	1870	1826
Adj Flow Rate, veh/h	11	5	0	71	5	2	152	2603	125	76	2255	34
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	23	2	13	5	2	3	4	2	3	1	2	5
Cap, veh/h	80	36		149	106	170	173	3982	1226	93	3743	1134
Arrive On Green	0.01	0.02	0.00	0.05	0.06	0.06	0.10	0.78	0.78	0.10	1.00	1.00
Sat Flow, veh/h	1485	1870	1447	1739	1870	1572	1753	5106	1572	1795	5106	1547
Grp Volume(v), veh/h	11	5	0	71	5	2	152	2603	125	76	2255	34
Grp Sat Flow(s),veh/h/ln	1485	1870	1447	1739	1870	1572	1753	1702	1572	1795	1702	1547
Q Serve(g_s), s	1.3	0.5	0.0	7.1	0.5	0.2	15.4	41.2	3.4	7.5	0.0	0.0
Cycle Q Clear(g_c), s	1.3	0.5	0.0	7.1	0.5	0.2	15.4	41.2	3.4	7.5	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	80	36		149	106	170	173	3982	1226	93	3743	1134
V/C Ratio(X)	0.14	0.14		0.48	0.05	0.01	0.88	0.65	0.10	0.82	0.60	0.03
Avail Cap(c_a), veh/h	322	140		348	119	182	326	3982	1226	115	3743	1134
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00
Upstream Filter(I)	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	0.81	0.81	0.81
Uniform Delay (d), s/veh	85.2	86.8	0.0	79.5	80.3	71.6	80.1	8.9	4.7	79.9	0.0	0.0
Incr Delay (d2), s/veh	0.8	1.8	0.0	2.4	0.2	0.0	13.3	0.8	0.2	25.8	0.6	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.5	0.2	0.0	3.3	0.2	0.1	7.5	13.5	1.2	3.9	0.2	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	86.0	88.6	0.0	81.9	80.5	71.7	93.4	9.7	4.9	105.7	0.6	0.0
LnGrp LOS	F	F		F	F	E	F	A	A	F	A	A
Approach Vol, veh/h		16	A		78			2880			2365	
Approach Delay, s/veh		86.8			81.5			14.0			4.0	
Approach LOS		F			F			B			A	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	13.8	144.9	13.4	7.9	22.2	136.4	6.6	14.7
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	11.5	107.5	29.5	13.5	33.5	85.5	31.5	11.5
Max Q Clear Time (g_c+I1), s	9.5	43.2	9.1	2.5	17.4	2.0	3.3	2.5
Green Ext Time (p_c), s	0.0	43.6	0.1	0.0	0.3	37.0	0.0	0.0

Intersection Summary	
HCM 6th Ctrl Delay	10.7
HCM 6th LOS	B

Notes

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	555	5	450	10	0	5	550	2295	10	5	1740	120
Future Volume (veh/h)	555	5	450	10	0	5	550	2295	10	5	1740	120
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	607	0	367	11	0	1	598	2495	7	5	1891	50
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	696	0	1235	19	0	17	671	3291	1022	9	2929	722
Arrive On Green	0.20	0.00	0.20	0.01	0.00	0.01	0.19	0.64	0.64	0.01	0.46	0.46
Sat Flow, veh/h	3563	0	3170	1781	0	1585	3456	5106	1585	1781	6434	1585
Grp Volume(v), veh/h	607	0	367	11	0	1	598	2495	7	5	1891	50
Grp Sat Flow(s),veh/h/ln	1781	0	1585	1781	0	1585	1728	1702	1585	1781	1609	1585
Q Serve(g_s), s	25.1	0.0	12.2	0.9	0.0	0.1	25.6	51.7	0.2	0.4	34.5	2.7
Cycle Q Clear(g_c), s	25.1	0.0	12.2	0.9	0.0	0.1	25.6	51.7	0.2	0.4	34.5	2.7
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	696	0	1235	19	0	17	671	3291	1022	9	2929	722
V/C Ratio(X)	0.87	0.00	0.30	0.59	0.00	0.06	0.89	0.76	0.01	0.56	0.65	0.07
Avail Cap(c_a), veh/h	820	0	1345	164	0	146	954	4466	1386	70	4104	1011
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	59.3	0.0	32.0	74.9	0.0	74.5	59.7	18.8	9.7	75.5	32.0	23.3
Incr Delay (d2), s/veh	9.0	0.0	0.1	26.3	0.0	1.5	7.8	0.5	0.0	45.2	0.2	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	12.3	0.0	4.8	0.6	0.0	0.0	11.8	18.8	0.1	0.3	13.1	1.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	68.4	0.0	32.2	101.2	0.0	76.0	67.6	19.3	9.7	120.7	32.2	23.3
LnGrp LOS	E	A	C	F	A	E	E	B	A	F	C	C
Approach Vol, veh/h		974			12			3100			1946	
Approach Delay, s/veh		54.7			99.1			28.6			32.2	
Approach LOS		D			F			C			C	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.8	104.0		6.6	35.5	75.2		34.7				
Change Period (Y+Rc), s	6.0	6.0		5.0	6.0	6.0		5.0				
Max Green Setting (Gmax), s	6.0	133.0		14.0	42.0	97.0		35.0				
Max Q Clear Time (g_c+I1), s	2.4	53.7		2.9	27.6	36.5		27.1				
Green Ext Time (p_c), s	0.0	44.3		0.0	1.9	23.4		2.6				

Intersection Summary		
HCM 6th Ctrl Delay		34.1
HCM 6th LOS		C

Notes

User approved volume balancing among the lanes for turning movement.

Intersection	
Int Delay, s/veh	0.8

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	50	2640	25	0	2185
Future Vol, veh/h	0	50	2640	25	0	2185
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	500	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	5	2	5	0	2
Mvmt Flow	0	54	2870	27	0	2375

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	-	1435	0	0	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	7.2	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.95	-	-	-	-
Pot Cap-1 Maneuver	0	103	-	-	0	-
Stage 1	0	-	-	-	0	-
Stage 2	0	-	-	-	0	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	-	103	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	73.7	0	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBT
Capacity (veh/h)	-	-	103	-
HCM Lane V/C Ratio	-	-	0.528	-
HCM Control Delay (s)	-	-	73.7	-
HCM Lane LOS	-	-	F	-
HCM 95th %tile Q(veh)	-	-	2.4	-

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	130	70	2595	195	290	1895
Future Volume (veh/h)	130	70	2595	195	290	1895
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No		No			No
Adj Sat Flow, veh/h/ln	1826	1826	1870	1752	1678	1870
Adj Flow Rate, veh/h	141	3	2821	114	315	2060
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	5	5	2	10	15	2
Cap, veh/h	168	150	2994	870	331	4239
Arrive On Green	0.10	0.10	0.59	0.59	0.21	0.83
Sat Flow, veh/h	1739	1547	5274	1485	1598	5274
Grp Volume(v), veh/h	141	3	2821	114	315	2060
Grp Sat Flow(s),veh/h/ln	1739	1547	1702	1485	1598	1702
Q Serve(g_s), s	9.8	0.2	62.8	4.2	24.0	14.1
Cycle Q Clear(g_c), s	9.8	0.2	62.8	4.2	24.0	14.1
Prop In Lane	1.00	1.00		1.00	1.00	
Lane Grp Cap(c), veh/h	168	150	2994	870	331	4239
V/C Ratio(X)	0.84	0.02	0.94	0.13	0.95	0.49
Avail Cap(c_a), veh/h	261	233	3009	875	331	4253
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	54.6	50.3	23.5	11.4	48.2	3.0
Incr Delay (d2), s/veh	13.0	0.1	7.0	0.1	36.7	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.9	0.1	24.2	1.3	12.6	2.6
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	67.7	50.3	30.5	11.5	84.8	3.1
LnGrp LOS	E	D	C	B	F	A
Approach Vol, veh/h	144		2935			2375
Approach Delay, s/veh	67.3		29.8			13.9
Approach LOS	E		C			B

Timer - Assigned Phs	1	2				6		8
Phs Duration (G+Y+Rc), s	30.0	76.6				106.6		16.4
Change Period (Y+Rc), s	4.5	4.5				4.5		4.5
Max Green Setting (Gmax), s	25.5	72.5				102.5		18.5
Max Q Clear Time (g_c+I1), s	26.0	64.8				16.1		11.8
Green Ext Time (p_c), s	0.0	7.3				30.1		0.2

Intersection Summary		
HCM 6th Ctrl Delay		23.9
HCM 6th LOS		C

Intersection						
Int Delay, s/veh	0.2					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	15	2780	75	0	2025
Future Vol, veh/h	0	15	2780	75	0	2025
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	500	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	0	2	5	0	2
Mvmt Flow	0	16	3022	82	0	2201

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	-	1511	0	0	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	7.1	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.9	-	-	-	-
Pot Cap-1 Maneuver	0	95	-	-	0	-
Stage 1	0	-	-	-	0	-
Stage 2	0	-	-	-	0	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	-	95	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	50.6	0	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBT
Capacity (veh/h)	-	-	95	-
HCM Lane V/C Ratio	-	-	0.172	-
HCM Control Delay (s)	-	-	50.6	-
HCM Lane LOS	-	-	F	-
HCM 95th %tile Q(veh)	-	-	0.6	-

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Future Year 2038 PM Peak With Mitigation

Movement	WBL	WBR	NBT	NBR	SBL	SBT	
Lane Configurations							
Traffic Volume (veh/h)	75	385	3490	70	180	3020	
Future Volume (veh/h)	75	385	3490	70	180	3020	
Initial Q (Qb), veh	0	0	0	0	0	0	
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00		
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	
Work Zone On Approach	No		No			No	
Adj Sat Flow, veh/h/ln	1841	1856	1870	1648	1752	1870	
Adj Flow Rate, veh/h	82	0	3793	59	196	3283	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	
Percent Heavy Veh, %	4	3	2	17	10	2	
Cap, veh/h	99		4051	1108	233	4543	
Arrive On Green	0.06	0.00	0.79	0.79	0.07	0.89	
Sat Flow, veh/h	1753	1572	5274	1397	3237	5274	
Grp Volume(v), veh/h	82	0	3793	59	196	3283	
Grp Sat Flow(s),veh/h/ln	1753	1572	1702	1397	1618	1702	
Q Serve(g_s), s	9.5	0.0	122.1	1.9	12.2	40.7	
Cycle Q Clear(g_c), s	9.5	0.0	122.1	1.9	12.2	40.7	
Prop In Lane	1.00	1.00		1.00	1.00		
Lane Grp Cap(c), veh/h	99		4051	1108	233	4543	
V/C Ratio(X)	0.83		0.94	0.05	0.84	0.72	
Avail Cap(c_a), veh/h	403		4051	1108	411	4543	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00	
Uniform Delay (d), s/veh	95.5	0.0	17.0	4.6	93.8	3.5	
Incr Delay (d2), s/veh	15.6	0.0	5.5	0.1	8.1	1.0	
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	
%ile BackOfQ(50%),veh/ln	4.8	0.0	42.3	0.5	5.4	8.8	
Unsig. Movement Delay, s/veh							
LnGrp Delay(d),s/veh	111.1	0.0	22.5	4.7	101.9	4.5	
LnGrp LOS	F		C	A	F	A	
Approach Vol, veh/h	82	A	3852			3479	
Approach Delay, s/veh	111.1		22.2			10.0	
Approach LOS	F		C			A	
Timer - Assigned Phs	1	2				6	8
Phs Duration (G+Y+Rc), s	19.7	168.3				188.0	16.6
Change Period (Y+Rc), s	5.0	6.0				6.0	5.0
Max Green Setting (Gmax), s	26.0	151.0				182.0	47.0
Max Q Clear Time (g_c+I1), s	14.2	124.1				42.7	11.5
Green Ext Time (p_c), s	0.5	26.5				107.7	0.2
Intersection Summary							
HCM 6th Ctrl Delay			17.5				
HCM 6th LOS			B				

Notes

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	125	5	15	220	15	480	15	2925	100	235	2645	80
Future Volume (veh/h)	125	5	15	220	15	480	15	2925	100	235	2645	80
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1648	1870	1693	1900	1870	1693	1737	1870	1885
Adj Flow Rate, veh/h	136	5	1	239	16	0	16	3179	64	255	2875	59
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	17	2	14	0	2	14	11	2	1
Cap, veh/h	155	52	44	283	63		28	3392	953	289	3774	1181
Arrive On Green	0.09	0.03	0.03	0.09	0.03	0.00	0.02	0.66	0.66	0.09	0.74	0.74
Sat Flow, veh/h	1781	1870	1585	3045	1870	1434	1810	5106	1434	3209	5106	1598
Grp Volume(v), veh/h	136	5	1	239	16	0	16	3179	64	255	2875	59
Grp Sat Flow(s),veh/h/ln	1781	1870	1585	1522	1870	1434	1810	1702	1434	1605	1702	1598
Q Serve(g_s), s	13.6	0.5	0.1	13.9	1.5	0.0	1.6	99.7	2.8	14.1	60.5	1.8
Cycle Q Clear(g_c), s	13.6	0.5	0.1	13.9	1.5	0.0	1.6	99.7	2.8	14.1	60.5	1.8
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	155	52	44	283	63		28	3392	953	289	3774	1181
V/C Ratio(X)	0.88	0.10	0.02	0.85	0.26		0.58	0.94	0.07	0.88	0.76	0.05
Avail Cap(c_a), veh/h	193	156	132	634	343		50	3392	953	303	3774	1181
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	81.2	85.3	85.1	80.4	84.8	0.0	88.0	26.9	10.6	80.9	14.0	6.4
Incr Delay (d2), s/veh	29.1	0.8	0.2	6.9	2.1	0.0	17.6	6.4	0.1	24.1	1.5	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	7.6	0.2	0.0	5.8	0.8	0.0	0.9	38.6	1.0	6.7	20.8	0.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	110.3	86.1	85.3	87.2	86.9	0.0	105.7	33.3	10.8	105.0	15.5	6.4
LnGrp LOS	F	F	F	F	F		F	C	B	F	B	A
Approach Vol, veh/h		142			255	A		3259			3189	
Approach Delay, s/veh		109.3			87.2			33.2			22.5	
Approach LOS		F			F			C			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	22.2	125.6	21.2	11.0	8.8	139.0	20.2	12.0
Change Period (Y+Rc), s	6.0	6.0	4.5	6.0	6.0	6.0	4.5	6.0
Max Green Setting (Gmax), s	17.0	88.0	37.5	15.0	5.0	100.0	19.5	33.0
Max Q Clear Time (g_c+I1), s	16.1	101.7	15.9	2.5	3.6	62.5	15.6	3.5
Green Ext Time (p_c), s	0.1	0.0	0.8	0.0	0.0	31.4	0.1	0.0

Intersection Summary	
HCM 6th Ctrl Delay	31.8
HCM 6th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑	↱	↰↰	↑	↱	↰↰	↑↑↑	↱	↰↰	↑↑↑	↱
Traffic Volume (veh/h)	195	20	150	445	45	450	110	2375	320	320	2430	145
Future Volume (veh/h)	195	20	150	445	45	450	110	2375	320	320	2430	145
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	212	22	100	484	49	0	120	2582	250	348	2641	113
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	261	135	187	535	283		158	2863	1134	388	3203	1114
Arrive On Green	0.08	0.07	0.07	0.15	0.15	0.00	0.09	1.00	1.00	0.11	0.63	0.63
Sat Flow, veh/h	3456	1870	1585	3456	1870	1585	3456	5106	1585	3456	5106	1585
Grp Volume(v), veh/h	212	22	100	484	49	0	120	2582	250	348	2641	113
Grp Sat Flow(s),veh/h/ln	1728	1870	1585	1728	1870	1585	1728	1702	1585	1728	1702	1585
Q Serve(g_s), s	10.9	2.0	10.7	24.8	4.1	0.0	6.1	0.0	0.0	17.9	71.9	4.1
Cycle Q Clear(g_c), s	10.9	2.0	10.7	24.8	4.1	0.0	6.1	0.0	0.0	17.9	71.9	4.1
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	261	135	187	535	283		158	2863	1134	388	3203	1114
V/C Ratio(X)	0.81	0.16	0.53	0.91	0.17		0.76	0.90	0.22	0.90	0.82	0.10
Avail Cap(c_a), veh/h	682	275	306	643	283		278	2863	1134	432	3203	1114
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	0.00	0.52	0.52	0.52	1.00	1.00	1.00
Uniform Delay (d), s/veh	82.0	78.4	74.7	74.8	66.5	0.0	80.8	0.0	0.0	78.9	25.9	8.6
Incr Delay (d2), s/veh	6.1	0.6	2.4	14.7	0.3	0.0	3.9	2.8	0.2	19.6	2.6	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.1	1.0	4.5	12.2	2.0	0.0	2.7	0.7	0.1	9.0	28.2	1.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	88.0	79.0	77.1	89.4	66.8	0.0	84.7	2.8	0.2	98.5	28.4	8.7
LnGrp LOS	F	E	E	F	E		F	A	A	F	C	A
Approach Vol, veh/h		334			533	A		2952			3102	
Approach Delay, s/veh		84.2			87.4			5.9			35.6	
Approach LOS		F			F			A			D	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	24.7	105.4	32.3	17.5	12.7	117.4	18.1	31.8
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	22.5	79.5	33.5	26.5	14.5	87.5	35.5	24.5
Max Q Clear Time (g_c+I1), s	19.9	2.0	26.8	12.7	8.1	73.9	12.9	6.1
Green Ext Time (p_c), s	0.3	50.0	1.1	0.3	0.2	12.3	0.7	0.1

Intersection Summary	
HCM 6th Ctrl Delay	29.3
HCM 6th LOS	C

Notes

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	50	15	195	245	15	100	125	2640	170	60	2930	20
Future Volume (veh/h)	50	15	195	245	15	100	125	2640	170	60	2930	20
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1856	1870	1870	1885	1870	1870	1870	1870	1870	1870	1870	1841
Adj Flow Rate, veh/h	54	16	0	266	16	9	136	2870	125	65	3185	13
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	3	2	2	1	2	2	2	2	2	2	2	4
Cap, veh/h	145	52		291	214	253	156	3585	1113	81	3369	1029
Arrive On Green	0.04	0.03	0.00	0.13	0.11	0.11	0.09	0.70	0.70	0.06	0.88	0.88
Sat Flow, veh/h	1767	1870	1585	1795	1870	1585	1781	5106	1585	1781	5106	1560
Grp Volume(v), veh/h	54	16	0	266	16	9	136	2870	125	65	3185	13
Grp Sat Flow(s),veh/h/ln	1767	1870	1585	1795	1870	1585	1781	1702	1585	1781	1702	1560
Q Serve(g_s), s	5.3	1.5	0.0	22.5	1.4	0.9	13.6	68.8	4.6	6.5	80.8	0.2
Cycle Q Clear(g_c), s	5.3	1.5	0.0	22.5	1.4	0.9	13.6	68.8	4.6	6.5	80.8	0.2
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	145	52		291	214	253	156	3585	1113	81	3369	1029
V/C Ratio(X)	0.37	0.31		0.91	0.07	0.04	0.87	0.80	0.11	0.80	0.95	0.01
Avail Cap(c_a), veh/h	318	140		291	214	253	272	3585	1113	114	3369	1029
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.33	1.33	1.33
Upstream Filter(I)	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	0.49	0.49	0.49
Uniform Delay (d), s/veh	81.0	85.8	0.0	74.5	71.2	63.9	81.1	18.2	8.7	83.8	8.7	3.8
Incr Delay (d2), s/veh	1.6	3.4	0.0	31.1	0.1	0.1	13.5	2.0	0.2	12.7	3.9	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.5	0.8	0.0	3.8	0.7	0.4	6.8	25.4	1.7	3.2	10.0	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	82.6	89.2	0.0	105.6	71.4	64.0	94.6	20.2	8.9	96.5	12.6	3.8
LnGrp LOS	F	F		F	E	E	F	C	A	F	B	A
Approach Vol, veh/h		70	A		291			3131			3263	
Approach Delay, s/veh		84.1			102.4			23.0			14.3	
Approach LOS		F			F			C			B	
Timer - Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	12.7	130.9	27.0	9.5	20.3	123.3	11.4	25.1				
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5				
Max Green Setting (Gmax), s	41.5	114.5	22.5	13.5	27.5	98.5	24.5	11.5				
Max Q Clear Time (g_c+I1), s	18.5	70.8	24.5	3.5	15.6	82.8	7.3	3.4				
Green Ext Time (p_c), s	0.0	36.5	0.0	0.0	0.2	15.1	0.1	0.0				
Intersection Summary												
HCM 6th Ctrl Delay			22.8									
HCM 6th LOS			C									
Notes												

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	455	0	530	15	5	15	625	2375	15	5	2910	605
Future Volume (veh/h)	455	0	530	15	5	15	625	2375	15	5	2910	605
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	495	0	549	16	5	1	679	2582	11	5	3163	367
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	561	0	1147	25	21	4	707	3671	1140	9	3341	823
Arrive On Green	0.16	0.00	0.16	0.01	0.01	0.01	0.20	0.72	0.72	0.00	0.52	0.52
Sat Flow, veh/h	3563	0	3170	1781	1513	303	3456	5106	1585	1781	6434	1585
Grp Volume(v), veh/h	495	0	549	16	0	6	679	2582	11	5	3163	367
Grp Sat Flow(s),veh/h/ln	1781	0	1585	1781	0	1816	1728	1702	1585	1781	1609	1585
Q Serve(g_s), s	28.5	0.0	28.0	1.9	0.0	0.7	40.7	60.2	0.4	0.6	97.4	30.3
Cycle Q Clear(g_c), s	28.5	0.0	28.0	1.9	0.0	0.7	40.7	60.2	0.4	0.6	97.4	30.3
Prop In Lane	1.00		1.00	1.00		0.17	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	561	0	1147	25	0	25	707	3671	1140	9	3341	823
V/C Ratio(X)	0.88	0.00	0.48	0.65	0.00	0.24	0.96	0.70	0.01	0.58	0.95	0.45
Avail Cap(c_a), veh/h	629	0	1208	34	0	35	709	3671	1140	34	3348	825
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	86.4	0.0	51.6	102.8	0.0	102.2	82.5	16.7	8.3	104.0	47.6	31.5
Incr Delay (d2), s/veh	12.9	0.0	0.3	25.5	0.0	4.8	24.4	0.6	0.0	49.9	6.8	0.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	14.3	0.0	11.4	1.1	0.0	0.4	20.4	22.5	0.1	0.4	39.5	11.7
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	99.3	0.0	51.9	128.3	0.0	107.0	106.9	17.4	8.3	153.9	54.4	31.9
LnGrp LOS	F	A	D	F	A	F	F	B	A	F	D	C
Approach Vol, veh/h		1044			22			3272			3535	
Approach Delay, s/veh		74.4			122.5			35.9			52.2	
Approach LOS		E			F			D			D	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	7.0	156.6		7.9	48.8	114.8		38.0
Change Period (Y+Rc), s	6.0	6.0		5.0	6.0	6.0		5.0
Max Green Setting (Gmax), s	4.0	148.0		4.0	43.0	109.0		37.0
Max Q Clear Time (g_c+I1), s	2.6	62.2		3.9	42.7	99.4		30.5
Green Ext Time (p_c), s	0.0	49.5		0.0	0.1	9.4		2.5

Intersection Summary		
HCM 6th Ctrl Delay		48.6
HCM 6th LOS		D

Notes

User approved pedestrian interval to be less than phase max green.
User approved volume balancing among the lanes for turning movement.

Intersection						
Int Delay, s/veh	2.1					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	75	2855	5	0	3365
Future Vol, veh/h	0	75	2855	5	0	3365
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	500	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	5	2	0	0	2
Mvmt Flow	0	82	3103	5	0	3658

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	-	1552	0	0	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	7.2	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.95	-	-	-	-
Pot Cap-1 Maneuver	0	85	-	-	0	-
Stage 1	0	-	-	-	0	-
Stage 2	0	-	-	-	0	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	-	85	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	173.7	0	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBT
Capacity (veh/h)	-	-	85	-
HCM Lane V/C Ratio	-	-	0.959	-
HCM Control Delay (s)	-	-	173.7	-
HCM Lane LOS	-	-	F	-
HCM 95th %tile Q(veh)	-	-	5.3	-

Movement	WBL	WBR	NBT	NBR	SBL	SBT	
Lane Configurations							
Traffic Volume (veh/h)	235	140	2725	85	115	3250	
Future Volume (veh/h)	235	140	2725	85	115	3250	
Initial Q (Qb), veh	0	0	0	0	0	0	
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00		
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	
Work Zone On Approach	No		No			No	
Adj Sat Flow, veh/h/ln	1678	1752	1870	1826	1826	1870	
Adj Flow Rate, veh/h	255	30	2962	55	125	3533	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	
Percent Heavy Veh, %	15	10	2	5	5	2	
Cap, veh/h	279	259	3235	980	149	3854	
Arrive On Green	0.17	0.17	0.63	0.63	0.09	0.75	
Sat Flow, veh/h	1598	1485	5274	1547	1739	5274	
Grp Volume(v), veh/h	255	30	2962	55	125	3533	
Grp Sat Flow(s),veh/h/ln	1598	1485	1702	1547	1739	1702	
Q Serve(g_s), s	19.9	2.2	64.2	1.7	9.0	69.9	
Cycle Q Clear(g_c), s	19.9	2.2	64.2	1.7	9.0	69.9	
Prop In Lane	1.00	1.00		1.00	1.00		
Lane Grp Cap(c), veh/h	279	259	3235	980	149	3854	
V/C Ratio(X)	0.92	0.12	0.92	0.06	0.84	0.92	
Avail Cap(c_a), veh/h	308	287	3239	981	158	3882	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	
Uniform Delay (d), s/veh	51.5	44.1	20.3	8.8	57.2	12.4	
Incr Delay (d2), s/veh	28.9	0.2	4.7	0.0	30.1	4.0	
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	
%ile BackOfQ(50%),veh/ln	10.2	0.8	23.4	0.5	5.1	20.9	
Unsig. Movement Delay, s/veh							
LnGrp Delay(d),s/veh	80.4	44.3	24.9	8.9	87.3	16.4	
LnGrp LOS	F	D	C	A	F	B	
Approach Vol, veh/h	285		3017			3658	
Approach Delay, s/veh	76.6		24.6			18.8	
Approach LOS	E		C			B	
Timer - Assigned Phs	1	2				6	8
Phs Duration (G+Y+Rc), s	15.4	84.9				100.3	26.6
Change Period (Y+Rc), s	4.5	4.5				4.5	4.5
Max Green Setting (Gmax), s	11.5	80.5				96.5	24.5
Max Q Clear Time (g_c+I1), s	11.0	66.2				71.9	21.9
Green Ext Time (p_c), s	0.0	13.4				23.9	0.2
Intersection Summary							
HCM 6th Ctrl Delay			23.7				
HCM 6th LOS			C				

Intersection						
Int Delay, s/veh	0.2					
Movement	**WBL**	**WBR**	**NBT**	**NBR**	**SBL**	**SBT**
Lane Configurations						
Traffic Vol, veh/h	0	25	2785	25	0	3485
Future Vol, veh/h	0	25	2785	25	0	3485
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	500	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	5	2	5	0	2
Mvmt Flow	0	27	3027	27	0	3788

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	-	1514	0	0	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	7.2	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.95	-	-	-	-
Pot Cap-1 Maneuver	0	90	-	-	0	-
Stage 1	0	-	-	-	0	-
Stage 2	0	-	-	-	0	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	-	90	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Approach	**WB**		**NB**		**SB**	
HCM Control Delay, s	61.4		0		0	
HCM LOS	F					

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBT
Capacity (veh/h)	-	-	90	-
HCM Lane V/C Ratio	-	-	0.302	-
HCM Control Delay (s)	-	-	61.4	-
HCM Lane LOS	-	-	F	-
HCM 95th %tile Q(veh)	-	-	1.1	-

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Future Year 2038 WE Peak With Mitigation

Movement	WBL	WBR	NBT	NBR	SBL	SBT	
Lane Configurations							
Traffic Volume (veh/h)	25	140	3110	45	105	2855	
Future Volume (veh/h)	25	140	3110	45	105	2855	
Initial Q (Qb), veh	0	0	0	0	0	0	
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00		
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	
Work Zone On Approach	No		No			No	
Adj Sat Flow, veh/h/ln	1707	1841	1870	1693	1767	1870	
Adj Flow Rate, veh/h	27	0	3380	37	114	3103	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	
Percent Heavy Veh, %	13	4	2	14	9	2	
Cap, veh/h	37		4176	1173	156	4598	
Arrive On Green	0.02	0.00	0.82	0.82	0.05	0.90	
Sat Flow, veh/h	1626	1560	5274	1434	3264	5274	
Grp Volume(v), veh/h	27	0	3380	37	114	3103	
Grp Sat Flow(s),veh/h/ln	1626	1560	1702	1434	1632	1702	
Q Serve(g_s), s	2.4	0.0	51.3	0.7	5.0	22.1	
Cycle Q Clear(g_c), s	2.4	0.0	51.3	0.7	5.0	22.1	
Prop In Lane	1.00	1.00		1.00	1.00		
Lane Grp Cap(c), veh/h	37		4176	1173	156	4598	
V/C Ratio(X)	0.72		0.81	0.03	0.73	0.67	
Avail Cap(c_a), veh/h	136		4442	1248	159	4868	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00	
Uniform Delay (d), s/veh	69.7	0.0	7.1	2.4	67.5	1.8	
Incr Delay (d2), s/veh	23.0	0.0	1.1	0.0	15.3	0.3	
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	
%ile BackOfQ(50%),veh/ln	1.2	0.0	12.8	0.1	2.4	1.2	
Unsig. Movement Delay, s/veh							
LnGrp Delay(d),s/veh	92.8	0.0	8.2	2.5	82.8	2.2	
LnGrp LOS	F		A	A	F	A	
Approach Vol, veh/h	27	A	3417			3217	
Approach Delay, s/veh	92.8		8.1			5.0	
Approach LOS	F		A			A	
Timer - Assigned Phs	1	2				6	8
Phs Duration (G+Y+Rc), s	11.9	123.5				135.4	8.3
Change Period (Y+Rc), s	5.0	6.0				6.0	5.0
Max Green Setting (Gmax), s	7.0	125.0				137.0	12.0
Max Q Clear Time (g_c+I1), s	7.0	53.3				24.1	4.4
Green Ext Time (p_c), s	0.0	64.3				83.5	0.0
Intersection Summary							
HCM 6th Ctrl Delay			7.0				
HCM 6th LOS			A				

Notes

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	140	10	20	175	20	410	15	2630	125	315	2435	120
Future Volume (veh/h)	140	10	20	175	20	410	15	2630	125	315	2435	120
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1796	1870	1767	1870	1870	1767	1811	1870	1870
Adj Flow Rate, veh/h	152	11	1	190	22	0	16	2859	75	342	2647	89
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	7	2	9	2	2	9	6	2	2
Cap, veh/h	171	98	83	236	52		27	3245	952	387	3758	1167
Arrive On Green	0.10	0.05	0.05	0.07	0.03	0.00	0.02	0.64	0.64	0.12	0.74	0.74
Sat Flow, veh/h	1781	1870	1585	3319	1870	1497	1781	5106	1497	3346	5106	1585
Grp Volume(v), veh/h	152	11	1	190	22	0	16	2859	75	342	2647	89
Grp Sat Flow(s),veh/h/ln	1781	1870	1585	1659	1870	1497	1781	1702	1497	1673	1702	1585
Q Serve(g_s), s	15.2	1.0	0.1	10.2	2.1	0.0	1.6	83.5	3.5	18.1	51.1	2.8
Cycle Q Clear(g_c), s	15.2	1.0	0.1	10.2	2.1	0.0	1.6	83.5	3.5	18.1	51.1	2.8
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	171	98	83	236	52		27	3245	952	387	3758	1167
V/C Ratio(X)	0.89	0.11	0.01	0.81	0.42		0.59	0.88	0.08	0.88	0.70	0.08
Avail Cap(c_a), veh/h	193	156	132	691	343		49	3245	952	521	3758	1167
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	80.4	81.3	80.8	82.4	86.1	0.0	88.1	27.2	12.6	78.4	13.0	6.6
Incr Delay (d2), s/veh	33.8	0.5	0.1	6.4	5.4	0.0	18.5	3.8	0.2	13.0	1.1	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	8.6	0.5	0.0	4.6	1.1	0.0	0.9	32.4	1.3	8.4	17.7	1.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	114.3	81.7	80.9	88.8	91.5	0.0	106.5	31.0	12.7	91.3	14.1	6.8
LnGrp LOS	F	F	F	F	F		F	C	B	F	B	A
Approach Vol, veh/h		164			212	A		2950			3078	
Approach Delay, s/veh		111.9			89.1			30.9			22.5	
Approach LOS		F			F			C			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	26.8	120.4	17.3	15.5	8.8	138.5	21.8	11.0
Change Period (Y+Rc), s	6.0	6.0	4.5	6.0	6.0	6.0	4.5	6.0
Max Green Setting (Gmax), s	28.0	77.0	37.5	15.0	5.0	100.0	19.5	33.0
Max Q Clear Time (g_c+I1), s	20.1	85.5	12.2	3.0	3.6	53.1	17.2	4.1
Green Ext Time (p_c), s	0.7	0.0	0.6	0.0	0.0	34.6	0.1	0.1

Intersection Summary	
HCM 6th Ctrl Delay	30.9
HCM 6th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	225	20	175	530	55	530	170	2020	495	495	1935	225
Future Volume (veh/h)	225	20	175	530	55	530	170	2020	495	495	1935	225
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	245	22	128	576	60	0	185	2196	392	538	2103	166
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	295	164	241	616	337		222	2377	1020	583	2910	1039
Arrive On Green	0.09	0.09	0.09	0.18	0.18	0.00	0.13	0.93	0.93	0.17	0.57	0.57
Sat Flow, veh/h	3456	1870	1585	3456	1870	1585	3456	5106	1585	3456	5106	1585
Grp Volume(v), veh/h	245	22	128	576	60	0	185	2196	392	538	2103	166
Grp Sat Flow(s),veh/h/ln	1728	1870	1585	1728	1870	1585	1728	1702	1585	1728	1702	1585
Q Serve(g_s), s	12.6	2.0	13.4	29.6	4.9	0.0	9.4	38.2	4.1	27.6	54.2	7.3
Cycle Q Clear(g_c), s	12.6	2.0	13.4	29.6	4.9	0.0	9.4	38.2	4.1	27.6	54.2	7.3
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	295	164	241	616	337		222	2377	1020	583	2910	1039
V/C Ratio(X)	0.83	0.13	0.53	0.94	0.18		0.83	0.92	0.38	0.92	0.72	0.16
Avail Cap(c_a), veh/h	682	275	335	643	337		278	2377	1020	643	2910	1039
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	0.00	0.50	0.50	0.50	1.00	1.00	1.00
Uniform Delay (d), s/veh	81.0	75.8	70.4	72.9	62.5	0.0	77.5	4.6	1.6	73.7	28.3	11.9
Incr Delay (d2), s/veh	6.0	0.4	1.8	20.7	0.2	0.0	8.6	4.1	0.5	18.0	1.6	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.9	1.0	5.6	15.0	2.4	0.0	4.2	3.2	0.9	13.6	21.8	2.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	87.0	76.2	72.3	93.6	62.7	0.0	86.1	8.8	2.1	91.7	29.9	12.3
LnGrp LOS	F	E	E	F	E		F	A	A	F	C	B
Approach Vol, veh/h		395			636	A		2773			2807	
Approach Delay, s/veh		81.6			90.7			13.0			40.7	
Approach LOS		F			F			B			D	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	34.9	88.3	36.6	20.3	16.1	107.1	19.9	37.0
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	33.5	68.5	33.5	26.5	14.5	87.5	35.5	24.5
Max Q Clear Time (g_c+I1), s	29.6	40.2	31.6	15.4	11.4	56.2	14.6	6.9
Green Ext Time (p_c), s	0.8	21.1	0.5	0.3	0.2	20.6	0.8	0.2

Intersection Summary	
HCM 6th Ctrl Delay	36.3
HCM 6th LOS	D

Notes

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑↑↑	↱	↰	↑↑↑	↱
Traffic Volume (veh/h)	50	15	215	290	20	115	190	2485	250	95	2505	35
Future Volume (veh/h)	50	15	215	290	20	115	190	2485	250	95	2505	35
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1856	1870	1870	1885	1870	1870	1870	1870	1870	1870	1870	1826
Adj Flow Rate, veh/h	54	16	0	315	22	16	207	2701	171	103	2723	21
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	3	2	2	1	2	2	2	2	2	2	2	5
Cap, veh/h	145	52		351	276	335	226	3320	1030	114	2997	908
Arrive On Green	0.04	0.03	0.00	0.16	0.15	0.15	0.13	0.65	0.65	0.08	0.78	0.78
Sat Flow, veh/h	1767	1870	1585	1795	1870	1585	1781	5106	1585	1781	5106	1547
Grp Volume(v), veh/h	54	16	0	315	22	16	207	2701	171	103	2723	21
Grp Sat Flow(s),veh/h/ln	1767	1870	1585	1795	1870	1585	1781	1702	1585	1781	1702	1547
Q Serve(g_s), s	5.3	1.5	0.0	28.5	1.8	1.4	20.7	70.7	7.6	10.3	72.5	0.5
Cycle Q Clear(g_c), s	5.3	1.5	0.0	28.5	1.8	1.4	20.7	70.7	7.6	10.3	72.5	0.5
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	145	52		351	276	335	226	3320	1030	114	2997	908
V/C Ratio(X)	0.37	0.31		0.90	0.08	0.05	0.91	0.81	0.17	0.91	0.91	0.02
Avail Cap(c_a), veh/h	377	140		351	276	335	272	3320	1030	114	2997	908
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.33	1.33	1.33
Upstream Filter(I)	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	0.61	0.61	0.61
Uniform Delay (d), s/veh	81.0	85.8	0.0	70.7	66.2	56.5	77.6	23.4	12.3	81.8	16.1	8.2
Incr Delay (d2), s/veh	1.6	3.3	0.0	24.4	0.1	0.1	29.8	2.3	0.3	40.3	3.4	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.5	0.8	0.0	17.0	0.9	0.6	11.3	27.3	2.9	5.9	20.4	0.2
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	82.6	89.2	0.0	95.1	66.3	56.6	107.4	25.7	12.7	122.1	19.5	8.2
LnGrp LOS	F	F		F	E	E	F	C	B	F	B	A
Approach Vol, veh/h		70	A		353			3079			2847	
Approach Delay, s/veh		84.1			91.5			30.5			23.1	
Approach LOS		F			F			C			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	16.0	121.5	33.0	9.5	27.4	110.1	11.4	31.1
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	11.5	108.5	28.5	13.5	27.5	92.5	30.5	11.5
Max Q Clear Time (g_c+I1), s	12.3	72.7	30.5	3.5	22.7	74.5	7.3	3.8
Green Ext Time (p_c), s	0.0	29.5	0.0	0.0	0.2	16.1	0.1	0.0

Intersection Summary		
HCM 6th Ctrl Delay		31.2
HCM 6th LOS		C

Notes

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	470	0	385	5	0	5	410	2370	5	5	2520	525
Future Volume (veh/h)	470	0	385	5	0	5	410	2370	5	5	2520	525
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	511	0	358	5	0	1	446	2576	3	5	2739	251
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	636	0	1041	11	0	10	518	3248	1008	9	3161	779
Arrive On Green	0.18	0.00	0.18	0.01	0.00	0.01	0.15	0.64	0.64	0.01	0.49	0.49
Sat Flow, veh/h	3563	0	3170	1781	0	1585	3456	5106	1585	1781	6434	1585
Grp Volume(v), veh/h	511	0	358	5	0	1	446	2576	3	5	2739	251
Grp Sat Flow(s),veh/h/ln	1781	0	1585	1781	0	1585	1728	1702	1585	1781	1609	1585
Q Serve(g_s), s	17.4	0.0	10.8	0.4	0.0	0.1	15.9	46.8	0.1	0.4	47.6	12.1
Cycle Q Clear(g_c), s	17.4	0.0	10.8	0.4	0.0	0.1	15.9	46.8	0.1	0.4	47.6	12.1
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	636	0	1041	11	0	10	518	3248	1008	9	3161	779
V/C Ratio(X)	0.80	0.00	0.34	0.47	0.00	0.10	0.86	0.79	0.00	0.55	0.87	0.32
Avail Cap(c_a), veh/h	988	0	1354	56	0	50	712	3438	1067	56	3211	791
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	49.7	0.0	32.1	62.5	0.0	62.4	52.4	16.9	8.4	62.6	28.4	19.4
Incr Delay (d2), s/veh	2.7	0.0	0.2	28.4	0.0	4.7	7.9	1.3	0.0	43.3	2.7	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	8.0	0.0	4.2	0.2	0.0	0.0	7.3	16.3	0.0	0.3	17.6	4.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	52.5	0.0	32.3	91.0	0.0	67.1	60.3	18.1	8.4	105.9	31.2	19.6
LnGrp LOS	D	A	C	F	A	E	E	B	A	F	C	B
Approach Vol, veh/h		869			6			3025			2995	
Approach Delay, s/veh		44.2			87.0			24.3			30.3	
Approach LOS		D			F			C			C	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.6	86.3		5.8	24.9	68.0		27.5				
Change Period (Y+Rc), s	6.0	6.0		5.0	6.0	6.0		5.0				
Max Green Setting (Gmax), s	4.0	85.0		4.0	26.0	63.0		35.0				
Max Q Clear Time (g_c+I1), s	12.4	48.8		2.4	17.9	49.6		19.4				
Green Ext Time (p_c), s	0.0	27.8		0.0	1.0	12.4		3.2				
Intersection Summary												
HCM 6th Ctrl Delay			29.5									
HCM 6th LOS			C									

Notes

User approved volume balancing among the lanes for turning movement.

Intersection						
Int Delay, s/veh	1.8					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	70	2855	10	0	3005
Future Vol, veh/h	0	70	2855	10	0	3005
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	500	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	5	2	5	0	2
Mvmt Flow	0	76	3103	11	0	3266

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	-	1552	0	0	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	7.2	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.95	-	-	-	-
Pot Cap-1 Maneuver	0	85	-	-	0	-
Stage 1	0	-	-	-	0	-
Stage 2	0	-	-	-	0	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	-	85	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	156.5	0	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBT
Capacity (veh/h)	-	-	85	-
HCM Lane V/C Ratio	-	-	0.895	-
HCM Control Delay (s)	-	-	156.5	-
HCM Lane LOS	-	-	F	-
HCM 95th %tile Q(veh)	-	-	4.8	-

Movement	WBL	WBR	NBT	NBR	SBL	SBT	
Lane Configurations							
Traffic Volume (veh/h)	215	125	2740	90	125	2880	
Future Volume (veh/h)	215	125	2740	90	125	2880	
Initial Q (Qb), veh	0	0	0	0	0	0	
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00		
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	
Work Zone On Approach	No		No			No	
Adj Sat Flow, veh/h/ln	1752	1752	1870	1826	1752	1870	
Adj Flow Rate, veh/h	234	12	2978	60	136	3130	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	
Percent Heavy Veh, %	10	10	2	5	10	2	
Cap, veh/h	258	229	3317	1005	159	3974	
Arrive On Green	0.15	0.15	0.65	0.65	0.10	0.78	
Sat Flow, veh/h	1668	1485	5274	1547	1668	5274	
Grp Volume(v), veh/h	234	12	2978	60	136	3130	
Grp Sat Flow(s),veh/h/ln	1668	1485	1702	1547	1668	1702	
Q Serve(g_s), s	18.5	0.9	65.6	1.9	10.7	47.0	
Cycle Q Clear(g_c), s	18.5	0.9	65.6	1.9	10.7	47.0	
Prop In Lane	1.00	1.00		1.00	1.00		
Lane Grp Cap(c), veh/h	258	229	3317	1005	159	3974	
V/C Ratio(X)	0.91	0.05	0.90	0.06	0.86	0.79	
Avail Cap(c_a), veh/h	293	261	3378	1024	181	4104	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	
Uniform Delay (d), s/veh	55.6	48.2	19.7	8.5	59.6	8.5	
Incr Delay (d2), s/veh	28.1	0.1	3.6	0.0	28.8	1.0	
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	
%ile BackOfQ(50%),veh/ln	9.8	0.4	23.6	0.6	5.7	13.0	
Unsig. Movement Delay, s/veh							
LnGrp Delay(d),s/veh	83.7	48.3	23.3	8.6	88.5	9.5	
LnGrp LOS	F	D	C	A	F	A	
Approach Vol, veh/h	246		3038			3266	
Approach Delay, s/veh	81.9		23.0			12.8	
Approach LOS	F		C			B	
Timer - Assigned Phs	1	2				6	8
Phs Duration (G+Y+Rc), s	17.2	91.4				108.6	25.2
Change Period (Y+Rc), s	4.5	4.5				4.5	4.5
Max Green Setting (Gmax), s	14.5	88.5				107.5	23.5
Max Q Clear Time (g_c+I1), s	12.7	67.6				49.0	20.5
Green Ext Time (p_c), s	0.1	19.3				50.1	0.2
Intersection Summary							
HCM 6th Ctrl Delay			20.2				
HCM 6th LOS			C				

Intersection						
Int Delay, s/veh	0.3					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	25	2805	30	0	3090
Future Vol, veh/h	0	25	2805	30	0	3090
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	500	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	5	2	5	0	2
Mvmt Flow	0	27	3049	33	0	3359

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	-	1525	0	0	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	7.2	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.95	-	-	-	-
Pot Cap-1 Maneuver	0	89	-	-	0	-
Stage 1	0	-	-	-	0	-
Stage 2	0	-	-	-	0	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	-	89	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	62.3	0	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBT
Capacity (veh/h)	-	-	89	-
HCM Lane V/C Ratio	-	-	0.305	-
HCM Control Delay (s)	-	-	62.3	-
HCM Lane LOS	-	-	F	-
HCM 95th %tile Q(veh)	-	-	1.1	-

APPENDIX D

RECOMMENDED ROADWAY IMPROVEMENTS

Table D1 - Roadway Improvements Plan

ID	Intersection	Existing (2017)	Base Year 2038 (Without Project) With Mitigation	Future Year 2038 (WITH Project) With Mitigation
Maui Veterans Highway @				
1	Nakii Road	#1 N Maui Veterans Hwy Nakii Rd	#1 N Maui Veterans Hwy Nakii Rd	#1 N Maui Veterans Hwy Nakii Rd
2	Kamaaina Road [1]	#2 N Maui Veterans Hwy Kamaaina Road	#2 N Maui Veterans Hwy Kamaaina Road	#2 N Maui Veterans Hwy Kamaaina Road
3	Proposed NEW Middle Access	#3 N Maui Veterans Hwy DHHL/DLNR Access	#3 N Maui Veterans Hwy DHHL/DLNR Access	#3 N Maui Veterans Hwy DHHL/DLNR Access
4	Mehameha Loop (South)	#4 N Maui Veterans Hwy Mehameha Lp	#4 N Maui Veterans Hwy Mehameha Lp	#4 N Maui Veterans Hwy Mehameha Lp
9	DHHL South Driveway 1	#9 N Maui Veterans Hwy DHHL South Dwy 1	#9 N Maui Veterans Hwy DHHL South Dwy 1	#9 N Maui Veterans Hwy DHHL South Dwy 1
10	DHHL South Driveway 2	#10 N Maui Veterans Hwy DHHL South Dwy 2	#10 N Maui Veterans Hwy DHHL South Dwy 2	#10 N Maui Veterans Hwy DHHL South Dwy 2
11	DHHL South Driveway 3	#11 N Maui Veterans Hwy DHHL South Dwy 3	#11 N Maui Veterans Hwy DHHL South Dwy 3	#11 N Maui Veterans Hwy DHHL South Dwy 3
5	North Kihei Road	#5 N Maui Veterans Hwy N Kihei Rd/ Monsanto DW	#5 N Maui Veterans Hwy N Kihei Rd/ Monsanto DW	#5 N Maui Veterans Hwy N Kihei Rd/ Monsanto DW

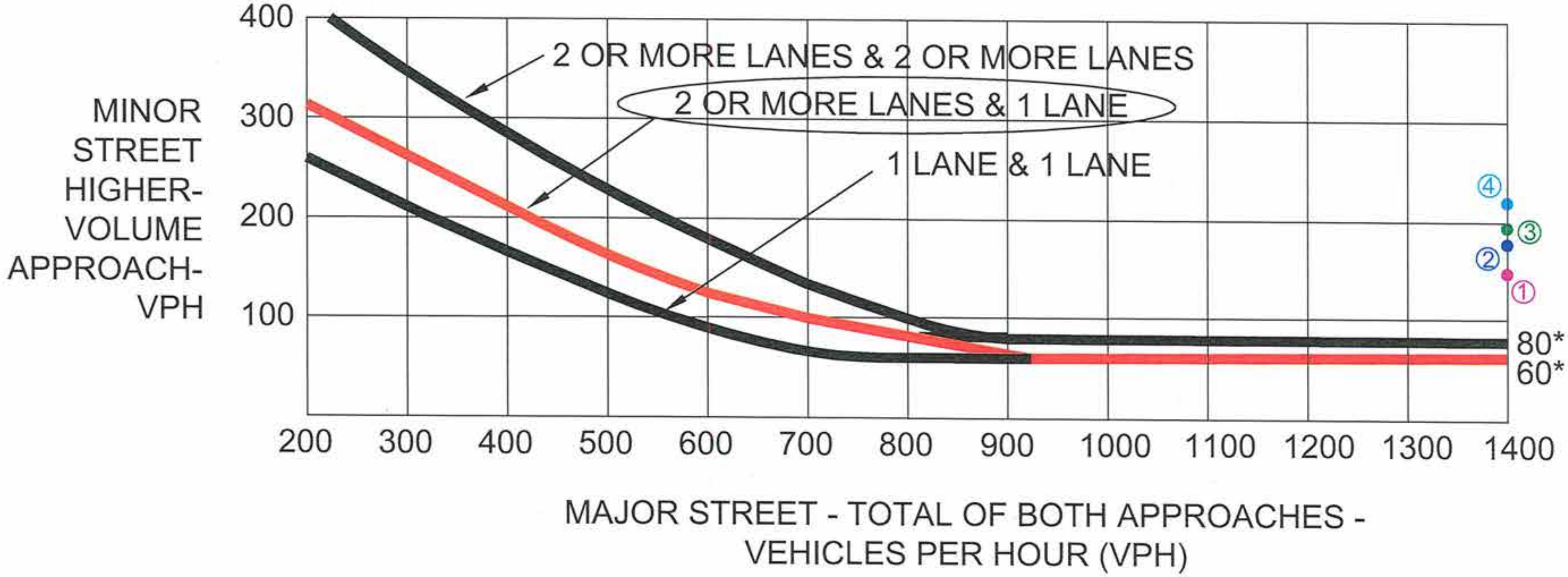
Maui Veterans Highway

Notes:
- Green highlighted shows proposed improvement.
1. As part of Puunene Heavy Industrial Subdivision, the southbound left-turn lane is recommended to be lengthened and a new exclusive westbound right-turn lane and acceleration lane from Kamaaina Road onto Maui Veterans Highway is recommended.

APPENDIX E

TRAFFIC SIGNAL WARRANTS

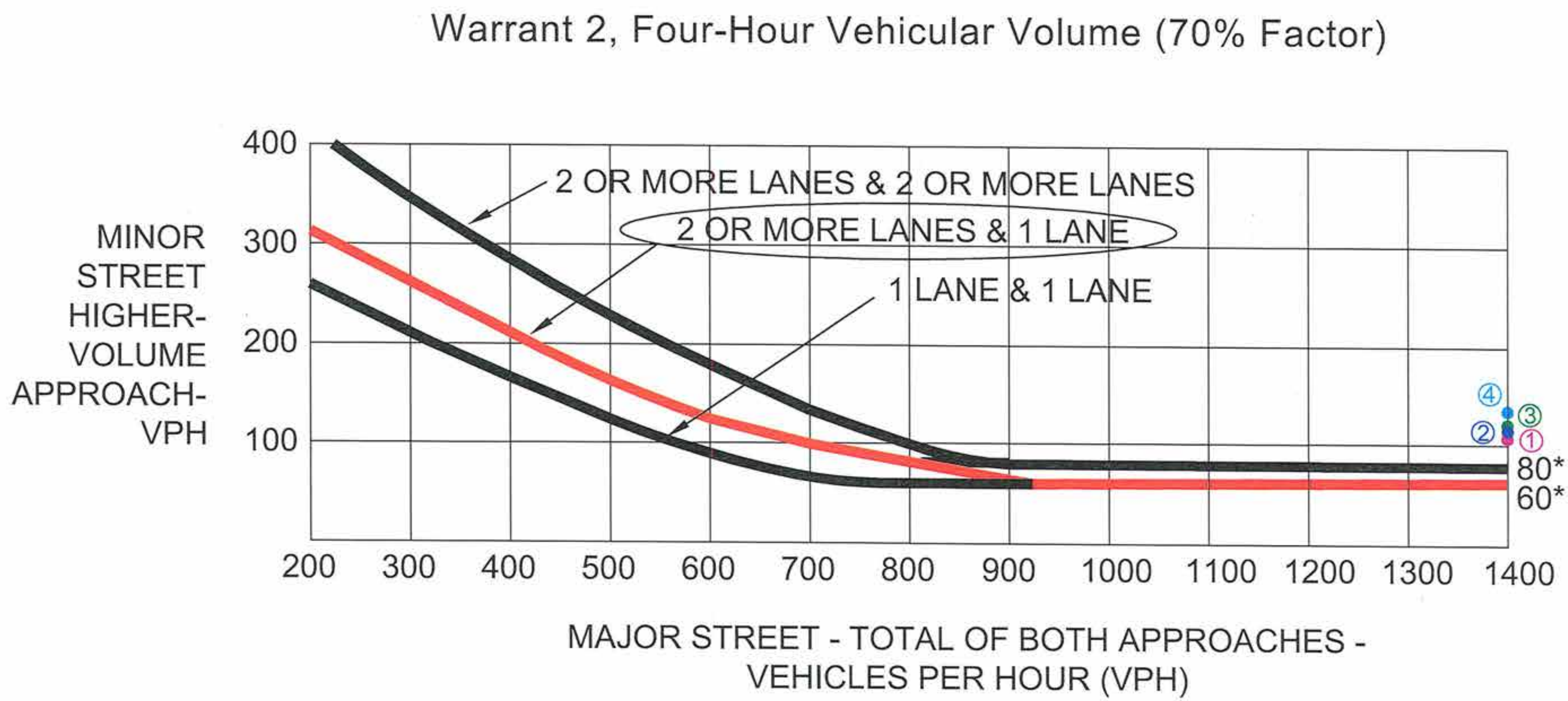
Warrant 2, Four-Hour Vehicular Volume (70% Factor)



*Note: 80 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 60 vph applies as the lower threshold volume for a minor-street approach with one lane.

① (12:30 PM to 1:30 PM), (2303, 149)
② (1:30 PM to 2:30 AM), (2205, 181)
③ (2:30 AM to 3:30 AM), (2397, 199)
④ (3:30 PM to 4:30 PM), (2465, 210)

DLNR INDUSTRIAL AND BUSINESS PARK TIAR	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS,SURVEYORS • HONOLULU,HAWAII	FIGURE
	BASE YEAR 2038 WITHOUT PROJECT FOUR HOUR TRAFFIC SIGNAL WARRANT FOR MAUI VETERANS HIGHWAY/DHHL/DLNR ACCESS INTERSECTION	E1



*Note: 80 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 60 vph applies as the lower threshold volume for a minor-street approach with one lane.

① (12:30 PM to 1:30 PM), (2319, 114)
② (1:30 PM to 2:30 AM), (2209, 121)
③ (2:30 AM to 3:30 AM), (2410, 122)
④ (3:30 PM to 4:30 PM), (2475, 130)

DLNR INDUSTRIAL AND BUSINESS PARK TIAR	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS • HONOLULU, HAWAII	FIGURE
	BASE YEAR 2038 WITHOUT PROJECT FOUR HOUR TRAFFIC SIGNAL WARRANT FOR MAUI VETERANS HIGHWAY/MEHAMEHA LOOP SOUTH INTERSECTION	E2

APPENDIX F

BASE YEAR 2038 SUPPLEMENTARY ANALYSIS

<u>Appendix F</u>: Alternative Base Year 2038 Scenario Without DHHL North & South Parcels, DLNR Industrial & Business Park & MRPSC

Based on discussions with HDOT, it was requested that an iterative Base Year 2038 scenario be analyzed that excludes the three (3) proposed State Pulehunui developments; DHHL North and South Project, DLNR Industrial and Business Park, and Maui Regional Public Safety Complex (MRPSC).

As described in Section 4.1-4.2, an annual defacto growth rate of 2.1 percent per year was applied along Maui Veterans Highway. In addition, numerous developments are forecast to be completed within the vicinity of the Project and generate additional traffic along Maui Veterans Highway. Table F.1 shows the total peak hour traffic volumes forecast to be generated by other known developments for this scenario. Note this table excludes the DHHL North and South Project, DLNR Industrial and Business Park and MRPSC.

F.1 Base Year 2038 Without Mitigation Conditions (No DHHL-DLNR-MRPSC)

<u>[1] Maui Veterans Highway & Nakii Road</u>

It is anticipated that during the AM peak hour, the southbound left turn will operate at LOS F and overcapacity conditions, though the intersection will continue to operate at LOS D overall. During the PM peak hour, the westbound right turn and southbound left turn will operate at LOS F and overcapacity conditions and LOS E overall. During the WE peak, the southbound is anticipated to operate at LOS F.

<u>[2] Maui Veterans Highway & Mehameha Loop/Kamaaina Road</u>

It is anticipated that during the AM peak hour, the southbound left turn will operate at LOS F and overcapacity conditions. During the PM peak hour, the northbound through movement, movements on the westbound approach and southbound left turn movement will operate at LOS F and overcapacity conditions, and the northbound left turn approach will operate at LOS F. Overall, the intersection is anticipated to operate at LOS E. During the WE peak, all movements are anticipated to operate at LOS D or higher with the exception of the northbound left turn movement and the southbound left turn movement, which will operate at LOS E.

<u>[4] Maui Veterans Highway & Mehameha Loop South</u>

All movements are anticipated to operate at LOS C with the exception of the westbound shared LT/TH lane, which will operate at LOS F for AM and WE peaks, and overcapacity for the PM peak, though volumes are minimal, with only 5 vehicles anticipated to arrive throughout the entire hour for all peaks.

<u>[5] Maui Veterans Highway/Piilani Highway & North Kihei Road</u>

During the AM peak hour, the westbound left turn and southbound left turn is anticipated to operate at LOS F. The northbound left turn, eastbound left turn and westbound shared TH/RT is anticipated to operate at LOS E, and the intersection is as anticipated to operate at LOS C overall. During the PM peak hour, various movements will operate at LOS F, with the southbound left turn operating with overcapacity conditions. Overall, the intersection will operate at LOS F for the PM peak hour. During the WE peak, the westbound left turn movement and southbound left turn movements are anticipated to operate at LOS F and the westbound shared TH/RT movement is anticipated to operate at LOS E. Overall, the intersection is anticipated to operate at LOS C. Volumes on the westbound approach are anticipated to be minimal, with 10-30 vehicles arriving per hour throughout all peak hours. Similarly, only approximately 5 vehicles are anticipated to arrive during the hour at the southbound left turn approach for all peak hours.

F.2 Base Year 2038 With Mitigation Conditions (No DHHL-DLNR-MRPSC)

The following improvements are recommended. With the listed mitigation implemented, all mainline northbound and southbound through movements along Maui Veterans Highway and overall LOS are anticipated to operate at LOS D or better for all peak hours at intersections. Some movements on the minor street approaches and the mainline left-turn movements may operate at LOS E/F due to low volume movements or long cycle lengths that prioritize the mainline Maui Veterans Highway traffic. However, all movements are anticipated to operate under capacity, with the exception of the westbound shared LT/TH movement at Maui Veterans Highway and Mehameha Loop South, which is only anticipated to serve 5 vehicles across the entire hour for all peak hours.

<u>[1] Maui Veterans Highway & Nakii Road</u>

- Widen Maui Veterans Highway to provide an additional southbound left-turn lane, resulting in two southbound left turn lanes on Maui Veterans Highway. Also, widen Nakii Road to provide an exclusive left turn lane and a channelized right turn lane.
    - Northbound: Two (2) through lanes and one (1) right-turn lane
    - Southbound: Two (2) left-turn lanes and two (2) through lanes
    - Westbound: One (1) left-turn lane and one (1) right-turn lane

<u>[2] Maui Veterans Highway & Mehameha Loop/Kamaaina Road</u>

- Implement planned roadway improvements listed in Section 4.3
- Widen Maui Veterans Highway to provide an additional southbound left-turn lane, resulting in two southbound left turn lanes on Maui Veterans Highway.
    - Northbound: One (1) left-turn, two (2) through lanes and one (1) right-turn lane
    - Southbound: Two (2) left-turn lanes, two (2) through lanes and one right-turn lane
    - Eastbound: Shared left-turn/through/right-turn lane
    - Westbound: One (1) shared left-turn/through lane and one (1) right turn lane

<u>[5] Maui Veterans Highway/Piilani Highway & North Kihei Road</u>

- Widen Maui Veterans Highway to provide an additional southbound through lane, resulting in three (3) southbound through lanes on Maui Veterans Highway
    - Northbound: Two (2) left-turn lanes, two (2) through lanes and one (1) right-turn lane
    - Southbound: One (1) left-turn lane, three (3) through lanes and one right-turn lane
    - Eastbound: One (1) exclusive left-turn lane, one (1) shared left-turn/through lane, and two (2) right-turn lanes
    - Westbound: One (1) left-turn lane, and one (1) shared through/right-turn lane

Figure F1 and F2 illustrate the lane configuration, forecast traffic volumes and movement LOS for Base Year 2038 WITHOUT and WITH the recommended mitigation, respectively. Table F2 summarizes the Base Year 2038 LOS at the study intersections compared to existing conditions. Table F3 summarizes roadway improvements at the study intersections for Base Year 2038.

Table F.1 Background Developments Trip Generation (Without DHHL-DLNR-PSD)

Land Use	Independent Variable (ITE Code)	Size	AM Peak Hour			PM Peak Hour			WE Peak Hour		
			Enter (vph)	Exit (vph)	Total (vph)	Enter (vph)	Exit (vph)	Total (vph)	Enter (vph)	Exit (vph)	Total (vph)
Puunene Heavy Industrial Subdivision [1]	Industrial Park (130)	65.92 acres	392	80	472	99	372	471	100	211	311
Central Maui Baseyard Expansion	Industrial Park (130)	100 acres	506	104	610	123	465	588	151	320	471
Piilani Promenade 2	Retail/Commercial (820)	530,000 SF	268	164	432	703	777	1,480	1,096	993	2,089
	Industrial Park (130)	58,000 SF (5 Acres)									
Maui Bay Villas [1,2]	Timeshare (265)	388 Dwelling Units	210	110	60	319	136	183	319	136	183
	Beach Park (415)	12 Stalls									
Kihei High School [1,2]	High School (530)	946 students	270	127	397	58	65	123	116	66	182
Total NEW External Trips			1,646	585	1,971	1,302	1,815	2,845	1,782	1,726	3,236

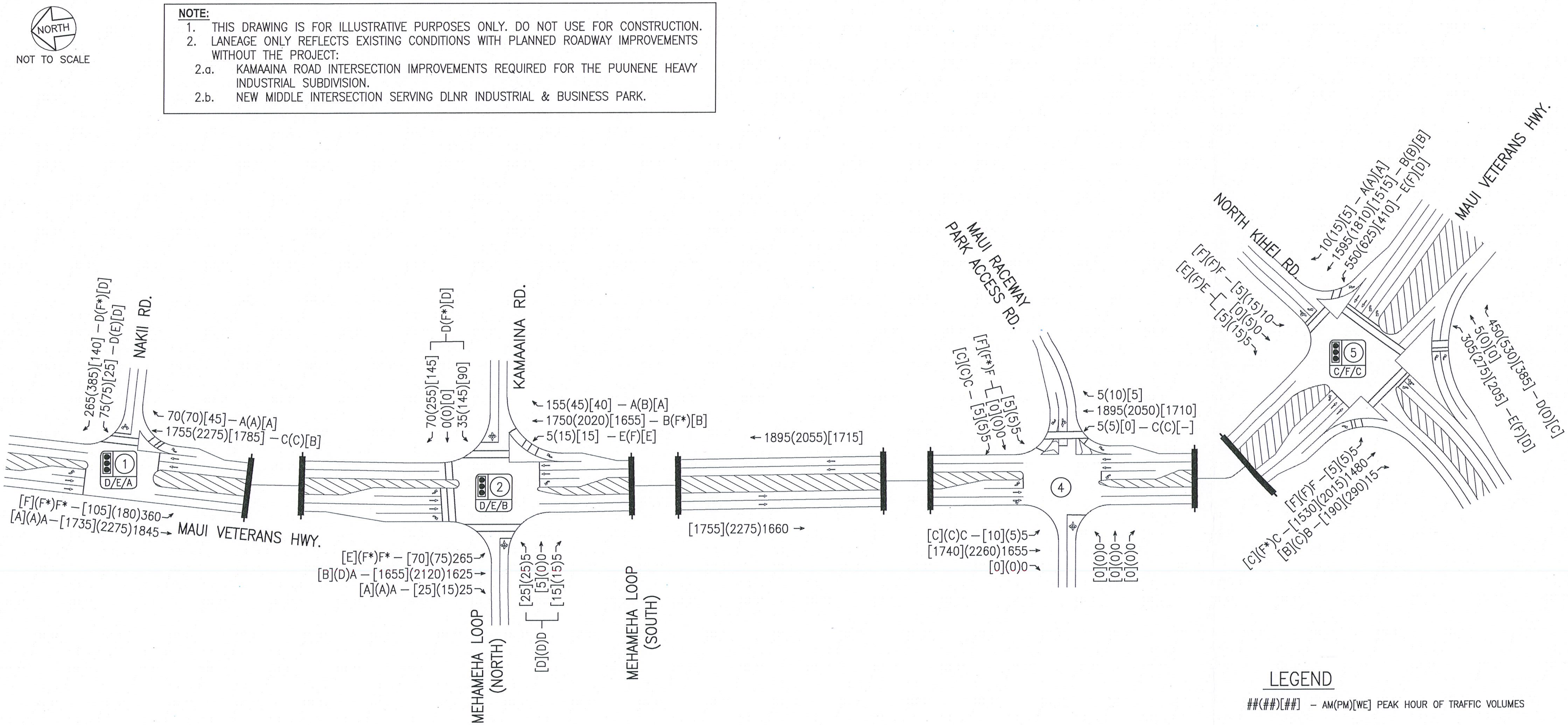
Notes:

- kSF = 1,000 Square Feet of Gross Leasable Area

1. Trip generation taken from TIAR's prepared for each respective development.

2. Table 4.2 shows total new external trips generated by each development. However, due to its location further south in Kihei, only a portion of these trips traverse the study intersections along Maui Veterans Highway.

NOTE:
1. THIS DRAWING IS FOR ILLUSTRATIVE PURPOSES ONLY. DO NOT USE FOR CONSTRUCTION.
2. LANEAGE ONLY REFLECTS EXISTING CONDITIONS WITH PLANNED ROADWAY IMPROVEMENTS WITHOUT THE PROJECT:
   2.a. KAMAAINA ROAD INTERSECTION IMPROVEMENTS REQUIRED FOR THE PUUNENE HEAVY INDUSTRIAL SUBDIVISION.
   2.b. NEW MIDDLE INTERSECTION SERVING DLNR INDUSTRIAL & BUSINESS PARK.



LEGEND

##(##)[##] – AM(PM)[WE] PEAK HOUR OF TRAFFIC VOLUMES

(X) – UNSIGNALIZED INTERSECTION X

Y A/A/A – SIGNALIZED INTERSECTION Y, OVERALL AM/PM/WE LOS

A(A)[A] – AM(PM)[WE] LOS

** – LOS NOT COMPUTED

DLNR INDUSTRIAL AND BUSINESS PARK TIAR

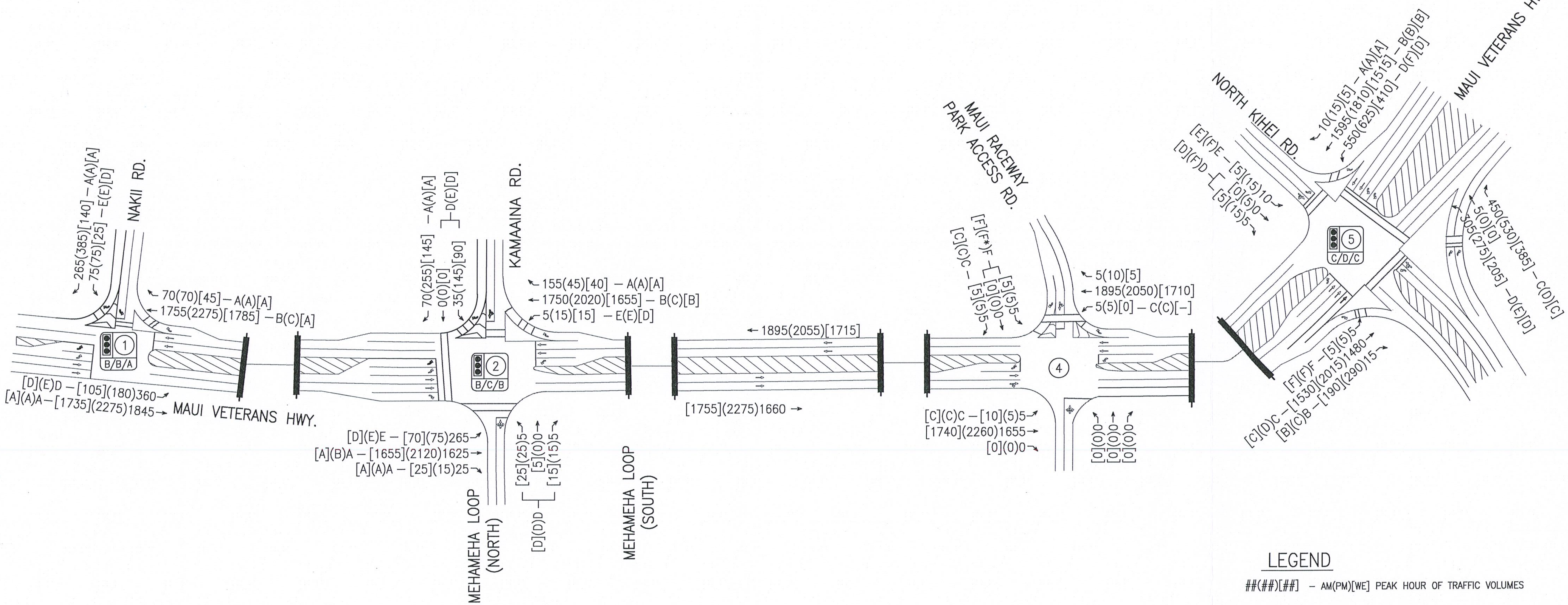
ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS,SURVEYORS • HONOLULU,HAWAII

FIGURE F1

BASE YEAR 2038 NO DHHL-DLNR-PSD (WITHOUT MITIGATION) LANE CONFIGURATION, TRAFFIC VOLUMES AND LOS

NOT TO SCALE

NOTE:
1. THIS DRAWING IS FOR ILLUSTRATIVE PURPOSES ONLY. DO NOT USE FOR CONSTRUCTION.
2. LANEAGE ONLY REFLECTS EXISTING CONDITIONS WITH PLANNED ROADWAY IMPROVEMENTS WITHOUT THE PROJECT:
   - 2.a. KAMAAINA ROAD INTERSECTION IMPROVEMENTS REQUIRED FOR THE PUUNENE HEAVY INDUSTRIAL SUBDIVISION.
   - 2.b. NEW MIDDLE INTERSECTION SERVING DLNR INDUSTRIAL & BUSINESS PARK.



LEGEND

- ##(##)[##] – AM(PM)[WE] PEAK HOUR OF TRAFFIC VOLUMES
- (X) – UNSIGNALIZED INTERSECTION X
- (Y) A/A/A – SIGNALIZED INTERSECTION Y, OVERALL AM/PM/WE LOS
- A(A)[A] – AM(PM)[WE] LOS
- ** – LOS NOT COMPUTED

DLNR INDUSTRIAL AND BUSINESS PARK TIAR

ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS, SURVEYORS • HONOLULU, HAWAII

BASE YEAR 2038 NO DHHL-DLNR-PSD (WITH MITIGATION) LANE CONFIGURATION, TRAFFIC VOLUMES AND LOS

FIGURE
F2

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS

TABLE F1: LOS SUMMARY TABLE
EXISTING, BASE YEAR 2038 AND BASE YEAR 2038 WITH MITIGATION CONDITIONS
(NO DHHL-DLNR-PSD)

Intersection	Existing Conditions									Base Year 2038 Conditions (No DLNR - DHHL - PSD)									Base Year 2038 with Mitigation Conditions (No DLNR - DHHL - PSD)								
	AM			PM			WE			AM			PM			WE			AM			PM			WE		
	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
1: Maui Veterans Hwy & Nakii Rd																											
NB TH	9.3	0.74	A	8.5	0.74	A	6.9	0.64	A	22.5	0.91	C	30.9	0.98	C	11.1	0.82	B	19.2	0.89	B	24.0	0.96	C	8.9	0.79	A
NB RT	5.3	0.01	A	4.5	0.02	A	4.5	0.01	A	8.0	0.04	A	5.3	0.05	A	4.4	0.03	A	7.1	0.04	A	4.5	0.05	A	3.6	0.03	A
WB LT	36.4	0.63	D	27.8	0.47	C	30.6	0.42	C	50.1	0.73	D	57.6	0.56	E	38.2	0.33	D	57.1	0.83	E	69.6	0.79	E	45.3	0.57	D
WB RT	21.6	0.02	C	21.7	0.02	C	18.9	0.05	B	46.2	0.63	D	677.8	2.33	F*	42.7	0.57	D	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A
SB LT	28.0	0.78	C	27.5	0.64	C	22.8	0.52	C	284.9	1.50	F*	344.6	1.56	F*	82.0	0.88	F	47.6	0.84	D	67.9	0.79	E	35.4	0.56	D
SB TH	2.8	0.50	A	3.4	0.64	A	2.8	0.48	A	5.3	0.71	A	8.5	0.84	A	3.4	0.66	A	4.7	0.70	A	6.4	0.82	A	2.8	0.65	A
OVERALL	7.5	-	A	6.5	-	A	5.2	-	A	38.4	-	D	67.6	-	E	10.0	-	A	15.8	-	B	17.9	-	B	7.0	-	A
2: Maui Veterans Hwy & Mehameha Lp North/Kamaaina Rd																											
NB LT	69.3	0.40	E	36.7	0.43	D	30.6	0.43	C	75.4	0.43	E	93.9	0.56	F	64.6	0.50	E	73.6	0.43	E	77.5	0.53	E	51.7	0.48	D
NB TH	6.9	0.65	A	6.7	0.63	A	7.2	0.60	A	15.2	0.82	B	68.0	1.05	F*	17.8	0.83	B	14.1	0.81	B	23.7	0.92	C	11.0	0.78	B
NB RT	4.1	0.00	A	3.9	0.01	A	4.7	0.00	A	7.0	0.12	A	14.3	0.07	B	8.3	0.02	A	6.6	0.12	A	7.3	0.07	A	5.2	0.02	A
EB LT/TH/RT	23.7	0.03	C	26.1	0.15	C	20.2	0.13	C	48.5	0.04	D	51.6	0.13	D	40.2	0.15	D	48.2	0.04	D	51.3	0.10	D	36.5	0.15	D
WB LT/TH										-	-	-	-	-	-	-	-	-	50.6	0.32	D	59.3	0.66	E	39.3	0.45	D
WB LT/TH/RT	23.7	0.03	C	25.3	0.01	C	19.7	0.03	B	52.2	0.42	D	122.9	1.04	F*	47.6	0.70	D	-	-	-	-	-	-	-	-	-
WB RT										-	-	-	-	-	-	-	-	-	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A
SB LT	42.2	0.64	D	135.8	0.95	F	54.4	0.56	D	382.9	1.70	F*	222.4	1.14	F*	68.1	0.84	E	63.9	0.87	E	75.2	0.81	E	44.2	0.60	D
SB TH	5.9	0.58	A	7.1	0.68	A	7.5	0.62	A	5.6	0.64	A	41.3	0.98	D	13.4	0.76	B	5.1	0.63	A	19.2	0.90	B	9.1	0.74	A
SB RT	3.7	0.02	A	3.9	0.01	A	4.9	0.02	A	2.7	0.02	A	9.4	0.01	A	6.2	0.02	A	2.4	0.02	A	5.1	0.01	A	4.3	0.02	A
OVERALL	6.8	-	A	7.7	-	A	7.8	-	A	37.0	-	D	62.1	-	E	18.6	-	B	13.9	-	B	23.8	-	C	11.8	-	B
4: Maui Veterans Hwy & Mehameha Loop South																											
NB LT	11.5	0.00	B	12.9	0.01	B	-	-	-	15.5	0.02	C	24.2	0.03	C	-	-	-	15.5	0.02	C	24.2	0.03	C	-	-	-
WB LT/TH	111.3	0.06	F	144.1	0.08	F	71.9	0.04	F	1078.8	0.91	F	2393.4	1.81	F*	760.7	0.68	F	1078.8	0.91	F	2393.4	1.81	F*	760.7	0.68	F
WB RT	14.1	0.01	B	14.3	0.01	B	12.7	0.01	B	20.8	0.02	C	22.9	0.03	C	18.5	0.02	C	20.8	0.02	C	22.9	0.03	C	18.5	0.02	C
SB LT	12.1	0.01	B	12.2	0.01	B	10.9	0.01	B	18.4	0.02	C	20.5	0.02	C	16.3	0.03	C	18.4	0.02	C	20.5	0.02	C	16.3	0.03	C
OVERALL	0.1	-	-	0.1	-	-	0.1	-	-	1.6	-	-	2.8	-	-	1.2	-	-	1.6	-	-	2.8	-	-	1.2	-	-
5: Piilani Hwy/Maui Veterans Hwy & N Kihei Rd/Monsanto Drwy																											
NB LT	29.3	0.76	C	33.4	0.79	C	24.9	0.66	C	63.8	0.89	E	101.1	0.95	F	51.9	0.84	D	43.2	0.84	D	90.1	0.93	F	40.0	0.81	D
NB TH	10.5	0.56	B	11.0	0.58	B	9.5	0.53	A	12.3	0.69	B	19.5	0.77	B	12.3	0.69	B	13.9	0.76	B	19.5	0.78	B	13.3	0.75	B
NB RT	7.1	0.01	A	7.2	0.01	A	6.8	0.00	A	6.1	0.01	A	8.1	0.01	A	6.2	0.00	A	6.9	0.01	A	8.1	0.01	A	6.8	0.00	A
EB LT	30.6	0.59	C	33.4	0.51	C	25.6	0.50	C	64.7	0.77	E	81.5	0.54	F	47.0	0.50	D	45.5	0.70	D	74.9	0.54	E	37.4	0.47	D
EB RT	18.2	0.23	B	21.2	0.32	C	17.3	0.14	B	38.2	0.34	D	51.2	0.48	D	33.3	0.39	C	26.1	0.33	C	46.4	0.47	D	25.9	0.38	C
WB LT	57.2	0.48	E	49.2	0.46	D	60.0	0.26	E	97.3	0.58	F	128.2	0.66	F	83.8	0.46	F	73.4	0.55	E	115.5	0.62	F	71.9	0.45	E
WB TH/RT	37.4	0.08	D	41.2	0.16	D	68.9	0.29	E	72.8	0.06	E	104.4	0.20	F	60.6	0.10	E	52.9	0.06	D	97.3	0.23	F	49.8	0.10	D
SB LT	113.7	0.52	F	141.4	0.45	F	79.4	0.32	E	117.0	0.56	F	152.2	0.58	F	98.5	0.55	F	94.2	0.54	F	143.0	0.58	F	86.3	0.54	F
SB TH	22.9	0.81	C	35.1	0.94	D	16.2	0.73	B	33.7	0.87	C	140.6	1.19	F*	30.3	0.90	C	24.6	0.72	C	43.8	0.85	D	20.3	0.71	C
SB RT	14.1	0.01	B	15.5	0.12	B	11.7	0.10	B	16.8	0.01	B	27.6	0.24	C	14.0	0.12	B	16.6	0.01	B	26.1	0.19	C	14.3	0.12	B
OVERALL	19.9	-	B	25.4	-	C	15.4	-	B	32.4	-	C	80.4	-	F	26.6	-	C	24.8	-	C	42.6	-	D	21.0	-	C

Table F3 - Roadway Improvements Plan

ID		Intersection	Existing (2017)	Base Year 2038 (Without DHHL-DLNR-MRPSC) With Mitigation [2]
Maui Veterans Highway @				
1	Maui Veterans Highway	Nakii Road	#1 N Maui Veterans Highway Nakii Rd	#1 N Maui Veterans Highway Nakii Rd
2	Maui Veterans Highway	Kamaaina Road [1]	#2 N Maui Veterans Highway Kamaaina Road	#2 N Maui Veterans Highway Kamaaina Road
4	Maui Veterans Highway	Mehameha Loop (South)	#4 N Maui Veterans Highway Mehameha Lp	#4 N Maui Veterans Highway Mehameha Lp
5	Maui Veterans Highway	North Kihei Road	#5 N Maui Veterans Highway N Kihei Rd/ Monsanto DW	#5 N Maui Veterans Highway N Kihei Rd/ Monsanto DW

Notes:

- Green highlighted shows proposed improvement.

1. As part of Puunene Heavy Industrial Subdivision, the southbound left-turn lane is recommended to be lengthened and a new exclusive westbound right-turn lane and acceleration lane from Kamaaina Road onto Maui Veterans Highway is recommended.

ELECTRICAL DEMAND ANALYSIS

APPENDIX P

ECM Inc. Electrical Engineering Consultants

130 N. Market Street • Wailuku HI 96793-1716 • 808.242.8070 • Fax: 808.244.9539 • Email: ecm@ecm-maui.com

DLNR Industrial and Business Park
Engineering Report

Project Description:

The State of Hawai'i, Department of Land and Natural Resources (DLNR) proposes the DLNR Industrial and Business Park, with a mix of light industrial, commercial, and public/quasi-public uses at Pulehunui, Maui. The project encompasses approximately 280 acres, including a 20.3 acre site for the proposed Division of Forestry and Wildlife (DOFAW) administrative facilities and baseyard, and 83 light industrial/commercial lots ranging from 0.5 acre to 5 acres.

Maui Electric Company (MECO):

Currently, the Maalaea Power Plant has transmission circuits to Lahaina, Kahului, Pukalani, Kula and the Kihei area. However, with the closure of HC&S's harvesting operations MECO lost approximately 16 MW emergency power and 4 WM of scheduled power. Besides this, there is a proposed closure of MECO's Kahului Power Plant, but the date has not been established. This will eventually cause MECO's Maalaea Power Plant to become the only generation plant. Should the Maalaea Power Plant become the only generating plant on the island, some upgrades and additions to the plant may be needed to accommodate overall needs. Although renewable energy sources have lowered average demands, MECO must still remain capable of accommodating maximum demands.

To accommodate the proposed DLNR Industrial and Business Park along with other planned developments in the area (DHHL, etc.) planned development (DLNR, DHHL, etc.), MECO will eventually need to install a new substation in the vicinity of the project, provided that land can be obtained and secured. A typical lot size for a substation is preferred to be a one acre parcel with perpetual easements. Their preferred location would be near their existing transmission lines along Mehameha Loop or at the Maui Veterans Highway and the Kamaaina Road intersection. MECO advises that the general timeframe for the installation of a new substation falls within the range of approximately 6 to 7 years. If land cannot be acquired for the site, MECO may need to upgrade its Maalaea Sub 39 and build another distribution circuit. In doing so, existing distribution poles and related overhead lines may need to be replaced, accordingly.

MECO has not stated exactly what additional load would trigger the new substation yet, as their current demand loads have changed. For this project, based on light industrial/commercial use and lot ranging from 0.5 acre to 4 acres, the estimated electrical demand for project is a little over 3.2 mega-watts as shown in Table #1. However, the actual demand could vary due to the variety of acceptable usage possible on light industrial/commercial properties. It should be also noted that the heavy industrial subdivision project Pulehunui Industrial Park (Pua'a Industrial Park) which is on the same circuit as this project has been completed and lots have been sold. The electrical demand for this project is estimated to be approximately 1 megawatt, but may vary as lots come on line. MECO will need to consider both these projects as well as the timing and loads of the proposed future projects from A&B and DHHL (which are currently being meter planned) in determining when they will need to have the new substation on-line. It is true the energy efficient designs or use of reusable energy system could lower the electrical demands for the project. But they cannot be accommodated for at this time as they would be at discretion of the individual lot owners.

For this project's onsite, MECO's preferred route of entry with their distribution into the project would be from either Kamaaina Road or South Firebreak Road. The Developer may decide to go with all overhead or underground distribution system for an overhead system. MECO would install all of the overhead distribution system (poles, anchors, lines, pole-mounted transformers and street lights) as needed. The installation of the underground distribution systems (lines and pad-mounted transformers) will also be done by MECO, but the Developer will be responsible to install underground infrastructure (conduit, handholes, equipment pads, etc.). It will be the responsibility of the individual lot owner and/or its contractors to submit their own service requests to MECO, accordingly. Thereafter, the individual lot owner and/or its contractors must coordinate their installation of all necessary infrastructures and services required to MECO's satisfaction and approval.

Easements will be required to cover any and all new poles, overhead and underground facilities located in private property and to include required vehicular access.

Table 1 – Estimated Project Demand Load
**Note: This is an estimate of demand loads not connected loads*

Lot Size	Number	KWA/Lot	Total (KW)
0.5 to less than 1 acre	18	25	450
1 to less than 3 acres	32	30	960
3 to less than 5 acres	25	50	1,250
5 acres	8	50	400
DOFAW (20 acres)	1	150	150
Total	83		3,210

AUGUST 16, 2017 COMMUNITY MEETING MATERIALS

APPENDIX

~~P~~Q

DLNR INDUSTRIAL AND BUSINESS PARK MEETING SUMMARY

Held at Kihei Community Center on August 16, 2017 at 5:30 p.m

Meeting Purpose: The Department of Land and Natural Resources (DLNR) conducted a public informational meeting to discuss the proposed DLNR Industrial and Business Park at Pulehunui, Maui, as well as to gain initial community feedback on the project.

Attendance: Sixteen (16) persons attended the meeting (See Sign In Sheet, **Exhibit "A"**)

A. Meeting Summary

The project team presented a PowerPoint presentation which discussed the proposed project, purpose and need, and provided information on the entitlements process. A copy of the PowerPoint presentation is attached as **Exhibit "B"**. The presentation was followed by a question and answer session with the community members present.

B. Questions and Comments

The following summarizes the questions and comments from the participants at the meeting:

Q: *Is there market demand for the project?*

A: A Market Demand Study is being conducted and will be included in the Draft Environmental Impact Statement (EIS) for public review and comment. The project location is included in the Pulehunui Growth Area in the Maui Island Plan, which describes it as a logical area for expansion of industrial uses as it is located halfway between Kahului and Kīhei.

Q: *Why aren't these lands being used for housing?*

A: The primary purpose of this project is to develop these lands for income generation to support DLNR's nature, cultural and recreational resource management programs. Leases of the project will be awarded by a competitive process, such as a request for proposals, so there are no identified potential tenants at this time. However, it is envisioned that the project would provide opportunities for local businesses.

Housing is not part of DLNR's mission. Also, the Maui Island Plan does not contemplate housing as suitable for this area. It is remotely located from public transportation and facilities, and will likely be surrounded by other industrial use developments.

Q: *Will the project create a demand for additional housing?*

Q: *Are there sufficient water/wastewater resources for this project?*

Q: *Has there been a review of the former military uses of the project area, such as unexploded ordinances?*

A: These issues will be addressed in the Draft EIS.

Q: *What is the vertical height of structures constructed in the project area?*

A; The vertical height limit for the proposed zoning designation is 60 feet.

Q: *Is a new prison part of the project?*

A: No the proposed prison is a separate project.

The project received support from the Kihei Community Association and Go Maui, who looked forward to continued engagement and transparency with DLNR. A Maui County Councilmember stated that the project will require a Community Plan amendment. She encouraged DLNR to participate in the Kihei-Makena Community Plan review process. See **Exhibits "C"**, **"D"**, and **"E"**.

K:\DATA\SOH DLNR\Pulehunui MP EIS 1882\Meetings\081617 Community Meeting Memo.DraftEIS.doc

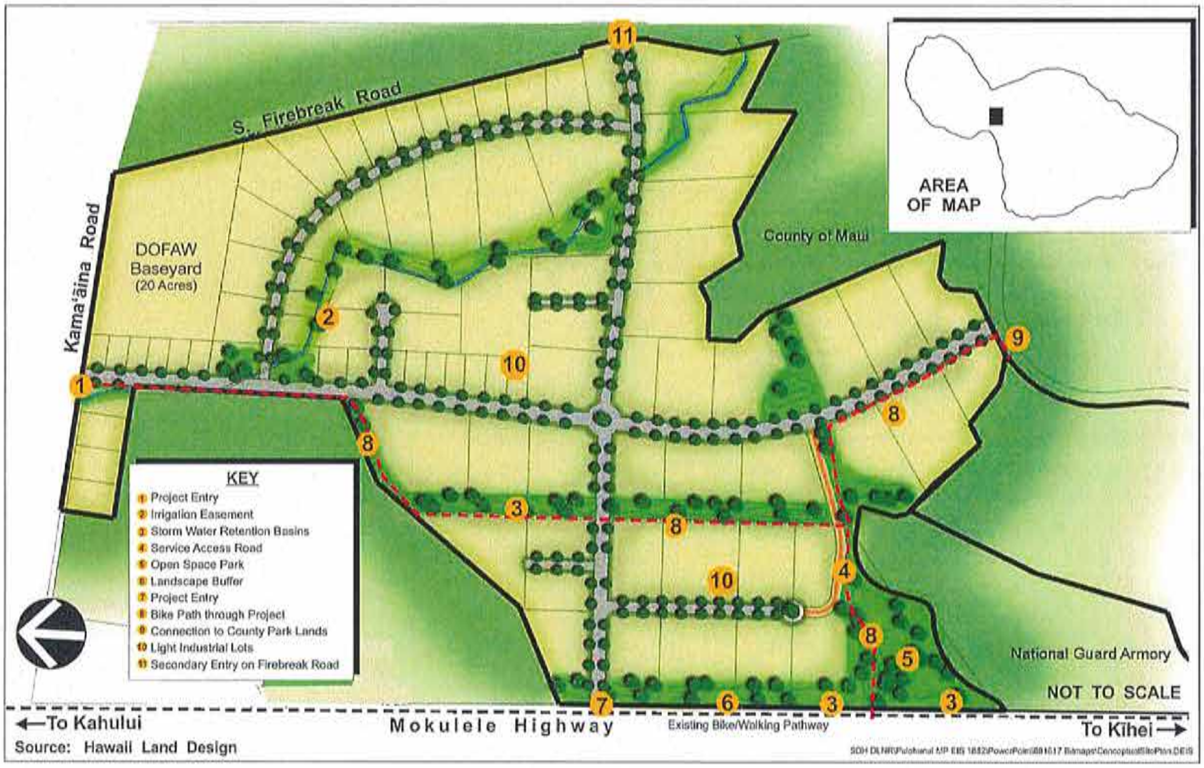
DEPARTMENT OF LAND AND NATURAL RESOURCES
Industrial and Business Park Community Meeting
August 16, 2017
Sign-In Sheet

	NAME (PRINT)	AFFILIATION (PRINT)	ADDRESS (STREET/MAILINGCITY, STATE ZIP CODE) (PRINT)	PHONE (PRINT)	E-MAIL (PRINT)
1	LADVIA TAYLOR	TAXPAYOR			
2	Scott WAlsh	K.-HANA Nursery			
3	Kaleo Manuel	DHHL			
4	Selena Pang	PBR HAWAII			
5	Rosalyn Baker	St. Senator			
6	Basil Oshiro	Aha Moku			
7	Kehau Filimoeatu	NPK			
8	Robert Stoner	StF Land Co			
9	C HAYES				
10	Chris	The Maui News			
11					

EXHIBIT "A"

	NAME (PRINT)	AFFILIATION (PRINT)	ADDRESS (STREET/MAILINGCITY, STATE ZIP CODE) (PRINT)	PHONE (PRINT)	E-MAIL (PRINT)
12	Kelly T. King	Maui County Council			
13	Tasha Kama				
14	BLANCA LAFOLETTE	PACIFIC RIM LAND			
15	MIKE MORAN	KCA			
16	Tom Blackburn Rodriguez	Go Maui			
17	Howard Rodrigues	Olowalu			
18					
19					
20					
21					
22					
23					

DLNR INDUSTRIAL AND BUSINESS PARK
PULEHUNUI, MAUI



DLNR
INDUSTRIAL AND BUSINESS PARK

Community Meeting

August 16, 2017

EXHIBIT "B"

DEPARTMENT OF LAND AND NATURAL RESOURCES OVERVIEW

PRESENTATION OVERVIEW

- Department of Land and Natural Resources Overview
- Industrial and Business Park Project Overview
- EIS and Entitlement Process
- Outreach and Community Benefits

DLNR LAND DIVISION

- Land Division is one of 10 divisions within DLNR
- Assists Board of Land and Natural Resources in overseeing the management of 1.3 million acres of State lands
  - Leasing (commercial, industrial, agriculture, resorts, renewable energy)
  - Easements, revocable permits, and rights of entry
  - Shoreline certification in conjunction with Office of Conservation and Coastal Lands and Department of Accounting and General Services
  - Enforcement actions (e.g., shoreline encroachments, unauthorized commercial activities)
  - Land acquisition

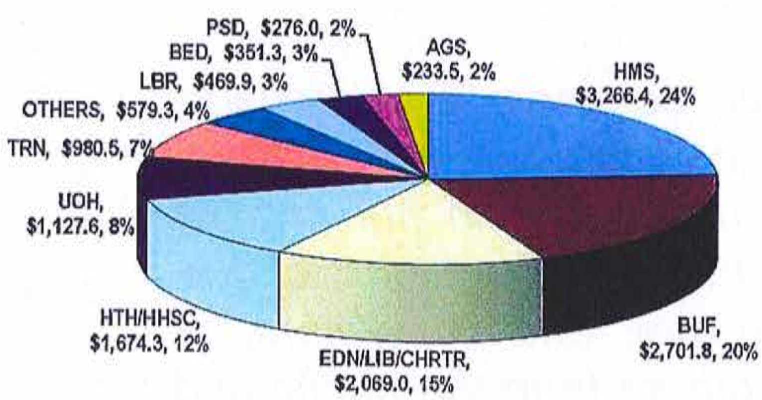
DEPARTMENT OF LAND AND NATURAL RESOURCES MISSION

"Enhance, protect, conserve and manage Hawaii's unique and limited natural, cultural and historic resources held in public trust for current and future generations of the people of Hawaii nei, and its visitors, in partnership with others from the public and private sectors."

DLNR LEASE RENT REVENUES
The Special Land Development Fund

Land Division:	100% funding of annual operating budget
Office of Conservation and Coastal Lands (OCCL):	100% funding of annual operating budget
Engineering Division:	▪ Dam Safety Program (majority funding for personnel costs, operations costs and funding for water gauges for streams and dams) ▪ Geothermal Mining Program
Division of Forestry and Wildlife (DOFAW):	▪ Threatened and Endangered Species Program ▪ Invasive Species Program ▪ Other operational expenses such as covering overtime pay in past years for Wildland Firefighting
State Parks:	▪ Life Guard Services
Commission on Water Resource Management (CWRM):	▪ Fund five (5) Positions (2 hydrologists, 1 conservation/drought coordinator, 1 planner, 1 engineering aid) ▪ Funds for Stream Monitoring and certain other stream related studies

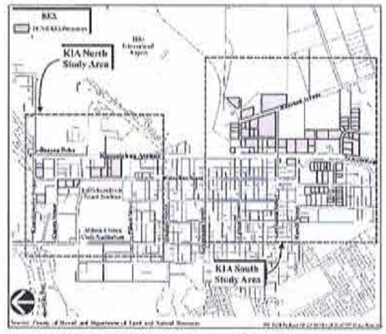
FISCAL YEAR 2017 SUPPLEMENTAL BUDGET STATEWIDE TOTALS BY DEPARTMENT (ALL FUNDS)



- State total budget is approximately $13.7 billion
  - DLNR budget is approximately $138.3 million, or 1.0 percent of total

DLNR LEASED LANDS

Sand Island Business Park
Honolulu, O'ahu



Kanoelehua Industrial Area
Hilo, Hawai'i

Banyan Drive
Hilo, Hawai'i

Milltown Lots
Waipahu, Hawai'i

NEED FOR LONG-TERM RELIABLE REVENUE SOURCE

- Land and natural resource protection programs have difficulty competing with other government programs for general fund support

- Limited amount of designated lands for income generation are critical for the long-term viability and sustainability of DLNR natural resource protection programs

DLNR INDUSTRIAL AND BUSINESS PARK OVERVIEW

PROJECT LEASE REVENUE

- Some of the environment-related DLNR divisions and programs that will receive financial support from the lease revenue generated at the DLNR Industrial and Business Park are:

Land Division

Division of State Parks

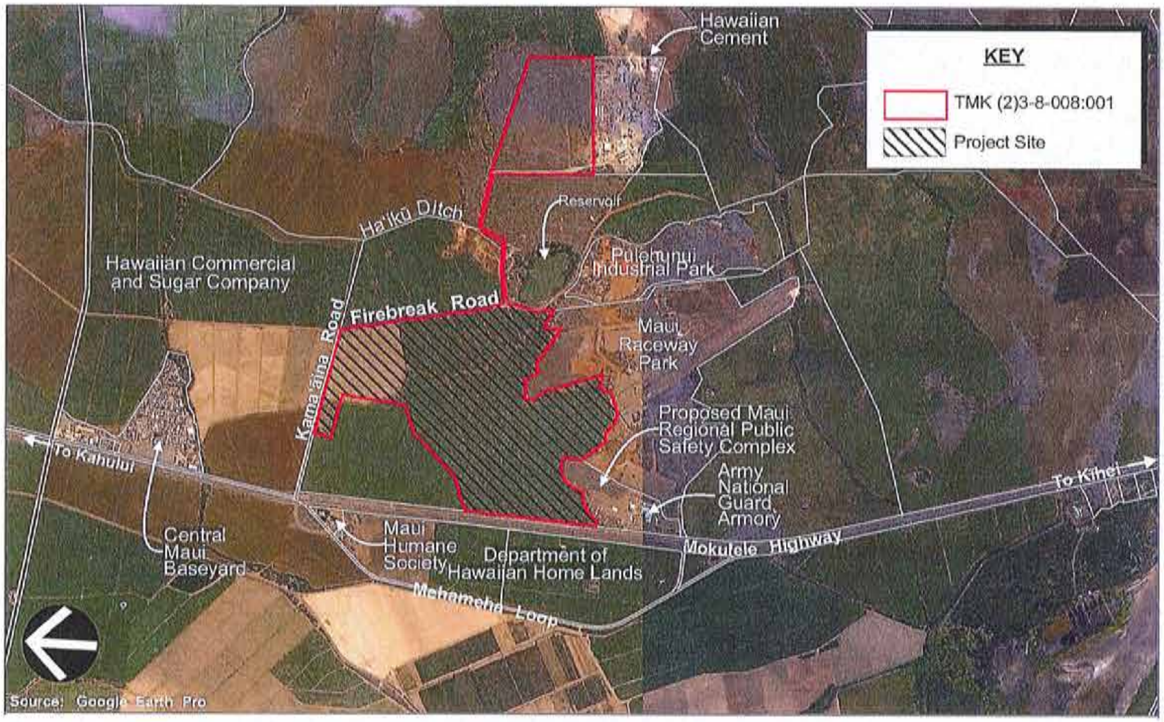
Commission on Water Resource Management

Division of Forestry and Wildlife

Engineering Division

Office of Conservation and Coastal Lands

PROPERTY LOCATION MAP



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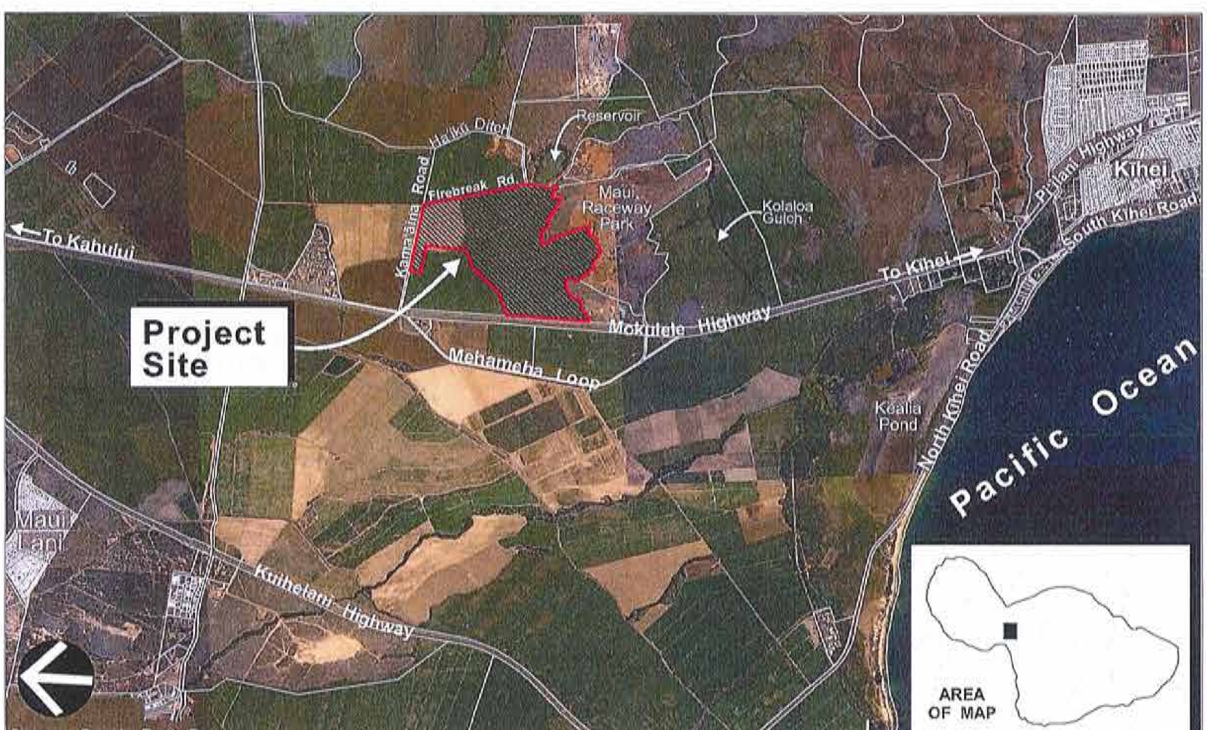
REGIONAL LOCATION MAP



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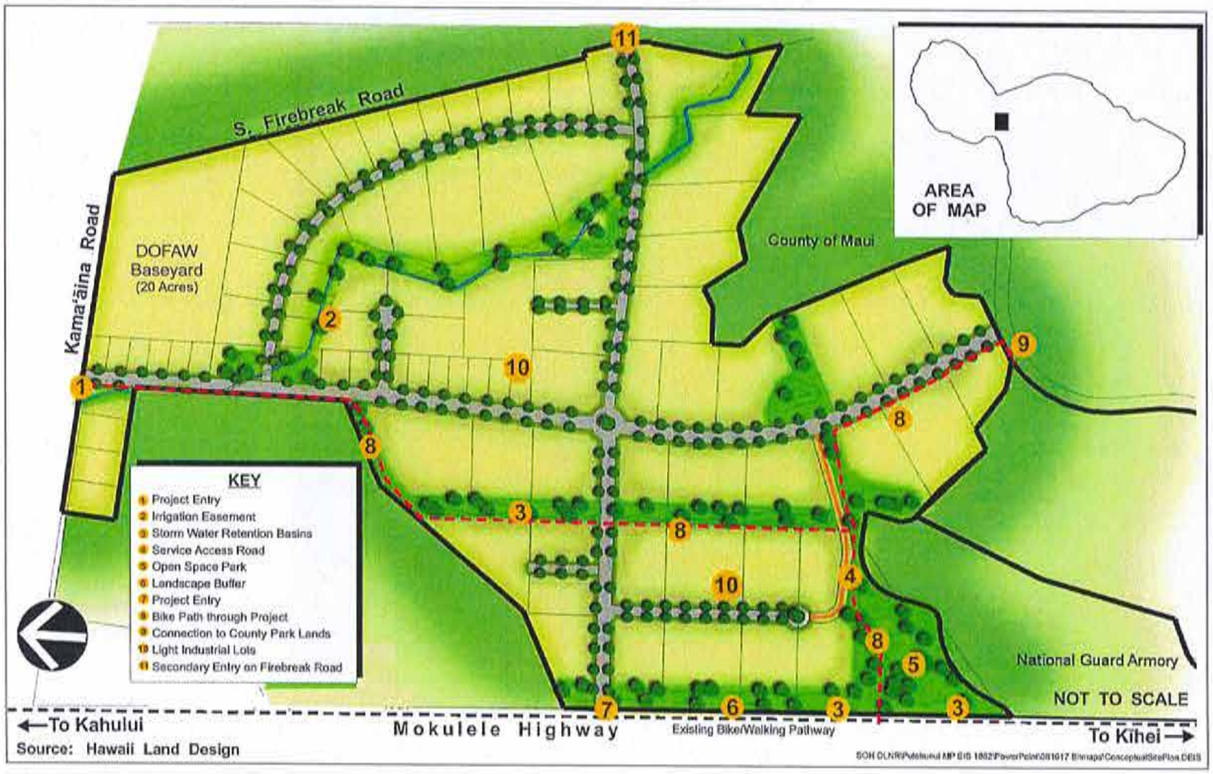
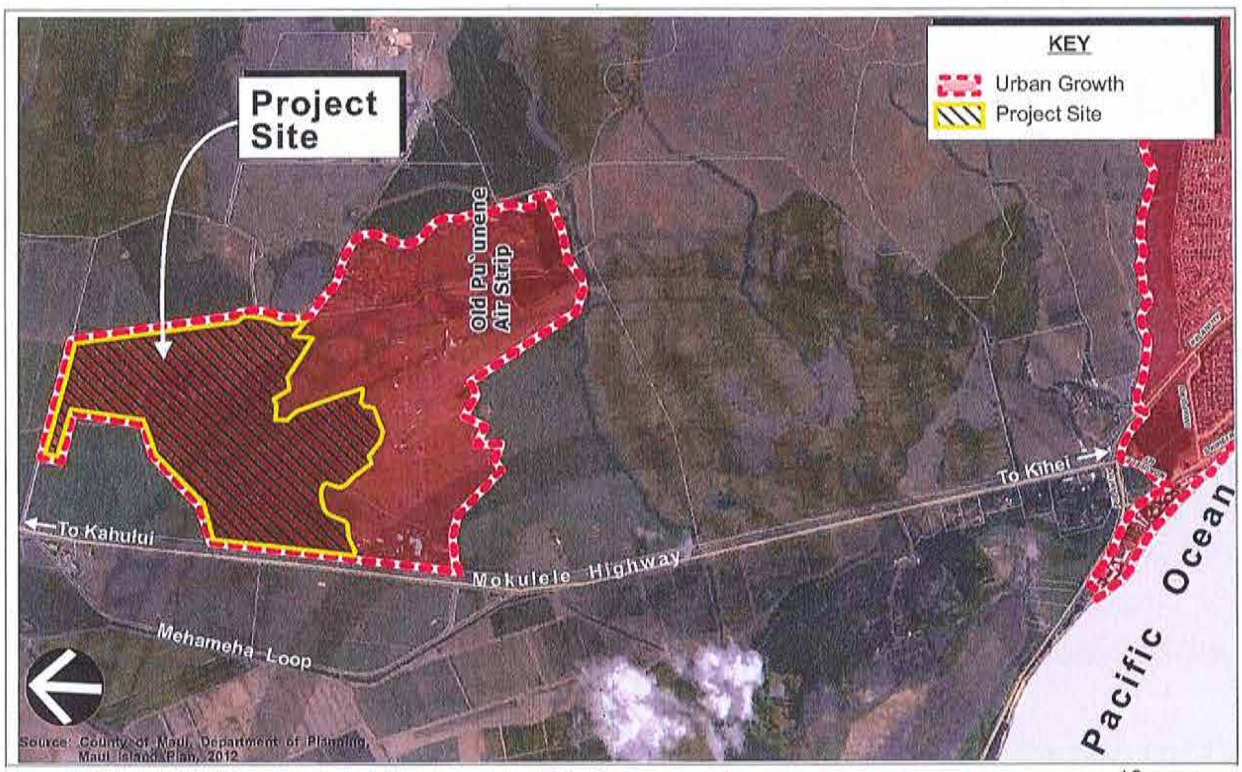
SITE PLAN



PROJECT DESCRIPTION

- 280-acre portion of TMK (2)3-8-008:001, owned by State of Hawai'i
- Variety of small, medium, and large lots to meet needs of lessees
- Internal roadway networks, as well as bicycle, open space and drainage networks to be developed
- Accessed via Mokulele Highway, Kama'āina Road, and Raceway Park Access Road

MAUI ISLAND PLAN MAP



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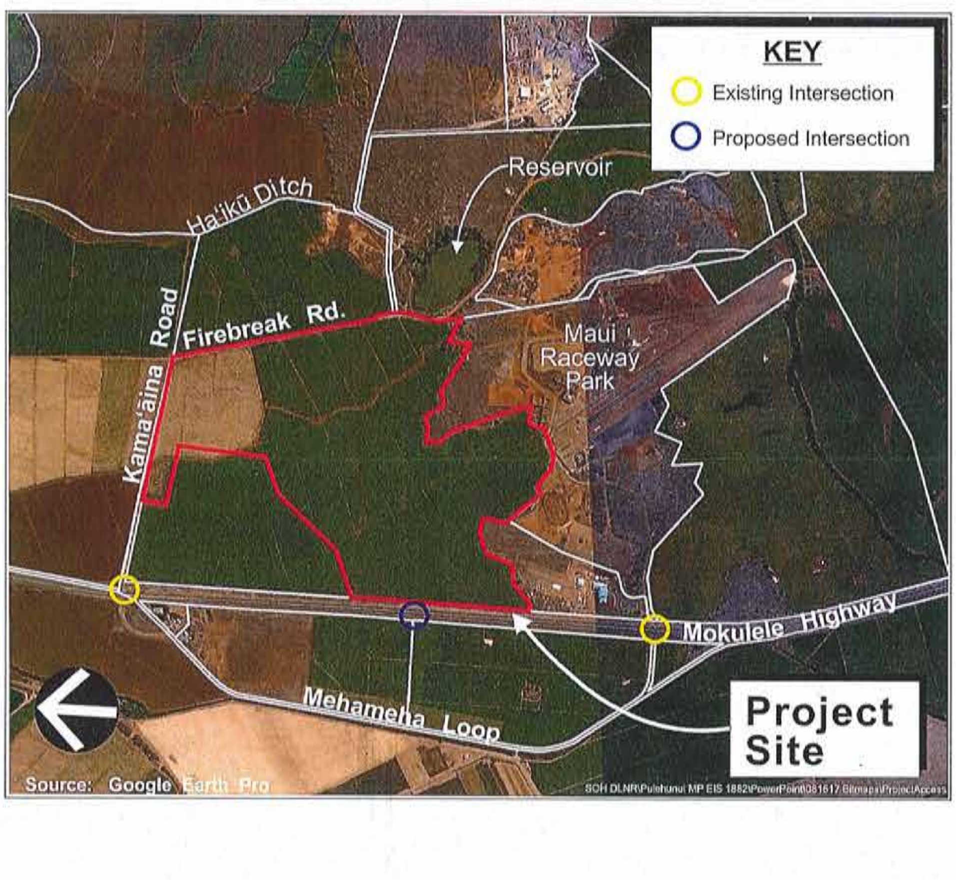
PROJECT ACCESS



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ANTICIPATED LAND USES
M-1 Light Industrial Zoning

- **Light Industrial Uses**
  - Warehouse and storage buildings
  - Manufacturing
  - Baseyards
  - Wholesale businesses
  - etc.
- **Government Uses**
  - Proposed 20-acre Division of Forestry and Wildlife (DOFAW) Baseyard
  - Other government uses
- **Limited Commercial Uses**

MAUI ISLAND PLAN
Pulehunui Growth Area

"The Pulehunui planned growth area envisions land uses that are compatible with surrounding agricultural operations. The planned growth area represents a logical expansion of industrial land use in the area."

CONCEPTUAL RENDERING

CONCEPTUAL RENDERING

CHAPTER 343, HRS
ENVIRONMENTAL IMPACT STATEMENT

- Use of State Lands and Funds triggers need for environmental review
- Environmental Impact Statement (EIS) will be prepared
- EIS Preparation Notice was published March 8, 2017

EIS AND ENTITLEMENTS

STATE AND COUNTY LAND USE ENTITLEMENTS

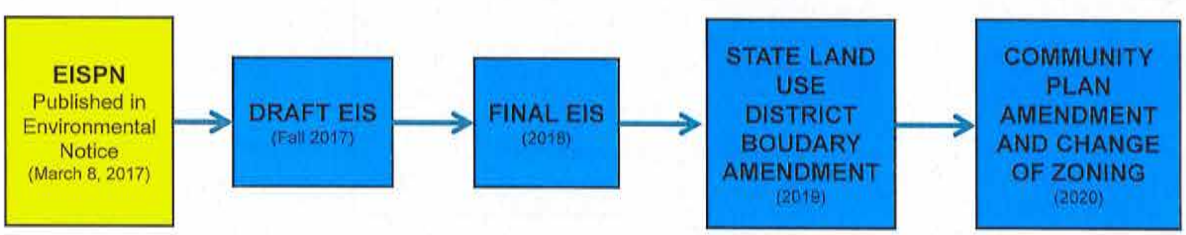
Entitlements	Current	Proposed
State Land Use District	Agricultural	Urban
Kihei-Makena Community Plan	Project District 10 (portion)	Light Industrial
	Agriculture (portion)	Light Industrial
Zoning	Agricultural	M-1 Light Industrial District

EIS TECHNICAL STUDIES

Report	Consultant
Master Plan Concept, Landscape Plan	Hawaii Land Design
Preliminary Engineering and Drainage Report	Austin, Tsutsui & Associates, Inc.
Traffic Impact Analysis Report	Austin, Tsutsui & Associates, Inc.
Noise Study	Yoichi Ebisu
Air Quality Study	BD Neal
Archaeological Inventory Survey	Scientific Consultant Services
Cultural Impact Assessment	Scientific Consultant Services
Biological Resources Study	Robert Hobdy
Design Guidelines, View Analysis	Bowers + Kubota
Market Study	ACM
Fiscal and Economic Impact Assessment	Munekiyo Hiraga/Bruce Plasch
Agricultural Impact Assessment	Munekiyo Hiraga/Bruce Plasch
Sustainability Report	Munekiyo Hiraga
Financial Feasibility Study	Fukuda Valuation and Consulting
Hydrogeological Study	Tom Nance Water Resource Engineering

OUTREACH AND COMMUNITY BENEFITS

PROJECT TIMELINE
EIS and Entitlement Process



COMMUNITY BENEFITS

- Economic development and job opportunities for Maui residents
- Long-term revenue stream to support a wide range of DLNR programs
- New source of tax revenue for Maui County and State of Hawai'i
- Opportunity for repurposing idle former sugarcane lands
- Appropriately placed development within the Urban Growth Boundary of the Maui Island Plan
- Opportunity for State Agency Collaboration

STAKEHOLDER ENGAGEMENT

- DLNR has met with:
  - Sierra Club
  - Maui Tomorrow
  - Kihei Community Association
  - Aha Moku representatives
  - Neighboring Landowners
  - Elected officials
  - State agencies
  - County administration

DLNR will continue to coordinate with interested stakeholders as planning for the project moves forward

Mahalo!

Project website: http://dlnr.Hawaii.gov/ld/proposed-dlnr-industrial-and-business-park-at-pulehunui-maui/

Department of Land and Natural Resources
1151 Punchbowl Street, Room 220
Honolulu, Hawaii 96813
Dlnr.land@hawaii.gov
Phone: (808)587-0419

8/16/17

Go Maui, Inc.

Tom Blackburn Rodrigues
Executive Consultant

808-283-4570
tominmaui@icloud.com

Go Maui would like to schedule a meeting to discuss project in more detail.

Thank you,

Tom B.

EXHIBIT "C"

DEPARTMENT OF LAND AND NATURAL RESOURCES

PUBLIC INFORMATION MEETING SCHEDULED ON PROPOSED LIGHT INDUSTRIAL/COMMERCIAL BUSINESS PARK AT PULEHUNUI

AUGUST 16, 2017

TESTIMONY OF TOM BLACKBURN-RODRIGUEZ ON BEHALF OF GO MAUI, INC.

Chair and commission members, my name is Tom Blackburn-Rodriguez and I am testifying on behalf of Go Maui, Inc., an nonprofit organization supporting affordable housing, good paying jobs and access to water for housing development.

Go Maui supports the efforts of DLNR to develop a Light Industrial and Business Park at Pulehunui as an opportunity to expand the use of State lands to generate economic development and job opportunities for Maui residents in an area identified for future growth and to meet the demand for light industrial space.

Importantly, the project will provide a long-term revenue source to support DLNR's various natural, cultural and recreational resource management programs through rent from the leasing of lots within the Industrial and Business Park. This includes management of public lands as well as support for divisions within the DLNR, including the Commission on Water Resources Management, Division of Forestry and Wildlife, State Parks, Office of Conservation and Coastal Lands, Engineering Division, and Land Division. The state is tight on money and creative efforts to raise additional funds are needed to meet our critical public needs.

The proposed project will include small, medium and large lots utilized for light industrial, commercial, non-profit and public/quasi-public uses, along with necessary infrastructure.

Go Maui fully expects that the project will be subject to extensive regulatory oversight and approvals. As this is a proposed use of State lands, an Environmental Impact Statement (EIS) is required pursuant to Chapter 343, Hawai'i Revised Statutes.

Upon completion of the EIS, the project will require a State Land Use District Boundary Amendment from the State Land Use Commission and a Community Plan Amendment and Change of Zoning from the Maui County Council.

Our support for this project is based on our respectful expectation that the DNLR will comply fully and transparently with all applicable land use, archeological and cultural regulations. Thank you for the opportunity to testify tonight.

EXHIBIT "D"

AUG 21 2017

COMMENT FORM

DEPARTMENT OF LAND AND NATURAL RESOURCES
INDUSTRIAL AND BUSINESS PARK

COMMUNITY MEETING
August 16, 2017

Name: Kelly King
Affiliation: Maui County Council
Address:
Phone No.: 808-283-1954 (cel)
Alternate No:
Email Address: kelly.king@mauicounty.us

Please write any comments you wish to share on the proposed project below.

The County Council Planning Committee will begin addressing the Kihei-Makena Community Plan around the end of 2018/early 2019. Please coordinate changes with the community meetings we will be holding so you don't need to "amend" the Plan

Please submit your comments by the end of the meeting or, if you wish, you may mail your comments attention to the address below by **August 30, 2017**:

Russell Tsuji, Administrator
Land Division
Department of Land and
Natural Resources
1151 Punchbowl Street, Suite 220
Honolulu, Hawai'i 96813

Colleen Suyama, Senior Associate
Munekiyo Hiraga
305 High Street, Suite 104
Wailuku, Hawai'i 96793

Should you have any questions, please feel free to contact Colleen Suyama at 244-2015.

EXHIBIT "E"

OUTREACH MEETINGS WITH AGENCIES AND COMMUNITY GROUPS

APPENDIX Q-1

CONSULTATION
WITH AGENCIES AND COMMUNITY GROUPS

AGENCIES/STAKEHOLDER GROUPS	DATES
COUNTY OF MAUI	
Department of Environmental Management	January 31, 2017
Department of Fire and Public Safety	January 31, 2017
Department of Housing and Human Concerns	January 31, 2017, February 27, 2017, March 13, 2017, June 7, 2017
Department of Parks and Recreation	January 31, 2017, June 29, 2017
Department of Planning	September 29, 2016, January 31, 2017, August 16, 2017, June 25, 2018
Department of Public Works	September 29, 2016, January 31, 2017, June 29, 2017
Department of Water Supply	January 31, 2017, December 20, 2017, February 16, 2018
Mayor Alan Arakawa	January 31, 2017
Councilmember Alika Atay	February 7, 2017
Councilmember Robert Carroll	
Councilmember Kelly King	January 31, 2017, June 25, 2018
Councilmember Yuki-Lei Sugimura	January 24, 2017
STATE OF HAWAI'I	
Department of Accounting and General Services	February 15, 2017
Department of Hawaiian Home Lands	June 23, 2016, November 29, 2016, February 15, 2017, June 5, 2017, December 6, 2017, January 18, 2018, May 1, 2018, October 1, 2018, October 18, 2018, November 28, 2018
Department of Public Safety	February 15, 2017, May 1, 2018
Department of Transportation, Ken Tatsuguchi	June 5, 2017, October 18, 2018
Office of Environmental Quality Control	November 29, 2016
Office of Hawaiian Affairs	December 12, 2016
Office of Planning	November 28, 2016
State Land Use Commission	November 28, 2016
Lt. Governor Shan Tsutsui	February 15, 2017
Representative Kaniela Ing	August 24, 2017
Representative Angus McKelvey	August 24, 2017
Representative Kyle Yamashita	November 28, 2016, August 24, 2017
Senator Roz Baker	June 7, 2017
OTHERS	
Aha Moku O Kula Makai	June 25, 2018, October 16, 2018
Central Maui Baseyard	May 9, 2018
Go Maui	June 25, 2018
Hawaii Construction Alliance	August 16, 2017
HC&S	July 16, 2018
Kihei Community Association	August 15, 2017
Maui Tomorrow, Director Al Perez	January 31, 2017
Neighboring Land Owners	August 16, 2017
Sierra Club, Lucienne De Naie	January 31, 2017
Wailuku Aha Moku	February 7, 2017, May 16, 2017, October 16, 2018