WAIʻALE

Final Environmental Impact Statement

Volume 2 of 2 | Appendices

Prepared by:

PBR HAWAII & ASSOCIATES, INC.

October 2011

List of Appendices

APPENDIX A: PLANNING PROCESS

WAI‘ALE

“Growth in Central Maui is due in large part to the fact that our kids grow up, they get educated, they have an opportunity to live and work on Maui, and they choose to do so. The challenge we face together is ensuring that our community can accommodate for this growth in a manner that will make Maui an even better place to live. That's what Wai‘ale is all about.”
— GRANT CHUN, A&B PROPERTIES

COMMUNITY VISION STATEMENT

Create a socially integrated community with a unique sense of identity and character, capitalizing on its location and natural features.

As an extension of Kahului “Dream City”, Wai‘ale will be a community that makes both visitors and residents feel welcomed and plans for the long range community and civic facilities to support the Central Maui region.

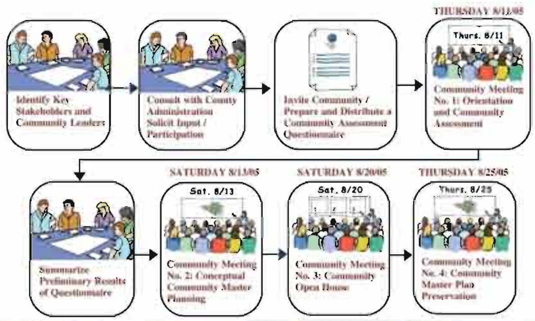
KEY COMMUNITY PLANNING GOALS

- Provide walkable mixed-use neighborhoods.
- Provide homes for a variety of income ranges, ages, and lifestyles. If so desired, a resident can grow up and spend their entire life in the community with the appropriate housing types available.
- Plan for community facilities to meet the region's current and future needs.
- Include a multi-modal transportation system that accommodates walking, biking, jogging, and driving.
- Include commercial activities (including locally-owned stores and restaurants), schools, and other civic and recreational facilities.
- Respect the natural and historical significance of the land.
- Capitalize on the views of Haleakalā, the West Maui Mountains, and other significant landmarks.

WAI‘ALE COMMUNITY PLANNING PROCESS

Wai‘ale has been planned through a community-based process including meetings with key stakeholders, community leaders, the County of Maui Administration, and Maui residents. Questionnaires, informational meetings, and planning workshops held in August 2005 sought community input and participation in developing a vision and conceptual master plan for Wai‘ale.

The products of these meetings are Wai‘ale's conceptual master plan and vision statement, which envisions a socially integrated community with a unique sense of identity and character that makes both visitors and residents feel welcomed.



“I loved this experience. The feedback and commitment of all the participants was great. The end result truly represents the needs and wants of the community. Wai‘ale will become the neighborhood of choice for generations to come.”
-KAY FUKUMOTO, COMMUNITY PARTICIPANT

ALTERNATIVE CONCEPT PLANS (PREPARED BY COMMUNITY PARTICIPANTS)

KEY PLANNING ELEMENTS

1. **Public Facilities and Future Civic Use Reserve**
   - Regional Park
   - Community Support Facilities
     - Social Services
     - Special Needs Housing
   - Mixed-Use “Town Center”
2. **Transportation Systems**
   - Roadways
   - Transit
   - Bike Paths
   - Pedestrian Paths
3. **Mix of Land Uses/Smart Growth Principles**
   - Residential (Single-Family and Multi-Family)
   - Mixed-Use Business/Commercial (with Multi-Family Residential)
   - Light Industrial
   - Civic Uses/Town or Village Centers
   - Parks and Recreation
   - Open Space
4. **Site Attributes and Cultural/Burial Preserves**
   - Waikapū Stream
   - Light Industrial Uses
   - Preserving Views of West Maui Mountains and Haleakalā
   - Preserving Existing Cultural Sites and Burials


1


2

“It was gratifying to experience an open planning process that truly welcomed participation from diverse sectors of the community.”
— COUNCILMEMBER JOSEPH PONTANILLA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4

Mahalo. *A sincere mahalo to all those who participated in and contributed to this important community planning effort. Your insights were terrific and we look forward to your continued participation as we move forward with our planning.*

SHAPING OUR COMMUNITY'S FUTURE.

COMMUNITY PARTICIPANTS (AS OF SUMMER OF 2005)

Jim Berling
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Jacob Kellaw
Valerie Monson
Amanda Cowan
Daryl Atay
Mark Tracy
Mike & Monika Irwin
Yvone Kahaumoepua
Jim Dodd
Reid Kawabata
Steph Ohigashi
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Dana Naone Hall
Florence Nakama
Joan Martin
Kallie Keith
Kevin Gillies
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Mary Baga
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Patricia Rouse
Rosie Elcopilla
Wayne Hikiji
Jacqueline Perreira
Robin Cabral
Harmut "Hoppy" Bielow
Katrina Madamba
Lynne Gilroy
Rick Medina

A&B PROPERTIES, INC.
A SUBSIDIARY OF ALEXANDER & BALDWIN, INC.

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VILLAGE CONCEPT

- 10-Minute Bike Ride to Village Center
- 5-Minute Walkable Neighborhoods

PLANNED PUBLIC FACILITIES

TRANSPORTATION SYSTEMS

- Interconnected system of bike and pedestrian paths promotes a walkable community
- Major roads provide more connections through the region
- Minor roads laid out in a modified grid pattern promote connectivity and alternative routes through Wai‘ale

NEXT STEPS

1. **Complete Technical Studies** *(August 2005 - March 2006)*
   - Marketing Fiscal Impact
   - Archaeology
   - Cultural
   - Flora and Fauna
   - Noise
   - Air Quality
   - Traffic Impact
   - Preliminary Engineering and Drainage
   - Hydrology
   - Legal
   - Land Survey
2. **Refine Community Master Plan** *(September 2005 - Ongoing)*
   - Keep the community informed and involved in planning process
   - Put your name on our contact list
3. **Consult with the County Administration and State Agencies** *(September 2005 - Ongoing)*
4. **Begin Land Use Approval Process** *(November 2005 - Ongoing)*
5. **Participate in County Plan Updates** *(Ongoing)*

“We want to make sure our kids can grow up and live on Maui in a community we can all feel proud of.”
-GRANT CHUN, A&B PROPERTIES

Village Center
- Neighborhood Commercial Uses
- Community Services
- Farmer's Market
- Connected to Residential Villages through Pedestrian and Bicycle Paths

Village Mixed Use (VMX)
- Commercial, Office Retail, Civic, and Multi-Family Residential Uses
- Connected with Community through Pedestrian and Bicycle Paths

Mixed Use
- Social Services
- Civic, Business, and Multi-Family Residential Uses

Schools
- Elementary School within Residential Village
- Middle School within 5-Minute Walk to Regional Community Center and Regional Park

Public Support Facilities & Regional Community Center
- Public and Recreational Uses
- Community Center Similar to Neal Blaisdell Center

Health & Wellness / Medical Center
- Public Uses
- Adjacent to Regional Community Center and Park

Conceptual Community Master Plan

WAI'ALE

PBR HAWAII

A&B PROPERTIES, INC.

LEGEND

Use	Description	Approximate Area (Acres)	Approximate No. of Dwellings
Village Center	Neighborhood commercial, community services, and farmer's market	10	
Village Mixed Use (VMX)	Mix of commercial, office, retail, civic and Multi-Family (MF) residential (5-8 Dwelling Units (DU/Acre)	54	270-430
Mixed Use		70	210-350
Schools		28	
Public Suport Facilities & Regional Community Center		46	
Health & Wellness/ MedicalCenter		40	
Medium Density Residential	MF dwellings (A-2, 45' height, 4 stories, 15-20 DU/Acre)	119	1785 - 2380
Low Density Residential	Single-Family detached and duplex homes (3.5-7 DU/Acre)	203	710-1420
Parks		199	
Community Gardens		10	
Greenways & Open Space		47	
Greenway & Bike/Pedestrian Paths		--	
Landmark Buildings		--	
		TOTAL: 826 ACRES	2975 - 4580 Units

Integrating the community's vision and conceptual plans for Wai'ale, the Conceptual Community Master Plan illustrates the overall land use and circulation concept. The plan addresses the long term needs of Central Maui by providing recreational and civic areas to support the regional growth. As a community planned to meet the future housing needs, the master plan incorporates traditional neighborhood design with the key principles of Smart Growth.

10 PRINCIPLES OF SMART GROWTH

1. A mix of land uses
2. Compact building design
3. A range of housing opportunites and choices (density and types)
4. Walkable neighborhoods
5. Distinctive, attractive communities with a strong sense of place
6. Preservation of open spaces, farmland, natural beauty, and environmental areas
7. Development directed towards existing communities
8. A variety of transportation choices
9. Predictable, fair, and cost-effective development
10. Community and stakeholder collaboration in development decisions

Residential Villages
- Seven Residential Villages Offering a Variety of Housing Types
- Neighborhood Parks within Walking Distance
- Easily Accessible

Parks, Greenways & Open Space
- Regional Park and Neighborhood Parks near Residential Villages
- Greenways and Open Space Enhance Wai'ale's Visual Character

Community Gardens
- Cultivated Fruits, Vegetables, and Flowers

Bicycle/Pedestrian Paths
- Encourages Multi-Modal Transportation
- Integrated with Network of Open Spaces and Greenways
- Links All Land Uses within Wai'ale

Landmark Buildings
- Enhances Community's Character at Prominent Locations

"The community of Maui needs to have vital services provided in a central location: a hospital site, a regional community center, a regional park, a location for county baseyards, social services facility spaces, affordable housing and school sites. This project is a great give back to the Maui community."

-MAYOR ALAN K. ARAKAWA

Appendix B: Geological Reconnaissance Survey

GEOLOGICAL RECONNAISSANCE

WAIALE DEVELOPMENT

KAHULUI, MAUI, HAWAII

W.O. 6438-00   APRIL 13, 2011

Prepared for

A&B PROPERTIES, INC.

CLAYTON S. MIMURA
LICENSED PROFESSIONAL ENGINEER
No. 4176-C
HAWAII, U.S.A.

THIS WORK WAS PREPARED BY
ME OR UNDER MY SUPERVISION.

SIGNATURE   4-30-12
EXPIRATION DATE OF THE LICENSE

GEOLABS, INC.
Geotechnical Engineering and Drilling Services
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Hawaii • California

GEOLOGICAL RECONNAISSANCE
WAIALE DEVELOPMENT
KAHULUI, MAUI, HAWAII

W.O. 6438-00 APRIL 13, 2011

TABLE OF CONTENTS

GEOLOGICAL RECONNAISSANCE

WAIALE DEVELOPMENT

KAHULUI, MAUI, HAWAII

W.O. 6438-00 APRIL 13, 2011

EXECUTIVE SUMMARY

An on-ground field reconnaissance survey and geological mapping of the project site was conducted by two geologists from our Maui office. Locations in the field were established using features shown on the topographic survey map and a hand-held Global Positioning System (GPS) receiver.

The mapping included in-situ dune structures and areas where the original dunes had been obliterated, heavily impacted or degraded. The locations of these structures and areas are presented on the Generalized Geologic Map, Plate 2.

During the course of our field reconnaissance, we did not find natural lithified sand dunes that could be considered to be pristine geological features. The majority of the dunes within the project limits have essentially been obliterated by human activities.

In the southern part of the site, south of Waiko Road, the former dune lands were flattened and tilled for the cultivation of sugar cane. The north central portion of the site includes some small clusters of dunes. However, these dune clusters have been degraded by longstanding ranching activities and other agricultural use. The north western portion of the site has been heavily disturbed by sand mining, stockpiling and agricultural use. However, this area also includes the larger and comparatively more representative examples of the remaining dune structures within the site.

EXECUTIVE SUMMARY

SECTION 1. GENERAL

1.1 Introduction

This geological reconnaissance report presents the findings and conclusions from our field reconnaissance survey of the proposed Waiale Development area in the central portion of Maui, to the south of the town of Kahului on the Island of Maui, Hawaii. The project location and general vicinity are shown on the Project Location Map, Plate 1.

This report summarizes the findings from our literature search and field reconnaissance survey and presents our conclusions. The findings and conclusions presented herein are subject to the limitations noted at the end of this report.

1.2 Project Considerations

The proposed project involves a master plan development on about 545 acres located along the western side of Kuihelani Highway, on both the northern and southern sides of Waiko Road.

The general area is mapped from a geology perspective as consolidated calcareous dunes, which are sand blown inland from ancient beaches and later lithified (Stearns, et. al). However, much of the site has been disturbed due to past human activities, including agricultural and industrial use. Therefore, currently the extent of natural lithified sand dunes on the site may be limited.

A geological reconnaissance was performed by geologists from our Maui office to identify and map the location of natural lithified sand dunes remaining at the project site. The topographic survey previously done was used as a base map. Additionally, the project surveyor assisted our geologists to locate reference points within the site.

1.3 Purpose and Scope

The purpose of our geological reconnaissance was to obtain an overview of the surface conditions at the project site to develop a generalized soil/rock data set to formulate geotechnical findings and conclusions concerning the extent and condition of natural lithified sand dunes within the project site. The scope of our work included the following tasks and work efforts:

1. Research of available literature pertaining to the geology of the site and surrounding region.
2. Conducting an on-ground field reconnaissance of the site by two geologists from our Maui office.
3. Conducting geological and engineering analyses of the field and literature data to formulate our findings and conclusions.
4. Preparing this report which summarizes our work on the project and presents our findings and conclusions.
5. Coordinating our overall work on the project by our engineer.
6. Quality assurance of our work and client/design team consultation by our principal engineer.
7. Miscellaneous work efforts such as drafting, word processing, and clerical support.

END OF GENERAL

SECTION 2. SITE CHARACTERIZATION

2.1 Regional Geology

The Island of Maui was built by two major volcanoes, the older West Maui (Tertiary Epoch) and the more recent East Maui, also known as Haleakala (Pleistocene Epoch). The Isthmus of Maui is a narrow, gently sloping plain located between these two volcanoes. The project site is located in the western area of this gently sloping plain.

The Isthmus of Maui was created by lava flows from East Maui (Haleakala) banking against the older flank of West Maui. Stratigraphy in the isthmus is complicated due to the multitude of erosional and depositional forces that have played roles in its creation. Much of the eastern and western sides of the isthmus are comprised of alluvium washed from the slopes of West Maui and Haleakala. The erosional processes in the slopes above the isthmus are dominated by the detachment of soil and rock masses from the mountain walls, and the soil materials are transported downslope toward the Isthmus primarily by gravity as colluvium.

Once these materials reach the stream or other natural drainage course, the alluvial process becomes dominant, and the sediments are transported and deposited as alluvium. In general, stream flows in Hawaii are intermittent and flashy, i.e., the stream flows transmit large volumes of water for very short durations. Because of this, the transport of sediments is intermittent, and the bulk of the stream's hydraulic load consists of a poorly-sorted mixture of boulders, cobbles, gravel, sands, and fines. When the erosional base levels change, these sediment loads are left as deposits.

When deposits are left in-place for long periods of time, chemical processes begin to alter the materials, simultaneously causing a breakdown or weathering of the materials. Chemical processes also cause induration, or cementation, of the coarse-grained portion of the sediment into a poorly-consolidated sedimentary rock or conglomerate. Simultaneously, erosion continues in the areas above the valley floors and upstream in headwaters. This continued erosion generates material, which is transported downslope covering the older alluvial deposits. Depending on the local base level and rate of transport, these newer sediments are generally transient in terms of geologic time. In addition, their consistency and density are generally less than those of the older, partially consolidated deposits.

Underlying the alluvial deposits are overlapping lavas from the West Maui and East Maui volcanoes. The bulk of the Haleakala shield was built during the late Pliocene and early Pleistocene Epoch by thinly bedded basaltic lava flows of the Honomanu Volcanic Series. During the Pleistocene Epoch, the characteristics of the lavas changed to very hard, thickly bedded flows of andesitic composition. These lavas have been grouped as the Kula Volcanic Series.

Further complicating the stratigraphy of the isthmus was the development of broad fringing reefs in the bay formed at the juncture between West Maui and East Maui; and, glacio-eustatic sea level changes that occurred during the Pleistocene Epoch in response to the advance and retreat cycles of continental glaciation. During the glacial advances, water was bound into the wide spread glaciers as ice on a year round basis and less water was available to fill the ocean basins. As a consequence, global sea levels fell below the current sea level. During the retreats, more water was available and sea levels rose.

When the sea levels fell, the fringing reefs, with their complement of calcium carbonate sand derived from both detrital and bioclastic sources, were exposed to the prevailing tradewinds which blew in about the same direction as the current tradewinds but were estimated to have an average velocity of about 60 miles per hour. These winds, transporting the loose sand from the reef areas, resulted in a strip of sand dunes that extended from the present Wailuku-Kahului area to as far as the south coast of the Maui Isthmus, blanketing the volcanic and alluvial deposits on the floor of the isthmus.

Similar dune formations can be found on the northwest portion of Molokai, in the Kahuku-Laie and Waimanalo areas on the Island of Oahu and the Kekaha-Mana area of Kauai.

2.1.1 Dune Morphology

Three things are required for dune formation to occur: a large supply of sand, wind speeds capable of moving it, and an ideal location for its accumulation. Once sand begins to pile up, ripples and dunes can form. Wind continues to move sand up to the top of the pile until the pile is so steep that it collapses under its own weight. The collapsing sand comes to rest when it reaches just the right steepness to keep the dune stable.

The repeating cycle of sand inching up the windward side to the dune crest, then slipping down the dune's slip face allows the dune to inch forward, migrating in the direction the wind blows. This creates an internal structure called cross-bedding.

Due to the nearly constant high velocity prevailing winds, the Isthmus dunes formed as longitudinal dunes, i.e., the axes of the dune ridges were parallel to the wind direction rather than normal to the wind direction as in typical crescent dunes.

As a result of gravitational sorting during wind transport of the sand, the average size of the sand grains in the dunes decreases with increasing distance from the source of the sand. Similarly, the height, and thickness, of the dunes decrease with distance. In the Wailuku-Kahului area, the sand grains tend to be relatively coarse; and, the dunes are relatively high. As the dunes approach Maalaea, the grains become very fine and become intermixed with wind blown alluvial silt; and the dunes are often a thin veneer over underlying alluvial and residual soils.

2.2 Lithification

As rain falls through the atmosphere, the water reacts with carbon dioxide, sulfur compounds and nitrogen compounds in the air to form a weakly acidic solution of carbonic, sulfuric and nitric acids. When this solution comes in contact with carbonate materials, such as calcium carbonate sand, the acid will dissolve a portion of the material and carry it away in solution. As the reaction continues, the pH of the solution increases and when it reaches neutral, the carbonate will precipitate out of the solution, leaving behind carbonate to act as a cement between grains.

The Isthmus dunes have been described as "lithified dunes", i.e., dunes that have been consolidated by cementation to form calcareous sandstone. More appropriately, the dunes should be described as "partially lithified dunes". In general, the cementation found in the dunes is relatively weak and tends to vary with grain size and local rainfall. In the Kahului area, where the sand is coarser and local rainfall is about 20 inches per year, the degree of cementation is higher and is of greater extent. In the Waikapu-Waiale area, where rainfall is less than about 15 inches per year and the sand grains are finer, lithification is less pronounced, often limited to a "crust" on the surface.

Much better examples of lithified dunes on Maui are found at Keoupuolani Regional Park, which has some of the most pristine remnant dunes on Maui; Haleki`i-Pihana Heiau State Monument; and, the Dunes at Maui Lani Golf Course. Good dune examples elsewhere in Hawaii are the Kahuku area of the north shore of Oahu, Waimanalo on Oahu; and, to an extent, in the northwest part of the Island of Molokai.

END OF SITE CHARACTERIZATION

SECTION 3. DISCUSSSION

3.1 <u>Geological Reconnaissance</u>

An on-ground reconnaissance of the project site was conducted by two geologists from our Maui office. The fieldwork occurred between February 10 and March 10, 2011. Locations in the field were established using features shown on the topographic survey map and a hand-held Global Positioning System (GPS) receiver. Following the field mapping, features were plotted on the base topographic plan which was then superimposed on the most recent aerial photograph of the site and surrounding area.

The mapping included in-situ dune structures and areas where the original dunes had been obliterated, heavily impacted or degraded. The locations of these structures and areas are presented on the Generalized Geologic Map, Plate 2. The following sections describe the structures and areas.

3.1.1 <u>Dune Structures</u>

These mapping units represent areas where there are recognizable dunes. In general, these dunes retain their original form but have been degraded by their use for ranching, agricultural use and other human activities. They are predominantly covered with non-native and invasive vegetation, such as buffelgrass (Cenchrus ciliaris), haole koa (Leucaena leucocephala) and kiawe (Prosopis pallida). These plants are commonly used as forage for livestock; and, the trampling by cattle and horses degrades the surface of the dunes.

Our field reconnaissance and mapping disclosed two clusters of dune structures in the north central portion of the site. Due to past agricultural activities, the clusters have been designated as “degraded areas”.

3.1.2 <u>Obliterated Areas</u>

These mapping units represent those areas where the original sand dunes have been removed, graded, tilled or otherwise obliterated by human activities, such as large scale agriculture, sand mining operations and other activities. This includes the areas south of Waiko Road, and the northeastern and northwestern portions of the site. While the northwestern portion of the site has been heavily impacted by human activity, it also contains the larger remaining dunes. The approximate limits of sand mining operations are shown on the Generalized Geologic Map, Plate 2.

3.1.3 Heavily Impacted Areas

These mapping areas represent the portions of the site which have been impacted from longstanding ranching and other agricultural activities. This includes the north central portion of the site. There are some remnant dunes. However, the remnant dunes are smaller and largely degraded from ranching and other human activities.

3.2 Summary

During the course of our field reconnaissance, we did not find natural sand dunes that could be considered to be pristine geological features. The majority of the dunes within the project limits have essentially been obliterated by human activities.

In the southern part of the site, south of Waiko Road, the former dune lands were flattened and tilled for the cultivation of sugar cane. The north central portion of the site includes some small clusters of dunes. However, these dune clusters have been degraded by longstanding ranching activities and other agricultural use. The north western portion of the site has been heavily disturbed by sand mining, stockpiling and agricultural use. However, this area also includes the larger and comparatively more representative examples of the remaining dune structures within the site.

Much better examples of lithified dunes on Maui are found at Keoupuolani Regional Park, which has some of the most pristine remnant dunes on Maui; Haleki`i-Pihana Heiau State Monument; and, the Dunes at Maui Lani Golf Course. Good dune examples elsewhere in Hawaii are the Kahuku area of the north shore of Oahu, Waimanalo on Oahu; and, to an extent, in the northwest part of the island of Molokai.

END OF DISCUSSION

SECTION 4. LIMITATIONS

The discussions submitted herein are based, in part, upon information obtained from in-house literature research and our field exploration. Variations of conditions may occur in localized areas.

The locations indicated in this report are approximate, having been referenced from features shown on the topographic survey map and aerial photo. The physical locations should be considered accurate only to the degree implied by the methods used.

This report has been prepared for the exclusive use of A&B Properties, Inc. for specific application to the proposed "*Waiale Development*" project in accordance with generally accepted geotechnical engineering principles and practices. No warranty is expressed or implied.

This geological reconnaissance conducted at the project site was not intended to investigate the potential presence of hazardous materials existing at the site. It should be noted that the equipment, techniques, and personnel used to conduct a geo-environmental exploration differ substantially from those applied in geotechnical engineering and engineering geology.

END OF LIMITATIONS

CLOSURE

The following plates are attached and complete this report:

-ΩΩΩΩΩΩΩΩΩ-

Respectfully submitted,

GEOLABS, INC.

By Nicholas K. Mitchell

Nicholas Mitchell, P.G.
Project Geologist

By

Dayton E. Fraim, P.G., P.E.
Project Engineer/Geologist

By Clayton S. Mimura

Clayton S. Mimura, P.E.
President

CSM:DEF:as

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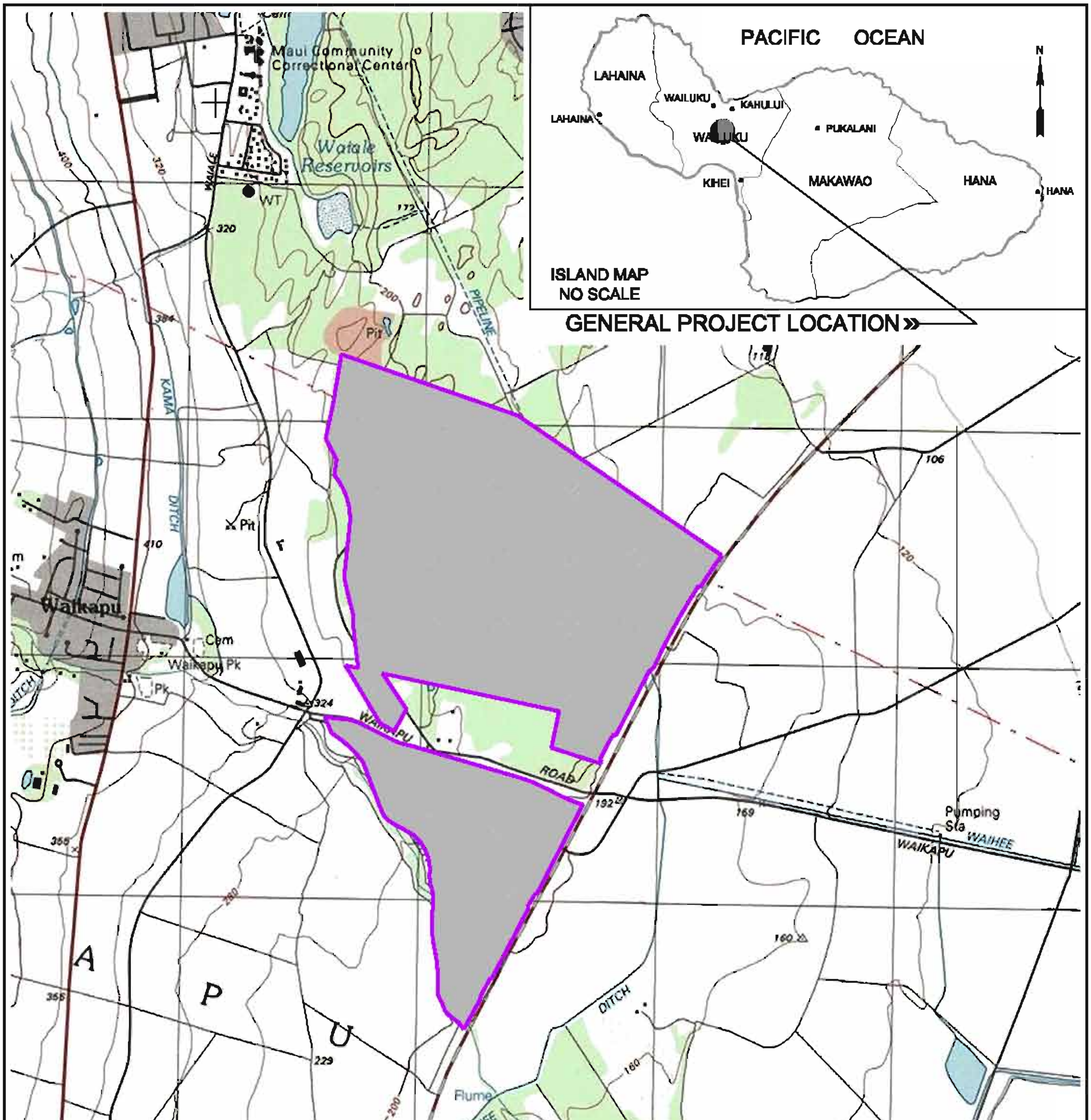


PROJECT LOCATION

PROJECT LOCATION MAP

WAIALE DEVELOPMENT
KAHULUI, MAUI, HAWAII

2000 1000 0 2000 FT.

GRAPHIC SCALE

N

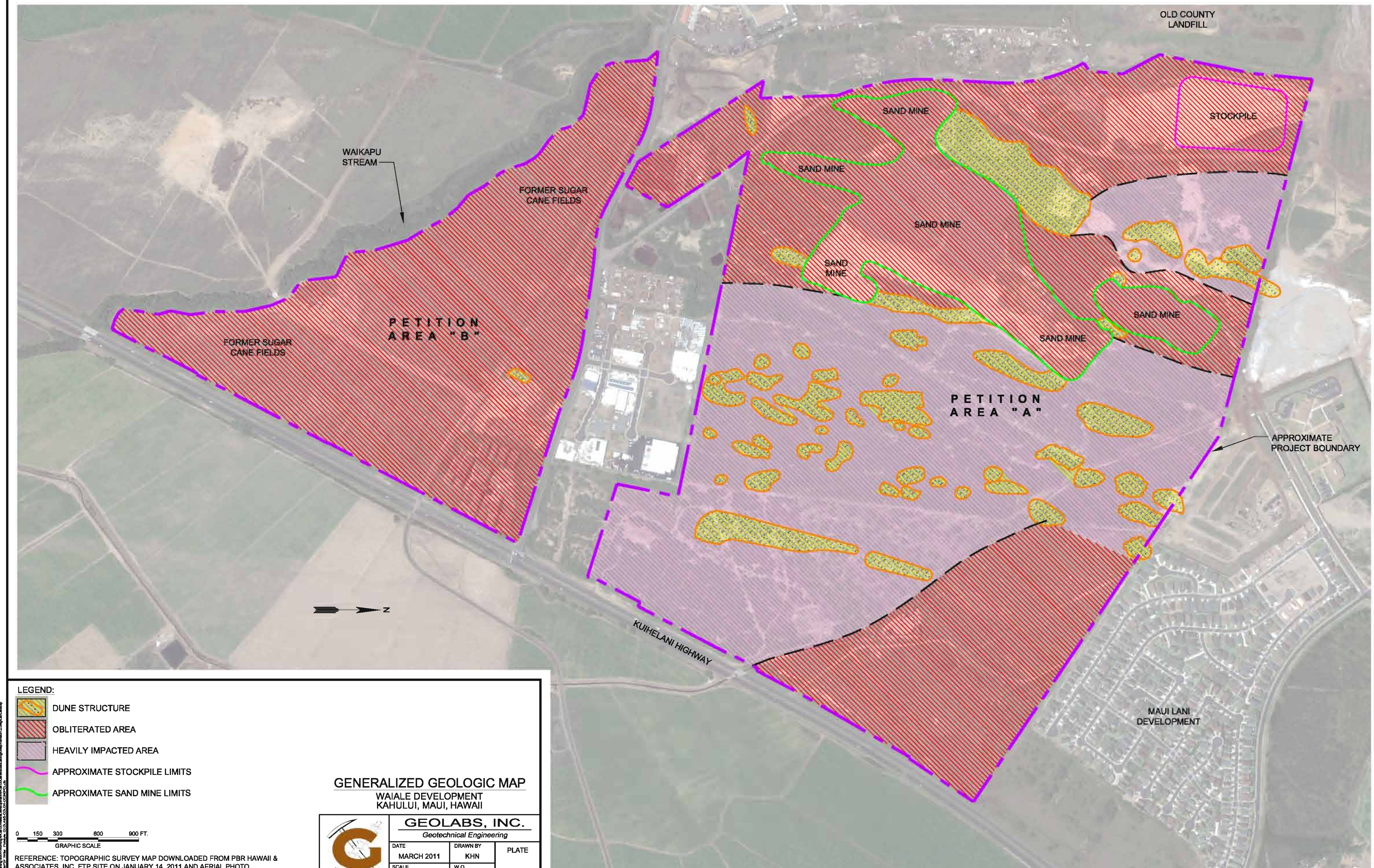
REFERENCE: MAP CREATED WITH TOPO!® ©2001 NATIONAL GEOGRAPHIC (WWW.NATIONALGEOGRAPHIC.COM/TOPO).

GEOLABS, INC.

Geotechnical Engineering

DATE	DRAWN BY	PLATE
MARCH 2011	KHN	
SCALE	W.O.	
1" = 2,000'	6438-00	1

CAD User: KIM File Last Updated: March 18, 2011 9:58:40am Plot Date: March 18, 2011 - 9:59:31am
File: T:\Drafting-6604\Working\6438-00WaialeDevelopment\6438-00PLM.dwg\PLM
Plotter: Adobe PDF Plotstyle: GEOLABS-Color-AllSameWidth.ctb



LEGEND:

- DUNE STRUCTURE
- OBLITERATED AREA
- HEAVILY IMPACTED AREA
- APPROXIMATE STOCKPILE LIMITS
- APPROXIMATE SAND MINE LIMITS

0 150 300 600 900 FT.
GRAPHIC SCALE

REFERENCE: TOPOGRAPHIC SURVEY MAP DOWNLOADED FROM PBR HAWAII & ASSOCIATES, INC. FTP SITE ON JANUARY 14, 2011 AND AERIAL PHOTO DOWNLOADED FROM PBR HAWAII & ASSOCIATES, INC. FTP SITE ON MARCH 2, 2011.

GENERALIZED GEOLOGIC MAP

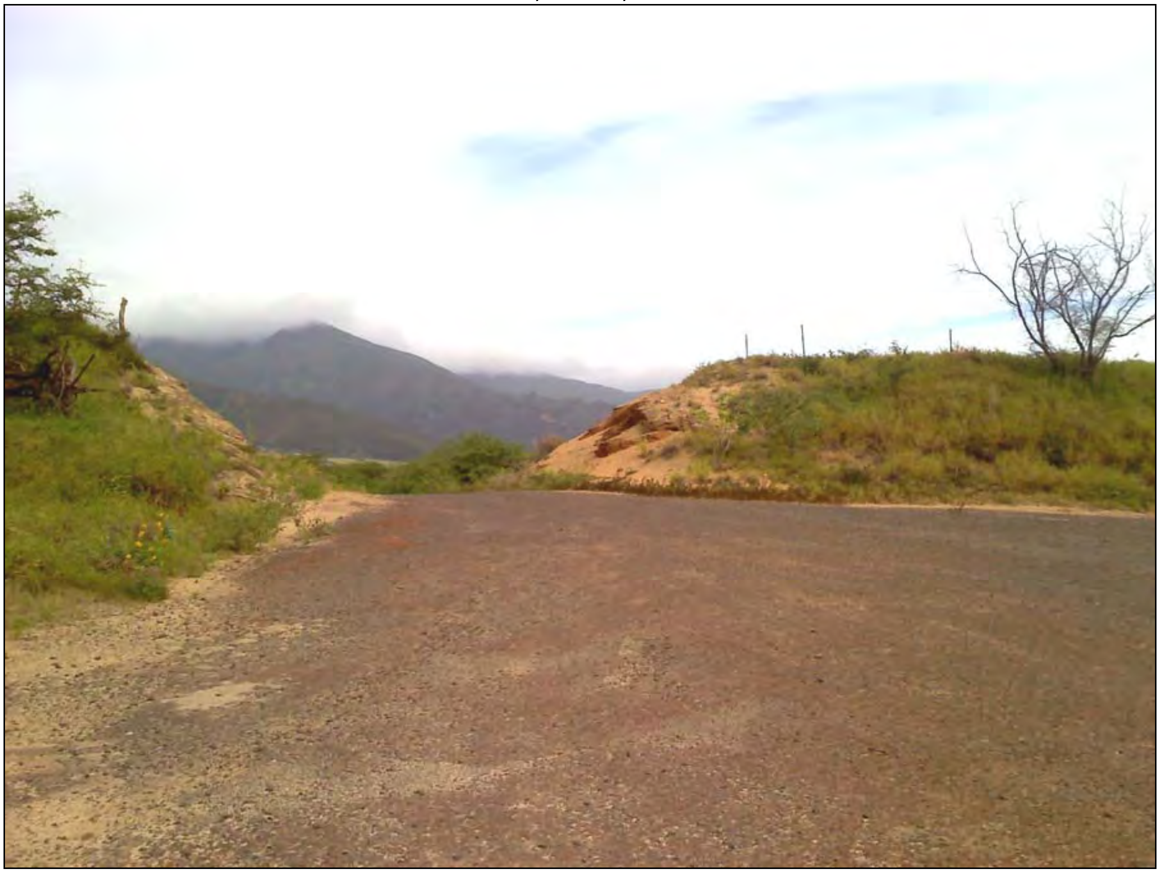
WAIALE DEVELOPMENT
KAHULUI, MAUI, HAWAII

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
MARCH 2011	KHN	2
SCALE	W.O.	
1" = 300'	6438-00	

Photograph 1: Dune Structures - Northwest Preserve Area

Photograph 2: Heavily Impacted Area – North Central Area



Photograph 3: Dune Structure cut by road

Photograph 4: Heavily Impacted Dune Structure

Photograph 5: Area obliterated by sand mining with impacted dunes in background

Appendix C: Aquatic Resource Survey

AQUATIC RESOURCE SURVEY

for the

WAI'ALE PROJECT

WAIKAPU AND WAILUKU, MAUI, HAWAII

INTRODUCTION

The Wai'ale Project is situated on 545 acres of land in Waikapu and Wailuku in central Maui, TMK's (2) 3-8-05:23 (por.) & 37, and TMKs (2) 3-8-07:71, 101 (por.) & 104 (see Figure 1). The northern boundary is adjacent to the Maui Lani Project, the western boundary is adjacent to light industrial uses, agricultural uses and near Waikapu Stream, and the eastern boundary is adjacent to Kuihelani Highway (see Figure 1). This aquatic resource survey was initiated in compliance with environmental requirements of the planning process. Its purpose was to determine if there were any wetlands or other aquatic resources that might fall under the jurisdiction of the U.S. Army Corps of Engineers under provisions of the Clean Water Act (1973 and as amended).

SITE DESCRIPTION

The property consists of gently sloping lands of Maui's central valley. Soils are characterized as Puu One Sand (PZUE) and Jaucus Sand (JaC) series (Foote et al, 1972). Puu One Sand, 7-30% slopes is an excessively drained, light brownish, loose sandy soil averaging 20 inches deep over a strongly cemented sand layer that is 20 to 40 inches deep. Jaucus Sand, 0 – 15 % slope is an excessively drained calcareous soil formed by wind deposition of coral sand and seashells into low, loose grained dunes. This soil is a mixture of sand and small amounts of silt and organic matter creating a pale brown color. It is more than 60 inches deep. Vegetation varied considerably over this large project area. The largest area was a savannah dominated by buffelgrass (*Cenchrus ciliaris*) and kiawe trees (*Prosopis pallida*). The former sugar cane agricultural lands were a very diverse array of weedy species including golden crown-beard (*Verbesina encelioides*), buffelgrass, Guinea grass (*Megathyrsus maximus*), Castor bean (*Ricinus communis*), swollen fingergrass (*Chloris barbata*), koa haole (*Leucaena leucocephala*) and spiny amaranth (*Amaranthus spinosus*). The sand excavation areas were very sparsely vegetated with small crownflower (*Calotropis procera*), 'uhaloa (*Waltheria indica*), tree tobacco (*Nicotiana glauca*), buffelgrass, fuzzy rattlepod (*Crotalaria incana*), 'ilima (*Sida fallax*) and sourbush (*Pluchea carolinensis*). Rainfall in this area averages 20 inches per year with most falling during the winter months, but then followed by a long dry season (Armstrong, 1983). The only stream which flows near this project is Waikapu Stream, which is a perennial stream that issues from a wet windward valley in the southern West Maui Mountains and flows down to Kealia Pond and to the leeward coast of central Maui. Waikapu Stream flows along but just outside the southwest boundary of this project for about a mile between Waiko Road and Kuihelani Highway.

SITE HISTORY

Maui is an island of two mountains that are connected by a low isthmus. Prevailing northeast trade winds striking the windward side of central Maui speed up as they squeeze through the isthmus between these two mountains. On the West Maui side these northeast winds careen off the mountains slopes and are accelerated in a southward direction across the slopes toward Maalaea. Over many millennia these strong winds have driven great amounts of coral sand inland creating great fields of dunes that extend about five miles across the isthmus. These dunes have deeply buried the alluvial soils that were deposited across the eastern flank of the mountain over the past million years (Stearns, 1985). These dunes entrain with the direction of the prevailing wind and lie perpendicular to the slope of the land. For a long period of history these dunes remained relatively free of dense vegetation and were constantly shifting and being driven by the wind.

In the mid-1800s kiawe trees were introduced to Hawaii from the coastal deserts of northern Chile and these trees thrived in our dry lowlands. They quickly spread throughout the central Maui isthmus and their roots began to stabilize the dunes. Then dryland grasses and shrubs began to fill in between the kiawe.

These dune lands were considered to be marginal to useless for agriculture but some of the flatter areas were improved by spreading bagasse on the sand to improve its organic content. In this way about 130 acres of this project was gradually brought into cultivation. This acreage has since been abandoned and now stands idle.

Another agricultural practice that was used in the early to mid-1900s to prevent stream flooding damage in fields was to create berms of boulders and soil along stream banks to better channelize storm flows. Waikapu Stream, which is adjacent to the southwest boundary of this project, has a 4 to 6 foot high berm that dates from this former time. This berm also prevents any natural drainage of runoff into the stream from the surrounding plain.

In recent years portions of the northwest corner of the property have been used for sand excavation work. This has resulted in the leveling of some of the dunes to create a flat landscape. This landscape is now only sparsely vegetated with hardy xerophytes.

WETLANDS/WATERS OF THE U.S. ASSESSMENT AND DETERMINATION

The goal of this aquatic resource survey was to utilize guidelines and methods outlined in the U.S. Army Corps of Engineers Wetlands Delineation Manual (1987) and the more recent Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Hawaii and Pacific Islands Region (2010) to determine whether the Wai'ale Project area is a wetland for purposes of Section 404 of the Clean Water Act (1973) or contains any other aquatic resources that would qualify as Waters of the U.S.

Having read and considered the Introduction, the Technical Guidelines and the Characteristics and Indicators of Hydrophytic Vegetation, Hydric Soils and Wetland Hydrology, we come to the methods.

PART IV: METHODS

Section B. Preliminary Data Gathering and Synthesis

The following information sources were available and were used:

- USGS Wailuku Quadrangle Map, 1: 24,000 scale, 1955
- National Wetland Inventory Mapping, USFWS, 1991 and as amended
- National List of Plant Species That Occur in Wetlands: Hawaii, USFWS, 2004
- Soil Survey, SCS / NRCS, 1972
- Aerial Photography: Google Earth, 2011 & Infra-red Series, MA 9-182, Oct.27, 1990.

Step 1. Identifying the Project Area on a Map (see Figure 2). The USGS map does not show any wetlands, drainage ditches, gulches or streams. One plantation pipeline passes through the project underground, but surfaces into an open gunite-lined ditch that runs for about 600 feet before passing under Kuihelani Highway and out of the project area.

Step 2. Prepare a Base Map (see Figure 2).

Step 3. Determine the Size of the Project Area – 545 acres (see Figure 2).

Step 4. Summarize Available Information on Vegetation. The descriptions given in the Soil Survey for each soil type itemize the plant species that are dominant there. The information in the Plant Database characterizes each native or naturalized species in Hawaii with regard to their potential to grow in wetland or aquatic habitats.

Step 5. Determine Whether the Vegetation on the Project Area is Adequately Characterized. The plant species listed in the soil survey for each soil type sufficiently characterize each area. However, a complete survey of the vegetation on this project area was performed concurrently with this aquatic resource survey and this allowed for a complete walk-through look at the entire area. A complete plant species list was compiled and this information was used to acquire a more accurate and comprehensive understanding of the character of the vegetation.

Step 6. Summarize Available Information on Area Soils. The SCS/NRCS Soil Survey gives a comprehensive account of the two soils series found in the project area.

Step 7. Determine if Soils Have Been Adequately Characterized. Yes they have. The Puu One Sand is as described. There are extensive areas with loose sand layers over deeper layers of lithified sand. In some areas the lithified sands are exposed at the surface. The soils survey typically examined soil profiles to a depth of 60 inches, but in bank cuts where depths of up to 30 feet can be observed, profiles continue to show layers of sand with no traces of alluvial substrate. This sandy soil is characterized as being excessively drained which means it is quite porous and does not accumulate surface waters. The Jaucus Sand is also as described although the surface layer has been modified by decades of sugar cane farming.

Step 8. Summarize Available Hydrology Data. There are no hydrology features or indicators on any of the photographs, maps, surveys or databases examined.

Step 9. Determine if Hydrology is Adequately Characterized. The entire area appears to be as characterized. A complete walk-through of the project area failed to find any apparent wetland hydrology features.

Section C. Selection of Method

A routine Determination method was selected because of the lack of complexity of the environment and the relative uniformity of conditions within the parameters of vegetation, soils and hydrology.

a. Level 1 – Onsite Inspection Unnecessary. Routine Determination method was further selected because the information already obtained is deemed sufficient for making a determination for the entire project area.

Section D. Routine Determination – Onsite Inspection Unnecessary

Although for this Determination method, an onsite inspection is unnecessary, I had the benefit for a full flora and fauna survey that was concurrently conducted on this same project area. I was thus able to acquire an even better characterization of the vegetation, soils and hydrology on the property. The following are the procedures established for conducting the analysis to come up with a wetland determination.

Step 1 – Determine Whether Available Data are Sufficient for the Entire Project Area.

The vegetation , soils, and the hydrology within the entire project area appear to be adequately characterized in the Plant Data Base, the Soil Survey, the USGS Wailuku Quadrangle Map, the National Wetland Inventory Map and aerial photography.

Step 2 – Determine Whether Hydrophytic Vegetation is Present.

For each of the three community types a Wetland Determination Data Form was completed. No dominant hydrophytic vegetation was found in any of these plant communities. Both in the Dominance Test Worksheets, and the Prevalence Index Worksheets were skewed toward Facultative Upland and Upland species.

Step 3 – Determine Whether Wetland Hydrology is Present.

No wetland hydrology indicators were found in any of the three plant communities in the project area. No streams, gullies or drainages bring water into this area from outside its borders, and all rainfall quickly percolates down through these porous soils.

Step 4 – Determine Whether the Soils Parameter Must be Considered.

Since no Obligate wetland plants were found in the project area and no wetland hydrology was found to occur here, we proceed to Step 5.

Step 5 – Determine whether Hydric Soils are Present.

No hydric soils were found in any part of the project area. All of the soils were highly porous sand soils. No water accumulates on the surface or within several feet of the surface. No hydric soils indicators were identified in any part of this project.

Step 6 – Wetland Determination.

No positive wetland indicators were found in any of the parameters of vegetation, soils or hydrology in the three plant communities that encompass this entire 545 acre project. These data are recorded in the three attached Wetland Determination Data Forms. This entire Waiale Project area is found to be non-wetland in character.

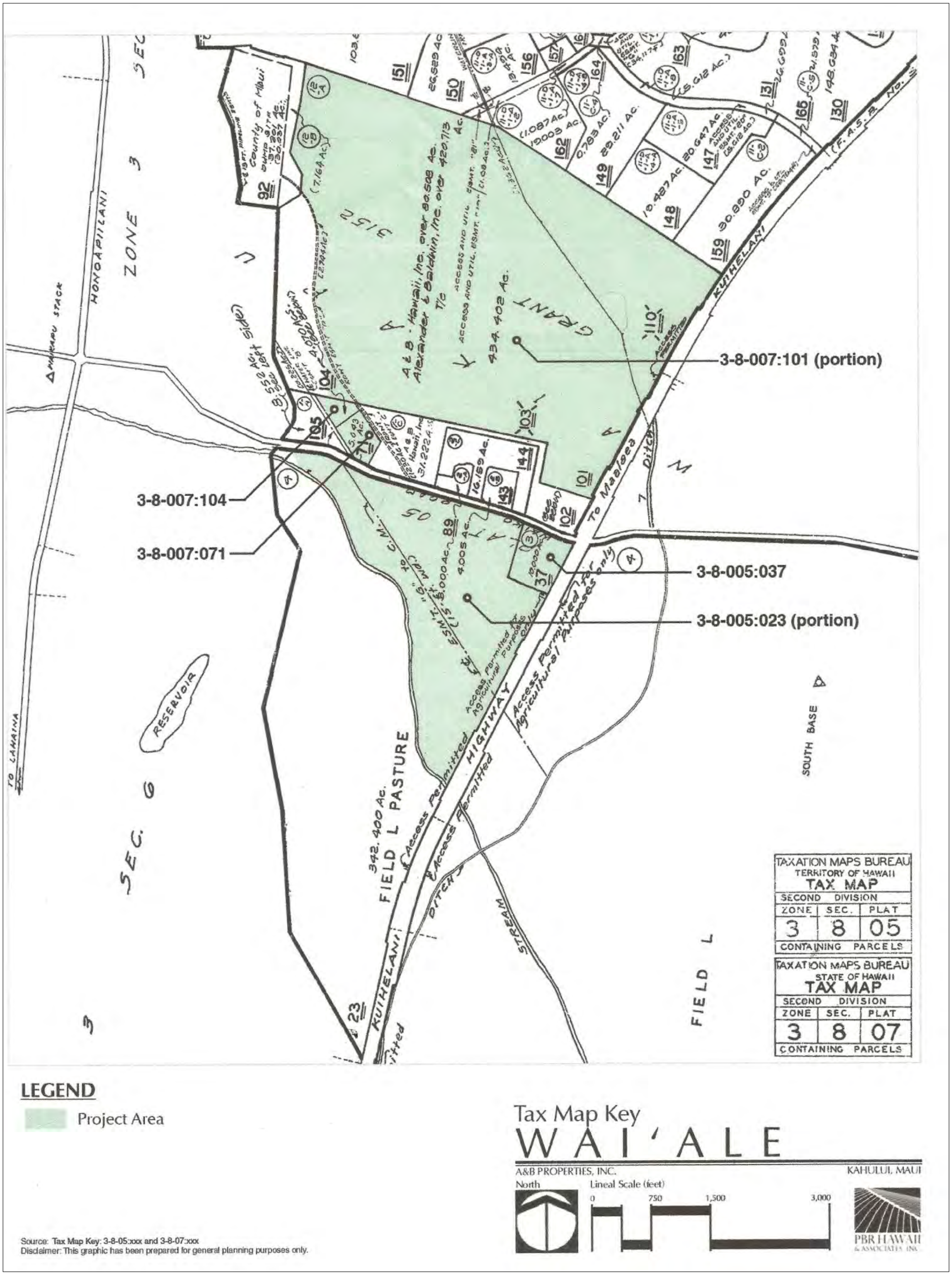


Figure 1 – Project Area

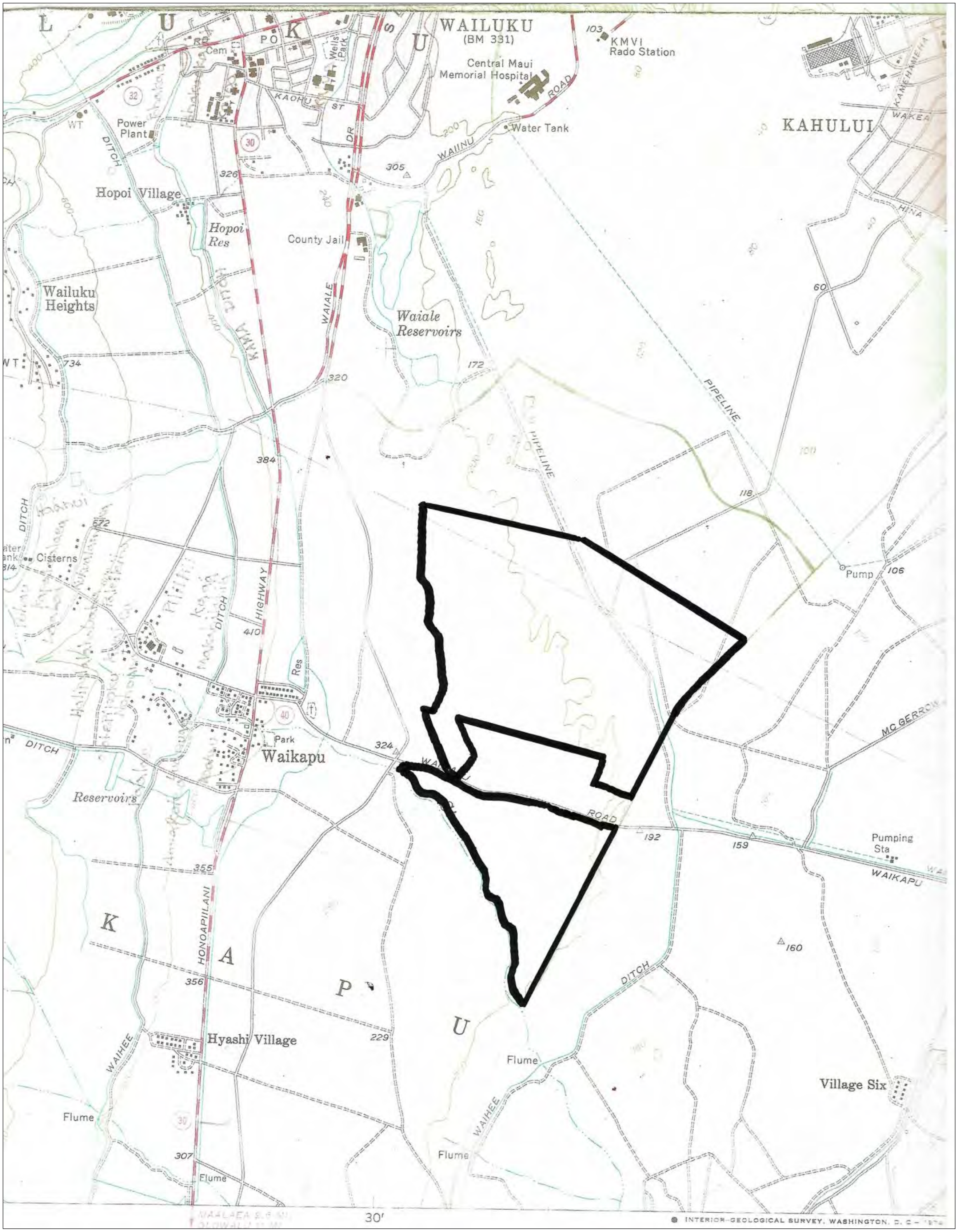


Figure 2 – U.S.G.S. Wailuku Quadrangle Map of project area

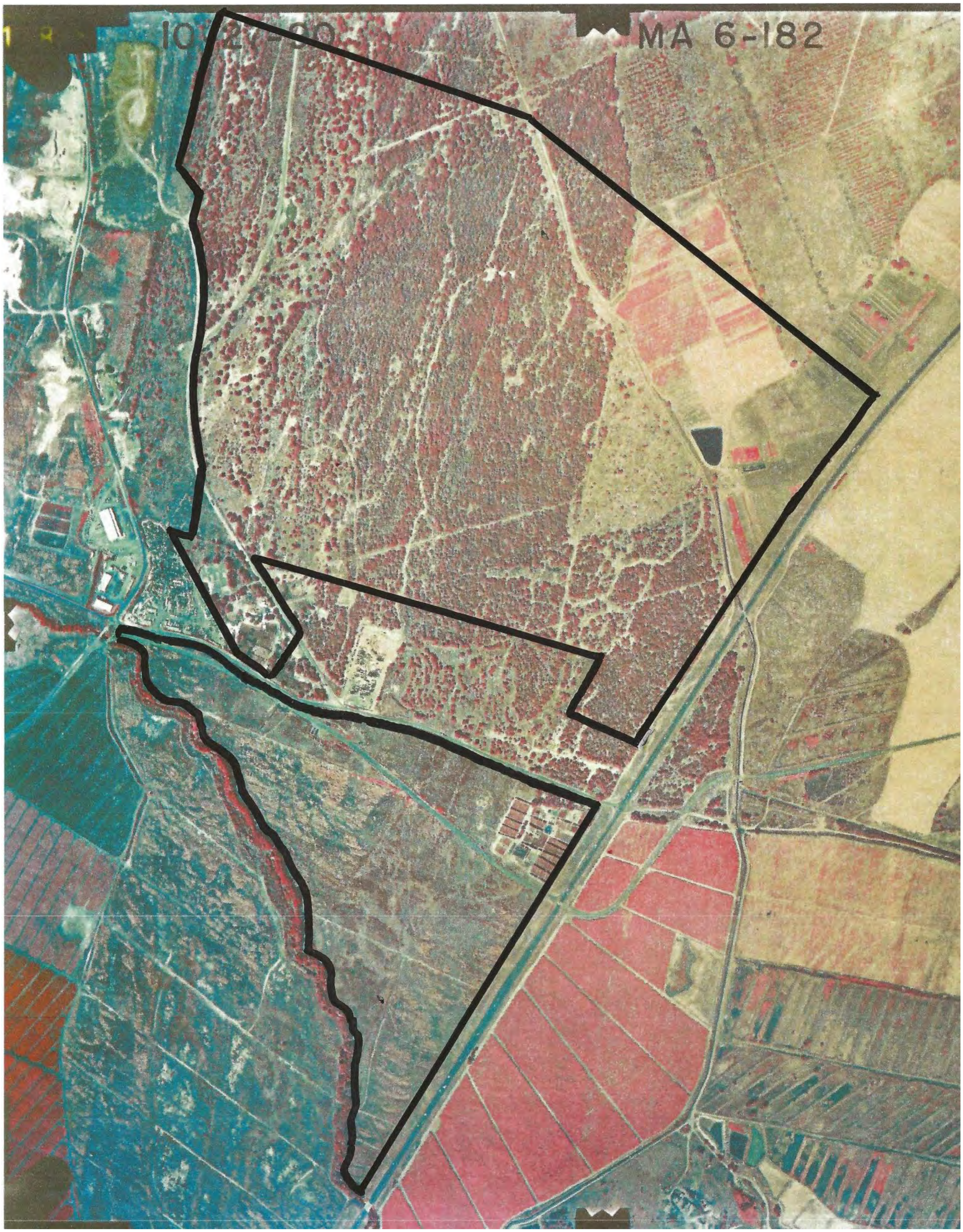


Figure 3 – 1990 Infrared aerial photograph of project area
Reservoir in upper right corner has since been abandoned, is dilapidated and no longer functional.

WETLAND DETERMINATION DATA FORM – Hawai'i and Pacific Islands

Project/Site: Waiale Project City: Waikapu Sampling Date: 1/26-28/11 Time: ______

Applicant/Owner: A & B Properties, Inc. State/Terr.: Hawaii Island: Maui Sampling Point: 1

Investigator(s): Robert W. Hobdy TMK/Parcel: (2) 3-8-05:(Por); 37 (2) 3-8-07: 71,101(por),104

Landform (hillslope, coastal plain, etc.): gently sloping plain Local relief (concave, convex, none): none

Lat: 21° 51' North Long: 156° 29.3' West Datum: ______ Slope (%): 3%

Soil Map Unit Name: Puu One Sand, 7-30% slopes NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation NO, Soil NO, or Hydrology NO significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation NO, Soil NO, or Hydrology NO naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

	Yes	No
Hydrophytic Vegetation Present?		X
Hydric Soil Present?		X
Wetland Hydrology Present?		X
Is the Sampled Area within a Wetland?		X

Remarks: This sandy habitat is gently undulating. The soil is excessively drained. All field observations and data revealed no traces of gullies, drainages or wetlands.

VEGETATION – Use scientific names of plants.

Stratum / Species	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: 345 acres)			
1. Prosopis pallida	65	Yes	FACU
2.			
3.			
4.			
5.			
= Total Cover	65%		
Sapling/Shrub Stratum (Plot size: 345 acres)			
1. Lantana camara	10	Yes	UPL
2. Leucaena leucocephala	7	Yes	UPL
3. Calotropis procera	5	No	UPL
4. Nicotiana glauca	3	No	UPL
5. Pluchea carolinensis	2	NO	FAC
= Total Cover	27%		
Herb Stratum (Plot size: 345 acres)			
1. Cenchrus ciliaris	85	Yes	FACU
2. Megathyrsus maximus	5	No	FAC
3. Verbesina enceliodes	5	No	FACU
4. Waltheria indica	3	No	FACU
5. Leonotis nepetifolia	3	NO	FACU
6. Eragrostis pectinacea	2	NO	FACU
7. Dactyloctenium aegyptium	2	NO	UPL
8.			
= Total Cover	105%		
Woody Vine Stratum (Plot size: 345 acres)			
1. 0			
2.			
= Total Cover	0%		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	0	x 1 = 0
FACW species	0	x 2 = 0
FAC species	7	x 3 = 21
FACU species	163	x 4 = 652
UPL species	27	x 5 = 135
Column Totals:	197 (A)	808 (B)

Prevalence Index = B/A = 4.10

Hydrophytic Vegetation Indicators:

NO 1 - Rapid Test for Hydrophytic Vegetation

NO 2 - Dominance Test is >50%

NO 3 - Prevalence Index is ≤3.0[1]

NO Problematic Hydrophytic Vegetation[1] (Explain in Remarks or in the delineation report)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ____ No X

Remarks: A total of 117 plant species were recorded from this 345 acre natural duneland habitat. No obligate wetland species were found and just three facultative wetland species were found growing in the bottom of an abandoned and dilapidated little agricultural reservoir that no longer receives water other than small puddles of rainfall that are ephemeral. Nineteen percent of the plant species in this habitat are Facultative, 41% are Facultative Upland and 32% are upland species

SOIL

Sampling Point: 1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-20	10YR 5/2	100	—				Loose	excessively drained
20-40	10YR 5/2	100	—				Cemented	hard but porous

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: None

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Muck Presence (A8)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Dark Surface (S7)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ Stratified Layers (A5)
- ___ Sandy Mucky Mineral (S1)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed): NO

Type: ____________

Depth (inches): ____________

Hydric Soil Present? Yes ___ No X

Remarks:

No observable hydric soil indicators present.

HYDROLOGY

Wetland Hydrology Indicators: (Explain observations in Remarks, if needed.) none

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Tilapia Nests (B17)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Fiddler Crab Burrows (C10) (Guam, CNMI, and American Samoa)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ______

Water Table Present? Yes ___ No X Depth (inches): ______

Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): ______

Wetland Hydrology Present? Yes ___ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

No observable wetland hydrology indicators present.


Sampling Area 1 –Savannah of buffelgrass and kiawe


Sampling Area 1 – Open plain with loose sand and some exposed lithified sand at surface

WETLAND DETERMINATION DATA FORM – Hawai'i and Pacific Islands

Project/Site: Waiale Project City: Waikapu Sampling Date: 1/26-29/11 Time: ______

Applicant/Owner: A & B Properties, Inc. State/Terr. Hawaii Island: Maui Sampling Point: 2

Investigator(s): Robert W. Hobdy TMK/Parcel (2) 3-8-05: 23 (Por.), 37; (2) 3-8-07: 7, 101 (Por.), 104

Landform (hillslope, coastal plain, etc.): gently sloping plain Local relief (concave, convex, none): None

Lat: 21° 51' North Long: 156° 29.3' West Datum: ______ Slope (%): 3 %

Soil Map Unit Name: Puu One Sand, Jaucus Sand NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation No, Soil No, or Hydrology No significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation No, Soil No, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ____ No X	Is the Sampled Area within a Wetland?	Yes ____ No X
Hydric Soil Present?	Yes ____ No X		
Wetland Hydrology Present?	Yes ____ No X		

Remarks: This sandy habitat is gently undulating. The soil is excessively drained. All field observations and data reveal no traces of gullies, drainages or wetlands. There are no connections with Waikapu Stream which is an adjacent aquatic feature to the south.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 130 acres)	Absolute % Cover	Dominant Species?	Indicator Status
1. Prosopis pallida	4	Yes	FACU
2. Macaranga tanarius	2	No	UPL
3.			
4.			
5.			
= Total Cover	6		
Sapling/Shrub Stratum (Plot size: 130 acres)			
1. Ricinus communis	10	Yes	FACU
2. Leucaena leucocephala	7	No	UPL
3.			
4.			
5.			
= Total Cover	17		
Herb Stratum (Plot size: 130 acres)			
1. Cenchrus ciliaris	20	Yes	FACU
2. Verbesina encelioides	20	Yes	FACU
3. Megathyrsus maximus	15	No	FAC
4. Chloris barbata	10	No	FAC
5. Amaranthus spinosus	5	No	FACU
6.			
7.			
8.			
= Total Cover	70		
Woody Vine Stratum (Plot size: 130 acres)			
1.			
2.			
= Total Cover	0		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC:	0	(A)
Total Number of Dominant Species Across All Strata:	4	(B)
Percent of Dominant Species That Are OBL, FACW, or FAC:	0%	(A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	0	x 1 = 0
FACW species	0	x 2 = 0
FAC species	25	x 3 = 75
FACU species	59	x 4 = 236
UPL species	9	x 5 = 45
Column Totals:	93 (A)	356 (B)

Prevalence Index = B/A = 3.83

Hydrophytic Vegetation Indicators:

No 1 - Rapid Test for Hydrophytic Vegetation

No 2 - Dominance Test is >50%

No 3 - Prevalence Index is ≤3.0[1]

No Problematic Hydrophytic Vegetation[1] (Explain in Remarks or in the delineation report)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ____ No X

Remarks: A total of 111 plant species were recorded from this abandoned cane field habitat. None of these species were Obligate or Facultative Wetland species, 22% were Facultative, 44% were Facultative Upland and 32% were Upland species.

SOIL

Sampling Point: 2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-13	10YR 6/3	100	—				Loose	excessively drained
13-22	10YR 6/4	100	—				Loose	excessively drained
22-60	10YR 7/4	100	—				Loose	excessively drained

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: none

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Muck Presence (A8)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Dark Surface (S7)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ Stratified Layers (A5)
- ___ Sandy Mucky Mineral (S1)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed): no

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes ___ No X

Remarks:

No observable hydric soil indicators present

HYDROLOGY

Wetland Hydrology Indicators: (Explain observations in Remarks, if needed.) none

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Tilapia Nests (B17)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Fiddler Crab Burrows (C10) (Guam, CNMI, and American Samoa)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ______

Water Table Present? Yes ___ No X Depth (inches): ______

Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): ______

Wetland Hydrology Present? Yes ___ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

No observable wetland hydrology indicators present.


Sampling Area 2 – Abandoned agricultural field with assortment of non-wetland weeds


Sampling Area 2 - Abandoned agricultural field with assortment of non-wetland weeds

WETLAND DETERMINATION DATA FORM – Hawai'i and Pacific Islands

Project/Site: Waiale Project City: Waikapu Sampling Date: 1/26-28/11 Time: ______

Applicant/Owner: A & B Properties, Inc. State/Terr. Hawaii Island: Maui Sampling Point: 3

Investigator(s): Robert W. Hobdy TMK/Parcel: (2) 3-5-07: 101 (por.)

Landform (hillslope, coastal plain, etc.): leveled land Local relief (concave, convex, none): none

Lat: 20° 51.5' North Long: 156° 29.5' West Datum: ______ Slope (%): Level

Soil Map Unit Name: Puu One Sand NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ______ (If no, explain in Remarks.)

Are Vegetation Yes, Soil Yes, or Hydrology NO significantly disturbed? Are "Normal Circumstances" present? Yes ______ No X

Are Vegetation No, Soil No, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

	Yes	No
Hydrophytic Vegetation Present?		X
Hydric Soil Present?		
Wetland Hydrology Present?		

Is the Sampled Area within a Wetland? Yes ______ No ______

Remarks: This 70 acre area has had significant alterations made to its surface by the removal of vegetation and sand. But the character of the soil is unchanged and the vegetation is returning with basicly the same array of Facultative, Facultative upland and upland species and no wetland hydrology has been destroyed or exposed.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 70 acres)	Absolute % Cover	Dominant Species?	Indicator Status
1. Prosopis pallida	5	Yes	FACU
2.			
3.			
4.			
5.			
	5% = Total Cover		
Sapling/Shrub Stratum (Plot size: 70 acres)			
1. Calotropis procera	10	Yes	UPL
2. Nicotiana glauca	5	NO	UPL
3. Pluchea carolinensis	3	NO	FAC
4.			
5.			
	18% = Total Cover		
Herb Stratum (Plot size: 70 acres)			
1. Waltheria indica	5	Yes	FACU
2. Cenchrus ciliaris	5	Yes	FACU
3. Crotalaria indica	3	NO	UPL
4. Sida fallax	3	NO	UPL
5.			
6.			
7.			
8.			
	16% = Total Cover		
Woody Vine Stratum (Plot size: 70 acres)			
1. 0			
2.			
	0 = Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	0	x 1 = 0
FACW species	0	x 2 = 0
FAC species	3	x 3 = 9
FACU species	15	x 4 = 60
UPL species	21	x 5 = 105
Column Totals:	39 (A)	174 (B)

Prevalence Index = B/A = 4.46

Hydrophytic Vegetation Indicators:

No 1 - Rapid Test for Hydrophytic Vegetation

No 2 - Dominance Test is >50%

No 3 - Prevalence Index is ≤3.0[1]

No Problematic Hydrophytic Vegetation[1] (Explain in Remarks or in the delineation report)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ______ No X

Remarks: The Vegetation was stripped off during sand excavation work. The vegetation is gradually growing back but it is still sparse. The Species are the same as the previous ones that grow in the surrounding area. A total of 50 species were recorded in this habitat, none of which are Obligate or Facultative Wetland. Eighteen per cent were Facultative, 48% were Facultative Upland and 34% were upland species.

SOIL

Sampling Point: 3

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-?	10YR 5/2	100	—				Loose to solid	crushed lithified sand

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: None

__ Histosol (A1)
__ Histic Epipedon (A2)
__ Black Histic (A3)
__ Hydrogen Sulfide (A4)
__ Muck Presence (A8)
__ Depleted Below Dark Surface (A11)
__ Thick Dark Surface (A12)
__ Sandy Gleyed Matrix (S4)
__ Sandy Redox (S5)
__ Dark Surface (S7)
__ Loamy Gleyed Matrix (F2)
__ Depleted Matrix (F3)
__ Redox Dark Surface (F6)
__ Depleted Dark Surface (F7)
__ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

__ Stratified Layers (A5)
__ Sandy Mucky Mineral (S1)
__ Red Parent Material (TF2)
__ Very Shallow Dark Surface (TF12)
__ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed): NO
Type: ____
Depth (inches): ____

Hydric Soil Present? Yes ____ No X

Remarks: The original surface soil was similar to that which occurs in sampling area 1. As much as 30 feet of sand has been removed in some places, but the exposed surface remains the same. The substrate is still excessively drained sand but the surface is now level.

HYDROLOGY

Wetland Hydrology Indicators: (Explain observations in Remarks, if needed.) None

Primary Indicators (minimum of one required; check all that apply)

__ Surface Water (A1)
__ High Water Table (A2)
__ Saturation (A3)
__ Water Marks (B1)
__ Sediment Deposits (B2)
__ Drift Deposits (B3)
__ Algal Mat or Crust (B4)
__ Iron Deposits (B5)
__ Inundation Visible on Aerial Imagery (B7)
__ Water-Stained Leaves (B9)
__ Aquatic Fauna (B13)
__ Tilapia Nests (B17)
__ Hydrogen Sulfide Odor (C1)
__ Oxidized Rhizospheres on Living Roots (C3)
__ Presence of Reduced Iron (C4)
__ Recent Iron Reduction in Tilled Soils (C6)
__ Thin Muck Surface (C7)
__ Fiddler Crab Burrows (C10) (Guam, CNMI, and American Samoa)
__ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

__ Surface Soil Cracks (B6)
__ Sparsely Vegetated Concave Surface (B8)
__ Drainage Patterns (B10)
__ Dry-Season Water Table (C2)
__ Salt Deposits (C5)
__ Stunted or Stressed Plants (D1)
__ Geomorphic Position (D2)
__ Shallow Aquitard (D3)
__ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ____ No X Depth (inches): ____
Water Table Present? Yes ____ No X Depth (inches): ____
Saturation Present? (includes capillary fringe) Yes ____ No X Depth (inches): ____

Wetland Hydrology Present? Yes ____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: No observable wetland hydrology indicators present.

Sampling Area 3 – Sand excavation site, leveled and surfaced with a thin layer of gravel
Partially re-vegetated with upland and facultative upland plant species.

Sampling Area 3 - Sand excavation site, leveled and surfaced with a thin layer of gravel
Partially re-vegetated with upland and facultative upland plant species.

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Appendix D: Flora and Fauna Survey

BIOLOGICAL RESOURCES SURVEY

for the

WAI'ALE PROJECT

WAIKAPU AND WAILUKU, MAUI

by

Robert W. Hobdy
Environmental Consultant
Kokomo, Maui
March 2011

Prepared for:
A & B Properties, Inc.

BIOLOGICAL RESOURCES SURVEY
Wai'ale Project

INTRODUCTION

The Wai'ale Project is situated on 545 acres of land in Waikapu and Wailuku in central Maui TMK's (2) 3-8-005:023 (por.) & 37, and TMK's (2) 3-8-07:71, 101 (por.) & 104. The northern boundary is adjacent to Maui Lani Project, the western boundary is adjacent to light industrial uses, agricultural uses and along Waikapu Stream, and the eastern boundary is adjacent to Kuihelani Highway (see Figure 1). This biological survey and assessment was initiated in compliance with environmental requirements of the planning process.

SITE DESCRIPTION

This property consists of gently sloping lands of Maui's central valley. Elevations range from 150 feet to 320 feet above sea level. Soils are made up of the Pu'u One Sand (PZUE) and Jaucus Sand (JaC) series (Foote et al, 1972). Vegetation consists of abandoned sugar cane agricultural fields and open grassland and kiawe savannah. Portions of the savannah are being grazed by cattle and horses while a smaller area is bare sand from a former excavation project. The area is seasonally dry during the summer receiving only about 20 inches per year (Armstrong, 1983).

BIOLOGICAL HISTORY

During pre-contact times the central Maui isthmus was vegetated with low growing, hardy native plants that could survive among wind-blown, shifting sand dunes. Typical species included ‘ilima (*Sida fallax*), ‘a'ali'i (*Dodonaea viscosa*), creeping naupaka (*Scaevola coriacea*), naio (*Myoporum sandwicense*), (*Bonamia menziesii*) no common name, pä'ü o Hi'iaka (*Jacquemontia ovalifolia* subsp. *sandwicensis*) and native mints (*Haplostachys* spp.). Over the past 200 years most of these species have become rare here or have disappeared, primarily through the effects of agriculture, fires and grazing animals.

Parts of this property with slightly better soil were eventually converted to sugar cane agriculture and later small portions were temporarily used for a passion fruit farm and a turf grass operation. But the bulk of the property has been used for livestock grazing and a small feed lot. Deer are now also common throughout this area.

Today, land uses include agriculture, grazing and a feed lot operation. Vegetation has been mostly converted to aggressive non-native plant species that can withstand these disturbances.

SURVEY OBJECTIVES

This report summarizes the findings of a flora and fauna survey of the proposed Wai'ale Project which was conducted in January and February 2011. This report supplements a flora and fauna report that was conducted for the same project in April 2007.
The objectives of the survey were to:

1. Document what plant and animal species occur on the property or may likely occur in the existing habitat.
2. Document the status and abundance of each species.
3. Determine the presence or likely occurrence of any native flora and fauna, particularly any that are Federally listed as Threatened or Endangered. If such occur, identify what features of the habitat may be essential for these species.
4. Determine if the project area contains any special habitats which if lost or altered might result in a significant negative impact on the flora and fauna in this part of the island.
5. Note which aspects of the proposed development pose significant concerns for plants or for wildlife and recommend measures that would mitigate or avoid these problems.

BOTANICAL SURVEY REPORT

SURVEY METHODS

A walk-through botanical survey method was used following routes to ensure maximum coverage of the many habitats in this large property. Areas most likely to harbor native or rare plants such as undisturbed areas were more intensively examined. Notes were made on plant species, distribution and abundance as well as terrain and substrate.

DESCRIPTION OF THE VEGETATION

The vegetation of this large property is dominated by buffelgrass (*Cenchrus ciliaris*) which occupies most habitats. Also common are kiawe (*Prosopis pallida*), golden crown-beard (*Verbesina encelioides*), Guinea grass (*Megathyrsus maximus*) and ‘uhaloa (*Waltheria indica*).

The old agricultural fields have sparse stands of remnant sugar cane with an assortment of weeds. The pasture areas are primarily kiawe trees and buffelgrass. The sand excavation areas are highly disturbed with much bare ground and hardy weeds.

A total of 131 species of plants were recorded during the survey. Of these four were indigenous native plants: ‘uhaloa (*Waltheria indica*), ‘ilima (*Sida fallax*), kou (*Cordia subcordata*) and popolo (*Solanum americanum*). All four of these are wide spread and common in Hawai'i as well as in other Pacific islands. An additional two species, niu (*Cocos nucifera*) and ko or sugar cane (*Sacharum officinarum*) are of Polynesian origin and common.

DISCUSSION AND RECOMMENDATIONS

The vegetation throughout the project area is dominated by a great variety of non-native plants. The four native species and the two Polynesian introductions are all common and of no particular environmental concern.

No federally listed Endangered or Threatened native plant species (USFWS, 2009) were encountered during the course of the survey. Nor were any species that are candidate for such status seen. No special habitats or rare plant communities were seen on the property.

As a result of these above conditions there is little of botanical concern on this property and the proposed land use changes are not expected to have a significant negative impact on the botanical resources in this part of Maui.

No recommendations are deemed necessary or appropriate regarding the botanical resources on this property.

PLANT SPECIES LIST

Following is a checklist of all those vascular plant species inventoried during the field studies. Plant families are arranged alphabetically within each of two groups: Monocots and Dicots. Taxonomy and nomenclature of the flowering plants are in accordance with Wagner et al. (1999).

For each species, the following information is provided:

1. Scientific name with author citation.

2. Common English or Hawaiian name.

3. Bio-geographical status. The following symbols are used:

   endemic = native only to the Hawaiian Islands; not naturally occurring anywhere else in the world.
   indigenous = native to the Hawaiian Islands and also to one or more other geographic area(s).
   non-native = all those plants brought to the islands intentionally or accidentally after western contact.

4. Abundance of each species within the project area:

   abundant = forming a major part of the vegetation within the project area.
   common = widely scattered throughout the area or locally abundant within a portion of it.
   uncommon = scattered sparsely throughout the area or occurring in a few small patches.
   rare = only a few isolated individuals within the project area.

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
MONOCOTS			
ALOACEAE (Aloe Family)			
Aloe vera (L.) Burm. F.	aloe	non-native	rare
ARECACEAE (Palm Family)			
Cocos nucifera L.	niu, coconut	Polynesian	rare
Washingtonia robusta Wendland	Mexican, washingtonia	non-native	rare
ASPARAGACEAE (Asparagus Family)			
Furcraea foetida (L.) Haw.	Mauritius hemp	non-native	rare
Sansevieria trisfasciata Prain	bowstring hemp	non-native	rare
CYPERACEAE (Sedge Family)			
Cyperus rotundus L.	nut sedge	non-native	rare
MUSACEAE (Banana Family)			
Musa acuminata x *balbisiana* Colla	banana	non-native	rare
ORCHIDACEAE (Orchid Family)			
Papilionanthe hookeriana x *teres*	"Miss Joaquim" vanda	non-native	rare
POACEAE (Grass Family)			
Bothriochloa pertusa (L.) A.Camus	pitted beardgrass	non-native	rare
Brachiaria subquadripara (Trin.) Hitchc.	-------------------	non-native	rare
Cenchrus ciliaris L.	buffelgrass	non-native	abundant
Cenchrus echinatus L.	common sandbur	non-native	rare
Chloris barbata (L.) Sw.	swollen fingergrass	non-native	uncommon
Chloris virgata Sw.	feather fingergrass	non-native	uncommon
Cynodon dactylon (L.) Pers.	Bermuda grass	non-native	rare
Dactyloctenium aegyptium (L.) Willd.	beach wiregrass	non-native	uncommon
Digitaria insularis (L.) Mez ex Ekman	sourgrass	non-native	uncommon
Digitaria violascens Link	kukaepua'a	non-native	rare
Echinochloa crus-galli (L.) P. Beauv.	barnyard grass	non-native	rare
Eleusine indica (L.) Gaertn.	wiregrass	non-native	rare
Eragrostis amabilis (L.) Wight & Arnott	Japanese lovegrass	non-native	rare
Eragrostis pectinacea (Michx) Nees	Carolina lovegrass	non-native	uncommon
Leptochloa fusca (L.) Kunth *subsp. uninervia* (K.Presl) N.Snow	sprangletop	non-native	rare
Megathyrsus maximus (Jacq.) Simon & Jacobs	Guinea grass	non-native	common
Melinis repens (Willd.) Zizka	Natal redtop	non-native	rare
Saccharum officinarum L.	sugar cane	Polynesian	uncommon
Setaria verticillata (L.) P. Beauv.	bristly foxtail	non-native	uncommon
Tragus berteronianus Schult.	bur grass	non-native	rare
DICOTS			
ACANTHACEAE (Acanthus Family)			
Asystasia gangetica (L.) T. Anderson	Chinese violet	non-native	rare
AMARANTHACEAE (Amaranth Family)			
Alternanthera pungens Kunth	khaki weed	non-native	rare

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
Amaranthus spinosus L.	spiny amaranth	non-native	rare
Amaranthus viridis L.	slender amaranth	non-native	rare
Atriplex suberecta Verd.	---------------	non-native	rare
Chenopodium carinatum R. Br.	keeled goosefoot	non-native	uncommon
Chenopodium murale L.	'aheahea	non-native	rare
Salsola tragus L.	Russian thistle, tumbleweed	non-native	rare
ANACARDIACEAE (Mango Family)			
Mangifera indica L.	mango	non-native	rare
APOCYNACEAE (Dogbane Family)			
Asclepias physocarpa (E.Mey.) Schlect.	baloon plant	non-native	rare
Calotropis procera (Ait.) Ait. f.	small crown flower	non-native	uncommon
ASTERACEAE (Sunflower Family)			
Ageratum conyzoides L.	maile hohono	non-native	rare
Bidens pilosa L.	Spanish needle	non-native	uncommon
Calyptocarpus vialis Less.	-----------------	non-native	rare
Conyza bonariensis (L.) Cronq.	hairy horseweed	non-native	rare
Conya canadensis (L.) Cronq.	horseweed	non-native	rare
Dyssodia tenuiloba (DC.) B.L. Rob.	Dahlberg daisy	non-native	rare
Eclipta prostrata (L.) L.	false daisy	non-native	rare
Emilia fosbergii Nicolson	red pualele	non-native	rare
Encelia farinosa A. Gray	brittlebush	non-native	rare
Flaveria trinervia (Spreng.) C. Mohr	clustered yellowtops	non-native	rare
Galinsoga parviflora Cav.	-----------------	non-native	rare
Heterotheca grandiflora Nutt.	telegraph weed	non-native	rare
Parthenium hysterophorus L.	Santa Maria	non-native	rare
Pluchea carolinensis (Jacq.) G. Don	sourbush	non-native	uncommon
Pluchea indica (L.) Less.	Indian fleabane	non-native	rare
Senecio madagascariensis Poir.	fireweed	non-native	rare
Sonchus oleraceus L.	pualele	non-native	rare
Synedrella nodiflora (L.) Gaertn.	nodeweed	non-native	rare
Tridax procumbens L.	coat buttons	non-native	uncommon
Verbesina encelioides (Cav.) Benth. & Hook.	golden crown-beard	non-native	common
Xanthium Strumarium L.	kikania	non-native	rare
Zinnia peruviana (L.) L.	puapihi	non-native	rare
BIGNONIACEAE (Bigonia Family)			
Tabebuia heterophylla (A.P. de Candolle) Britton	pink tecoma	non-native	rare
BORAGINANCEAE (Borage Family)			
Cordia subcordata Lam.	kou	indigenous	rare
Heliotropium procumbens Mill.	fourspike heliotrope	non-native	uncommon
BRASSICACEAE (Mustard Family)			
Coronopus didymus (L.) Sm.	swinecress	non-native	rare
Lepidium virginicum L.	pepperweed	non-native	rare

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
Lobularia maritima (L.) Desv.	sweet alyssum	non-native	rare
Sisymbrium altissimum L.	tumble mustard	non-native	rare
BUDDLEIACEAE (Butterfly Bush Family)			
Buddleia asiatica Lour.	dog tail	non-native	rare
CARYOPHYLLACEAE (Pink Family)			
Polycarpon tetraphyllum (L.) L.	four-leaved allseed	non-native	rare
CASUARINACEAE (She-oak Family)			
Casuarina equisetifolia L.	common ironwood	non-native	rare
CLEOMACEAE (Cleome Family)			
Cleome gynandra L.	wild spider flower	non-native	rare
CONVOLVULACEAE (Morning Glory Family)			
Ipomoea obscura (L.) Ker-Gawl.	-----------------	non-native	rare
Ipomoea triloba L.	little bell	non-native	rare
Merremia aegyptia (L.) Urb.	hairy merremia	non-native	rare
CUCURBITACEAE (Gourd Family)			
Cucumis dipsaceus Ehrenb. ex Spach	hedgehog gourd	non-native	rare
Momordica charantia L.	bitter melon	non-native	rare
EUPHORBIACEAE (Spurge Family)			
Codiaeum variegatum (L.) Blume	croton	non-native	rare
Euphorbia heterophylla L.	kaliko	non-native	rare
Euphorbia hirta L.	hairy spurge	non-native	uncommon
Euphorbia hypericifolia L.	graceful spurge	non-native	uncommon
Euphorbia lactea Haworth	milk-striped euphorbia	non-native	rare
Euphorbia prostrata Aiton	protrate spurge	non-native	rare
Macaranga tanarius (L.) Mull. Arg.	parasol leaf tree	non-native	rare
Ricinus communis L.	Castor bean	non-native	uncommon
FABACEAE (Pea Famly)			
Chamaecrista nictitans (L.) Moench	partridge pea	non-native	uncommon
Crotalaria incana L.	fuzzy rattlepod	non-native	uncommon
Crotalaria pallida Aiton	smooth rattlepod	non-native	uncommon
Crotalaria retusa L.	rattlepod	non-native	rare
Desmanthus pernambucanus (L.) Thellung	slender mimosa	non-native	rare
Desmodium tortuosum (Sw.) DC.	Florida beggarweed	non-native	uncommon
Gliricidia sepium (N. Jacquin) Steudel	madre de cacao	non-native	rare
Indigofera hendecaphylla Jacq.	creeping indigo	non-native	rare
Indigofera suffruticosa Mill.	inikö	non-native	rare
Leucaena leucocephala (Lam.) de Wit	koa haole	non-native	uncommon
Macroptilium atropupureum (DC.) Urb.	siratro	non-native	rare
Macroptilium lathyroides (L.) Urb.	wild bean	non-native	rare
Neonotonia wightii (Wight & Arnott) Lackey	glycine	non-native	rare
Pithecellobium dulce (Roxb.) Benth.	'opiuma	non-native	rare
Prosopis pallida (Humb. & Bonpl. ex Willd.) Kunth	kiawe	non-native	common

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
Senna occidentalis (L.) Link	coffee senna	non-native	rare
Senna siamea (Lam.) H. Irwin & Barneby	Siamese shower	non-native	rare
Senna surattensis (N.L.Burm.) H.Irwin & Barneby	kolomona	non-native	rare
Trifolium repens L.	white clover	non-native	rare
Vicia sativa L.	common vetch	non-native	rare
LAMIACEAE (Mint Family)			
Leonotis nepetifolia (L.) R. Br.	lion's ear	non-native	uncommon
MALVACAE (Mallow Family)			
Abutilon grandifolium (Willd.) Sweet	hairy abutilon	non-native	rare
Malva parviflora L.	cheeseweed	non-native	rare
Malvastrum coromandelianum (L.) Garcke	false mallow	non-native	uncommon
Sida fallax Walp.	'ilima	indigenous	uncommon
Sida rhombifolia L.	Cuban jute	non-native	uncommon
Sida spinosa L.	prickly sida	non-native	rare
Waltheria indica L.	'uhaloa	indigenous	common
MELIACEAE (Mahogany Family)			
Melia azedarach L.	pride of India	non-native	rare
MORACEAE (Fig Family)			
Ficus benjamina L.	weeping fig	non-native	rare
MYRTACEAE (Myrtle Family)			
Syzygium cumini (L.) Skeels	Java plum	non-native	rare
NYCTAGINACEAE (Four-o'clock Family)			
Boerhavia coccinea Mill.	scarlet spiderling	non-native	uncommon
OXALIDACEAE (Wood Sorrel Family)			
Oxalis corniculata L.	'ihi	Polynesian	rare
PASSIFLORACEAE (Passion Flower Family)			
Passiflora foetida L.	love-in-a-mist	non-native	rare
PLANTAGINACEAE (Plantain Family)			
Plantago lanceolata L.	narrow-leaved plantain	non-native	rare
POLYGONACEAE (Buckwheat Family)			
Rumex obtusifolius L.	bitter dock	non-native	rare
PORTULACACEAE (Purslane Family)			
Portulaca oleracea L.	pigweed	non-native	rare
PRIMULACEAE (Primrose Family)			
Anagallis arvensis L.	scarlet pimpernel	non-native	rare
SOLANACEAE (Nightshade Family)			
Capsicum frutescens L.	chile pepper	non-native	rare
Datura stramonium L.	Jimson weed	non-native	rare
Nicandra physalodes (L.) Gaertn.	apple of Peru	non-native	rare
Nicotiana glauca R.C. Graham	tree tobacco	non-native	uncommon
Solanum americanum Mill.	popolo	non-native	rare
Solanum lycopersicum L.	cherry tomato	non-native	rare

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
VERBENACEAE (Verbena Family)			
Lantana camara L.	lantana	non-native	uncommon
Stachytarpheta jamaicensis	Jamaica vervain	non-native	rare

FAUNA SURVEY REPORT

SURVEY METHODS

A walk-through fauna survey method was conducted in conjunction with the botanical survey. All parts of the project area were covered. Field observations were made with the aid of binoculars and by listening to vocalizations. Notes were made on species, abundance, activities and location as well as observations of trails, tracks, scat and signs of feeding. In addition an evening visit was made to the area to record crepuscular activities and vocalizations and to see if there was any evidence of occurrence of the Hawaiian hoary bat (*Lasiurus cinereus semotus*) in the area.

RESULTS

MAMMALS

Six species of non-native mammals or their signs were observed in the project area during four site visits. Taxonomy and nomenclature follow Tomich (1986). Most common were axis deer (*Axis axis*). One herd was seen, but their tracks, scat, antler rubbings and signs of feeding were seen throughout the area. Also common were cattle (*Bos Taurus*) which were in the pastures or concentrated in feed lots. Uncommon or rare were horses (*Equus caballus*), mongoose (*Herpestes auropunctatus*), feral cats (*Felis catus*) and dogs (*Canis familiaris*).

Other non-native mammals one would expect to see in this habitat include mice (*Mus domesticus*) and rats (*Rattus* spp.). These rodents feed on seeds, fruits, insects, eggs and herbaceous vegetation and are prey for the cats and mongoose.

A special effort was made to look for the native Hawaiian hoary bat by making an evening survey at four sites in the area. When present in an area these bats can be easily identified as they forage for insects, their distinctive flight patterns clearly visible in the glow of twilight. No evidence of such activity was observed though visibility was excellent and plenty of flying insects were seen. In addition, a bat-detecting device (Batbox IIID) was employed, set to the frequency of 27,000 Hertz which these bats are known to use for echolocation. No bats were detected at any site using this device.

BIRDS

Both the diversity of birds and their numbers were substantial across the project area due to the presence of cattle feed lots with grains and insect populations. Nineteen species of birds were seen during four site visits to the property. Taxonomy and nomenclature follow American Ornithologists' Union (2009). Included were eighteen introduced, non-native species and one migratory species, the kolea or Pacific golden-plover (*Pluvialis fulva*).

The common bird species included: zebra dove (*Geopelia striata*), common myna (*Acridotheres tristis*), spotted dove (*Streptopelia chinensis*), gray francolin (*Francolinus pondicerianus*), northern cardinal (*Cardinalis cardinalis*), and house finch (*Carpodacus mexicanus*). The remaining thirteen species were uncommon to rare on the property. A few other non-native birds such as the nutmeg mannikin (*Lonchura punctulata*) and the mourning dove (*Zenaida macroura*) might occasionally be seen here, but the habitat is not suitable for Hawaii's native forest birds that are presently restricted to higher elevations beyond the range of mosquitoes and the deadly avian diseases they carry and transmit. None of the Endangered nene goose (Branta Sandwicensis) were seen in this kiawe forest habitat.

Hawaiian Biodiversity and Mapping records indicate that several of the Endangered Hawaiian stilt (*Himantopus mexicanus knudseni*) and Hawaiian coot (*Fulica alai*) have been occasionally seen at a small plantation reservoir a half mile to the southwest of the project area. These waterbirds are attracted to such aquatic features. No such aquatic features occur within the project area and these birds are not likely to utilize this dry habitat.

REPTILES

Just one species of reptile, the non-native mourning gecko, was observed. These geckos were scattered throughout the project area and could be heard making their chipping calls during the evening survey.

INSECTS

An abundance of insect species were observed in the project area during four site visits. The onset of the wet season stimulates the emergence of many species from dormancy. A total of thirty six species were recorded in nine insect orders. Taxonomy and nomenclature follow Nishida et al (1992). Three native species were seen including the endemic and Endangered Blackburn's sphinx moth (*Manduca blackburni*) as well as two indigenous dragonflies, the globe skimmer (*Pantala flavescens*) and the green darner (*Anax junius*). The remaining thirty three species were an array of non-native insect introductions or accidental arrivals.

One species was abundant across the project area, the dung fly (*Musca sorbens*). Another six species were common: the European garden spider (*Araneus diadematus*), the tachinid fly (*Lespesia archippivora*), the honey bee (*Apis mellifera*), the kiawe moth (*Anacamptodes fragillaria)*, the monarch butterfly (*Danaus plexippus*) and the globe skimmer.

MOLLUSKS

Two species of non-native snails were observed within the property, both of which are common species but were rare here. These were the giant African snail (*Achatina fulica*) and the rosy cannibal snail (*Euglandina rosea*).

DISCUSSION AND RECOMMENDATIONS

The fauna life on this project area is strongly dominated by non-native species. Of 6 mammals, 15 birds, 1 reptile, 36 insects and 3 mollusks, only 3 insects were native to Hawaii: the endemic and Endangered Blackburn's Sphinx moth, and two indigenous dragonflies the green darner and the globe skimmer.

The Endangered Blackburn's sphinx moths seen were in the egg and larval stages of growth, and they were found in significant numbers on their alternate host plant species, the non-native tree tobacco (*Nicotiana glauca*). Approximately 300 tree tobacco plants were found on the property, mostly in recently disturbed areas on the northern part of the property. These shrubs, like most of the rest of this property, were experiencing a flush of new growth in response to recent winter rains and were growing vigorously. The rains and the vigorous plant growth stimulate a burst of seasonal insect activity as many species emerge from dormancy and begin a new cycle of growth and breeding. The blackburn's sphinx moth fits the annual pattern which typically lasts from December through April during which time they breed, lay eggs which hatch on host plants on which they feed until they mature. Then they migrate to the leaf litter below the host plants where they pupate. The pupae then begin a long stage of dormancy until the next winter rains renew the cycle.

About 7% of the tree tobacco plants (or about 20 widely scattered shrubs) were found to have one or more eggs on the leaves. One plant had newly hatched larvae that had begun to feed on the leaves and one other plant had a fully grown 5 inch long caterpillar on it. These larvae have the capacity to ingest the toxic nicotine in these leaves without being poisoned. These toxins then protect the larvae from potential predators. Blackburn's sphinx moths co-evolved with native ʻaiea trees of the genus *Nothocestrum* which are also in the nightshade family and contain similar toxins as the tree tobacco. ʻAiea trees are quite rare now and this led to the decline in populations of the moth and its eventual placement on the Endangered species list. But with the spread of the tree tobacco, this moth has been able to successfully switch host plants and its numbers are now increasing.

Tree tobacco is a non-native weed that would, under other circumstances, have no particular value. Since, however, it has been shown to be important to the survival and increase of the Blackburn's sphinx moth, it has been given ancillary protections as an essential food plant for this moth under the Endangered Species Act.

It is recommended that the owners consult with the U.S. Fish and Wildlife Service to develop an appropriate mitigation plan for the Blackburn's sphinx moth in this project area.

The two indigenous dragonflies, the green darner and the globe skimmer, are both species that are found in other parts of the world besides Hawaii. The green darner is also native to the U.S. mainland and Mexico where it is widespread and common. The globe skimmer is found throughout the tropics worldwide. Both species are common in Hawaii. Neither species is of any particular environmental concern and no recommendations are offered.

The list of insect species was fairly extensive and many Orders were represented. Other native species were watched for, especially those that are rare or listed. No damselflies (*Megalagrion* spp.) were observed. The habitat was unsuitable for these delicate, water-loving insects. Also, no yellow-faced bees (*Hylaeus* spp.) were seen. These small solitary bees are particularly attracted to the flowers of ʻilima (Sida fallax) to which they are well-adapted. ʻIlima plants were seen in moderate amounts across the project area and these were in full flower, but none of these bees were observed.

No Hawaiian hoary bats were detected during the evening survey at four sites within the property. While the habitat does not appear ideal for these bats, one cannot preclude the occasional presence of these highly mobile creatures.

No native bird species were found on the property during four site visits and none are to be expected in this habitat. Nonetheless, there are native seabirds, the Endangered Hawaiian petrel (*Pterodroma sandwichensis*) and the Threatened Newell's shearwater (*Puffinus newelli*), that fly over these lowlands on the way to their burrows high in the mountains. These seabirds, and especially the fledglings, are attracted to bright lights in the evenings and early dawn hours and can become disoriented and crash. They are then vulnerable to injury, vehicle strikes and predators. It is recommended that any significant outdoor lighting in any proposed development on this property be shielded to direct the light downward to minimized disorientation of these protected seabirds.

No other issues are anticipated with wildlife species.

ANIMAL SPECIES LIST

Following is a checklist of the animal species inventoried during the field work. Animal species are arranged in descending abundance within five groups: Mammals, Birds, Reptiles, Insects and Mollusks.. For each species the following information is provided:

1. Common name
2. Scientific name
3. Bio-geographical status. The following symbols are used:

    endemic = native only to Hawaii; not naturally occurring anywhere else in the world.
    indigenous = native to the Hawaiian Islands and also to one or more other geographic area(s).
    non-native = all those animals brought to Hawaii intentionally or accidentally after western contact.
    migratory = spending a portion of the year in Hawaii and a portion elsewhere. In Hawaii the migratory birds are usually in the overwintering/non-breeding phase of their life cycle.

4. Abundance of each species within the project area:

    abundant = many flocks or individuals seen throughout the area at all times of day.
    common = a few flocks or well scattered individuals throughout the area.
    uncommon = only one flock or several individuals seen within the project area.
    rare = only one or two seen within the project area.

COMMON NAME	SCIENTIFIC NAME	STATUS	ABUNDANCE
MAMMALS			
Axis deer	*Axis axis Erxleben*	non-native	common
Cattle	*Bos taurus* L.	non-native	common
Horse	*Equus caballus* L.	non-native	uncommon
Mongoose	*Herpestes auropunctatus* Hodgson	non-native	uncommon
Cat	*Felis catus* L.	non-native	uncommon
Dog	*Canis familiaris* L.	non-native	rare
BIRDS			
Zebra dove	*Geopelia striata* L.	non-native	common
Common myna	*Acridotheres tristis* L.	non-native	common
Spotted dove	*Streptopelia chinensis* Scopoli	non-native	common
Gray francolin	*Francolinus pondicerianus* Gmelin	non-native	common
Northern cardinal	*Cardinalis cardinalis*	non-native	common
House finch	*Carpodacus mexicanus* Muller	non-native	common
Black francolin	*Francolinus francolinus* L.	non-native	uncommon
House sparrow	*Passer domesticus* L.	non-native	uncommon
Chicken	*Gallus gallus domesticus* L.	non-native	uncommon
Red-crested cardinal	*Paroaria coronata* Miller	non-native	uncommon
Cattle egret	*Bubulcus ibis* L.	non-native	uncommon
Japanese white-eye	*Zosterops japonicus* Temminck & Schlegel	non-native	rare
Java sparrow	*Padda oryzivora* L.	non-native	rare
African silverbill	*Lonchura cantans* Gmelin	non-native	rare
Chestnut mannikin	*Lonchura malacca* L.	non-native	rare
Northern mockingbird	*Mimus polyglottos* L.	non-native	rare
Common peafowl, Peacock	*Pavo cristatus* L.	non-native	rare
Guinea fowl	*Numida meleagris*	non-native	rare
Kolea, Pacific golden-plover	*Pluvialis fulva* Gmelin	migratory	rare

INSECTS

Order ARANAE - true spiders

ARANEIDAE (Orb Weaver Family)

European garden spider	*Araneus diadematus* Clerck	non-native	common
Garden spider	*Argiope appensa* Walkenaer	non-native	rare

SALTICIDAE (Jumping Spider Family)

Jumping spider	*Hasarius adansoni* Audouin	non-native	rare

Order COLEOPTERA - beetles

COCCINELLIDAE (Lady Beetle Family)

Three striped lady beetle	*Brumoides suturalis* Fabricius	non-native	rare
Seven spot lady beetle	*Coccinella septempunctata* Mulsant	non-native	uncommon

Order DIPTERA - flies

CALLIPHORIDAE (Blowfly Family)

Bluebottle fly	*Calliphora vomitoria* L.	non-native	uncommon

MUSCIDAE (Housefly Family)

House fly	*Musca domestica* L.	non-native	uncommon
Dung fly	*Musca sorbens* Wiedemann	non-native	abundant

SYRPHIDAE (Hoverfly Family)

Green hover fly	*Ornidea obesa* Fabricius	non-native	rare
Australian hover fly	*Simosyrphus grandicornis* Macquart	non-native	uncommon

TACHINIDAE (Tachinid Fly Family)

Tachinid fly	*Lespesia archippivora* Riley	non-native	common

Order HOMOPTERA - true bugs

APHIDIDAE (Aphid Family)

Cowpea aphid	*Aphis craccivora koch*	non-native	uncommon

Order HYMENOPTERA - bees and wasps

APIDAE (Honey Bee Family)

Honey bee	*Apis mellifera* L.	non-native	common
Sonoran carpenter bee	*Xylocopa sonorina* Smith	non-native	common

FORMICIDAE (Ant Family)

Argentine ant	*Linepithema humile* Mayer	non-native	uncommon

VESPIDAE (Vespid Wasp Family)

Mud wasp	*Pachodynerus nasidens* Latreille	non-native	rare
Paper wasp	*Polistes aurifer* Saussure	non-native	rare

COMMON NAME	SCIENTIFIC NAME	STATUS	ABUNDANCE
Order LEPIDOPTERA - butterflies and moths			
GEOMETRIDAE (Geometer Moth Family)			
Kiawe moth	*Anacamptodes fragilaria* Grossbeck	non-native	common
GRACILLARIIDAE (Leaf Miner Family)			
Lantana leaf miner	*Cremastobombycia lantanella* Busck	non-native	uncommon
HESPERIIDAE (Skipper Butterfly Family)			
Fiery skipper	*Hylephila phyleus* Drury	non-native	uncommon
LYCAENIDAE (Gossamer Wing Butterfly Family)			
Long-tailed blue	*Lampides boeticus* L.	non-native	uncommon
Lantana scrub hairstreak	*Strymon bazochii* Goddart	non-native	uncommon
NOCTUIDAE (Owlet Moth Family)			
Castor semi-looper	*Achaea janata* L.	non-native	uncommon
-----------------	*Condica illecta* Walker	non-native	rare
-----------------	*Melipotes indomita* Walker	non-native	rare
NYMPHALIDAE (Brush Foot Butterfly Family)			
Passion flower butterfly	*Agraulis vanillae* L.	non-native	rare
Monarch butterfly	*Danaus plexippus* L.	non-native	common
Painted lady	*Vanessa cardui* L.	non-native	uncommon
PIERIDAE (White and Sulpher Butterfly Family)			
Large orange sulpher butterfly	*Phoebis agarithe* Boisduval	non-native	uncommon
Little white cabbage butterfly	*Pieris rapae* L.	non-native	uncommon
SPHINGIDAE (Sphinx Moth Family)			
Blackburn's sphinx moth	*Manduca blackburni* Butler	endemic	uncommon
Order MANTODEA - mantises			
MANTIDAE (Mantis Family)			
Praying mantis	*Tenodera angustipennis* Saussure	non-native	rare
Order ODONATA - dragonflies and damselflies			
AESHNIDAE (Darner Dragonfly Family)			
Green darner	Anax junius Drury	indigenous	rare
LIBELLULIDAE (Skimmer Dragonfly Family)			
Globe skimmer	*Pantala flavescens* Fabricius	indigenous	common
Black saddlebags dragonfly	*Tramea lacerata* Hagen	non-native	rare
Order ORTHOPTERA - grasshoppers, locusts and crickets			
ACRIDIDAE (Grasshopper Family)			
Small locust	*Oedaleus abruptus* Thunberg	non-native	uncommon

REPTILES

GEKKONIDAE (Gecko Family)			
Mourning gecko	*Lepidodactylus lugubris* Dumeril & Bibron	Polynesian	uncommon

MOLLUSKS

ACHATINIDAE			
Giant African snail	*Achatina fulica* Ferussac	non-native	rare
SPIRAXIDAE			
rosy cannibal snail	*Euglandina rosea* Ferussac	non-native	rare

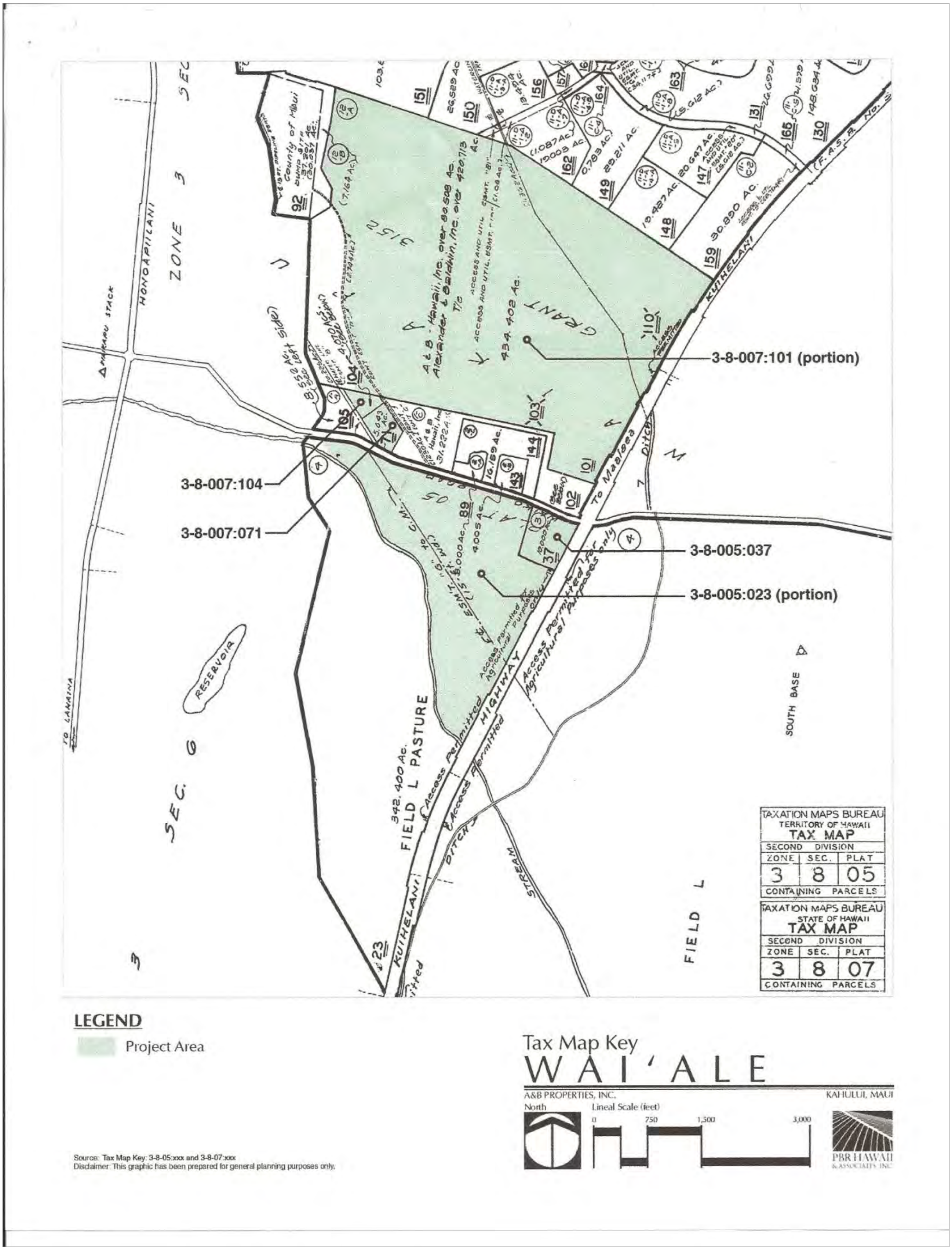

Figure 1 Wai'ale Project

Figure 2 Kiawe/buffelgrass savannah.

Figure 3 Area leveled from sand excavation and surfaced with a thin layer of gravel.

Figure 4 Former sugar cane lands that are now idle and are now occupied by an assortment of weeds.

Figure 5 Level grassland with scattered trees and shrubs in northeast corner of property.

Figure 6 Tree tobacco shrub growing in dry grassland.

Figure 7 Tree tobacco shrub with blue-green leaves and yellow flowers


Figure 8 Tree tobacco shrub with two eggs of the endemic and Endangered Blackburn’s sphinx moth

Figure 9 Tree tobacco shrub with a fully developed, 5 inch long Blackburn's Sphinx moth caterpillar.

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BOTANICAL AND FAUNA SURVEYS

for the

WAI'ALE PROJECT

WAIKAPU, WAILUKU, MAUI

by

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Prepared for:
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BOTANICAL AND FAUNA SURVEY for the WAI'ALE PROJECT WAIKAPŪ, WAILUKU, MAUI

INTRODUCTION

The Wai'ale Project is situated on 829 acres of land in Waikapū and Wailuku in central Maui (TMK (2) 3-8-05:23,27,71,101,104,105). The land is bounded on the east by Kuihelani Highway, on the north by new single family homes, on the west by undeveloped lands and on the south by sugar cane fields. This survey and assessment was initiated in compliance with environmental requirements of the planning process.

SITE DESCRIPTION

This property consists of gently sloping lands of Maui's central valley. Elevations range from 150 ft. to 320 ft. above sea level. Soils are made up of wind-blown sands of the Pu'u One Sand (PZUE) and Jaucus Sand (JaC) series with gently rolling dunes (Foote et al, 1972). Vegetation consists of sugar cane agricultural fields, open grassland and kiawe savannah and a narrow strip of riparian forest along Waikapū Stream which runs through the property. Portions of the savannah are being grazed by cattle and horses while a smaller area is bare sand from an ongoing excavation project. The area is seasonally dry during the summer receiving only 15 in. to 20 in. per year (Armstrong, 1983).

BIOLOGICAL HISTORY

During precontact times this central Maui isthmus was vegetated with low growing, hardy native plants that could survive among wind-blown, shifting sand dunes. Typical species included 'ilima (*Sida fallax*), 'a'ali'i (*Dodonaea viscosa*), creeping naupaka (*Scaevola coriacea*), naio (*Myoporum sandwicense*), (*Bonamia menziesii*) no common name, pā'ū o Hi'iaka (*Jacquemontia ovalifolia* subsp. *sandwicensis*) and native mints (*Haplostachys* spp.). Over the past 200 years most of these species have become rare here or have disappeared, primarily through the effects of agriculture, fires and grazing animals.

Parts of this property with slightly better soil were eventually converted to sugar cane agriculture and later small portions were temporarily used for a passion fruit farm and a turf grass operation. But the bulk of the property has been used for livestock grazing and a small feed lot. Deer are now also common throughout this area.

Today land uses include agriculture, grazing, a metal recycling operation and sand excavation. Vegetation has been mostly converted to aggressive non-native plant species that can withstand these disturbances.

SURVEY OBJECTIVES

This report summarizes the findings of a flora and fauna survey of the proposed Wai'ale Project which was conducted in April, 2007.
The objectives of the survey were to:

1. Document what plant, bird and mammal species occur on the property or may likely occur in the existing habitat.
2. Document the status and abundance of each species.
3. Determine the presence or likely occurrence of any native flora and fauna, particularly any that are federally listed as Threatened or Endangered. If such occur, identify what features of the habitat may be essential for these species.
4. Determine if the project area contains any special habitats which if lost or altered might result in a significant negative impact on the flora and fauna in this part of the island.

BOTANICAL SURVEY REPORT

SURVEY METHODS

A walk-through botanical survey method was used following routes to ensure maximum coverage of the many habitats in this large property. Areas most likely to harbor native or rare plants such as the stream corridor and undisturbed dunes were more intensively examined. Notes were made on plant species, distribution and abundance as well as terrain and substrate.

DESCRIPTION OF THE VEGETATION

The vegetation on this large property is dominated by buffelgrass (*Cenchrus ciliaris*) which occupies most habitats. Also common are kiawe (*Prosopis pallida*), sugar cane (*Saccharum officinarum*), sourgrass (*Digitaria insularis*), koa haole (*Leucaena leucocephala*), Guinea grass (*Panicum maximum*) and 'uhaloa (*Waltheria indica*). Java plum trees (*Syzygium cumini*) line the Waikapū Stream corridor.

The agricultural fields are monotypic stands of sugar cane with an assortment of weeds along the field roads. The pasture areas are primarily kiawe trees and buffelgrass and Guinea grass. The metal recycling and sand excavation areas are highly disturbed with much bare ground and hardy weeds along the margins.

A total of 125 species of plants were recorded during the survey. Of these four were indigenous native plants: ʻuhaloa (*Waltheria indica*), ʻilima (*Sida fallax*), kou (*Cordia subcordata*) and popolo (*Solanum americanum*). All four of these are widespread and common in Hawai'i as well as in other Pacific islands. An additional three species, kukui (*Aleurites moluccana*), niu (*Cocos nucifera*) and ko or sugar cane are of Polynesian origin and common. The remaining 118 plant species are non-native and include agricultural crop plants. Pasture grasses, a few ornamental plantings and many common weeds.

DISCUSSION AND RECOMMENDATIONS

The vegetation throughout the project area is dominated by a great variety of non-native plants. The four native species and the three Polynesian introductions are all common and of no particular environmental concern.

No federally listed Endangered or Threatened native species (USFWS,1999) were encountered during the course of the survey. Nor were any species that are candidate for such status seen. No special habitats or rare plant communities were seen on the property.

As a result of these above conditions there is little of botanical concern on this property and the proposed land use changes are not expected to have a significant negative impact on the botanical resources in this part of Maui.

No recommendations are deemed necessary or appropriate regarding the botanical resources on this property.

PLANT SPECIES LIST

Following is a checklist of all those vascular plant species inventoried during the field studies. Plant families are arranged alphabetically within each of two groups: Monocots and Dicots. Taxonomy and nomenclature of the flowering plants are in accordance with Wagner et al. (1999).

For each species, the following information is provided:

1. Scientific name with author citation
2. Common English or Hawaiian name.
3. Bio-geographical status. The following symbols are used:
   endemic = native only to the Hawaiian Islands; not naturally occurring anywhere else in the world.
   indigenous = native to the Hawaiian Islands and also to one or more other geographic area(s).
   non-native = all those plants brought to the islands intentionally or accidentally after western contact.
   polynesian = all those plants brought to the islands by the Hawaiians during the course of their migrations.

4. Abundance of each species within the project area:
   abundant = forming a major part of the vegetation within the project area.
   common = widely scattered throughout the area or locally abundant within a portion of it.
   uncommon = scattered sparsely throughout the area or occurring in a few small patches.
   rare = only a few isolated individuals within the project area.

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANC
MONOCOTS			
AGAVACEAE (Agave Family)			
Furcraea foetida (L.) Haw.	Mauritius hemp	non-native	rare
Sansevieria trifasciata Prain	bowstring hemp	non-native	rare
ALOEACEAE (Aloe Family)			
Aloe vera (L.) Burm. f.	aloe vera	non-native	rare
ARECACEAE (Palm Family)			
Cocos nucifera L.	niu	Polynesian	rare
Veitchia merrillii (Beccari) H.E. Moore	Manila palm	non-native	rare
Washingtonia robusta Wendland	desert palm	non-native	rare
CYPERACEAE (Sedge Family)			
Cyperus rotundus L.	nut sedge	non-native	rare
POACEAE (Grass Family)			
Bothriochloa pertusa (L.) A. Camus	pitted beardgrass	non-native	rare
Brachiaria subquadripara (Trin.) Hitchc.	---------------	non-native	rare
Cenchrus ciliaris L.	buffelgrass	non-native	abundant
Cenchrus echinatus L.	common sandbur	non-native	rare
Chloris barbata L. Sw.	swollen fingergrass	non-native	uncommon
Chloris divaricata R. Br.	stargrass	non-native	rare
Cynodon dactylon (L.) Pers.	Bermuda grass	non-native	rare
Digitaria insularis (L.) Mez ex Ekman	sourgrass	non-native	common
Digitaria violascens Link	kukaepua'a uka	non-native	rare
Echinochloa crus-galli (L.) P. Beauv.	barnyard grass	non-native	rare
Eleusine indica (L.) Gaertn.	wiregrass	non-native	rare

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANC
Eragrostis amabilis (L.) Wight & Arnott	Japanese lovegrass	non-native	uncommon
Eragrostis pectinacea (Michx.) Nees	Carolina lovegrass	non-native	uncommon
Leptochloa fusca (L.) Kunth *subsp. uninervia* (K. Presl.) N. Snow	sprangletop	non-native	rare
Melinis repens (Willd.) Zizka	Natal redtop	non-native	rare
Oplismenus hirtellus (L.) P. Beauv.	basketgrass	non-native	rare
Panicum maximum Jacq.	Guinea grass	non-native	common
Saccharum officinarum L.	sugar cane	Polynesian	common
Setaria verticillata (L.) P. Beauv.	bristly foxtail	non-native	rare
DICOTS			
ACANTHACEAE (Acanthus Family)			
Asystasia gangetica (L.) T. Anderson	Chinese violet	non-native	rare
AMARANTHACEAE (Amaranth Family)			
Alternanthera pungens Kunth	khaki weed	non-native	rare
Amaranthus spinosus L.	spiny amaranth	non-native	rare
Amaranthus viridis L.	slender amaranth	non-native	uncommon
ANACARDIACEAE (Mango Family)			
Mangifera indica L.	mango	non-native	rare
Schinus terebinthifolius Raddi	Christmas berry	non-native	rare
APOCYNACEAE (Dogbane Family)			
Thevetia peruviana (Pers.) K. Schum.	be-still tree	non-native	rare
ASCLEPIADACEAE (Milkweed Family)			
Asclepias physocarpa (E.Mey.) Schlecter	baloon plant	non-native	rare
Calotropis procera (Ait.) Ait.f.	small crown flower	non-native	rare
ASTERACEAE (Sunflower Family)			
Ageratum conyzoides L.	maile hohono	non-native	uncommon
Bidens pilosa L.	Spanish needle	non-native	uncommon

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANC
Calyptocarpus vialis Less	------------------	non-native	rare
Conyza bonariensis (L.) Cronq.	hairy horseweed	non-native	rare
Conyza canadensis (L.) Cronq.	horseweed	non-native	rare
Dyssodia tenuiloba (DC.) B.L. Rob.	Dahlberg daisy	non-native	rare
Eclipta prostrata (L.) L.	false daisy	non-native	rare
Emilia fosbergii Nicolson	red pualele	non-native	rare
Encelia farinosa A. Gray	brittlebush	non-native	rare
Galinsoga parviflora Cav.	-----------------	non-native	rare
Heterotheca grandiflora Nutt.	telegraph weed	non-native	rare
Parthenium hysterophorus L.	Santa Maria	non-native	rare
Pluchea carolinensis (Jacq.) G. Don	sourbush	non-native	uncommon
Pluchea indica (L.) Less.	Indian fleabane	non-native	rare
Sonchus oleraceus L.	*pualele*	non-native	rare
Synedrella nodiflora (L.) Gaertn.	nodeweed	non-native	rare
Tridax procumbens L.	coat buttons	non-native	uncommon
Verbesina encelioides (Cav.) Benth. & Hook.	golden crown-beard	non-native	uncommon
Xanthium strumarium L.	*kikania*	non-native	rare
Zinnia peruviana (L.) L.	*puapihi*	non-native	rare
BIGNONIACEAE (Bignonia Family)			
Tabebuia heterophylla (A.P. de Candolle) Britton	pink tecoma	non-native	rare
BORAGINACEAE (Borage Family)			
Cordia subcordata Lam.	*kou*	indigenous	rare
Heliotropium procumbens Mill.	---------------------	non-native	rare
BRASSICACEAE (Mustard Family)			

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANC
Lepidium virginicum L.	pepperweed	non-native	rare
BUDDLEIACEAE (Butterfly Bush Family)			
Buddleia asiatica Lour.	dog tail	non-native	rare
CACTACEAE (Cactus Family)			
Opuntia ficus-indica (L.) Mill.	panini	non-native	rare
CARICACEAE (Papaya Family)			
Carica papaya L.	papaya	non-native	rare
CASUARINACEAE (She-oak Family)			
Casuarina equisetifolia L.	common ironwood	non-native	rare
CHENOPODIACEAE (Goosefoot Family)			
Atriplex suberecta Verd.	-------------------	non-native	rare
Chenopodium carinatum R. Br.	keeled goosefoot	non-native	uncommon
Chenopodium murale L.	'aheahea	non-native	rare
CONVOLVULACEAE (Morning Glory Family)			
Ipomoea obscura (L.) Ker-Gawl	-----------------	non-native	rare
Ipomoea triloba L.	little bell	non-native	rare
Merremia aegyptia (L.) Urb.	hairy merremia	non-native	rare
CUCURBITACEAE (Gourd Family)			
Momordica charantia L.	balsam pear	non-native	rare
EUPHORBIACEAE (Spurge Family)			
Aleurites moluccana (L.) Willd.	kukui	Polynesian	rare
Chamaesyce hirta (L.) Millsp.	hairy spurge	non-native	uncommon
Chamaesyce hypericifolia (L.) Millsp.	graceful spurge	non-native	uncommon
Chamaesyce prostrata (Aiton) Sm.	prostrate spurge	non-native	rare
Euphorbia lactea Haworth	milk-striped euphorbia	non-native	rare
Macaranga tanarius (L.) Mull. Arg.	parasol leaf tree	non-native	uncommon

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANC
Ricinus communis L.	Castor bean	non-native	rare
FABACEAE (Pea Family)			
Acacia farnesiana (L.) Willd.	klu	non-native	uncommon
Canavalia cathartica Thouars	*maunaloa*	non-native	rare
Chamaecrista nictitans (L.) Moench	partridge pea	non-native	uncommon
Crotalaria incana L.	fuzzy rattlepod	non-native	uncommon
Crotalaria pallida Aiton	smooth rattlepod	non-native	uncommon
Crotalaria retusa L.	---------------	non-native	rare
Desmanthus pernambucanus (L.) Thellung	slender mimosa	non-native	rare
Desmodium tortuosum (Sw.) DC.	Florida beggarweed	non-native	rare
Gliricidia sepium (N. Jacqin) Steudel	madre de cacao	non-native	rare
Indigofera hendecaphylla Jacq.	creeping indigo	non-native	rare
Indigofera suffruticosa Mill.	*'iniko*	non-native	rare
Leucaena leucocephala (Lam.) deWit	*koa haole*	non-native	common
Macroptilium atropurpureum (DC.) Urb.	-----------------	non-native	rare
Macroptilium lathyroides (L.) Urb.	wild bean	non-native	rare
Neonotonia wightii (Wight & Arnott) Lackey	glycine	non-native	rare
Pithecellobium dulce (Roxb.) Benth.	'opiuma	non-native	rare
Prosopis pallida (Humb. & Bonpl. ex Willd.) Kunth	kiawe	non-native	common
Samanea saman (Jacq.) Merr.	monkeypod	non-native	rare
Senna occidentalis (L.) Link	coffee senna	non-native	rare
Senna surattensis (N.L.Burm.) H. Irwin & Barneby	kolomona	non-native	rare
LAMIACEAE (Mint Family)			
Leonotis nepetifolia (L.) R.Br.	lion's ear	non-native	uncommon
MALVACEAE (Mallow Family)			

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANC
Abutilon grandifolium (Willd.)Sweet	hairy abutilon	non-native	rare
Malva parviflora L.	cheeseweed	non-native	rare
Malvastrum coromandelianum (L.) Garcke	false mallow	non-native	uncommon
Sida fallax Walp.	'ilima	indigenous	uncommon
Sida rhombifolia L.	Cuban jute	non-native	uncommon
Sida spinosa L.	prickly sida	non-native	rare
MELIACEAE (Mahogany Family)			
Melia azedarach L.	pride of India	non-native	rare
MORACEAE (Fig Family)			
Ficus microcarpa L. f.	Chinese banyan	non-native	rare
MYRTACEAE (Myrtle Family)			
Syzygium cumini (L.) Skeels	Java plum	non-native	uncommon
NYCTAGINACEAE (Four-o'clock Family)			
Boerhavia coccinea Mill.	scarlet spiderling	non-native	uncommon
Bougainvillea spectabilis Willd.	bougainvillea	non-native	rare
Mirabilis jalapa L.	four-o'clock	non-native	rare
OXALIDACEAE (Wood Sorrel Family)			
Oxalis corniculata L.	yellow wood sorrel	non-native	rare
PAPAVERACEAE (Poppy Family)			
Argemone mexicana L.	Mexican poppy	non-native	rare
PASSIFLORACEAE (Passion Flower Family)			
Passiflora edulis Sims	passion fruit	non-native	rare
Passiflora foetida L.	Love-in-a-mist	non-native	rare
PLANTAGINACEAE (Plantain Family)			
Plantago lanceolata L.	narrow-leaved plantain	non-native	rare
PORTULACACEAE (Purslane Family)			

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANC
Portulaca oleracea L.	pigweed	non-native	rare
RUTACEAE (Rue Family)			
Murraya paniculata (L.) Jack	mock orange	non-native	rare
SOLANACEAE (Nightshade Family)			
Capsicum frutescens L.	chili pepper	non-native	rare
Datura stramonium L.	Jimson weed	non-native	rare
Nicotiana glauca R.C. Graham	tree tobacco	non-native	uncommon
Solanum americanum Mill.	popolo	indigenous	rare
Solanum lycopersicum L.	cherry tomato	non-native	rare
STERCULIACEAE (Cacao Family)			
Waltheria indica L.	*'uhaloa*	indigenous	common
VERBENACEAE (Verbena Family)			
Lantana camara L.	lantana	non-native	uncommon
Stachytarpheta jamaicensis	Jamaica vervain	non-native	rare

FAUNA SURVEY REPORT

SURVEY METHODS

A walk-through fauna survey method was conducted in conjunction with the botanical survey. All parts of the project area were covered. Field observations were made with the aid of binoculars and by listening to vocalizations. Notes were made on species abundance, activities and location as well as observations of trails, tracks, scat and signs of feeding. In addition an evening visit was made to the area to record crepuscular activities and vocalizations and to see if there was any evidence of occurrence of the Endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*) in the area.

RESULTS

MAMMALS

Four mammals were observed on the property during four site visits. Taxonomy and nomenclature follow Tomich (1986).

<u>Axis deer</u> (*Axis axis*) – Deer sign was found on all parts of the property. This included tracks, droppings, antler rubbings and feeding signs. These herbivores spend the day bedded down in sheltered areas, then come out in the evening to feed.

<u>Cattle</u> (*Bos taurus*) – Small herds of cattle were being grazed in the northern part of the property or being fattened in a feed lot along Waikō Road.

<u>Horse</u> (*Equus caballus*) – A few horses were being pastured along with the cattle in the northern part of the property.

<u>Mongoose</u> (*Herpestes auropunctatus*) – A couple of mongoose were seen hunting in the margins of the cane fields. Their droppings were more plentiful indicating a significant population.

Other mammals that likely occur on the property, but which were not seen, include rats (*Rattus rattus*), mice (*Mus domesticus*) and feral cats (*Felis catus*). Rats and mice feed on seeds, fruit and herbaceous vegetation and feral cats as well as mongoose hunt for the rodents and birds.

A special effort was made to look for the native Hawaiian hoary bat by making an evening surveys of the property. These bats are known to occur sporadically at mid elevations across Kula. When present in an area they can be easily identified as they forage for insects, their distinctive flight patterns clearly visible in the glow of twilight. No evidence of such activity was observed though visibility was excellent and plenty of flying insects were seen.

BIRDS

There were moderate numbers of a diverse array of birds observed in the pastures, fields, disturbed areas, and forested stream corridors. A total of seventeen species of birds were recorded, including one indigenous waterbird, one migrant bird and fifteen non-native species. Taxonomy and nomenclature follow American Ornithologists' Union (2005).

Zebra dove (*Geopelia striata*) – Small groups of these doves were seen and heard on all parts of the property feeding in open areas.

Common myna (*Acridotheres tristis*) – Mynas were common in pairs in kiawe trees and openings throughout the property.

Spotted dove (*Streptopelia chinensis*) – Individuals of these large doves were commonly seen in flight and congregating around the feed lot.

Gray francolin (*Francolinus pondicerianus*) – Families of these francolins were seen on the field margins and in grassy openings and their calls were frequently heard.

Northern cardinal (*Cardinalis cardinalis*) – Many of these red birds were seen or heard calling from trees throughout the property.

Nutmeg mannikin (*Lonchura punctulata*) – Small flocks of these small brown birds were seen feeding in grasslands or congregating in kiawe and koa haole trees.

House Finch (*Carpodacus mexicanus*) –Pairs and small groups of these finches were seen feeding in kiawe and ironwood trees.

House sparrow (*Passer domesticus*) – Several of these sparrows were seen feeding in trees and around old abandoned structures and equipment.

Black francolin (*Francolinus francolinus*) – A few of these striking birds were seen in flight and more were heard making their distinctive buzzing calls.

Japanese white-eye (*Zosterops japonica)* – Two pairs of these small green birds were seen foraging in kiawe trees for caterpillars and making their high-pitched calls.

Cattle egret (*Bubulcus ibis*) – Three of these large white egrets were seen flying over the property or feeding in grassy fields near livestock.

Red-crested cardinal (*Paroaria coronata*) - One pair of these red-headed cardinals were seen and heard in a kiawe tree in the northern part of the property.

Chicken (*Gallus gallus*) – One rooster was heard calling from brushland near the sand excavation opertation on the northwest side of the property.

Northern mockingbird (*Mimus polyglottos*) – One mockingbird was seen flying between kiawe trees. Its long tail with white margins is distinctive.

Pacific golden-plover, Kolea (*Pluvialis fulva*) – One of these migrant plovers was seen near a small abandoned reservoir. It was molting into its breeding plumage in preparation for its summer flight to the arctic.

Black-crowned night-heron, 'Auku'u (*Nycticorax nycticorax hoactli*) – One of these indigenous herons was seen feeding along an open section of the Waihe'e Ditch on the northeast side of the property.

Barn owl (*Tyto alba*) - One barn owl was flushed from its daytime perch in a dense forest along Waikapū Stream. These birds become active at dusk and are nocturnal feeders on rodents in fields and pastures.

A few other non-native birds might be expected to be found on this property but the habitat is not suitable for Hawai'is native forest birds that typically live at higher elevations in native forests. Nor is their any true wetland habitat on the property that might attract any of Hawai'is Endangered waterbirds.

INSECTS

While insects in general were not tallied, they were abundant throughout the area and no doubt fueled much of the observed bird life. One native Sphingid moth, Blackburn's sphinx moth (*Manduca blackburni*), has been put on the Federal Endangered species list and this designation requires special focus (USFWS 2000). Blackburn's sphinx moth is known to occur in parts of East Maui and northern Central Maui and has recently been found on the northeastern edge of this property along Kuihelani Highway. Its native host plants are species of 'aiea (*Nothocestrum spp.)* and non-native alternative host plants are tobacco (*Nicotiana tabacum*) and tree tobacco (*Nicotiana glauca*). No 'aiea or tobacco plants occur in this area but perhaps as many as 200 tree tobacco plants were found scattered around the more disturbed parts of the property. Each plant encountered was examined but no Blackburn's sphinx moths or their larvae were seen. The larvae of these moths are active on their host plants during about a three month period following winter rains when vegetation is lush, after which they burrow into the soil to pupate. This survey was conducted during the post larval period when the larvae are not active so it would be logical not to have encountered any. No old sign of feeding, however, was observed on any of the plants so it is unclear if Blackburn's sphinx moth was active in the area this year.

CONCLUSIONS AND RECOMMENDATIONS

Fauna surveys are seldom comprehensive due to the short window of observation, the seasonal nature of animal activities and the usually unpredictable nature of their daily movements. This survey might have turned up a few more non-native species if it had been prolonged and at different times of the year, but it is unlikely that any rare native forest birds or water birds would have been found. These species have specialized habitat requirements that do not occur on this property.

No Federally Endangered or Threatened mammal, bird or insect species were found on the property. The indigenous 'auku'u and the migrant kolea are both widespread and fairly common native species that occur on all the main Hawaiian Islands as well as on the American continent. The remaining mammal and bird species are all non-native and of no particular environmental concern. No special fauna habitats were identified on this property either.

Because of the above conditions it is determined that there is little of concern regarding the fauna on this property outside of the possibility of the seasonal occurrence of Blackburn's sphinx moth here and the proposed project is not expected to have a significant negative impact on the fauna resources in this part of Maui.

It is recommended that the tree tobacco plants be monitored during the winter months prior to any clearing work in their vicinity to ascertain that no Endangered Blackburn's sphinx moth or their larvae, should they be present, are harmed or destroyed.

ANIMAL SPECIES LIST

Following is a checklist of the animal species inventoried during the field work. Animal species are arranged in descending abundance within two groups: Mammals and Birds. For each species the following information is provided:

1. Common name
2. Scientific name
3. Bio-geographical status. The following symbols are used:
   - endemic = native only to Hawaii; not naturally occurring anywhere else in the world.
   - indigenous = native to the Hawaiian Islands and also to one or more other geographic area(s).
   - migratory = all species that spend part of their annual life cycle in Hawaii and part of it elsewhere. Migrant birds typically spend their spring and summer months breeding in the arctic and their fall and winter months in Hawaii.
   - non-native = all those animals brought to Hawaii intentionally or accidentally after western contact.
4. Abundance of each species within the project area:
   - abundant = many flocks or individuals seen throughout the area at all times of day.
   - common = a few flocks or well scattered individuals throughout the area.
   - uncommon = only one flock or several individuals seen within the project area.
   - rare = only one or two seen within the project area.

COMMON NAME	SCIENTIFIC NAME	STATUS	ABUNDANCE
MAMMALS			
Axis deer	*Axis axis*	non-native	common
Cattle	*Bos taurus*	non-native	common
Horse	*Equus caballus*	non-native	uncommon
Mongoose	*Herpestes auropunctatus*	non-native	rare
BIRDS			
Zebra dove	*Geopelia striata*	non-native	common
Common myna	*Acridotheres tristis*	non-native	common
Spotted dove	*Streptopelia chinensis*	non-native	common
Gray francolin	*Francolinus pondicerianus*	non-native	common
Northern cardinal	*Cardinalis cardinalis*	non-native	common
Nutmeg mannikin	*Lonchura punctulata*	non-native	uncommon
House finch	*Carpodacus mexicanus*	non-native	uncommon
House sparrow	*Passer domesticus*	non-native	uncommon
Black francolin	*Francolinus francolinus*	non-native	uncommon
Japanese white-eye	*Zosterops japonica*	non-native	uncommon
Cattle egret	*Bubulcus ibis*	non-native	uncommon
Red-crested cardinal	*Paroaria coronata*	non-native	rare
Chicken	*Gallus gallus*	polynesian	rare
Northern mockingbird	*Mimus polyglottos*	non-native	rare
Pacific golden-plover, Kolea	*Pluvialis fulva*	migrant	rare
Black-crowned night-heron, 'Auku'u	*Nycticorax nycticorax hoactli*	indigenous	rare
Barn owl	*Tyto alba*	non-native	rare

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Appendix E: Archaeological Inventory Survey

SCS Project Number 913-5

AN ARCHAEOLOGICAL INVENTORY SURVEY OF APPROXIMATELY 607-ACRES OF LAND IN WAI`ALE, WAILUKU AND WAIKAPŪ AHUPUA`A, WAILUKU DISTRICT, ISLAND OF MAUI, HAWAI`I [TMK: (2) 3-8-005: 023 (POR.), 37 AND (2) 3-8-007: 71, 101, 102, 104]

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ABSTRACT

Archaeological Inventory Survey was conducted on approximately 607-acres of land in Waiale, Wailuku and Waikapū Ahupua`a, Wailuku District Maui [TMK: (2) 3-8-005:23 (por.), 37 and (2) 3-8-007: 71, 101, 102, 104]. The project area, slated for a residential community inclusive of housing, parks, schools, and light industry, is located on lands that have been historically utilized for various purposes (e.g., agriculture, ranching, and sand mining). [Please note the project area acreage was erroneously stated as 617 acres in the draft version of this report (SCS 913-1). The correct acreage of the project area is approximately 607 acres. This error has been corrected in the current version of this report (SCS 913-5)].

Previous archaeological investigations have occurred on portions of the approximately 607-acre land area, which led to the documentation of burials, a terrace, and several historic-period sites. These include State Site No. 50-50-04-3525, Site -4200, Site -4201, and Site -4202. Additionally, burials previously identified by Archaeological Services Hawaii, Inc. within a portion of the project area will be specifically addressed under separate cover in a Burial Treatment Plan. Only one new archaeological site was identified during the current Inventory Survey. The single-feature site consisted of a subsurface firepit/imu designated as State Site No. 50-50-04-6578.

A total of 282 mechanically excavated trenches and five manually excavated units were placed throughout the project area. While 281 of the trenches and five manual test trenches yielded negative results, one trench (ST-90) revealed the presence of Site -6578, the subsurface fire pit/*imu* noted above.

Data derived from stratigraphic analysis indicated a large number of ground alteration events through time as the lands were used for industrial agricultural production (e.g., sod farming, sugarcane). Natural processes illustrating flooding and deposition via upslope runoff were also deciphered in the strata. Manual excavation of stratigraphic trenches in the immediate vicinity of Site -5504 did not reveal additional human remains or associated cultural deposits. Nonetheless, its boundaries have been better defined.

Precautionary Archaeological Monitoring is recommended for most portions of the project area which contain natural, sandy matrices that are relatively undisturbed. These locations will be dedicated in an Archaeological Monitoring Plan. In addition, two recommendations are proposed for the burial site (Site -5504) located near Kuihelani Highway. First, a predetermined area of the sand berm in which exposed, displaced human remains alerted the presence of a traditional human burial site (Site -5504), should be closely Monitored for the recovery of any other displaced osseous remains. This area was searched during the current work phase but did not yield additional remains. Second, a Burial Treatment Plan will be prepared for Site -5504 and submitted to the State Historic Preservation Division (SHPD) and the Maui/Lana`i Islands Burial Council (MLIBC) for review. The currently utilized, small section of the Spreckels Ditch (Site -1508), located in the eastern portion of the project area has been documented and will continue in its present state. No further work is recommended for Site -1508. Site -6578, the *imu* feature, has been documented and sampled, and no further work is recommended.
[Please note: As the above-mentioned burials were inadvertently identified by ASH archaeologists, Scientific Consultant Services, Inc. did not consult with community members, as per HAR § 13-276-5(a) and (a) (4) (g)].

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INTRODUCTION

At the request of A&B Properties, Inc., Scientific Consultant Services (SCS), Inc. conducted Archaeological Inventory Survey on approximately 607 acres of mostly undeveloped, but utilized land within Wai`ale, Wailuku and Waikapū Ahupua`a, Wailuku District, Island of Maui, Hawai`i [TMK: (2) 3-8-005:23 (POR.), 37 and (2) 3-8-007: 071, 101, 102, 104] (Figures 1 and 2). Initial fieldwork was conducted from June 13 to September 5, 2008 by SCS archaeologists Tomasi Patolo, B.A. (Field Director), Ian Bassford, B.A., Allison Chun, Ph.D., David Dillon, B.A., Randy Ogg, B.A., and Guerin Tome, B.A., under the direction of the Principal Investigator Michael Dega, Ph.D. A second phase of testing work occurred intermittently between August 3, 2009 and September 16, 2009, with fieldwork conducted by Dave Perzinski, B.A. (Field Director), Ian Bassford, B.A., and Brian Armstrong, B.A., under the same Principle Investigator. The Archaeological Inventory Survey was performed to investigate the presence/absence of historic properties on portions of the acreage not previously subject to formal archaeological work. Once identified, sites were to be evaluated in terms of function, temporal affinity, and significance, among other criteria.

According to the County of Maui's Real Property Tax Assessment website (www.mauipropertytax.com) accessed on Monday, 15 September 2008, the project area is comprised of six tax map key parcels:

- TMK: (2) 3-8-005: 023 por. (122.0-acres; fee owner A&B-Hawaii Inc.)
- TMK: (2) 3-8-005: 037 (10.0-acres; fee owner A&B-Hawaii Inc.)
- TMK: (2) 3-8-007: 071 (5.043-acres; fee owner A&B-Hawaii Inc.)
- TMK: (2) 3-8-007: 101 (434.402-acres; fee owner A&B-Hawaii Inc.)
- TMK: (2) 3-8-007: 102 (31.222-acres; fee owner A&B-Hawaii Inc.)
- TMK: (2) 3-8-007: 104 (4.07-acres; fee owner A&B-Hawaii Inc.)

Development of the project area, know as the Wai`ale project, is slated for a residential community inclusive of housing, parks, schools, and light industry. The project area is located on lands that have been, and are being, utilized for various purposes, including agriculture, ranching, and sand mining, among others.

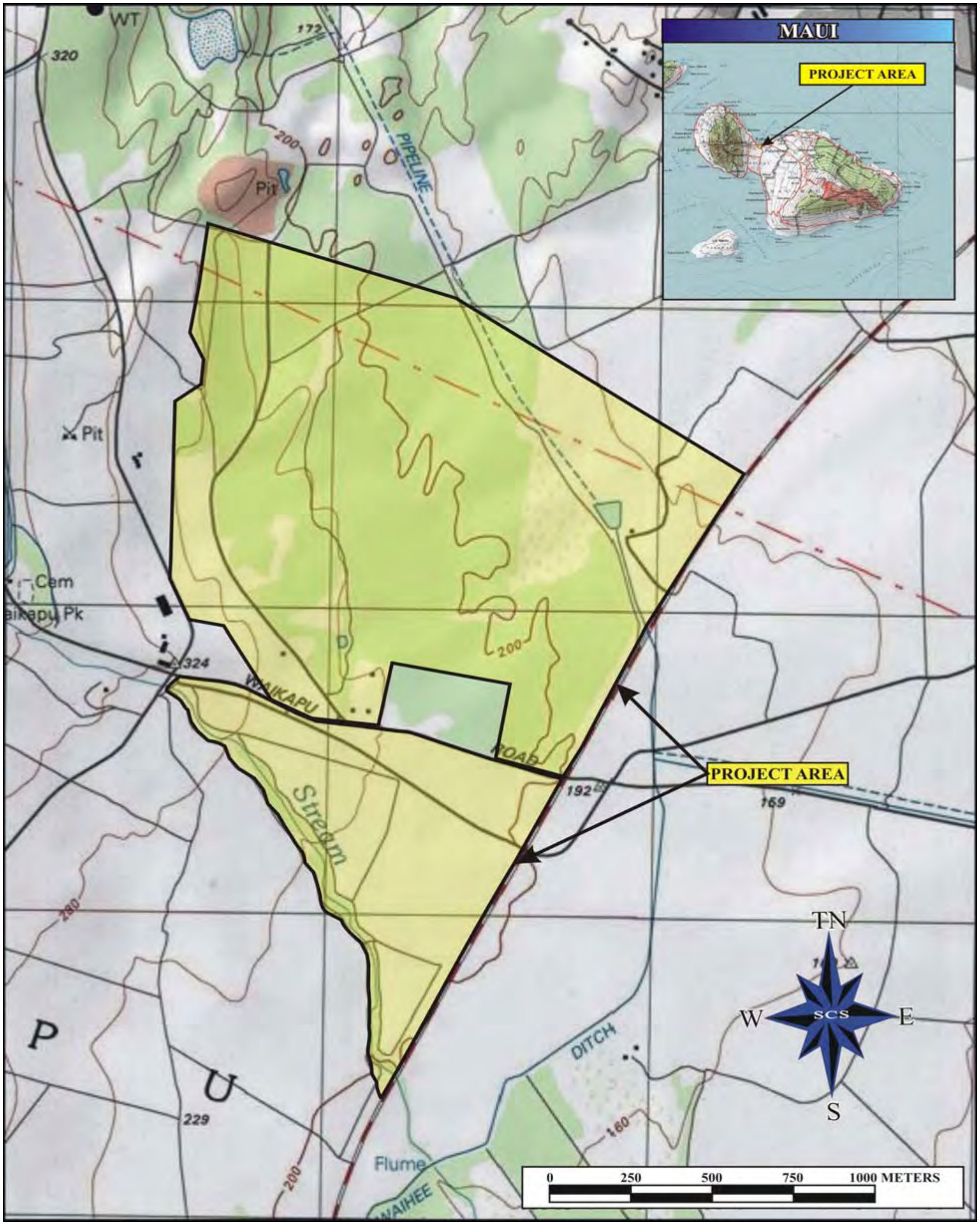

Figure 1: United States Geological Survey (USGS) Wailuku Quadrangle Map Showing Project Area Location.

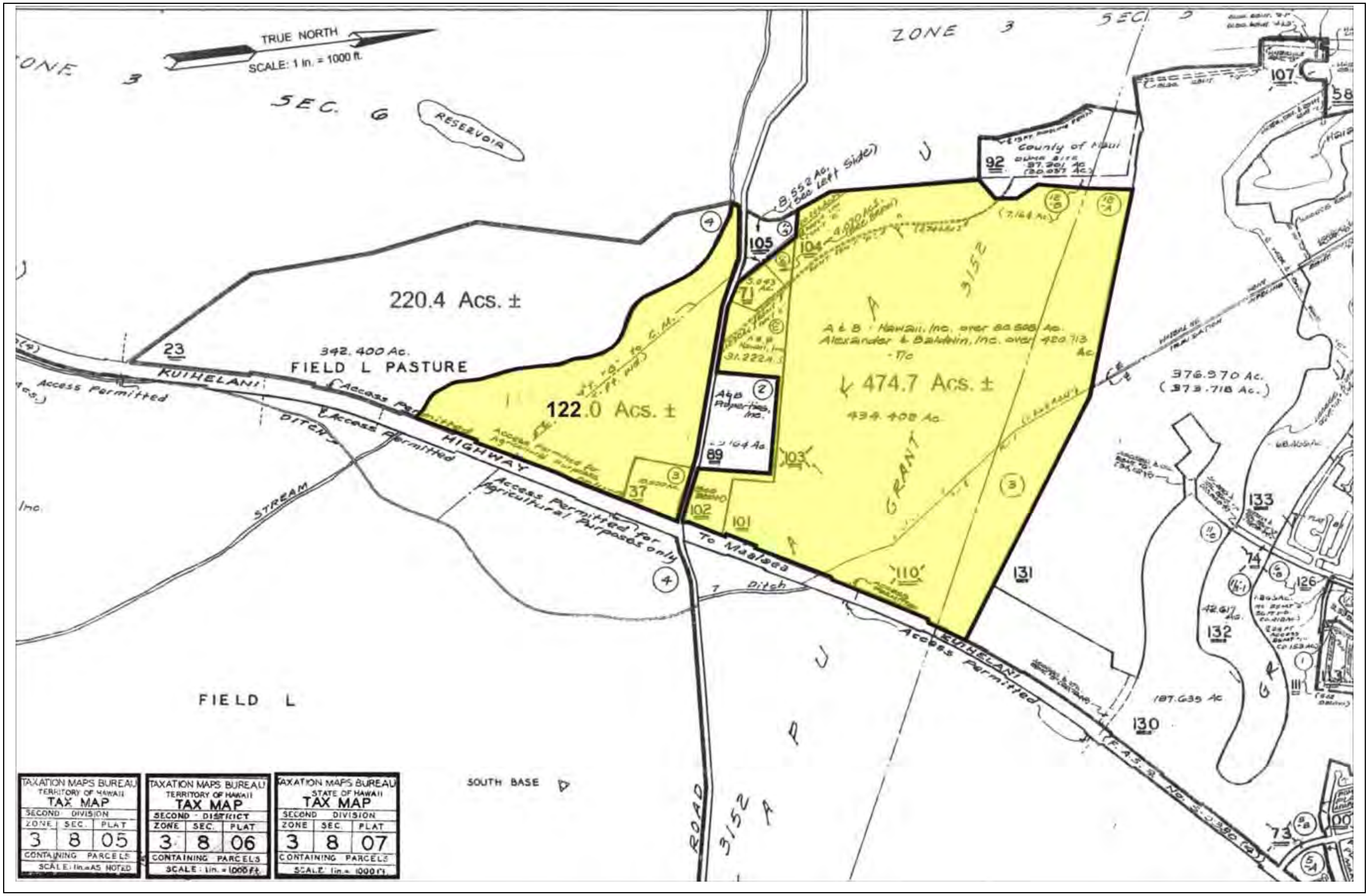

Figure 2: Tax Map Key [TMK: (2) 3-8-005, 3-8-006, and 3-8-007] Showing Project Area Location.

GEOGRAPHIC SETTING

The multi-acre project area is situated between *c.* 3.65 kilometers (km) southwest of Kahului Harbor coastline and *c.* 4.85 km north-northeast from the beaches of Mā`alaea. The project area is also situated within an elevation of *c*. 37 and 98 meters (120 and 320 ft.) above mean sea level on the isthmus between the West Maui Mountains and Haleakalā (see Figure 1). The project area is bordered by Waikapū Stream and a combination of residential, commercial and unused lands. Waiko Road, oriented east-west, bisects the project area into two main acreages; 122.0-acres south of Waiko Road and 474.7-acres north of Waiko Road. In general the overall shape of the project area is that of a cone with the apex of the cone pointed in a southerly direction. On the western flank of the project area lays commercial businesses and Waikapū Stream while its eastern flank is bordered by Kuihelani Highway. The northern boundary of the project area abuts the Maui Lani residential development.

With the exception of natural topography and Waikapū Stream, no natural features (*i.e.*, major hills or named *pu`u*, valleys, plateaus) exist within the project area confines. Many portions have been extensively altered via mechanical means with uses such as construction baseyards, agriculture, sod farming, and sand mining, to name a few. The relatively intact portions of the project area north of Waiko Road consist of mainly undisturbed sand dunes presently utilized as cattle grazing lands. In addition, modern debris (*e.g.,* abandoned cars, building materials, yard refuse) is evident mainly in the northeast corner, or within an area accounting for approximately 10 percent of the project area. Natural vegetation (as opposed to intentionally planted vegetation) covers approximately 60 percent of the project area with the remaining 40 percent being cleared lands for various uses (see below).

PROJECT AREA SOILS

According to Foote *et al.* (1972:48–49, 115–116, 117), the project area contains three different types of matrices (Figure 3). These matrices are described as Jaucas sand (JaC), Pulehu clay loam (PsA), and Puuone sand (PZUE). Jaucas sand, with zero to fifteen percent slopes, has rapid permeability. While water erosion is slight, aeolian forces can degrade the Jaucas matrix where vegetation is lacking. Water retention per foot has been measured to 0.5 to 1.0 inch. Given such a low retention capacity and landscape instability (sand migration, etc.), utilization of the landscape in recent times has been dominated by uses such as pasture land, sugarcane cultivation (planted in imported clay-silty clay over the sand beds), truck crops, and urban development. Pulehu clay loam, sometimes associated with Jaucas sand, exists with zero to three percent slopes and has a moderate permeability. Erosion is slight with a water retention

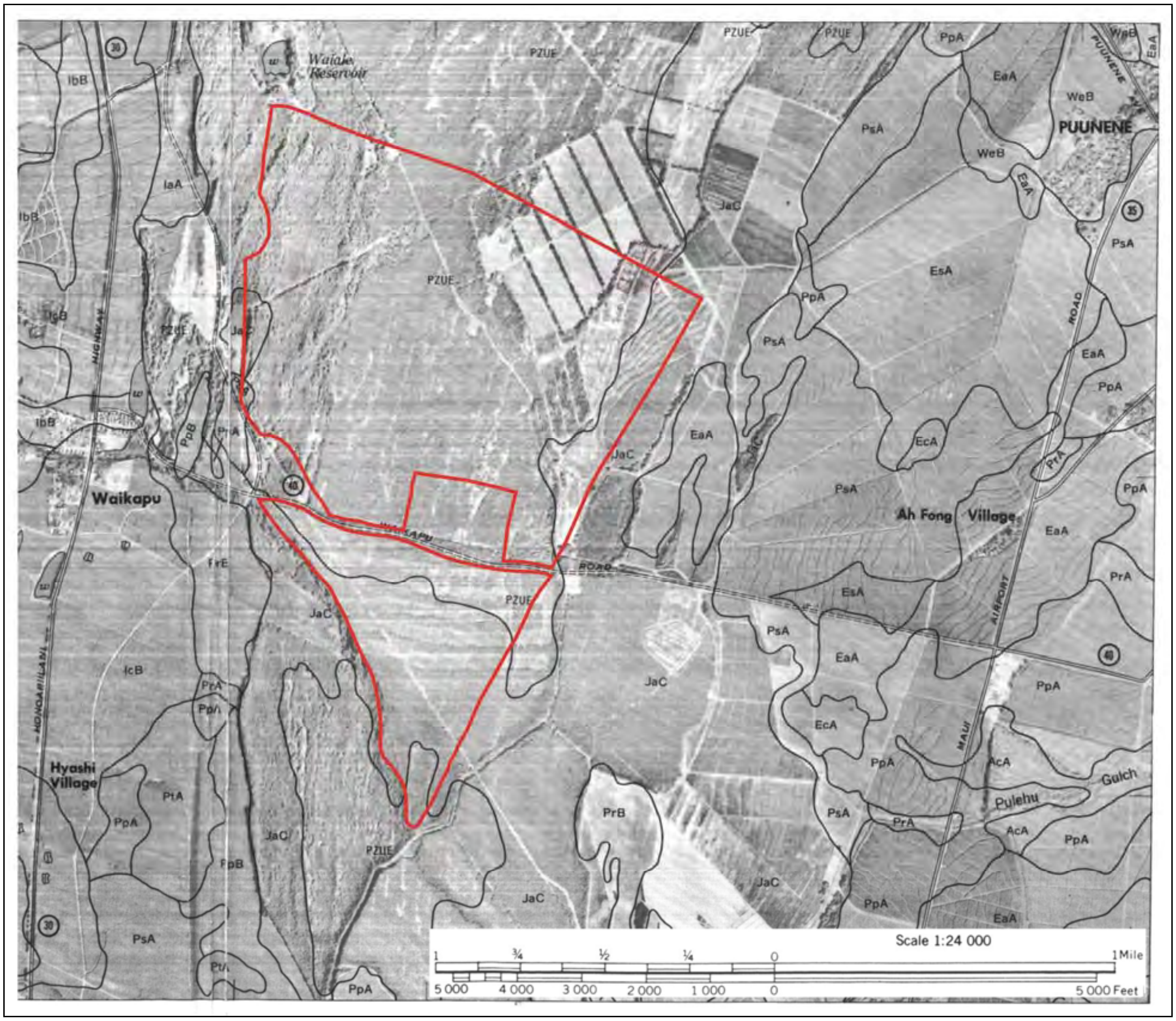

Figure 3: Foote *et al.* (1972) Soil Survey Map Showing Project Area Location.

capacity of approximately 1.4 inches per foot. The Pulehu clay loam is utilized for sugarcane, truck crops, and pastureland. Puuone sand, sometimes associated with Jaucas sand, is created from coral and seashells and occurs on seven to thirty percent slopes and has rapid permeability. Cementation of this matrix has been found within 20 inches of the ground surface. The severity of aeolian forces that can erode this type of matrix is classified as moderate to severe. Water retention per foot is 0.7 inches. Puuone sand is utilized for pastureland and home sites.

PROJECT AREA VEGETATION

The project area contained mainly non-native vegetation inclusive of lion's ear (*Leonotis nepetifolia*), Guinea grass (*Panicum maximum*), *kiawe* (*Prosopis pallida*), *koa haole* (*Leucaena leucocephala*), castor bean (*Ricinus communis*), buffel grass (*Cenchrus ciliaris*), lantana

(*Lantana camara*), *klu* (*Acacia farnesiana*), *koa haole* (*Leucaena leucocephala*), indigo (*Indigo suffruticosa*), glycine (*Glycine wightii*), tree tobacco (*Nicotiana glauca*), cow pea (*Macroptilium lathyroides*), and golden crown-beard (*Verbesina encelioides*). Native vegetation observed in the project area included `uhaloa (*Walteria indica*). Coconut (*Cocos nucifera*), a plant brought to the Hawaiian Islands by initial colonists, is also present.

CLIMATE

The area in which the project area lies is the dry region of Maui's isthmus. Rainfall indicators, according to Price (1983:62), show that the project area could receive up to 5 inches during the winter months of December through February. Higher elevations within Wailuku and Waikapū Ahupua`a are prone to receive more precipitation due to increased rainfall, fog drip, and lower temperature climates. The frequency of the project area receiving much upland runoff appears intermittent, given the lack of multiple streams directly emptying onto the project area. Currently, the only source of water that could feed the project area would be Waikapū Stream.

TRADITIONAL AND HISTORIC SETTING

The project area lies near the base of the southeastern slope of Maui's second largest volcano, Pu`u Kukui, that rises to over 1,764 m (5,788 feet) amsl. While most of the project area is situated within the boundaries of Waikapū Ahupua`a, a narrow strip of the project area [TMK: (2) 3-8-007:101] lies in Wailuku Ahupua`a; Waikapū and Wailuku Ahupua`a occur adjacent to one another. Both *ahupua`a* are located on the northeastern side of West Maui in the district of Wailuku.

TRADITIONAL SETTING OF WAILUKU DISTRICT

Wailuku District is frequently mentioned in historical texts and oral tradition as being politically, ceremonially, and geographically important during traditional times (Cordy 1981, 1996; Kirch 1985). Wailuku was considered a "chiefly center" (Sterling 1998:90) with many of the chiefs and much of the area's population residing near or within portions of `Īao Valley and lower Wailuku. The importance of the district is reflected by the relatively large number of *heiau* (temple/shrine/place of worship) that were reportedly present in pre-Contact times. Oral tradition accounts surrounding these *heiau* provide examples of how religion tied into political power in the traditional Wailuku setting. Indeed, the period immediately preceding contact with the Europeans was one of considerable upheaval and conflict. *Wailuku*, meaning 'water of destruction' (Pukui *et al.*, 1974), succinctly describes the area in the late 1700s. Political power emanating from Moloka`i was an active element during the mid-eighteenth century. The resulting battle at Kalae`ili`ili (A.D. 1765) led to the expulsion of Keeaumoku and the Moloka`i *ali`i* (chief) and the beginning of Kahekili's reign (Kamakau 1992). Kahekili successfully defended his capital in Wailuku throughout the 1770s, until his defeat at the hands of Kamehameha's forces.

Closer to the current project area, in the southwest corner of Wailuku District, pre-Contact settlement was not as dense as concentrations to the north. Climate had much to do with that trend, as the lower Waikapū-Mā`alaea area is a more arid environment than the rain-soaked areas located upslope. According to Tomonari-Tuggle and Tuggle (1991), the majority of the pre-Contact population was located southwest of the project area, near what is now Ukumehame Beach State Park. Settlement was also probable north of Keālia Pond in Waikapū Ahupua`a. Handy and Handy (1972) report that before the historic sugarcane plantations in this region, water from Waikapū Stream ". . . was diverted into *lo`i* [irrigated terraces] and its overflow was dissipated on the dry plains of the broad isthmus between West and East Maui" (ibid: 496).

Wailuku District would see drastic change after Captain James Cook's 1778 arrival in Kahului Bay. The reign of Kamehameha I was intertwined with the increasing presence of Europeans within the Hawaiian Islands. By 1821, American missionaries had established a foothold in Lāhainā and arrived in Wailuku the following year. The religion of the Hawaiian people began to wane under the influence of Christianity. Fredericksen and Fredericksen (2002:4) point to a girls' seminary (Central Female Boarding School), established in Wailuku in 1836, as one of the initial steps in the conversion of Hawaiian language and customs in Maui. Sterling (1998:86) notes that "the district of Wailuku was once thickly settled, *kuleanas* to the number of over 400 were granted to natives and others. A large portion of these cultivated *kalo* with the aid of water from the river."

In 1848, commissioners of the Māhele instigated an extreme modification to traditional land tenure on all islands that resulted in a division of lands and a system of private ownership. The Māhele was based upon the principles of Western law. While 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 society into that of a market economy (Kuykendall Vol. I 1938:145, footnote 47, *et passim*; Daws 1968:111; Kame`eleihiwa 1992:169–170, 176). The dramatic shift from a redistributive economy to a market economy resulted in drastic changes to land tenure, among other things. As a result, foreigners demanded private ownership of land to ensure their investments (Kuykendall Vol. I, 1938:145, *et passim*; Kame`eleihiwa 1992:178.

Once lands were made available and private ownership was instituted, Native Hawaiians, including the *maka`āinana* (commoners), were able to claim land plots upon which they had been cultivating and living. Oftentimes, foreigners were simply just given lands by the *ali`i*. However, commoners would often only make claims if they had first been made aware of the foreign procedures (*kuleana* lands, or land commission awards). These claims could not include any previously cultivated or currently fallow land, *okipu*, stream fisheries, or many other natural resources necessary for traditional survival (Kame`eleihiwa 1992:295; Kirch and Sahlins 1992). Awarded parcels were labeled as Land Commission Awards (LCAs). If occupation could be established through the testimony of witnesses, the petitioners were issued a Royal Patent number and could then take possession of the property. Commoners claiming house lots in Honolulu, Hilo, and Lāhainā were required to pay commutation to the government before obtaining a Royal Patent for their awards (Chinen 1961:16). A handful of foreigners (*e.g.*, Anthony Catalena, James Louzada, and E. Bailey) gained control of large parcels of lands that would later be used for mass cultivation of sugar. Significantly, the majority of LCAs were awarded to Hawaiians, a gauge that can be used to measure pre-Contact settlement, since there was little overall change in traditional land use among Hawaiians prior to 1853 (Creed 1993:38).

TRADITIONAL AND HISTORIC SETTING OF WAILUKU AHUPUA`A

Much of the pre-Western contact folklore and history of the Wailuku Ahupua`a involves `Īao Valley with peripheral areas (*e.g.*, Waihe`e, Waiehu, Greater Wailuku) giving additional content. As only a limited portion of the project area is situated in the Wailuku Ahupua`a, only an overview of the Wailuku Ahupua`a traditional setting will be displayed in the following paragraphs.

One of the earliest references for `Iao Valley itself refers to a Maui king in power during the A.D. 1400s (Sterling 1998:84). The king, Kaka`e, was held in such reverence that commoners could not look upon him without suffering punishment by death. King Kaka`e thus became a hermit within `Īao Valley during the 1400s so that his subjects could live without fear. It was supposed that this king also created a royal burial grounds (*Kapela*), an enigmatic place that was designated for himself and for worthy successors as a sacred burial area.

The Wailuku area, as Kirch (1985:134) also notes, was an important center of political development during late prehistoric and early historic times and was the seat of powerful chiefs, including Kahekili, arch-rival of Kamehameha. Kamehameha I's unification of the Hawaiian Islands in 1790 brought Maui under the political control of its first non-Maui chief during July of that year. The last king of Maui was Kahekili II, son of King Kekaulike, both who are supposedly interred at the sacred burial grounds in upper `Īao Valley. By the early historic period, significant natural and cultural changes had taken place, not only due to contact with westerners, but also because of internal social and environmental restructuring and external social and environmental factors (*e.g.*, foreign species being introduced as well as foreign ideologies). These combined to have a severe impact on Hawaiian environments, land-tenure, and social structures.

Connolly (1974:5) states that pre-Contact `Īao valley had a large population base with "most people residing in a settlement near `Īao Needle." Supposedly, the subsistence base of this population consisted of fish and taro, with Kahului Harbor and the coast close by and *lo`i* systems lining `Īao Valley's stream banks. Prehistoric ditches or *`auwai* were utilized in taro cultivation (Connolly 1974:5). Sterling (1998:86) adds that two *`auwai* within the valley "have existed immemorially and were evidently constructed for the purpose of irrigating *kalo* on the plains which stretch away to the northward and southward of the [`Īao] river. Several minor *`auwai* have, since ancient times, tapped the river at different points lower down and spread the water through the lands in the gulch on either side of the river bed."

Past archaeological research (Fredericksen and Fredericksen 1996:52) has revealed that habitation sites along what is now Lower Main Street in Wailuku, "are associated with the rich taro producing lands in the Lower `Īao River flood plain, and the extensive cultivation systems present in `Iao Valley." These habitation sites have been dated to the A.D. 15th through 17th centuries. The `Īao Valley area was not only renowned for its agricultural base during prehistoric times but its ceremonial and political base as well (see also Cordy 1996; Donham 1996).

Haleki`i Heiau, part of the Haleki`i-Pihana Heiau complex, was constructed during the mid and late 18th century (Sterling 1998:89). Yent (1983:7) noted an interesting life cycle for the *ali`i* who lived nearby those *heiau*. Kamehameha I's wife was born there, Kahekili lived there, and Kekaulike died there. Thrum (1909:46) reported that Kamehameha I evoked his war god at Pihana Heiau after his warriors defeated Kalanikupule's forces during the Battle of `Īao in 1790. The two *heiau* are primarily associated with Kahekili, who is connected with the Haleki`i-Pihana complex between A.D. 1765 and 1790, and Kamehameha, during his conquering of Maui in 1792 (Yent 1983:18).

Importantly, Haleki`i and Pihana Heiau are the only remaining pre-Contact Hawaiian structures of religious and historical importance in the Wailuku-Kahului area that are easily accessible to the public (Estioko-Griffin and Yent 1986:3). As stated, the area is known not only for its religious and/or ceremonial significance, but for its political prominence as well.

The Fredericksen and Fredericksen (1996:52) report that politically, Wailuku [village] was known as a central settlement for high ranking chiefs and their retinue. The Wailuku area was also witness to many battles, from the Battles of `Īao and Sand Hill to the Battles of Kepaniwai and Kakanilua. The most famous battle was at Kepaniwai where in July 1790, Kamehameha I finally wrested control of Maui Island. Kamehameha I and his warriors landed at the Kawela portion of Kahului Bay and proceeded up `Īao and other valleys to score a decisive victory. *Wailuku*, meaning ‘water of destruction,’ succinctly describes the area in which many of these major battles occurred. Warriors apparently dwelt in the Kauahea area of `Īao Valley (southeast of `Īao Stream below Pihana Heiau), and were "trained in war skills and there was a boxing site in the time of Kahekili" (Sterling 1998:89).

Several periods of various land utilization strategies occurred within `Īao Valley and down below on the floodplains. Between 1778 and 1848, traditional land use occurred within `Īao Valley, albeit on a smaller scale, as the "Conquest" period began and the Sandalwood and whaling trades dominated political and commercial activity within the islands (Kirch and Sahlins 1992). Quite another conspicuous effect of the growing influence of foreigners in the Hawaiian Islands was the systematic division of lands, the Māhele of 1848. The Land Commission oversaw land divisions of three groups: Crown Lands (king), Konohiki Lands, and Government Lands, all of which were, in theory, open to the prerogative of native tenants. The awarded land claims, known as Land Commission Awards (LCA), bordered `Īao Valley. They were numerous in quantity and concentrated on the plateau above the stream valley, along the top of its sidewalls. Burgett and Spear (2003) and Tome and Dega (2004) both conducted studies adjacent to that area. In a study of land use near the `Īao Stream, Burgett and Spear (2003) noted that Wailuku area residents submitted 199 land claims of which 127 of these were awarded by the Land Commission in 1848 (Waihona `Aina 1998). The LCA information lists several categories of land use in Wailuku area through time, from pre-Historic times through at least the middle of the 19$^{th}$ century (see Burgett and Spear 2003 and Tome and Dega 2004). These include: *lo`i* systems (pondfield cultivation of irrigated taro), *kula* lands (dry land, not wet or taro land), *hala* clumps (*Pandanus odoratissimus* or screw pine; the leaves provide material for weaving baskets or mats), and *po`alima*. Several land divisions parcels were also claimed, from *`ili* (subdivision of *ahupua`a* lands) to *mo`o* (land subdivision of an *`ili*) to *apana* (land division of a *kuleana*).

There are no LCAs or any other claims of land (*e.g.,* royal patents, land grants) present within the Wailuku Ahupua`a section of the project area (see Figure 2). A single Land Grant is present on TMK: (2) 3-8-007: 101 and is identified as Land Grant 3152. This particular Land Grant will be further discussed in the **TRADITIONAL AND HISTORIC SETTING OF WAIKAPŪ AHUPUA`A** section of this report. When looking at a more regional scale of the Waikapū area, in general, more LCA's were awarded within upland reaches, where soils more amenable to agriculture and habitation occur (see below).

Traditional land utilization within and `Īao Valley was, on an initially small scale, replaced by sugar cane cultivation during the 1850s. This small-scale cultivation began with Kamehameha III and was further intensified by foreign plantation managers and owners such as Peck, among others (see Sterling 1998:86).

Many of the awarded LCAs in the area were under sugar cane cultivation by the mid 19th century. By the late 1800s, much of the `Īao Valley and its immediate surroundings were planted with sugar cane. Sugar cane fields extended along the borders of `Iao Valley, within the valley, and even occurred between the Haleki`i-Pihana Heiau site. Connolly (1974:5) notes that in the early 1900s, the sugar cane industry dominated commerce and land use in the `Īao Valley area; it created a fair amount of water irrigation ditches, terraces, free standing walls, historic house sites, and mill structures. Agricultural terracing and a Portuguese worker's camp were located in the lower stream valley. The Portuguese laborers "lived in the stream bed area, growing taro and other vegetables in the *lo`i* and working as laborers on the plantation. This population lived in a worker's camp until the flood of 1916" (Connolly 1974:5). This flood presumably ended habitation within lower `Īao Valley.

In 1912, a rock crusher was installed in `Īao Valley by Mr. Willie Crozier, an entrepreneur who wanted to supply all of the rock needed for construction projects on Maui. This crusher, however, was also destroyed in the 1916 flood. The flood itself, generated within `Īao Valley, demolished taro *lo`i*, the rock crusher, the Portuguese Camp, and, among other things, portions of the two *heiau*. Yent (1983:7) suggests that major erosion of both Haleki`i and Pihana Heiau was due to the 1916 flood. The western half of Haleki`i eroded down the steep valley slope and the eastern half was eroded by `Īao Stream. Importantly, archaeological remnants in the valley were dramatically affected by the flood.

Sugar cane cultivation continued in and near the valley after the flood though, with plantations rebuilding the water systems feeding the sugar cane fields (Connolly 1974:6). Cultivation of sugar cane dominated land use of the project area environs through the middle of this century. During World War II, military training was done in *mauka* `Īao Valley areas while ranching also occurred. Remnants of these activities (and earlier historic occupations) include iron broilers and concrete foundation walls (large ovens), concrete-lined trenches, and concrete house pads (Bordner 1983:6–9). During the late 1980s, the upper portion of the project area transitioned from sugar cane to macadamia nut production and in the late 1990s, production fell and the fields of macadamia nut were abandoned (Veith 1999).

<u>The Battle of Kakanilua</u>

Many legends point to a famous battle occurring in the sand dunes between Wailuku and Kahului. The Battle of Kakanilua [valley], as it is known, is repeated often as follows[1]:

> "These names, Piipii and Ahulau, are grievous and fear causing thing in the heart of Kalaniopuu for his chiefs and commoners who dies together in the battle of Kakanilua valley fought with the King Kahekili; all the warriors died except for four. Sixteen-hundred people were killed in the Battle of Kakanilua. Of the opponents, 800 were the warriors of the Alapa Regiment of Kohala and Hamakua under the leadership of Kauanonoula (k), grandson of Peleioholani (k), the chiefs of Hilo. Eight hundred were of the Piipii Regiment under the chiefly leadership of Kekuhaupio (k); all died. Killed was Keawehano, second ranking chief of the Alapa Battalion, and Kauanoanoa, chiefly leader, and his son Kawahaopeleiholani survived as did the great Leader Kekuhaupio and Honolii, second ranking chief of the Piipii warriors."

Other than "sand dunes", there is no clear indication of where this battle occurred. In some instances, the word "valley" is used after "Kakanilua" but in most cases, "sands" are noted. The major dune system of central Maui runs from lower Wailuku to Waikapū. As has been raised at two meetings of the Maui/Lana`i Islands Burial Council (meeting dates October 30, 2003, November 26, 2003), some feel the battle location occurs in the current Maui Lani development.

TRADITIONAL AND HISTORIC SETTING OF WAIKAPŪ AHUPUA`A

As previously mentioned, most of the current project area is situated within the Waikapū Ahupua`a located in the land division once known as "Nā Wai Eha" (The Four Streams). This area is "…comprised the four great valleys [Waihe`e, Waiehu, Wailuku, and Waikapū] which cut far back into the slopes of West Maui and drain the eastward watershed of Pu`u Kukui and the ridges radiating northeastward, eastward, and southeastward from it" (Handy and Handy 1972). Currently, only the Waikapū Stream is located in the project area and could empty, if diverted, onto the project area. Waikapū was renowned for "…its majesty and splendid living, whose

[1]**KE ALOHA AINA / PART 1 & 2 / March 2 & 9, 1907 Mookuauhau Haikupuna Holopuni O John Liwai Kalaniopuuikapali-0- Molilele-Ma-Wai-0-Ahukini-Kau-Hawaii Ena The Complete Ancestry of John Liwai Kalaniopuuikapali-o-MoliIele-ma-wai-o-Ahukini-Kau- Hawaii Ena** *Page numbers are from reprinted article and translation in Hawaiian Genealogies Volume II*

native songs gather flowers in the dew and weave wreaths of ohelo berries" (S.W. Nailiili in Sterling 1998:93). W. D. Alexander (in Sterling 1998:63) states that "…the lands of Waikapū and Wailuku appropriated almost the whole of the isthmus so as to cut off half of the lands in the district of Kula from access to the sea. These two *ahupua`a,* together with Waiehu and Waihe`e, which were independent, belonging to no *Moku*, were called Na Poko, and have been formed into a district in modern times."

According to Handy and Handy (1972:497) and Pukui *et al.* (1974:223), the name "Waikapū" (Water of the Conch) refers to an ancient cave in the area where a famous conch shell (*pū*) was hidden until it was stolen by Puapua-lenalena (a supernatural dog). Sterling (1998) offers two alternative origins of the name "Waikapū." In one account, the area, known as "Nā Wai Eha," was renowned for the battles fought there; the name Waikapū (the water where the conch was blown) referred to a conch shell which was blown to announce the commencement of a battle [C. W. Stoddard (1894) in Sterling 1998:63]. In another account [H. T. Cheever (1851) in Sterling 1998:63], "Waikapū" (Forbidden Water) refers to the time Kamehameha I, the Conqueror, beached his canoes at Kalepolepo and placed a *kapu* (taboo, restriction) on the nearest stream [Stoddard (1894)in Sterling 1998:63]. Although Waikapū Stream is not the closest stream to Kalepolepo, it does drain into Keālia Pond, and it may have been the closest stream with flowing water at the time of Kamehameha's landing (Sterling 1998:63).

Waikapū once was the setting of vast wet-land taro fields. Evidence of the widespread *lo`i* planting is provided by the Land Commission Awards that indicate there once were more than 1,300 wet-land taro patches extending along the boundaries of Waikapū Stream (Creed 1993). Handy and Handy (1972: 497) describe the general Waikapū area as follows:

> Spreading north and south from the base of Waikapu to a considerable distance below the valley are the vestiges of extensive wet-taro plantings, now almost obliterated by sugar-cane cultivation; a few here and there are preserved in plantation camps and under house and garden sites along the roads. Among these gardens there were, in 1934, a few patches of Japanese taro. Far on the north side, just above the main road and at least half a mile below the entrance to the canyon, an extensive truck garden on old terrace ground showed the large area and the distance below and away from the valley that was anciently developed in terraced taro culture. On the south side there are likewise several sizable *kuleana* where in 1934 old terraces were used for truck gardening. In the largest of these a few old patches were flooded and planted with Hawaiian wet taro. Several terraces were used as ponds planted with lotus for their edible

> seed. There were probably once a few small terraces on the narrow of valley bottom in the lower canyon.

Available archival research indicates no Land Commission Awards were awarded within the portion of the current project area located in the Waikapū Ahupua`a. The dearth of Land Commission Awards within the current project area and the area immediately surrounding the project area may be attributed to an absence of pre-1848 Hawaiian population, a result of settlement conditions within these particular *ahupua`a* favoring upland loci (see Creed 1993) where more precipitous conditions are present and ideal for agricultural pursuits. However, as previously stated, a single Land Grant is present on TMK: (2) 3-8-007: 101 and identified as Land Grant 3152. This grant occurs within the project area confines only on the Waikapū Ahupua`a side of the project area. As the mention of Land Grant 3152 in this paragraph is to solely notify the reader of the presence of a land claim, a further explanation of the specific Land Grant will be detailed in the following section regarding the events that occurred in the Waikapū Ahupua`a during late Historic Period.

THE LATE HISTORIC PERIOD AND GROWTH OF THE SUGAR INDUSTRY

Another influence that brought change to Maui was foreign commercialism. Two Chinese brothers, Ahung and Atai, of Honolulu's Hungtai Company arrived in Wailuku in 1828 to explore the possibility of setting up one of its earliest sugar mills. Atai soon created a plant that processed sugarcane cultivated by Hawaiians, named the Hungtai Sugar Works (Dorrance and Morgan 2000:15-16). Ahung later joined Kamehameha III's sugar producing enterprise, although by 1844 both operations had ceased. In 1862, The Wailuku Sugar Company was established and would expand sugar production over the next 126 years of its existence (4,450 acres by 1939), still more than three decades before its maximum production levels.

As it expanded its territory, the Wailuku Sugar Company first appeared on maps in the area in the 1920s, although their acquisition of land south of the project area may have been as early as the turn of the century (Kennedy and Trimble 1992:4). On November 18, 1875 Henry Cornwell, through Grant 3152, acquired Waikapū Ahupua`a from the state government (ibid.1992). *Hawaiian Reports*, 4:248 in Sterling (1998:95) contains the following passage entitled the "Opinion of the Court by McCully, J., in the Matter of the Boundaries of Pulehunui (from) which discusses the acquisition of Waikapū from the state government:

> The land of Waikapu, belonging to the Government, was set over to the Department of Education. There is in the office of the Department a map of Waikapu, and survey notes on separate paper taken to refer to it. The notes and the names written

> on the map were in the handwriting of one J.W. Marsh, deceased, who had been a clerk in this Department…
>
> In 1875 the Board of Education sold at auction the "Land known as the ahupua'a of Waikapu, saving grants hitherto made within said ahupua`a, or sales by the Board of Education," to Henry Cornwell, the Government issuing a royal patent in the above terms without survey or statement of area. Mr. Cornwell afterward sold to Claus Spreckels and others the part known as Waikapu Commons.

By the turn of the century, a large portion of Waikapū, and possibly portions of the project area, was under sugarcane cultivation.

Wailuku Sugar Company ended production in 1988, having averaged over 30,000 tons of sugar produced annually at its pinnacle in the 1970s (Dorrance and Morgan 2000:66). Owner C. Brewer & Company, Ltd. shut down sugar cultivation on the project area, which was then used almost entirely for pineapple cultivation starting no later than 1992 (Kennedy and Trimble 1992:1). The lands were under pineapple for at least the next three years (Tomonari-Tuggle 1991:11) (and probably slightly longer) before transitioning to smaller-scale "garden" plots.

RANCHING

Livestock was introduced to the Hawaiian Islands in 1793 when Captain Vancouver transported cattle and sheep aboard his ship the *Discovery* with the intention of giving the four cows, two bulls, four ewes, and two rams to Kamehameha I as a gift of goodwill. The rough seas and intense heat of the journey took its toll on the health of the cattle and several of the animals died. In order to ensure that the cattle population would increase, a ten year *kapu* was placed on slaughtering them. Eventually the cattle did recover in number. However, once the 10 year *kapu* on cattle slaughter had been lifted the number of cattle increased so dramatically they became a dangerous nuisance. As they were allowed to roam wild gardens were destroyed and the Native Hawaiians were terrified of being attacked. Managing and controlling the unruly animals became a necessity. In order to solve this problem Kamehameha I employed "a varied crew with unsavory reputations who had immigrated to the islands to escape their pasts" as bullock *hunters* to capture the animals (Cowan-Smith and Stone 1988:8).

Things were about to change in 1803 when Captain Richard Cleveland and his partner Captain William Shaler introduced horses to the Islands. These men brought aboard their ship, the HMS *Lelia Byrd*, several horses including a stallion and a mare with foal which they presented as gifts to Kamehameha. Soon the horses, like the cattle, were roaming freely across the Islands. The horses (*lio*) adapted rapidly to the rough terrain where the cattle grazed and "their ability to work the livestock [did not] go unnoticed" (Cowan-Smith and Stone 1988:12).

Around 1830, Kamehameha III brought Mexican *vacqueros* from Vera Cruz to the Big Island to teach the local men how to rope and handle the animals. As the cattle and horse populations proliferated the animals were transferred to the various Hawaiian Islands and the vacqueros, which now included local cowboys, were needed on the outer islands.

Cattle were on the Island of Maui as early as 1806. Amaso Delano, in Brennan 1995:97, provides the following account of the effect cattle had on traditional life on Maui:

> They had recently brought to this island, one of the bulls the Captain Vancouver landed at Owhyee (Hawaii). He had made very great destruction amongst their sugar cane and gardens, breaking them and their cane patches and tearing them to pieces with his horns and tearing them with his feet. He would run after and frighten the natives and appeared to have the disposition to do all the mischief he could, so much so that he was an unwelcome guest among them.

As sandalwood and *koa* were diminishing, cattle became an important resource to the Hawaiian economy. By 1820, the number of cattle had increased to such a degree they were aggressively being hunted for their hides. In addition, their tallow and meat became important commodities of local and international trade. Soon cattle and their importance in the trade industry flourished to such an extent that Hawai`i became a major supplier of beef to California during the Gold Rush and subsequently to the visiting whaling ships, as well (Cowan-Smith and Stone 1988:6). Currently, a portion of the project area (*i.e.*, TMK: (2) 3-8-007: 101) is utilized for cattle ranching and albeit not known when, if ever, cattle ranching terminated within Waikapū Ahupua`a, the presence of such could be interpreted as having continued the Historic Period tradition of cattle ranching within the Waikapū Ahupua`a.

Besides the unification of the islands, perhaps the most significant development following contact with Westerners was the Māhele of 1848. Many awards were distributed in areas bordering `Īao Valley. Most land in that area was being utilized for the cultivation of taro and *hala* trees, and for house sites resting near agricultural production areas.

Another significant development was the cultivation of sugar cane, which began in the `Īao Valley area during the 1850s. Sugar cane became the dominant crop cultivated in the area and provided occupational opportunities for both local and non-local residents. With sugar cane cultivation came irrigation and processing structures across the landscape like irrigation ditches, mills, and other infrastructures supporting the cash crop production. Sugar cane cultivation continued through the 20th century.

RECENT HISTORIC PERIOD AND PRESENT LAND USE

During the 20th century, sugar cane cultivation continued on an intensive scale. Sugar cane continued to be the dominant activity in the Wailuku-Waikapū area, although small taro plots were still being cultivated. In addition, ranching became a viable activity in the Wailuku and Waikapū areas, particularly in *mauka* areas below the precipitous cliffs of the West Maui mountain range. At present, the portion of the project area located within Wailuku Ahupua`a contains portions of land that have been extensively altered via mechanical means with regards to commercial development (*e.g.,* construction baseyards) and other modern day uses (*i.e.,* sod farming and sand mining). The relatively intact portions of the project area north of Waiko Road consist of mainly undisturbed sand dunes utilized for cattle ranching. In addition, modern debris (*e.g.,* building materials, yard refuse) is evident mainly in the northeast corner that accounts for approximately 10 percent of the project area. Natural vegetation (as opposed to intentionally planted vegetation) covers approximately 60 percent of the project area with the remaining 40 percent being cleared lands for various uses.

PREVIOUS ARCHAEOLOGICAL RESEARCH

Multiple archaeological projects have occurred within and near the current project area. This section first provides a general overview of previous archaeological work in the Wailuku-Waikapū area and the results of the work (Figure 4). The second section specifically targets archaeological projects conducted directly within the current project area.

WAILUKU AHUPUA`A SELECTED PREVIOUS ARCHAEOLOGICAL STUDIES

Overview

Early work in the region primarily concentrated on known *heiau*. For example, Thrum (1909) conducted the first archaeological survey within Wailuku Ahupua`a. Thrum first identified the much investigated Haleki`i and Pihana Heiau. In addition to Thrum's work at the monumental structures, Stokes mapped the site in 1916. Walker also recorded the site in 1931, after his island-wide survey of Maui in which he identified many *heiau* within Wailuku Ahupua`a. Kenneth P. Emory in 1959 was the next archaeologist working at that particular site. During his time he reconstructed portions of Halekii and rendered another map of the *heiau*. The most recent work at the site was conducted by Yent (1983, 1984, and 1995) who undertook

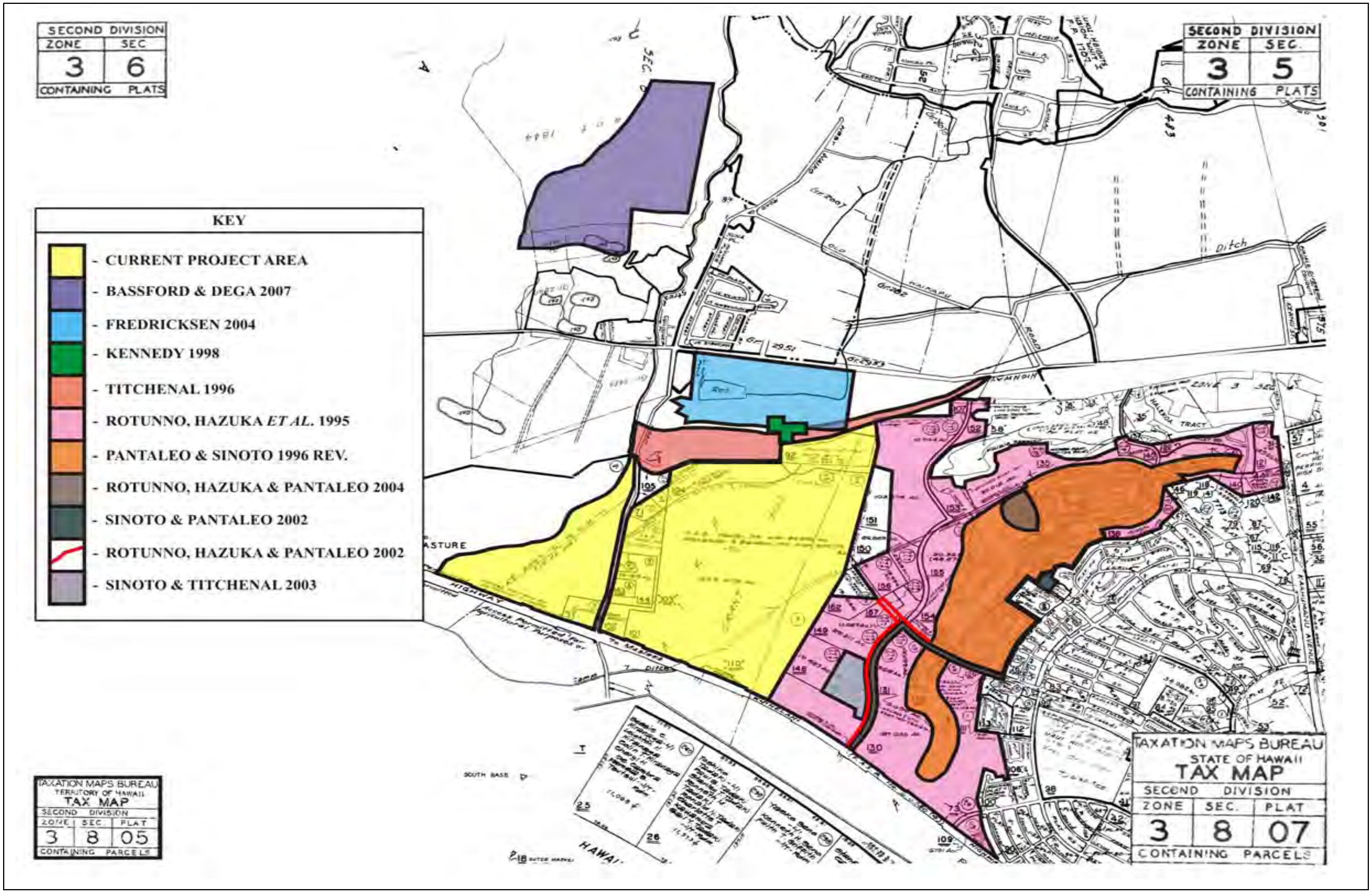

Figure 4: Combined Tax Map Keys [(2) 3-5, 3-6, 3-8-005, 3-8-007] Showing Previous Archaeological Work in the General Project Area and Environs.

systematic survey, mapping, and excavations as part of a restoration plan. Yent's (1995) work yielded plan views of the site and detailed profiles of the *heiau*, as well as revealed construction techniques utilized to build the features.

Prior to the modern era, the only large-scale survey of Wailuku Ahupua`a and environs, albeit slightly biased towards coastal structures, was conducted by Walker (1931). Recently, many other archaeological projects have been conducted in the area and have yielded much data regarding settlement pattern and land utilization within the *ahupua`a*. Kirch (1985:144) notes, however, that a "more intensive study of these important regions will help to unravel the sequence of economic, social, and political change that led to the development of the powerful Maui chiefdoms witnessed by Cook and others."

Connolly (1974), as part of the initial `Iao Valley Phase I Flood Control Project conducted an archaeological survey within `Īao Valley. Connolly's survey augmented a preliminary reconnaissance of the study area by K. Moore of Bishop Museum in April 1974, the latter noting the presence of stone structural remains thought to be taro or *lo`i* terraces. During the survey, Connolly recorded two historic complexes composed of a substantial amount of terraces, free-standing walls, ditches, historic house foundations, and several stone mounds.

Identified by Connolly (1974) and designated as State Site No. 50-50-04-2978 (Wallace System Complex) and 50-50-04-2979 (North Terrace System Complex), the former sites, located on the south stream bank of `Īao Valley, consisted of twenty terraces; two irrigation ditches; one free-standing, diversionary wall; and two house foundations. The North Terrace System Complex consisted of a wetland taro system represented by six taro terraces, two free-standing walls, and two stone mounds of unknown function. Connolly (1974) believed both sites (and all features) to have been constructed during historic times, the sites presumably constructed by Portuguese workers living in a camp within the valley. Several interesting artifacts were also recovered during the survey and represent traditional taro processing such as the fractured basalt *poi* pounder and the unfinished basalt *poi* pounder. Connolly's (1974) work in `Éao Valley streambed set a precedent for anticipated findings during other studies in the environs of `Éao Valley.

In 1984, spurred by the finding of a human tibia fragment during an imported sand fill operation for the construction of a Jack-in-the-Box restaurant in Lahaina, Earl Neller recorded an intact human burial in the Wailuku Sand Hills (TMK: 3-8-07:2) while attempting to locate the area from which the bone might have been mined. While Neller never found the exact location of the displaced remain, his investigation did lead to the identification of a single intact human skeleton protruding from the ground surface, as well as other remains on the surface. Neller theorized that there might be as many as three other graves that were disturbed-probably during other, non-sand mining activities (*e.g.*, dirt-biking). Based on such, he recommended that archaeologists probe the Wailuku Sand Hills for additional human burials.

During the 1990s, the intensity of archaeological work conducted in Wailuku escalated, including much work involving the Maui Lani Development area where many traditional-period human burials have been found. In 1990, Rotunno and Cleghorn located human burials on TMK: (2) 3-8-007: 2 and 110 in an area known as the Maui Lani Development Property. The human burials found on this tax map key were designated as State Site 50-50-04-2797 (Rotunno and Cleghorn 1990). In 1992, archaeological work on grounds of the Nisei Veterans Memorial Center [TMK: (2) 3-8-07:123] located pre-Contact habitation sites (Site 50-50-04-3120) with associated human burials along with a portion Site 50-50-04-3112, identified as the Kahului Railroad (Fredericksen and Fredericksen 1992). Six years later, in a Fredericksen *et al*. September 1998 (Revised) archaeological Data Recovery report, radiocarbon samples obtained from Site -3120 provided dates between A.D. 90 to 1970 for the site. Also in 1992, more human burials were found during construction on the property of the Maui Homeless Shelter [TMK: (2) 3-8-46:21, (Donham 1992)]. The year 1994 saw the additional discovery of human burials. At the Maui Lani Development Property (Rotunno-Hazuka *et al.* 1995) multiple human burials were found. They were designated State Site 50-50-04-2797. At the site of the Home Maid Bakery [TMK: (2) 3-8-37:49] on Lower Main Street in Wailuku, Donham (1994) discovered both historic and pre-Contact human burials. The site number assigned to those particular burials was Site 50-50-04-3556.

In 1995 several projects were conducted in Wailuku that led to the discovery of several loci containing human burials. Dunn *et al.* (1995; 2004) identified three pre-Contact sites along Waiale Road during Archaeological Monitoring for the installation of a sewer pipeline. Site 50-50-04-4005 consisted of a single, disturbed human burial located in fill material; Site 50-50-04-4067 was a hearth; and Site 50-50-04-4068 was an assemblage of 34 subsurface features that included 13 human burials and 21 habitation features. A radiocarbon sample obtained from the hearth provided a radiocarbon date of A.D. 1434 to 1669 (98%) and A.D. 1772 to 1794 (2%) at 2 Sigma. Fredericksen and Fredericksen (1995) also conducted an archaeological survey along Waiale Road in Wailuku though yielding negative results. Based on the presence of sand, known to contain human burials, archaeological monitoring was recommended. However, the recommendation was not adhered to and resulted in several tons of graded sand containing human remains that had to be mechanically screened for recovery. Fredericksen and

Fredericksen (1995) believe that the human remains had originated as part of an existing burial complex previously identified as Site -2916.

Pantaleo and Sinoto (1996 Rev.) conducted subsurface sampling on TMK: (2) 3-8-07:2.110 via 90 backhoe trenches, 2 shovel scrapes, and 1 manually excavated trench. The excavations led to the discovery of two previously unrecorded sites eventually assigned as State Site 50-50-04-4146 and 50-50-04-4147. Each of these sites yielded the presence of a single human burial. Additional excavations at one previously recorded site (Site 50-50-04-2797) revealed the presence of four additional human burials that were interpreted as part of Site -2797.

On Lower Main Street and Mill Street in Wailuku Fredericksen and Fredericksen (1996) conducted Data Recovery on TMK: (2) 3-4-039: portion 81 and 82. Excavations at State Site 50-50-04-4127 revealed two extensive, subsurface cultural deposits, both "overlain by fill from historic earthmoving activities associated with construction of the Kahului Railroad and Lower Main Street" (ibid:1996). While the upper cultural deposit was disturbed by the aforementioned activities, the lower layer contained intact pre-Contact features and artifacts associated with habitation. Artifacts associated with fishhook manufacture, lithic tool utilization and production, and food preparations were recovered from Layer II deposits. The deposits were radiocarbon dated and results suggested the site was occupied during the late pre-Contact period (A.D. 1570–1780). Importantly, this habitation site is likely associated with the lower `Iao River flood plain in which taro was presumably produced. Thus, habitation occurred above the valley floor while taro production for households occurred on the rich but narrow alluvial flood plains of `Iao Valley.

Cordy (1996) and Donham (1996) provide overview studies of prior archaeological work conducted in the Wailuku area. Cordy (1996) discussed an overview of Māhele documents on land patterns in `Īao Valley that clearly showed the lower valley region contained irrigated taro fields throughout the flood plain and houses and associated grave sites at the base of the sand dunes bordering the sides of the flood plain. Donham (1996) also summarized that house sites occur along the base of the sand dunes, although the population moved *mauka* through time.

A year later, Fredericksen and Fredericksen (1997) conducted an Archaeological Inventory Survey on TMK: (2) 3-4-039:82 that led to the identification of an undocumented cultural deposit interpreted as a habitation site (State Site 50-50-14-4414) and an extension of their 1996 documented cultural deposit (State Site 50-50-04-4127). A single radiocarbon sample obtained from the former provided a calibrated date of A.D. 1325 to 1340 and A.D. 1390 to 1670 at 2 Sigma with a 95 percent probability rate.

During Archaeological Monitoring, Sinoto and Pantaleo (2002 Rev.) reported a single human burial that had been almost entirely displaced due to grading for the new Pu`uone Kingdom Hall in Kahului. The displaced remains were collected, analyzed with the remaining *in situ* portion of the burial, and concluded that the finding was that of a “prehistoric indigenous Hawaiian individual” (ibid:2002 Rev.:1). State site 50-50-04-5126 was assigned to the burial and preservation was selected in place where the *in situ* portion of the burial was found.

That same year, Rotunno-Hazuka and Pantaleo (2002) reported on the results of subsurface testing just north of the subject project area. The excavation of 32 trenches was completed on two proposed roadway corridors designated as the Maui Lani Parkway and Kamehameha Avenue. Trenching failed to reveal cultural deposits within the Pulehu-Ewa-Jaucus matrices.

Sinoto and Titchenal (2003) conducted Archaeological Inventory Survey for the proposed Phase VII Residential Project of the Maui Lani Development Area in which 15 trenches were excavated via mechanical means. The results of this project were also negative.

Rotunno-Hazuka and Pantaleo (2004) reported the results of Archaeological Monitoring that led to the documentation of two human burials during mass-grading for the Bluffs Subdivision. One burial, interpreted as the remains of an infant, was assigned as Site -5404. The second burial, an adult male, was exhumed and placed with a previously identified burial site assigned as Site 4146-Locality 12. Together, the burials were classified as belonging to a “traditional Native Hawaiian burial ground” (ibid: 15). Included in their report was the inadvertent finding of at least three human burials by Archaeological Services Hawaii (ASH), LLC, along the western flank of a nearby sand berm constructed by HC&S. Subsequently, the burials’ location was assigned as State Site 50-50-04-5504. A brief inquisition to the Maui/Lanai Islands Burial Council to obtain the burials’ disposition ensued and to date, no formal archaeological work has been conducted and no formal plan to preserve the burials has been submitted for review. Please note: As the above-mentioned burials were inadvertently identified by ASH archaeologists, Scientific Consultant Services, Inc. did not consult with community members, as per HAR § 13-276-5(a) and (a) (4) (g).

An Archaeological Inventory Survey on TMK: (2) 3-3-002: portion of 001 and 3-4-032: portion of 001 by Tome and Dega (2004) led to the identification of four archaeological sites, one of which was previously recorded as Site -1508, Spreckels Ditch. Site 50-50-04-5564 was an historic bridge constructed and used for the transportation during Wailuku's sugar cane industry; Site 50-50-04-5565 was the former *lo'i* fields used during pre-Contact into early post-Contact times; Site 50-50-04-5566 was the small, concrete-lined irrigation ditch also constructed and used during the sugar cane industry and most likely stemmed into aiding the macadamia nut industry. A supplement of eleven stratigraphic trenches was placed at various points along the proposed routes that tested subsurface soil deposits for human alteration and influence. ST-9, ST-10, and ST-11 aided the confirmation that the former *lo'i* fields, once abundant in the lower portions of Iao Valley, still exist and that they were under fill. With the exception of the former *lo'i* fields that were once used in pre-Contact times, no traditional archaeological sites were found thus, attributing the intensive cultivation of sugar cane and macadamia nuts to the destruction and removal of such sites (Tome and Dega 2004).

WAIKAPŪ AHUPUA`A SELECTED PREVIOUS ARCHAEOLOGICAL STUDIES

In 1988, PHRI conducted a cursory archaeological reconnaissance survey of an 80 acre property over a four day period. This survey included the area containing the existing Pohakea Quarry and its surrounding environs (M.L.K. Rosendahl 1988). Although six newly identified historic sites were located during his project, none were assigned state site numbers until nineteen years later when Scientific Consultant Services, Inc. would conduct Inventory Survey of the area and also provided a reassessment of the sites. Nineteen years later, Scientific Consultant Services' Dagher and Dega (2007) reported on the re-location of five PHRI sites (M.L.K. Rosendahl 1988) in the Pohakea Quarry area as well as finding two previously unrecorded sites. Altogether, a total of seven sites (Site 50-50-09-6061 through -6067) were fully documented and assessed as having Historic Era (post-1778 to pre-1950s) associations.

A year later Kennedy (1989) reported on an archaeological study of TMK: (2) 3-5-02:1 that involved a surface survey and limited subsurface testing (the subsurface testing was conducted utilizing the excavation of six backhoe trenches that revealed the presence of sand). He reported that no archaeological materials had been found and that modern debris observed on the surface of his project area was likely the result of landfill processes.

Also in 1989, PHRI conducted Archaeological Inventory Survey of over 600 acres within the Waikapū Mauka Partners Golf Resort located to the north of the current project area (Brisbin *et al.*1991). The report, cited as Haun (1989) in Brisbin *et al.* 1991 and documenting the findings of this survey, was not available at the State Historic Preservation Division (SHPD) and appears not to have been printed or reviewed by the SHPD. Based on the findings and recommendations of Haun's (1989) Inventory Survey, Archaeological Data Recovery was applied to nine sites (comprised of over 46 features) identified during the initial survey (Haun (1989) in Brisbin *et al.* 1991). These nine sites show that this area was utilized for extensive traditional dryland agriculture with limited habitation and some historic ranching activities. It is summarized that only a few habitation sites were located below 500 feet amsl and that the agricultural sites were "continuously distributed" throughout the project area. Fifteen radiocarbon samples collected from data recovery excavations conducted at several of the features yielded sufficient amounts of charcoal suitable for providing reliable dates. The range of the radiocarbon dates suggests initial occupation of the project area occurred during the early 1500s and continued through historic times (Brisbin *et al.* 1991).

Kennedy (1994) conducted an Archaeological Inventory Survey on TMK: (2) 3-6-02:2 (POR.) and TMK: (2) 3-6-04:2 (POR.) within Waikapū Ahupua`a. During the survey a total of 18 sites, comprised of 74 features, were newly identified. These sites also indicated that the area was primarily utilized for traditional agriculture, although there was some evidence of limited habitation, including burials, and ceremonial use. Kennedy (1994) concluded that these sites could be a continuation of the occupation described by Brisbin *et al.* (1991). Five charcoal samples collected from test excavations of several of the features were submitted for radiocarbon dating. These samples yielded dates ranging from A.D. 1040 through 1950, somewhat earlier than postulated in Brisbin *et al.* (1991).

Titchenal (1996) conducted Archaeological Inventory Survey for a proposed water retention basin and associated lands within both Waikapū and Wailuku Ahupua`a [TMK: (2) 3-5-02:01 (POR.) and TMK: (2) 3-5-01:17 (POR.)]. Thirteen backhoe trenches utilized to sample the project area did not yield any subsurface cultural material. Pedestrian survey of the project area also yielded negative results. Although the survey provided negative results, Archaeological Monitoring was recommended due to the presence of sand dunes nearby the project area.

In 1997, Aki Sinoto Consulting (ASC), in association with Garcia and Associates (GANDA), conducted Archaeological Inventory Survey of 15 acres of land north of Pōhākea Gulch. This study included a small portion of the current project area and the site of the present-day, currently operating Pohakea Quarry. One structural feature was documented during the survey. Given the description of this feature and the site location map, the feature may be associated with Site 50-50-09-6062 (T-6) or 50-50-09-6063 (T-11) which were initially documented by PHRI in 1988 (Eblè and Pantaleo 1997:9). This structural feature is briefly described below:

> This feature consisted of a short remnant segment of a free-standing, stacked stone wall incorporating a post and wire fence. This remnant, oriented east to west, measures 8 meters in length and .80 to 1.0 meters in width and height. The extensive clearing evident in the surrounding area most likely destroyed the rest of the wall within the boundaries of the current project area. The construction technique, orientation, and dimensions of the remnant features suggest possible association with Sites T-6, T-11, or other walls present in the *mauka* areas.

Buffum and Dega (2001) reported negative results from an archaeological study of 7.5-acres on TMK: (2) 3-5-04:92 through systematic surface survey which failed to reveal extant archaeological sites. It was conclusion was that the absence of any structures was likely a product of extensive landscape modifications through sugar cane and pineapple cultivation on the parcel over the past c. 150-200 years.

Another archaeological study in the Waikapū area that did not lead to the identification of archaeological sites was an Inventory Survey by Davis (2003). Approximately 57-acres of Tax Map Keys: (2) 3-5-02:005 and 3-5-15:071 were subject to pedestrian survey on moderate to steeply sloping terrain (<30 to 60°). Davis (2003:1) suggested that such a landscape "would be the primary determining factor for land use…". In other terms, the landscape was steep enough wherein agricultural or habitation use, among others, would be limited. Davis (2003) did report that the survey crew noted a cave high on a ridgeline to the south, outside the study area, but did not further investigate the area as it was on private land.

Following an Archaeological Inventory Survey of approximately 100-acres in 2003 of Tax Map Keys: (2) 3-8-7: 101 (POR.) and 3-5-02: 01 (POR.)**,** Fredericksen (2004) recommended a section of the Kama Ditch (found during the survey) for preservation. No other sites were identified during the research. Although abandoned an estimated 30 years prior to the survey, the non-functional ditch was identified as having historic associations with the plantation-era.

Wilson and Dega (2005) conducted an Archaeological Inventory Survey on TMK: (2) 3-5-02: 02 and 03 within the Waikapū Ahupua`a and recorded seven archaeological sites associated with plantation/historic times: Waihee Ditch (State Site 50-50-04-5197); Waikapu Ditch (50-50-04-5493); an un-named, lesser ditch (50-50-04-5729); a second un-named, lesser ditch (50-50-04-5726); a large, un-named reservoir (50-50-04-5727); a series of fourteen sugarcane-field erosion-control, soil berms (50-50-04-5728); and a County dirt road named "Old Waikapu Road" (50-50-04-5730). No traditional Hawaiian sites were found in this project area.

Bassford and Dega (2007) conducted Archaeological Inventory Survey of TMK: (2) 3-6-04: 03 (POR.) and 06 (POR.). The project yielded only negative results for any surface features, subsurface cultural deposits, or human remains. Some modern materials were observed in many of the trench profiles (*e.g.*, plastic, black irrigation hosing, concrete aggregate chunks) and were interpreted as remnants of the previous land use practices of commercial sugarcane cultivation in the area.

Finally, the 29-acre parcel occurring in the center of the current project area along Waiko Road (TMK: 3-8-7: 89, 143, 144 por), known as the "Consolidated Baseyards", was subject to long term Archaeological Monitoring. The acreage is owned by another party who is developing the land for light industrial use. Monitoring was conducted in 2006 and 2007 by SCS (Pestana and Dega 2008). During subsurface construction activities, one site comprising two features was identified and assigned State Site No. 50-50-04-6226. The two features included two isolated areas of human remains, which have been protected under approved burial treatment plans.

ARCHAEOLOGICAL STUDIES CONDUCTED WITHIN THE CURRENT PROJECT AREA

Eight archaeological projects have been completed or are in the process of being completed within the current project area. The current Inventory Survey represents one of the projects near completion. Another project, Archaeological Monitoring within the Hawaiian Cement Sand Mining areas, also continues at present. Mitigation of State Site No. 50-50-04-5504 (burial) will be completed upon n acceptance of the current report. Thus, a total of five projects (with adjunct mitigation) have been completed in the project area, two are being brought to conclusion, and one project requires additional mitigation. Summary information of all eight projects is listed chronologically below. Figure 5 illustrates projects that have occurred in the current project area.

Moore and Kennedy (1998):

An Archaeological Inventory Survey Report for a Proposed Sand Mine to be Located at TMK: 3-8-07: 101 (por.) in Waikapū and Wailuku Ahupua`a, Wailuku District, Island of Maui

This study, the first formal archaeological work to occur within the current project area, consisted of survey and testing across approximately 90 acres of undeveloped land in the northwest portion of the project area. The survey area consisted of two separate, but adjacent parcels of land bisected by an access road. Area A occurred to the east of the access road and consisted of 59 acres. Area B consisted of 30.3 acres and occurred to the west of the access road.

A total of 117 trenches were excavated in the project area which resulted in the identification of three sites. Site 50-50-04-4200 consists of four burials and associated artifacts, Site -4201 contained one burial, and Site -4202 was composed of a tiered terrace with paving thought to represent a temporary habitation locus. All three sites occurred within Area A and were interpreted as associated with prehistoric/early historic times. Following, a Burial Treatment Plan was composed for Site -4200 and Site -4201 (see below).

Monitoring of sand mining activities in this area was undertaken by Archaeological Services Hawaii, LLC (see Rotunno-Hazuka and Pantaleo n.d. below)

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Kennedy and Moore (1998)

A Revised Burial Treatment Plan for a Proposed Sand Mine To Be Located at TMK: 3-8-07: 101 (por.) in Waikapu and Wailuku Ahupua`a, Wailuku District, Island of Maui

The Burial Treatment Plan (BTP) followed the findings of the above noted Inventory Survey and covered Site -4200 and Site -4201. The plan includes temporary mitigation measures (fencing and buffer around sites during construction activities), as well as provisions for long term preservation in place of all five burials. The plan was prepared in consultation with the Maui/Lana`i Islands Burial Council (MLIBC) and the preservation tenets of the plan are still in place as of this writing.

Fredericksen and Fredericksen (1996)

Report on the Waikapu Human Remains Recovery Project, Waikapu, Maui, Hawaii (Borrow Site 50-50-04-3525) TMK: 3-8-07: 104

This report discusses the recovery of human remains both on site and removed off site during sand mining activities. The area of origination occurs along the western flank of the current parcel. The project commenced in May 1994, with mitigation occurring intermittently at least through February 1996. Mitigation included the recovery, description, and inventory of remains. Members of the Maui/Lana`i Islands Burial Council conducted on-site re-interment of the remains in March, 1995. A total Minimum Number of Individuals (MNI) equated to twenty-two individuals recovered during this project. This population included both males and females of various age. All recovered remains, as well as those left *in situ*, remain protected on the parcel.

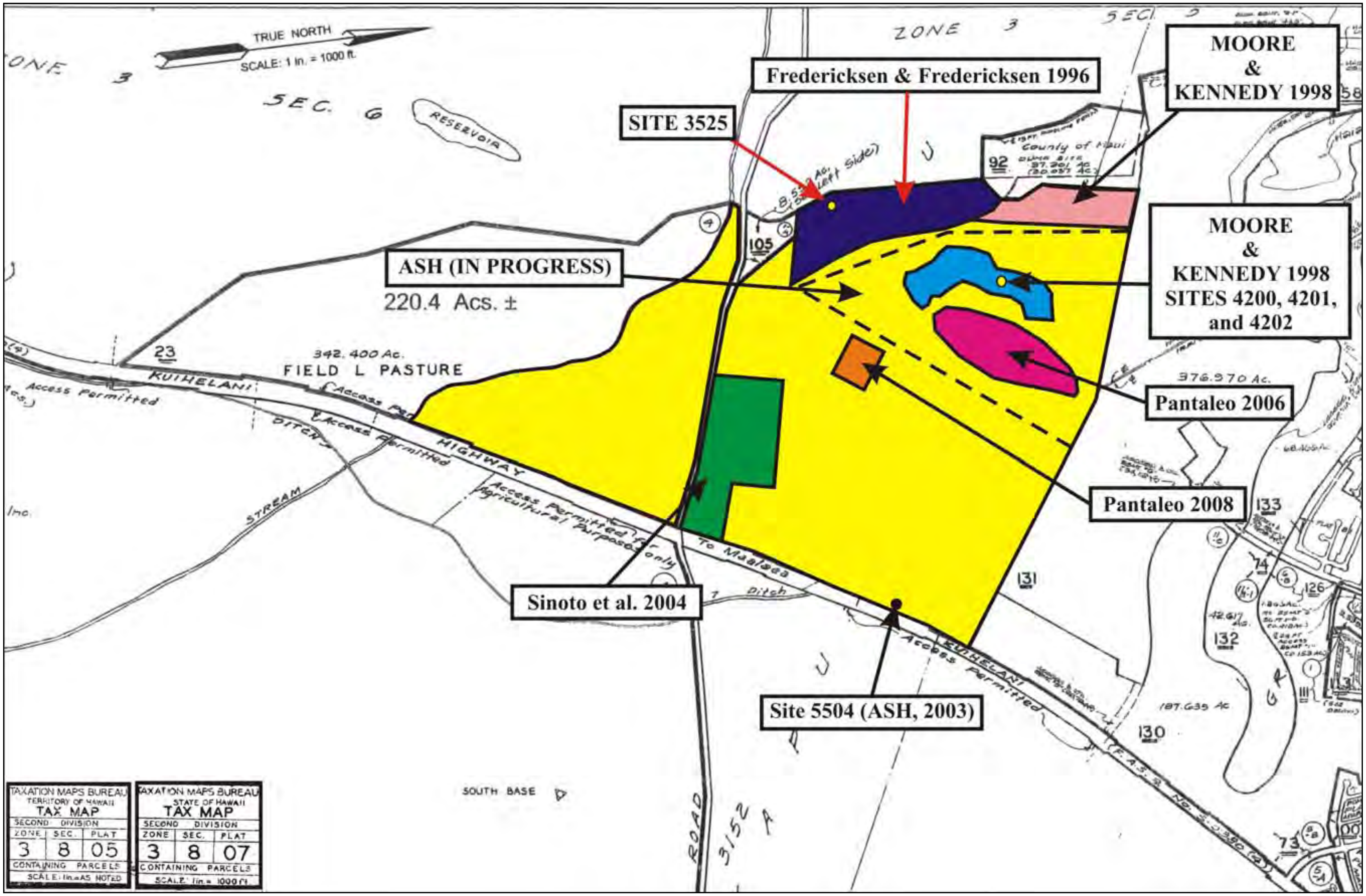

Figure 5: Previous Archaeological Work Conducted within Project Area Boundaries.

<u>Sinoto *et al*. (2004)</u>

Archaeological Inventory Survey of the Proposed Industrial Park Development Area, Waikapu, Wailuku, Maui Island TMK: 3-8-07:89 & 102 (por.).

Archaeological Inventory Survey of TMK: (2) 3-8-07:89 & 102 (por.) was completed by Sinoto *et al*. (2004). Parcel 89 occurs outside the current project area and is known as the "Consolidated Baseyards." Parcel 102 is located in the southeastern-most corner of the current parcel. The Inventory Survey involved both pedestrian survey and testing (eight mechanically-excavated trenches). The results of the project were negative; no historic properties were identified on either Parcel 89 or Parcel 102. The authors noted that approximately 75% of the project area had been previously impacted by mechanical means.

<u>Pantaleo 2006</u>

Archaeological Assessment for the Proposed Hawaiian Cement and Ameron Sand Mining Area, Maui Lani Subdivision Lot 12-A, Waikapu Ahupua`a, Wailuku District, Island of Maui TMK: 3-8-07: 101 (por.)

Inventory Survey of this 50-acre parcel was conducted in 2006 though use of survey and the excavation of 50 backhoe trenches. The study area occurs in the northern portion of the current project area and is a section of a license to Hawaiian Cement for sand mining. Testing amounted to one trench per acre and no surface or subsurface cultural remains were identified. While the results of the project were negative, Archaeological Monitoring was recommended due to the sandy nature of the locale and potential for the discovery of burials.

<u>Pantaleo 2008</u>

Archaeological Assessment of a 15-Acre Portion of Hawaiian Cement Sand Mining Area, Maui Lani Subdivision Lot 12-A, Waikapu Ahupua`a, Wailuku District TMK: 3-8-07: 101 (por.)

Inventory Survey of this 15-acre parcel was conducted in 2008 through use of surface survey and representative testing. The area covered by this study is in the central portion of the current project area. A total of 20 trenches were mechanically excavated within the project area. The results of testing were negative and the project was re-designated as an Archaeological Assessment. Due to the presence of sand and thus, the possibility of burials being present in the project area, Archaeological Monitoring was recommended for the project area (see below).

<u>Rotunno-Hazuka and Pantaleo (2008)</u>

Archaeological Monitoring Plan For All Grading and Grubbing Activities at a 15-Acre Portion of Land at Hawaiian Cement Located at TMK: 3-8-07:101 (por.) Waikapu Ahupua`a, Wailuku District, Island of Maui

This Archaeological Monitoring Plan is an outgrowth of the recommendation made after completion of the Archaeological Assessment work (see above report). At the time of this writing, several burials were identified during this Monitoring project (see below update).

<u>Rotunno-Hazuka and Pantaleo (n.d.)</u>

Hawaiian Cement Sand Mining: Archaeological Monitoring Summary for TMK: 3-8-07: 101 Pors., Archaeological Services Hawaii, LLC, July 2009 (Supersedes the 2003 Interim Monitoring Report Update)

This Monitoring summary covers the area subject to Inventory Survey by Moore and Kennedy (1998; designated as Phase A and Phase B), the 50-acre Assessment survey area documented by Pantaleo (2006; Phase C), and the Assessment area documented by Pantaleo (2008; Phase D). Phase A was further divided into six locales known as Locale 1, Locale 2, Locale 2 extension, Locale 3, Locale 4, and Locale 4 extension. Forty-nine inadvertent burials from Phase A were *in situ* and/or were probably *in situ*. Additional to the *in situ* burials are scatters of human skeletal remains that were disturbed prior to Hawaiian Cement grading activities and do not contain an *in situ* component. A minimum of 21 individuals are represented within the scatters. Phase B contained 2 burial features, 1 partial *in situ* and 1 recently disturbed, probable *in situ*. Phase C, the 50-acre survey area, has not yielded any burials and grading by Hawaiian Cement is complete. Within Phase D, the 15-acre survey area, documentation and lab work of the disturbed remains is not complete, however the data is as follows: at least 3 *in situ* burials and a large scatter of human skeletal remains that were previously and possibly recently disturbed have been identified within a discrete 0.90 acre area. Within the scatter, a minimum of 14 individuals are represented. Together, the phased Hawaiian Cement Sand Mining area contains 54 inadvertent burial features which contain articulated, *in situ* human remains and/or were likely to contain *in situ* burial features, as well as a minimum of 35 individuals represented within the assemblage of scattered human remains. In addition to these inadvertent finds by ASH, five previously identified burial features were documented during the Moore and Kennedy (1998) survey, as is noted above (Figure 6).

Specific plans for the preservation of these burials will be detailed under separate cover in a Burial Treatment Plan authored by Archaeological Services Hawaii, LLC. Appropriate interim protocol and procedures, including demarcation and protection of these areas has been instituted.

Inadvertent Discovery:

The inadvertent discovery of multiple burials (one *in situ* and two areas of scattered remains) in the project area occurred on October 27, 2003. The discovery area occurs in the east-northeastern portion of the project area near Kuihelani Highway. The burials, designated as State Site No. 50-50-04-5504, were discovered by ASH employees who had been working at Maui Lani. The following summary paraphrases the Maui/Lana`i Islands Burial Council meeting minutes for October 30, 2003, and November 26, 2003 in which the burials are discussed.

ASH employees, working at the adjacent Maui Lani parcel, investigated an area known as the “Sod Farm” that had been subject to grading by a front-end loader without an archaeological monitor present. Three areas (designated as Area I, II, and III) were found to contain remains, of which would eventually be one *in situ* burial and two areas of scattered remains. During the October 30, 2003 meeting of the MLIBC, the council made a three-part motion concerning the remains: that the area where the human skeletal remains were found be assigned a state inventory site number; that there be a good faith archaeological attempt to define the boundaries of the inadvertent burial area; and that the disturbed dune sands within the inadvertent burial discovery area be screened in order to recover any other human skeletal remains.

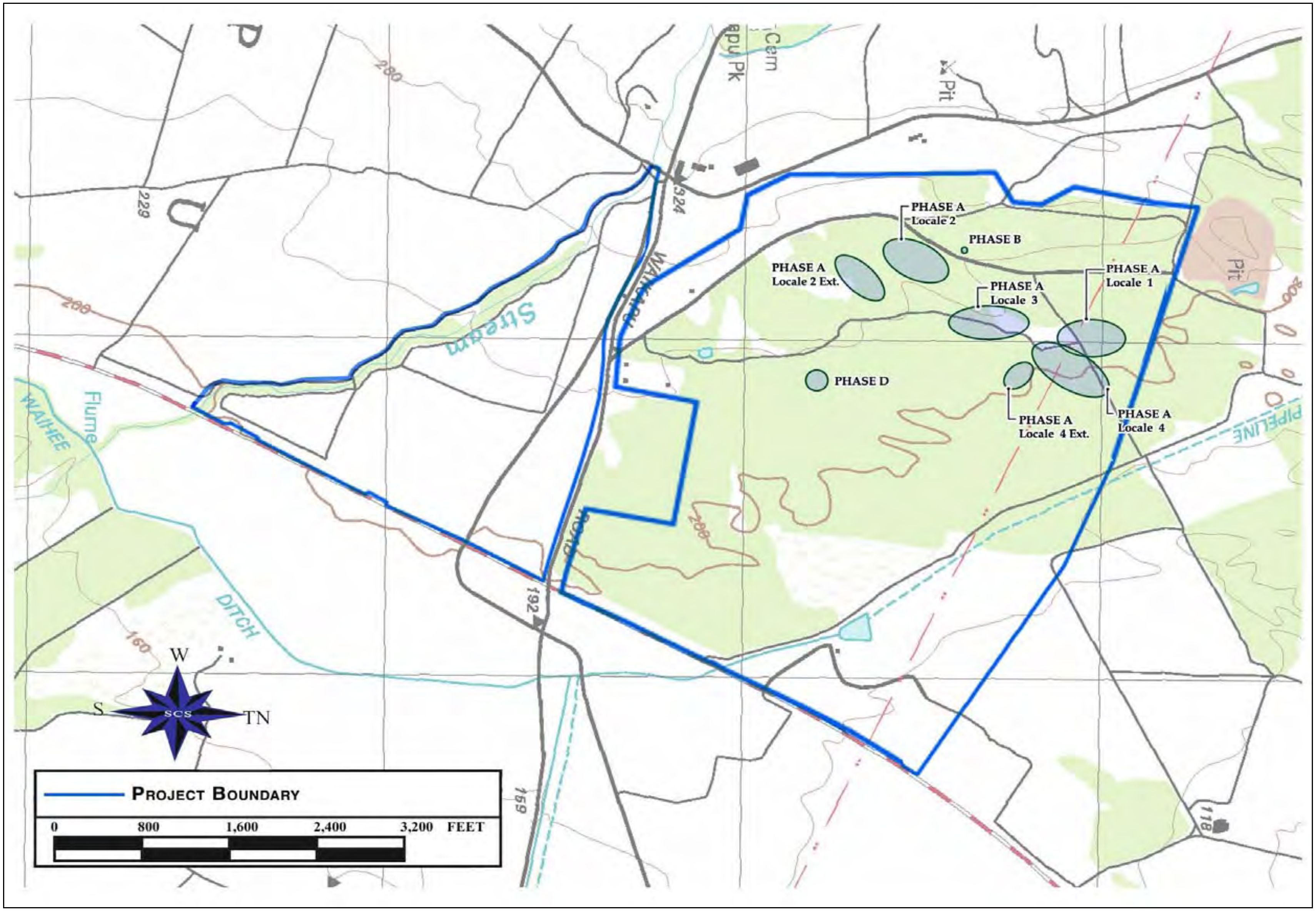

Figure 6: Archaeological Services Hawaii (ASH) Map Showing Hawaiian Cement Testing Locales.

The project was updated again by ASH at the November 26, 2003 meeting of the MLIBC. The three areas containing remains were noted and little work had occurred since the previous meeting, beyond the identification and additional, exposed remains. The inadvertent discovery area still contained one possible *in situ* burial and two areas of scattered remains. There is little information on these burials between November 26, 2003 and in 2008 when SCS conducted fieldwork in the area for the current project (see results below). Please note: As the above-mentioned burials were inadvertently identified by ASH archaeologists, Scientific Consultant Services, Inc. did not consult with community members, as per HAR § 13-276-5(a) and (a) (4) (g).

SCS Current Project (Tome and Dega-in preparation)

The current document presents the results of this Inventory Survey (see below). Briefly, only one new site was identified, State Site No. 50-50-04-6578, an *imu* pit. No burials were identified during the current project.

Previous archaeological work within the project area has revealed definite patterns concerning historic properties in the project area. First and foremost, the ubiquity of burials in this sandy locale is recognizable. However, burials do not appear to occur throughout the entire parcel. Based on the information in hand, they appear clustered in areas of higher elevation dunes (Hawaiian Cement area, recovery area [Fredericksen and Fredericksen 1996]. The burials do not appear as isolates but rather occur in sizeable groupings. That a fairly high proportion of burials occur in this locale may be attributed, at least partially, to the nature of the area: large sand dune systems. These lands would have been quite economically-poor areas for traditional practices, particularly farming and habitation (given the perceived lack of readily available fresh water). Other classes of historic properties that have been documented on the subject parcel include habitation (terrace, *imu* or fire pit) and more modern constructions (water irrigation ditches). The limit of archaeological site types in the area is brought more into focus when compared with the overall settlement pattern of the wider Wailuku/Waikapū region.

GENERAL SETTLEMENT PATTERN AND LAND USE: WAILUKU AND WAIKAPŪ AHUPUA`A

As the current project area is situated within Wailuku and Waikapū Ahupua`a, the settlement pattern for both *ahupua`a* will be generalized in this section of the report.

Archaeological evidence suggests that initial settlement (colonization) in the Hawaiian Islands occurred along windward shoreline areas between the A.D. 4th and 11th centuries. Pollen evidence suggests a settlement date of the A.D. 9th century (see Athens 1997), a date that is more widely accepted. For the most part, these populations utilized local resources and concentrated settlement near the coastline. Cordy in Creed 1993 suggests that upper valley areas on windward coasts were likely populated before the A.D. 1100s. Wailuku Ahupua`a (and possibly Waikapū Ahupua`a) and its coastal environs are thought to have been initially settled around A.D. 1100 to 1200. Generally, the windward coastal settlement was still dominant, but populations began exploiting and living in more upland *kula* zones from the c. 12th century. The Wailuku area is considered to have been a chiefly and ceremonial center during pre-Contact times. The numerous *heiau* attest to the significance of the area (*e.g*., Haleki`i and Pihana Heiau) and war gods were invoked by Hawaiians at the temples (*e.g*., by Kamehameha I). Settlement, burial grounds, coastal exploitation of marine resources, and *lo`i* systems in `Īao Valley were supposedly common during pre-Contact times. Greater population expansion to inland areas did not occur until the *c*. A.D. 12th century, with greatest expansions occurring inland between the 14th through 16th century. Large scale or intensive agricultural endeavors were, at that time, contemporary with expanded habitation. Between A.D. 1500 and 1700, archaeological data indicates that habitation occurred within `Īao Valley, with the valley itself utilized as taro-producing lands. Coastal lands were still utilized for settlement and taro was cultivated in near-coastal reaches and in the uplands. More upland areas of Maui, such as the Kula area, saw the influx of a greater population base concomitant with the construction of large garden enclosures, ceremonial structures, and more permanent habitation sites by *c*. A.D. 1600.

Landscape in the intermediate areas, such as those that are gently to moderately sloped and are located near Waikapū Stream on the northeast side of Pu`u Kukui, were often the former location of taro cultivation along stream courses; dryland taro was grown on *kula* lands, and populations settled in both areas. It is possible that the *kalo* patches described in the LCA accounts of upslope Waikapū region originated during the "Expansion Period" of A.D. 1400 to 1600, perpetuating through historic times (Kirch 1985). However, most of the LCAs for the area describe almost no cultivation occurring in the area during the 1850s. This is primarily due to the prevalence of the lands being used for pasture and sugar cane cultivation (Creed 1993:74). Primary settlement and resource zones lay outside the current medial environmental zone in Wailuku proper, near perennial water sources (*e.g.*, `Īao Valley, Waihee, Waiehu). The only substantial settlement along this medial isthmus zone between 300 and 600 feet amsl was at Waikapū, to the west of the current project area, near the base of Waikapū Stream Valley (see Creed 1993). The current project area lies on the isthmus of Maui, borders a perennial water source (*i.e*., the Waikapū Stream), and is primarily scrubland. It is an area considered peripheral to more resource-rich zones in Wailuku. That many burials have been found in/near the project area sands further attests to sandy matrices often being utilized as burial interment locales. This could be more to do with the economic nature of the land (sand is not profitable in terms of agriculture or other natural resources) rather than the location.

Historic utilization of the Wailuku-Waikapū landscape was dominated by industrially-produced cash crops, sugar cane and pineapple, made possible by water channeled from traditional sources (*e.g.*, Waikapū Stream) through plantation lands. Historic features associated with this period are represented as water features in the form of reservoirs (*e.g.,* Hopoi Reservoir) and water channels (*e.g.*, Waikapu Ditch, Waihee Ditch). This area was also an important transportation corridor linking both the south and north flanks of the Maui isthmus, with Honoapi`ilani Highway having been demarcated as a Government Road on area maps by 1882 (Creed 1993:20).

Overall, the settlement pattern for the current project area suggests a more narrow range of site types associated with various landforms (see Cordy 1996 and Donham 1996 for a more detailed discussion on settlement pattern summaries). For instance, irrigated *kalo* fields would occur on the flood plains where alluvial soil (not sand) and hydrological output are both present in sufficient quantities (and quality) to allow for successful cultivation. Related to a wholly different soil type, traditional subsurface habitation deposits with associated burial loci occur within sand dunes adjacent to the flood plains (*e.g.,* sand dunes located in the project area). Sand dunes occur on both sides of the Waikapū Stream valley flood plain. In some locations, traditional activity areas were also utilized during Historic times. For example, sugar cane cultivation occurred on an industrial level in flood plain reaches from the 1850s; those same lands that were likely used for *kalo* cultivation. A survey of all topographic features associated with the valley has yielded variable land use patterns through time.

PROJECT AREA EXPECTATIONS

Based on historical documents and previous archaeological research, several classes of archaeological sites were expected in the project area prior to fieldwork. The traditional background of the Waikapū area, authored by Creed (1993:19–21), provides an extensive list, but most of these site types (*i.e., kula* lands, *wauke* patches, *hala* trees, taro and sweet potato patches) would be expected in more *mauka* reaches of Waikapū. The presence of Waikapū Stream would perhaps not be enough to expect agricultural complexes in this predominant sand dune area. More probable, human burials were expected within sandy matrices, particularly undeveloped natural dune locations. Habitation sites were possible, consisting of both surface features (terraces, platforms) and subsurface evidence (fire pits for food processing, etc.).

Finally, historic period sites were highly expected, given their presence on USGS maps (Kama Ditch, etc.). Land use disturbance throughout time was also though to be present and documented, particularly considering the known sand mining activities over the years in the project area as well as varied land uses (pasture, orchid farming, etc.).

METHODOLOGY

FIELD METHODOLOGY

Two phases of Inventory Survey were performed by SCS in the project area. Phase I fieldwork was conducted between June 13, 2008 and September 5, 2008 by a varying number of SCS archaeologists, including Tomasi Patolo, B.A. (Field Director), Ian Bassford, B.A., Allison Chun, Ph.D., David Dillon, B.A., Randy Ogg, B.A., and Guerin Tome, B.A. under the direction of the Principle Investigator Michael Dega, Ph.D. Phase II fieldwork was conducted intermittently between August 3, 2009 and September 16, 2009 by D. Perzinski, B.A. (Field Director) Brian Armstrong, B.A., and Ian Bassford, B.A., with M. Dega the Principle Investigator. Archaeological Inventory Survey was performed to investigate the presence/absence of archaeological features in the project area through complete pedestrian survey and representative subsurface investigations. If identified assessments were to be made on site function, construction methods, and any associated subsurface cultural deposits. The ultimate goal was to assess the sites in terms of significance and provide recommended mitigation.

Multiple field tasks were completed during this Archaeological Inventory Survey. Pedestrian survey was conducted in order to assess project area geographical features, areas of recent disturbance, identify archaeological sites, and select locations for subsurface examination. All portions of the project area were surveyed. Previously identified sites, inclusive of burial locales (*i.e*., Moore and Kennedy 1998, Fredericksen and Fredericksen 1996) were re-identified during survey. Vegetation within the project area was identified using Whistler (1995) as a reference.

The primary component of this Inventory Survey was representative testing of the project area not previously subject to sampling. Mechanically excavated stratigraphic trenches (ST) were placed in areas thought to potentially contain subsurface archaeological deposits and to provide a sample of testing across the project area. These trenches allowed for assessing sediment matrix types across a large area, the results in turn providing some evidence for past and present land utilization.

A total of 282 mechanically excavated and five manually excavated trenches were completed during Phase I and Phase II of this project. The testing program, including the location and number of trenches, was developed in direct consultation and with the concurrence of the SHPD. Figures 7 and 8 depict the location of each excavated trench per phase. Appendix A provides additional information for Phase I and Phase II trenches while Appendix B provides representative stratigraphic profiles for both Phase I and Phase II. The figure also shows locations in the project area that were not subject to testing during the current work, but were indeed subject to pedestrian survey. Note that areas not tested during the current project are recommended for full-time Archaeological Monitoring during future ground altering activities.

A handheld Garmin eTrex Legend Global Positioning System (GPS) unit was utilized to plot mechanically excavated stratigraphic trench locations and any archaeological sites within the project area. Soil stratigraphy encountered during excavation was documented utilizing metric graph paper and United States Department of Agriculture (USDA) Munsell soil color charts. Once identified, portable archaeological materials—soils sampled included—were collected and recorded with applicable provenience and curated for laboratory analysis.

LABORATORY METHODOLOGY

All field notes, film photographs, and collected archaeological materials were curated at the SCS laboratory in Honolulu. All stratigraphic profiles have been drafted for presentation within this report. Representative plan view sketches showing location and morphology of identified sites/features/deposits were illustrated. Selected soil samples containing organic materials were submitted to Beta Analytic, Inc. for radiocarbon dating (Appendix C). All retrieved artifact and midden samples were cleaned, sorted, and analyzed. Marine gastropods and bivalves were identified using applicable references. Significant artifacts were photographed and classified for qualitative analysis. These are presented in Appendix D of this report. All metric measurements and weights were also recorded for quantitative analysis. Midden samples were minimally identified to the lowest possible taxonomic classification (e.g., bivalve, gastropod mollusk, echinoderm, fish, bird, and mammal). All data were clearly recorded on standard laboratory forms that included numbers and weights (as appropriate) of each constituent category.

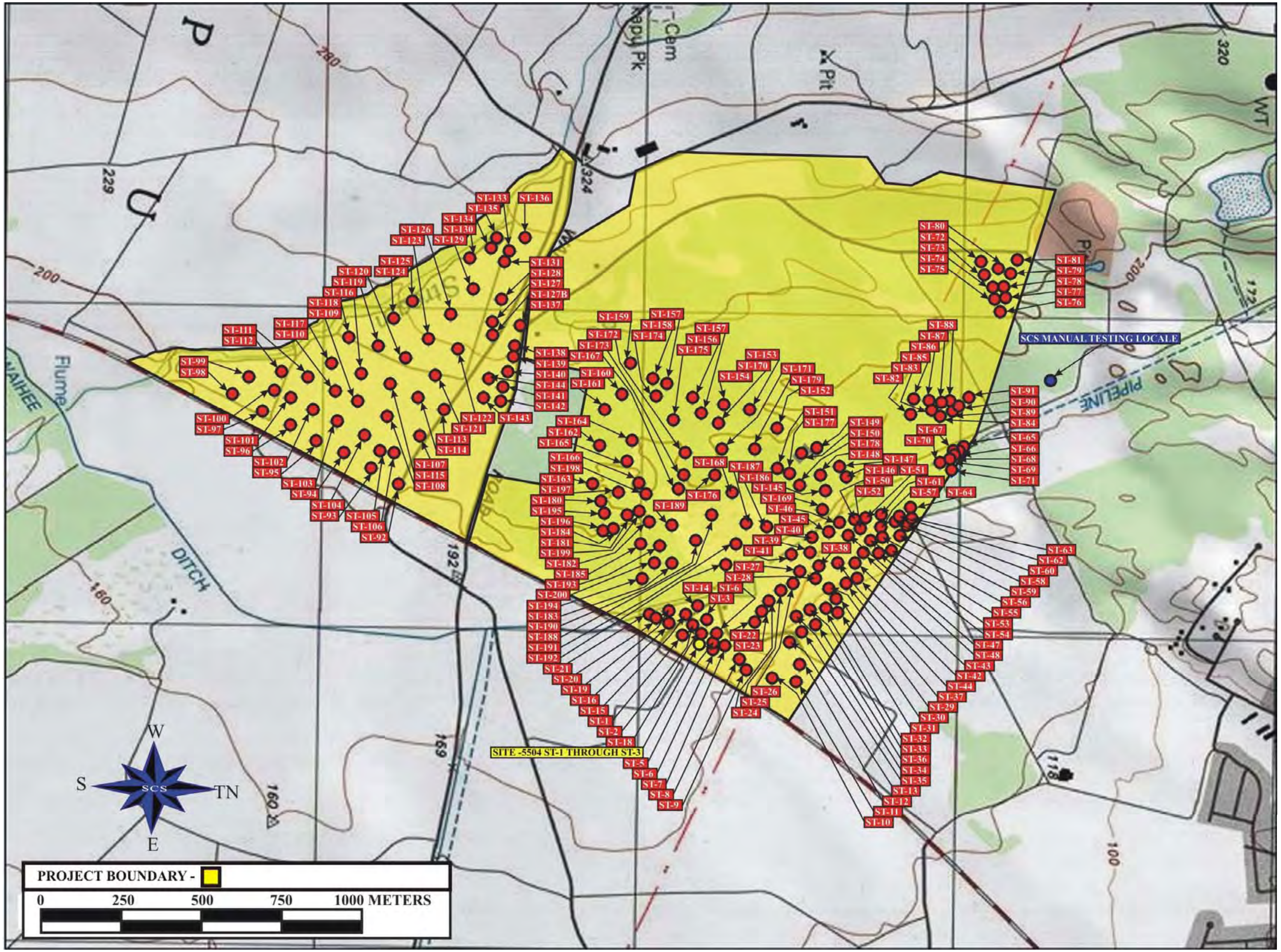

Figure 7: United States Geological Survey Wailuku Quadrangle Map Showing Manual and Mechanically Excavated Stratigraphic Trench Locations in Phase I.

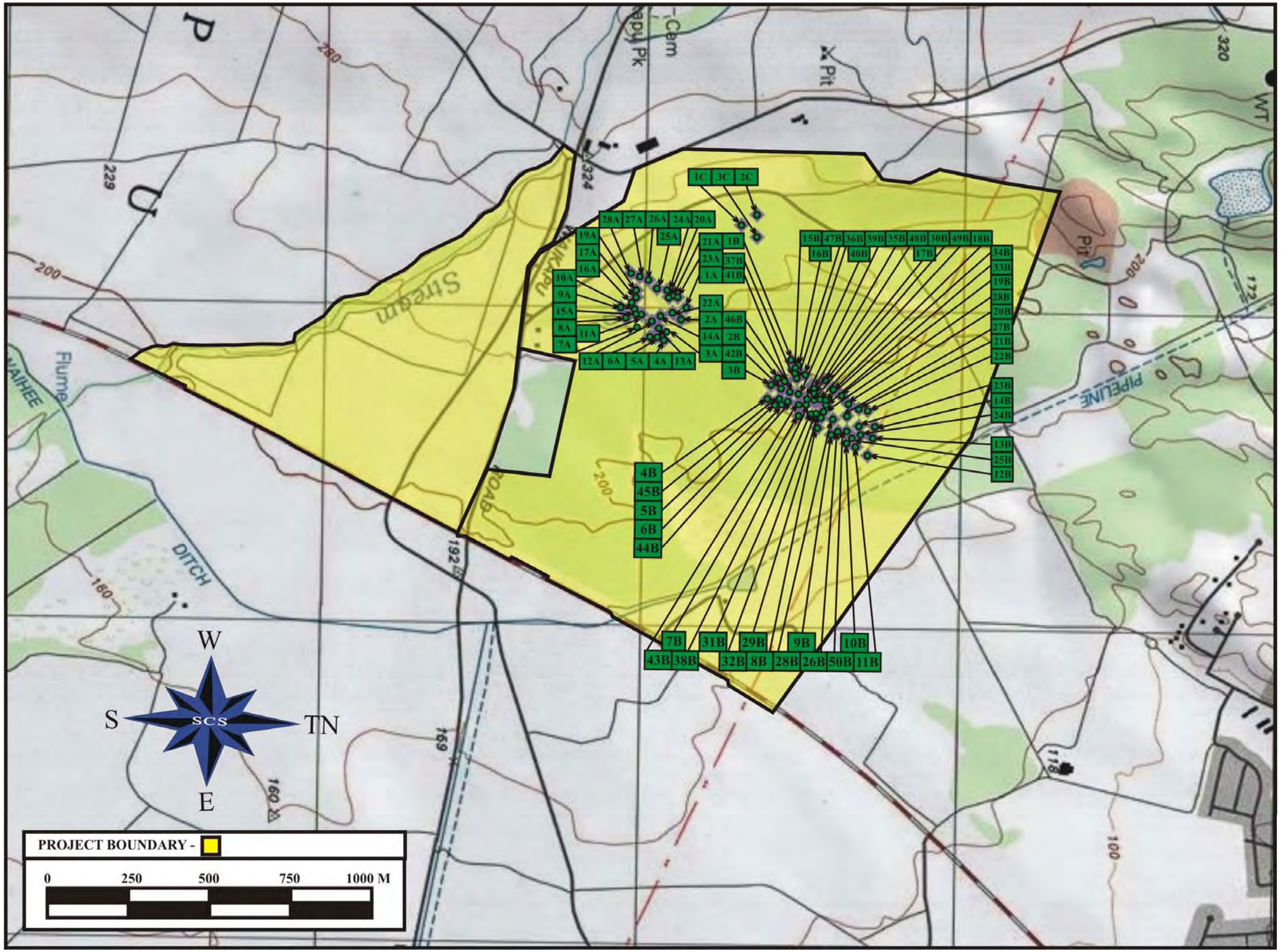

Figure 8: United States Geological Survey Wailuku Quadrangle Map Showing Manual and Mechanically Excavated Stratigraphic Trench Locations in Phase II.

<u>INVENTORY SURVEY RESULTS</u>

Archaeological Inventory Survey was conducted on approximately 607-acres of land in Wai`ale, Wailuku and Waikapū Ahupua`a, Wailuku District Maui [TMK**:** (2) 3-8-005: 23 (por.), 37 and (2) 3-8-007: 71, 101, 102, 104]. The project area was divided into seven sections designated Area A through Area G (Figure 9). Pedestrian survey, the first phase of work, was conducted to locate any extant archaeological sites and potential areas for subsurface investigations via mechanical (*i.e.,* backhoe) excavation within project area boundaries. During the survey, historic-recent activity areas were identified and represented various uses (*e.g.,* agriculture, landscaping, equipment baseyards, scrap metal repository, ranching) (Figure 10). Several modern structures were also observed within the northeast portion of the project area, these included an abandoned concrete reservoir and remnant concrete foundations (relating to sod farm that once occupied a portion of the project area).

In total, one new archaeological site was identified during this Inventory Survey project. The site consisted of a subsurface firepit/*`imu* identified during testing. The firepit has been designated as State Site 50-50-04-6578 (Figure 11). Two other sites, previously given State Site Numbers but not part of any completed projects in the area, were also identified (see Figure 11). These include State Site No. 50-50-04-5504, initially identified in 2003, and consisting of at least three human burials (one *in situ* and two scattered). This site was re-located near Kuihelani Highway. The second site consists of a portion of the Spreckels Ditch. The site has been previously designated as State Site No. 50-50-04-1508 and also runs beyond the current project area boundaries.

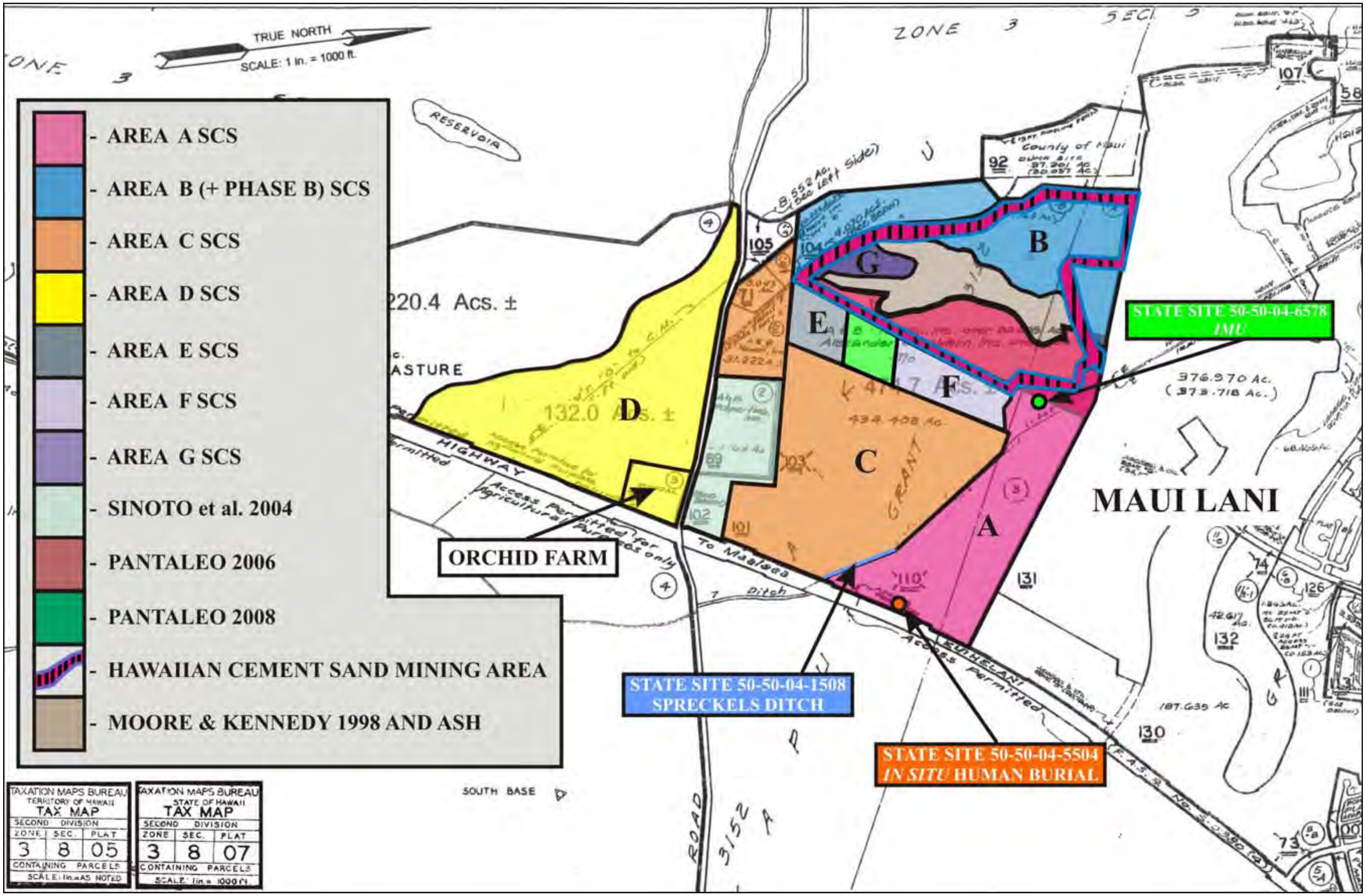

Figure 9: Tax Map Keys [3-8-005 and 3-8-007] Showing Areas A through G, Archaeological Sites Located by Scientific Consultant Services (SCS), Inc., Archaeological Services Hawaii Area of Operation, and Hawaiian Cement Sand Mining Area.

Figure 10: Photograph of Project Area Showing Existing Road and Cattle Ranching Locale. View to Northeast.

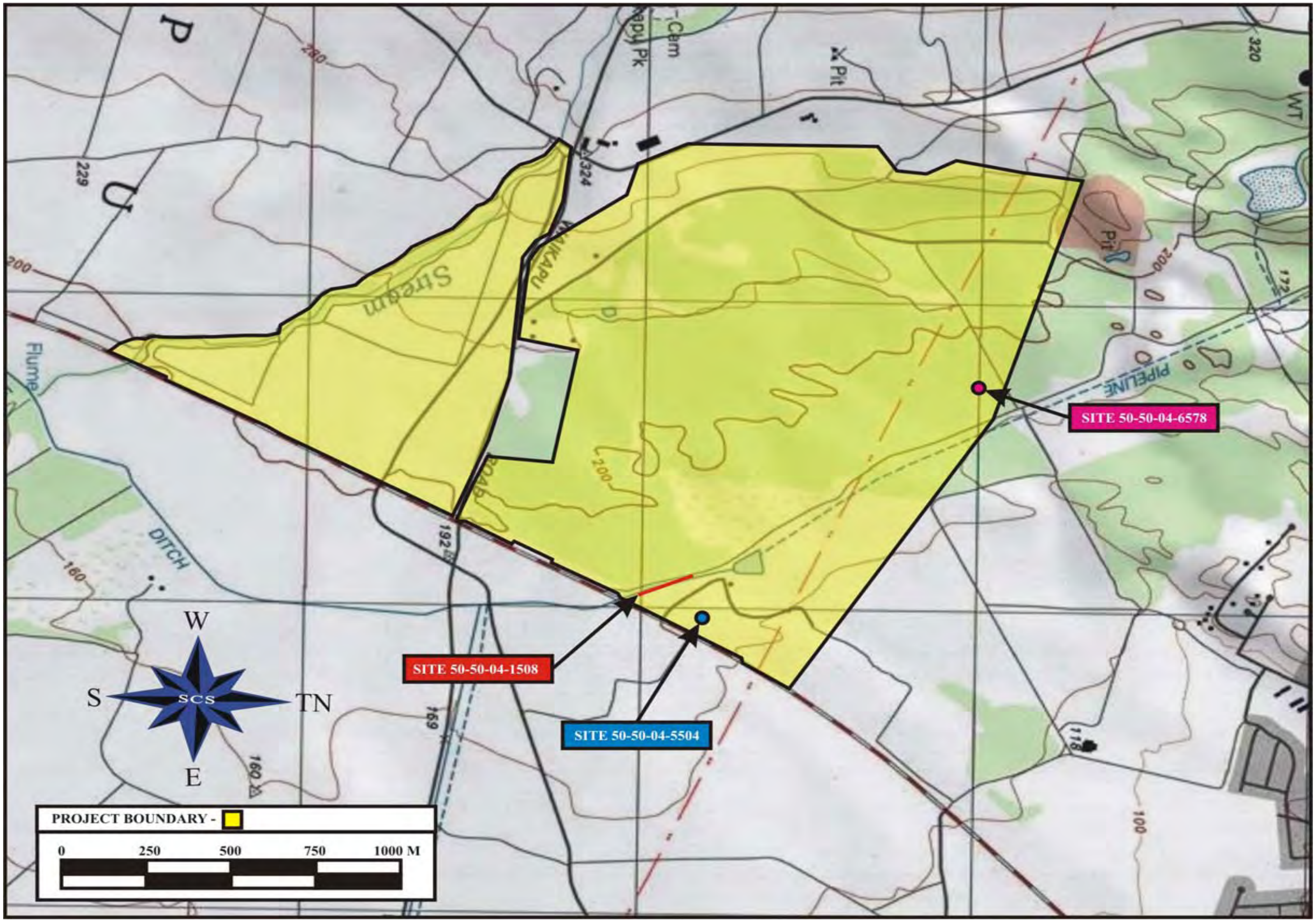

Figure 11: USGS Map Showing Identified Site Locations by SIHP Number.

At the conclusion of pedestrian survey, the project area was divided into seven sections for testing. Testing was completed in two phases: Phase I=Sections A, B, C, D; Phase II=Sections E, F, and G. These sections represent all locations in the project area not previously subject to formal archaeological work (see Previous Archaeology section above), as well as areas actually amenable to testing. As noted above, exceptions to testing included areas currently in use, such as Parcel 37, the orchid farm (see Figure 9). These seven sections were selected as a) they were not previously subject to archaeological work and b) they were not in active use and were open for testing. The sections also contained mostly natural, undeveloped portions of the dune system and represented variation in elevations and geophysical characteristics. In total, 282 trenches were mechanically excavated and five units were manually excavated (four stratigraphic trenches and a test unit) (see Figure 9). The manually excavated units were utilized to investigate areas which were difficult for backhoe access. The results of pedestrian survey and excavations (manual and mechanical) within the project area are discussed in more detail below.

AREA A

Area A is an irregularly shaped, east-west trending linear area situated within a portion of TMK: (2) 3-8-007: 101 (por.). The Maui Lani Subdivision is located on the northern flank and the Hawaiian Cement sand mining area occurs to the west (see Figure 9). Area A is covered with dry grasses, low shrubs, with small to medium-sized *kiawe* (*Prosopis padilla*) and *haole koa* (*Leucaena leucocephala*) trees. In addition, Area A contains remnants of a sod farm and locations with modern debris. Area A includes two businesses, identified as Hawaiian Cement and Brendan Balthazar. Pedestrian survey and testing of Area A led to the identification of two previously identified sites and one newly identified site.

The two previously identified sites within Area A consist of a portion of the Spreckels Ditch (State Site No. 50-50-04-1508) and second, a locale containing human remains (State Site No. 50-50-04-5504). The newly identified site (State Site No. 50-50-04-6578), a subsurface fire pit/*imu*, was also identified during the current testing. A total of eighty-five (85) trenches were mechanically (N=83) and manually (N=2) were excavated within Area A.

The considerable number of excavated units in this sector is attributed to a) the dunes in this area are less disturbed than other locales and b) Site -5504 revealed the presence of human remains and the boundaries of the site were not previously determined. The average length and depth of the 82 mechanically-excavated trenches was 6.2 meters long and 1.10 meters below surface, respectively. The 82 trenches contained between one and nine stratigraphic layers; 100 percent of these trenches contained sandy matrices (alternating strata being well-sorted and lithified)—the former being the type of matrix in which traditional human burials are often found. Other matrices observed in these Area A trenches included clay, loam, and silt. Twenty-two of the 82 manually excavated trenches (approximately 27 percent) revealed the presence of either waterworn basalt cobbles and/or basalt pebbles, representing natural river rock deposition through time. Sixteen of the 82 manually excavated trenches (approximately 19 percent) displayed modest evidence (*e.g.*, plastic, modern charcoal staining, imported soils) of activity likely associated with sugarcane cultivation. The three manually excavated units (a stratigraphic trench and a test unit) revealed the presence of at least two strata containing between three variants of sandy matrices: silty sand, loose sand, and lithified sand. These three manually excavated units, associated with Site -5504, did not reveal additional human remains.

STATE SITE 50-50-04-5504 HUMAN BURIAL SITE (SCS SITE TS-1)

State Site 50-50-04-5504 was first identified during casual observation an ASH, Inc, employee while conducting Archaeological Monitoring at nearby Maui Lani, adjacent to the current project area (see Figure 9). While constructing a sand berm paralleling Kuihelani Highway, human remains were displaced and mixed with sandy matrices. At the conclusion of the initial investigation, a minimum of three individual human remains had been located; one *in situ* and the other two scattered on the surface of the sandy area (see also Previous Archaeology section above). Although the information was presented to the Maui/Lanai Islands Burial Council in 2003, no further action was taken to investigate the site or officially document the findings. It assumed that the remains were simply left where they were identified.

During the current Inventory Survey, SCS archaeologists Ian Bassford and Tomasi Patolo searched the area in which Site -5504 was located and re-identified the location containing the *in situ* human remains. The area was demarcated by plastic "Caution" tape. Although an extensive search for the displaced components of the site was completed, the two locations were not found. These *iwi* were likely covered and protected in place. Given the time lapse of six years (the human remains in Site -5504 were first observed in 2003), from the moment of discovery to the current SCS investigation and relocation, it can be theorized that the human remains might have been covered over by shifting sands (either natural or human induced).

The only confirmed presence of human remains within Site -5504 was the *in situ* burial. As the disposition of the two scattered burials was unknown, SCS conducted manual excavation in the general area of the *in situ* burial. The burial pit in which the *in situ* human burial was indeed re-located and measures approximately 1.5 m long by 1.0 m wide. During the current Inventory Survey, no excavation was conducted to expose any portion of this burial or obtain a vertical depth of the *in situ* burial. Thus, beyond identifying and conducting GPS of the burial location, no additional information regarding the current status of the *in situ* burial was gleaned. However, Stratigraphic Trenches 1, 2, and 3 were utilized to determine the presence or absence of additional human remains in the general area of the *in situ* burial (Figure 12).

Stratigraphic Trench 1

Stratigraphic Trench (ST) 1 was situated near the edge of an area that was previously utilized as a sod farm. ST-1's long axis was oriented 177/357° (magnetic; southeast/northwest) and placed approximately 3.5 meters northwest of the *in situ* human burial identified as part of State Site 50-50-04-5504. ST-1 measured 4.0 meters (m) long, 1.0 m wide, and was excavated to a maximum depth of 84 centimeters (cm) below ground surface. Six strata were identified in ST-1 (Figures 13 and 14). Layer I [4–30 cm thick below surface (bs)] consisted of a dark yellowish brown (10YR 3/4) and brown (7.5YR 5/4) sand (80%) and silt (20%) mixture with isolated pebbles, some limestone fragments, and approximately five percent grass roots. Layer II (4–18 cm thick) was a fine to slightly coarse, light reddish brown (5YR 6/3) sand with few roots and very small gravel. Layer III (3–16 cm thick) was a fine, reddish brown (2.5YR 5/4) sand with coral fragments. Layer IV (8–40 cm thick) was a compact, fine to very fine when crushed, light reddish brown (2.5YR 6/4) sand with few coral fragments in the upper portion of the layer. Layer V (8–15 cm thick) was a loose, fine, light reddish brown (2.5YR 7/4) sand with few grass roots and isolated panels of lithified sand in the upper portion of the layer. Layer VI comprised the base of excavation for ST-1 and was identified as a hard packed, brown (10YR 5/3) silty sand with coral fragments. Excavation of ST-1 terminated due to the presence of hard packed sand at the base of the trench. No cultural material was observed during the excavation of ST-1.

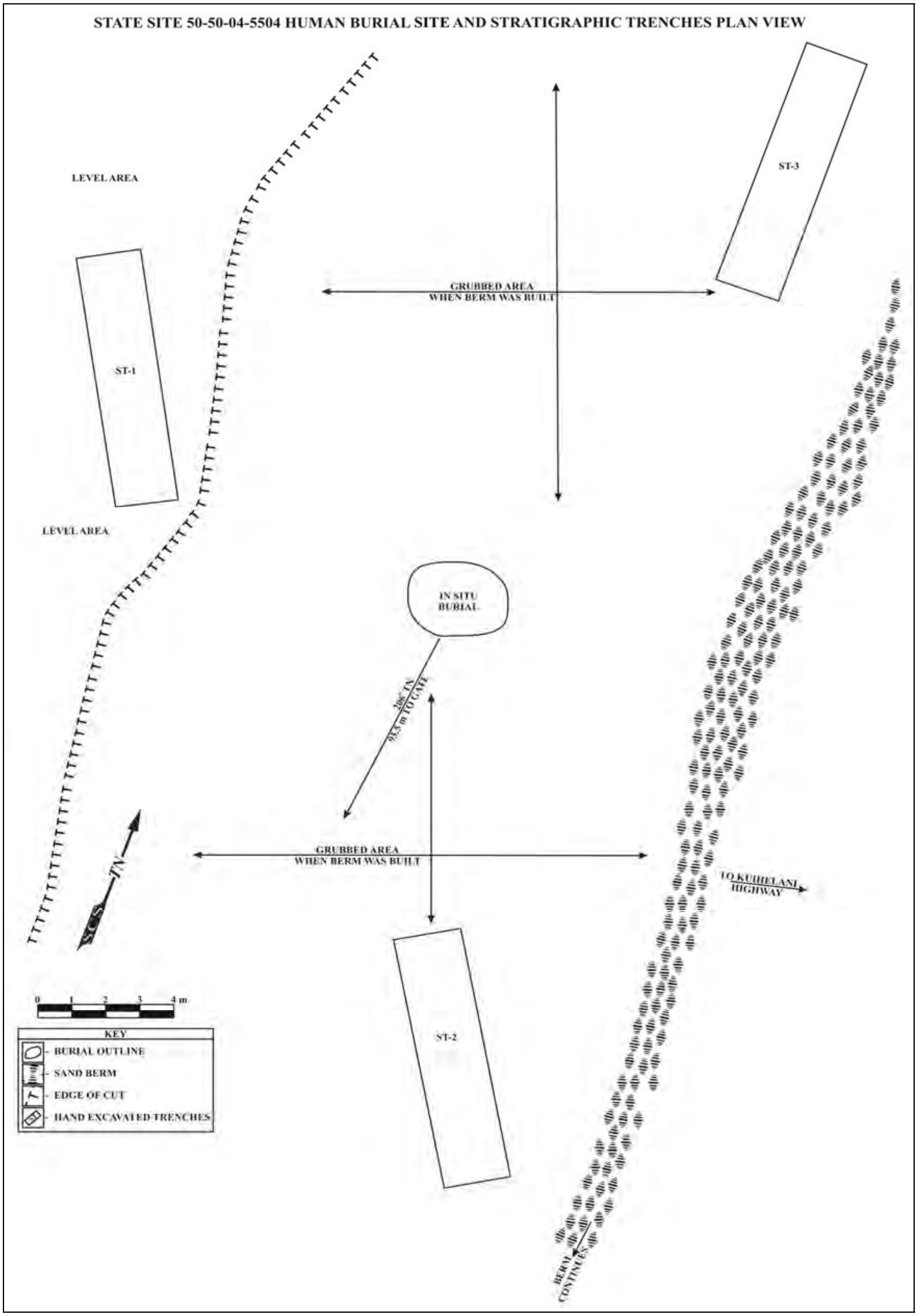

Figure 12: Plan View Drawing Showing Locations of Stratigraphic Trenches 1 Through 3 in the Vicinity of State Site 50-50-10-5504 Human Burial Site.

Figure 13: Photograph of Stratigraphic Trench 1 West Wall Profile in the Vicinity of State Site 50-50-10-5504 Human Burial Site. View to West.

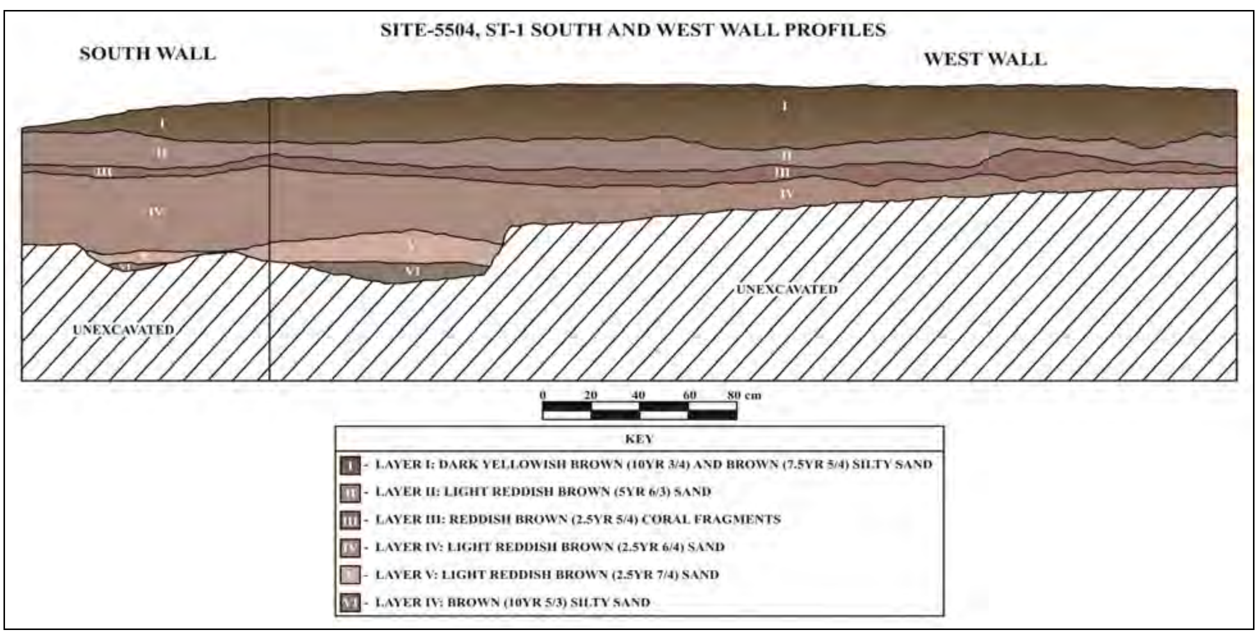

Figure 14: Profile Drawing of Stratigraphic Trench 1 West Wall in the Vicinity of State Site 50-50-10-5504 Human Burial Site.

Stratigraphic Trench 2

ST-2 was placed in an area that had been previous modified (2003) for construction of the sand berm. ST-2's long axis was oriented 20/200° (magnetic; northeast/southwest) and placed approximately five meters northeast of the *in situ* human burial identified as part of State Site 50-50-04-5504. ST-2 measured 4.0 meters (m) long, 1.0 m wide, and was excavated to a maximum depth of 28 centimeters (cm) below ground surface. Two strata were identified (Figure 15). Prior to the excavation of ST-2, matrices that had been displaced by mechanical means were removed (overburden) so that intact matrices could be investigated without contamination. Layer I (4 –24 cm thick) was composed of fine to very fine, pale brown (10YR 6/3) sand with approximately 2 percent roots. No rocks or cultural remains were observed in Layer I. Layer I was interpreted as having been previously disturbed. Layer II comprised the base of excavation for ST-2 and was composed of fine (when crushed), blocky, light reddish brown (2.5YR 7/3) lithified sand with very few rootlets in its upper strata and a few pieces of naturally deposited coral. Although a portion of Layer II was excavated, excavation of ST-2 was eventually terminated due to the vertical continuation of the lithified sand (*i.e.*, Layer II). No cultural material was observed during the excavation of ST-2.

Stratigraphic Trench 3

ST-3's long axis was oriented 170/350° (magnetic; southeast/northwest) and placed approximately 4.5 meters south of the *in situ* human burial identified as part of State Site 50-50-04-5504. ST-3 measured 4.0 meters (m) long, 1.0 m wide, and was excavated to a maximum depth of 42 centimeters (cm) below ground surface. Three strata were identified (Figures 16 and 17). Like ST-2, matrices that had been displaced by mechanical means were removed prior to the excavation of ST-3 so that intact matrices could be investigated without contamination. Layer I (4–8 cm thick) was a fine, pale brown (10YR 6/3) sand with some roots and no rocks. Layer I was interpreted as previously disturbed. Layer II (4–14 cm thick) was a blocky (fine to very fine when crushed), light reddish brown (2.5YR 6/3–7/3) lithified sand with fragments of coral. Layer III comprised the base of excavation for ST-3 and was composed of fine to slightly coarse, light reddish brown (2.5YR 7/4) sand with no roots or stones. No cultural material was observed during the excavation of ST-3.

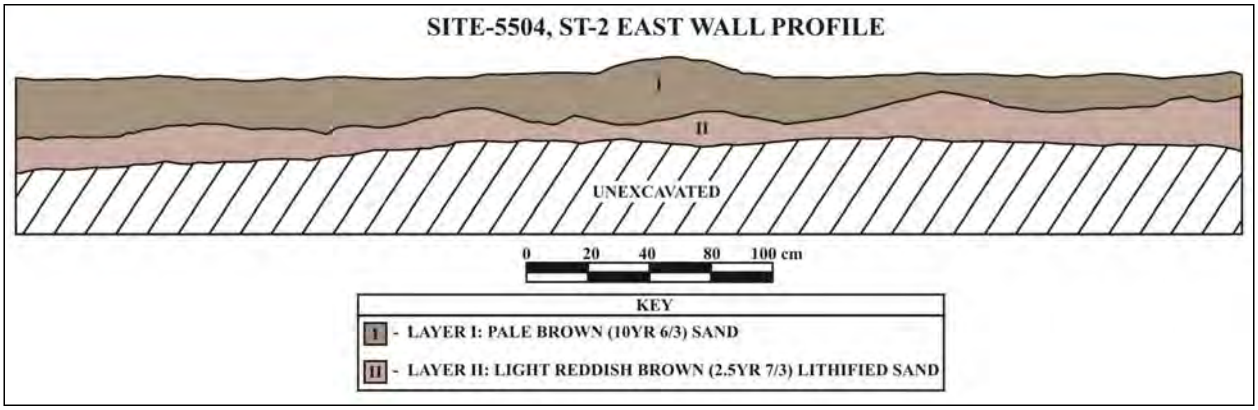

Figure 15: Profile Drawing of Stratigraphic Trench 2 East Wall in the Vicinity of State Site 50-50-10-5504 Human Burial Site.

Figure 16: Photograph of Stratigraphic Trench 3 North Wall Profile in the Vicinity of State Site 50-50-10-5504 Human Burial Site. View to North.

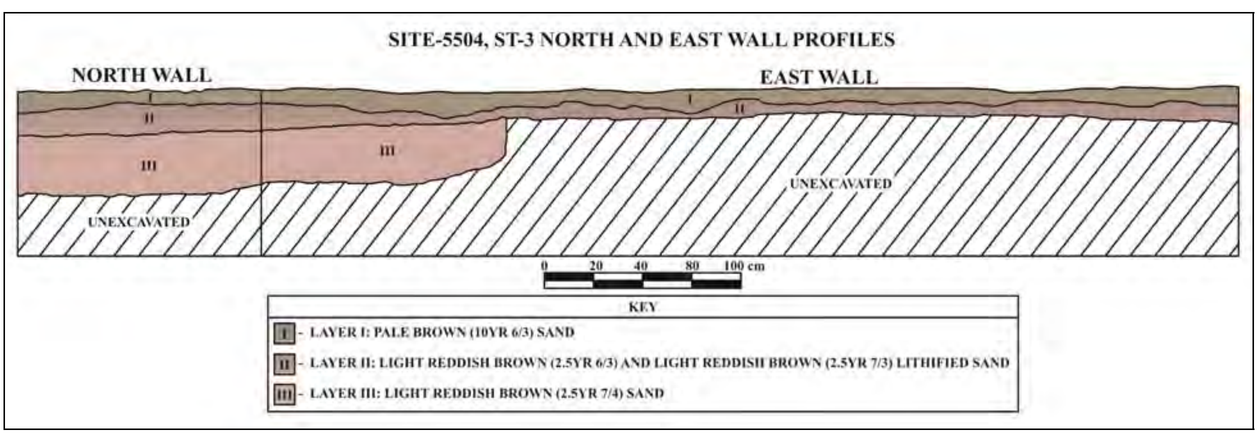

Figure 17: Stratigraphic Trench 3 North and East Wall Profile Drawing in the Vicinity of State Site 50-50-10-5504 Human Burial Site.

STATE SITE 50-50-04-1508 SPRECKELS DITCH SECTION (SCS SITE TS-2)

State Site 50-50-04-1508 is the second of two previously identified archaeological sites within the current project area (see Figure 9). Also located in Area A, Site -1508 is an historic, single feature site identified as a section of the Spreckels Ditch (State Site 50-50-04-1508). This particular section of the Spreckels Ditch is an open-air, linear, concrete-lined ditch constructed in a relatively flat area of sand dune. The concrete represents recent improvement to the ditch. The dimensions of the open-aired section of the ditch within the project area measure approximately 321.9 m long by 2.5 m wide (804.75 m^2); the interior base of the ditch could not be described well as the ditch is still active (*i.e.*, accumulated soil on the ditch interior and flowing water prevented the acquisition of accurate depth measurements). Modern glass beer bottles and food debris [*e.g.*, recently collected *opihi* (*Cellana* sp.) shells] were identified near the ditch. Although the section of Spreckels Ditch within the project area is visible, the remainder of the north section within the project area is located in subsurface contexts. A 1997 USGS map shows a reservoir being fed from the subsurface pipeline portion of the Spreckels Ditch from the northern project area boundary. The visible section of Spreckels Ditch continues out of the project area, under Kuihelani Highway and onto tax map key (2) 3-8-006:003 where the ditch becomes known as the Camp 7 Ditch.

STATE SITE 50-50-04-6578 TRADITIONAL SITE (SCS SITE TS-3)

State Site 50-50-04-6578 is the third and final archaeological site located in Area A and the only one identified during the current Inventory Survey (see Figure 9; see Figure 11). The single feature site was located during the mechanical excavation of Stratigraphic Trench 90 (ST-90). ST-90 measured 5.3 m long by 1.0 m wide, and was excavated to a maximum depth of 173 centimeters (cm) below ground surface. Four strata and one subsurface feature were identified in the trench (see Appendix B). Layer I (0–40 cmbs thick) was composed of loose, pinkish gray (7.5YR 6/2) sandy loam with less than 5% of its matrix comprised of rocks and roots. Layer II (40–120 cmbs) was a very fine, light brown (7.5YR 6/3) sand with few roots. Layer III (120–160 cmbs) consisted of loose, very fine pinkish gray (7.5YR 7/2) sand with few roots. Layer IV (160 + cmbs) was a compact, brown (7.5YR 5/2) silty loam. The mechanical excavation of ST-90 was terminated in basal layers and in one section of the trench (near center), due to the presence of charcoal stained waterworn basalt rocks. Once explored manually, this concentration would later be interpreted as an *imu* and has been designated as State Site 50-50-04-6578. Except for the *imu*, no additional cultural materials or features were observed during the excavation of the four strata in ST-90. Following the excavation of ST-90, the location of the *imu* was manually investigated.

The profile of ST-90's west wall shows the *imu* to have been constructed within Layer II; the thickness of the charcoal staining directly associated with the subsurface feature was approximately 2 to 6 cm thick (Figure 18). The horizontal dimensions of the *imu* measured 0.86 m long by 0.60 m wide, with depths varying between 26 and 53 cmbs. The underground oven (*i.e*., the *imu*) was constructed of waterworn basalt cobbles laid in a semi-circular ring, within which flatter cobbles of the same type were placed in the interior (Figures 19 and 20). A single, charred botanical sample was collected from the matrices of the *imu* and submitted to Beta Analytic, Inc. for analysis (Beta No. 249137/ SCSRC 614) (Appendix C). This sample provided a conventional radiocarbon age of 150±40 years BP (Before Present). Based on OxCal version 3.5, this radiocarbon age produced a calibrated date range of 1660 to 1960 A.D. (2 sigma; 95.4% probability) and 1720 to 1780 A.D. (1 sigma; 25% probability) (Appendix C). This date range indicates a relatively late period of use [*i.e.*, late pre-Contact to early post-Contact (Western Contact 1778 A.D.)]. The lack of historic artifacts and modern debris within the associated context of the feature, type of construction material to construct the feature, combined with the result of the radiocarbon sample, suggests the single feature site may have traditional-period associations. The feature was interpreted to represent a single food preparation event.

SCS MANUAL TESTING LOCALE

The SCS Manual Testing Locale is also located in Area A, specifically in the area currently under license to Hawaiian Cement for sand mining (Archaeological Services Hawaii, Inc. is conducting Archaeological Monitoring of this area) (see Figures 5 and 9). This SCS Manual Testing Locale is not related to any archaeological site and was done more for representative testing of various locales and is located on a small sand dune knoll approximately 8.0 m long by 7.5 m wide, with varying above ground surface heights between 3 and 37 cm (Figure 21). Modern disturbance identified as a push pile, probably created by one of the machines utilized by Hawaiian Cement to "cut" away sand slopes, was present in the locale's northwest corner. Visibility from the locale was vast, overlooking central Maui and beyond. A total of two excavation units (one stratigraphic trench and one test unit) were manually excavated as the topographic location suggested subsurface cultural deposits might be present. Accessibility by backhoe was also extremely difficult, given the steepness of the terrain.

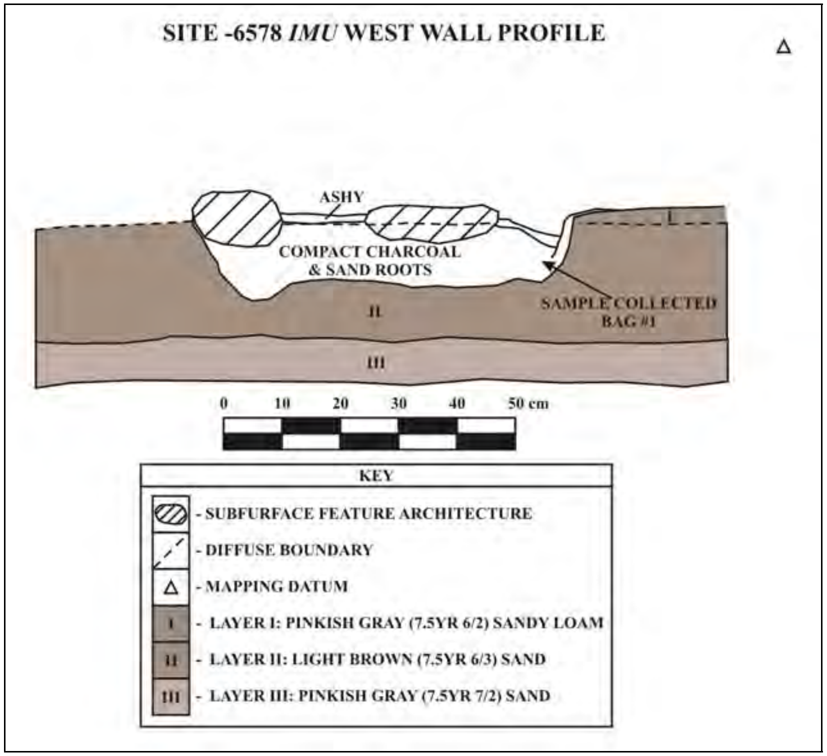

Figure 18: State Site 50-50-10-6578 *Imu* West Wall Profile Drawing.

Figure 19: Photograph of State Site 50-50-10-6578 *Imu*. View to West.

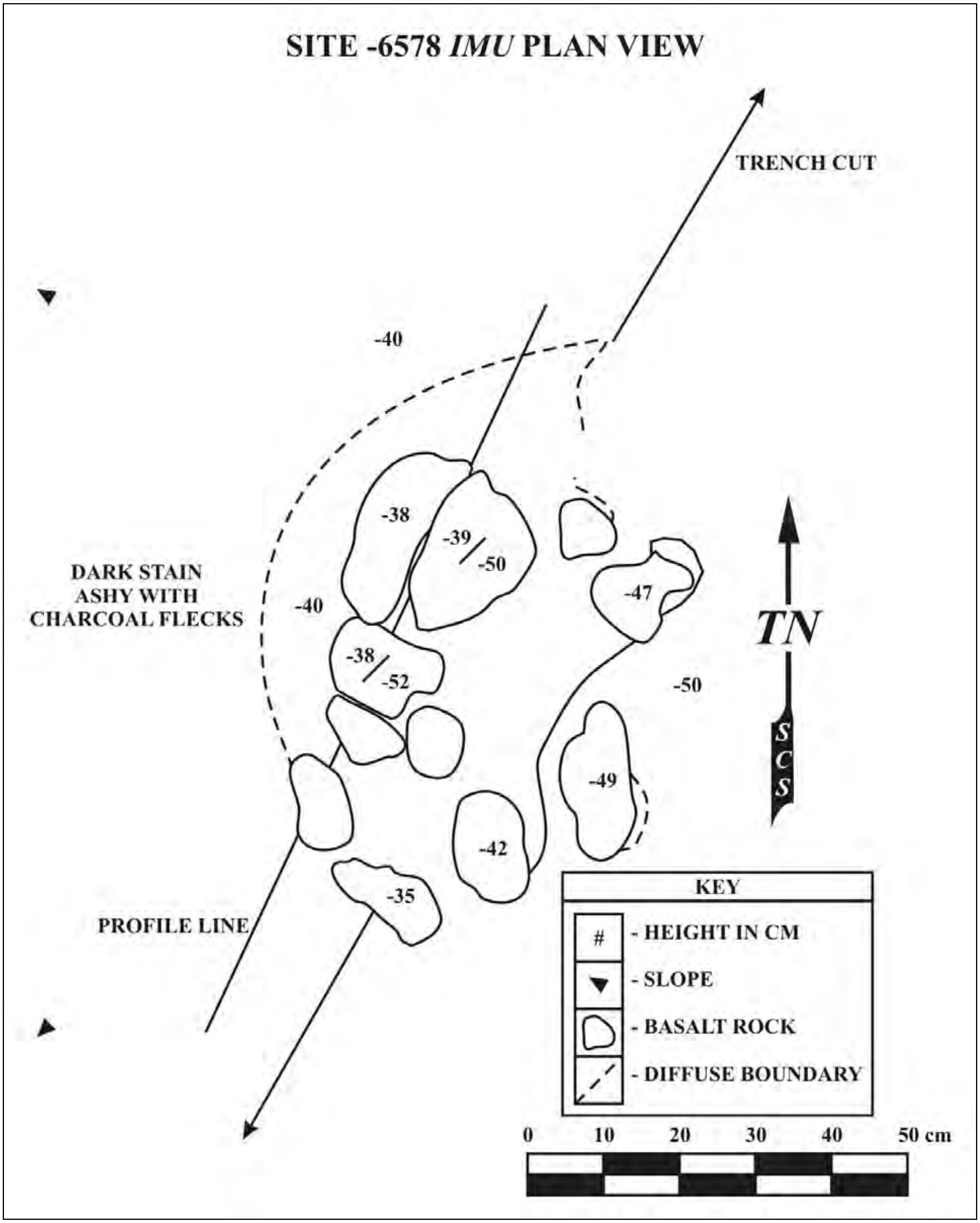

Figure 20: State Site 50-50-10-6578 *Imu* Plan View Drawing.

Figure 21: Photograph of SCS Manual Testing Locale (MTL). View to Northeast.

Test Unit 1 (SCS MANUAL TESTING LOCALE)

Test Unit (TU) 1 was the first (of two) manually excavated units placed in the SCS Manual Testing Locale to investigate the presence/absence of subsurface cultural deposits. Situated near the center of a small sand dune knoll, TU-1 measured 1.0 m by 1.0 m and was excavated to a maximum depth of 21 cm below surface. Only one stratum was observed. Layer I consisted of fine to very fine, dark grayish brown (10YR 4/2) silty sand that did not produce any cultural material. Excavation of TU-1 was terminated due to the presence of very hard lithified sand encountered throughout the test unit base. Cultural material was not observed during the excavation of the single strata.

Stratigraphic Trench 1 (SCS MANUAL TESTING LOCALE)

ST-1 was the second of two manually excavated units placed to investigate the small sand dune knoll for the presence/absence of subsurface cultural deposits. Oriented 120/300° (magnetic; southeast/northwest), ST-3 measured 3.5 meters (m) long, 1.0 m wide, and was excavated to a maximum depth of 78 centimeters (cm) below ground surface. Three strata were identified (Figures 22 and 23). Layer I (4–28 cm thick) was composed of fine to very fine, dark grayish brown (10YR 4/2) silty sand. Layer II (38–52 cm thick) was a coarse, brownish yellow (10YR 6/6) sand with pockets of lithified sand and very few roots. While the excavation of Layer I terminated on the compacted sand in the west two-thirds of the trench, Layer II was observed in the eastern one-third of ST-1. Layer IIA, like Layer II, was also observed in the eastern third of ST-1. Layer IIA was interpreted as a moderately compact, fine to very fine, pale red (2.5YR 6/2) silty sand containing pockets of lithified sand. Excavation of ST-1 was terminated due to the presence of very hard, compact lithified sand encountered throughout the trench. Cultural material was not observed during the excavation of the three strata.

AREA B

Area B constitutes the western/northwestern portion of the survey area and is situated on TMK: (2) 3-8-007:101 (por.) and 3-8-007:104. The Maui Lani Subdivision is located on its northern flank, the Hawaiian Cement sand mining area to its southwest flank, and Maui Landscape Specialty, Inc. located to the southwest flank (see Figure 9). Area B encompasses two businesses identified as Ameron International Corporation and Tom's Backhoe. The majority of Area B is mostly flat, this likely the result of previous clearing, sand mining, and compaction actions.

A total of ten trenches were mechanically excavated in Area B that revealed between two and nine strata. The average length and depth of the ten trenches was 6.1 meters and 1.36 meters, respectively. All these trenches contained sandy matrices of varying compactness and sorting. Overall, other matrices observed during the excavation of the ten trenches in Area B were identified as loam, silt, and various hues of lithified sand. Only one of the ten trenches revealed the presence of waterworn basalt cobbles, which represented "river rock." One of the ten trenches also displayed evidence of modern disturbance, based on the presence of buried logs to approximately 60 cm below the ground surface. All trenches were culturally sterile.

AREA C

Area C occurs in the center of the project area and is primarily situated on TMK: (2) 3-8-007: 101 (por.), with 3-8-007:71 and 3-8-007:102 also composing the area. Area C contains ranching leases with Brendan Balthazar, Gary Vares, Christopher Lopes, and Manual Lopes (see Figure 9). The majority of Area C is covered with dry grasses, low shrubs, and small to medium sized *kiawe* (*Prosopis padilla*) and *haole koa* (*Leucaena leucocephala*) trees. In addition, Area C contains lands presently used for cattle ranching and informal roads.

Figure 22: Photograph of SCS Manual Testing Locale Stratigraphic Trench 1 Southwest Profile. View to Southwest.

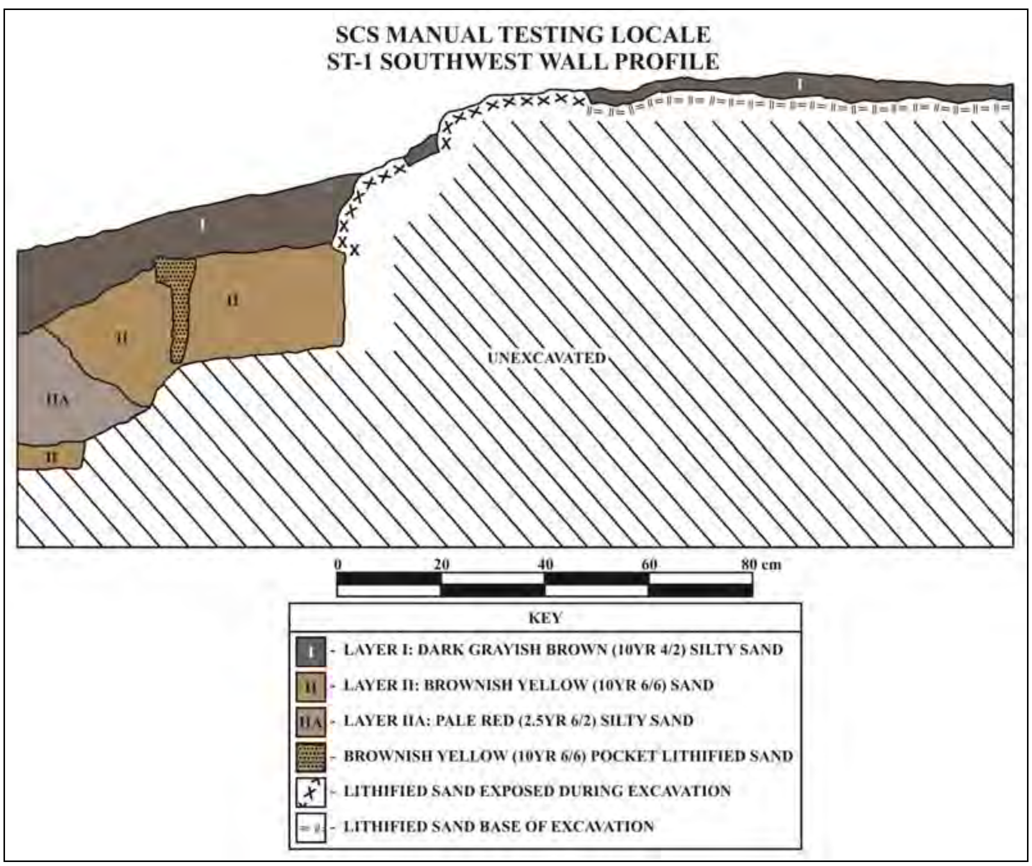

Figure 23: SCS Manual Testing Locale Stratigraphic Trench 1 Southwest Profile Drawing.

A total of 56 trenches were mechanically excavated in Area C, the result of which produced trenches that contained between one and nine strata. All of the trenches contained sandy matrices yet none yielded cultural deposits; all trenches were sterile. The average length and depth of the 56 trenches was 6.5 meters and 1.42 meters, respectively. Beside sand, other matrices observed during the excavations in Area C were identified as loam, silt, and various hues of lithified sand. Sixteen of the 56 trenches (approximately 29 percent) revealed the presence of either waterworn basalt cobbles and/or basalt pebbles interpreted as “river rock.” None of the 56 trenches in Area C exhibited modern disturbances. Survey and excavation of Area C was not totally devoid of cultural material; casual commutes to and from this portion of the project area did lead to the recovery of one basalt core on the surface of one of the many informal cattle paths (see Appendix D for artifact photo). This single artifact (isolated find) is interpreted as having Traditional associations. Prior to the isolated finding of the basalt core, the two closest mechanically excavated trenches, ST-149 (33 meters to the north) and ST-150 (26 meters to the southeast) which were placed on the flanks of the location where the basalt core was found, produced negative results for cultural material.

AREA D

Area D is a somewhat triangular-shaped parcel situated on TMK: (2) 3-8-007:23 (por.) and includes the small parcel 3-8-007:037. Waiko Road is located on its northern flank and Kuihelani Highway on its east flank, with a sugarcane field to the south and west flanks. Tax Map Key (2) 3-8-007: 37 is located specifically within the northeastern corner of Area D and contains an active orchid farm (see Figure 9). This area was not tested. The majority of Area D is covered with remnant/fallow sugarcane and dry grasses. At the time Area D was surveyed, the sugarcane had been cultivated and removed.

A total of 54 trenches were mechanically excavated in Area D. No trenches were excavated within Parcel 37, an active orchid farm, to avoid commercial disturbance to their operations. No cultural deposits were identified in the trenches excavated on Parcel 23. Trenching did yield stratigraphy containing two to nine strata, of which sand occurred in each trench to varying degrees. The average length and depth of the 54 trenches was 6.5 meters and 1.42 meters, respectively. Overall, other matrices observed during the excavation of the 54 trenches in Area D were identified as loam and silt. The lithified sand observed in many of the trenches in Areas A, B, and C was observed in only three of the Area D trenches (Stratigraphic Trenches 111, 138, and 139). Thirty-one of the 54 trenches (57 percent) contained either waterworn basalt cobbles and/or basalt pebbles interpreted as “river rock.” Thirty-two of the 54 trenches (59 percent) contained modern debris (*e.g.*, black plastic irrigation tubes, metal, and glass) and charred botanical remnants of sugarcane cultivation. The upper level soils on Parcel 23 primarily consist of imported fill. These soils were brought onto the predominantly sandy landscape and bedded to grow sugar cane.

AREA E

Area E is a rectangular-shaped section consisting of c. 40-acres and is situated in the southern, central portion of the project area on TMK: (2) 3-8-007:101 (por.). The area is licensed to Hawaiian Cement. An Archaeological Assessment (Pantaleo 2008) and Archaeological Monitoring (Rotunno-Hazuka and Pantaleo 2008) were conducted on the 15-acre parcel directly to the north (see Figure 9). This parcel is bordered by the aforementioned project area to the north, Area C (of this report) to the east, a cattle feed area and Consolidated Baseyards to the south, and the current Monitoring area of ASH, Inc. to the west. The majority of Area E is covered with dry grasses and *kiawe* and slightly undulates on an east-west axis (elevation decreases to the east).

A total of 28 trenches were mechanically excavated in Area E during Phase II research. All trenches were sterile, with none yielding cultural materials of any period. Area E strata were variable, being very shallow to the south (due to river rock and shallow saprolitic basement) and deeper to the central and northern sections. Most matrices were homogenous across the area, with most trenches exhibiting five strata: Layer I was composed of pale brown (10YR 6/3) very fine sand (loose) and few, subangular cobbles. Layer II consisted of brown (10YR 5/3) silty sand (loose) with common rootlets and few, subangular pebbles and cobbles. Layer III consisted of very pale brown (10YR 7/4) fine sand with was very hard (lithified). Layer IV was composed of brown (10YR 5/3) very fine, sub-angular, granular sand. Rounded basalt cobbles were common. Layer V was composed of strong brown (7.5YR 5/6) very fine, loose sand. Few rootlets and roots were present. This “key” for the 28 trenches slightly varied, again, between the northern and southern portions of the area due to stratigraphic depth and presence/absence of natural pebbles and cobbles. Appendix B provides representative stratigraphic profiles from Area E.

AREA F

Area F is also a somewhat rectangular-shaped parcel situated on TMK: (2) 3-8-007:101 (por.) and consists of c. 50-acres of undeveloped land. Area F is licensed to Hawaiian Cement and occurs directly to the north of the 15-acre project area studied through an Archaeological Assessment (Pantaleo 2008) and Archaeological Monitoring (Rotunno-Hazuka and Pantaleo 2008) (see Figure 9). This segment is bordered by the aforementioned project area to the south, Area C (of this report) to the east, Area A (of this report) to the north, and the current Monitoring area of ASH, Inc. to the west. Directly to the west is a wide swath of cleared area that is overlain by basalt base course. The majority of Area E is covered with dry grasses and *kiawe* and also slightly undulates on an east-west axis (elevation decreases to the east).

A total of 50 stratigraphic trenches were mechanically excavated in Area F during Phase II research. All trenches were sterile, with none yielding cultural materials of any period. Area F strata were quite homogenous, with less variation in depth and content. Sandy sediment dominated the matrices and typically, six strata were encountered. Layer I was composed of brown (7.5YR 4/3) very fine, silty sand (loose) with common roots. Layer II consisted of very pale brown (10YR 7/4) sand with a clear boundary. Layer III consisted of light brown (7.5YR 6/4) very fine, mostly lithified sand. Layer IV was composed of brownish yellow (10YR 6/6) very fine, sub-angular, granular sand. Layer V consisted of brown (10YR 5/3) very fine, loose sand. Natural basalt cobbles were common. Layer IV was composed of reddish brown (5YR 4/4) clay. Few rootlets and roots were present. The clay represented the base of excavation in most cases. This "key" for the 50 trenches slightly varied, again, although homogeneity was high in this section. Appendix B provides representative stratigraphic profiles from Area F.

AREA G

This small area occurs in the western portion of the project area, between several previous project areas (see Figure 9). The location has been previously graded and the surface is covered with basalt base course. To cover as much of the project area as possible, SCS excavated three trenches in this disturbed locale. The location occurs to the north and east of Parcel 104 and to the south and west of the enveloping ASH, Inc. Hawaiian Cement Sand Mining area. Area G is situated on TMK: (2) 3-8-007:101 (por.).

A total of three (3) trenches were mechanically excavated in Area G during Phase II research. All trenches were sterile, with none yielding cultural materials of any period. Area G strata was homogenous, with five layers present in each of the trenches. Layer I was composed of gray (5YR 5/1) basalt base course (artificial layer). Layer II was composed of brown (10YR 4/3) silt loam. Layer III consisted of dark gray (5YR 4/1) basalt gravels (artificial layer). Layer IV consisted of brownish yellow (10YR 6/6) sand with no roots or clastics. Layer V was composed of dark reddish brown (5YR 3/3) clay with strong structure. This "key" for the 3 trenches showed redundancy in matrices encountered within the three trenches, all of which were sterile. Appendix B provides representative stratigraphic profiles from Area G.

CONSULTATION

The initial conceptual plan for the Waiale Project was formulated with the participation of the greater Maui Community, including those with knowledge of the Wai`ale area. Excerpts from a flyer explaining the process and identifying some of the participants are presented in Appendix E. Archaeological Consultants Hawaii, Inc. (ASH) has also consulted with the Maui/Lana`i Islands Burial Council (MLIBC) regarding the inadvertent finding of human skeletal remains, identified during Archaeological Monitoring of portions of the current project area, on three separate occasions. The initial presentation to the MLIBC occurred on October 30, 2003 and the follow-up occurred on November 26, 2003. On August 28, 2008, ASH provided the MLIBC with an up-date on the number of burials located within the Hawaiian Cement, AMERON sand mining, and Maui Lani Project Areas. Thus, consultation with the community, including the MLIBC, has been on-going for over 5 years.

DISCUSSION AND CONCLUSION

Excluding previously identified State Site No. 50-50-04-3525, sites within the work area of Archaeological Services Hawaii (ASH) (State Site No. 50-50-04-4200, -4201, and -4202), as well as two previously identified sites (Spreckels Ditch, State Site No. 50-50-04-1508 in Area A of the project area and human burial site, State Site No. 50-50-04-5504, also in Area A), current Inventory Survey of the approximate 607-acre area of land yielded only one previously unrecorded archaeological site (see Figure 9). This site was identified as a subsurface oven (*imu*) and designated State Site No. 50-50-04-6578. The mechanical excavation of 282 stratigraphic trenches (and five manual trenches) revealed that 40 trenches (20 percent) produced evidence for human alteration and influence (modern) through the presence of subsurface modern debris and charred botanical remnants. The alterations of matrices are interpreted to be the result of sugarcane cultivation, sand mining, or a combination. The finding of a single subsurface *imu* aside, the lack of additional subsurface archaeological cultural materials and features in the remaining trenches did not support the existence of significant settlement, either temporary or permanent, within the project area. This is not surprising considered the instability of the surface (sand) and the location of the project area (mid-isthmus). A single surface find (isolated find), interpreted as a basalt core, was the only artifact found in the project area and was the likely result of Traditional-period transient movement through the area (see Appendix D for artifact photo).

Based upon previous archaeological research for the project area and environs, as well as archival research of historical texts regarding central Maui, two main types of archaeological sites associated with traditional and historic times were suspected to occur within the project area: agricultural sites (temporary habitation features possibly included) and human burials. Agricultural sites were expected to occur only in Area D, due to its proximity to Waikapū Stream, but none were identified. The area is too sandy for cultivation; modern cultivation in the area involved importing massive amounts of non-sandy soil in which to plant sugar cane. It is unlikely such practices would have occurred in prehistoric/early historic times. Only one agriculturally-related historic surface site was found in the project area, a segment of the previously identified Spreckels Ditch (Site -1508). Potentially, temporary habitation/activity sites (temporary in the sense of occupation for only a few hours during the day) would be present. Evidence for temporary occupation was identified in the form of Site -6578, the subsurface fire pit, and the single, isolated basalt hammerstone. No other artifacts or ecofacts supporting habitation were identified in the project area.

As is well documented in the State, human burials are often found in sandy sediment. For the current project area, human burials were expected to be found in such sandy matrices, but more so in the natural sand dunes of Areas A, B, and C due to absence of modern agricultural disturbances (*i.e*., sugarcane). However, with the exception of Site -5504, in which evidence for three burials (one *in situ* and two scattered) was previously identified, no additional human burials were found. Various types of terrain (*e.g.*, sand dune hilltops, hill slopes, flats, swales) were mechanically and manually excavated yet all were sterile. Site -5504 aside, the project area, at least the north half, is not devoid of human remains, as shown by the excavations of Moore and Kennedy (1998), the results of Archaeological Monitoring in the Hawaiian Cement areas, and the recovery project on Parcel 104. In addition, the adjacent Maui Lani Subdivision (north) is well known to also contain many burials interred within sandy matrices.

This begs the question: in over 287 excavated trenches, why were no burials identified during this project? Certainly sampling could be one reason, as 100% of the project area was not tested. Second, was depth a factor? A majority of the trenches were excavated to at least 1.5-2.0 mbs, certainly at depths containing burials in the area (see Previous Archaeology section above). Depth appears not to have been a factor. Third, the lack of burials could be associated with lack of settlement in the area. This appears unlikely, given the large number of burials in the Hawaiian Cement area, but there is still the lack of habitation deposits in the area. Fourth, could the known burials be exclusively associated with the Battle of Kakanilua? This remains a possibility, although the battle text appears more to reflect the Maui Lani area than the current project area. Also, an analysis of the identified burials could reveal whether weaponry (sling stones, etc.) or skeletal trauma was present, to further associate with the battle. Finally, it is possible, given the state of the currently tested areas, that burials are most often found in the larger, undisturbed natural sand dunes. Much of the current project area has been subject to some form of grading/clearing through time. It is also possible that burials were more often to occur at higher elevations (c. 250-350 ft. a.m.s.l.) within a sand dune belt extending from the western/central portion of the current project area through Maui Lani toward Wailuku.

Past research in the general environs of the current project area, combined with the presence of previously undocumented Site -6578 (the *imu*) and several previously identified burials, suggests that the current project parcel was not the location for primary settlement during Traditional or historic times. Burial is one site type identified in the project area, as well as a subsurface feature associating with transient use of one portion of the area. In the Waikapū area, the settlement pattern is such that a majority of the agricultural plots with associated habitations were situated above what is now the Honoapiilani Highway (c.400 ft. elevation), mostly near Waikapū Stream, and much upland from the current project area. The current parcel did not reveal evidence for agriculture, beyond modern sugar cane cultivation (no formal sites though). No evidence of permanent occupation was found; this not surprising considering the land type and surface. Permanent settlement is typically associated with stable land surfaces, not potentially shifting dune surfaces. In all, this isthmus area is somewhat a “barren zone”, but differs from the “barren zone” of southeastern Maui in that the current parcel has deep, sandy stratigraphy while the latter consists of shallow soils overlying bedrock. Both these zones, however, were transitional environmental areas between coastal and upland resources. As such, they would have supported transient occupation more so than permanent settlement, with subsistence regimes being minimal. These zones compose an outer periphery to settlement core areas such as Wailuku.

In sum, the highest concentration of human burials (previously identified State Sites -4200 and -4201) within the project area is located to the east of Area B and was identified in the area utilized as sand mining for Hawaiian Cement (currently Monitored by ASH) (see Figure 5). Area A contains an historic agricultural site identified as a portion of the Spreckels’ Ditch (Site -1508) and two Traditional-period sites [Site -6578 (the *imu*) and Site -5504 (evidence for three burials)]. Area B did not reveal the presence of sites. While only an isolated basalt core was found on its ground surface, Area C also did not reveal the presence of a site. Area D, while thought to contain potential agricultural sites due to its proximity to Waikapū Stream, also yielded negative results. Areas E, F, and G were also sterile. The project area, cast as a “barren zone” of sorts above, appears to have been peripheral to even modest settlement and activity from traditional times through historic times, the latter period wherein the area was used more heavily for sugar cane cultivation and more recently, the profitable business of sand mining.

SIGNIFICANCE ASSESSMENTS

Three sites are evaluated herein for significance as a) they occur in the current project area and b) are not being mitigated by other firms working in the project area. The aforementioned burials occurring in Hawaiian Cement areas are being mitigated by ASH, Inc. and the burials noted on parcel 104 have been mitigated by Fredericksen and Fredericksen (Xamanek, Inc.). Thus, three sites are being evaluated herein: newly identified *imu* (State Site 50-50-04-5504), a segment of Spreckels Ditch (State Site 50-50-04-1508), and the three burials (State Site 50-50-04-5504). Please note: As the above-mentioned burials were inadvertently identified by ASH archaeologists, Scientific Consultant Services, Inc. did not consult with community members, as per HAR § 13-276-5(a) and (a) (4) (g). All three sites are subject to the broad criteria established for the State of Hawai`i's Register of Historic Places §13-275-6 classified below:

Criterion A:	Site is associated with events that have made a significant contribution to the broad patterns of our history.
Criterion B:	Site is associated with the lives of persons significant to our past.
Criterion C:	Site is an excellent site type; embodies distinctive characteristics of a type, period, or method of construction, or represents the work of a master, or possesses high artistic values, or represents a significant and distinguishable entity whose components may lack individual construction.
Criterion D:	Site has yielded or has the potential to yield information important in prehistory or history.
Criterion E:	Site has cultural significance; probable religious structures or burials present (State of Hawai`i criteria only).

Of the five criteria, the historic Spreckels Ditch (Site -1508) will continue to be classified under Criterions A and D as it is associated with events that have made an important contribution to the broad patterns of Hawaii State history (*i.e.,* Maui's sugar industry) and has yielded information important to history. The burial site (Site -5504) is considered significant under Criterion D and E in that while the mere presence of the site has yielded additional information to prehistory, the site is culturally significant (E). The late-traditional/ early historic period *imu*

(Site -6578) is considered significant under Criterion D in that the site has yielded information to prehistory.

RECOMMENDATIONS

Several archaeological actions are being recommended for the current project area and the archaeological sites present within its confines. First, full-time Archaeological Monitoring is recommended for sandy locations in the project area and those locales not subject to testing. Second, while the general boundaries of Site -5504 (burials) have been determined, no direct excavation of the osseous remains was conducted which would have allowed—at a minimum—evaluating the age, sex, and ethnicity of the burials. While identified in 2003 by an ASH, Inc. employee, it appears that no formal mitigation or preservation of the site has occurred over the past six years. Several recommendations are posed herein for Site -5504. First, with regards to the displaced human remains first observed in the sand berm that parallels Kuihelani Highway, the sand berm should be closely monitored by at least two individuals for the purposes of recovering any additional displaced human remains. Second, a Burial Treatment Plan should be written for Site -5504 and submitted to the SHPD-Culture History section and the MLIBC for consultation and approval. Please note: As the above-mentioned burials were inadvertently identified by ASH archaeologists, Scientific Consultant Services, Inc. did not consult with community members, as per HAR § 13-276-5(a) and (a) (4) (g).

Next, the presence of an open-aired section of a modified historic structure (concrete reinforcement) will continue to be utilized by currently lessees of the land. No further archaeological work is recommended for the segment running through the project area. The site's use as an irrigation ditch appears limited, although it still does minimally feed current agricultural land within the project area and transports water for cattle in the area. Its presence in the project area was primarily for the transportation of water to sugarcane lands located southeast of the project area. The site has been previously recorded during other surveys in different portions of Wailuku, Waiehu, Waihee—now Waikapu—Spreckels Ditch was placed on the State of Hawai`i's Register of Historic Places. No further work is recommended for this small segment of the ditch. Much finer examples of the ditch, as noted in the above valleys, have been preserved and many are still in active use.

Regarding State Site 50-50-04-6578, the *imu*, no further archaeological work is recommended. The site has been mapped, recorded, and sampled. Areas within and near Site -6578 will be Monitored during ground altering work.

A Burial Treatment Plan will also be prepared to specifically address interim and permanent mitigation of those burials identified by Archaeological Services Hawaii, LLC. within the Hawaiian Cement sand mining area.

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APPENDIX A: MECHANICALLY EXCAVATED STRATIGRAPHIC TRENCH GENERAL INFORMATION

Arbitrary Excavation Location	Stratigraphic Trench Identification and Work Phase	GPS Coordinates (UTM; NAD83)	Dimensions (meters; LxWxMax D.)	Layer Types	Sandy Matrix Present? (Y/N)	River Rock Exposed? (Y/N, Provenience)	Cultural Material Observed	Modern Influence Provenience (Layer Designation)
Area A	ST-1 (Phase I)	E 0762009 N 2308131	8.3 x 1.0 x 1.35	5	Yes	No	Plastic irrigation line	I, II, IV
Area A	ST-2 (Phase I)	E 0761981 N 2308167	6.8 x 1.0 x 1.00	5	Yes	Yes; IV	-	-
Area A	ST-3 (Phase I)	E 0761961 N 2308206	7.0 x 1.0 x 1.04	5	Yes	No	-	-
Area A	ST-4 (Phase I)	E 0762005 N 2308243	9.3 x 1.0 x 1.14	5	Yes	No	-	-
Area A	ST-5 (Phase I)	E 0762030 N 2308229	9.0 x 1.0 x 1.20	5	Yes	No	-	-
Area A	ST-6 (Phase I)	E 0762054 N 2308231	7.2 x 1.0 x 1.15	2	Yes	No	-	-
Area A	ST-7 (Phase I)	E 0762042 N 2308269	6.8 x 1.0 x 1.22	4	Yes	No	-	-
Area A	ST-8 (Phase I)	E 0762084 N 2308313	5.0 x 1.0 x 0.87	5	Yes	No	-	-
Area A	ST-9 (Phase I)	E 0762116 N 2308333	9.2 x 1.0 x 1.00	6	Yes	No	-	-
Area A	ST-10 (Phase I)	E 0762142 N 2308416	5.0 x 1.0 x 0.50	1	Yes	No	Charcoal from modern burning	I
Area A	ST-11 (Phase I)	E 0762151 N 2308492	8.0 x 1.0 x 1.12	4	Yes	No	Charcoal from modern burning, pieces of plastic sheets and irrigation pipes	I
Area A	ST-12 (Phase I)	E 0762101 N 2308505	8.0 x 1.0 x 1.12	5	Yes	No	Pieces of plastic pipe	I
Area A	ST-13 (Phase I)	E 0762028 N 2308471	9.0 x 1.0 x 0.90	5	Yes	No	Imported soil	I
Area A	ST-14 (Phase I)	E 0761921 N 2308180	9.0 x 1.0 x 0.64	3	Yes	No	Imported soil, charcoal from modern burning	I
Area A	ST-15 (Phase I)	E 0761947 N 2308145	8.9 x 1.0 x 1.18	2	Yes	No	Plastic sheet	I
Area A	ST-16 (Phase I)	E 0761974 N 2308089	6.5 x 1.0 x 0.71	4	Yes	Yes; IV	-	I

Arbitrary Excavation Location	Stratigraphic Trench Identification and Work Phase	GPS Coordinates (UTM; NAD83)	Dimensions (meters; LxWxMax D.)	Layer Types	Sandy Matrix Present? (Y/N)	River Rock Exposed? (Y/N, Provenience)	Cultural Material Observed	Modern Influence Provenience (Layer Designation)
Area A	ST-17 (Phase I)	E 0761975 N 2308087	7.8 x 1.0 x 0.94	5	Yes	No	-	-
Area A	ST-18 (Phase I)	E 0762005 N 2308191	10.2 x 1.0 x 1.00	3	Yes	No	-	-
Area A	ST-19 (Phase I)	E 0761937 N 2308089	10.2 x 1.0 x 0.98	4	Yes	No	Glass, slag, iron wire	I, II
Area A	ST-20 (Phase I)	E 0761961 N 2308054	9.7 x 1.0 x 1.16	4	Yes	Yes; III	Imported soil	I, II
Area A	ST-21 (Phase I)	E 0761949 N 2308028	7.6 x 1.0 x 0.93	5	Yes	Yes; III, IIIA	Imported soil	I
Area A	ST-22 (Phase I)	E 0761964 N 2308359	5.3 x 1.0 x 0.75	5	Yes	No	-	-
Area A	ST-23 (Phase I)	E 0761932 N 2308380	5.5 x 1.0 x 0.72	4	Yes	No	-	-
Area A	ST-24 (Phase I)	E 0761898 N 2308401	6.3 x 1.0 x 0.90	4	Yes	Yes; III, IV	-	-
Area A	ST-25 (Phase I)	E 0761864 N 2308441	5.4 x 1.0 x 0.80	5	Yes	Yes; IV	Irrigation tubing, Charcoal from modern burning	I
Area A	ST-26 (Phase I)	E 0761842 N 2308478	6.0 x 1.0 x 1.22	6	Yes	No	-	-
Area A	ST-27 (Phase I)	E 0761807 N 2308499	6.2 x 1.15 x 1.15	3	Yes	Yes; II, III	-	-
Area A	ST-28 (Phase I)	E 0761827 N 2308545	7.2 x 1.0 x 1.20	5	Yes	Yes; III, IV	-	-
Area A	ST-29 (Phase I)	E 0761859 N 2308592	5.5 x 1.0 x 0.80	3	Yes	No	-	-
Area A	ST-30 (Phase I)	E 0761894 N 2308613	5.7 x 1.0 x 1.10	4	Yes	No	-	-
Area A	ST-31 (Phase I)	E 0761933 N 2308623	7.0 x 1.0 x 1.10	3	Yes	No	-	-
Area A	ST-32 (Phase I)	E 0761919 N 2308580	5.8 x 1.0 x 0.91	4	Yes	No	-	-
Area A	ST-33 (Phase I)	E 0761927 N 2308535	5.5 x 1.0 x 0.88	4	Yes	No	-	-
Area A	ST-34 (Phase I)	E 0761942 N 2308491	5.0 x 1.0 x 1.05	5	Yes	No	-	-
Area A	ST-35 (Phase I)	E 0761994 N 2308507	5.5 x 1.0 x 1.02	5	Yes	Yes; IV	-	-
Area A	ST-36 (Phase I)	E 0761971 N 2308552	6.0 x 1.0 x 1.04	3	Yes	No	-	-

Arbitrary Excavation Location	Stratigraphic Trench Identification and Work Phase	GPS Coordinates (UTM; NAD83)	Dimensions (meters; LxWxMax D.)	Layer Types	Sandy Matrix Present? (Y/N)	River Rock Exposed? (Y/N, Provenience)	Cultural Material Observed	Modern Influence Provenience (Layer Designation)
Area A	ST-37 (Phase I)	E 0761843 N 2308643	5.8 x 1.0 x 1.00	4	Yes	No	-	-
Area A	ST-38 (Phase I)	E 0761790 N 2308560	6.5 x 1.0 x 1.25	3	Yes	Yes; III	-	-
Area A	ST-39 (Phase I)	E 0761745 N 2308531	6.3 x 1.0 x 1.43	4	Yes	No	-	-
Area A	ST-40 (Phase I)	E 0761698 N 2308532	6.3 x 1.0 x 1.52	2	Yes	No	-	-
Area A	ST-41 (Phase I)	E 0761752 N 2308468	5.6 x 1.0 x 1.43	4	Yes	Yes; III	-	-
Area A	ST-42 (Phase I)	E 0761827 N 2308676	5.8 x 1.0 x 1.09	3	Yes	No	-	-
Area A	ST-42 Extension (Phase I)	E 0761827 N 2308676	8.4 x 1.0 x 1.19	6	Yes	No	-	-
Area A	ST-43 (Phase I)	E 0761775 N 2308669	5.0 x 2.7 x 1.35	2	Yes	No	-	-
Area A	ST-44 (Phase I)	E 0761778 N 2308615	5.0 x 1.0 x 0.65	4	Yes	No	Charcoal from modern burning	II
Area A	ST-45 (Phase I)	E 0761679 N 2308588	5.5 x 1.0 x 1.12	3	Yes	No	-	-
Area A	ST-46 (Phase I)	E 0761648 N 2308620	4.0 x 1.0 x 1.35	2	Yes	No	-	-
Area A	ST-47 (Phase I)	E 0761690 N 2308647	5.5 x 1.0 x 1.32	5	Yes	Yes; V	-	-
Area A	ST-48 (Phase I)	E 0761742 N 2308697	5.5 x 1.0 x 0.70	3	Yes	No	-	-
Area A	ST-49 (Phase I)	Data not taken	4.5 x 1.0 x 1.31	5	Yes	No	-	-
Area A	ST-50 (Phase I)	E 0761839 N 2308667	7.5 x 1.0 x 1.26	6	Yes	No	-	-
Area A	ST-51 (Phase I)	E 0761637 N 2308702	6.0 x 1.0 x 1.24	4	Yes	No	-	-
Area A	ST-52 (Phase I)	E 0761670 N 2308685	5.3 x 1.0 x 1.53	9	Yes	Yes; V	-	-
Area A	ST-53 (Phase I)	E 0761704 N 2308718	6.5 x 1.0 x 1.60	9	Yes	Yes; IX	Charcoal lens associated with modern burning	I, II, III, IV
Area A	ST-54 (Phase I)	E 0761744 N 2308746	7.4 x 1.0 x 0.83	4	Yes	No	-	-

Arbitrary Excavation Location	Stratigraphic Trench Identification and Work Phase	GPS Coordinates (UTM; NAD83)	Dimensions (meters; LxWxMax D.)	Layer Types	Sandy Matrix Present? (Y/N)	River Rock Exposed? (Y/N, Provenience)	Cultural Material Observed	Modern Influence Provenience (Layer Designation)
Area A	ST-55 (Phase I)	E 0761737 N 2308787	5.0 x 1.0 x 1.25	4	Yes	Yes; III	-	-
Area A	ST-56 (Phase I)	E 0761693 N 2308755	6.5 x 1.0 x 1.41	7	Yes	No	-	-
Area A	ST-57 (Phase I)	E 0761689 N 2308748	4.4 x 1.0 x 1.20	2	Yes	No	-	-
Area A	ST-58 (Phase I)	E 0761641 N 2308794	4.0 x 2.5 x 1.35	1	Yes	No	Possible collapse from sand mining	I
Area A	ST-59 (Phase I)	E 0761687 N 2308810	6.5 x 1.0 x 1.16	7	Yes	No	Rusted metal and wire	II, IIA
Area A	ST-60 (Phase I)	E 0761653 N 2308832	5.0 x 1.0 x 1.15	3	Yes	No	-	-
Area A	ST-61 (Phase I)	E 0761622 N 2308749	4.5 x 1.0 x 1.22	4	Yes	No	Charcoal from modern burning	I
Area A	ST-62 (Phase I)	E 0761627 N 2308810	3.0 x 1.0 x 1.40	7	Yes	No	-	-
Area A	ST-63 (Phase I)	E 0761630 N 2308850	4.1 x 1.0 x 1.45	6	Yes	No	-	-
Area A	ST-64 (Phase I)	E 0761601 N 2308843	4.5 x 1.0 x 1.76	4	Yes	No	-	-
Area A	ST-65 (Phase I)	E 0761412 N 2309003	4.0 x 1.0 x 0.74	2	Yes	No	-	-
Area A	ST-66 (Phase I)	E 0761425 N 2309003	5.8 x 1.0 x 0.80	4	Yes	No	-	-
Area A	ST-67 (Phase I)	E 0761428 N 2308982	7.7 x 1.0 x 0.96	6	Yes	No	-	-
Area A	ST-68 (Phase I)	E 0761444 N 2308977	3.2 x 1.0 x 0.56	4	Yes	No	-	-
Area A	ST-69 (Phase I)	E 0761448 N 2308961	9.7 x 1.0 x 0.10	2	Yes	No	-	-
Area A	ST-70 (Phase I)	E 0761457 N 2308932	5.2 x 1.0 x 0.56	8	Yes	No	-	-
Area A	ST-71 (Phase I)	E 0761482 N 2308968	5.8 x 1.0 x 0.66	4	Yes	No	-	-
Area B	ST-72 (Phase I)	E 0760824 N 2309049	5.4 x 1.0 x 0.96	3	Yes	Yes; III	-	-
Area B	ST-73 (Phase I)	E 0760868 N 2309065	5.4 x 1.0 x 1.20	7	Yes	No	Charcoal associated with recent use	IV, V, VI

Arbitrary Excavation Location	Stratigraphic Trench Identification and Work Phase	GPS Coordinates (UTM; NAD83)	Dimensions (meters; LxWxMax D.)	Layer Types	Sandy Matrix Present? (Y/N)	River Rock Exposed? (Y/N, Provenience)	Cultural Material Observed	Modern Influence Provenience (Layer Designation)
Area B	ST-74 (Phase I)	E 0760904 N 2309092	4.8 x 1.0 x 1.27	9	Yes	No	-	-
Area B	ST-75 (Phase I)	E 0760944 N 2309097	6.1 x 1.0 x 0.60	3	Yes	No	-	-
Area B	ST-76 (Phase I)	E 0760982 N 2309114	6.0 x 1.0 x 1.74	2	Yes	No	-	-
Area B	ST-77 (Phase I)	E 0760936 N 2309129	6.0 x 1.1 x 1.50	5	Yes	No	-	-
Area B	ST-78 (Phase I)	E 0760906 N 2309124	8.0 x 1.4 x 2.04	5	Yes	No	-	-
Area B	ST-79 (Phase I)	E 0760861 N 2309145	6.5 x 1.08 x 1.53	5	Yes	No	-	-
Area B	ST-80 (Phase I)	E 0760847 N 2309105	7.0 x 1.30 x 1.44	6	Yes	No	-	-
Area B	ST-81 (Phase I)	E 0760818 N 2309165	6.0 x 1.15 x 1.30	7	Yes	No	-	-
Area A	ST-82 (Phase I)	E 0761309 N 2308839	4.6 x 1.0 x 0.39	3	Yes	Yes; III	-	-
Area A	ST-83 (Phase I)	E 0761292 N 2308904	5.0 x 1.0 x 1.18	4	Yes	Yes; III, IV	-	-
Area A	ST-84 (Phase I)	E 0761311 N 2308931	7.3 x 1.0 x 1.10	5	Yes	Yes; II, IV	-	-
Area A	ST-85 (Phase I)	E 0761256 N 2308849	4.3 x 1.0 x 0.81	3	Yes	No	-	-
Area A	ST-86 (Phase I)	E 0761266 N 2308896	5.0 x 1.0 x 0.75	4	Yes	Yes; III	-	-
Area A	ST-87 (Phase I)	E 0761269 N 2308934	5.2 x 1.0 x 0.92	4	Yes	Yes; I, II, IV	-	-
Area A	ST-88 (Phase I)	E 0761255 N 2308959	5.5 x 1.0 x 1.86	3	Yes	No	-	-
Area A	ST-89 (Phase I)	E 0761297 N 2308969	5.7 x 1.0 x 1.13	8	Yes	Yes; IV, VI, VIII	-	-
Area A	ST-90 (Phase I)	E 0761281 N 2308991	5.3 x 1.0 x 1.73	4	Yes	No	Subsurface *Imu* (Site -5504)	-
Area A	ST-91 (Phase I)	E 0761254 N 2309019	6.1 x 1.0 x 1.17	3	Yes	Yes; I	-	-
Area D	ST-92 (Phase I)	E 0761552 N 2307238	5.2 x 1.0 x 1.62	5	Yes	No	Irrigation tubes	I, II, III, IV
Area D	ST-93 (Phase I)	E 0761505 N 2307149	8.2 x 1.0 x 1.60	6	Yes	No	-	I, II, III, IV, V
Area D	ST-94 (Phase I)	E 0761455 N 2307064	8.2 x 1.0 x 1.76	4	Yes	Yes; IV	Irrigation tubes	I, II

Arbitrary Excavation Location	Stratigraphic Trench Identification and Work Phase	GPS Coordinates (UTM; NAD83)	Dimensions (meters; LxWxMax D.)	Layer Types	Sandy Matrix Present? (Y/N)	River Rock Exposed? (Y/N, Provenience)	Cultural Material Observed	Modern Influence Provenience (Layer Designation)
Area D	ST-95 (Phase I)	E 0761416 N 2306976	9.2 x 1.0 x 1.63	6	Yes	Yes; V	Irrigation tubes	I, II, III
Area D	ST-96 (Phase I)	E 0761371 N 2306892	9.0 x 1.0 x 1.80	6	Yes	Yes; V	-	I, II, III
Area D	ST-97 (Phase I)	E 0761328 N 2306805	8.0 x 1.0 x 1.90	6	Yes	Yes; VI	-	I, II, III
Area D	ST-98 (Phase I)	E 0761278 N 2306714	5.0 x 1.0 x 1.70	6	Yes	No	-	I
Area D	ST-99 (Phase I)	E 0761221 N 2306760	5.2 x 1.0 x 1.77	5	Yes	No	-	I
Area D	ST-100 (Phase I)	E 0761263 N 2306845	8.8 x 1.0 x 1.63	5	Yes	No	Irrigation tubes	I, II
Area D	ST-101 (Phase I)	E 0761284 N 2306894	7.5 x 1.0 x 1.72	8	Yes	No	Irrigation tubes	I, II, III, IV, V, VI
Area D	ST-102 (Phase I)	E 0761321 N 2306963	9.2 x 1.0 x 1.54	5	Yes	Yes; VI	Irrigation tubes and charcoal from recent land use	I, II, III, IV
Area D	ST-103 (Phase I)	E 0761359 N 2307040	9.0 x 1.0 x 1.67	6	Yes	Yes; IV	Irrigation tubes	I, II, III
Area D	ST-104 (Phase I)	E 0761401 N 2307129	7.8 x 1.0 x 1.62	8	Yes	Yes; VII	Irrigation tubes	I, II, III, IV
Area D	ST-105 (Phase I)	E 0761447 N 2307177	6.5 x 1.0 x 1.60	5	Yes	Yes; IV	Irrigation tubes	I, II, III
Area D	ST-106 (Phase I)	E 0761450 N 2307221	8.4 x 1.0 x 1.27	4	Yes	No	Charcoal flecks from modern burning	I, II
Area D	ST-107 (Phase I)	E 0761399 N 2307302	7.15 x 1.3 x 1.50	5	Yes	Yes; III	-	-
Area D	ST-108 (Phase I)	E 0761340 N 2307199	8.5 x 1.10 x 1.20	6	Yes	Yes; VI	-	-
Area D	ST-109 (Phase I)	E 0761294 N 2307105	7.0 x 1.1 x 1.80	7	Yes	No	-	I, II, III
Area D	ST-110 (Phase I)	E 0761260 N 2307035	10.5 x 1.1 x 1.50	4	Yes	Yes; III, IV	-	I, II, III
Area D	ST-111 (Phase I)	E 0761218 N 2306945	9.5 x 1.1 x 1.70	9	Yes	No	-	I, II, III, IV, V, VI
Area D	ST-112 (Phase I)	E 0761202 N 2306863	9.3 x 1.1 x 1.60	7	Yes	No	-	I, II, III, IV
Area D	ST-113 (Phase I)	E 0761315 N 2307376	4.8 x 1.0 x 1.48	5	Yes	No	Irrigation tubes	I, II, III

Arbitrary Excavation Location	Stratigraphic Trench Identification and Work Phase	GPS Coordinates (UTM; NAD83)	Dimensions (meters; LxWxMax D.)	Layer Types	Sandy Matrix Present? (Y/N)	River Rock Exposed? (Y/N, Provenience)	Cultural Material Observed	Modern Influence Provenience (Layer Designation)
Area D	ST-114 (Phase I)	E 0761276 N 2307291	5.4 x 1.0 x 1.27	4	Yes	Yes; IV	-	I, II
Area D	ST-115 (Phase I)	E 0761234 N 2307205	6.5 x 1.0 x 1.50	4	Yes	Yes; IV	-	I, II
Area D	ST-116 (Phase I)	E 0761207 N 2307116	5.2 x 1.0 x 1.70	6	Yes	Yes; V	-	I, II, III
Area D	ST-117 (Phase I)	E 0761173 N 2307020	5.5 x 1.0 x 1.50	3	Yes	No	-	I, II
Area D	ST-118 (Phase I)	E 0761095 N 2307073	6.0 x 1.0 x 1.30	4	Yes	No	-	I, II, III
Area D	ST-119 (Phase I)	E 0761118 N 2307168	5.4 x 1.0 x 1.22	5	Yes	Yes; IV	Plastic irrigation line	I, II, III
Area D	ST-120 (Phase I)	E 0761157 N 2307254	6.0 x 1.0 x 1.50	5	Yes	Yes; IV	-	I, II, III
Area D	ST-121 (Phase I)	E 0761204 N 2307347	5.5 x 1.0 x 1.66	5	Yes	Yes; II	-	I, II, III, IV, V
Area D	ST-122 (Phase I)	E 0761127 N 2307414	6.6 x 1.0 x 1.40	4	Yes	Yes; III	-	I, II
Area D	ST-123 (Phase I)	E 0761095 N 2307323	5.0 x 1.0 x 0.95	4	Yes	Yes; V	Irrigation tubes	I, II
Area D	ST-124 (Phase I)	E 0761033 N 2307214	5.4 x 1.0 x 0.96	4	Yes	Yes; IV	Charcoal from modern burning	I, II
Area D	ST-125 (Phase I)	E 0760974 N 2307274	8.4 x 1.0 x 0.82	3	Yes	Yes; III	Irrigation tubes	I, II
Area D	ST-126 (Phase I)	E 0761019 N 2307391	4.7 x 1.0 x 1.20	8	Yes	Yes; III, VIII	Irrigation tubes	I, II, III, IV, V
Area D	ST-127 (Phase I)	E 0761038 N 2307525	5.2 x 1.0 x 1.36	6	Yes	Yes; III, IV	PVC and irrigation tubes	I, II, III, IV
Area D	ST-127B (Phase I)	E 0761078 N 2307522	5.4 x 1.0 x 1.64	3	Yes	Yes; III	Modern fire pit containing charred sugarcane	I, II, III
Area D	ST-128 (Phase I)	E 0760964 N 2307549	5.5 x 1.0 x 1.25	5	Yes	Yes; V	-	I, II, III
Area D	ST-129 (Phase I)	E 0760935 N 2307462	5.2 x 1.0 x 1.46	5	Yes	Yes; V	Charcoal flecks and irrigation tubes	I, II, III, IV
Area D	ST-130 (Phase I)	E 0760839 N 2307451	5.4 x 1.0 x 0.67	2	Yes	Yes; II	Irrigation tubes	I, II

Arbitrary Excavation Location	Stratigraphic Trench Identification and Work Phase	GPS Coordinates (UTM; NAD83)	Dimensions (meters; LxWxMax D.)	Layer Types	Sandy Matrix Present? (Y/N)	River Rock Exposed? (Y/N, Provenience)	Cultural Material Observed	Modern Influence Provenience (Layer Designation)
Area D	ST-131 (Phase I)	E 0760845 N 2307557	5.2 x 1.0 x 1.50	4	Yes	No	PVC pipes	I, II, III, IV
Area D	ST-132 (Phase I)	E 0760775 N 2307537	5.5 x 1.0 x 1.46	4	Yes	Yes; II	Irrigation tubes and charcoal flecks from modern fires	I, II, III
Area D	ST-133 (Phase I)	E 0760813 N 2307573	5.6 x 1.0 x 1.70	6	Yes	No	Plastic irrigation tubes	I, II, III
Area D	ST-134 (Phase I)	E 0760820 N 2307612	5.0 x 1.0 x 0.85	2	Yes	Yes; II	Plastic irrigation tubes	I
Area D	ST-135 (Phase I)	E 0760773 N 2307536	5.2 x 1.0 x 1.30	3	Yes	Yes; III, IIIA	Plastic irrigation tubes	I
Area D	ST-136 (Phase I)	E 0760772 N 2307624	5.7 x 1.0 x 1.50	5	Yes	No	Charcoal flecks and irrigation tubes	I, II, III, IV
Area D	ST-137 (Phase I)	E 0761044 N 2307610	4.2 x 1.0 x 1.50	4	Yes	No	Metal and 1 piece of glass	I, II, III
Area D	ST-138 (Phase I)	E 0761112 N 2307593	6.7 x 1.0 x 0.74	3	Yes	No	-	I, II
Area D	ST-139 (Phase I)	E 0761145 N 2307588	5.2 x 1.0 x 0.83	4	Yes	No	Plastic irrigation tubes	I, II
Area D	ST-140 (Phase I)	E 0761194 N 2307573	5.3 x 1.0 x 0.95	4	Yes	Yes; IV	Plastic irrigation tubes	I, II
Area D	ST-141 (Phase I)	E 0761240 N 2307557	5.2 x 1.0 x 1.34	6	Yes	No	-	I, II
Area D	ST-142 (Phase I)	E 0761284 N 2307554	4.4 x 1.0 x 1.30	6	Yes	No	Plastic irrigation tubes and charcoal flecks	I, II, III
Area D	ST-143 (Phase I)	E 0761273 N 2307500	5.5 x 1.0 x 1.45	4	Yes	No	Plastic	I

Arbitrary Excavation Location	Stratigraphic Trench Identification and Work Phase	GPS Coordinates (UTM; NAD83)	Dimensions (meters; LxWxMax D.)	Layer Types	Sandy Matrix Present? (Y/N)	River Rock Exposed? (Y/N, Provenience)	Cultural Material Observed	Modern Influence Provenience (Layer Designation)
Area D	ST-144 (Phase I)	E 0761217 N 2307516	5.4 x 1.0 x 1.48	4	Yes	No	Plastic irrigation tubes and charred *kiawe*	I, II
Area C	ST-145 (Phase I)	E 0761552 N 2308575	5.3 x 1.0 x 0.56	2	Yes	No	-	-
Area C	ST-146 (Phase I)	E 0761507 N 2308642	5.2 x 1.0 x 1.00	3	Yes	No	-	-
Area C	ST-147 (Phase I)	E 0761473 N 2308620	5.4 x 1.0 x 0.82	2	Yes	No	-	-
Area C	ST-148 (Phase I)	E 0761503 N 2308560	5.6 x 1.0 x 1.36	4	Yes	No	-	-
Area C	ST-149 (Phase I)	E 0761428 N 2308542	5.5 x 1.0 x 1.42	4	Yes	No	-	-
Area C	ST-150 (Phase I)	E 0761445 N 2308491	5.7 x 1.0 x 1.38	3	Yes	No	-	-
Area C	ST-151 (Phase I)	E 0761482 N 2308423	6.2 x 1.0 x 1.72	5	Yes	No	-	-
Area C	ST-152 (Phase I)	E 0761360 N 2308422	4.6 x 1.0 x 1.00	2	Yes	No	-	-
Area C	ST-153 (Phase I)	E 0761299 N 2308333	5.4 x 1.0 x 1.00	4	Yes	No	-	-
Area C	ST-154 (Phase I)	E 0761284 N 2308252	6.0 x 1.0 x 0.92	2	Yes	No	-	-
Area C	ST-155 (Phase I)	E 0761312 N 2308182	6.4 x 1.0 x 1.32	2	Yes	Yes; II	-	-
Area C	ST-156 (Phase I)	E 0761266 N 2308154	5.9 x 0.98 x 1.25	4	Yes	No	-	-
Area C	ST-157 (Phase I)	E 0761224 N 2308071	6.1 x 1.0 x 0.82	2	Yes	Yes; II	-	-
Area C	ST-158 (Phase I)	E 0761209 N 2308026	5.9 x 1.1 x 1.33	2	Yes	Yes; II	-	-
Area C	ST-159 (Phase I)	E 0761162 N 2307957	5.6 x 1.0 x 1.20	2	Yes	No	-	-
Area C	ST-160 (Phase I)	E 0761259 N 2307932	6.6 x 1.0 x 0.35	2	Yes	Yes; II	-	-
Area C	ST-161 (Phase I)	E 0761308 N 2307879	5.7 x 1.0 x 1.80	1	Yes	No	-	-
Area C	ST-162 (Phase I)	E 0761421 N 2307864	7.2 x 1.0 x 1.50	3	Yes	Yes; II	-	-
Area C	ST-163 (Phase I)	E 0761539 N 2307845	6.3 x 1.0 x 1.20	4	Yes	Yes; III	-	-

Arbitrary Excavation Location	Stratigraphic Trench Identification and Work Phase	GPS Coordinates (UTM; NAD83)	Dimensions (meters; LxWxMax D.)	Layer Types	Sandy Matrix Present? (Y/N)	River Rock Exposed? (Y/N, Provenience)	Cultural Material Observed	Modern Influence Provenience (Layer Designation)
Area C	ST-164 (Phase I)	E 0761404 N 2307968	5.2 x 1.0 x 1.45	1	Yes	No	-	-
Area C	ST-165 (Phase I)	E 0761467 N 2307952	5.5 x 1.0 x 1.40	1	Yes	No	-	-
Area C	ST-166 (Phase I)	E 0761540 N 2307993	5.9 x 1.0 x 1.70	3	Yes	No	-	-
Area C	ST-167 (Phase I)	E 0761555 N 2308114	6.2 x 1.0 x 1.30	4	Yes	Yes; III	-	-
Area C	ST-168 (Phase I)	E 0761562 N 2308283	5.9 x 1.0 x 1.55	2	Yes	No	-	-
Area C	ST-169 (Phase I)	E 0761609 N 2308566	5.9 x 1.0 x 1.65	1	Yes	No	-	-
Area C	ST-170 (Phase I)	E 0761347 N 2308239	5.9 x 1.0 x 1.85	1	Yes	No	-	-
Area C	ST-171 (Phase I)	E 0761426 N 2308250	5.7 x 1.0 x 1.40	3	Yes	Yes; III	-	-
Area C	ST-172 (Phase I)	E 0761437 N 2308138	6.5 x 1.0 x 0.80	2	Yes	Yes; II	-	-
Area C	ST-173 (Phase I)	E 0761511 N 2308128	5.6 x 1.0 x 1.85	1	Yes	No	-	-
Area C	ST-174 (Phase I)	E 0761262 N 2308043	5.1 x 1.0 x 1.10	5	Yes	Yes; III	-	-
Area C	ST-175 (Phase I)	E 0761338 N 2308096	6.0 x 1.0 x 1.60	1	Yes	No	-	-
Area C	ST-176 (Phase I)	E 0761509 N 2308229	6.0 x 1.0 x 1.50	2	Yes	No	-	-
Area C	ST-177 (Phase I)	E 0761496 N 2308463	5.8 x 1.0 x 2.10	1	Yes	No	-	-
Area C	ST-178 (Phase I)	E 0761536 N 2308493	6.6 x 1.0 x 1.30	1	Yes	No	-	-
Area C	ST-179 (Phase I)	E 0761422 N 2308352	5.9 x 1.0 x 1.80	1	Yes	No	-	-
Area C	ST-180 (Phase I)	E 0761594 N 2307872	5.6 x 1.0 x 0.60	1	Yes	No	-	-
Area C	ST-181 (Phase I)	E 0761636 N 2307955	5.9 x 1.0 x 1.60	2	Yes	No	-	-
Area C	ST-182 (Phase I)	E 0761656 N 2308028	6.2 x 1.0 x 1.50	2	Yes	No	-	-
Area C	ST-183 (Phase I)	E 0761787 N 2308100	5.9 x 1.0 x 1.50	4	Yes	Yes; IV	-	-
Area C	ST-184 (Phase I)	E 0761681 N 2307914	5.0 x 1.0 x 1.30	4	Yes	Yes; III	-	-
Area C	ST-185 (Phase I)	E 0761725 N 2308000	6.1 x 1.0 x 1.20	3	Yes	No	-	-

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Area C	ST-186 (Phase I)	E 0761667 N 2308393	6.0 x 1.0 x 0.90	4	Yes	No	-	-
Area C	ST-187 (Phase I)	E 0761659 N 2308327	5.5 x 1.0 x 1.50	4	Yes	Yes; III	-	-
Area C	ST-188 (Phase I)	E 0761633 N 2308221	5.7 x 1.0 x 0.90	5	Yes	No	-	-
Area C	ST-189 (Phase I)	E 0761665 N 2308098	5.8 x 1.0 x 1.30	4	Yes	No	-	-
Area C	ST-190 (Phase I)	E 0761712 N 2308171	5.6 x 1.0 x 1.40	2	Yes	No	-	-
Area C	ST-191 (Phase I)	E 0761723 N 2308299	5.2 x 1.0 x 1.30	1	Yes	No	-	-
Area C	ST-192 (Phase I)	E 0761789 N 2308265	5.8 x 1.0 x 1.00	3	Yes	Yes; II, III	-	-
Area C	ST-193 (Phase I)	E 0761731 N 2308059	5.9 x 1.0 x 1.00	2	Yes	No	-	-
Area C	ST-194 (Phase I)	E 0761838 N 2308009	6.1 x 1.0 x 0.90	4	Yes	Yes; II	-	-
Area C	ST-195 (Phase I)	E 0761634 N 2307884	5.5 x 1.0 x 1.20	1	Yes	No	-	-
Area C	ST-196 (Phase I)	E 0761688 N 2307877	5.8 x 1.0 x 1.40	2	Yes	No	-	-
Area C	ST-197 (Phase I)	E 0761565 N 2307926	6.0 x 1.0 x 1.30	4	Yes	Yes; IV	-	-
Area C	ST-198 (Phase I)	E 0761568 N 2308013	6.0 x 1.0 x 1.20	3	Yes	No	-	-
Area C	ST-199 (Phase I)	E 0761622 N 2307992	5.9 x 1.0 x 1.50	2	Yes	No	-	-
Area C	ST-200 (Phase I)	E 0761787 N 2308043	6.5 x 1.0 x 1.40	3	Yes	No	-	-
Area E	1A (Phase II)	E 0760999 N 2308131	7.12 x 1.0 x 2.36	5	Yes	Yes; IV	-	-
Area E	2A (Phase II)	E 0761039 N 2308111	7.28 x 1.0 x 2.48	2	Yes	No	-	-
Area E	3A (Phase II)	E 0761076 N 2304075	7.00 x 1.0 x 1.63	3	Yes	No	-	-
Area E	4A (Phase II)	E 0761104 N 2308059	7.68 x 1.0 x 0.72	3	Yes	No	-	-
Area E	5A (Phase II)	E 0761096 N 2308034	7.04 x 1.0 x 2.08	5	Yes	Yes; IV	-	-
Area E	6A (Phase II)	E 0761092 N 2308014	7.44 x 1.0 x 1.44	3	Yes	Yes; IV	-	-
Area E	7A (Phase II)	E 0761061 N 2307683	7.12 x 1.0 x 0.68	2	Yes	No	-	-

Arbitrary Excavation Location	Stratigraphic Trench Identification and Work Phase	GPS Coordinates (UTM; NAD83)	Dimensions (meters; LxWxMax D.)	Layer Types	Sandy Matrix Present? (Y/N)	River Rock Exposed? (Y/N, Provenience)	Cultural Material Observed	Modern Influence Provenience (Layer Designation)
Area E	8A (Phase II)	E 0761037 N 2307941	7.32 x 1.0 x 1.44	4	Yes	No	-	-
Area E	9A (Phase II)	E 0761006 N 2307925	7.20 x 1.0 x 1.20	4	Yes	Yes; IV	-	-
Area E	10A (Phase II)	E 0761004 N 2307962	7.44 x 1.0 x 1.60	4	Yes	Yes; IV	-	-
Area E	11A (Phase II)	E 0761022 N 2307987	5.48 x 1.0 x 1.68	4	Yes	Yes; IV	-	-
Area E	12A (Phase II)	E 0761043 N 2308021	6.80 x 1.0 x 1.44	4	Yes	Yes; IV	-	-
Area E	13A (Phase II)	E 0761066 N 2308041	6.96 x 1.0 x 1.36	4	Yes	Yes; IV	-	-
Area E	14A (Phase II)	E 0761027 N 2308049	7.20 x 1.0 x 2.08	2	Yes	No	-	-
Area E	15A (Phase II)	E 0761024 N 2307989	6.24 x 1.0 x 1.36	4	Yes	Yes; IV	-	-
Area E	16A (Phase II)	E 0761006 N 2307968	7.12 x 1.0 x 1.36	3	Yes	No	-	-
Area E	17A (Phase II)	E 0760973 N 2307973	5.48 x 1.0 x 0.64	2	Yes	No	-	-
Area E	18A (Phase II)	E 0760924 N 2308901	5.32 x 1.0 x 0.48	3	Yes	No	-	-
Area E	19A (Phase II)	E 0760949 N 2307973	3.28 x 1.0 x 0.40	3	Yes	No	-	-
Area E	20A (Phase II)	E 0760971 N 2308076	5.84 x 1.0 x 0.64	3	Yes	No	-	-
Area E	21A (Phase II)	E 0760975 N 2308079	5.28 x 1.0 x 0.96	4	Yes	Yes; IV	-	-
Area E	22A (Phase II)	E 0761015 N 2308086	5.28 x 1.0 x 1.28	4	Yes	Yes; IV	-	-
Area E	23A (Phase II)	E 0760971 N 2308101	5.28 x 1.0 x 1.24	5	Yes	Yes; IV	-	-
Area E	24A (Phase II)	E 0760946 N 2308067	5.20 x 1.0 x 1.28	4	Yes	Yes; IV	-	-
Area E	25A (Phase II)	E 0760942 N 2308034	5.12 x 1.0 x 0.64	3	Yes	No	-	-
Area E	26A (Phase II)	E 0760917 N 2308010	5.28 x 1.0 x 1.16	4	Yes	Yes; IV	-	-
Area E	27A (Phase II)	E 0760907 N 2307980	5.52 x 1.0 x 0.76	4	Yes	Yes; IV	-	-
Area E	28A (Phase II)	E 0760893 N 2307955	6.56 x 1.0 x 0.96	2	Yes	No	-	-
Area F	1B (Phase II)	E 0761161 N 2308459	5.92 x 1.0 x 2.08	3	Yes	No	-	-

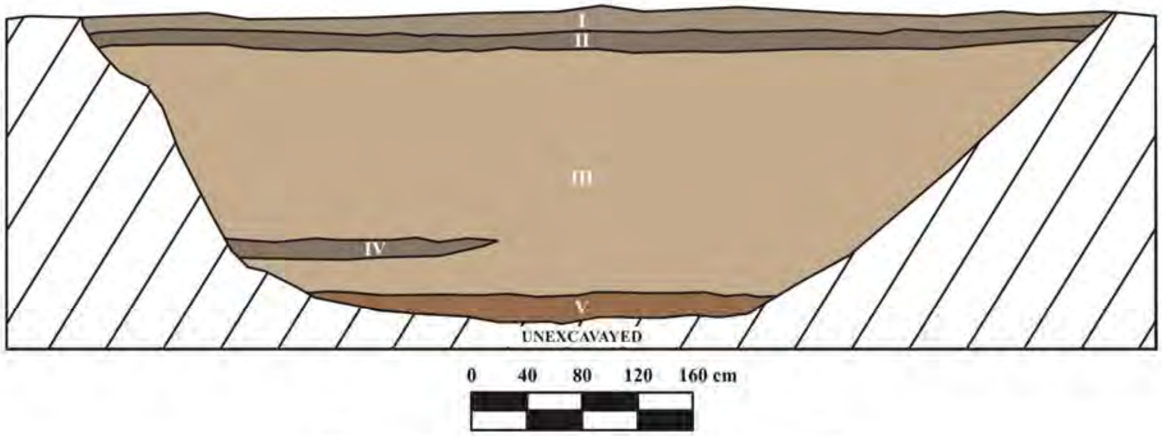
Arbitrary Excavation Location	Stratigraphic Trench Identification and Work Phase	GPS Coordinates (UTM; NAD83)	Dimensions (meters; LxWxMax D.)	Layer Types	Sandy Matrix Present? (Y/N)	River Rock Exposed? (Y/N, Provenience)	Cultural Material Observed	Modern Influence Provenience (Layer Designation)
Area F	2B (Phase II)	E 0761219 N 2308421	5.80 x 1.0 x 1.36	5	Yes	Yes, V	-	-
Area F	3B (Phase II)	E 0761243 N 2308400	8.00 x 1.0 x 1.28	3	Yes	Yes, V	-	-
Area F	4B (Phase II)	E 0761282 N 2308387	7.52 x 1.0 x 1.84	2	Yes	No	-	-
Area F	5B (Phase II)	E 0761302 N 2308415	5.84 x 1.0 x 1.44	4	Yes	Yes, V	-	-
Area F	6B (Phase II)	E 0761301 N 2308440	5.84 x 1.0 x 1.60	3	Yes	No	-	-
Area F	7B (Phase II)	E 0761336 N 2308488	7.44 x 1.0 x 2.08	3	Yes	No	-	-
Area F	8B (Phase II)	E 0761375 N 2308545	5.52 x 1.0 x 1.72	3	Yes	No	-	-
Area F	9B (Phase II)	E 0761397 N 2308592	5.60 x 1.0 x 1.12	2	Yes	No	-	-
Area F	10B (Phase II)	E 0761420 N 2308636	5.44 x 1.0 x 1.20	2	Yes	No	-	-
Area F	11B (Phase II)	E 0761434 N 2308668	6.80 x 1.0 x 0.96	3	Yes	No	-	-
Area F	12B (Phase II)	E 0761459 N 2308702	6.72 x 1.0 x 1.76	3	Yes	No	-	-
Area F	13B (Phase II)	E 0761403 N 2308720	6.80 x 1.0 x 1.52	3	Yes	No	-	-
Area F	14B (Phase II)	E 0761368 N 2308727	7.24 x 1.0 x 2.24	3	Yes	Yes, V	-	-
Area F	15B (Phase II)	E 0761183 N 2308475	5.60 x 1.0 x 1.84	3	Yes	Yes, V	-	-
Area F	16B (Phase II)	E 0761209 N 2308923	7.92x 1.0 x 1.12	3	Yes	Yes, V	-	-
Area F	17B (Phase II)	E 0761224 N 2308563	6.76 x 1.0 x 0.96	3	Yes	No	-	-
Area F	18B (Phase II)	E 0761250 N 2308590	7.84 x 1.0 x 1.04	5	Yes	No	-	-
Area F	19B (Phase II)	E 0761270 N 2308618	8.00 x 1.0 x 0.64	3	Yes	No	-	-
Area F	20B (Phase II)	E 0761295 N 2308643	5.84 x 1.0 x 1.76	2	Yes	No	-	-
Area F	21B (Phase II)	E 0761310 N 2308675	5.84 x 1.0 x 1.68	2	Yes	No	-	-
Area F	22B (Phase II)	E 0761319 N 2308704	5.76 x 1.0 x 0.88	3	Yes	No	-	-
Area F	23B (Phase II)	E 0761366 N 2308675	5.60 x 1.0 x 1.40	2	Yes	No	-	-

Arbitrary Excavation Location	Stratigraphic Trench Identification and Work Phase	GPS Coordinates (UTM; NAD83)	Dimensions (meters; LxWxMax D.)	Layer Types	Sandy Matrix Present? (Y/N)	River Rock Exposed? (Y/N, Provenience)	Cultural Material Observed	Modern Influence Provenience (Layer Designation)
Area F	24B (Phase II)	E 0761391 N 2308683	5.76 x 1.0 x 1.12	2	Yes	No	-	-
Area F	25B (Phase II)	E 0761403 N 2308654	5.92 x 1.0 x 1.72	3	Yes	No	-	-
Area F	26B (Phase II)	E 0761382 N 2308611	5.60 x 1.0 x 1.32	3	Yes	No	-	-
Area F	27B (Phase II)	E 0761336 N 2308637	5.76 x 1.0 x 1.84	3	Yes	No	-	-
Area F	28B (Phase II)	E 0761347 N 2308592	5.32 x 1.0 x 1.36	3	Yes	No	-	-
Area F	29B (Phase II)	E 0761319 N 2308568	5.68 x 1.0 x 1.96	3	Yes	No	-	-
Area F	30B (Phase II)	E 0761294 N 2308540	6.96 x 1.0 x 1.72	4	Yes	No	-	-
Area F	31B (Phase II)	E 0761337 N 2308531	5.36 x 1.0 x 1.72	3	Yes	No	-	-
Area F	32B (Phase II)	E 0761343 N 2308554	7.20 x 1.0 x 1.52	4	Yes	No	-	-
Area F	33B (Phase II)	E 0761296 N 2308574	5.44 x 1.0 x 1.72	2	Yes	No	-	-
Area F	34B (Phase II)	E 0761285 N 2308077	5.36 x 1.0 x 1.36	2	Yes	No	-	-
Area F	35B (Phase II)	E 0761237 N 2308530	6.44 x 1.0 x 0.88	3	Yes	No	-	-
Area F	36B (Phase II)	E 0761208 N 2308504	5.68 x 1.0 x 1.04	4	Yes	No	-	-
Area F	37B (Phase II)	E 0761188 N 2308473	5.68 x 1.0 x 0.96	3	Yes	No	-	-
Area F	38B (Phase II)	E 0761304 N 2308504	5.84 x 1.0 x 1.84	3	Yes	No	-	-
Area F	39B (Phase II)	E 0761282 N 2308511	5.36 x 1.0 x 1.84	3	Yes	No	-	-
Area F	40B (Phase II)	E 0761265 N 2308486	5.76 x 1.0 x 0.96	3	Yes	No	-	-
Area F	41B (Phase II)	E 0761262 N 2308458	5.68 x 1.0 x 1.00	3	Yes	No	-	-
Area F	42B (Phase II)	E 0761250 N 2308430	5.68 x 1.0 x 0.92	2	Yes	No	-	-
Area F	43B (Phase II)	E 0761299 N 2308486	5.68 x 1.0 x 1.68	3	Yes	No	-	-
Area F	44B (Phase II)	E 0761292 N 2308452	5.40 x 1.0 x 1.72	3	Yes	No	-	-
Area F	45B (Phase II)	E 0761283 N 2308427	5.96 x 1.0 x 1.76	3	Yes	No	-	-

Arbitrary Excavation Location	Stratigraphic Trench Identification and Work Phase	GPS Coordinates (UTM; NAD83)	Dimensions (meters; LxWxMax D.)	Layer Types	Sandy Matrix Present? (Y/N)	River Rock Exposed? (Y/N, Provenience)	Cultural Material Observed	Modern Influence Provenience (Layer Designation)
Area F	46B (Phase II)	E 0761230 N 2308443	5.68 x 1.0 x 1.36	3	Yes	No	-	-
Area F	47B (Phase II)	E 0761220 N 2308477	5.84 x 1.0 x 1.44	3	Yes	No	-	-
Area F	48B (Phase II)	E 0761248 N 2308531	5.92 x 1.0 x 1.96	2	Yes	No	-	-
Area F	49B (Phase II)	E 0761275 N 2308546	5.68 x 1.0 x 1.60	2	Yes	No	-	-
Area F	50B (Phase II)	E 0761382 N 2308639	5.60 x 1.0 x 1.04	3	Yes	No	-	-
Area G	1C (Phase II)	E 0760739 N 2308300	5.76 x 1.0 x 1.76	5	Yes	No	Plastic irrigation line and imported angular basalt gravel	I, II, III
Area G	2C (Phase II)	E 0760705 N 2308346	5.52 x 1.0 x 1.36	5	Yes	No	Imported angular basalt gravel	I, II, III
Area G	3C (Phase II)	E 0760975 N 2308267	5.92 x 1.0 x 1.44	5	Yes	No	Imported angular basalt gravel	I, II, III

APPENDIX B: REPRESENTATIVE MECHANICALLY EXCAVATED STRATIGRAPHIC TRENCH PROFILE DRAWINGS

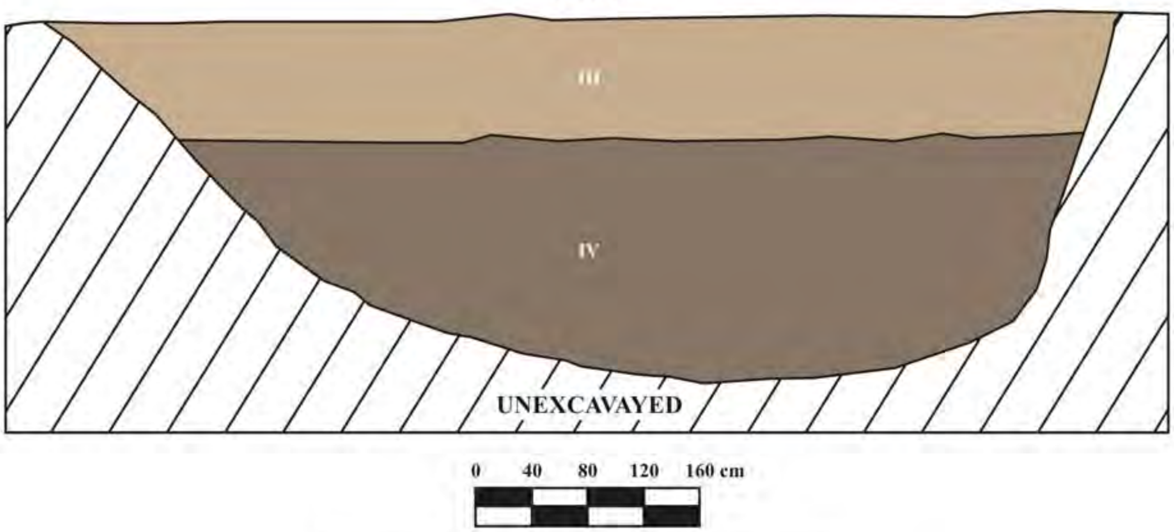
SITE E
ST-1E



KEY

- I - LAYER I: PALE BROWN (10YR 6/3) SAND
- II - LAYER II: BROWN (10YR 5/3) SAND
- III - LAYER III: VERY PALE BROWN (10YR 7/4) SAND
- IV - LAYER IV: BROWN (10YR 5/3) SAND
- V - LAYER V: STRONG BROWN (7.5YR 5/6) SAND

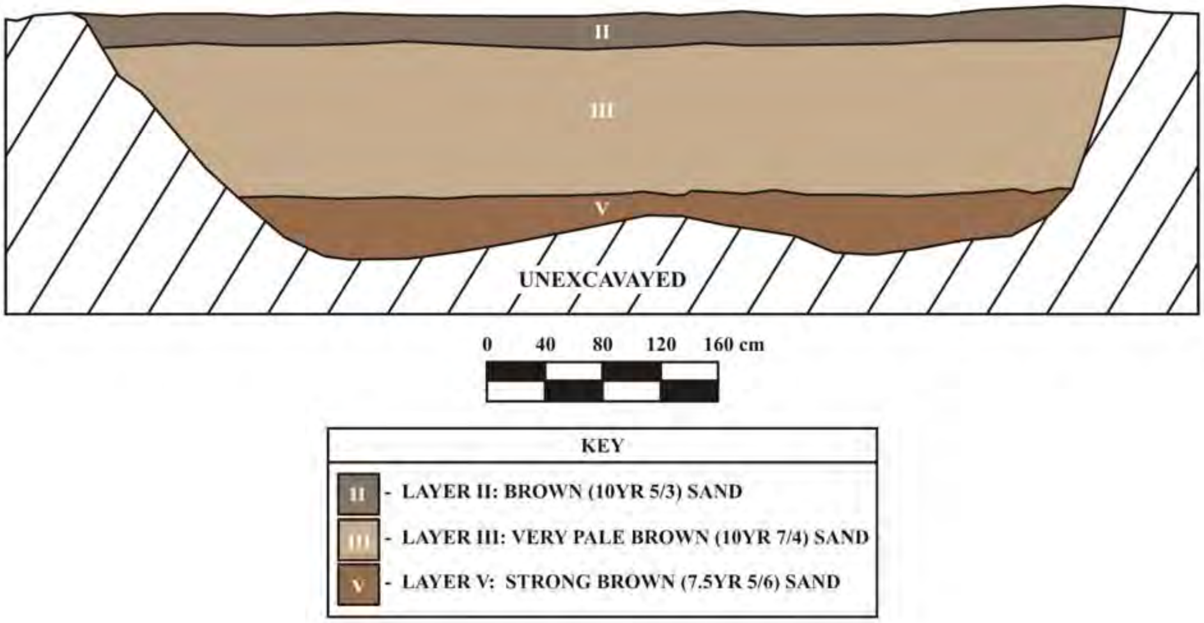
SITE E
ST-2E



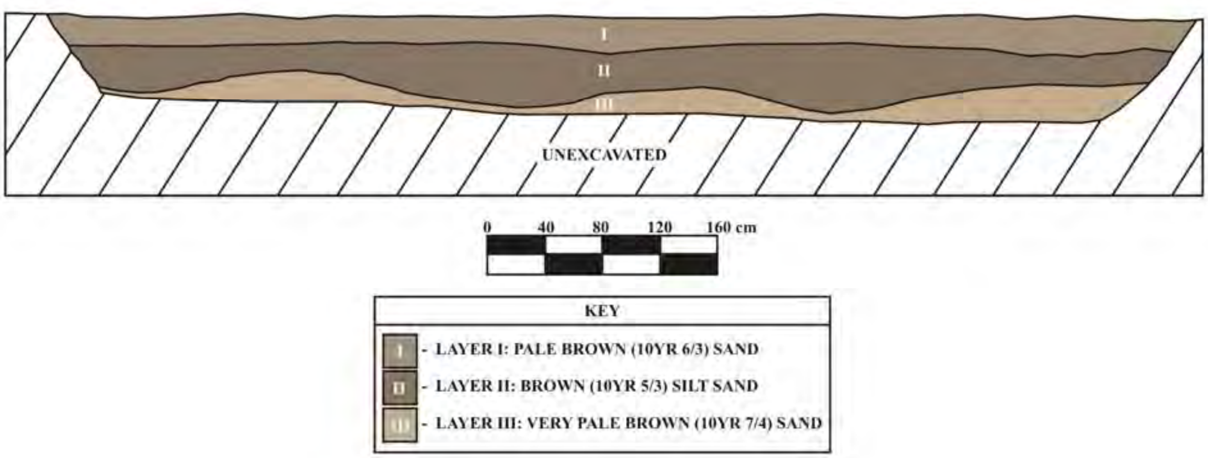
KEY

- III - LAYER III: VERY PALE BROWN (10YR 7/4) SAND
- IV - LAYER IV: BROWN (10YR 5/3) SAND

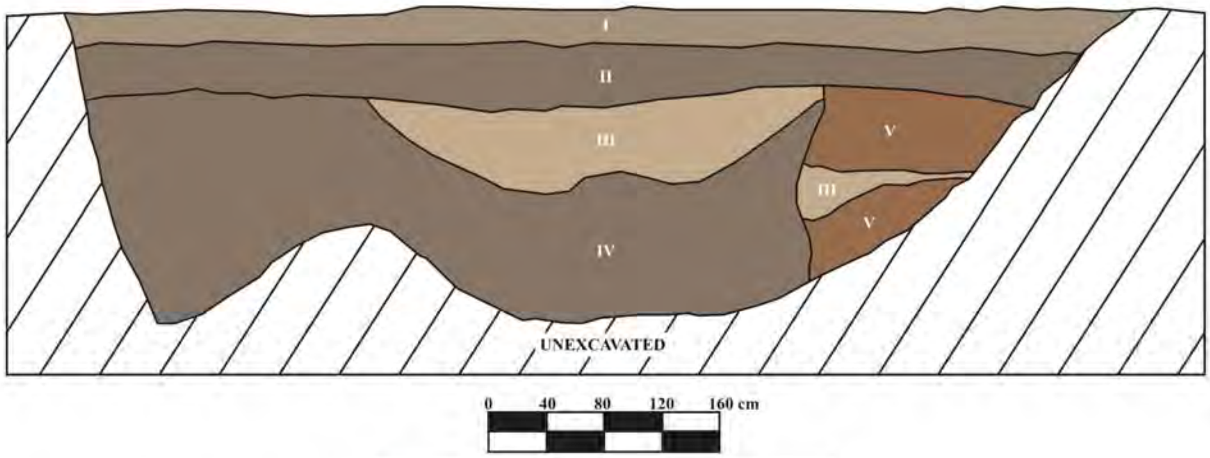
SITE E
ST-3E



SITE E
ST-4E



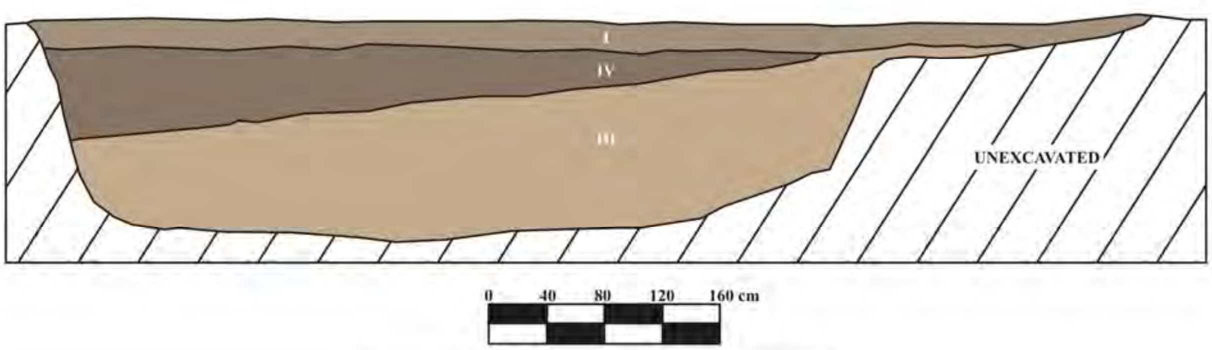
SITE E
ST-5E



KEY

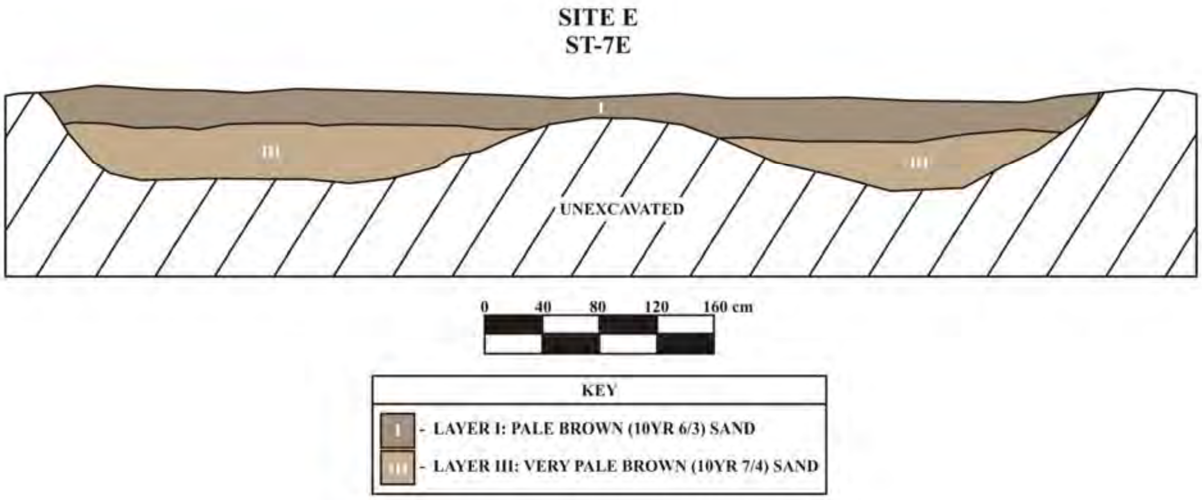
- I - LAYER I: PALE BROWN (10YR 6/3) SAND
- II - LAYER II: BROWN (10YR 5/3) SILT SAND
- III - LAYER III: VERY PALE BROWN (10YR 7/4) SAND
- IV - LAYER IV: BROWN (10YR 5/3) SAND
- V - LAYER V: STRONG BROWN (7.5YR 5/6) SAND

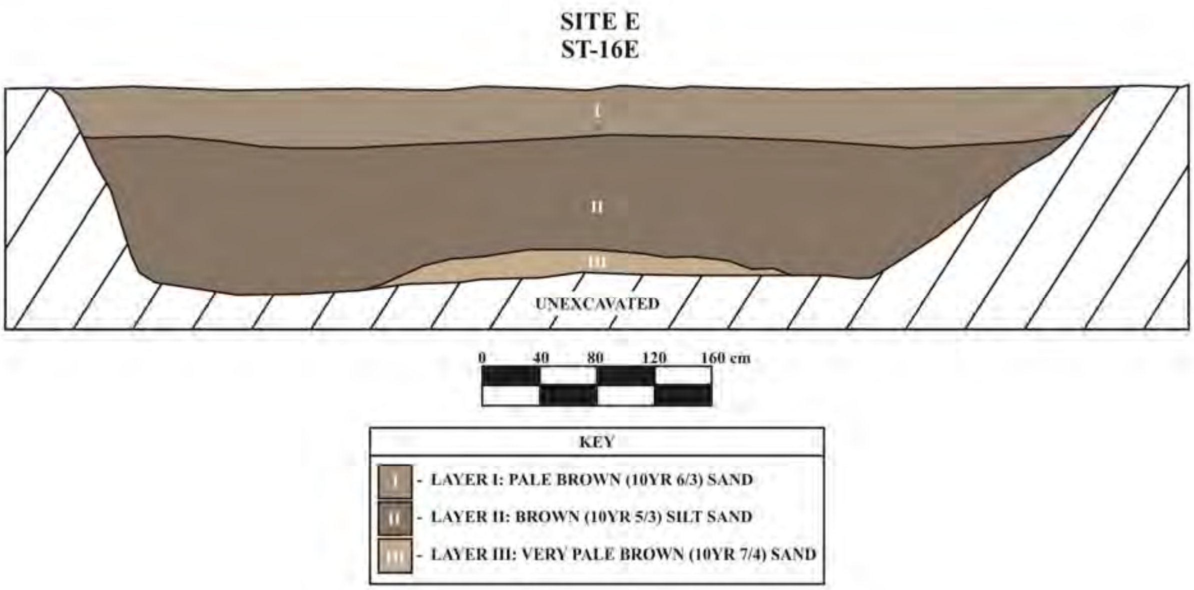
SITE E
ST-6E

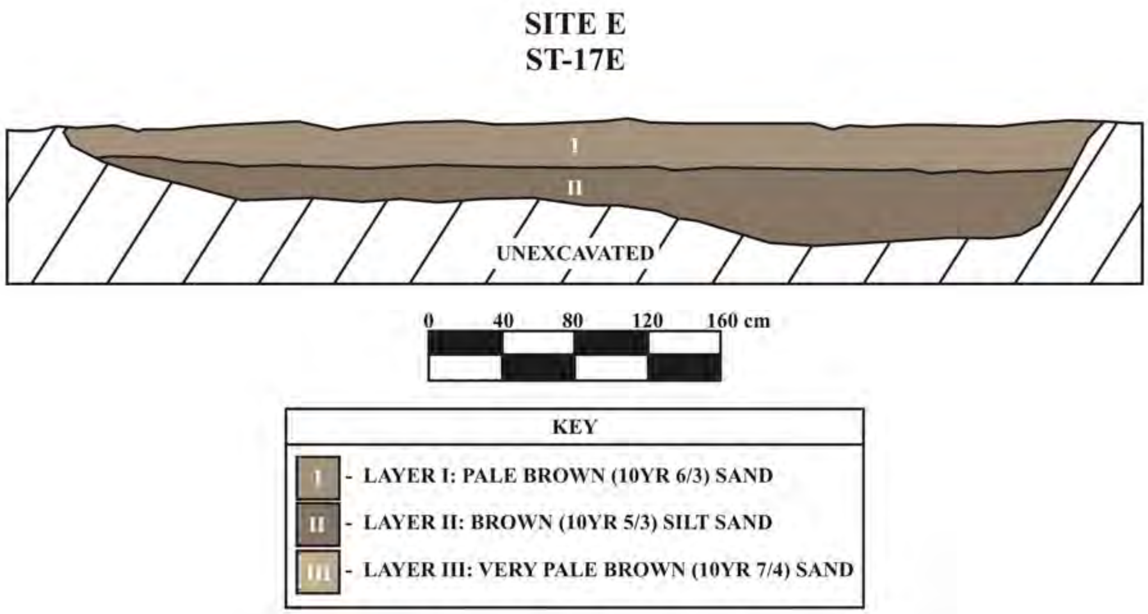


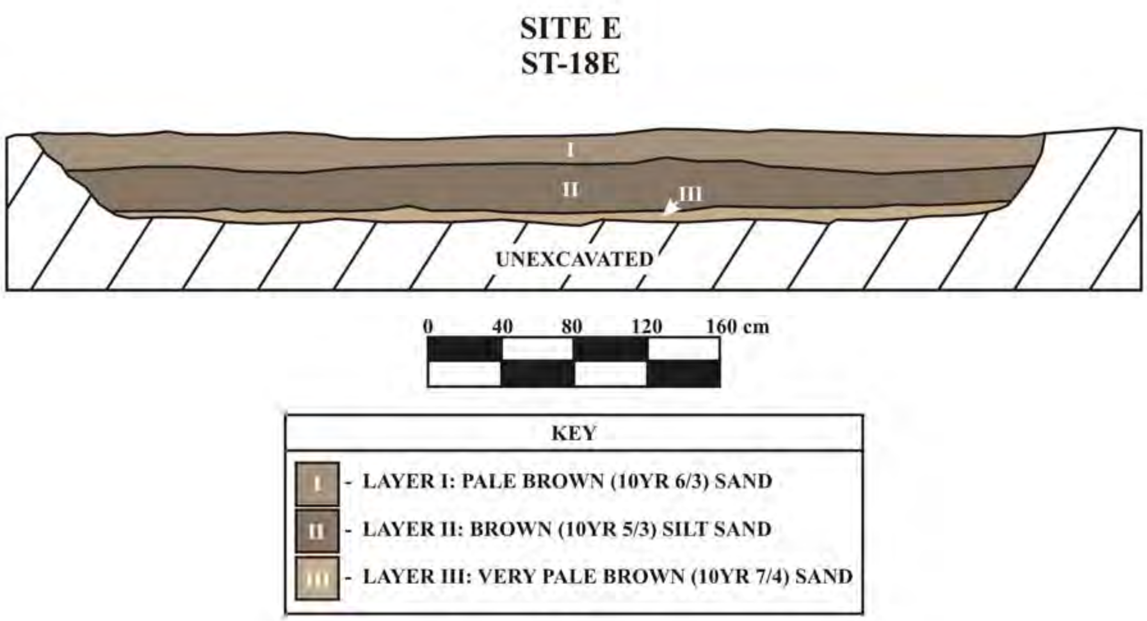
KEY

- I - LAYER I: PALE BROWN (10YR 6/3) SAND
- IV - LAYER IV: BROWN (10YR 5/3) SAND
- III - LAYER III: VERY PALE BROWN (10YR 7/4) SAND

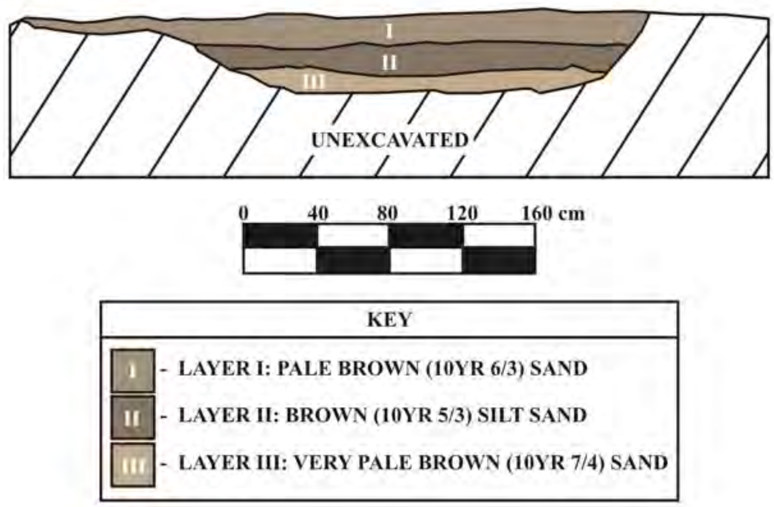

SITE E
ST-7E
I
III
III
UNEXCAVATED
0 40 80 120 160 cm
KEY
I - LAYER I: PALE BROWN (10YR 6/3) SAND
III - LAYER III: VERY PALE BROWN (10YR 7/4) SAND


SITE E
ST-16E
I
II
III
UNEXCAVATED
0 40 80 120 160 cm
KEY
I - LAYER I: PALE BROWN (10YR 6/3) SAND
II - LAYER II: BROWN (10YR 5/3) SILT SAND
III - LAYER III: VERY PALE BROWN (10YR 7/4) SAND

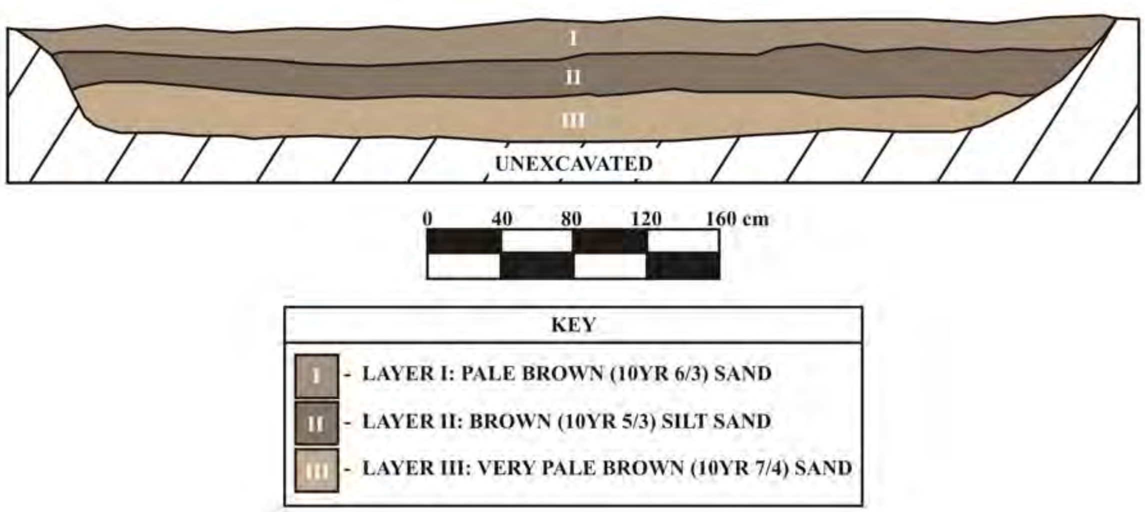

SITE E
ST-17E
I
II
UNEXCAVATED
0 40 80 120 160 cm
KEY
I - LAYER I: PALE BROWN (10YR 6/3) SAND
II - LAYER II: BROWN (10YR 5/3) SILT SAND
III - LAYER III: VERY PALE BROWN (10YR 7/4) SAND


SITE E
ST-18E
I
II
III
UNEXCAVATED
0 40 80 120 160 cm
KEY
I - LAYER I: PALE BROWN (10YR 6/3) SAND
II - LAYER II: BROWN (10YR 5/3) SILT SAND
III - LAYER III: VERY PALE BROWN (10YR 7/4) SAND

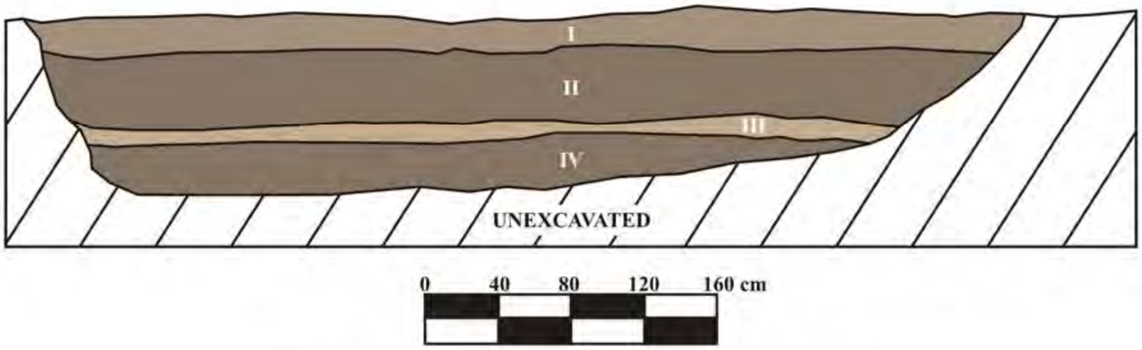
SITE E
ST-19E



SITE E
ST-20E



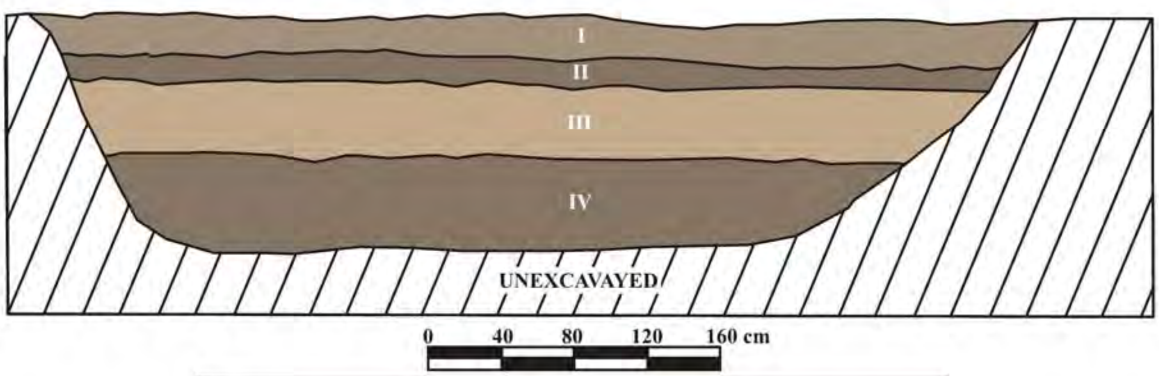
SITE E
ST-21E



KEY

- I - LAYER I: PALE BROWN (10YR 6/3) SAND
- II - LAYER II: BROWN (10YR 5/3) SILT SAND
- III - LAYER III: VERY PALE BROWN (10YR 7/4) SAND
- IV - LAYER IV: BROWN (10YR 5/3) SAND

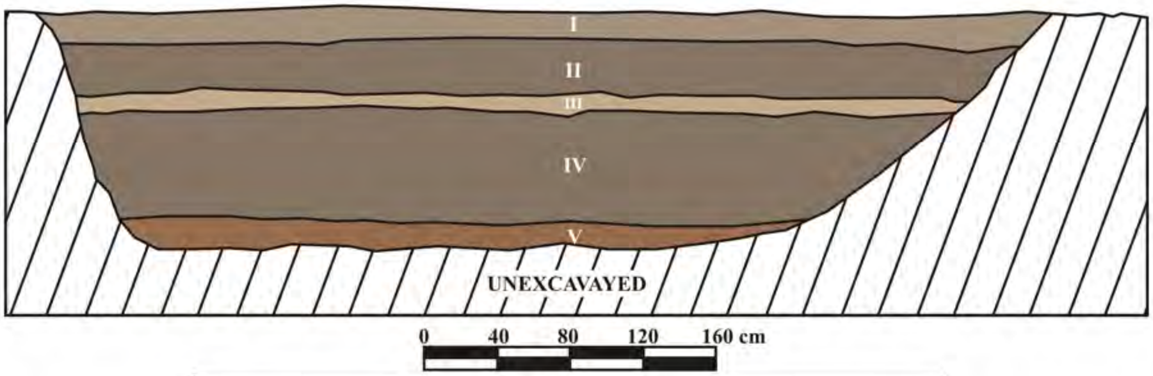
SITE E
ST-22E



KEY

- I - LAYER I: PALE BROWN (10YR 6/3) VERY FINE SAND, LOOSE
- II - LAYER II: BROWN (10YR 5/3) VERY FINE SILT SAND, LOOSE
- III - LAYER III: VERY PALE BROWN (10YR 7/4) VERY FINE SAND
- IV - LAYER IV: BROWN (10YR 5/3) VERY FINE SAND, LOOSE

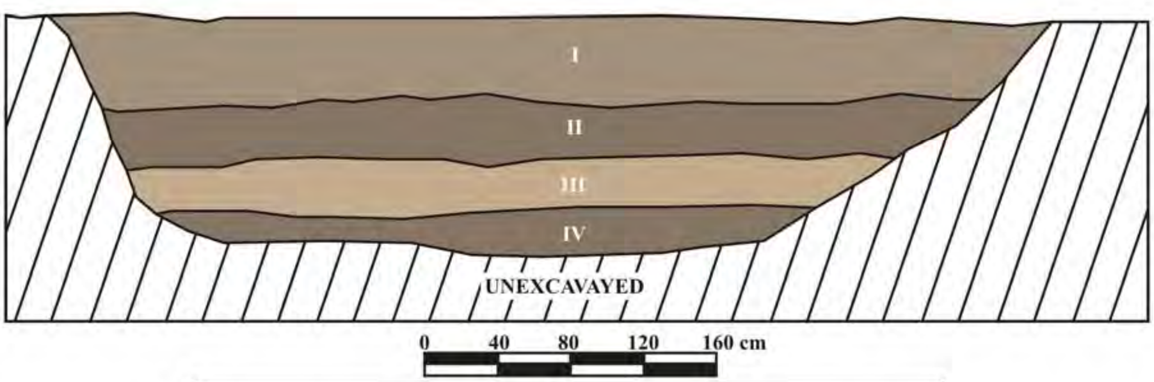
SITE E
ST-23E



KEY

- I - LAYER I: PALE BROWN (10YR 6/3) VERY FINE SAND, LOOSE
- II - LAYER II: BROWN (10YR 5/3) VERY FINE SILT SAND, LOOSE
- III - LAYER III: VERY PALE BROWN (10YR 7/4) VERY FINE SAND
- IV - LAYER IV: BROWN (10YR 5/3) VERY FINE SAND, LOOSE
- V - LAYER V: STRONG BROWN (7.5YR 5/6) VERY FINE SAND, LOOSE

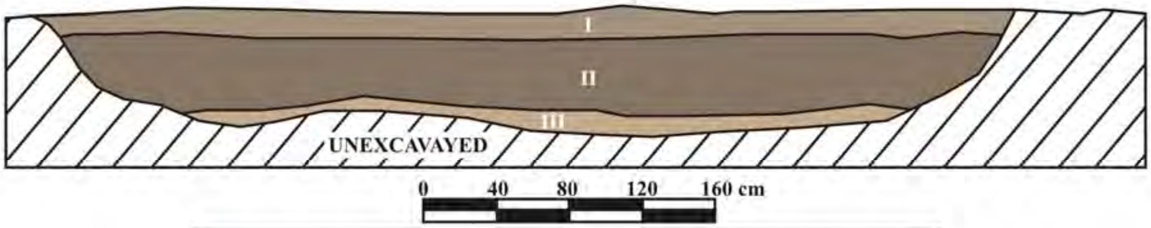
SITE E
ST-24E



KEY

- I - LAYER I: PALE BROWN (10YR 6/3) VERY FINE SAND, LOOSE
- II - LAYER II: BROWN (10YR 5/3) VERY FINE SILT SAND, LOOSE
- III - LAYER III: VERY PALE BROWN (10YR 7/4) VERY FINE SAND
- IV - LAYER IV: BROWN (10YR 5/3) VERY FINE SAND, LOOSE

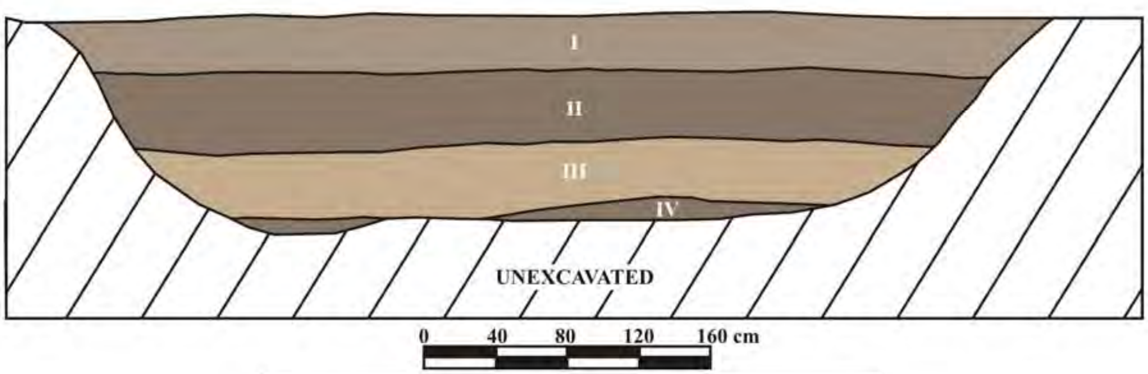
SITE E
ST-25E



KEY

- I - LAYER I: PALE BROWN (10YR 6/3) VERY FINE SAND, LOOSE
- II - LAYER II: BROWN (10YR 5/3) VERY FINE SILT SAND, LOOSE
- III - LAYER III: VERY PALE BROWN (10YR 7/4) VERY FINE SAND

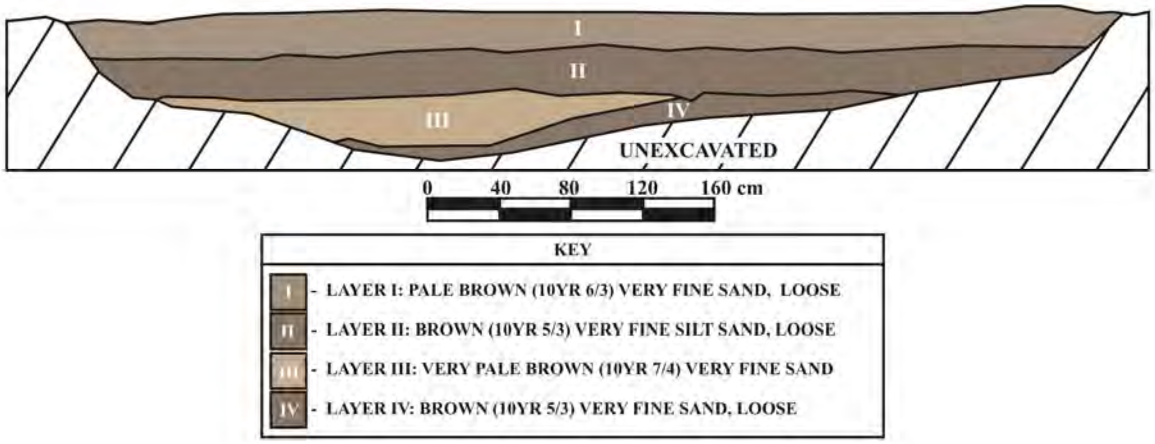
SITE E
ST-26E



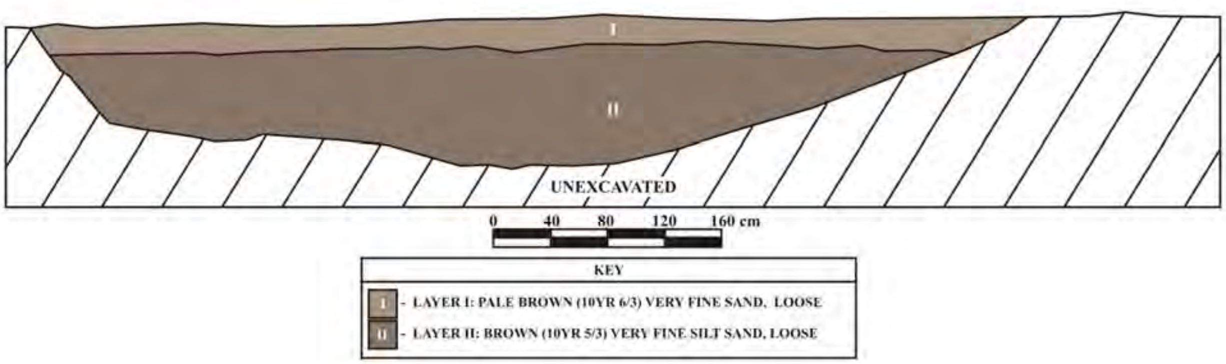
KEY

- I - LAYER I: PALE BROWN (10YR 6/3) VERY FINE SAND, LOOSE
- II - LAYER II: BROWN (10YR 5/3) VERY FINE SILT SAND, LOOSE
- III - LAYER III: VERY PALE BROWN (10YR 7/4) VERY FINE SAND
- IV - LAYER IV: BROWN (10YR 5/3) VERY FINE SAND, LOOSE

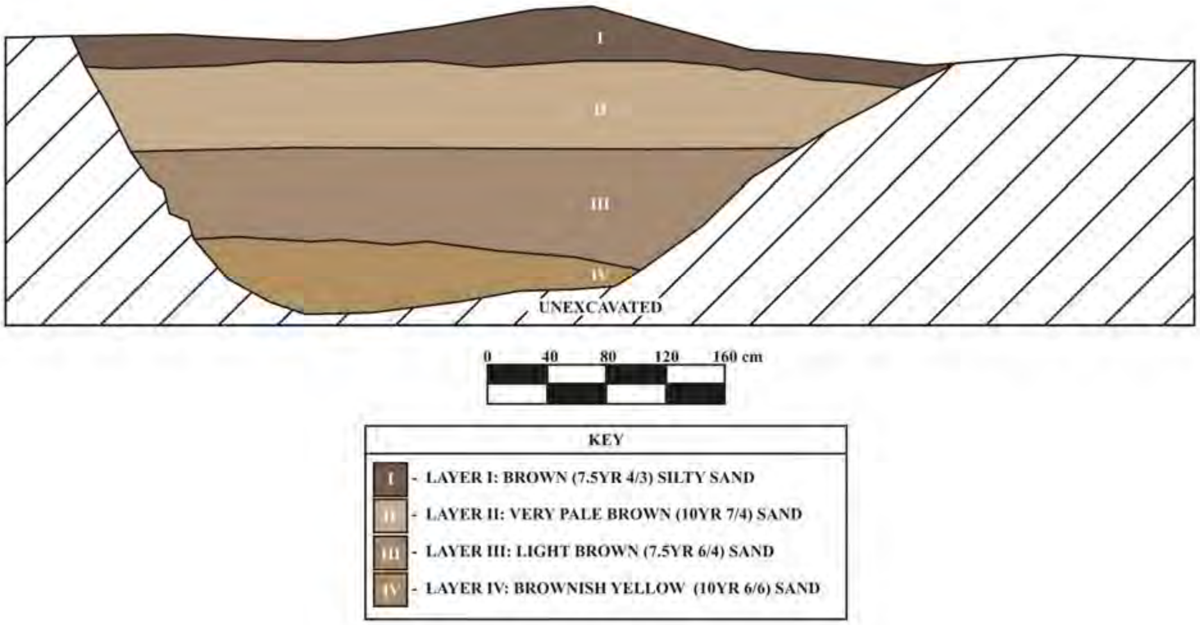
SITE E
ST-27E



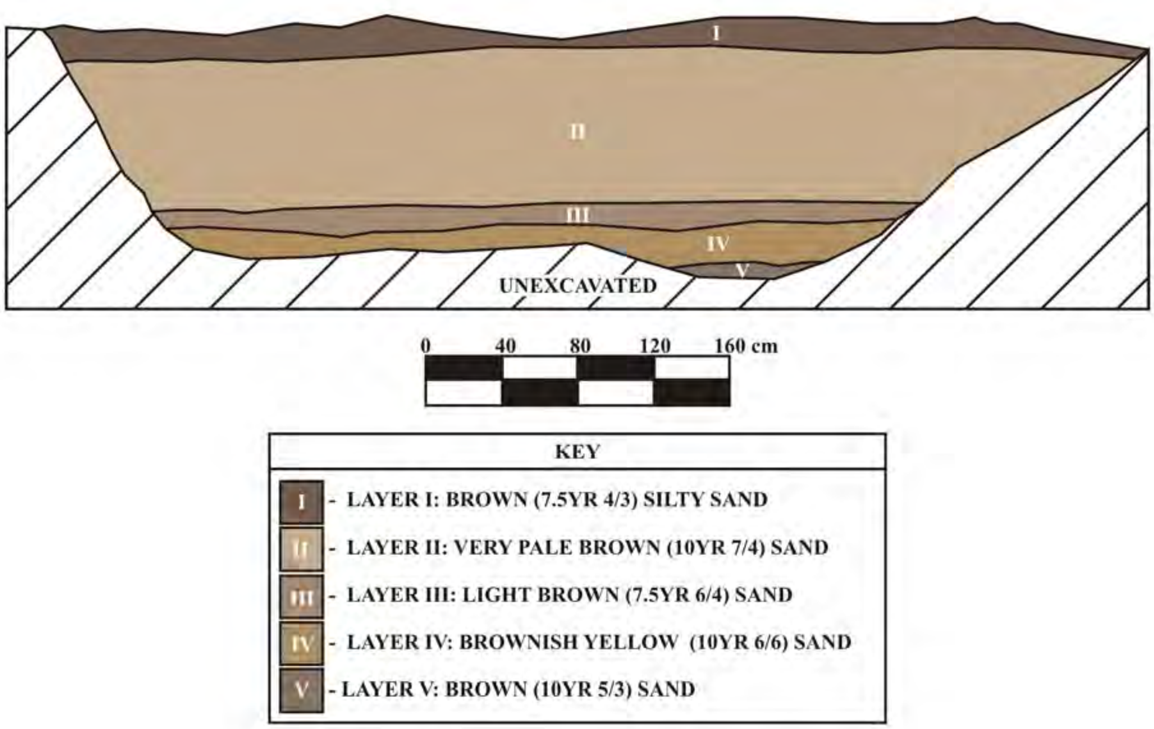
SITE E
ST-28E

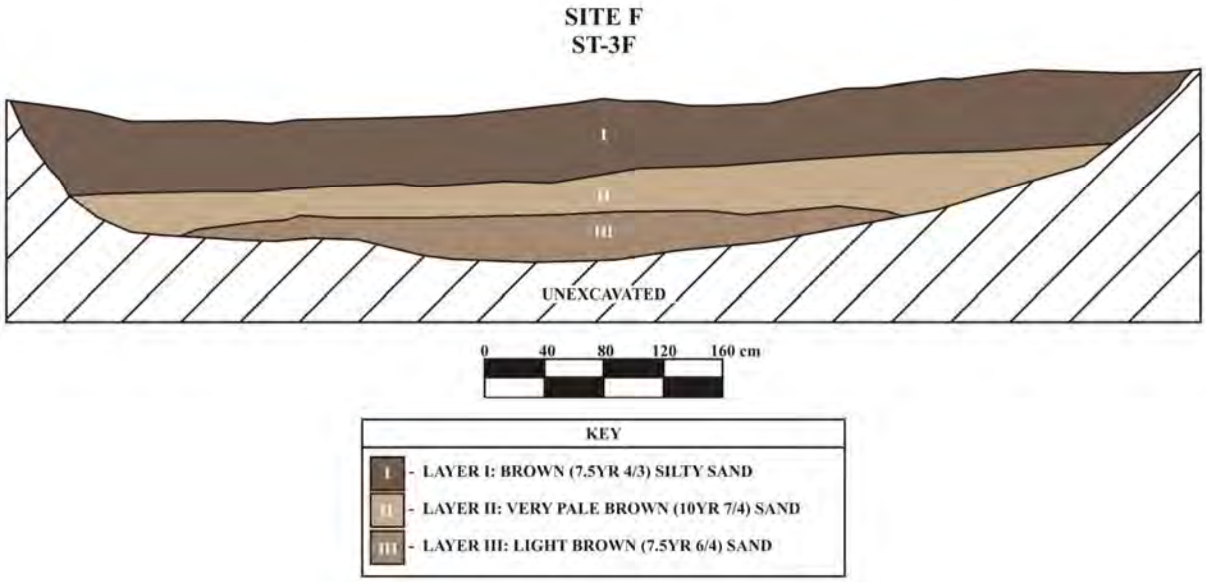


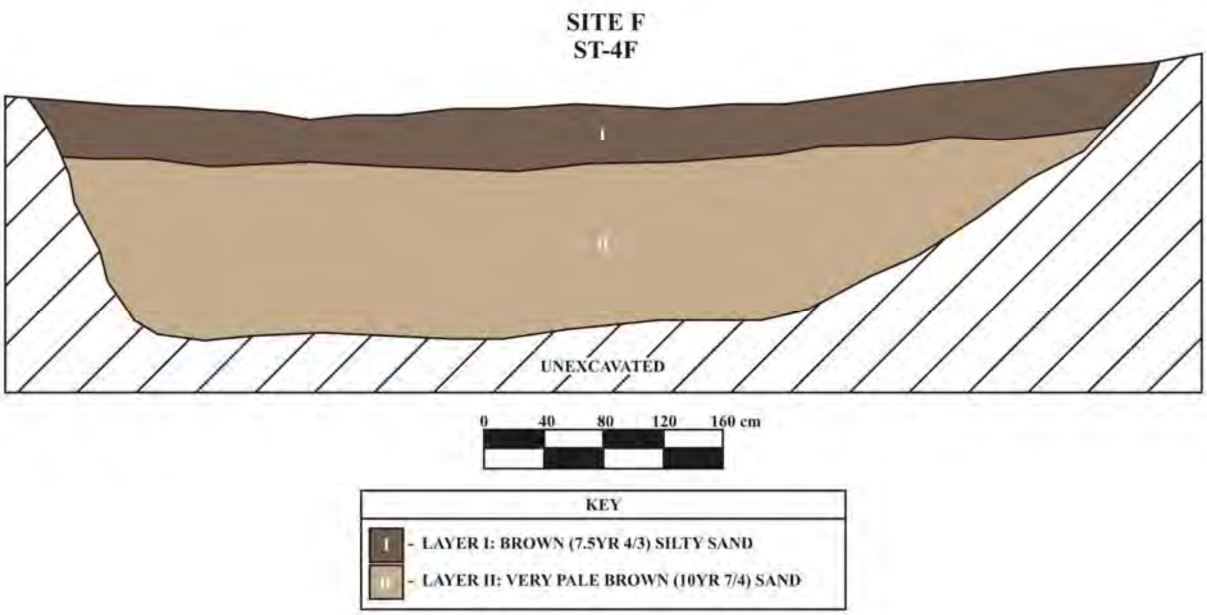
SITE F
ST-1F



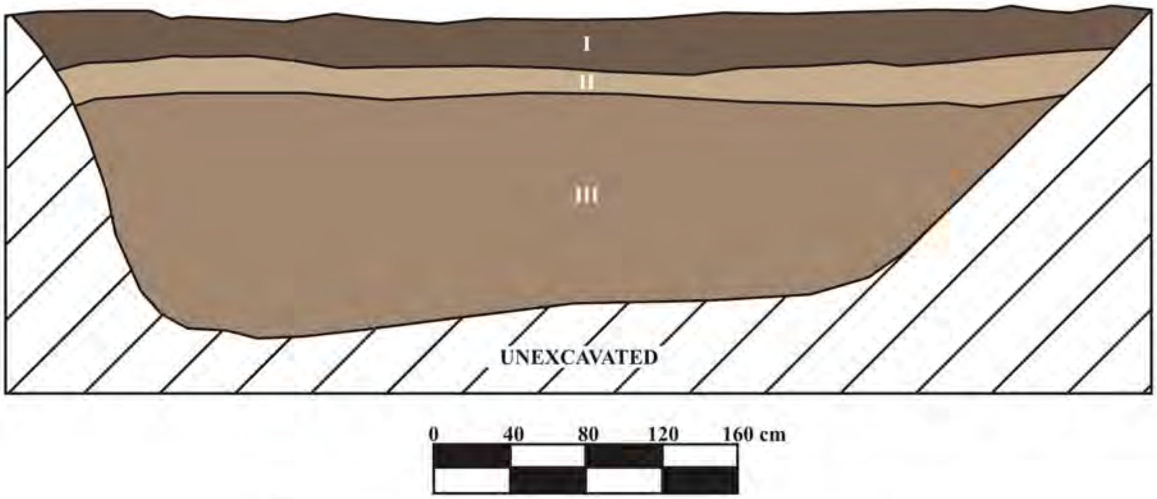
SITE F
ST-2F




SITE F
ST-3F
I
II
III
UNEXCAVATED
0
40
80
120
160 cm
KEY
I - LAYER I: BROWN (7.5YR 4/3) SILTY SAND
II - LAYER II: VERY PALE BROWN (10YR 7/4) SAND
III - LAYER III: LIGHT BROWN (7.5YR 6/4) SAND


SITE F
ST-4F
I
II
UNEXCAVATED
0
40
80
120
160 cm
KEY
I - LAYER I: BROWN (7.5YR 4/3) SILTY SAND
II - LAYER II: VERY PALE BROWN (10YR 7/4) SAND

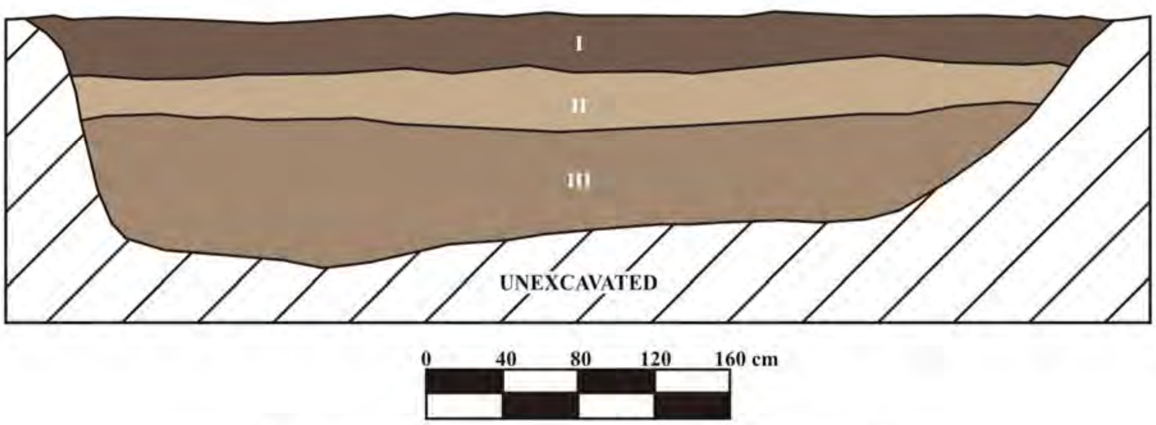
SITE F
ST-25F



KEY

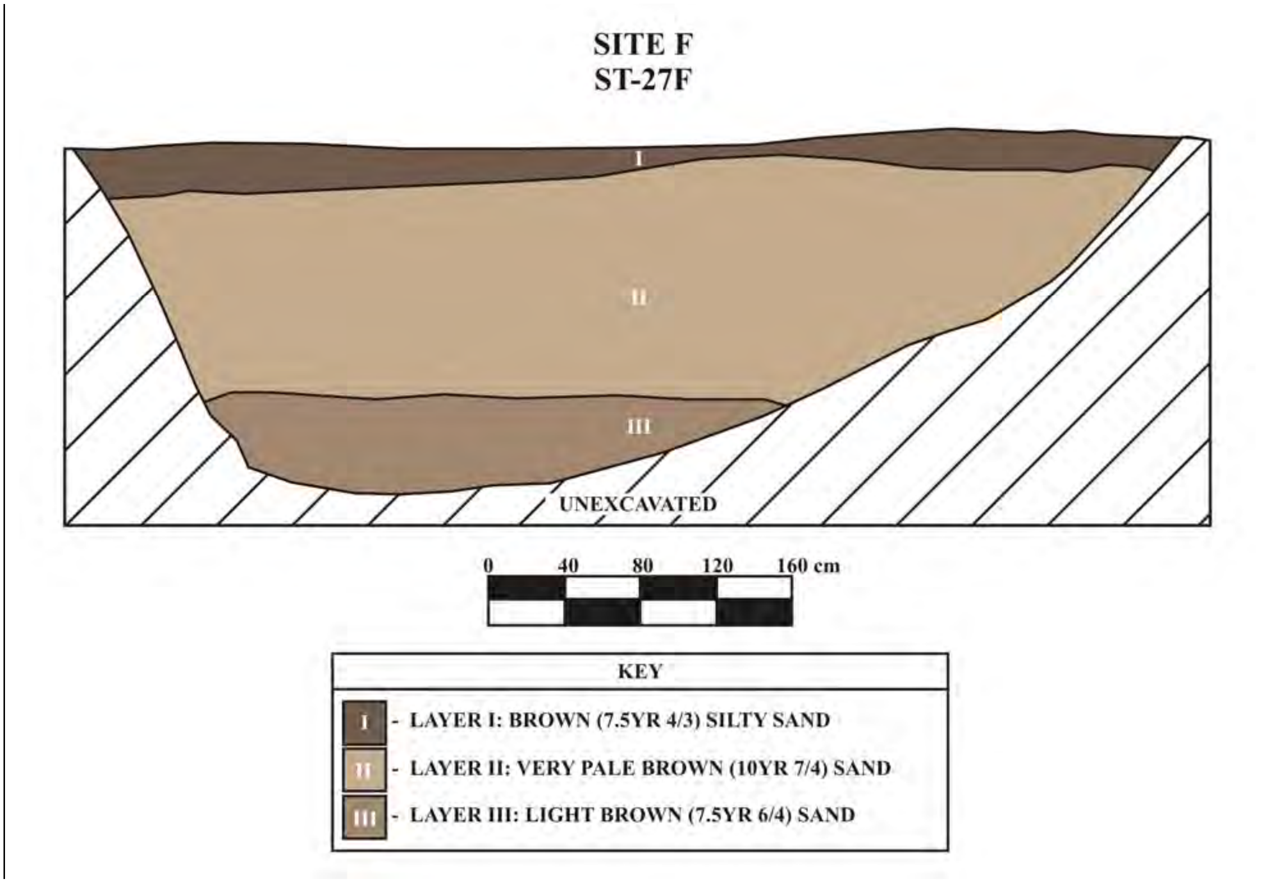
- I - LAYER I: BROWN (7.5YR 4/3) SILTY SAND
- II - LAYER II: VERY PALE BROWN (10YR 7/4) SAND
- III - LAYER III: LIGHT BROWN (7.5YR 6/4) SAND

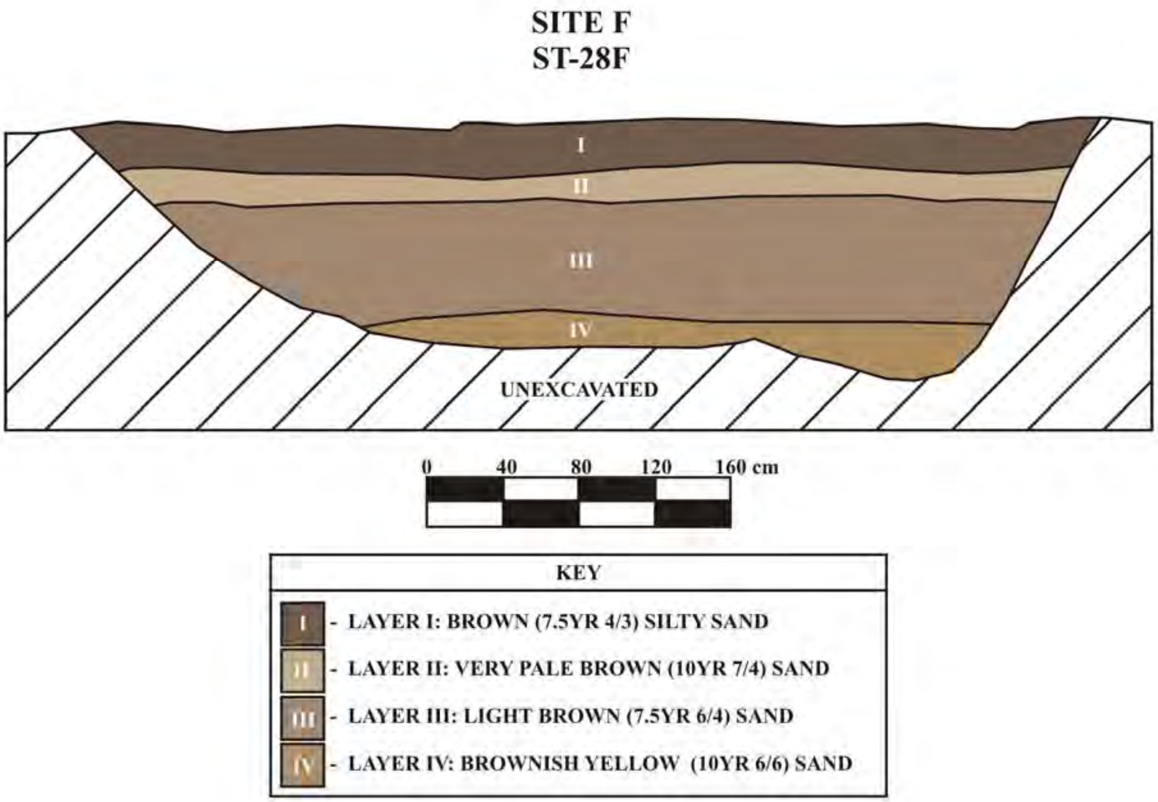
SITE F
ST-26F



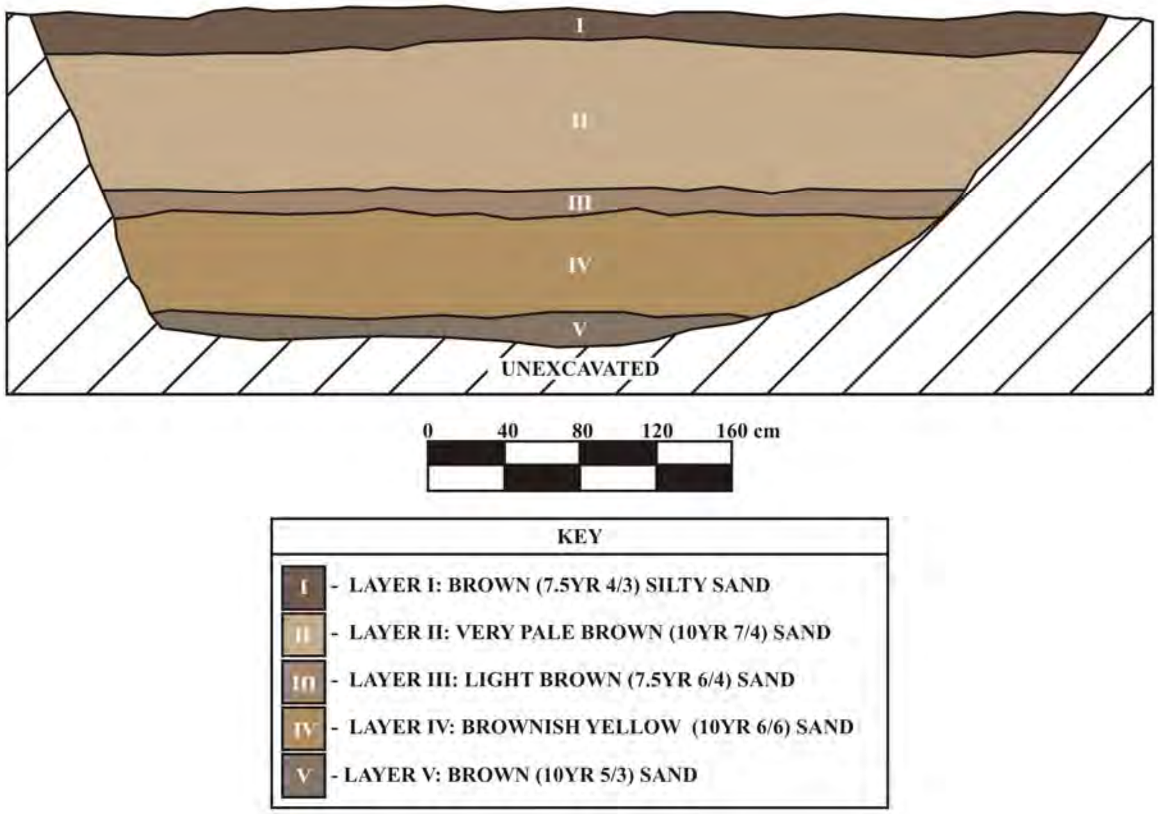
KEY

- I - LAYER I: BROWN (7.5YR 4/3) SILTY SAND
- II - LAYER II: VERY PALE BROWN (10YR 7/4) SAND
- III - LAYER III: LIGHT BROWN (7.5YR 6/4) SAND

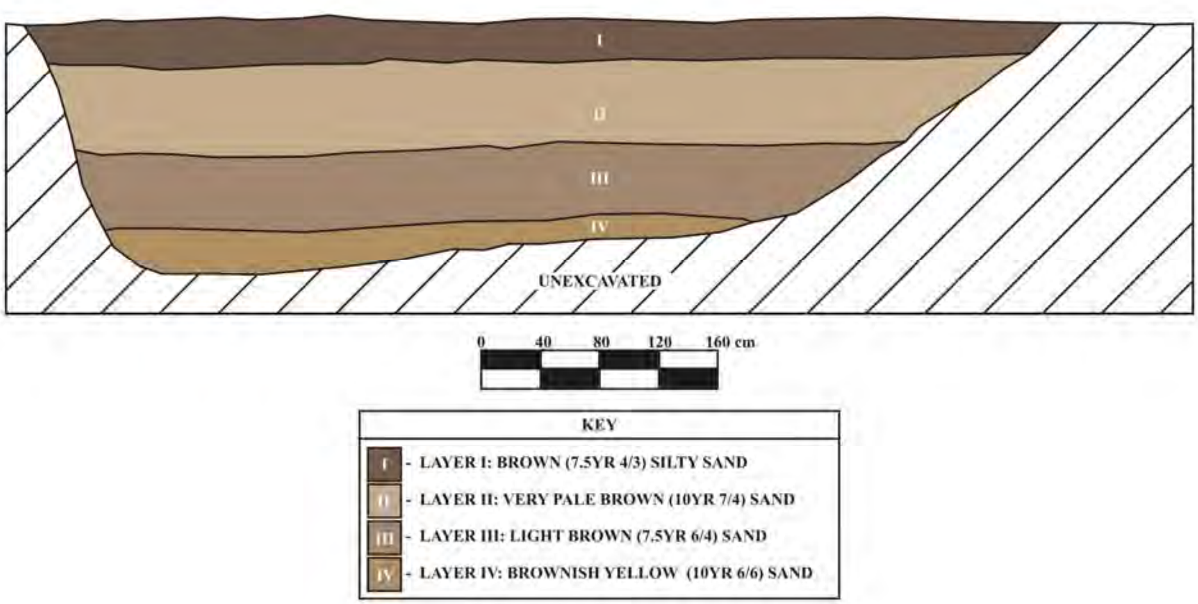

SITE F
ST-27F
I
II
III
UNEXCAVATED
0
40
80
120
160 cm
KEY
I - LAYER I: BROWN (7.5YR 4/3) SILTY SAND
II - LAYER II: VERY PALE BROWN (10YR 7/4) SAND
III - LAYER III: LIGHT BROWN (7.5YR 6/4) SAND


SITE F
ST-28F
I
II
III
IV
UNEXCAVATED
0
40
80
120
160 cm
KEY
I - LAYER I: BROWN (7.5YR 4/3) SILTY SAND
II - LAYER II: VERY PALE BROWN (10YR 7/4) SAND
III - LAYER III: LIGHT BROWN (7.5YR 6/4) SAND
IV - LAYER IV: BROWNISH YELLOW (10YR 6/6) SAND

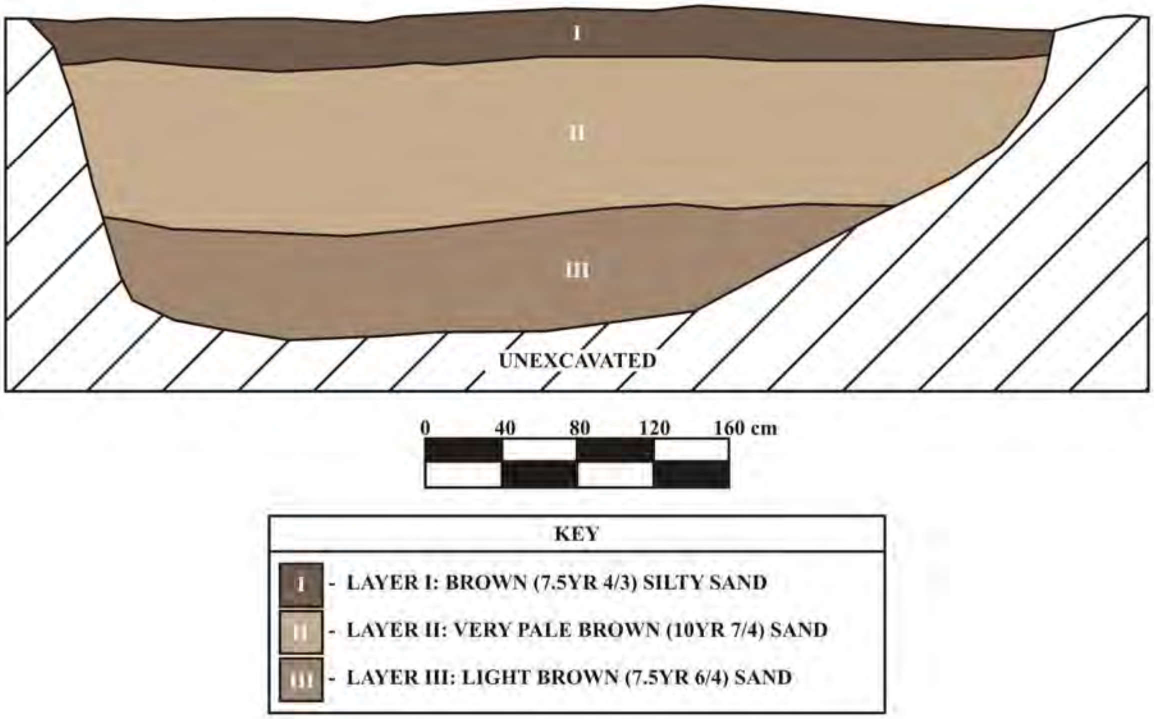
SITE F
ST-29F



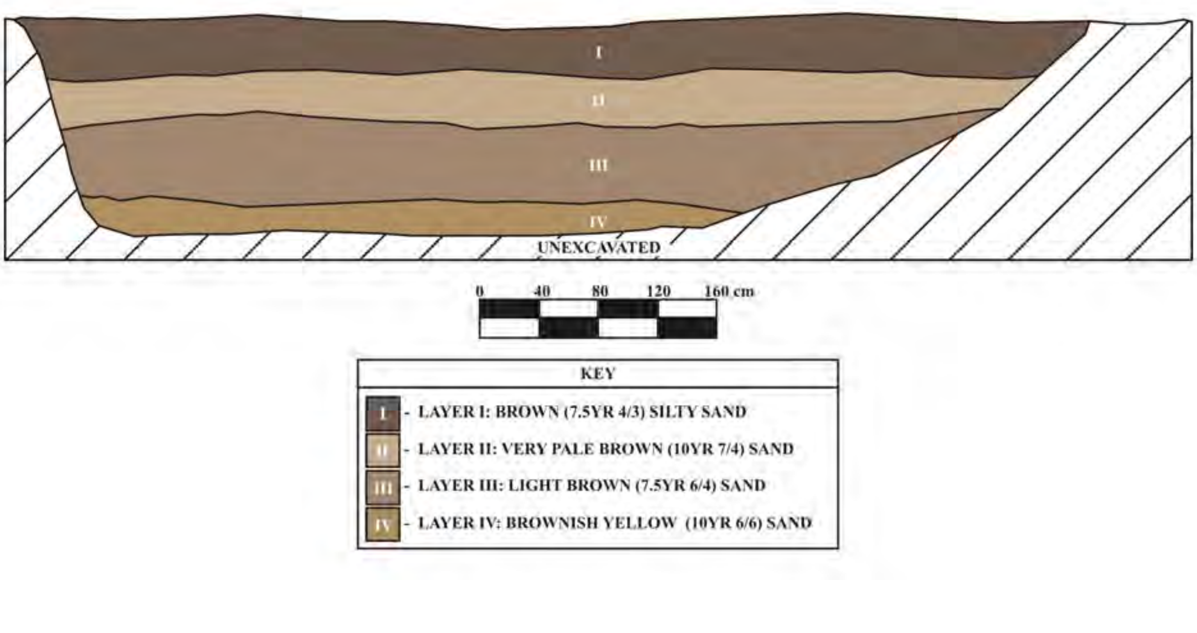
SITE F
ST-30F

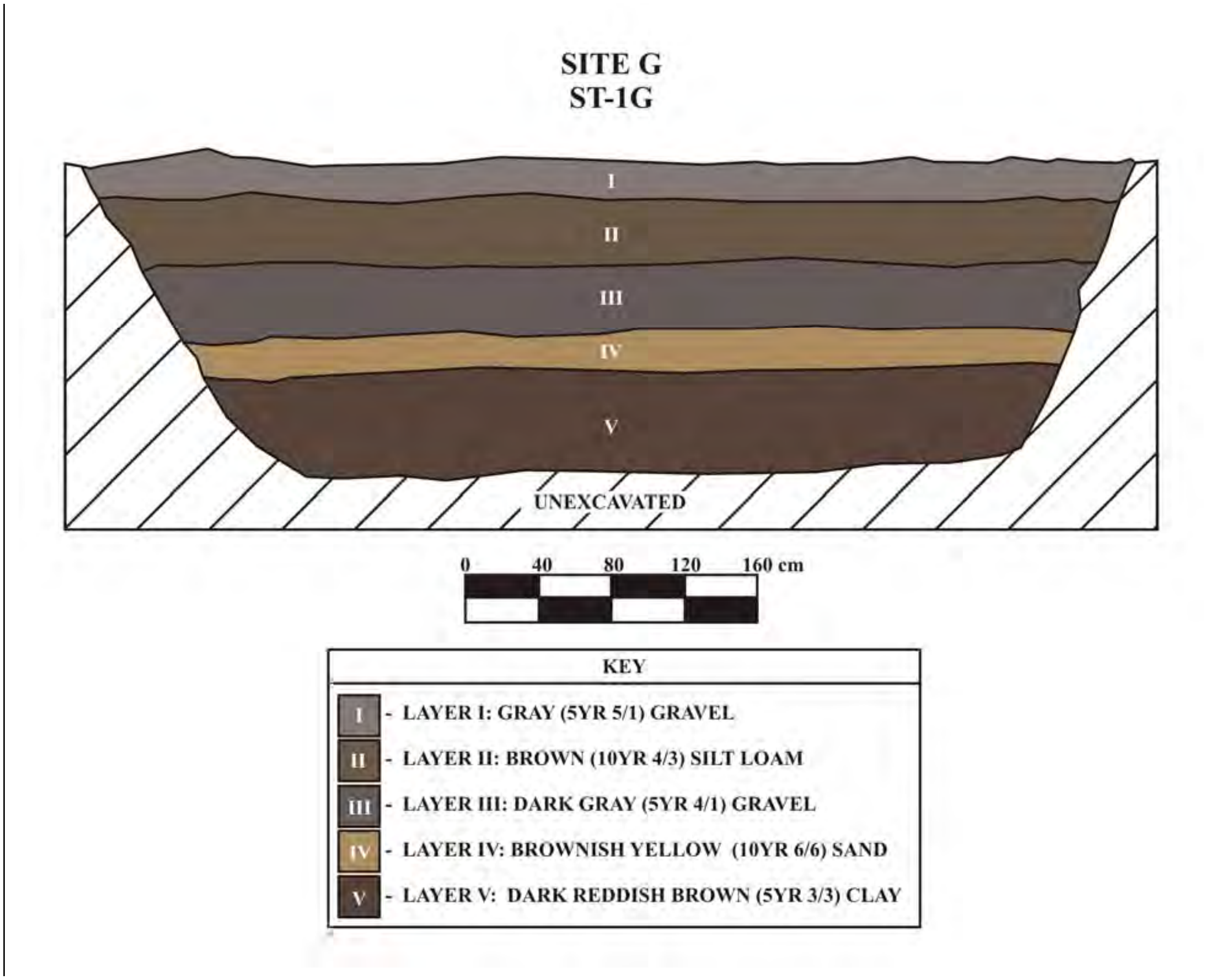


SITE F
ST-31F

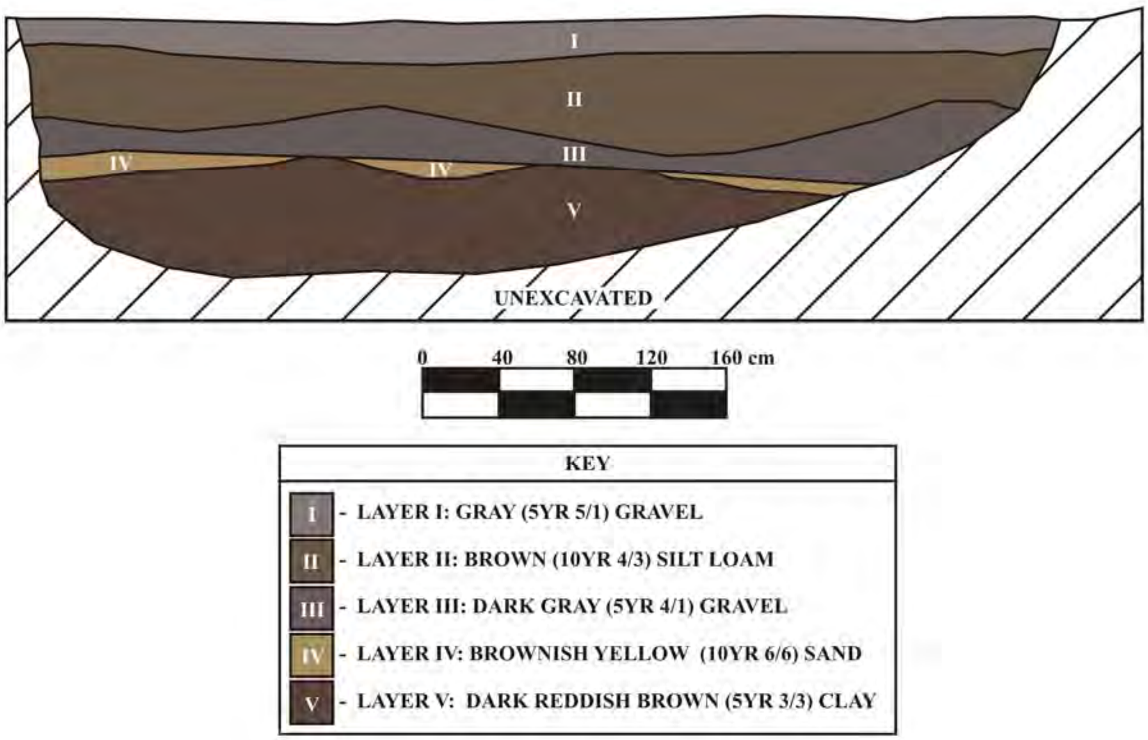


SITE F
ST-32F

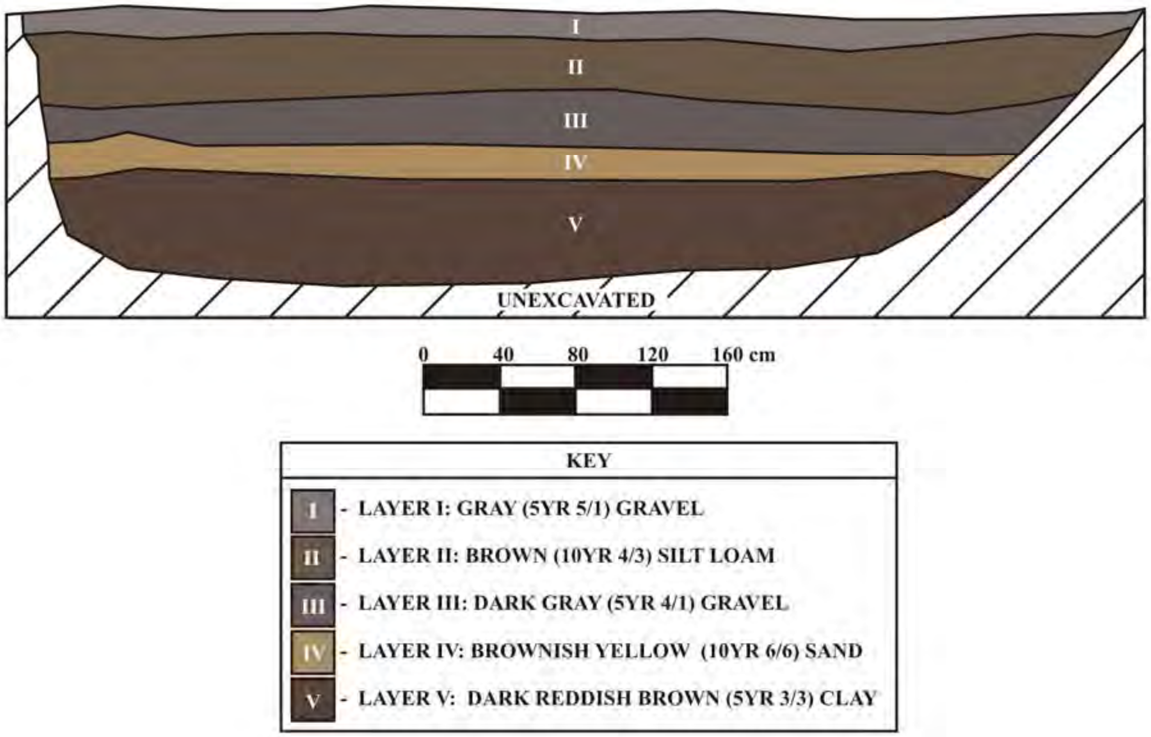



SITE G
ST-1G
I
II
III
IV
V
UNEXCAVATED
0
40
80
120
160 cm
KEY
I - LAYER I: GRAY (5YR 5/1) GRAVEL
II - LAYER II: BROWN (10YR 4/3) SILT LOAM
III - LAYER III: DARK GRAY (5YR 4/1) GRAVEL
IV - LAYER IV: BROWNISH YELLOW (10YR 6/6) SAND
V - LAYER V: DARK REDDISH BROWN (5YR 3/3) CLAY

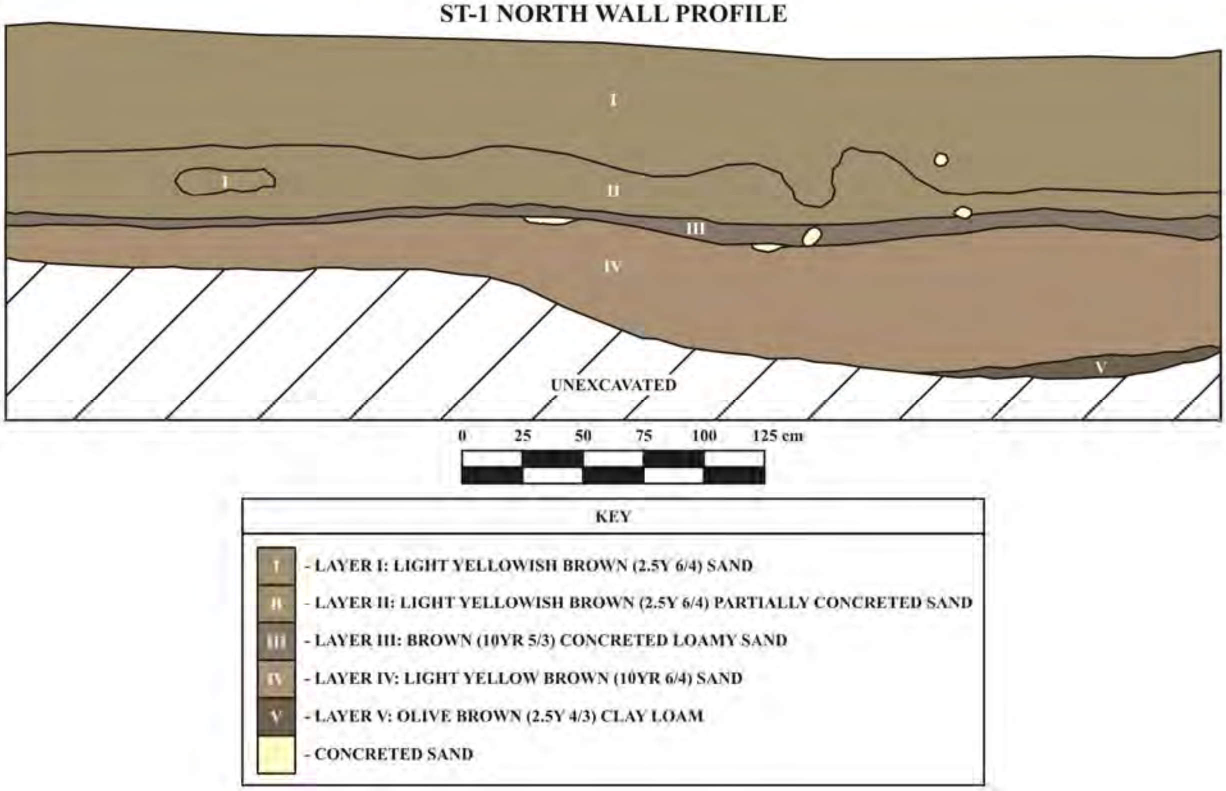
SITE G
ST-2G


I
II
III
IV
IV
V
UNEXCAVATED
0
40
80
120
160 cm
KEY
I - LAYER I: GRAY (5YR 5/1) GRAVEL
II - LAYER II: BROWN (10YR 4/3) SILT LOAM
III - LAYER III: DARK GRAY (5YR 4/1) GRAVEL
IV - LAYER IV: BROWNISH YELLOW (10YR 6/6) SAND
V - LAYER V: DARK REDDISH BROWN (5YR 3/3) CLAY

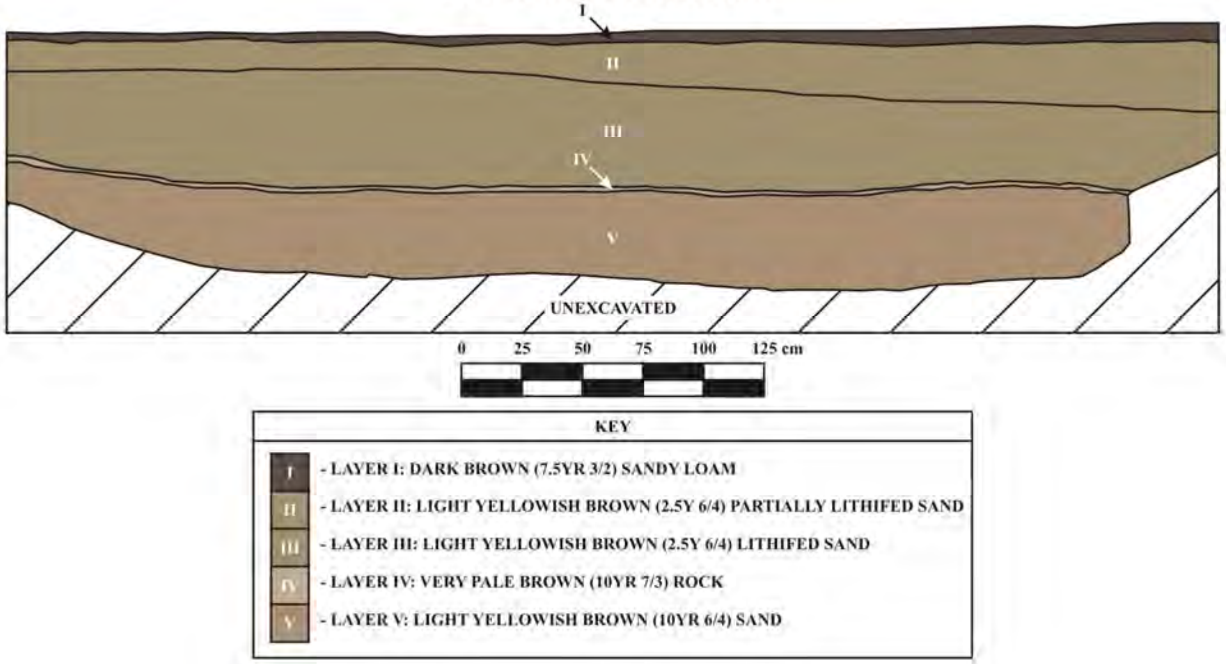
SITE G
ST-3G


I
II
III
IV
V
UNEXCAVATED
0
40
80
120
160 cm
KEY
I - LAYER I: GRAY (5YR 5/1) GRAVEL
II - LAYER II: BROWN (10YR 4/3) SILT LOAM
III - LAYER III: DARK GRAY (5YR 4/1) GRAVEL
IV - LAYER IV: BROWNISH YELLOW (10YR 6/6) SAND
V - LAYER V: DARK REDDISH BROWN (5YR 3/3) CLAY

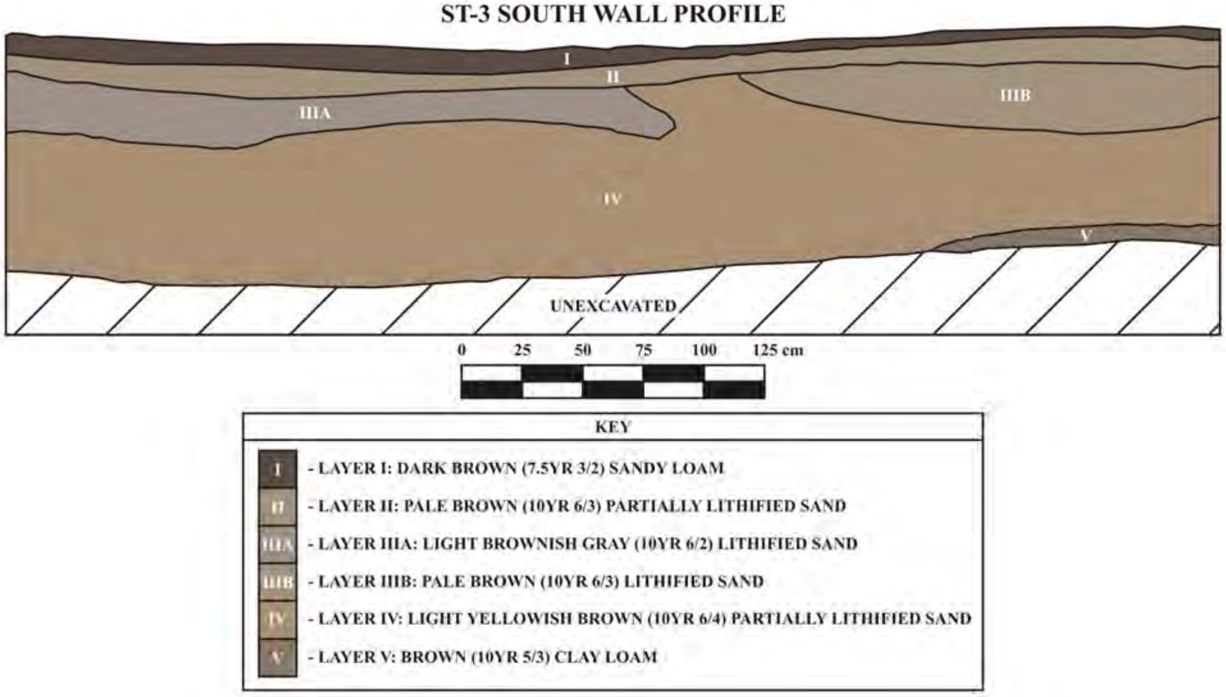
ST-1 NORTH WALL PROFILE



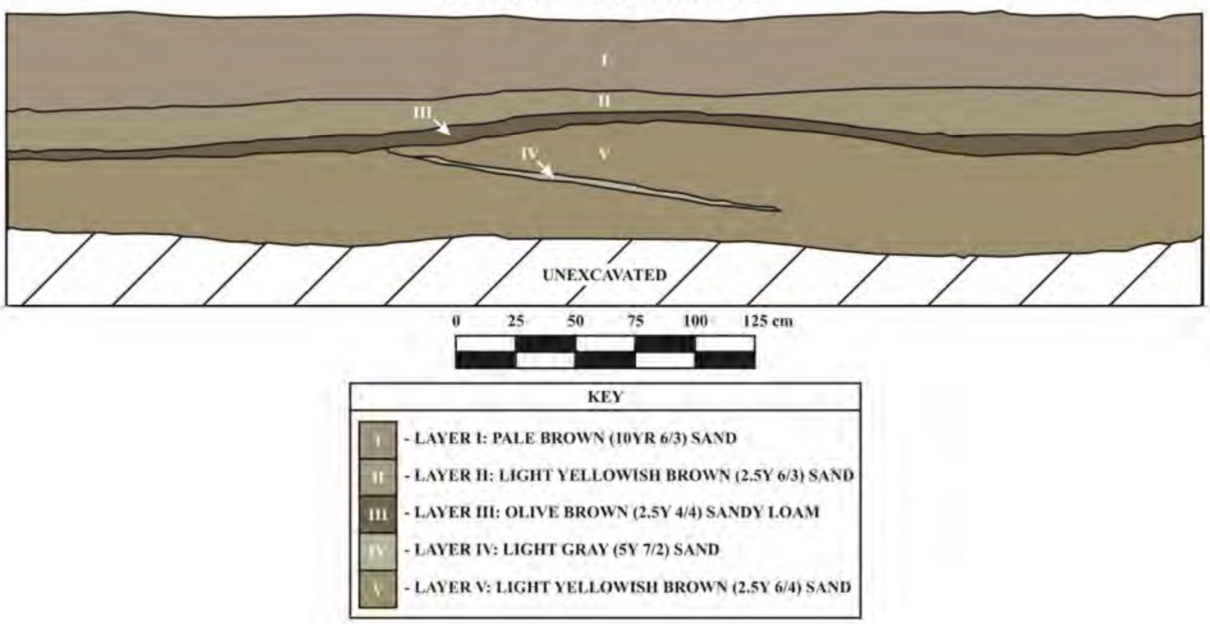
ST-2 WEST WALL PROFILE



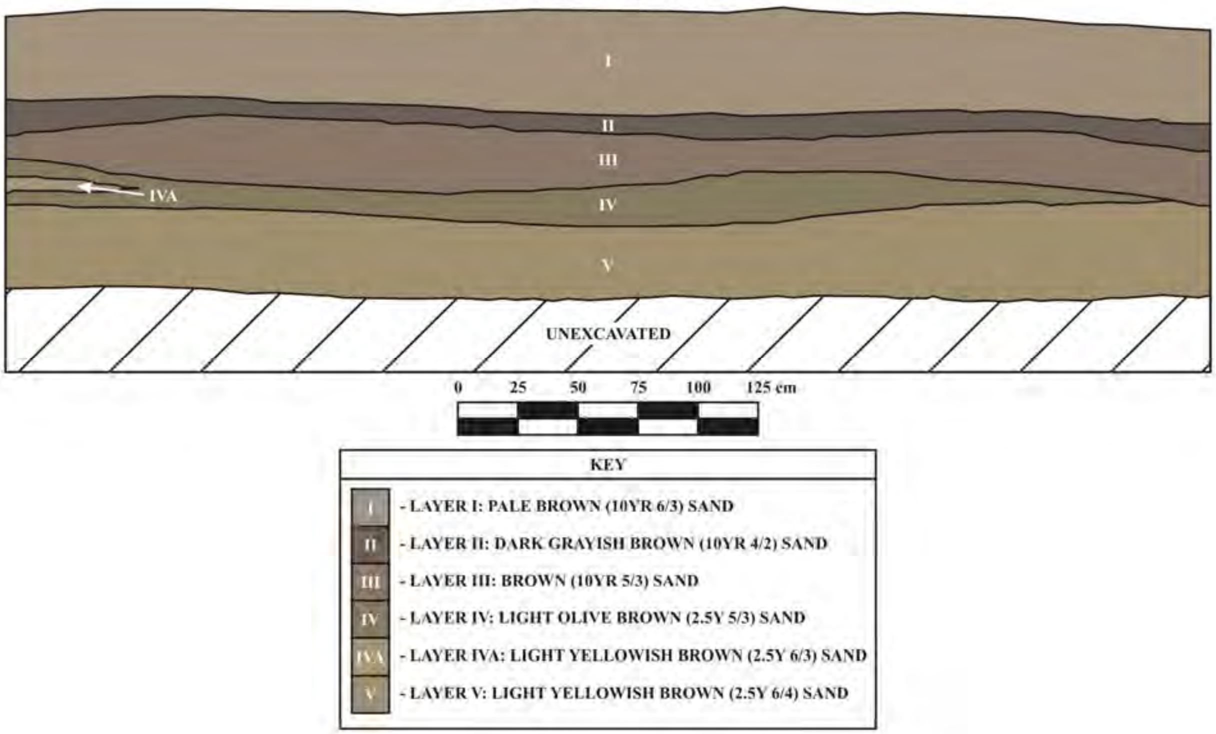
ST-3 SOUTH WALL PROFILE



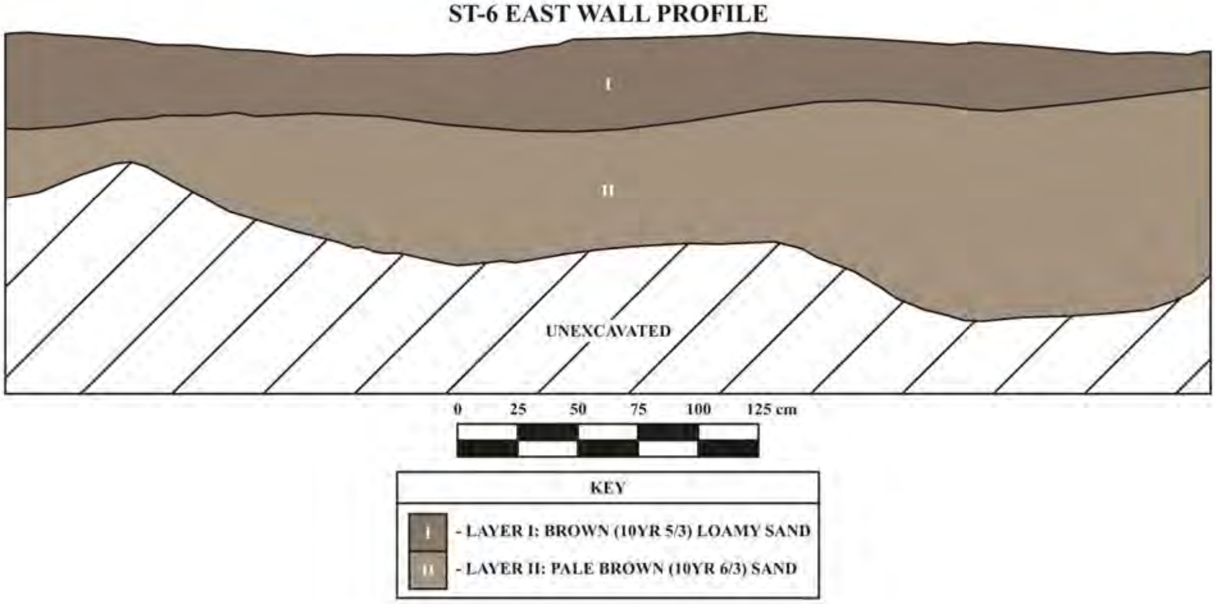
ST-4 EAST WALL PROFILE



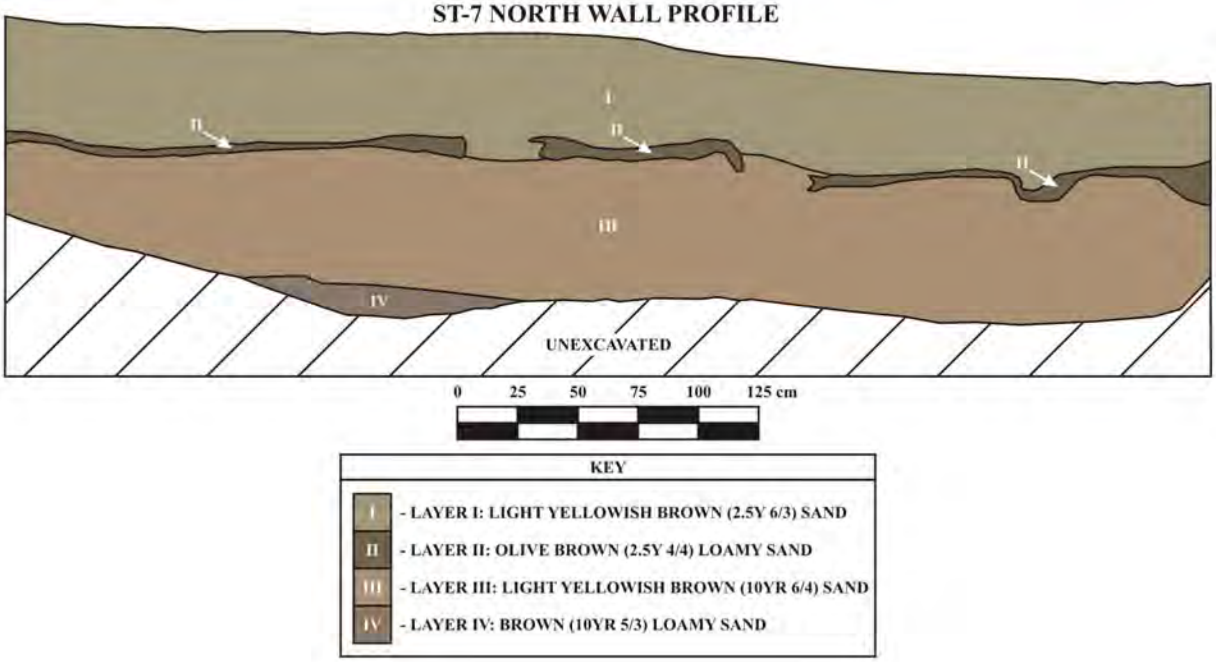
ST-5 WEST WALL PROFILE



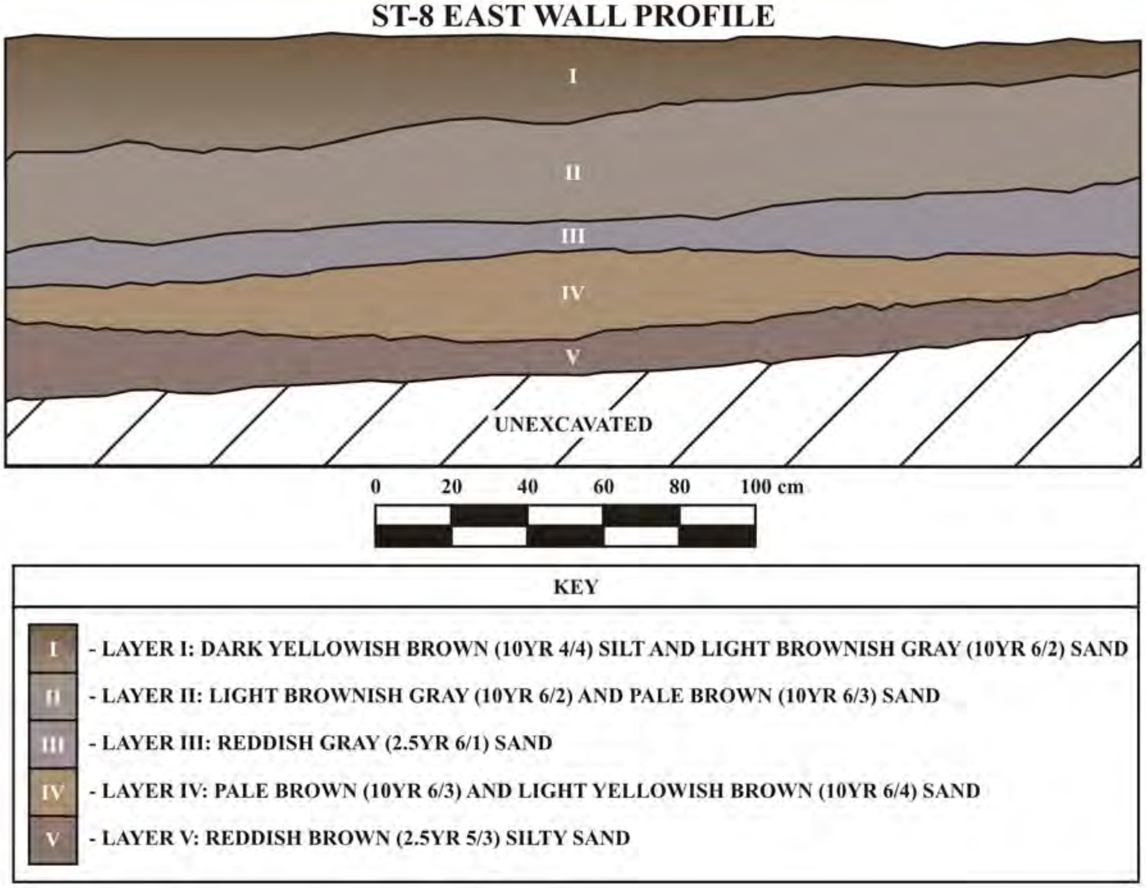
ST-6 EAST WALL PROFILE

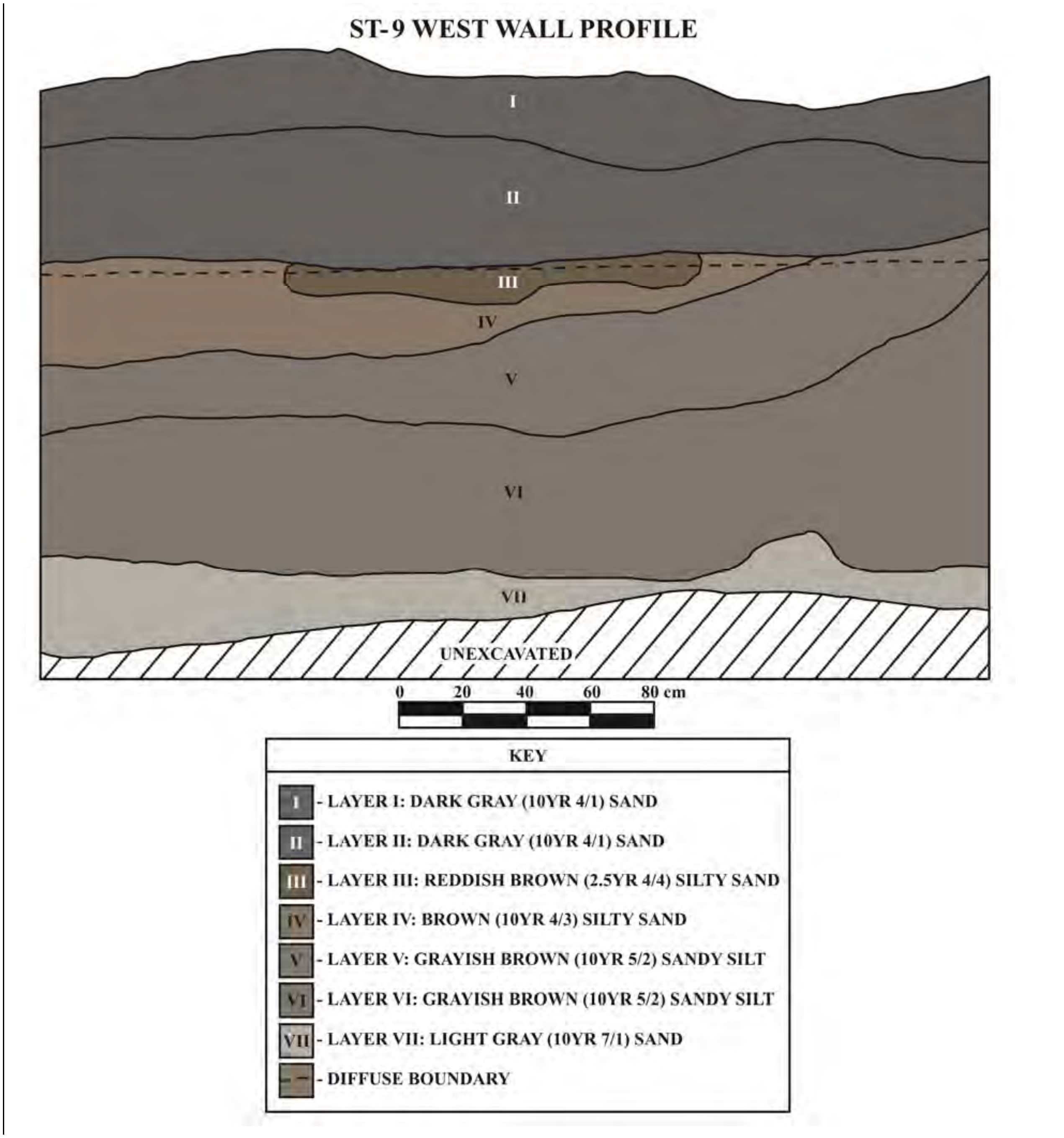


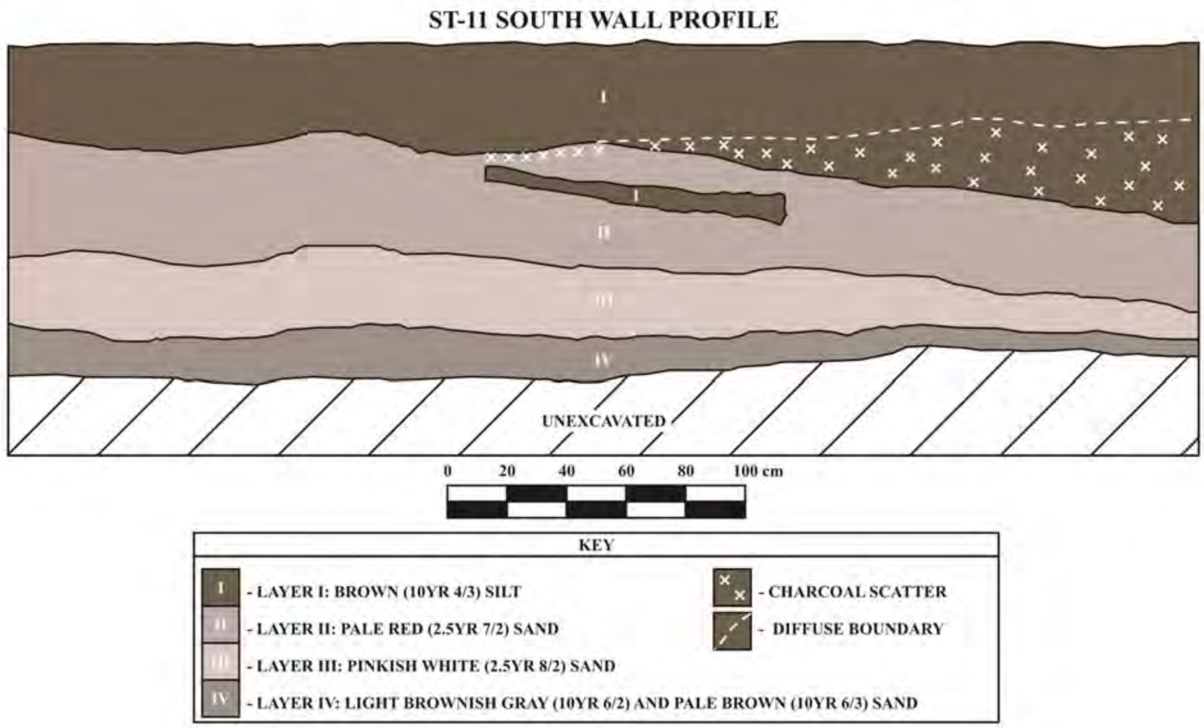
ST-7 NORTH WALL PROFILE

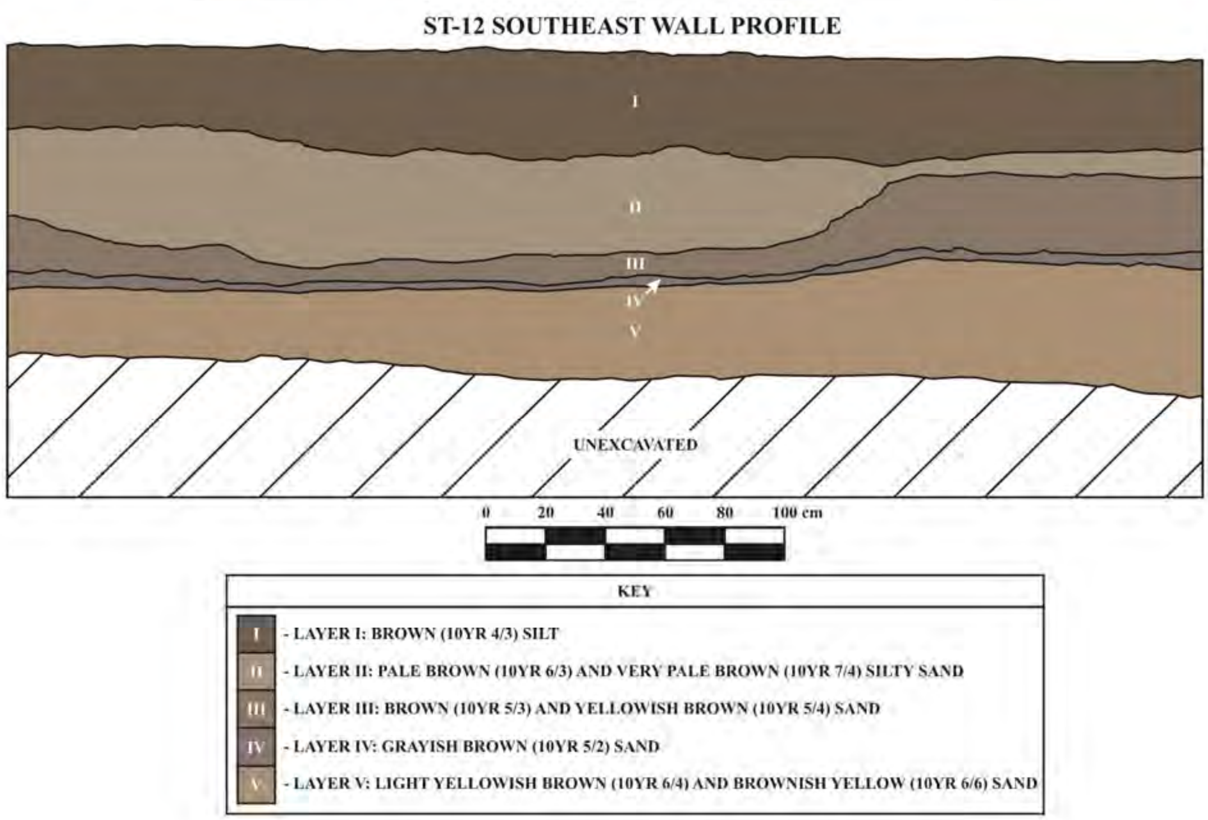


ST-8 EAST WALL PROFILE

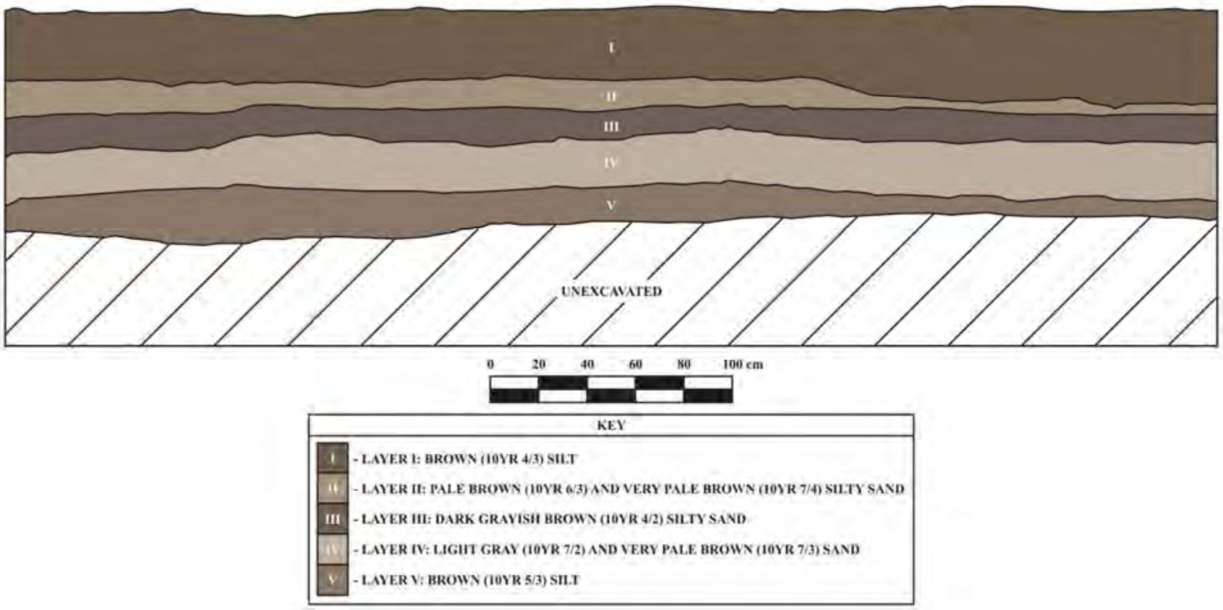



ST-9 WEST WALL PROFILE
I
II
III
IV
V
VI
VII
UNEXCAVATED
0
20
40
60
80 cm
KEY
I - LAYER I: DARK GRAY (10YR 4/1) SAND
II - LAYER II: DARK GRAY (10YR 4/1) SAND
III - LAYER III: REDDISH BROWN (2.5YR 4/4) SILTY SAND
IV - LAYER IV: BROWN (10YR 4/3) SILTY SAND
V - LAYER V: GRAYISH BROWN (10YR 5/2) SANDY SILT
VI - LAYER VI: GRAYISH BROWN (10YR 5/2) SANDY SILT
VII - LAYER VII: LIGHT GRAY (10YR 7/1) SAND
- DIFFUSE BOUNDARY

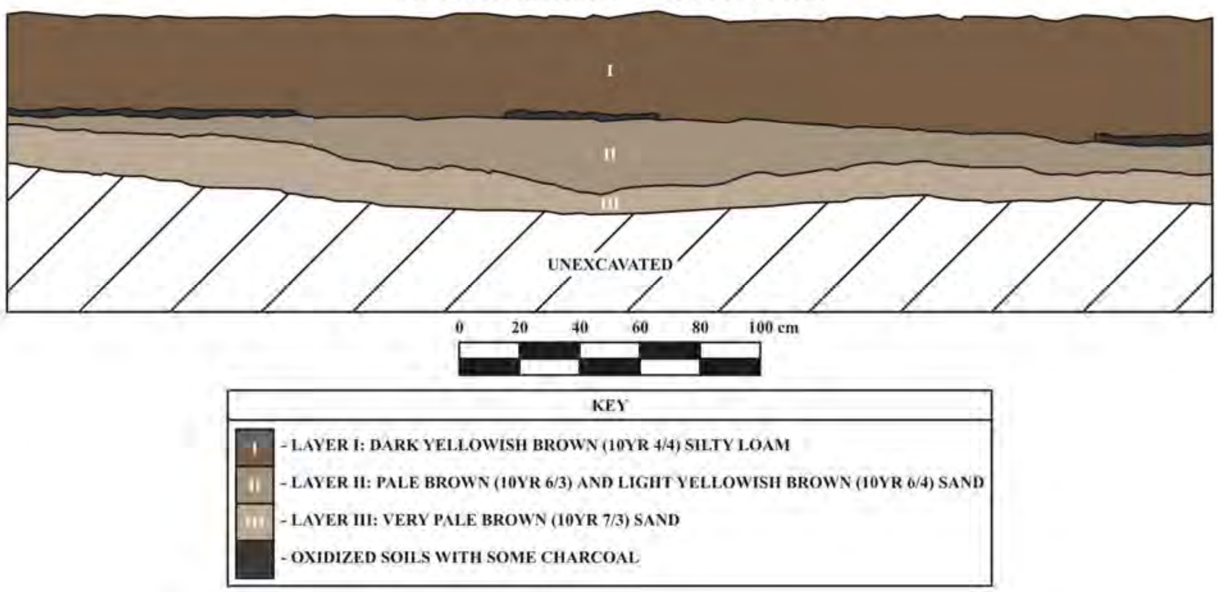

ST-11 SOUTH WALL PROFILE
I
I
II
III
IV
UNEXCAVATED
0 20 40 60 80 100 cm
KEY
I - LAYER I: BROWN (10YR 4/3) SILT
II - LAYER II: PALE RED (2.5YR 7/2) SAND
III - LAYER III: PINKISH WHITE (2.5YR 8/2) SAND
IV - LAYER IV: LIGHT BROWNISH GRAY (10YR 6/2) AND PALE BROWN (10YR 6/3) SAND
- CHARCOAL SCATTER
- DIFFUSE BOUNDARY


ST-12 SOUTHEAST WALL PROFILE
I
II
III
IV
V
UNEXCAVATED
0 20 40 60 80 100 cm
KEY
I - LAYER I: BROWN (10YR 4/3) SILT
II - LAYER II: PALE BROWN (10YR 6/3) AND VERY PALE BROWN (10YR 7/4) SILTY SAND
III - LAYER III: BROWN (10YR 5/3) AND YELLOWISH BROWN (10YR 5/4) SAND
IV - LAYER IV: GRAYISH BROWN (10YR 5/2) SAND
V - LAYER V: LIGHT YELLOWISH BROWN (10YR 6/4) AND BROWNISH YELLOW (10YR 6/6) SAND

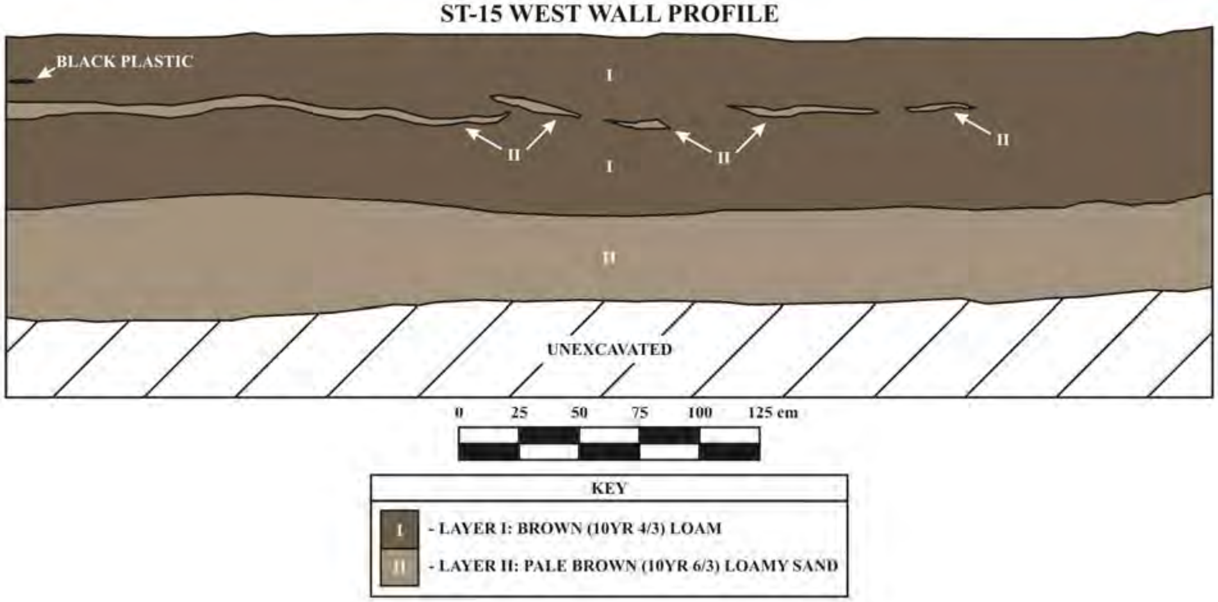
ST-13 SOUTHEAST WALL PROFILE



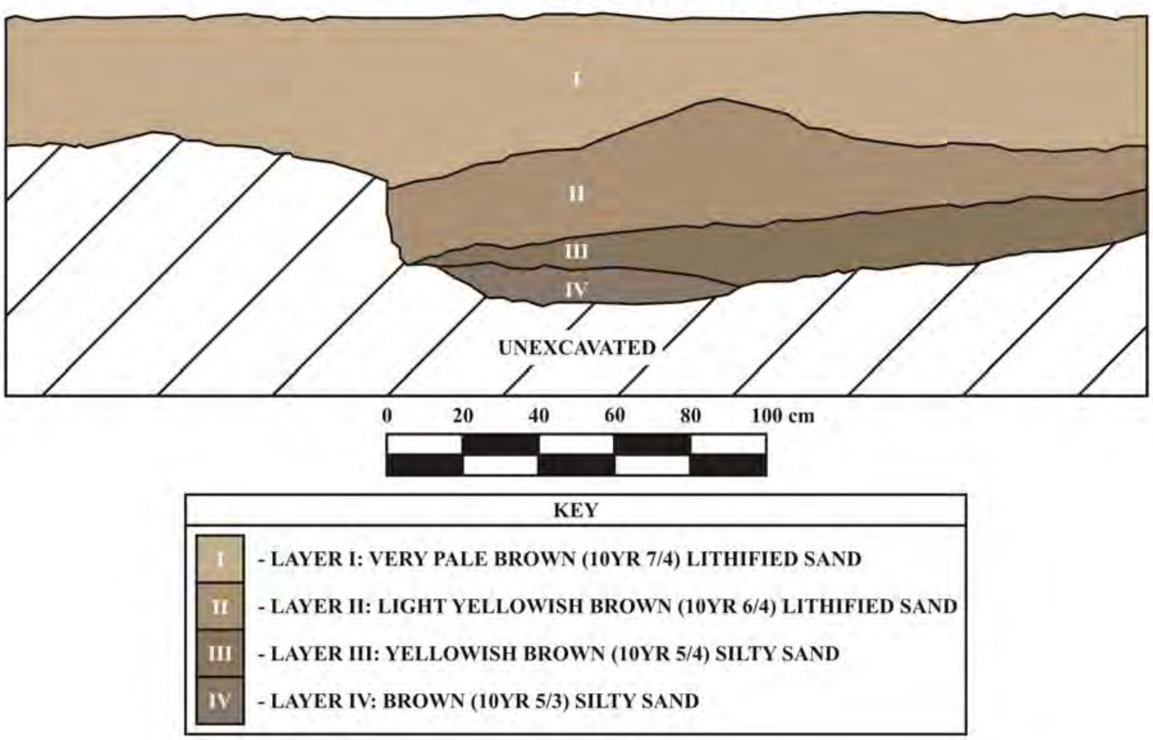
ST-14 NORTHEAST WALL PROFILE



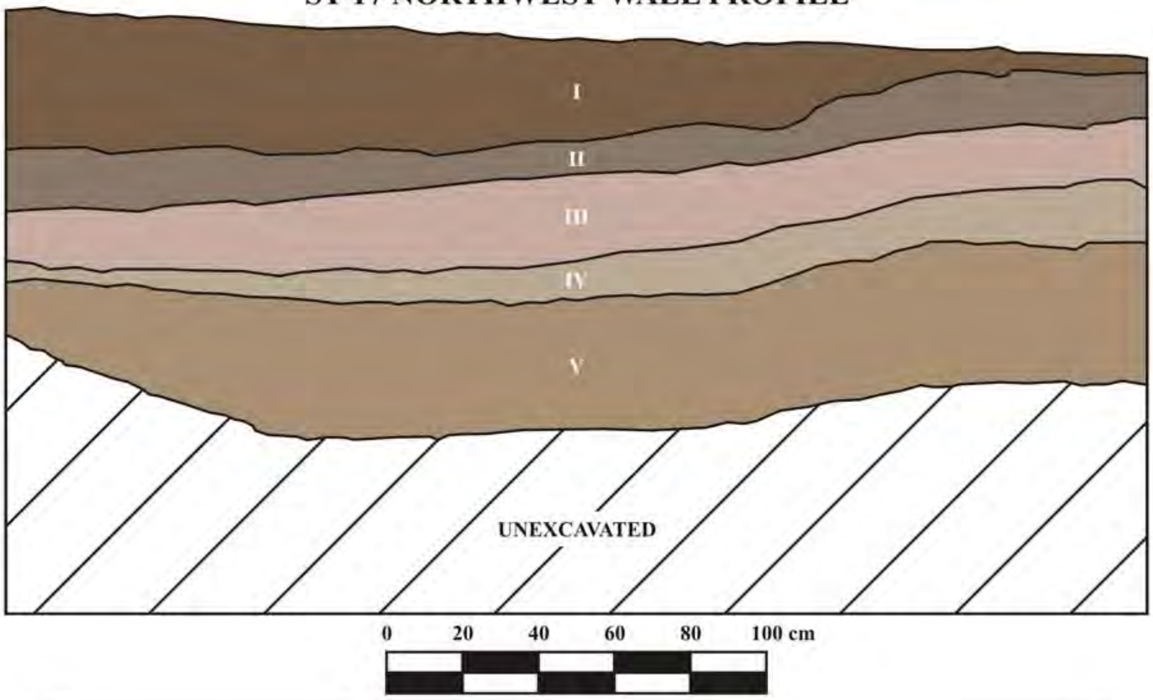
ST-15 WEST WALL PROFILE



ST-16 SOUTHEAST WALL PROFILE



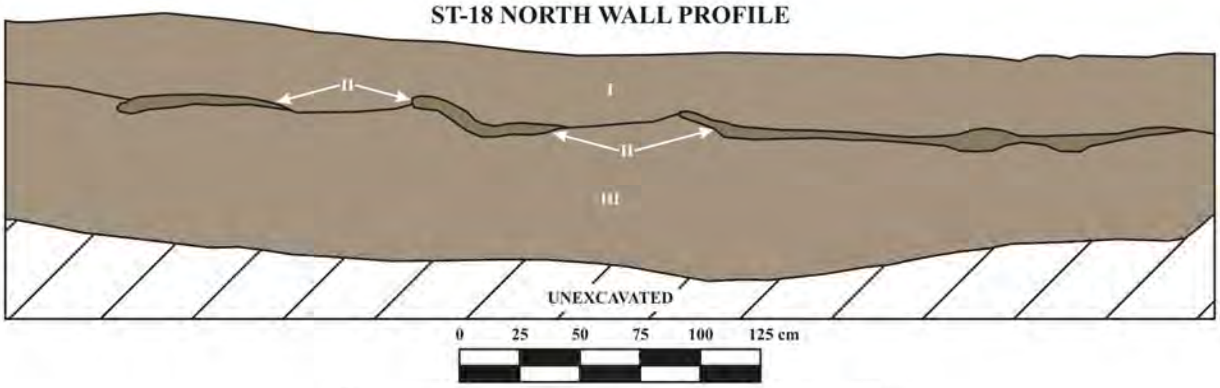
ST-17 NORTHWEST WALL PROFILE



KEY

- I - LAYER I: DARK YELLOWISH BROWN (10YR 4/4) SILT LOAM
- II - LAYER II: BROWN (10YR 5/3) SAND
- III - LAYER III: LIGHT REDDISH BROWN (2.5YR 7/3) AND LIGHT REDDISH BROWN (2.5YR 7/4) SAND
- IV - LAYER IV: VERY PALE BROWN (10YR 7/3) SAND
- V - LAYER V: LIGHT YELLOWISH BROWN (10YR 6/4) LITHIFIED SAND

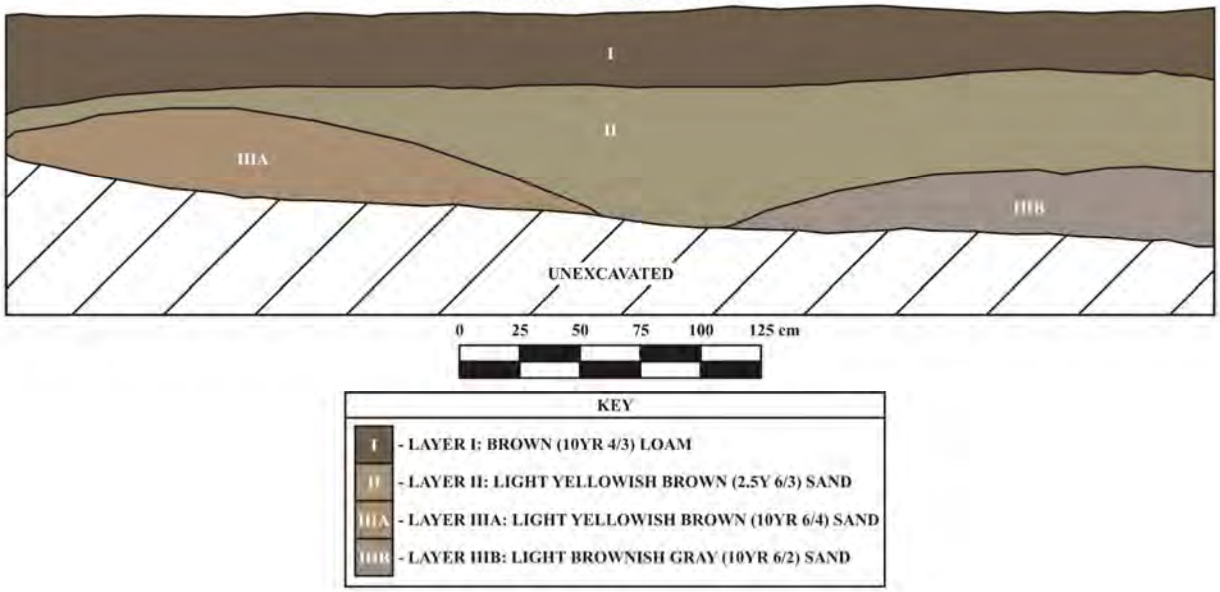
ST-18 NORTH WALL PROFILE



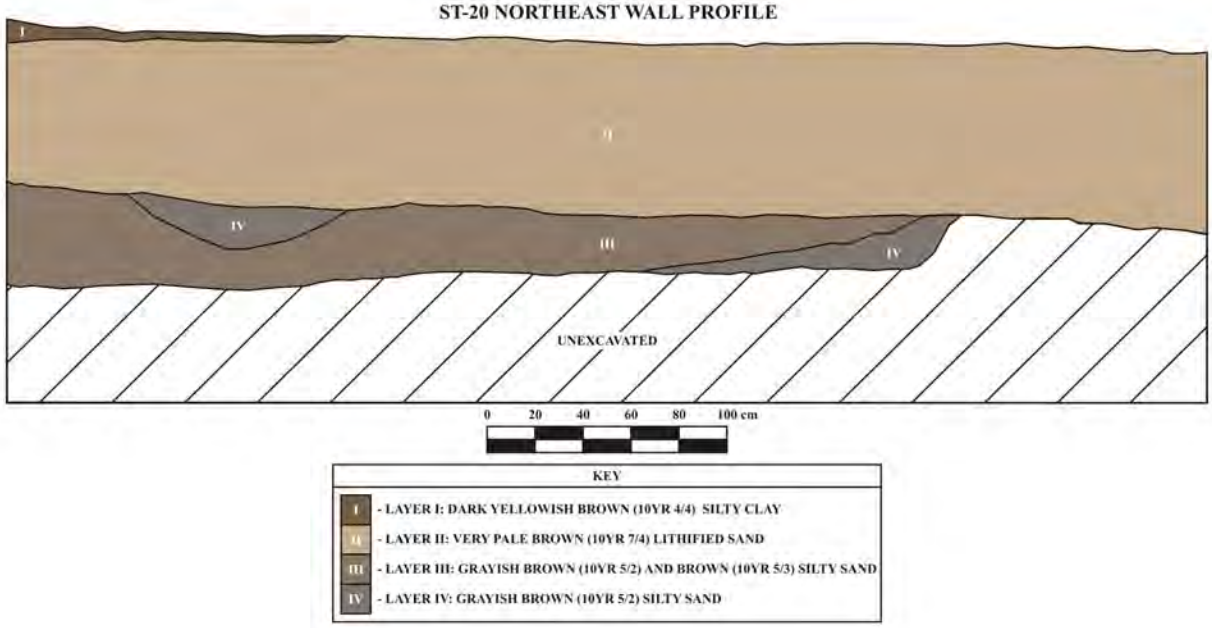
KEY

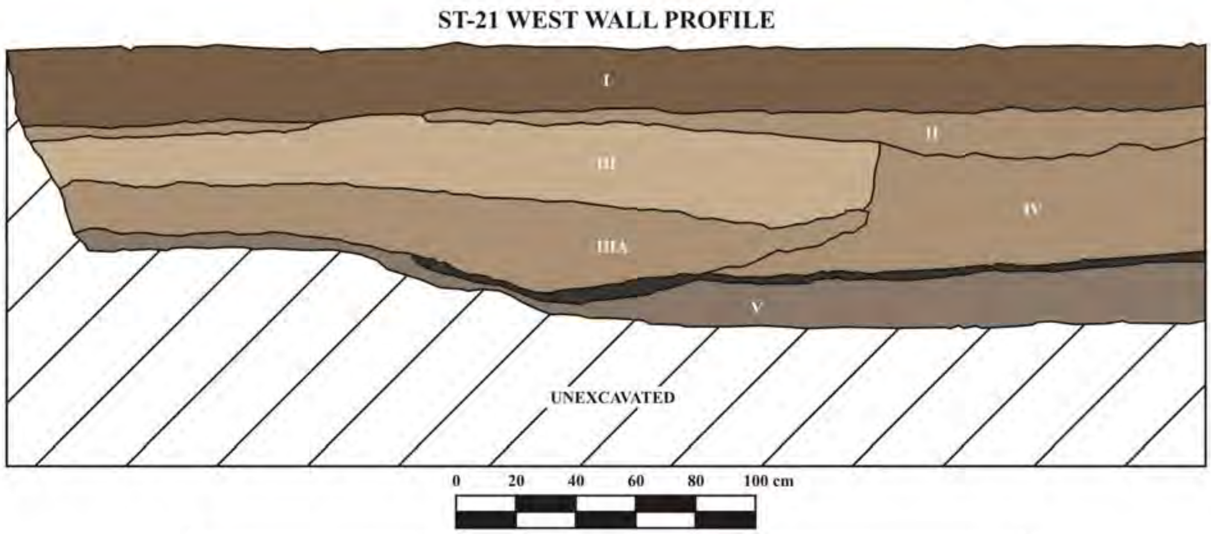
- I - LAYER I: PALE BROWN (10YR 6/3) SAND
- II - LAYER II: LIGHT OLIVE BROWN (2.5Y 5/3) LOAMY SAND
- III - LAYER III: PALE BROWN (10YR 6/3) SAND

ST-19 EAST WALL PROFILE



ST-20 NORTHEAST WALL PROFILE

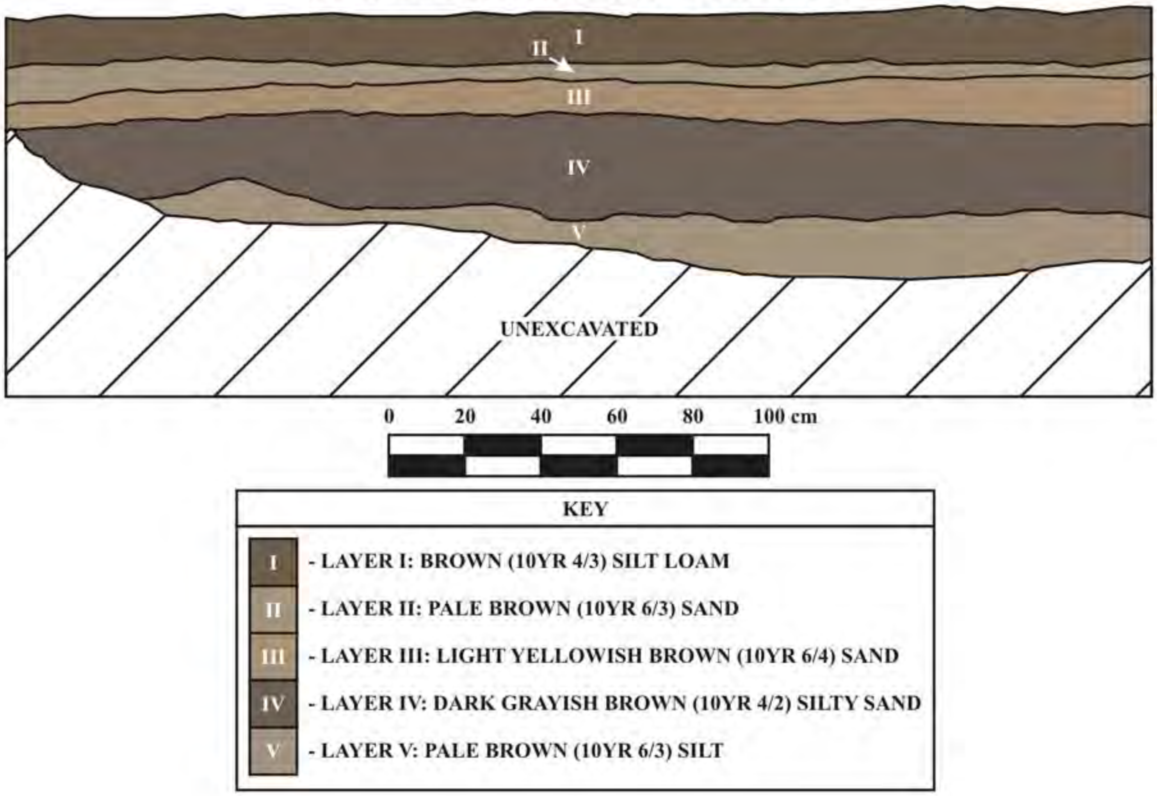




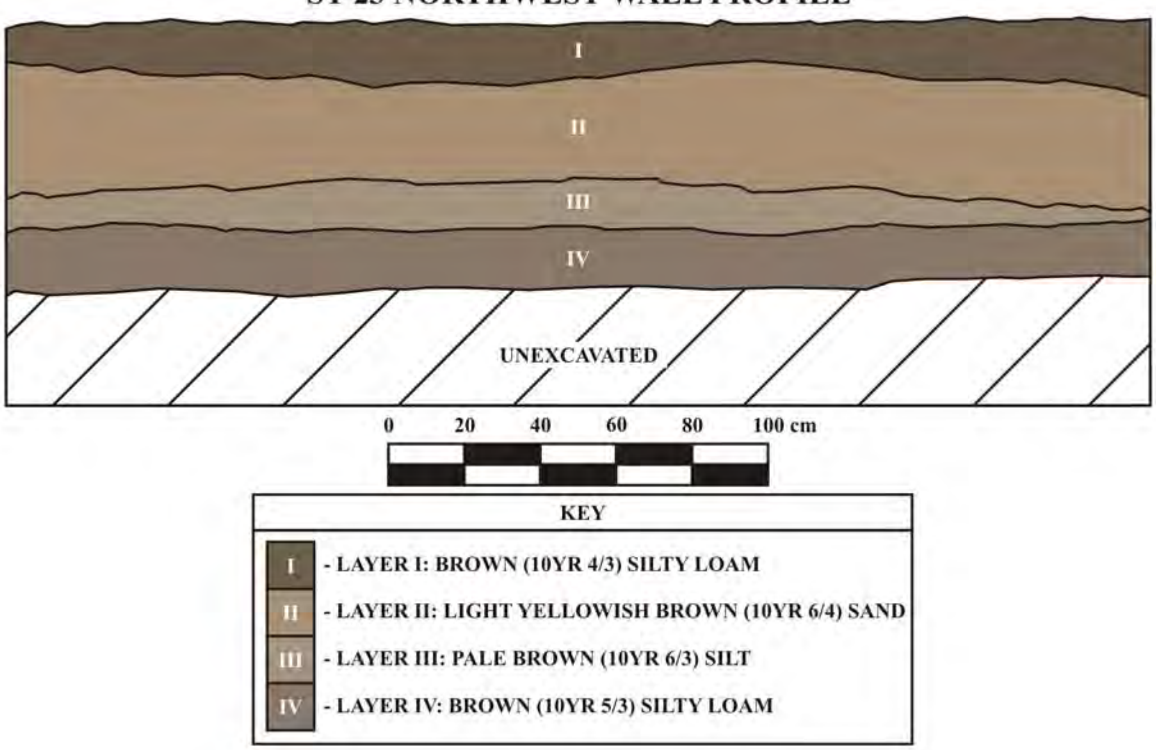
KEY

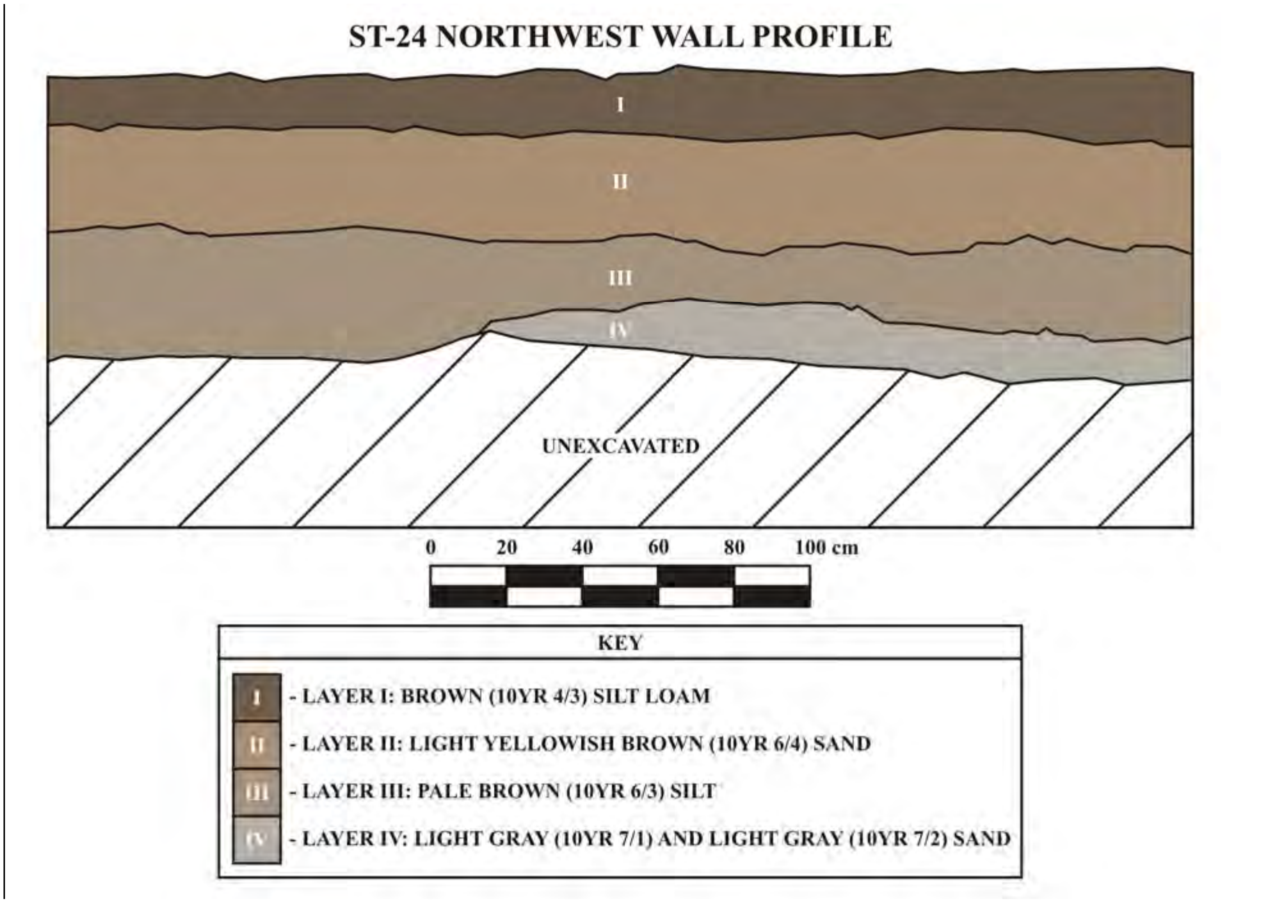
- I - LAYER I: DARK YELLOWISH BROWN (10YR 4/4) SILTY CLAY
- II - LAYER II: LIGHT YELLOWISH BROWN (10YR 6/4) LITHIFIED SAND
- III - LAYER III: VERY PALE BROWN (10YR 7/4) AND LIGHT YELLOWISH BROWN (10YR 6/4) SAND
- IIIA - LAYER IIIA: VERY PALE BROWN (10YR 7/4) AND LIGHT YELLOWISH BROWN (10YR 6/4) SAND
- IV - LAYER IV: YELLOWISH BROWN (10YR 5/4) SILTY SAND
- V - LAYER V: BROWN (10YR 5/3) SILT
- LENS OF DARK SILT

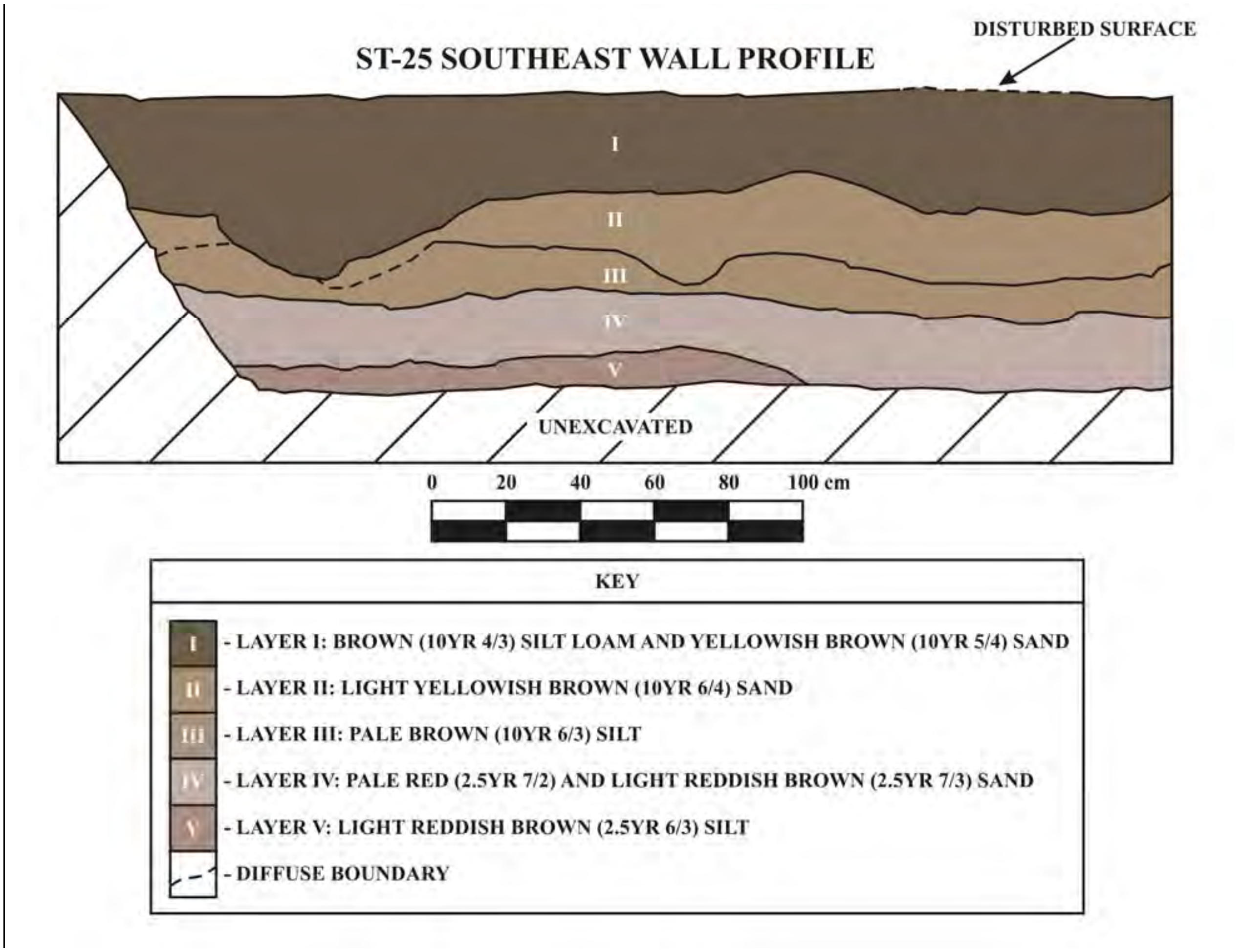
ST-22 SOUTHWEST WALL PROFILE

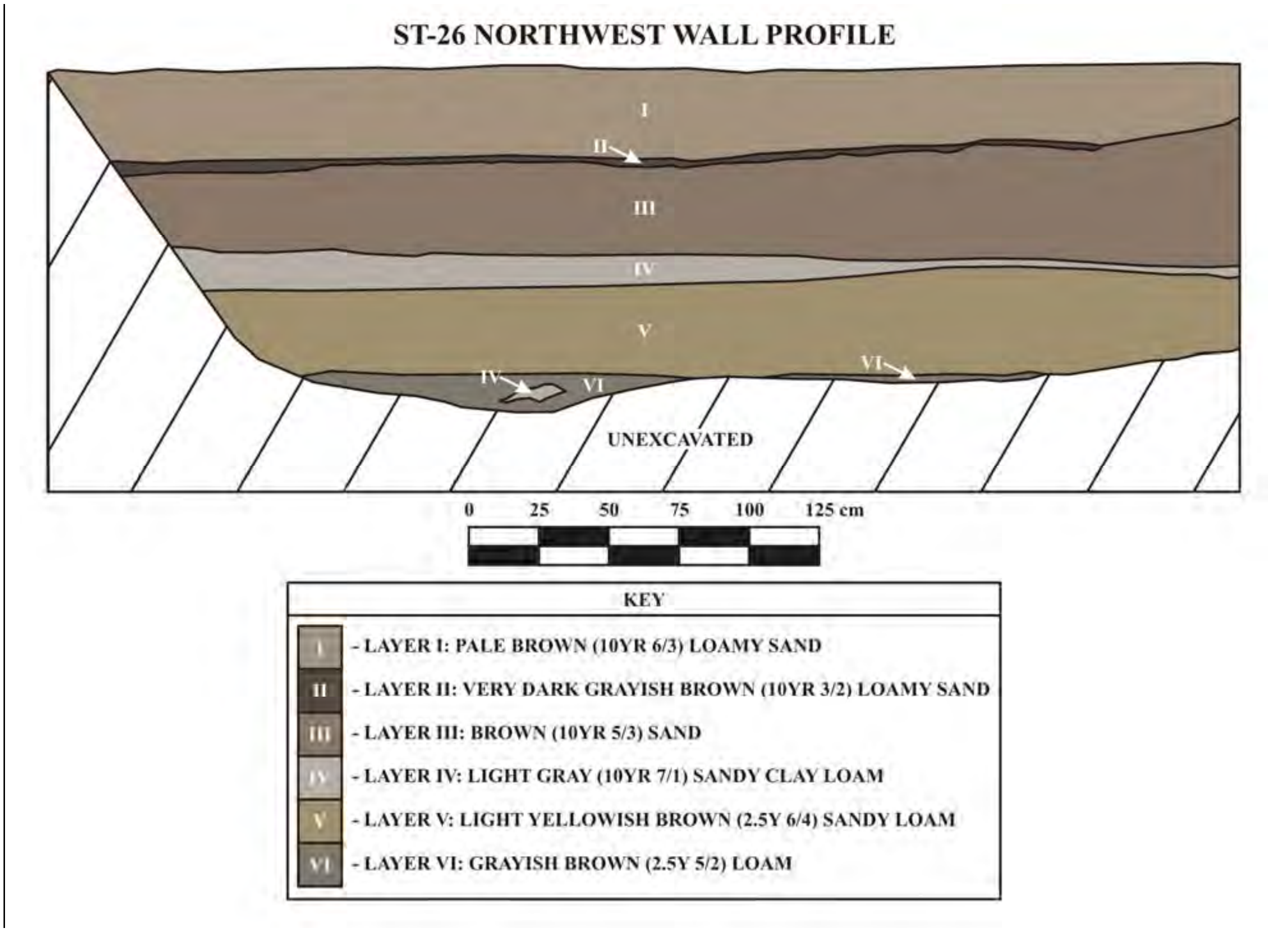


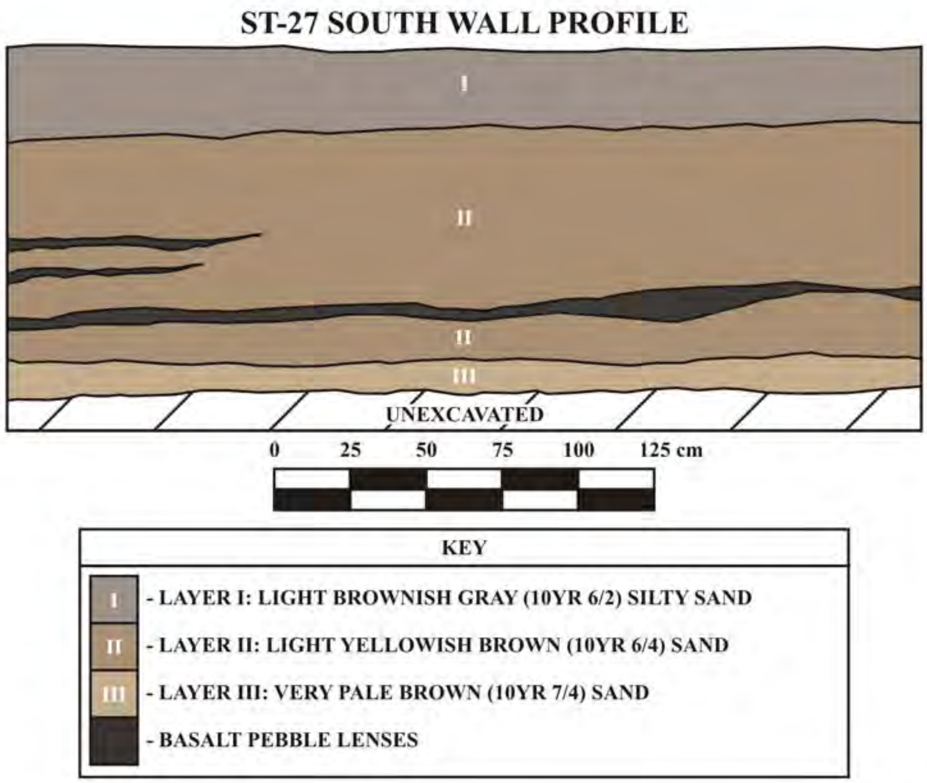
ST-23 NORTHWEST WALL PROFILE

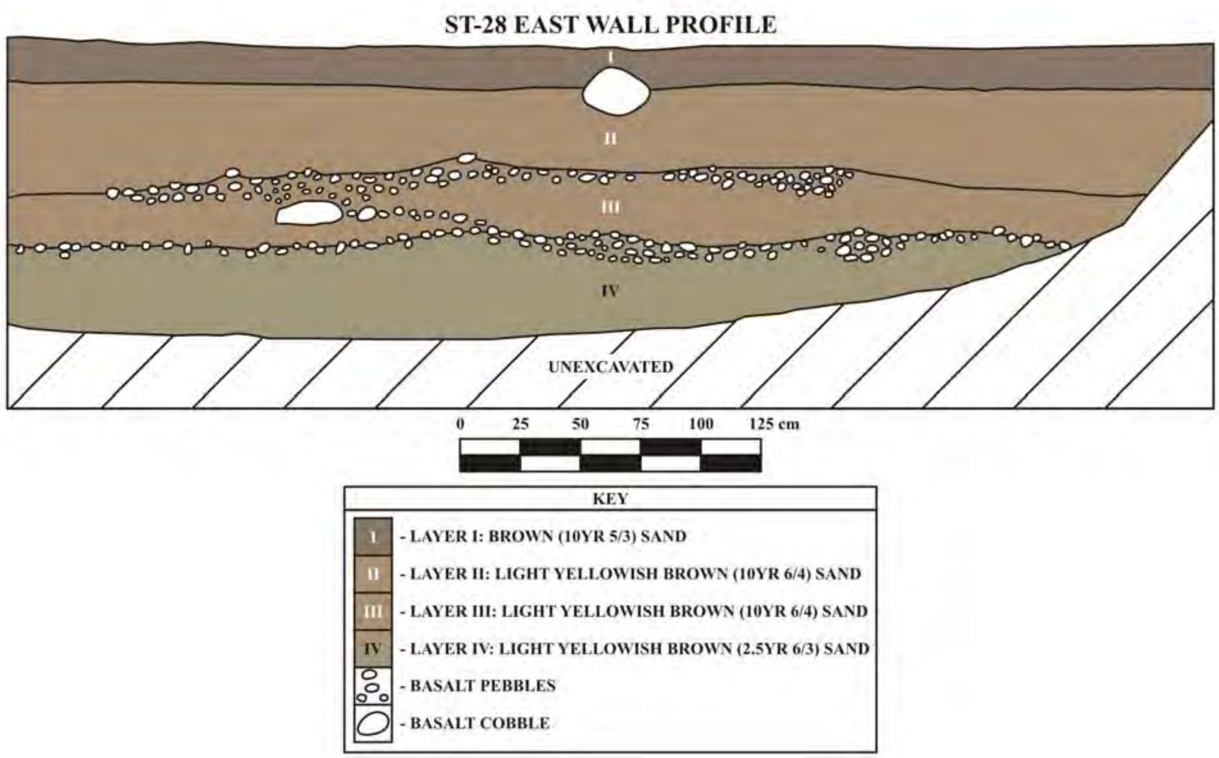



ST-24 NORTHWEST WALL PROFILE
I
II
III
IV
UNEXCAVATED
0
20
40
60
80
100 cm
KEY
I - LAYER I: BROWN (10YR 4/3) SILT LOAM
II - LAYER II: LIGHT YELLOWISH BROWN (10YR 6/4) SAND
III - LAYER III: PALE BROWN (10YR 6/3) SILT
IV - LAYER IV: LIGHT GRAY (10YR 7/1) AND LIGHT GRAY (10YR 7/2) SAND

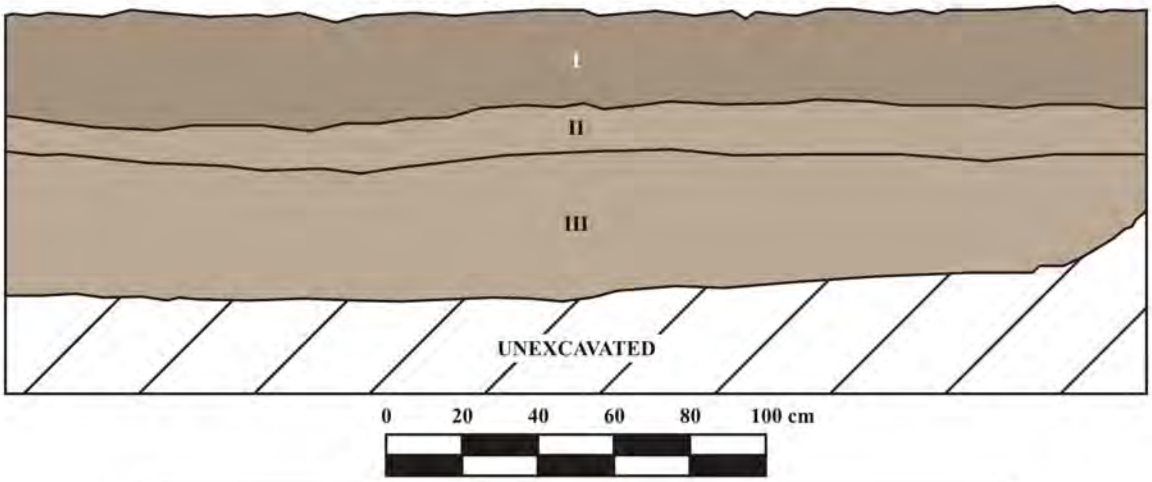

ST-25 SOUTHEAST WALL PROFILE
DISTURBED SURFACE
I
II
III
IV
V
UNEXCAVATED
0
20
40
60
80
100 cm
KEY
- LAYER I: BROWN (10YR 4/3) SILT LOAM AND YELLOWISH BROWN (10YR 5/4) SAND
- LAYER II: LIGHT YELLOWISH BROWN (10YR 6/4) SAND
- LAYER III: PALE BROWN (10YR 6/3) SILT
- LAYER IV: PALE RED (2.5YR 7/2) AND LIGHT REDDISH BROWN (2.5YR 7/3) SAND
- LAYER V: LIGHT REDDISH BROWN (2.5YR 6/3) SILT
- DIFFUSE BOUNDARY


ST-26 NORTHWEST WALL PROFILE
I
II
III
IV
V
VI
IV
VI
UNEXCAVATED
0
25
50
75
100
125 cm
KEY
- LAYER I: PALE BROWN (10YR 6/3) LOAMY SAND
- LAYER II: VERY DARK GRAYISH BROWN (10YR 3/2) LOAMY SAND
- LAYER III: BROWN (10YR 5/3) SAND
- LAYER IV: LIGHT GRAY (10YR 7/1) SANDY CLAY LOAM
- LAYER V: LIGHT YELLOWISH BROWN (2.5Y 6/4) SANDY LOAM
- LAYER VI: GRAYISH BROWN (2.5Y 5/2) LOAM


ST-27 SOUTH WALL PROFILE
I
II
II
III
UNEXCAVATED
0 25 50 75 100 125 cm
KEY
I - LAYER I: LIGHT BROWNISH GRAY (10YR 6/2) SILTY SAND
II - LAYER II: LIGHT YELLOWISH BROWN (10YR 6/4) SAND
III - LAYER III: VERY PALE BROWN (10YR 7/4) SAND
- BASALT PEBBLE LENSES


ST-28 EAST WALL PROFILE
I
II
III
IV
UNEXCAVATED
0 25 50 75 100 125 cm
KEY
I - LAYER I: BROWN (10YR 5/3) SAND
II - LAYER II: LIGHT YELLOWISH BROWN (10YR 6/4) SAND
III - LAYER III: LIGHT YELLOWISH BROWN (10YR 6/4) SAND
IV - LAYER IV: LIGHT YELLOWISH BROWN (2.5YR 6/3) SAND
- BASALT PEBBLES
- BASALT COBBLE

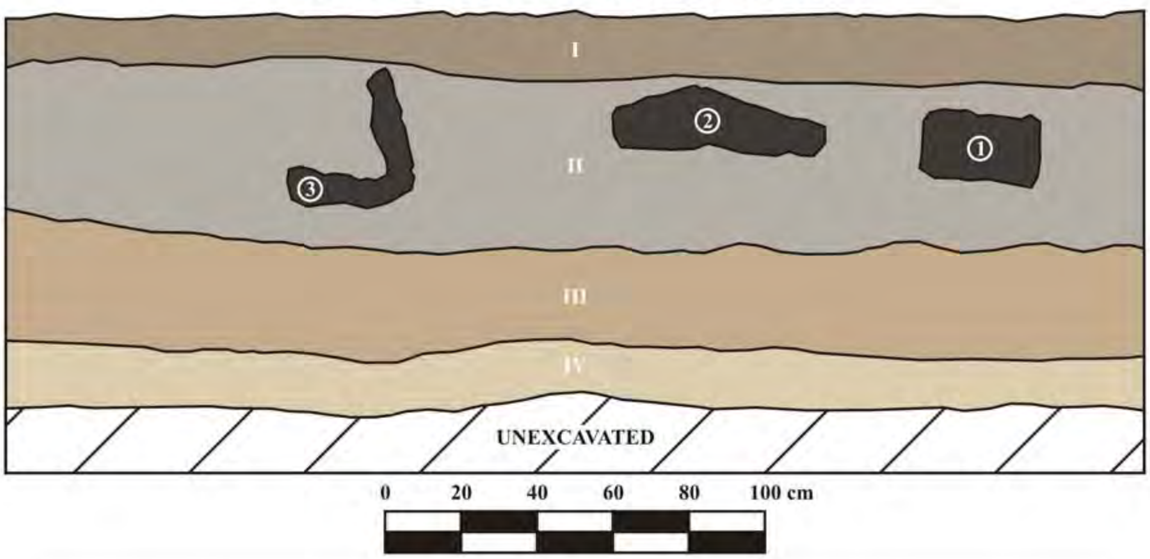
ST-29 NORTHEAST WALL PROFILE



KEY

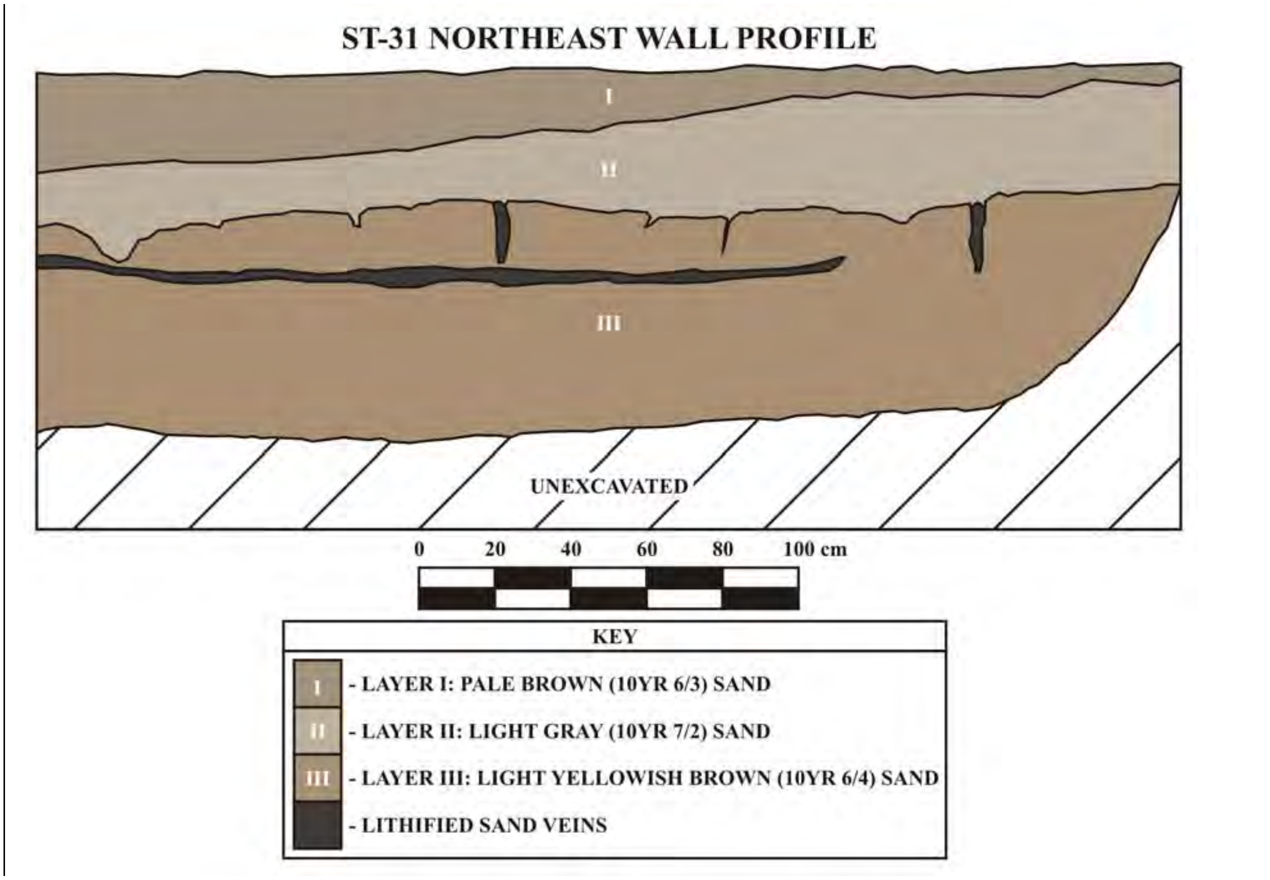
- LAYER I: PALE BROWN (10YR 6/3) SAND
- LAYER II: LIGHT GRAY (10YR 7/2) AND VERY PALE BROWN (10YR 7/3) SAND
- LAYER III: VERY PALE BROWN (10YR 7/3) LITHIFIED SAND

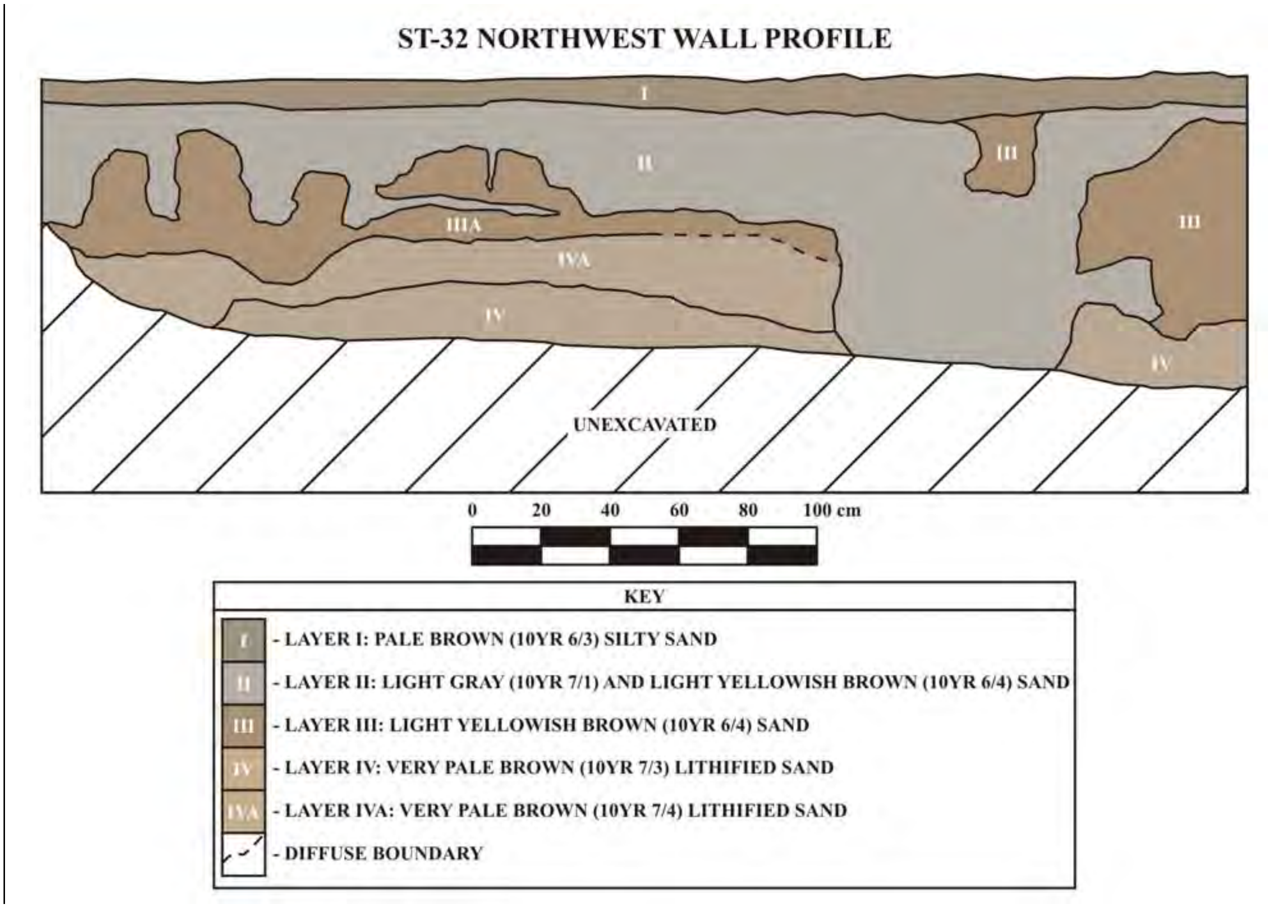
ST-30 NORTHEAST WALL PROFILE

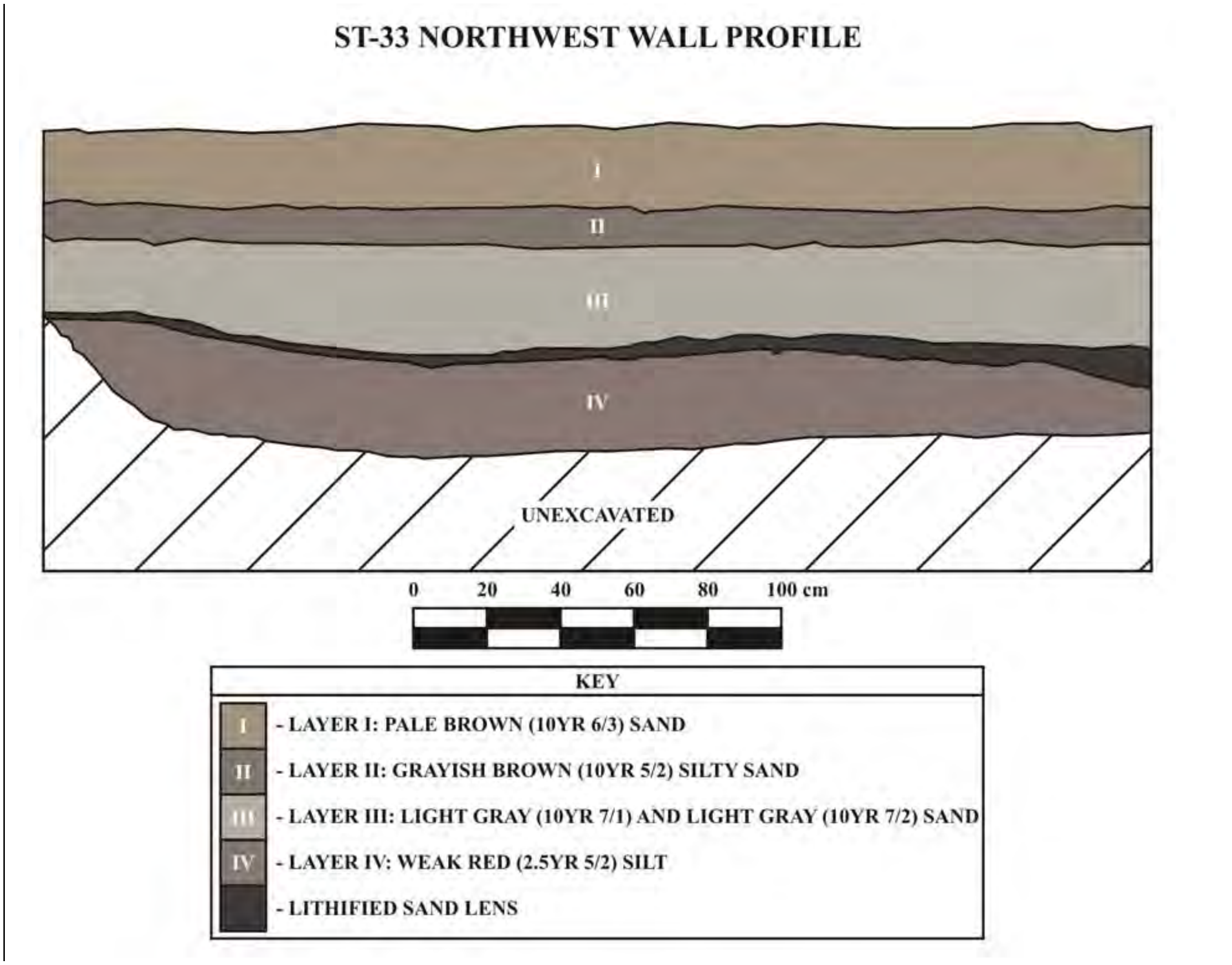


KEY

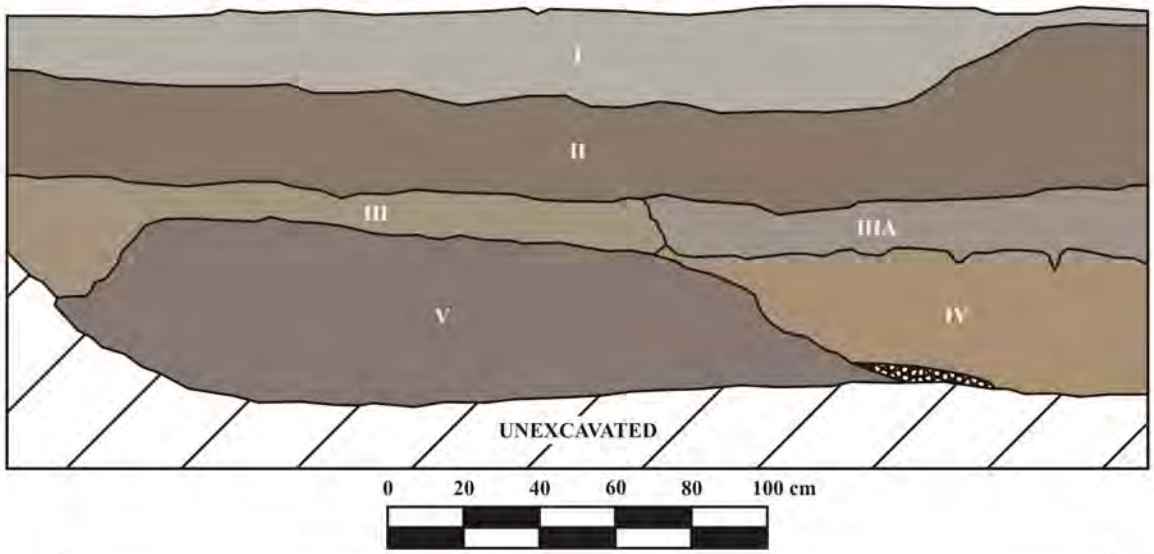
- LAYER I: PALE BROWN (10YR 6/3) SILTY SAND
- LAYER II: LIGHT GRAY (10YR 7/1) AND LIGHT GRAY (10YR 7/2) SAND
- LAYER III: VERY PALE BROWN (10YR 7/4) SAND
- LAYER IV: VERY PALE BROWN (10YR 8/3) AND VERY PALE BROWN (10YR 8/4) LITHIFIED SAND
- STAIN POCKETS


ST-31 NORTHEAST WALL PROFILE
I
II
III
UNEXCAVATED
0
20
40
60
80
100 cm
KEY
I - LAYER I: PALE BROWN (10YR 6/3) SAND
II - LAYER II: LIGHT GRAY (10YR 7/2) SAND
III - LAYER III: LIGHT YELLOWISH BROWN (10YR 6/4) SAND
- LITHIFIED SAND VEINS


ST-32 NORTHWEST WALL PROFILE
I
II
III
III
IIIA
IVA
IV
IV
UNEXCAVATED
0 20 40 60 80 100 cm
KEY
I - LAYER I: PALE BROWN (10YR 6/3) SILTY SAND
II - LAYER II: LIGHT GRAY (10YR 7/1) AND LIGHT YELLOWISH BROWN (10YR 6/4) SAND
III - LAYER III: LIGHT YELLOWISH BROWN (10YR 6/4) SAND
IV - LAYER IV: VERY PALE BROWN (10YR 7/3) LITHIFIED SAND
IVA - LAYER IVA: VERY PALE BROWN (10YR 7/4) LITHIFIED SAND
- DIFFUSE BOUNDARY

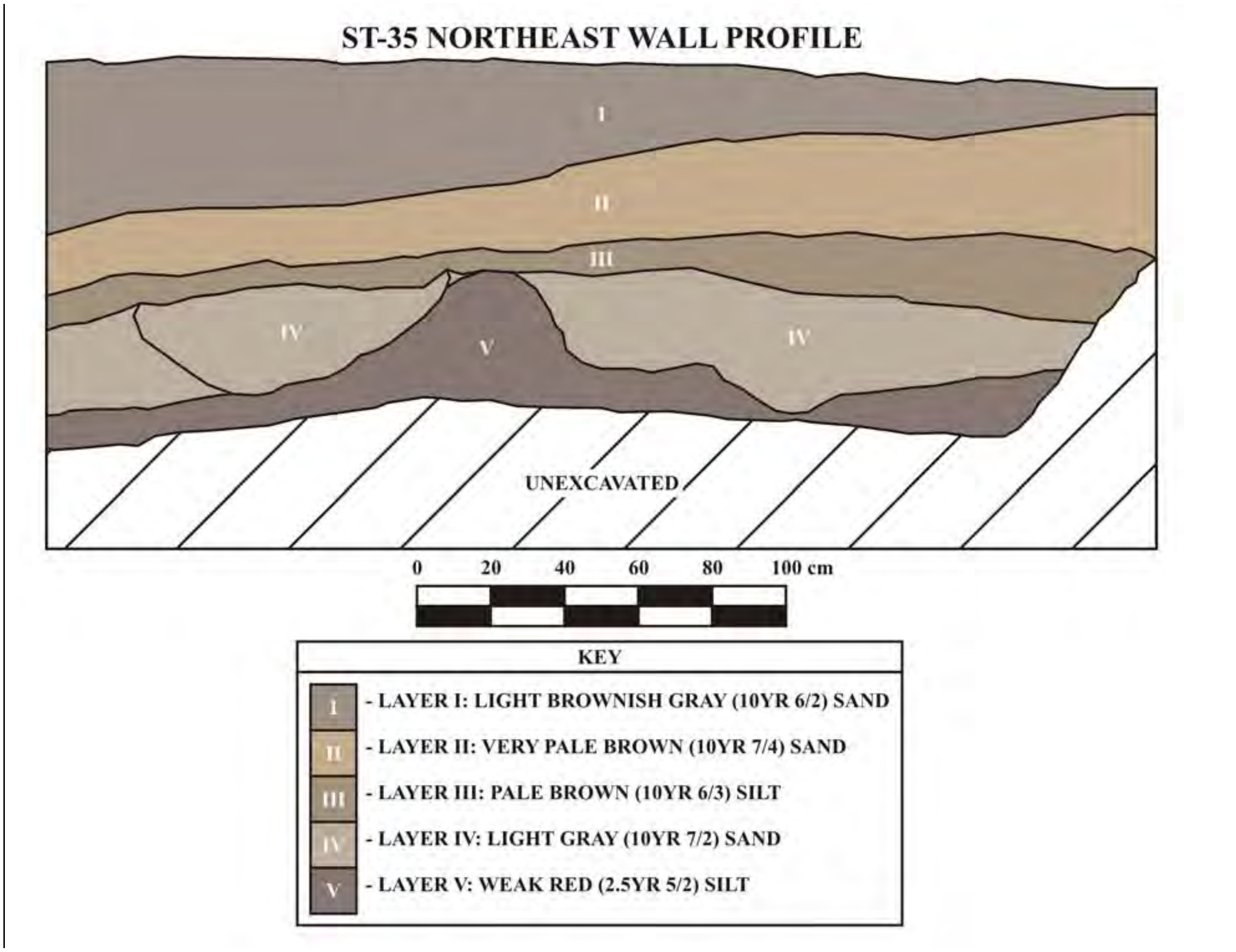

ST-33 NORTHWEST WALL PROFILE
I
II
III
IV
UNEXCAVATED
0
20
40
60
80
100 cm
KEY
I - LAYER I: PALE BROWN (10YR 6/3) SAND
II - LAYER II: GRAYISH BROWN (10YR 5/2) SILTY SAND
III - LAYER III: LIGHT GRAY (10YR 7/1) AND LIGHT GRAY (10YR 7/2) SAND
IV - LAYER IV: WEAK RED (2.5YR 5/2) SILT
- LITHIFIED SAND LENS

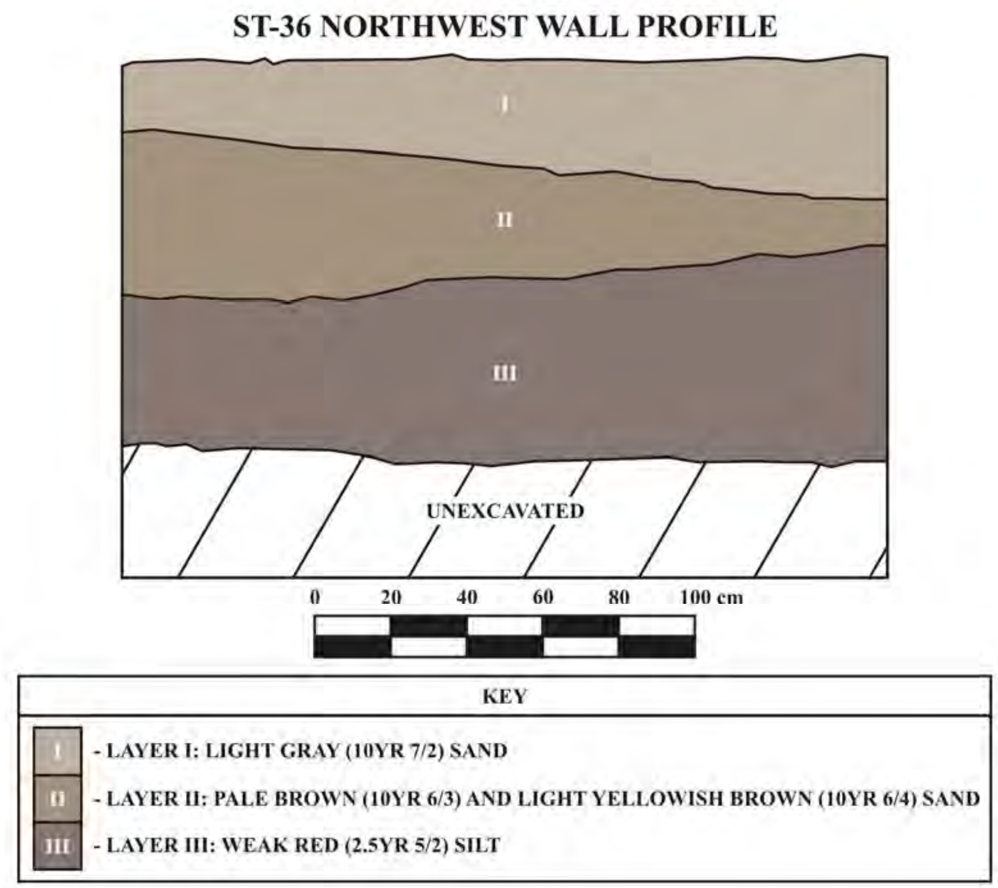
ST-34 SOUTHWEST WALL PROFILE



KEY

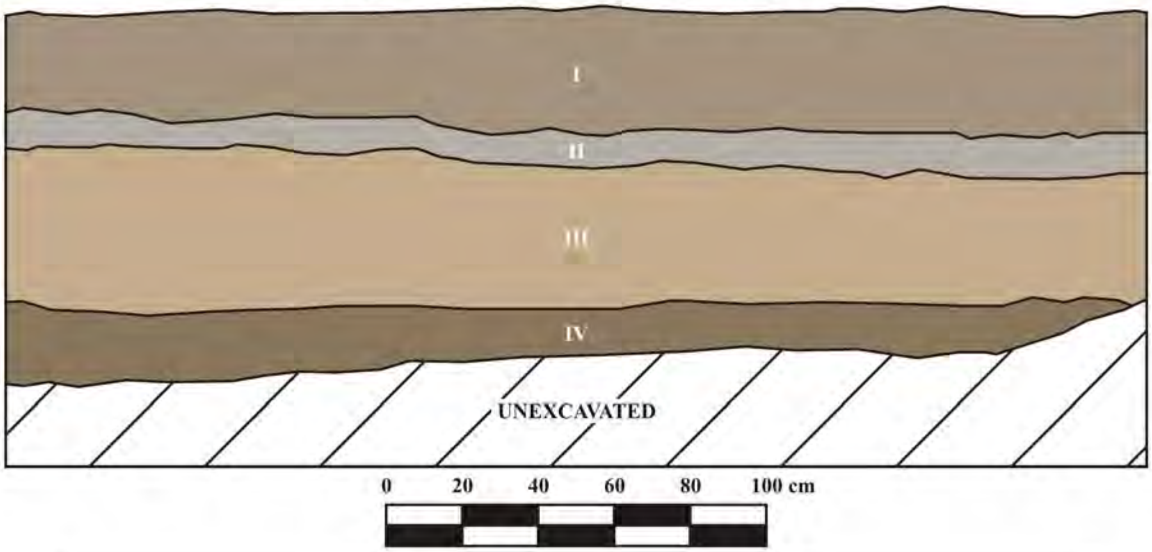
- LAYER I: LIGHT GRAY (10YR 7/1) AND LIGHT GRAY (10YR 7/2) SAND
- LAYER II: BROWN (10YR 5/3) SAND
- LAYER III: PALE BROWN (10YR 6/3) SILT
- LAYER IIIA: LIGHT BROWNISH GRAY (10YR 6/2) AND VERY PALE BROWN (10YR 7/3) SAND
- LAYER IV: LIGHT YELLOWISH BROWN (10YR 6/4) AND BROWNISH YELLOW (10YR 6/6) SAND
- LAYER V: WEAK RED (2.5YR 5/2) SILT
- BASALT GRAVEL POCKET


ST-35 NORTHEAST WALL PROFILE
I
II
III
IV
V
IV
UNEXCAVATED
0
20
40
60
80
100 cm
KEY
I - LAYER I: LIGHT BROWNISH GRAY (10YR 6/2) SAND
II - LAYER II: VERY PALE BROWN (10YR 7/4) SAND
III - LAYER III: PALE BROWN (10YR 6/3) SILT
IV - LAYER IV: LIGHT GRAY (10YR 7/2) SAND
V - LAYER V: WEAK RED (2.5YR 5/2) SILT



ST-36 NORTHWEST WALL PROFILE
I
II
III
UNEXCAVATED
0
20
40
60
80
100 cm
KEY
I - LAYER I: LIGHT GRAY (10YR 7/2) SAND
II - LAYER II: PALE BROWN (10YR 6/3) AND LIGHT YELLOWISH BROWN (10YR 6/4) SAND
III - LAYER III: WEAK RED (2.5YR 5/2) SILT

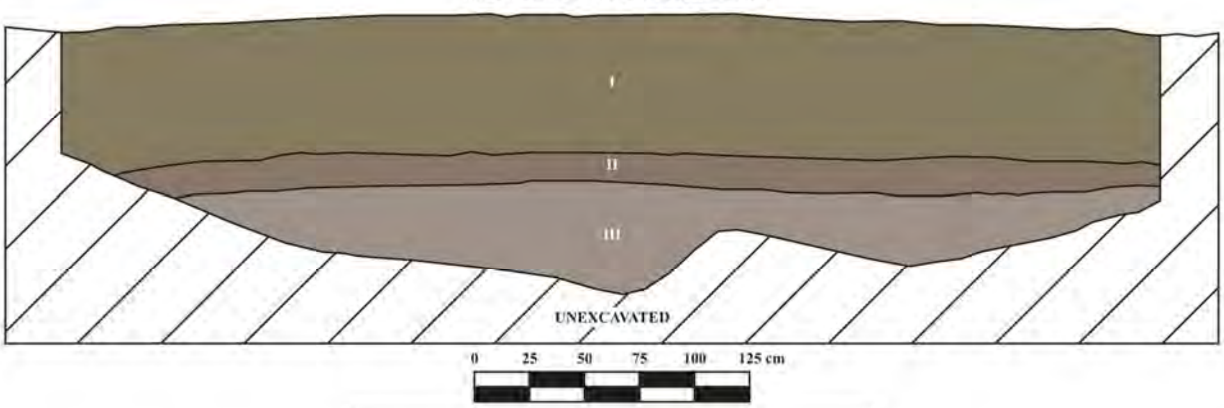
ST-37 SOUTHEAST WALL PROFILE



KEY

- LAYER I: PALE BROWN (10YR 6/3) SAND
- LAYER II: LIGHT GRAY (10YR 7/1) SILTY SAND
- LAYER III: VERY PALE BROWN (10YR 7/4) AND LIGHT YELLOWISH BROWN (10YR 6/4) SAND
- LAYER IV: YELLOWISH BROWN (10YR 5/4) SILTY LOAM

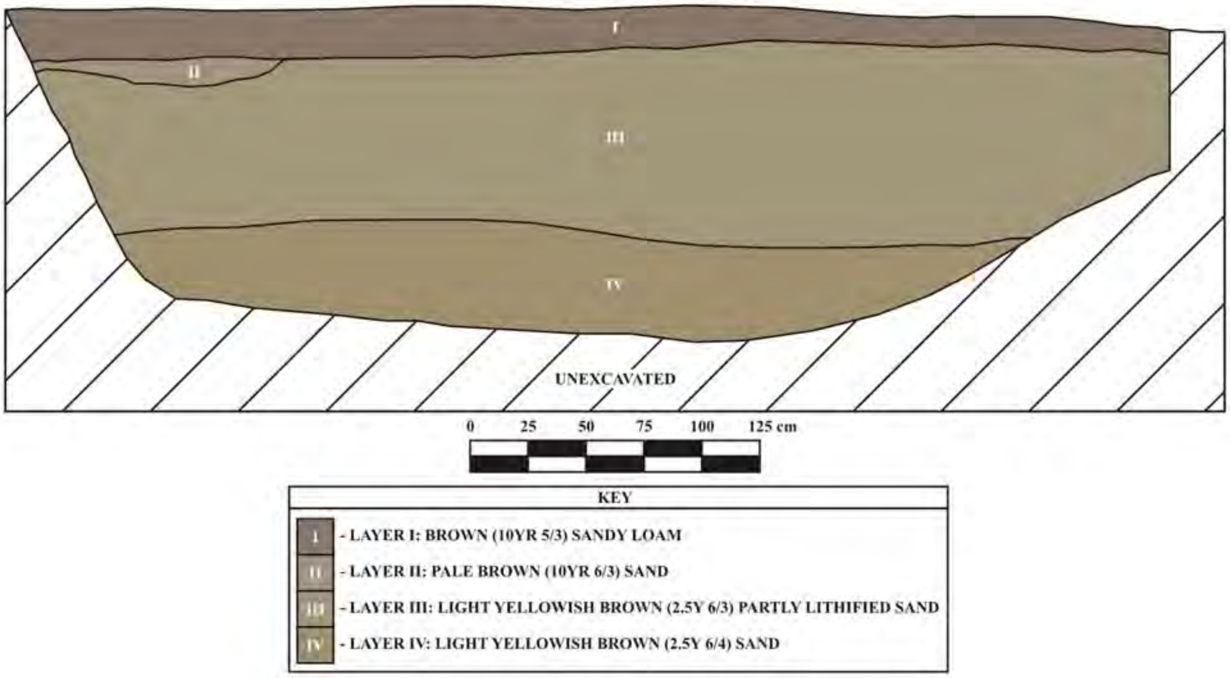
ST-38 EAST WALL PROFILE



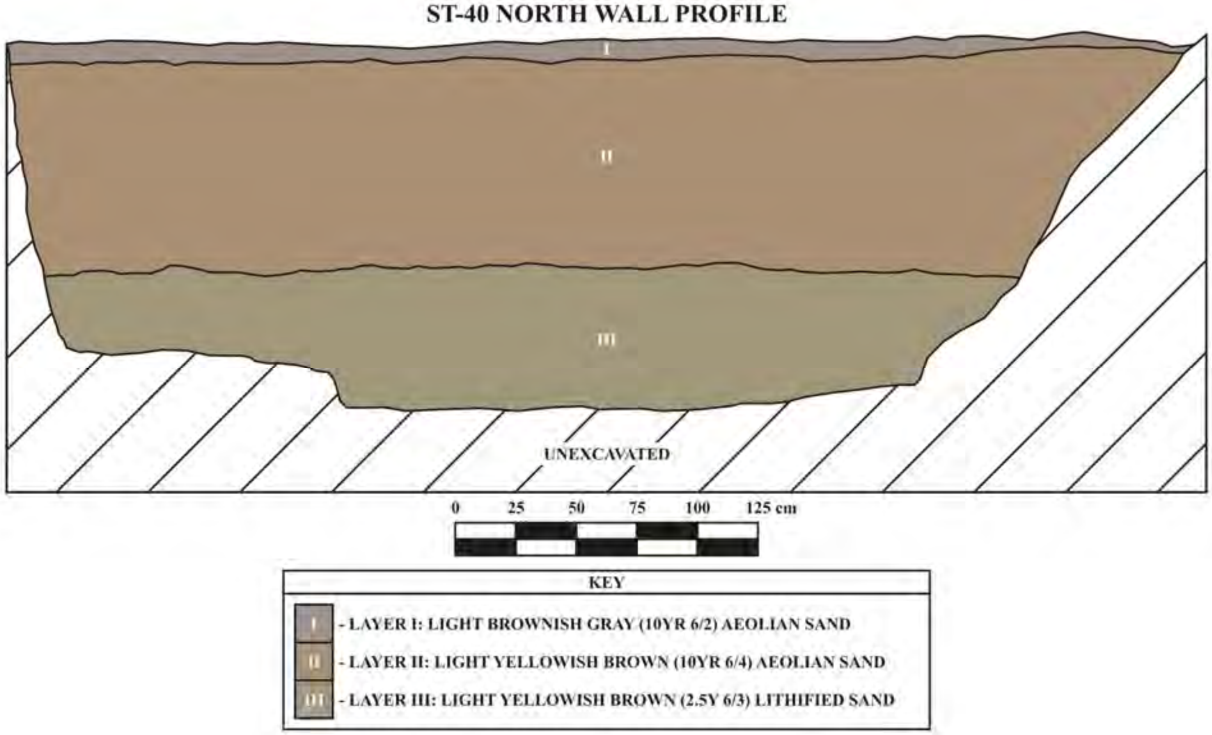
KEY

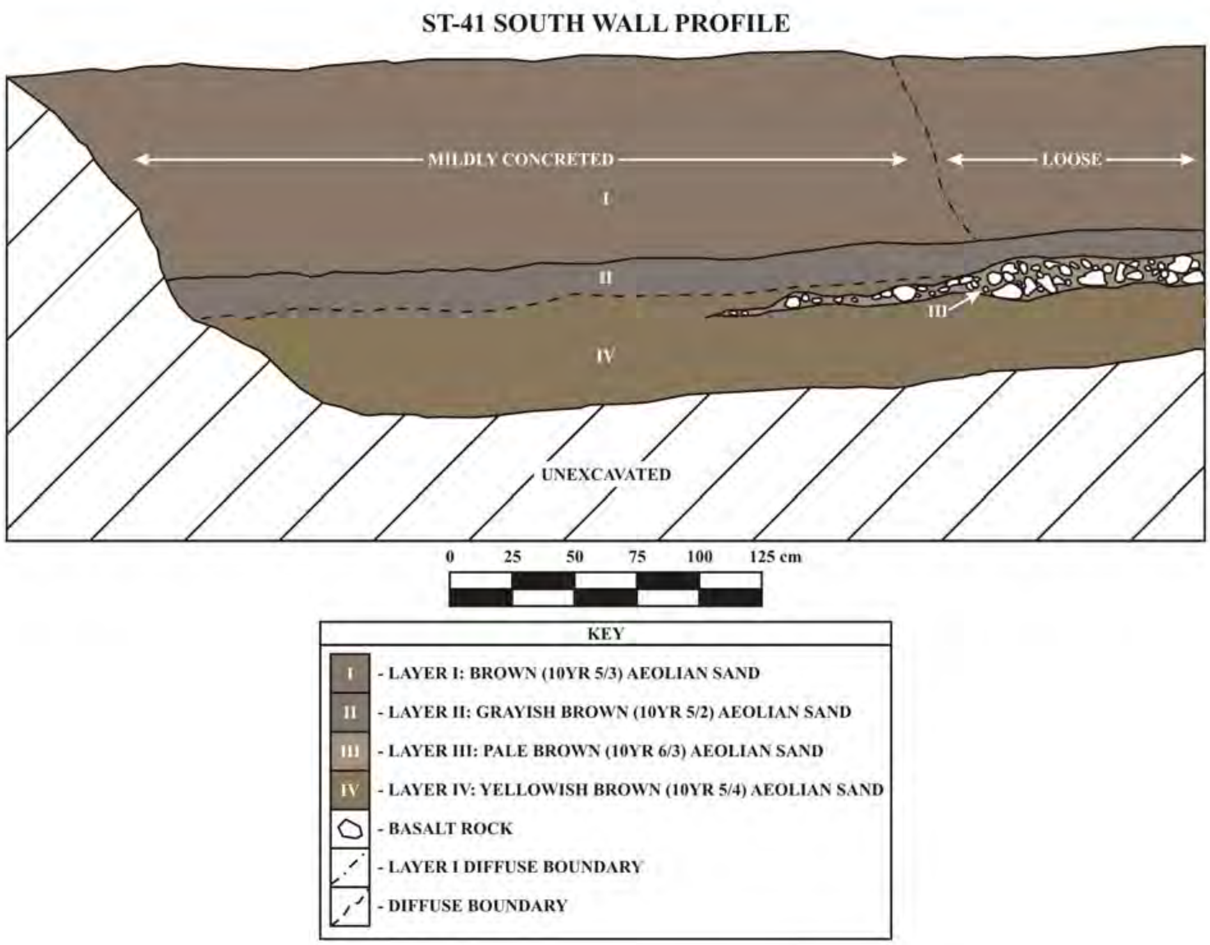
- LAYER I: LIGHT OLIVE BROWN (2.5Y 5/3) LOAMY SAND
- LAYER II: BROWN (10YR 5/3) LOAMY SAND
- LAYER III: LIGHT BROWNISH GRAY (10YR 6/2) LOAMY SAND

ST-39 WEST WALL PROFILE

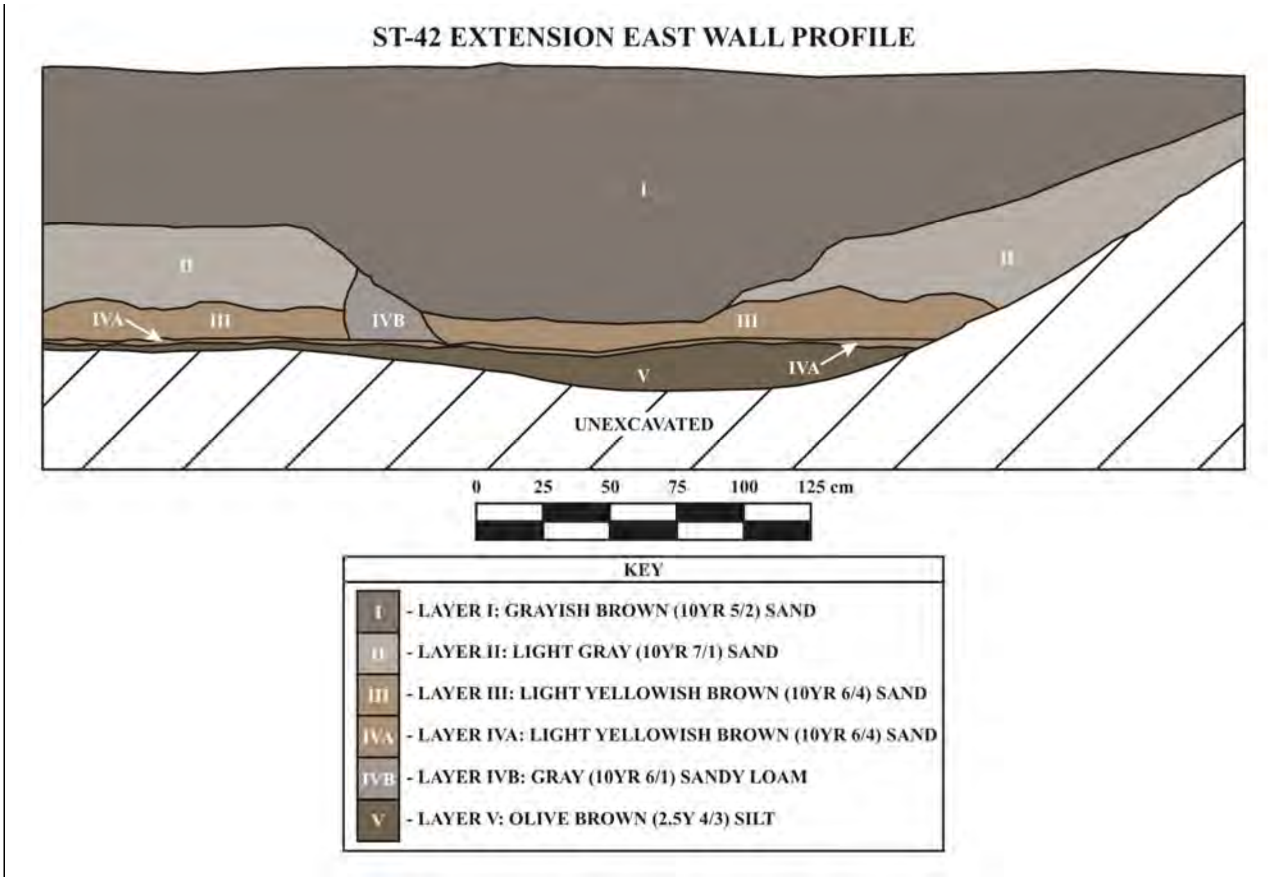


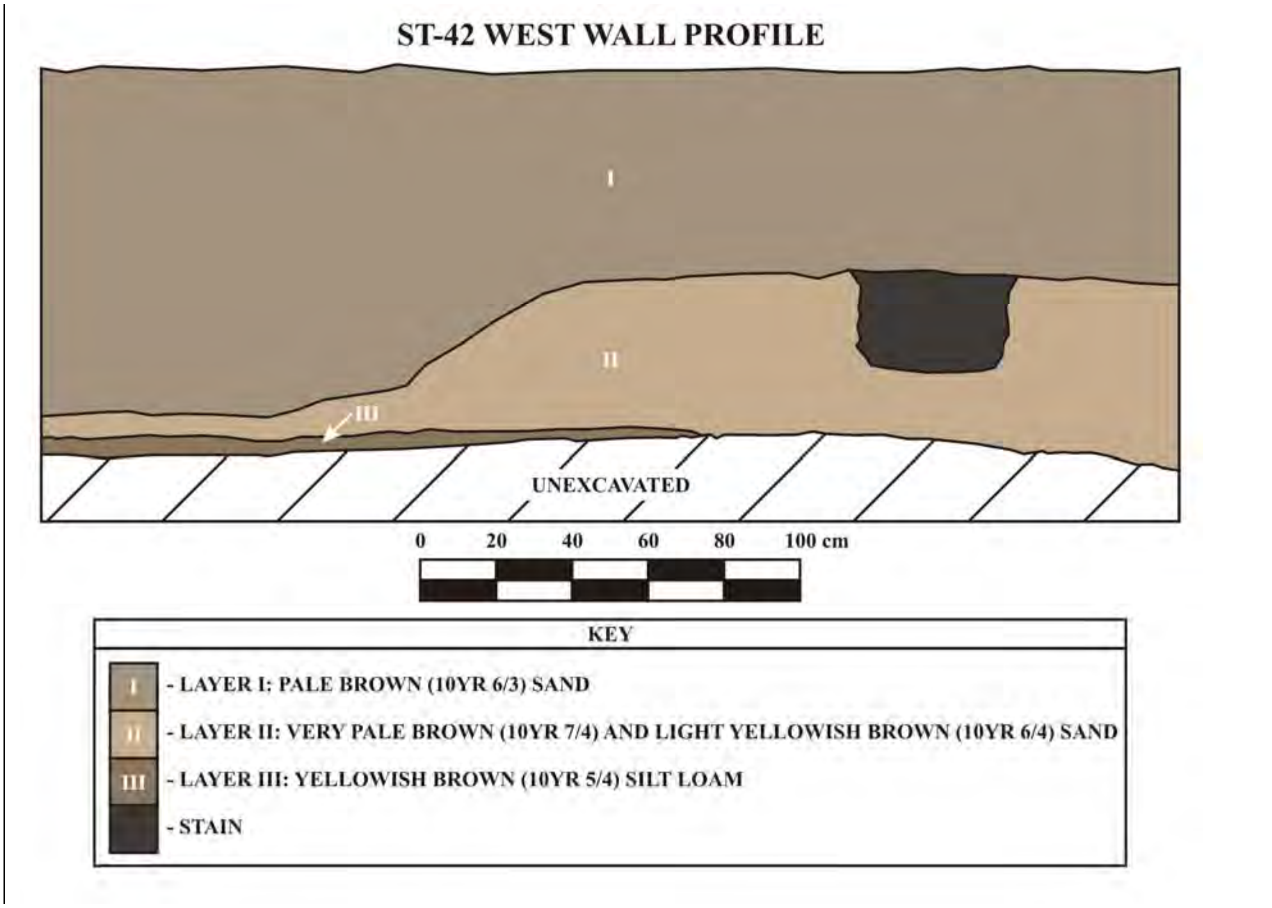
ST-40 NORTH WALL PROFILE

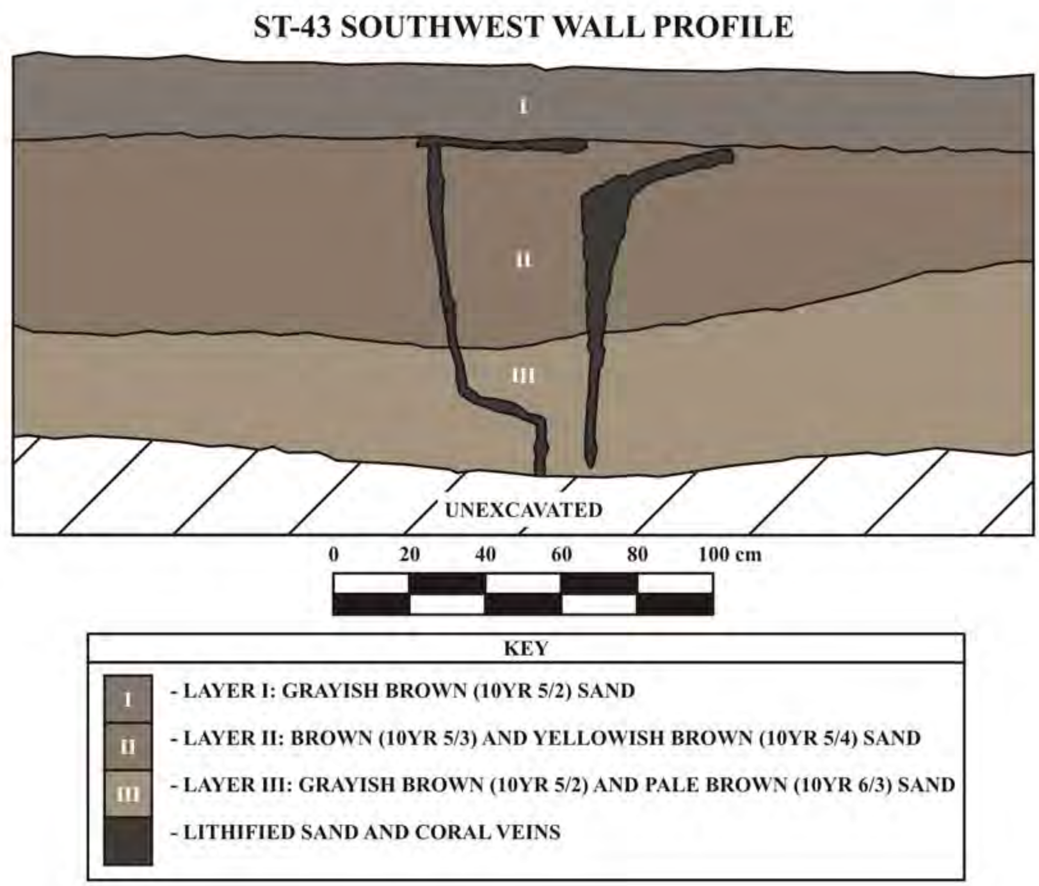


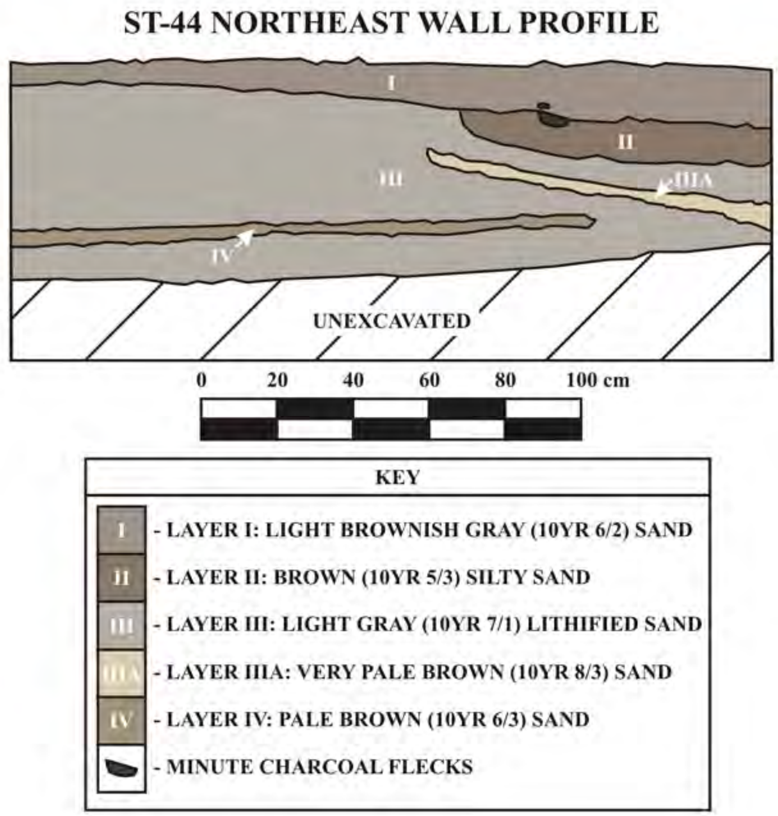


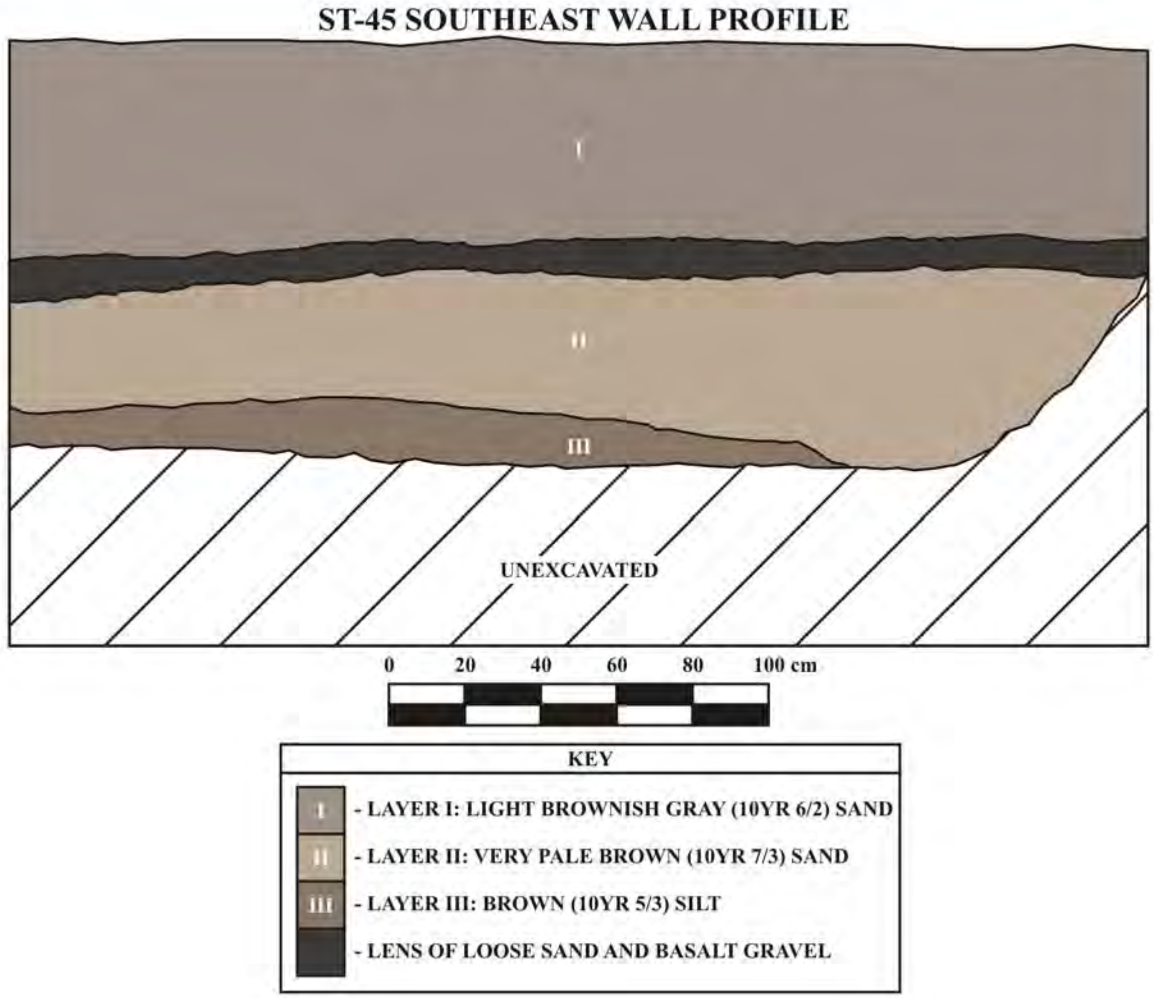
ST-41 SOUTH WALL PROFILE
MILDLY CONCRETED
LOOSE
I
II
III
IV
UNEXCAVATED
0
25
50
75
100
125 cm
KEY
I - LAYER I: BROWN (10YR 5/3) AEOLIAN SAND
II - LAYER II: GRAYISH BROWN (10YR 5/2) AEOLIAN SAND
III - LAYER III: PALE BROWN (10YR 6/3) AEOLIAN SAND
IV - LAYER IV: YELLOWISH BROWN (10YR 5/4) AEOLIAN SAND
- BASALT ROCK
- LAYER I DIFFUSE BOUNDARY
- DIFFUSE BOUNDARY

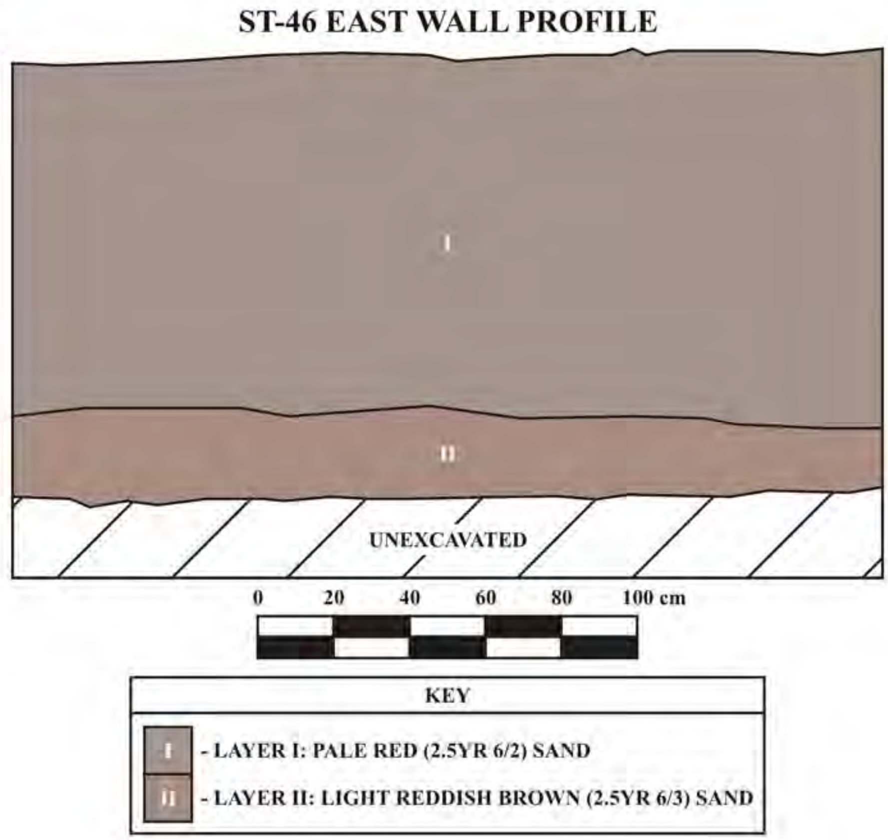

ST-42 EXTENSION EAST WALL PROFILE
I
II
II
IVA
III
IVB
III
V
IVA
UNEXCAVATED
0 25 50 75 100 125 cm
KEY
I - LAYER I: GRAYISH BROWN (10YR 5/2) SAND
II - LAYER II: LIGHT GRAY (10YR 7/1) SAND
III - LAYER III: LIGHT YELLOWISH BROWN (10YR 6/4) SAND
IVA - LAYER IVA: LIGHT YELLOWISH BROWN (10YR 6/4) SAND
IVB - LAYER IVB: GRAY (10YR 6/1) SANDY LOAM
V - LAYER V: OLIVE BROWN (2.5Y 4/3) SILT

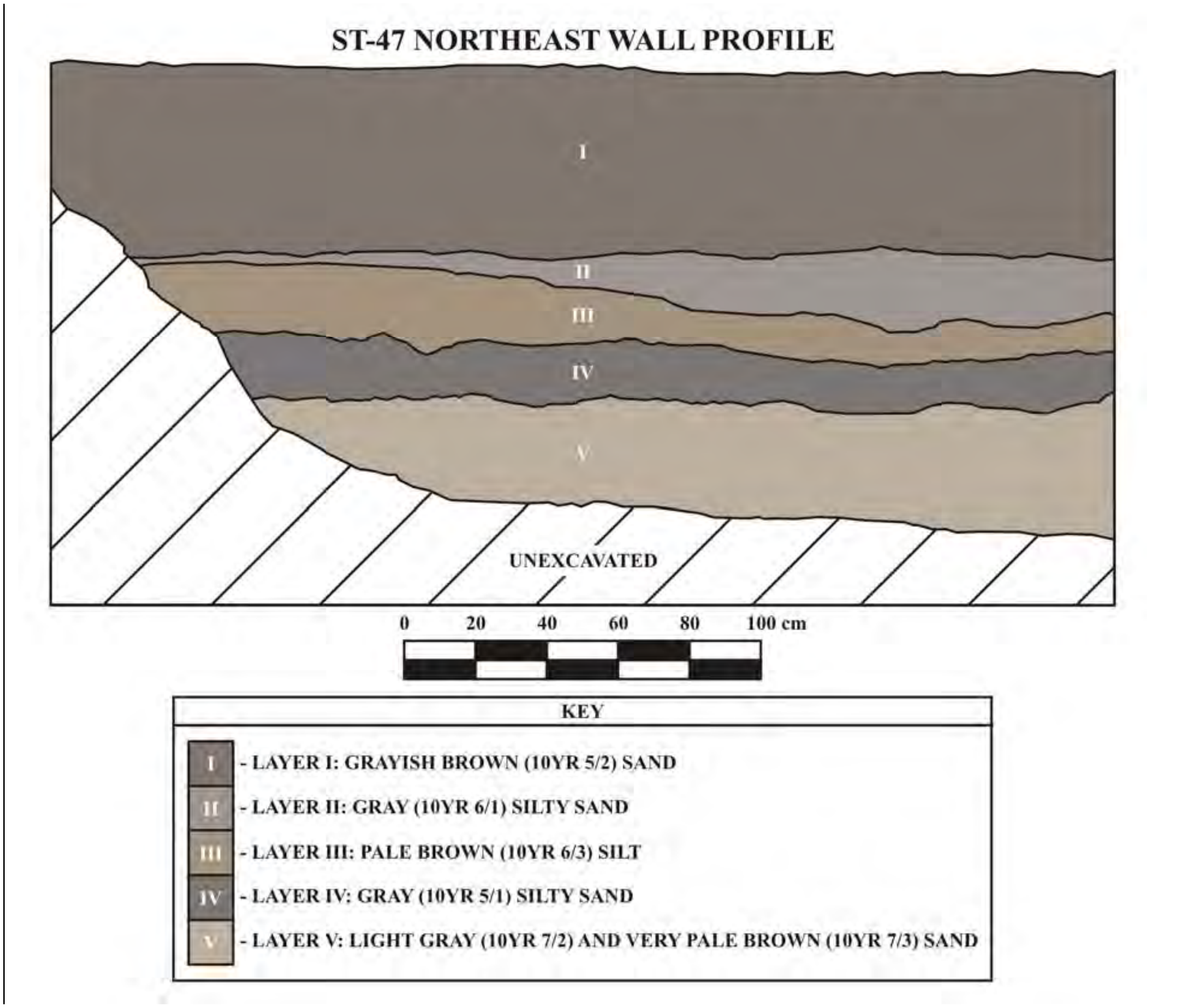

ST-42 WEST WALL PROFILE
I
II
III
UNEXCAVATED
0
20
40
60
80
100 cm
KEY
I
- LAYER I: PALE BROWN (10YR 6/3) SAND
II
- LAYER II: VERY PALE BROWN (10YR 7/4) AND LIGHT YELLOWISH BROWN (10YR 6/4) SAND
III
- LAYER III: YELLOWISH BROWN (10YR 5/4) SILT LOAM
- STAIN


ST-43 SOUTHWEST WALL PROFILE
I
II
III
UNEXCAVATED
0 20 40 60 80 100 cm
KEY
I - LAYER I: GRAYISH BROWN (10YR 5/2) SAND
II - LAYER II: BROWN (10YR 5/3) AND YELLOWISH BROWN (10YR 5/4) SAND
III - LAYER III: GRAYISH BROWN (10YR 5/2) AND PALE BROWN (10YR 6/3) SAND
- LITHIFIED SAND AND CORAL VEINS

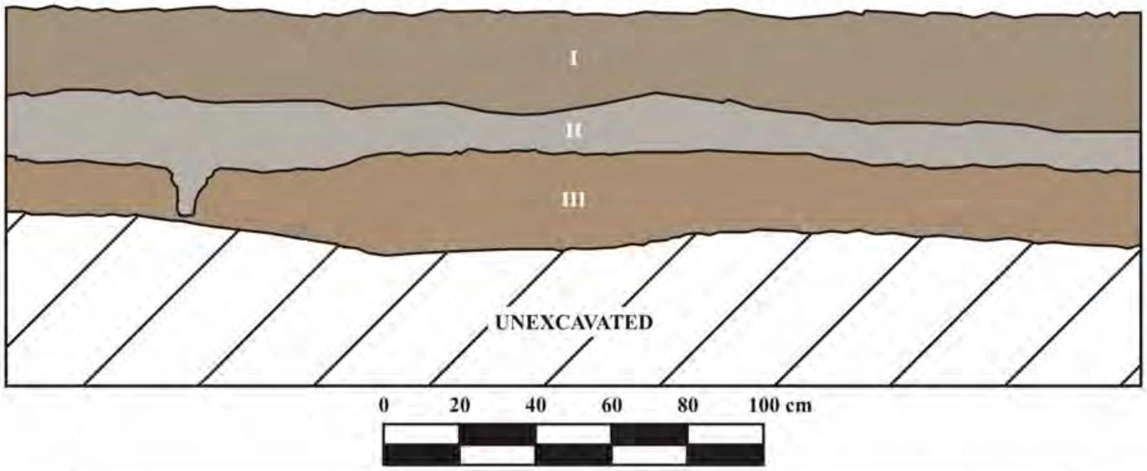

ST-44 NORTHEAST WALL PROFILE
I
II
III
IIIA
IV
UNEXCAVATED
0
20
40
60
80
100 cm
KEY
I - LAYER I: LIGHT BROWNISH GRAY (10YR 6/2) SAND
II - LAYER II: BROWN (10YR 5/3) SILTY SAND
III - LAYER III: LIGHT GRAY (10YR 7/1) LITHIFIED SAND
IIIA - LAYER IIIA: VERY PALE BROWN (10YR 8/3) SAND
IV - LAYER IV: PALE BROWN (10YR 6/3) SAND
- MINUTE CHARCOAL FLECKS


ST-45 SOUTHEAST WALL PROFILE
I
II
III
UNEXCAVATED
0
20
40
60
80
100 cm
KEY
I - LAYER I: LIGHT BROWNISH GRAY (10YR 6/2) SAND
II - LAYER II: VERY PALE BROWN (10YR 7/3) SAND
III - LAYER III: BROWN (10YR 5/3) SILT
- LENS OF LOOSE SAND AND BASALT GRAVEL


ST-46 EAST WALL PROFILE
I
II
UNEXCAVATED
0
20
40
60
80
100 cm
KEY
I - LAYER I: PALE RED (2.5YR 6/2) SAND
II - LAYER II: LIGHT REDDISH BROWN (2.5YR 6/3) SAND


ST-47 NORTHEAST WALL PROFILE
I
II
III
IV
V
UNEXCAVATED
0
20
40
60
80
100 cm
KEY
- LAYER I: GRAYISH BROWN (10YR 5/2) SAND
- LAYER II: GRAY (10YR 6/1) SILTY SAND
- LAYER III: PALE BROWN (10YR 6/3) SILT
- LAYER IV: GRAY (10YR 5/1) SILTY SAND
- LAYER V: LIGHT GRAY (10YR 7/2) AND VERY PALE BROWN (10YR 7/3) SAND

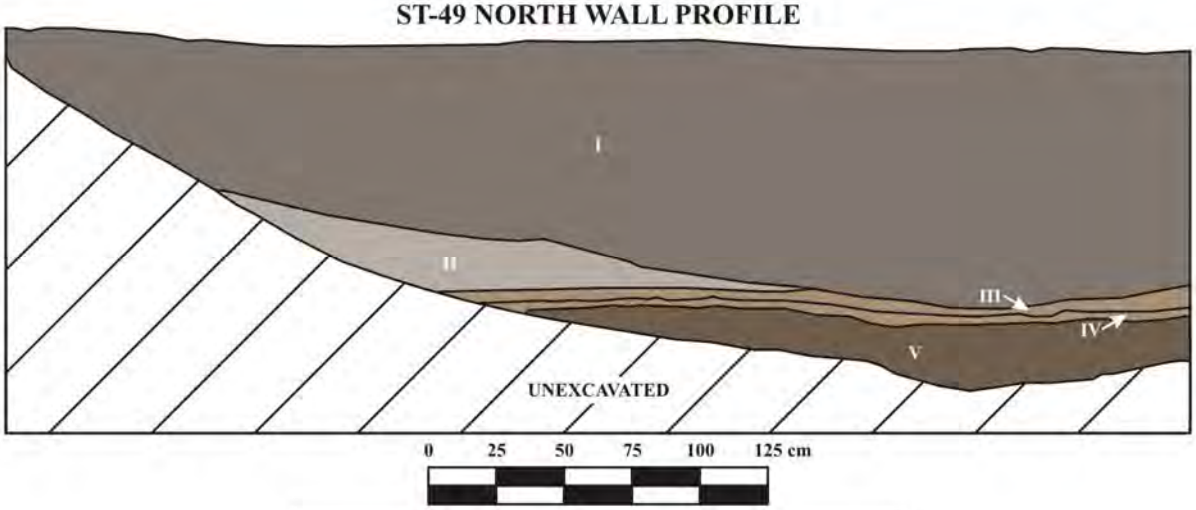
ST-48 NORTHWEST WALL PROFILE



KEY

- LAYER I: PALE BROWN AND (10YR 6/3) AND LIGHT YELLOWISH BROWN (10YR 6/4) SAND
- LAYER II: LIGHT GRAY (10YR 7/1) LITHIFIED SAND
- LAYER III: LIGHT YELLOWISH BROWN (10YR 6/4) LITHIFIED SAND

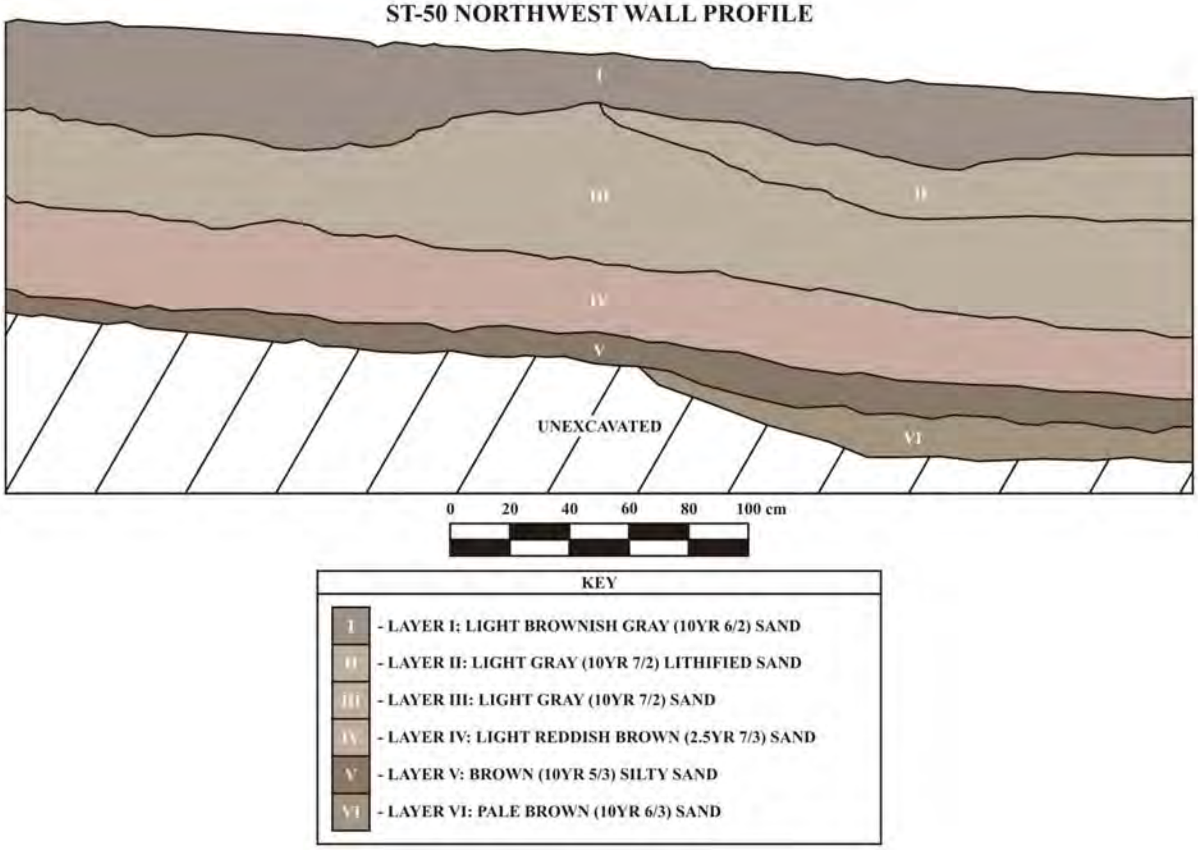
ST-49 NORTH WALL PROFILE



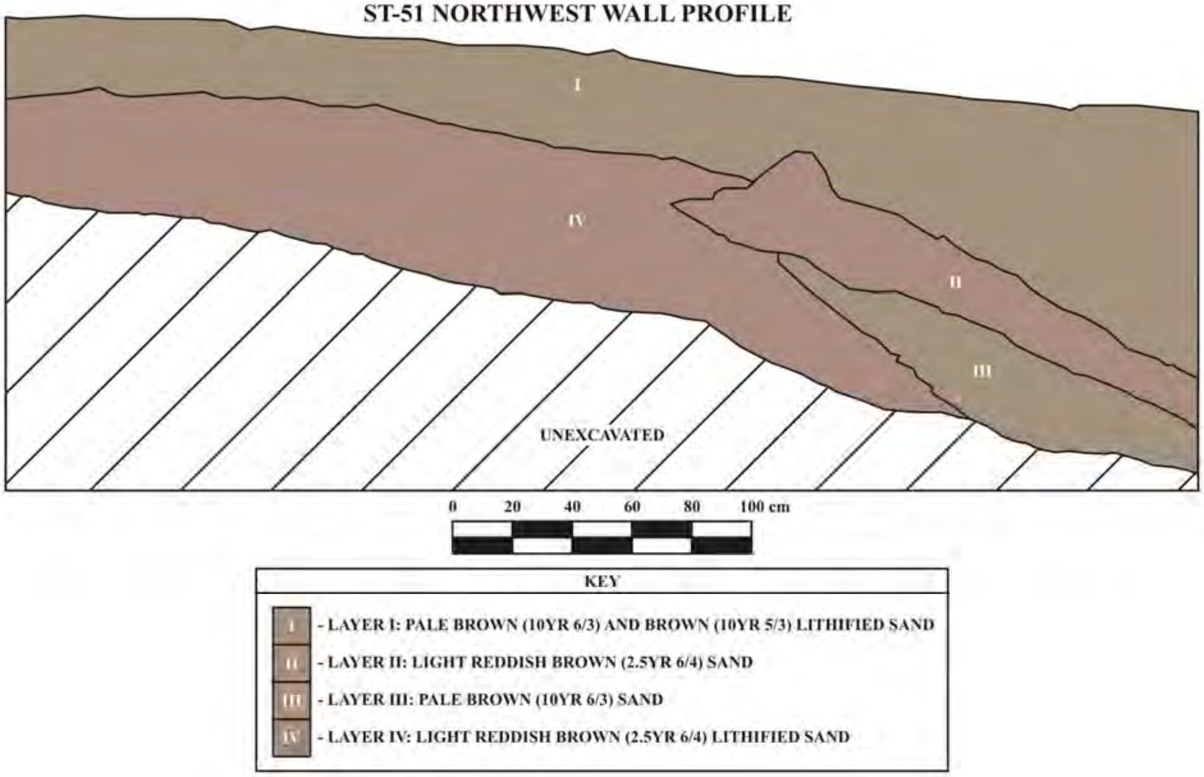
KEY

- LAYER I: GRAYISH BROWN (10YR 5/2) SAND
- LAYER II: LIGHT GRAY (10YR 7/1) SAND
- LAYER III: LIGHT YELLOWISH BROWN (10YR 6/4) SAND
- LAYER IVA: LIGHT YELLOWISH BROWN (10YR 6/4) SAND
- LAYER V: OLIVE BROWN (2.5Y 4/3) SILT

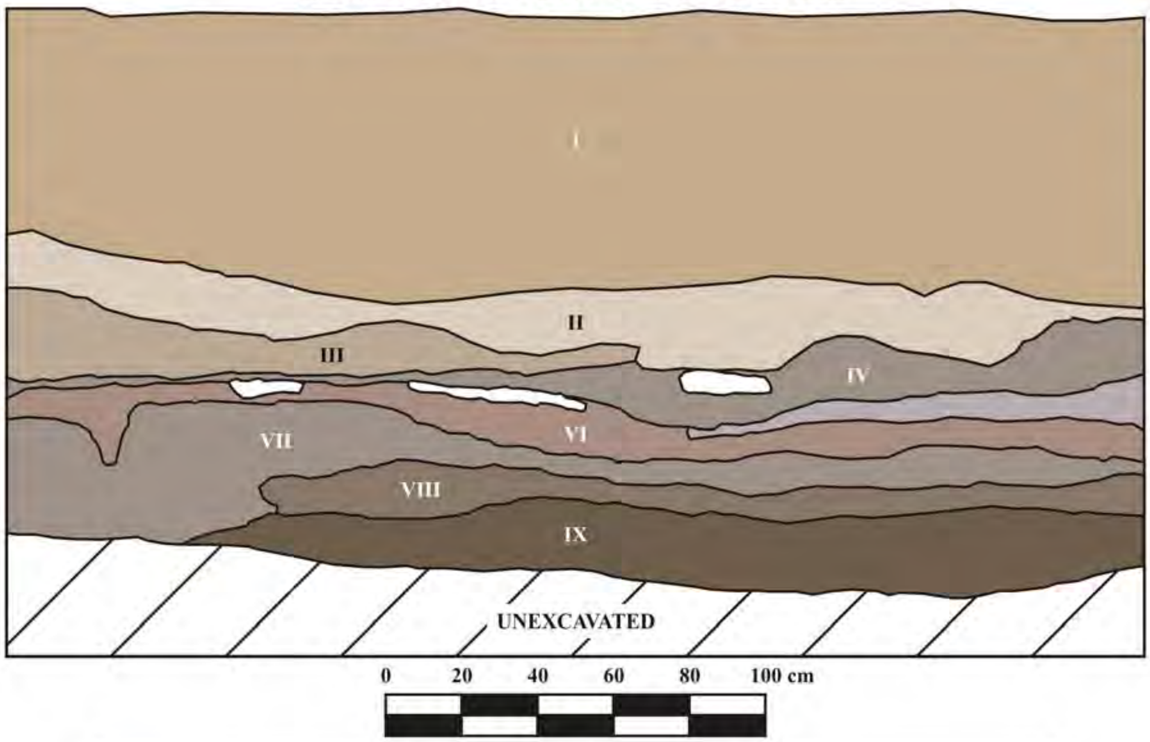
ST-50 NORTHWEST WALL PROFILE



ST-51 NORTHWEST WALL PROFILE



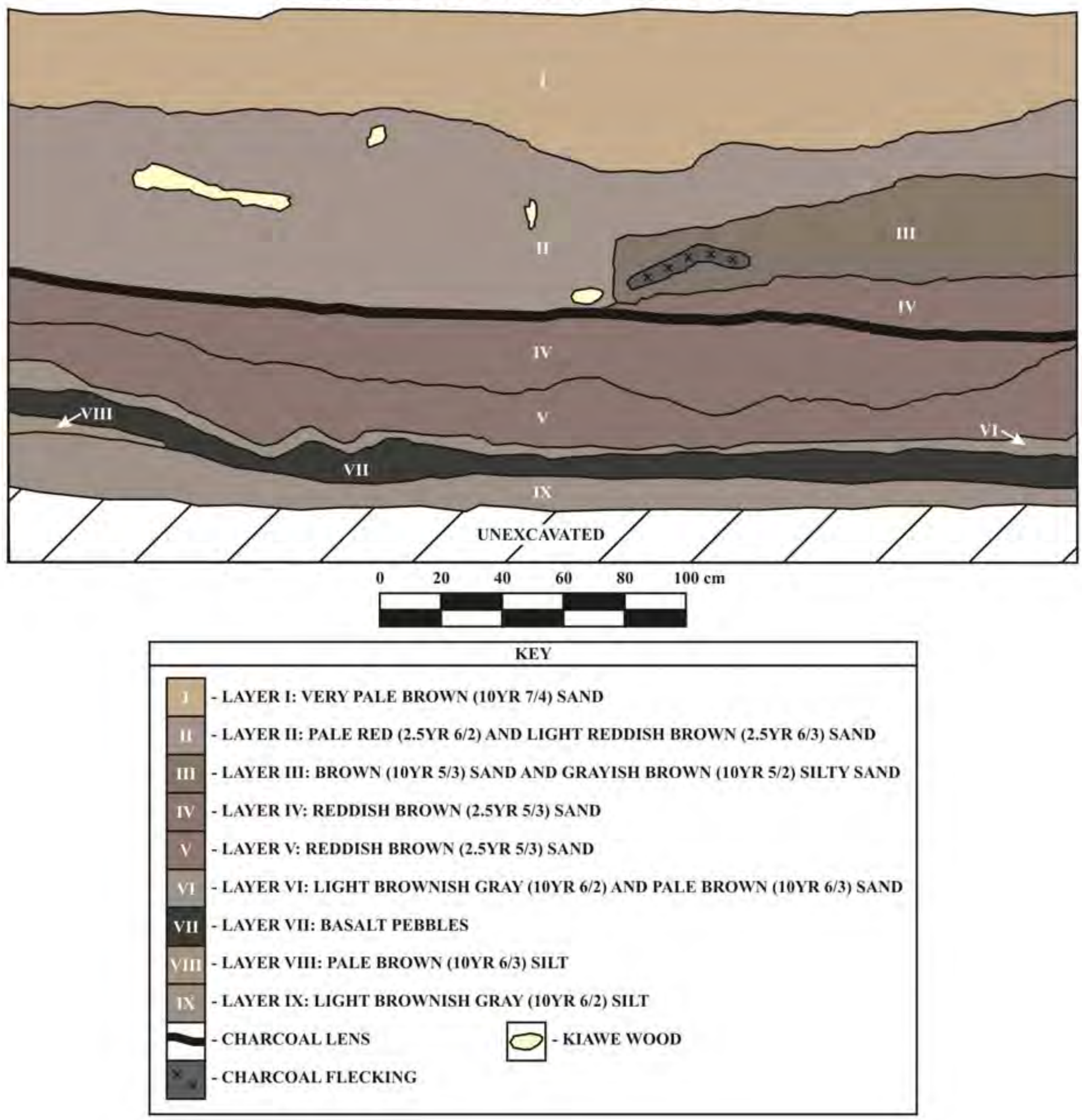
ST-52 NORTHWEST WALL PROFILE



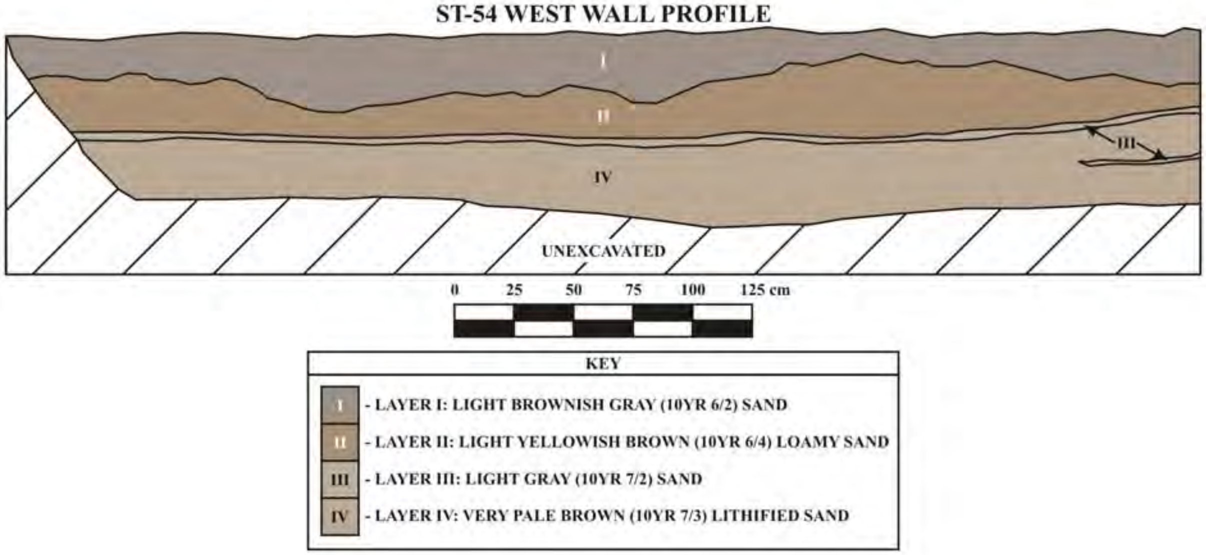
KEY

- I - LAYER I: VERY PALE BROWN (10YR 7/4) SAND
- II - LAYER II: VERY PALE BROWN (10YR 8/2) SAND
- III - LAYER III: VERY PALE BROWN (10YR 7/3) AND VERY PALE BROWN (10YR 7/4) SAND
- IV - LAYER IV: PALE RED (2.5YR 6/2) SILTY SAND
- V - LAYER V: LIGHT REDDISH GRAY (2.5YR 7/1) SAND
- VI - LAYER VI: LIGHT REDDISH BROWN (2.5YR 6/3) SILT
- VII - LAYER VII: LIGHT BROWNISH GRAY (10YR 6/2) SILTY SAND
- VIII - LAYER VIII: BROWN (10YR 5/3) SILTY LOAM
- IX - LAYER IX: BROWN (10YR 4/3) SILTY LOAM

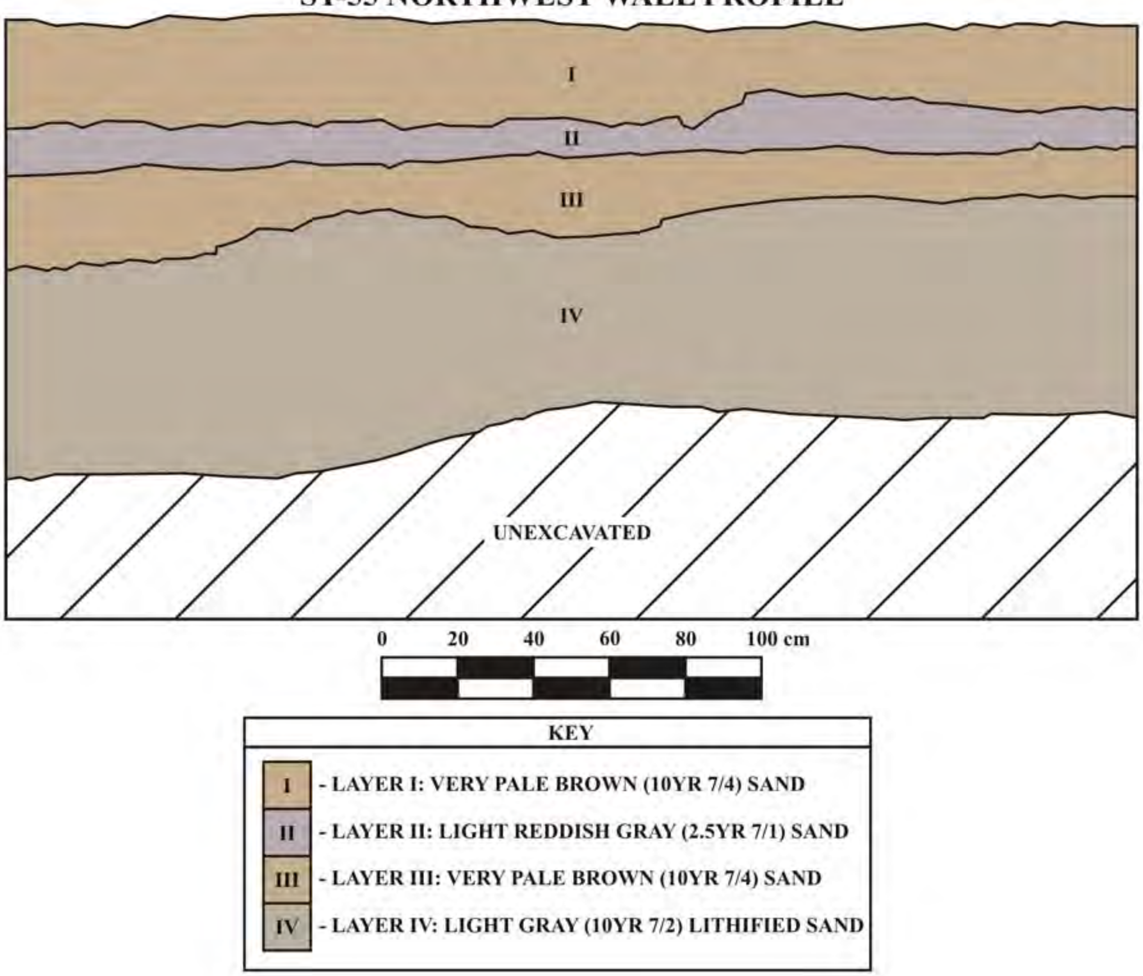
ST-53 NORTHEAST WALL PROFILE



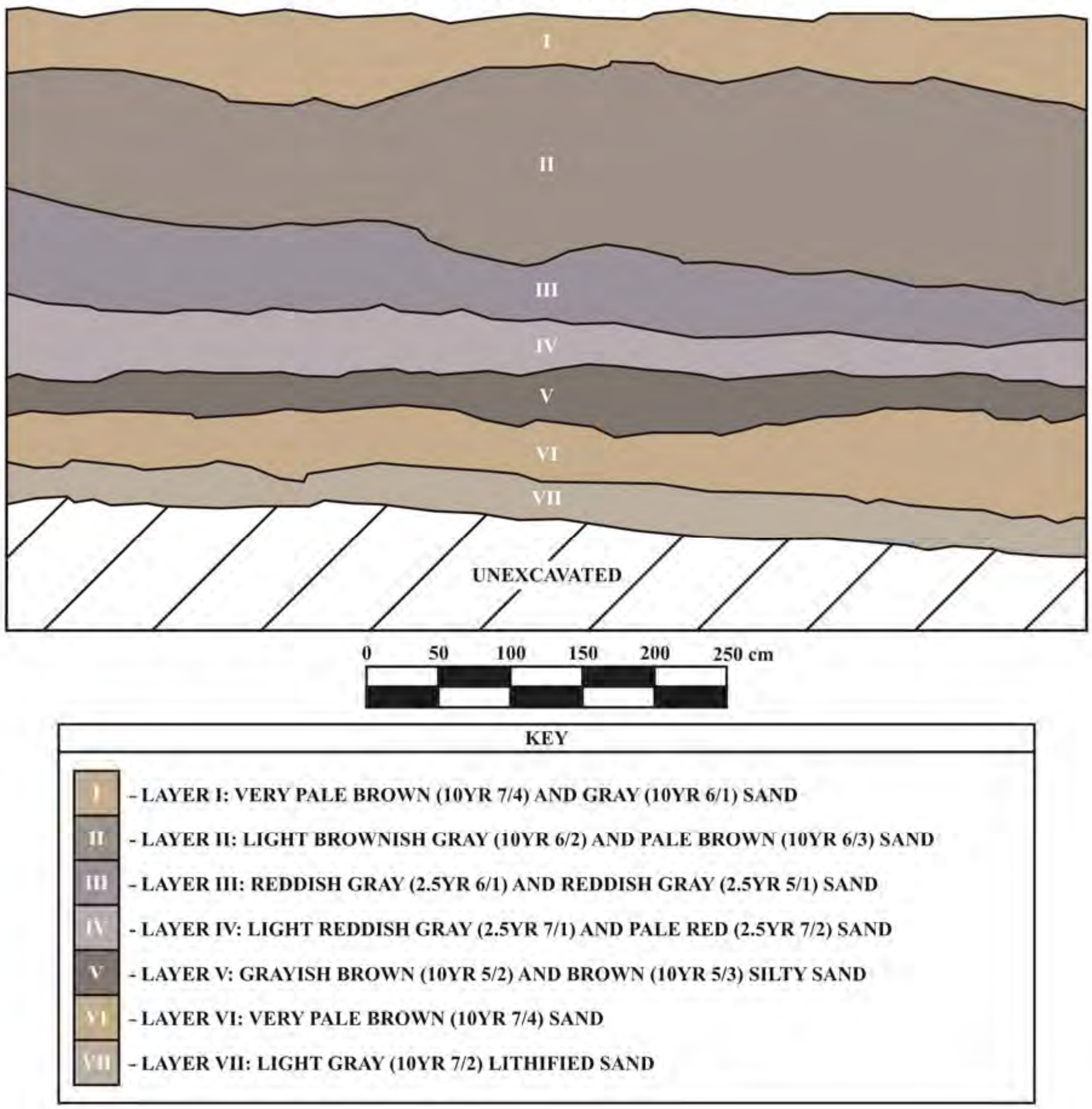
ST-54 WEST WALL PROFILE



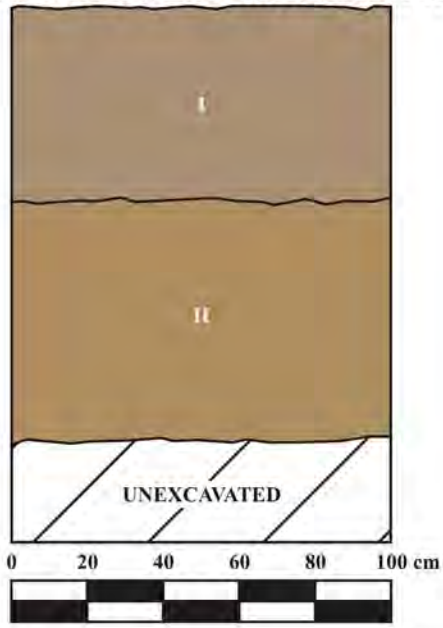
ST-55 NORTHWEST WALL PROFILE



ST-56 NORTHWEST WALL PROFILE

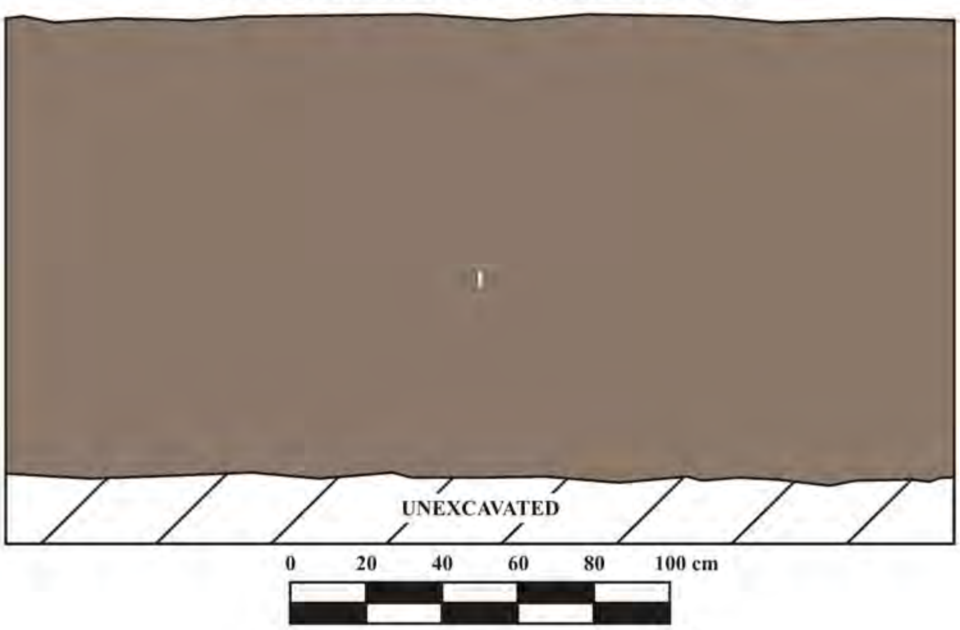


ST-57 NORTHWEST WALL PROFILE



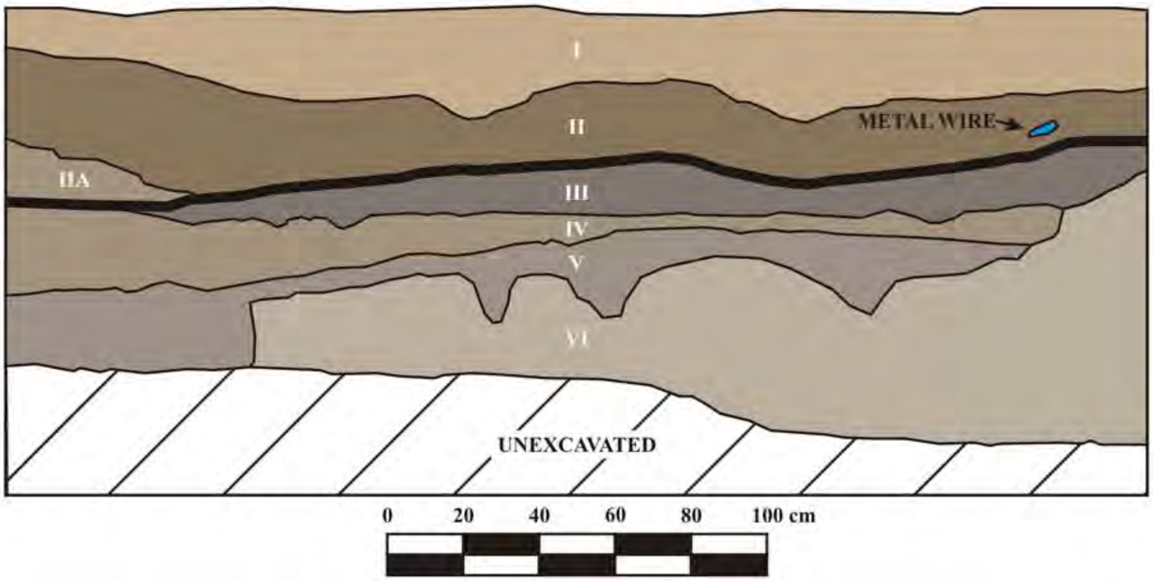
KEY
I - LAYER I: LIGHT YELLOWISH BROWN (10YR 6/4) SAND
II - LAYER II: LIGHT YELLOWISH BROWN (10YR 6/4) AND BROWNISH YELLOW (10YR 6/6) SAND

ST-58 SOUTHWEST WALL PROFILE



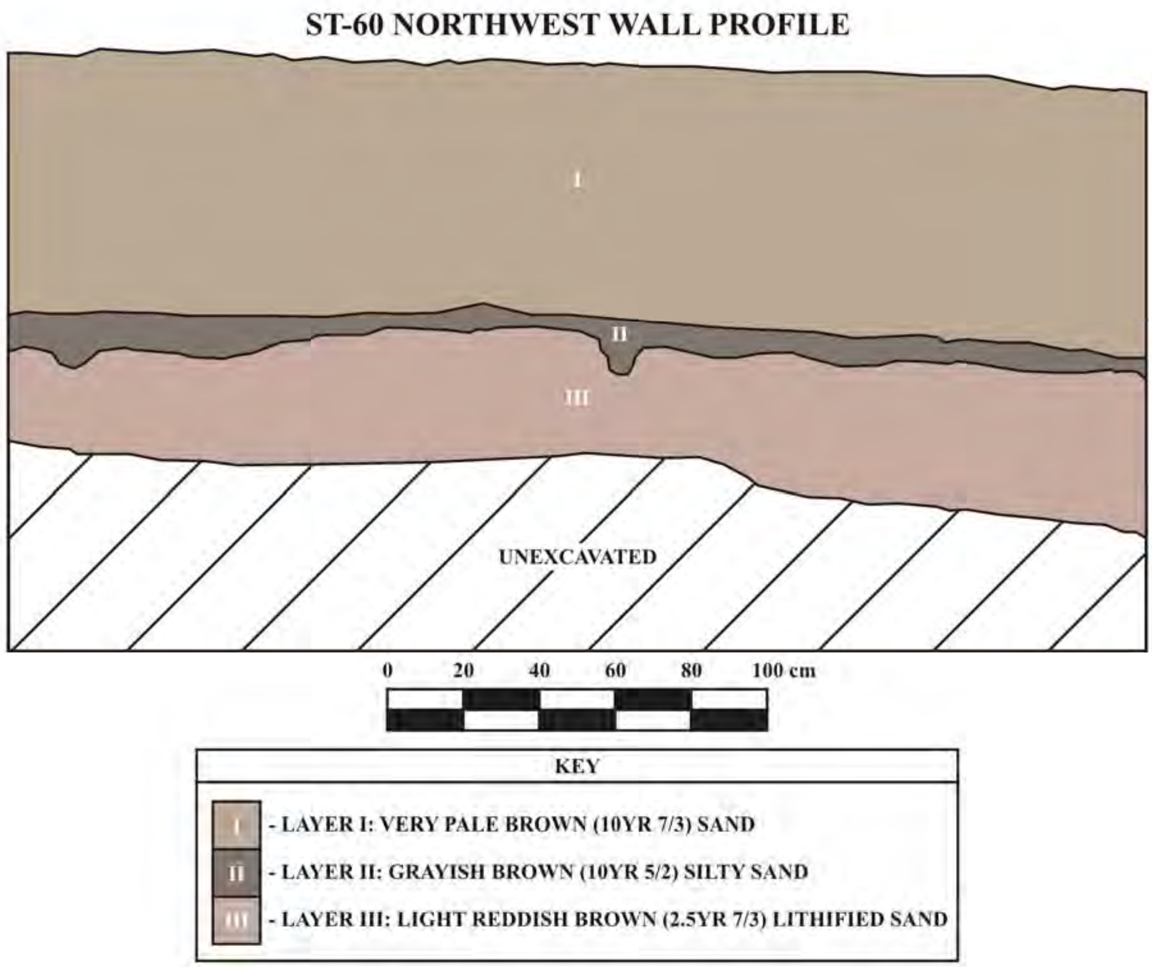
KEY
I - LAYER I: BROWN (10YR 5/3) SAND

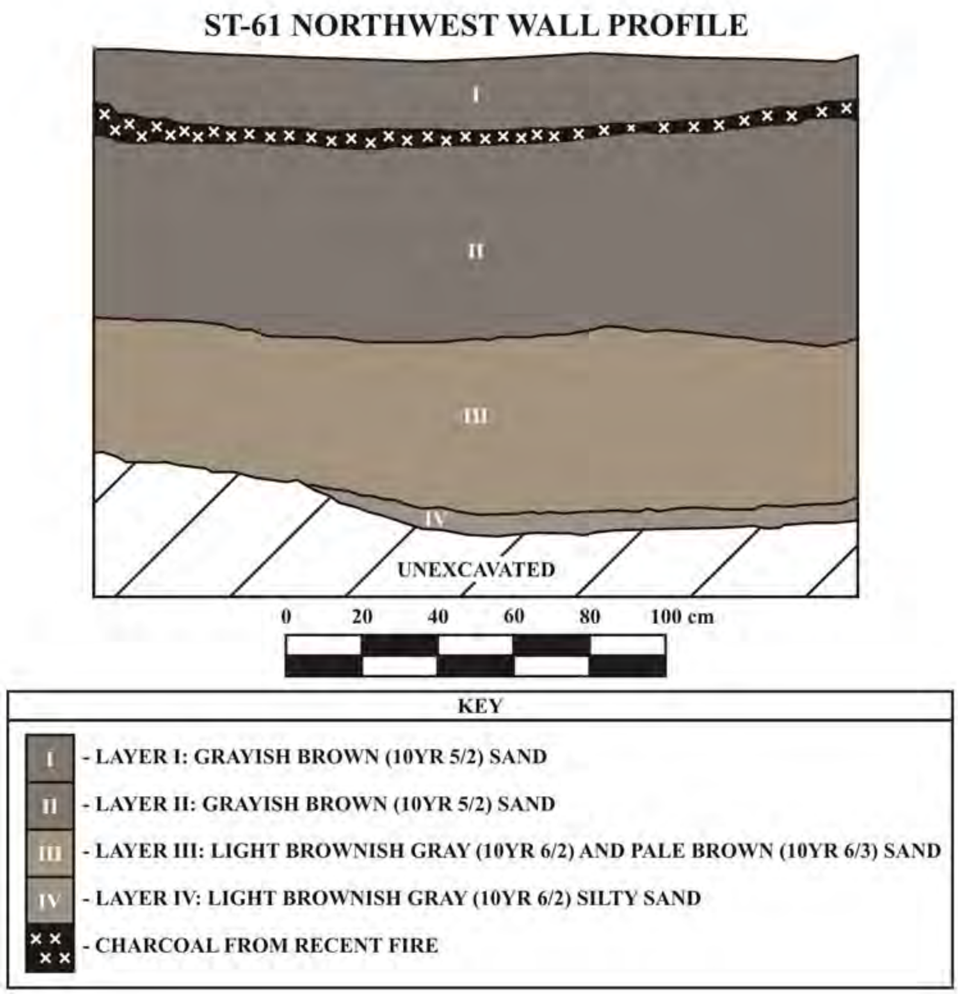
ST-59 NORTHWEST WALL PROFILE



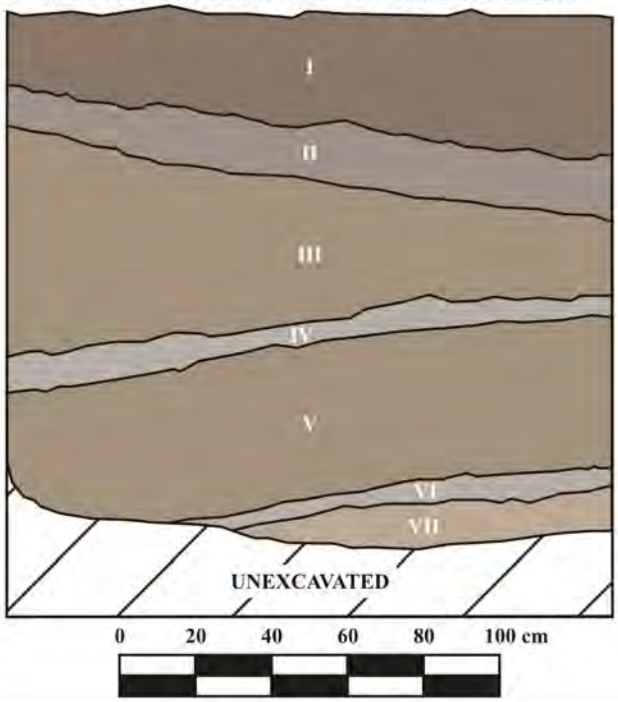
KEY

- I - LAYER I: VERY PALE BROWN (10YR 7/4) SAND
- II - LAYER II: YELLOWISH BROWN (10YR 5/4) SAND
- IIA - LAYER IIA: PALE BROWN (10YR 6/3) SAND
- III - LAYER III: GRAYISH BROWN (10YR 5/2) AND LIGHT YELLOWISH BROWN (10YR 6/4) SAND
- IV - LAYER IV: PALE BROWN (10YR 6/3) SAND
- V - LAYER V: LIGHT BROWNISH GRAY (10YR 6/2) AND PALE BROWN (10YR 6/3) SILTY SAND
- VI - LAYER VI: LIGHT GRAY (10YR 7/2) LITHIFIED SAND


ST-60 NORTHWEST WALL PROFILE
I
II
III
UNEXCAVATED
0
20
40
60
80
100 cm
KEY
I - LAYER I: VERY PALE BROWN (10YR 7/3) SAND
II - LAYER II: GRAYISH BROWN (10YR 5/2) SILTY SAND
III - LAYER III: LIGHT REDDISH BROWN (2.5YR 7/3) LITHIFIED SAND


ST-61 NORTHWEST WALL PROFILE
I
II
III
IV
UNEXCAVATED
0 20 40 60 80 100 cm
KEY
I - LAYER I: GRAYISH BROWN (10YR 5/2) SAND
II - LAYER II: GRAYISH BROWN (10YR 5/2) SAND
III - LAYER III: LIGHT BROWNISH GRAY (10YR 6/2) AND PALE BROWN (10YR 6/3) SAND
IV - LAYER IV: LIGHT BROWNISH GRAY (10YR 6/2) SILTY SAND
- CHARCOAL FROM RECENT FIRE

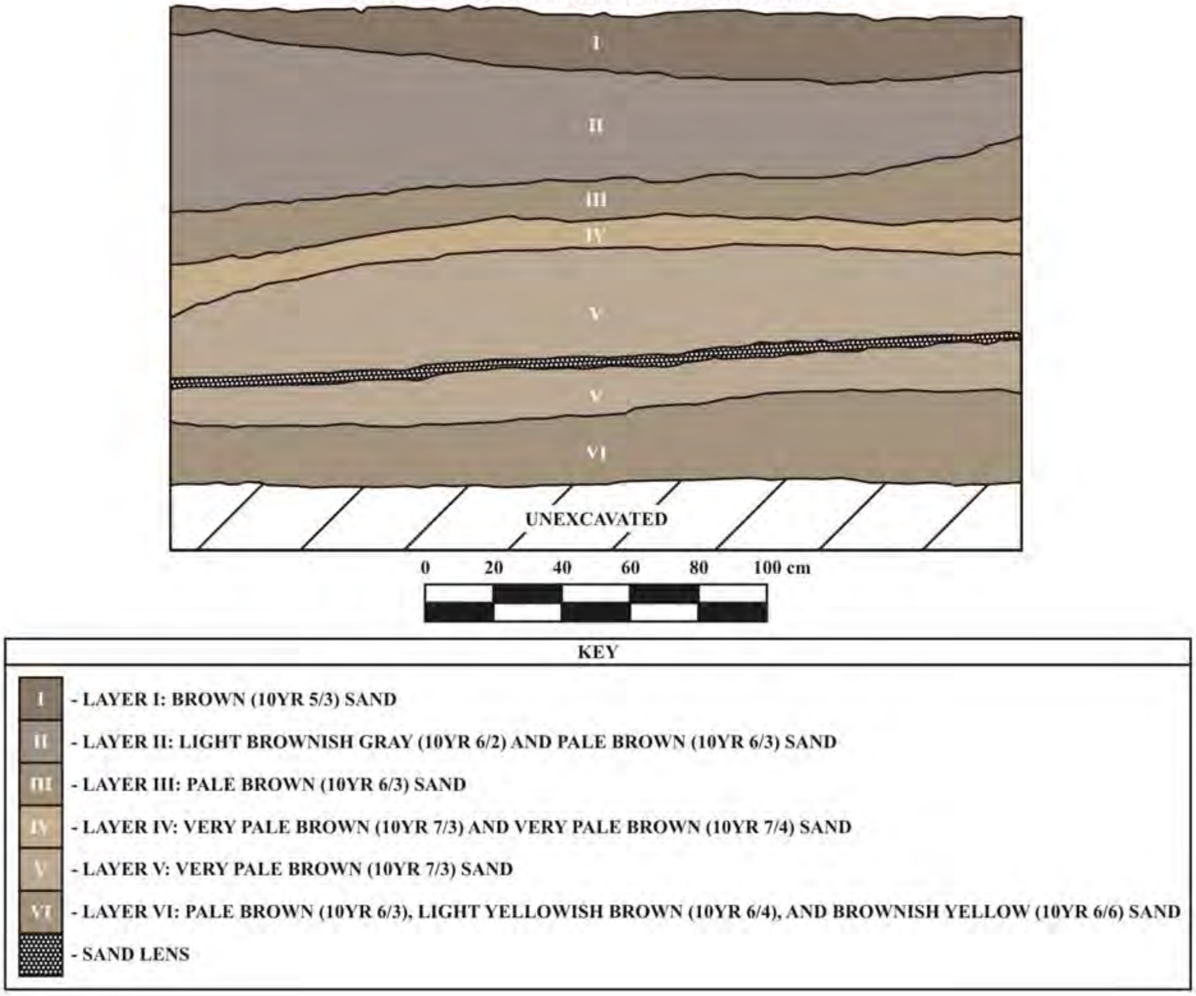
ST-62 NORTHEAST WALL PROFILE



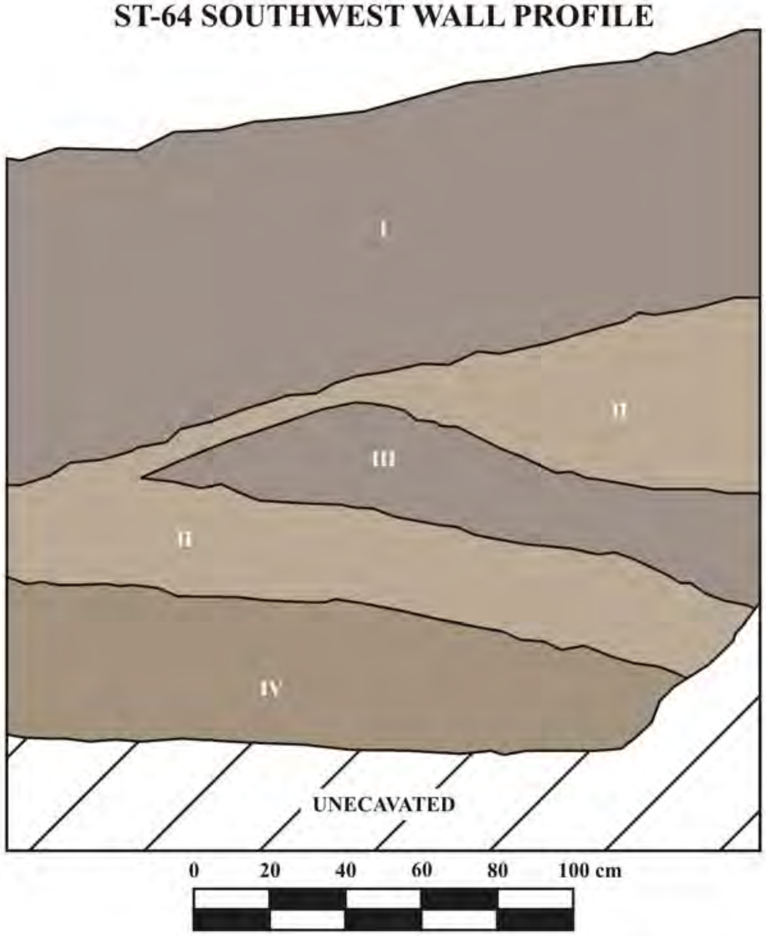
KEY

- I - LAYER I: BROWN (10YR 5/3) SAND
- II - LAYER II: LIGHT BROWNISH GRAY (10YR 6/2) SAND
- III - LAYER III: PALE BROWN (10YR 6/3) AND LIGHT YELLOWISH BROWN (10YR 6/4) SAND
- IV - LAYER IV: LIGHT GRAY (10YR 7/1) AND VERY PALE BROWN (10YR 7/3) SAND
- V - LAYER V: PALE BROWN (10YR 6/3) AND LIGHT YELLOWISH BROWN (10YR 6/4) SAND
- VI - LAYER VI: LIGHT GRAY (10YR 7/1) AND VERY PALE BROWN (10YR 7/3) SAND
- VII - LAYER VII: VERY PALE BROWN (10YR 7/3) AND VERY PALE BROWN (10YR 7/4) SAND

ST-63 NORTHEAST WALL PROFILE

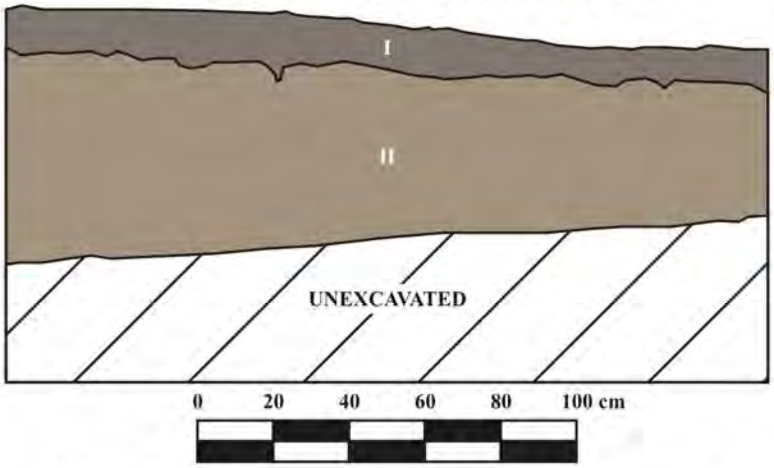


ST-64 SOUTHWEST WALL PROFILE



KEY
I - LAYER I: LIGHT BROWNISH GRAY (10YR 6/2) AND PALE BROWN (10YR 6/3) SAND
II - LAYER II: VERY PALE BROWN (10YR 7/3) SAND
III - LAYER III: LIGHT BROWNISH GRAY (10YR 6/2) SAND
IV - LAYER IV: PALE BROWN (10YR 6/3) AND BROWN (10YR 5/3) SAND

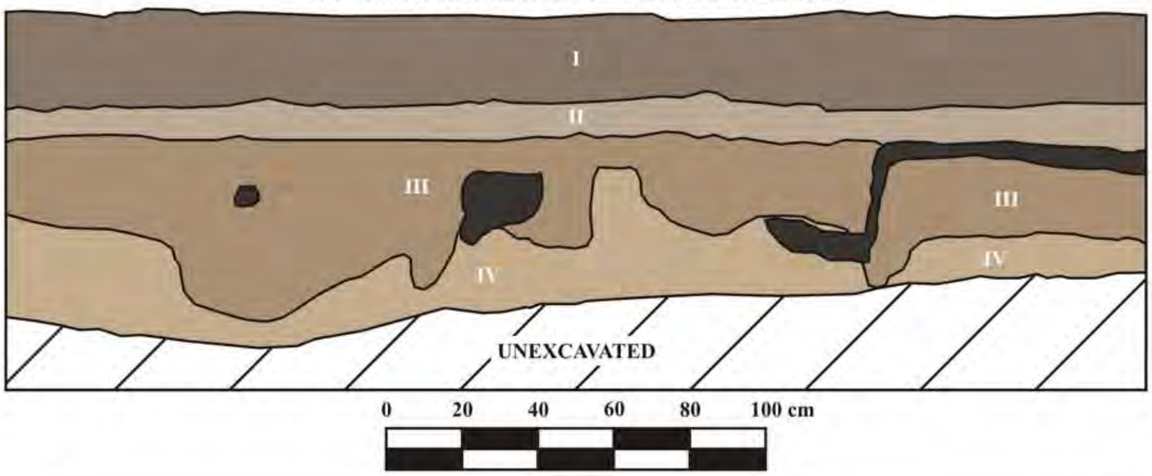
ST-65 NORTHWEST WALL PROFILE



KEY

- I - LAYER I: GRAYISH BROWN (10YR 5/2) SILTY SAND
- II - LAYER II: PALE BROWN (10YR 6/3) LITHIFIED SAND

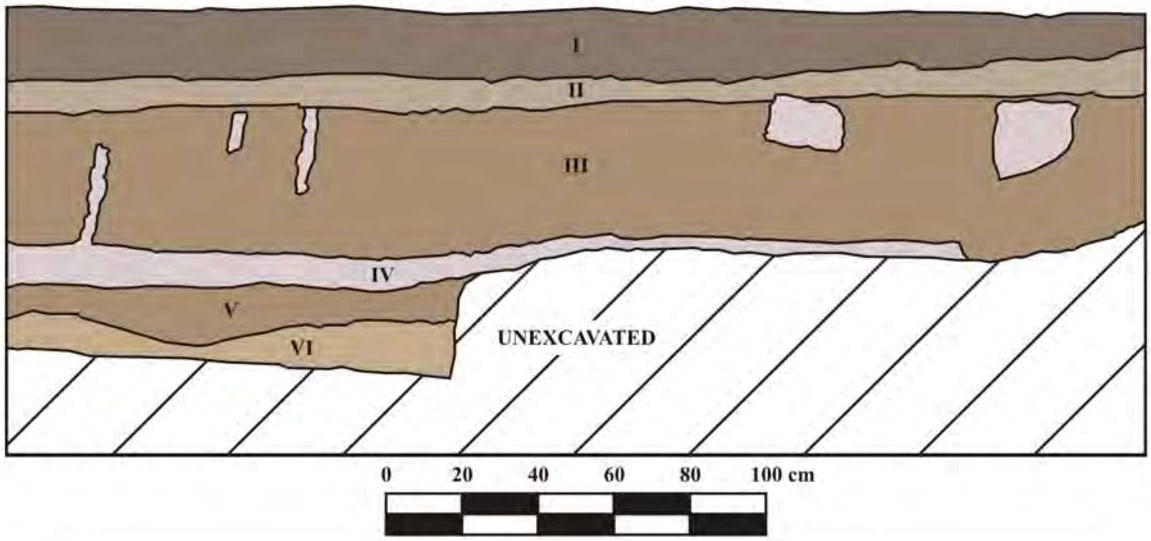
ST-66 NORTHEAST WALL PROFILE



KEY

- I - LAYER I: BROWN (10YR 5/3) SILT
- II - LAYER II: VERY PALE BROWN (10YR 7/3) AND VERY PALE BROWN (10YR 7/4) SAND
- III - LAYER III: LIGHT YELLOWISH BROWN (10YR 6/4) AND BROWNISH YELLOW (10YR 6/6) SAND
- IV - LAYER IV: VERY PALE BROWN (10YR 7/4) LITHIFIED SAND
- - SANDSTONE

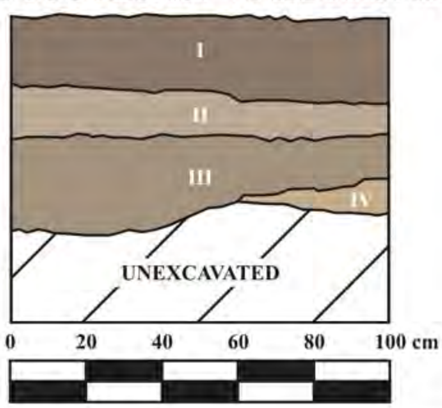
ST-67 EAST WALL PROFILE



KEY

- I - LAYER I: BROWN (10YR 5/3) SILT
- II - LAYER II: VERY PALE BROWN (10YR 7/3) AND VERY PALE BROWN (10YR 7/4) SAND
- III - LAYER III: LIGHT YELLOWISH BROWN (10YR 6/4) AND BROWNISH YELLOW (10YR 6/6) SAND
- IV - LAYER IV: WHITE (2.5YR 8/1) SANDSTONE
- V - LAYER V: LIGHT YELLOWISH BROWN (10YR 6/4) SAND
- VI - LAYER VI: VERY PALE BROWN (10YR 7/4) LITHIFIED SAND

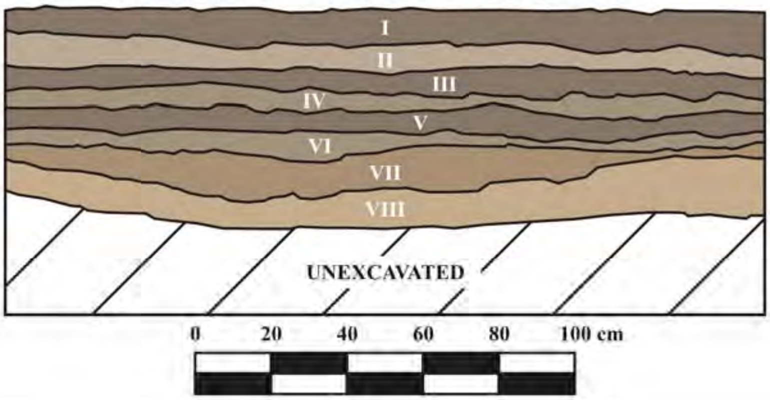
ST-68 SOUTHEAST WALL PROFILE



KEY

- I - LAYER I: BROWN (10YR 5/3) SILT
- II - LAYER II: VERY PALE BROWN (10YR 7/3) AND VERY PALE BROWN (10YR 7/4) SAND
- III - LAYER III: LIGHT YELLOWISH BROWN (10YR 6/4) AND BROWNISH YELLOW (10YR 6/6) SAND
- IV - LAYER IV: VERY PALE BROWN (10YR 7/4) LITHIFIED SAND

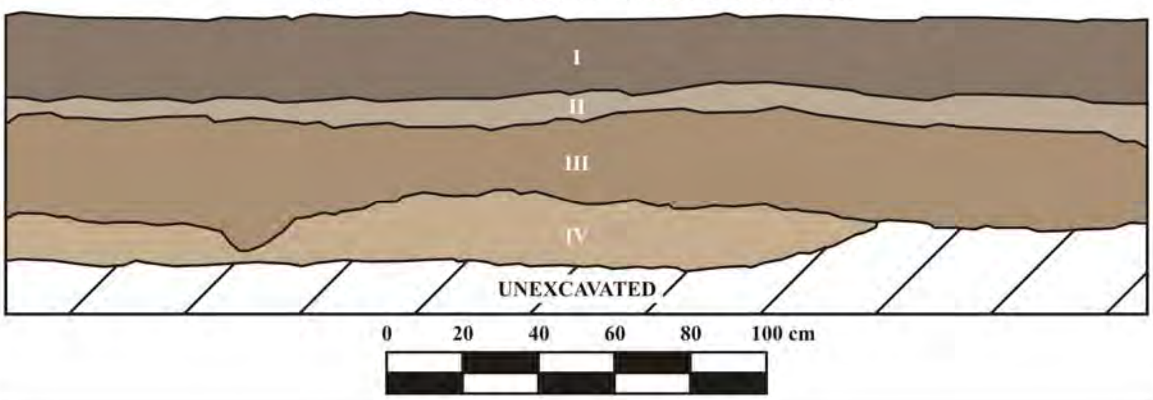
ST-70 SOUTHWEST WALL PROFILE



KEY

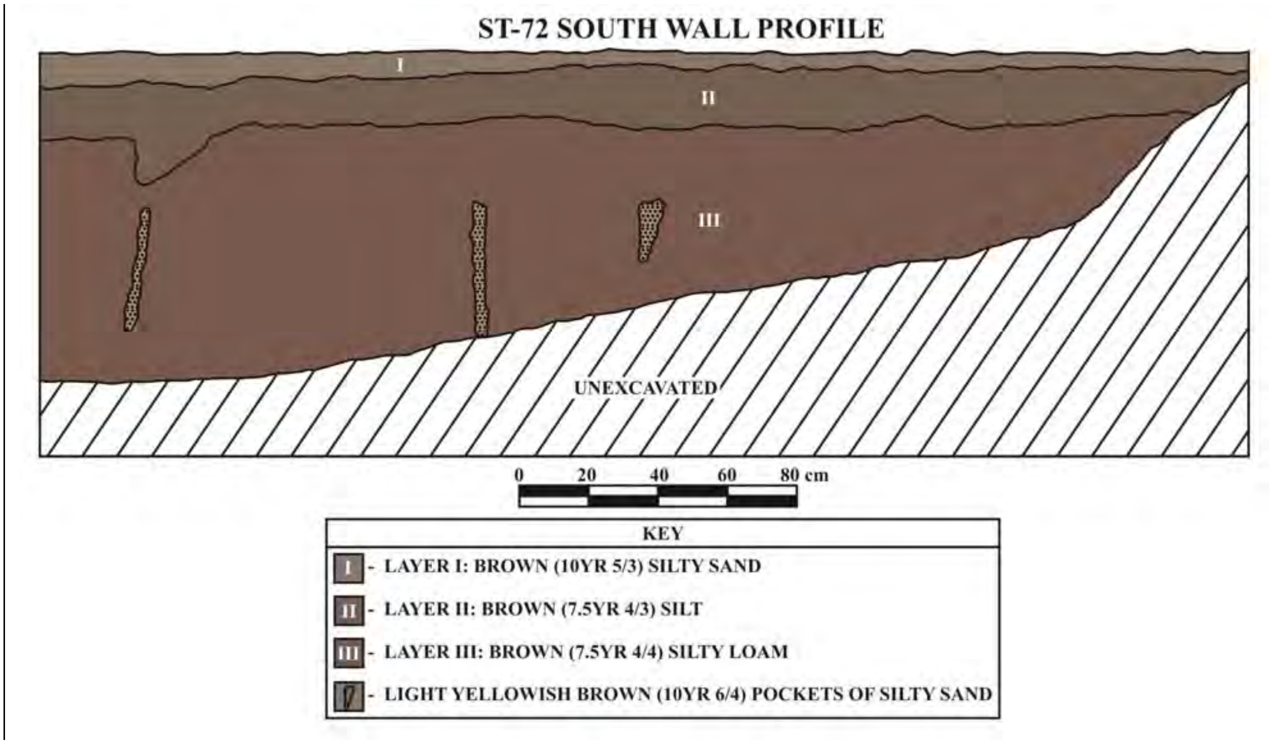
- LAYER I: BROWN (10YR 5/3) SILTY SAND
- LAYER II: VERY PALE BROWN (10YR 7/3) AND VERY PALE BROWN (10YR 7/4) SAND
- LAYER III: BROWN (10YR 5/3) SILTY SAND
- LAYER IV: PALE BROWN (10YR 6/3) SAND
- LAYER V: BROWN (10YR 5/3) SILTY SAND
- LAYER VI: PALE BROWN (10YR 6/3) SAND
- LAYER VII: LIGHT YELLOWISH BROWN (10YR 6/4) AND BROWNISH YELLOW (10YR 6/6) SAND
- LAYER VIII: VERY PALE BROWN (10YR 7/4) LITHIFIED SAND

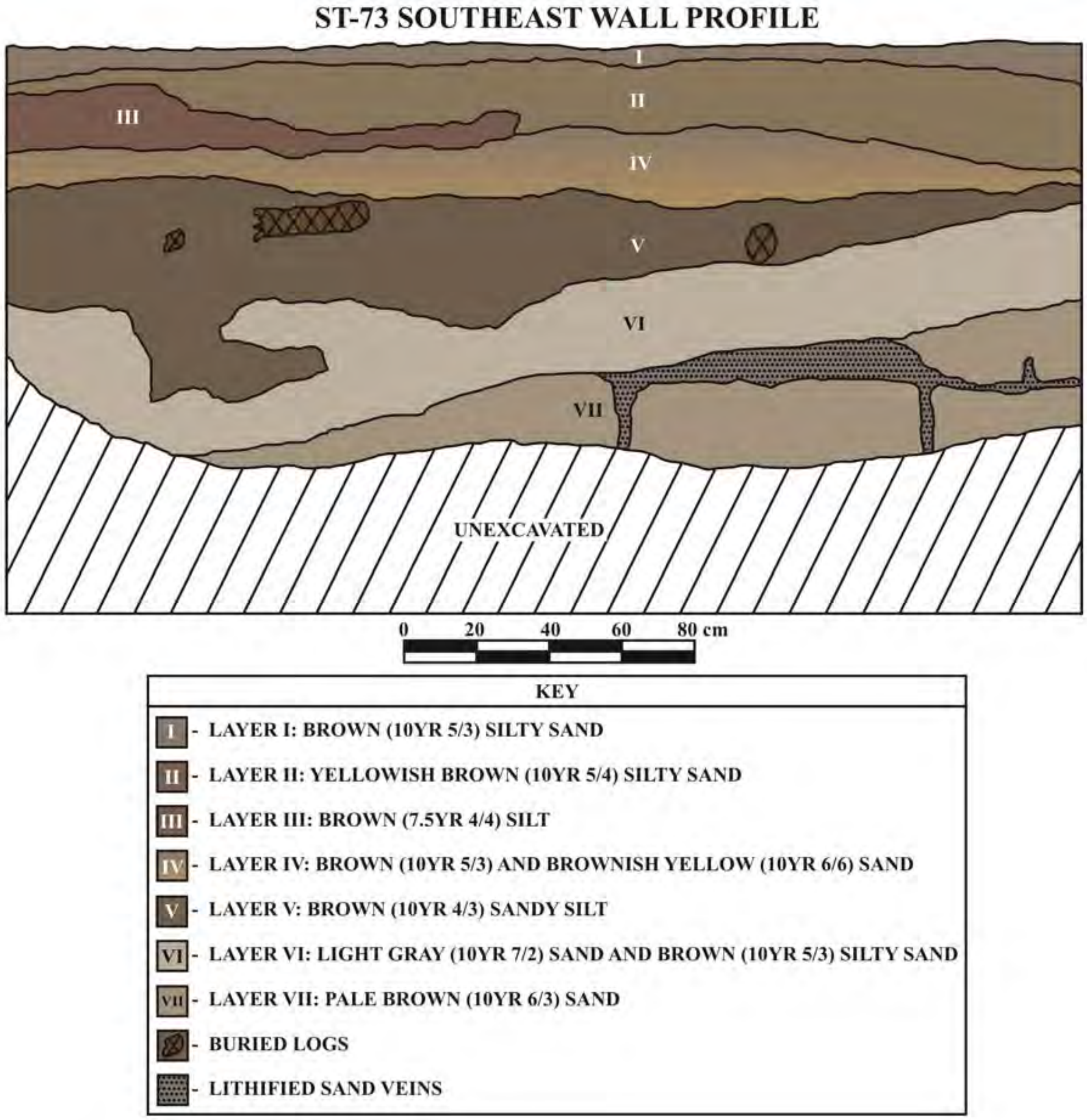
ST-71 NORTHWEST WALL PROFILE



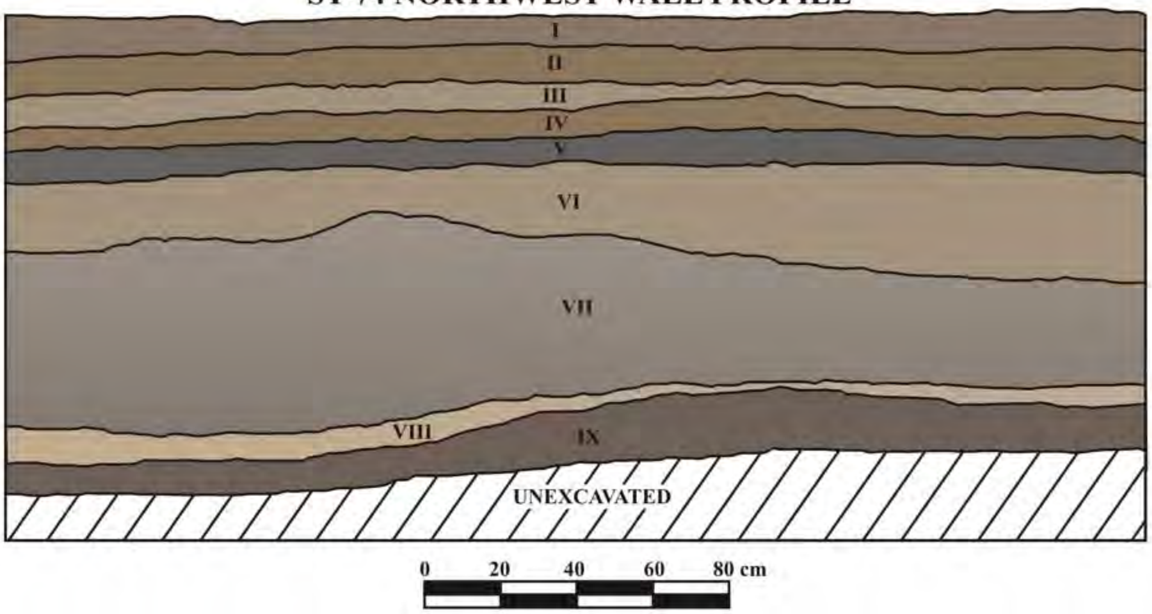
KEY

- LAYER I: BROWN (10YR 5/3) SILT
- LAYER II: VERY PALE BROWN (10YR 7/3) AND VERY PALE BROWN (10YR 7/4) SAND
- LAYER III: LIGHT YELLOWISH BROWN (10YR 6/4) AND BROWNISH YELLOW (10YR 6/6) SAND
- LAYER IV: VERY PALE BROWN (10YR 7/4) AND LIGHT YELLOWISH BROWN (10YR 6/4) LITHIFIED SAND


ST-72 SOUTH WALL PROFILE
I
II
III
UNEXCAVATED
0
20
40
60
80 cm
KEY
I - LAYER I: BROWN (10YR 5/3) SILTY SAND
II - LAYER II: BROWN (7.5YR 4/3) SILT
III - LAYER III: BROWN (7.5YR 4/4) SILTY LOAM
- LIGHT YELLOWISH BROWN (10YR 6/4) POCKETS OF SILTY SAND


ST-73 SOUTHEAST WALL PROFILE
I
II
III
IV
V
VI
VII
UNEXCAVATED
0 20 40 60 80 cm
KEY
I - LAYER I: BROWN (10YR 5/3) SILTY SAND
II - LAYER II: YELLOWISH BROWN (10YR 5/4) SILTY SAND
III - LAYER III: BROWN (7.5YR 4/4) SILT
IV - LAYER IV: BROWN (10YR 5/3) AND BROWNISH YELLOW (10YR 6/6) SAND
V - LAYER V: BROWN (10YR 4/3) SANDY SILT
VI - LAYER VI: LIGHT GRAY (10YR 7/2) SAND AND BROWN (10YR 5/3) SILTY SAND
VII - LAYER VII: PALE BROWN (10YR 6/3) SAND
- BURIED LOGS
- LITHIFIED SAND VEINS

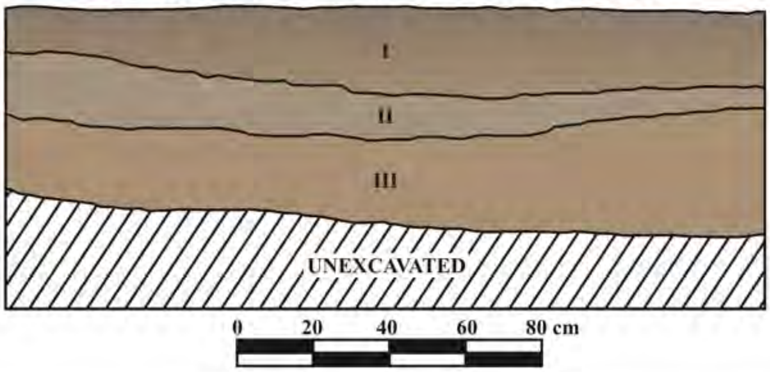
ST-74 NORTHWEST WALL PROFILE



KEY

- I - LAYER I: BROWN (10YR 5/3) SILTY SAND
- II - LAYER II: YELLOWISH BROWN (10YR 5/4) SILTY SAND
- III - LAYER III: PALE BROWN (10YR 6/3) SAND
- IV - LAYER IV: YELLOWISH BROWN (10YR 5/4) SILT
- V - LAYER V: DARK GRAY (10YR 4/1) SILTY SAND
- VI - LAYER VI: PALE BROWN (10YR 6/3) SAND
- VII - LAYER VII: LIGHT BROWNISH GRAY (10YR 6/2) AND GRAYISH BROWN (10YR 5/2) SAND
- VIII - LAYER VIII: VERY PALE BROWN (10YR 7/3) AND VERY PALE BROWN (10YR 7/4) SAND
- IX - LAYER IX: DARK GRAYISH BROWN (10YR 4/2) SILT

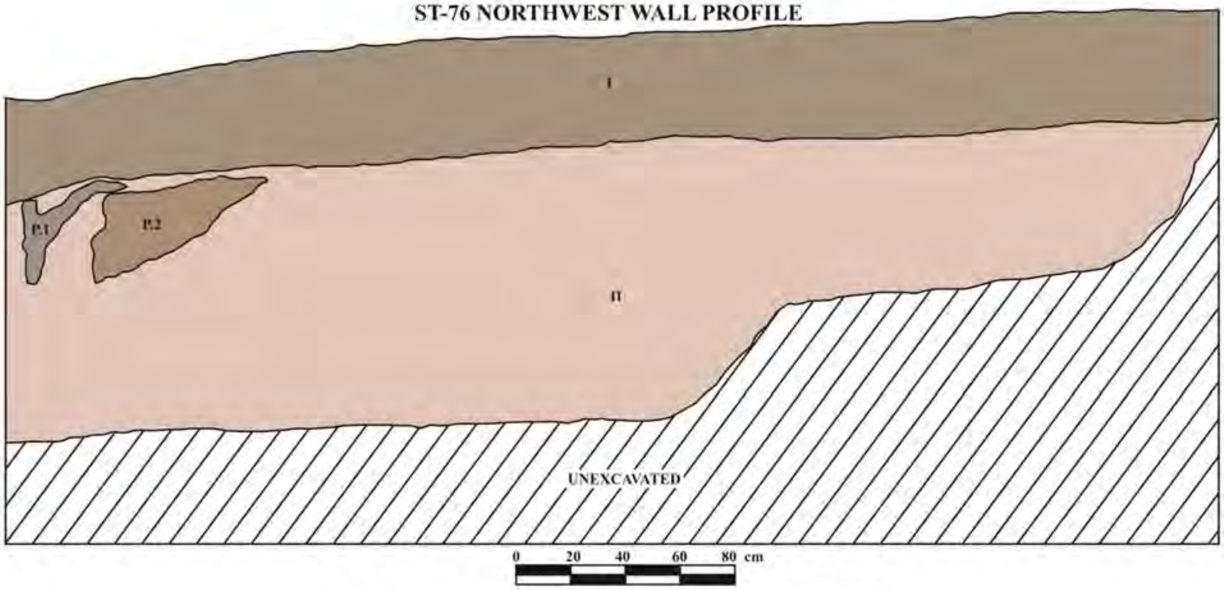
ST-75 NORTHWEST WALL PROFILE



KEY

- I - LAYER I: BROWN (10YR 5/3) AND LIGHT YELLOWISH BROWN (10YR 6/4) SAND
- II - LAYER II: PALE BROWN (10YR 6/3) SAND
- III - LAYER III: LIGHT YELLOWISH BROWN (10YR 6/4) SAND

ST-76 NORTHWEST WALL PROFILE



KEY

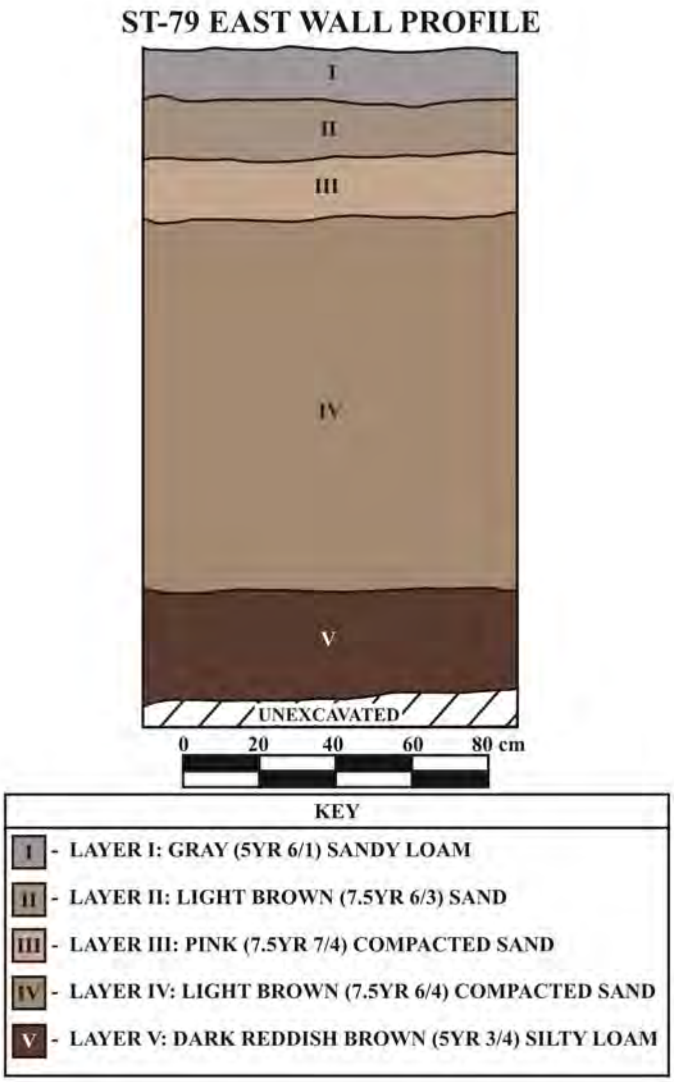
- I - LAYER I: PALE BROWN (10YR 6/3) SAND
- II - LAYER II: PINK (2.5YR 8/3) LITHIFIED SAND
- P.1 - POCKET 1: LIGHT BROWNISH GRAY (10YR 6/2) SILTY SAND
- P.2 - POCKET 2: LIGHT YELLOWISH BROWN (10YR 6/4) SAND

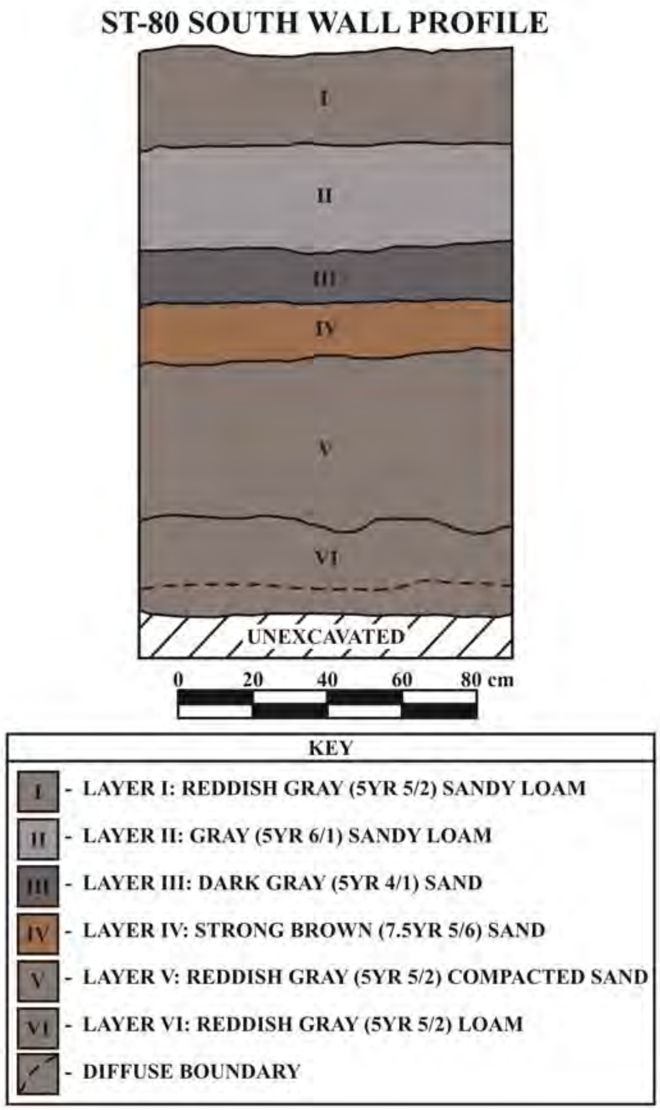
ST-77 SOUTH WALL PROFILE

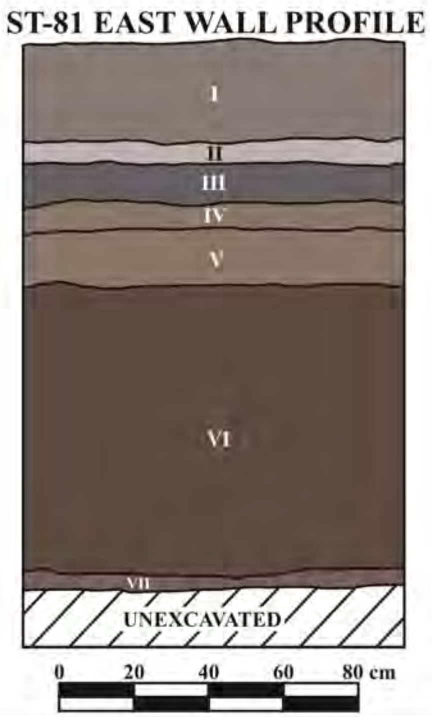
KEY
I - LAYER I: PINKISH GRAY (5YR 6/2) SANDY LOAM
II - LAYER II: PINKISH GRAY (5YR 6/2) SAND
III - LAYER III: PINKISH GRAY (5YR 7/2) CONCRETED SAND
IV - LAYER IV: LIGHT BROWN (7.5YR 6/4) SAND
V - LAYER V: PINKISH GRAY (5YR 7/2) SAND
- ROOTS

ST-78 NORTHEAST WALL PROFILE

KEY
I - LAYER I: DARK REDDISH GRAY (5YR 4/2) SANDY LOAM
II - LAYER II: GRAY (5YR 5/1) SAND
III - LAYER III: REDDISH GRAY (5YR 5/2) SAND
IV - LAYER IV: BROWN (10YR 4/3) SANDY LOAM
V - LAYER V: BROWN (7.5YR 5/2) SILTY SAND


ST-79 EAST WALL PROFILE
I
II
III
IV
V
UNEXCAVATED
0
20
40
60
80 cm
KEY
I - LAYER I: GRAY (5YR 6/1) SANDY LOAM
II - LAYER II: LIGHT BROWN (7.5YR 6/3) SAND
III - LAYER III: PINK (7.5YR 7/4) COMPACTED SAND
IV - LAYER IV: LIGHT BROWN (7.5YR 6/4) COMPACTED SAND
V - LAYER V: DARK REDDISH BROWN (5YR 3/4) SILTY LOAM

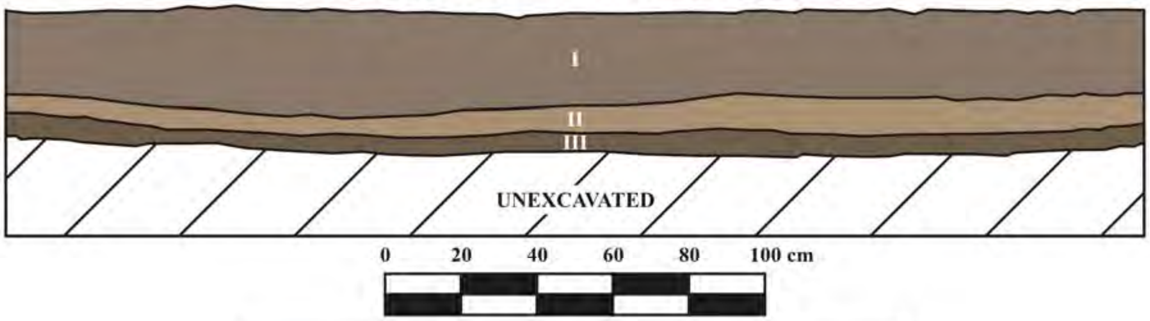

ST-80 SOUTH WALL PROFILE
I
II
III
IV
V
VI
UNEXCAVATED
0
20
40
60
80 cm
KEY
I - LAYER I: REDDISH GRAY (5YR 5/2) SANDY LOAM
II - LAYER II: GRAY (5YR 6/1) SANDY LOAM
III - LAYER III: DARK GRAY (5YR 4/1) SAND
IV - LAYER IV: STRONG BROWN (7.5YR 5/6) SAND
V - LAYER V: REDDISH GRAY (5YR 5/2) COMPACTED SAND
VI - LAYER VI: REDDISH GRAY (5YR 5/2) LOAM
- DIFFUSE BOUNDARY



KEY

- I - LAYER I: REDDISH GRAY (5YR 5/2) SANDY LOAM
- II - LAYER II: LIGHT GRAY (5YR 7/1) SAND
- III - LAYER III: DARK GRAY (5YR 4/1) SANDY SILT
- IV - LAYER IV: REDDISH BROWN (5YR 5/3) SAND
- V - LAYER V: REDDISH BROWN (5YR 5/3) SANDY SILT
- VI - LAYER VI: DARK REDDISH BROWN (5YR 3/3) SAND
- VII - LAYER VII: REDDISH BROWN (5YR 4/3) SILT

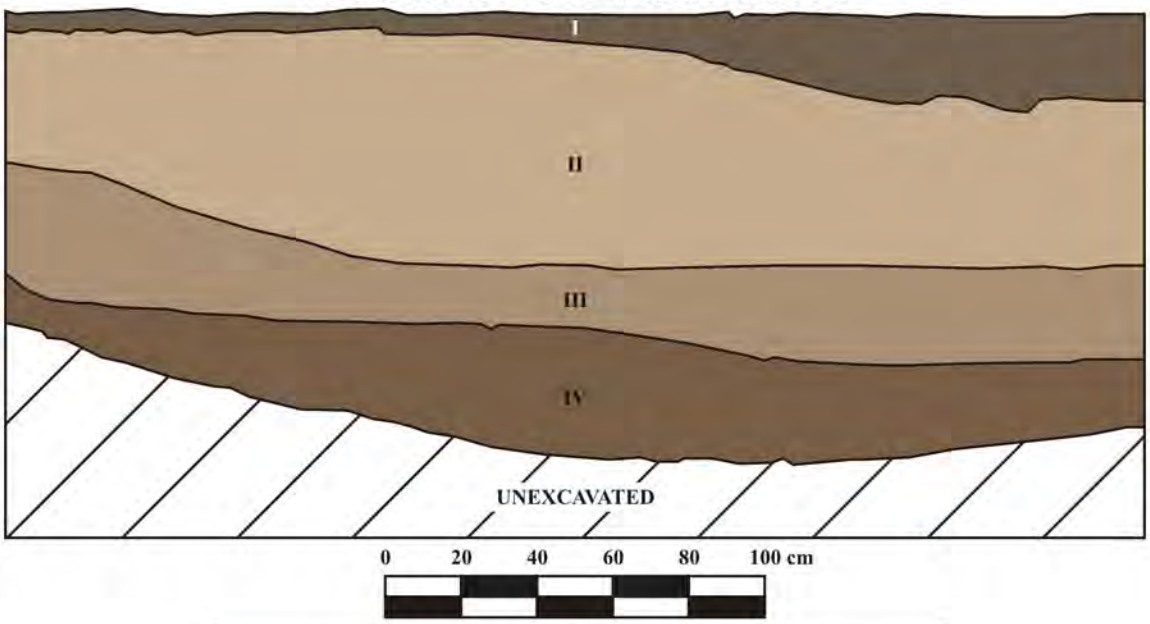
ST-82 NORTHEAST WALL PROFILE



KEY

- I - LAYER I: BROWN (10YR 5/3) SILT
- II - LAYER II: LIGHT YELLOWISH BROWN (10YR 6/4) SAND
- III - LAYER III: BROWN (10YR 4/3) SILT LOAM

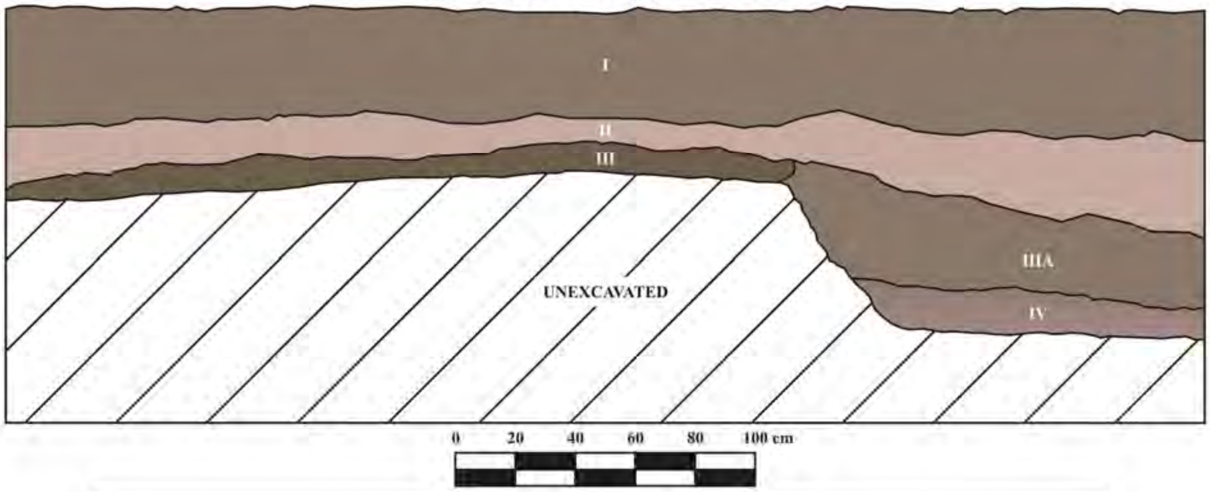
ST-83 NORTHWEST WALL PROFILE



KEY

- I - LAYER I: BROWN (10YR 4/3) SANDY SILT
- II - LAYER II: VERY PALE BROWN (10YR 7/4) LITHIFIED SAND
- III - LAYER III: LIGHT YELLOWISH BROWN (10YR 6/4) SAND
- IV - LAYER IV: DARK YELLOWISH BROWN (10YR 4/4) SILTY LOAM

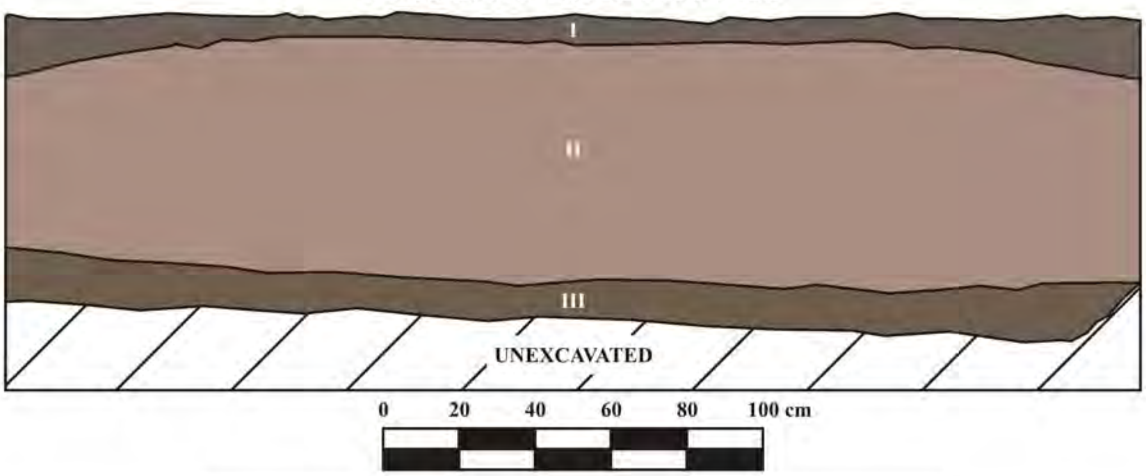
ST-84 SOUTH WALL PROFILE



KEY

- I - LAYER I: BROWN (10YR 5/3) SILT
- II - LAYER II: LIGHT REDDISH BROWN (2.5YR 7/3), PALE RED (2.5YR 6/2), AND LIGHT REDDISH BROWN (2.5YR 6/3) SAND
- III - LAYER III: BROWN (10YR 4/3) SILT LOAM
- IIIA - LAYER IIIA: BROWN (10YR 5/3) SILT
- IV - LAYER IV: WEAK RED (2.5YR 5/2) AND LIGHT REDDISH BROWN (2.5YR 6/3) SAND

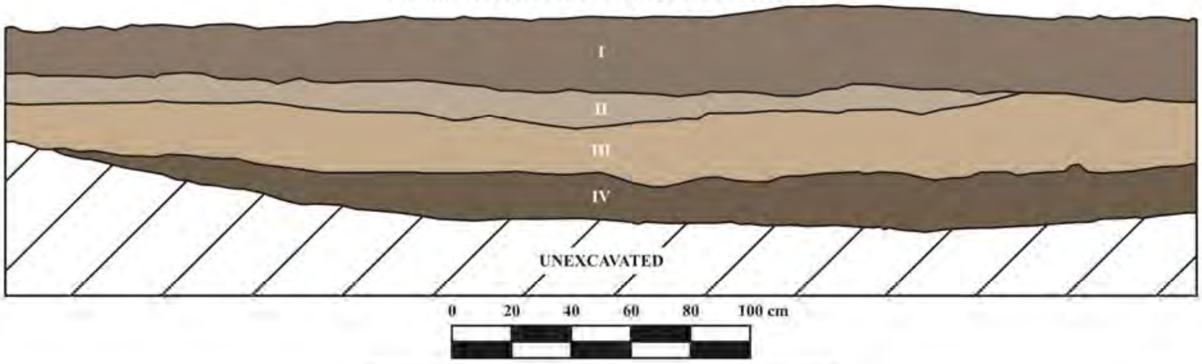
ST-85 EAST WALL PROFILE



KEY

- I - LAYER I: DARK GRAYISH BROWN (10YR 4/2) SILTY SAND
- II - LAYER II: LIGHT REDDISH BROWN (2.5YR 6/3) LITHIFIED SAND
- III - LAYER III: BROWN (10YR 4/3) SILTY LOAM

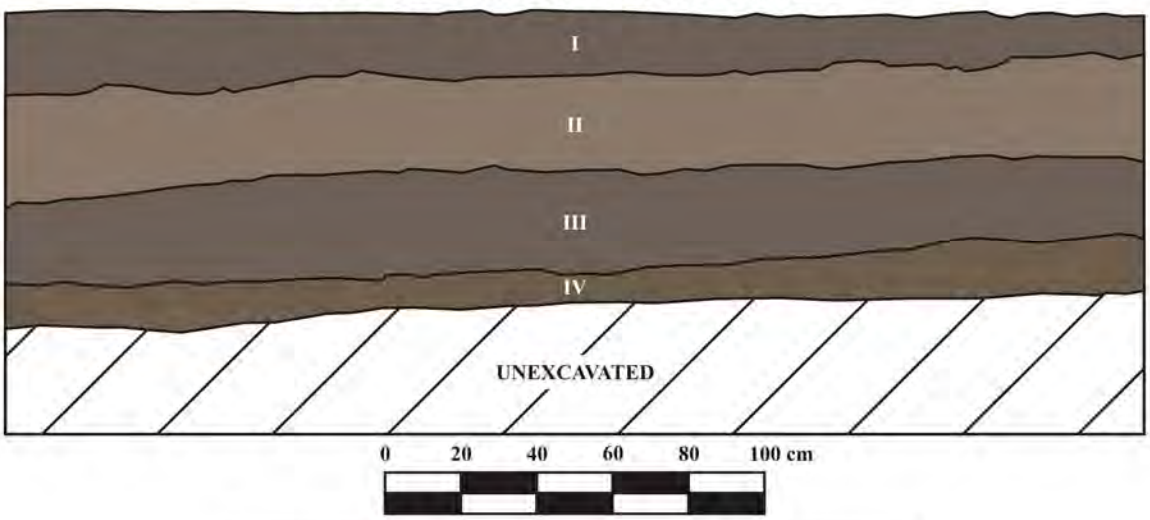
ST-86 NORTHEAST WALL PROFILE



KEY

- I - LAYER I: BROWN (10YR 5/3) SANDY SILT
- II - LAYER II: VERY PALE BROWN (10YR 7/3) SAND
- III - LAYER III: VERY PALE BROWN (10YR 7/4) SAND
- IV - LAYER IV: BROWN (10YR 4/3) SILTY LOAM

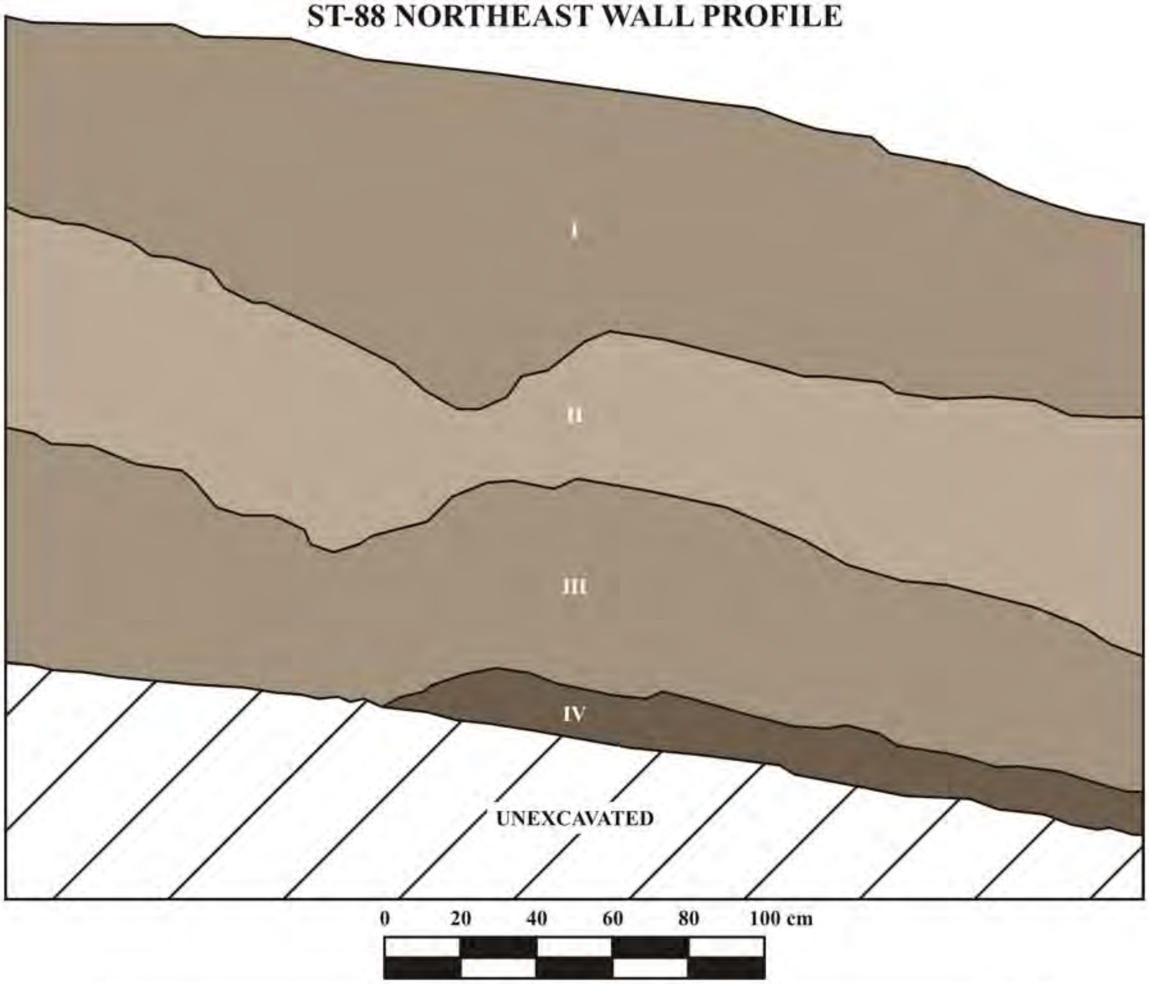
ST-87 NORTHWEST WALL PROFILE



KEY

- I - LAYER I: DARK GRAYISH BROWN (10YR 4/2) SILTY SAND
- II - LAYER II: BROWN (10YR 5/3) SILTY SAND
- III - LAYER III: DARK GRAYISH BROWN (10YR 4/2) SILT
- IV - LAYER IV: BROWN (10YR 4/3) SILTY LOAM

ST-88 NORTHEAST WALL PROFILE



KEY

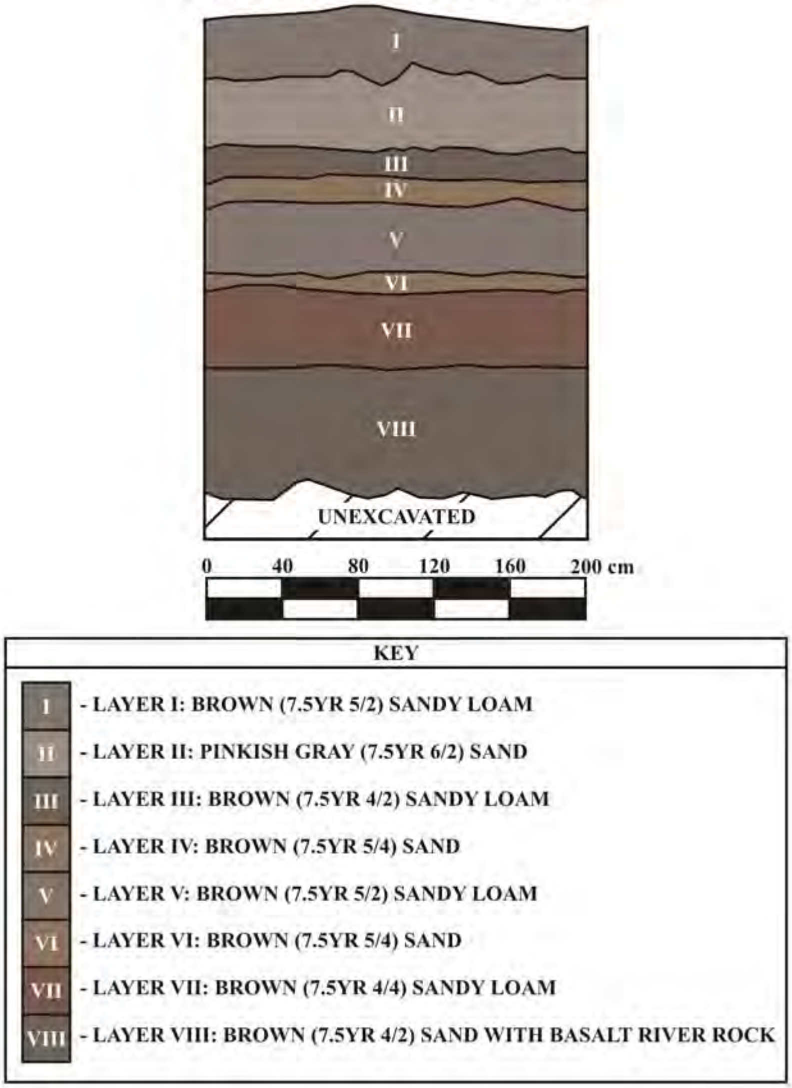
- LAYER I: PALE BROWN (10YR 6/3) SAND

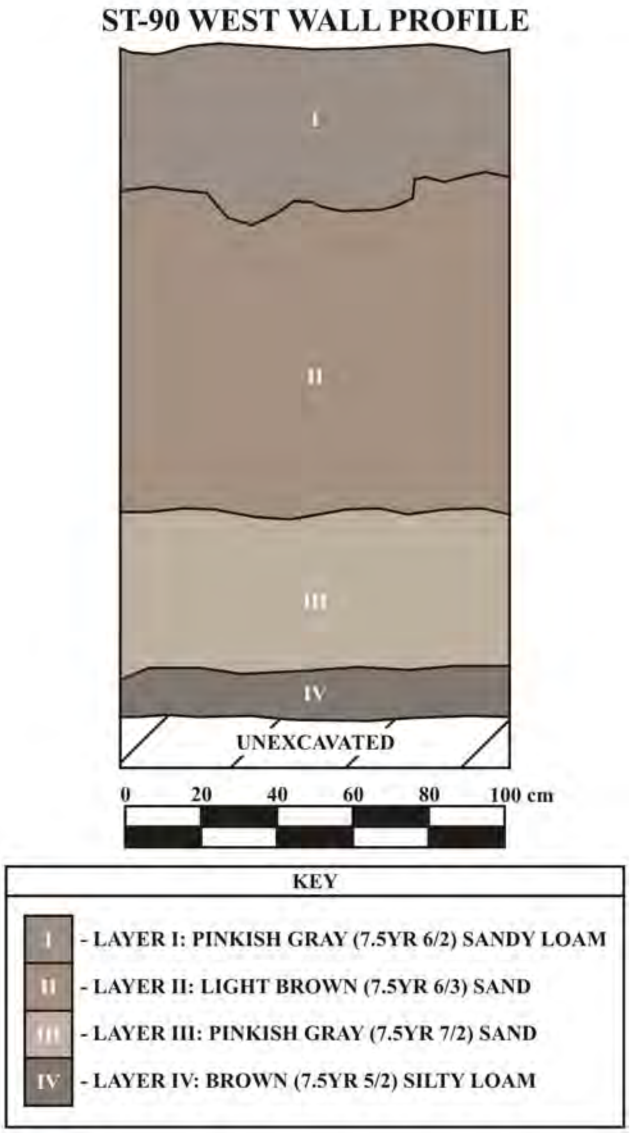
- LAYER II: VERY PALE BROWN (10YR 7/3) AND VERY PALE BROWN (10YR 7/4) SAND

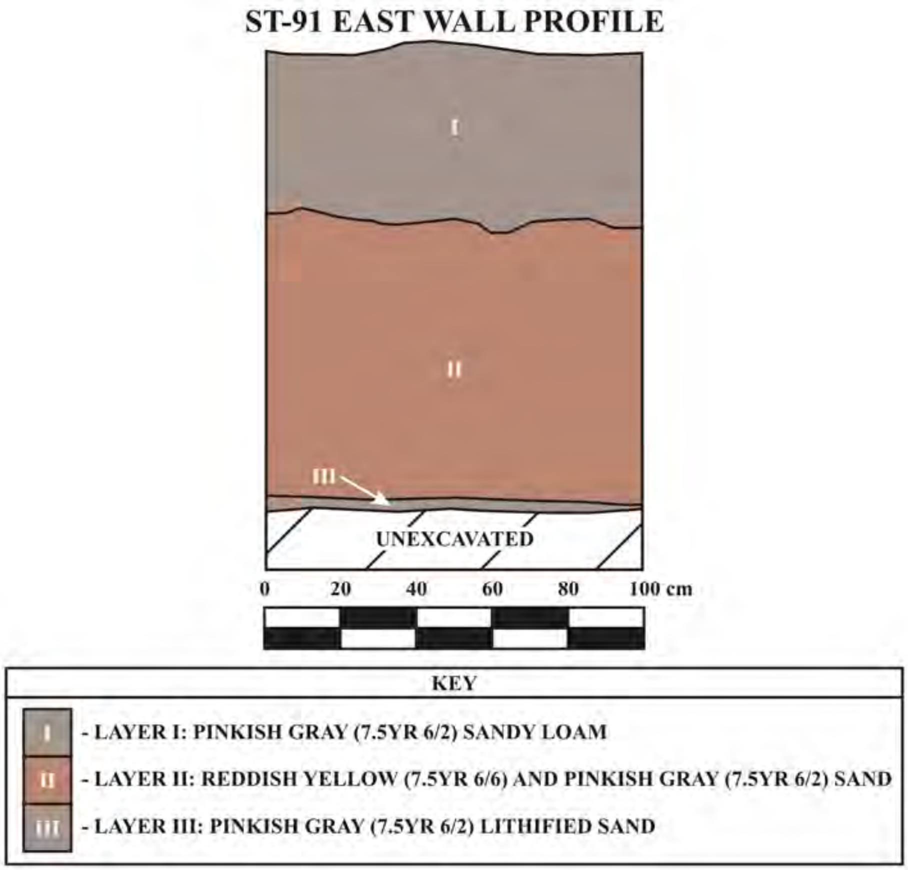
- LAYER III: PALE BROWN (10YR 6/3), LIGHT YELLOWISH BROWN (10YR 6/4), VERY PALE BROWN (10YR 7/4) SAND

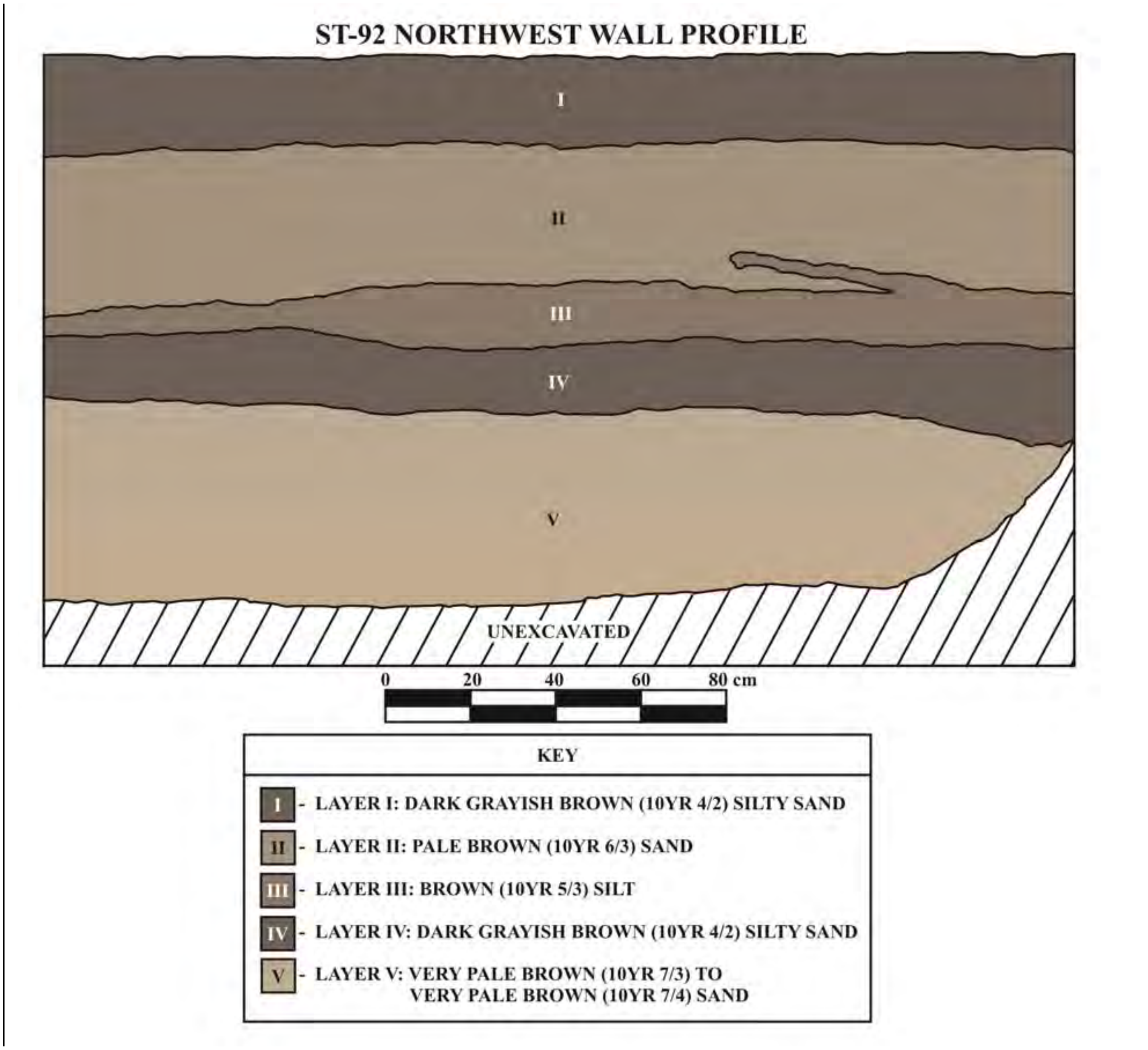
- LAYER IV: BROWN (10YR 4/3) SILT LOAM

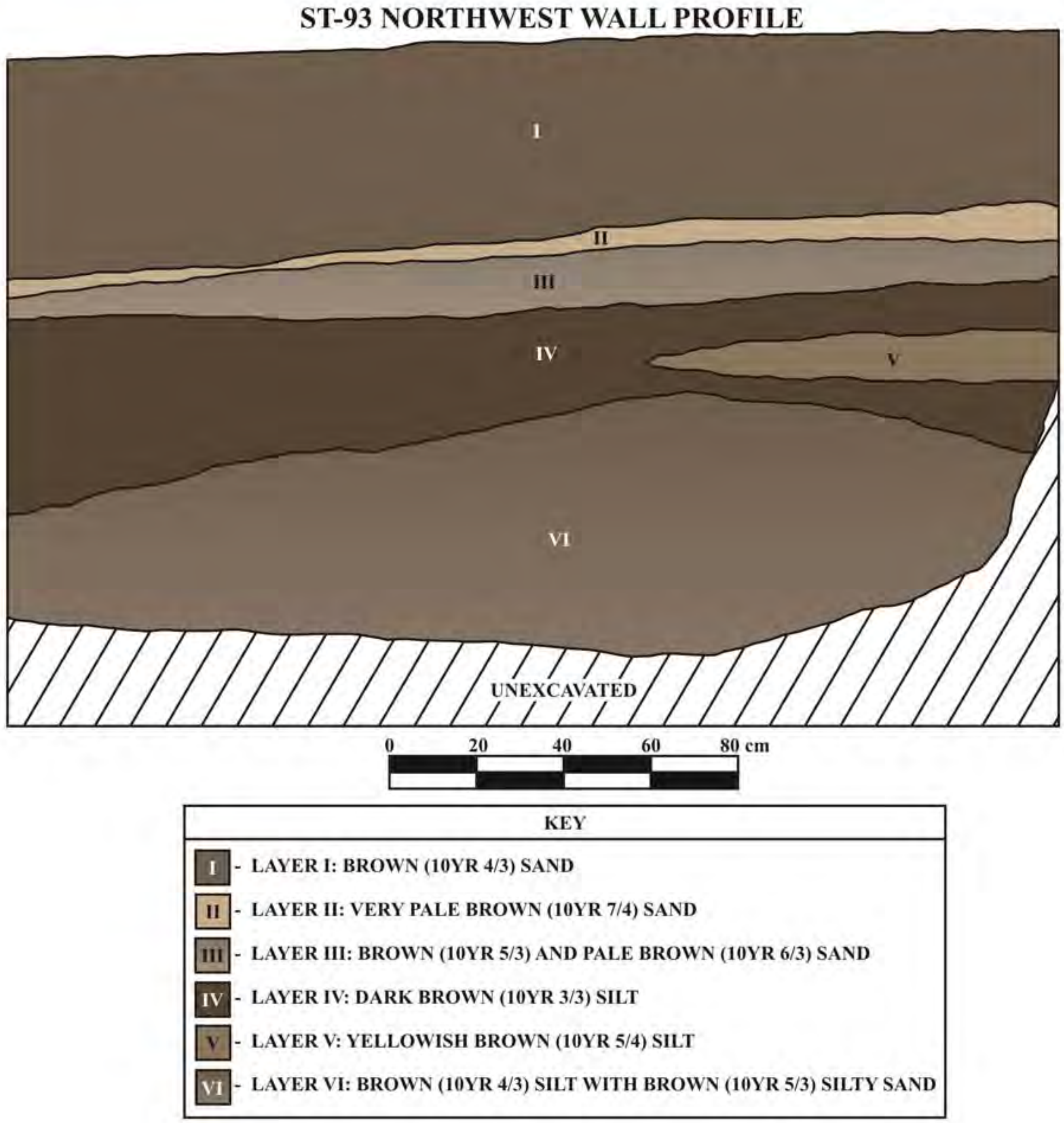
ST-89 WEST WALL PROFILE



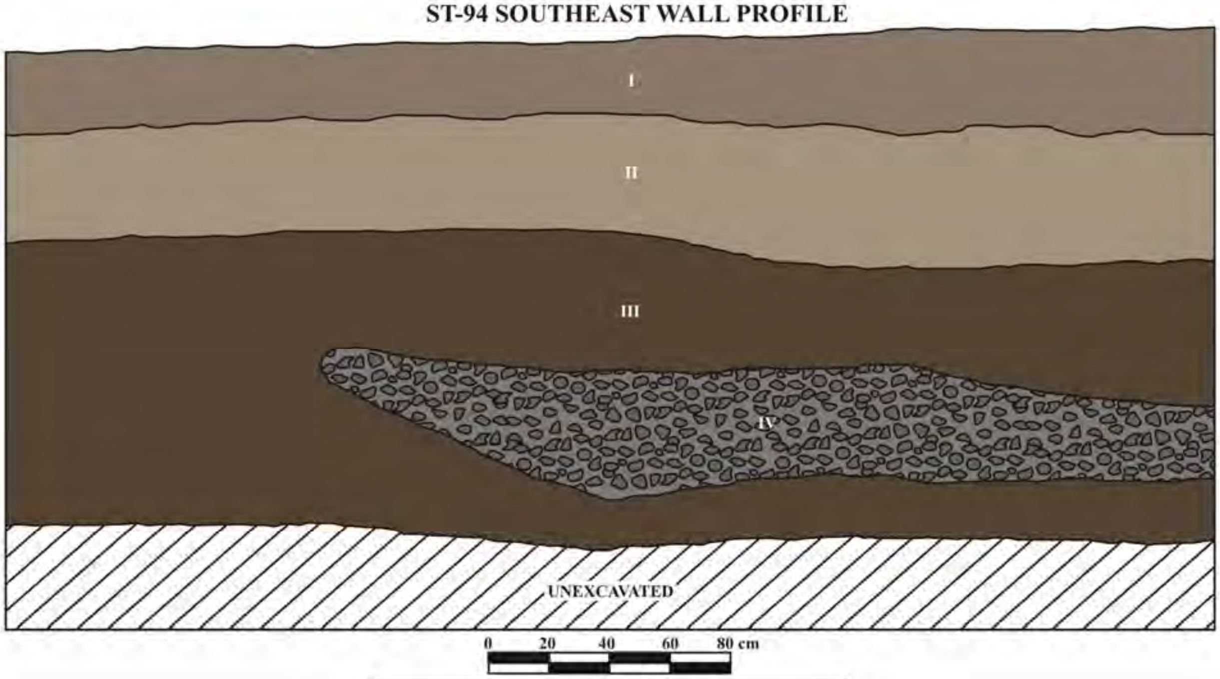

ST-90 WEST WALL PROFILE
I
II
III
IV
UNEXCAVATED
0
20
40
60
80
100 cm
KEY
I - LAYER I: PINKISH GRAY (7.5YR 6/2) SANDY LOAM
II - LAYER II: LIGHT BROWN (7.5YR 6/3) SAND
III - LAYER III: PINKISH GRAY (7.5YR 7/2) SAND
IV - LAYER IV: BROWN (7.5YR 5/2) SILTY LOAM


ST-91 EAST WALL PROFILE
I
II
III
UNEXCAVATED
0
20
40
60
80
100 cm
KEY
I - LAYER I: PINKISH GRAY (7.5YR 6/2) SANDY LOAM
II - LAYER II: REDDISH YELLOW (7.5YR 6/6) AND PINKISH GRAY (7.5YR 6/2) SAND
III - LAYER III: PINKISH GRAY (7.5YR 6/2) LITHIFIED SAND


ST-92 NORTHWEST WALL PROFILE
I
II
III
IV
V
UNEXCAVATED
0
20
40
60
80 cm
KEY
I - LAYER I: DARK GRAYISH BROWN (10YR 4/2) SILTY SAND
II - LAYER II: PALE BROWN (10YR 6/3) SAND
III - LAYER III: BROWN (10YR 5/3) SILT
IV - LAYER IV: DARK GRAYISH BROWN (10YR 4/2) SILTY SAND
V - LAYER V: VERY PALE BROWN (10YR 7/3) TO VERY PALE BROWN (10YR 7/4) SAND


ST-93 NORTHWEST WALL PROFILE
I
II
III
IV
V
VI
UNEXCAVATED
0
20
40
60
80 cm
KEY
I - LAYER I: BROWN (10YR 4/3) SAND
II - LAYER II: VERY PALE BROWN (10YR 7/4) SAND
III - LAYER III: BROWN (10YR 5/3) AND PALE BROWN (10YR 6/3) SAND
IV - LAYER IV: DARK BROWN (10YR 3/3) SILT
V - LAYER V: YELLOWISH BROWN (10YR 5/4) SILT
VI - LAYER VI: BROWN (10YR 4/3) SILT WITH BROWN (10YR 5/3) SILTY SAND

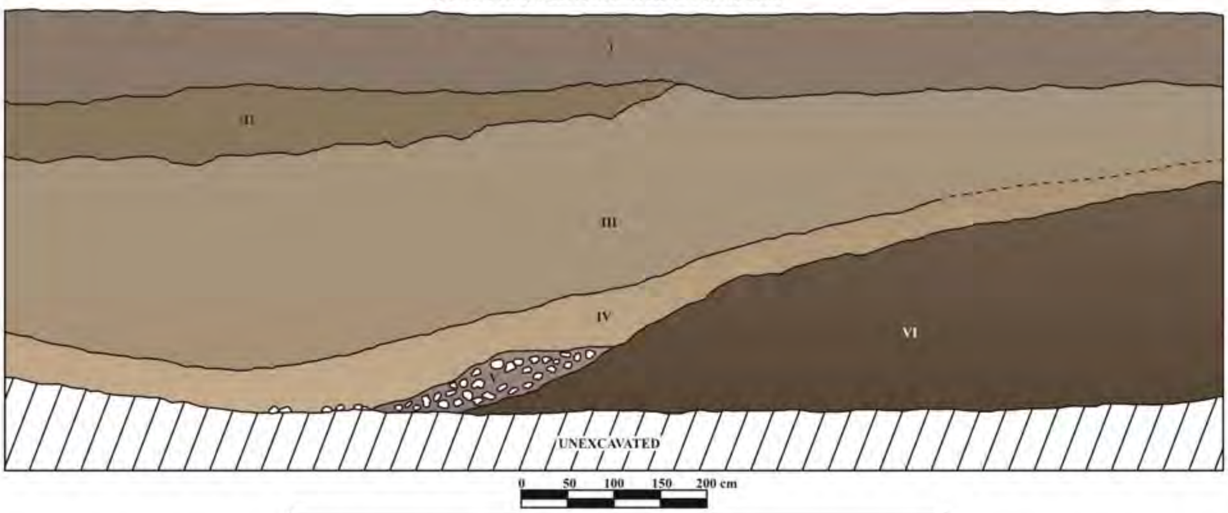
ST-94 SOUTHEAST WALL PROFILE



KEY

- I - LAYER I: BROWN (10YR 5/3) SILTY SAND
- II - LAYER II: PALE BROWN (10YR 6/3) AND BROWN (10YR 5/3) SAND
- III - LAYER III: DARK BROWN (10YR 3/3) SILTY LOAM
- IV - LAYER IV: GRAY (10YR 5/1) SILT

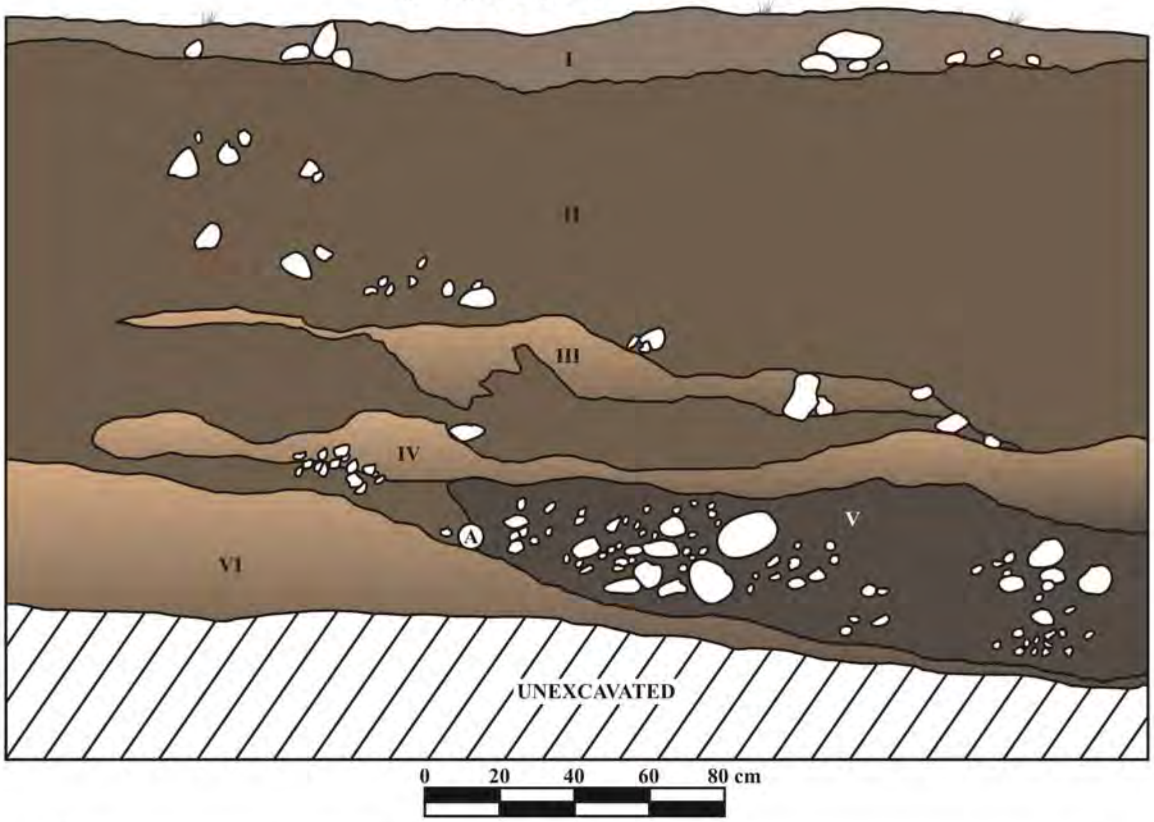
ST-95 NORTHWEST WALL PROFILE



KEY

- I - LAYER I: BROWN (10YR 5/3) SAND
- II - LAYER II: YELLOWISH BROWN (10YR 5/4) SAND
- III - LAYER III: PALE BROWN (10YR 6/3) AND LIGHT YELLOWISH BROWN (10YR 6/4) SAND
- IV - LAYER IV: LIGHT YELLOWISH BROWN (10YR 6/4) AND VERY PALE BROWN (10YR 7/4) SAND
- LAYER V: LIGHT REDDISH BROWN (2.5YR 6/4) AND WEAK RED (2.5YR 5/2) SAND AND SILT
- VI - LAYER VI: BROWN (10YR 4/3) AND DARK BROWN (10YR 3/3) SILTY LOAM
- DIFFUSE BOUNDARY

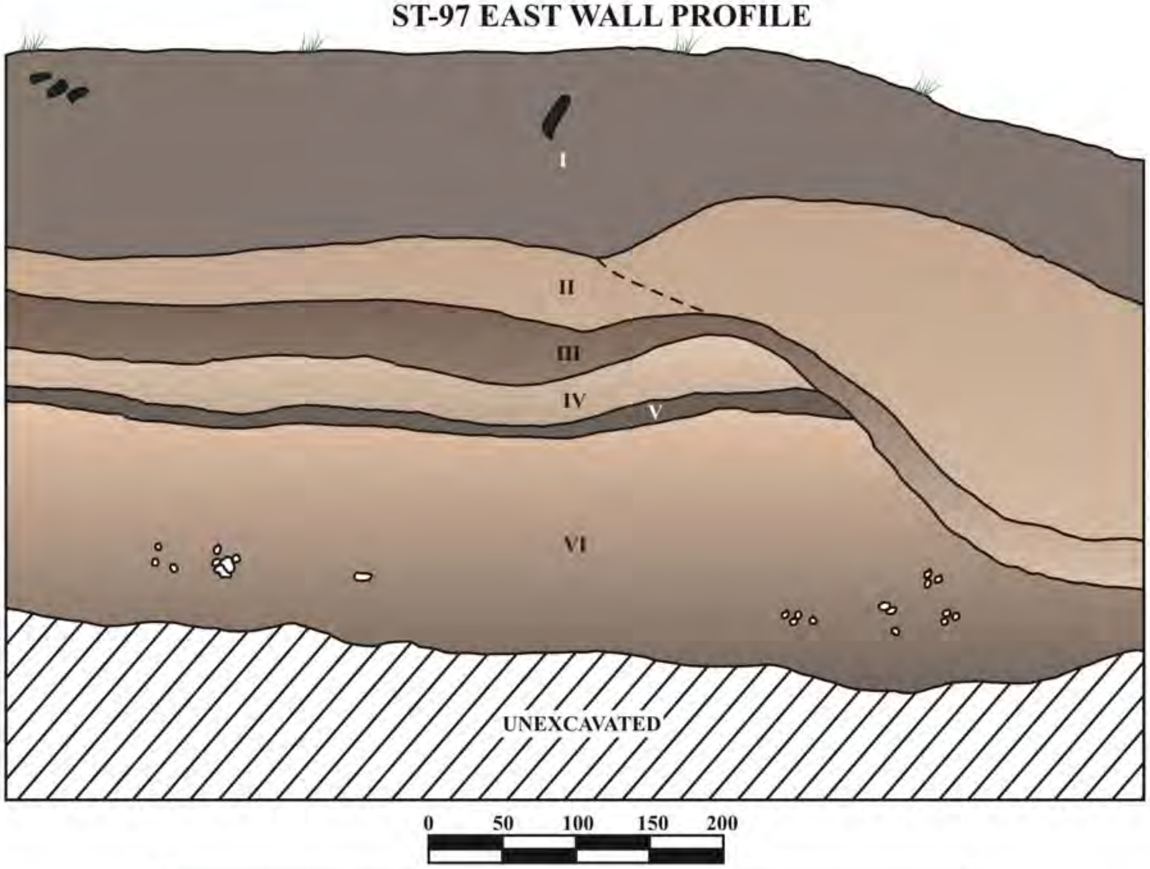
ST-96 WEST WALL PROFILE



KEY

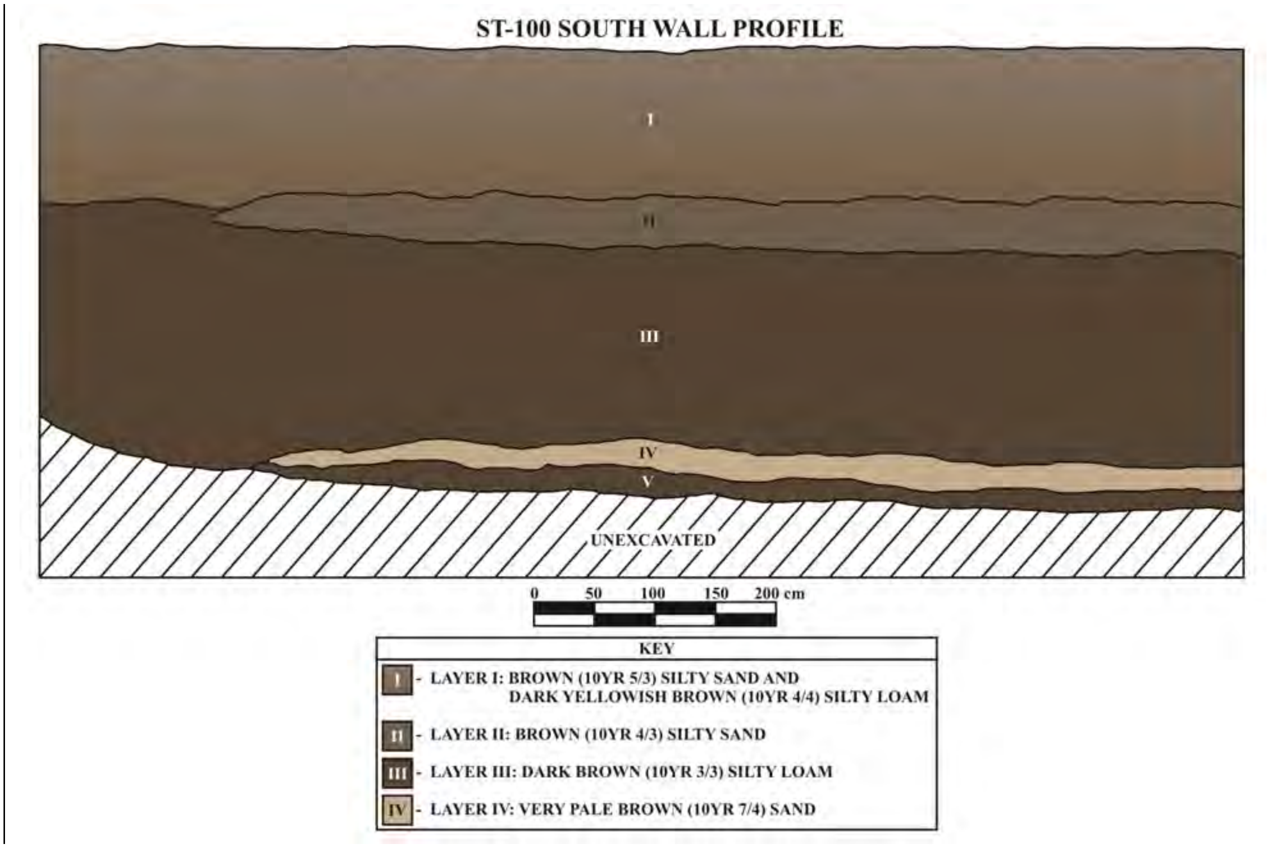
- I - LAYER I: BROWN (10YR 5/3) SILT
- II - LAYER II: BROWN (10YR 4/3) SANDY SILT
- III - LAYER III: REDDISH YELLOW (7.5YR 7/6) AND VERY DARK GRAYISH BROWN (10YR 3/2) SAND
- IV - LAYER IV: REDDISH YELLOW (7.5YR 7/6) AND VERY DARK GRAYISH BROWN (10YR 3/2) SAND
- V - LAYER V: VERY DARK GRAYISH BROWN (10YR 3/2) SAND
- VI - LAYER VI: REDDISH YELLOW (7.5YR 7/6) SAND
- A - *KUKUI* NUT/ PROBABLY STREAM TRANSPORTED
- BASALT ROCK

ST-97 EAST WALL PROFILE

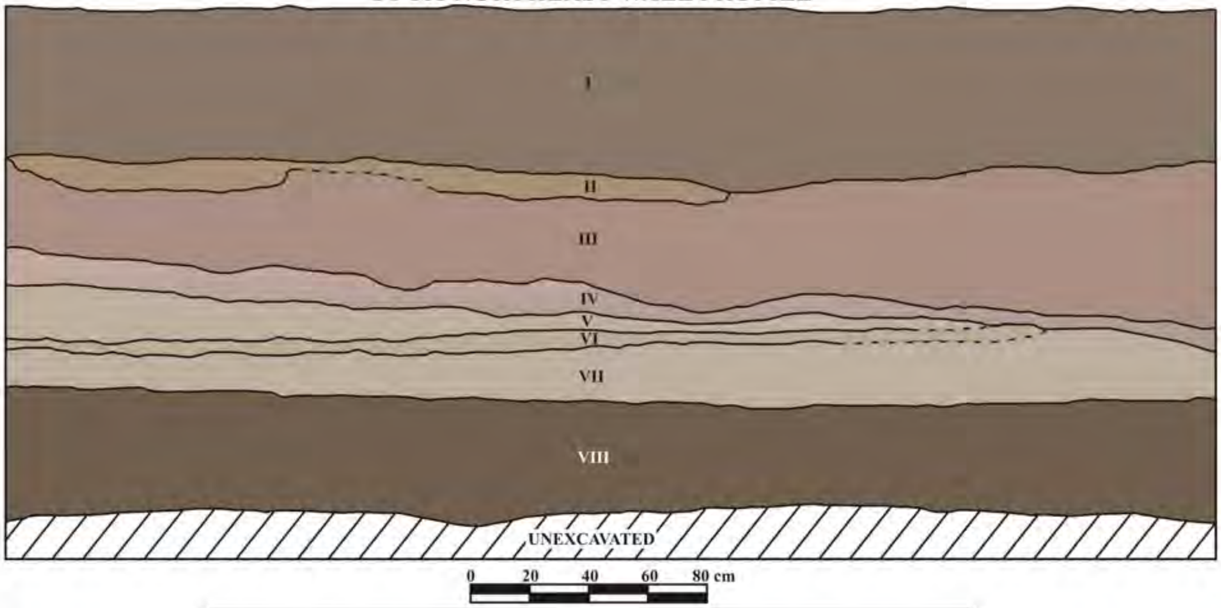


KEY

- I - LAYER I: BROWN (7.5YR 5/2) SANDY SILT
- II - LAYER II: MOTTLED PINK (7.5YR 7/4) SAND AND BROWN (7.5YR 5/2) SILT
- III - LAYER III: BROWN (7.5YR 4/3) MOTTLED WITH PINK (7.5YR 8/3) SILT
- IV - LAYER IV: PINK (7.5YR 8/3) WITH BROWN (7.5YR 4/3) SAND
- V - LAYER V: DARK GRAYISH BROWN (10YR 4/2) SILT
- VI - LAYER VI: PINK (7.5YR 8/4) WITH BROWN (7.5YR 4/3) AND DARK GRAYISH BROWN (10YR 4/2) SAND
- SMALL BASALT COBBLES AND GRAVEL
- IRRIGATION PIPE
- DIFFUSE BOUNDARY


ST-100 SOUTH WALL PROFILE
I
II
III
IV
V
UNEXCAVATED
0 50 100 150 200 cm
KEY
I - LAYER I: BROWN (10YR 5/3) SILTY SAND AND DARK YELLOWISH BROWN (10YR 4/4) SILTY LOAM
II - LAYER II: BROWN (10YR 4/3) SILTY SAND
III - LAYER III: DARK BROWN (10YR 3/3) SILTY LOAM
IV - LAYER IV: VERY PALE BROWN (10YR 7/4) SAND

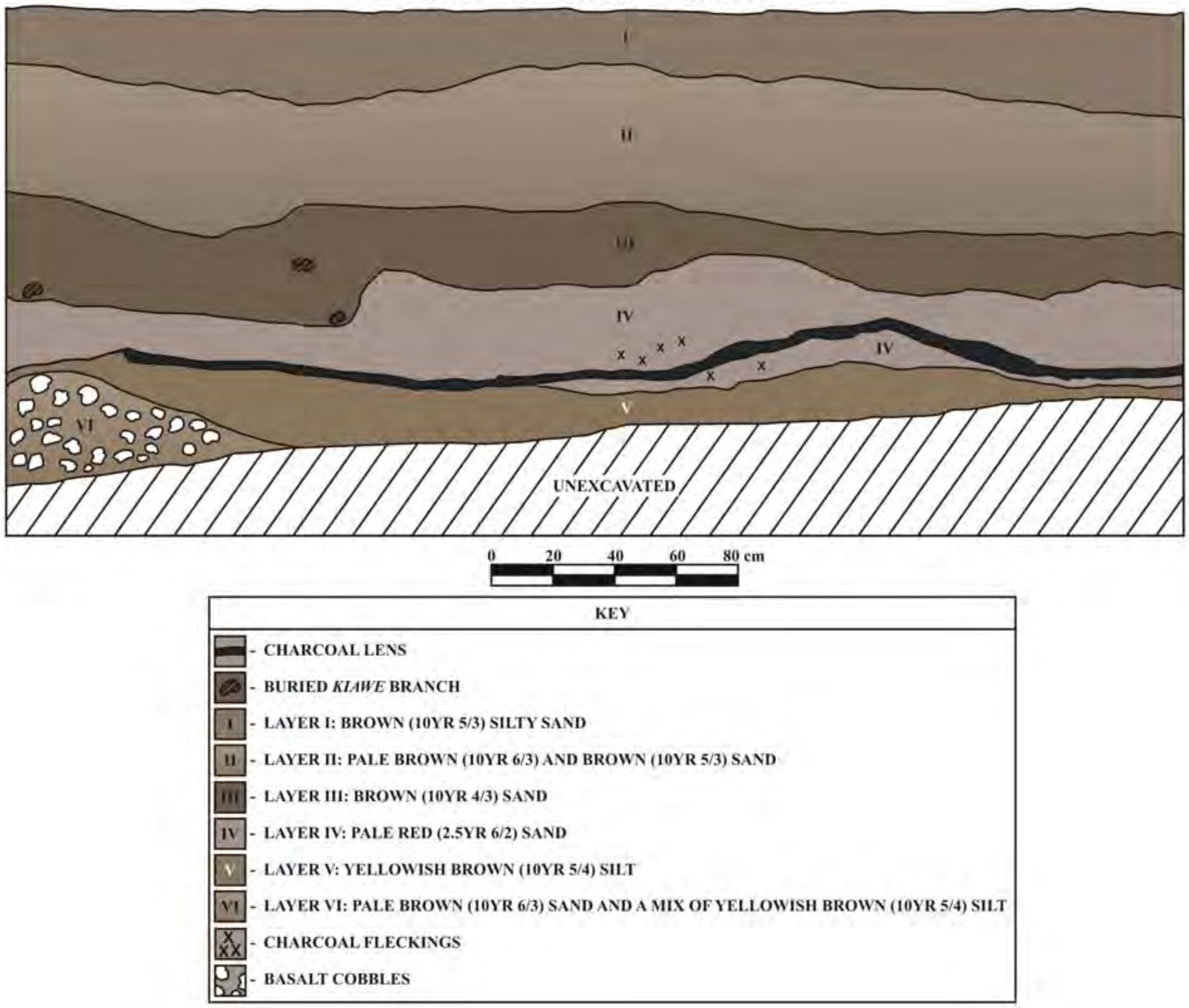
ST-101 NORTHEAST WALL PROFILE

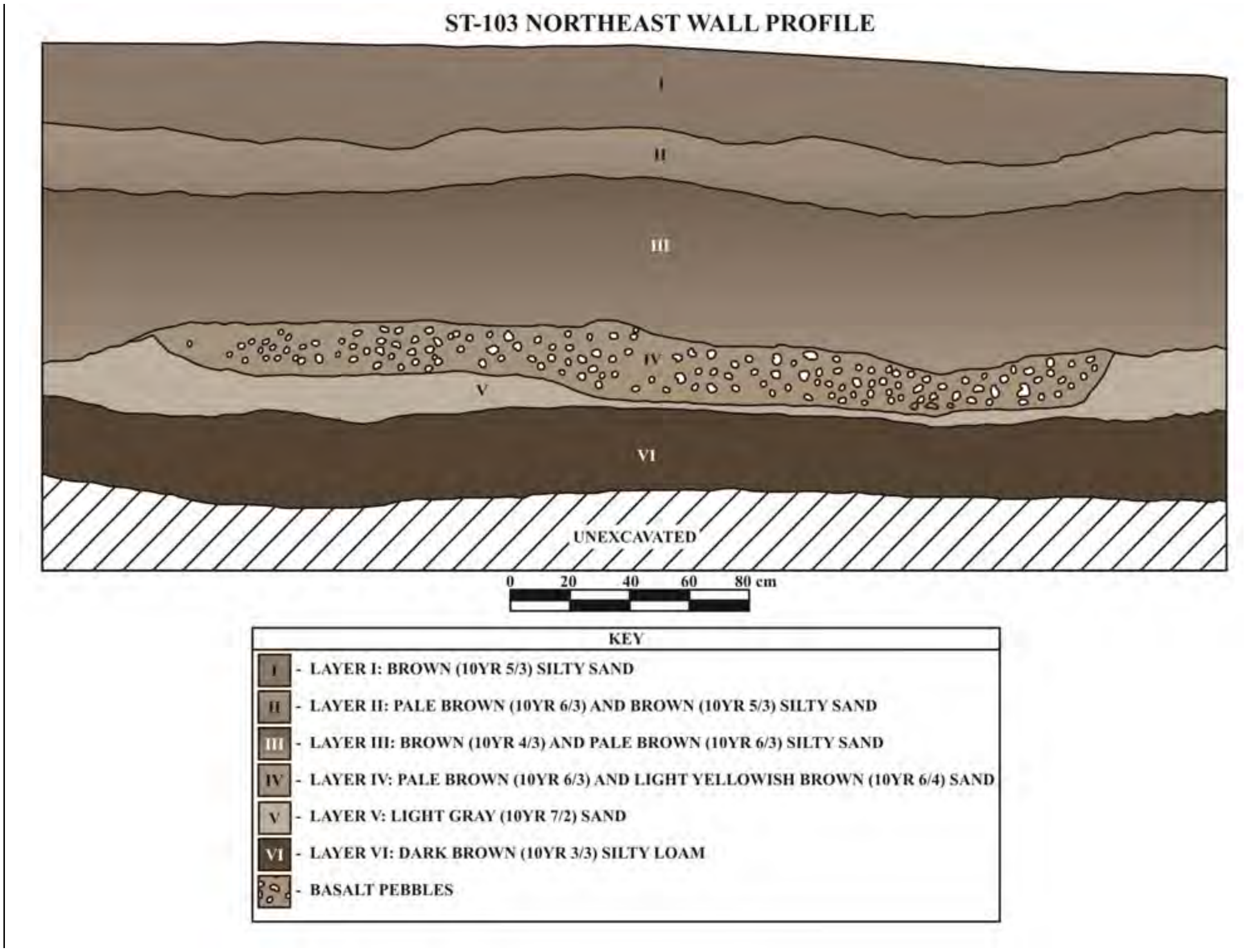


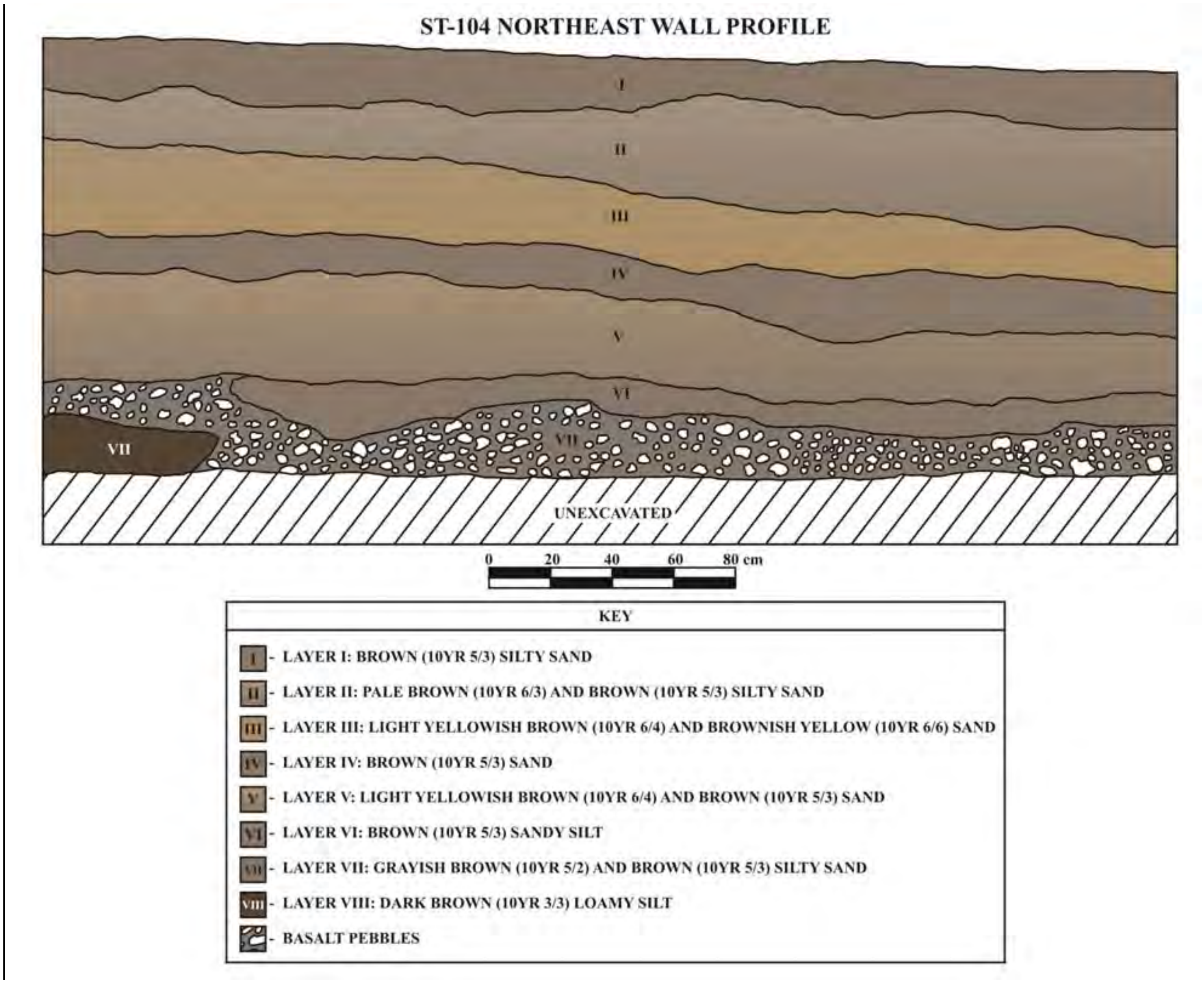
KEY

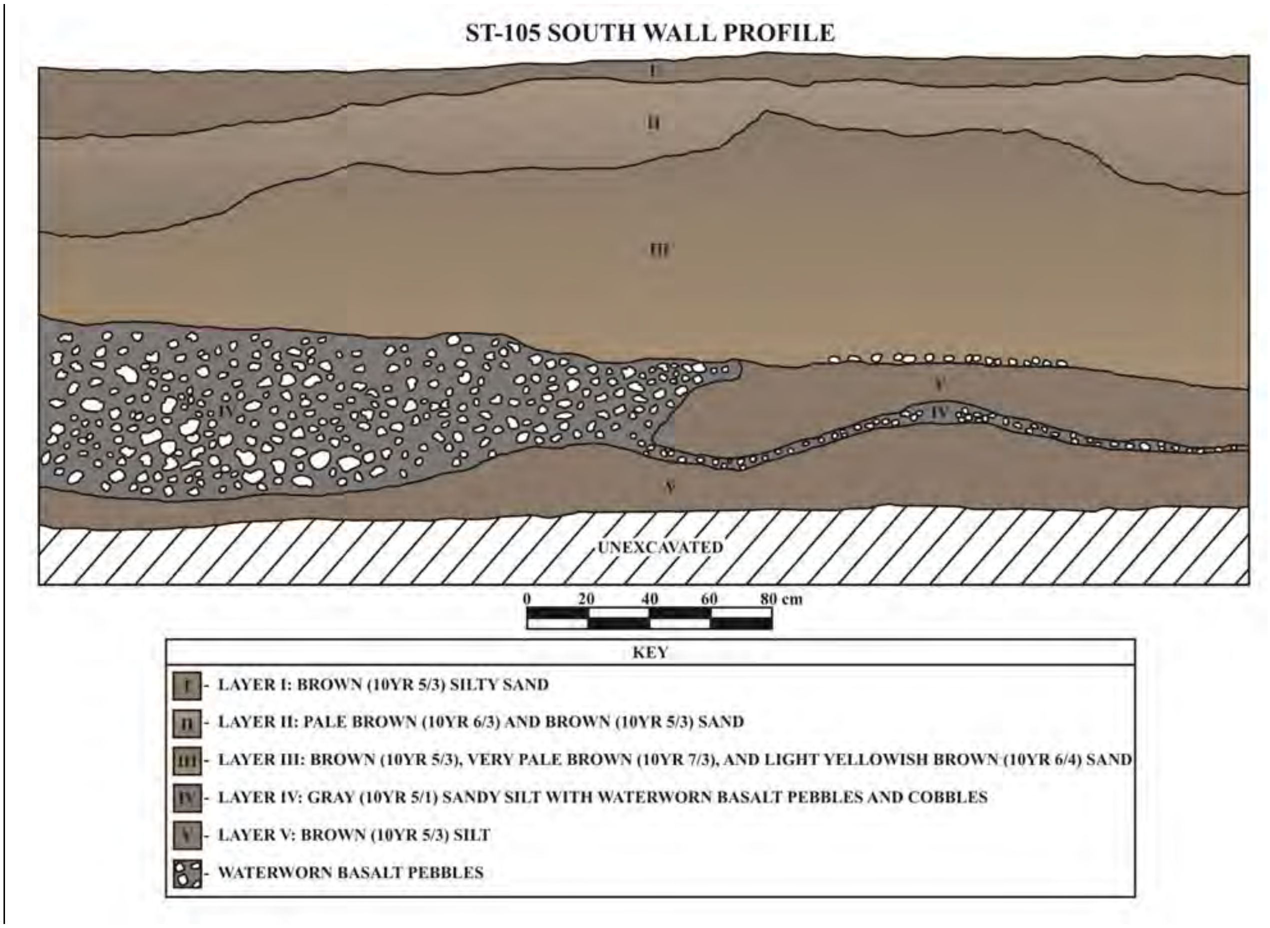
- I - LAYER I: BROWN (10YR 5/3) SILTY SAND
- II - LAYER II: LIGHT YELLOWISH BROWN (10YR 6/4) SAND
- III - LAYER III: LIGHT REDDISH BROWN (2.5YR 6/3) SAND
- IV - LAYER IV: LIGHT REDDISH BROWN (2.5YR 7/3) AND PALE RED (2.5YR 6/2) SILTY SAND
- V - LAYER V: LIGHT GRAY (10YR 7/2) SAND
- VI - LAYER VI: VERY PALE BROWN (10YR 7/3) SILT
- VII - LAYER VII: LIGHT GRAY (10YR 7/2) SAND
- VIII - LAYER VIII: BROWN (10YR 4/3) SILTY LOAM
- DIFFUSE BOUNDARY

ST-102 NORTHEAST WALL PROFILE



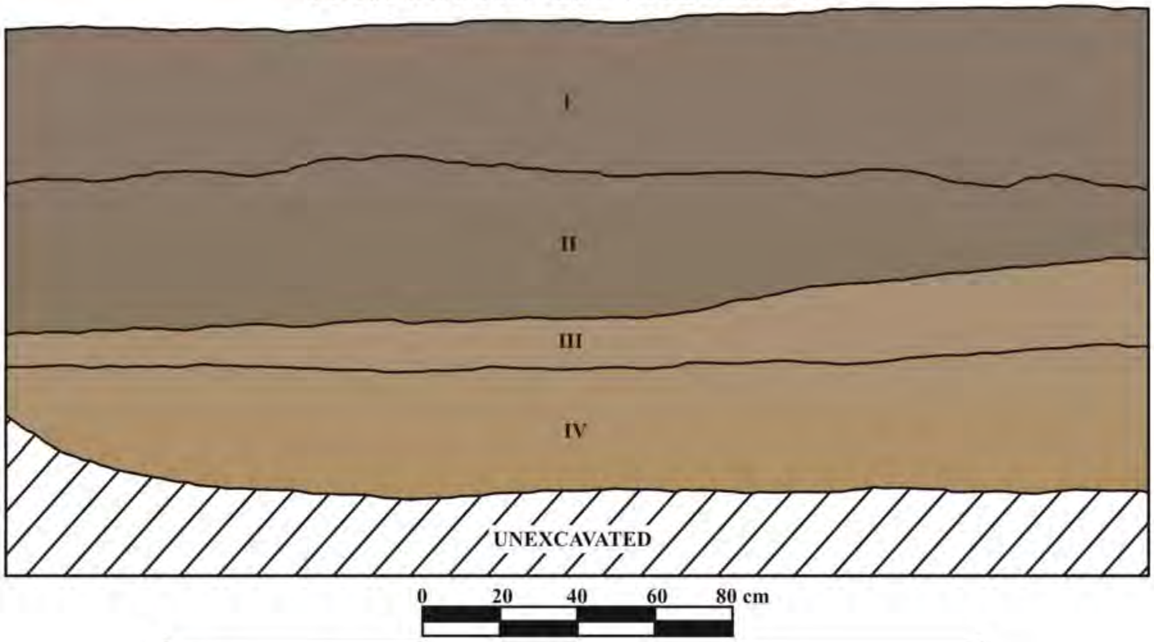

ST-103 NORTHEAST WALL PROFILE
I
II
III
IV
V
VI
UNEXCAVATED
0 20 40 60 80 cm
KEY
I - LAYER I: BROWN (10YR 5/3) SILTY SAND
II - LAYER II: PALE BROWN (10YR 6/3) AND BROWN (10YR 5/3) SILTY SAND
III - LAYER III: BROWN (10YR 4/3) AND PALE BROWN (10YR 6/3) SILTY SAND
IV - LAYER IV: PALE BROWN (10YR 6/3) AND LIGHT YELLOWISH BROWN (10YR 6/4) SAND
V - LAYER V: LIGHT GRAY (10YR 7/2) SAND
VI - LAYER VI: DARK BROWN (10YR 3/3) SILTY LOAM
- BASALT PEBBLES


ST-104 NORTHEAST WALL PROFILE
I
II
III
IV
V
VI
VII
VII
UNEXCAVATED
0 20 40 60 80 cm
KEY
I - LAYER I: BROWN (10YR 5/3) SILTY SAND
II - LAYER II: PALE BROWN (10YR 6/3) AND BROWN (10YR 5/3) SILTY SAND
III - LAYER III: LIGHT YELLOWISH BROWN (10YR 6/4) AND BROWNISH YELLOW (10YR 6/6) SAND
IV - LAYER IV: BROWN (10YR 5/3) SAND
V - LAYER V: LIGHT YELLOWISH BROWN (10YR 6/4) AND BROWN (10YR 5/3) SAND
VI - LAYER VI: BROWN (10YR 5/3) SANDY SILT
VII - LAYER VII: GRAYISH BROWN (10YR 5/2) AND BROWN (10YR 5/3) SILTY SAND
VIII - LAYER VIII: DARK BROWN (10YR 3/3) LOAMY SILT
- BASALT PEBBLES



ST-105 SOUTH WALL PROFILE
I
II
III
IV
V
IV
V
UNEXCAVATED
0
20
40
60
80 cm
KEY
I - LAYER I: BROWN (10YR 5/3) SILTY SAND
II - LAYER II: PALE BROWN (10YR 6/3) AND BROWN (10YR 5/3) SAND
III - LAYER III: BROWN (10YR 5/3), VERY PALE BROWN (10YR 7/3), AND LIGHT YELLOWISH BROWN (10YR 6/4) SAND
IV - LAYER IV: GRAY (10YR 5/1) SANDY SILT WITH WATERWORN BASALT PEBBLES AND COBBLES
V - LAYER V: BROWN (10YR 5/3) SILT
- WATERWORN BASALT PEBBLES

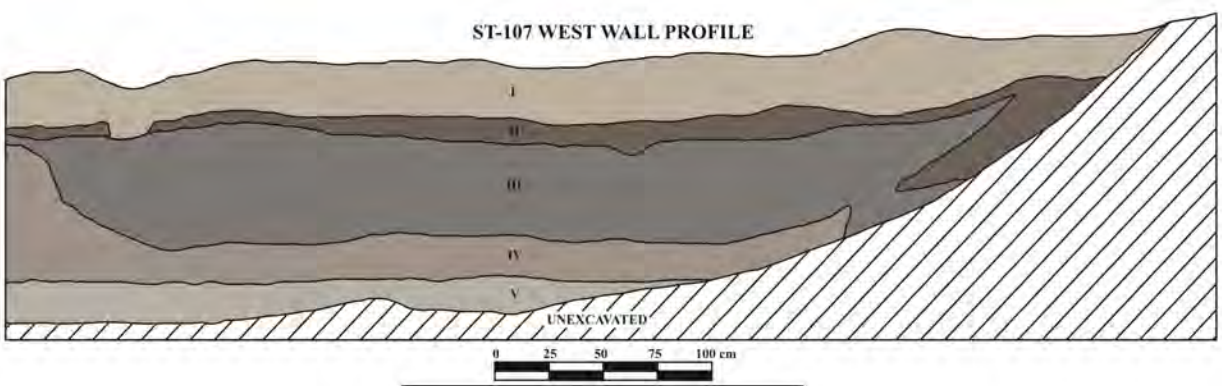
ST-106 SOUTHWEST WALL PROFILE



KEY

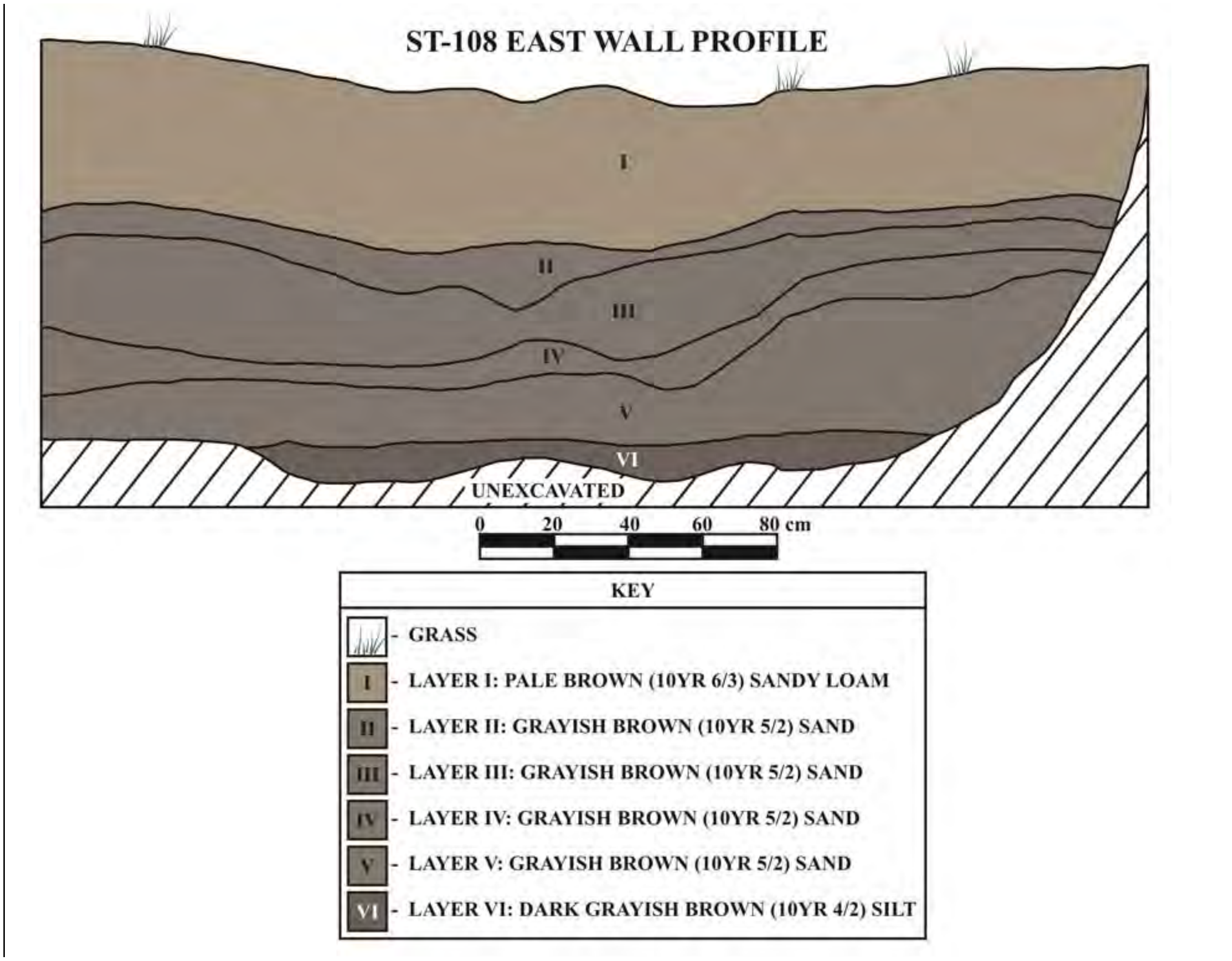
- I - LAYER I: BROWN (10YR 5/3) SILTY SAND
- II - LAYER II: BROWN (10YR 5/3) AND YELLOWISH BROWN (10YR 5/4) SAND
- III - LAYER III: LIGHT YELLOWISH BROWN (10YR 6/4) SAND
- IV - LAYER IV: LIGHT YELLOWISH BROWN (10YR 6/4) AND BROWNISH YELLOWISH (10YR 6/6) SAND

ST-107 WEST WALL PROFILE

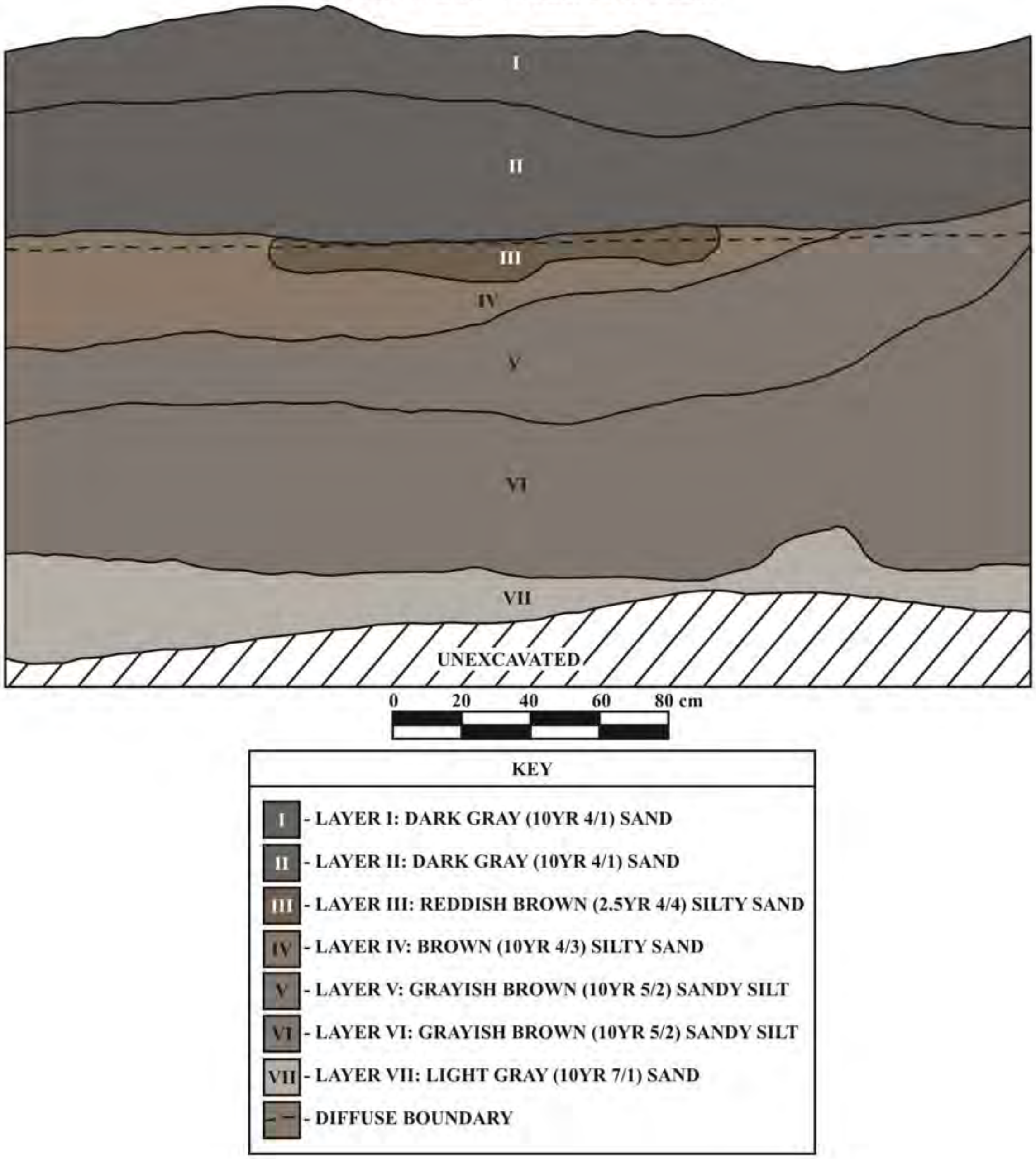


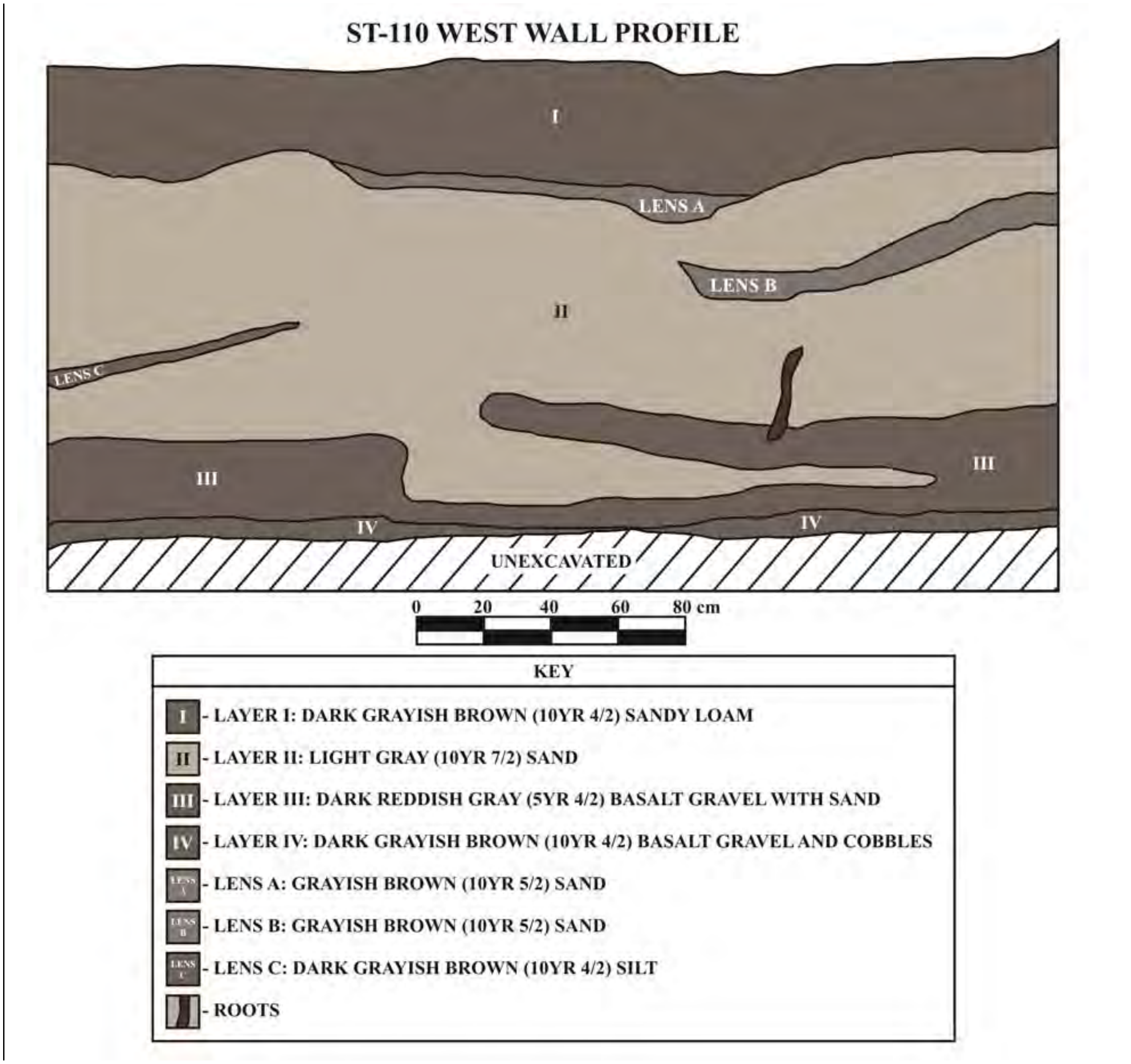
KEY

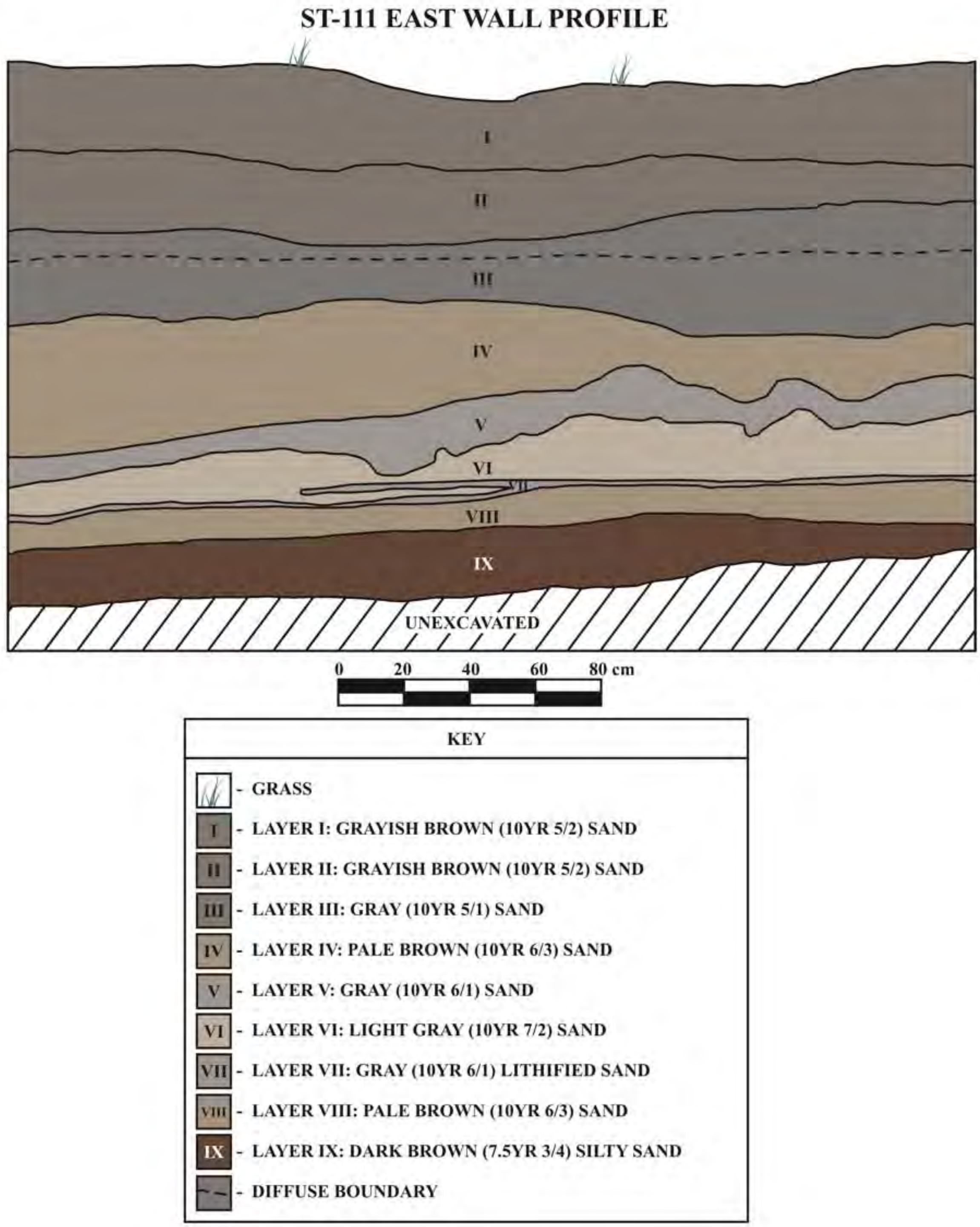
- I - LAYER I: LIGHT GRAY (10YR 7/2) SAND
- II - LAYER II: DARK GRAYISH BROWN (10YR 4/2) SILT
- III - LAYER III: GRAY (10YR 6/1) AND GRAY (10YR 5/1) SAND
- IV - LAYER IV: LIGHT BROWNISH GRAY (10YR 6/2) SILT
- V - LAYER V: LIGHT GRAY (10YR 7/1) SAND

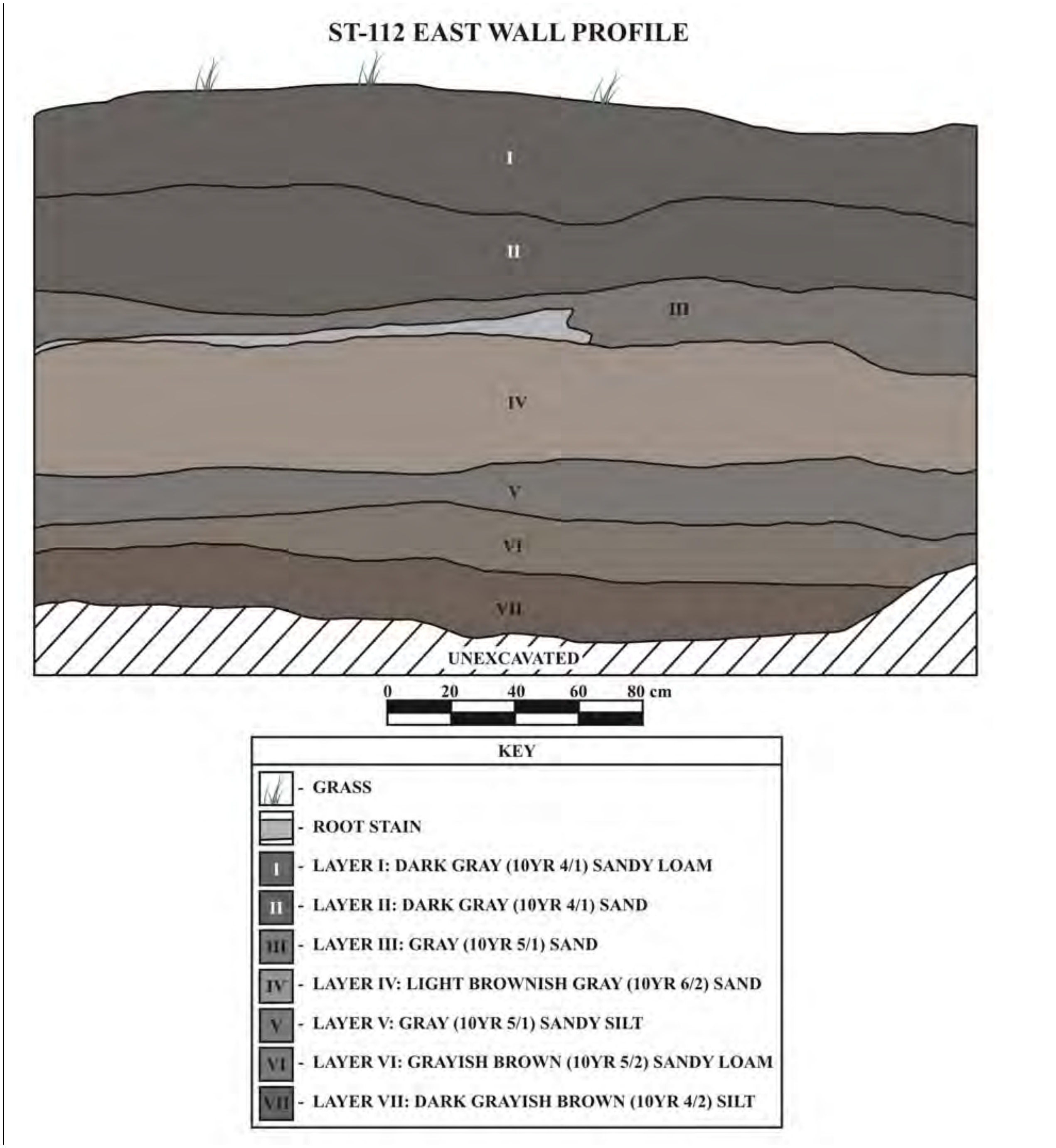

ST-108 EAST WALL PROFILE
I
II
III
IV
V
VI
UNEXCAVATED
0
20
40
60
80 cm
KEY
- GRASS
I - LAYER I: PALE BROWN (10YR 6/3) SANDY LOAM
II - LAYER II: GRAYISH BROWN (10YR 5/2) SAND
III - LAYER III: GRAYISH BROWN (10YR 5/2) SAND
IV - LAYER IV: GRAYISH BROWN (10YR 5/2) SAND
V - LAYER V: GRAYISH BROWN (10YR 5/2) SAND
VI - LAYER VI: DARK GRAYISH BROWN (10YR 4/2) SILT

ST-109 WEST WALL PROFILE



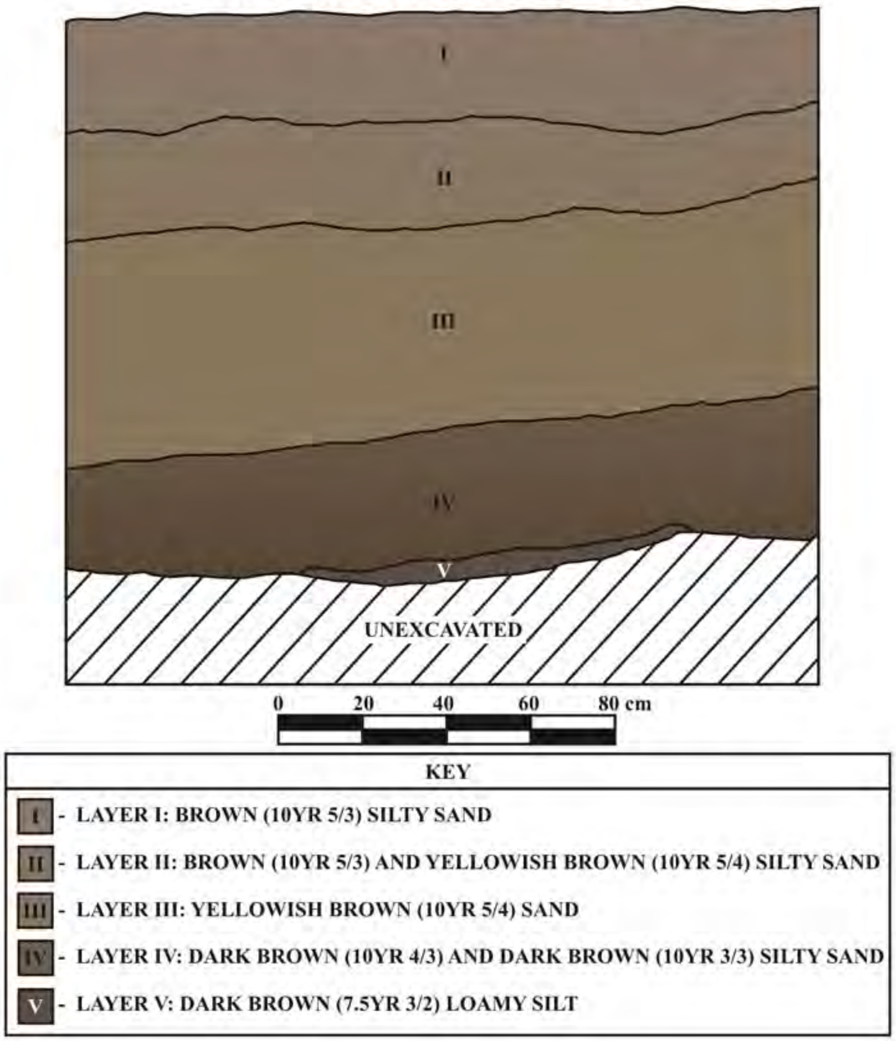

ST-110 WEST WALL PROFILE
I
LENS A
LENS B
II
LENS C
III
III
IV
IV
UNEXCAVATED
0
20
40
60
80 cm
KEY
I - LAYER I: DARK GRAYISH BROWN (10YR 4/2) SANDY LOAM
II - LAYER II: LIGHT GRAY (10YR 7/2) SAND
III - LAYER III: DARK REDDISH GRAY (5YR 4/2) BASALT GRAVEL WITH SAND
IV - LAYER IV: DARK GRAYISH BROWN (10YR 4/2) BASALT GRAVEL AND COBBLES
- LENS A: GRAYISH BROWN (10YR 5/2) SAND
- LENS B: GRAYISH BROWN (10YR 5/2) SAND
- LENS C: DARK GRAYISH BROWN (10YR 4/2) SILT
- ROOTS

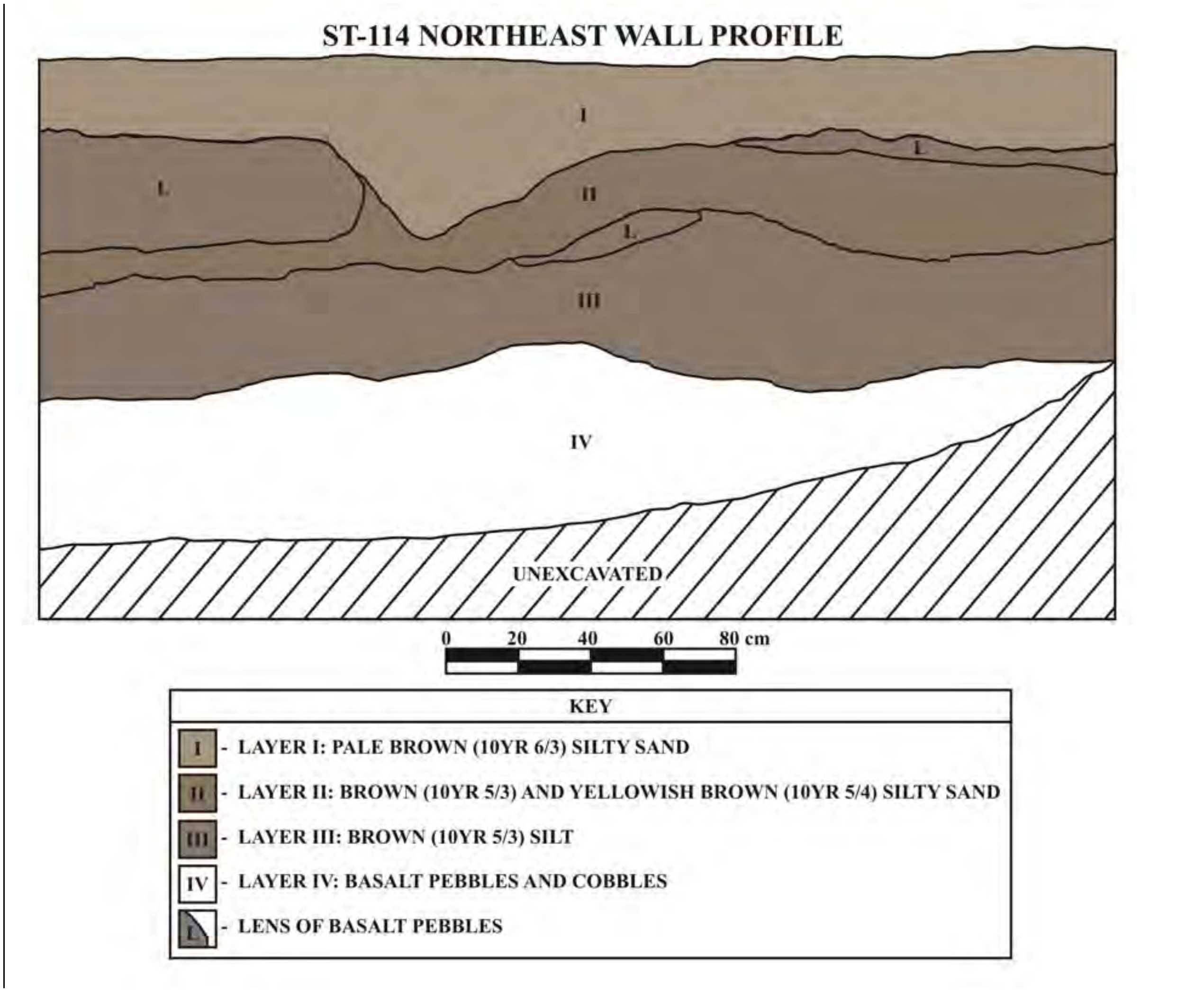

ST-111 EAST WALL PROFILE
I
II
III
IV
V
VI
VII
VIII
IX
UNEXCAVATED
0
20
40
60
80 cm
KEY
- GRASS
- LAYER I: GRAYISH BROWN (10YR 5/2) SAND
- LAYER II: GRAYISH BROWN (10YR 5/2) SAND
- LAYER III: GRAY (10YR 5/1) SAND
- LAYER IV: PALE BROWN (10YR 6/3) SAND
- LAYER V: GRAY (10YR 6/1) SAND
- LAYER VI: LIGHT GRAY (10YR 7/2) SAND
- LAYER VII: GRAY (10YR 6/1) LITHIFIED SAND
- LAYER VIII: PALE BROWN (10YR 6/3) SAND
- LAYER IX: DARK BROWN (7.5YR 3/4) SILTY SAND
- DIFFUSE BOUNDARY

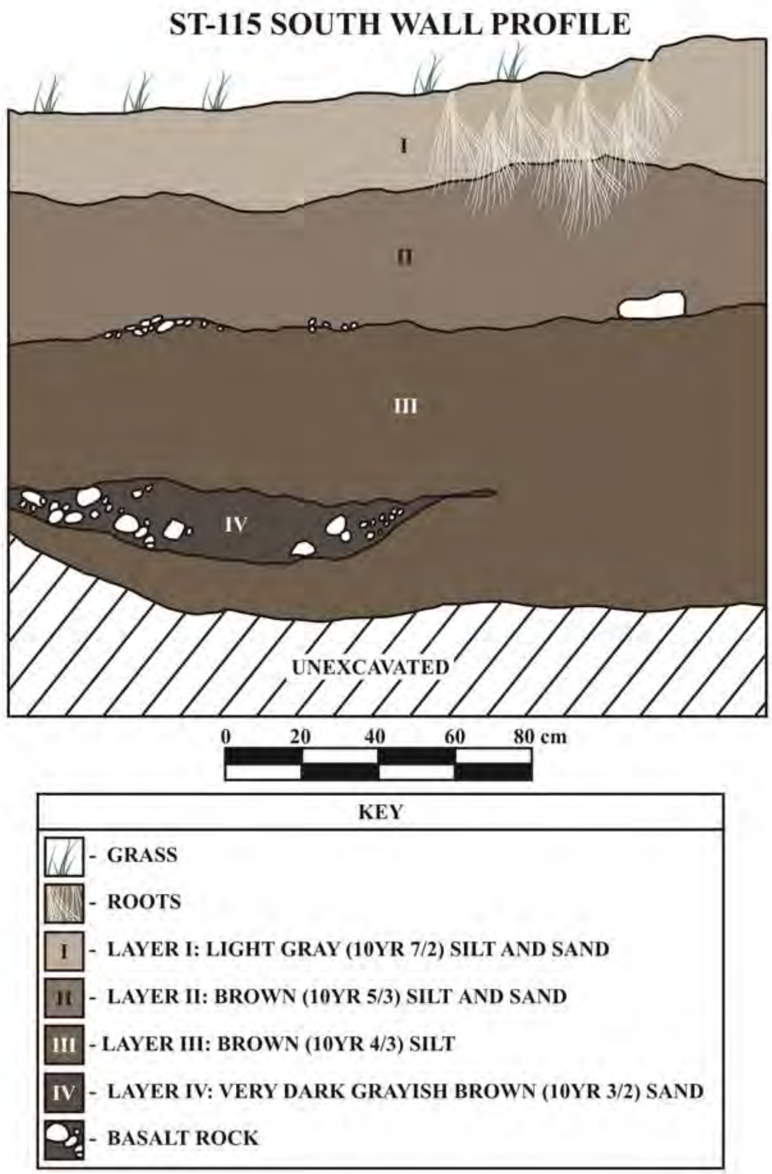


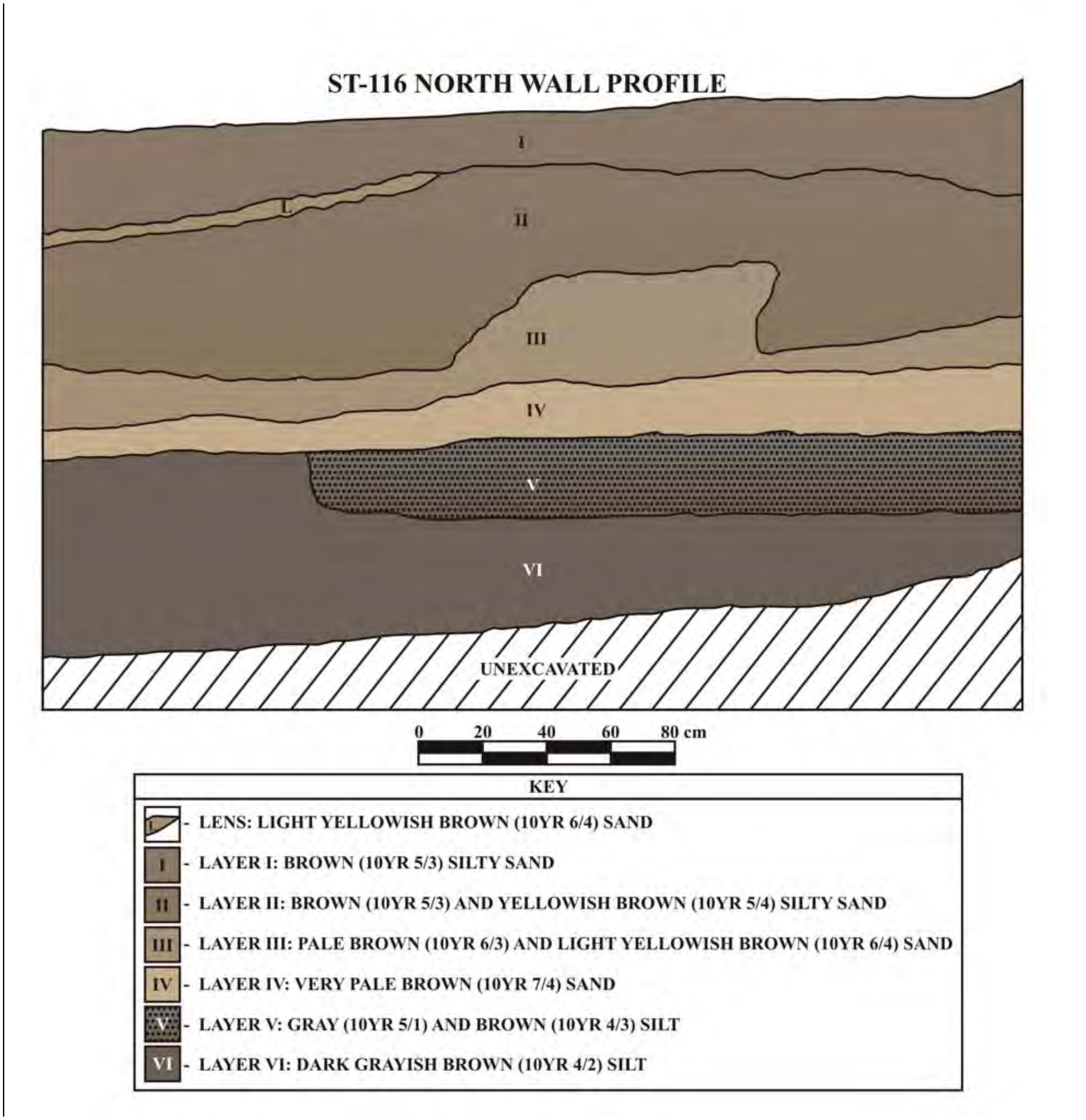
ST-112 EAST WALL PROFILE
I
II
III
IV
V
VI
VII
UNEXCAVATED
0
20
40
60
80 cm
KEY
- GRASS
- ROOT STAIN
I - LAYER I: DARK GRAY (10YR 4/1) SANDY LOAM
II - LAYER II: DARK GRAY (10YR 4/1) SAND
III - LAYER III: GRAY (10YR 5/1) SAND
IV - LAYER IV: LIGHT BROWNISH GRAY (10YR 6/2) SAND
V - LAYER V: GRAY (10YR 5/1) SANDY SILT
VI - LAYER VI: GRAYISH BROWN (10YR 5/2) SANDY LOAM
VII - LAYER VII: DARK GRAYISH BROWN (10YR 4/2) SILT

ST-113 NORTHEAST WALL PROFILE

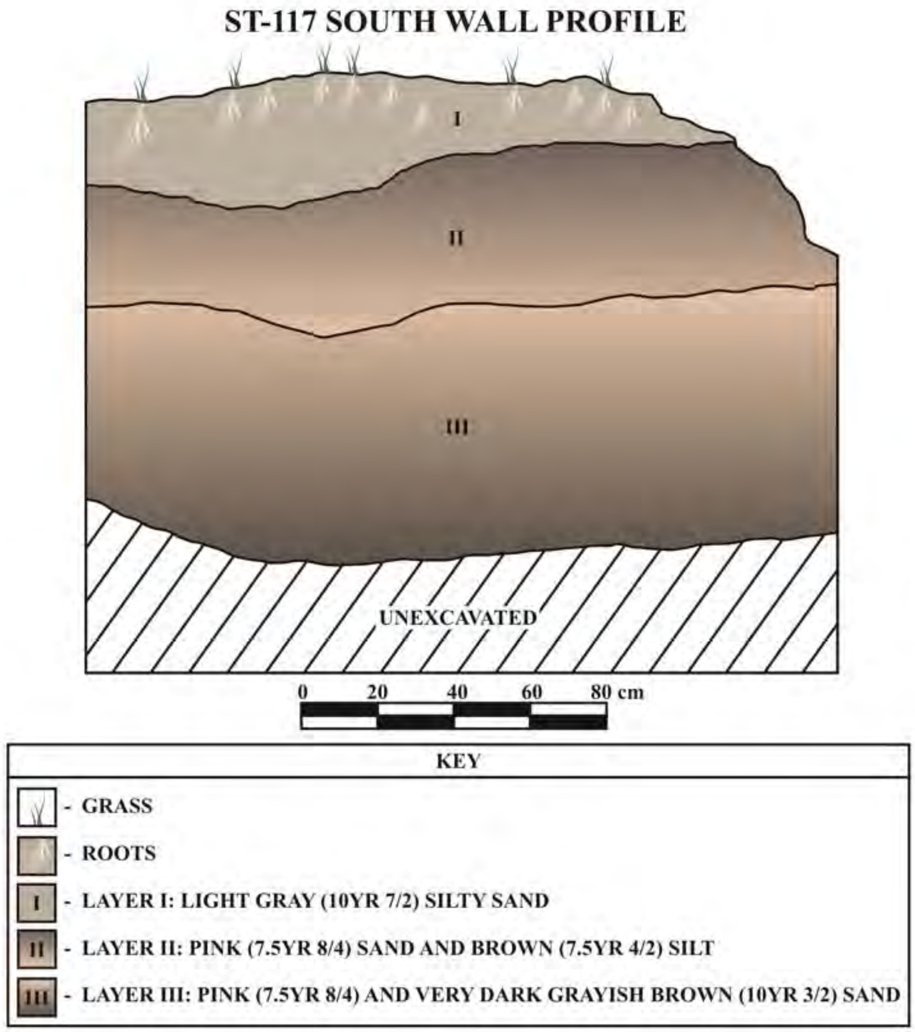


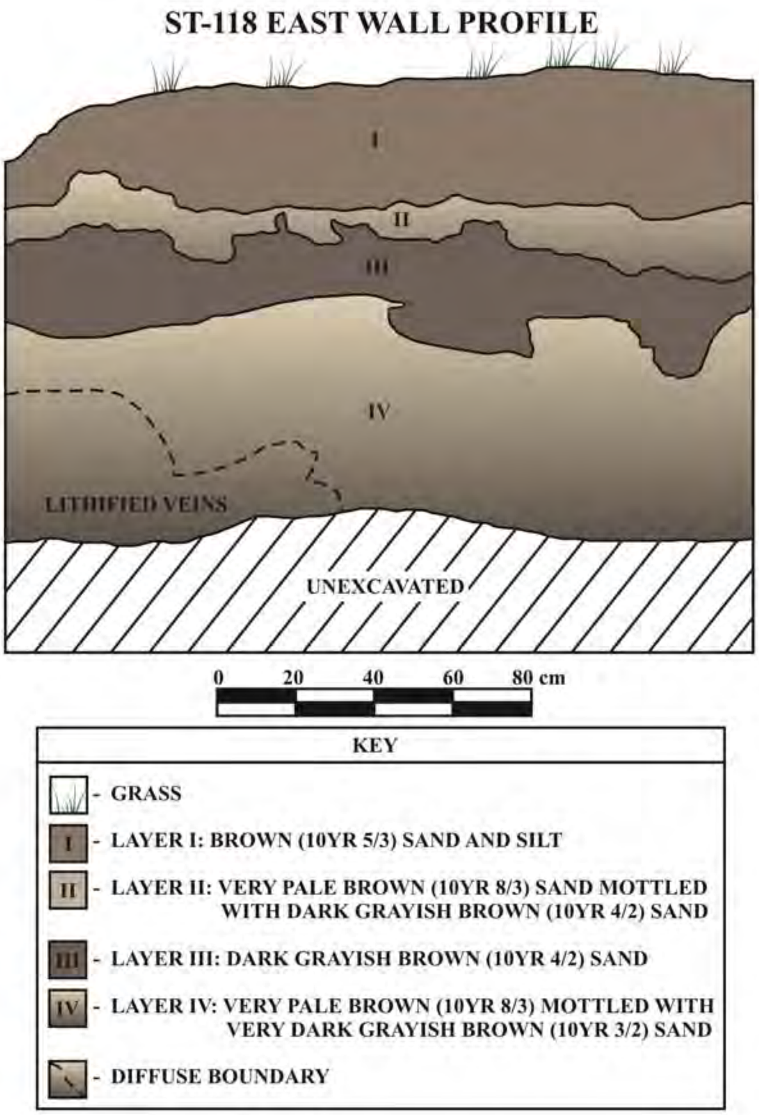

ST-114 NORTHEAST WALL PROFILE
I
L
II
L
L
III
IV
UNEXCAVATED
0 20 40 60 80 cm
KEY
I - LAYER I: PALE BROWN (10YR 6/3) SILTY SAND
II - LAYER II: BROWN (10YR 5/3) AND YELLOWISH BROWN (10YR 5/4) SILTY SAND
III - LAYER III: BROWN (10YR 5/3) SILT
IV - LAYER IV: BASALT PEBBLES AND COBBLES
L - LENS OF BASALT PEBBLES

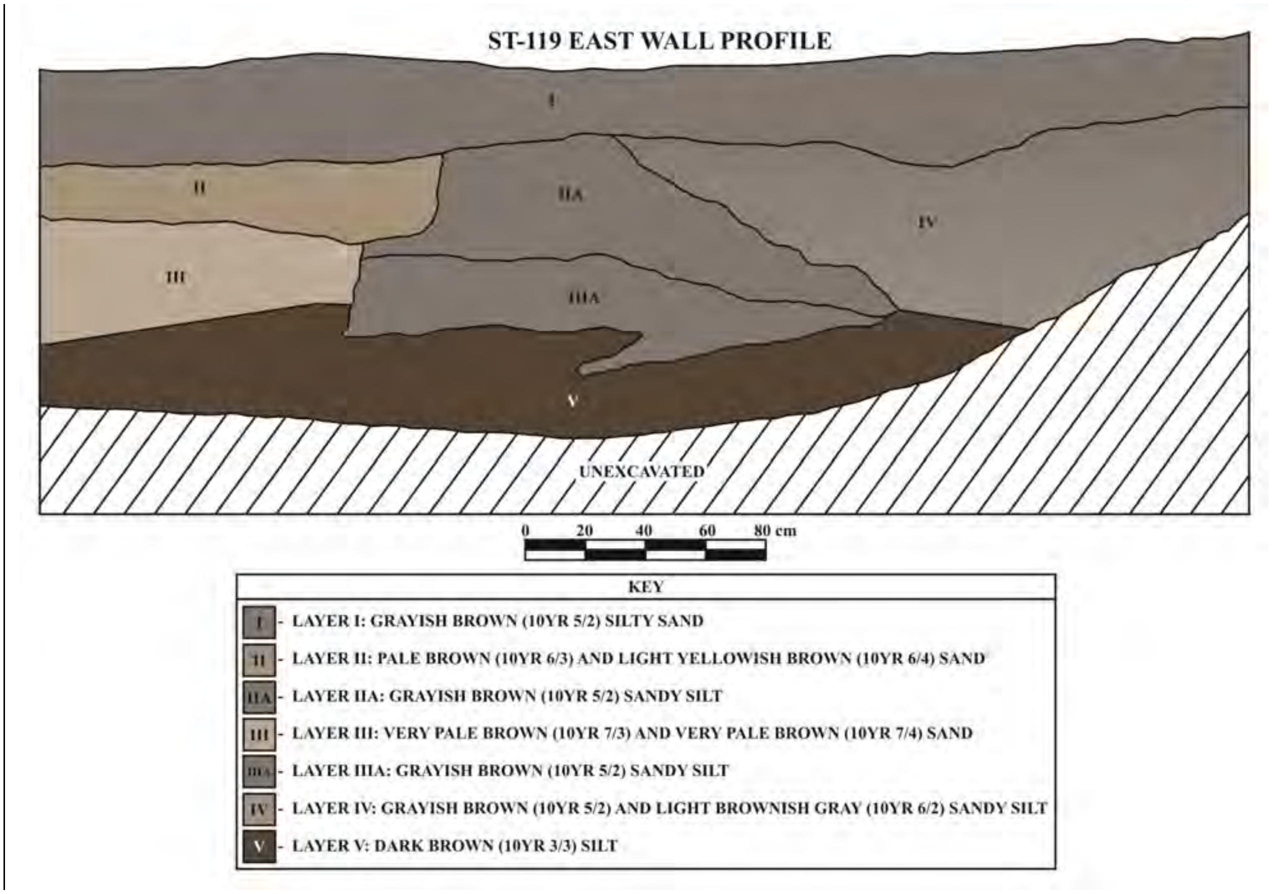

ST-115 SOUTH WALL PROFILE
I
II
III
IV
UNEXCAVATED
0
20
40
60
80 cm
KEY
- GRASS
- ROOTS
I - LAYER I: LIGHT GRAY (10YR 7/2) SILT AND SAND
II - LAYER II: BROWN (10YR 5/3) SILT AND SAND
III - LAYER III: BROWN (10YR 4/3) SILT
IV - LAYER IV: VERY DARK GRAYISH BROWN (10YR 3/2) SAND
- BASALT ROCK

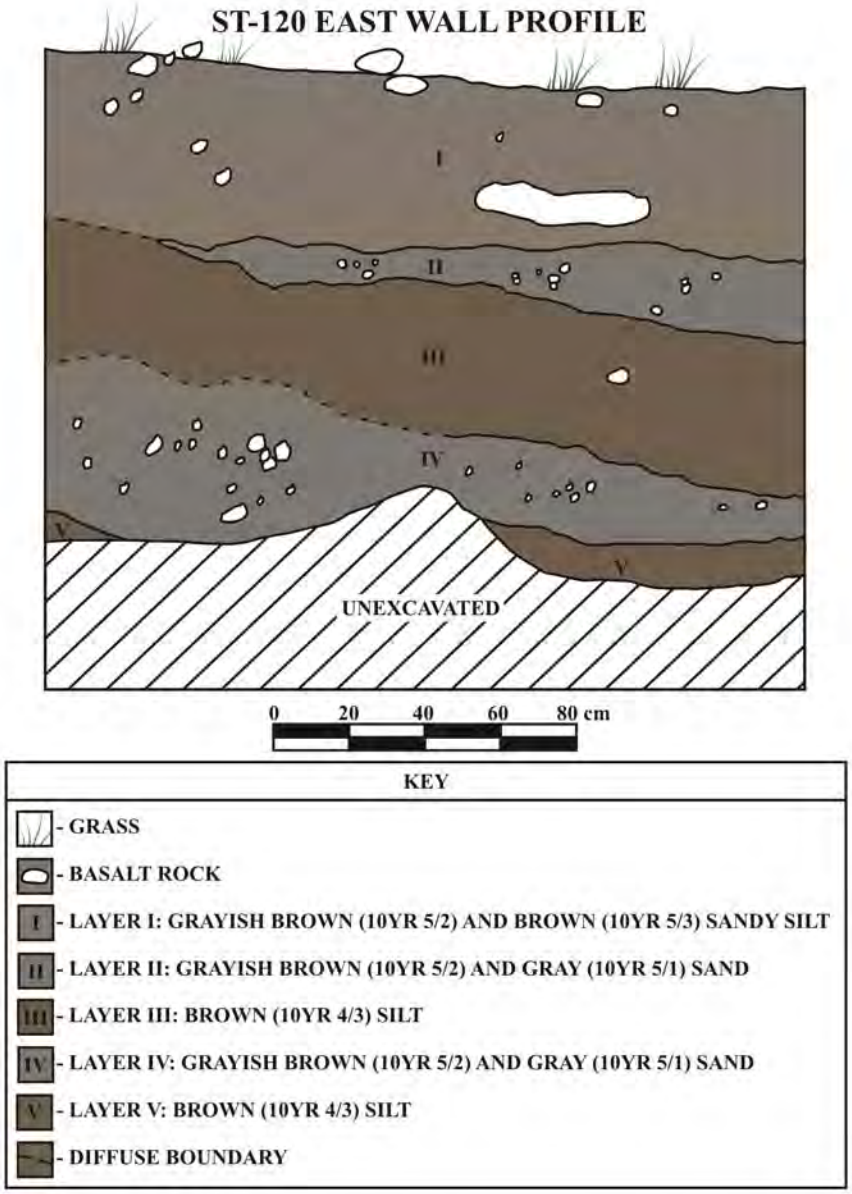


ST-116 NORTH WALL PROFILE
I
L
II
III
IV
V
VI
UNEXCAVATED
0
20
40
60
80 cm
KEY
L - LENS: LIGHT YELLOWISH BROWN (10YR 6/4) SAND
I - LAYER I: BROWN (10YR 5/3) SILTY SAND
II - LAYER II: BROWN (10YR 5/3) AND YELLOWISH BROWN (10YR 5/4) SILTY SAND
III - LAYER III: PALE BROWN (10YR 6/3) AND LIGHT YELLOWISH BROWN (10YR 6/4) SAND
IV - LAYER IV: VERY PALE BROWN (10YR 7/4) SAND
V - LAYER V: GRAY (10YR 5/1) AND BROWN (10YR 4/3) SILT
VI - LAYER VI: DARK GRAYISH BROWN (10YR 4/2) SILT

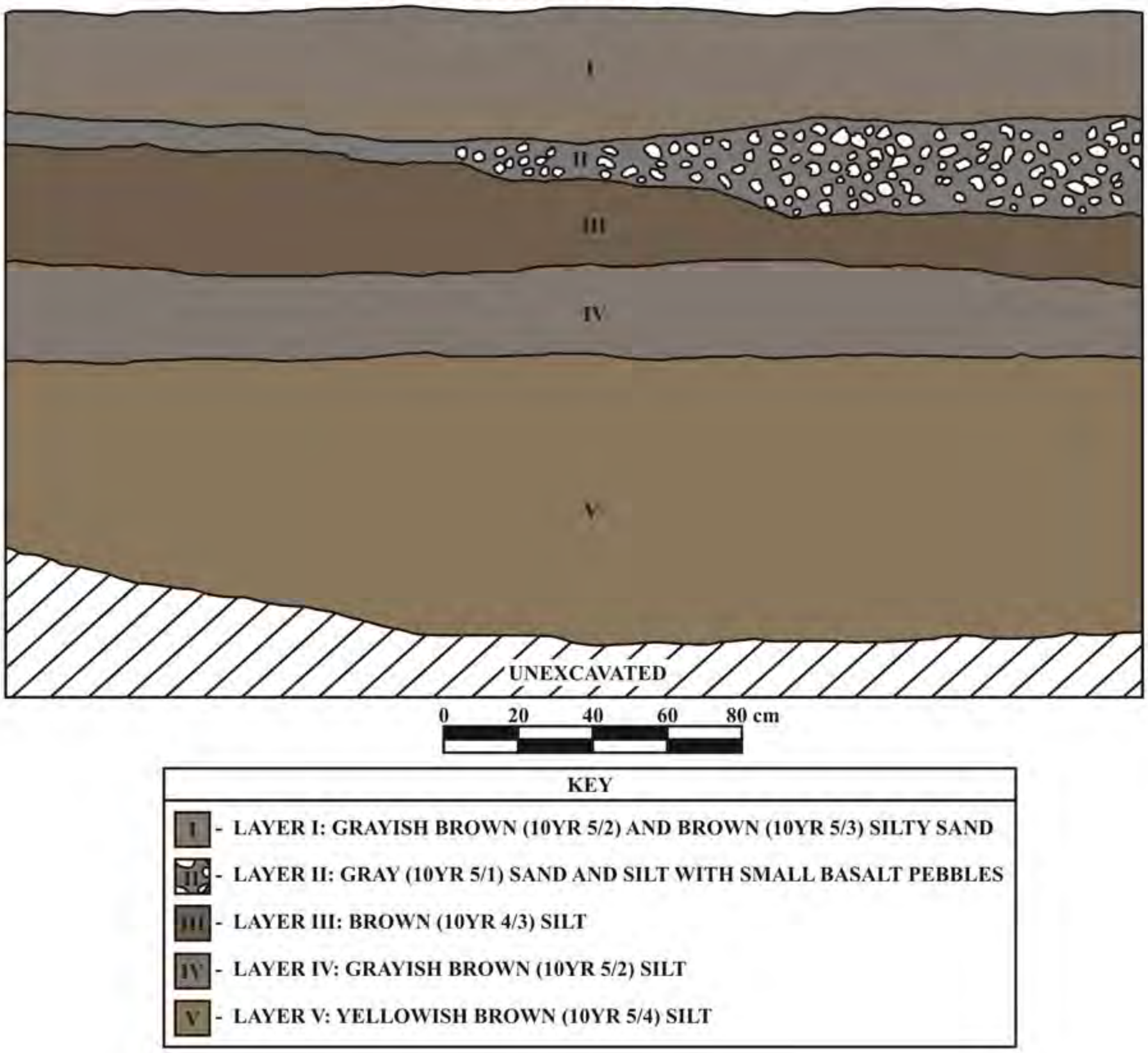

ST-117 SOUTH WALL PROFILE
I
II
III
UNEXCAVATED
0
20
40
60
80 cm
KEY
- GRASS
- ROOTS
I
- LAYER I: LIGHT GRAY (10YR 7/2) SILTY SAND
II
- LAYER II: PINK (7.5YR 8/4) SAND AND BROWN (7.5YR 4/2) SILT
III
- LAYER III: PINK (7.5YR 8/4) AND VERY DARK GRAYISH BROWN (10YR 3/2) SAND


ST-118 EAST WALL PROFILE
I
II
III
IV
LITHIFIED VEINS
UNEXCAVATED
0
20
40
60
80 cm
KEY
- GRASS
I - LAYER I: BROWN (10YR 5/3) SAND AND SILT
II - LAYER II: VERY PALE BROWN (10YR 8/3) SAND MOTTLED WITH DARK GRAYISH BROWN (10YR 4/2) SAND
III - LAYER III: DARK GRAYISH BROWN (10YR 4/2) SAND
IV - LAYER IV: VERY PALE BROWN (10YR 8/3) MOTTLED WITH VERY DARK GRAYISH BROWN (10YR 3/2) SAND
- DIFFUSE BOUNDARY

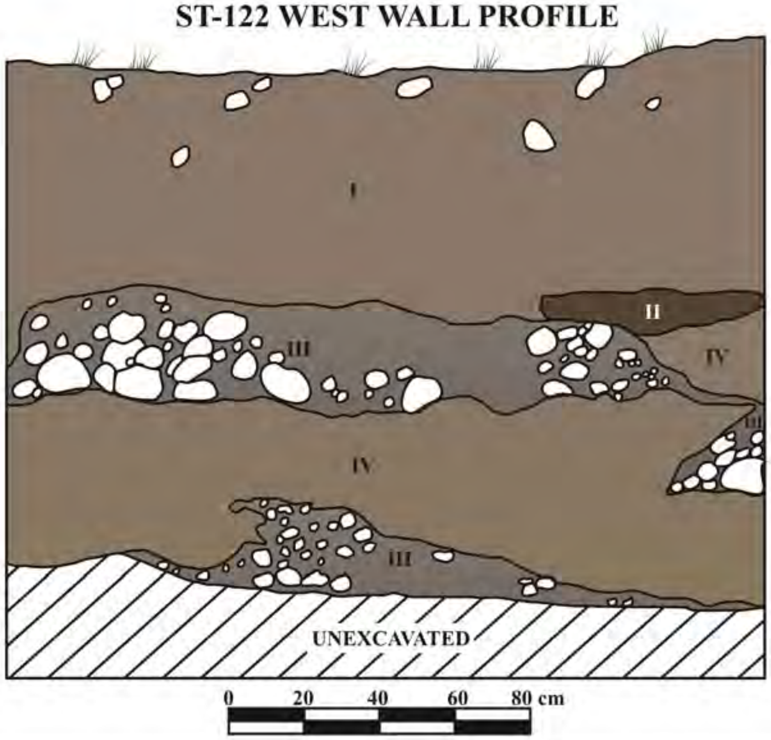

ST-119 EAST WALL PROFILE
I
II
IIA
IV
III
IIIA
V
UNEXCAVATED
0
20
40
60
80 cm
KEY
I - LAYER I: GRAYISH BROWN (10YR 5/2) SILTY SAND
II - LAYER II: PALE BROWN (10YR 6/3) AND LIGHT YELLOWISH BROWN (10YR 6/4) SAND
IIA - LAYER IIA: GRAYISH BROWN (10YR 5/2) SANDY SILT
III - LAYER III: VERY PALE BROWN (10YR 7/3) AND VERY PALE BROWN (10YR 7/4) SAND
IIIA - LAYER IIIA: GRAYISH BROWN (10YR 5/2) SANDY SILT
IV - LAYER IV: GRAYISH BROWN (10YR 5/2) AND LIGHT BROWNISH GRAY (10YR 6/2) SANDY SILT
V - LAYER V: DARK BROWN (10YR 3/3) SILT


ST-120 EAST WALL PROFILE
I
II
III
IV
V
V
UNEXCAVATED
0
20
40
60
80 cm
KEY
- GRASS
- BASALT ROCK
- LAYER I: GRAYISH BROWN (10YR 5/2) AND BROWN (10YR 5/3) SANDY SILT
- LAYER II: GRAYISH BROWN (10YR 5/2) AND GRAY (10YR 5/1) SAND
- LAYER III: BROWN (10YR 4/3) SILT
- LAYER IV: GRAYISH BROWN (10YR 5/2) AND GRAY (10YR 5/1) SAND
- LAYER V: BROWN (10YR 4/3) SILT
- DIFFUSE BOUNDARY

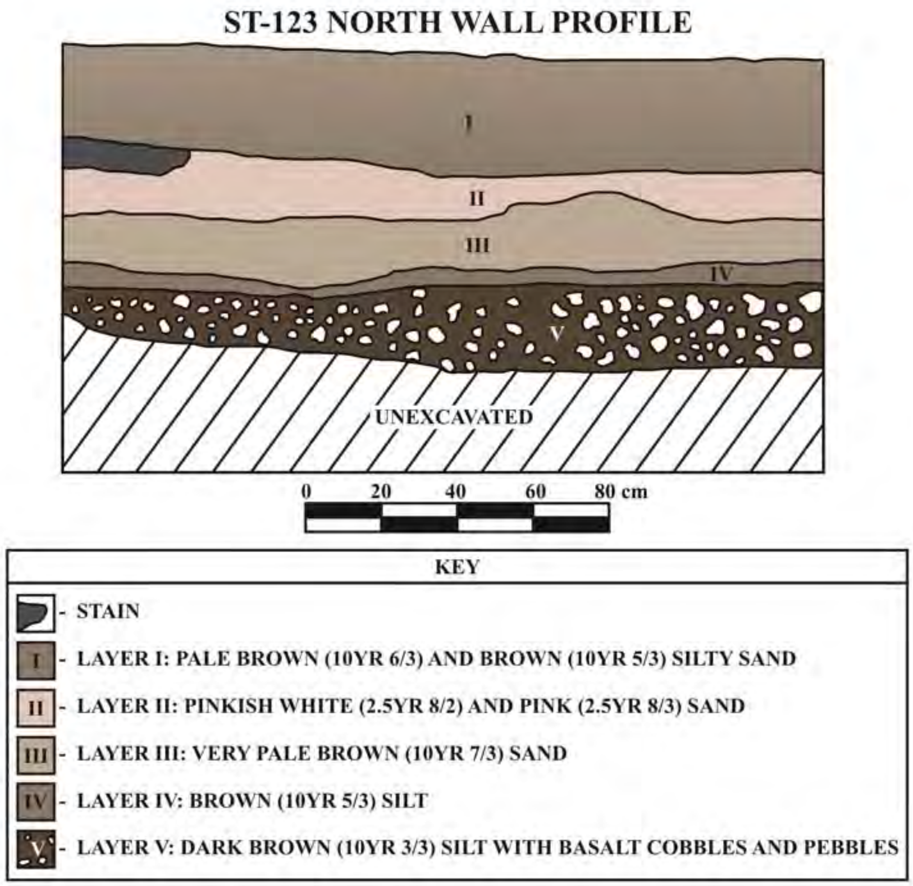
ST-121 WEST WALL PROFILE



ST-122 WEST WALL PROFILE

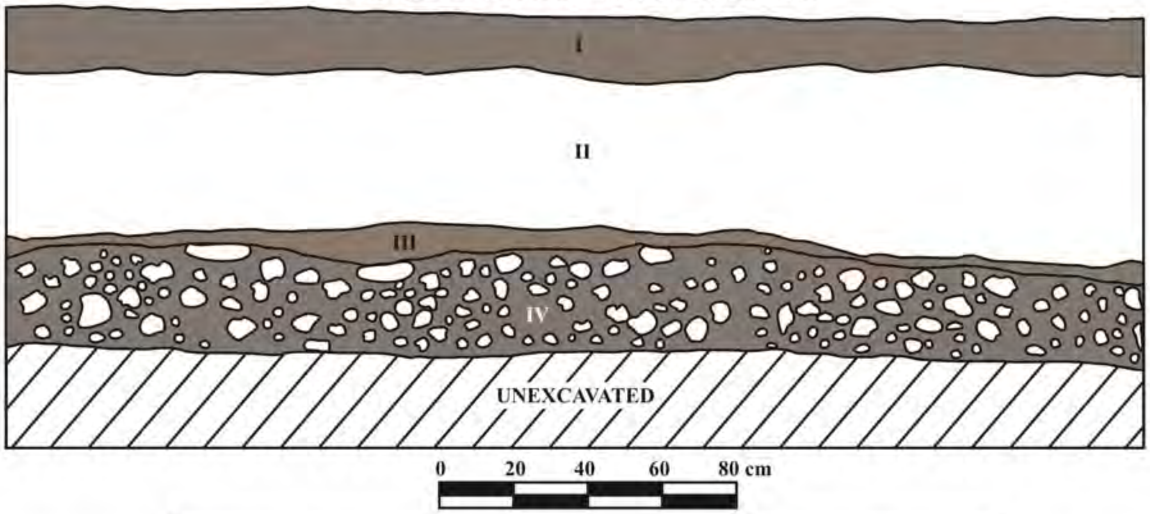


KEY
- GRASS
- BASALT ROCK
I - LAYER I: BROWN (10YR 5/3) SANDY SILT
II - LAYER II: DARK BROWN (10YR 3/3) SILT
III - LAYER III: GRAYISH BROWN (10YR 5/2) AND DARK GRAYISH BROWN (10YR 4/2) SAND WITH BASALT COBBLES AND PEBBLES
IV - LAYER IV: BROWN (10YR 5/3) AND YELLOWISH BROWN (10YR 5/4) SILT



ST-123 NORTH WALL PROFILE
I
II
III
IV
V
UNEXCAVATED
0
20
40
60
80 cm
KEY
- STAIN
- LAYER I: PALE BROWN (10YR 6/3) AND BROWN (10YR 5/3) SILTY SAND
- LAYER II: PINKISH WHITE (2.5YR 8/2) AND PINK (2.5YR 8/3) SAND
- LAYER III: VERY PALE BROWN (10YR 7/3) SAND
- LAYER IV: BROWN (10YR 5/3) SILT
- LAYER V: DARK BROWN (10YR 3/3) SILT WITH BASALT COBBLES AND PEBBLES

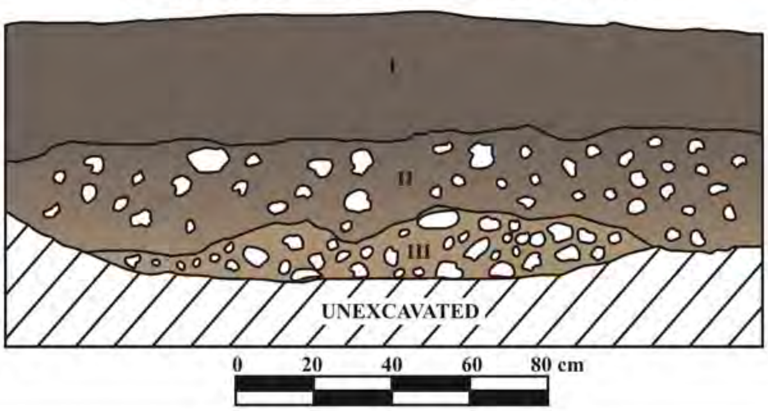
ST-124 NORTH WALL PROFILE



KEY

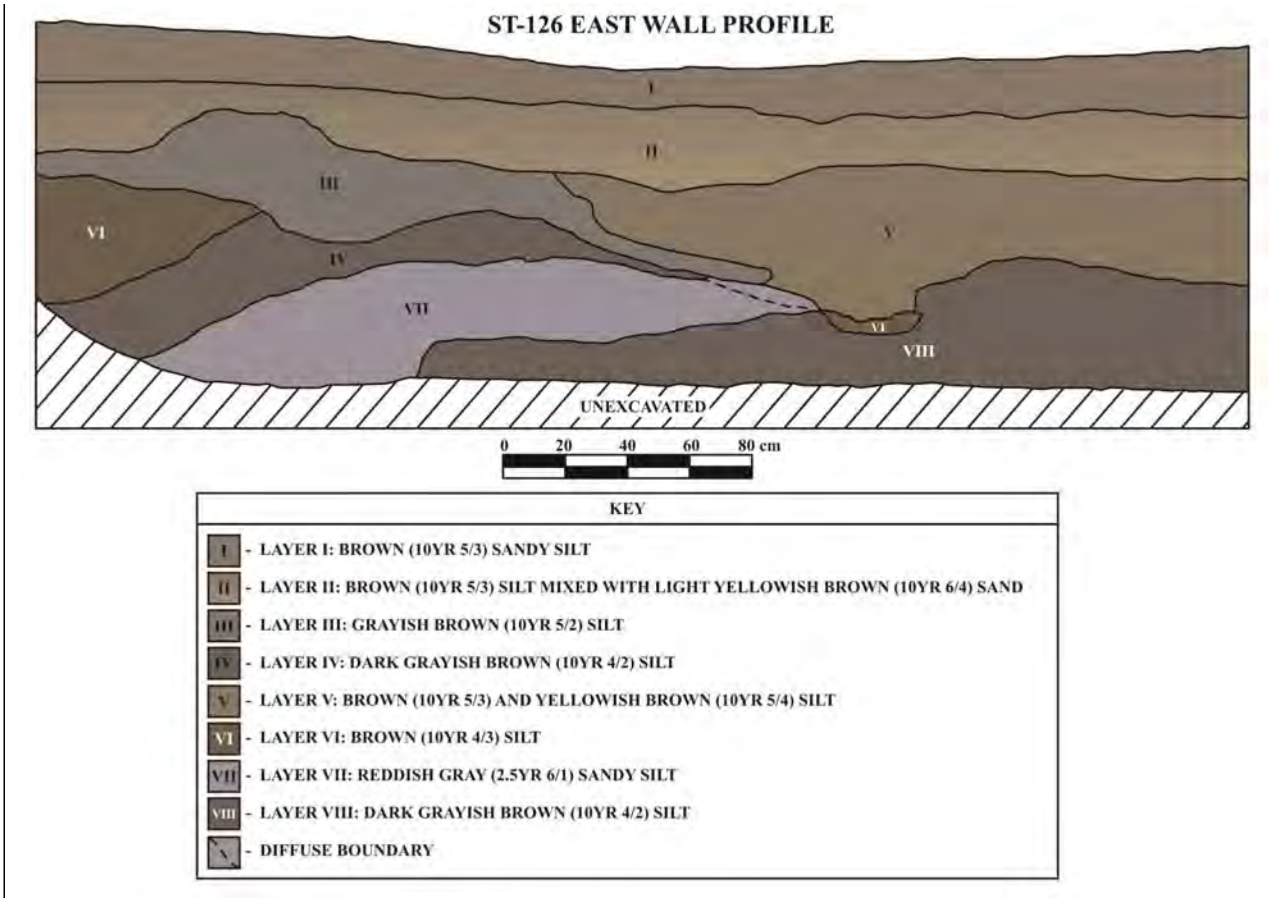
- I - LAYER I: GRAYISH BROWN (10YR 5/2) AND BROWN (10YR 5/3) SILTY SAND
- II - LAYER II: MOTTLED SILT, SAND, BASALT PEBBLES
- III - LAYER III: BROWN (10YR 5/3) SILT
- IV - LAYER IV: GRAYISH BROWN (10YR 5/2) SILT

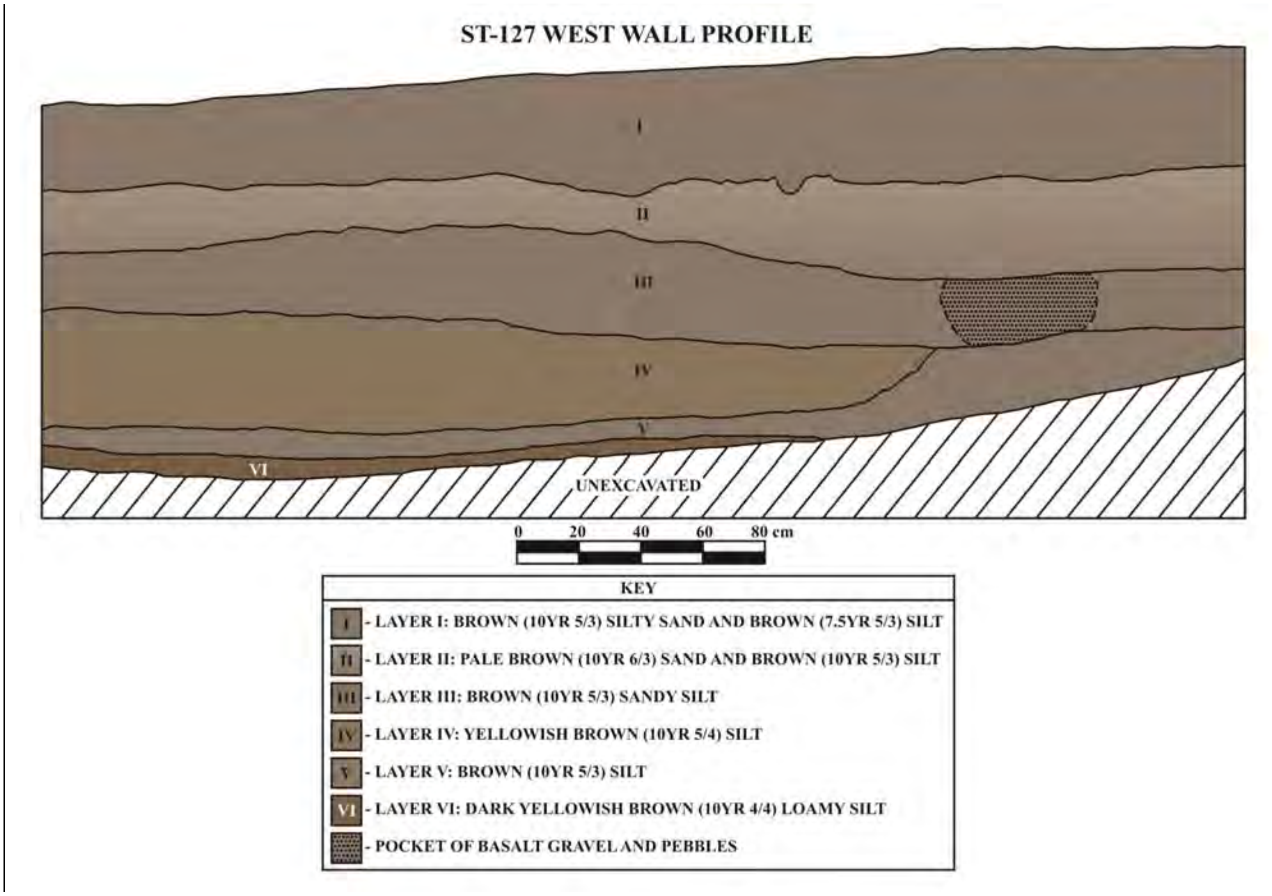
ST-125 NORTHEAST WALL PROFILE

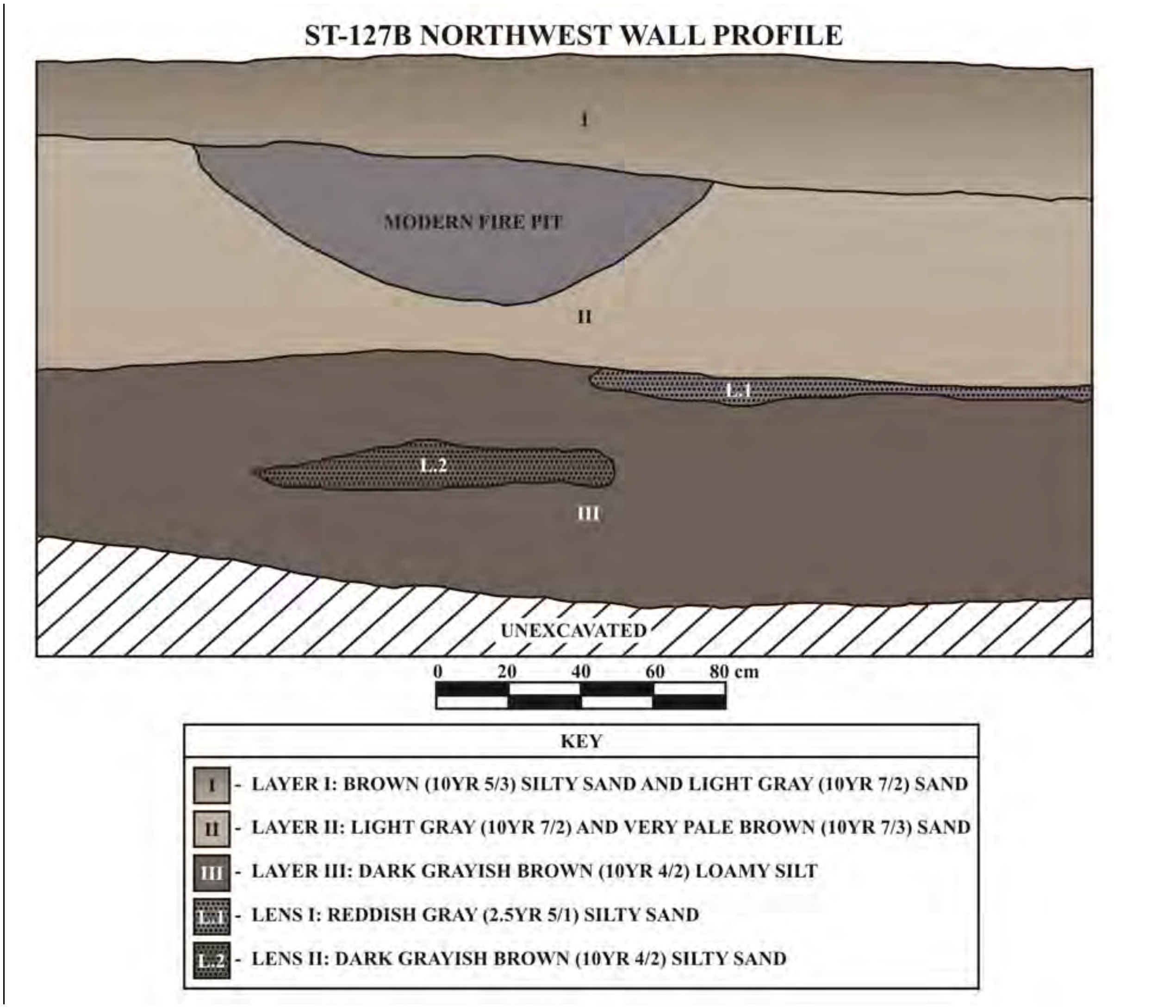


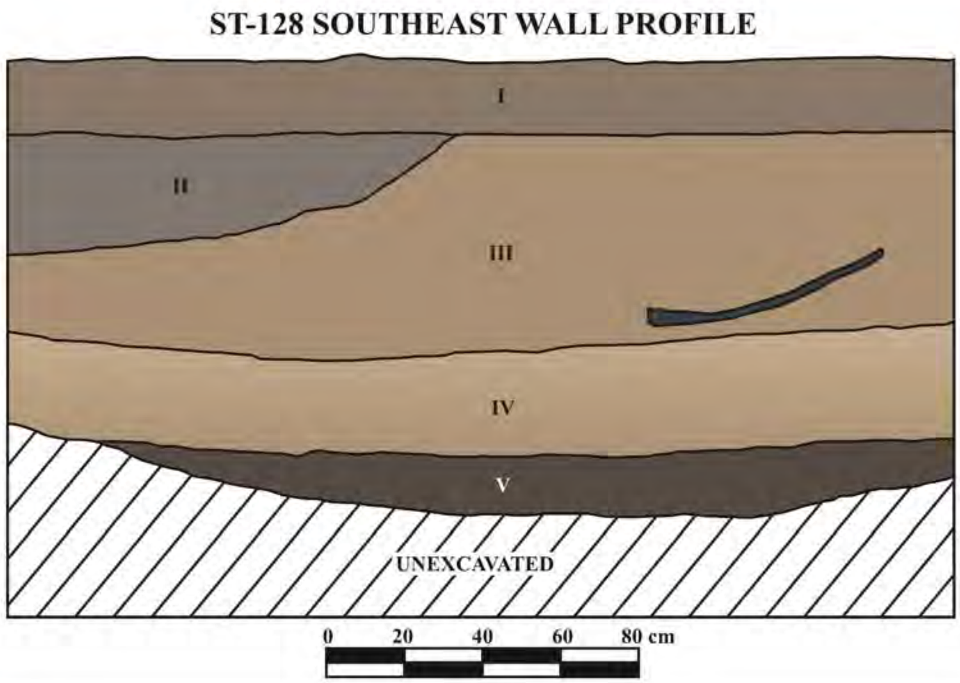
KEY

- I - LAYER I: DARK GRAYISH BROWN (10YR 4/2) SILTY LOAM
- II - LAYER II: DARK GRAYISH BROWN (10YR 4/2) SILTY LOAM AND LIGHT YELLOWISH BROWN (10YR 6/4) SAND WITH PEBBLES/COBBLES
- III - LAYER III: LIGHT YELLOWISH BROWN (10YR 6/4) SAND WITH BASALT PEBBLES AND COBBLES
- BASALT ROCKS


ST-126 EAST WALL PROFILE
I
II
III
IV
V
VI
VII
VI
VIII
UNEXCAVATED
0 20 40 60 80 cm
KEY
I - LAYER I: BROWN (10YR 5/3) SANDY SILT
II - LAYER II: BROWN (10YR 5/3) SILT MIXED WITH LIGHT YELLOWISH BROWN (10YR 6/4) SAND
III - LAYER III: GRAYISH BROWN (10YR 5/2) SILT
IV - LAYER IV: DARK GRAYISH BROWN (10YR 4/2) SILT
V - LAYER V: BROWN (10YR 5/3) AND YELLOWISH BROWN (10YR 5/4) SILT
VI - LAYER VI: BROWN (10YR 4/3) SILT
VII - LAYER VII: REDDISH GRAY (2.5YR 6/1) SANDY SILT
VIII - LAYER VIII: DARK GRAYISH BROWN (10YR 4/2) SILT
- DIFFUSE BOUNDARY


ST-127 WEST WALL PROFILE
I
II
III
IV
V
VI
UNEXCAVATED
0 20 40 60 80 cm
KEY
I - LAYER I: BROWN (10YR 5/3) SILTY SAND AND BROWN (7.5YR 5/3) SILT
II - LAYER II: PALE BROWN (10YR 6/3) SAND AND BROWN (10YR 5/3) SILT
III - LAYER III: BROWN (10YR 5/3) SANDY SILT
IV - LAYER IV: YELLOWISH BROWN (10YR 5/4) SILT
V - LAYER V: BROWN (10YR 5/3) SILT
VI - LAYER VI: DARK YELLOWISH BROWN (10YR 4/4) LOAMY SILT
- POCKET OF BASALT GRAVEL AND PEBBLES

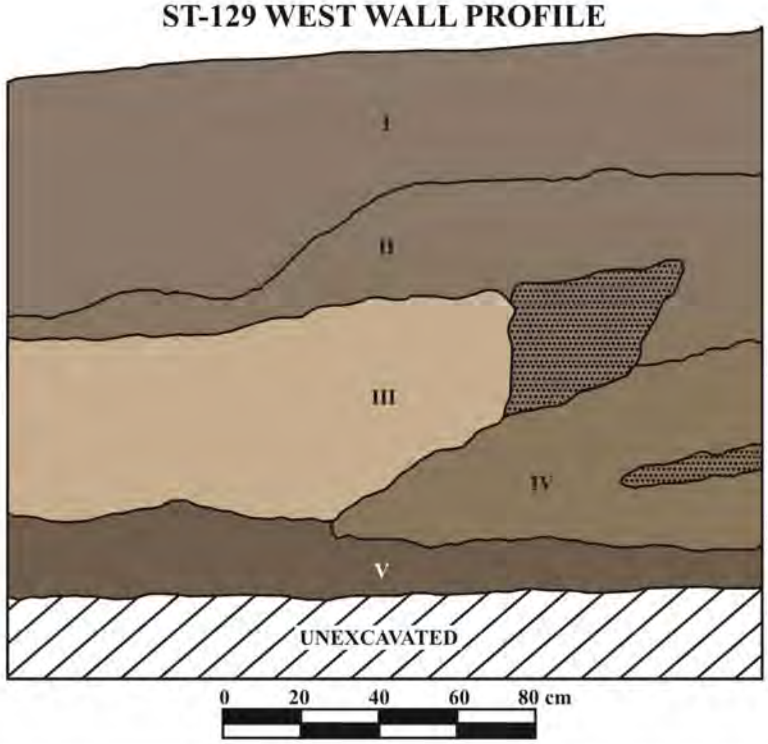

ST-127B NORTHWEST WALL PROFILE
I
MODERN FIRE PIT
II
L.1
L.2
III
UNEXCAVATED
0 20 40 60 80 cm
KEY
I - LAYER I: BROWN (10YR 5/3) SILTY SAND AND LIGHT GRAY (10YR 7/2) SAND
II - LAYER II: LIGHT GRAY (10YR 7/2) AND VERY PALE BROWN (10YR 7/3) SAND
III - LAYER III: DARK GRAYISH BROWN (10YR 4/2) LOAMY SILT
L.1 - LENS I: REDDISH GRAY (2.5YR 5/1) SILTY SAND
L.2 - LENS II: DARK GRAYISH BROWN (10YR 4/2) SILTY SAND



KEY

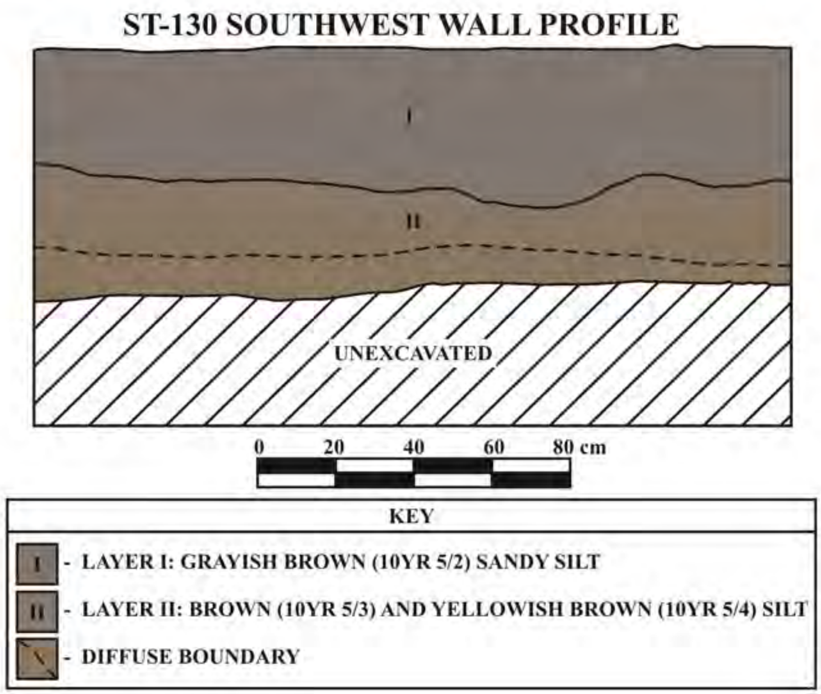
- STAIN
- LAYER I: BROWN (10YR 5/3) SILTY SAND
- LAYER II: GRAYISH BROWN (10YR 5/2) SAND
- LAYER III: LIGHT YELLOWISH BROWN (10YR 6/4) SAND
- LAYER IV: VERY PALE BROWN (10YR 7/4) AND LIGHT YELLOWISH BROWN (10YR 6/4) SAND
- LAYER V: VERY DARK GRAYISH BROWN (10YR 3/2) LOAMY SILT

ST-129 WEST WALL PROFILE

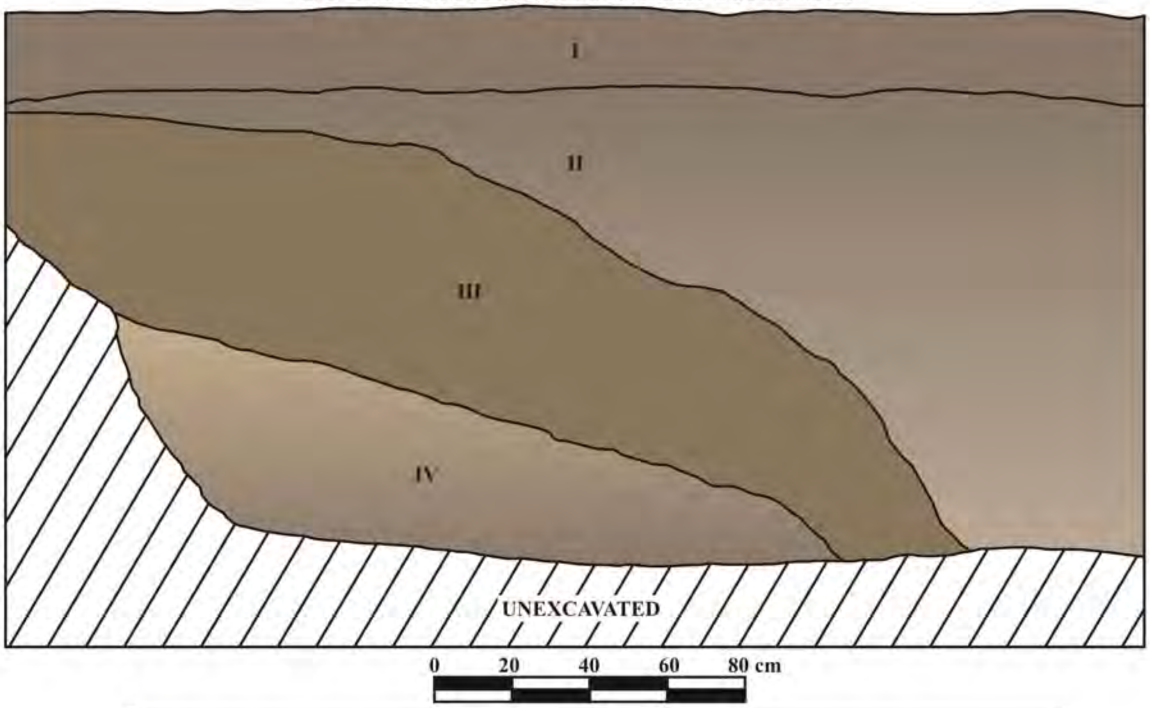


KEY

- ROCKY POCKETS
- LAYER I: BROWN (10YR 5/3) SILTY SAND
- LAYER II: BROWN (10YR 5/3) SILTY SAND AND YELLOWISH BROWN (10YR 5/4) SANDY SILT
- LAYER III: VERY PALE BROWN (10YR 7/4) SAND
- LAYER IV: YELLOWISH BROWN (10YR 5/4) SILT
- LAYER V: BROWN (10YR 4/3) LOAMY SILT


ST-130 SOUTHWEST WALL PROFILE
I
II
UNEXCAVATED
0 20 40 60 80 cm
KEY
I - LAYER I: GRAYISH BROWN (10YR 5/2) SANDY SILT
II - LAYER II: BROWN (10YR 5/3) AND YELLOWISH BROWN (10YR 5/4) SILT
- DIFFUSE BOUNDARY

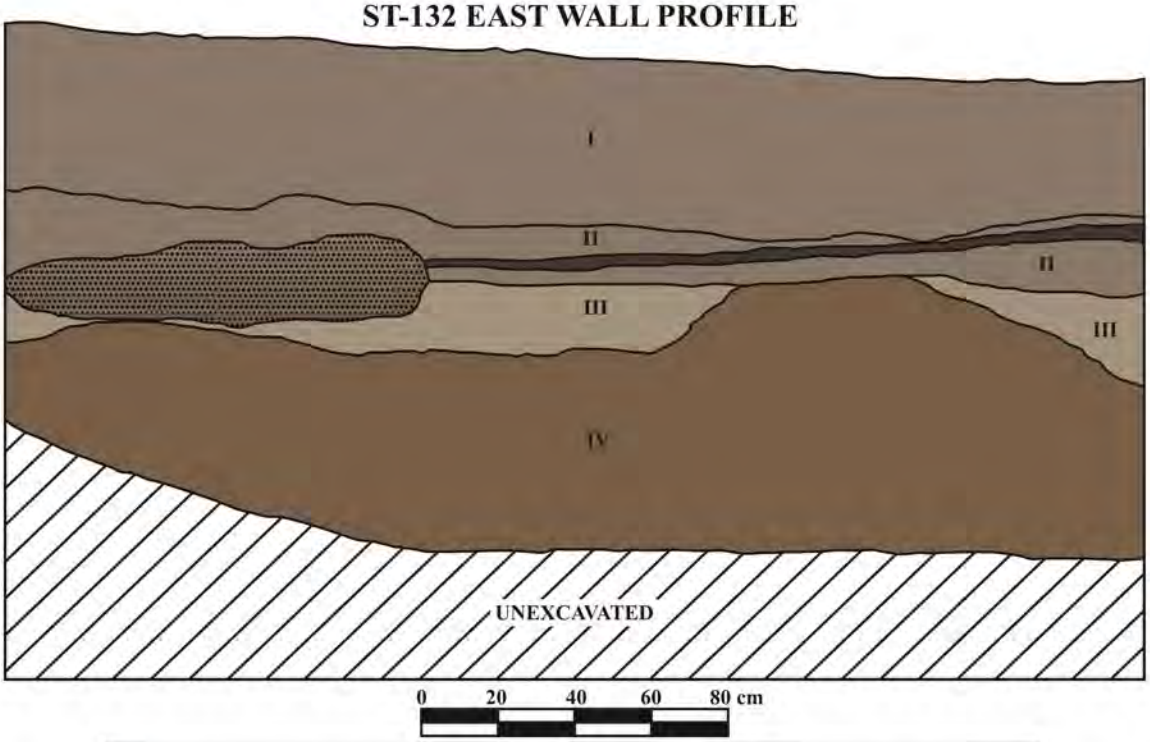
ST-131 NORTHEAST WALL PROFILE



KEY

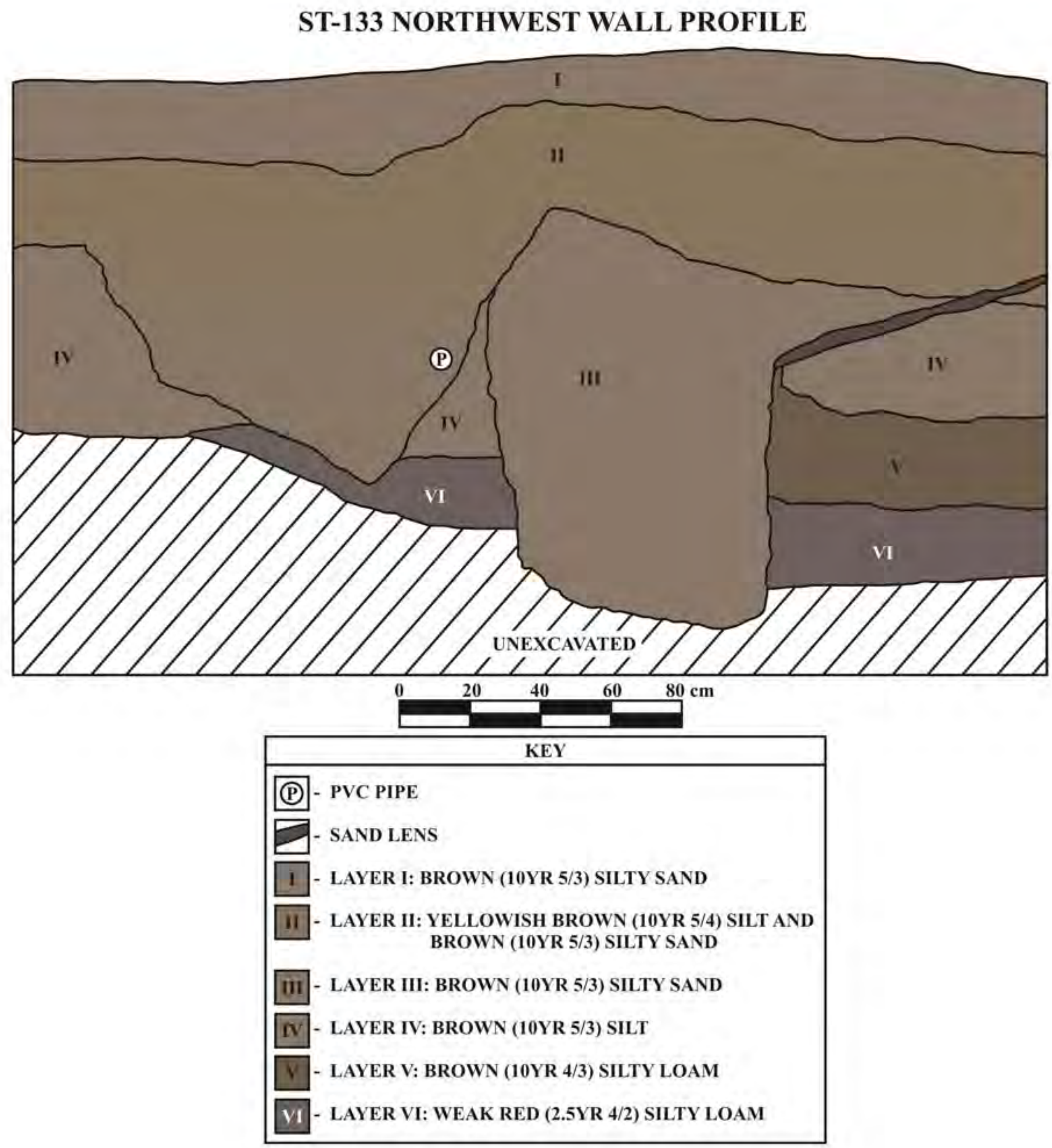
- I - LAYER I: BROWN (10YR 5/3) SILTY SAND
- II - LAYER II: BROWN (10YR 5/3) SILTY SAND AND VERY PALE BROWN (10YR 7/3) SAND
- III - LAYER III: YELLOWISH BROWN (10YR 5/4) SILT
- IV - LAYER IV: VERY PALE BROWN (10YR 7/4) SAND AND BROWN (10YR 5/3) SILT

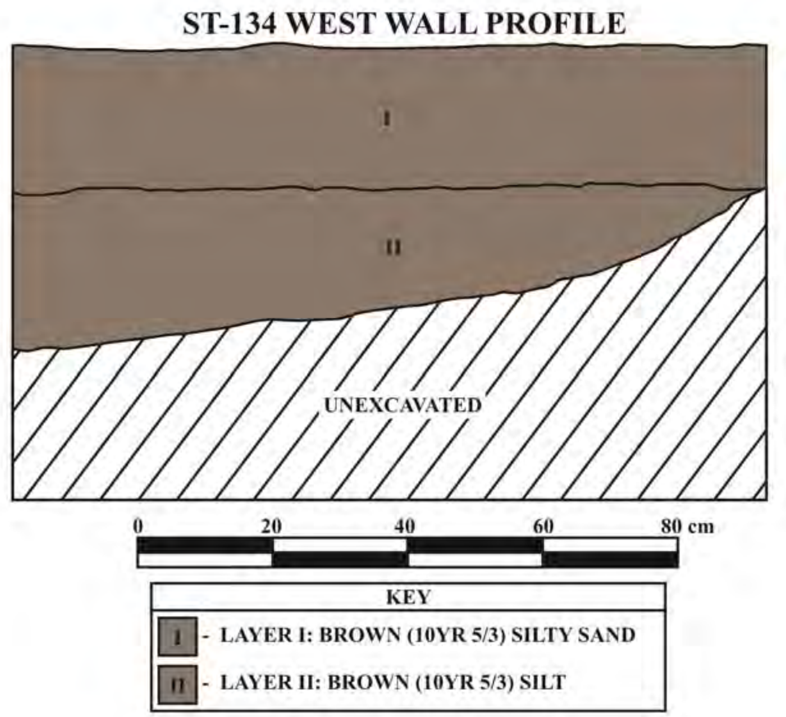
ST-132 EAST WALL PROFILE

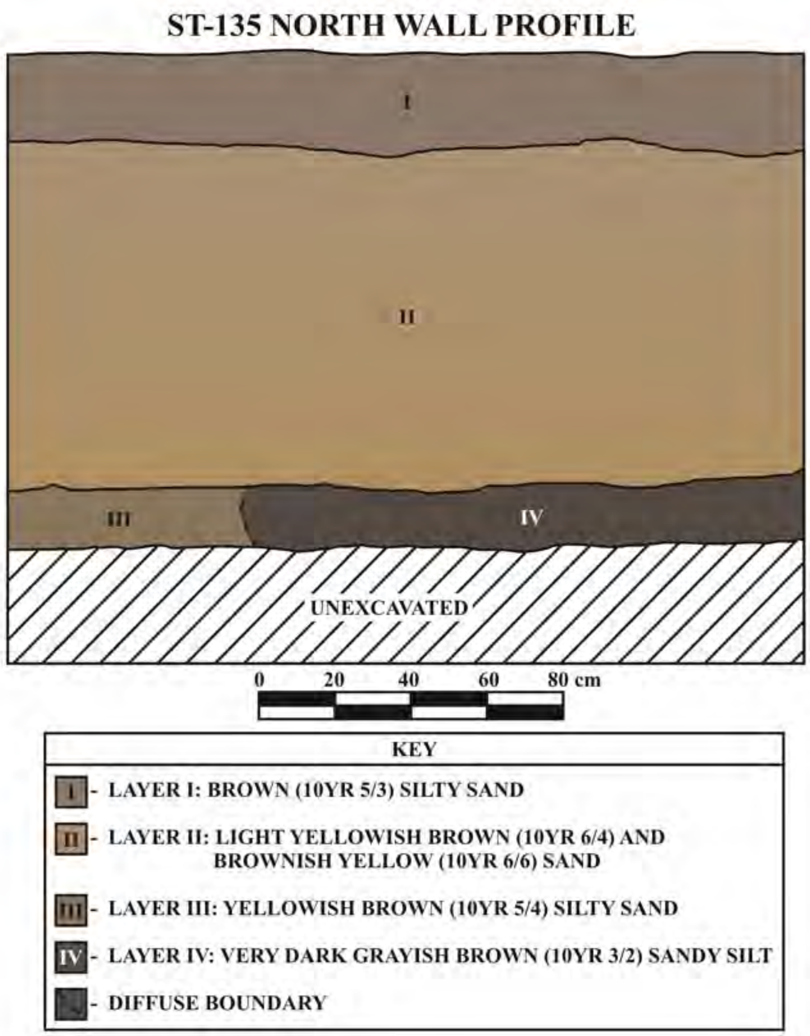


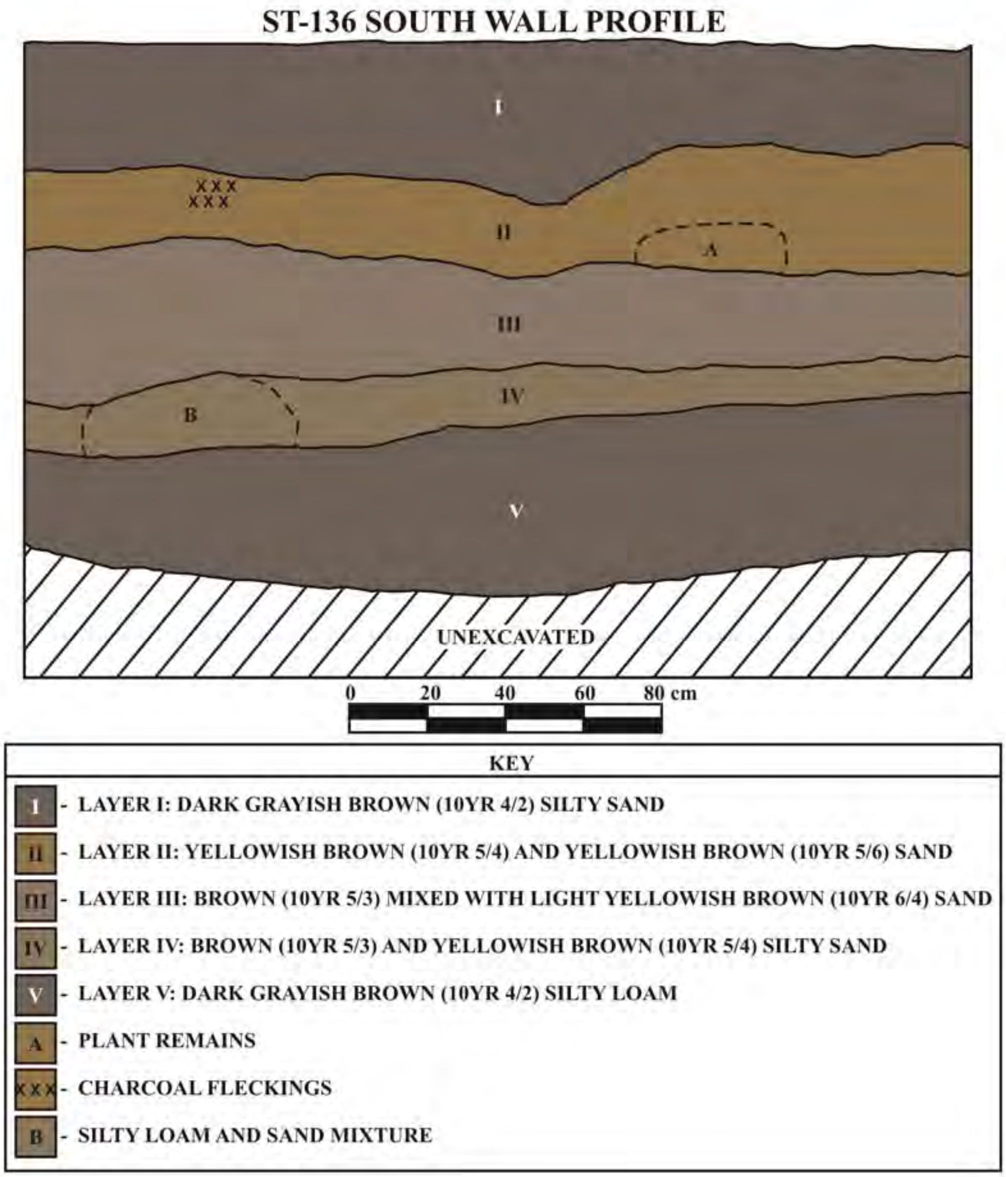
KEY

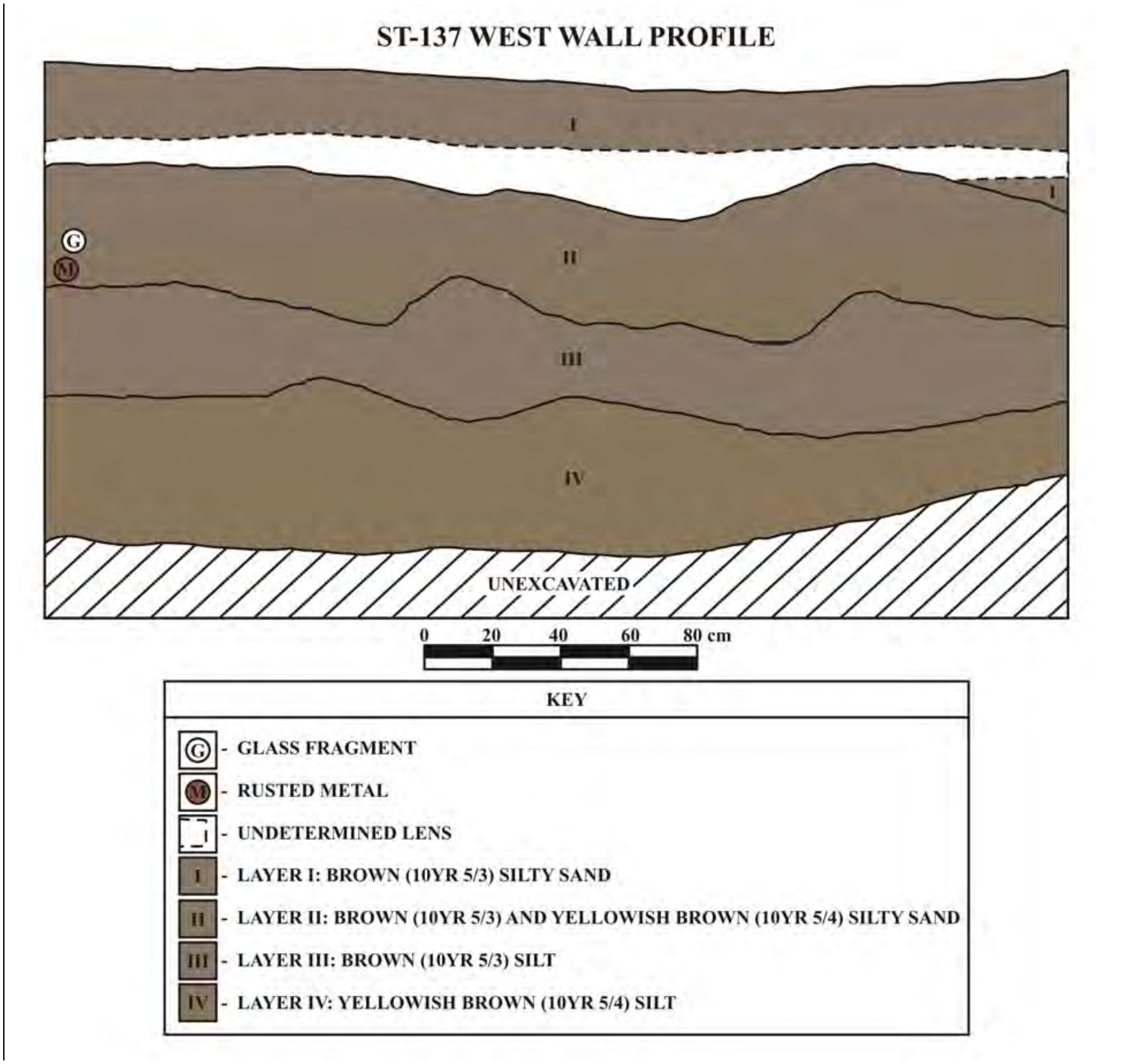
- POCKET OF BASALT ROCK: BROWN (10YR 5/3) AND BROWN (10YR 4/3) SANDY SILT
- SAND LENS
- I - LAYER I: BROWN (10YR 5/3) SILTY SAND
- II - LAYER II: BROWN (10YR 5/3) SILT
- III - LAYER III: PALE BROWN (10YR 6/3) SILT
- IV - LAYER IV: DARK YELLOWISH BROWN (10YR 4/4) SILTY LOAM


ST-133 NORTHWEST WALL PROFILE
I
II
IV
III
IV
IV
V
VI
VI
UNEXCAVATED
0
20
40
60
80 cm
KEY
PVC PIPE
SAND LENS
LAYER I: BROWN (10YR 5/3) SILTY SAND
LAYER II: YELLOWISH BROWN (10YR 5/4) SILT AND BROWN (10YR 5/3) SILTY SAND
LAYER III: BROWN (10YR 5/3) SILTY SAND
LAYER IV: BROWN (10YR 5/3) SILT
LAYER V: BROWN (10YR 4/3) SILTY LOAM
LAYER VI: WEAK RED (2.5YR 4/2) SILTY LOAM

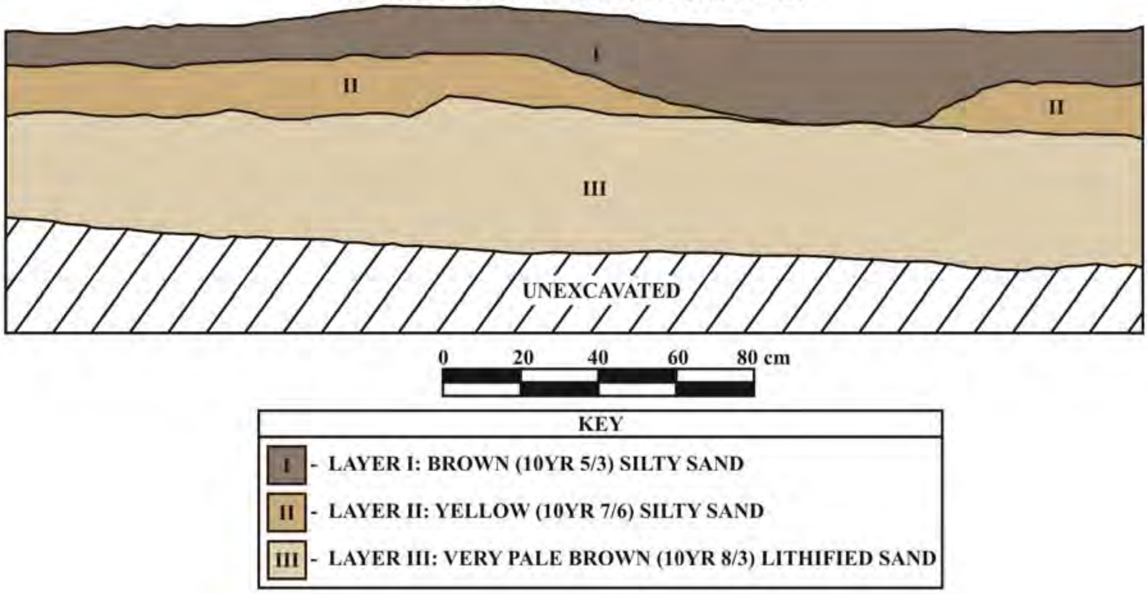

ST-134 WEST WALL PROFILE
I
II
UNEXCAVATED
0
20
40
60
80 cm
KEY
I - LAYER I: BROWN (10YR 5/3) SILTY SAND
II - LAYER II: BROWN (10YR 5/3) SILT


ST-135 NORTH WALL PROFILE
I
II
III
IV
UNEXCAVATED
0 20 40 60 80 cm
KEY
I - LAYER I: BROWN (10YR 5/3) SILTY SAND
II - LAYER II: LIGHT YELLOWISH BROWN (10YR 6/4) AND BROWNISH YELLOW (10YR 6/6) SAND
III - LAYER III: YELLOWISH BROWN (10YR 5/4) SILTY SAND
IV - LAYER IV: VERY DARK GRAYISH BROWN (10YR 3/2) SANDY SILT
- DIFFUSE BOUNDARY

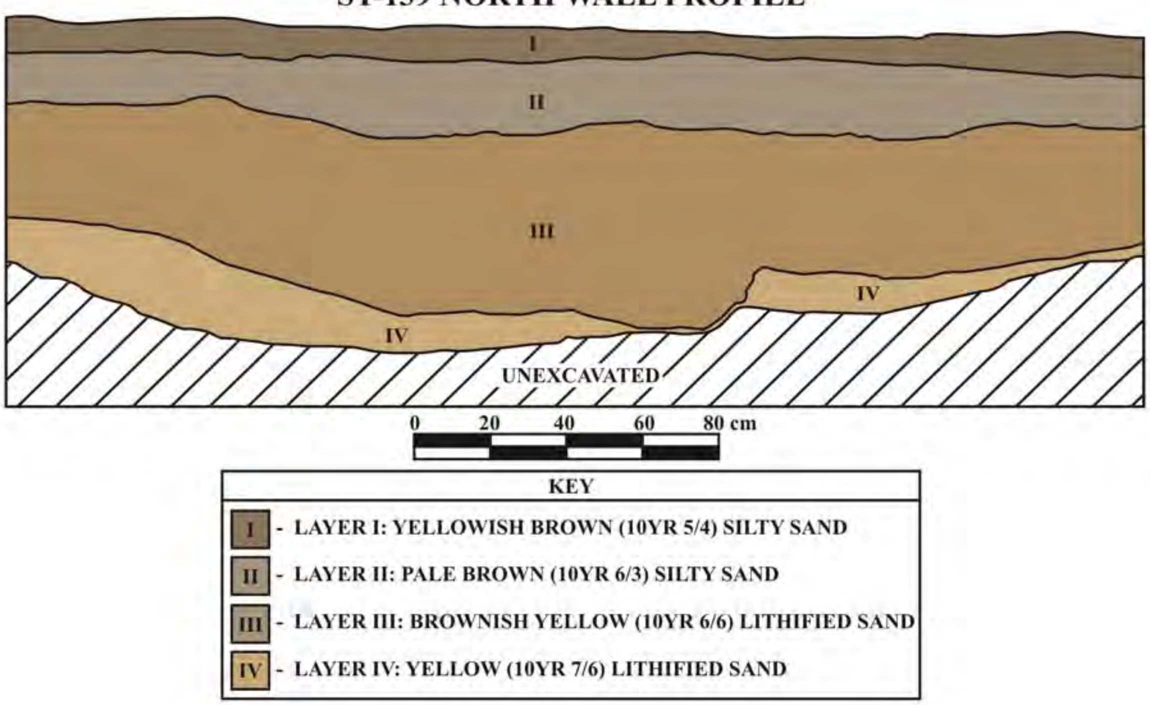

ST-136 SOUTH WALL PROFILE
I
II
III
IV
V
A
B
UNEXCAVATED
0
20
40
60
80 cm
KEY
I - LAYER I: DARK GRAYISH BROWN (10YR 4/2) SILTY SAND
II - LAYER II: YELLOWISH BROWN (10YR 5/4) AND YELLOWISH BROWN (10YR 5/6) SAND
III - LAYER III: BROWN (10YR 5/3) MIXED WITH LIGHT YELLOWISH BROWN (10YR 6/4) SAND
IV - LAYER IV: BROWN (10YR 5/3) AND YELLOWISH BROWN (10YR 5/4) SILTY SAND
V - LAYER V: DARK GRAYISH BROWN (10YR 4/2) SILTY LOAM
A - PLANT REMAINS
XXX - CHARCOAL FLECKINGS
B - SILTY LOAM AND SAND MIXTURE

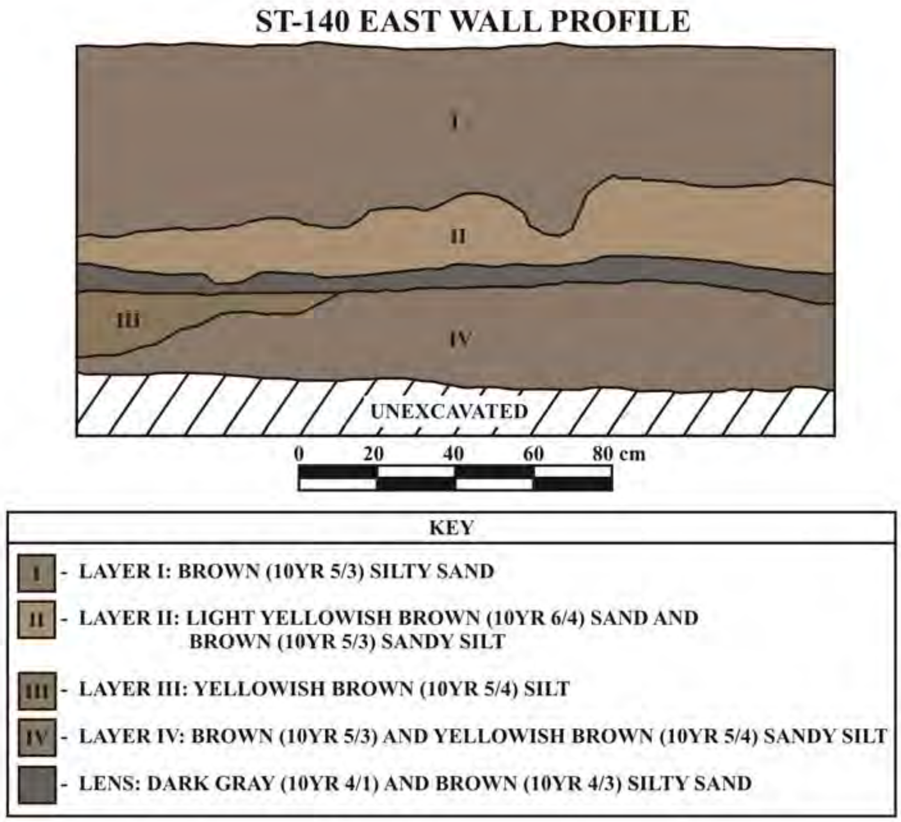

ST-137 WEST WALL PROFILE
I
I
II
III
IV
UNEXCAVATED
0
20
40
60
80 cm
KEY
G - GLASS FRAGMENT
M - RUSTED METAL
- UNDETERMINED LENS
I - LAYER I: BROWN (10YR 5/3) SILTY SAND
II - LAYER II: BROWN (10YR 5/3) AND YELLOWISH BROWN (10YR 5/4) SILTY SAND
III - LAYER III: BROWN (10YR 5/3) SILT
IV - LAYER IV: YELLOWISH BROWN (10YR 5/4) SILT

ST-138 NORTH WALL PROFILE

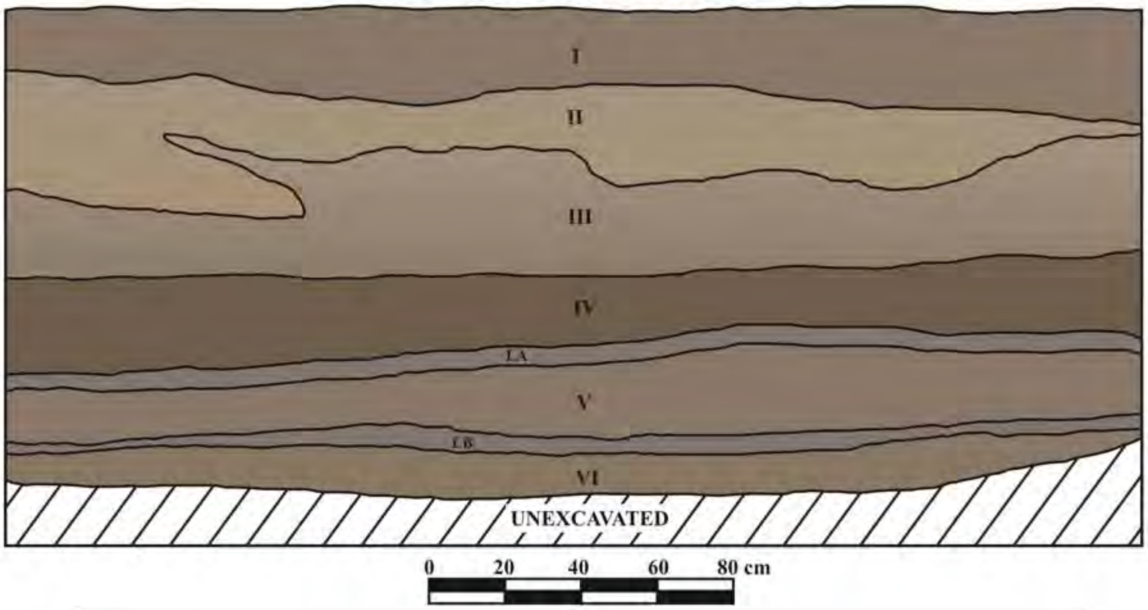


ST-139 NORTH WALL PROFILE



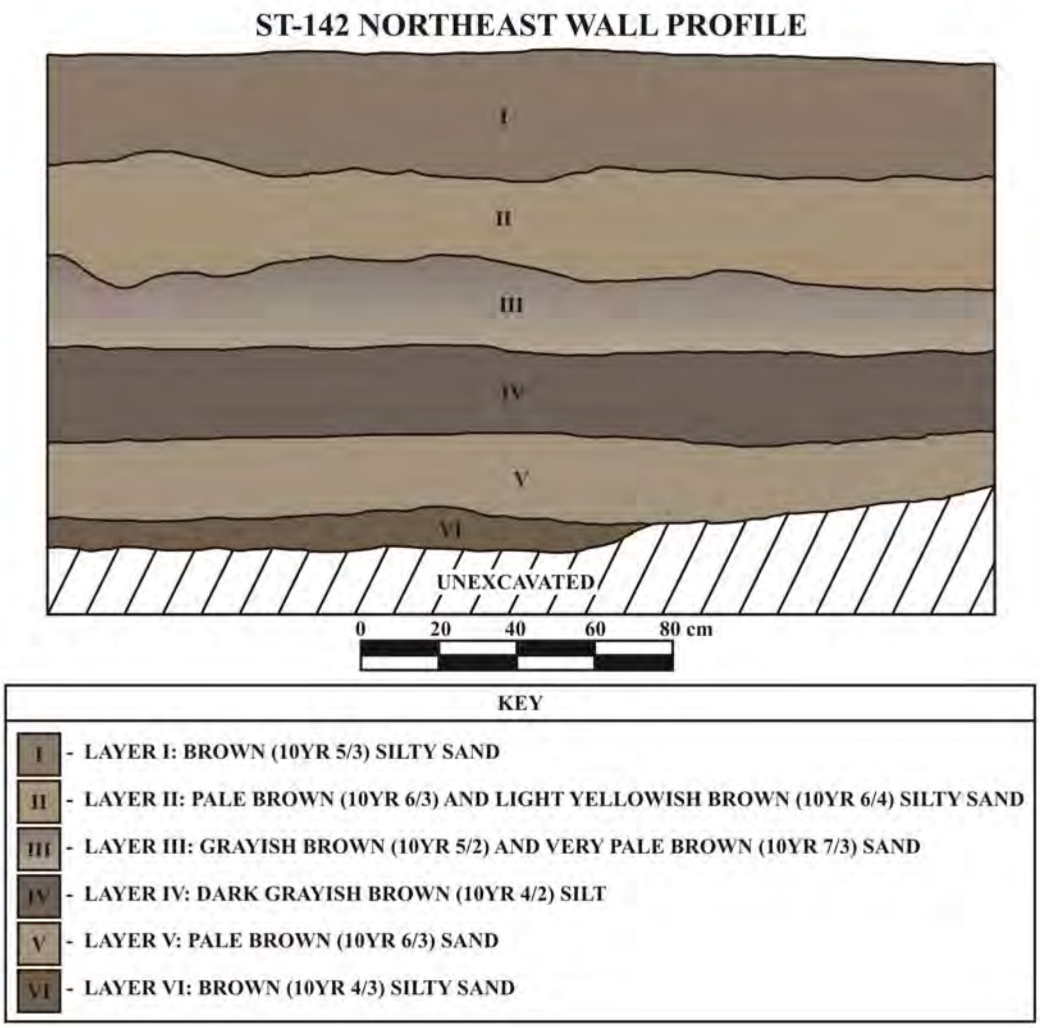

ST-140 EAST WALL PROFILE
I
II
III
IV
UNEXCAVATED
0
20
40
60
80 cm
KEY
I - LAYER I: BROWN (10YR 5/3) SILTY SAND
II - LAYER II: LIGHT YELLOWISH BROWN (10YR 6/4) SAND AND BROWN (10YR 5/3) SANDY SILT
III - LAYER III: YELLOWISH BROWN (10YR 5/4) SILT
IV - LAYER IV: BROWN (10YR 5/3) AND YELLOWISH BROWN (10YR 5/4) SANDY SILT
- LENS: DARK GRAY (10YR 4/1) AND BROWN (10YR 4/3) SILTY SAND

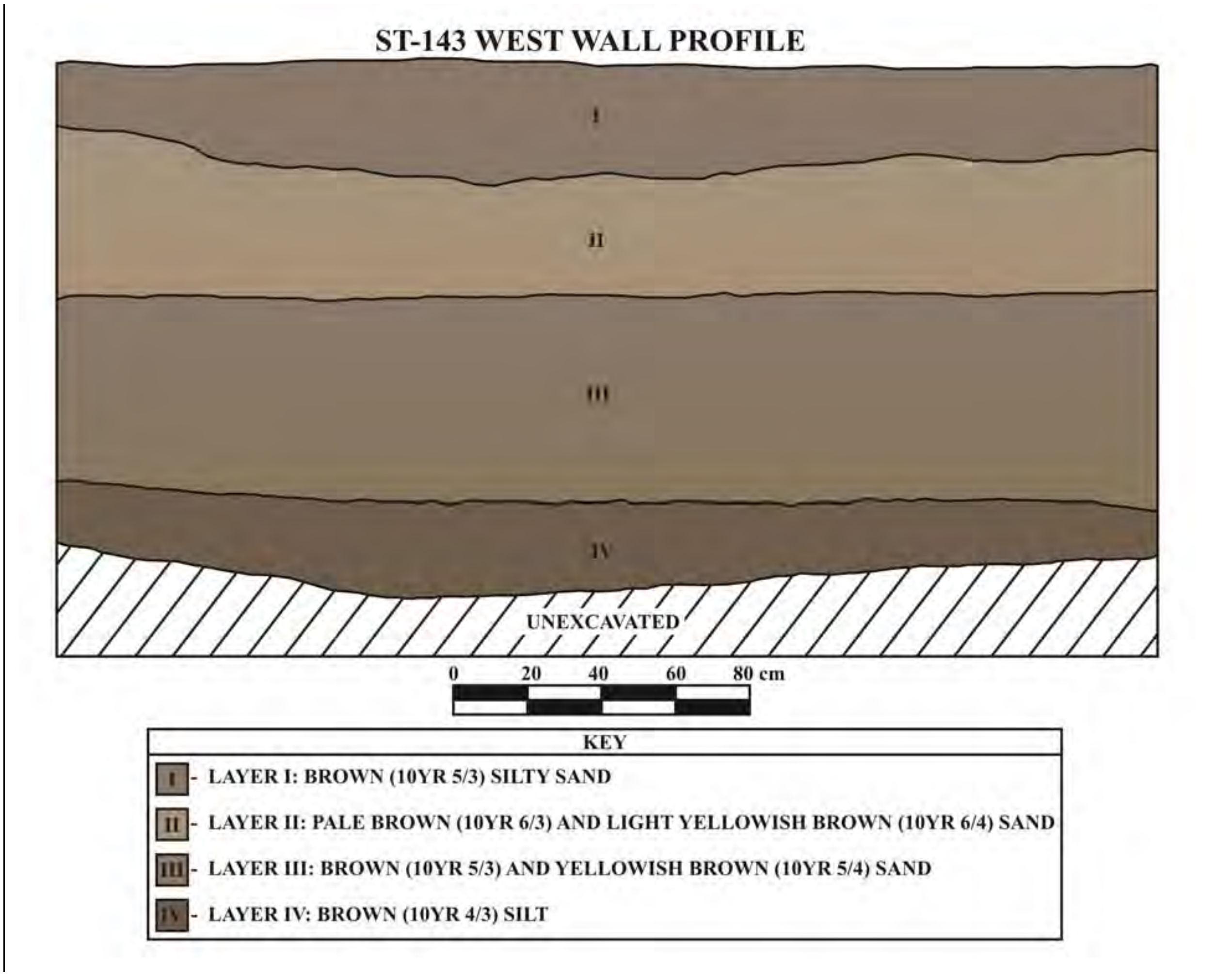
ST-141 WEST WALL PROFILE

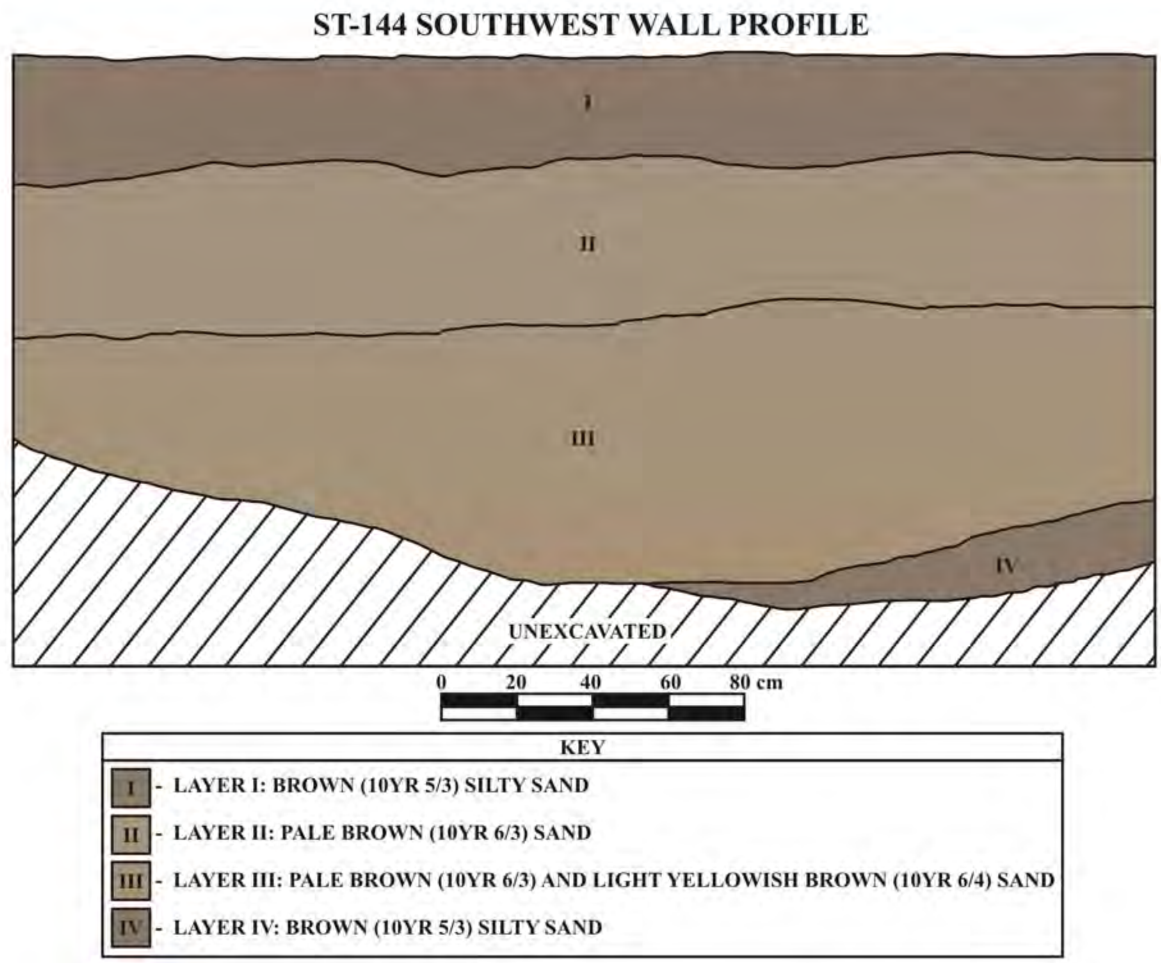


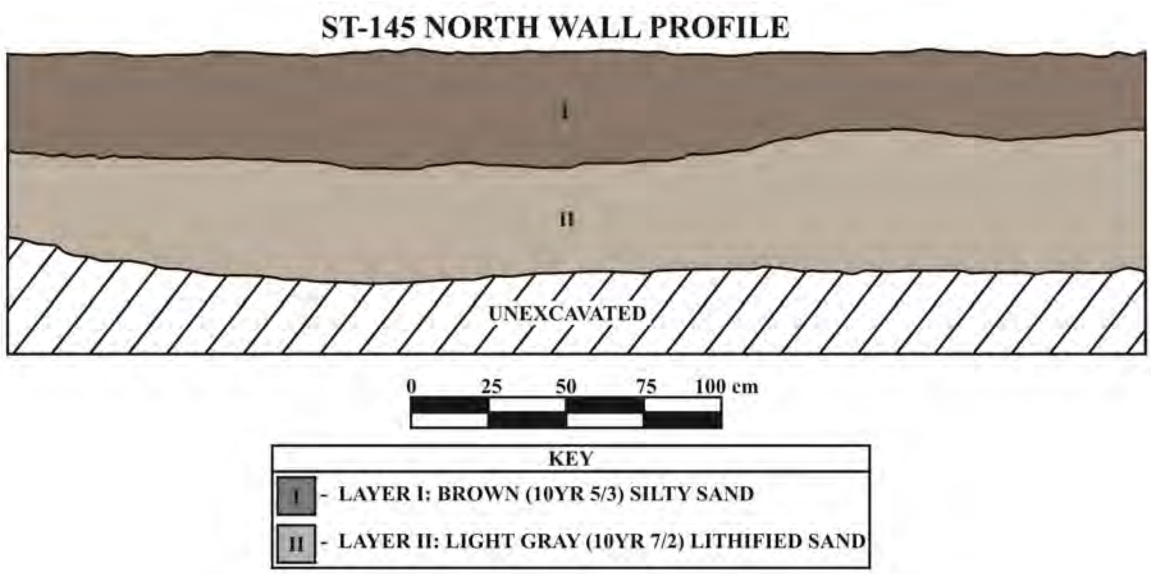
KEY

- I - **LAYER I: BROWN (10YR 5/3) SILTY SAND**
- II - **LAYER II: PALE BROWN (10YR 6/3) AND LIGHT YELLOWISH BROWN (10YR 6/4) SILTY SAND**
- III - **LAYER III: PALE BROWN (10YR 6/3) AND BROWN (10YR 5/3) SAND**
- IV - **LAYER IV: BROWN (10YR 4/3) SILT**
- V - **LAYER V: BROWN (10YR 5/3) SILT**
- VI - **LAYER VI: BROWN (10YR 5/3) AND YELLOWISH BROWN (10YR 5/4) SILT**
- LA - **LENS A: GRAYISH BROWN (10YR 5/2) SILT**
- LB - **LENS B: GRAYISH BROWN (10YR 5/2) SANDY SILT**

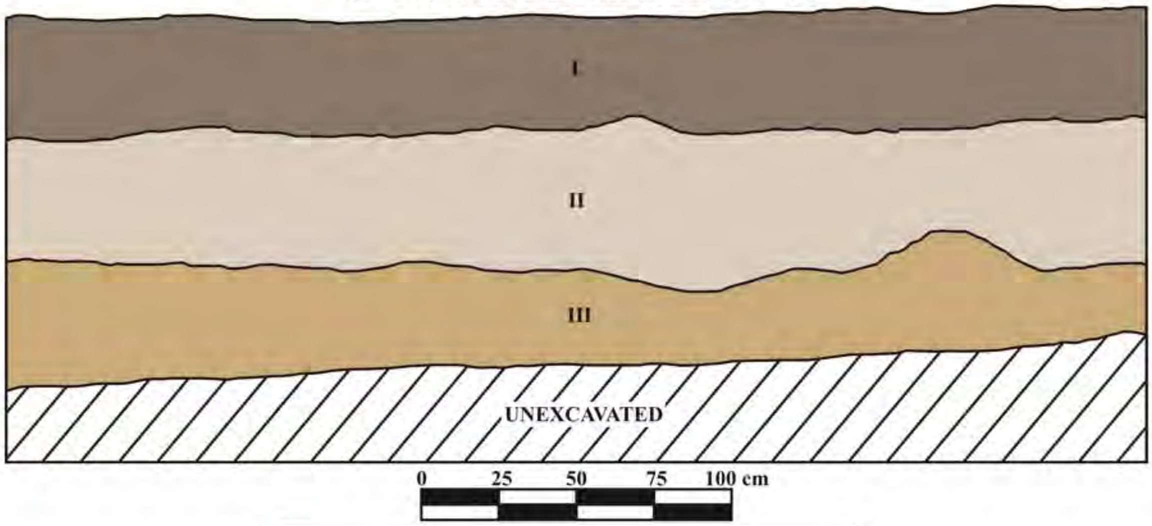

ST-142 NORTHEAST WALL PROFILE
I
II
III
IV
V
VI
UNEXCAVATED
0
20
40
60
80 cm
KEY
I - LAYER I: BROWN (10YR 5/3) SILTY SAND
II - LAYER II: PALE BROWN (10YR 6/3) AND LIGHT YELLOWISH BROWN (10YR 6/4) SILTY SAND
III - LAYER III: GRAYISH BROWN (10YR 5/2) AND VERY PALE BROWN (10YR 7/3) SAND
IV - LAYER IV: DARK GRAYISH BROWN (10YR 4/2) SILT
V - LAYER V: PALE BROWN (10YR 6/3) SAND
VI - LAYER VI: BROWN (10YR 4/3) SILTY SAND


ST-143 WEST WALL PROFILE
I
II
III
IV
UNEXCAVATED
0
20
40
60
80 cm
KEY
I - LAYER I: BROWN (10YR 5/3) SILTY SAND
II - LAYER II: PALE BROWN (10YR 6/3) AND LIGHT YELLOWISH BROWN (10YR 6/4) SAND
III - LAYER III: BROWN (10YR 5/3) AND YELLOWISH BROWN (10YR 5/4) SAND
IV - LAYER IV: BROWN (10YR 4/3) SILT


ST-144 SOUTHWEST WALL PROFILE
I
II
III
IV
UNEXCAVATED
0 20 40 60 80 cm
KEY
I - LAYER I: BROWN (10YR 5/3) SILTY SAND
II - LAYER II: PALE BROWN (10YR 6/3) SAND
III - LAYER III: PALE BROWN (10YR 6/3) AND LIGHT YELLOWISH BROWN (10YR 6/4) SAND
IV - LAYER IV: BROWN (10YR 5/3) SILTY SAND


ST-145 NORTH WALL PROFILE
I
II
UNEXCAVATED
0 25 50 75 100 cm
KEY
I - LAYER I: BROWN (10YR 5/3) SILTY SAND
II - LAYER II: LIGHT GRAY (10YR 7/2) LITHIFIED SAND

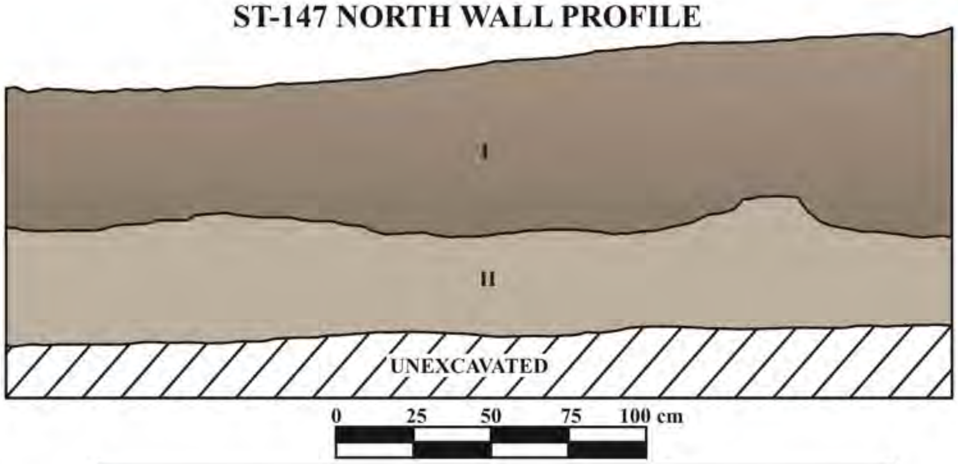
ST-146 NORTH WALL PROFILE



KEY

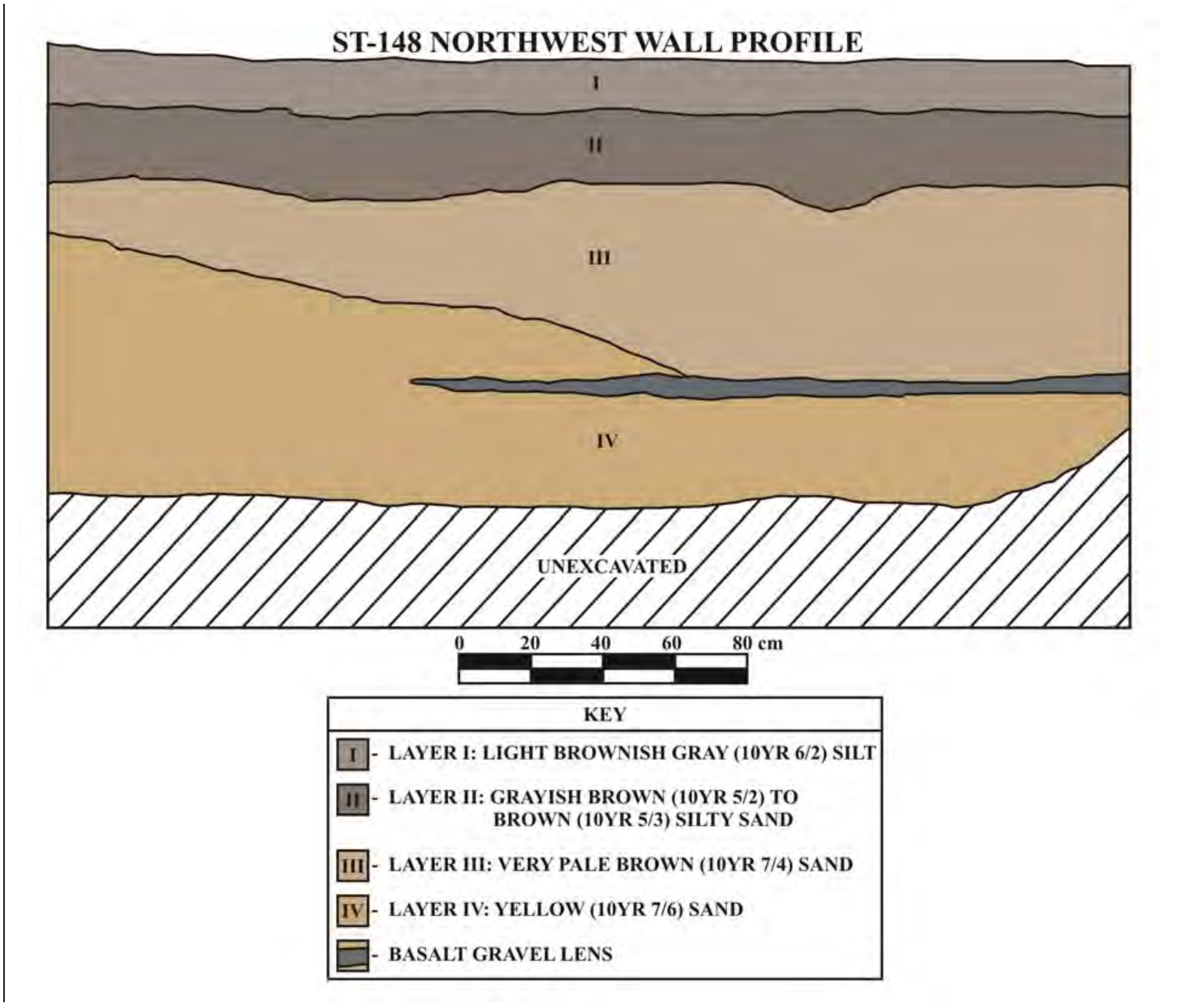
- I - LAYER I: BROWN (10YR 5/3) SILTY SAND
- II - LAYER II: VERY PALE BROWN (10YR 8/2) SAND
- III - LAYER III: YELLOW (10YR 7/6) LITHIFIED SAND

ST-147 NORTH WALL PROFILE



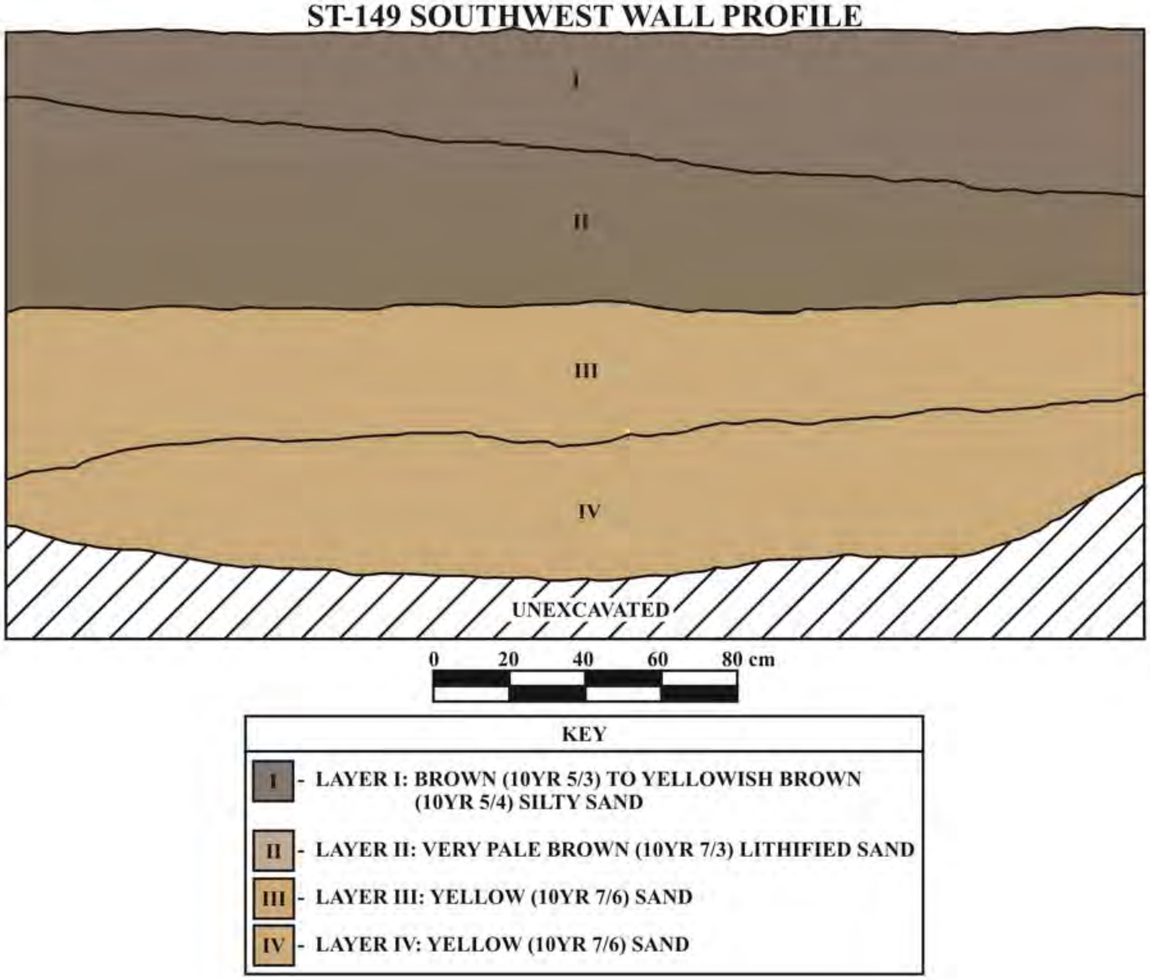
KEY

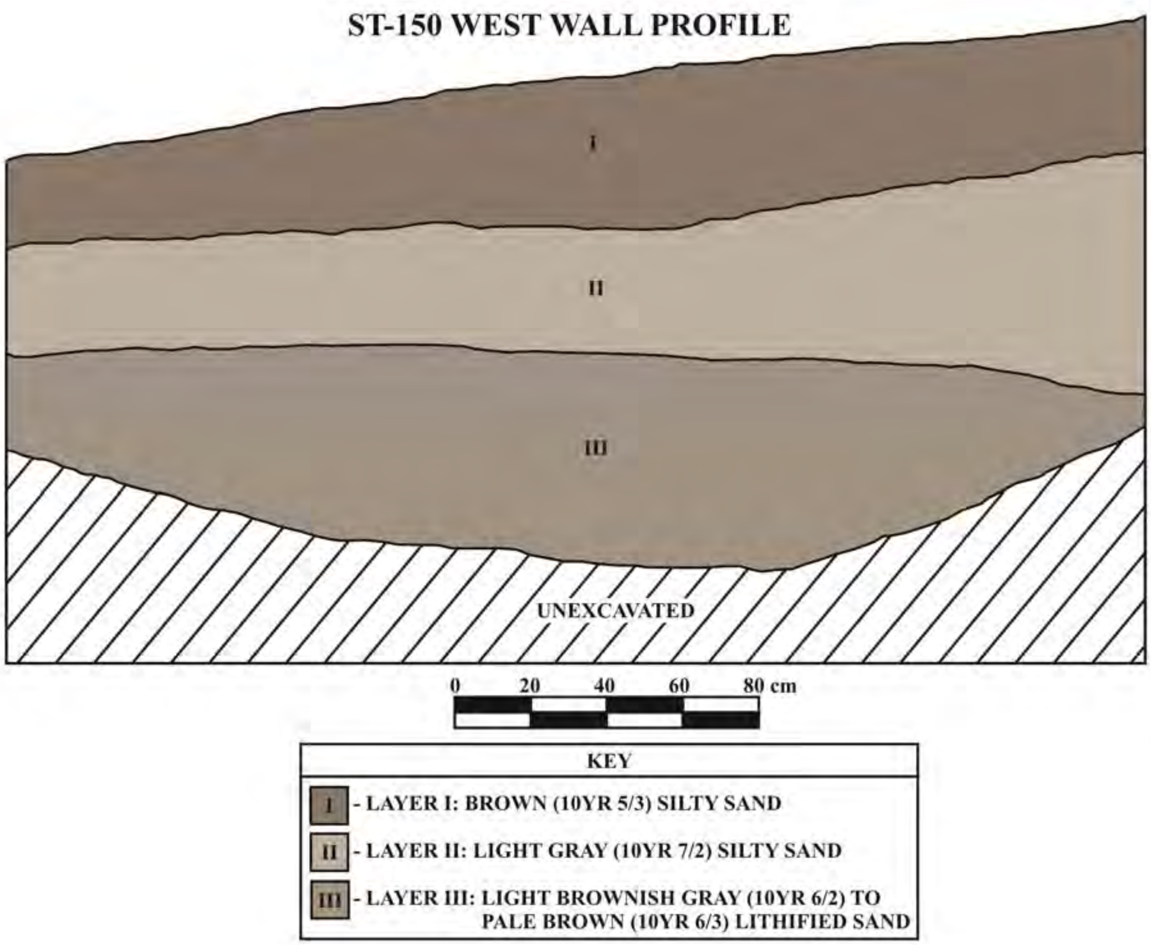
- I - LAYER I: PALE BROWN (10YR 6/3) AND BROWN (10YR 5/3) SILTY SAND
- II - LAYER II: LIGHT GRAY (10YR 7/2) SAND

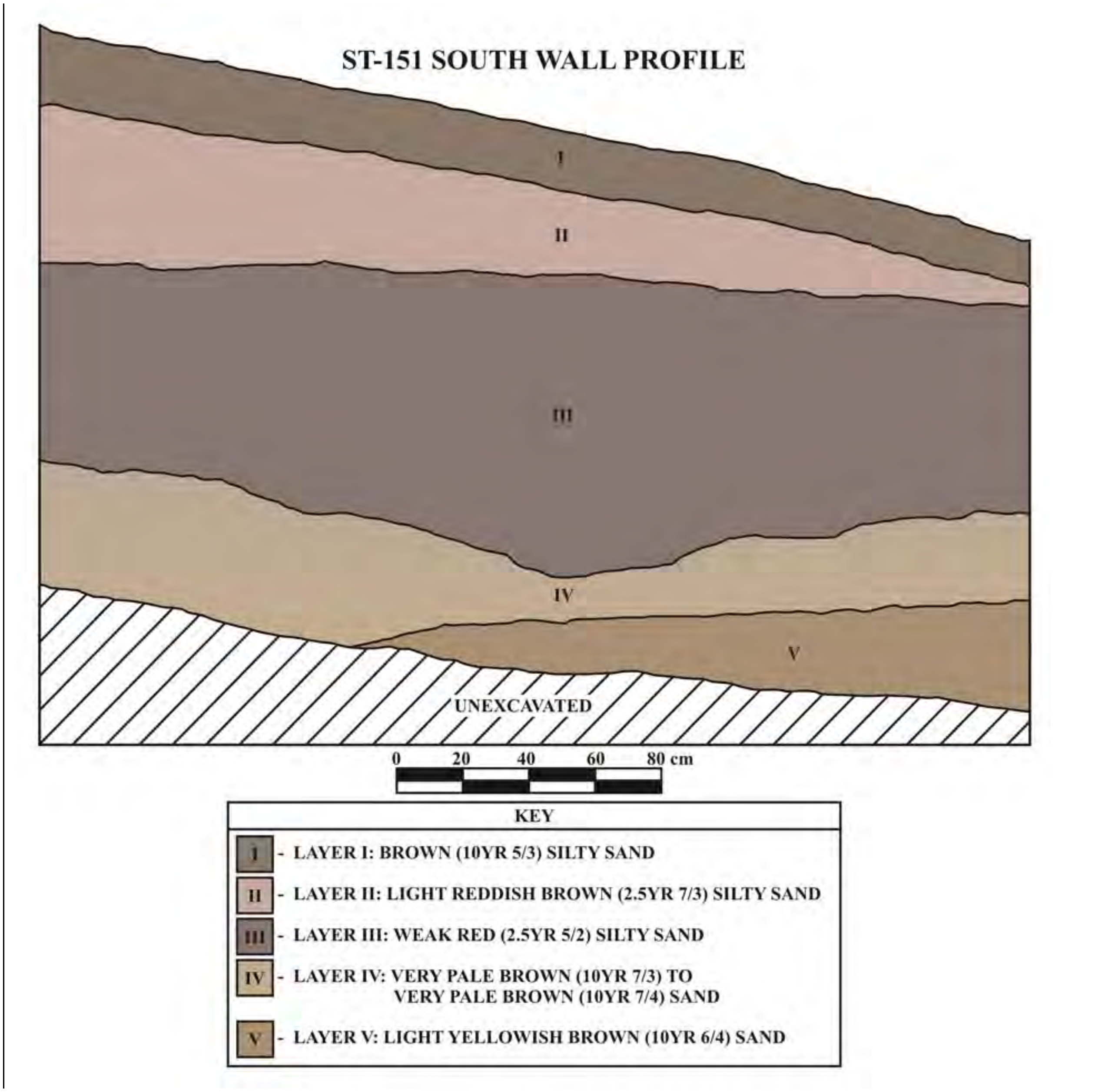


ST-148 NORTHWEST WALL PROFILE
I
II
III
IV
UNEXCAVATED
0 20 40 60 80 cm
KEY
I - LAYER I: LIGHT BROWNISH GRAY (10YR 6/2) SILT
II - LAYER II: GRAYISH BROWN (10YR 5/2) TO BROWN (10YR 5/3) SILTY SAND
III - LAYER III: VERY PALE BROWN (10YR 7/4) SAND
IV - LAYER IV: YELLOW (10YR 7/6) SAND
- BASALT GRAVEL LENS

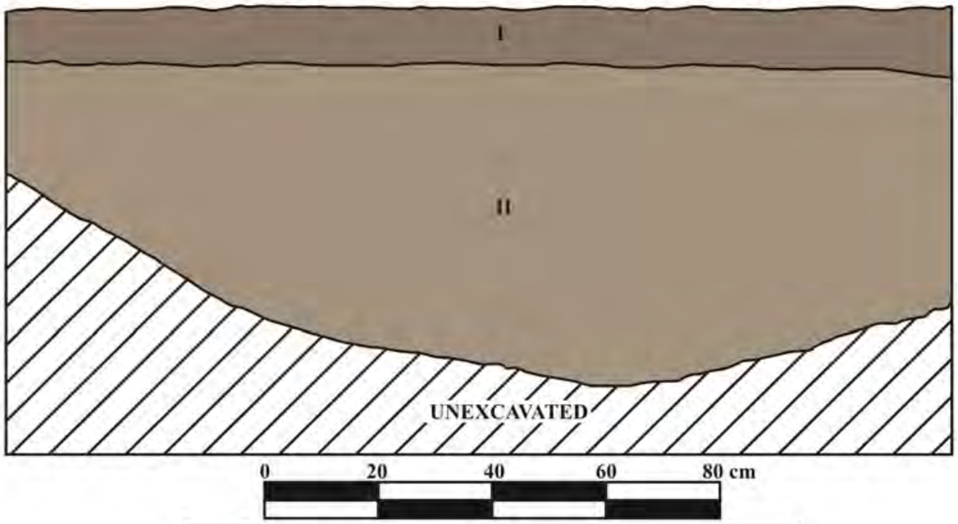
ST-149 SOUTHWEST WALL PROFILE




ST-150 WEST WALL PROFILE
I
II
III
UNEXCAVATED
0 20 40 60 80 cm
KEY
I - LAYER I: BROWN (10YR 5/3) SILTY SAND
II - LAYER II: LIGHT GRAY (10YR 7/2) SILTY SAND
III - LAYER III: LIGHT BROWNISH GRAY (10YR 6/2) TO PALE BROWN (10YR 6/3) LITHIFIED SAND


ST-151 SOUTH WALL PROFILE
I
II
III
IV
V
UNEXCAVATED
0
20
40
60
80 cm
KEY
I - LAYER I: BROWN (10YR 5/3) SILTY SAND
II - LAYER II: LIGHT REDDISH BROWN (2.5YR 7/3) SILTY SAND
III - LAYER III: WEAK RED (2.5YR 5/2) SILTY SAND
IV - LAYER IV: VERY PALE BROWN (10YR 7/3) TO VERY PALE BROWN (10YR 7/4) SAND
V - LAYER V: LIGHT YELLOWISH BROWN (10YR 6/4) SAND

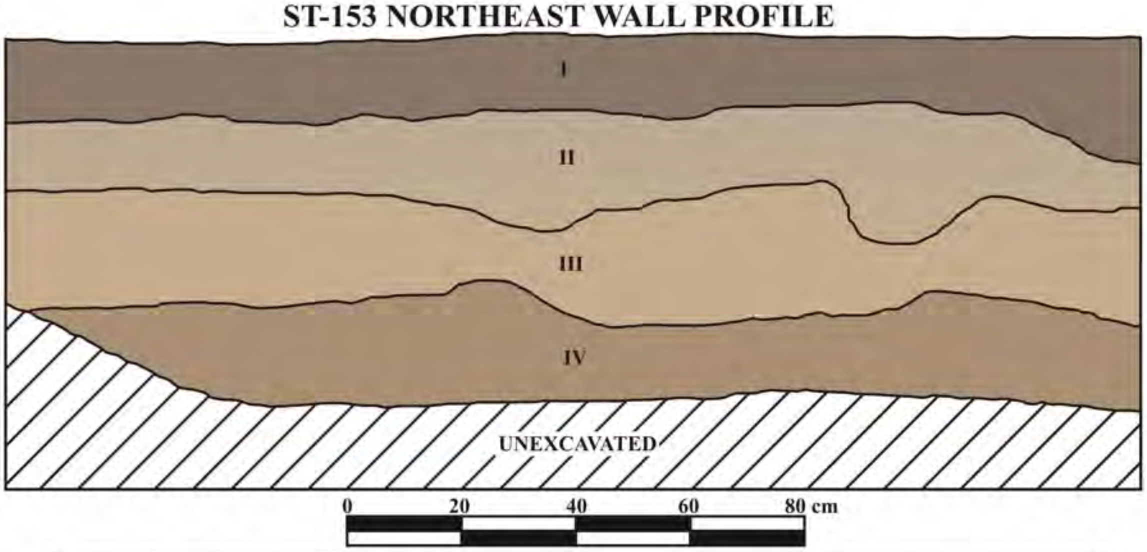
ST-152 NORTHEAST WALL PROFILE



KEY

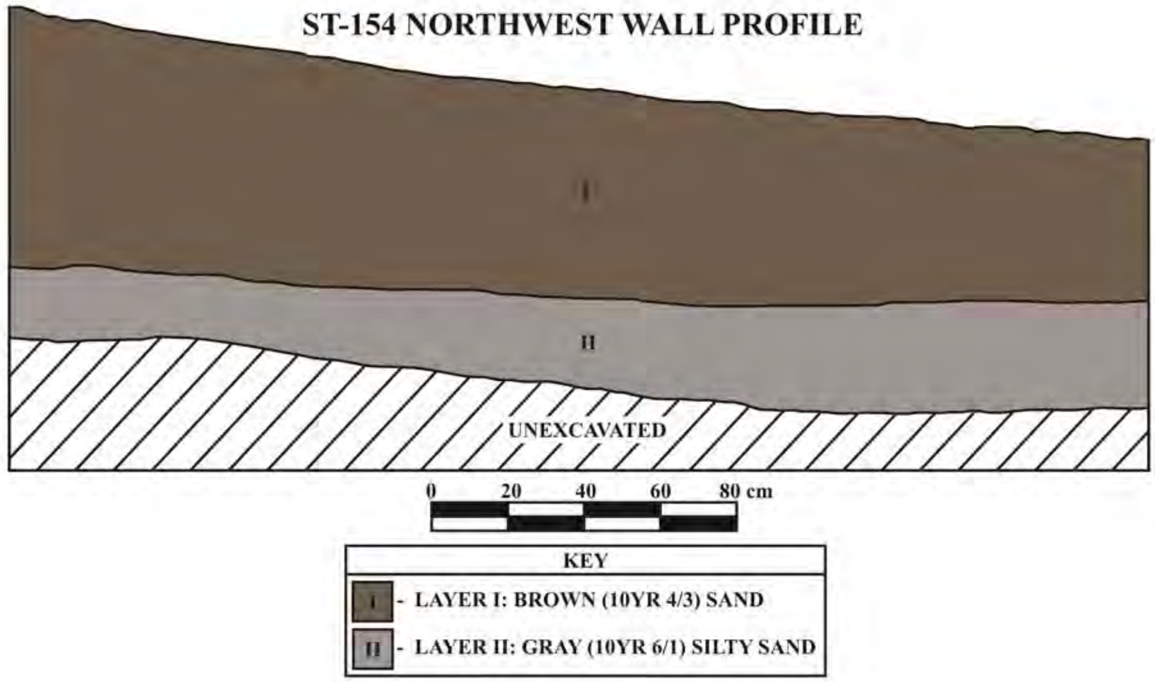
- I - LAYER I: BROWN (10YR 5/3) SILTY SAND
- II - LAYER II: PALE BROWN (10YR 6/3) LITHIFIED SAND

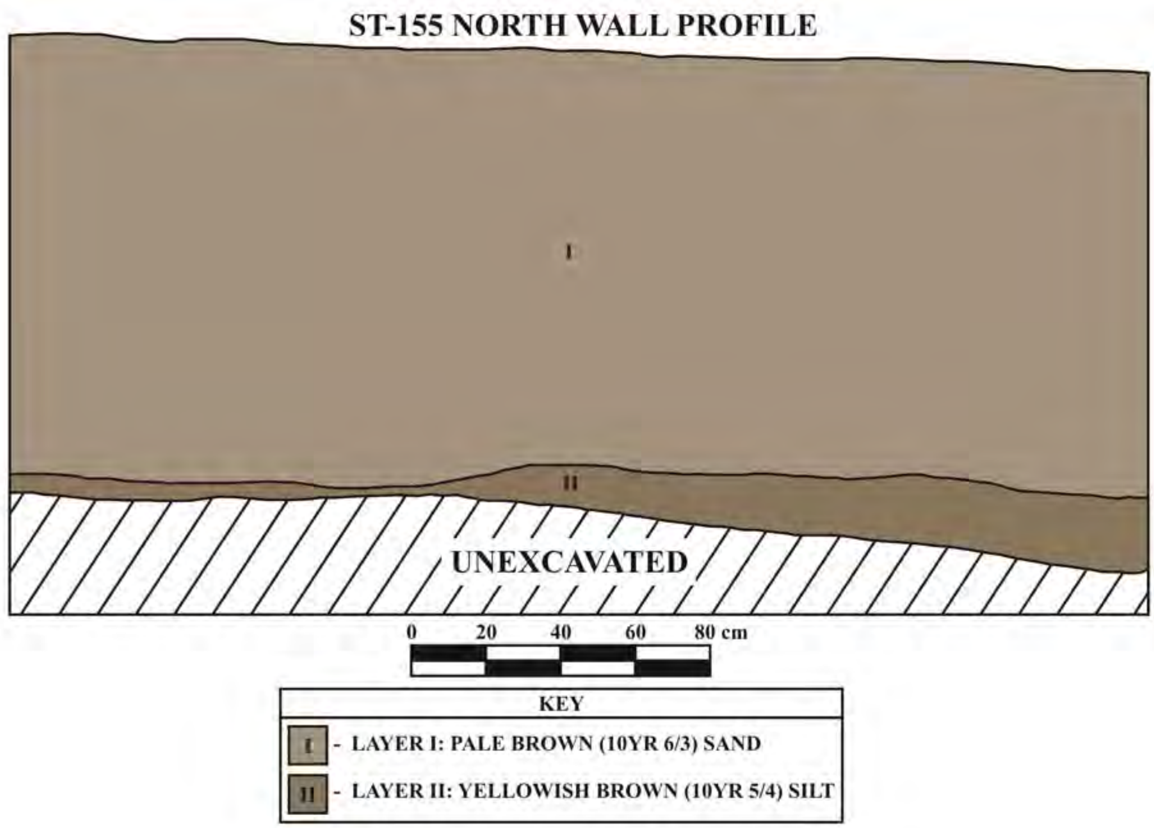
ST-153 NORTHEAST WALL PROFILE



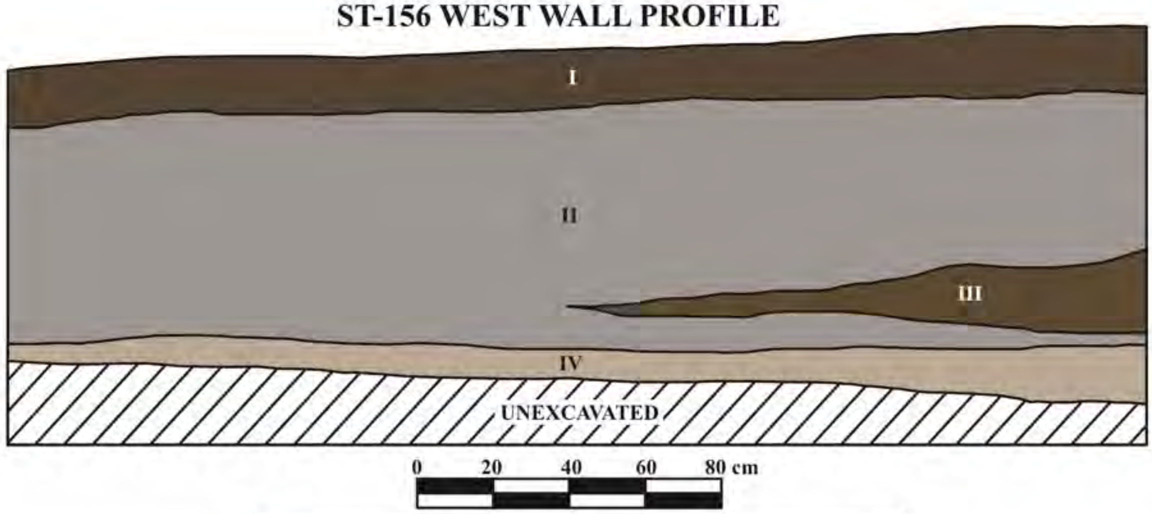
KEY

- I - LAYER I: BROWN (10YR 5/3) SILTY SAND
- II - LAYER II: VERY PALE BROWN (10YR 7/3) SILTY SAND AND VERY PALE BROWN (10YR 7/4) SAND
- III - LAYER III: VERY PALE BROWN (10YR 7/4) SAND
- IV - LAYER IV: LIGHT YELLOWISH BROWN (10YR 6/4) SAND


ST-154 NORTHWEST WALL PROFILE
I
II
UNEXCAVATED
0
20
40
60
80 cm
KEY
I - LAYER I: BROWN (10YR 4/3) SAND
II - LAYER II: GRAY (10YR 6/1) SILTY SAND


ST-155 NORTH WALL PROFILE
I
II
UNEXCAVATED
0
20
40
60
80 cm
KEY
I - LAYER I: PALE BROWN (10YR 6/3) SAND
II - LAYER II: YELLOWISH BROWN (10YR 5/4) SILT

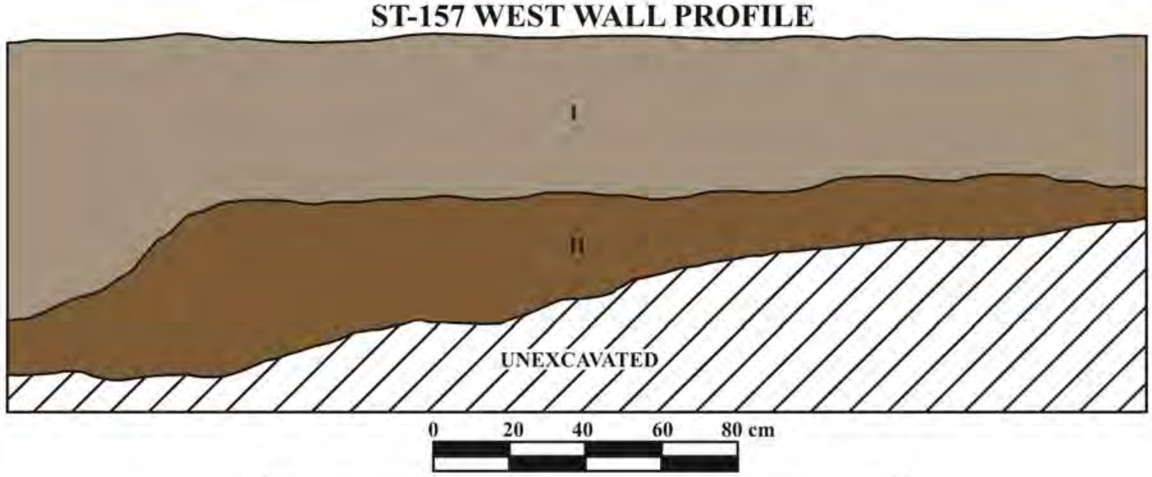
ST-156 WEST WALL PROFILE



KEY

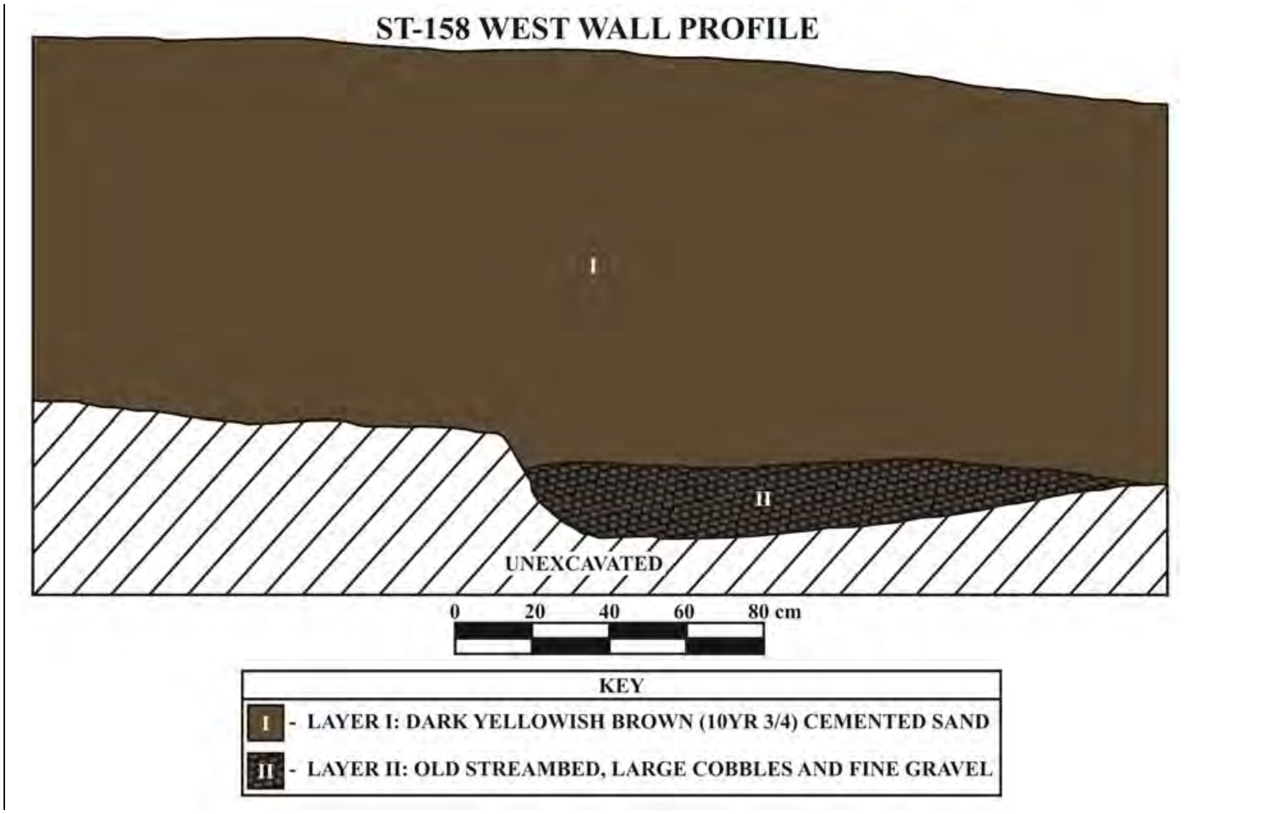
- I - LAYER I: BROWN (10YR 5/3) SILTY SAND
- II - LAYER II: GRAY (10YR 6/1) SILTY SAND
- III - LAYER III: DARK YELLOWISH BROWN (10YR 3/4) SAND
- IV - LAYER IV: VERY PALE BROWN (10YR 7/3) SILTY SAND

ST-157 WEST WALL PROFILE



KEY

- I - LAYER I: PALE BROWN (10YR 6/3) SILTY SAND
- II - LAYER II: DARK YELLOWISH BROWN (10YR 4/6) BASALT COBBLES AND SMALL BOULDERS

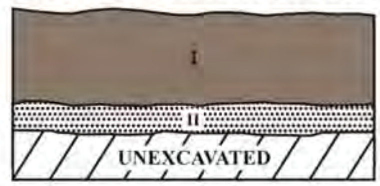

ST-158 WEST WALL PROFILE
I
II
UNEXCAVATED
0 20 40 60 80 cm
KEY
I - LAYER I: DARK YELLOWISH BROWN (10YR 3/4) CEMENTED SAND
II - LAYER II: OLD STREAMBED, LARGE COBBLES AND FINE GRAVEL

ST-159 SOUTHEAST WALL PROFILE

KEY

- I - LAYER I: BROWN (10YR 5/3) SAND
- II - LAYER II: VERY PALE BROWN (10YR 7/3) COMPACTED SAND

ST-160 SOUTHEAST WALL PROFILE



KEY

- I - LAYER I: BROWN (10YR 5/3) SAND
- II - LAYER II: BASALT COBBLES AND PEBBLES

ST-161 NORTHEAST WALL PROFILE

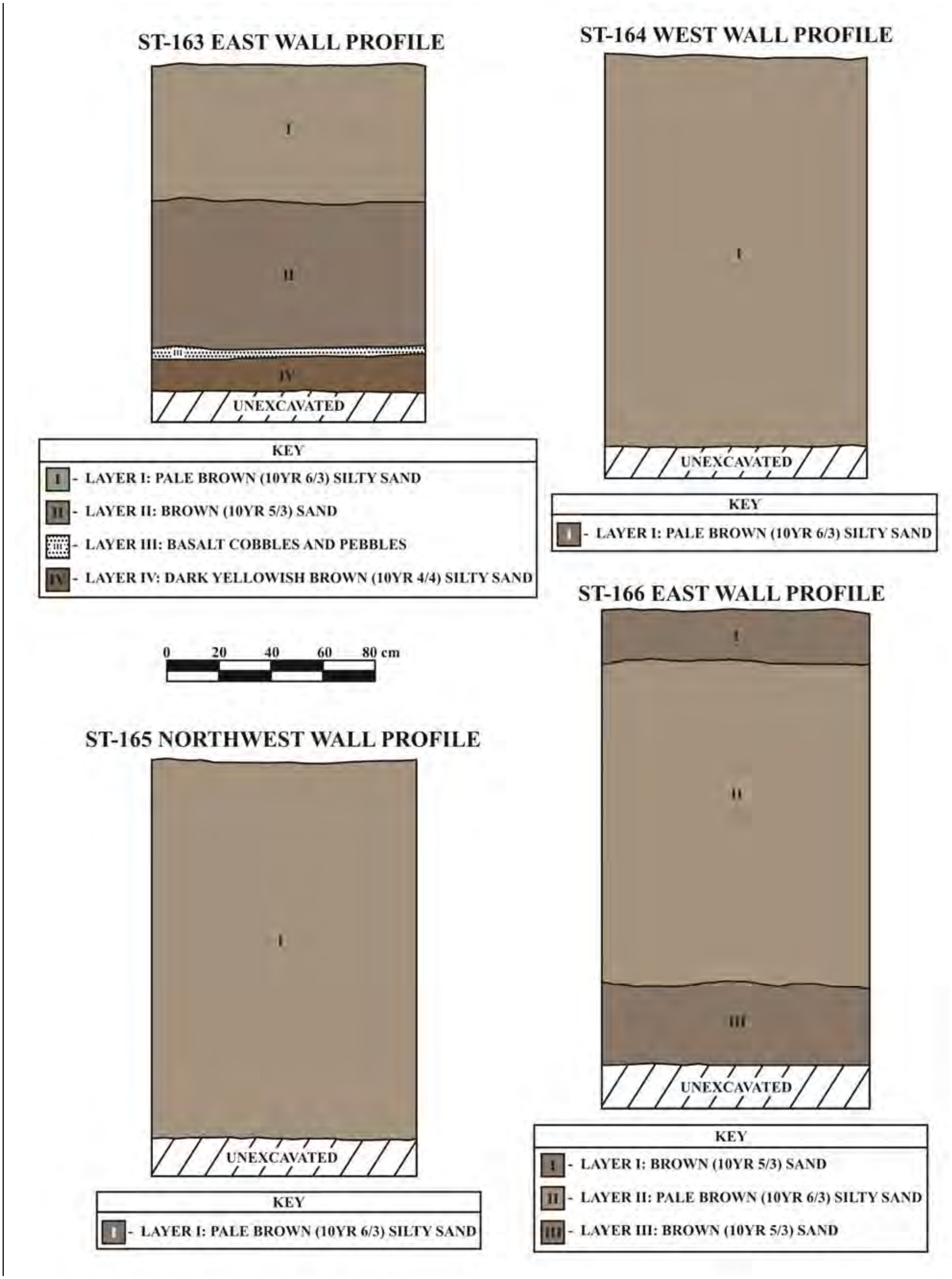
KEY

- I - LAYER I: PALE BROWN (10YR 6/3) SILTY SAND

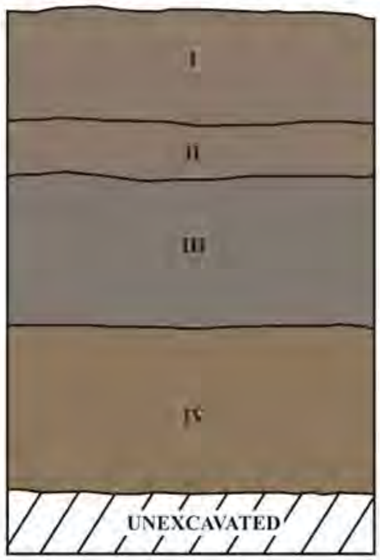
ST-162 EAST WALL PROFILE

KEY

- I - LAYER I: PALE BROWN (10YR 6/3) SILTY SAND
- II - LAYER II: BASALT COBBLES AND PEBBLES
- III - LAYER III: BROWN (10YR 5/3) SAND


ST-163 EAST WALL PROFILE
I
II
III
IV
UNEXCAVATED
KEY
I - LAYER I: PALE BROWN (10YR 6/3) SILTY SAND
II - LAYER II: BROWN (10YR 5/3) SAND
III - LAYER III: BASALT COBBLES AND PEBBLES
IV - LAYER IV: DARK YELLOWISH BROWN (10YR 4/4) SILTY SAND
0 20 40 60 80 cm
ST-164 WEST WALL PROFILE
I
UNEXCAVATED
KEY
I - LAYER I: PALE BROWN (10YR 6/3) SILTY SAND
ST-165 NORTHWEST WALL PROFILE
I
UNEXCAVATED
KEY
I - LAYER I: PALE BROWN (10YR 6/3) SILTY SAND
ST-166 EAST WALL PROFILE
I
II
III
UNEXCAVATED
KEY
I - LAYER I: BROWN (10YR 5/3) SAND
II - LAYER II: PALE BROWN (10YR 6/3) SILTY SAND
III - LAYER III: BROWN (10YR 5/3) SAND

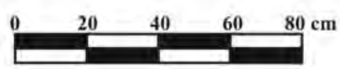
ST-167 SOUTHWEST WALL PROFILE



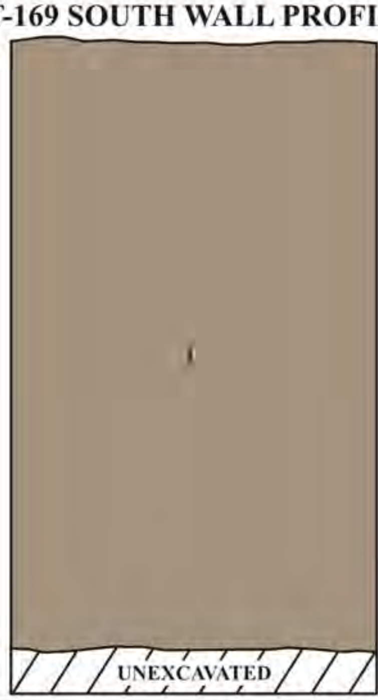
KEY
I - LAYER I: BROWN (10YR 5/3) SAND
II - LAYER II: BROWN (10YR 5/3) SAND
III - LAYER III: GRAYISH BROWN (10YR 5/2) SILTY SAND
IV - LAYER IV: YELLOWISH BROWN (10YR 5/4) SILT

ST-168 SOUTHWEST WALL PROFILE

KEY
I - LAYER I: PALE BROWN (10YR 6/3) SILTY SAND
II - LAYER II: LIGHT GRAY (10YR 7/2) SILTY SAND

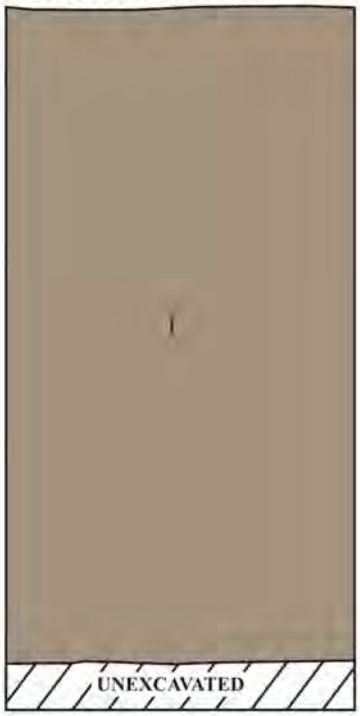


ST-169 SOUTH WALL PROFILE



KEY
I - LAYER I: PALE BROWN (10YR 6/3) SILTY SAND

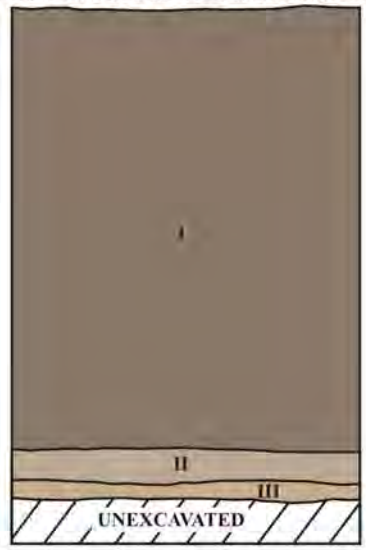
ST-170 NORTHEAST WALL PROFILE



KEY

I - LAYER I: PALE BROWN (10YR 6/3) SILTY SAND

ST-171 NORTH WALL PROFILE

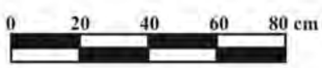


KEY

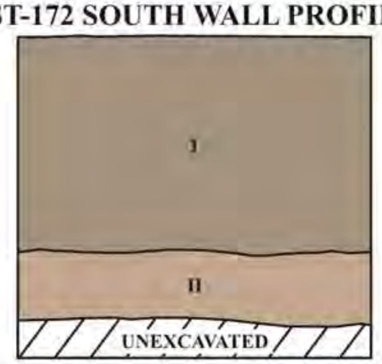
I - LAYER I: PALE BROWN (10YR 6/3) SILTY SAND

II - LAYER II: VERY PALE BROWN (10YR 7/3) CONCRETED SAND

III - LAYER III: VERY PALE BROWN (10YR 7/4) SAND



ST-172 SOUTH WALL PROFILE



KEY

I - LAYER I: PALE BROWN (10YR 6/3) SILTY SAND

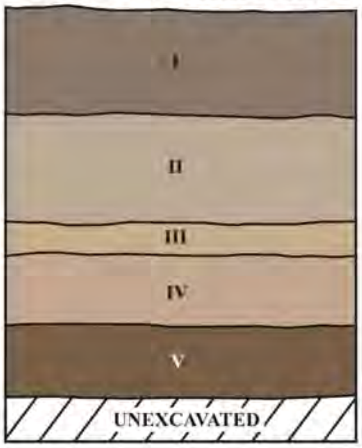
II - LAYER II: PINK (7.5YR 7/4) SAND

ST-173 SOUTHWEST WALL PROFILE

KEY

I - LAYER I: PALE BROWN (10YR 6/3) SILTY SAND

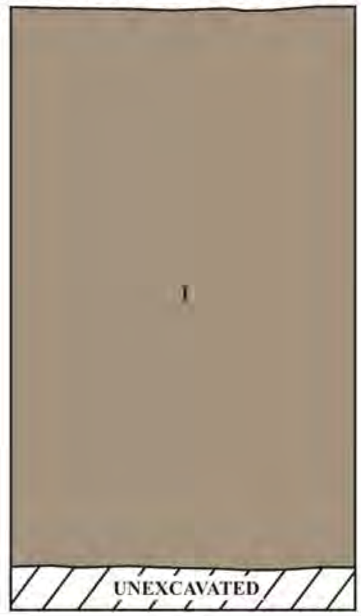
ST-174 NORTH WALL PROFILE



KEY

- I - LAYER I: BROWN (10YR 5/3) SILTY SAND
- II - LAYER II: VERY PALE BROWN (10YR 7/3) CONCRETED SAND
- III - LAYER III: VERY PALE BROWN (10YR 7/4) SAND
- IV - LAYER IV: PINK (7.5YR 7/4) SAND
- V - LAYER V: DARK YELLOWISH BROWN (10YR 4/4) SILT

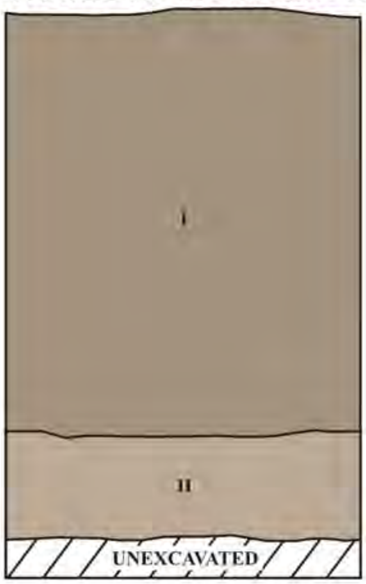
ST-175 WEST WALL PROFILE



KEY

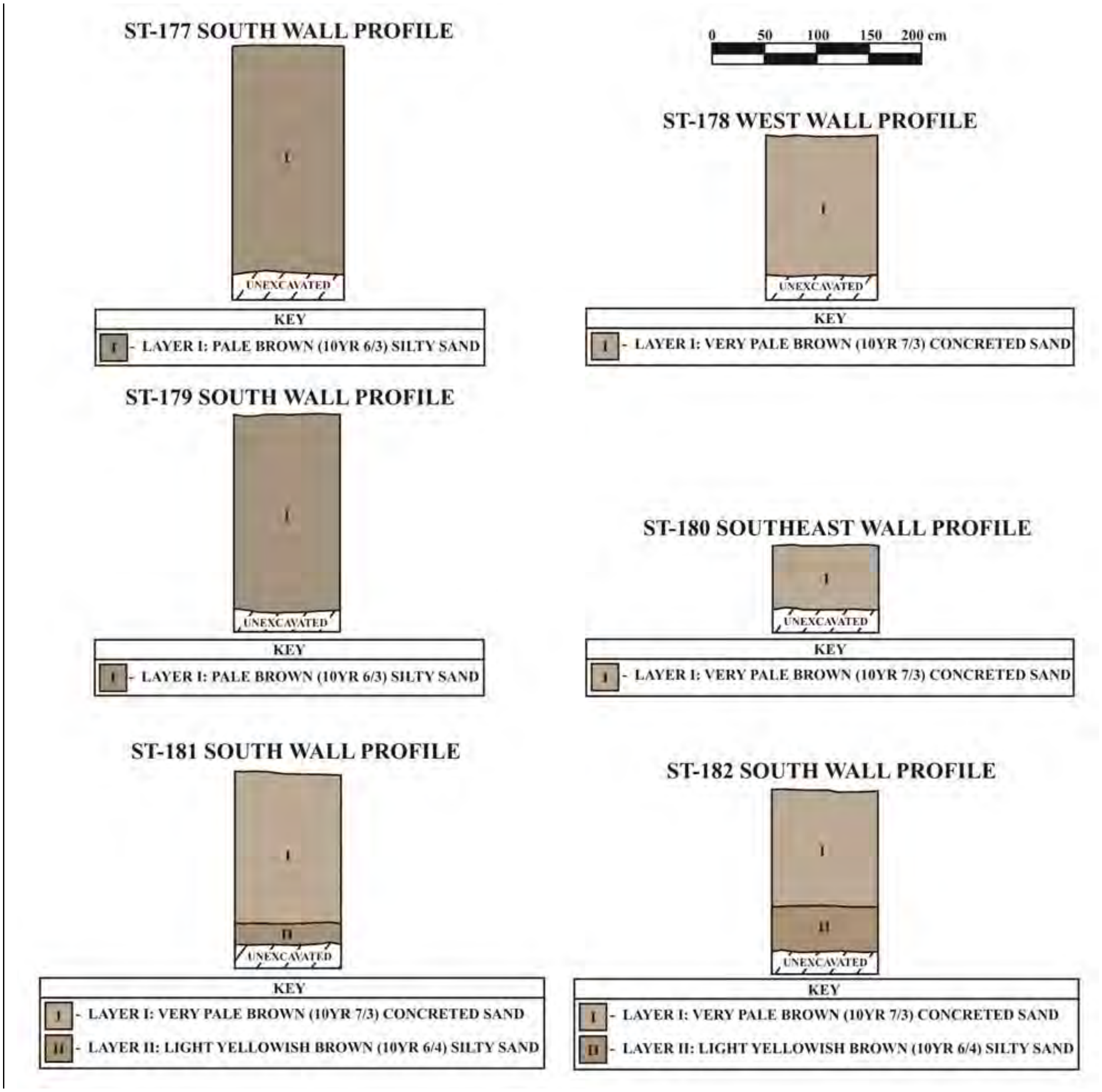
- I - LAYER I: PALE BROWN (10YR 6/3) SILTY SAND

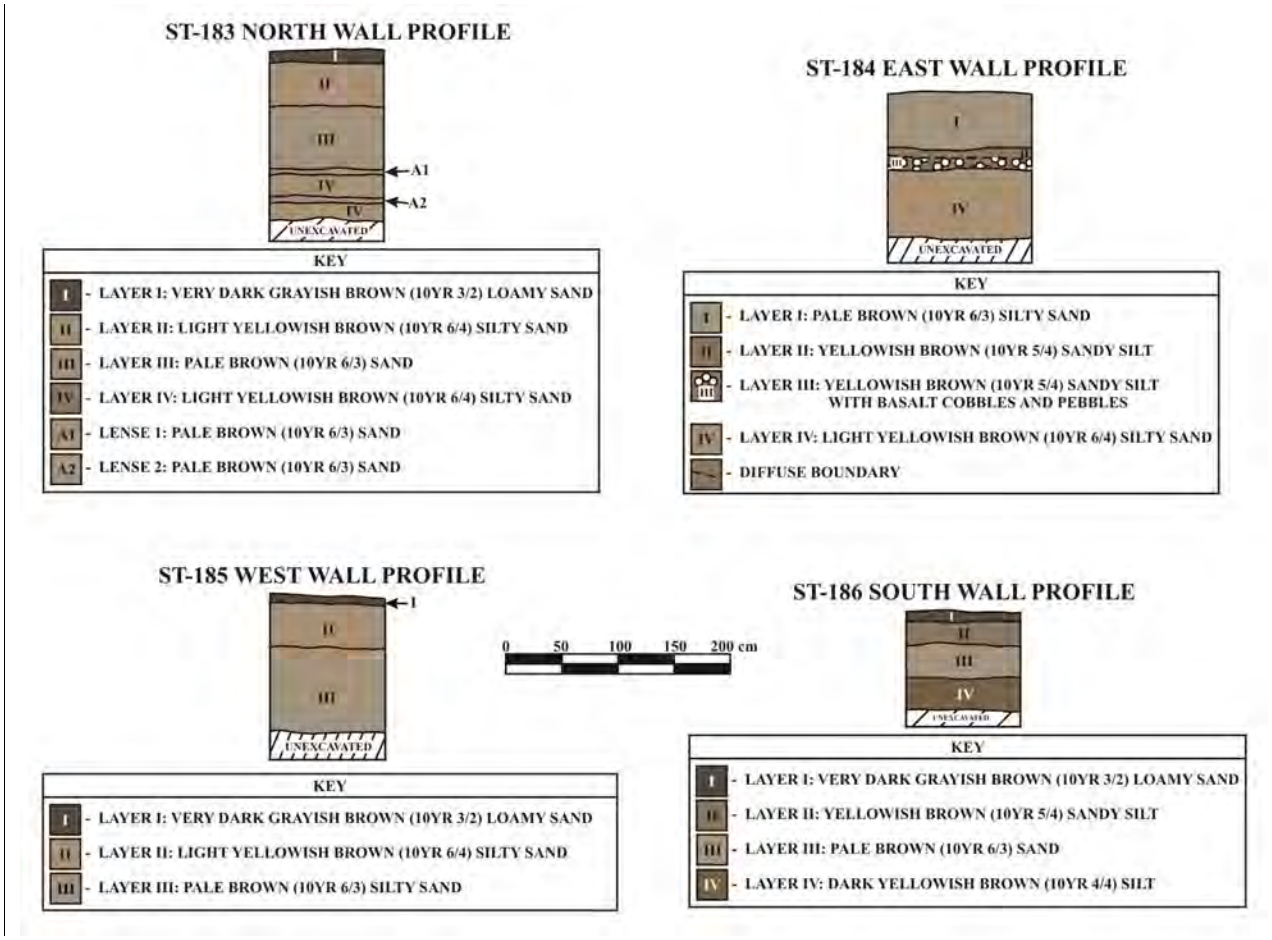
ST-176 SOUTH WALL PROFILE



KEY

- I - LAYER I: PALE BROWN (10YR 6/3) SILTY SAND
- II - LAYER II: VERY PALE BROWN (10YR 7/3) CONCRETED SAND


ST-177 SOUTH WALL PROFILE
I
UNEXCAVATED
KEY
I - LAYER I: PALE BROWN (10YR 6/3) SILTY SAND
0 50 100 150 200 cm
ST-178 WEST WALL PROFILE
I
UNEXCAVATED
KEY
I - LAYER I: VERY PALE BROWN (10YR 7/3) CONCRETED SAND
ST-179 SOUTH WALL PROFILE
I
UNEXCAVATED
KEY
I - LAYER I: PALE BROWN (10YR 6/3) SILTY SAND
ST-180 SOUTHEAST WALL PROFILE
I
UNEXCAVATED
KEY
I - LAYER I: VERY PALE BROWN (10YR 7/3) CONCRETED SAND
ST-181 SOUTH WALL PROFILE
I
II
UNEXCAVATED
KEY
I - LAYER I: VERY PALE BROWN (10YR 7/3) CONCRETED SAND
II - LAYER II: LIGHT YELLOWISH BROWN (10YR 6/4) SILTY SAND
ST-182 SOUTH WALL PROFILE
I
II
UNEXCAVATED
KEY
I - LAYER I: VERY PALE BROWN (10YR 7/3) CONCRETED SAND
II - LAYER II: LIGHT YELLOWISH BROWN (10YR 6/4) SILTY SAND

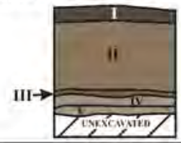

ST-183 NORTH WALL PROFILE
I
II
III
IV
IV
A1
A2
UNEXCAVATED
KEY
I - LAYER I: VERY DARK GRAYISH BROWN (10YR 3/2) LOAMY SAND
II - LAYER II: LIGHT YELLOWISH BROWN (10YR 6/4) SILTY SAND
III - LAYER III: PALE BROWN (10YR 6/3) SAND
IV - LAYER IV: LIGHT YELLOWISH BROWN (10YR 6/4) SILTY SAND
A1 - LENSE 1: PALE BROWN (10YR 6/3) SAND
A2 - LENSE 2: PALE BROWN (10YR 6/3) SAND
ST-184 EAST WALL PROFILE
I
III
IV
UNEXCAVATED
KEY
I - LAYER I: PALE BROWN (10YR 6/3) SILTY SAND
II - LAYER II: YELLOWISH BROWN (10YR 5/4) SANDY SILT
III - LAYER III: YELLOWISH BROWN (10YR 5/4) SANDY SILT WITH BASALT COBBLES AND PEBBLES
IV - LAYER IV: LIGHT YELLOWISH BROWN (10YR 6/4) SILTY SAND
- DIFFUSE BOUNDARY
ST-185 WEST WALL PROFILE
I
II
III
UNEXCAVATED
KEY
I - LAYER I: VERY DARK GRAYISH BROWN (10YR 3/2) LOAMY SAND
II - LAYER II: LIGHT YELLOWISH BROWN (10YR 6/4) SILTY SAND
III - LAYER III: PALE BROWN (10YR 6/3) SILTY SAND
0 50 100 150 200 cm
ST-186 SOUTH WALL PROFILE
I
II
III
IV
UNEXCAVATED
KEY
I - LAYER I: VERY DARK GRAYISH BROWN (10YR 3/2) LOAMY SAND
II - LAYER II: YELLOWISH BROWN (10YR 5/4) SANDY SILT
III - LAYER III: PALE BROWN (10YR 6/3) SAND
IV - LAYER IV: DARK YELLOWISH BROWN (10YR 4/4) SILT

ST-187 SOUTH WALL PROFILE

KEY

- I - LAYER I: VERY DARK GRAYISH BROWN (10YR 3/2) LOAMY SAND
- II - LAYER II: BROWN (10YR 4/3) SANDY SILT
- III - LAYER III: YELLOWISH BROWN (10YR 5/4) SANDY SILT
- IV - LAYER IV: LIGHT YELLOWISH BROWN (10YR 6/4) SILTY SAND

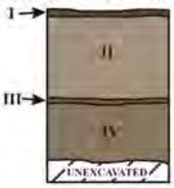
ST-188 SOUTH WALL PROFILE



KEY

- I - LAYER I: VERY DARK GRAYISH BROWN (10YR 3/2) LOAMY SAND
- II - LAYER II: YELLOWISH BROWN (10YR 5/4) SANDY SILT
- III - LAYER III: DARK GRAYISH BROWN (10YR 4/2) LOAMY SAND
- IV - LAYER IV: PALE BROWN (10YR 6/3) SAND
- V - LAYER V: LIGHT YELLOWISH BROWN (10YR 6/4) SILTY SAND

ST-189 SOUTHEAST WALL PROFILE



KEY

- I - LAYER I: VERY DARK GRAYISH BROWN (10YR 3/2) LOAMY SAND
- II - LAYER II: PALE BROWN (10YR 6/3) SILTY SAND
- III - LAYER III: DARK GRAYISH BROWN (10YR 4/2) LOAMY SAND
- IV - LAYER IV: YELLOWISH BROWN (10YR 5/4) SANDY SILT

ST-190 NORTH WALL PROFILE

KEY

- I - LAYER I: VERY DARK GRAYISH BROWN (10YR 3/2) LOAMY SAND
- II - LAYER II: PALE BROWN (10YR 6/3) SILT

ST-192 NORTH WALL PROFILE

KEY

- I - LAYER I: VERY DARK GRAYISH BROWN (10YR 3/2) LOAMY SAND
- II - LAYER II: PALE BROWN (10YR 6/3) SILT WITH BASALT COBBLES
- III - LAYER III: YELLOWISH BROWN (10YR 5/4) SILT WITH BASALT PEBBLES
- BASALT ROCKS
- BASALT PEBBLE POCKETS

ST-191 NORTHEAST WALL PROFILE

KEY

- I - LAYER I: PALE BROWN (10YR 6/3) SILTY SAND

ST-194 SOUTHWEST WALL PROFILE

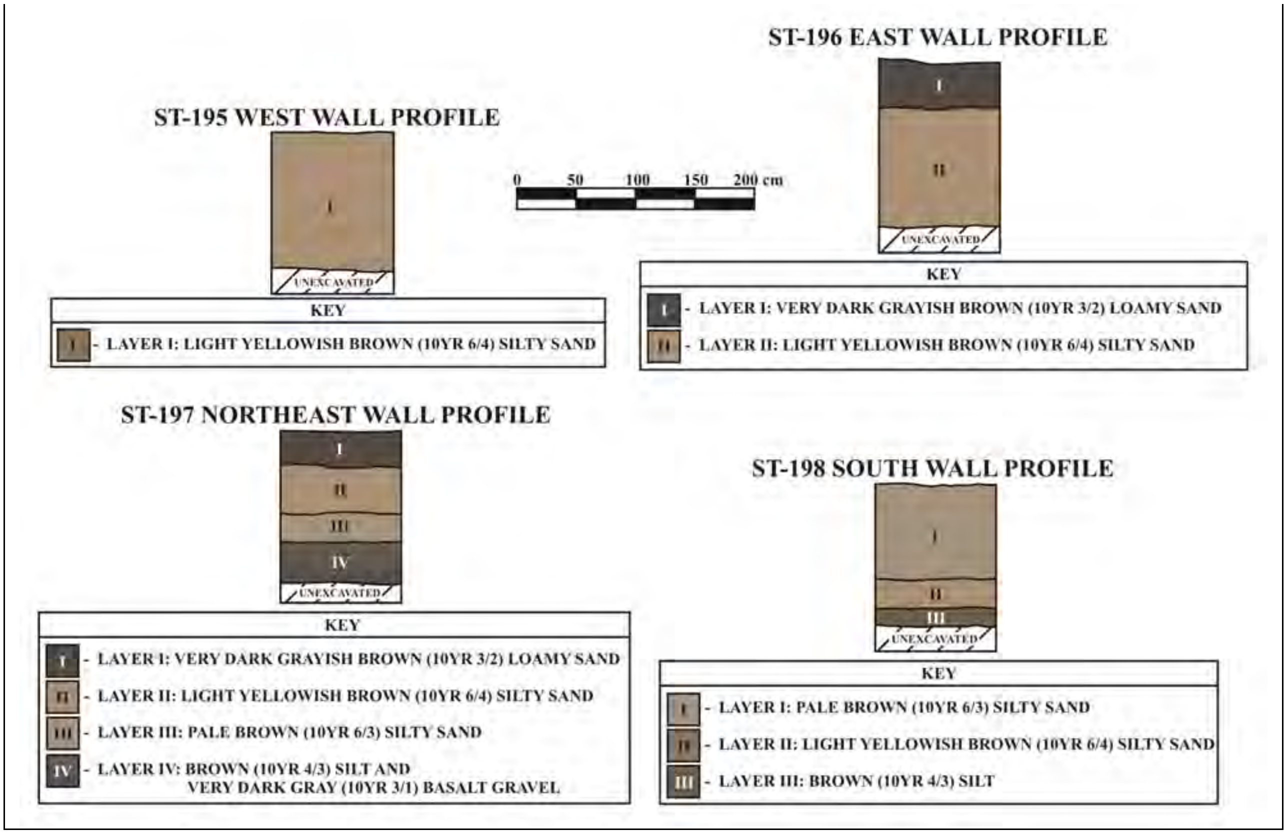
KEY

- I - LAYER I: VERY DARK GRAYISH BROWN (10YR 3/2) LOAMY SAND
- II - LAYER II: YELLOWISH BROWN (10YR 5/4) SANDY SILT WITH BASALT COBBLES AND PEBBLES
- III - LAYER III: PALE BROWN (10YR 6/3) SILTY SAND
- IV - LAYER IV: DARK YELLOWISH BROWN (10YR 4/4) SILT

ST-193 SOUTH WALL PROFILE

KEY

- I - LAYER I: VERY DARK GRAYISH BROWN (10YR 3/2) LOAMY SAND
- II - LAYER II: LIGHT YELLOWISH BROWN (10YR 6/4) SILTY SAND


ST-195 WEST WALL PROFILE
I
UNEXCAVATED
KEY
I - LAYER I: LIGHT YELLOWISH BROWN (10YR 6/4) SILTY SAND
0 50 100 150 200 cm
ST-196 EAST WALL PROFILE
I
II
UNEXCAVATED
KEY
I - LAYER I: VERY DARK GRAYISH BROWN (10YR 3/2) LOAMY SAND
II - LAYER II: LIGHT YELLOWISH BROWN (10YR 6/4) SILTY SAND
ST-197 NORTHEAST WALL PROFILE
I
II
III
IV
UNEXCAVATED
KEY
I - LAYER I: VERY DARK GRAYISH BROWN (10YR 3/2) LOAMY SAND
II - LAYER II: LIGHT YELLOWISH BROWN (10YR 6/4) SILTY SAND
III - LAYER III: PALE BROWN (10YR 6/3) SILTY SAND
IV - LAYER IV: BROWN (10YR 4/3) SILT AND
VERY DARK GRAY (10YR 3/1) BASALT GRAVEL
ST-198 SOUTH WALL PROFILE
I
II
III
UNEXCAVATED
KEY
I - LAYER I: PALE BROWN (10YR 6/3) SILTY SAND
II - LAYER II: LIGHT YELLOWISH BROWN (10YR 6/4) SILTY SAND
III - LAYER III: BROWN (10YR 4/3) SILT

ST-199 EAST WALL PROFILE

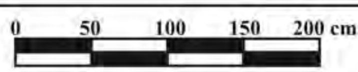
KEY

- I - LAYER I: PALE BROWN (10YR 6/3) SILTY SAND
- II - LAYER II: BROWN (10YR 4/3) SILT

ST-200 SOUTHEAST WALL PROFILE

KEY

- I - LAYER I: VERY DARK GRAYISH BROWN (10YR 3/2) LOAMY SAND
- II - LAYER II: PALE BROWN (10YR 6/3) SAND
- III - LAYER III: LIGHT YELLOWISH BROWN (10YR 6/4) SILTY SAND



APPENDIX C: SITE 50-50-10-6578 *IMU* RADIOCARBON DATA

BETA

BETA ANALYTIC INC.

DR. M.A. TAMERS and MR. D.G. HOOD

4985 S.W. 74 COURT
MIAMI, FLORIDA, USA 33155
PH: 305-667-5167 FAX:305-663-0964
beta@radiocarbon.com

REPORT OF RADIOCARBON DATING ANALYSES

Dr. Robert L. Spear

Report Date: 10/8/2008

Scientific Consultant Services, Inc.

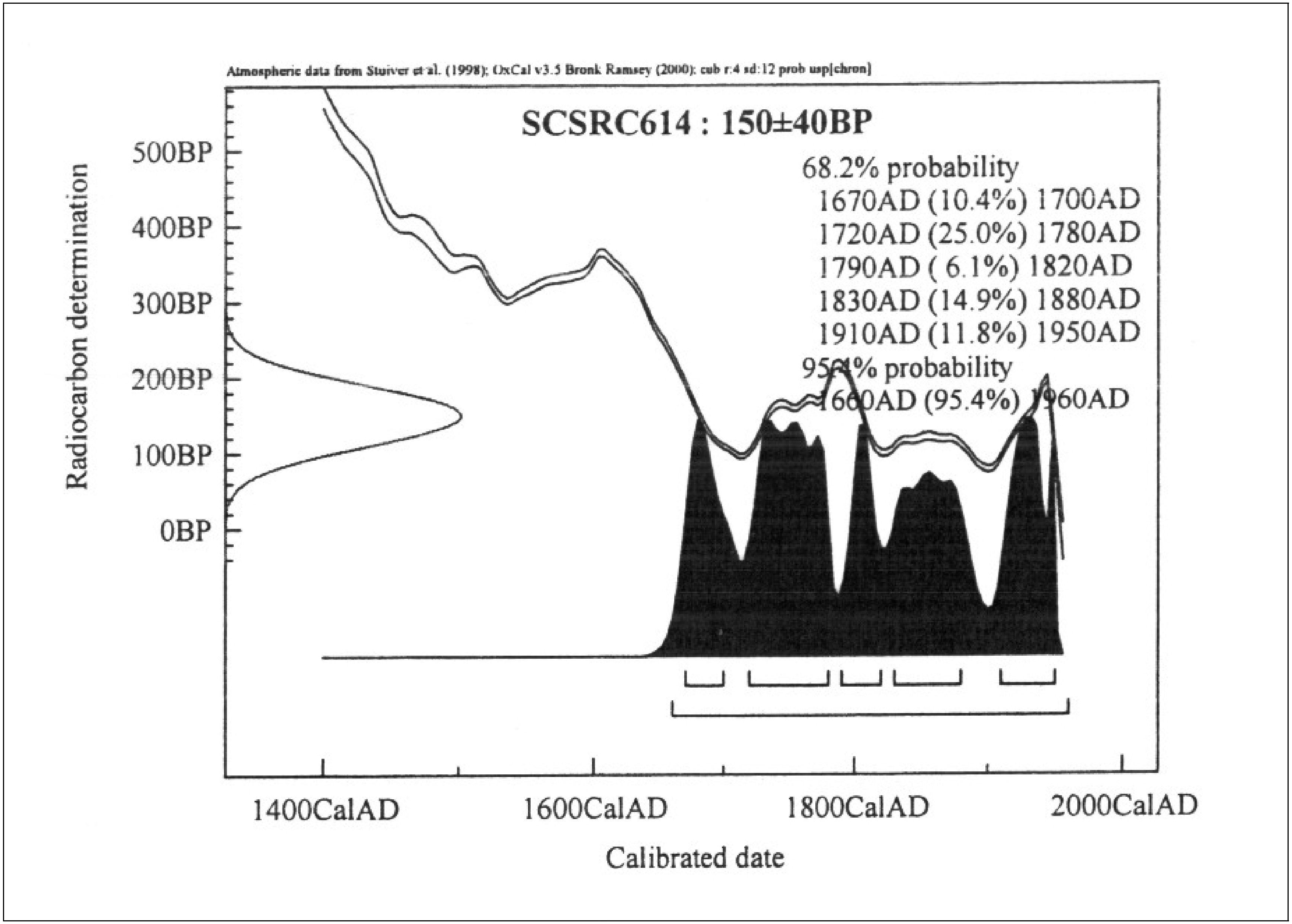
Material Received: 9/16/2008

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 249137	160 +/- 40 BP	-25.5 o/oo	150 +/- 40 BP

SAMPLE : SCSRC614
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 1660 to 1960 (Cal BP 290 to 0)

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.


Atmospheric data from Stuiver et al. (1998); OxCal v3.5 Bronk Ramsey (2000); cub r:4 sd:12 prob usp[chron]
SCSRC614 : 150±40BP
68.2% probability
1670AD (10.4%) 1700AD
1720AD (25.0%) 1780AD
1790AD (6.1%) 1820AD
1830AD (14.9%) 1880AD
1910AD (11.8%) 1950AD
95.4% probability
1660AD (95.4%) 1960AD
Radiocarbon determination
500BP
400BP
300BP
200BP
100BP
0BP
1400CalAD
1600CalAD
1800CalAD
2000CalAD
Calibrated date

APPENDIX D: PHOTOGRAPH OF ISOLATED BASALT CORE

D1

APPENDIX E: CONSULTATION

Mahalo. A sincere mahalo to all those who participated in and contributed to this important community planning effort. Your insights were terrific and we look forward to your continued participation as we move forward with our planning.

SHAPING OUR COMMUNITY'S FUTURE.

COMMUNITY PARTICIPANTS (AS OF SUMMER OF 2005)

Jim Berling
Raymond Hew
Blaine Kobayashi
Gilbert Coloma-Agaran
Glenn Yamasaki
Curtis Tom
Dan Crockford
Alvin T. Imada
Scott Sakakihara
Zandra Amaral
Dr. Barry Shitamoto
Sgt. Mitchell Pellazar
Keith Regan
Michele Yoshimura
Rob Parsons
John Summers
Glenn Ueno
Milton Arakawa
Valeriano Martin
Sydney Kikuchi
Michael Foley
Alice L. Lee
Eric Barstan
Dave DeLeon
Agnes Hayashi
Kathleen Ross Aoki
Herman Andaya
Ed & Denise Vogel
Jamie Tavares

Roy Katsuda
Robyne Nishida Nakao
Tony Krieg
Garret Hew
Willie Kennison
Rev. Dexter Teruya
Stan Gima
Bob Takitani
Leilani Pulmano
Michele M. Hamada
Dick Mayer
Mark Sheenan
Russel Gushi
Mark King
Jo-Ann Ridao
Lloyd Lee
Mr. & Mrs. Larry Anderson
Steve Kikuchi
Sharon Suzuki
Councilmember Charmaine Tavares
Councilmember Joe Pontanilla
Leslie Wilkins
Jeanne Skog
Meleana Higgins
Tom Blackburn-Rodrigues
Glayds Baisa
Sandy Baz
Neal Shinyama
Randy Yamanuha

Lani Correa
Steve Miller
Leiane Paci
Darren Suzuki
Dave Gleason
Wesley Lo
Lucienne deNaie
David Schenk
Claire Miyasato
Leatrice M. Kauahi
Kaimo Muhlestein
Boyd Mossman
Henry Spencer
Brian McCafferty
Susan Moikeha
Suzanne Freitas
Ed Reinhardt
Dr. Kevin Omuro
Wally & Darlene Rogers
Kay Fukumoto
Stan Franco
George Paresa
Cielo Molina
Ken Nomura
Noe Deleon
Jacob Kellow
Valerie Monson
Amanda Cowan
Daryl Atay

Mark Tracy
Mike & Monika Irwin
Yvette Kahauolopua
Jim Dodd
Reid Kawabata
Steph Ohigashi
Bill Ruidas
Colleen V. Cluney
Dana Naone Hall
Florence Nakama
Joan Martin
Kallie Keith
Kevin Gillies
Les Kuloloio
Mary Baga
Melissa Prince
Mike Victorino
Mr. & Mrs. Eric Umetsu
Patricia Rouse
Rosie Etoquilla
Wayne Hikiji
Jacqueline Perreira
Robyn Cabral
Hartmut "Hoppy" Bielous
Katrina Madamba
Lynne Gilroy
Rick Medina

A&B PROPERTIES, INC.
A SUBSIDIARY OF ALEXANDER & BALDWIN, INC.

Meredith Ching, Vice President
Grant Chun, Vice President
Clyde Murashige, Vice President
Charlie Buckingham, Manager, Leasing
Jeff Faulkner, Manager, Construction
Linda Howe, Manager, Community Relations
Hideo Kawahara, Manager, Engineering & Construction
Jason Koga, Manager, Land & Environmental
Paul Oshiro, Manager, Government Relations
Melanie Kaimiola, Planning Technician
Sharon Shimabukuro, Administrative Assistant
Mercer "Chubby" Vicens, Vicens Entitlement Group

PBR HAWAII

Tom Witten, President
Grant Murakami, Senior Associate
Scott Abrigo, Planner
Lacey Kazama, Planner
Ryan Gonzalez, Graphic Designer
Chris Chavez, Graphic Designer

For more information, please contact Sharon Shimabukuro at: **sshimabukuro@abprop.com**

WAI'ALE

"Growth in Central Maui is due in large part to the fact that our kids grow up, they get educated, they have an opportunity to live and work on Maui, and they choose to do so. The challenge we face together is ensuring that our community can accommodate for this growth in a manner that will make Maui an even better place to live. That's what Wai'ale is all about."

- GRANT CHUN, A&B PROPERTIES

COMMUNITY VISION STATEMENT

Create a socially integrated community with a unique sense of identity and character, capitalizing on its location and natural features.

As an extension of Kahului "Dream City", Wai'ale will be a community that makes both visitors and residents feel welcomed and plans for the long range community and civic facilities to support the Central Maui region.

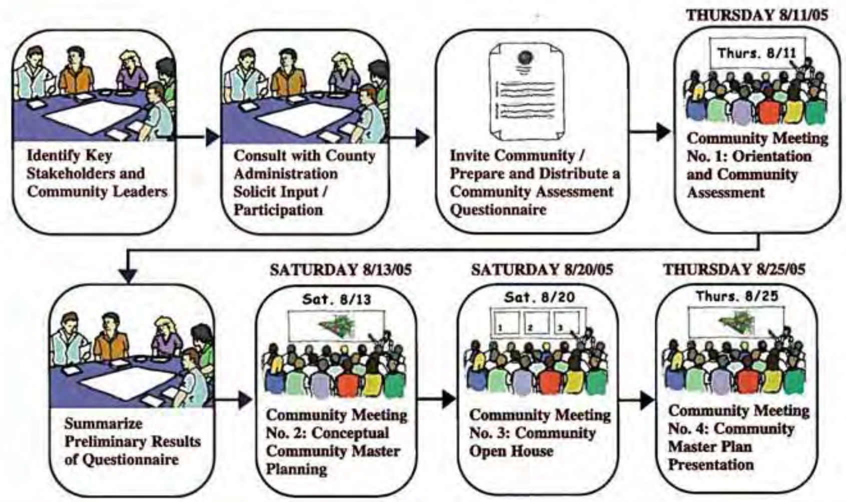
KEY COMMUNITY PLANNING GOALS

- Provide walkable mixed-use neighborhoods.
- Provide homes for a variety of income ranges, ages, and lifestyles. If so desired, a resident can grow up and spend their entire life in the community with the appropriate housing types available.
- Plan for community facilities to meet the region's current and future needs.
- Include a multi-modal transportation system that accommodates walking, biking, jogging, and driving.
- Include commercial activities (including locally-owned stores and restaurants), schools, and other civic and recreational facilities.
- Respect the natural and historical significance of the land.
- Capitalize on the views of Haleakalā, the West Maui Mountains, and other significant landmarks.

WAI'ALE COMMUNITY PLANNING PROCESS

Wai'ale has been planned through a community-based process including meetings with key stakeholders, community leaders, the County of Maui Administration, and Maui residents. Questionnaires, informational meetings, and planning workshops held in August 2005 sought community input and participation in developing a vision and conceptual master plan for Wai'ale.

The products of these meetings are Wai'ale's conceptual master plan and vision statement, which envisions a socially integrated community with a unique sense of identity and character that makes both visitors and residents feel welcomed.



"I loved this experience. The feedback and commitment of all the participants was great. The end result truly represents the needs and wants of the community. Wai'ale will become the neighborhood of choice for generations to come."

-KAY FUKUMOTO, COMMUNITY PARTICIPANT

Appendix F: Archaeological Inventory Survey Acceptance Letter

LINDA LINGLE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

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

LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

RUSSELL Y. TSUJI
FIRST DEPUTY

KEN C. KAWAHARA
DEPUTY DIRECTOR - WATER

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

February 28, 2010

Michael F. Dega, Ph.D.
Scientific Consultant Services, Inc.
711 Kapiolani Boulevard, Suite 975
Honolulu, Hawai'i 96813
shpdreply@scshawaii.com

LOG NO: 2010.1166
DOC NO: 1002PC41
Archaeology

SUBJECT: Chapter 6E-42 Historic Preservation Review – REVISED
Archaeological Inventory Survey of Six Separate Parcels Comprising 607 Acres
Wailuku/Waikapu Ahupua'a, Wailuku District, Island of Maui, Hawai'i
TMKs: (2) 3-8-005:023 por.; (2) 3-8-005:037; (2) 3-8-007:071; (2) 3-8-007:101;
(2) 3-8-007:102; (2) 3-8-007:104

Thank you for the opportunity to again review this revised report, which our staff received in PDF format on February 23 (Tome and Dega 2010): *An Archaeological Inventory Survey of Approximately 607 Acres of Land*...Scientific Consultant Services, Inc.

The report was reviewed by SHPD staff on July 30 of 2009 (SHPD LOG NO: 2009.2922; DOC NO: 0907PC38), December 23 of 2009 (SHPD LOG NO: 2009.4702; DOC NO: 0912PC82) and again on February 12 of 2010 (SHPD LOG NO: 2010.1137; DOC NO: 1002PC06), resulting in several requested revisions.

The survey area as described in the report has been revised from the original 616.74 to 607 acres comprising a portion of TMK (2) 3-8-005:023 and the entirety of TMKs (2) 3-8-005:037 and (2) 3-8-007:071, 101, 102 and 104. Fieldwork, carried out between June 23 and September 4, 2008 and again during September of 2009, was comprised of a 100% pedestrian survey, identification and recording of sites and included the mechanical excavation of 282 trenches and five manually excavated test units. One new site, now on record as SIHP #50-50-04-6578 [subsurface fire pit/*imu*], was identified in ST 90, with two previously identified sites, SIHP #50-50-04-1508 [portion of the Spreckels Ditch] and #50-50-04-5504 [traditional period *in situ* human burial] also found to be within the bounds of the current survey area.

The report now contains the required information as specified in HAR §13-276-5 regarding report documentation of inventory level field work completed in general and is acceptable.

We agree that SIHP #50-60-04-1508 (Spreckels Ditch), -5504 and -6578 are significant under Criterion D of the National and Hawai'i Registers of Historic Places for their ability to yield information important to history or prehistory and that -1508 is further significant under Criterion A for its association with events that have made an important contribution to the broad patterns of Hawai'i State history (*i.e.*, Maui's sugar industry). As a traditional period burial site, SIHP #50-50-04-5504 is also significant under Criterion E of the Hawai'i Register of Historic Places for its importance to the native Hawaiian people.

We are also in agreement that full-time archaeological monitoring should occur during all future ground altering disturbance in the project area where sand stratigraphy is known to be present as well as areas whicb were not subject to subsurface testing during the inventory survey. As such, a project wide monitoring plan will also need to be submitted for review and approval to the SHPD prior to any ground altering disturbance getting underway.

Lastly, while identified in 2003 by an Archaeological Services Hawai'i, LLC employee, it appears that no formal mitigation or preservation of SIHP #50-50-04-5504 has yet occurred. We agree that with respect to the displaced human remains first observed in the sand berm that parallels Kuihelani Highway, the berm should be closely monitored by at least two individuals for the purposes of recovering any additional displaced human remains. A Burial Treatment Plan should also be written for this site and submitted to the SHPD Culture & History section and the MLIBC for consultation and approval.

Now that the archaeological inventory report has been accepted pursuant to HAR §13-276, please send one hardcopy and a text searchable PDF copy on CD, clearly marked **FINAL** to the attention of "**SHPD Library**" at the Kapolei SHPD office. However, before doing so, please correct the typo on page 62 which refers the SIHP #50-50-04-6578 as SIHP #50-50-04-5504.

Aloha,

Nancy A. McMahon

Nancy McMahon, Deputy SHPO/State Archaeologist
State Historic Preservation Division

Appendix G: Data Recovery Plan and Preservation Plan

FINAL BURIAL SITE COMPONENT OF A DATA RECOVERY PLAN AND PRESERVATION PLAN FOR SITES 50-50-04-5504 and 6679 AT A & B PROPERTIES PARCEL TMK: 3-8-07:101 PORS. WAIKAPU AND WAILUKU *AHUPUA'A;* WAILUKU DISTRICT; ISLAND OF MAUI

FOR: A&B Properties

BY: Lisa J. Rotunno-Hazuka,
And Jeffrey Pantaleo (MA)

REVISED SEPTEMBER 2010
JUNE 2010

ARCHAEOLOGICAL SERVICES HAWAII, LLC.
1930 A VINEYARD ST.
WAILUKU, HI 96793

"Protecting, Preserving, Interpreting the Past While Planning the Future"

INTRODUCTION

Under contract to landowner A & B Properties, Inc (A &B) of 11 S. Puunene Avenue, Kahului, Hi and per Hawaii Administrative Rules (HAR)§ 13-300-40, Archaeological Services Hawaii, LLC (ASH) proposes this Burial Component of a Preservation Plan and Data Recovery Plan for Sites 50-50-04-5504 and 50-50-04-6679 situated at the former Hawaiian Cement sand operations located within Waikapu and Wailuku *ahupua'a*, Wailuku District, Island of Maui, TMK 3-8-07:101 pors (Figures 1 and 2).

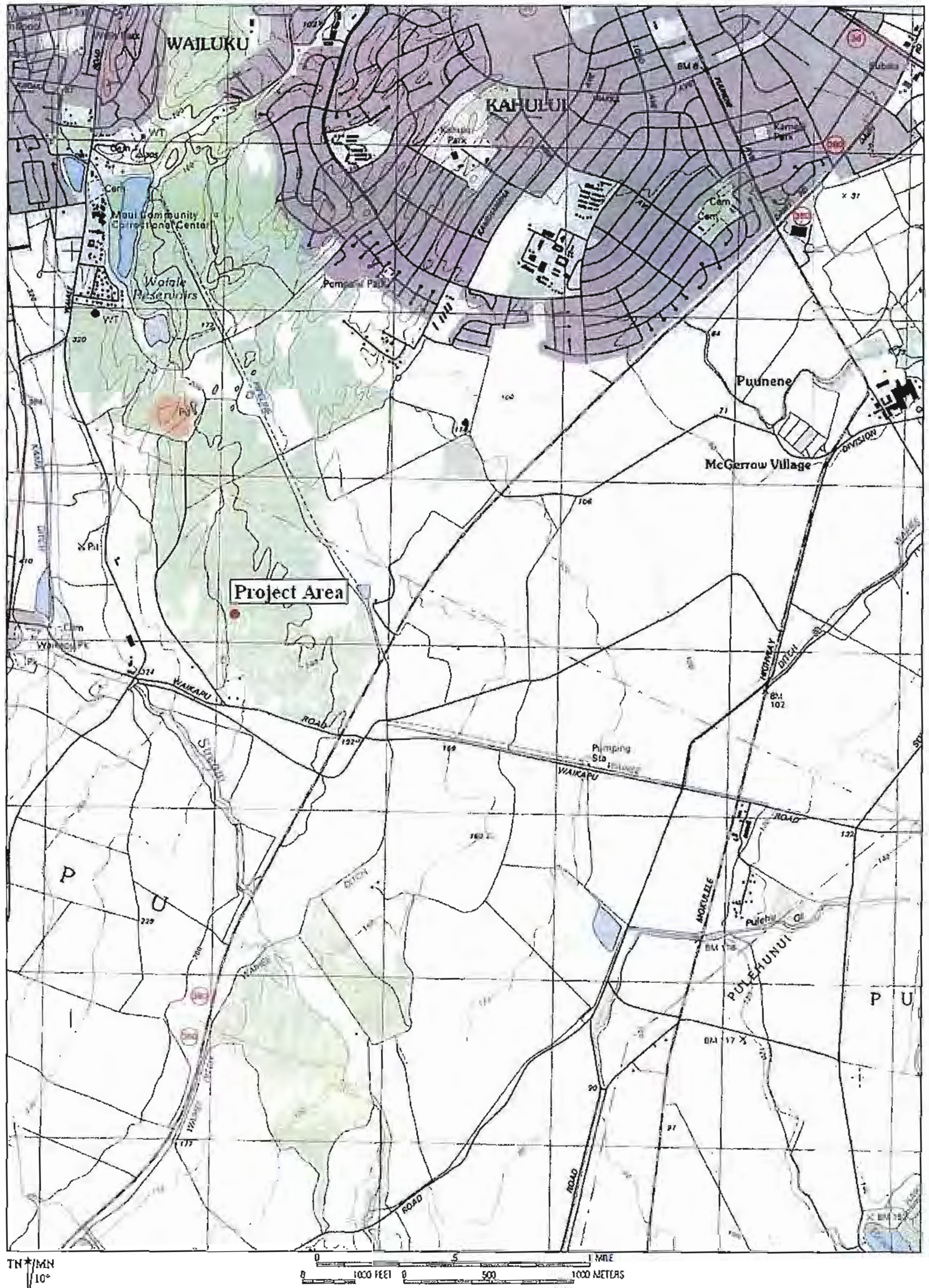
The Preservation Plan proposes the preservation in place of inadvertent burial features of Site 5504 and 6679 consisting of thirty-three partially intact primary burial features (Features 8, 9, 12a, 14a-18c, 20-26, 29, 31a, 33a/b, 34, 43, 44, 53a/c, 54, 56-58, 61 and Site 5504), thirteen burial pits which are highly probable to contain human skeletal remains (Features 12b, 14b, 18d, 32, 33c, 36-41, 53b and 59) six recently disturbed, possible primary burials (Features 4, 19, 22a, 31b, 50 and 55) and secondarily deposited/scatters of human skeletal remains with no primary/*in situ* component representing thirty-six individuals (Features 1a-f, 5, 6, 11, 13, 27, 28, 35a/b, 42, 47a/b, 52 and 56a-q). The Data Recovery Plan presents the relocation of two partially intact primary burial features (Features 46 and 49a) and five secondary scatters (Features 48, 49b/c, 51 and 60). These burial features will be preserved within five established preservation areas that constitute approximately 30 acres (Figure 3).

PROJECT AREA DESCRIPTION

The project area which consists of approximately 154.00 acres is located within Waikapu and Wailuku *ahupua'a*, Wailuku District. It is comprised of four distinct areas designated Phases A-D (Figure 3). Phases A, C and D are to the east of the current access road, and Phase B is to the west. Phase A, composed of 59 acres, contained two parallel north-south trending sand dune ridge lines which decrease in elevation towards Kuihelani Highway to the east. Within Phase A, the sand dune ridgeline closest to the access road was designated as the primary dune and the adjacent dune was the secondary ridgeline. Phase B, comprised of 30.3 acres, contained several large dunes which slope from west to east. Phase C is adjacent and east of Phase A and consists of approximately 50 acres of undulating sand dunes significantly lower than Phase A. Phase D is situated along the south east side of Phase C and is comprised of 15-acres. Similar topography was noted at Phase D when compared with Phase C. This phased project area is a portion of a larger parcel, TMK 3-8-07: 101 consisting of approximately 434.00 acres. This larger parcel is bounded to the north by undeveloped lands of Maui Lani Development, to the south by undeveloped lands and a Base yard as well as Waiko Road, to the east by Kuihelani Highway and to the west by portions of the County Landfill (Figure 2). Burial sites have been found within these adjoining areas.

In 1998, Archaeological Consultants of the Pacific, Inc. conducted an archaeological inventory survey (AIS) of the project area where a total of 117 backhoe trenches were excavated resulting in the discovery of two burial sites within Phase A (Site 4200 and 4201) comprised of five burial features and a multi-stepped terrace. Site 4200 contained four primary burials (a-d) which were partially articulated. Site 4201 was comprised of one burial feature situated within a tiered terrace designated Site 4202. Site 4202 measured 15.0 m (e/w) long by 13.0 wide (n/s) and was constructed of waterworn basalt cobbles. These burial sites were preserved in place within Preservation Area 1 per a previously accepted Burial Treatment and Preservation Plan (Figure 4-Kennedy and Moore 1998).

Grading activities have been intermittently conducted from 2000 through 2009. Monitoring began in Phase B, and progressed to Phase A, C and lastly within Phase D in 2009. Two Preservation Areas designated Preservation Area 1 and 4 will be established within Phase A, one within Phase B and is assigned Preservation Area 2, one within Phase D which is Preservation Area 3 and the last one, Preservation Area 5 situated along Kuihelani Highway in the vicinity of Site 5504.



Map created with TOPO!® ©2002 National Geographic (www.nationalgeographic.com/topo)

Figure 1. Project Area Location Map on USGS Map

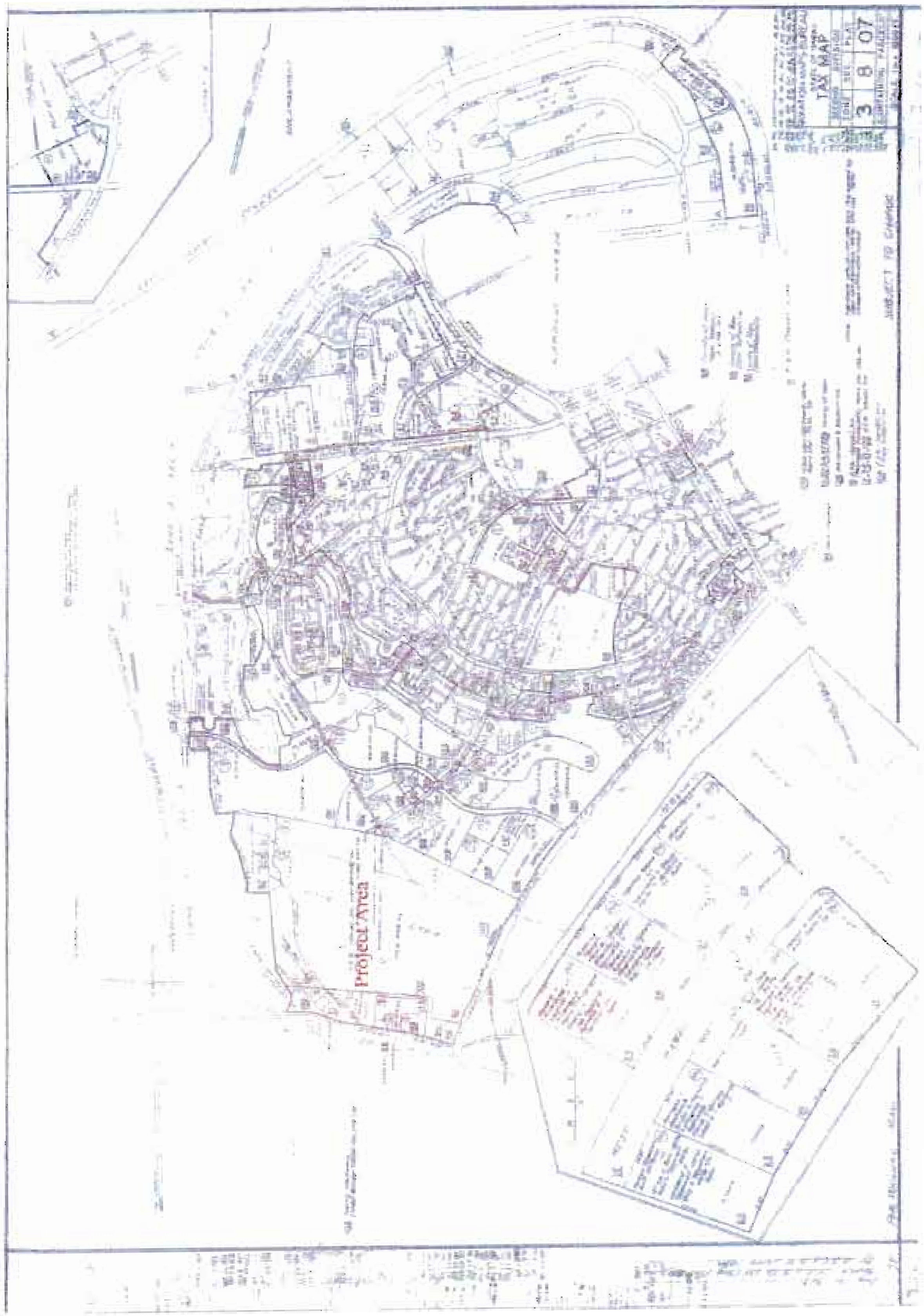


Figure 2. Location of Project Area on Tax Map Key 3-8-07

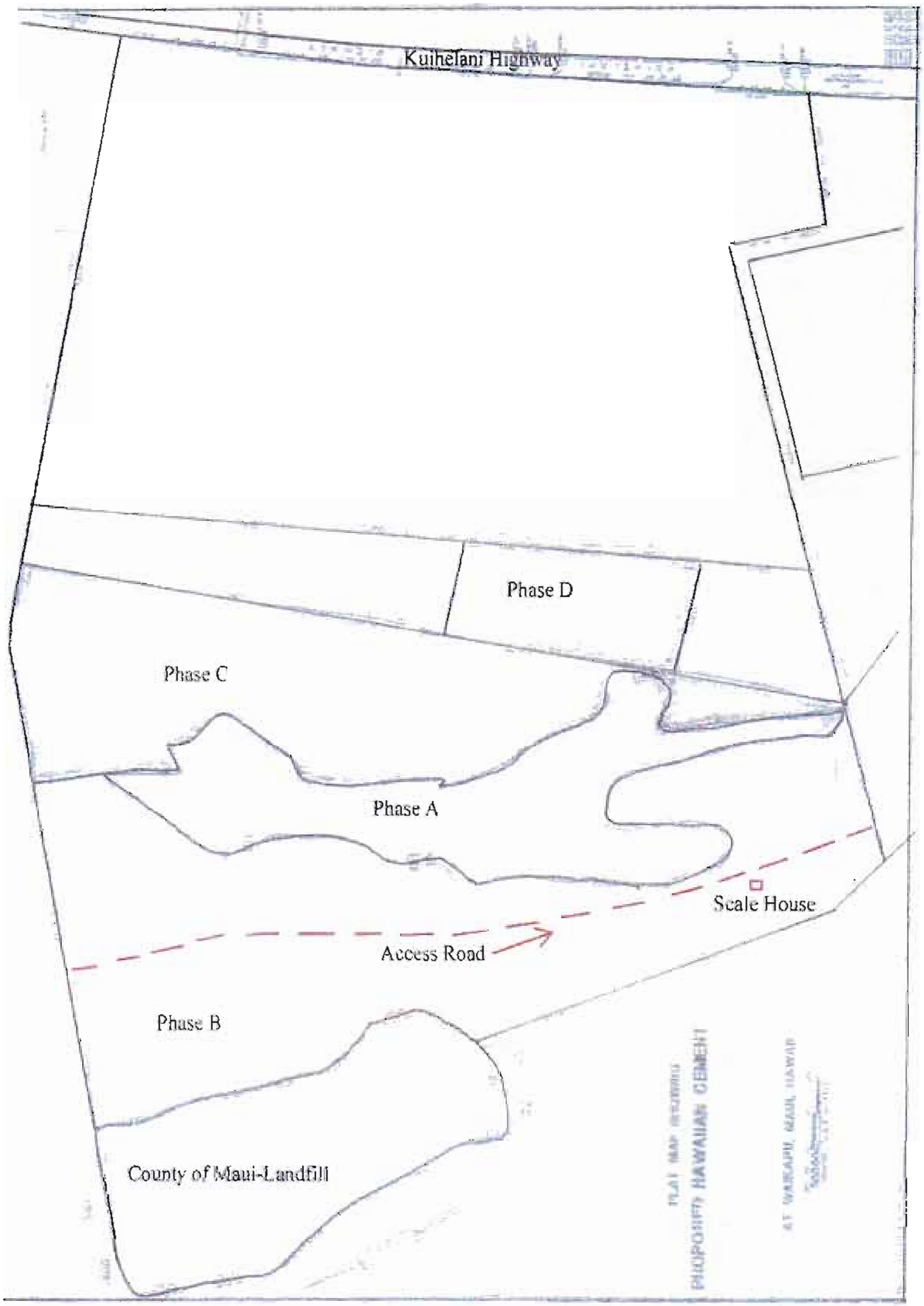


Figure 3. Map Showing Location of Phases A-D within TMK 3-8-07:101

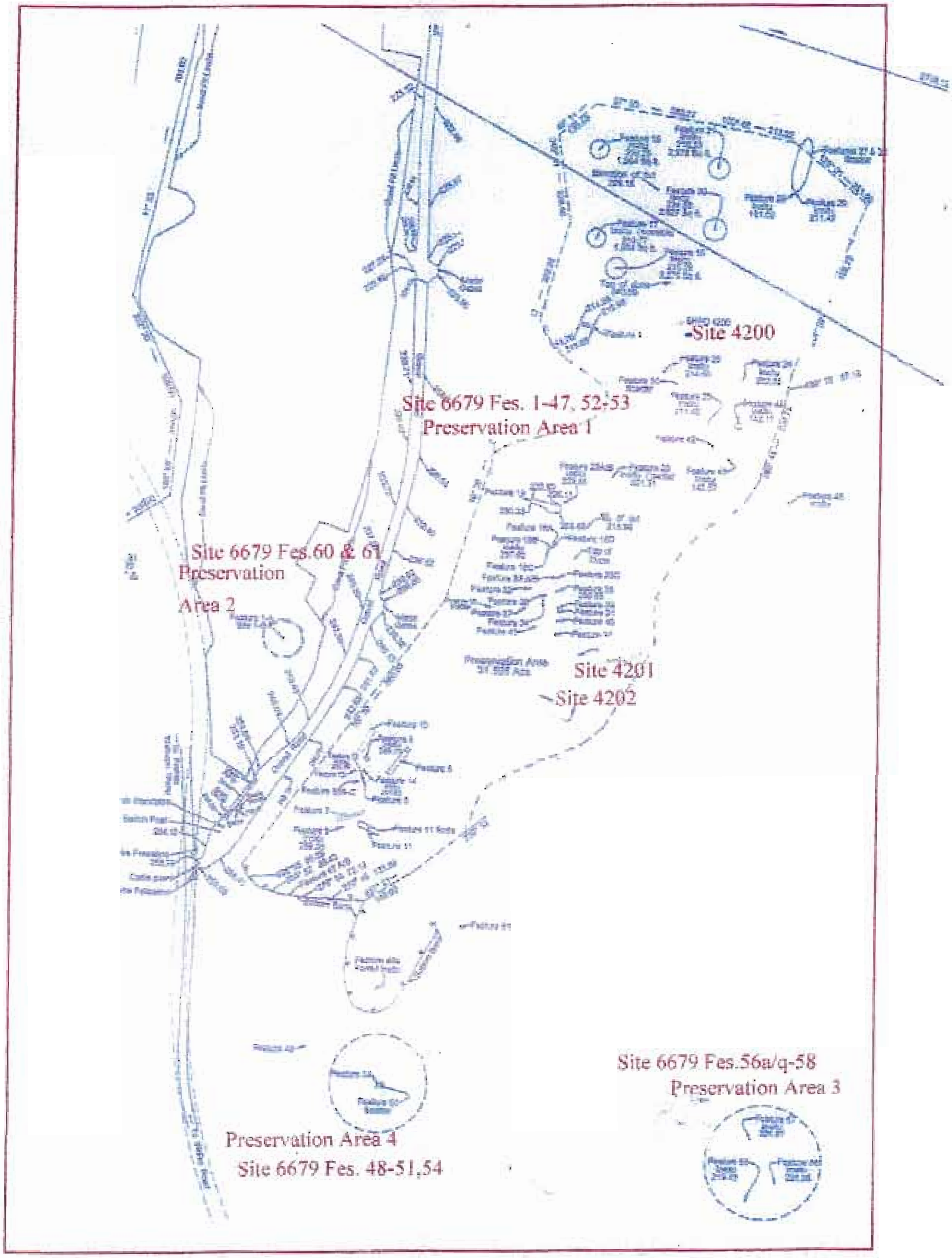


Figure 4. Plan View Map of Project Area Showing Burial Features Within Preservation Areas 1-4

The following methods and procedures were instituted at Hawaiian Cement when displaced human skeletal remains were identified during sand mining operations. In addition to these procedures once an *in situ* burial feature has been identified, a 50 ft. buffer is erected around the site and grading commences outside the buffer while maintaining a 2:1 slope outside the 50 ft. buffer line.

METHODS AND PROCEDURES

The primary reason for monitoring at the above location was to determine the presence of unmarked Native Hawaiian burial features and previously disturbed secondarily deposited human skeletal remains.

The methods for monitoring sand removal at a highly sensitive area were as follows: Initially all vegetation must be removed following the below protocol. After vegetation was removed and if 2 or more burials were identified in the immediate area, controlled excavations were instituted. Controlled excavations consisted of grading with a D-6 dozer in controlled 4-6 inch lifts. Controlled excavations were performed within the "Grade B" Layer II grayish brown fine silty sand through the "Grade A" yellowish brown fine to coarse sand up to 5.0 ft. If no additional burials were identified during the controlled grading process, the D-9 dozer was again utilized. After vegetation removal and no burials have been identified in the area, then grading with the D-9 is initiated. If skeletal remains are exposed during grading activities, the below methods for displaced human remains will be instituted.

All primary, intact or partially intact burial features were surveyed by the professional survey crew of Alexander and Baldwin and left in place pending a determination. After the burials were documented, a layer of clean sand was placed over the remains and then covered with a tarp. The tarp was covered in sand and a wooden pallet was placed over the tarp to further protect the burial. A buffer zone of 50.0 ft. was erected around the primary in situ remains. Grading outside the buffer zone must maintain a 2:1 slope to protect the integrity of the geological feature and or cultural landscape. All displaced skeletal remains were collected and curated at the ASH lab.

Field inspections were performed of previously graded areas and inadvertently discovered burial features to ascertain the presence of additional burials exposed through natural erosional processes (aeolian, alluvial) and to insure that protective measures for the burials consisting of tarps, yellow caution tape and orange fencing were still in place.

METHODS AND PROCEDURES FOR MONITORING VEGETATION REMOVAL

Monitoring of vegetation removal is difficult due to low visibility and dangerous conditions (falling trees). As the dozer topples trees and removes only surface vegetation and the fine silty humic layer that supports it, the silt fills the air and obscures all visibility. Due to these conditions, a set of procedures was instituted that would provide a safe working environment for the archaeologist, and would diminish disturbances to shallow burial features and or scattered skeletal remains.

1. A predetermined area would be initially grubbed of vegetation.

2. The dozer sets up on the down-wind side and clears in the up wind direction. The dozer makes one pass, thus clearing a single swath. The operator is informed that the cuts should be at a maximum of 1.0 ft. deep and that the dozer may only make one initial pass through the area due to the potential for previously disturbed skeletal remains and or intact, primary burial features. One initial pass would prevent the skeletal remains from being further fragmented and scattered.

3. After the dozer makes this initial pass and if the dust has settled, the archaeologist walks the initial swath, as the dozer moves into position for the second swath (Figure 5).

4. The dozer then clears the next swath and is essentially moving in the up-wind direction.

5. Step 3 is initiated again, and followed by step 4 until the entire area has undergone and initial vegetation removal.

6. Once the predetermined area has been opened up, the entire process is repeated until all the vegetation and the silty organic layer removed.

7. Periodic field inspections are performed of areas that have recently undergone vegetation removal. These field inspections, particularly after several days of wind erosion, have identified burial features and disturbed skeletal remains.

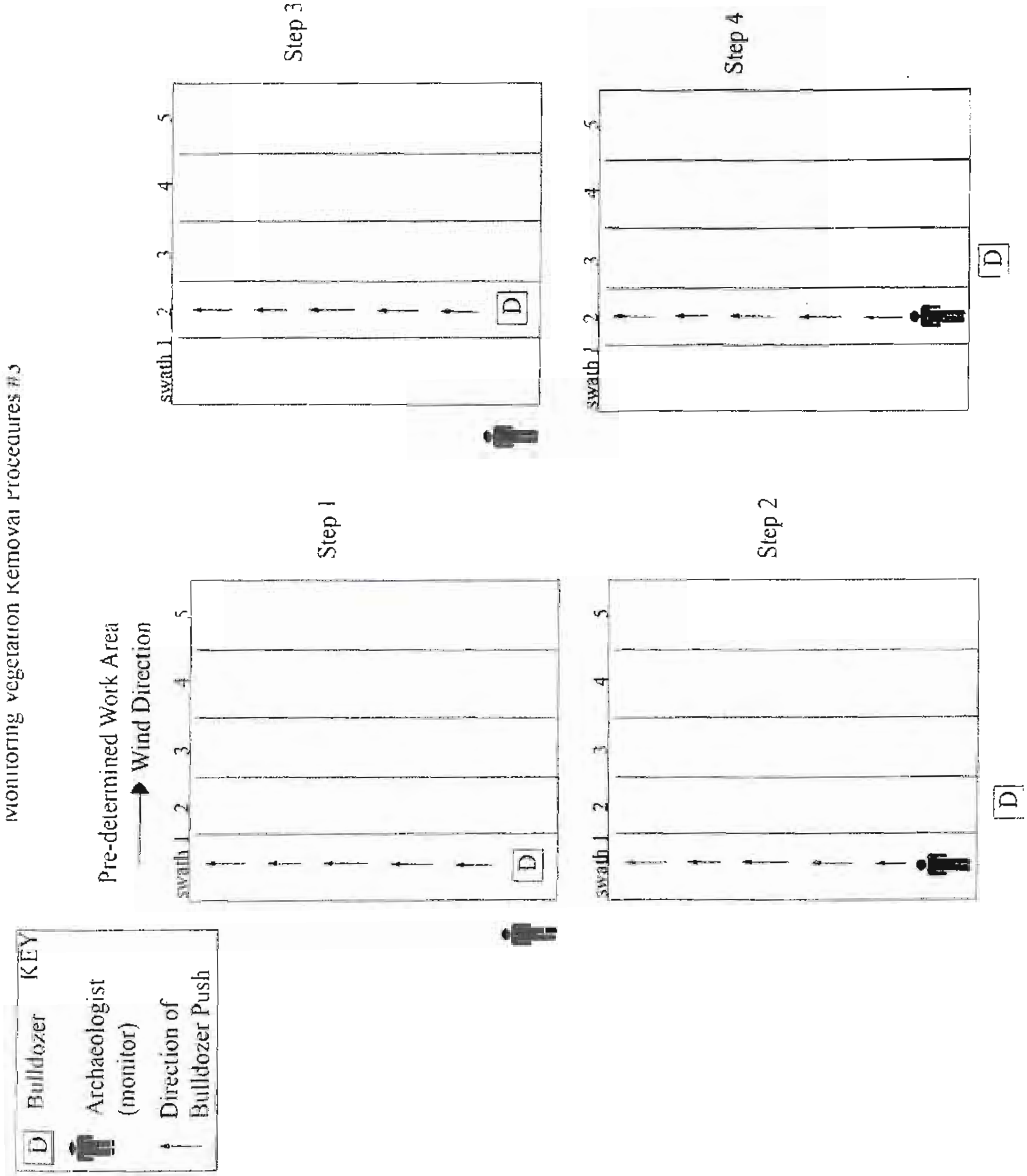


Figure 5. Map Showing Methods for Monitoring Vegetation Removal with Fair to Low Visibility

METHODS AND PROCEDURES FOR DISPLACED HUMAN REMAINS

ASH methods and procedures for displaced human skeletal remains are described below.

1. Upon identification of displaced human remains, a possible burial pit outline, or basalt and coral manuports all construction activities in the immediate area of the find is temporarily halted.

2. SHPD and the MLIBC shall be notified.

3. Mark the perimeter of the avoidance area with yellow caution tape, and or orange construction fencing and cover the remains to protect them from the elements

4. Extend a baseline through the center of the dispersal area.

5. Mark all displaced remains with pin flags and produce a plan view map. Locate and identify displaced remains and only collect the displaced remains.

6. If a concentration is identified, map the concentration and leave in place for determination of disposition and controlled manual excavations, as warranted.

7. Manually rake bulldozed or other mechanically produced tailings and screen push piles to collect all displaced and fragmented remains.

8. Complete an osteological inventory of the collected remains to determine the components that may be left *in situ* or missing.

9. If a concentration or possible burial pit was identified, place a 2.0 by 2.0 meter controlled test unit, centrally locating the concentration within the test unit. Clean the surface with a trowel to determine if a pit outline is present. Map pit outline.

10. If no concentration was identified and raking is complete, skip to blade testing on item #13.

11. Excavate the *in situ* portion to identify any articulation, document the articulated portion within the pit outline, and collect all clearly displaced remains. Articulated remains and those in an anatomically correct position, shall be left in place until a disposition determination can be made by SHPD in consultation with the MLIBC.

12. Fill out all test excavation and burial forms and draw a plan view map of the *in situ* remains. Then cover remains with a thin layer of sand (if SHPD and MLIBC have seen the feature) and or tarp.

13. Conduct mechanical blade testing in potential areas of further discoveries. Blade testing is conducted by removing shallow (2-6") lifts over a predetermined area.

The burial features are described by their body positions and mode of interment. The body positions are divided into four categories (extended, semi-extended, flexed, fully flexed) which describe the relationship of the torso to the legs. The mode of interment presents the context of the human skeletal remains. The context of a burial may be of two types, primary and secondary. Age and sex determination are based on the observation of morphological features and diagnostic attributes of the skeletal remains. According to Buistra and Ubelker (1994), there are seven age classes used to segregate the osteological remains (White 2000:341-342). Additionally, due to the disturbances exhibited at the burial site, the percent of articulated, intact human remains is presented within each burial feature description. See further burial terminology below.

BODY POSITION
Supine/Extended-Legs and Arms extend outward from the body.
Semi-Extended-The torso is extended and the lower legs flexed back.
Flexed-The upper legs bent brought partially up to the lower torso. Lower legs are folded underneath the upper legs. Arms may be extended down the sides, or bent towards the chest.
Fully Flexed-The upper legs bent brought up to the chest with the lower legs folded underneath the upper legs. Arms are bent up towards the chest.

BURIAL CONTEXT
Primary-A primary burial is the original place the human skeletal remains were buried. Most often primary burials are articulated in an anatomically correct placement for that type of body position; however in some cases, such as bundle burials, the remains may not be articulated but they are in their original context.
Secondary-A secondary context is not the first, original interment location and is often associated with a disturbance that is intentional displacement (i.e. indigenous disturbance by placing a burial adjacent to an older burial thus displacing the older burial, through bone acquisition and etc.) or inadvertent disturbance (i.e. environmental factors such as shoreline erosion, aeolian (wind), alluvial (water/stream flow), floralturbation (tree roots), or human intervention).
Previously Disturbed-This terminology refers to all activities which occurred to the burial area prior to the current undertaking. Human remains with old breaks, or bleaching (white color) are categorized as such.
Recently Disturbed-This definition describes any activity that happened during the present monitoring activities at the project area.
Recently disturbed possible primary/*in situ*-This definition applies to skeletal remains that have been displaced during monitoring activities and based on the condition of the remains, as well as the percentage collected greater than 90%, the burial was likely articulated and in its primary condition prior to monitoring.
Isolated Finds-Isolated finds consist of 1-3 fragments of skeletal remains which are solitary and do not appear to belong to burial features in close proximity, and do not constitute an individual.

AGE CATEGORIES

Fetal-Before birth

Infant-0-3 Years

Child-3-12 Years

Adolescent-12-20 Years

Middle Adult-35-50 Years

Older Adult-50+ Years

Young Adult-20-35 Years

DETERMINING PERCENTAGE OF ARTICULATION

To further describe the burial context of each feature, a percentage of the completeness or portions which remain intact and articulated have been added to the burial descriptions and Table I. These percentages are calculated using the following methods.

The upper torso is calculated at 50% and comprised of the following percentages. Cranium 5%, scapula, clavicle and ribcage (10%),vertebral column including c-vertebrae and thoracic vertebrae (5%), Right arm (10%), Right hand (5%), Left hand (5%) and Left arm (10%).

The lower torso is calculated at 50% and is comprised of the following percentages. Lumbar vertebrae, innominate and sacrum (10%), Right leg (15%), Right foot (5%), Left leg (15%) and Left foot (5%).

RESULTS

Site 6679 is comprised of all burial features identified within Phases A, B and D. Site 5504 is a solitary burial situated along Kuihelani Highway. A total of 70 burial features have been identified to date within Phase A. These features consist of partially intact primary burials (n=30), burial pits which are highly possible to contain primary burial features (n=12), recently disturbed possible primary burial features (n=5) and secondarily deposited scatters of human remains (n=23). The majority of these features will be preserved in place within Preservation Areas 1 and 4. Within Phase B a partially intact burial feature (n=1) and a secondary scatter of human remains (n=1) have been identified and these two burial features will be preserved within Preservation Area 2. A total of 22 burial features were documented at Phase D and were comprised of partially intact primary burials (n=3), a burial pit (n=1), a recently disturbed possible primary burial (n=1) and secondary deposits of human skeletal remains (n=17). All burials will be preserved in place and or in close proximity to where they were identified within Preservation Area 3. Lastly, a partially intact burial feature inadvertently discovered along Kuihelani Highway will be preserved in place within Preservation Area 5. The burials are further discussed below and are presented in Table I.

STRATIGRAPHY

Within the project area and surrounding inland sand dunes, a four-layer stratigraphic sequence has been recorded. Layer I consists of an organic, humic layer with decaying leaf and twig matter. Underlying Layer II, is the grayish brown silty sand which contains the majority of the burial features and vegetation. This layer, also designated as the "Grade B" layer ranges from 8 inches to 5.0 ft. thick and is aeolian deposited. Layer II contains more silt than Layer III and when mined is used as pipe bedding for utility installation and as fertilizer for the sugar cane fields due to the high phosphorus content. Layer II directly overlies Layer III, the coarse to fine yellowish brown sand and appears as a distinctly yellowish gold color. This layer is referred to as "Grade A" sand being fine to coarse with little to no silt and when harvested is utilized for the purposes of making concrete. The upper horizons of Layer III can be loose and stratified with cross-bedding in cross-section being aeolian driven prior to the deposition of Layer II. The upper and lower sections of Layer III may sometimes be a lithified, sand stone layer. Layer III, like the underlying Layer IV clay stratum may also contain burial features. Layer IV is a reddish brown silty clay which contains numerous rounded cobbles and boulders and appears to have been a colluvial deposit.

Table I. Quantitative Burial Data for Phases A-D

SITE	FEATURE	PHASE	AGE/SEX	DESCRIPTION	PIP	RELOCATE	PRES. AREA	INDIVIDUAL
Site 6679	1a	A	MAF	Secondary Scatter	X		Preservation 1	1
Site 6679	1b	A	OAM	Secondary Scatter	x		Preservation 1	2
Site 6679	1c	A	INFANT	Secondary Scatter-1+/- 4mos	X		Preservation 1	3
Site 6679	1d	A	INFANT	Secondary Scatter-o-6mos	X		Preservation 1	4
Site 6679	1e	A	OAM	Secondary Scatter	X		Preservation 1	5
Site 6679	1f	A	MAM	Secondary Scatter	X		Preservation 1	6
Site 6679	2	A		2ndary scatter belonging to Fe.1a,b,e,f	n/a			1, 2, 5 and 6
Site 6679	3	A	Adole. F	2ndary scatter-may have been clay pit bur.	X		Preservation 1	7
Site 6679	4	A	OAM	Rec.dist.prob.primary-clay pit burial	X		Preservation 1	8
Site 6679	5	A	OAM	Secondary Scatter	X		Preservation 1	9
Site 6679	6	A	CHILD	2ndary Scat same Individ.as Fe. 7 and 10	X		Preservation 1	10
Site 6679	7	A		2ndary Scatter belongs to Feature 6	X		Preservation 1	10
Site 6679	8	A	INFANT	Partial Primary	X		Preservation 1	11
Site 6679	9	A	MA?	Partial Primary	X		Preservation 1	12
Site 6679	10	A		2ndary Scatter belongs to Feature 6	X		Preservation 1	10
Site 6679	11	A	MAM	Secondary Scatter-Robust	X		Preservation 1	13
Site 6679	12a	A	INFANT	Partial Primary-fully flexed	X		Preservation 1	14
Site 6679	12b	A		Burial Pit	X		Preservation 1	BP1
Site 6679	13	A		Secondary Scatter	X		Preservation 1	15
Site 6679	14a	A	MAM	Partial Primary-only foot articulated	X		Preservation 1	16
Site 6679	14b	A		Burial Pit	X		Preservation 1	BP2
Site 6679	15	A	YAM	Partial Primary-Robust-flexed	X		Preservation 1	17
Site 6679	16	A	YAM	Partial Primary-fully flexed	X		Preservation 1	18
Site 6679	17a	A	YAF	Partial Primary-flexed	X		Preservation 1	19
Site 6679	17b	A	MAM	Partial Primary-clay pit burial	X		Preservation 1	20
Site 6679	18a	A	YAF	Partial Primary-flexed	X		Preservation 1	21
Site 6679	18b	A	CHILD	Partial Primary-lithified slabs	X		Preservation 1	22
Site 6679	18c	A	YAF	Partial Prim.-deep lithified pit-full.flexed	X		Preservation 1	23
Site 6679	18d	A		Burial Pit-deep lithif.pit with boulders	X		Preservation 1	BP3
Site 6679	19	A		Rec.Dist.Prob.Partial Prim.	X		Preservation 1	24
Site 6679	20	A	YAM	Partial Primary-perf.human molar	X		Preservation 1	25
Site 6679	21	A	MAM	Partial Primary-basalt artifacts	X		Preservation 1	26
Site 6679	22a	A	YAF	Rec.Dist.Prob.Partial Prim.	X		Preservation 1	27

Table II. (cont) Quantitative Burial Data for Phases A-D

Site 6679	22b	A	YAM	Primary Burial-likely fully flexed	X		Preservation 1	28
Site 6679	23	A	OAF	Partial Primary-context indeterminate	X		Preservation 1	29
Site 6679	24	A	?AM	Partial Primary-flexed	X		Preservation 1	30
Site 6679	25	A	OAF	Partial Primary-flexed	X		Preservation 1	31
Site 6679	26	A	MAM	Partial Primary-fully flexed	X		Preservation 1	32
Site 6679	27	A	OAM	Secondary Scatter	X		Preservation 1	33
Site 6679	28	A	?AM	Secondary Scatter	X		Preservation 1	34
Site 6679	29	A	MAM	Partial Primary-fully flexed-lith.slabs	X		Preservation 1	35
Site 6679	30	A		2ndary E16Scatter belongs to Feature 26	X		Preservation 1	32
Site 6679	31a	A	MAF	Partial Primary-perforated conus shells	X		Preservation 1	36
Site 6679	31b	A	MAM	Rec.dist.prob.primary	X		Preservation 1	37
Site 6679	32	A		Burial Pit	X		Preservation 1	BP4
Site 6679	33a	A	ADULT	Partial Primary-disturbed in cult.context	X		Preservation 1	38
Site 6679	33b	A	Adolescent	Partial Primary-disturbed in cult.context	X		Preservation 1	39
Site 6679	33c	A		Burial Pit	X		Preservation 1	BP5
Site 6679	34	A	MAM	Partial Primary-perforated conus shells	X		Preservation 1	40
Site 6679	35a	A	INFANT	Secondary Scatter-0-1 year	X		Preservation 1	41
Site 6679	35b	A	INFANT	Secondary Scatter	X		Preservation 1	42
Site 6679	36	A		Burial Pit	X		Preservation 1	BP6
Site 6679	37	A		Burial Pit	X		Preservation 1	BP7
Site 6679	38	A		Burial Pit	X		Preservation 1	BP8
Site 6679	39	A		Burial Pit	X		Preservation 1	BP9
Site 6679	40	A		Burial Pit	X		Preservation 1	BP10
Site 6679	41	A		Burial Pit	X		Preservation 1	BP11
Site 6679	42	A	YA?	Isolated Find 2 cranial-Y.A.? IF1	X		Preservation 1	43
Site 6679	43	A	ADULT	Primary -sacrum dors. Side up in pit	x		Preservation 1	44
Site 6679	44	A	MAM	Partial Primary	X		Preservation 1	45
Site 6679	46	A	YAM	Partial Primary to be disinterred		X*	Preservation 1	46
Site 6679	47a	A	YAF	Secondary Scatter	X		Preservation 1	47
Site 6679	47b	A	INFANT	Secondary Scatter-6mos-1 year	X		Preservation 1	48
Site 6679	48	A	OAM	Secondary Scatter		X	Preservation 4	49
Site 6679	49a	A	MAM	Partial Primary to be disinterred		X*	Preservation 4	50
Site 6679	49b	A	CHILD	Secondary Scatter-7-10 YRS		X	Preservation 4	51
Site 6679	49c	A	YAF	Secondary Scatter		X	Preservation 4	52

Table III. (cont) Quantitative Burial Data for Phases A-D

Site 6679	50	A	MAF	2ndary Scat. But may have been part.intact	X		Preservation 4	53
Site 6679	51	A	MAM	Secondary Scatter		X	Preservation 4	54
Site 6679	52	A	ADULT	Isolated Find 1 Long Bone- IF2+E98	X		Preservation 1	55
Site 6679	53a	A	MAM	Partial Primary	X		Preservation 1	56
Site 6679	53b	A		Burial Pit	X		Preservation 1	BP12
Site 6679	53c	A		Primary -cranium, humerus in pit	X		Preservation 1	57
Site 6679	54	A	MAM	Partial Primary-ww cobble-fully flexed	X		Preservation 4	58
Site 6679	55	D	CHILD	Rec.dist. Prob.primary-6 year +/- 24 mos	X		Preservation 3	59
Site 6679	56	D	YAF	Partial Primary-pit excavated into lithified	X		Preservation 3	60
Site 6679	56a	D	OAM	Secondary Scatter	X		Preservation 3	61
Site 6679	56b	D	OAM	Secondary Scatter	X		Preservation 3	62
	56c	D	OAM	Secondary Scatter	X		Preservation 3	63
	56d	D	OAM	Secondary Scatter	X		Preservation 3	64
	56e	D	OAF	Secondary Scatter	X		Preservation 3	65
	56f	D	MAM	Secondary Scatter	X		Preservation 3	66
	56g	D	MAM	Secondary Scatter	X		Preservation 3	67
	56h	D	OAF	Secondary Scatter	X		Preservation 3	68
	56i	D	OAF	Secondary Scatter	X		Preservation 3	69
	56j	D	MAM	Secondary Scatter	X		Preservation 3	70
	56k	D	OAM	Secondary Scatter	X		Preservation 3	71
	56l	D	YAF	Secondary Scatter	X		Preservation 3	72
	56m	D	OAF	Secondary Scatter	X		Preservation 3	73
	56n	D	MAM	Secondary Scatter	X		Preservation 3	74
	56o	D	MAM	Secondary Scatter	X		Preservation 3	75
	56p	D	CHILD	Secondary Scatter	X		Preservation 3	76
	56q	D	INFANT	Secondary Scatter	X		Preservation 3	77
	57	D		Partial Primary-pit excavated into lithified	X		Preservation 3	78
	58	D	MAF	Partial Primary-fully flexed	X		Preservation 3	79
	59	D		Burial Pit	X		Preservation 3	BP13.
	Fe. 60	B		Secondary (formerly 1B)		x	Preservation 2	80
	Fe. 61	B	OAM	Partial Primary (formerly2B)-fully flexed.	x		Preservation 2	81
Site 5504		N/A		Partial Primary	x		Preservation5	82

OAM=Older Adult Male OAF=Older Adult Female MAM=Middle Adult Male MAF=Middle Adult Femal YAM=Younger Adult Male
YAF=Younger Adult Female ?Sex or Age Indeterminate Adole.=Adolescent

PHASE A

Phase A is situated along the east side of the current scale house access road and is comprised of two parallel dune ridgelines. The first dune system which is oriented north-south contains the highest ridgeline. The dunes are undulating and consist of approximately 59.0 acres.

Features 1a-f

Features 1a-f are comprised of the co-mingled skeletal remains of six individuals which were recovered from two discrete linear areas (Features 1 and 2) and designated as recently and previously disturbed. The Feature 1 area measured 55.0 m long by 40.0 m wide and Feature 2 was 20.0 m long by 5.0 m wide (Figure 6). Upon completion of discussions with SHPD, the methods for displaced skeletal remains consisting of mapping, raking and testing were undertaken to ascertain if a primary/*in situ* portion was extant and to collect all displaced human remains (Figure 7). After testing was completed, no *in situ* burial features were identified, and the skeletal population constituted of six co-mingled individuals. Features 1a, b, e, and f, are the remains of adults and Features 1c and 1d are the remains of infants. Osteological analysis of the human skeletal remains (HSR) was performed at the ASH lab to determine sex and age using the criteria listed in the methods section. The results are presented below for each of the individuals.

Feature 1a

Feature 1a is the remains of a middle adult female individual. The sex was determined from the size of the brow ridge as well as the shape of the gonial angle and age was based on the cranial suture closure.

Feature 1b

Feature 1b was identified as an older adult male individual. Sex was determined by the overall robustness of remains, brow ridge size, the mastoid process, and gonial angle. Estimated age was based upon observation of cranial suture closure in which 90% of them were considered obliterated and or are no longer visible.

Feature 1c

Osteological analysis of Feature 1c was determined to be an infant 1+/- 4 mos, and was based upon dentition (unerupted deciduous teeth) and stage of unfused vertebrae. Sex determination can`t be established at infancy.

Feature 1d

Feature 1d is also the remains of an infant estimated to be between newborn and 6 months of age. Age was based on the observation of size of the non-fused Os coxae growth. Osteological analysis to determine sex could not be established.

Feature 1e

Feature 1e is an older adult male individual where sex determination was based on observation of the greater sciatic notch and shape/size of the gonial angle of the mandible. Estimated age was based on the alveolar resorption of the maxilla and mandible as well as noting visible degradation of the surface of the pubic symphysis, which is commonly associated with old age.

Feature 1f

Osteological analysis of the recovered skeletal remains belonging to Feature 1f were determined to be a middle adult male. This was based on complete epiphyseal fusion and that the pubic symphysis in addition to other surface features had not yet undergone significant deterioration.

A total of six individuals comprised of two older adult males (Features 1b and e), a middle adult male (Feature 1f), a middle adult female (Feature 1a) and two infants (Features 1c and d) have been recorded for both the Feature 1 and 2 areas. Minimal quantities of skeletal remains were collected at Feature 2 and belonged with the adult assemblage recovered from Feature 1. The proposed treatment for Features 1a-f is preservation in place within Preservation Area 1(Figure 8 and Table I). The collected remains of these six individuals shall be prepared and reinterred in the area where they were discovered.

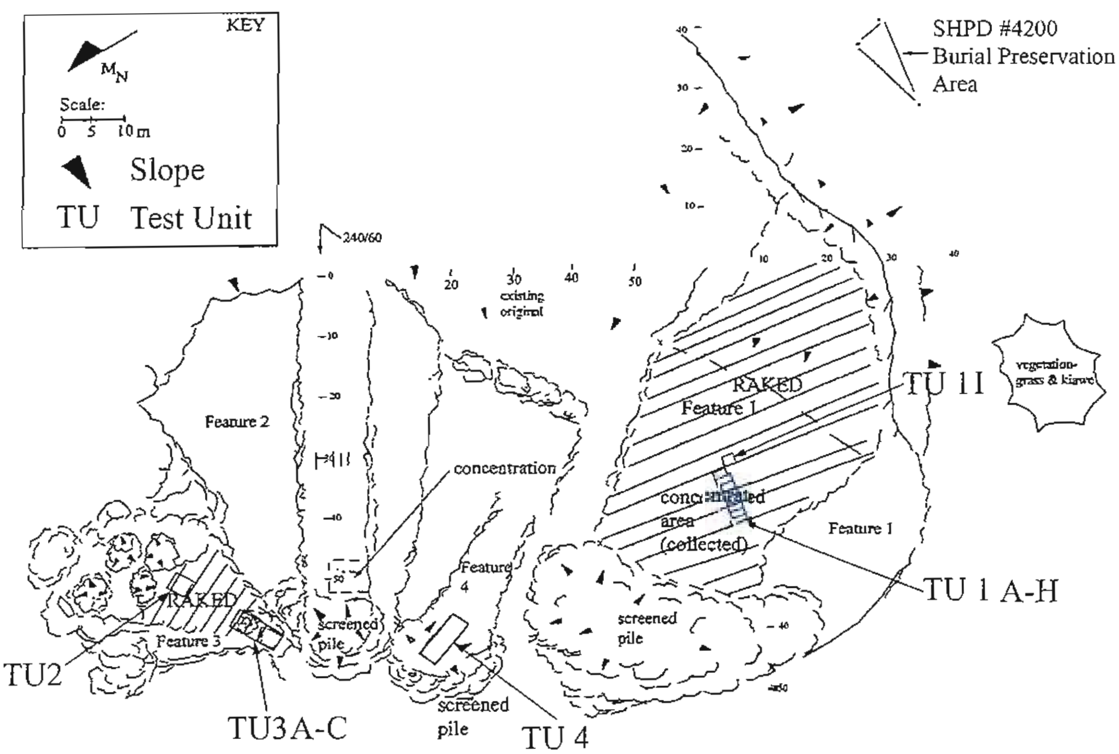


Figure 6. Plan View Map of Features 1-4

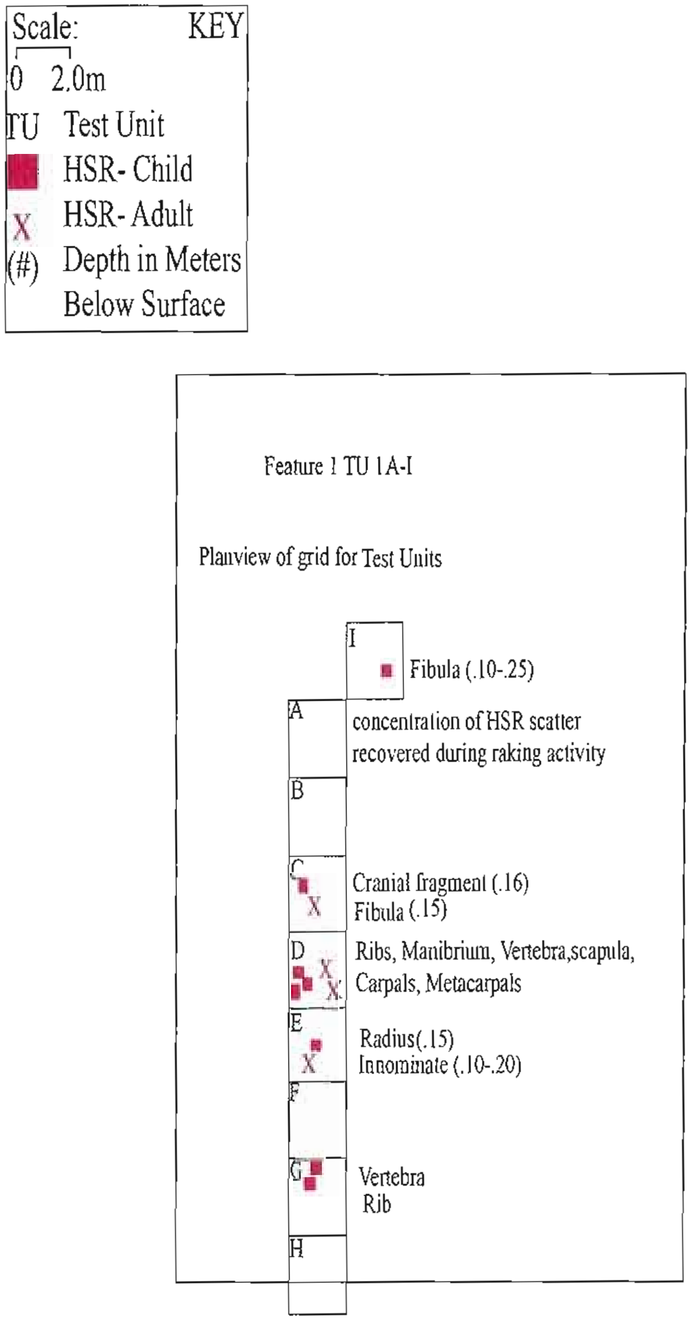


Figure 7. Plan View Map of Testing at Feature 1 Area

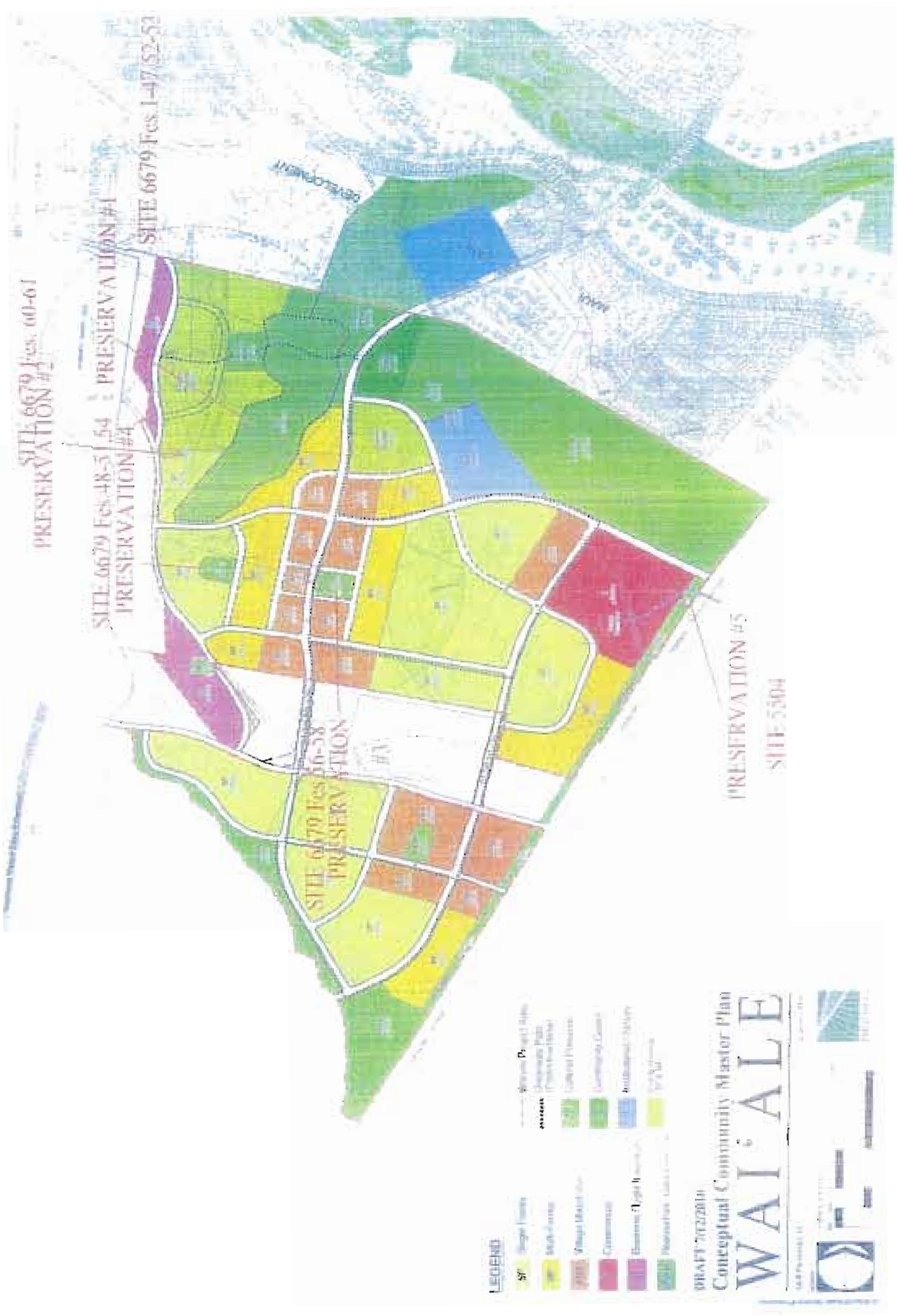


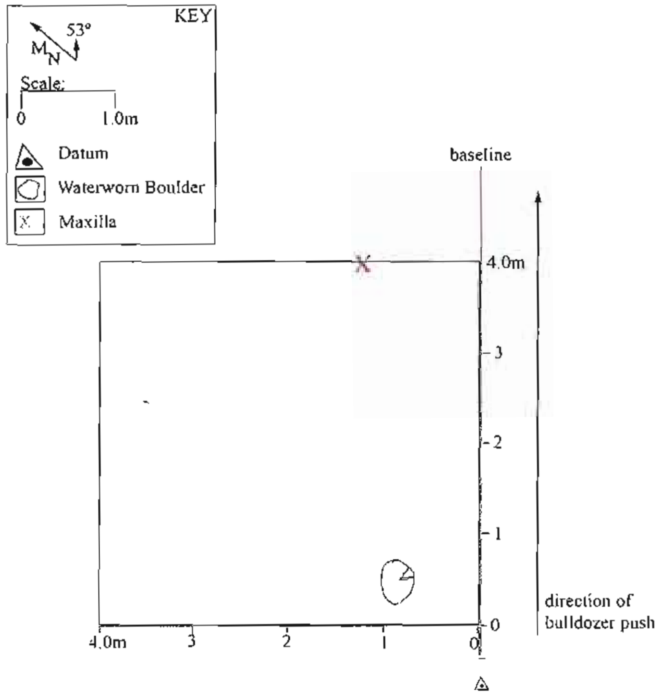
Figure 8. Plan View Map Showing Preservation Areas 1-5 for Site 50-50-04-6679 within Development Area

Feature 2

The Feature 2 area is located east of Feature 1 juxtaposed to Features 3 and 4 (see Figure 7). It measured 20.0 m long by 5.0 m wide and contained minimal skeletal remains. Recovered from the Feature 2 area is the right trapezium and distal phalange, 1st metacarpal of the right hand. Left hand remains consisted of the capitate and hamate and from the right foot the 3rd metatarsal a long with the distal phalange of the 1st metatarsal was recovered. Additionally two rib fragments and the distal end of the left fibula were also collected and these aforementioned skeletal remains belonged to the adults recovered from the Feature 1 area. Thus no individual was collected from the Feature 2 area.

Feature 3

Feature 3 was inadvertently exposed during monitoring activities when the D-9 bulldozer was grading "Grade B" grayish brown sand material mixed with compact, dense alluvial clay (the clay stratum is usually the basal layer and Grade B sand is found at the surface). The observation of these two soils mottled together exemplifies prior disturbances. Upon the discovery of human skeletal remains, all mechanical activity was halted in the immediate area and hand testing commenced. Scattered skeletal remains were spread over a 15.0 m long by 25.0 m wide area where two test areas (TU2 and TU3a-c) were set up to collect all disturbed remains and to ascertain if an intact, primary component was present (Figure 9). Diagnostic traits indicating sex was based on the size of the brow ridge and age was based on epiphyseal fusion. Further analysis of the skeletal remains identified old breaks along the occipital portion of the cranium indicating that Feature 3 was previously disturbed and secondarily deposited. This prior disturbance is further supported by the mixed soil matrix (Grade B sand and alluvial clay) previously mentioned and recorded during testing. The skeletal remains of Feature 3 were designated as a secondary deposit that was previously and recently disturbed and shall be preserved in place within Preservation Area 1 (see Figure 8 and Table I).



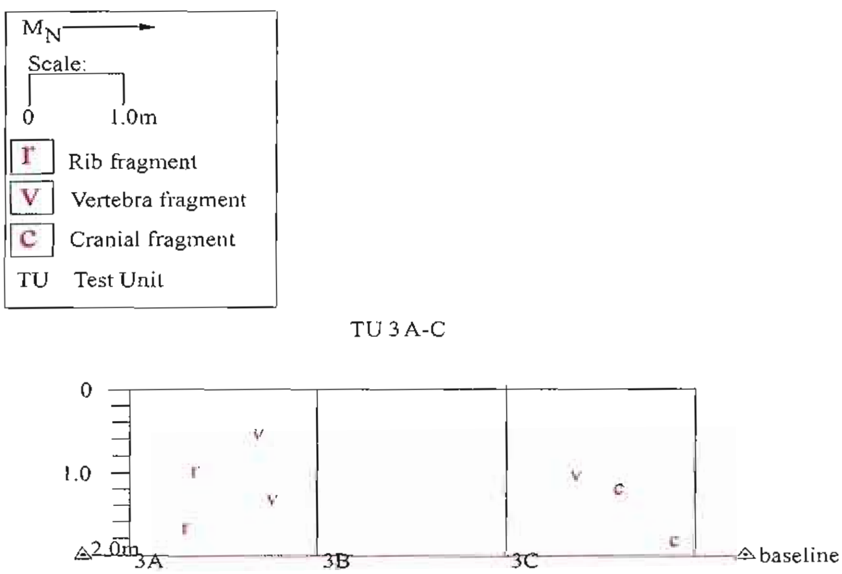


Figure 9. Plan View Map of Site 6679 Feature 3 Area Showing Skeletal Remains within Dozer Track (Top) and Test Units 3A-C (Bottom)

Feature 4

Feature 4 was discovered while determining the extent of secondarily deposited skeletal remains of Features 2 and 3. The dozer was removing a disturbed soil matrix and was grading sand above the basal clay layer when sand mixed with clay peds and skeletal remains were exposed. All mechanical equipment was stopped and testing of the area was continued by hand. And 8.0 m long by 4.0 m wide grid designated TU 4 was erected over the scatter to recover all disturbed human remains and to ascertain if a primary and or *in situ* burial was extant within the Feature 4 area (Figure 10). TU 4 was excavated to the compact, clay surface where no burial pit outline or articulated remains were observed, however testing and raking recovered approximately 98% of this individual. During analysis of the skeletal remains to ascertain sex and age of this individual, clay particles were observed adhering to the bone. Based on the presence of these clay particles and the documentation of clay peds mixed with sand during testing, Feature 4 was likely a primary clay pit burial that was recently disturbed and is the remains of an older adult male.

Age was based on several factors. The extreme occlusal wear and alveolar resorption of the mandible and maxilla as well as the obtuse angle of the vertical ramus and corpus of the mandible (typically associated with advanced age-Steele & Bramblett, 1988: 51). Furthermore, the cranial sutures were almost completely obliterated indicating near complete fusion and extensive metamorphosis in the auricular and periauricular surface areas of the ilium were also noted. Sex determination was based on the sciatic notch and overall robust nature of the remains. Feature 4 was determined to be recently displaced and shall be preserved in place and or reinterred within the area where it was discovered.

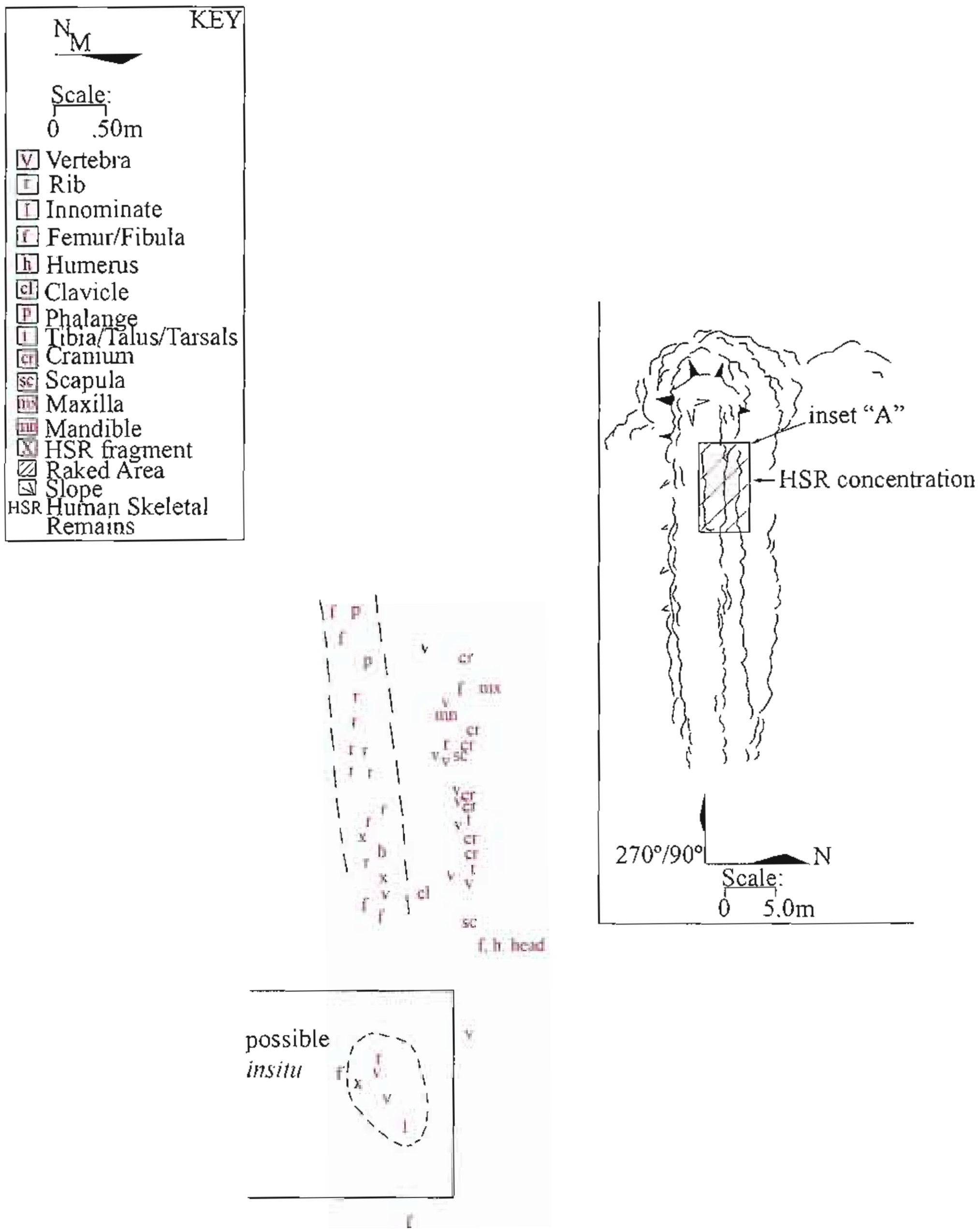


Figure 10. Plan View Map of Site 6679, Feature 4, TU 4

After the discovery of eight individuals from the Features 1-4 area, sand mining activities were relocated to the south central portion of the project area near the western boundary line.

Feature 5

Feature 5 was documented as a secondarily deposited scatter of human skeletal remains identified during monitoring of surface vegetation removal (vegetation grubbing). Upon removal of trees and various plant materials, disturbed skeletal remains comprised of a partial left innominate and tarsals/metatarsals of the left foot were exposed. Four test units (TU1-4); TU1, a 2.0m by 2.0m unit; and TU2- TU4, all 1.0m by 1.0m units, were placed upon the scatter to ascertain if a burial pit outline and/or a primary/*in situ* portion of this feature was present (Figure 11). Test Units 1-3 were negative, and TU 4 contained a human metatarsal in the southwest corner near the base of Layer I at .25 meters below the surface (m bs). The tarsal was entwined in a small root mass indicative that the burial was previously disturbed and encased by the root ball of the tree (floralturbation) and during tree removal or "tree-throw" the metatarsal was exposed and deposited on the surface.

A two-layer stratigraphic sequence was recorded within TU 1-4 (Figure 12). Layer I was a disturbed yellowish brown silty sand with numerous root inclusions and Layer II was a grayish brown silty sand (Grade B), slightly compact recorded from .20-.26 m bs. Due to limited findings within a disturbed layer, Feature 5 was designated as previously disturbed, secondarily deposited remains. Osteological analysis determined that the remains belonged to an older adult male. Sex determination was based on the shape of the sciatic notch and age was based on metamorphosis observed in the auricular and periauricular area, which typically indicates an advanced age. Feature 5 was determined to be previously disturbed but will be preserved in the area where it was discovered (see Figure 8 and Table I).

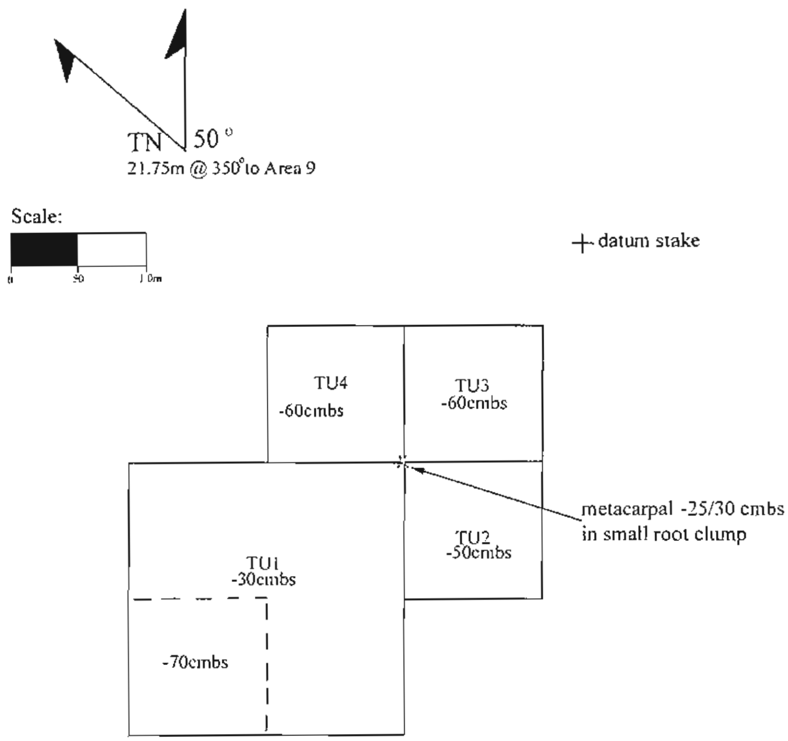


Figure 11. Plan View Map of Site 6679, Feature 5, TU1-4

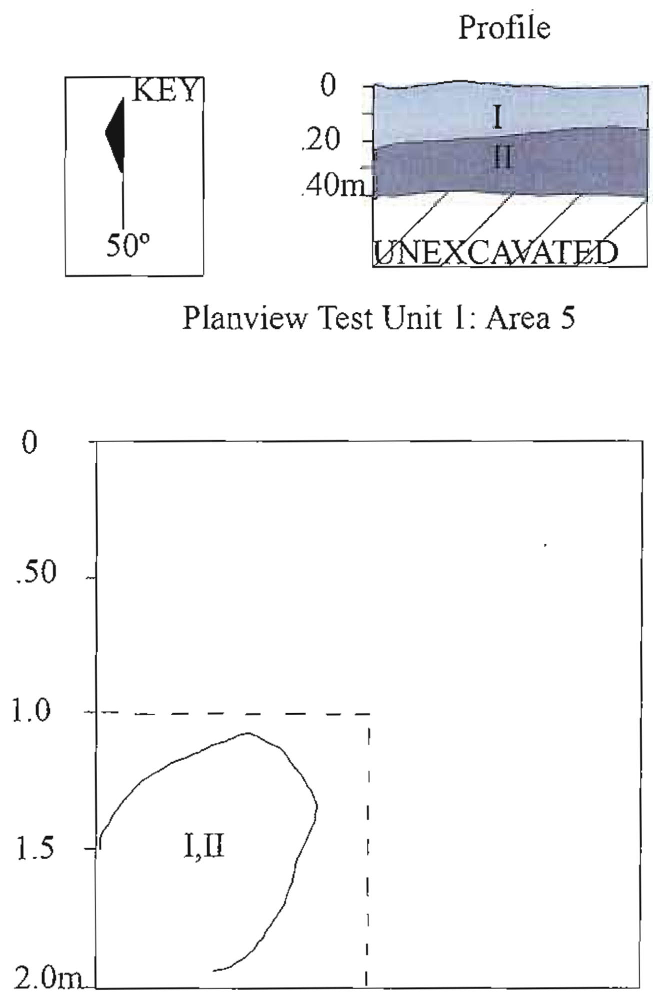


Figure 12. Plan View Map of Site 6679, Feature 5, Test Unit 1

Feature 6

Upon the discovery of Feature 5, a larger area was grubbed of vegetation. As this area contained numerous trees and thick dust, the entire area was grubbed and the archaeologist inspected the area per methods exemplified on Figure 5. During the inspection, several areas of scattered remains and or concentrated human remains were identified and designated as Features 6-10. Each feature area was then investigated separately to ascertain the context of the skeletal remains. Feature 6 was comprised of four cranial fragments located upon the surface at 258 amsl. The area was raked and shovel scraped where no additional remains were identified (Figure 13). Osteological analysis of the remains determined that Feature 6 remains belonged to a child approximately 3 years old. Testing then commenced at the Feature 7 area.

Feature 7

Feature 7 was comprised of a scatter of skeletal remains within a 25.0 m long by 9.0 m wide area, thus a grid system was erected over the spread and was comprised of twenty-four 4.0 m by 4.0 m grid designated TU 1A-X. Initially each grid was raked to ascertain presence absence of skeletal remains. If skeletal remains were present, hand excavations were instituted within that particular grid and some adjoining grids (Figure 13). All material was screened through nested ¼" and 1/8" mesh screens. Definitive sex determination could not be established at this age. Feature 6 will be reinterred in the area where it was discovered and thus preserved in place. Feature 7 is further discussed below.

The testing program documented the surface matrix as the "Grade B" Layer II grayish brown silty sand which contained concreted (ped) "Grade A" inclusions (Layer III) and rootlets throughout. The presence of concreted Layer III peds mottled with Layer II exemplifies a previously disturbed layer. TU 1D and 1E consisted of the above matrix with discontinuous lenses of coarse "Grade A" yellowish brown sand, another indication of disturbance. Test units 1A-J, 1M, 1O, 1U, and 1V were hand-excavated from .20 m-.50 m below the surface to collect all disturbed materials. The disturbed collected remains from the Feature 7 area were comprised of the right innominate, cranial fragments, the right tibia and fibula, ribs, and tarsals and belonged to a child (3 yr +/-12 mos). Age determination was based on dentition (deciduous erupted teeth) and epiphyseal stage of fusion for innominate and long bones (at this age sex is indeterminate). Additionally, the four cranial fragments collected at the Feature 6 area, appear to belong with the Feature 7 assemblage. Through the above testing program, Feature 7 was determined to be previously disturbed and secondarily deposited prior to the Hawaiian Cement grading operations.

Feature 7, along with Feature 6 will be preserved in the area where it was found place in the southern portion of Preservation Area 1 (see Figure 8 and Table I).

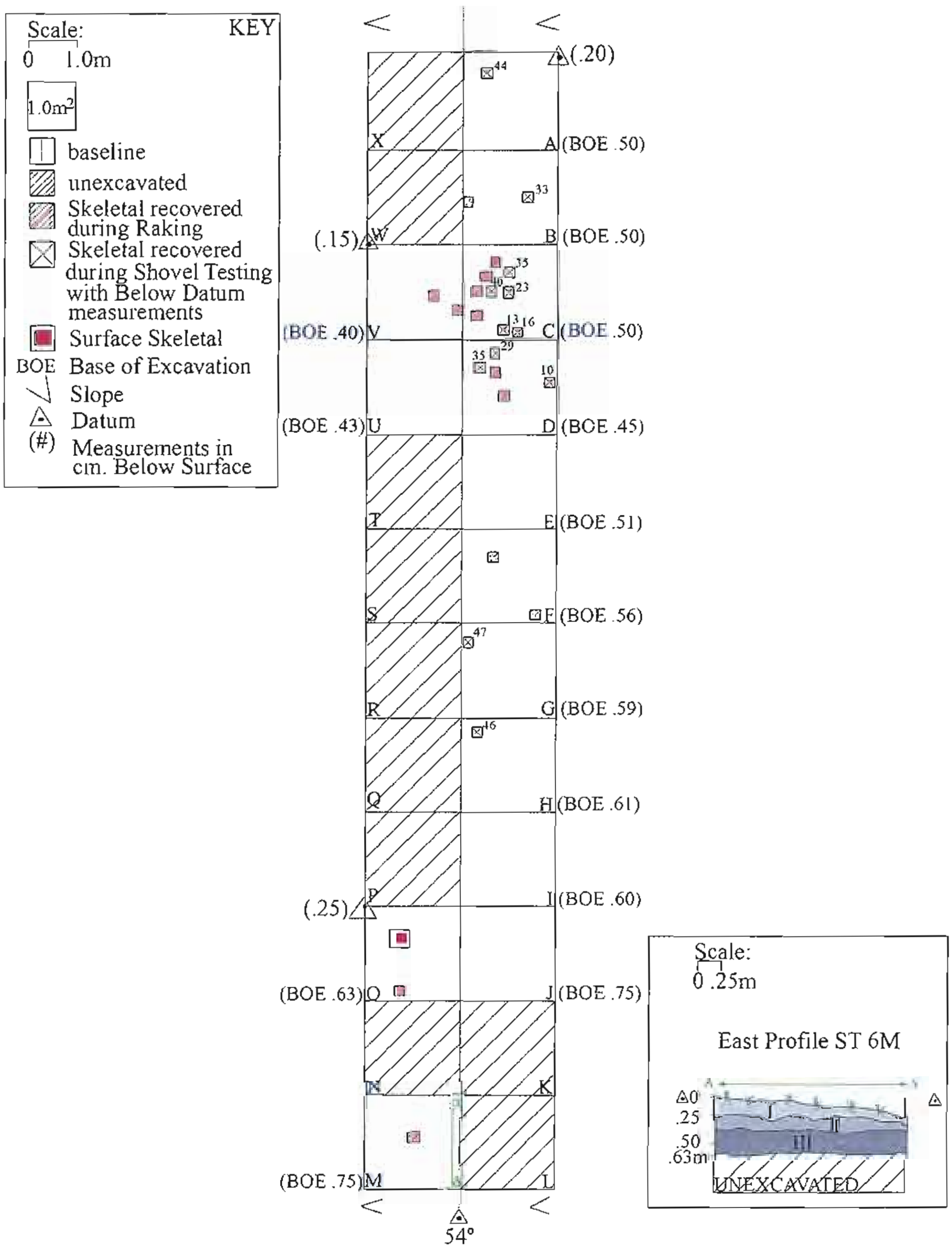


Figure 13. Plan View Map of Testing Grid for Site 6679, Features 6 and 7, TU 1A-X

Feature 8

Feature 8 was identified during the subsequent survey and was comprised of a concentration of small cranial fragments. Minimal testing was initiated, documenting a slightly disturbed cranium articulated with the upper cervical vertebrae. Upon this documentation no further testing was warranted and Feature 8 was designated as a primary *in situ* infant burial. This sand burial was surveyed in at 259 amsl and shall be preserved in place within the southern portion of Phase I.

Feature 9

Feature 9 was identified during the subsequent walk-through of a previously grubbed area which recorded Features 6-10. On the surface, it consisted of cranial fragments and one tooth within a possible burial pit outline (Figure 14). A 1.0 by 1.0 m test unit was placed over the surficial skeletal remains (cranial and tooth) and as excavations proceeded, a partially intact, fragmented in place, primary burial feature was documented from .15 m to .28 m bs (Figure 15). Feature 9 was within a burial pit (259 amsl) defined by a darker sandy loam soil (10YR ¾) with numerous root inclusions. Although Feature 9 was disturbed, it was positioned anatomically correct for a flexed burial. Collected displaced remains consisted of cervical vertebrae, ribs, humerus, ulna, fibula, tibia and maxillae. Analysis of these remains determined that Feature 9 is a middle adult individual where age was based on minimal occlusal wear of recovered permanent teeth. Due to the fragmentary condition, Diagnostic criteria used to determine sex was not definitive enough from *in situ* portion of remains to correctly identify sex. Feature 9 is a partially intact, primary burial which had been previously and recently (minimal) disturbed and shall be preserved in place within the southern portion of Preservation Area 1 (see Figure 8 and Table I).

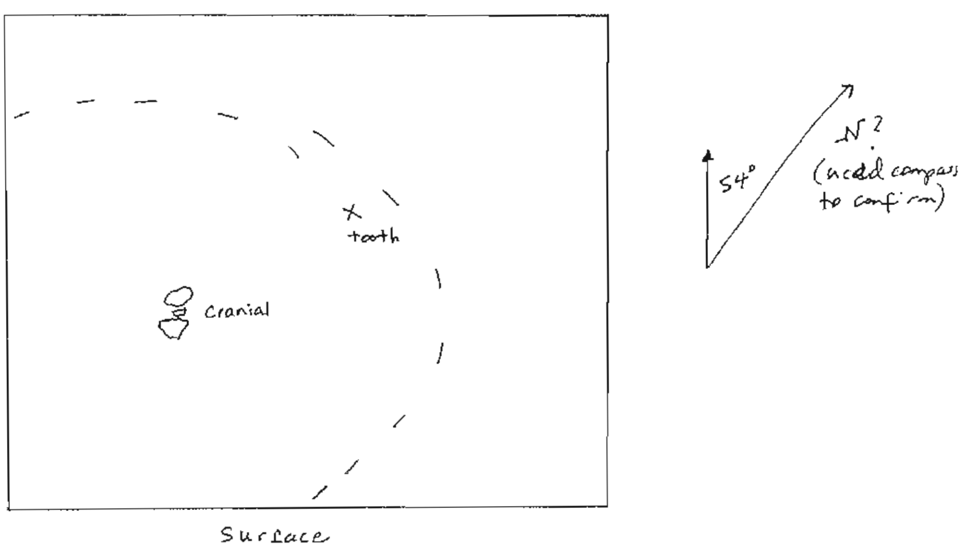


Figure 14. Plan View Map of Site 6679, Feature 9, Surface of TU 1

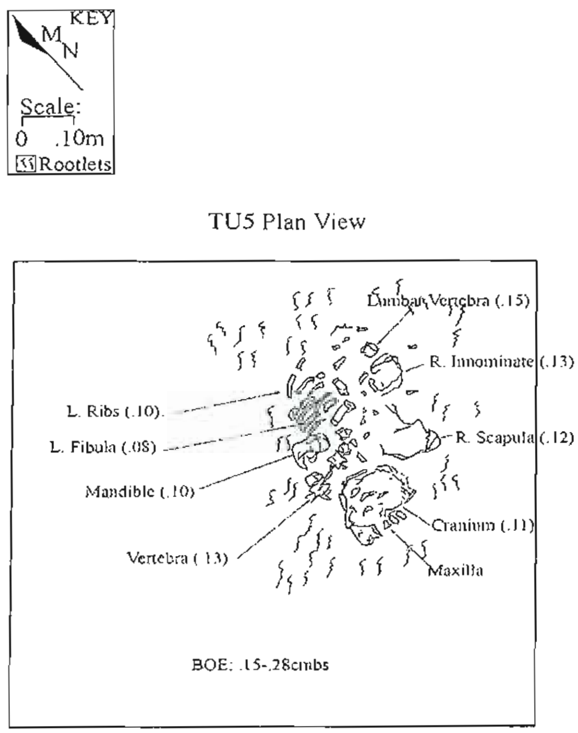


Figure 15. Plan View Map of Site 6679, Feature 9, .15-.28 mbs of TU 1

Feature 10

Feature 10 was also identified during the field inspection of the south central portion of the project area. It consisted of displaced remains within a 21.0 m long by 6.0 m wide swath. To determine nature and extent of the remains, a baseline was set up and a grid system erected consisting of 19-2.0 by 2.0 m test units (TU) (Figure 16). All TUs were initially raked, and 8 were hand-excavated. Testing resulted in the identification of a dense root zone .05-.20 m bs (indicative of prior disturbances) and secondarily deposited skeletal remains consisting primarily of unidentifiable skeletal remains from a child. Blade testing and a second grid system was erected in the area and secondarily deposited skeletal remains comprised of a clavicle, metatarsal, sacrum fragment, cranial fragments and various unidentifiable human skeletal remains were collected from TU2 b, c, l, r and z (Figure 17). Faunal remains comprised of rat or mice were also recovered from the hand testing. Analysis of the osteological assemblage determined that the skeletal remains belonged to a child approximately 3+/- 12 months of age. Estimated age was based on observation of erupted deciduous teeth. Diagnostic traits indicating sex could not be established at this age. The skeletal remains from the Feature 10 area were assessed with the Features 6 and 7 assemblage and were determined to be from the same individual. Thus, Features 6, 7 and 10 are from the same child and shall be preserved together within this south central area.

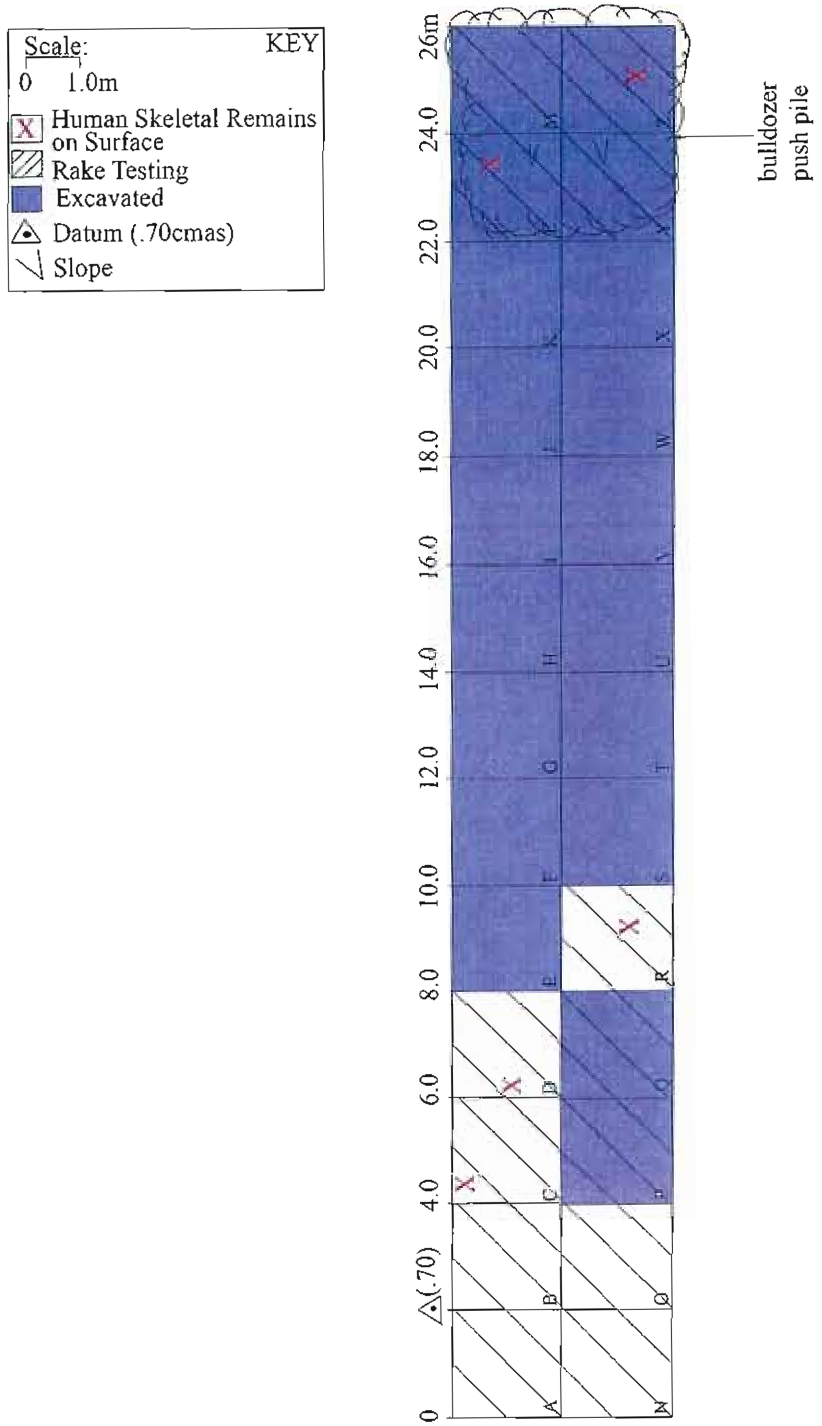


Figure 16. Plan View Map of Grid System, Site 6679, Feature 10, TU 1a-s.

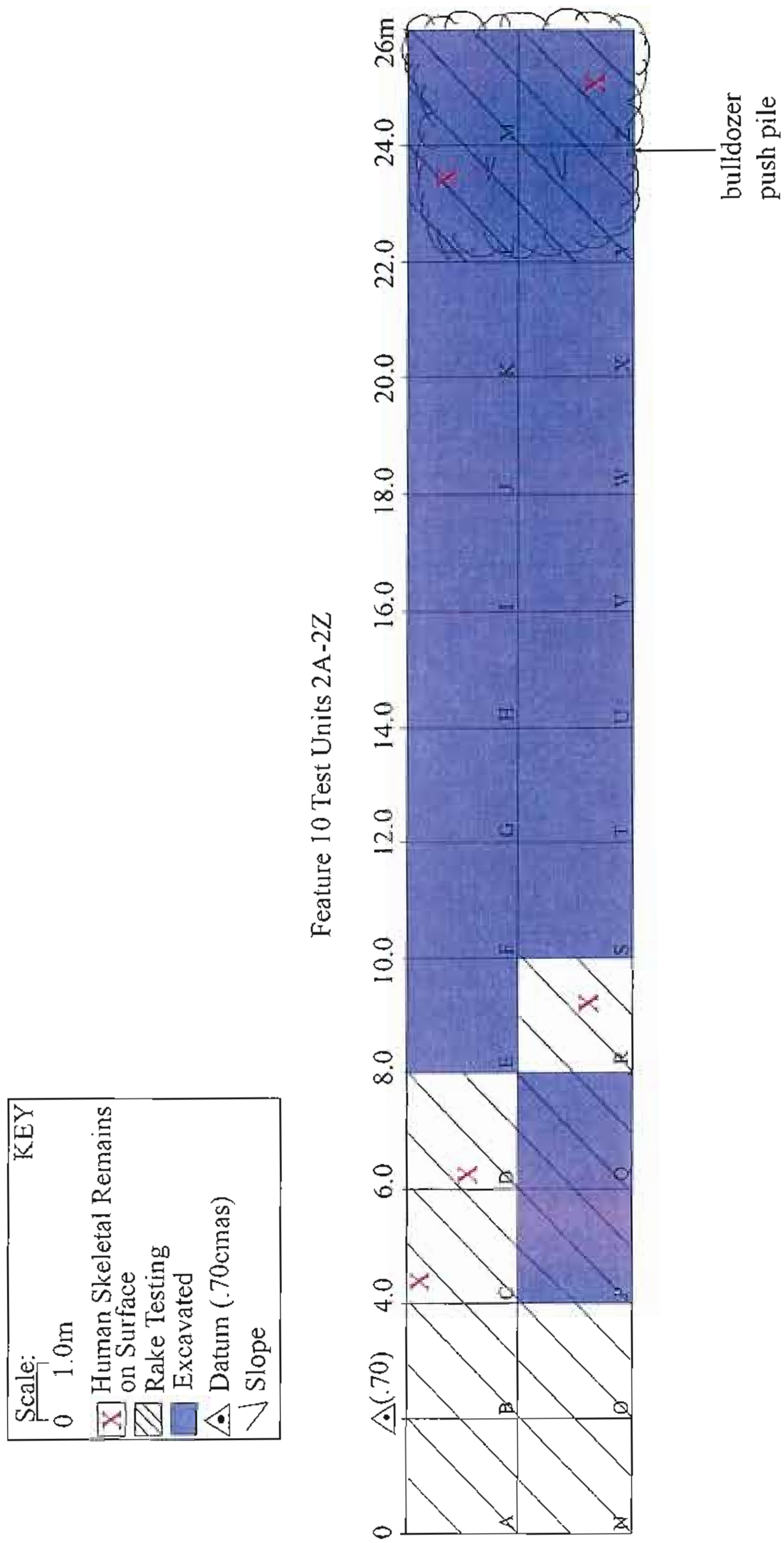


Figure 17. Plan View Map of Second Grid System, Site 6679, Feature 10, TU 2a-z

Feature 11

Feature 11 was identified after vegetation grubbing of the southeastern perimeter. It consisted of a scatter of human skeletal remains. Three-1.0 m by 1.0 m test units (TU 1a-c) were placed over and adjacent to the surficial scatter. Results from the testing identified concentrated secondarily deposited skeletal remains within TU 1a while TU 1b and 1c were negative (Figure 18). The skeletal remains, though concentrated, were not articulated and appeared to have been re-buried but not in a cultural context (i.e. construction workers). Analysis of the osteological assemblage documented the remains as a robust middle adult male approximately 35 years of age. The remains were primarily from the right side of the individual, however a few tarsals and metatarsals from the left side were collected. Since portions of the right side of Feature 11 were collected, this individual may have originally been buried on their left side, thus the right side would have endured the majority of the disturbance. Based on this presumption, it is possible that a portion of the left side may still be in situ within the nearby vicinity. Since this south central section will be preserved, no further testing was warranted for the Feature 11. The age of Feature 11 was determined by dentition (moderate occlusal wear on the teeth). Criteria used to determine sex included the shape of the sciatic notch, and size of clavicle and femoral head. Feature 11 was a previously disturbed secondarily deposited burial. The skeletal remains of Feature 11 shall be preserved within the area where identified, the south central portion of Preservation Area 1 (see Figure 8 and Table I).

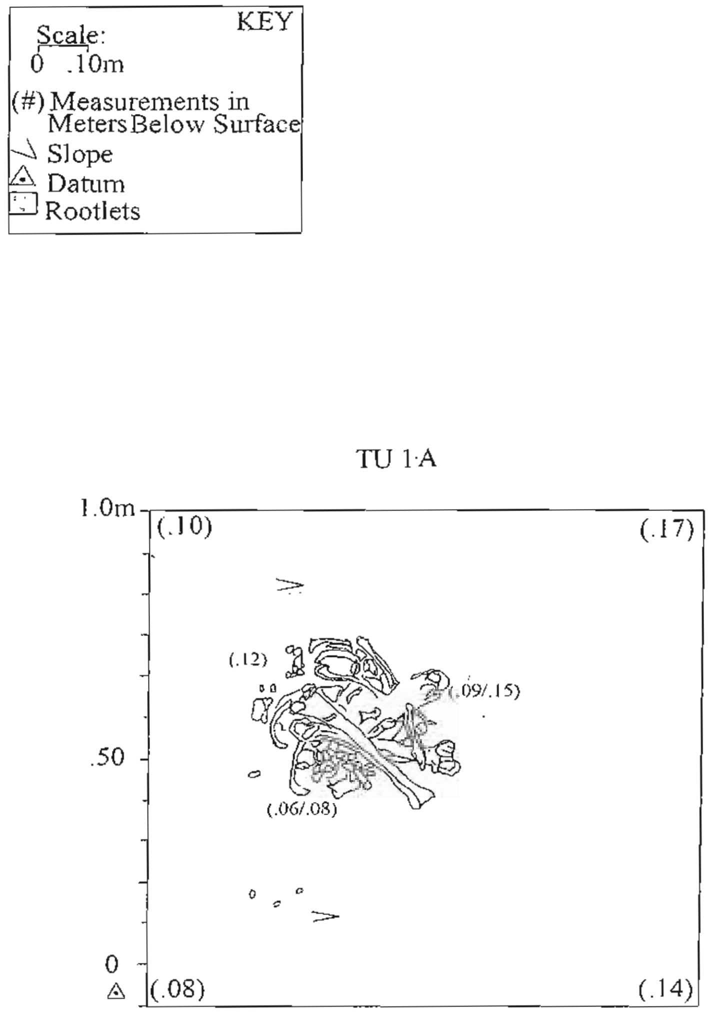


Figure 18. Plan View Map of Feature 11, TU 1a.

Additional Testing at Features 5-11

Features 5-7 and 10-11 were documented as previously disturbed secondarily deposited human skeletal remains as well as partially intact primary burial features. Each locality incurred varying degrees of disturbance. Due to the pervasiveness of these disturbances, additional testing was instituted to ascertain the vertical and horizontal extent of these former disturbances. The testing program consisted of blade testing mentioned in the methods and procedure section. Blade testing consists of large, broad swaths that are graded down to a sterile level. The dozer grades/excavates the swath in 4-6 inch controlled increments while the archaeologist monitors each pass. Five blade tests were conducted to determine the presence/absence of additional subsurface cultural remains resulting in the discovery of Features 12-14. The results are listed below.

Features 12a and 12b

Feature 12a was identified during Blade Test 2 upon the knoll adjacent and west of the Feature 5. Upon the exposure of skeletal remains at the base of the trench (approximately 3.5-4.0 m bs) and in the dozer tailings, mechanical testing was halted and raking of the trench floor and stockpile as well as hand excavations were initiated. A 1.0m by 1.0m test unit was placed over the skeletal remains and identified a primary *in situ* burial at 255-elevation amsl. The burial was placed face down with legs fully flexed in a defined burial pit. The pit was composed of numerous rootlets and measured .85 m long by .55 m wide, oriented at 180 degrees extending outside of the test unit (Figure 19). Minimal disturbance occurred along the right humerus, right scapula, cervical vertebrae and a few ribs. Feature 12a was assessed as an infant 12 mos+/- 6 mos based on deciduous teeth. Definitive sex determination could not be established at this age.

During the raking and testing procedures, as well as inspection of the trench walls, two additional features were identified and designated Features 12b and 13. Feature 12b consisted of a possible burial pit outline containing sand mixed with clay peds and a water worn basalt cobble and is situated approximately .20 m east of Feature 12a. Due to its close proximity to a known primary burial feature, no testing was conducted at Feature 12b, however based on the presence of clay peds mixed within the sand, Feature 12b is likely a primary clay pit burial feature. Feature 13 was documented in the north wall of Blade Test 2 and is further discussed below. Feature 12a was determined to be a partially intact, primary burial that was recently disturbed. Feature 12b was designated as a possible burial pit and along with Feature 12a, shall be preserved in place within the southern portion of Preservation Area 1.

Feature 13

Feature 13 comprised of disturbed skeletal remains was noted in the north wall of Blade Test 2 from .20-.27 m bs (Figure 20). A 1.3 m by 1.0 m test unit was hand excavated to a maximum depth of .67 m bs where no additional skeletal remains were collected, however clay peds were again noted within the sand matrix. Minimal skeletal remains (cranial and long bone fragments) were collected from a disturbed context and no primary burial feature or pit outline was noted during the testing. Feature 13 will be reinterred within the area it was found and preserved in placed within Preservation Area 1.

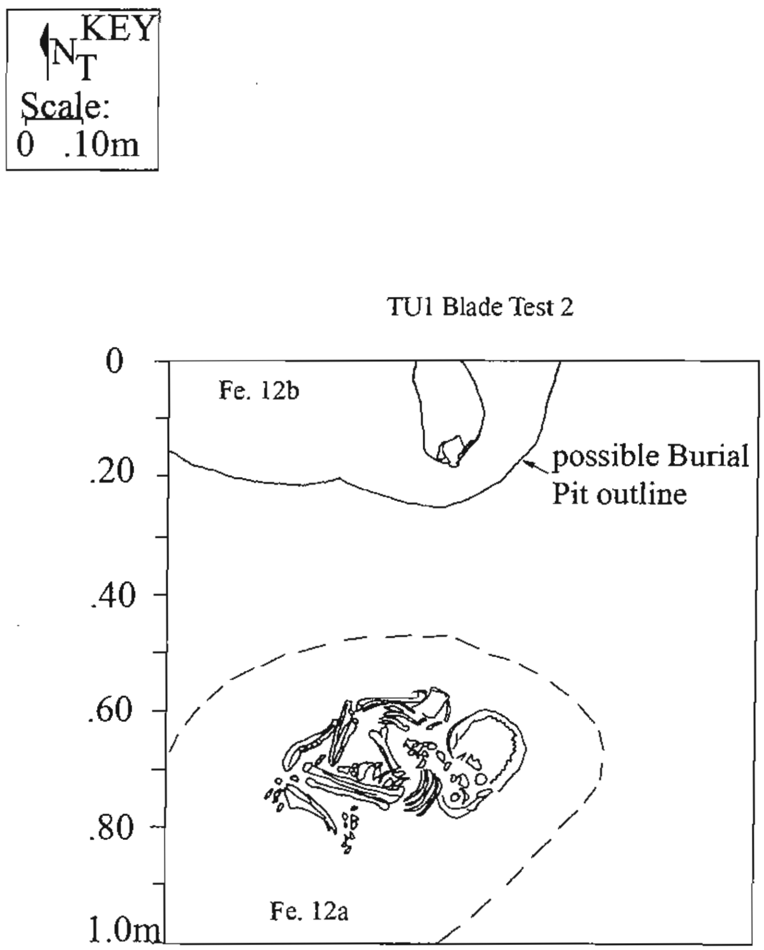


Figure 19. Plan View Map of Site 6679, Features 12a and 12b, TU 1a

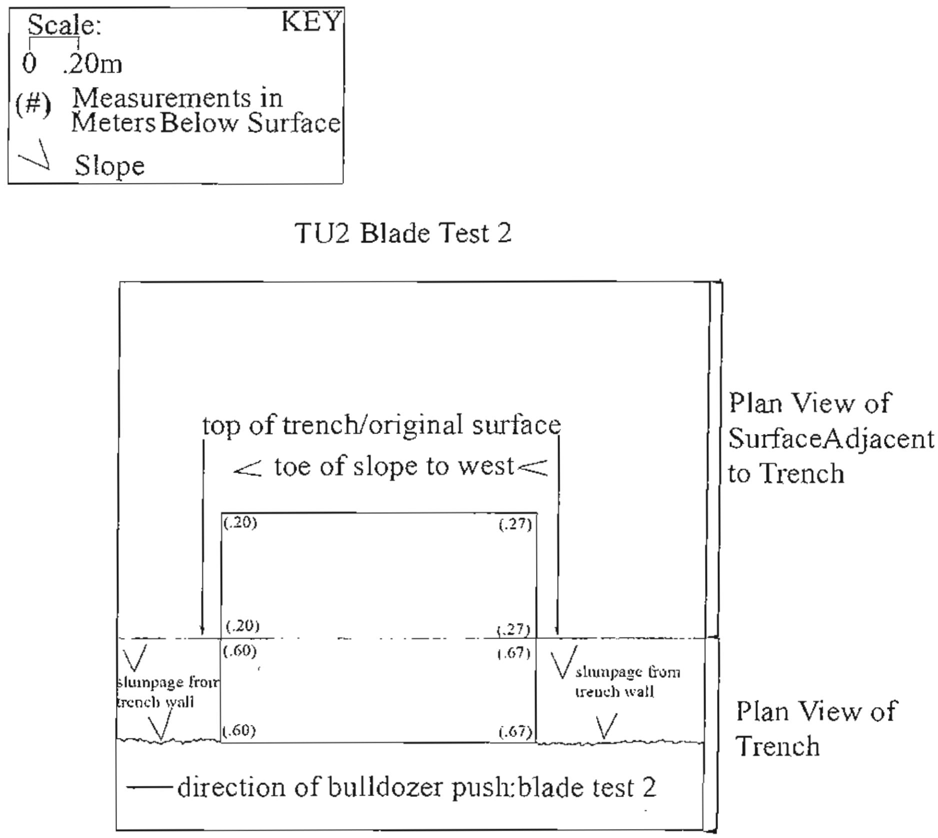


Figure 20. Plan View Map of Site 6679, Shove Test TU1, Feature 13

Features 14a and 14b

Feature 14a was identified on the floor of Blade Test 1 at approximately 1.20 m bs and was comprised a few ribs which appeared to be disturbed (Figure 21). An initial 1.0 by .50 m test unit (TU 1A) was placed over the ribs to determine the context of the human remains. This unit was eventually expanded into a 1.0 by 1.0 m unit and subsequent additional test units (TU1B-D) were placed adjacent to TU1A. Thus, a total of four-contiguous 1.0m by 1.0 m test units (TU 1A-D) were undertaken on and around Feature 14 documenting disturbed soils and skeletal remains as well as three pit outlines, one of which was designated Feature 14b. These disturbed skeletal remains (which constitute 25% of the individual) consisted of scapulae, a mandible, ribs, vertebrae, rt. innominate, rt. patella and bones from the hands and rt. foot (Figure 22). Within TU1 A-D, an initial pit outline was recorded from .70-.83 m bs and the disturbed remains were observed from .80-1.20 m bs (Figure 23). As excavations proceeded downward, displaced remains (which lacked long bones) were collected within each subsequent level displaying no articulation or purposeful arrangement. The initial burial pit, oriented at 110 degrees, was clearly distinct on the southeastern side where it becomes obscure and indistinct on the south and west and is completely obliterated to the north and northeastern sides. Based on the intact portions, this initial pit appeared to measure 2.10 m long by 1.20 m wide. The subsequent lower pit identified from 1.05 to 1.22 m bs appeared to measure 1.60 m long by 1.00 m wide and was oriented at 120 degrees (see Figure 23). This lower pit contained fill that was a light grayish-brown silty sand with a high root content and both disturbed and primary skeletal remains of Feature 14 comprised of two ribs, a portion of a cranium, innominate and an articulated left foot (Figure 24). Osteological analysis determined the remains belonged to a middle adult male individual. Sex determination was based on the shape of the sciatic notch and mandible. Estimated age was based on moderate occlusal wear. The third possible pit outline was located within TU1D extension at 1.30 m bs along the northeast and southwest edges of the unit. Due to its close proximity to Feature 14, this possible pit was not investigated but was designated as Feature 14b.

Feature 14 has been designated as a partially intact (articulated left foot within burial pit) burial feature that was previously and recently disturbed. Due to the absence of long bones, the skeletal remains may have been disturbed in a cultural context possibly for bone acquisition. As previously discussed, disturbed skeletal remains were collected from successive layers (.80-1.20 m bs) within an upper and lower burial pit outline. The collected remains comprise approximately 25% of this individual with a notable lack of long bones being identified and or recovered. The upper burial pit outline likely represents the intrusion into this burial pit either during traditional times (for bone reclamation), or during a more recent activity such as a pit excavated by construction workers for reburial of the disturbed remains. The soil profile also indicates various episodes of previous disturbances with mixed Layers II and III and an inverted stratigraphy with Layer III (yellowish brown coarse Grade A sand) overlying Layer II (Figure 25). The proposed treatment for Features 14 and 14 b shall be preservation in place within this southern portion of Preservation Area 1.

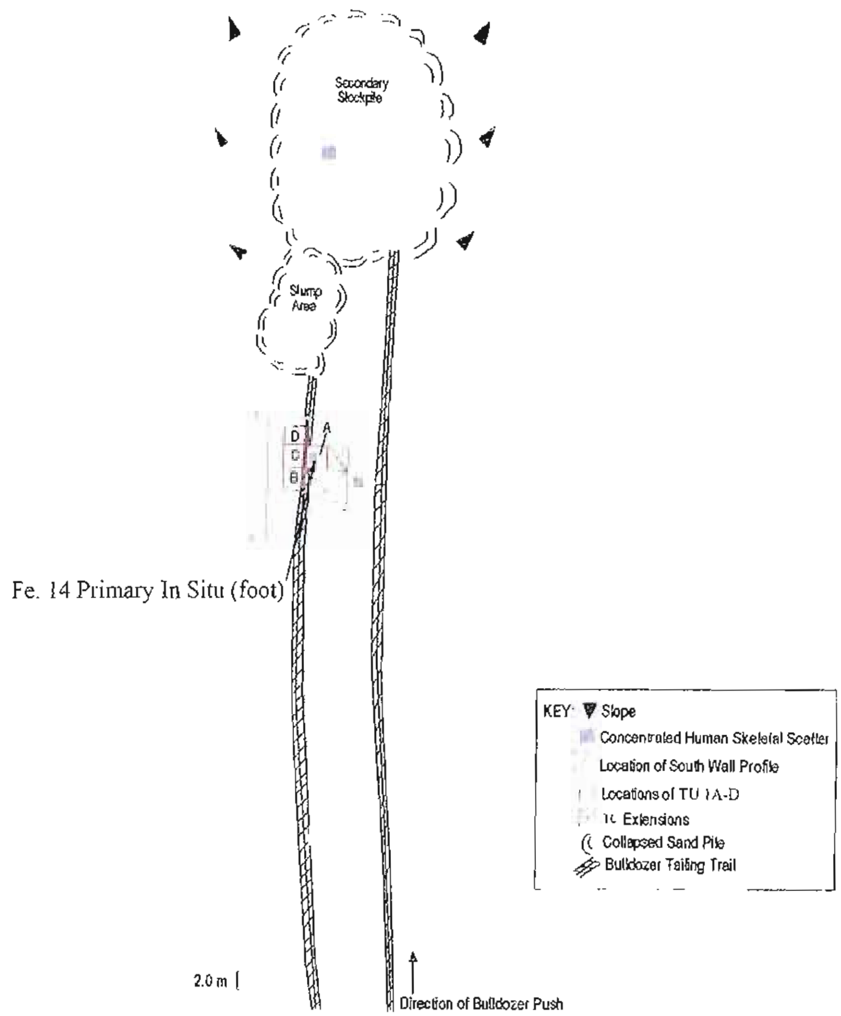


Figure 21. Plan View Map of Site 6679, Blade Test 1, Feature 14, Showing TU1A-D

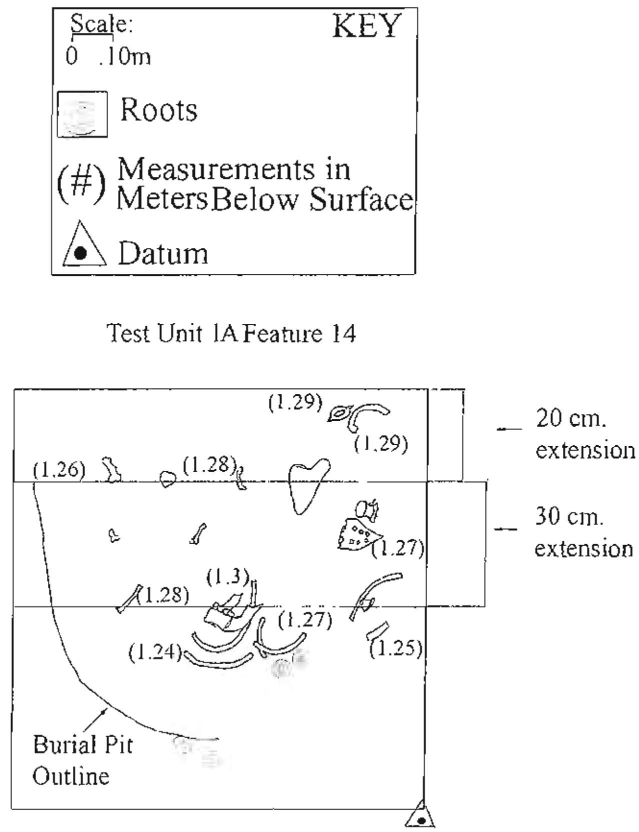


Figure 22. Plan View Map of Site 6679, Blade Test 1, Feature 14a, Test Unit 1a

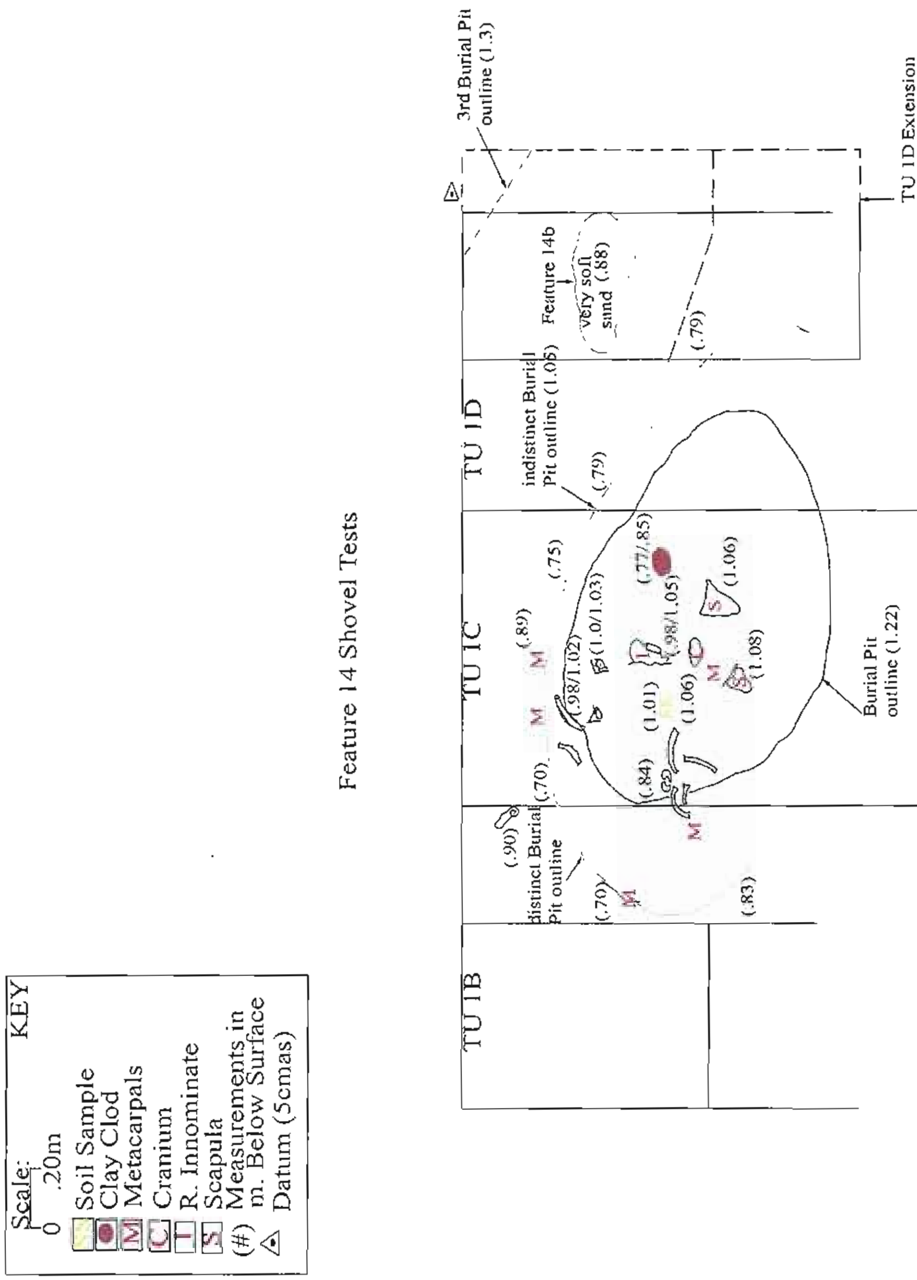


Figure 23. Plan View Map of Feature 14 testing Showing Test Units 1A-D

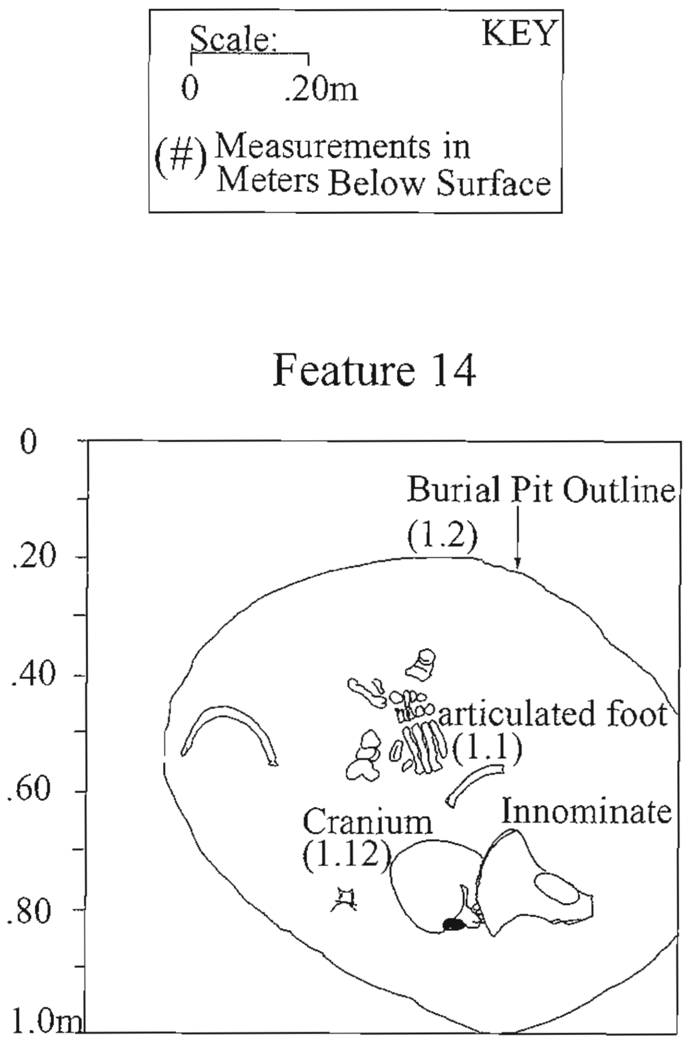
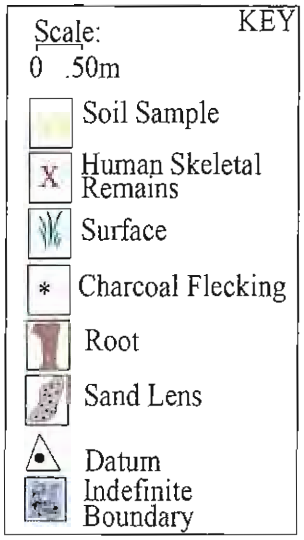


Figure 24. Plan View Map of STU 12 Showing Articulation of Left Foot, Feature 14



Feature 14 Burial Pit #2, Blade Test #1 South Profile

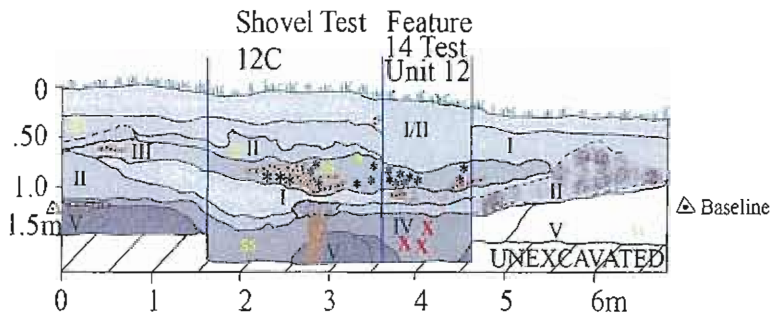


Figure 25. Stratigraphic Profile of South Wall Blade Test 2 Showing Location of Site 6679 Feature 14

Due to the documentation of intensive and extensive disturbances across this knoll top, along with the discovery of secondarily deposited skeletal remains and partially intact primary burial features, grading activities were relocated back to the northern portion of the project area west of Features 1-4.

Feature 15

Feature 15 was inadvertently exposed while cutting "Grade B" aeolian sand near the base of the dune. As the D-9 pushed material into the sand stockpile, skeletal remains comprised of long-bones and tarsals from both feet were identified. All mechanical grading was stopped and the archaeologist walked the dozer track to determine presence absence of additional skeletal remains. At the beginning of the cut, articulated clavicles and one phalange was identified and a 1.0 m by 1.0 m test unit (TU1) was placed over the concentration documenting the grayish brown

(Grade B) sand mixed with coarse concreted peds (probable pitfill). At .05 m bs, a distinct burial pit outline excavated into the lithified (Grade A) yellowish-brown coarse sand was identified. Excavations continued and additional articulated skeletal remains were documented to .11 m bs and consisted of the left arm, a few carpals, ribs, scapula and vertebrae. No additional human remains were identified in TU 1 except for a disturbed, proximal end of a humerus. Based on the position of these articulated remains, Feature 15 was placed on their right side in a flexed position and situated at 215 amsl (Figure 26).

Laboratory analysis of the skeletal remains documented a robust young adult male approximately 30 years of age. Sex was determined by the robusticity of the skeletal remains (specifically the long bones, brow ridge and gonial angle) and the sciatic notch of the left innominate. Estimated age was determined through minimal occlusal wear, cranial suture closure and the fusion of the clavicle (epiphyses). Feature 15 was determined to be a primary partial *in situ* burial which was recently disturbed and will be preserved in place within the northwestern portion of Preservation

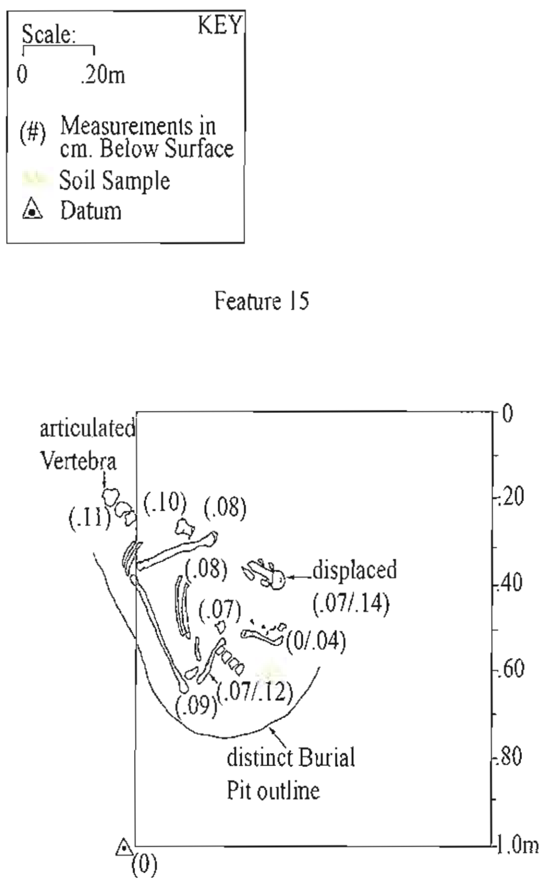


Figure 26. Plan View Map of Site 6679, Feature 15

Feature 16

Feature observed during monitoring of sand mining activities near the toe of the extant dune. As the dozer was grading sand into a stockpile, displaced skeletal remains were observed within the dozer track near the stock pile. Once skeletal remains were exposed, a 50.0 m baseline was erected to ascertain the context of the skeletal remains (primary or secondary) (Figure 27). Two areas of concentrated remains were noted that required further exploration. The first area was along the push pile and the second was at the beginning of the dozer track. The stockpile area was raked and screened and all disturbed skeletal remains (cervical vertebrae, a carpal, and fragments of the innominate and sacrum) were collected. A 2.0 m by 2.0 m test unit (TU 1) was excavated over the skeletal remains and possible pit at the beginning of the track. During the testing a recently disturbed primary burial was documented from .01-.10 m bs within a distinct pit and designated Feature 16a (see Figures 28 and 29). The burial pit was comprised of a pale brown sand surrounded by a yellowish brown almost cemented sand. It measured 1.30 m long by .70 m wide and was oriented 210 degrees. Within the pit, the burial was flexed, placed on its stomach with legs tilted to the left and the fragmented cranium appeared face-up (see Figure 28). While shovel scraping around TU 1, a second possible pit was noted adjacent and east of Feature 16 and temporarily designated Feature 16b. This pit also contained a pale brown sand with numerous roots and measured 1.20 m long by .60 m wide and oriented at 342 degrees. TU 1 was expanded an additional 1.0 m to the east to test Feature 16b where no skeletal remains were documented and excavations terminated at .23 m bs (see Figure 30). Due to a lack of cultural materials, Feature 16b is likely a depression from a former tree.

Based on the above, Feature 16 is a primary burial of a young adult male that was recently disturbed. Sex was determined by the shape of the gonial angle and size of brow ridge and mastoid process and Age was based on dentition (minimal occlusal wear). Features 16 and the anomalous pit shall be preserved in place within the northwestern portion of Preserve Area 1 see Figure 8 and Table I.

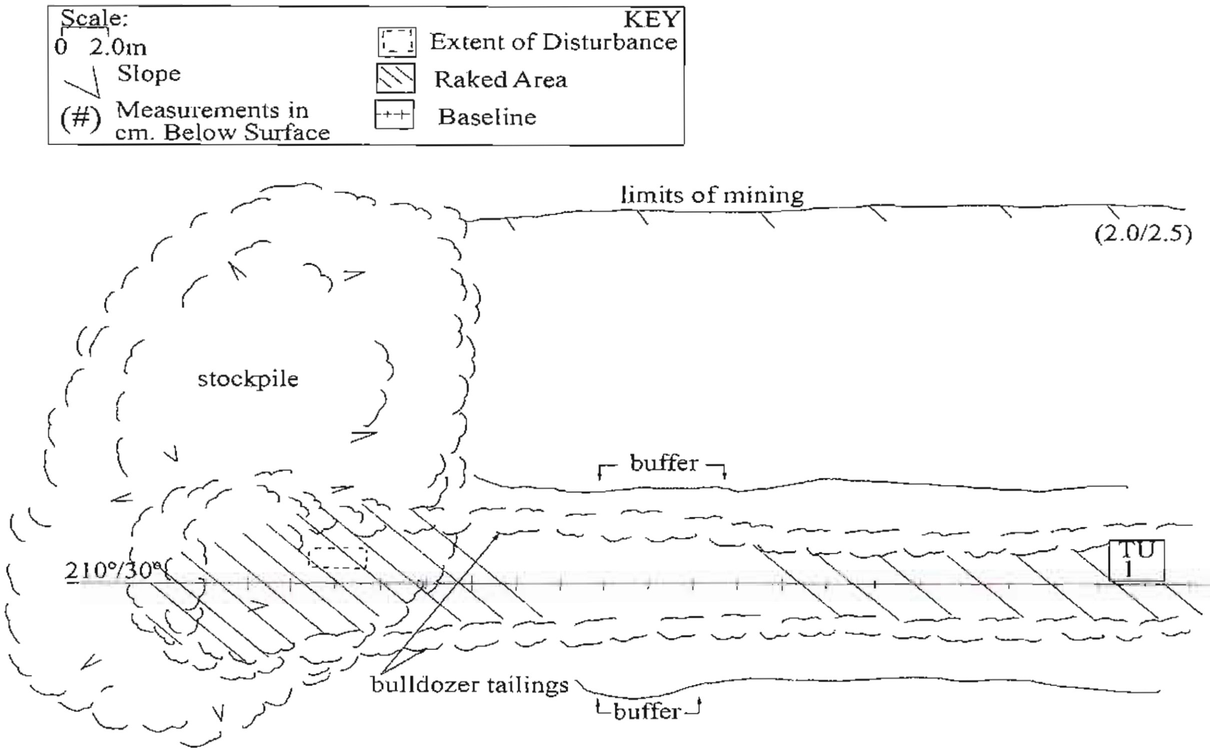


Figure 27. Plan View Map of Scatter for Site 6679, Feature 16, TU 1

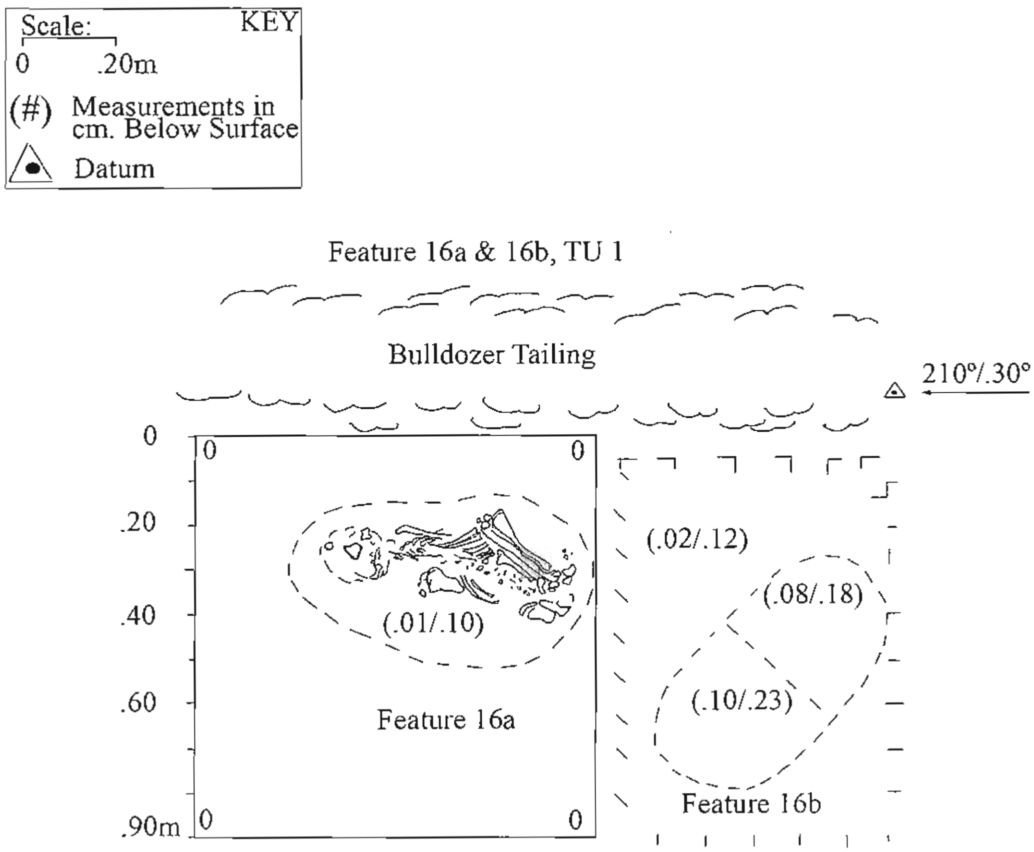


Figure 28. Plan View Map of site 6679, Features 16a and 16b, Test Unit 1

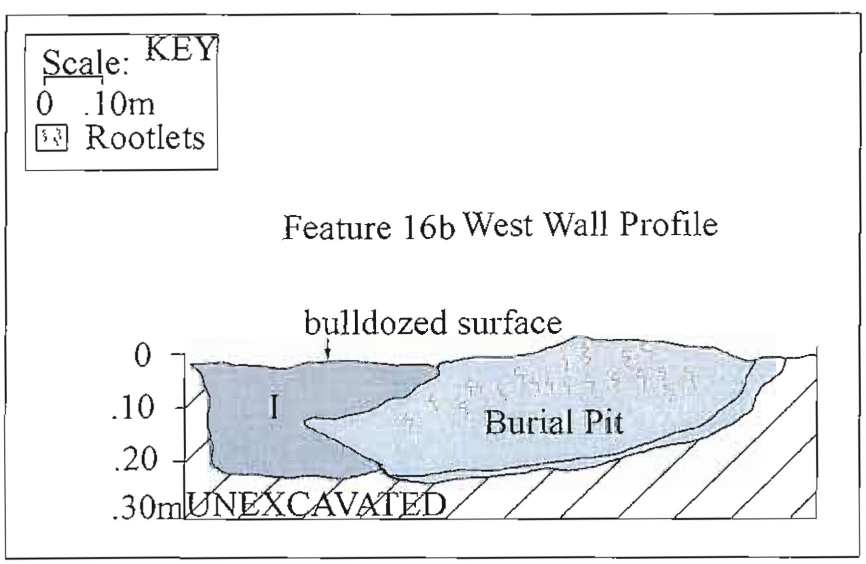


Figure 29. Profile of West Wall, Site 6679, Feature 16b

Feature 17a and b

Feature 17a was originally identified during a field inspection after an intense rain storm. Water flowed through the floor/graded surface of the project area exposing and re-depositing human remains along the sandy clay surface. A baseline approximately 40.0 m long was erected along these re-deposited materials and all clearly displaced remains were collected and consisted of ribs, carpals and phalanges from both hands, long bones of both arms except for left ulna, portions of the maxillae, mandible and cranium (Figure 30). While documenting the disturbance only the right scapula, a few cervical vertebrae and portions of the clavicles were still articulated within the sand burial pit and designated as Feature 17a. The collected displaced remains from Feature 17a belong to a young adult female. Sex was determined by the shape of the gonial angle as well as size of remains. Estimated age was determined through the dentition, cranial suture closure and observation of epiphyseal closure of the long bones. Feature 17a was determined to be a recently disturbed primary burial feature that will be preserved within Preservation Area 1.

After a subsequent storm, additional skeletal remains were dispersed along the floor of the pit and a concentration of skeletal remains was noted within the clay adjacent to Feature 17a (which is a sand burial). After the skeletal remains were documented along the baseline, a 2.0m by 1.0m test unit (TU 2) was excavated over the new concentration (Figure 31). A defined burial pit within the Layer IV clay was apparent at .26 m bs, measured 1.0 m long by .60 m wide and was oriented at 20 degrees. An articulated right femur and foot were identified at .23 m bs and this burial was designated as Feature 17b (Figure 33). As excavations continued, the burial extended outside the boundaries of TU 2, thus another test unit was excavated along the north side of TU 2 exposing the upper torso of Feature 17b. The testing documented a clay pit burial placed on its left side flexed with right arms extended down the side. Bird bone was noted just outside the burial pit along the northeast side of the cranium. Feature 17b is a middle adult male that was disturbed by the storm wash along the right innominate and ribs. Sex was determined by the shape of the sciatic notch and size of femoral and humeral head. Estimated age was based on cranial suture closure as well as observation of moderate occlusal wear of dentition. The faunal remains comprised of bird bone were likely a grave good that was slightly displaced from the burial pit by rushing water. Feature 17b (a clay pit burial) was recently disturbed and will be preserved in place in the northern section of Preservation Area 1 (see Figure 8 and Table I).

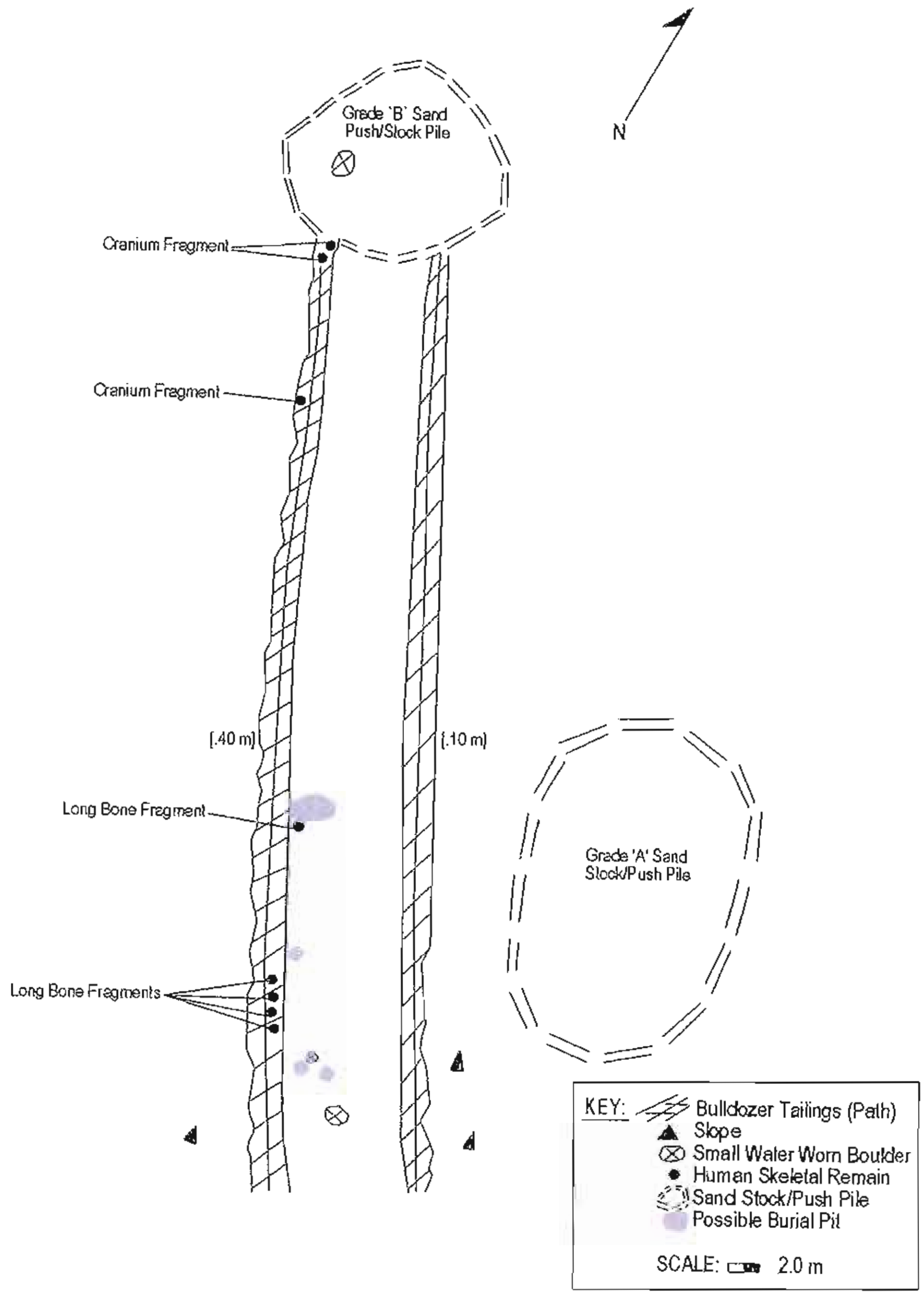


Figure 30. Plan View Map of Surface Scatter, Feature 17

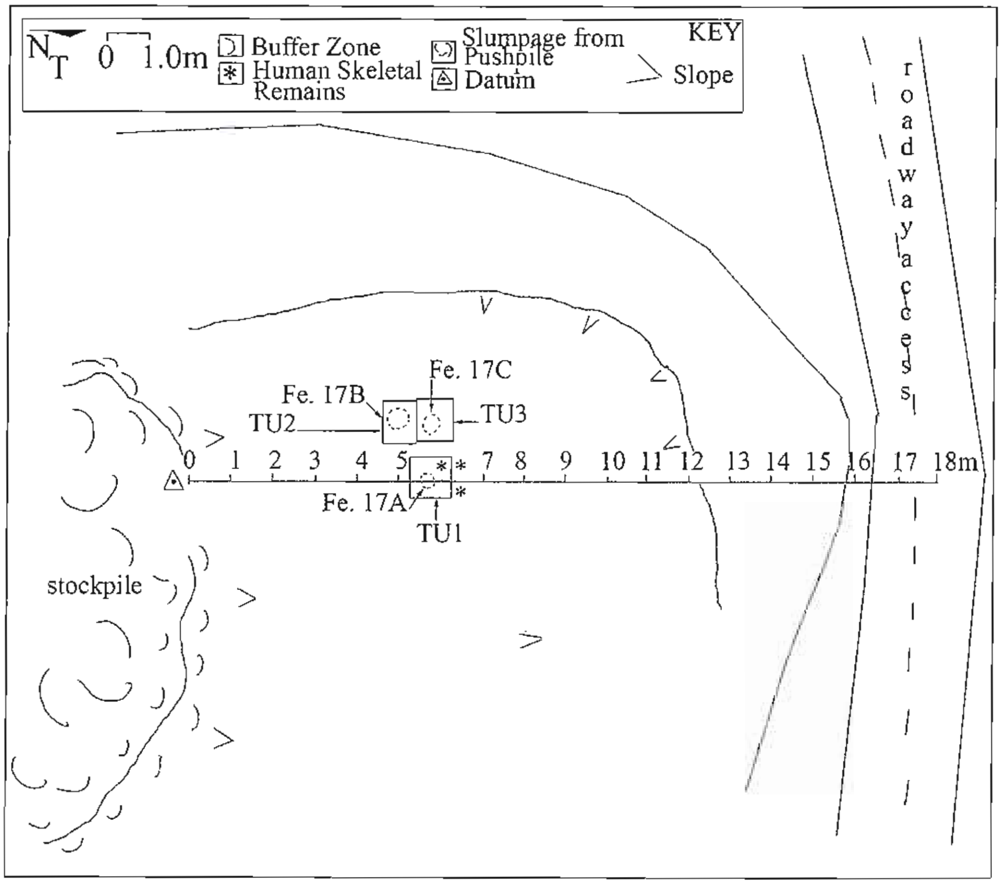


Figure 31. Plan View Map Showing Test Units 1-3 for Site 6679 Features 17a and b

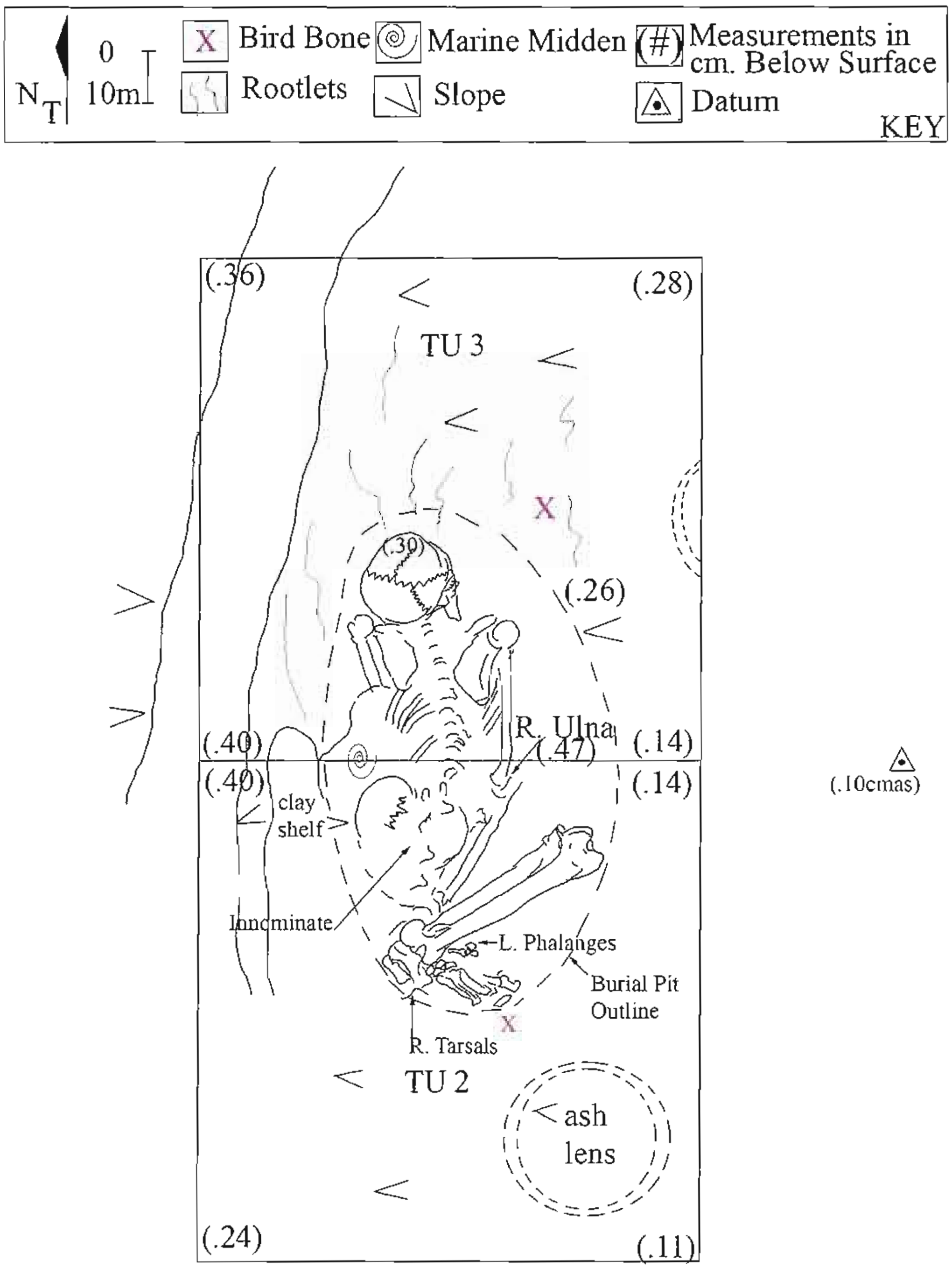


Figure 32. Plan View Map of Site 6679, Feature 17b, Clay Pit Burial, TU 2 and 3

Upon the discovery of Features 15-17 in the northern portion of the project area, sand mining activities were relocated to the center of the Phase A.

Feature 18a-d

Features 18a-d were identified during monitoring of grading activities within the central portion of Phase A. The features are situated along the slope near the top of the dune adjacent to future Features 33a-c (Figure 33). Burial feature 18a was first observed because a distinct pit outline measuring 1.00 m long by .60 m wide was identified within the yellowish-brown "Grade A" sand. The pit contained a light yellowish grey silty sand with a high root content, and was clearly evident within the yellowish gold sand. Upon identification of the pit all mechanical dozing ceased and the area was examined documenting two additional potential burial pits (Features 18b and 18c). A 2.0 by 2.0 m test unit was placed over Feature 18a documenting a primary *in situ* burial placed on its back, flexed with legs and cranium tilted towards the right side. The left arm was flexed crossing over the torso to the right clavicle, and the right arm extended along the right side where the right hand is adjacent to right innominate (Figure 34). A lithifiied sandstone cobble was noted on the sternum and may have been a burial marker and or part of a burial capstone. Displaced remains consisted of the right leg long bones, tarsals of the left foot and the frontal piece of cranium. Feature 18a is designated as a recently disturbed primary burial of a young adult female situated at 237 amsl. Sex was established by size of humeral head and clavicle.

The second burial pit, Feature18b, was adjacent and north of Feature 18a measuring .50 m (e/w) by .40 m (n/s).contained two lithified slabs and one tarsal belonging to a child which was documented at .17 cm below the surface of the pit (see Figure 34). No other remains were observed at this depth, and due to the determination that Feature18b was cultural, no other excavations were warranted and Feature 18b is presumed to be a primary *in situ* burial of a child. Estimated age was preliminarily based on the size of the tarsal.

Feature 18c is a defined pit within the lithified "Grade A" sand which measured .94 m by .94 m (Figure 35). A 1.0 by 1.0 m test unit was placed over the burial pit, however after excavations commenced, the pit became larger and at .40 m bs bootlegs to the east, thus the unit was expanded subsurface following the excavated pit. At 1.77 m bd, the western portion of the pit (which is on the downslope side) terminates on concreted sand creating a shelf as the eastern portion of the pit continues downward (Figure 36). And organic deposit of reddish brown silty clay was noted on the lithified sand shelf and likely represents a purposeful preparation of a step for access to the burial below. This cultural manifestation was noted at another deep burial pit at the Maui Lani development burial TS 9. Test excavations at TS9 noted that each lithified step or shelf contained a layer of clay loam deposit which was surmised to prevent erosion of the lithified sand during continuous access on the steps. Excavations along the eastern side of the Feature 18c burial pit noted the occipital portion of the cranium at 1.62 m bs with the remainder of the burial situated at 1.70-1.77 m bs. The base of the pit was documented at 1.82 m bs and measured 1.05 m long by .45 m wide. The burial pit in its entirety measured 1.09 m long by .87 m wide including the western shelf/step. Although the burial was not fully exposed, excavations showed that Feature 18c was placed on their right side, fully flexed with left arm bent encircling the flexed legs (see Figure 36). Feature 18c is a primary burial feature of young adult female. Sex was based on the gracile brow line and mandible as well as the shape and size of the gonial angle.

While inspecting the surfaces around Feature 18a, another possible pit designated Feature 18d was observed to the north of Feature 18a. This pit was J-shaped on the surface and measured 1.35 m long by .39-.88 m wide, however at .04-.15 m bs the shape of the pit changed to an oval shape and a basalt cobble was noted in the northwest portion of the pit (Figure37). Excavations continued to approximately 1.00 m bs where three aligned basalt boulders were noted (Figure 38). The pit was bisected and two boulders were removed. Excavations continued for another .20 m when a second layer of boulders was noted which contained an upright oblong boulder. Upon the identification of two layers of basalt boulders with an upright stone in a pit excavated into the lithified sand, no further excavations were deemed necessary at Feature 18d (Figure 39). Based on the location of this presumed burial site atop a high sand dune, coupled with the uniqueness of the pit (the presence of basalt boulders and an upright stone within a deep lithified pit) Feature 18d was likely a well respected, high status individual.

Features 18a-d are primary burial features with little to no disturbances. These burials will be preserved in placed within the central portion of Preservation Area 1.

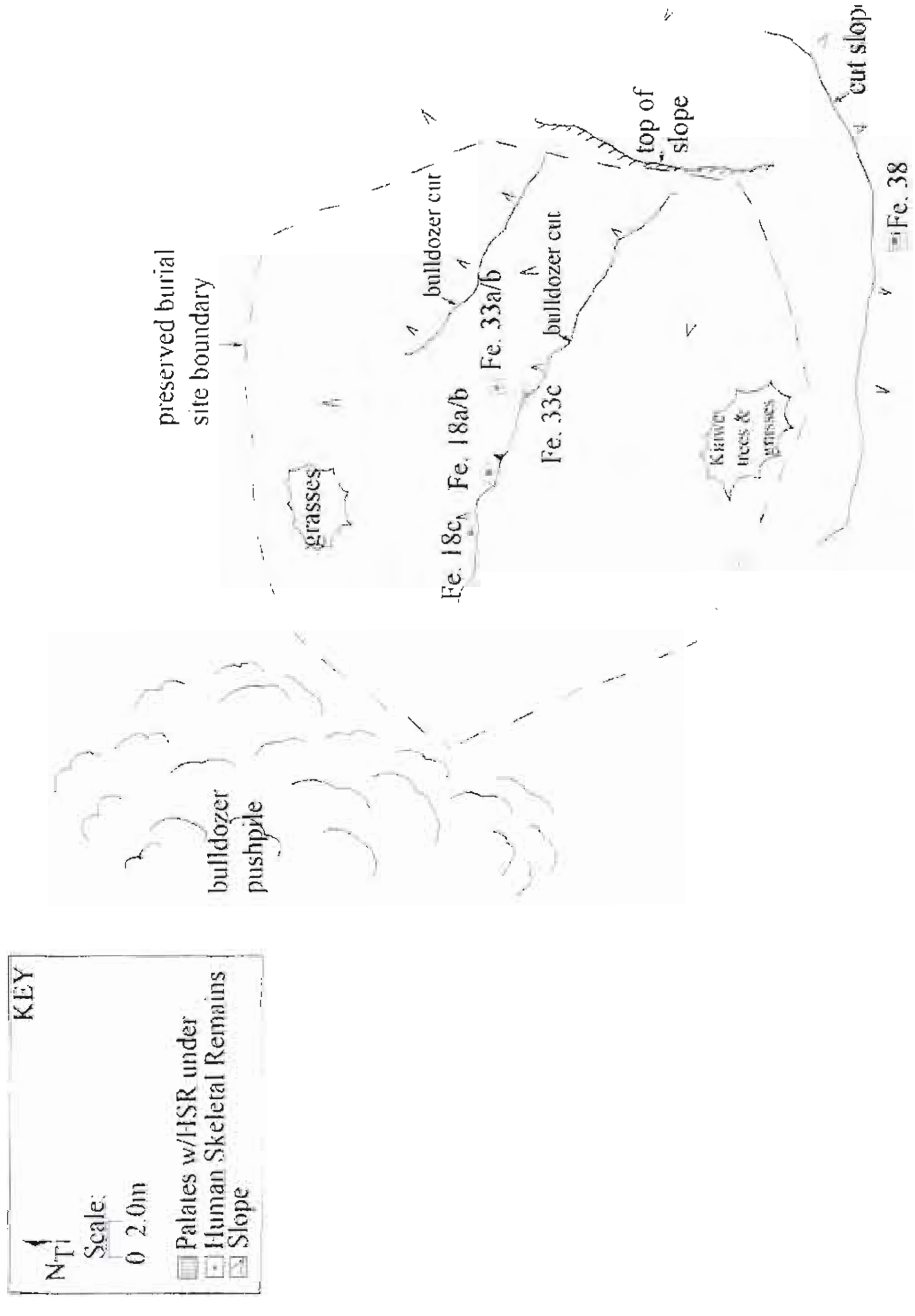


Figure 33. Plan View Map of Site 6679, Features 18a-d and 33a-c

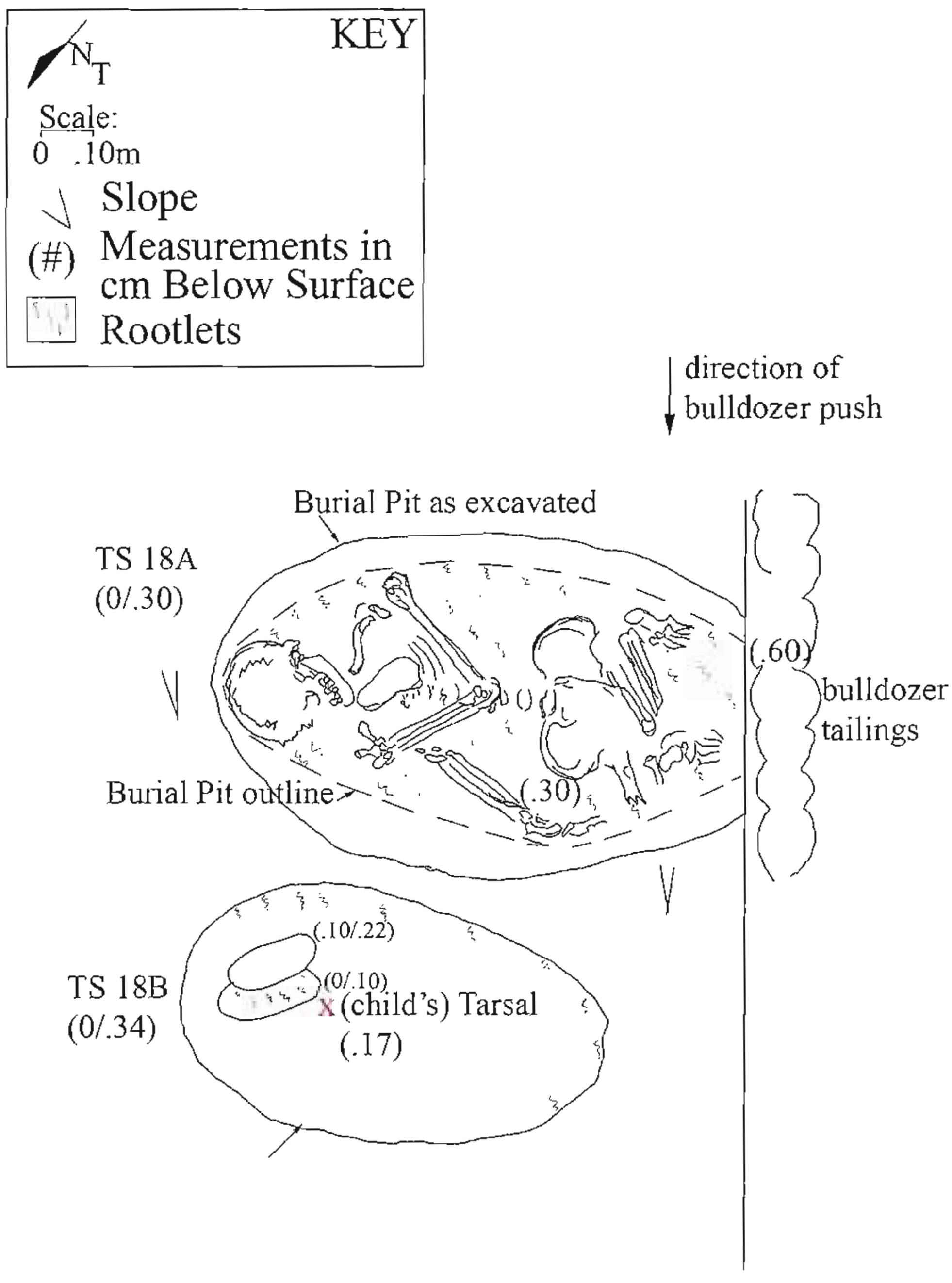


Figure 34. Plan View Map of Features 18a& 18b

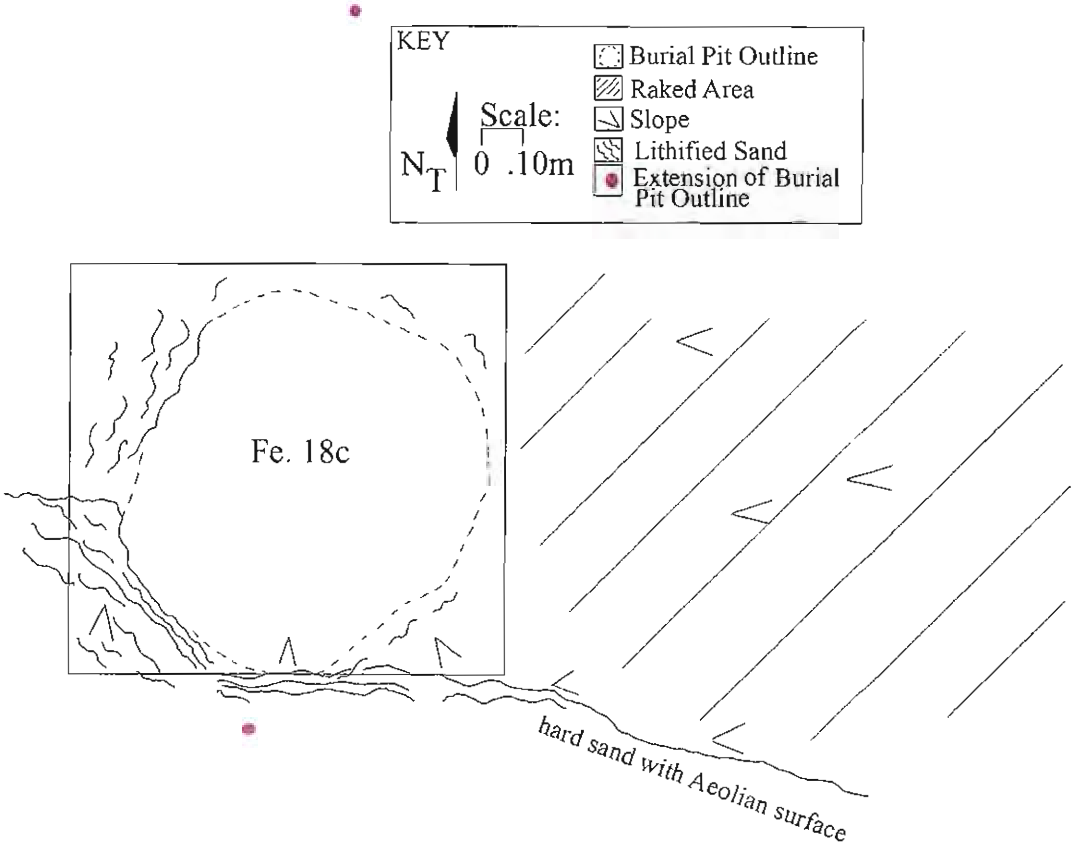


Figure 35. Plan View Map of Burial Pit Outline for Site 6679, Feature 18c at Surface

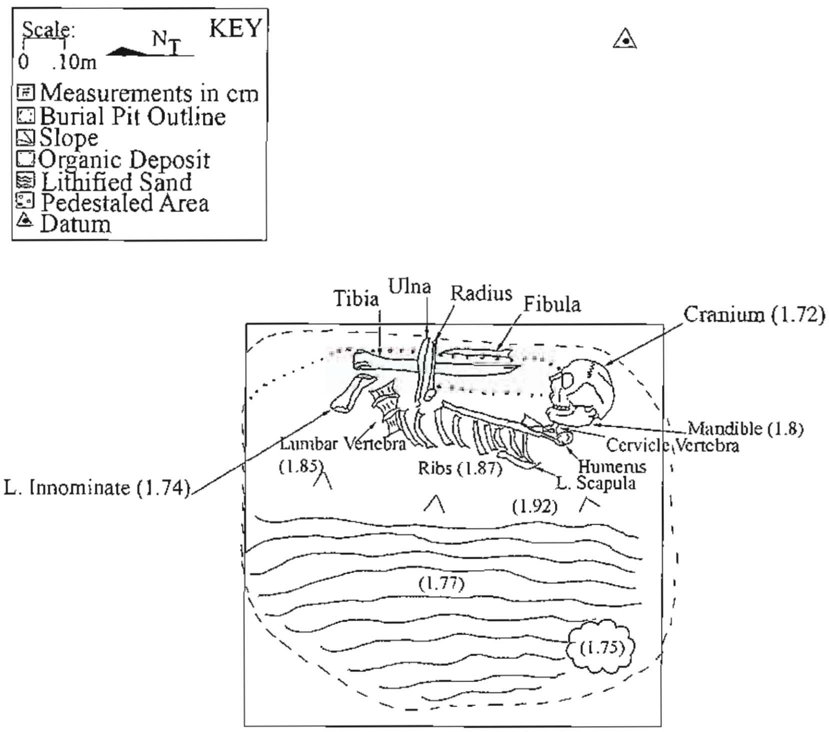


Figure 36. Plan View Map of Feature 18c at Base of Excavations (1.82 m bs)

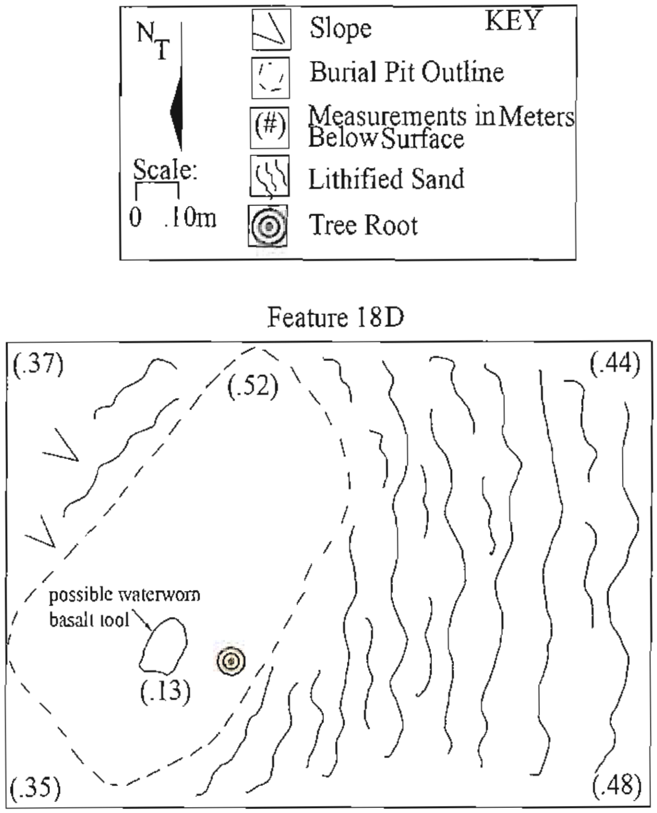


Figure 37. Plan View Map of Site 6679, Feature 18d at .15 m bs

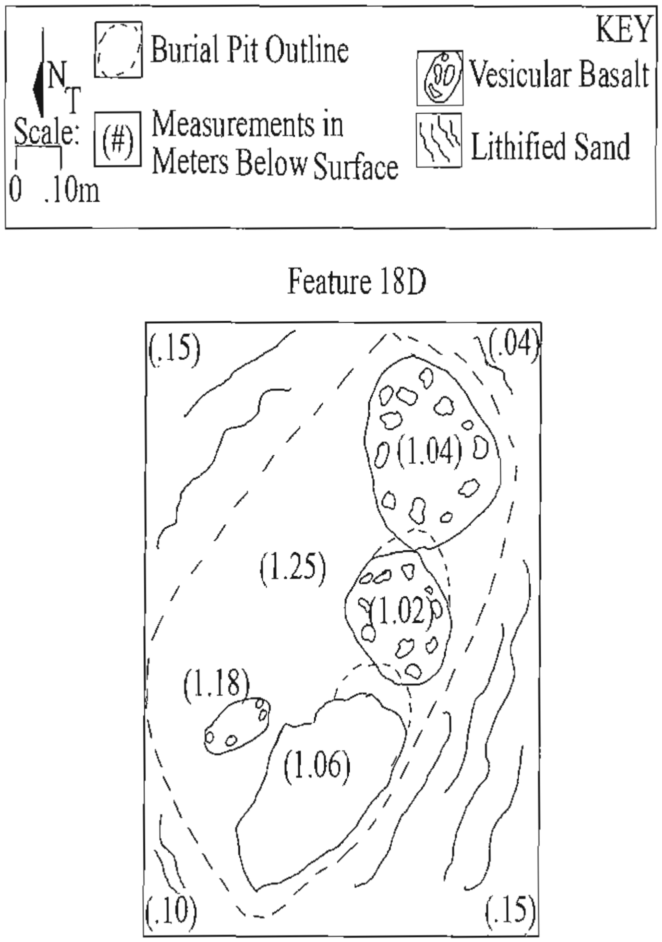


Figure 38. Plan View Map of Site 6679, Fe. 18d Showing Aligned Boulders at approximately 1.00m bs

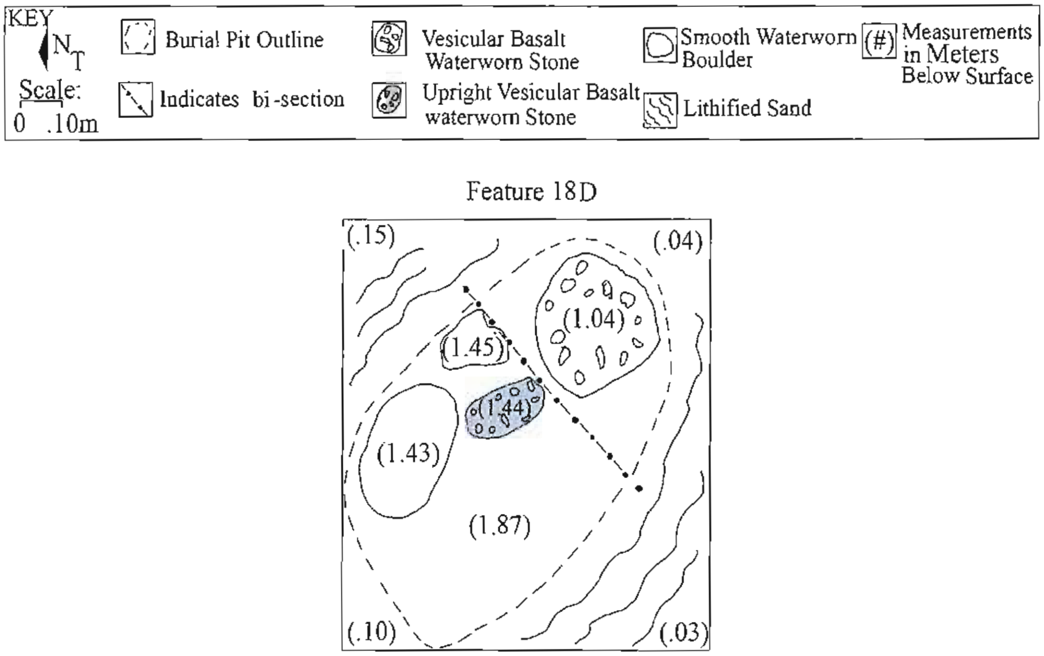


Figure 39. Plan View Map of Site 6679, Feature 18d at 1.20 m bs

Feature 19

Feature 19 was designated as a recently displaced possible primary burial. It was identified and partially disturbed during grading activities in the central portion of the project area. As the dozer was pushing sand into a stockpile, several skeletal remains were observed in the dozer tailing. A baseline was erected documenting the skeletal elements spread within a 12.0 m long by 6.0 m area (315 degrees) from 226 to 230 amsl (Figure 40). During documentation, no concentration of skeletal remains or a burial pit indicative of a primary/*in situ* component was noted. The collected displaced remains consisted primarily of the upper torso except for portions of the cranium (frontal and parietals), vertebrae and ribs. Additionally the right arm bones were fragmented as compared with the left arm bones. Also collected were shaft fragments of both fibula, a portion of the right femur shaft and most of the bones of both feet.

Laboratory analysis of the osteological assemblage indicates that Feature 19 is the remains of a young adult female. Sex was determined from the size/shape of the sciatic notch, the clavicle and attributes of the cranium. Estimated age was based on observation of minimal occlusal wear of dentition, epiphyseal union of long bones as well as cranial suture closure. Although less than 90% of this individual was collected, it is possible that the upper portions of Feature 19 may have been articulated prior to the current undertaking. Thus Feature 19 has been categorized as a recently disturbed possible primary burial that will be preserved in the area where it was identified (see Figure 8 and Table I).

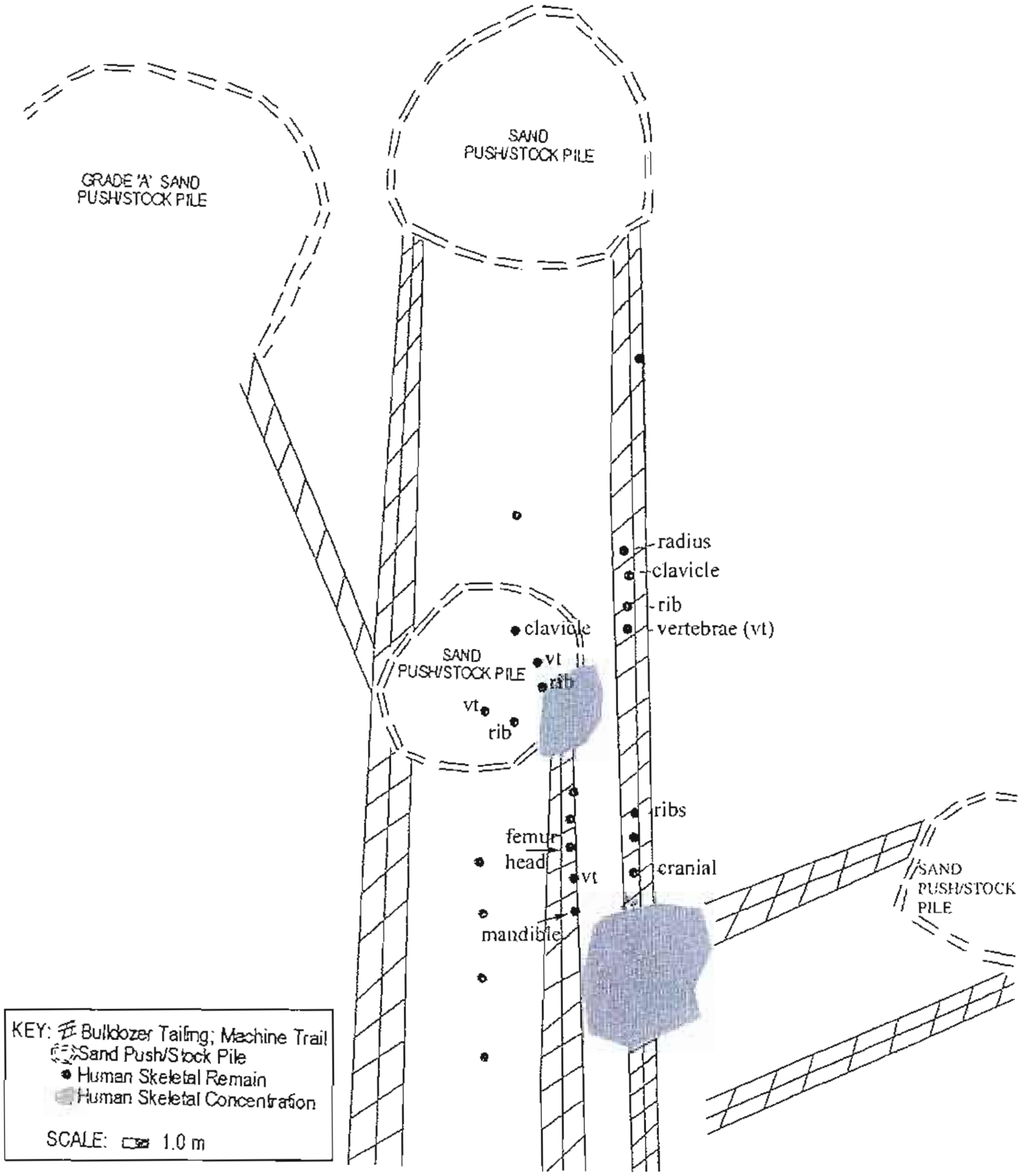


Figure 40. Plan View Map of Surface Scatter, Site 6679, Feature 19

Feature 20

Feature 20 was identified during monitoring of grading activities with a D-6 bulldozer upon a high dune situated in the northern portion of Phase A. After the skeletal remains were exposed a plan view map was created documenting the findings (Figure 41). Raking, shovel scraping and screening was instituted within the dozer pass and stockpiles. Upon the identification of a concentration of remains, a 2.0m by 2.0 m test unit was placed over the concentration documenting articulated and displaced but anatomically correct remains comprised of the innominate with lumbar and thoracic vertebrae, as well as a portion of the left hand (Figure 42). The innominate and lower vertebrae were slightly displaced from their original, primary context however they were still articulated and held together by a root mass. Collected displaced remains consisted of portions of the cranium, vertebrae and ribs, both clavicle, right ulna, left humerus fragments of right foot and right hand. A perforated human molar was also found close to the scatter and is presumed to have been a grave good. Based on the foregoing, Feature 20 has been designated as a partially, intact primary burial of a young adult female situated at 225 amsl (approximately 20.0 ft above the surrounding surface). Sex was established through observation of the sciatic notch, humeral head and acetabulum and estimated age was based on observation of epiphyseal fusion of long bones as well as cranial suture closure. Feature 20 will be preserved in place within northeastern portion of Preservation Area.

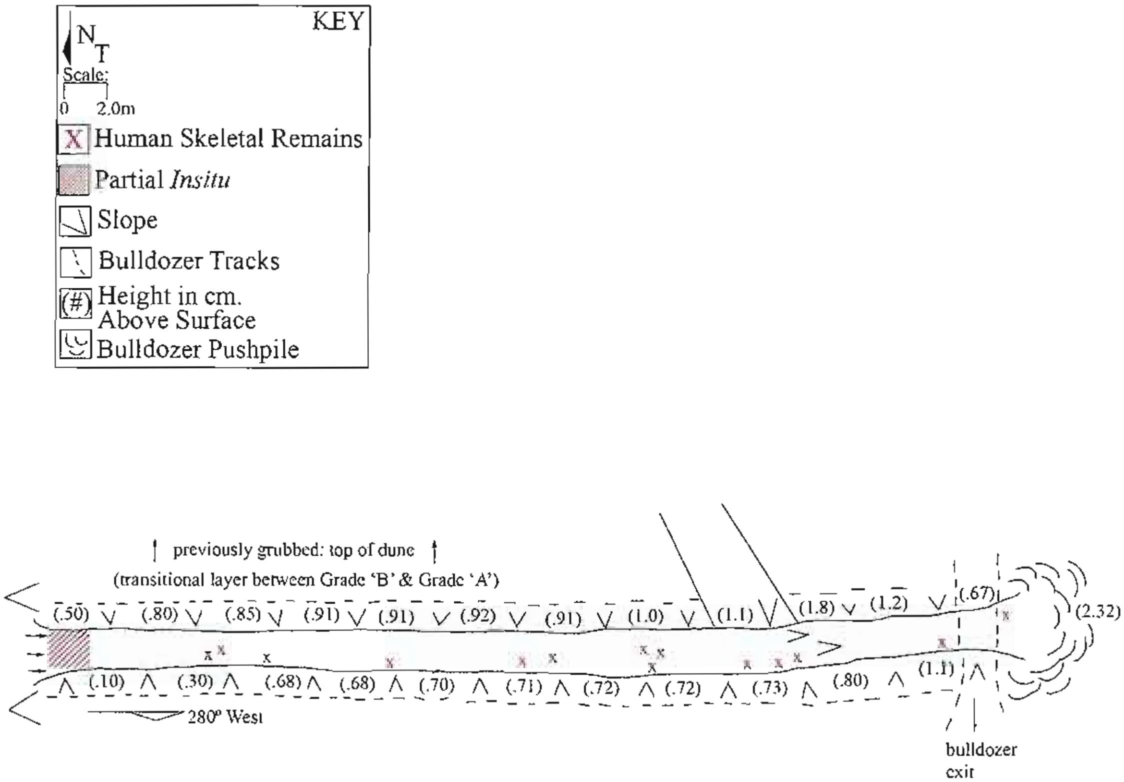


Figure 41. Plan View Map of Scattered Human Remains, Site 6679 Feature 20 within Bulldozer Track

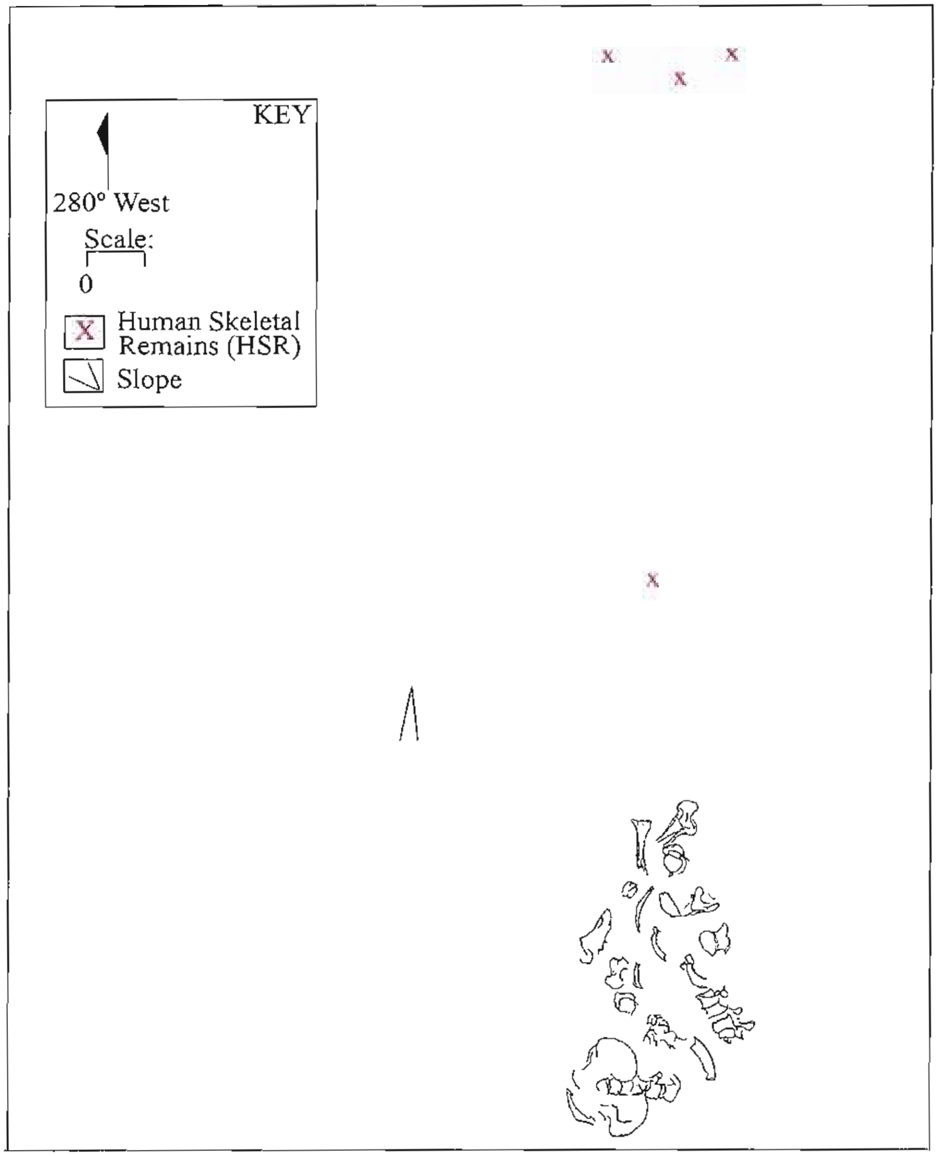


Figure 42. Plan View Map of Test Unit Showing Partially Articulated Remains Site 6679-Feature 20

Feature 21

Feature 21 was identified in the northern portion of Phase A just north of Feature 20. It was observed during grading activities utilizing a D6 bulldozer. Upon the discovery of skeletal remains, hand testing was initiated and documented a clearly defined burial pit excavated into the lithified sand and measured .60 m (n/s) by .30 m (e/w) and was oriented at 325 degrees. Within the pit are *in situ* human remains consisting primarily of long bones in a tightly flexed, "bundle like" position along with basalt artifacts (Feature 43). Specifically, Feature 21 consists of robust skeletal remains comprised of articulated right and left arms with hands, articulated right leg with foot, articulated left tibia, fibula and foot where the left femur is not articulated and positioned under the right humerus. The long bones of the left and right femur exhibit cut marks likely from the basalt chopper and basalt flake embedded into the proximal end of the left femur. The cut marks appear to be related to the removal of these extremities from the torso as opposed to inflicted trauma. Missing from the osteological assemblage of Feature 21 is the cranium, the chest and shoulder girdle (vertebrae, ribs, sternum, scapulae, clavicle), patella and the pelvic girdle (sacrum and innominate). Additionally, an *opihi* shell (*cellana sp.*) was recovered while screening material in close proximity to the burial pit. Based on the above information, along with the analysis of the skeletal remains, Feature 21 belongs to a mid adult male situated at 216.63 amsl which shall be preserved in place within the northern portion of Preserve Area 1.

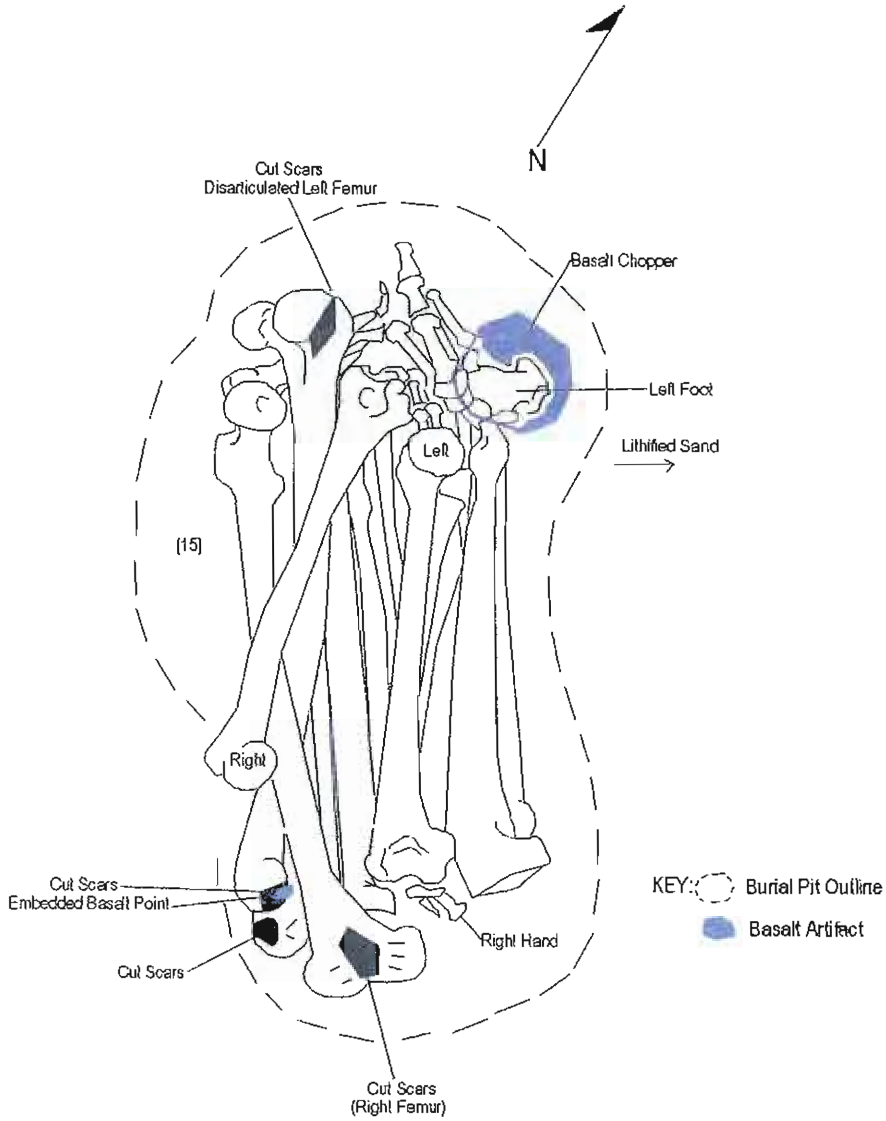


Figure 43. Plan View Map of Site 6679, Feature 21

Features 22a and b

Feature 22a and b consists of two individuals; one that was recently displaced and was likely a primary burial (Feature 22a) and the other, which remains *in situ* in its primary position (Feature 22b). Feature 22a was inadvertently exposed while monitoring a D-6 bulldozer cutting and pushing sand up against a steep vertical cut slope. Once the skeletal remains were identified a 45.0 m area was cordoned off and raked in an effort to document the findings (Figure 44). The area was raked, shovel scraped and screened where no intact component of Feature 22a was identified. The testing recovered approximately 98% of this individual, thus it is presumed that Feature 22a was a primary *in situ* burial that was recently displaced. Observation of the skeletal remains identified this individual as a young adult female. Estimated age was based on observation of the auricular surface of the ilia, minimal occlusal wear of dentition as well as epiphyseal and cranial suture closure. Sex was determined by the sciatic notch and cranial characteristics.

During the testing and documentation of Feature 22a, a second possible burial pit with skeletal remains was identified and designated Feature 22b. A 1.0m by 1.0m test unit was erected over the findings and at .11 mbs a defined burial pit measuring .75 m long by .66 m wide and oriented at 150 degrees was identified. Within the pit were *in situ* remains comprised of cranium, humeral head and a portion of the mandible situated at elevation 223.85 amsl (Figure 45). Excavations proceeded around the cranium to insure the remains were articulated and in their primary context. The atlas (1^{st} cervical vertebrae) was confirmed under the cranium approximately .10m into the pit. Based on the position of these remains, within a relatively small pit, the individual appears to be placed in a sitting position and is the remains of a young adult male. The only disturbance to this individual was to the top of cranium. Sex determination was based on the size of humeral head and attributes of cranium and mandible. Age was based on stage of fusion for humeral head and cranial suture closure.

Feature 22b is documented as a young adult male primary burial feature and Feature 22a is a young adult female probable primary burial that was recently disturbed from its original context. Both features are young adults that will be preserved in place (Feature 22b) and or near where they were found (Feature 22a) within the central portion of Preservation Area 1 (see Figure 8 and Table I).

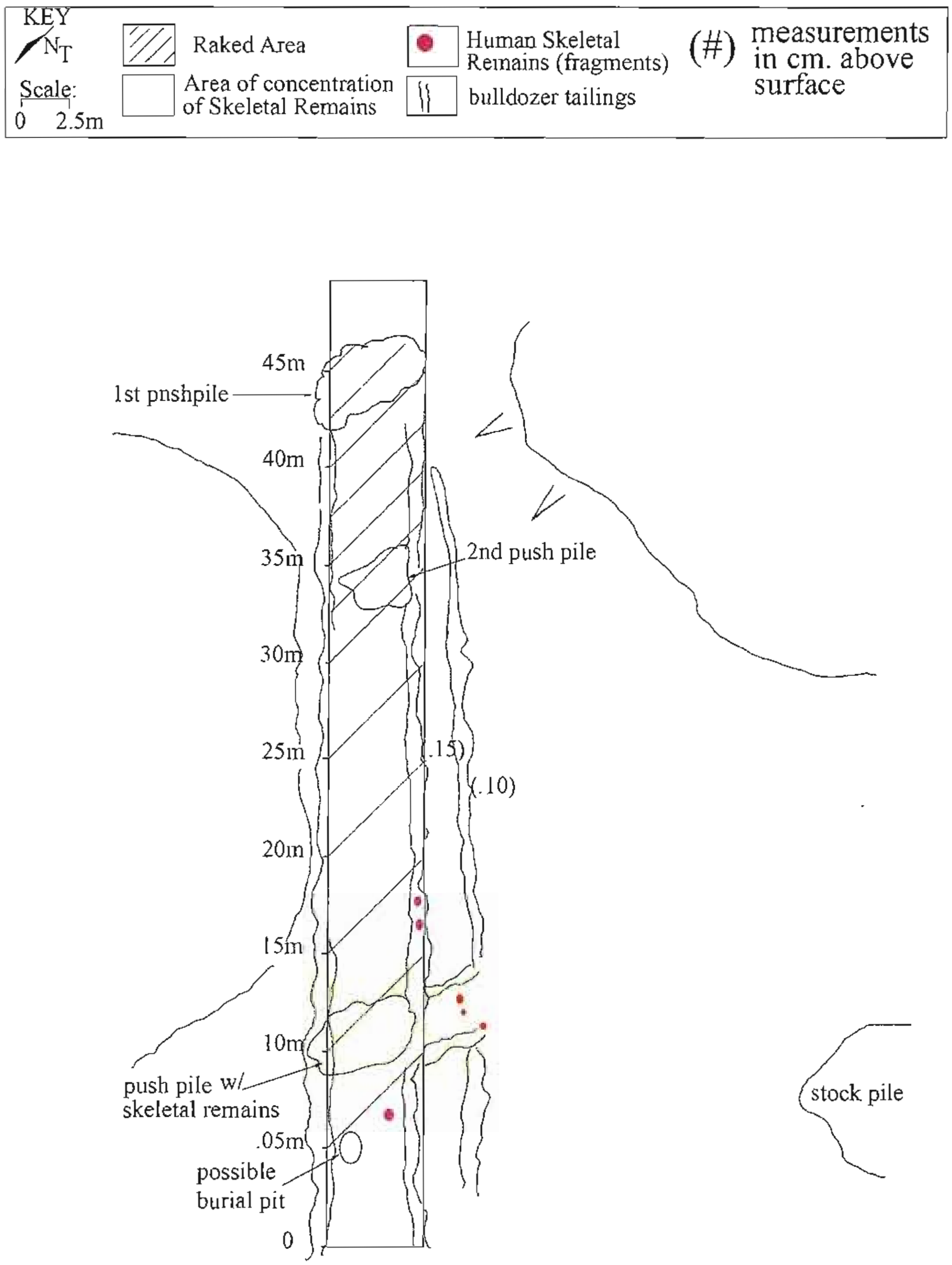


Figure 44. Plan View Map of Scattered Human Remains for Site 6679, Feature 22a

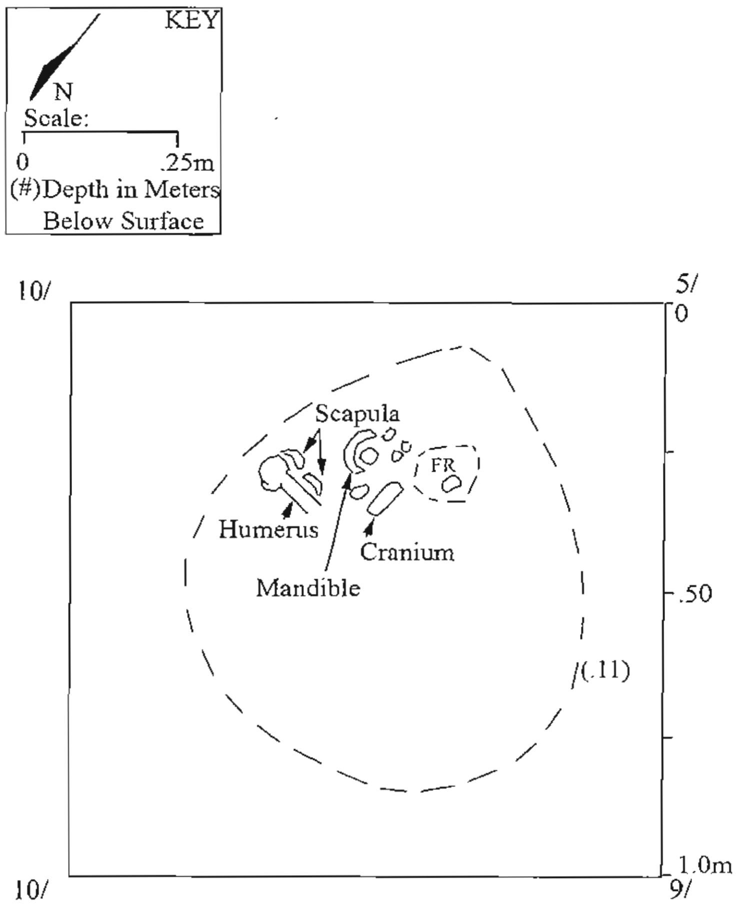


Figure 45. Plan View Map of Site 6679, Feature 22b.

Features 23a and 23b

Feature 23 was inadvertently exposed during controlled grading with the D-6 dozer. As grading commenced within the lithified sand, human remains were identified within the dozer track that measured 26.0 m long by 6.0 m wide and two possible burial pits were also visible on the surface (Figure 46). The first distinct pit within the sandstone contained grayish silty sand- Grade B (10YR 5/3.5) with sand stone peds and a concentration of broken remains (tarsals, calcaneous, talus, fibula and phalange) and was designated Feature 23a. A 1.0m by 1.0m test unit (TU1) was placed over the burial pit and excavated down to a maximum depth of 0.22cm below the current surface. The oval shaped burial pit measured 0.90 (n/s) by 0.45m (e/w) and at approximately .02-.05 m below the surface in the pit, anatomically correctly positioned humerus (left), scapula, ribs, portions of foot (right) and hands (both) were noted within the pit (Figure 47). All excavations were ceased at this point and raking and collection of displaced human remains were initiated. Most of the skeletal elements that were not previously documented were collected except for some ribs and portions of the feet and innominate. The human remains of Feature 23a were from an older adult female approximately 60 + years of age. Estimated age was based on observation of the mandible exhibiting subperiosteal/abcessed lower central incisors, as well as alveolar resorption- which typically indicates old age. Sex was determined by the sciatic notch. The amorphous shaped second pit (Feature 23b) was also excavated (TU2) into lithified sand and contained a grayish silty sand. Excavations terminated at .17 m into the pit where no human remains were identified (Figure 48). The pits function is inconclusive, but due to its shape it was likely from tree fall and or tree removal and likely not a cultural pit. Feature 23a was determined to be a primary burial feature that was recently disturbed and will be preserved in place. Feature 23b was not a burial pit and was designated as an anomalous pit like 16b.

Due to the identification of Features 18-23, grading activities relocated to the secondary ridge within the northeastern portion of the Phase A.

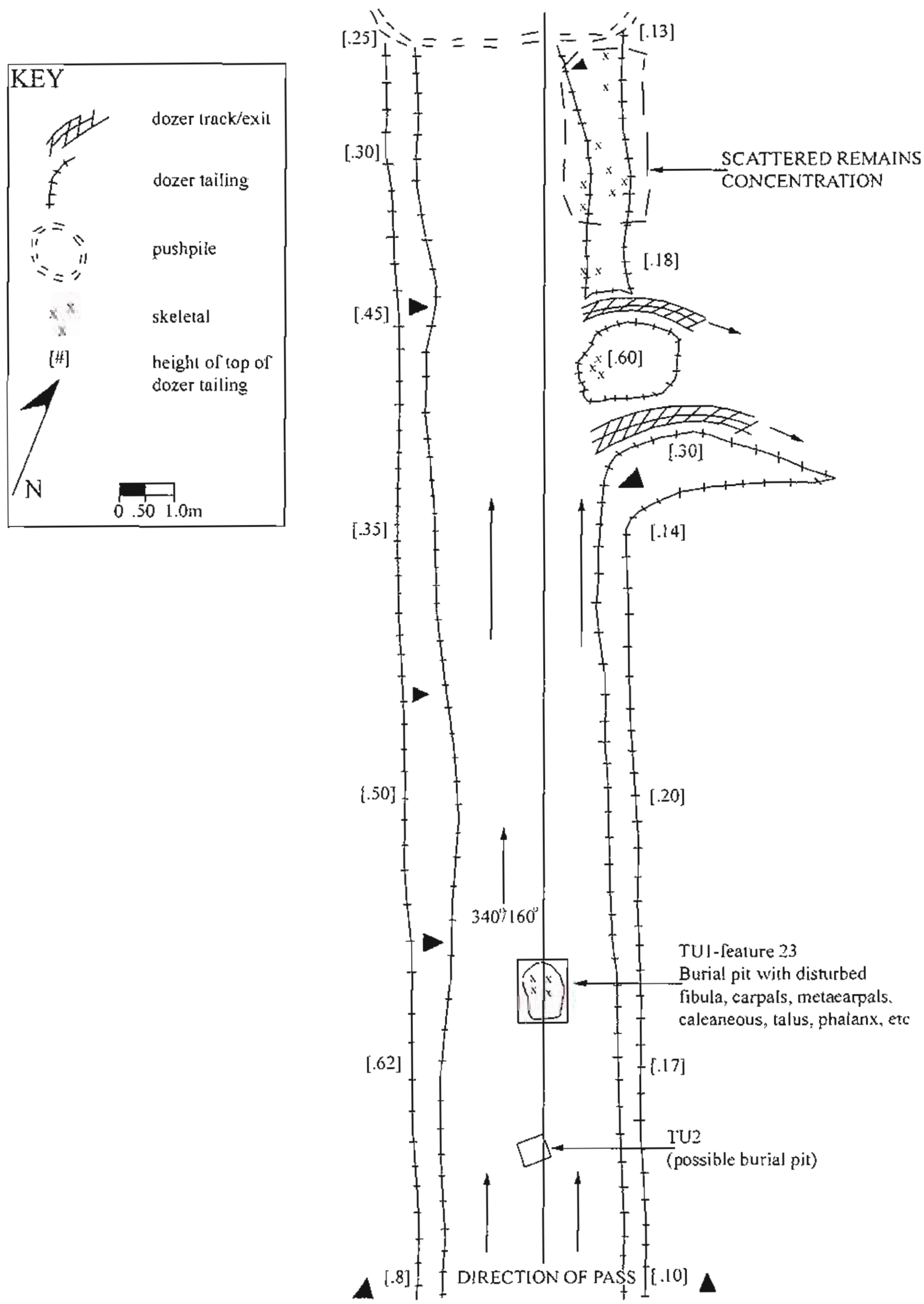


Figure 46. Plan View Map of Surface Scatter at Site 6679 Showing Features 23a and 23b

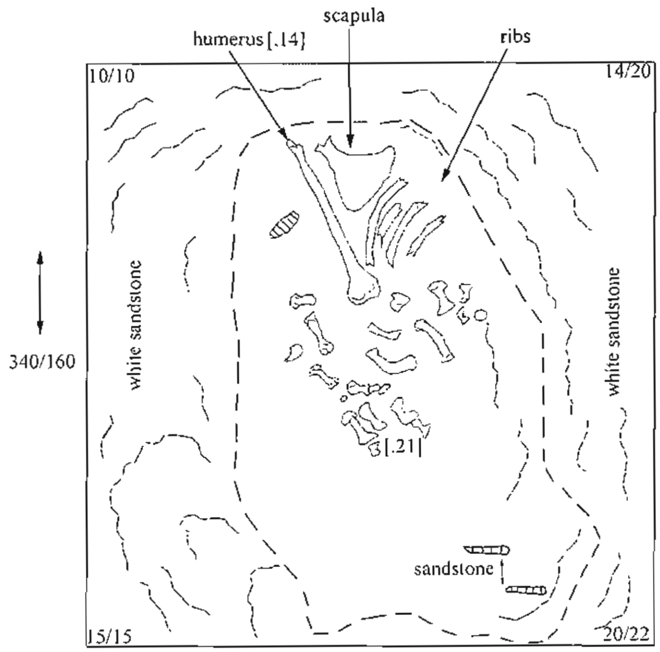
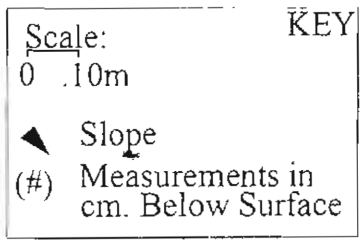


Figure 47. Plan View Map of Site 6679, Feature 23a, Test Unit 1



Feature 23 TU 2 I/1

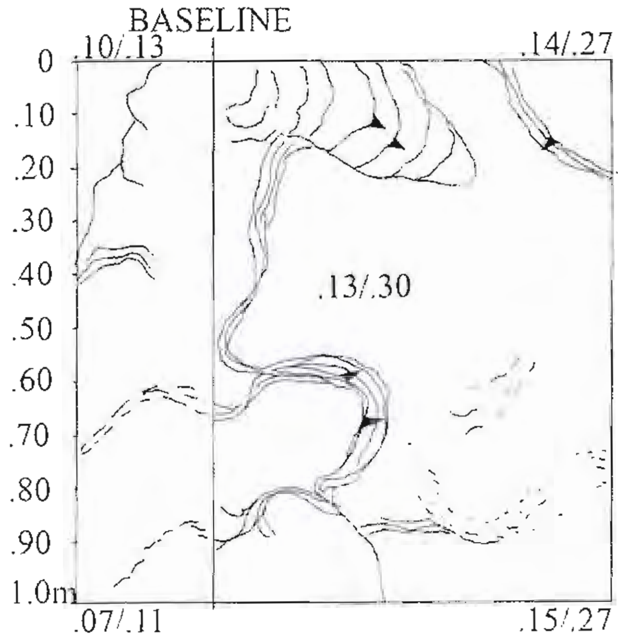


Figure 48. Plan View Map of TU 2 at Feature 23b

Feature 24

Feature 24 was identified during controlled grading within the secondary ridgeline northeast of Site 6679 Features 1-5 and previously identified burial feature Site 4200. During the sand mining activities, a burial pit, skeletal remains and a section of a trench from the 1998 inventory survey were documented within the dozer track (Figure 49). Feature 24 was comprised of a distinct burial pit excavated into sandstone. The pitfill was a very dark brown to dark grayish brown (10YR6/3) silty sand with dense organic root matter and pale brown sandstone peds. The pit measured 1.10 m (e/w) by 0.65 m, was oriented at 65 degrees and contained a primary *in situ* burial almost entirely encased in root matter. The burial was placed on its left side in a flexed position at an elevation of 202.85 amsl (Feature 50). Although most remains were intact within the pit, the controlled grading slightly displaced a portion of the right leg and left foot. No further testing was conducted and detailed analysis to ascertain sex and age was not performed. However based on the robustness of the right femur and tibia, Feature 24 may represent an adult male that will be preserved in place in the north eastern portion of Preserve Area 1.

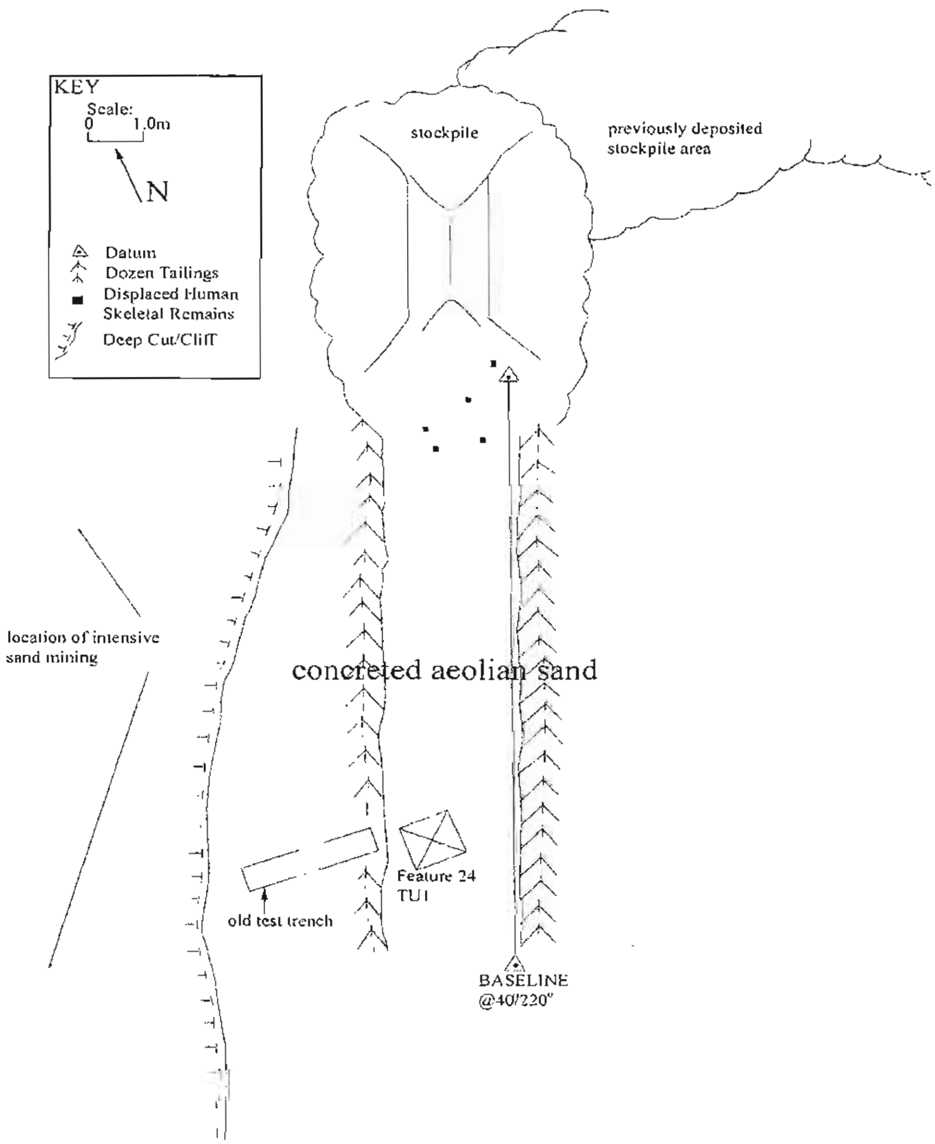


Figure 49. Plan View Map of Surface Scatter at Site 6679, Feature 24

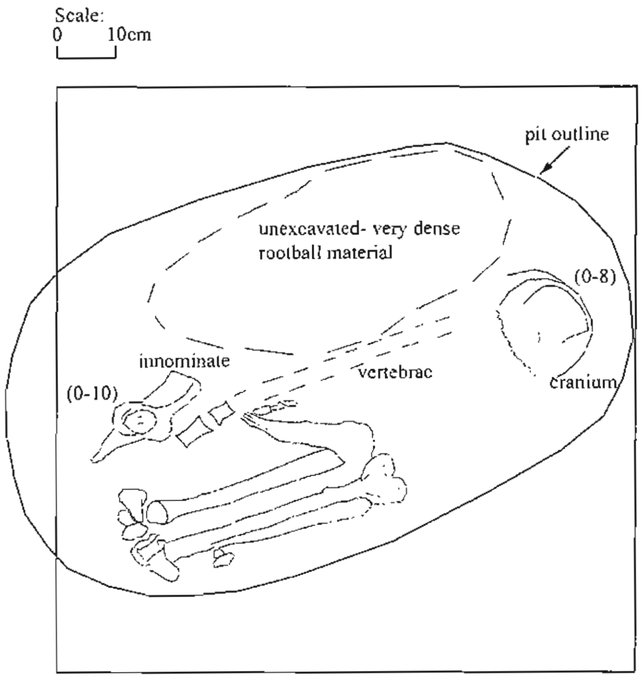


Figure 50. Plan View Map of Site 6679, Primary Burial Feature 24

Feature 25

Feature 25 was inadvertently exposed in the dozer track and stockpile during grading activities within the secondary ridgeline. A concentration of skeletal remains was noted at the beginning of the dozer tailing and within the stock push pile. A 1.0m by 1.0m test unit was hand excavated over the first concentration to ascertain if an *in situ* component was extant (Figure 51). Testing documented a burial feature excavated into concreted sandstone with dense root matting around the skeletal remains. The burial is placed on its right side at 211.42 amsl, in a fully flexed position within a pit that measures 0.80m (n/e) by 0.45m and contains grayish silty sand-7.5 YR 6/3 (Figure 52). Displaced remains consisting of a probable grave marker (waterworn cobble), portions of the cranium, the left tibia, fibula, femur, 3 cervical vertebrae and portions of the feet were collected and are curated at the ASH lab. Once articulation and the primary context of the individual was established, no further excavations were warranted. Laboratory analysis of the displaced remains determined that Feature 25 was an older adult female. Sex was ascertained through observation of the sciatic notch. Estimated age was based on cranial suture closure and extreme occlusal wear, which included abscessed cavities near the lower molars. Feature 25 was determined to be a primary partially *in situ* individual that was recently disturbed. Like Feature 24, Feature 25 will be preserved in place within the northeastern portion of Preservation Area 1 (see Figure 8 and Table I).

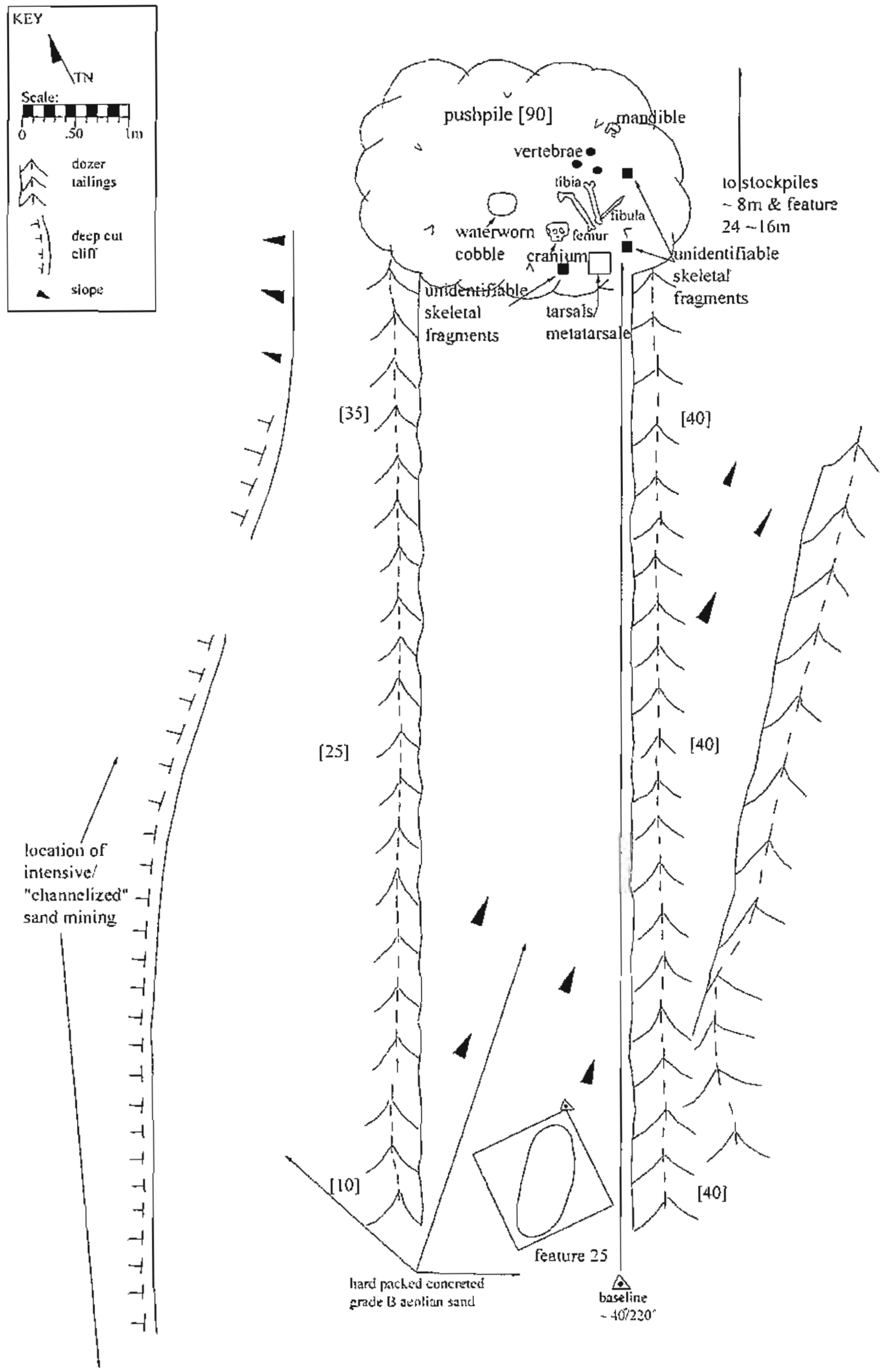


Figure 51. Plan View Map of Activity area for Site 6679, Feature 25

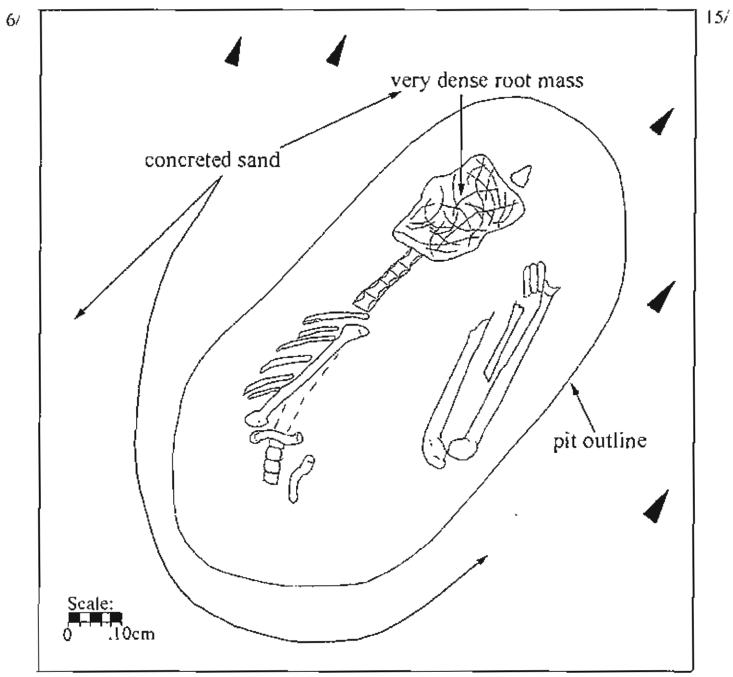


Figure 52. Plan View Map of Site 6679, Feature 25

Feature 26

Feature 26 was first noted during monitoring of sand mining operations, and like Features 24 and 25 is a primary burial within a pit excavated into sandstone. The burial pit measures 1.10 m long by .60 m wide, is oriented at 330 degrees and comprised of silty pale brown sand (10YR6/3) surrounded by a10YR 6/2 light brown grey sandstone (Figure 53). The burial is fully flexed and placed on its left side with a water worn cobble (probable grave marker) placed at the back (occipital) portion of the cranium. Recent disturbance to Feature 26 occurred along the right humerus, sacrum, the femur and portions of both feet. This individual is a middle adult male that will be preserved in place within the northeastern portion of Preservation Area 1.

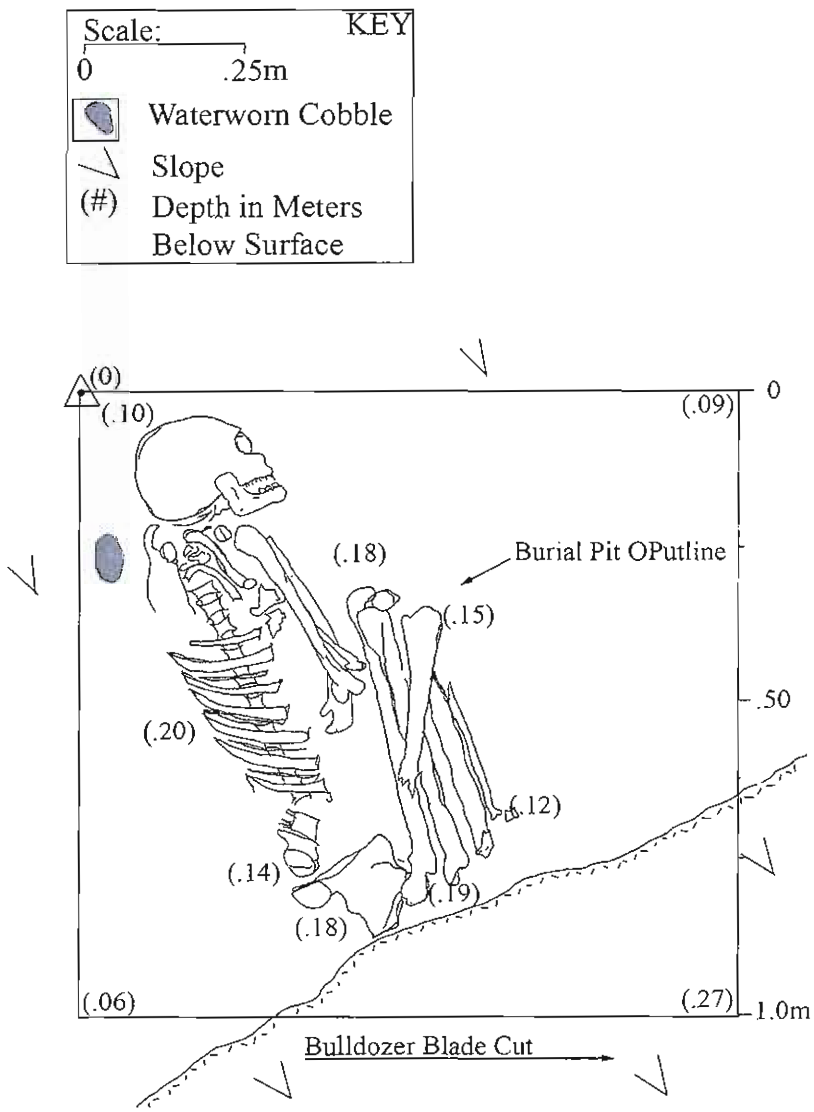


Figure 53. Plan View Map of Site 6679, Feature 26

Feature 27

Feature 27 was identified during monitoring of sand mining activities with human remains observed within the dozer tract approximately 30 meters long. A plan view map was created documenting the events and subsequent scatter (Figure 54). The remains were observed to be fragmented, bleached and thus were in a secondary context being previously disturbed. This area contained an access road that once bisected the dune, thus, Feature 27 was likely disturbed during the construction of this road. The area has been raked, shovel scraped and mapped where no primary and or *in situ* remains have been identified. The soil profile of the dozer cut exemplified a 5-layer stratigraphic sequence, where Layers I and II were disturbed matrices. Layer III appeared to be an old A horizon overlying two intact layers of sand, Layers IV and V (Figure 57). The disturbed remains from Feature 27 were from Layers I and II. Collected skeletal remains consist of ribs, portions of all long bones except the right fibula, ulna, innominate and foot. The osteological assemblage for Feature 27 is from an older adult male approximately 50+ years of age. Estimated age was based on observation of extreme osteophytes on proximal and distal ends of long bones as well as cranial suture closure. Sex was based on observation of gonial angle and mastoid process, as well as overall size of remains. Feature 27 is determined to be a secondarily deposited scatter of human skeletal remains that were previously disturbed. The collected remains of Feature 27 will be preserved in the area near where they were discovered in the north central portion of Preservation Area 1.

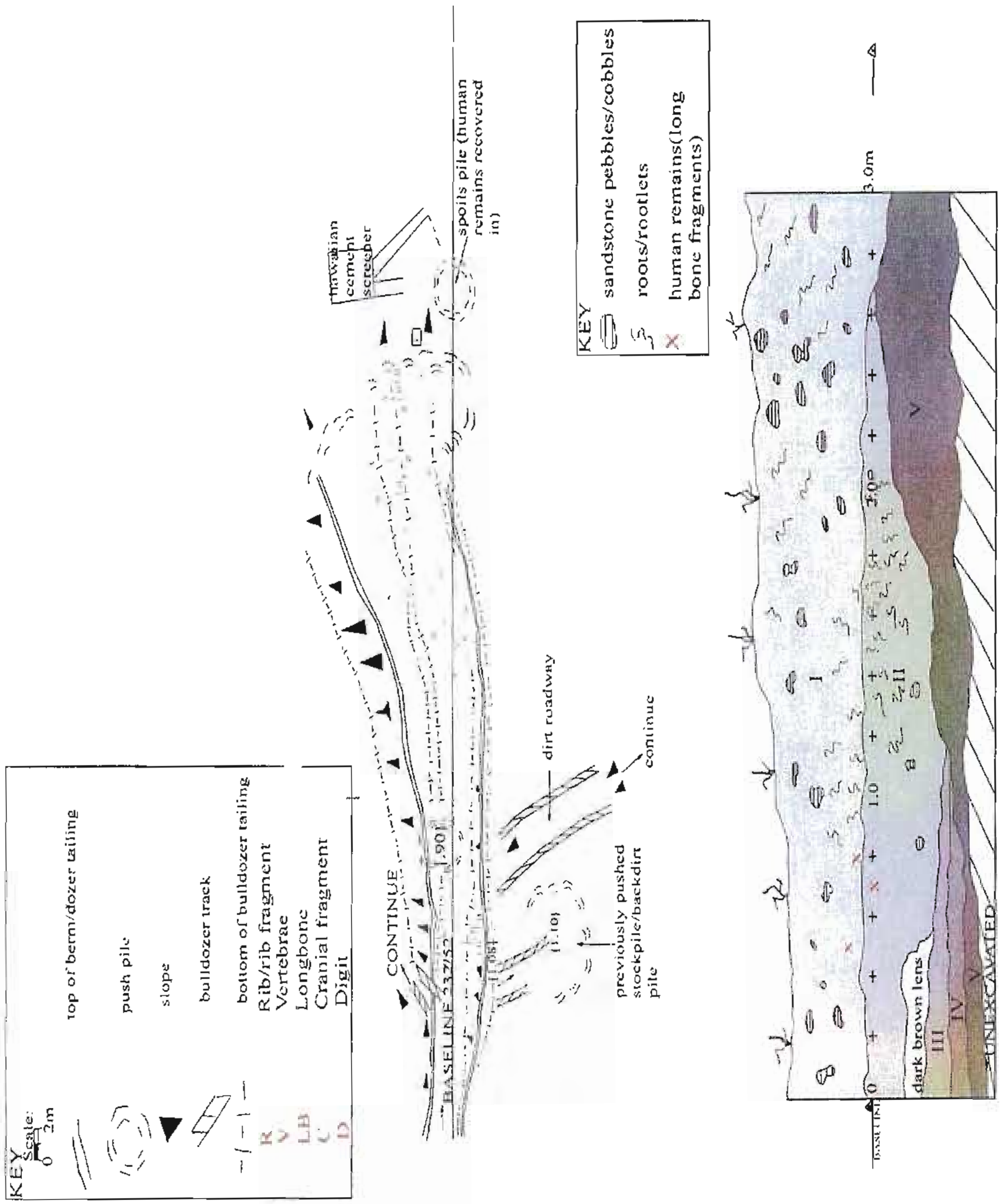


Figure 54. Plan View Map and Profile of Site 6679, Feature 27 Area

Feature 28

Feature 28 was inadvertently exposed during monitoring of bulldozer activities in the same previously disturbed area as Feature 27. The human skeletal remains were distributed within a 25.0 m long by 12.0 m wide area of the bulldozer's track (Figure 54). Due to the volume and linear distribution of the human skeletal remains, it was initially thought that two individuals were represented within the assemblage. Thus, the linear secondary scatters were temporarily designated as Feature areas 28a and 28b (Figure 55). A 4.0m by 4.0m test unit (TU1) was erected at the start of the bulldozer's path and a 6.0m by 2.0m shovel test (STU1) placed near the bulldozer push pile at the end of the track. Testing in these localities was undertaken to ascertain if a primary *in situ* component was extant and to collect all disturbed remains. Recovery efforts suggested that the skeletal remains belong to one person and these remains were very fragmented and fragile being weathered and bleached out. Over1000 fragmented and bleached skeletal elements were collected and analysis of the remains determined that Feature 28 is an adult male. Sex was determined by observation of the clavicle and femoral head, as well as the gonial angle of the mandible. Estimated age was based on the epiphysis of clavicle. Based on the fragmented condition of the osteological assemblage, Feature 28 was a secondary deposit that was previously disturbed possibly during the access road construction. Like Feature 27, the collected displaced remains of this individual will be reburied and preserved in the northeastern portion of Preservation Area 1.

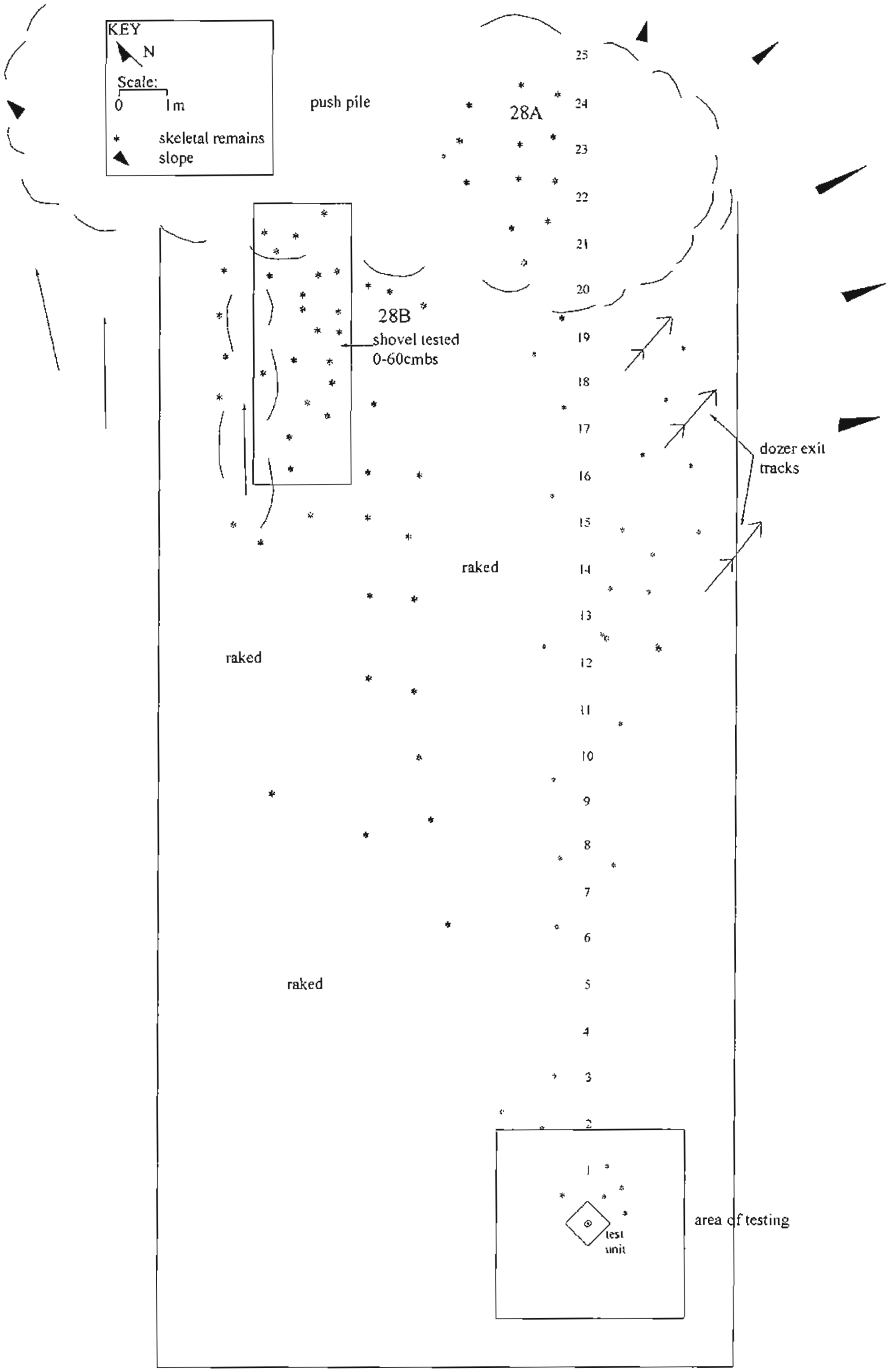


Figure 55. Plan View Map of Surface Scatter, Feature 28.

Feature 29

Feature 29 was identified within the same area as the above features (Features 27-28); however this burial was in a primary *in situ* context within the work area (Figure 56). The grading activities bifurcated the top of the burial pit, exposing and disturbing the femoral heads, carpals and metatarsals. A 1.0m by 1.0m test unit (TU1) was erected and hand-excavated exposing an articulated individual within a defined pit at .38 m bs (Figure 57). The pit measured .78m (n/s) by .74m (e/w) and was excavated within lithified sand. Two lithified slabs appeared to have been placed on top of the pit. The burial was unusually placed with the head down first in the pit, approximately 0.20 cm below the innominate. The remains were fully flexed with the left and right arms and hands extended below and underneath the torso with the hands a little higher in elevation than the arms. A lithified slab was covering the left side of the individual from the lower sacrum and lumbar vertebrae up to the scapula. A basalt sub-angular cobble was placed atop the lithified slab. Analysis of the remains exemplified Feature 29 as a middle adult male individual. Sex was established upon observation of the sciatic notch in the innominate, as well as overall robusticity of the remains. Estimated age was based on epiphyseal fusion and skeletal remains which lacked osteophytes. Feature 29 was determined to be a recently disturbed primary burial that will be preserved in place within the northern portion of Preserve Area 1.

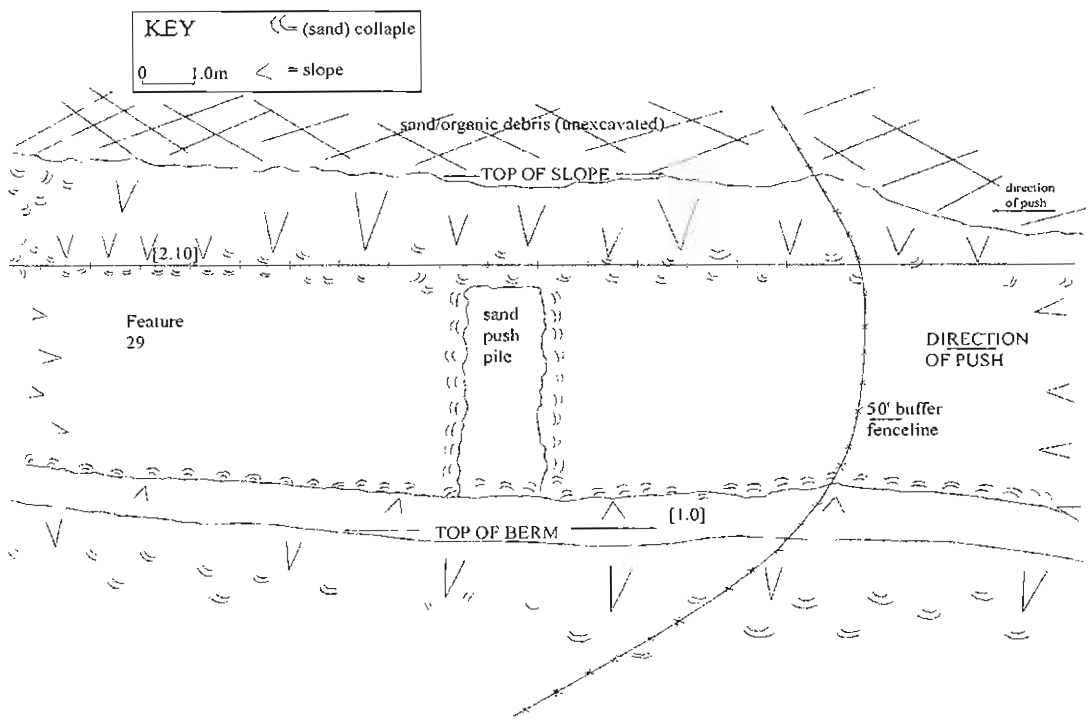


Figure 56. Plan View Map of Site 6679, Feature 29 Area

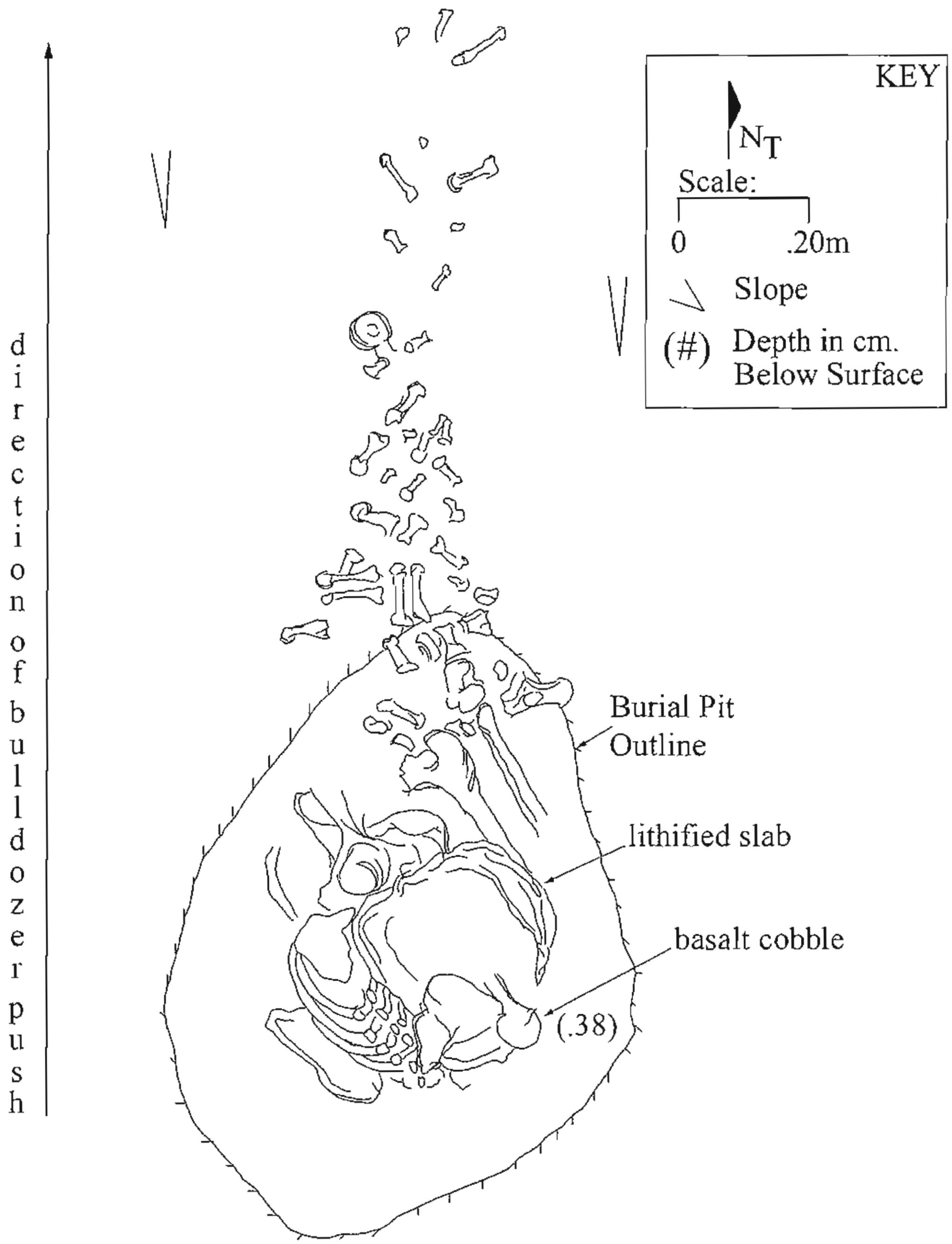


Figure 57. Plan View Map of Site 6679, Feature 29 Burial

Feature 30

During a field inspection near the Feature 26 area, a previously displaced skeletal scatter was identified. The skeletal remains consisted of phalanges which likely belonged to Feature 26, and will be reinterred with that respective individual.

Based on the discovery of Features 24-30 within the northeastern portion of the Phase A project area, as well as the documentation of prior disturbances, grading activities relocated to the central portion of the project area.

Features 31a and 31b

Grading activities were again undertaken in the central portion of Phase A approximately 200 ft. south of Feature 18. Due to the presence of documented burials in the central area, grading activities were implemented in a pre-determined area in a controlled manner with a D-6 dozer. After the vegetation was cleared across the top of the knoll several areas containing skeletal remains and possible burial pits were observed (Figure 58). Upon this discovery, all possible features were labeled and designated Features 31-41 and hand testing was performed. The first area tested was Features 31a and 31b comprised of a remnant burial pit and displaced skeletal remains approximately .10 m below the existing surface. Feature 31a was placed in a flexed position on their back possibly on their left side in an east/west orientation. Several perforated conus (*puka* shells) were placed on the chest and underneath the mandible of the burial and were likely a necklace or wristlet (Figure 59). Articulation was noted on the cranium, cervical vertebrae and portions of the right hand which was laid across the chest. Recent disturbance occurred along the lower extremities however some of the collected remains had old breaks indicative of prior disturbances. During the analysis of the osteological assemblage, Feature 31a was determined to be a middle adult female that was partially disturbed from its primary context. Sex was determined by the shape of the sciatic notch and age was based on fused epiphyses of the long bones. Also noted during the lab analysis was evidence of a second individual (a mid-adult male) and designated Feature 31b. Based on the linear pattern of the disturbed remains extending from the burial pit, it appears that Features 31a and 31b were likely buried together. No intact component was observed for Feature 31b, thus it has been designated as recently disturbed probable *in situ*. Sex determination for Feature 31b was through observation of the sciatic notch. Estimated age was based on overall condition of the remains as well as cranial suture closure. Features 31a and 31b will be preserved in place within the central portion of the Preservation Area 1.

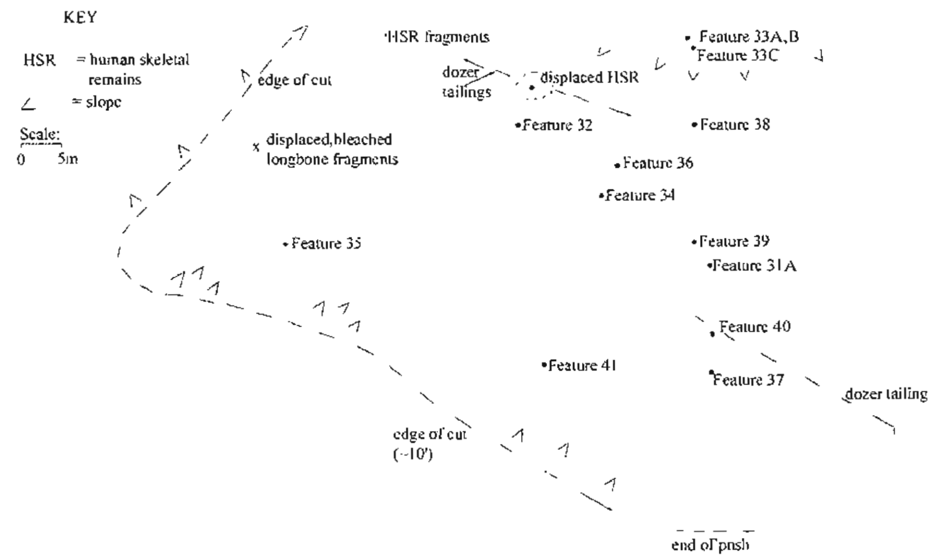


Figure 58. Plan View Map Showing Locations of Features 31-41, Site 6679

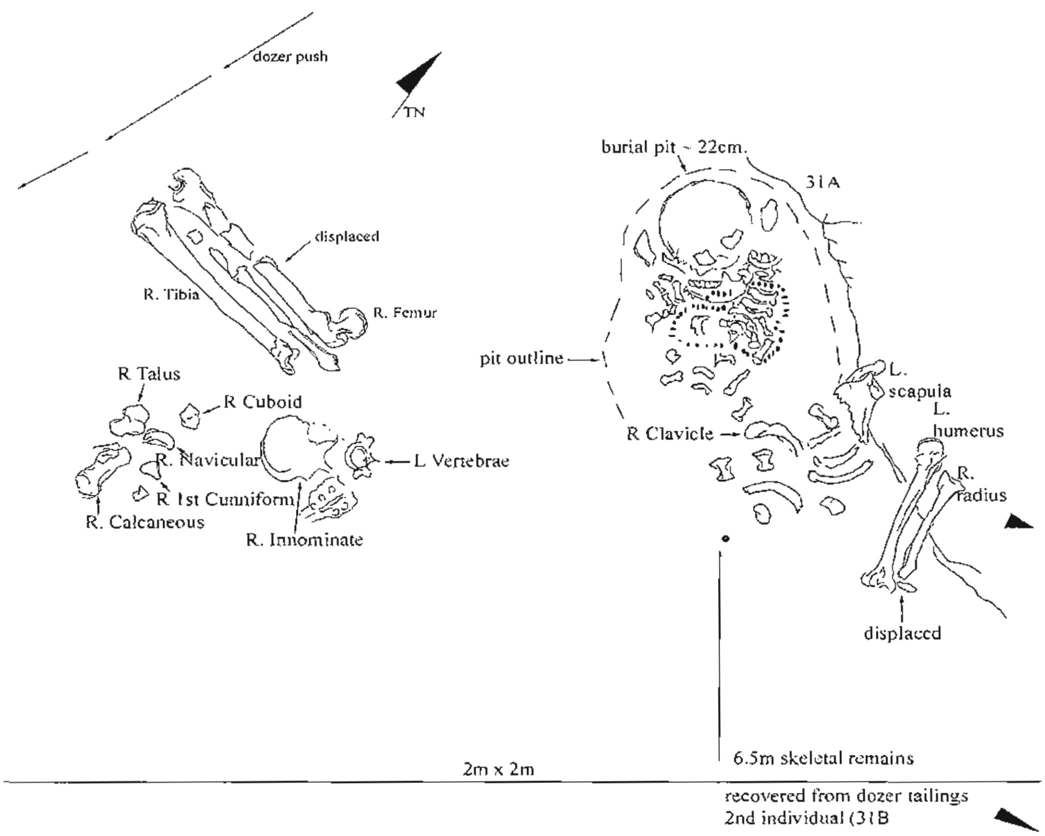


Figure 59. Plan View Map for Site 6679, Features 31a and 31b

Feature 32

During a field inspection after vegetation grubbing, Feature 32 was discovered and consisted of a possible burial pit within grey silty sand (Grade B) that was transitioning into yellowish brown fine to coarse "Grade A" sand. The area was scraped and brushed off revealing a distinct (probable) burial pit outline with 4 large waterworn boulders (Figure 60). Tiny rootlets were observed around the circumference of the pit outline, providing further evidence of a burial pit. Feature 32, designated as a possible burial pit, was not tested but is assumed to contain a primary *in situ* burial.

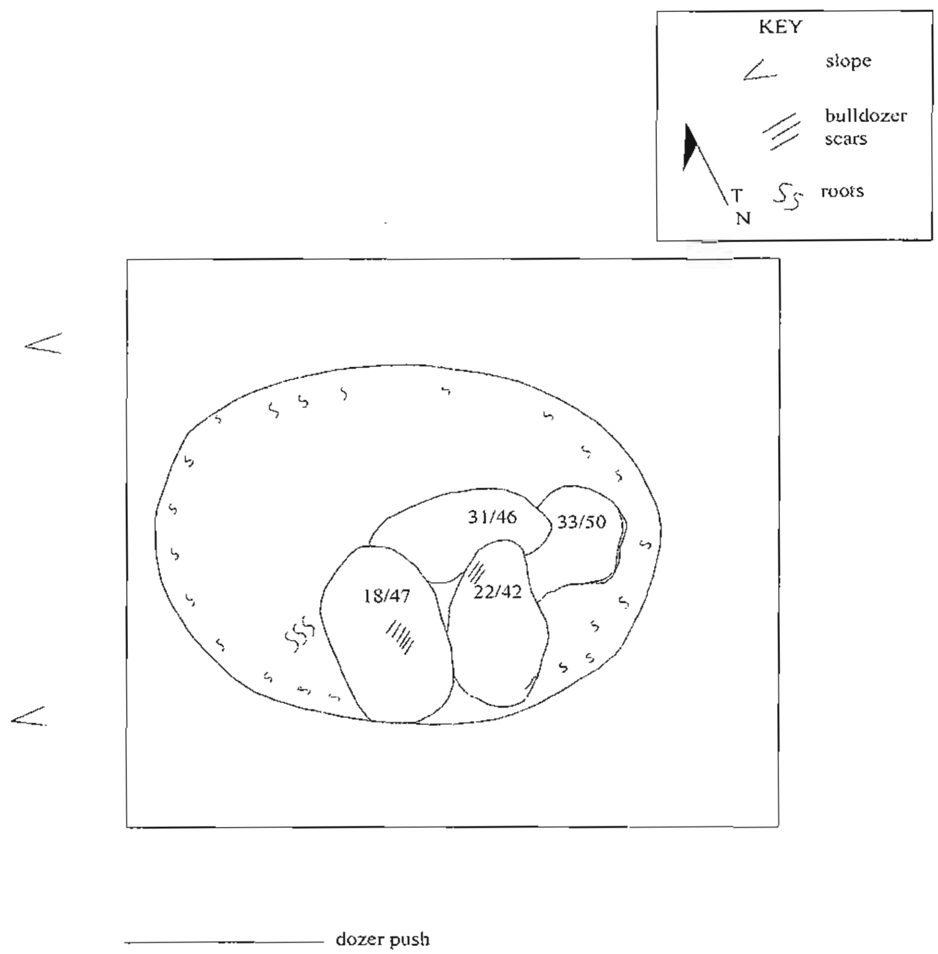


Figure 60. Plan View Map of Probable Burial Pit, Feature 32

Features 33a-c

As previously discussed in the methods section periodic field inspections were performed of previously graded areas. During an inspection of the slope containing Features 18a-c, an area with concentrated fragmented remains was noted and designated Feature 33. Apparently wind erosion had exposed this burial feature. A 1.0m by 1.0m test unit was excavated over the concentration documenting the co-mingled remains of two individuals (Features 33a and b) within a primary context (Figure 61). The burial pit was excavated into lithified sand and measured .40m long by .35m wide and contained the shattered, disarticulated skeletal remains of an adult (33a) and adolescent (33b) that was likely previously disturbed in a cultural context. Age of the individuals was based on epiphyseal and cranial suture closure, as well as size of the remains. The fragmented remains of Feature 33a consisted of cranial, a mandible, a calcaneous, phalanges and long bone shaft fragments. The osteological assemblage which constitutes the adolescent (33b) was portions of the cranium, maxillae, mandible and long bone shaft fragments. While cleaning (shovel scraping and troweling) around this initial finding, a second burial pit designated Feature 33c was identified .20 m southeast of Feature 33a and b. Feature 33c was a distinct circular pit excavated into the lithified sand and measured approximately .40m long by .25m wide. Although Feature 33c was not excavated, it is designated as a burial pit which is highly likely to contain an articulated primary burial feature. Features 33a and b are primary features that were likely previously disturbed in a cultural context. Features 33a-c will be preserved in place within the central portion of Preserve Area #1.

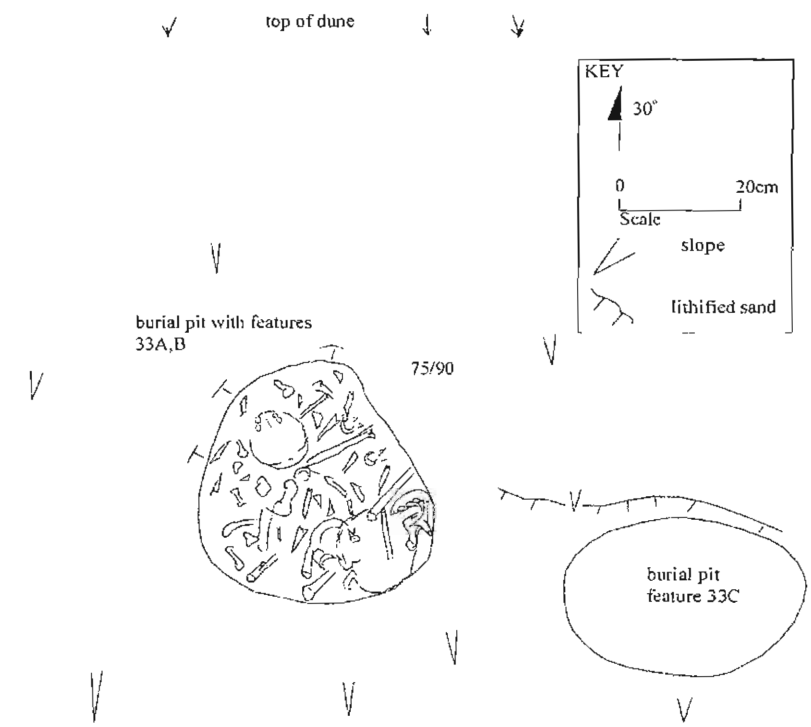


Figure 61. Plan View Map of Features 33a & 33b, and Unexcavated Burial Pit (33c)

Feature 34

Feature 34 consisted of partially disturbed human skeletal remains, a water worn basalt cobble and *puka* shells within a concentrated area. A 2.0m by 2.0m test unit was placed over the concentration which revealed a partially intact burial within a pit excavated into lithified sandstone. The burial pit measured approximately .70m long by .30m wide and contained a middle adult male placed on their back with cranium face-up (Figure 62). The *in situ* portions consisted of the cranium (except for the occipital and mastoid process of the right side), lower vertebrae, ribs, sternum, scapula, 3 *puka* shells, and phalanges). The *puka* shells (Conus sp.) were located in the vicinity of the manibrium indicating a possible neck adornment. Displaced remains consisted of additional phalange, rib fragments, left scapula, *puka* shells, right tibia, long bones of the arms and legs, and left patella. Sex was determined by the sciatic notch of the right innominate and age was estimated on the stage of fused epiphyses of long bones. Two manuports (waterworn cobbles) were collected in the vicinity of the displaced portion of the cranium. Feature 34 was determined to be a recently disturbed primary burial feature that will be preserved in place in Preserve Area 1 (see Figure 8 and Table I).

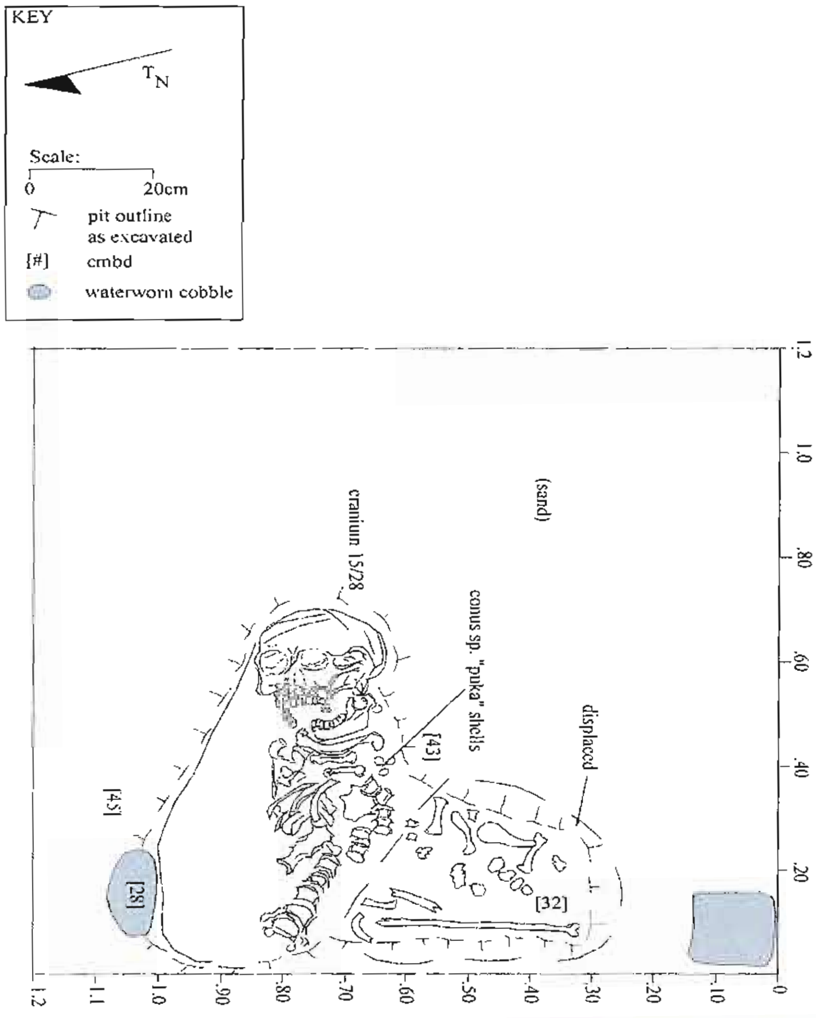


Figure 62. Plan View Map of Site 6679, Feature 34

Features 35a and 35b

Features 35a and 35b consisted of secondarily deposited skeletal fragments situated within the area containing Features 31-41. Feature 35a remains belong to an infant (newborn to 12mos) and Feature 35b is a second infant (approximately 1+/- 12mos). The minimal remains constituting Feature 35a consisted of cranial fragments and both tibia. For Feature 35b was also minimal portions of the cranium (occipital), ribs, left scapula and clavicle, left radius, a partial left Os coxae, and the right tibia. Shovel scraping was performed around the finds but no burial pit or additional human remains were identified. Features 35a and 35b may have an intact component in the area which has not yet been documented. In particular, because primarily left components of Feature 35b were recovered, Feature 35b may be lying on its right side. Features 35a and 35b will be preserved in the area where they were identified.

Features 36-41

Features 36-41 consists of probable burial pits within the yellowish-brown (Grade A) sand that contained the grayish-brown silty sand pit fill (Figure 65). Most pits were circular in shape containing numerous roots and several contained manuports of small boulders and cobbles. No testing was performed upon the pits to confirm the presence/absence of primary burial features. These features are further discussed below.

Feature 36

Feature 36 is a probable burial pit that is circular-shaped, contains numerous roots in the southern half and measures 0.75m (e/w) by 0.70m (n/s).

Feature 37

Feature 37 is a possible burial pit which is circular in shape and measures 0.85m (e/w) by 0.90m (n/s).

Feature 38

This feature is a possible burial pit that is oval in shape (tear drop) and measures 1.85m (e/w) by 0.45-0.85m (n/s).

Feature 39

Feature 39 is a circular shaped probable burial pit that measures .84m (e/w) by .95m (n/s) and contains loose, grey silty sand pit fill.

Feature 40

Feature 40 is an oval shaped probable burial pit that is unexcavated. It is oval-shaped and measures 0.90m (e/w) by 0.75m (n/s).

Feature 41

This feature is a possible burial pit that is unexcavated. It is oval-shaped and measures 0.85m (e/w) by 0.90m (n/s).

After documenting additional primary burial features (Features 31-34) as well as numerous probable burial pits (Features 36-41) within this central area, grading activities relocated to the north and Features 31-41 will be preserved in place.

Feature 42

Feature 42 was identified during mass excavations and consisted of two isolated cranial fragments of the left and right parietals. Upon the identification of the finding, the area was inspected, raked and blade tested to ascertain the presence of additional skeletal remains. No other skeletal remains were documented, however due to these findings sand mining activities were continued away from this area to the northeast. The Feature 42 cranial fragments are from a young adult based on the pronounced sutures and will be compared with the osteological assemblages collected from this area to determine if they belong to another individual. Upon completion of the bone inventory, Feature 42 will be preserved within this area of Preserve Area 1.

Feature 43

As mining continued a possible burial pit was identified and assigned Feature 43. The burial pit was small measuring approximately 0.30 m long (e/w) by 0.20 m wide. Excavations upon the pit documented a sacrum (dorsal side up) centrally located within the pit at approximately 0.15 cmbs (Figure 63). Due to the presence of skeletal remains within a defined burial pit, no further excavations were warranted. Based on the position of the sacrum, and the small burial pit outline, this individual is presumed to have been placed face down in a fully flexed position. Upon this discovery all grading was discontinued. The stockpile of sand, which had been generated from the grading activities around Features 42 and 43, was pushed further to the west towards the screening operations. Upon moving the sand stockpile, human skeletal remains were identified at the base of the stockpile and assigned Feature 44.

Feature 43 was determined to be a primary burial feature that will be preserved in place within Preservation Area 1 (see Figure 8 and Table I).

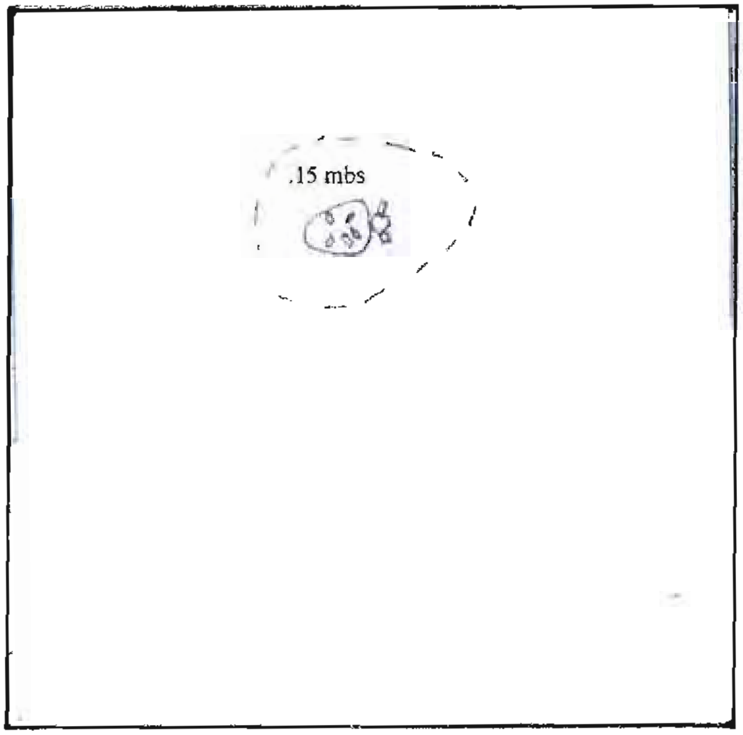


Figure 63. Plan View Map of Feature 43

Feature 44

Feature 44 was disturbed while relocating sand stockpiles created around Features 42 and 44. Upon moving the stockpile further to the west, displaced skeletal remains were identified at the base of the stockpile and consisted of portions of the lower extremities and arm (carpals, radius and ulna). The procedures for disturbed skeletal remains were instituted and a partially intact burial feature was noted. The primary, *in situ* portions of Feature 44 were the vertebral column (except L4 and L5), both humeri, scapulae, clavicle and ribs. The entire cranium was present except for the top of the occipital. The patellae and the distal ends of both the femur, though slightly displaced are positioned anatomically correct for a fully flexed burial. Based on the presence of articulated remains, no further testing was deemed necessary. Feature 44 is designated as a primary burial of a middle adult male that has recently been disturbed. Sex was determined through the sciatic notch of the innominate and size of the humeral and femoral heads. Age was based on epiphyseal fusion and cranial suture closure. Feature 44 was determined to be a partially intact primary burial feature which will be preserved in place at Preserve Area 1.

Feature 45 was not issued.

Feature 46

Feature 46 was identified during monitoring of grading activities within the lithified (Layer III) sand layer. Once skeletal remains were observed, all mechanical excavations were terminated and recovery and testing efforts were undertaken (Figure 65). A 2.0m by 2.0m test unit was placed over the exposed remains (portions of the cranium and some ribs) and determined that a possible burial pit outline and articulation was present along the ribs and pelvic region (lumbar and thoracic vertebrae, innominate and sacrum) (Figures 66-68). Disturbance occurred on both femurs, tibia, right fibula and a few carpals, partial left humerus and an assortment of ribs and vertebra. Analysis of the skeletal remains determined Feature 46 to be a young adult male. Age was based on epiphyseal closure and sex was ascertained by observation of the sciatic notch as well as overall robustness of remains. Feature 46 was determined to be a recently disturbed primary burial feature that will be relocated to Preserve Area 1. Relocation is due to the proposed extension of Kamehameha Avenue into the project area from the Maui Lani to the north.

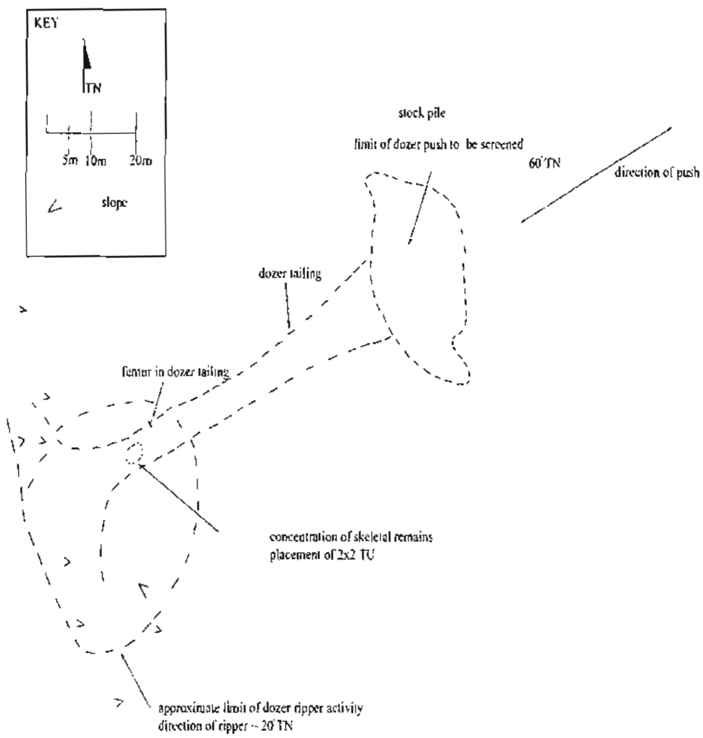


Figure 64. Plan View Map of Site 6679, Feature 46 Scatter and Grading Activities

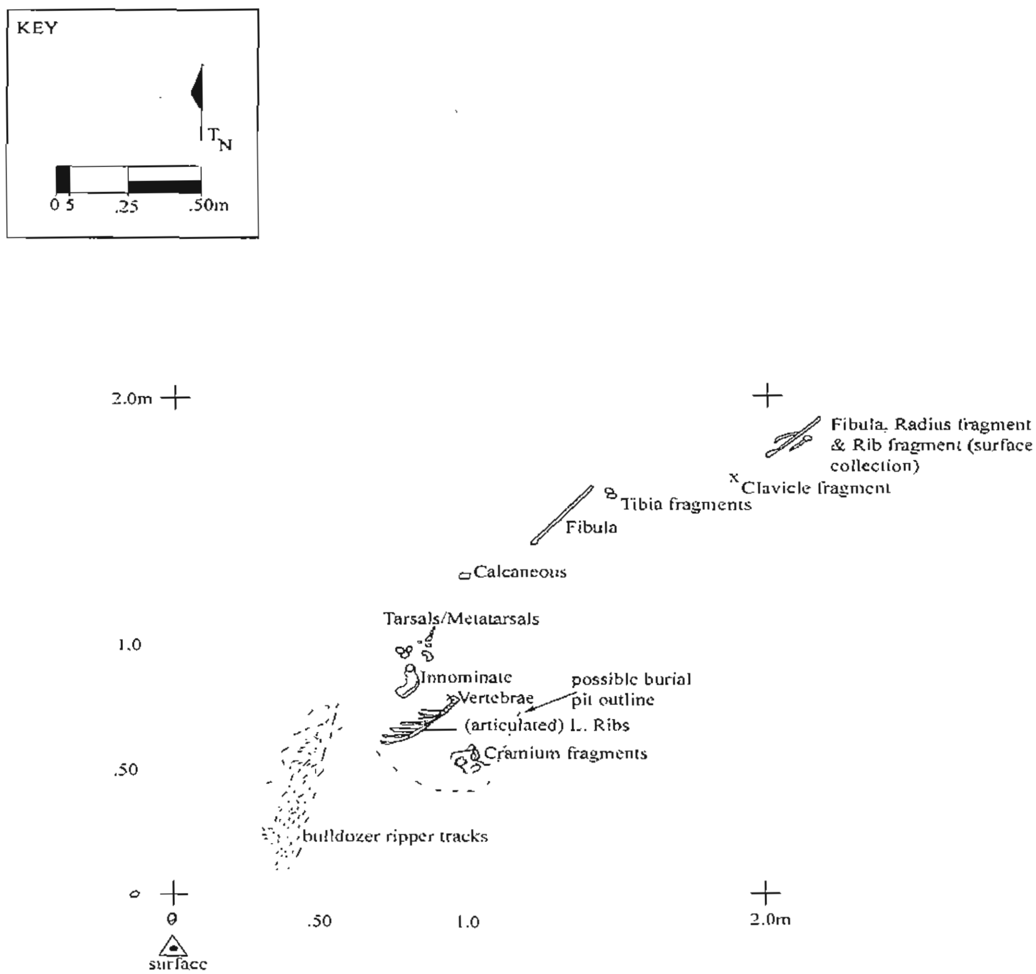


Figure 65. Plan View Map of Primary Burial Feature 46, Site 6679

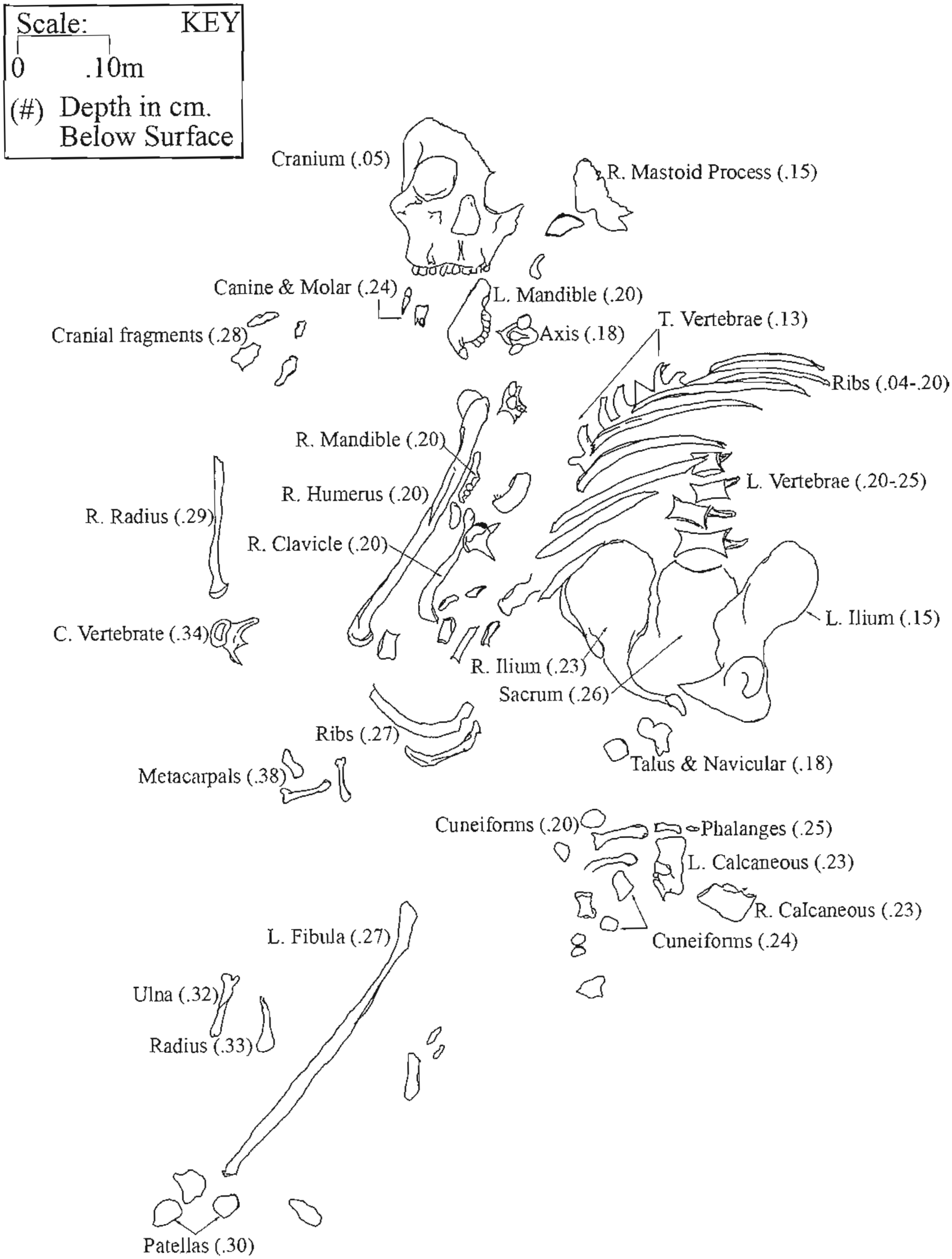


Figure 66. Plan View of Site 6679, Feature 46

After the discovery of Features 42-44 and 46, grading activities were relocated to the southern portion of the project area, where Features 47-53 were identified.

Feature 47 a and b

Features 47a and b are comprised of a secondary deposit of skeletal remains of two individuals. The skeletal remains of Feature 47a belong to an adolescent to young adult female and one infant designated 47b. The skeletal remains were observed during a field inspection and were located along the edge of the knoll containing Features 5-11. The area has been raked and hand screened to collect all displaced human skeletal remains. No *in situ*, primary portion of these remains has been identified. During testing of Features 5-11, this area had been significantly altered prior to the sand mining activities, thus Features 47a and 47b were designated as previously and possibly recently disturbed scatters.

Laboratory analysis of the collected remains identified Feature 47a as an adolescent/young adult female approximately 19-23 years of age based on observation of active fusion in the distal end of radius and right clavicle/sternal facet. Sex was determined through observation of the acetabulum and pre-auricular sulcus. Feature 47b is an infant approximately 6 months to 1 year old. Estimated age is based on non-fused epiphyses. Sex determination could not be established at this time. Features 47a and b are secondary scatters that will be preserved in the southern area of Preservation Area 1 (see Figure 8 and Table I).

Feature 48

Feature 48 consists of a secondary deposit of human skeletal remains which were recently and previously disturbed. The remains were dispersed across a 33.0 meter long by 3.0 meter wide tract, and consisted of ribs, cranial, scapulae, cervical and thoracic vertebrae as well as small long bone shaft fragments (Figures 67 and 68). Procedures for displaced skeletal remains were instituted however no primary and or articulated portion of Feature 48 was identified. Based on dentition (occulsal wear and alveolar resorption) and cranial suture closure, Feature 48 was determined to be and older adult female and the skeletal remains shall be preserved within Preservation Area 4.

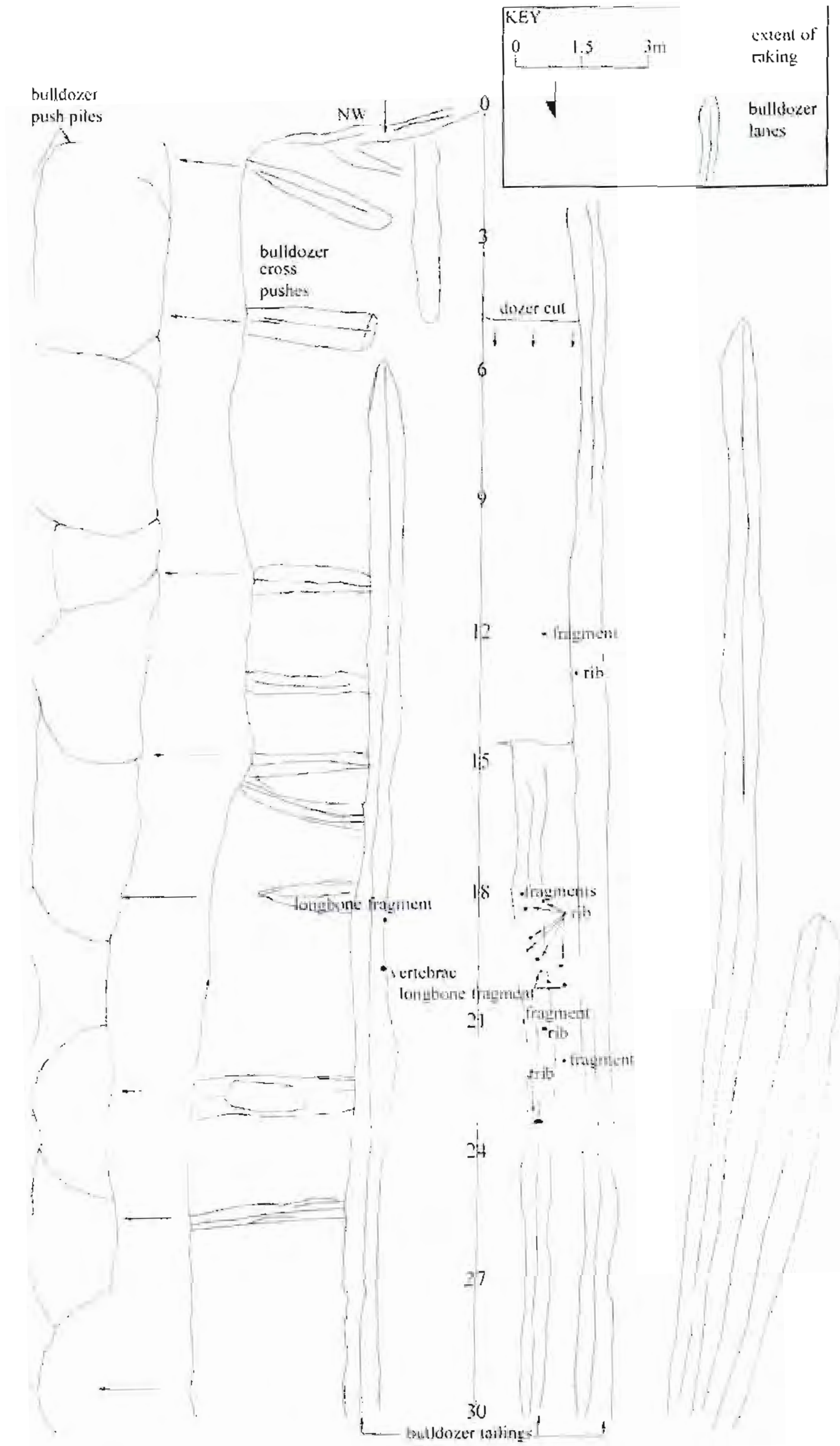


Figure 67. Plan View Map of Activity Area of Feature 48, from 0-30 m

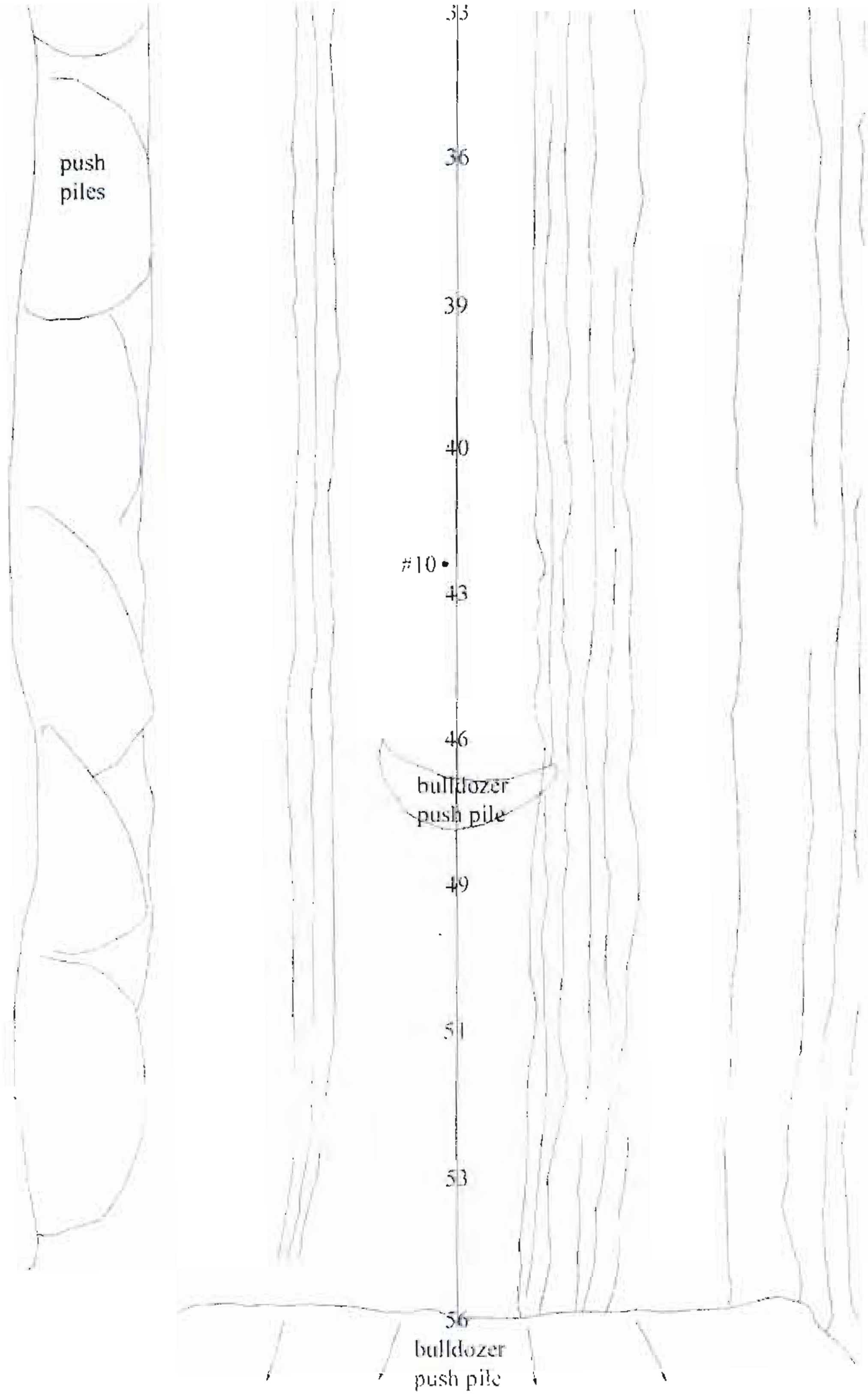


Figure 68. Plan View Map of Activity Area of Feature 48, From 33.0-56. m

Features 49 a-c

Features 49a-c was identified during a field inspection along a low small knoll approximately 2.0-6.0 ft. higher than the surrounding graded area. Several skeletal fragments were exposed and all mechanical activities were terminated. A plan view map was drawn and hand testing was initiated documenting a partially articulated, primary individual designated Feature 49a (Figure 69). Articulation was noted along the vertebral column and left arm which was slightly displaced from its original position (Figure 70). Additionally, no defined burial pit was apparent in the test unit however both tibia (though disturbed) appeared to be anatomically correct for a fully flexed burial. Upon completion of testing, Feature 49a was designated as a partially intact primary burial of a robust middle adult male. Determination of age and sex for Feature 49a was based on size of the clavicle and cranial suture closure. Analysis of the osteological assemblage collected around Feature 49a identified extraneous remains belonging to a child 7-10 years of age (Feature 49b) and a young adult female, Feature 49c. Collected from Feature 49b, were portions of the cranium, tibia and metatarsals and age was based on the size and stage of epiphyseal fusion. For Feature 49c, age and sex was based on epiphyseal fusion and cranial suture closure. These extraneous remains were in a secondary context and thus contained no intact component.

Based on the above testing and analysis, Feature 49a was designated as a recently and possibly previously disturbed partially intact, primary burial feature and Features 49b and 49c were determined to be secondarily deposited human remains.

Due to the necessity for lateral access into the eastern portion of the proposed development, Feature 49a will be reinterred into Preservation Area 4 and all scattered skeletal remains from Features 49b and c will also be relocated to Preservation Area 4 (see Figure 8 and Table I).

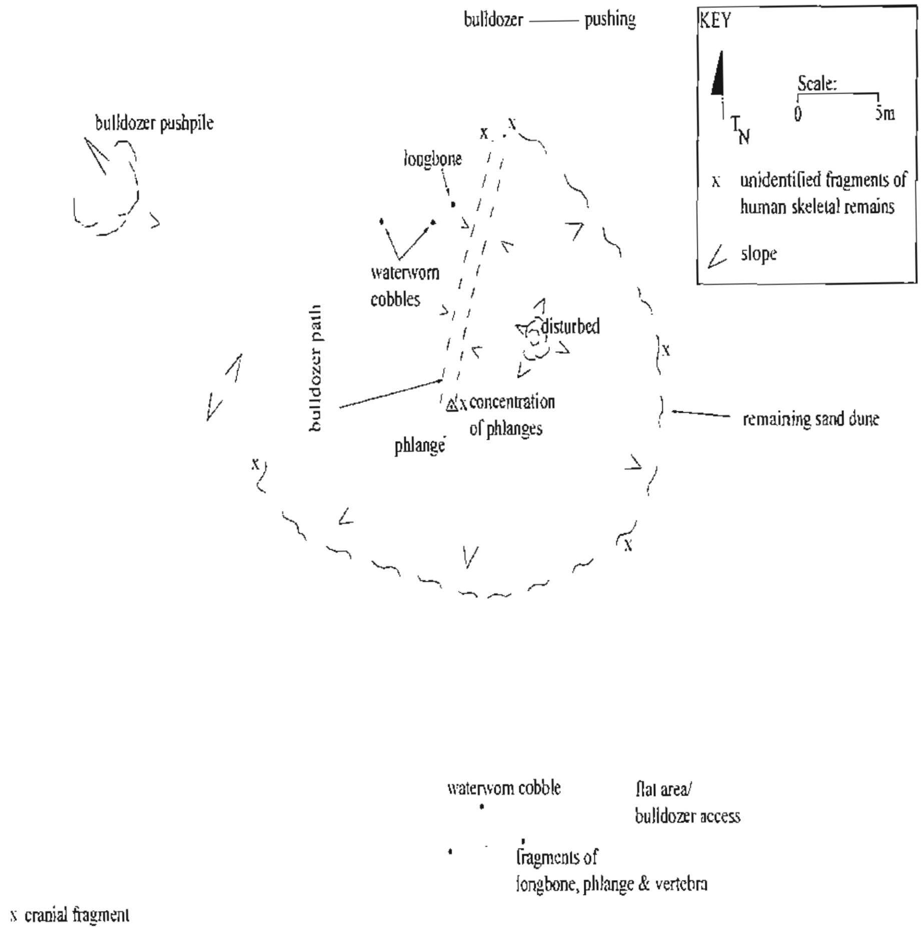


Figure 69. Plan View Map of Surface Scatter, Feature 49

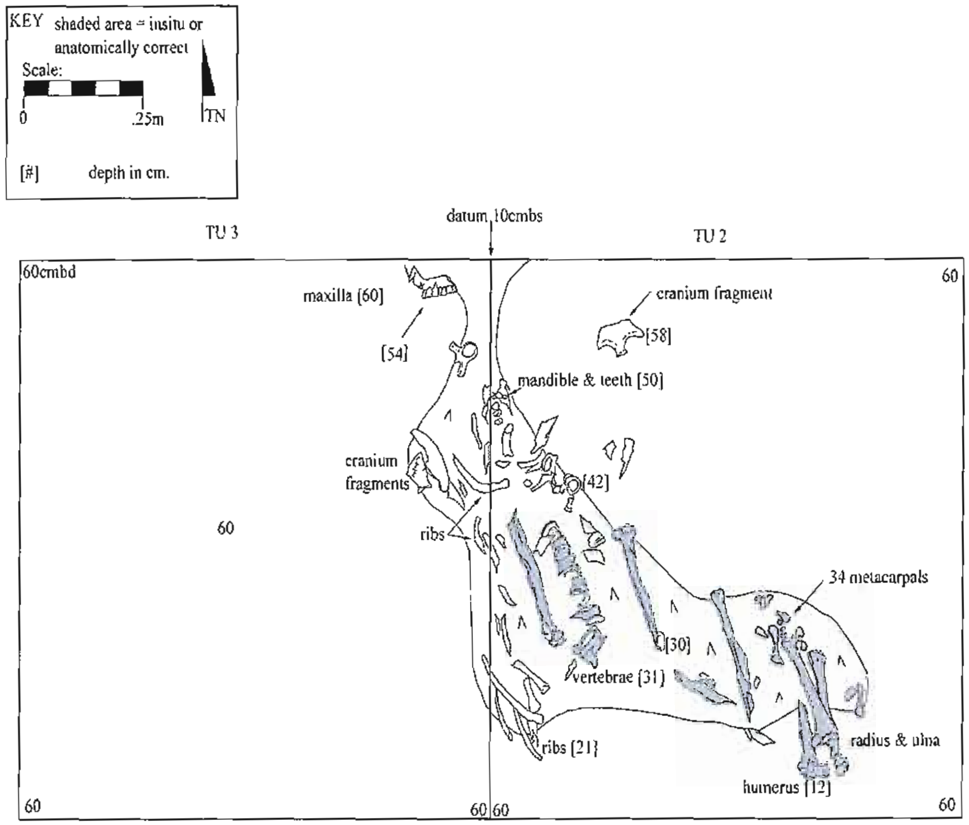


Figure 70. Plan View Map of Site 6679, Feature 49a showing Partial Articulation (shaded area)

Feature 50

Feature 50 consisted of human skeletal remains which were identified along the bulldozer tract and subsequent push pile. This inadvertent finding consisted of the frontal portion of the cranium, carpals/metacarpals of the right hand, clavicle, vertebrae, two complete ribs, both humeri and both innominate. A plan view map was created documenting the activity area (Figure 73). Raking of the initial findings was executed where several bones were recovered at the beginning of the tract along the western edge. A test unit was subsequently placed in this area however no burial pit or intact portion of Feature 50 was identified. Test excavation was halted at 0.35m bs as a hardened brown silt layer (undisturbed) was reached. Raking and shovel scraping was continued along the tract where no concentration of skeletal remains was documented. Laboratory analysis of the osteological assemblage belonging to Feature 50 determined this individual to be a middle adult female. Sex was determined upon examination of the sciatic notch of the innominate. Estimated age was based on cranial suture closure, eruption of all permanent teeth, as well as observation of dentine present in molars, which suggests individual to be between the ages of 20-30 years old (White & Folkens, 2000). Based on the linear spread and amount of skeletal remains collected, this feature was likely partially intact in a primary context and recently disturbed. Feature 50 will be preserved within the area it was identified. Prior to the reinterment ceremony, additional testing will be undertaken to ascertain if an *in situ* portion of this feature is extant. Feature 50 will be preserved within Preservation Area 4 along with primary burial Feature 54 and reinterred features (Features 49a-c).

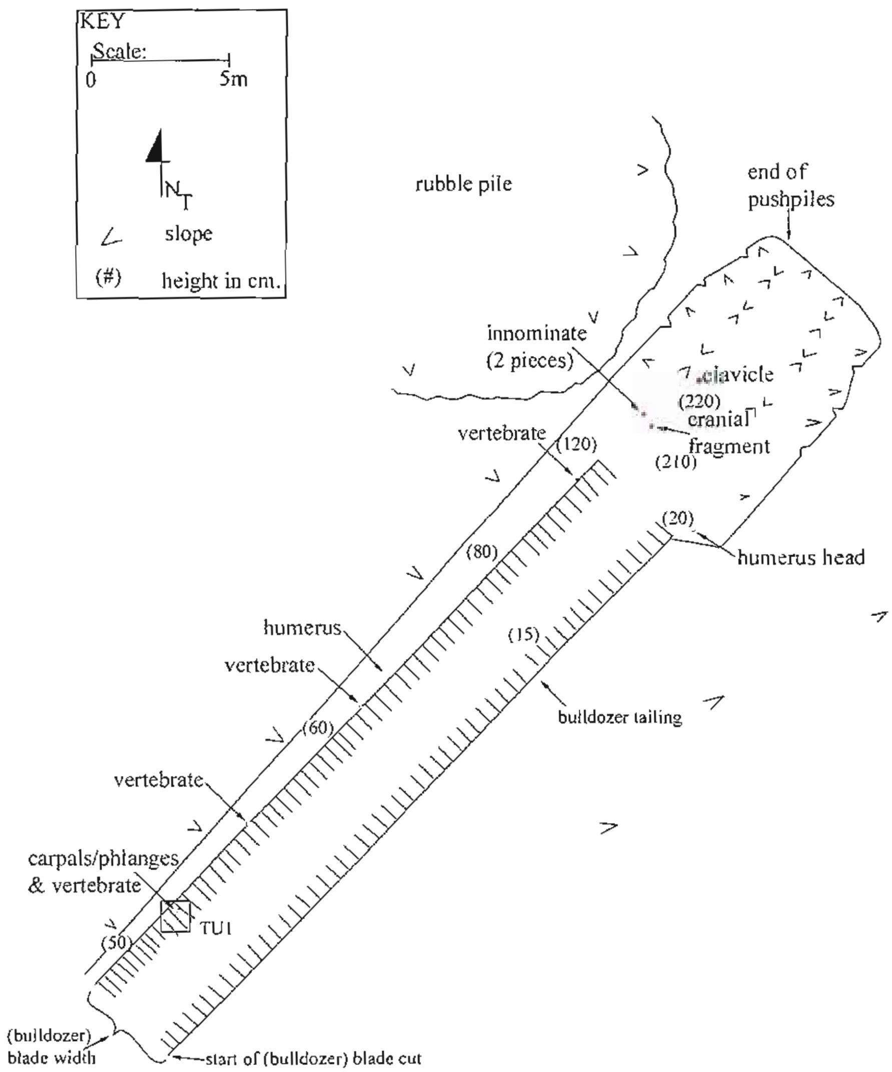


Figure 71. Plan View Map of Surface Scatter at Site 6679, Feature 50

Feature 51

Feature 51 was discovered during a field inspection of a previously grubbed and lightly graded area that had recently been subjected to heavy rainfall. During the inspection, a small concentration of skeletal remains consisting of portions of the innominate, carpals of the right hand, tarsals and metatarsals of the feet, the distal end of the tibia and a rib were identified and situated at approximately .15 m bs (6 inches). A plan view map was created documenting the recent activity in the area and subsequent surface scatter of remains (Figure 72). All dozer tracks and the previously grubbed vegetation was inspected and raked. Upon completion of these testing strategies around the periphery of the concentration, hand testing was then initiated on the surface scatter. A 3.0 m long by 2.0 m wide test unit (TU1) was placed over the concentration to ascertain the context. No intact component was observed during testing however fragmented portions of the left femur were collected. Also noted during the testing were depressions within the lithified sand (Figure 73). The depressions contained a loose silty humic sand in which the skeletal remains were mixed within. As this surface was just below the vegetation line, it is likely that the depressions were due to floralturbation (root intrusion) or bioturbation (animal intrusion) exemplifying that the skeletal remains were at least partially disturbed by root activity.

Laboratory analysis of recovered remains identified them as belonging to a middle adult male based on fused epiphyses of long bones. Sex was determined through observation of sciatic notch on the innominate. Feature 51 is a secondary scatter of skeletal remains that will be preserved within Preservation Area 4.

Feature 52

Feature 52 consists of one displaced long bone identified on the surface within Preservation Area 1. No other human remains have been identified with this isolated find to date.

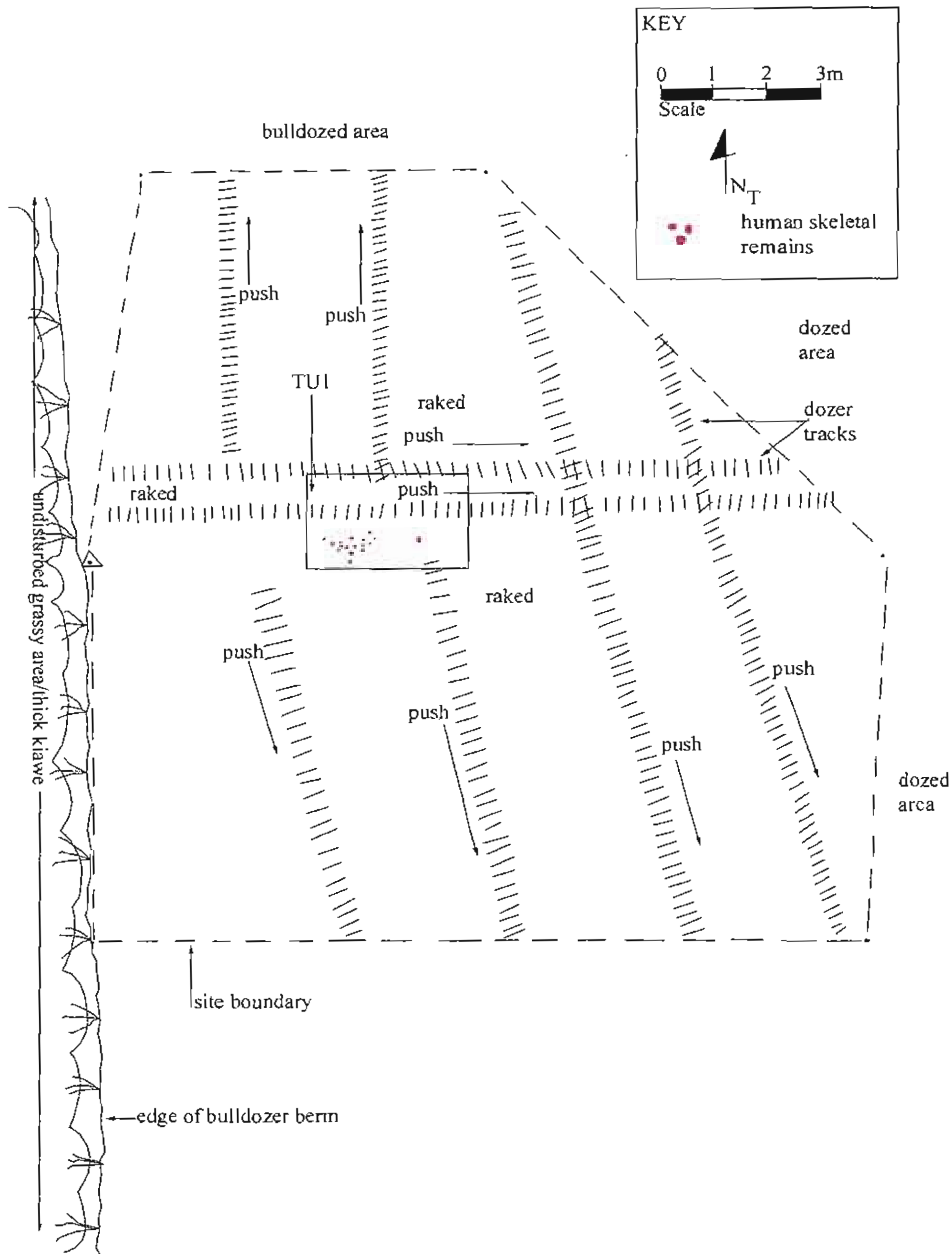


Figure 72. Plan View Map of Surface Scatter at Site 6679, Feature 51

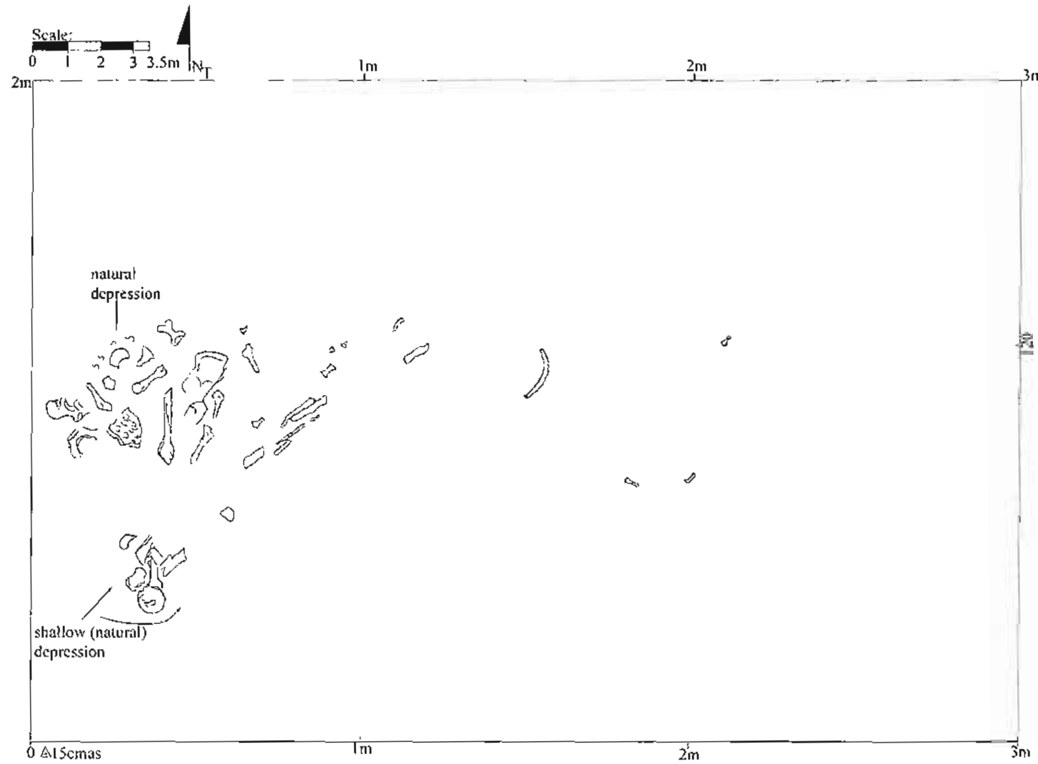
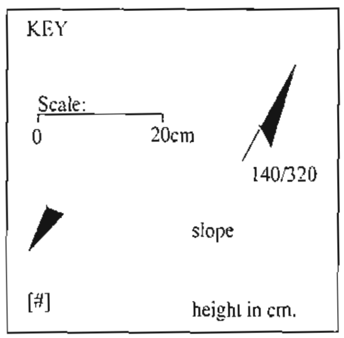


Figure 73. Plan View Map of Site 6679, Feature 1, Test Unit 1

Features 53a-c

Feature 53a was identified near Feature 12 during a field inspection and was comprised of a surface scatter of human remains consisting of two metatarsals, a talus, and the innominate. As no activity had occurred in this area for over a year, the skeletal remains were likely exposed from natural erosional forces (wind and rain). Per consultation with the SHPD and MLIBC, hand testing (TU1) was implemented to ascertain if a primary, *in situ* portion of Feature 53a was extant. Testing revealed the displaced right innominate approximately .40 m south of the surficial remains (left innominate, phalanges, talus) and no apparent burial pit (Figure 74). Since Feature 53a was situated along the western and northern sides of the test unit, a second test unit (TU 2) was placed adjacent and to TU1 along the north to ascertain the extent of Feature 53a and or additional skeletal remains. Testing at TU2 identified a displaced cranium and calcaneous within a concentration of roots at approximately .12 m bs (Figure 75). Disturbance to the cranium was evident due to a missing mandible and that the cranium exhibited evidence of burning. Although these remains were not articulated to those in TU 1, they may belong to Feature 53a. Based on cranial suture closure, dentition and the condition of the auricular and periauricular area, as well as the shape of the sciatic notch, the skeletal remains of Feature 53a from TU1 and TU2 belong to a middle adult male. Testing re-commenced and TU3 was placed to the east of TU2. This test unit was excavated to .15 m bs where a possible burial pit designated Feature 53b was noted in the northern half of the unit (Figure 76). This hemispherical shaped pit measured .60 m long by.45 m wide and contained several rootlet inclusions. Due to the proximity of this pit to known primary burial features and per direction of Mr. Hinano Rodrigues, SHPD Cultural Historian and Ms. Dana Naone Hall, MLIBC, testing of this pit was not warranted.



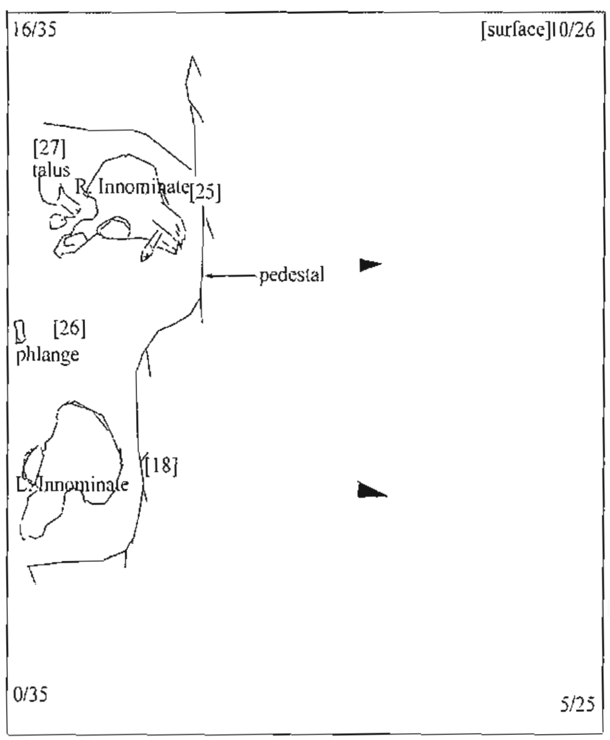


Figure 74. Plan View Map of Test Unit 1, Site 6679 Feature 53a

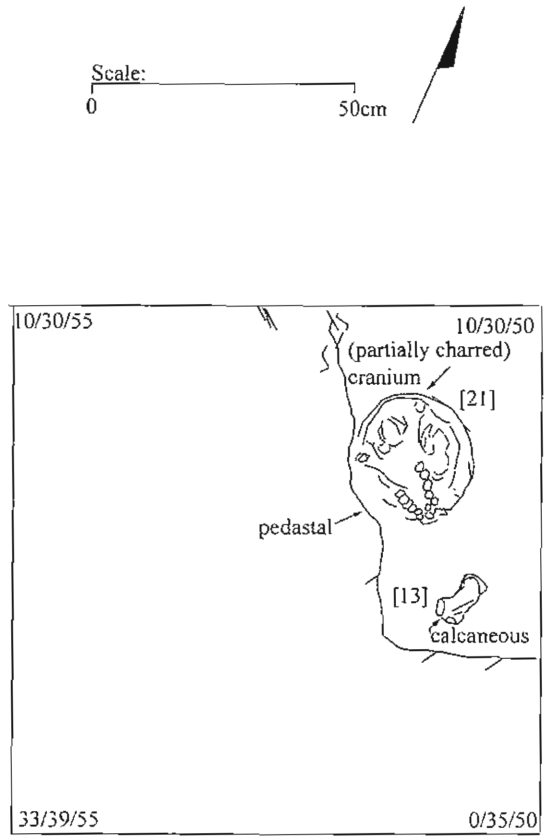


Figure 75. Plan View Map of Test Unit 2, Site 6679 Feature 53a

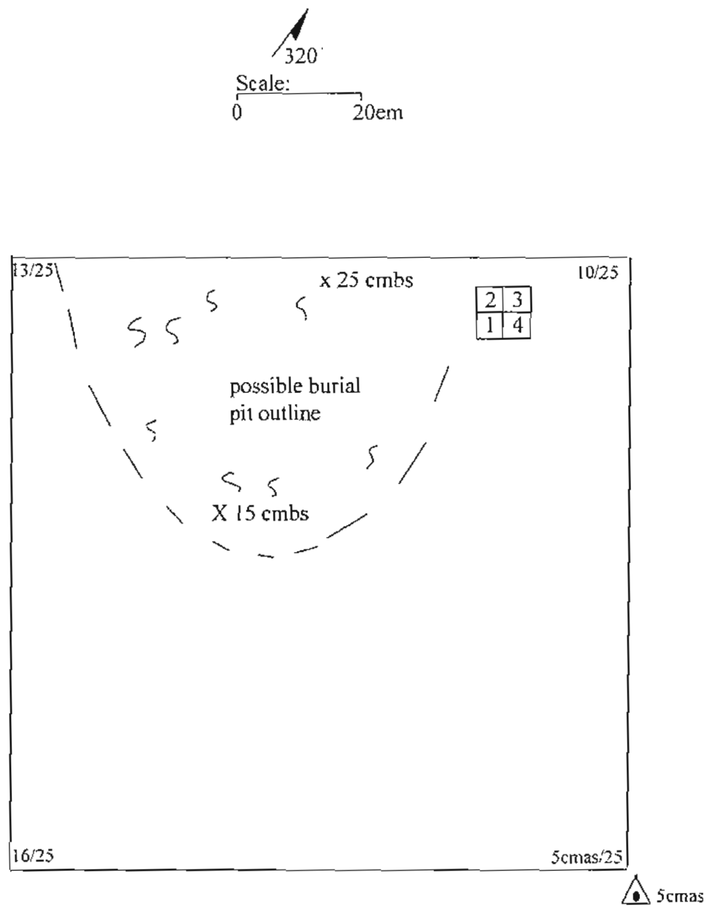


Figure 76. Plan View Map of Test Unit 3, Feature 53b

Proceeding south of TU3, TU4 was placed adjacent to and east of TU1. Within this test unit, a cranium, the proximal end of the humerus, a portion of a clavicle and scapula within a pit was identified at approximately .12 m bs. As these skeletal remains were determined to be anatomically correct and articulated, they were assigned Feature 53c and no further testing was deemed necessary (Figure 77). A fifth test unit, TU5, was placed adjacent to and west of TU1 to ascertain presence and or absence of additional human skeletal remains. Excavations were negative and terminated at approximately .25 m bs. Testing was then relocated to the north of TU5 and excavations terminated within this last unit (TU6) from to .26-.29 m bs. No human remains were identified in TU6 and all testing for the Feature 53 area was complete. Features 53a-c shall be preserved in place.

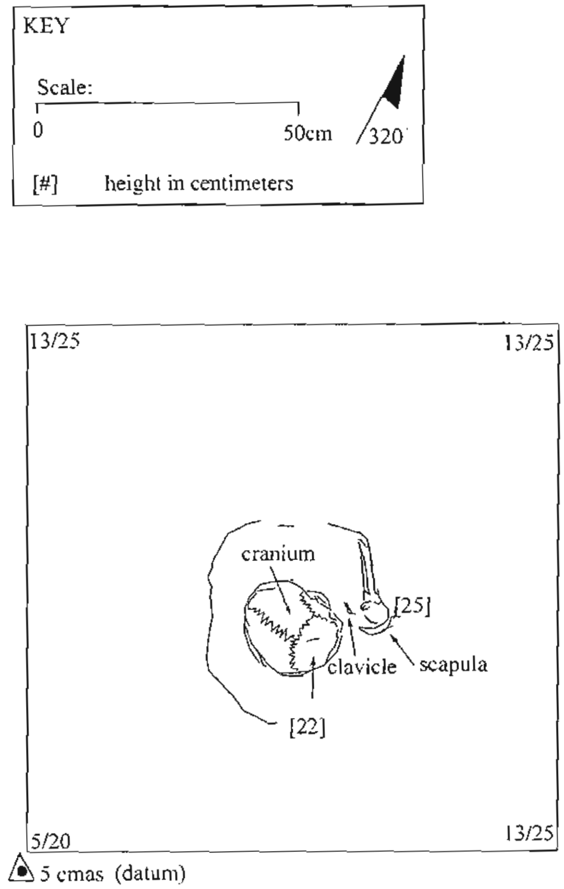


Figure 77. Plan View Map Test Unit 4, Feature 53c.

Feature 54

Feature 54 was identified during monitoring of the removal of stock piles. As grading activities reached the bottom of the spoil pile, concentrated remains as well as disturbed remains (portion of cranium, left scapula, left innominate and left femur) were observed. Hand testing was initiated and consisted of a 1.0m by 1.0m test unit designated TU1. At .10 m below the current surface a burial pit outline containing articulated remains with a large water worn cobble placed in the pelvic region was identified. Feature 54 was orientated at 240°/80° in a fully flexed position on the right side with the cranium face up (Figure 78). The remains belong to a middle adult male individual where sex was determined by the shape of the sciatic notch and the mastoid process. Age was estimated on cranial suture closure and the overall condition of the remains. Feature 54 has been designated as a primary burial feature which was minimally disturbed and will be preserved in place. Preservation Area 4 was created around Features 50 and 54 and is situated within the southern portion of Phase A.

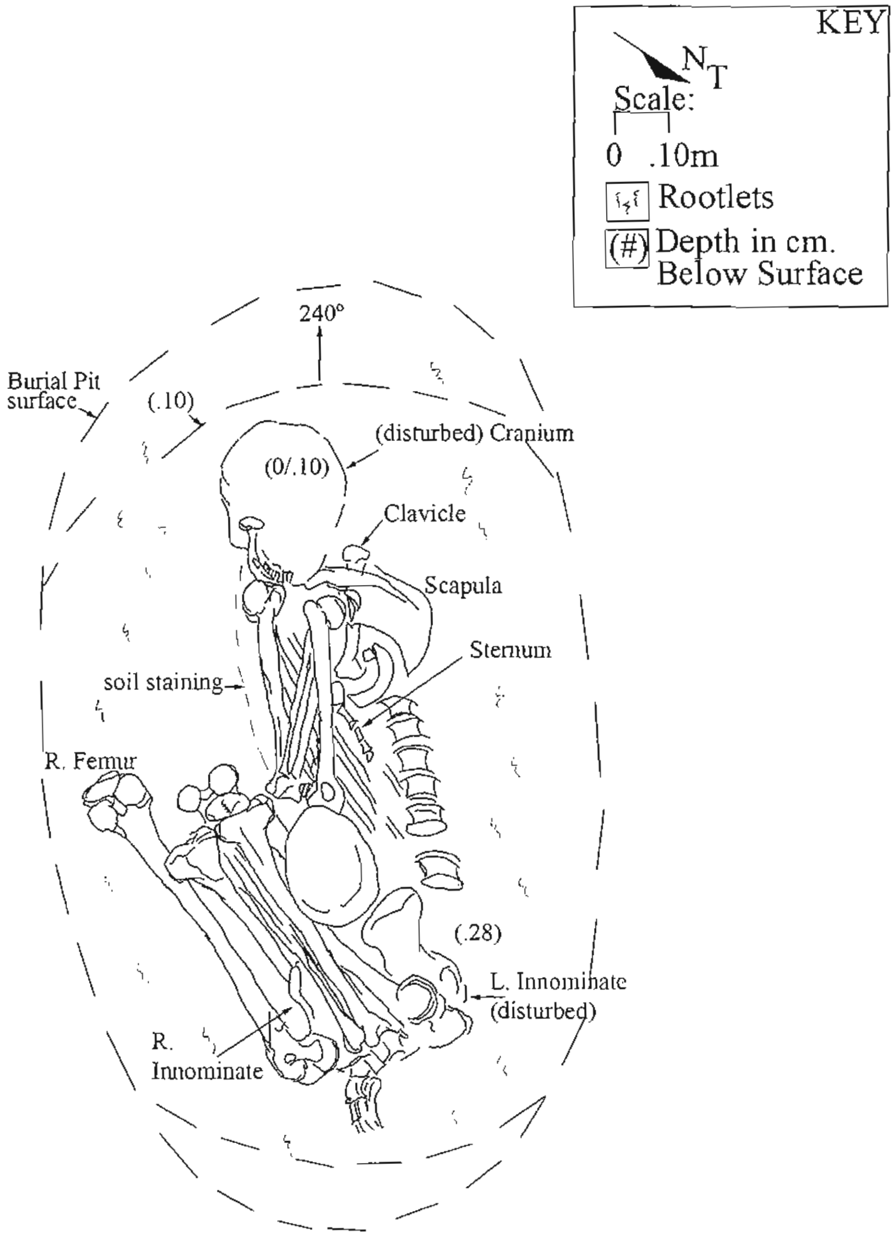


Figure 78. Plan View Map of Site 6679, Feature 54

After the discovery of these features and due to the concentration of human remains identified within Phase A, sand grading activities commenced within Phase C upon the completion of addendum inventory survey procedures. A total of test trenches were executed within the 50-acre Phase C area which were negative for cultural remains. Additionally, during the monitoring program within Phase C, no burial features were documented.

Upon completion of mining activities within Phase C, additional inventory survey procedures were executed within Phase D and resulted in negative findings. Thus, grading activities commenced within this 15-acre area.

PHASE D

Phase D is situated within the southeastern portion of the project area adjacent and east of Phase C. It is comprised of 15 acres which contain low undulating sand dunes. After approximately 5.0 acres had been graded, several burial sites and secondary scatters of human remains were identified within a 1.0 acre section. A total of three partially intact primary burials (Features 56-58), a burial pit (Feature 59), a recently disturbed possible intact burial (Feature 55) and the displaced skeletal remains of a minimum of seventeen individuals (Features 56a-q) were recorded. Upon the identification of this concentration, all grading activities were terminated within Phase D.

Feature 55

Feature 55 was inadvertently exposed during grading of sand to create separate stockpiles of "Grade B" and "Grade A" sand. Upon the identification of skeletal remains within the tailing and stockpile, all grading was halted (Figure 79). Recovery and testing was performed and no intact component of Feature 55 was identified. The remains were in a linear scatter at the transition between the Grade B and A soil horizons (Figure 80). Based on the osteological assemblage, it appears that this feature was likely recently intact and displaced during sand mining activities. Feature 55 is the remains of a child 6 years +/- 24 mos based on the stage of epiphyseal fusion of long bones and dentition. Sex at this age is indeterminate. The burial was lying on the border of the B/A horizon. The left side of a juvenile mandible was observed on the surface, as well as a concentration of long bones at the base of the stockpile. Since Feature 55 was determined to be a recently disturbed probable primary/*in situ* burial feature, it will be preserved in the place where it likely originated. A Preservation area has been established at this location and designated as Preservation Area 3 (see Figure 8 and Table I).

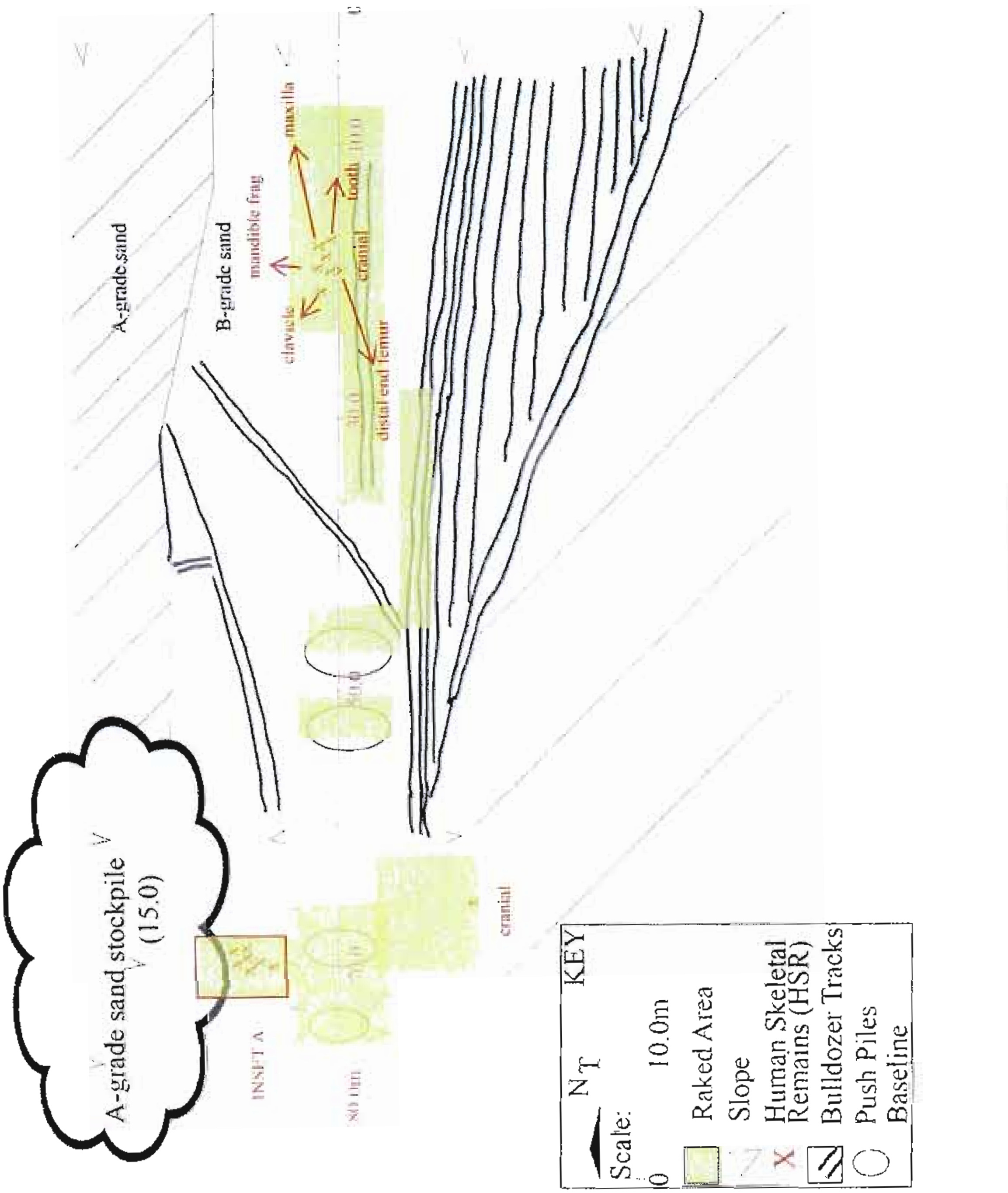


Figure 79. Plan View Map of Work Area Showing Dozer Track, Stockpiles and Location of Skeletal Remains for Feature 55

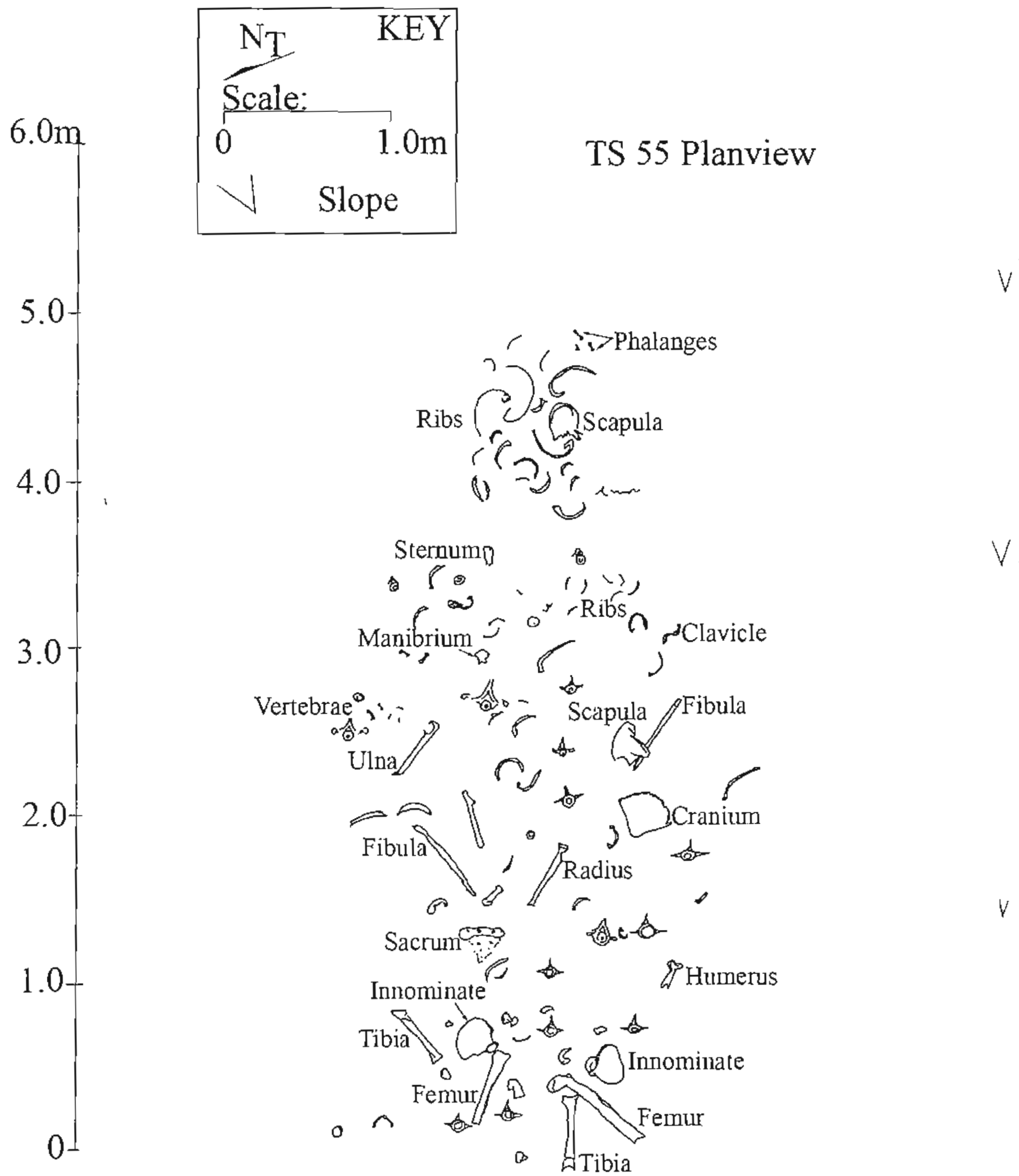


Figure 80. Plan View Map of Scatter for Site 6679, Feature 55 (Inset A on Figure 81)

Features 56-59

Features 56-59 were identified during monitoring of grading activities approximately 30 m (100.00 ft.) east of Feature 55. While creating a large stockpile, the monitor identified a linear pattern of scattered remains within the tailing leading up to the stockpile. A closer inspection noted skeletal remains on top of the stockpile and around the edges. A plan view map was created to document the activities (Figures 81 and 82) and resultant initial surface scatter of remains. Raking of the dozer tailings and around the top and sides of stockpile was initiated first. As the skeletal remains were collected, it was apparent that there were several individuals and artifacts represented in the assemblage as well as possible intact burials and burial pit outlines. Thus to collect all the displaced skeletal remains and to determine the presence of primary, intact burial features, areal excavations utilizing a grid system were instituted. The grid system consisted of fifty 2.0m by 2.0m units to be raked, shovel scraped and or hand-tested (Figure 83). The raking, screening and hand testing at the grid system documented three partially intact primary burial features (Features 56 and 58), and a probable burial pit containing a primary burial feature (Feature 59). Raking, shovel scraping and screening of the tailings and stockpile recovered additional skeletal remains in a secondary context (Features 56a-q). One additional intact burial feature was noted just outside the activity area and is designated as Feature 57. Features 56-59 are further discussed below.

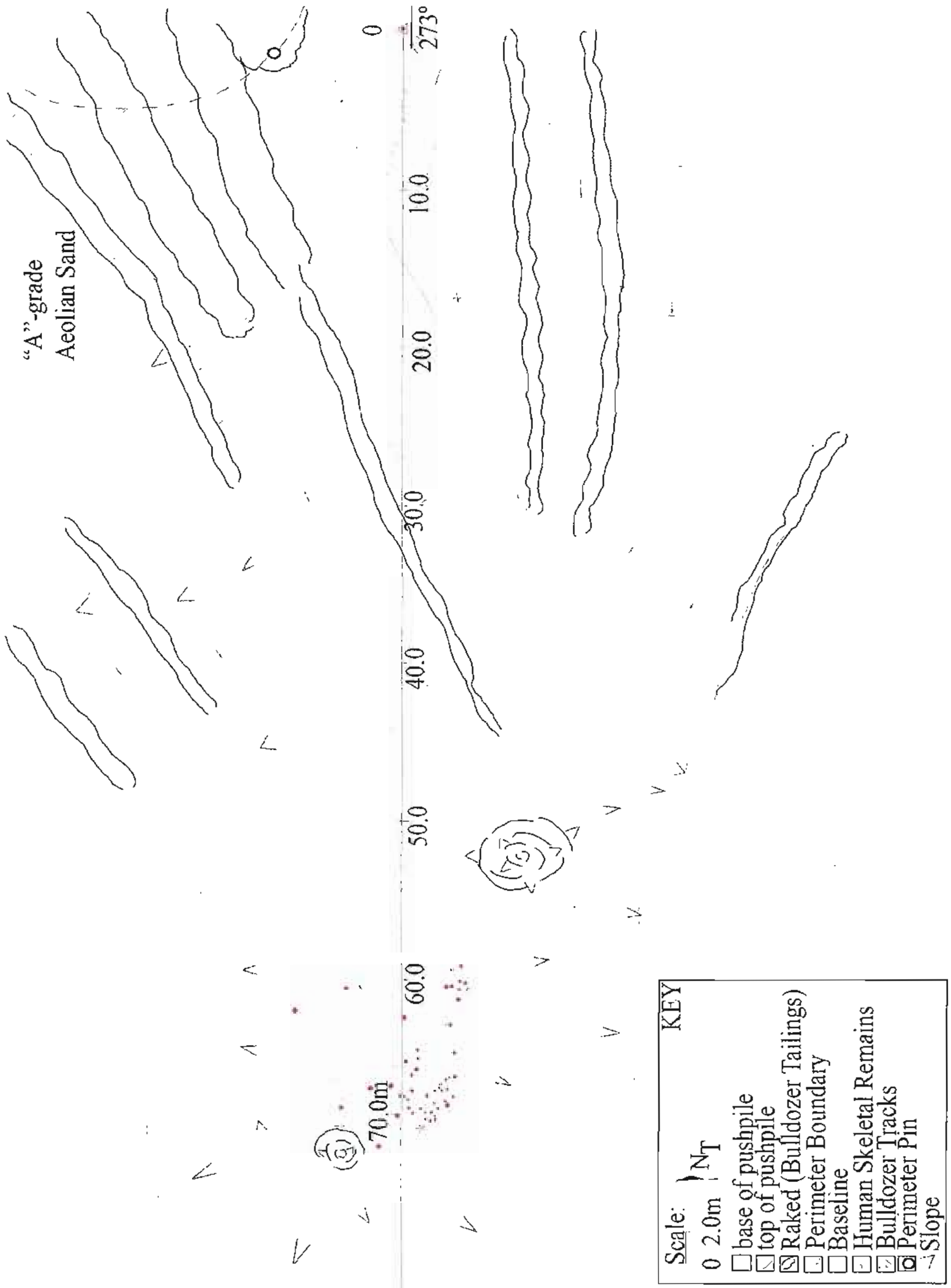


Figure 81. Plan View Map of Site 6679, Feature 56-59 Area

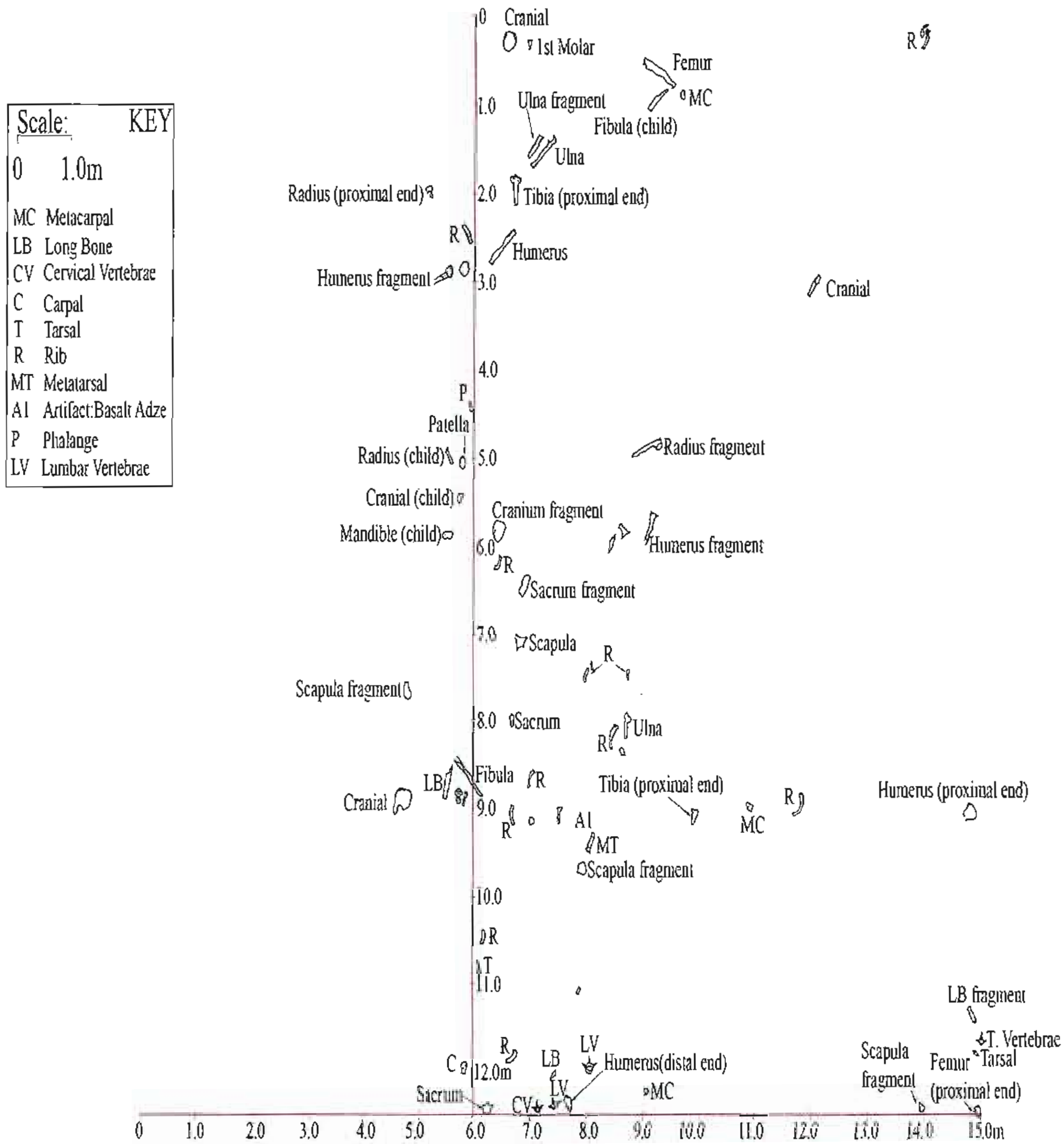


Figure 82. Plan View Map of Scatter within Dozer Tailing

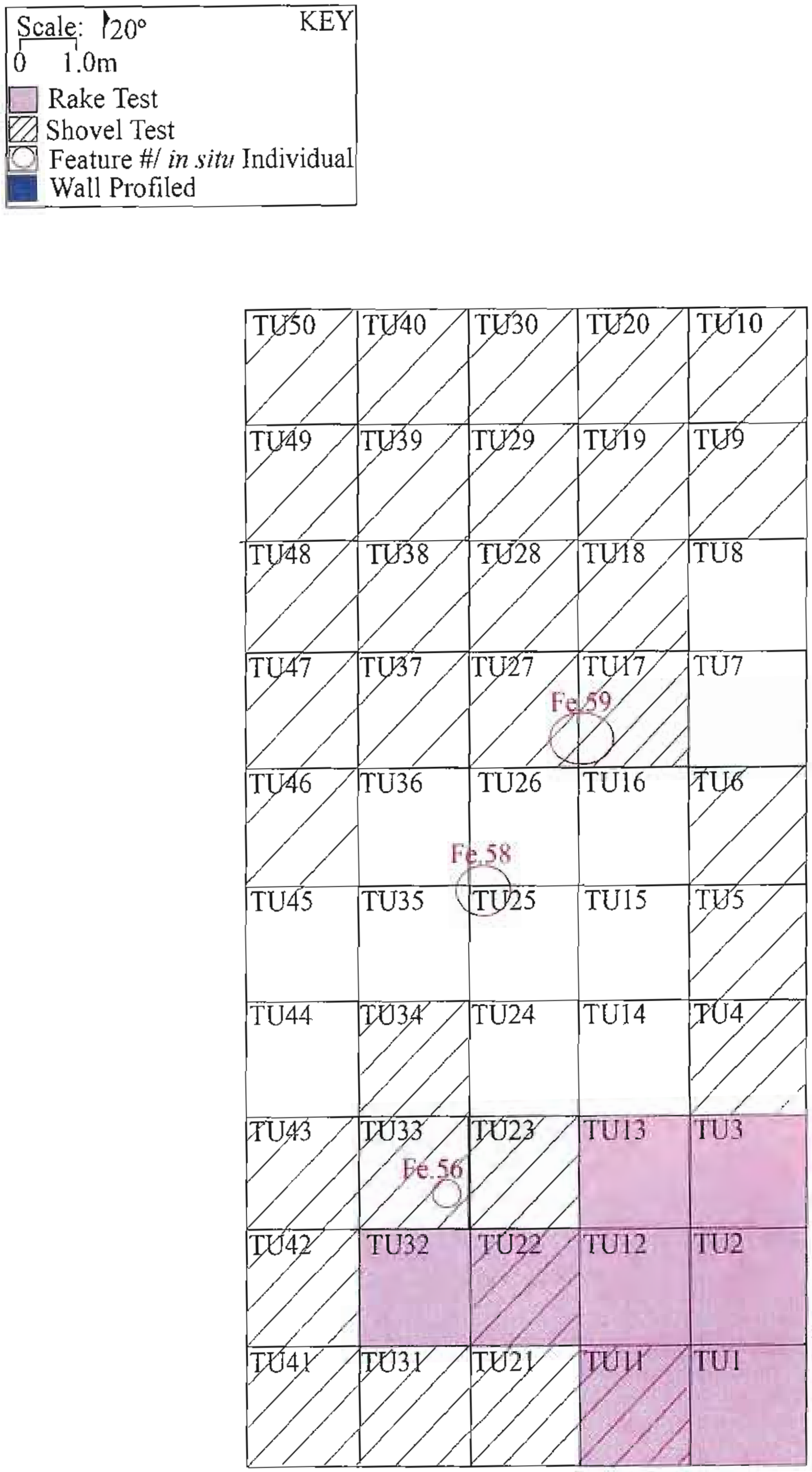


Figure 83. Plan View of Grid System for Areal Excavations

Feature 56

Feature 56 was documented within TU 33 grid and initially consisted of cranial fragments surrounded by a faint burial pit outline within the southeastern quadrant of the test unit (see Figures 84 and 85). As excavations continued, the burial pit became more defined at .10 m bs and was excavated into the lithified sandstone layer. The pit measured .90m long n/s by .70m wide, was oriented north/south and contained pitfill of the grayish brown "Grade B" sand with numerous roots, sandstone peds and articulated human skeletal remains. This individual was placed on their back, face up, head tilted slightly to the right in a fully flexed position (Figure 86). The hands, feet and pelvic region were not excavated in order to keep disturbance at a minimum. Feature 56 was determined to be a primary burial feature of a young adult female. As the burial was not fully exposed (particularly the innominate), sex determination was therefore based on observation of the brow ridge as well as the overall 'gracile' appearance of the skeletal remains. Estimated age was based on the stage of cranial suture closure and epiphyseal fusion. Feature 56 will be preserved in place within Preservation Area 3.

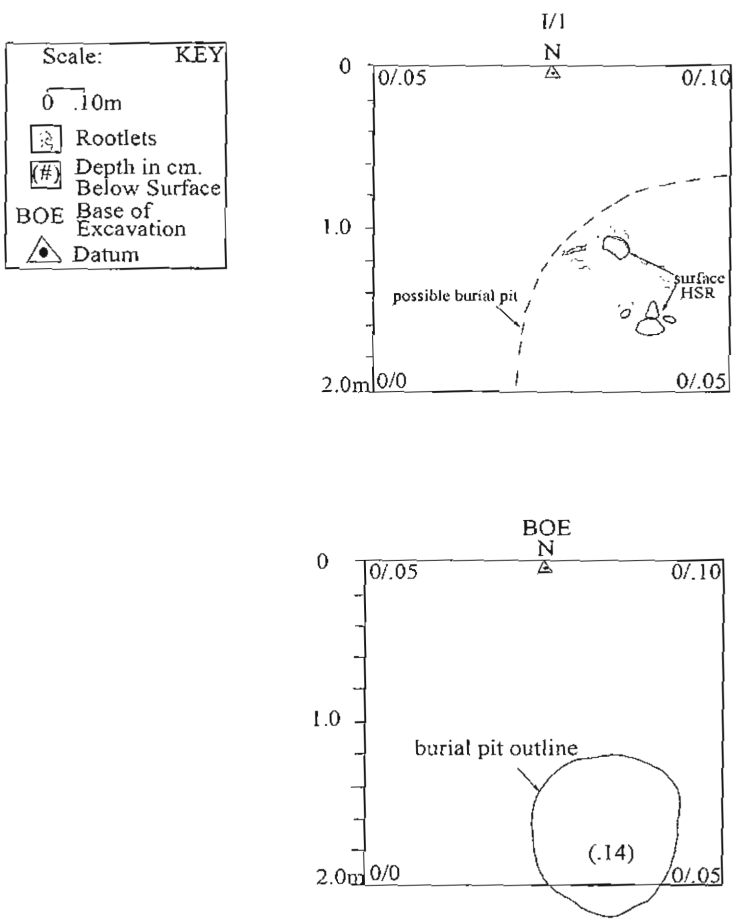


Figure 84. Plan View Map of Test Unit for Site 6679, Feature 56

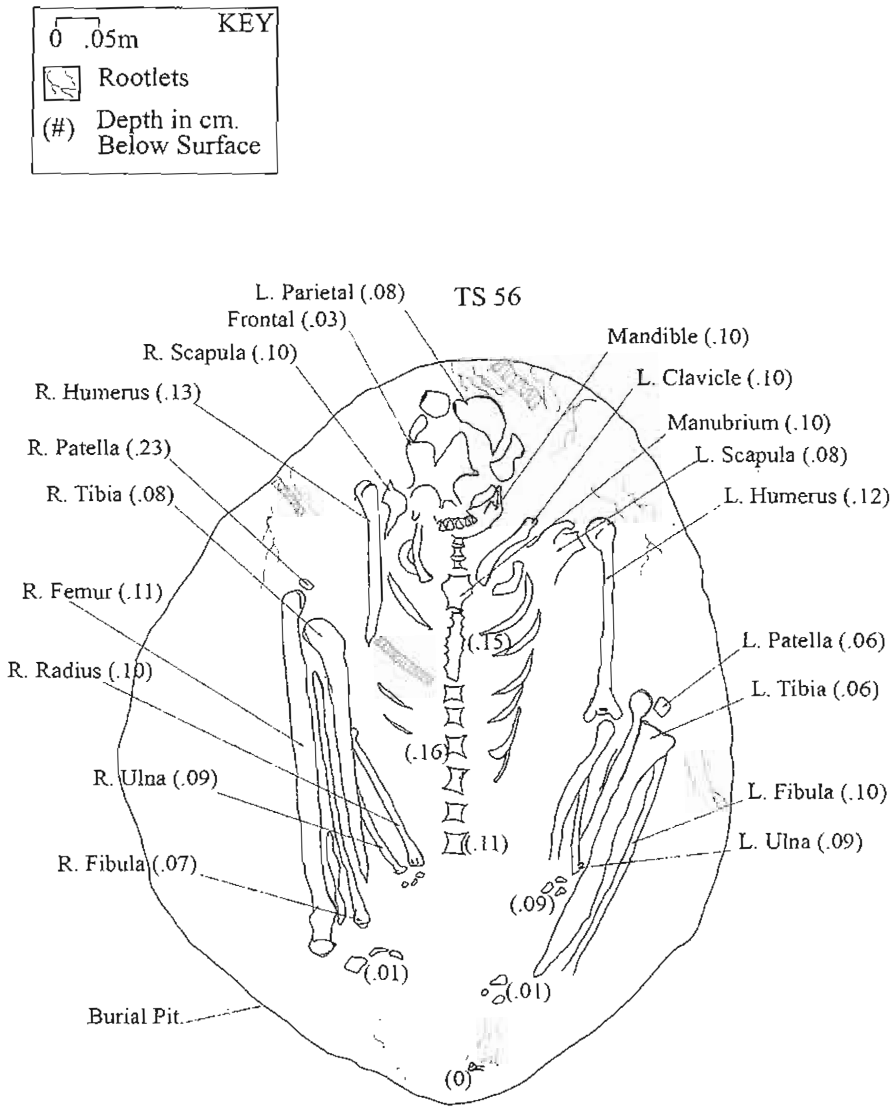


Figure 85. Plan View Map of Site 6679, Feature 56

The secondary deposit of human skeletal remains collected through raking and screening was analyzed and separated at the ASH lab. Initial results have identified seventeen individuals from this assemblage. As some of the skeletal remains have old breaks and do not constitute a great percentage of that individual, it is evident that these skeletal remains were disturbed prior to the sand mining activities. What is not evident is how these remains were secondarily deposited within this confined location and what degree of disturbance occurred during the current grading activities. As discussed in the methods section, the one assumption concerning recent disturbances is that if greater than 90% of this individual has been collected, and that the skeletal remains contain no old breaks, this individual would be categorized as recently disturbed probable primary burial. Additionally, several quality artifacts were recovered in a secondary context and are presumed to be grave goods.

The following are descriptions for Features 56a through 56q and are the result of the laboratory analysis discussed above. These features will be preserved in the area where they were found which has been designated Preservation Area 3.

Feature 56a

Feature 56a represents and older adult male individual aged 50+ years. Age was ascertained through observation of cranial sutures being obliterated, as well as dentition showing extreme occlusal wear. Sex was based on the sciatic notch, as well as the size of the nuchal crest and supra-orbital ridge of the cranium. When comparing the left and right ulna, which were fragmented, the skeletal remains were different colors indicative of differing depositional context and possible prior disturbance to the individual. Darker hues on skeletal remains may be attributed to decomposing organic materials (roots) and or intentionally placed organic grave goods and or *kapa*. White or bleached bone is almost always synonymous with prior exposure to the elements thus indicating previous disturbance. Approximately 70% of Feature 56a has been recovered.

Feature 56b

Feature 56b is an older adult male individual aged 50+ years. Sex was established through observation of the gonial angle as well as the supra-orbital ridge. Estimated age was established through alveolar reabsorption of both the maxilla and mandible, and extreme occlusal wear, as well as cranial suture closure. Approximately 66% of Feature 56b has been recovered.

Feature 56c

Feature 56c is also an older adult male individual. Characteristics consisting of the sciatic notch, size of humeral head and gonial angle of the mandible determined sex. Estimated age was established through cranial suture closure and osteophytes observed on the remains. Approximately 38% of Feature 56c has been recovered and the skeletal remains exhibited old breaks.

Feature 56d

Feature 56d is an older adult male individual. Age was determined through observation of cranial sutures being almost obliterated, as well as general condition of dentition being worn down from use. Sex determination was based on the size of the nuchal crest located in the occipital region of the skull, the shape of the brow ridge, and orbital margin. Approximately 44% of Feature 56d has been recovered.

Feature 56e

Feature 56e is an older adult female individual. Observation of the gonial angle, mastoid process and mental eminence determined sex. Estimated age was based on obliterated cranial sutures and extreme occlusal wearing on the teeth. Approximately 62% of Feature 56e has been recovered.

Feature 56f

Feature 56f is a middle adult male individual. Observation of the gonial angle of the mandible and supra-orbital ridge determined sex. Estimated age was based on dentition showing moderate occlusal wear, as well as cranial suture closure being very apparent. Old breaks were noted on some of the remains. Approximately 66% of Feature 56f has been recovered.

Feature 56g

Feature 56g is a middle adult male individual. Age was established through observation of cranial suture closure being fairly prominent, as well as moderate wearing on dentition. Sex determination was based on the gonial angle of the mandible, size of the mastoid process, and supra-orbital ridge. Old breaks were noted on some of the remains in this assemblage. Approximately 76% of Feature 56g has been recovered.

Feature 56h

Feature 56h is an older adult female individual. Extreme occlusal wearing on dentition was noted and established age. Sex was determined based on observation of the gonial angle of the mandible as well as the size of the mental eminence. Approximately 66% of Feature 56h has been recovered.

Feature 56i

Feature 56i is an older adult female individual. Age determination was established through observation of alveolar reabsorption and cranial suture closure. Sex was based on size/shape of the gonial angle, mastoid process and mental eminence. Old breaks as well as staining or discoloration was noted on some of the skeletal remains. Approximately 59% of Feature 56i has been recovered.

Feature 56j

Feature 56j is a middle adult male individual. The presence of obvious cranial sutures as well as observation of moderate occlusal wearing on dentition established estimated age. Sex was determined through analysis of mandibular condoyle, gonial angle shape/size, mastoid process, nuchal crest and size of the brow ridge. Approximately 63% of Feature 56j has been recovered.

Feature 56k

Feature 56k is an older adult male aged 50+ years. Cranial sutures were noted as being almost obliterated, and alveolar reabsorption was noted on both maxilla and mandible. These determined estimated age of the individual. Sex was determined through observation of size of mandibular condoyle, gonial angle of the mandible, mastoid process and nuchal crest. Approximately 63% of Feature 56k has been recovered.

Feature 56l

Feature 56l is a young adult female approximately 20-35 years of age at death. Estimated age was established through observation of prominent cranial sutures. Sex was determined from shape of the sciatic notch in the left innominate, shape/size of mandibular condoyle, gonial angle of the mandible, mastoid process and nuchal crest. Approximately 58% of Feature 56l has been recovered.

Feature 56m

Feature 56m is an older adult female aged 50+ years at death. Estimated age was established through observation of cranial sutures being almost obliterated or faded. Sex was determined through shape/size of nuchal crest located in the occipital region of the skull. Approximately 51% of Feature 56m has been recovered.

Feature 56n

Feature 56n is a middle adult male individual. Overall robusticity of the remains and size of femoral head helped establish the sex and age was based on cranial suture closure and epiphyseal fusion. Approximately 62% of Feature 56n has been recovered.

Feature 56o

Feature 56o is a middle adult male individual. Sex was determined through size of the nuchal crest located in the occipital region of the skull. Estimated age was established through prominence of cranial suture closure and epiphyseal fusion. Approximately 62% of Feature 56o has been recovered.

Feature 56p

Feature 56p is a child approximately 7 years +/- 24 mos. Estimated age was based on size of remains and dentition. Sex determination could not be established at this time. Approximately 72% of Feature 56 has been recovered.

Feature 56q

Feature 56q is an infant represented by fragmented cranial remains that appears to be approximately 1 year +/- 6 months. Estimated age was based on size of the remains. Only 3% of Feature 56q has been recovered and as such there may be a primary component to this individual within the Preservation Area 3.

Discussion of 56a-q

As previously discussed, a total of seventeen individuals have been recovered from a secondary context within a confined area of Phase D. Displaced artifacts which are presumed grave goods consisted of two Lei Niho Palaoa, one bone fishhook, two perforated cowrie shells (octopus lure) and three small adzes were collected at the 56a-q area (Appendix A). Unfortunately, these artifacts were recovered in a secondary context and it is indeterminate which burial(s) these grave goods were associated. The presence of the Lei Niho may indicate a higher status individual (s) and the fishhook and perforated cowrie shells were likely placed with an important fisherman. The adzes are small and may have been with one or a couple of burial features. These artifacts will be more fully discussed and analyzed in the monitoring report, however as they are likely grave goods, they will be reinterred adjacent to or with the Features 56a-q assemblage

Feature 57

Feature 57 appeared to be a primary burial feature within a burial pit excavated into the lithified sandstone. This feature was exposed on the existing surface, which was approximately 3.0 ft. below the original surface and was comprised of a cranium (which was slightly disturbed) within a pit. Due to the presence of numerous burial features within the immediate area, no testing was undertaken and Feature 57 shall be preserved in place

Feature 58

Feature 58 was identified during excavation of a series of test units within the grid system. Grid numbers 25, 26 and 36 were excavated, uncovering the primary/*in situ* portion of Feature 58. At the top of Layer I, Level 1 a possible burial pit outline was observed, however as excavations continued, it appeared that the pit had been disturbed along the southwestern side during the mechanical activity (Figure 86). At approximately .20 m bs the intact component of Feature 58 was identified. Articulation was observed in multiple areas; the mid to lower vertebral column, partial pelvic girdle, the entire left leg, and metacarpals of both left and right hands as well as the metatarsals of the left foot. The individual was orientated north/south, was fully flexed, placed on their left side, with both knees near the chest and both hands between the thighs (Figure 87). Disturbance occurred to the cranium and right side of the individual. The remains belong to a middle adult female individual. Sex was determined upon observation of the sciatic notch of the left innominate. Estimated age was based on observation of fused epiphyses of long bones. No other cultural materials were recovered with this individual. Feature 58 was determined to be a recently disturbed, primary partially intact burial feature which will be preserved in place within Preservation Area 3.

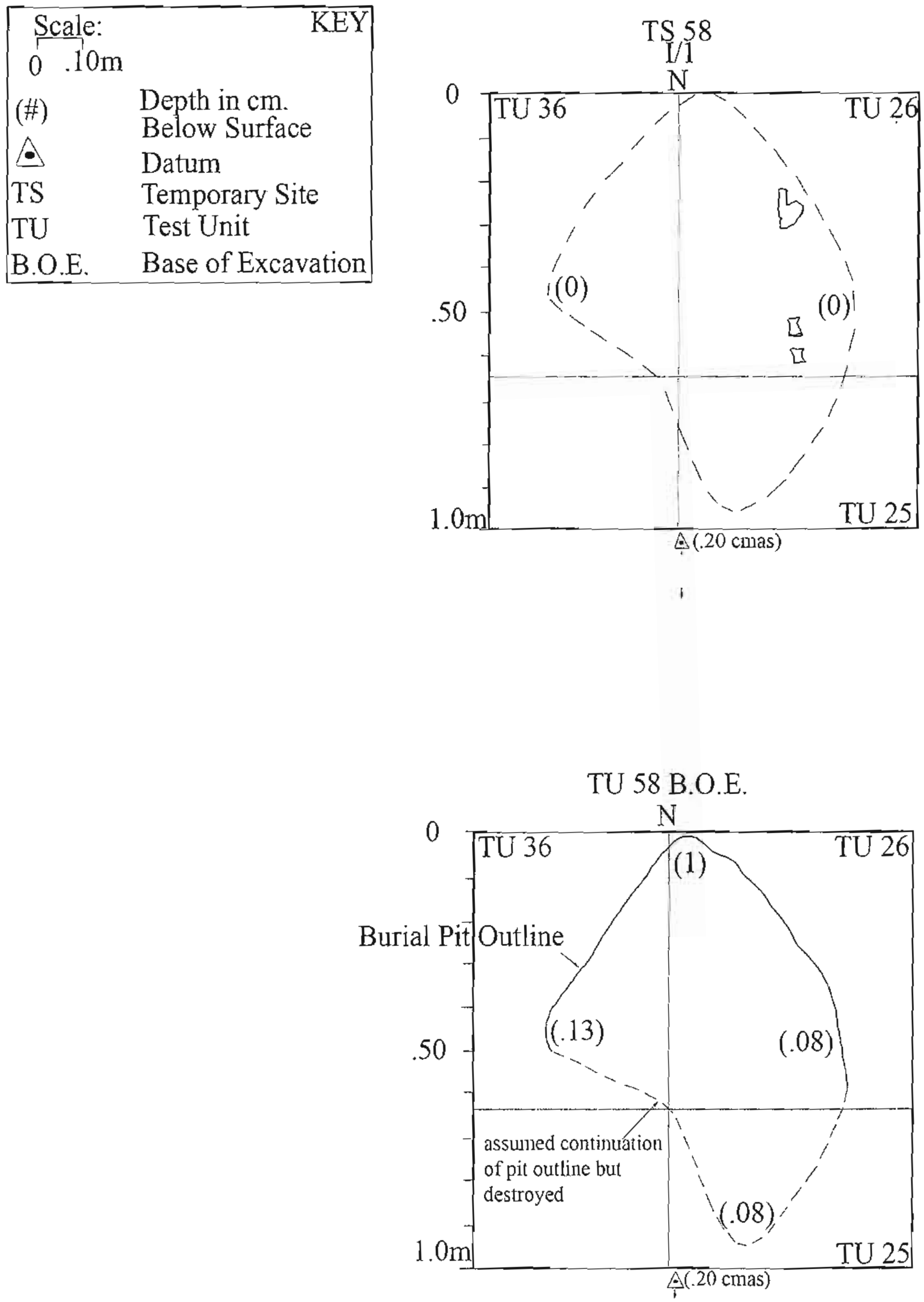


Figure 86. Plan View of Test Unit for Feature 58

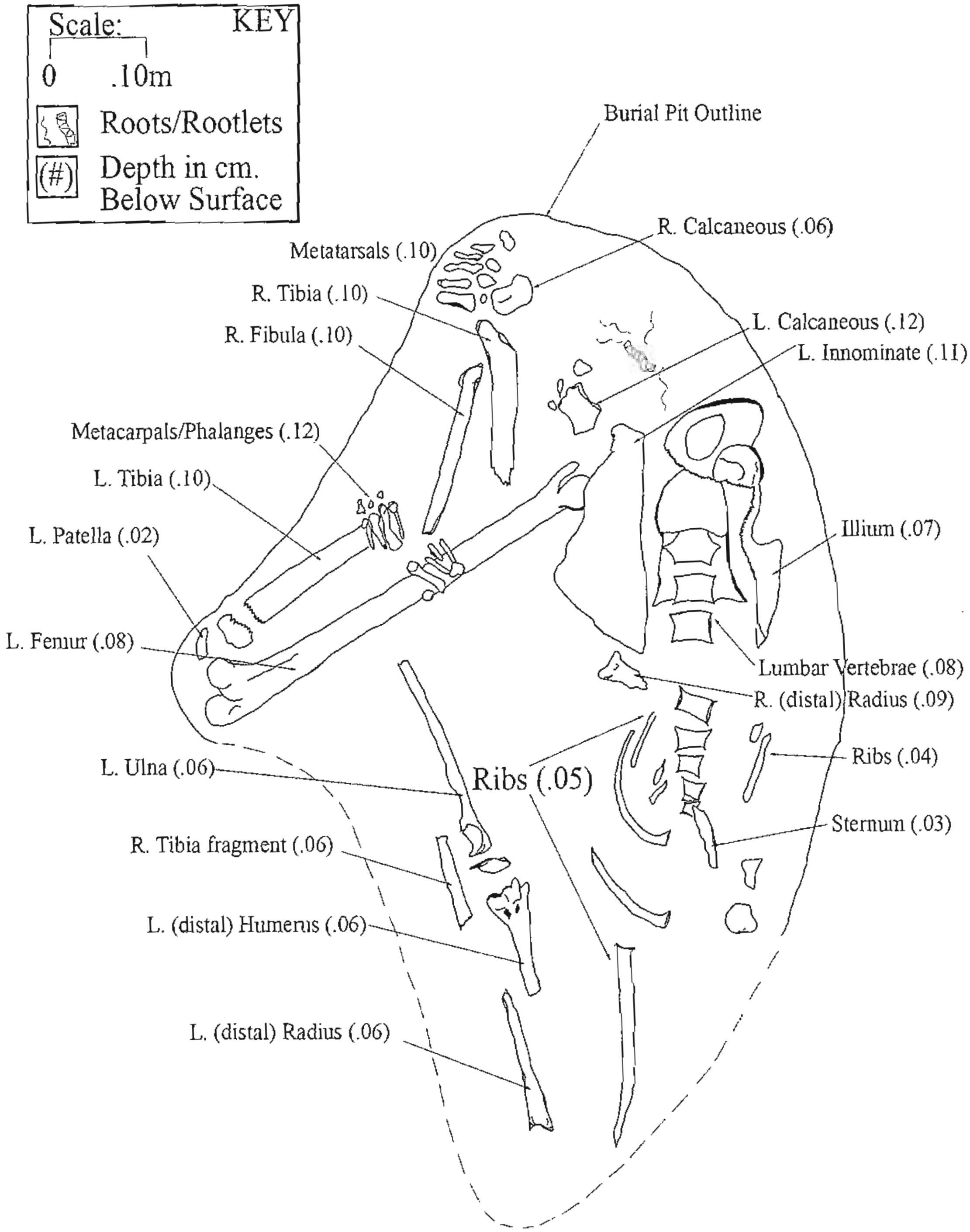


Figure 87. Plan View Map of Site 6679, Feature 58

Feature 59

Feature 59 was documented while testing grid numbers TU17 and TU27 and consists of a possible burial pit outline within the Layer III "Grade A" sand (see Figure 83). It is comprised of a circular area containing many rootlets and a grayish brown "Grade B" sand pit fill which is surrounded by the yellowish brown "Grade A" sand. Also noted along the edge of the possible pit outline is larger roots and small waterworn cobbles (Figure 90). No testing was conducted upon this possible burial pit as it will be preserved in place within Preservation Area 3.

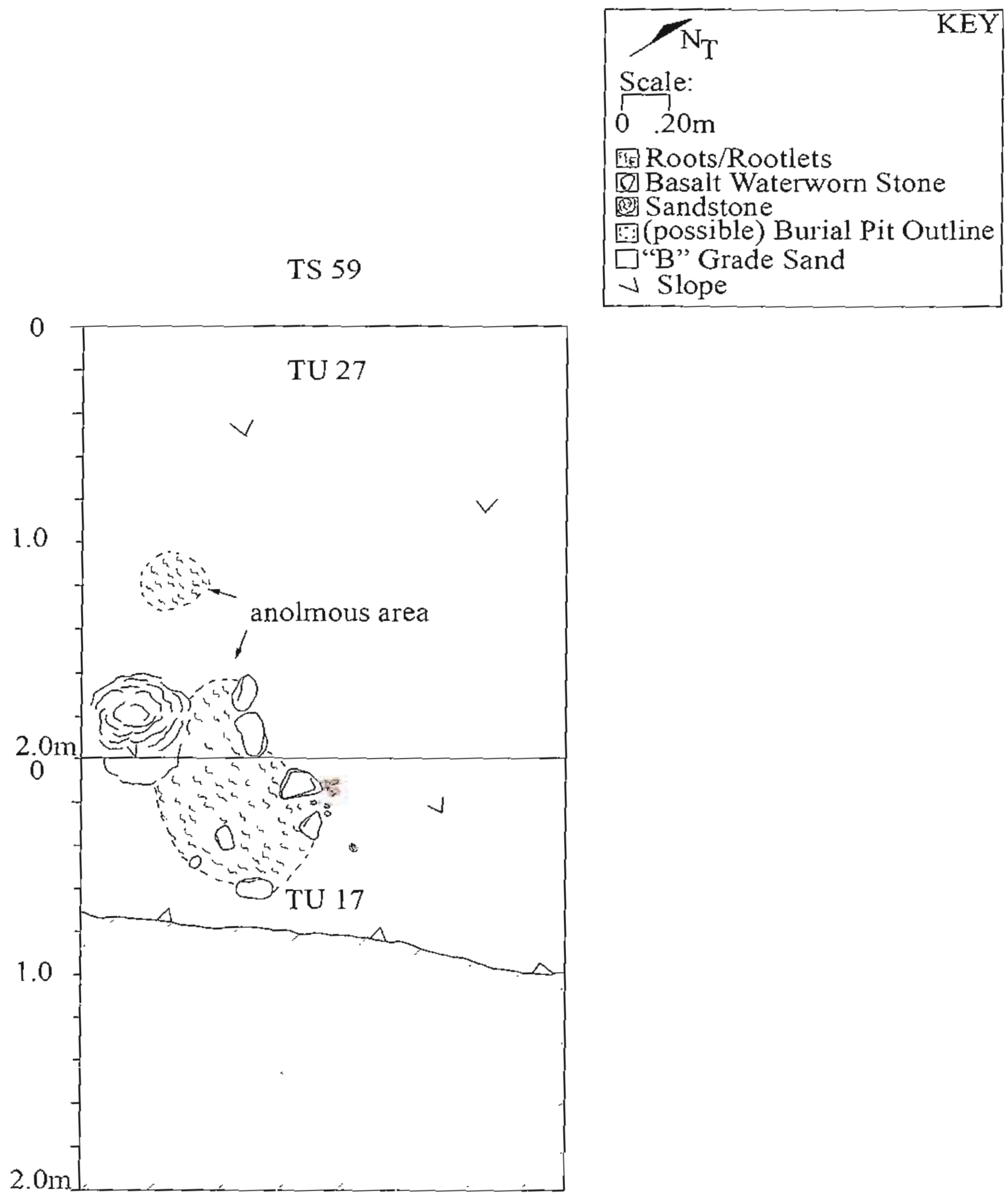


Figure 88. Plan View Map of Site 6679, Feature 59

PHASE B

Phase B which is located along the western side of the access road was the first area to be monitored. Only two burial features, Features 60 (formerly Fe.1b) and 61 (formerly Fe.2b) were identified within the 30 acres. Feature 60 was previously and recently displaced and Feature 61, a partially intact primary burial feature which will be preserved in place. A preservation area has been established around Feature 61 and is designated Preservation Area 2. The disturbed skeletal remains of Feature 60 will be reinterred within Preservation Area 2 (see Figure 8 and Table I).

Feature 60

Feature 60 was identified during grading activities near the slope adjacent to the County of Maui landfill. The remains though concentrated appeared to be from a previously disturbed burial, although the concentration was disturbed during the recent activities (Figures 88 and 89). Raking and several hand controlled excavations were initiated and recovered approximately 90% of the skeletal elements, however no primary component was documented. Missing skeletal elements from Feature 60 consisted of portions of the maxillae (nasal and sphenoid) and innominate. Feature 60 may have had an *in situ* component prior to the recent activities, however due to the prior disturbances the context was indeterminate. The skeletal remains of Feature 60 belong to a middle adult male. Sex determination was made by observation of the sciatic notch and overall size of remains. Age was based on cranial suture closure as well as minimal occlusal wear on dentition. Feature 60 will be reinterred with Feature 61 at Preservation Area 2.

Feature 61

Feature 61 is a partial primary burial feature of an older adult male that will be preserved in place. This inadvertent burial was identified during sand grading activities. Upon the identification of skeletal remains, hand testing was initiated. Feature 61 was placed on its back in a fully flexed position, slightly oriented towards the southeast. Although the humeri were displaced, the left ulna and radius indicated the left arm was fully extended along left side. The right ulna and radius appear to be semi-flexed, across left clavicle and under left tibia. The legs are fully flexed up towards the torso. This individual was determined to be an older adult male that will be preserved within Preservation Area 2.

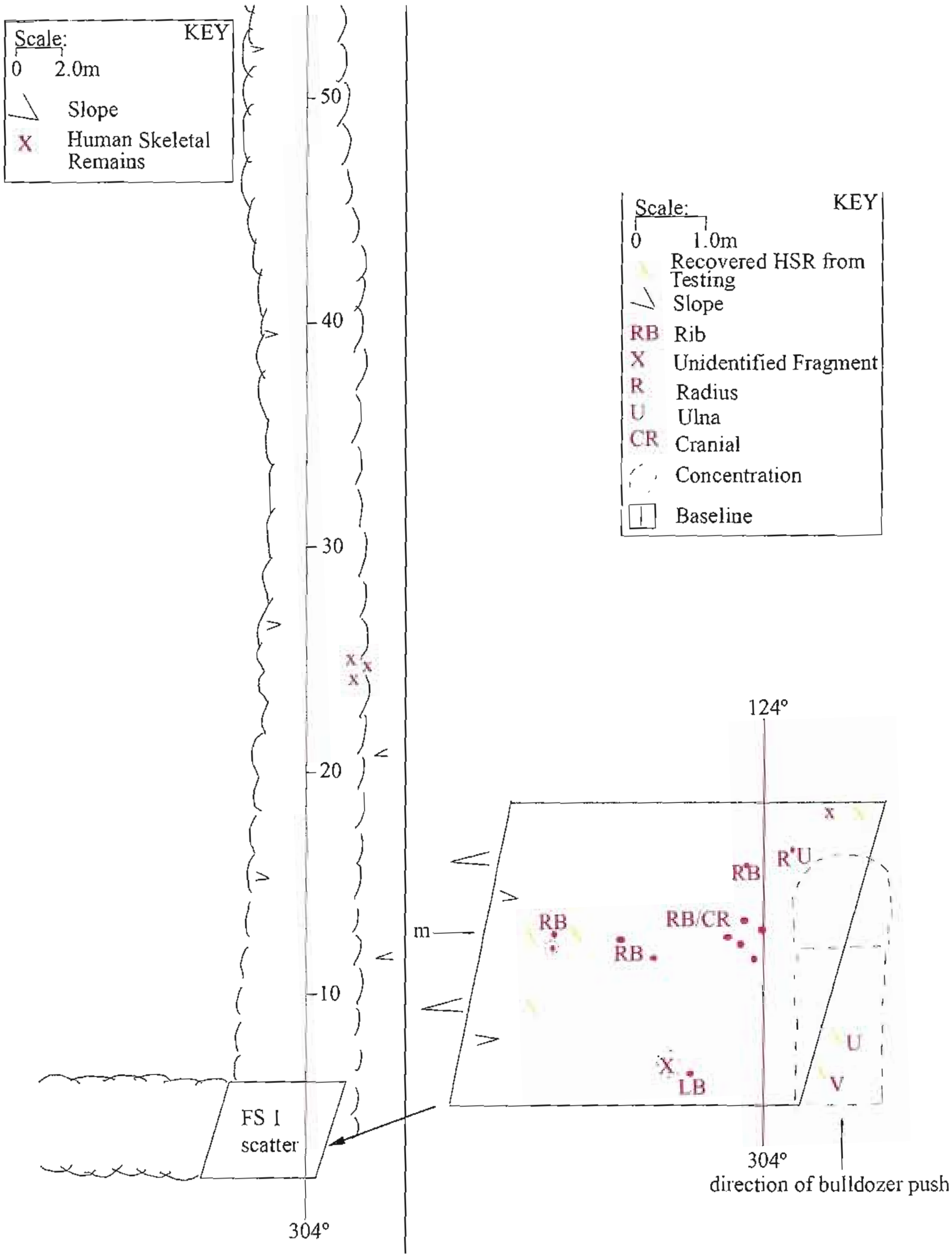


Figure 89. Plan View Map of Surface Scatter at Site 6679, Feature 60, Phase B

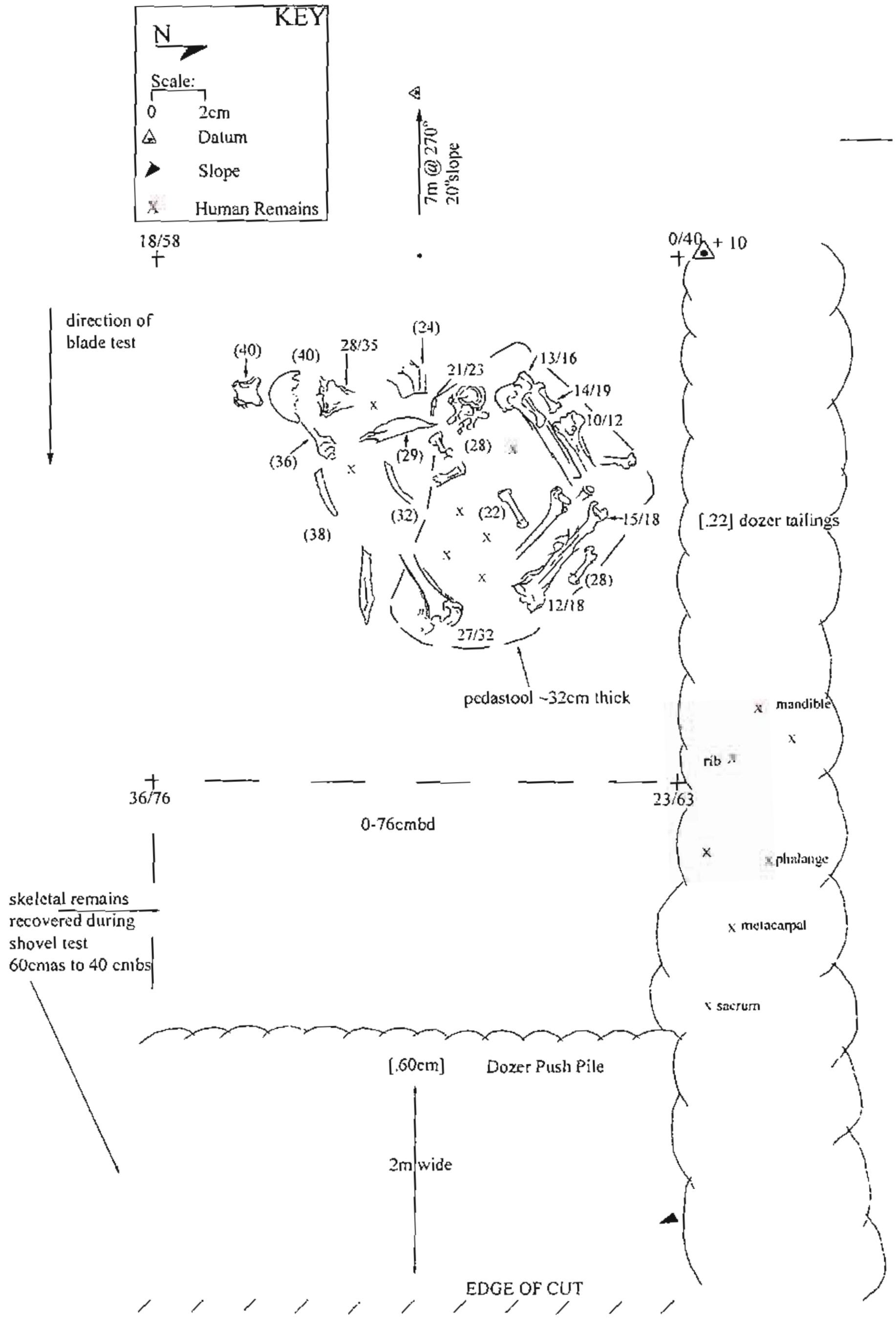


Figure 90. Plan View Map of Feature 60 Showing Concentration of Skeletal Remains

KUIHELANI HIGHWAY

Site 50-50-04-5504

Site 5504 is situated along Kuihelani Highway and comprised of a partially intact primary burial feature. This burial was disturbed during un-monitored activity by H.C.& S. The purpose of grading along Kuihelani Highway was to create a berm to prevent trespassers from entering and using this open space as a land fill. After the grading activities were observed, a field inspection was conducted where disturbed skeletal remains were collected, and a concentration of remains which appeared to be intact and articulated. Testing was conducted upon the concentration and exemplified a fully flexed individual placed on their left side where the middle and lower torso were partially intact. Disturbance to this individual occurred along portions of the right side, scapula, clavicles and cranium (Figure 92). Based on the sciatic notch and size of long bones, this individual is presumed to be a middle adult male. Age was based on stage of epiphyseal fusion and lipping of vertebrae centrum. Site 5504 will be preserved in place within Preservation Area 5 which has been established around this burial feature.

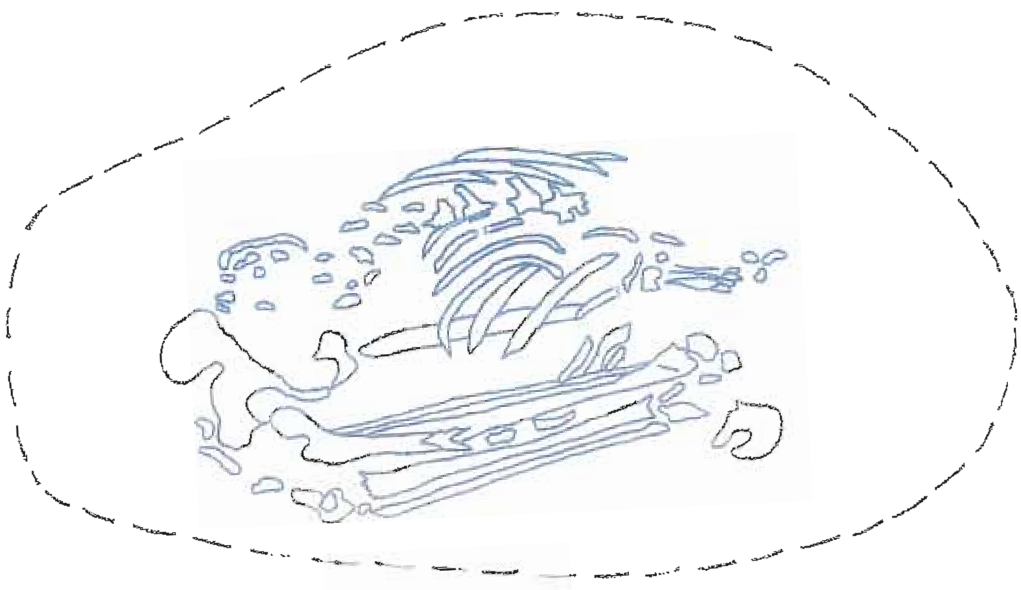


Figure 91. Plan View Map of Site 5504

DISCUSSION

The resultant data exemplified that this area, like adjoining parcels, was utilized during the traditional period as a cemetery. As discussed in the various burial descriptions, much of the area exhibited prior disturbances (before Hawaiian Cement grading) from past un-monitored sand mining, pastureland and nursery activities as evidenced by previously disturbed burial features, inverted stratigraphy and conversations with construction personnel. Although the project area was previously disturbed, a total of ninety-five locations containing inadvertently discovered human skeletal remains and burial pits were documented within the project area and assigned Sites 5504 and 6679. Site 6679 consisted of fifty-three primary and possible primary burial features (34 primary, 13 burial pits and 6 recently disturbed probable primary) and forty-one individuals in a secondary context. Site 5504 consisted of one primary burial. Due to the proposed development plan, the majority of the burial features will be preserved in place within five preservation areas totaling over thirty acres. Based on the location of Kamehameha Avenue extension and a lateral access road, two partially intact primary burial features and five secondary deposits of skeletal remains will be relocated into the closest preservation area.

The burial features were found at varying elevations ranging from 142.0 ft. to 255.00 ft amsl and identified along the tops, sides and toe of slopes. As such, there was no distinct pattern to the interment of these individuals. Three primary burials were interred with grave goods consisting of basalt flakes (Fe. 21) and perforated conus shells (Fes. 31a and 34). Unfortunately, the majority of artifacts were recovered in a secondary context at Phase D and consisted of basalt adzes, perforated cowrie shells, a bone fishhook, a bone Lei Niho and a Lei Niho Palaoa (whale tooth- Appendix A). Besides intentionally placed artifacts, several contained manuports of waterworn cobbles and boulders and a few had lithified slabs placed over the burial feature. Lastly, and most notably, two areas appeared to contain high status individuals based on the mode of interment (Features. 18c and 18d) and artifacts documented at the area (Features 56-58).

The treatment, preservation in place and or relocation, for Sites 5504 and 6679 has been previously accepted by the State Historic Preservation Division. As previously mentioned, the overwhelming majority of burial features will be preserved in place and the long-term preservation measures to protect these features in perpetuity are presented in the following Preservation Plan.

PRESERVATION PLAN

Short-Term Measures

Short-term protective measures are implemented at preservation areas during the interim period before and during construction. The burial features of Site 5504 and 6679 are currently protected by erecting orange caution fencing 50 ft. around the burial site. Additionally, each burial feature is covered with a layer of sand, tarp and plywood or wooden grate. To ensure the protection of the remnant sand dune feature containing the burials, a 2:1 slope must be maintained if grading occurs outside the temporary buffer zone (50 ft.). Periodic field inspections are performed to ensure that burial features are protected from the elements. All collected, displaced human skeletal remains are curated at the offices of ASH.

Any burials to be disinterred will be performed utilizing all accepted methods and procedures. As human skeletal remains are removed, they will be documented on Burial Inventory forms and placed into cardboard boxes lined with *kapa* and *ti* leaves. The disinterred burials will be curated at the ASH offices, where they will be prepared for reinterment by appropriate personnel.

Long-Term Preservation Measures

Long-term measures are a mitigation strategy to protect the site in perpetuity. These measures may not be adjusted and or changed without prior consultation and acceptance by the SHPD in consultation with the appropriate MLIBC members.

The proposed reinterment location for the burial features is within the preservation areas established around existing intact primary burials. Preservation Area 1 is the largest and comprised of 28.4 acres. It is situated within the northwestern quadrant of the project area. Preservation Area 1 contains the majority of the burial features and secondarily deposited human remains, Feature 46 shall be reinterred into Preservation Area 1. Preservation Area 2 consists of .2 acres and is situated within Phase B surrounding Feature 61. Feature 60 will be reinterred within Preservation Area 2. Preservation Area 3 measuring 1.7 acres is located south east of Preservation 1 and has been erected around Features 55-58. Preservation Area 4 comprised of 1.2 acres contains Features 50 and 54 and lies just south of Preservation Area 1. Secondary scatters, Features 48, 49b/c and 51, as well as a partial intact primary burial Feature 49a will be relocated and interred within Preservation Area 4. Preservation Area 5 contains Site 5504, a primary burial feature, and is comprised of .115 acres situated along Kuihelani Highway. All preservation areas will be protected in perpetuity by a combination of landscaping, signage, recordation, buffer zones and surface demarcation. These measures are discussed in detail below.

Surface Demarcation-All primary, *in situ* burial sites and reinterred human skeletal remains shall be marked on the surface by cobbles and or small boulders. For reinterred burials, a reinterment pit measuring approximately 4.0 ft. by 4.0 ft. by 3.0 ft. deep will be excavated adjacent to the *in situ* burial features. The bundles of human skeletal remains will be placed in the bottom of the pit and the remainder of the pit will be filled with clean sand. A concrete cap measuring approximately 4 inches thick or some other acceptable form of cover shall be placed over all burial features and inscribed with the SIHP number and KAPU. Soil and or sand will cover the concrete so that vegetation can be established. A large boulder and or several cobbles will be placed on the surface over the burial to demarcate its location.

Preservation Area/Buffer Zone-The preservation area includes the burial site, the surface demarcation and the buffer zone which surrounds the burials. The buffer zone is a protective area for the buried human remains in which temporary or permanent structures shall not be placed or built. Subsurface utilities and other uses shall be routed outside of the buffer zone. A minimum 50-100 ft. buffer zone will be established from the outer most burials within each preservation area. The buffer zone will be delineated by a combination of aligned boulders, fencing and vegetated berms as applicable and appropriate to each preservation area. Along the outside perimeter of these preservation areas will be clearly marked walking trails. The trails will encircle each preservation area and are envisioned to be utilized by the general public and those wishing to visit the preservation areas.

Only traditional and customary activities associated with Native Hawaiian burial sites shall be allowed within the preservation area. At this time, no access is afforded inside the preservation area except for maintenances purposes. For continued protection of the burials, Preservation Areas 1-5 will be clearly identified on all construction plans, as built plans and etc.

Landscaping-The interior of all preservation areas will be maintained with existing vegetation or landscaped with appropriate dryland Native plants to stabilize the sand dune formation. The Native plantings will be a combination of ground cover and shrubs that are not deeply rooted. Appropriate trees for ceremonial and religious areas such as Milo may be planted but must be placed away from any known burials. If existing non-native trees are removed or new trees planted, all excavations for proposed trees must be monitored by the archaeologist. Generally, trees that require removal are clear cut and the base is poisoned in place. Native plantings may consist of drought tolerant native plantings such as *naio papa,ililma* or other appropriate native plants found in the central Maui area. The landscaping shall be maintained so that the burial markers and signage are visible. Several openings not more than 3.0 ft. wide will be provided for maintenance purposes. To establish the native plantings, temporary irrigation may be installed on the surface. Within the preservation area, no trenching for subsurface irrigation will be permitted.

Signage-Bronze plaques measuring 18 inches by 10 inches shall be permanently affixed at two locations along the exterior of the preservation area. Signage would consist of the following:

Native Hawaiian Burial Sites
KAPU
State Site Number 50-50-04-6679
Please Respect This Area

Maintenance-The plaques, burial markers, landscaping and buffer zone delineation (aligned boulders, vegetated berms, fencing, landscaping) shall be maintained by the landowner, homeowners association or other applicable entity with such responsibilities. If any of these protective measures should deteriorate or are damaged over time, the landowner, homeowners association or applicable entity shall be responsible for the repair or replacement of these measures; however no changes may be made without written authorization by SHPD

To ensure perpetual protection of this burial site, periodic site inspections by the SHPD may be conducted to verify that the signage, platform and all long-term measures are in place and the site is adequately protected. Site inspections will be performed at mutually agreed upon times between the landowner, homeowners association or applicable entity and the SHPD staff.

Recordation- The preservation area shall be surveyed by a licensed surveyor and a metes and bounds description of the preservation area shall be recorded by the landowner, along with the Burial Treatment and Preservation Plan at the State of Hawaii Bureau of Conveyances within 90 days of written acceptance of the Burial Treatment and Preservation Plan by the Department of Land and Natural Resources-State Historic Preservation Division (DLNR-SHPD). The DLNR-SHPD and the Maui/Lanai Islands Burial Council (MLIBC) shall be provided with copies of the recorded Burial Treatment and Preservation Plan.

Access- Burial sites may be viewed from the walking trails at the preservation area. Access within the preservation areas for lineal and or cultural descendants is not afforded at this time, as no lineal and or cultural descendant claims have been received by the SHPD for these burial features. In the event that a future lineal or cultural descendancy claim is recognized by the MLIBC, access to the burial site within the preservation area shall be permitted at reasonable dates and times mutually agreed upon by the landowner and lineal and cultural descendants.

REFERENCES

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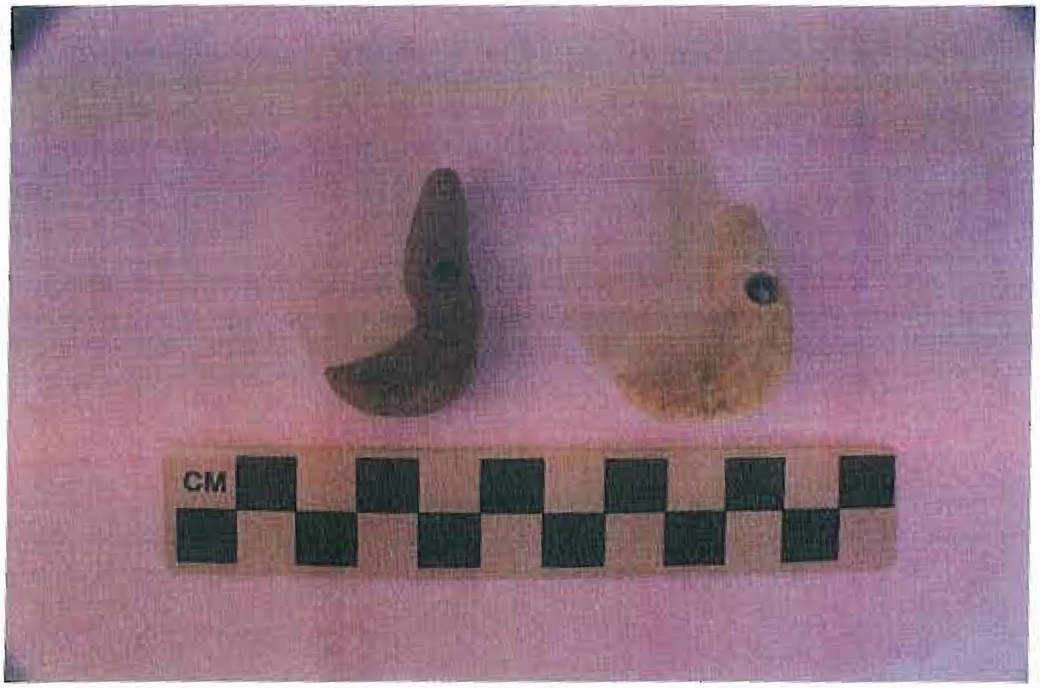
APPENDIX A



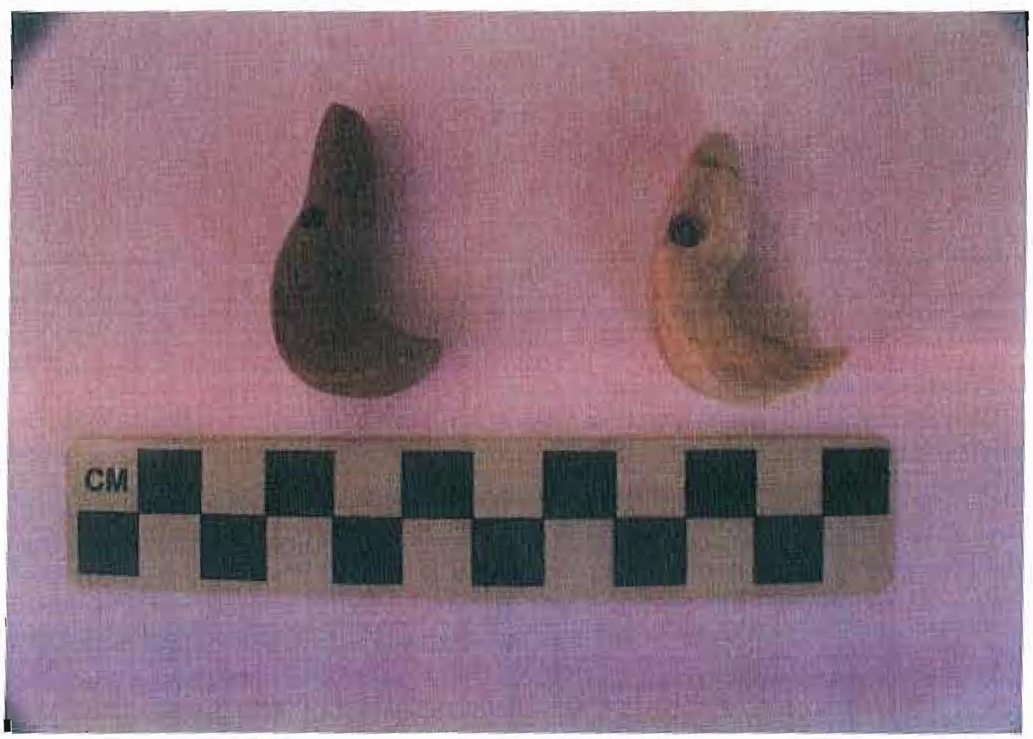


Figure 92. Artifacts Recovered From Site 6679, Features 56-58

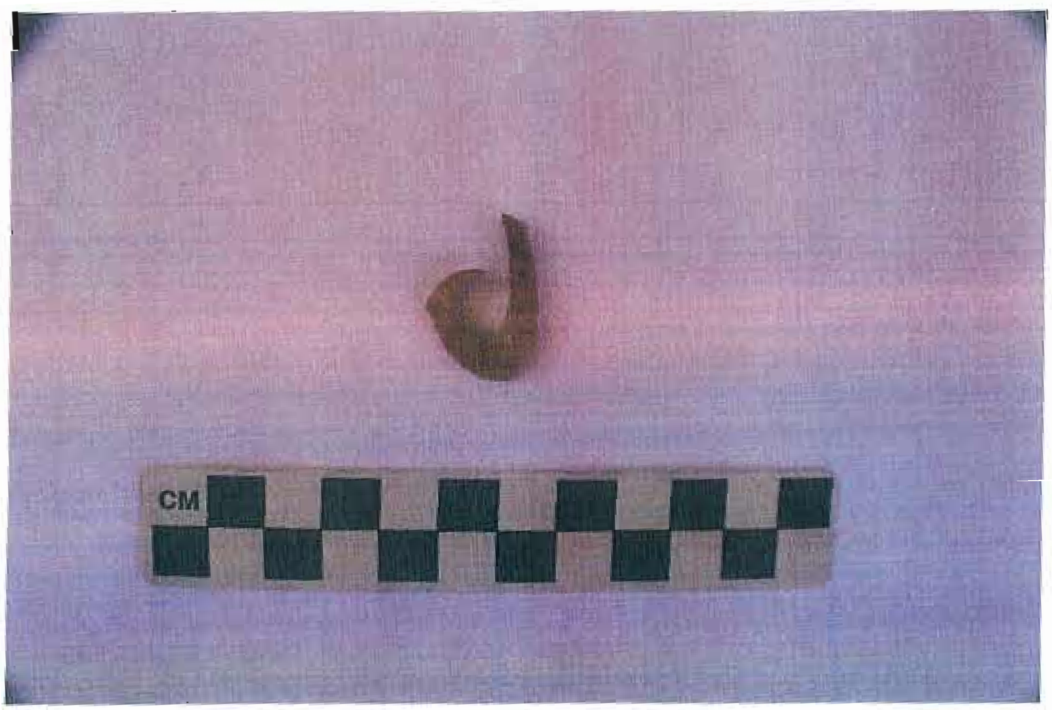


Figure 93. Artifacts Recovered From Site 6679, Features 56-58

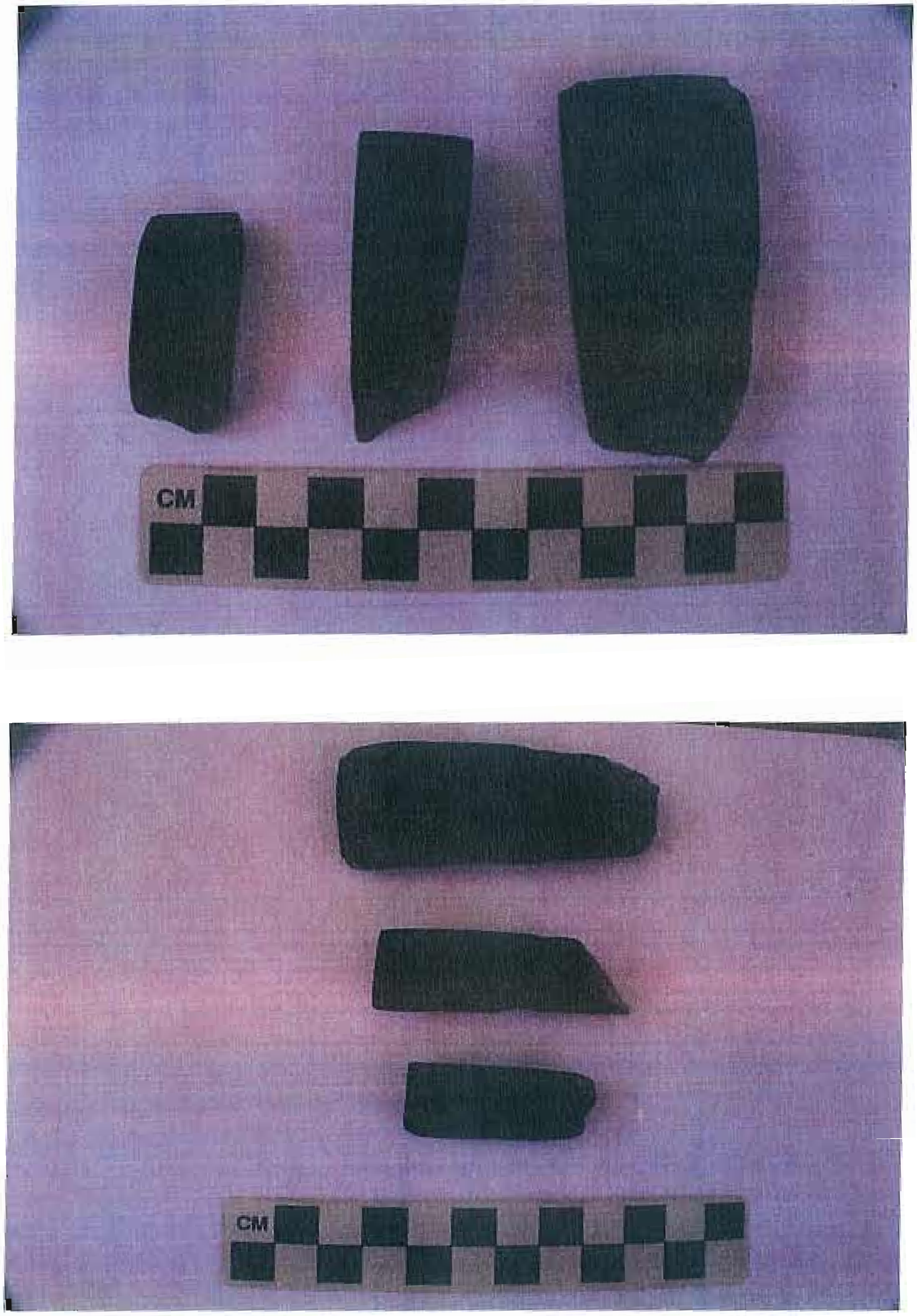


Figure 94. Artifacts Recovered From Site 6679, Features 56-58

Appendix H: Data Recovery Plan and Preservation Plan Acceptance Letter

LINDA LINGLE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

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

September 13, 2010

Mr. Grand Chun, Vice President
A & B Properties
11 S. Puunene Avenue
Kahului, Hawai'i 96732

LOG NO: 2010.0116
DOC NO: 1009.HR02

Dear Mr. Chun:

SUBJECT: Burial Site Component of a Data Recovery Plan and Preservation Plan for Sites 50-50-04-5504 and 6679 at A & B Properties Parcel, Wailuku Ahupua'a, Wailuku District, Island of Maui.
<u>TMK: (2) 3-8-07: 101Pors.</u>

The State Historic Preservation Division (SHPD) has reviewed and finds your Burial Site Component of a Data Recovery Plan and Preservation Plan in compliance with §HAR 13-300 (i) (j). You may proceed with its provisions.

Should you have any questions or concerns, please feel free to contact our Maui SHPD Cultural Historian, Mr. Hinano Rodrigues at 808 243-4640.

Sincerely,

Phyllis Coochie Cayan

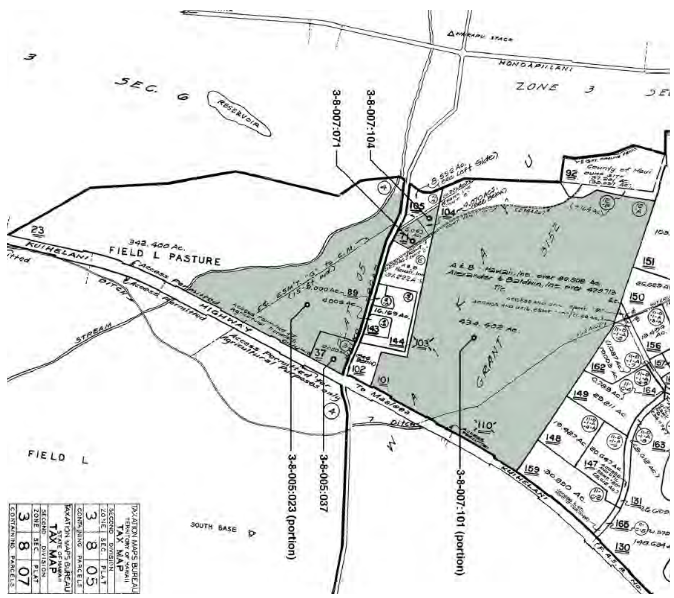
Phyllis Coochie Cayan
History and Culture Branch Chief
State Historic Preservation Division

cc: Mr. Hinano Rodrigues, SHPD Cultural Historian
Ms. Lisa Rotunno-Hazuka, ASH, LLC

Appendix I: Cultural Impact Assessment

CULTURAL IMPACT ASSESSMENT
For the
PROPOSED
Wai'ale Master Planned Community

March 2011



Hana Pono, LLC - PO Box 2039 Wailuku, HI 96793 – hanapono@gmail.com

CULTURAL IMPACT ASSESSMENT
For the

PROPOSED

Wai'ale Master Planned Community

TMK: (2) 3-8-07:071, 101(por.), and 104
and (2) 3-8-05:23 (por.), and 37

Prepared for:
Mr. Grant Chun
A & B Properties, Inc.
11 Pu'unene Ave.
Kahului, HI 96732

Prepared by:
Hana Pono, LLC
PO Box 2039
Wailuku, Maui, Hawai'i 96793

March 2011

Management Summary

Report	Cultural Impact Assessment for the proposed Wai'ale Master Planned Community
Date	February 2011
Project Location	County of Maui; Waikapu & Wailuku; focusing in the area of Na Wai Eha, Wailuku Moku, Waikapu & Wailuku ahupua'a, TMK(s): (2) 3-8-7:071, 101(por.), 104 and (2) 3-8-05: 023(por.) & 037
Acreage	Approx. 545 Acres
Ownership	Alexander & Baldwin, Inc.
Developer/Applicant	A&B Properties, Inc.
Project Description	A master planned residential community that includes: Village Mixed Use, Commercial, Business, Multi and Single Family Residences, Regional and Neighborhood parks, schools, and cultural preserves.
Region of Influence	Both Waikapu and Wailuku towns
Agencies Involved	SHPD/DLNR, Maui County Council, Maui County Planning Department, State Land Use Commission
Environmental Regulatory Context	The undertaking is subject to both State and County zoning regulations, and other environmental regulations
Results of Consultation	Community concerns center primarily around protection of the remaining intact sand dunes and probability for discovery of additional burials. Additionally, concerns about watershed management and protection; elimination of habitat for native pueo and nene; community education of cultural history of location, surrounding area, and associated placenames-significant events-relationships to greater physical/spiritual resources of Maui; and supervision by cultural monitors were concerns raised.
Recommendations	• Protection of additional discoveries of „Iwi Kupuna • Mapping and protection of Pu'u One sand dunes • Inclusion of Waikapu stream in significant landmarks • Educational community "touchpoints" • Cultural Advisors

Cultural Summary

A&B Properties, Inc. is proposing a master planned residential community located in the ahupua'a (land area) of Waikapu and Wailuku encompassing approximately 545 acres.

The project is located in the ahupua'a of Waikapu and Wailuku, in the Moku of Wailuku. Waikapu is the Southeastern most ahupua'a of the four streams collectively known as Na Wai Eha, the Four Waters. The project area borders the Waikapu stream on the South, the Maui Lani subdivision on the North, Kuihelani Highway on the East, and Honoapiilani Hwy on the west.

The large lithified sand dune system, known as the Pu'uone Sand Dunes, runs through the project as it sits at the base of Mauna Kahalawai (West Maui Mountains) and out into Ke Kula o Kama'oma'o (Central Maui Plain). Most of the land is now fallow cane fields, pasture land, and Kiawe/grasslands.

Table of Contents

Introduction

At the request of Mr. Grant Chun of A&B Properties Inc., Hana Pono, LLC has completed a report for the Cultural Impact Assessment of the proposed Wai'ale Master Planned Community located at Tax Map Key number: (2) 3-8-005: 023 (por.) and 037; and (2) 3-8-007: 071, 101 (por.), and 104 . This study was completed in accordance with State of Hawaii Chapter 343, HRS, and the State of Hawaii Office of Environmental Quality Control (OEQC) Guidelines for Assessing Cultural Impacts (1997).

Guiding Legislation for Cultural Impact Assessments

It is the policy of the State of Hawaii under Chapter 343, Hawaii Revised Statutes, to alert decision makers about significant environmental effects that may occur due to actions such as development, re-development, or other actions taken on lands. Articles IX and XII of the State Constitution, other state laws, and the courts of the state require the promotion and preservation of cultural beliefs, practices, and resources of native Hawaiians and other ethnic groups.

The Guidelines for Assessing Cultural Impacts, as adopted by the Environmental Council, State of Hawaii 1997 and administered by the Office of Environmental Quality Control, including HAR Title 11 Chapter 200-4(a), include effects on the cultural practices of the community and state. The Guidelines also amend the definition of "significant effect" to include adverse effects on cultural practices.

Goal and Purpose

The goal of this study is to identify any and all Native Hawaiian, traditional, historical, or otherwise noteworthy practices, resources, sites, and beliefs attached to the project area in order to analyze the impact of the proposed development on these practices and features. Consultations with lineal descendents or kupuna (Hawaiian elders) with knowledge of the area in gleaning further information are a central part of this study.

Scope

The scope of this report compiles various historical, cultural and topographical accounts and facts of the project area and its adjacent ahupua'a. "The geographical extent of the inquiry should, in most instances, be greater than the area over which the proposed action will take place. This is to ensure that cultural practices which may not occur within the boundaries of the project area, but which may nonetheless be affected, are included in the assessment. An ahupua'a is usually the appropriate geographical unit to begin an assessment of cultural impacts of a proposed action, particularly if it includes all of the types of cultural practices associated with the project area. In some cases, cultural practices are likely to extend beyond the ahupua'a and the geographical extent of the study area should take into account those cultural practices." (OEQC, Guidelines for Assessing Cultural Impacts, Nov 9, 1997)

Data will be compiled beginning with the first migrations of Polynesians to the area, progressing through the pre-contact period of Hawaiian settlement, containing data on the post-contact period, through to the current day and any cultural practices or beliefs still occurring in the project area. Hawaiian kupuna with ties to the area will be interviewed on their knowledge of the area and its associated beliefs, practices, and resources. Additionally, any other individuals or organizations with expertise concerning the types of cultural resources, practices and beliefs found within the geographical area in question will be consulted.

Project Area

The project is located in the State of Hawaii, County of Maui, at Tax Map Key number: (2) 3-8-005: 023 (por.) and 037; and (2) 3-8-007: 071, 101 (por.), and 104. Approximately 545 acres, the project is adjacent and south of the Maui Lani project and borders Kuihelani Hwy on the east. Waiko Road divides the property in two sections, an approximately 422 acre portion north of the road and the other approximately 123 acre portion to the south.

The island of Maui is comprised of twelve (12) traditional land districts, called moku. Each moku is made up of numerous ahupua'a, smaller land divisions wherein a self-inclusive community could find all the things needed for a satisfactory life. Usually these ahupua'a ran from the heights of the mountain peak to the edge of the outer reef like a giant pie slice, although many ahupua'a did not fit this template. Of the two peaks on Maui, the lower of the two is Mauna Kahalawai, what we now mistakenly call the West Maui Mountains. Mauna Kahalawai is made up of 3 moku, Lahaina, Ka'anapali, and Wailuku. Within the moku of Wailuku are four ahupua'a, Waihe'e, Wai'ehu, Wailuku, and Waikapu, from north to south. The project area resides in the moku of Wailuku and the ahupua'a of Waikapu with a portion in the ahupua'a of Wailuku. Handy relates that,

> *On the northeast coast of western Maui it was only the shores and adjacent flatlands below the taro terraces of Waihe'e and Wai'ehu that were favorable for the combined enterprises of planting potatoes and fishing. The flat north coasts, eastward from Wailuku, had fishing settlements here and there in ancient times and presumably sweet potato plantations…From Waihe'e to Waikapū there is much good land below and bounding the ancient terrace area on the kula and in the lower valleys which would be ideal for sweet potato culture, but it is said that little was grown in this section because there was so much taro (ESC Handy, 159,160).*

Approach & Method

The approach taken in this study was two-fold. Foremost, historical, involving as appropriate, a review of: mahele (land division of 1848), land court, census and tax records, previously published or recorded ethnographic interviews and oral histories; community studies, old maps and photographs and other archival documents. Secondly, an in-depth study involving oral interviews with living persons with ties, either lineal or cultural, to the project area and the surrounding region.

Objectives

The objectives of the Cultural Impact Assessment are as follows:

- to compile and identify historical and current cultural uses of the project area,
- to identify historical and current cultural beliefs & practices associated with project area,
- To assess the impact of the proposed action on the cultural resources, practices, and beliefs.

Tasks

Data gathered combined oral interviews of knowledgeable kupuna and families/individuals with long-standing ties to the area with all available written and recorded background information.

Archival Research

All sources of historical written data, old maps, and literature were culled for information.

Oral Interviews

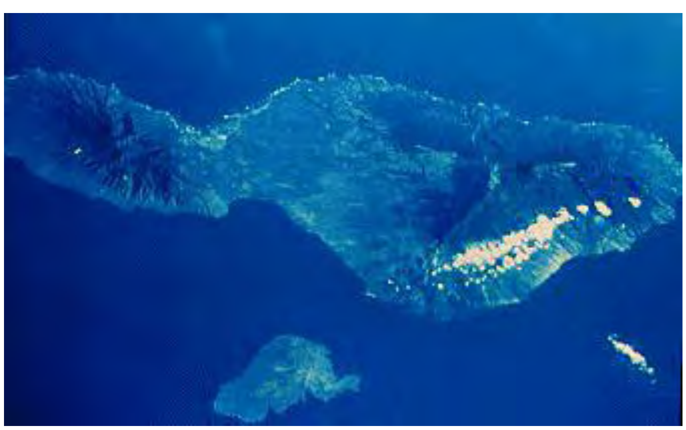
Tasks completed for oral interviews included: identification of appropriate individuals to be interviewed, determination of legitimate ties to project area and surrounding region, interview recorded in writing and by digital audiocassette, transcription of interview, compilation of pertinent data.

Level of Effort Undertaken

Interviewees are contacted and selected for inclusion in this report based on a sliding scale of legitimate authority based on the following characteristics: lineal descendents, cultural descendents, traditional practitioners, cultural practitioners, knowledgeable area residents of Hawaiian ancestry, knowledgeable concerned citizens. Every effort is made to obtain the highest quality interviewees and determination of appropriate individuals follows this criteria.

Historical & Current Cultural Resources & Practices

Maui, sometimes called the Valley Isle, is so named for the two picturesque mountains that gracefully meet in the broad sloping plains of Central Maui, known as Ke Kula Kama'oma'o. The central Maui plains were covered in native and endemic dryland forest species, hedged by two large open bays with wetland marshes that were home to many native species of birds and other wildlife. The gently rising shield of Haleakala stood in great contrast to the sheer, steeply cut valleys of Mauna Kahalawai (West Maui Mountains) that had over millennia deposited a great deal of erosional sediment across the breadth of its lowlands. The north-easterly trade winds, over thousands of years, blew sand from the beaches of Waihe'e and Kapoho in the north carrying them across Ke Kula Kama'oma'o and creating a complex of sand dunes more than eight miles long and some upwards of a hundred feet in height. Plants and gravity slowed then cemented much of the dunes, fixing them into a permanent feature of the Maui landscape.



As a deep fertile valley fronted by easily terraced *kula* land and the broad alluvial plain, the area of Waikapu and the surrounding valleys of Mauna Kahalawai were settled early in Polynesian migrations, leading to long-standing settlement and cultivation. Waikapu was said to have many temples and sites (Ashdown, 58) but not many of them were documented. The Pu'uone sand dunes complex that interrupted the isthmus was utilized as land to travel through, as a burial place for the deceased, and as a place to make war, surprise an enemy, or travel through on the way to victory. Where possible, ancient Hawaiians would have farmed what they could near a reliable source of water; sweet potato, banana, or other crops.

The importation of cattle and goats along with their rampant spread and lack of population control contributed in large part to the denuding of the entire central Maui plain, possibly causing the destruction of entire ecosystems for which there is no replacement. Then the importation of large-scale agriculture, sugarcane in the project parcels, transformed the land again into flatter more manageable areas. Lastly the rapid pace of development led to the mining of the sand dunes and cinder for development across the island. Currently the land is utilized as open space, fallowed cane fields, a small orchid farm, and pasturing for livestock. „Iwi kupuna have been discovered on previous archaeological studies and monitoring efforts within the project area and surrounding areas. The remnants of the Pu'uone sand dunes are a reminder to people of this once extensive and unique landform.

First migrations

Traditional stories start with the creation chant called "Kumulipo." The Kumulipo brings darkness into light. Embedded in this all-encompassing chant is the tale of the coming of the Hawaiian Islands through the mythical stories of Pele and another demigod named Maui who, with his brothers, pulls up all the islands from the bottom of the sea. Geologically speaking, the island of Maui formed in six separate volcanic "series" beginning with the Wailuku Volcanic Series (WVS) that formed the mass of Mauna Kahalawai. The WVS took Mauna Kahalawai up to 6 kilometers in height whereupon the summit collapsed forming a sunken crater that would later become the back of Iao Valley. After the next volcanic series, the Honolua Volcanic Series, there was a long pause in activity where wind, rain, and time were able to carve out the deep valleys and steep ridges that we now see. As erosional forces carved out the valleys and broke down the material into sediment and soil, it was washed out into Ke Kula Kama'oma'o creating large "alluvial fans" at the mouth of each valley. These fans connected together from Waihe'e to Waikapu creating an alluvial plain giving the area of Na Wai Eha the fertile soil that would later give rise to large swaths of lo'i kalo (Kyselka & Lanterman, 20-28).

Another part of the creation story tells of two of the major deities, Kane and Kanaloa. It was said that Kane, the god of fresh running water, and Kanaloa, god of the ocean and the „awa plant, traveled around the islands and sat and drank awa wherever they went. It goes to show that Kane and Kanaloa traveled in the area of Na Wai Eha, Kane pounding his digging stick into the ground to bring forth the life giving waters so that him and Kanaloa may drink „awa and bring life to the land. Mauna Kahalawai is much older than its companion mountain, over a million years old, allowing time to create valleys that cut deep into the mountain, Handy and Handy elaborate,

> *The old 'okana (land division) named Na Wai Eha (Na Wai Eha means 'The Four Streams') comprised the four great valleys which cut far back into the slopes of West*

Maui and drain the eastward watershed of Pu'u Kukui and the ridges radiating northeastward, eastward, and southeastward from it. Two of the great valleys, Waihe'e and Waiehu, open toward the ocean and their streams empty into it. Wailuku is partly landbound, but its stream flows into Kahului Bay, which has been eroded by the ocean out of what was formerly the stream mouth. Waikapu is landbound. The waters of its great stream, now utilized for irrigating a great acreage of sugar cane, formerly was diverted into lo'i and its overflow was dissipated on the dry plains of the broad isthmus between West and East Maui (Handy & Handy, 497).

Long after the alluvial plain of Ke Kula Kama'oma'o was formed by the meeting of the two mountains, the trade winds started blowing sand across the isthmus. At that time the Waikapu stream flowed northward, into Kahului Bay, and not towards the south and Kealia as it does now. "but sand dunes piled up by the wind blocked that route, forcing the stream into Ma'alaea bay" (Kyselka & Lanterman, 36). They continue, "Streaked across the isthmus and parallel in direction to the North-east trade winds are ridges 60 meters high that taper towards the South. Thirty thousand years ago, these hills were active, moving sand dunes. Now they're fixed in place, unmovable-turned to stone" (74). We see other sand dune formations across the Hawaiian island chain, at Ka'ena in O'ahu and at Polihale in Kauai, but here in Maui they changed even more, becoming lithified, cemented in place. Kyselka and Lanterman expound on their formation,

The lower seas of glacial times exposed great broad stretches of sandy beach at the isthmus. For centuries trade winds blew across the beaches, piling the sand up into long ridges, sorting it into fine and coarse layers. Shifting winds, working and reworking the old sand layers, have provided fascinating patterns of cross bedding…Vegetation anchored the drifting dunes. Plant roots, releasing carbonic acid, changed the calcium carbonate sand into a soluble bicarbonate form. Percolating through the dune, the calcium solution travels until it is reconverted into insoluble calcium carbonate, cementing the sand grains together. The sand dunes of the isthmus are now lithified, having been turned to stone in the cementing process. But nothing is permanent. Wind and water are now wearing away at the dunes, and technology hastens the process (74-75).

The occupation of the Hawaiian archipelago after its mythical creation came in distinct eras starting around 0 to 600 A.D. This was the time of migrations from Polynesia, particularly the Marquesas. Between 600 and 1100 A.D. the population in the Hawaiian Islands primarily expanded from natural internal growth on all of the islands. Through the course of this period the inhabitants of the Hawaiian Islands grew to share common ancestors and a common heritage. More significantly, they had developed a Hawaiian culture and language uniquely adapted to the islands of Hawai'i which was distinct from that of other Polynesian peoples (Fornander, 222).

Between 1100 and 1400 A.D., marks the era of the long voyages between Hawai'i and Tahiti and the introduction of major changes in the social system of the Hawaiian nation. The chants, myths and legends record the voyages of great Polynesian chiefs and priests, such as the high priest Pa'ao, the ali'inui (Head Chief) Mō'ikeha and his sons Kiha and La'amaikahiki, and high chief Hawai'iloa. Traditional chants and myths describe how these new Polynesian chiefs and their sons and daughters gradually appropriated the rule over the land from the original inhabitants through intermarriage, battles and ritual sacrifices. The high priest Pa'ao introduced a new religious system that used human sacrifices, feathered images, and enclosed heiau (temples) to facilitate their sacred religious practices. The migration coincided also with a period of rapid internal population growth. Remnant structures and artifacts dating to this time suggest that previously uninhabited leeward areas were settled during this period.

Settling of Wailuku Moku & Ahupua'a

At first the new colonists would have settled along the shoreline, within easy access to the bounty of the ocean and a number of plants they were familiar with from the Southern islands. "The rich valley bottoms which later they would clear, terrace, and irrigate for wet-taro cultivation were, in their pristine state, dense jungle…for this jungle the first settlers had no use". Handy elaborates,

> *For generations the small, slowly growing population clustered around shore sites near streams that supplied them with water. Such sites are best for inshore fishing. When they acquired taro, they no doubt rapidly cleared away the jungle along the streams to make room for taro patches, and there was a beginning of terraced flats that could be irrigated directly from the stream. If we may judge by the many ways in which taro is cultivated under varying conditions in the South Seas, this was their staple, and they would not be long in developing real plantations instead of merely planting along stream banks and in swampy places where there were springs (Handy & Handy, 12).*

For this, the area of Na Wai Eha was a perfect location for these early Polynesian settlers to make home. They began settling the coastal areas of Kahului, Mā'alaea, and Paukukalo, slowly moving upward clearing the jungle to create terraces. After many generations these settlers whose ancestors had never intensively farmed taro became a separate people, they became Hawaiians. They would have slowly cleared land and moved further up the valleys, creating home sites and small kauhale (family-group compounds) within the valleys of Na Wai Eha, settling into Waikapu.

By this time the Waikapu stream had long cut to the south, its former northward route blocked by the larger mountainous dunes that fronted Wailuku and Iao. But as the dunes approached and passed Waikapu valley they widened, fanning out further into the central Maui plains and decreasing in height. The Waikapu stream cut its way through this area, slowly curving southward and emptying into Kealia, its water filtering into the Ma'alaea bay.

The moku of Wailuku contains many great cultural treasures including the twin fishponds of Kanaha and Mauoni, the heiau Pihanakalani and Haleki'i, Alakaihonua in Waihe'e, and many of the highest ancient royalty buried secretively deep in Iao Valley. There was also access to a large deposit of „Alae or „Alaea at the leeward bay, called Mā'alaea (the place of Alaea). „Alaea was used for many things, medicinally to help with blood deficiencies, spiritually, and in food preparation. Access to these resources of freshwater, salt, easily terraced lands, fertile soil, „alaea, and calm harbors would have made the people who settled here very wealthy in their sense of the word.

Place Names Associated With This Area

The Hawaiian culture places a particular importance on place-names. Throughout Polynesia, cultures are for the most part ocean-based, surviving and building their cultures around the bounty of the sea. While Hawaiians share common history with all Pacific peoples, because of the unique factors of these high-islands, their culture turned decidedly more land-oriented than many other Pacific cultures. The abundant access to fresh water sources, fertile soil, relative lack of reef and reef fish compared to older south pacific islands all contributed to their formation of a completely unique and distinct culture; a culture that placed a high inherent value on land and landforms, landscapes and their relationship to people's lives. In place-names one can find its purpose, their purpose, and the hidden *kaona* (symbolism) behind the word.

Waikapu

There are many different stories associated with the name of this valley and ahupua'a, but perhaps the earliest known is that of the story of Puapualenalena and the conch shell. It was said that in ancient times a conch shell would ring out from the valley, heard around the island it was so loud and resounding. On the opposite, northern side of the Waikapu stream a dog named Puapualenalena was infatuated with this conch and wanted it for himself. One day, the owners of the conch had been careless and Puapualenalena gained entrance to the cave on the southern side of the stream that hid the conch, and from that point on it no longer sounded through the valley. The area was so named for the conch (Pu). The Water (Wai) of the Conch (Ka Pu) (Nupepa Kuokoa, 1872).

The name was said to have been usurped by Kamehameha after the famous battle of Kepaniwai, whereupon he changed it to honor his victory over the forces of Kalanikupule, chief of Maui after his father, Kahekili's, death. There are two versions of the name. One is *Wai-ka-pū*, the Water of the Conch, for the place where Kamehameha sounded the Pu to begin the battle for Maui. The second being *Wai-Kapu*, The Sacred Water. CW Stoddard, in his book Hawaiian Life details, "Kamehameha landed at Kalepolepo, and a kapu was put upon the nearest stream. It became sacred to royalty, as was the custom and is known as Wai-kapu to this hour-that is, the forbidden water". Stoddard continues,

> *Presently the monarch began his march; and at the second stream a great battle raged, so those water were called Luku. Luku-'to slaughter, to slay as in war, the destruction of many at once'…The enemy defeated and put to flight, and a third stream was called Ehu. Ehu-'to scare away, as dogs or hens,' or faint-hearted and sore-footed foes…There over the hill and down into the dale of Waihe'e rushed the panic-stricken hosts. As for the word Hee, it may mean, probably does mean in this case, utter rout, or to be dispersed in battle (CW Stoddard, 161).*

Wai'ale

A modern name for the reservoir dug to capture and store stream water taken from the rivers of Na Wai Eha.

Waiko

There are two interpretations of this name. The first, attributed to the book Maui Street Names, is "strong current" (Holt & Budnick). The second is "sugarcane water", ko being the Hawaiian word for sugarcane.

Pu’u Hele

Pu’u Hele is the name of a cinder cone that was where the Waikapu dump is now. There is an „olelo no’eau that says “You cannot claim a circuit of Maui unless after you have been all around, you circle the hill of Pu’u Hele, then climb to the top and proclaim, “Ua puni o Maui ia’u” (Sterling, 94). “I have circled Maui.”

Ke Kula o Kama’oma’o

Kula in this context speaks of the plains, pastureland, and open space typified by Maui’s central valley. Kama’oma’o, ma’oma’o relating to the “greenness” of things, speaks to a time before rampant unchecked livestock denuded the central valley and turned it into the “dustbowl” many think of it today. Ke Kula o Kama’oma’o are the “green plains” of Maui, a dryland forest stretching for miles broken only by the Pu’uone sand dunes and the changing climate when reaching higher elevations and more windward, wetter areas.

Traditional Hawaiian Uses & Practices

From the time of first settlement to the first contact by Western explorers in the late 1700’s, the Na Wai Eha area and the ahupua’a of Waikapu was slowly terraced and cultivated, allowing the development of a large population center, centered around the four great streams coming out of Mauna Kahalawai. Around each of the valleys of Waihe’e, Waiehu, Wailuku (Iao), and Waikapu there would have been localized centers of familial-community life focusing on the ability to cultivate the land and fish the sea. So much so, that by the time of European contact the area of Na Wai Eha, including the project area, was known around the archipelago for having an abundance of kalo. The land from the far reaches of Waihe’e all the way to the end of Waikapu toward Mā’alaea, viewed from afar, were one contiguous patchwork of lo’i kalo, fed by the life-giving waters of the four streams. In *Native Planters of Old Hawaii* Handy relates that even in the 1900’s one could still see the span of the old terraces, “spreading north and south from the base of Waikapū to a considerable distance below the valley are the vestiges of extensive wet-taro plantings” (Handy & Handy, 497).

Wetland taro would have been grown anywhere with enough water to support the flood-style irrigation favored by the traditional Hawaiian kalo farmers. In drier areas still suitable for some type of agriculture, sweet potato would have been farmed. In the Na Wai Eha region, these cultivated areas would have extended all the way from steep terraced valley walls into the Pu’uone sand dunes where crop cultivation was no longer a viable use of the land. Whereupon the shifting sands made it impossible to farm, the land was used as access to and from other ahupua’a.

There is much discussion about burials and the reasons Hawaiians buried their dead in certain places and a bit of discussion about that might be well warranted. Chiefs of old and those of noble status were for the most part buried in secret locations, their bones and flesh hidden from would-be thieves, looters, and those wanting to steal the mana (spiritual power) of that individual. The sacred valley of Iao is one such place known to be the resting place of the ancient chiefs, hidden away in caves and crevices out of sight from prying eyes. The place name

Kapalikapuokakae, or the Sacred Cliffs of Kakae speaks to this action of sequestering the bones of the ali'i in the sacred cliffs of Kakae, a high chief of old who lived and was buried in Iao. For those Hawaiians of lesser status, most were buried near to their home or in places of meaning. Locations facing the setting sun in the West, Komohana, were ideal for the burial of a dead relative as well as sandy places out of the reach of the ocean's waves.

The concept of *One Hanau* is one that speaks volumes about the mentality of the ancient Hawaiian people. To the Hawaiian people it is not "ashes to ashes, and dust to dust" but the concept of One Hanau, or the sands of one's birth, that resonate when burying a loved one. This is seen in the famous song *Hawaii Aloha* with the first line, "He Hawaii e Kuu One Hanau E", translated loosely as "O Hawaii, Sands of My Birth". Given that this large complex of sand dunes lie in between the fertile fishing grounds of Kahului and the lush valley floors of Na Wai Eha it would be expected that this is an area where burials would be found. This has been proven in the numerous archaeological studies and monitoring reports along the Pu'uone Sand Dunes, from Paukukalo to Ma'alaea. Previous archaeological studies and inventory surveys by Kennedy in 1997 and Rotunno-Hakuza for the adjacent Maui Lani master project, among others, indicate that the likelihood of encountering additional burials during construction is high. The Archaeological Inventory Survey completed by Scientific Consultant Services dated February 2010 included a total of 282 mechanically excavated and 5 manually excavated trenches within the project area. The lack of significant cultural finds, whether „iwi kupuna or otherwise, attests to the limited and sporadic use of the area by traditional peoples. "The current parcel, occurring in the more barren isthmus, contained extremely modest evidence of settlement through time. Thus the limitation of burial numbers may be concomitant with this limited occupation" (Tome & Dega 2008, 51).

Perhaps overshadowing even the multitude of lo'i kalo in Waikapu and Na Wai Eha are the stories of the battles waged along the sand dunes and into the uplands between warring chiefs. The most prominent battle that took place in the Pu'uone Sand Dunes is known by the name of *Ahulau ka Pi'ipi'i i Kakanilua*, the slaughter of the Pi'ipi'i at Kakanilua, otherwise known as the *Alapa* battle in the year 1776. It should be noted that the exact location of this battle is still not known and there is no archaeological evidence to support the idea that many warriors perished in the Wai'ale project site.

Kalaniopu'u, chief of Hawai'i Island during much of the reign of Kahekili was always seeking to gain control over Maui, desiring to extend his reign of power. Kahekili, although greatly feared, ushered in a period of peace and prosperity for the island of Maui, until Kalaniopu'u decided to invade. The Hawai'i chief had previously lost a battle on the southern slopes of Haleakalā and returned with his most fearsome and practiced regiments, the divisions called the Alapa and Pi'ipi'i. These divisions were hand-picked by the Hawai'i chief, all of them ali'i class, "there were 800 of them, all expert spear-point breakers, every one of whose spears went straight to the mark, like arrows shot from a bow, to drink the blood of a victim" (Kamakau, 85). They made landfall near Kiheipuko'a, their canoes stretching from Kealia all the way to Kapa'ahu, a distance of many miles and began marching across the isthmus towards Wailuku.

Kahekili gathered his forces and slaughtered the Alapa along the central plains of Maui. Kamakau continues, "Like a dark cloud hovering over the Alapa, rose the destroying host of

Kahekili seaward of the sand hills of Kahulu'u…They slew the Alapa on the sand hills at the southeast of Kalua." The next day Kalaniopu'u tried again to gain control of Kahekili's terrain and once again was outwitted, "Kalaniopu'u expected to enter Wailuku at Kakanilua, but Kahekili's men rose at dawn and occupied the sand hills of Kama'oma'o, and a portion of them took their stand on the side toward Waikapu turn" (85-87). Kalaniopu'u finally recognized the defeat of his battle plans and sent word to Kahekili that he wished a cessation of battle and mercy for those who survived.

Fornander also speaks of the Alapa battle in his book, *The Polynesian Race*, "Offering no resistance to the enemy while crossing the common, Kahekili distributed his forces in various directions on the Wailuku side of the common, and fell upon the Hawaii *corps d'armee* as it was entering among the sandhills south-east of Kalua, near Wailuku." Fornander continues with the fighting of the next day, "Distributing his own forces and the auxiliary Oahu troops, under the Oahu king, Kahahana, among the sandhills, from Waikapu to Wailuku, which skirt that side of the common, and stationing a reserve force at the turn of the Waikapu stream, he awaited the approach of the enemy coming from the Kealia salt ponds" (153-154). Kahekili, at the advice of his prophet, stationed his men at these strategic points imitating the fishermen enticing fish into a net. Once Kalani'opu'u's men had traveled far enough into the "net", Kahekili's prophet instructed, "the fish have entered the net, now draw the cord", meaning to encircle the enemy.

The "sluice net" that Kahekili created was a battle formation called a *kahului*, symbolized by the shape of a bay (hence the name of the city), a crescent moon, or commonly referred to in modern warfare tactics as a "pincer" formation. It is likely from the written accounts that Kahekili's warriors stretched from Paukukalo and the Lower Main-Waiale corridor all the way to Waikapu, a distance of several miles, creating a very large pincer formation. The fighting would have started with the most long-range of Hawaiian weapons, the ma'a or sling that can travel a distance of hundreds of yards, followed by a barrage of spears thrown by the Maui army towards the Hawaii army which had the strategic disadvantage of being at a lower elevation. Once the two armies were in too close quarters for the slingers to throw without endangering their own men, they would have engaged in weapon and hand-to-hand combat. With an estimated 800 men of the Alapa combined with the superior force of Kahekili's army at two or three times that size (1600-2400p) the battle of the first day would have covered a large area, both at the lower edge of the sand hills and out on to the open plain of central Maui. The second day's battle would have involved the rest of Kalaniopu'u's regiments, numbering into the thousands, fighting against Kahekili's army that included the assistance and warriors of Kahahana from O'ahu (Desha, 33-34). It could be surmised that with up to (and possibly surpassing) 8000 warriors engaged in multiple days of combat, the battle raged from the sandhills fronting Wailuku and Waikapu to the flat plains of Ke Kula o Kama'oma'o nearly all the way back to Kealia.

The next large battle that took place along this region was also the last battle to take place on Maui, the invasion of Maui by Kamehameha in the year 1790, at the battle commonly known as Kepaniwai. It was near Kalepolepo that Kamehameha is said to have landed his canoes for his invasion of Maui, but they stretched from Mā'alaea all the way to Kihei as well as landing forces in Kahului bay. Kamehameha had previously been beaten by the forces of Maui because of their furious use of the ma'a (sling) for which Maui's warriors were famous. But Kamehameha this time had the foreign technology of mortars, muskets, and cannons. It was here he uttered the now famous saying, “Imua e nā poki’i. He inu i ka wai awa’awa”, forward my brothers or drink of the bitter waters. He set fire to his canoes, their only form of retreat and challenged his men to win the battle or drink the bitter water of defeat and certain death. From Kalepolepo the army of Kamehameha pushed the warriors of Maui back to the slopes of Mauna Kahalawai. They fled first at Waikapu, then to Wailuku where some made it out the back pass to Olowalu, then to Waiehu and Waihe’e.

Post-Contact Historical Uses & Practices

After the consolidation of the islands under one monarch and the widespread infiltration of foreigners, the fertile kalo terraces of Waikapu fell into disrepair or were made suitable for other endeavors. Many of the old terraces were made into house pads, truck gardens, or plowed under to make way for the sugarcane plantations. As early as 1828 a Spaniard by the name of James Louzada was making syrup from the sugarcane in the Waikapu area. Although James is largely given credit for growing the cane and turning it into syrup, it was his brother-in-law, William Henry Cornwell, who received the entire ahupua’a and surrounding lowlands as Royal Patent Grant 3125 for the creation of a sugar plantation, Waikapu Sugar Company, which eventually merged with others to become Wailuku Sugar Company. This later became consolidated into the large holdings of Alexander & Baldwin (McGerty & Spear, 12).

> *By the mid-1900’s one could only see remnants of the old extensive terracing system, Now almost obliterated by sugar-cane production; a few here and there are preserved in plantation camps and under house and garden sites along the roads…Far on the north side, just above the main road and at least half a mile below the entrance to the canyon, an extensive truck garden on old terrace ground showed the large area and the distance below and away from the valley that was anciently developed in terraced taro culture (Handy, 497).*

The importation of cattle and goats decimated Maui’s central plains as their spread was left unchecked due to an edict protecting them from harm. In A Natural History of the Hawaiian Islands, Alison Kay expounds on the fate of the once green and vibrant valley,

> *The Hawaiian flora seems (like the native human inhabitant) to grow in an easy, careless way, which, though pleasingly artistic, and well adapted to what may be termed the natural state of the islands, will not long survive the invasions of foreign plants and changed conditions. Forest fires, animals and agriculture have so changed the islands, within the last fifty or sixty years, that one can now travel for miles, in some districts without finding a single indigenous plant; the ground being wholly taken possession of by weeds, shrubs, and grasses, imported from various countries (Kay, 636).*

Cane fields left fallow and rampant grazing exacerbated the effects of erosion, denuding the landscape to create the “dustbowl” of central Maui as we know it today. The importation of the Kiawe tree, originally brought to Honolulu by Father Bachelot spread across the island, usurping water in the soil from the already troubled native growth and once again contributing to the decimation of native wildlife and forest species. The Kiawe beans utilized by ranchers for cattle feed and the trunks and branches for fence posts held great usage for ranchers but meant little to Hawaiians.

Current Uses, Practices, & Resources of Project Area

The project area is currently being used for multiple purposes. The area south of Waiko Road, approximately 123 acres is mainly fallowed sugarcane fields and a small section devoted to an orchid farm. The larger portion to the north of Waiko, approximately 422 acres, has a large portion devoted to pasturing of cattle and horses and cattle feed lot. Also on the property are an industrial base yard and an area to stockpile sand.

One of our interviewees accesses the portion of the property to the north of Waiko Road to conduct contemporary cultural practices, honoring the „iwi kupuna for which she feels a sense of responsibility. Her contemporary or "neo-traditional" cultural practices involve Hawaiian cultural practices as well as teachings she has learned from a variety of spiritual faiths. She has been walking through the areas of the project still containing remnants of the sand dunes for a few years now and feels something must be done to honor these people buried in the area.

There are portions of the property that still contain intact, unaltered sand dune formations. Most of these dunes are located north of Waiko Road in TMK: 3-8-007:101(por.). These remaining intact sand dunes are some of the last remnants of a once uninterrupted dune complex that stretched from Kapoho village in Waihe'e all the way to Kealia in Ma'alaea. The project area also borders the Waikapu stream. One of the four great waters of Na Wai Eha, the water of Waikapu provided sustenance for generations of families by irrigating their crops, supplying fresh drinking water, and being a direct and constant reminder of the presence of Kane, deity of fresh water. The remaining sand dunes and the Waikapu stream are two important cultural features.

Synthesis of Archival, Literary, & Oral Accountings

The project area, mostly in the ahupua'a of Waikapu, with a portion in Wailuku, extending through the Pu'uone Sand Dunes and out into Ke Kula o Kama'oma'o is situated in a unique location in the Valley Isle. With unobstructed near bi-coastal views of Haleakala and Mauna Kahalawai, portions of intact sand dunes, burials, and bordering Waikapu stream, the project has the opportunity to capitalize on these cultural resources by educating the community and protecting them for future generations. The sand dunes blown across the isthmus over millennia along with the large alluvial plain washed down eons ago by the slow erosion of Mauna Kahalawai sit on top of a lava foundation created by flows from Haleakala.

The property was used for thousands of years to travel through, between Ma'alaea and Wailuku or those taking the longer trek across the central valley to Paia and Makawao. It could have been part of the advance, and then retreat, of Kalaniopu'u's forces during the Alapa battle of 1776, the last major war conducted on Maui prior to European contact. The sand dune system was selectively used as a place to inter the deceased of those commoners living in the vicinity. The viable portions with access to the Waikapu stream would have been in lo'i with other areas used for cultivation of sweet potato, banana, sugar cane, and other useful plants, although a lack of LCA's in this region attests to the poor farming conditions. Post-contact gardens grew out of taro patches, land was bulldozed and graded for large sugar cane fields and livestock swarmed the area eating native plants and clearing the way for erosion, Kiawe trees, and non-native grasses and shrubs. Although not noted in the flora and fauna study, some informants mentioned the area is used by the Nene and Pueo along with the Kolea as a pit stop and feeding grounds.

Potential Effects of Development & Proposed Recommendations

This report finds that the proposed Wai'ale Master Planned Community by A&B Properties, Inc. located at TMK(s): (2) 3-8-7:071, 101(por.), 104 and (2) 3-8-05: 023 (por.) & 037, resides in a culturally significant and unique land area. There are potential adverse effects to the remaining cultural resources extant on the property that can be mitigated with proper community consultation and proactive planning on the part of the developers. It should be noted that A&B Properties Inc. has done much in seeking to protect the known cultural resources on the property, creating more than 30 acres of cultural preserves and minimizing the need for relocation of burials.

Additional Finds

A large percentage of the project sits on remnants of previously altered sand dunes. Due to the underlying sandy nature of much of the project there is the potential for discovering additional burials during earth-disturbance activities. The flexibility to create additional cultural preserves and culturally appropriate buffer zones around additional burials as needed would go a long way in mitigating community concerns over disturbance to „iwi kupuna. At all times possible, preserving in place is highly suggested over relocation. Some of the knowledgeable individuals interviewed for this report commented that with the Wai'ale development A&B Properties has the opportunity to creatively take the next step in culturally appropriate handling of cultural resources, something that they feel other adjacent projects handled poorly.

Pu'u One Sand Dunes

The once majestic and geologically unique swath of Aeolian, lithified sand dunes has been decimated by large-scale agriculture, development, sand mining, and a general lack of understanding of the uniqueness of this natural feature. From its beginning in Waihe'e to its sloping end near Kealia the Pu'u One sand dune complex has shaped the lives of countless generations of Mauians, both pre and post-contact. Its formation altered the course of Waikapu stream, its placement determined the outcome of numerous battles, and its shifting sands contain the only visible remains of many of our ancestors. The remaining intact portions of sand dunes within the project area are one of its most authentically unique natural features and appropriate preservation and education about the dunes can go far in achieving the Vision Statement for Wai'ale, creating a community "with a „unique' sense of identity and character, capitalizing on its location and natural features" (PBR, 9).

Waikapu Stream

Currently the Waikapu stream borders along the southern boundary of the project. Although not situated within the project, Waikapu Stream is a significant cultural landmark and natural resource which can contribute to the vision of Wai'ale. The development plan includes a greenway and park along the entire length of the stream which significantly enhances the visual aesthetic provided by the perennial watercourse. Appropriate measures to mitigate potential adverse impacts to the stream resulting from the development of the project must be implemented, including best management practices during and after construction. Appropriate natural landscaping and signage along its border would serve to integrate and embrace the stream into the project while noting its historic and cultural significance to the region.

Educational Opportunities

The significant and unique natural, cultural landmarks in the project such as the remaining Pu'u One, Waikapu stream, and Cultural Preserves provide the opportunity to create educational "touchpoints" that can enhance the uniqueness and sense-of-place of the Wai'ale community. Finding exceptional and never-before-done ways of educating community members and the general public about the cultural and historical nature of the project area would further the community's perception of a balanced development. Knowledgeable kupuna and informants used in this report have offered their wisdom in helping to craft these educational outlets.

Cultural Advice

In order to assure the cultural integrity of the project, a qualified cultural specialist should participate in various cultural-related activities. Activities would include the development and implementation of a cultural orientation program for construction personnel, advice concerning inadvertent finds and related protocol, advice and assistance relating to planned burial preserves within the project (e.g. signage, access, landscaping, etc.), advice and assistance concerning potential educational "touchpoints" to enhance the project's unique sense of place, and advice and assistance with project names.

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2008 An Archaeological Inventory Survey of Approx. 617Ac. Of Land in Wailuku and Waikapu, Wailuku and Waikapu Ahupua'a, Wailuku District, Island of Maui, Hawai'i [TMK (2) 3-8-005: 023(por.), 37 and (2) 3-8-007: 71,101,102,104]

Appendix A: Interview Transcripts

Interview: Clare Apana

By: Kumu Keli'i Tau'a, & Kumu Keli'i Tau'a & Kainoa Horcajo
(Ms. Apana was interviewed on two separate occasions, once by Kumu Tau'a alone)
Date: January 18, 2011 & January 28, 2011

NOTE: Ms. Apana has declined to include her interview transcript as part of the CIA for the project. Her concerns about the project have been included in the text of the CIA even though her interview transcript has been withheld.

Interview: James Balau

By: Keli'i Tau'a
October 16th, 2010

JB: James Balau
KT: Keli'i Tau'a

JB: My name is James Balau.
JB: I was born in Honolulu and moved to Maui at a young age.
KT: So explain that. What where you looking for in the database?
JB: Well I was researching a lot of the ancient Hawaiian…before the monarchy. Kings and the battles and the wars, you know the kau'a. And just trying to figure out how the interaction with the western world actually affected their lives from that time all the way up until where we at now. So got me into the Mahele and everything, real deep into the Mahele. Victoria Creed, Dr. Victoria Creed a friend of mine has really helped me a lot…
…
KT: What is this called? What is this [area where you live]…
JB: This is Waikapu Gardens they call this, subdivision. This is the site of the old race track that was here, the horse track when Kalakaua used to come. So this was sugar cane, you know Hawaiian sugar cane, because this was all Waikapu commons yeah. Just right past this it starts the Wailuku ahupua'a you know so. This was all common, the common lands that they when actually turn into one race track and stables and stuff like that 1870, 1880.
KT: So prior to that, you know as shown right now the battle for the wai, for the water right, ironically the place, the places you just mentioned four in common – Waikapu, Wailuku, Waiehu, Waihe'e all have a commonality that it provided the water so that…go further back in time, mauka over here was all kalo land
JB: Yeah kalo. Kalo.
KT: So the ancient plants were all here. And the way they had this architecture of this land was going from Waikapu to Waiehu across not going mauka makai. So they could retain the water for the kalo. Today the last remnants are still found when you driving on Kahekili there's a water trough going down, down watering the macadamia when they were still actively planting. But that's the actual…
JB: Actual awai.
KT: Awai of the kalo. Which indicates that it you know it goes across the land rather than down the…
JB: Mauka makai
KT: Yeah. So…
JB: Even in Waikapu had that same same…same they had because they had two ancient awai's. One that hovered from deep in the valley came right at the top of…we call um Wailuku Heights now. She come at the bottom of Waikapu, right at Wailuku Heights and then come this way and zig zag back down. And then the other one over on the other side of the river and did the same thing, actually when cut right through, this way and down.
KT: But still on this side of Mauna Kahalawai.
JB: Yeah.
…

KT: And so you serving on the Maui Burial Council? Still actively?
JB: Still active.
KT: They haven't really looked into what has been found here in whatever was turned in so far?
JB: As far as what?
KT: The council in terms of findings and burials sites and so forth.
JB: What is interesting is so far, what has been brought to us mainly by Maui Lani because they were the largest land owner that bought in this area, the sand dunes…
KT: So is Maui Lani A&B?
JB: No Maui Lani bought from A&B.
KT: Okay.
JB: Yeah they bought from A&B so A&B now still selling off or wanting to develop yeah. So there's 1000 acres yeah that they had bought, Maui Lani, and they sold off to here there, stuff like that but from what we getting, the information that we getting there's literally hundreds, I can just in this area that we talking about, there's several phases and phase nine is a small phase but there's but you talking about hundreds of burials you know there that has been uncovered. Oh Pa'ilina is just right off the road over here you can see it. It's a big tomb that I am trying to…I said „a'ole cause they wanted to remove 13 individuals in C2 and I said no way. You know if everybody else going vote…
…
Talking about nene sightings:
KT: So you know how significance! How poetical!
JB: Now they coming back.
KT: Yeah!
JB: Every morning I get one flock about four or five they come, and they land the same place. Because they real territorial eh the nene. They chase you! They chase you these buggahs, they do you know! They territorial the buggahs, they chase you!
KT: So where do they land?
JB: Where they land is, they land at the park down the street.
KT: Right, right.
JB: They land at the park yeah. About four-five, maybe sometimes get six. But every day, every morning. About between 5:30 and 7:30, they there. And then they gone, they go. They fly.
KT: So you know we'll never know what's the connection of the spirituality and their coming and the fact that these things are happening in an area that was significant for them too. Now they re-growing back so.
JB: But you know get other things, not only the nene but the pueo in Waikapu. The Hawaiian owl is real prominent in this area, especially Waiko road, Waiale they real, they prominent.
KT: If you wehe ka maka, mean you open your eyes, you going see all of that because some others say no I no see nothing. But I initially in 2007 when I submitted a report, I wrote them on how predominate the pueo was in the area. Cause number one that's my aumakua so.
JB: Aumakua. That's my aumakua too that.
KT: Every day I drive into Baldwin you know I say aloha. Every night like you know like you sometimes going home late, you know aloha. And they respond. So when some of the kupuna say hey I no see just because they haven't been in tuned to some of the things or as they might be in tune with some other things. …
KT: It's…if you do proper protocol, hoailona come.

JB: Hoailona, yeah. That's right. I believe. See with me I was adopted yeah that's why my name Balau yeah. But my name was James Richard Kane. But I go by, I'm Balau yeah.
KT: Yeah. What is this?
JB: This is just the map. One of the maps of Waikapu. 1882 Monssarrat, old map. One of the first ones they came out with that was done in that area.
KT: What are the significant areas you wanna point out? Real interesting name right there already.
JB: Yeah. Get well you know…there is so many iwi yeah in Waikapu. Waikapu was interesting because was one of the first places where the haole, the foreigners came to reside, was one of three places. Honolulu, Lahaina and Waikapu. People no realize that Waikapu was one of the first places that the foreigners came and resided.
KT: What attracted them to Waikapu.
JB: What was told to me was that there was a lot of the richness of this area. They could have everything that they needed as far as produce. That was number one. The other thing was the access to calm Ma'alaea. You know so, the access to that was at that time was valuable. They had salt. Had over 15-20 salt pans down at Kealia. And down, also even had pasture because when Kamehameha when, once he when make you know the pipi was lifted, the ban on the pipi was lifted. Was wide, the Texas long horn over here, was ramped. So they had a lot of fenced in areas down there so they started doing cattle real fast already. And was easy the land of this area. And then the sweet potatoes, from Waikapu they would traverse about 10 miles to Waiakoa, right across there. Get that Irish potatoes, throw um on the boat, some of the sweet potatoes. They would ship um up to California for the gold rush.
…
KT: So interesting that I'm looking at this seeing…and seeing there's lot of redness in this area in the names. Ehunui.
JB: Pu'upahoihoi was one of the konahikis in this area. He was a contemporary of Kamehameha the great. When they went do the battle to conquer Maui, all the warriors and stuff like that came down and supposedly two areas was actually, he wen kina like assign konahikis to. He wen assign lands to. Was Waikapu and Kamaole ahupua'a. So a lot of the people, the descendants now that came from Waikapu if they trace back they go back to Big Island. People from Kamaole side also go back to that side. When they won the battle they wen help win, he wen award them place for live. Puapahoihoi was one of the main. Old man, he lived to real old. He was a konohiki. (Still looking through map) There awai. Several of course.
KT: What's on this side?
JB: Oh this Wailuku.
KT: Oh okay that's Wailuku.
JB: But you know the pu'uhele, you know the pu'ulele I mean, down at the end of Ma'alaea is quite important, you know the jumping off point for the spirits of this ahupua'a. It shows a connection with the nature and the spiritual, with the water, the rising of the sun, the setting of the sun. You get to one heiau that was over there you know, pu'ulele, you know. Now it's a pit.
KT: You know where that is?
JB: Yeah, yeah. It's the pit. They wen dig um up.
KT: We gotta go for a ride so I can see that then I can see the site.
JB: Yeah, yeah.
KT: Then later on I can go

JB: Used to be one cinder cone, was one heiau then they wen dig um up. Now it's one pit. Big, huge pit, with rubbish inside.
KT: Do you need to let you family know we going for short ride.
JB: Yeah I going just tell um.
DRIVES TO AREA
KT: So where to?
JB: Straight. It's only right down the road. Turn um, all the way out, we exit here. But what is interesting about this area yeah, is this area was, like you said the four ah, Waihe'e, Waiehu, Wailuku, Waikapu, was… know what I mean? Was not part of no district, no ahupua'a. It was like a kingdom within itself you know. In 1848, during the mahele, Kamehameha the third never even designate this area anything, was unassigned. Only had the whatever kuleana had that was it. He then, in 1848, the unassigned land, all this Waikapu and Wailuku common (we go right) all became under the department, the ministry of instruction, in 1848. So the ministry of instruction, he himself had the (and we go left) he had the duty, he could sell, lease, do whatever he wanted with the land. In 1875, Henry Cornwell, which live right up there, part of the crowning birds and everybody and stuff like that, he bought the interest. See that is the funny thing. If people remember the important thing of Waikapu is that the land in the Mahele it was Koi na ili na konohiki. The lands, the ili's of Waikapu is reserved for the konohiki, always. When the department of instruction, when they sold their land to Henry Cornwell they only sold their interest of that. The konohikis and the maka'ainana had their kuleanas and they had their rights. Their rights all was reserved and even in English when they when go sell um to Henry Cornwell, yeah we going sell um to you but remember (we going take one right) remember that these lands are still reserved. The people can still do what they need to do you know. He became, he became like the overseer is what actually he bought. He bought the rights to be like one konohiki basically of the area, that's all. He was a steward, his rights was. You still okay, you can do your sugar cane and stuff like that but this was one, that's why it was a special area.
KT: Interesting my wife work Hospice so I was sitting right over here yesterday I dropped her off, she wanted to walk while I did some more research. I was just trying to feel the place.
JB: Oh man. This place is unreal. It's unreal. So you can see some of the burials already. It's quartered off. What they wanted to do, Maui Lani wanted to basically remove the burial. Go ahead and remove this dune, the remnant of this dune, dig one hole you know and kanu, dig deep and my whole thing was 'no' after consulting with people you know that, the people of the area, Annette you know, some other people and just my gut feeling after I was up there. That's one pa'e lina, all kine shells had in side next to the burials. The archeologist said its scattered you know something like, but we talk on the side right…this is a typical burial site, thirteen-fourteen burials on top, all in C2. This is you know, been here for couple hundred of years all ready and the only disturbance came was when they excavated around yeah when they started coming. For whatever reason, this was the last place they was going excavate, and what happen? They find one pa'e lina, right then, right on top. So that means to us, to HALT, we when let um do everything and all the way to the end, now we going surface. We going show our face.
KT: Maika'i.
JB: Yeah and so my whole thing is we going, I'm asking to preserve the, everybody's in agreement so far to preserve this. Been going back and forth to Oahu because Oahu was gonna override and so. Uncle Charlie is no longer the chairman cause his time has lapsed. Ke'eaumoku was been voted in as chairman. Fisher is vice-chair still. Good group. So this is kina special. Moms, dads, brothers, sisters and it's in this area that archeologist trying to say that

this is not a cemetery site but it is. Definitely all the proof of ancient Hawaiian burial is here you know.
KT: Wow.
JB: So it's unreal. And they all in back, all in back, all in C2.
KT: And these people were, how many…
JB: This used to be one corridor. Used to be one road, one sugar cane road right on this side and they used to run by um. Had one big telephone pole like in the smack, almost in the middle of it but wasn't, was right off to the side of the burials. And all these years with all this ruckus, nobody knew this was one burial. Had landfill, not landfill but opala was thrown on top and all kind stuff but when time came for get rid of it, it showed its face. It said no. And it wasn't disturbed so. This is a special, special, to me I see this as being not as significant as far as the amount of burials as what they wen try and do out in Kapalua, cause Kapalua they wen grab bones from all over the place and they wen throw um right. But this one, this is important for our side.
KT: Oh yeah.
JB: This very important. This no can go. We cannot allow that already, enough already. Get hundreds and hundreds of burials over here you know. Now lucky thing, through our efforts of this, the next area they going give us 33 acres they going preserve.
KT: Over there?
JB: Yeah all inside that area, 33 acres, big land, all going be preservation because get plenty burials.
KT: Who is developing that over there?
JB: That's all A&B property. That's all A&B. They like build homes. Maui Lani sold to them. But this is massive.
KT: Right there is that trees?
JB: This is…yeah that's trees, yeah. This is two see they came this way. When they came for excavate they came this way. They wen hit these two about two years before they even found the other one. But they never do, they wen quarter off these two and they never go in the back and go do test pits. What they did is they went around, unreal lucky thing they never just grab. But what was bad was they wen proceed all the way around knowing that had the burials on top. You know I have a good relationship with Uncle Les. Uncle Les is for you know…doing the right thing I know. And but you know he's always, you know he's caught in the middle yeah. He gotta do the right thing but he work for the developer. It's hard, it's tough.
…
JB: All inside here get burials. But according to Maui Lani, they have never come forward with any evidence of any battle, the archeologist. But when I was doing my research and stuff, Kamakau and stuff like that, he was saying that lot of the bodies was heaped up at the south eastern corner of Kalua ahupua'a which is in this area but more down by where all the new homes was built in Kahului. You know what I mean? That is long time ago that. So if had anything and that's why probably no more evidence, I'm saying because over there get like one or two, supposedly never have nothing inside there except one or two. But inside here get about 15-20, so right inside here.
KT: And was just left.
JB: Now they just leave it. They have to make a burial. And then we get three acres inside here with burials also, that is preserved. But the bones was all heaped up down there. So we asked get any war implements, they found any war implements, nothing.

KT: So Annette brought out their one digging, they came up with dog bone and pig bone in bracelets. And I inspired to her that warriors wouldn't be wearing that and the reason is they clack!
JB: Buggah make noise.
KT: Yeah. (straight ahead)
JB: (Straight ahead)
KT: Yeah so why would they have been in the area. Must have been just families living up here, you know, gifts to the deceased.
JB: Right, right, right.
…
JB: You know what is funny, even the developers, they never even find cattle bones as much. They find little bit, cattle bones. And this area was well known all the way down to Kealia, well known to have. This was the place with the papipi. They when go make the…
KT: Corral.
JB: Corral…was all over the place. But I noticed that the nene, the pueo, they coming, plenty now. Plenty.
KT: Something, something is happening.
JB: Something happen, yeah. I can tell you one story Kumu? I going tell you one story. The pueo always follow me home, always. So when I drive up Waiko road I know he coming and I pray, aloha, you know and I pray. Okay…go home everything good. One morning, my…I was going through problems. Me I got divorced over a year now yeah…just wasn't happening. One morning just no was right feeling in the na'au. I driving down Waiko road outta the right hand side I see this thing coming. I can see um now, peripheral vision, but I driving, I sticking to the road. And I knew already what was. I never even look at um. You would think maybe one myna bird, no I already knew what was. But this was about 8:00 in the morning now, the pueo he only come visit me between 5 and 8:00 at night. 8:00 in the morning driving down. Pow! Pumb! I pull over the side. I cry, cry, cry, cry, cry, cry, cry, cry. Something was to come. Something was to happen. I needed to hemo ele ele eke, I needed to do that, which I had to do anyway, forgive, but the divorce was coming. That was the sign and sure enough my wife wen ask me for one divorce. I already knew, I already knew. She never have to tell me. So I know that's my ancestors coming and letting me know "bruddah, you need to calm down. You need to hemo all your bad stuff inside, so you going cry whatever you gotta do get rid of it. You do what is pono yeah." And that's why to this day I have a good relationship with my ex-wife you know. It's true me finding out who I am through experiences, through prayer that's really brought me and I know, I know for one fact that you know our aumakua is just like what the preachers call angels you know, same thing, no more difference, same thing. They there, they our ancestors coming to us, that's our blood. But right over here, camp 7 was right there. And this is, right inside this area is where the heiau, get two, get here and up there. Gone now. But this is pu'ulele, this whole area right here is pu'ulele.
KT: So this is where you wanted to show me? [Standing now off Honoapiʻilani Highway near the stoplight that takes you to the mud flats/ Kealiʻa Ponds]
JB: Yeah but now no more the pu'u. The pu'u is gone. They dug this up. This is where the spirits would jump, boomp, boomp, boomp, back to Tahiti or Kahiki. And Kihawahine, the mo'o would also have appearances.
KT: So this story comes to you from?

JB: Comes through the olis that had yeah and also through Ke’eaumoku, he talked to me about this. But Ke’eaumoku was mostly he talked to me about the other one on the other side, the wahine yeah, the mountain. And through Vicky Creed, Dr. Victoria Creed, through her research she pointed out to me pu’ulele.
KT: Its’ interesting on what they’ve done with it, no?
JB: Yeah.
KT: But becomes an opala place.
JB: Yeah become opala place and this was the one of the two heiaus that is mentioned even when the story of ai kanaka which is my children’s ancestor when Kaluaihakoko out in Kihei you know where cove park? Kaluaihakoko? Well Aihakoko had a kahu and the kahu died and Aihakoko cry, cry, cry and that name Kaluaihakoko was named after his kahu, the pit of sorrow yeah, kalua. And our family name is Kalua’u, you know the pit of sorrow. We go back to what’s his name, Kekaulike. When he passed on, when he passed on this was one of the points that he came, that they brought yeah his body back, all the way back to Kalua yeah down for his return of the body. They had to pass through Pupalikomohana. Wailuku, Waihe’e all the way down to Ma’alaea to Pulehu Nui all the way back to that rock, had one big rock, I forget the name of the rock on that side was the boundaries of the moku of Wailuku. Technically this is Ukumehame over here, right after this road this is not Waikapu over here, this is Ukumehame.
KT: What was the name of the other heiau?
JB: Ah man. In 18, 19 early 19…camp six was over here. Camp seven I’m sorry.
KT: So camp seven was filled with what nationality?
JB: You know…
KT: Japanese?
JB: I think was the Japanese along with the… like Waikapu because the Japanese cemetery was up there. When they make they was bringing the bodies up to where they…right by my place get the last dune yeah. They when bury on top the dune. Hawaiian burials underneath and get the Japanese on top. I forget the name of the heiau. But majority of this land was common land. You know only until Henry Cornwell started to do the sugar thing it was utilized. Other than that it was just for you know use of harvesting whatever they needed yeah. Because never even have kiawe wood till 1830 you know so this was just sand dunes with natural grass and stuff yeah. And that’s why the complexity was changing all the time. That’s the same stream, always empty out cause perennial. Waikapu stream was perennial, never did stop, always had water go to Kealia pond. Always, always. In fact it’s noted that this river would always flow along with Iao in Wailuku, always flow.
KT: Very interesting.
JB: Yeah never did stop.
KT: No more any signs now of where the water would be.
JB: Still stay, get. You know how I can tell? When you go up to Wailuku Heights, the highest point, you look down you going look for one brush way of all trees, the thing take you the natural pathway of the river, the natural pathway. But that’s all salt pans down there, had how many salt pans. The Hawaiians used to be over there. We only think of Big Island, I mean Kaua’i as having, no no. Kealia had one of the largest salt making, you know traditional salt making pans over there.
…

Interview: Ron Jacintho

By: Keli'i Tau'a
October 18, 2010

RJ: Ron Jacintho
KT: Keli'i Tau'a

KT: Let's start from…You're a Maui boy?

RJ: Yup

KT: Yeah. So your full name is? Can you give me your full name?

RJ: Ronald Raymond Jacintho

…

RJ: I did archeological survey down there and I own this property down there and trying to get into his farm parcel and they have some foundations. They did the survey, they did the archeological survey everything but they still never ever had it…state historical preservation never did come and inspect it, never did. We been doing this for two and a half years, we paid the people forty something thousand dollars of property taxes, $18000 a year, every six months. I try to put electric inside, I trying to do this and you just stuck and you just wait. And you cannot touch the property, and I wanna touch it. I wanna go in with good heart, I like get good luck and this is my home as well as your home. That's the way I look at it. This is how I was born and raised here and I'm proud to say that. You know what I'm saying? I'm proud to say I born and raised in Hawaii. To me, it's an honor in life, of the millions of people we can honestly say that we was born and raised in Maui no ka oi. I'm proud to say that you know what I mean? And my parents came from Portugual, both sides and they when struggle to survive and stay here and just so as your parents you know what I mean? I remember old lady Tau'a and I know that old man Tau'a too, I remember the whole family right above MDG, Maui Dry Goods. And Haha Mendez right on the corner.

…

KT: So anyway, the reason why we contacted you as I pointed out, there going be development all over here and what our confused about, Bully didn't tell me if they're gonna be developing on your land too or down there by the…

RJ: No I think its way behind.

KT: By the cattle.

RJ: The cattle. Below yeah yeah by the cattle.

KT: Cause the sections are called Waipo then Waiale.

RJ: Waiale

KT: Is ah gonna be for A&B.

RJ: But no can put nothing on Wailae already. Pau. Because this is Waiale yeah. Ok this road over here. That road that you when turn in, that road is still get the stop sign? That road is the plantation road, go right out to um Ma'alaea. He come like this, plantation road, come right through here. He go right through, along side the prison, this side the prison. He go along side the Mortuary and that was the plantation road right into the mill yard. That's where Wailuku Sugar Mill Yard. Okay..then they when go into Walmarts. They when close the mill down. They made subdivision, industrial park. And they went into pineapple. They went into pineapple.

KT: Where did they put pineapple?

RJ: All in the sugar cane fields. When they when go for sugar cane, they when go into pineapple.

KT: On Waiale?

RJ: On all the fields that they had give up the sugar. Which was all this end down here. Over here actually, over here never did have sugar. And the only reason why, but this was the main road for the plantation. Okay then all this when go away. They sold all this land and all. Then when Spenser homes when buy this land up here, and made this subdivision. I made this subdivision in 1991, I made this subdivision here. I when complete in 1995 after I get all the permits. I move here '91 but we got the permits and everything and finally I completed this industrial park. I made this industrial park, 1995 complete. Then they gave… Wailuku Heights. When you come from Wailuku you see all the new houses coming over. Well now they make the drain come from up there, from the Wailuku Heights from all into this retention basin in the back here. Okay…then Spenser made these houses over here four hundred twenty houses who get to dump the drain, all drainage goes into this retention basin in the back. So what they did was they needed a road from Wailuku to Waikapu. So that's what this plantation Waiale road is totally shut down and all privately owned. There's no road anymore, pau. When the developers came in they made um put the drains all into this last section of Wailuku Sugar Company. So the last section, my boundary goes like this and it goes, and the next section over this is the industrial park which was approved back in the „90s. Then had to put in the lowest parcel off the whole Waiale road became the retention basin. So everything that Wailuku Sugar sold from here up, the drainage goes into the retention basin. So…they made all the new developments put in this road all the way to Wailuku. And that's official Waiale and it's gonna be turned over to the county. And they also going come after this, they already got the plans going over here already. From Waipo road its gonna go straight out to the Tropic…it's going out to the golf course. And then they gonna make one branch road go out to the Tropical Plantation. And that is all, that is all coming out probably next year or another year or so.

KT: So um…go back further than the development that you just explained. Did you know of any Hawaiian culture sites around?

RJ: No. No.

KT: Never?

RJ: Never. I don't know anything about it. All I know is that you know the opportunity that I had after Wailuku Sugar company gave up, they went into Wailuku…Wailuku water company and they gave up the sugar. What happen was they sold their land, they been selling, selling and selling. And I came at the right place at the right time and they when offer me this section here. So when I came all the studies and surveys and everything was done but I did the development here. Under the supervision of the archeologists which was Lisa. Lisa is one of …well she real well known and she good you know. So Lisa did up this for us, the physical work. The studies was done by Wailuku Sugar which like I said, they gave, Wailuku Sugar no exist anymore and now its Wailuku Water Company. Was Wailuku…what now was…Waikapu...no. Wailuku Ag. Was Wailuku Ag. From Wailuku Sugar to Wailuku Ag because they went into the mac nuts.

KT: Right.

RJ: Then they gave that up, in the mac nuts they gave that up so they not farming anymore but they retain the water rights yeah for farm use. Which we have water meters from them, this that parcel there and this parcel here is still under Wailuku Water Company. We get special meters, we pay and then that thing is all…well anyhow that's kina where its at.

Historical in Waikapu from what I understand and all, I mean you know like um, down where the prison is and the Maui Lani. We did Maui Lani okay. On Waiale and then the street light that goes down to Maui Lani and goes all the way down to Kam Avenue and goes out to Kuilani Highway. We did the first phase. We did the second phase we did all. On that side, plenty graves. And the way I look at the Hawaiians and you know what would make the most sense is I think that's where maybe you know from the mountain Iao Valley which you get plenty history and they came down to the lower lands to protect their lands and that's probably where they had their battles and stuff and where you going bury your loved one? You going put um in the same where you can be. You no can put um inside pohaku. So obviously that's why that sections down there get plenty graves. But that all come and makes sense yeah.

KT: Yeah

RJ: Yeah so. But we did dig a lot of graves there and it is recorded and me, I respect cause if was my parents or something bra or my family I like everybody respect you know what I mean.

KT: So when you were doing, just for historical sake, when you were saying you respect, what did you do to demonstrate respect so other people can maybe learn from what you did.

RJ: Well we under construction so the first thing is, all people there are instructed already as they digging, with or without an archeological inspector there, it doesn't matter, if we hit any bones or anything, we stop work immediately. We will not proceed anymore no. Cause to me it's like I said you know…I worship my family you know and even it doesn't matter, to me its respect. You like get good luck, that's what it takes to get good luck in life yeah.

KT: Yeah.

RJ: Of respect yeah. If you get respect you can make it in life. You can go anywhere in this world with respect. If you give respect you gain respect. Its real simple I think. But that down there we had yeah we did. Over here…nothing. We never came up nothing but over here its not sandy kine ground, not too much sand already. More, more the kine ah, more river rock.

…

RJ: I see the nene bird up here in the field right up here. The nene birds stay right here, right next to the prison by the, by the houses inside that park right there.

KT: They come in now.

RJ: They fly. You can see um fly right across here. The flock, they go they go over there. I think I dunno what they do they drink water over here. Unreal you know.

…

RJ: You talk about the pu'u and stuff. Inside this sand hill down here…that's all get. Over here no more, over here more high land eh. Over here as far as I know this place for..you know I been around in and outta here with the plantation working all thirty something years. I know this side no more, I know this side no more the mounds ah…the pu'us, no more. But I know inside there…

KT: By the golf course

RJ: Up. Between the golf course where at now and right inside this thick kiawe where Brandon Balthazar get cattle ah. All A&B land though that. Inside there get plenty. I been in there they get sand ah they been buying sand from A&B ah. How he get one pu'u here then level then one more over there, and one over here. But plenty on top is burial. Plenty on top the pu'u is burial. See they get the fence around yeah. But I know inside here yeah. I seen that property I know that for sure.

KT: So around here, none of your employees have ever experienced spiritual visitations?

RJ: I never did. I never did.

KT: I just left a good friend, he showed me on his computer, spiritual pictures laid out like this. Oh my gosh. When I get um I gonna be able to show people like you.

RJ: Yeah. I never did have nothing over here. We work over here day night and we had this placed blessed so meantime I get all my places blessed you know when we, when we buy. We bless. We get the priest come over and I let um bless the place for good luck so nobody get sore. We can make one business so we can feed the family so the people who work for me I highly believe that. I feel honored that the good Lord when pick me in life to um provide for my employees so their spouse and their children you know that I feel like I'm honored you know what I mean so. And um so we always try, we always have the place blessed and we feel like good luck so we all can make it in life. No more sore, no more nobody get hurt, everybody good luck ah and make life go so. We been blessed. We work here day and night and you know me, to me it um like the old people say and I'm sure your parents told you that, you no have to been afraid of the dead. You gotta be afraid of the live ones. The ones that stay living.

KT: Ok so you work this area. If there was a name given to this area, it's part of Waikapu.

RJ: Waikapu. Always been Waikapu. Anytime they say, anytime was eh you going Waikapu automatically you going come up to Waipo road to come to Waikapu. That was it. Waikapu um…they all come, you going see…anything happening is automatically Waikapu is from Waipo road this way. You know, that's Waikapu and then I even like the Tropical Plantation you would say oh Tropical Plantation but everybody know but thats Waikapu. You know what I mean? That's all part of Waikapu.

KT: See so it's beyond.

RJ: Well no. Tropical Plantation is right here see this? So that's above, kina like the border line of Waikapu and from there down is more considered more Ma'alaea. Yeah so anytime you mention Waikapu you automatic, Waiko road is Waikapu.

KT: Okay.

RJ: That's, that's how almost everybody takes it.

KT: Good definition. So the way I need to question to make sure it’s documented, You would be considered…although since you’ve worked here for quite a few years you’d be a lineal descendant which is defined as connected to the land there. A cultural descendant

RJ: Not, not really but you know like. I would think that this area here is to being connected in constructed and trucking this area had a lot of sand, sandy area. And that’s the reason why I believed they would never ever grow cane. Had too much sand, not enough dirt. And then once you get down to a certain degree, it’s all the river runoff, you know the „ili ili. Yeah so that was it. So I no think that was real physical to grow cane here and that’s why…and you know as well as I know you know Patric Dirego. You know Eugene Dirego, the Dirego boys. They was one of the original guys who had their license, trucking and that was back in about „75-’76. And they had their sand pit right here. They used to purchase sand from Wailuku Sugar Company, Wailuku Sugar at the time. And we used to purchase sand from them. So I’ve been here for about thirty years. I have bought sand from Wailuku Sugar Company, which is Wailuku Agro business, 25 years ago, 20 years ago. I became good friends with the people that represented Wailuku Sugar Company by purchasing sand from them but I have never found anything that in the ground. I never. I honestly can say that I never ever seen anything, you know nothing. So I dunno about this area here you know over here but um other than that…

KT: So most of the plants were kiawe? Kiawe trees?

RJ: Over here no nothing. Over here I no even remember the kiawe. I think I dunno if they when try to grow cane or what. All I remember over here was kina just…like was… I never ever remember kiawe here. Very little if anything yeah. I only remember taking sand from this for construction projects. But I, that was all of this section here which I no remember seeing anything in that ground. I dunno nothing about that. But um I would say about thirty years ago cause I got my license 1978 and I been in business that’s thirty two years you know what I mean but this section as far as I know I remember had plenty dirt. You get so much sand and you hit dirt and you stop. You gotta keep moving and keep moving yeah. So it’s just like you know it’s like the ending part of the sand like. This is just about the maximum height of the sand. This side over here, this side over here I dunno how much sand get but I know, I know like when we dig our sewers and stuff like that, not sewer but one of the sewers drain, plenty sand down here. But if you go behind here, they put this runoff drain in, nothing. Amazing ah! And then get little bit sand up here but you know that side of the river, I no think get any sand at all. Already just like, just like moving out yeah. More the ‘ili’ili and just hand-size rock and one or two big boulders but you know what, mostly all rock and dirt.

KT: You know they said Maui was two pieces fit together.

RJ: Two pieces yeah.

KT: So to say that „ili’ili can be found…it’s from ocean right?

RJ: Well could be but you know like I said to me this strip inside here, this strip in here I would say is almost all sand yeah, sand ocean eh. And just like this…was this the elevation at the time of the water? And today that is the elevation of the water and this is one big island when was two islands you know and where was the stopping point because I can tell you right now I can go right up the street and I can dig right across the street, right up the street and there’s no sand. I think I know this land right here. And there’s no sand and right below that get sand. So it’s amazing! So what when happen 2000 years ago, 3000 years ago I cannot tell you but I know the sand stops right about up here. I know that for sure. And the rest I know for sure is just rotten dirt. Because I know across this highway, Honoapi'ilani Highway, I put any money down you ain't gonna find no sand and that's not solid ground, not blue rock, but you get all loose rock and dirt. That is solid sand but get little bit dirt. But no more the „ili'ili though. But get little bit dirt though. Could be the, could be the dirt form the wind from thousands of years but I don't know, I don't know

KT: So you have any opinion about all of these developments coming in?

RJ: What is my opinion? To me the most important thing is you cannot stop progress. Progress goes on. I'm partial to construction because I did that all my life. I raised my family in construction so of course I will be partial to construction eh. That's my number one goal in life. That's how I fed my family. That's how I made it in life. So for construction yes, I vote for construction. With respect to the ground. And designated areas, if we have to have designated areas to for burials and stuff like that yes. To go in there and just mass ex, without respect, I don't wanna get involved. And I don't want the job. I no like even work on that. With respect, the right way, yes.

KT: So…have you run into any of these hotshot people from away, coming in and not concern and…

RJ: Respect yeah, and I believe that. And that's the only way you can make um, with respect. I no say just go in and mess that you know if you gotta divert you gotta go around or you gotta designate an area which if the Hawaiians was there first then I think they still belong there. But you put um in a designated area. I no care at what cost but you gotta respect that. That I believe highly. If get grave, I tell you respect. If it's something that you think you can go over… It's like I get Makena right now. Underneath is solid rock, you can see the lava flow. I no touch um until they tell me it's okay but I still like know, if they tell me no, I like know why. That's all I asking. I not going against the system but I like know why. You no can tell me that one Hawaiian had bury in solid lava rock when its shows lava and on top they made one rest area or one house or old shack. You know what I mean? I tell you I not going disrespect that but I telling you I no agree either. Or let's dig it out and find out. You know. I tell you yeah.

KT: May I ask where you living now? Are down there, Makena?

RJ: No, no.

KT: You up Kula?

RJ: I living Wailuku now, Spenser homes, and the fact is because my wife got sick December '06, December 4th. We was in Queens Hospital with one respirator for four months and we came home from Queens Hospital on an air ambulance, with a respirator and a trailer and they pronounce her dead, stage four, terminal. We bought her home from Honolulu in four months on noni juice yeah. And she lived with me for three and a half more years. And we bought that house just to speculate that we came from Honolulu with the air ambulance, to the ambulance, on a gurney, upstairs with a respirator. Six months later the respirator was gone. She was walking and talking and going all over and feeding through her mouth and everything, from the day we came home, we came home April 3rd, '07. She died seven weeks ago…so.

KT: Great story.

RJ: Yeah I tell you what ah I tell you that's a miracle lady and I believe you know I mean like but…um you know so…I tell you outta respect we respect our own ground because this is the place we was born and raised to ah and that why me, I get disgusted when they say oh they kids stay California, they kids stay Las Vegas, what for? More better you just stay here and enjoy your aina. This is your aina over here. You was born and raised over here. Why should you leave? You should stay. They shouldn't, we shouldn't be leaving. Me I ask my children please no leave me. I get seven grandchildren but I like them stay right under my wings. Not to take care, they all independent but braddah they need help I'm here. You know what I mean? That's the way I look at it.

END

Interview: Chris Hoku'ao Pellegrino

(Note: Hoku'ao declined to be digitally recorded for his interview. Instead he preferred that we rely on his comment letter sent into A&B Properties, Inc. for his concerns of the project. A copy of that letter is included below)

November 6th, 2010

From: Hōkūao Pellegrino
P.O. Box 967
Wailuku, Hawai'i 96793

RECEIVED

NOV 17 2010

A&B PROPERTIES-MAUI

To: A&B Properties, Inc.,
P.O. Box 156
Kahului, Hawai'i 96732.
Attention: Grant Chun (Vice President)

Re: **Waiale Development (EISPN) Comments**
TMK: (2) 3-8-05:23 (por.) and 37, and (2) 3-8-07:71, 101 (por.), and 104

Aloha e Mr. Chun,

My name is Hōkūao Pellegrino and I am a 32 year resident of the ahupua'a (land division) known as Waikapū. I am a lineal and cultural descendant of kūpuna who lived and continue to live in this ahupua'a. Over the last 10 years, I have conducted extensive research on the cultural and biological landscape and resources of Waikapū. My research includes but is not limited to native land titles, burial site identification, botanical surveys, watershed assessment, water resource management, estuary studies, traditional wetland and dryland agriculture, and cultural landscape GIS mapping and identification. I am well aware of the proposed project area and many of the cultural and biological features that lie within.

Due to being away completing my graduate studies in 2005, I was unable to participate in the community discussions. However, I have been following this project closely and have reviewed the EIS preparation document and other pertinent documents regarding the scope of this project.

As a concerned kama'āina of Waikapū, I would like to review the environmental and land use permitting component of this proposed project. Mahalo. Below are a few preliminary concerns that I identified within the EIS preparation document.

1.9 Public Consultation

During the 2005 public planning and consulting process for local residents, were those attendees informed about the burial sites as well as burials that had been inadvertently disturbed on the proposed project site? Pertinent information such as this along with proposed burial preservation areas can greatly influence the public's response to how this project was planned. I would like to request that there be further discussions with the neighboring communities, especially those of Waikapū and the community association.

2.1.3 History of the Property

The historical name of the southern portion of this proposed development is Kama'oma'o / Ke Kula o Kama'oma'o, which refers to the central plains of Maui. The name Wai'ale refers to the pond / reservoir which captures water that is being diverted from Waihe'e, Waiehu, and Wailuku.

I would like to note that the historical usage of this property predates the cultivation of sugar by HC&S, cattle and horse grazing, and the current sand-mining practices. Extensive pu'u one (sand dunes) existed prior to the flattening of the project area by HC&S and Wailuku Sugar Company for agricultural purposes in the late 1800's early 1900's These stretched from the coastal region of Waiheʻe to the Keālia Pond and was the longest sand dune feature on the island of Maui. These puʻu one were utilized for burying those kūpuna who were from the Waikapū and surrounding land divisions as well as those who fell to their death during the numerous battles which took place in these vicinities. It is for this reason, many burial sites have been identified within the confines of this project and more will likely come about in the developmental phase.

Trails and roadways connected the ahupuaʻa of Waikapū and those neighboring ahupuaʻa across the central plains in the moku of Kula. During the time of the Great Māhele and even prior to that, native tenants of both districts traversed the lands north and south of East Waikō Road in order to cultivate their wetland loʻi kalo (taro patch) or dryland ʻuala (sweet potatoes).

As a Hawaiian and cultural practitioner, I would like to see more of an effort by the landowner and developer to incorporate the value of culturally significant areas such as the one being proposed for development. Incorporating important details like place names and other examples as specified above brings a greater historical context of the property, which in essence bring greater depth to the meaning of the proposed area. These details can bring forth an added value and cultural awareness to those who may call this place home in the future. Incorporating a detailed historical summary of the property can greatly assist in fulfilling the component within **2.3.1 Vision Statement for Waiʻale - Respecting the natural, historical, and cultural significance of the land.**

4.1 Archaeological and Historic Resources

While I acknowledge a long term preservation plan for those 80 or so burials which have been identified and inadvertently disturbed, I would like to know what the developer intends to do if they come across more burials within the project area? I am deeply concerned as to how these burials are treated and the need for them to be undisturbed, rather than removed and reinterred on a vacant lot planted with native plants. This process is becoming all to common, especially in other developments surrounding the project area. The cultural preserves within the conceptual design are limited to the north western part of the project. I would like to see other cultural preserves, especially in the area south of East Waikō Road if other inadvertent burials are found.

I would also like to request that in the DEIS, all remaining intact puʻu one (sand dunes) be mapped. I would like to see these areas preserved and a buffer zone established so that the lithified dunes will not be disturbed by any external impacts (i.e. grating, excavating). Majority of all the ancient sand dunes of Waikapū have been disturbed or destroyed. These sites are both geologically and culturally significant and I would like to see that those that are remaining, are left in tact with minimal or no disturbance at all.

A clearly defined map showing the location of cultural features in relationship to the proposed design would also be of great assistance.

Section 4.7.3 Water Resources

The water resources of the ahupuaʻa of Waikapū is something I am intimately knowledgeable of. I am well aware that no surface water from the Waikapū Stream will be utilized for this project. However, I would like the DEIS to include updated information on the proposed Waiʻale Water Treatment Facility and its impact on surface water streams of Waiheʻe, Waiehu, and Wailuku. I would also like to request that the

DEIS include how this impacts the availability of water being pumped from the aquifer in the Wailuku region.

The Waikapū stream is a very important cultural and biological resource and in the conceptual plan, it abuts a park on the south side of the development. I would like the DEIS to address the drainage or waste water concerns so that it does not enter the stream. Keālia Pond National Wildlife Refuge and Sanctuary is located directly south of the proposed project and his home to migratory birds, many of which are endangered. Keālia Pond at times breaches into Mā'alaea Bay. I would like the DEIS to explain how this project will not impact Keālia by means of waste, pollutants, and run off in the Waikapū Stream and that the characteristics of the stream will not be altered.

Currently the Waikapū Stream does not flow all year long due to 3 diversions capturing a total of 4 MGD mauka of the property. If the proposed project were to move forward, I would like to see the possibility of incorporating this perennial stream into the scope of this project. Allowing the stream to flow would enhance Keālia in terms of their water resource for protecting the native species. The Waikapū Stream would be another added value to this development and would help others understand how we should best manage our resources mauka to makai within the Waikapū ahupua'a. The restoration of this stream would show a good faith effort on A&B's end to ensure the protection of this important resource and how it can play an integral role in and around the proposed project.

Mahalo for this opportunity for me to share my concerns and requests regarding this project. I look forward to seeing these concerns addressed in the DEIS. If you have any questions, please feel free to contact me at (808) 430-4534 or Hokuao44@msn.com

Me ka 'oia'i'o maoli nō,

Hokuao Pellegrino

Interview: Leslie Vida

By Keli'i Tau'a
October 20, 2010

KT: Keli'i Tau'a
LV: Leslie Vida

KT: So to get right into it, can you pronounce your full name?

LV: My name is Leslie Vida.

KT: Your family next door said there's three generations of Leslie.

LV: Yes, yes my older son lives up the road and my grandson is building a home right across here in the subdivision across

KT: So this is where your family bought land?

LV: No, my dad inherited it. My grandmother was a Cockett.

KT: So may I ask how old you are?

LV: 79

KT: Young man yet

LV: I no feel young

KT: Where does your family come from originally?

LV: Well my dad was born, where my dad was born I cannot answer I don't know. But he was raised right down the road down here.

KT: OK

LV: His mother lived there, my grandmother was Sarah Cockett.

KT: Ok

LV: And she was the one that owned all this land and then when she passed away, my dad inherited it. So that's how we get all this.

KT: Uh huh, so this whole way we went over there first and the man over there said no you live this side. And then the women across over here she's a Vida too?

LV: She's a Vida too. She married to Pito, she's my sister.

KT: Oh ok, so when you guys were growing up. What school did you go to?

LV: I went St. Anthony, then I went to Kamehameha and I graduated from St. Anthony.

KT: You went Oahu Kamehameha?

LV: Yeah, I was classmate with Don Ho guys. Then I got into trouble, so I had to leave.

KT: I'm a Kamehameha grad myself, Oahu

LV: Oh you are

KT: But I born I Kula born in Waiakoa area. So Maui No Ka Oi. I had to come back here. So when you were growing up here, you folks use to run around, play around the neighborhood?

LV: Yeah, yeah

KT: What were some of the things you did?

LV: Mostly I would swim in the Punawai's. Make tin boats and ride boat in the Punawai's, play sports.

KT: Where was the Punawai located?

LV: Had one down here below the subdivision. And then had some down the road by the plantation and all that had about four five Punawai's.

KT: Now you talk about plantation, it's past Waiko road right?

LV: Yeah

KT: They use to have housing, plantation houses.

LV: Yeah, well not past Waiko, right on Waiko. Right across Waiko was all plantation homes before was camp.

…

KT: What about Hawaiian plants?

LV: Oh well, Hawaiian plants my mother had all kind. My mother who lived up the road.

KT: Ok

LV: She had all kinds plants. So as far as you, I knew ginger and all that kine stuff.

KT: What about um, before all of this use to kinda be taro land.

LV: Taro, right

KT: So when you were young boy you saw people were still planting taro?

LV: No

KT: By that time you were young boy gone?

LV: When I was young boy this where my sister live now, had one Japanese family living in that house. And they were vegetable farmers. They were leasing the land from my dad for vegetable farming. But we had one Punawai up right, up there. We had Kuleana water which we still have but the Punawai not there anymore. The plantation changed to put water all in pipes. So my oldest boy get one home where the Punawai was.

KT: So good you guys all get water in pipes so go to the houses?

LV: Yeah

KT: Cause water big problem now for everybody.

LV: They giving us problems too. Even with our water rights we getting problems. We get the paper where it states that we have Kuleana water rights but, still we had to go to all kind meetings and everything. And I don't like what's happening.

…

LV: In a way we raised here yeah, we so use to with doing what we wanna do. And, now I get neighbors right both sides of me. I was more comfortable in pineapple field or the cane fields. Now they play loud music. I don't like it, I don't like it. In the olden days was way better living. We was just like country, five minutes to town. You understand what I mean.

…

KT: So when you were growing up, was the trains coming all the way over here?

LV: No, only the trains use to come to Wailuku.

KT: Ok

LV: Wailuku Sugar and came up to the, by Wells Park across where they had one store over there. Had one depot over there.

KT: So it turned around over there, back down to Kahului through Puunene.

LV: Went Puunene and then went all the way up Haiku.

KT: Haiku, yeah, that was a fun time.

LV: Oh yeah, I wish I had good fun over here too boy it was Waikapu was good place, everybody respect each other you know. Waikapu was a good place I grew up in a good place.

…

LV: In my younger days I guess I was out spoken. What I thought was right was right, what was wrong was wrong he couldn't change my mind you know.

KT: Maybe more people should do exactly that. So I'm glad you stating that you don't really like what is happening. The best we can do is submit this report the way people are saying it. Then it’s in the hand of the politicians like yourself.

LV: Yeah, I don't like it, I don't like it one bit. I want it to stay agriculture, that's what I wanted, now we fighting over water and all that kind stuff. It's because all this building you know what I mean. And then get certain people they trying to say I own all the water. No way that water is for you. Who owns the mountains, who owns the river tell me and they get the right to say they own the water that runs in the river. No way, no way we use to go swim in the river.

KT: Can you remember catching opae or o'opu?

LV: Yeah, o'opu, I remember all that kind stuff, we use to go up the valley. Get coffee everything up the valley. We use to go up the valley all the time. My grandson goes, he knows all the trails in the mountain now. We use to hang out up there, climb the red hill, climb certain hills just for fun. You no see kids doing that now.

KT: No, they only in back of the machines playing.

LV: Yeah, yeah but we use to hang out. We use to go up the Punawai, way up, #1 Punawai they call it. Had an old Filipino man, that was ditch man for the plantation. He lived up there and we use to go camp in his garage, spend the weekend and right next is the Punawai we go swim, take a bath and sleep „till the next day. We stayed the whole weekend, come home Sunday. That was our fun those days. Today you no see kids doing that. We use to walk all the way Paia, walk all the way up the mountain. Today you try tell the kids walk, no way they not going walk. We use to have fun in Waikapu you know.

KT: I'm happy to hear you say that cause people don't look at Waikapu like that. You have a lot here that people should know about.

LV: I love this place and like I told my kids, they all telling me give them their land now. I tell them you guys wait till I die. I give you guys the land now, maybe you guys sell um and they going hurt me. You know. I own this land and I proud of owning this land in Waikapu. I not ready, about to give or relinquish ownership. This house I going give to my granddaughter, my first granddaughter. It's all made out in a will already, she going get this house. Her son, if something happens to her, her son gets it. And I proud to live over here.

KT: Good

LV: I'm what you call a Hawaiian

KT: Ok

LV: I'm proud of being Hawaiian.

KT: So how much percent Hawaiian, how much

LV: Quarter Hawaiian

KT: Quarter Hawaiian, Portugese

LV: No, Polak. My dad was Hawaiian, Spanish, Indian

KT: Wow

LV: My grandfather was Spanish

…

KT: No, you folks deserve it, you lived your land. The story you tell is important, so mahalo nui loa

LV: We live in this world. Us as small kids with my dad, never have this, this was all taro patch land. So this road here was all hills, and all that. So we had to dig um down and make one, cause my dad he cut the road up here. So from down the other house down there, the red house, that was the original house there. We had to dig this road all with pick and shovel, blisters and everything.

KT: So during the time you were digging you never ran across any bones?

LV: No, no never. We never did run across any bones on this land.

…

LV: You see I was born in Kahului at the old Puunene hospital. That was the hospital I was born.

KT: Yeah, yeah

LV: And then in 19 anyway the second world war, my dad built this house and then we moved from Kahului to Waikapu. And ever since then, I been here.

KT: So that's 1942?

LV: 42, 41 or 42. So I guess one of the best things I ever did was I came back. After I graduated from high school, I moved to Honolulu and I also got into trouble in Honolulu. And my uncle who worked as a court clerk in Honolulu called my dad and said “Eh, you better get this guy if not they going lock um up.” So my dad came down and brought me home. And I wanted to go in the army but, I got mixed up with a woman.

Appendix J: Traffic Impact Analysis Report

TRAFFIC IMPACT ANALYSIS REPORT
WAIALE DEVELOPMENT
WAILUKU, MAUI, HAWAII

FINAL

March 21, 2011

Prepared for:

A&B Properties, Inc.
822 Bishop Street
Honolulu, Hawaii 96813

Austin, Tsutsumi & Associates, Inc.
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TRAFFIC IMPACT ANALYSIS REPORT
WAIALE DEVELOPMENT

Wailuku, Maui, Hawaii

FINAL

Prepared for

A&B Properties, Inc.

Prepared by
Austin, Tsutsumi & Associates, Inc.
Civil Engineers • Surveyors
Honolulu • Wailuku • Hilo, Hawaii

March 21, 2011

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AUSTIN, TSUTSUMI & ASSOCIATES, INC. CIVIL ENGINEERS • SURVEYORS
CONTINUING THE ENGINEERING PRACTICE FOUNDED BY H. A. R. AUSTIN IN 1934

KENNETH K. KUROKAWA, P.E.
TERRANCE S. ARASHIRO, P.E.
DONOHUE M. FUJII, P.E.
STANLEY T. WATANABE
IVAN K. NAKATSUKA, P.E.
ADRIENNE W. L. H. WONG, P.E., LEED AP

FINAL

TRAFFIC IMPACT ANALYSIS REPORT
WAIALE DEVELOPMENT
Waikapu, Maui, Hawaii

I. INTRODUCTION

This report documents the findings of a traffic study conducted by Austin, Tsutsumi, and Associates, Inc. (ATA) to evaluate the potential traffic impacts resulting from the Waiale Project.

A. Background and Location

The project is situated within Waikapu, a primarily residential area with some industrial and commercial uses. The Project site is more specifically located west of Kuihelani Highway, south of the Maui Lani development, east of Waiale Road, and north of the intersection of Honoapiilani Highway/Kuihelani Highway. See Figure 1 for the Project location.

B. Project Description

A&B Properties Inc. plans to develop a mixture of 2,250 single-family and multi-family dwellings as well as commercial, light industrial, parks and school on approximately 550 acres of land currently designated as "Agricultural" within the Waikapu area. Land has also been set aside for approximately 300 single-family and multi-family affordable housing to be developed by the County of Maui. See Figure 2 for the Project site plan

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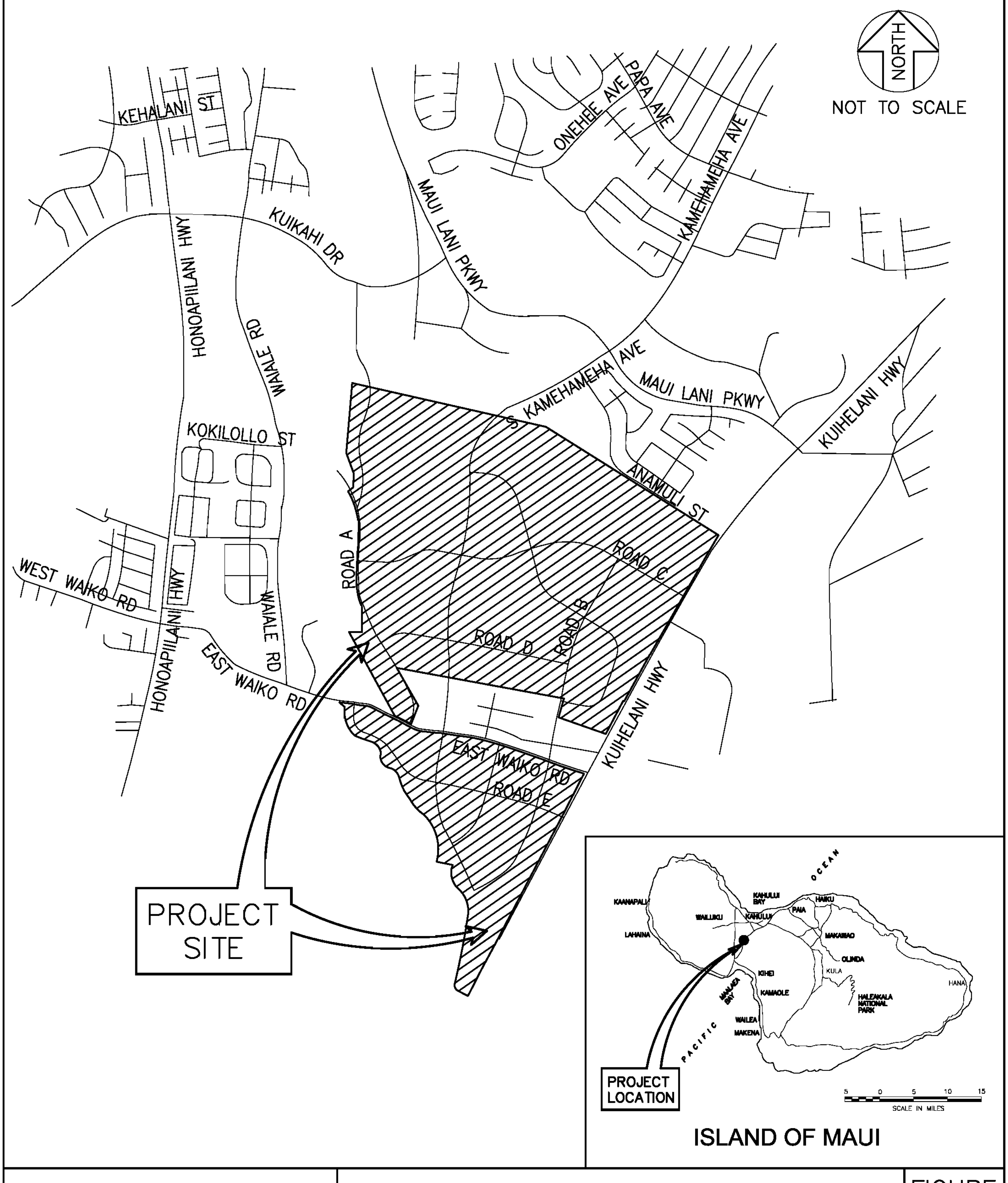
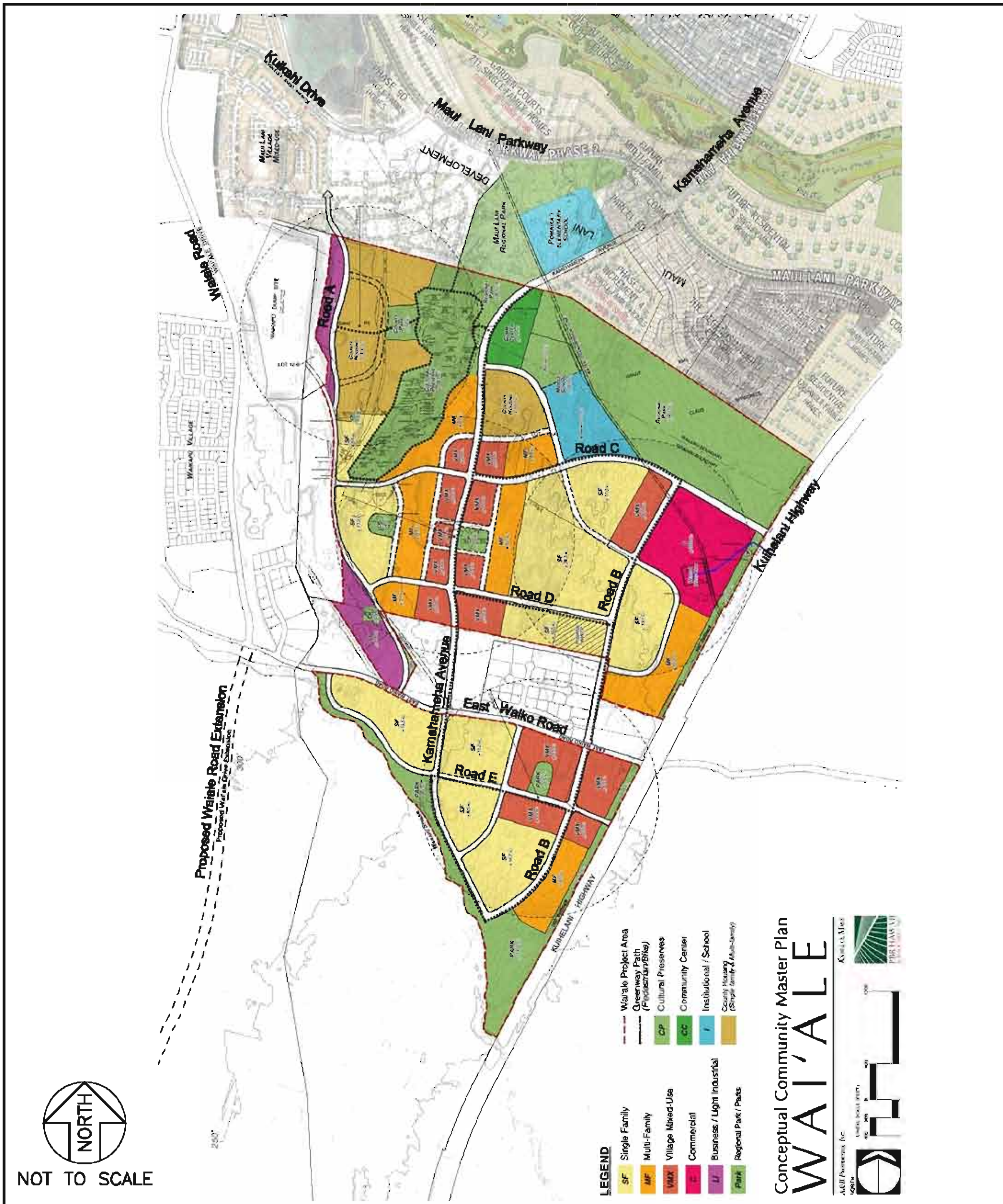


WAIALE DEVELOPMENT	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS • HONOLULU, HAWAII	FIGURE
	LOCATION MAP	1



WAIALE DEVELOPMENT	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS • HONOLULU, HAWAII	FIGURE
	SITE PLAN	2

C. Study Methodology

This study will address the following:

1. Assess existing traffic operating conditions at key locations within the study area.
2. Project Base Year 2022 traffic (without improvements) including traffic generated by the Maui Travel Demand Forecasting Model (MTDFM).
3. Identify planned roadway improvements and potential traffic mitigative measures for the Base Year 2022 Traffic.
4. Reassign traffic with the new and improved roadways proposed in the project.

D. Definitions

- **Base Year 2022** – describes scenario where vehicular traffic volumes for the year 2022 are projected without the roadway improvements.
- **High, or Heavy Turning Movement Volume** – a subjective term that for this report, shall be used to describe conditions where the turning movement volume forms a significant component of the traffic processed through the intersection, and noticeably reduces capacity along the main arterial. This term can apply to a single heavy turning movement, or the collective effect of all turning movements.
- **Level-of-Service (LOS)** – as based on The Highway Capacity Manual – Special Report 209 (HCM), dated 2000, LOS is a qualitative measure used to describe the conditions of traffic flow at intersections. Values range from LOS A (minimal delay) to LOS F (congested).
- **Volume to Capacity (v/c) ratio** – as based on The Highway Capacity Manual – Special Report 209 (HCM), dated 2000, v/c is the ratio of flow rate to capacity for a transportation facility.
- **Trips** – for the purposes of this report, vehicular trips traversing the roadway network. Note that this term can also signify other modes of transportation, however vehicular trips will be the only trips considered in this report.

II. EXISTING CONDITIONS

A. Roadway System

West Waiko Road

West Waiko Road is an east-west, two-way, two-lane undivided collector road with a posted speed limit of 20 miles per hour (mph). West Waiko Road begins approximately 4,500 feet west of Honoapiilani Highway in an established residential neighborhood, and extends eastward towards its terminus at its intersection with Honoapiilani Highway and East Waiko Road.

East Waiko Road

East Waiko Road is an east-west, two-way, two-lane, undivided collector road with a posted speed limit of 20 mph. East Waiko Road currently serves residential and industrial land uses, while also providing connectivity (via Waiale Road) to the Waikapu Gardens Subdivision and areas further north of it, including Wailuku via Waiale Road. Through the Waikapu region, the 20-foot wide East Waiko Road is currently narrow and winding; the road appears to offer limited sight distance around some of its curves, and is stop-controlled approximately 650 feet east of its intersection with Waiale Road.

Waiale Road

Waiale Road is a north-south, two-way, two-lane, undivided collector road with a posted speed limit of 20 mph. To the north, Waiale Road serves as an extension of Lower Main Street – wherefrom it extends southward past the Maui Community Correctional Center and residential areas, and eventually terminates at its intersection with East Waiko Road.

Between Kuikahi Drive and East Waiko Road, Waiale Road serves as the sole access to the residents of the Waikapu Gardens Subdivision. Each of the Waikapu Gardens' three (3) existing accesses intersects with Waiale Road as "tee-intersections", with single-lane approaches.

Honoapiilani Highway

Honoapiilani Highway is a north-south, two-way, two-lane, undivided arterial with posted speed limits ranging between 30 mph and 45 mph in the vicinity of the Project. Honoapiilani Highway begins as the continuation of South High Street near Kahookele Street, and continues southward through Waikapu, Maalaea, and wraps around the "Pali" towards West Maui.

Channelization is provided at all of its major intersections within the vicinity of the project.

Kuihelani Highway

Kuihelani Highway is a north-south, two-way, four-lane, divided arterial with a posted speed limit of 55 mph in the vicinity of the Project. Kuihelani Highway begins to the north in Kahului at its intersection with Puunene Avenue and Dairy Road. The road extends southward along the eastern border of the Maui Lani Development, intersects with East Waiko Road, and ultimately terminates at its signalized intersection with Honoapiilani Highway to the south near Maalaea.

Kuikahi Drive

Kuikahi Drive is an east-west, two-way, two-lane, undivided collector road with a posted speed limit of 30 mph. Kuikahi Drive begins approximately 1.2 miles west of Honoapiilani Highway within the Wailuku Heights Development – eventually extending eastward to intersect with Honoapiilani Highway, and terminates at its intersection with Maui Lani Parkway.

Maui Lani Parkway

Maui Lani Parkway is a east-west, two-way, two-lane, divided collector road with a posted speed limit of 20 mph. It begins to the east at its intersection with Kuihelani Highway and curves northward at its intersection with Kuikahi Drive and terminates to the north at its intersection with Kaahumanu Avenue. The segment between Kuikahi Drive and Puumele Street is currently not constructed.

Kamehameha Avenue

Kamehameha Avenue is a north-south, two-way, two-lane collector road with a posted speed limit of 20 mph within the vicinity of the Project. It begins at its intersection with Hana Highway, provides access within the Maui Lani development and terminates to the south near the Pomakai Elementary school.

B. Existing Traffic Volumes

Manual turning movement traffic counts and field observations were conducted at the following study intersections on Tuesday, September 28, 2010 and Wednesday, September 29, 2010:

- Kuikahi Drive/Honoapiilani Highway (Signalized)
- Kuikahi Drive/Waiale Road (Signalized)
- Maui Lani Parkway/Kamehameha Avenue (Unsignalized)
- Maui Lani Parkway/Kuihelani Highway (Signalized)
- East Waiko Road/West Waiko Road/Honoapiilani Highway (Signalized)
- East Waiko Road/Waiale Road (Unsignalized)
- East Waiko Road/Kuihelani Highway (Signalized)

Based on the count data, it was determined that the weekday AM peak hour of traffic occurs between 7:15 AM and 8:15 AM and the weekday PM peak hour of traffic occurs between 4:00 PM and 5:00 PM. The turning movement count data is included in Appendix A.

C. Existing Traffic Conditions

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 – Special Report 209 (HCM), dated 2000, 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.

Methodology

Analysis for the study intersections was performed using Synchro and RODEL. Synchro is an analysis program that is capable of preparing reports consistent with HCM methodology. These reports contain control delay results, based on intersection lane geometry, signal timing inputs, and hourly traffic volume.

Synchro assigns a LOS based on delay (see Appendix B) as a qualitative measure of performance. These results, as confirmed or refined by field observations, constitute the technical analysis that will form the basis for the recommendations outlined in this report.

Regional Observations

Honoapiilani Highway and Kuihelani Highway serve as the primary arterials through the Waikapu area. While the former generally serves traffic originating from or destined towards Wailuku, the latter serves traffic originating from or destined towards Kahului, Hana, or Upcountry. During the AM peak hour of traffic, congestion occurs along Honoapiilani Highway headed towards Wailuku; the northbound queue extends to near Kehalani Parkway, which is situated approximately 0.8 miles south of Main Street. No congestion was observed to occur along Kuihelani Highway within the study area.

Waiale Road, in addition to its service as a collector road for Waikapu Gardens and the nearby industrial areas, currently provides an alternate north-south route between east Wailuku and Waikapu. However, its ability to process traffic is limited by its slow posted speed limits and termination as a minor approach to East Waiko Road.

Maui Lani Parkway provides access to both Honoapiilani Highway via Kuikahi Drive and Kuihelani Highway as well as the residential area of Maui Lani. Currently, Maui Lani Parkway is a two-lane two-way roadway with a wide median to accommodate future roadway expansion.

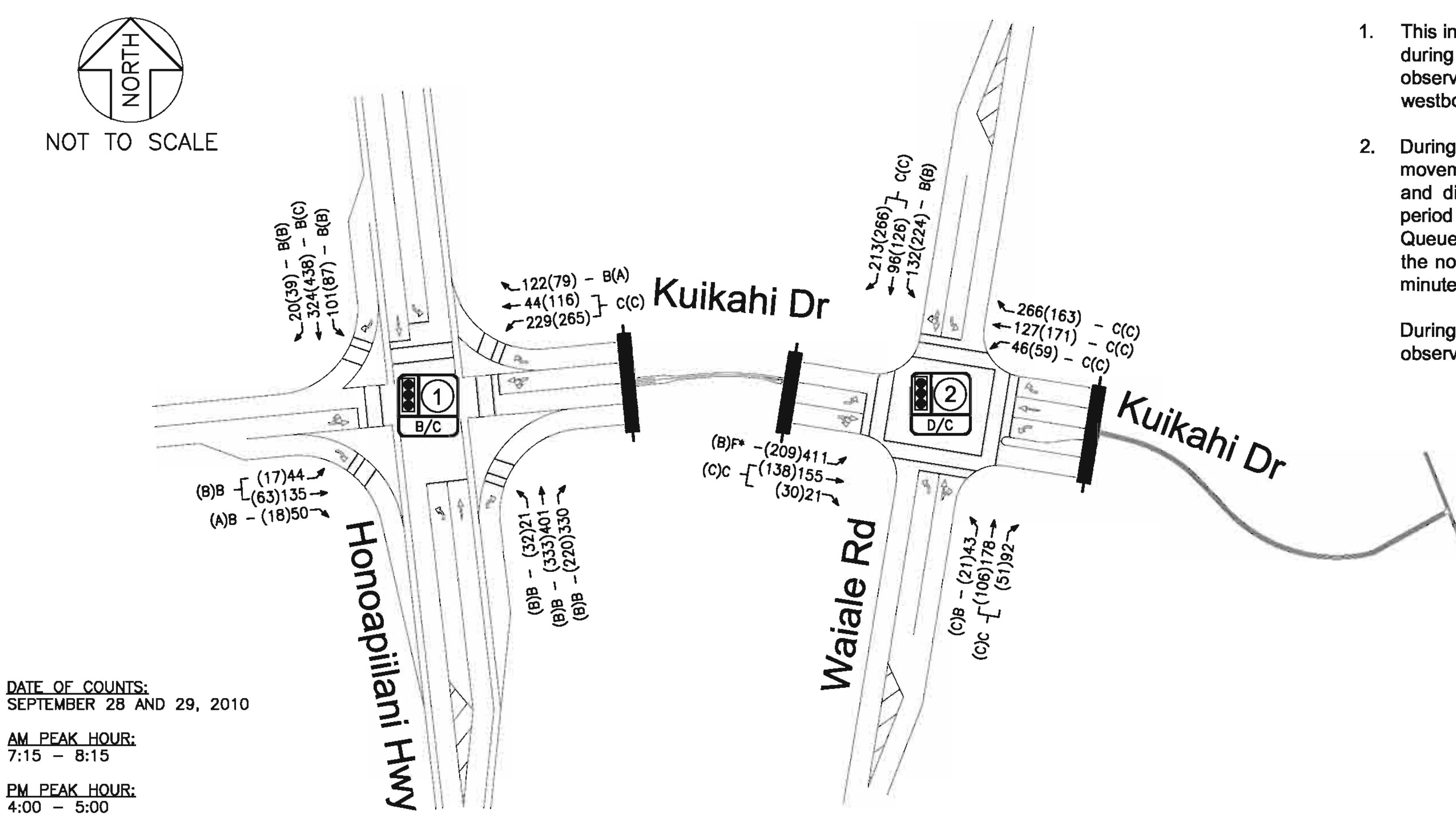
The Waikapu/South Wailuku area has experienced considerable growth in residential land use; this growth is anticipated to continue in tandem with commercial, industrial, park and other ancillary land uses. Currently, Waikapu traffic within the study area and within the region bounded by Honoapiilani Highway and Kuihelani Highway is provided access to Honoapiilani Highway and Kuihelani Highway via East Waiko Road and Kuikahi Drive/Maui Lani Parkway.

Observations and Intersection Analysis

The recent opening of the Kuikahi Drive extension (June 2010) has significantly reduced traffic volume along East Waiko Road, especially southbound right-turns and eastbound left-turns at the East Waiko Road/Kuihelani Highway intersection. Therefore, traffic along East Waiko Road was observed to operate relatively smoothly during both peak hours of traffic.

Within the study area during the AM peak hour of traffic, congestion was observed at intersections along Kuikahi Drive and Maui Lani Parkway. During the (PM) peak hour of traffic, no congestion was observed at any of the study intersections.

See Figures 3a and 3b for existing lane configurations, volumes, LOS and intersection observations. See Table 1 for Existing LOS and v/c ratios. See Appendix C for intersection analysis worksheets.



OBSERVATIONS:

1. This intersection was observed to operate relatively smoothly during the AM(PM) peak hours of traffic. Longer delays were observed on the westbound approach due to the heavier westbound left-turn movement and shared movement.
2. During the AM peak hour of traffic, the eastbound left-turn movement was observed to extend beyond its storage length and did not clear after each cycle length. The congested period was observed to last 30 minutes.
   Queues were also observed to back into the intersection in the northbound direction for a short period, approximately 5 minutes.
   During the (PM) peak hour of traffic, the intersection was observed to operate smoothly.
3. During the AM(PM) peak hour of traffic, congestion was observed on all approaches due to the all-way stop control. The congested period was observed to last approximately 20 minutes. During the congested period, queues could extend approximately 20 vehicles on all the approaches during the AM(PM) peak hours of traffic except the northbound approach which has lower volumes.
4. This intersection was observed to generally operate smoothly during both peak hours of traffic. However, during the AM peak hour of traffic on one occasion, the eastbound queue extended approximately 20 vehicles and was able to clear after two cycle lengths.

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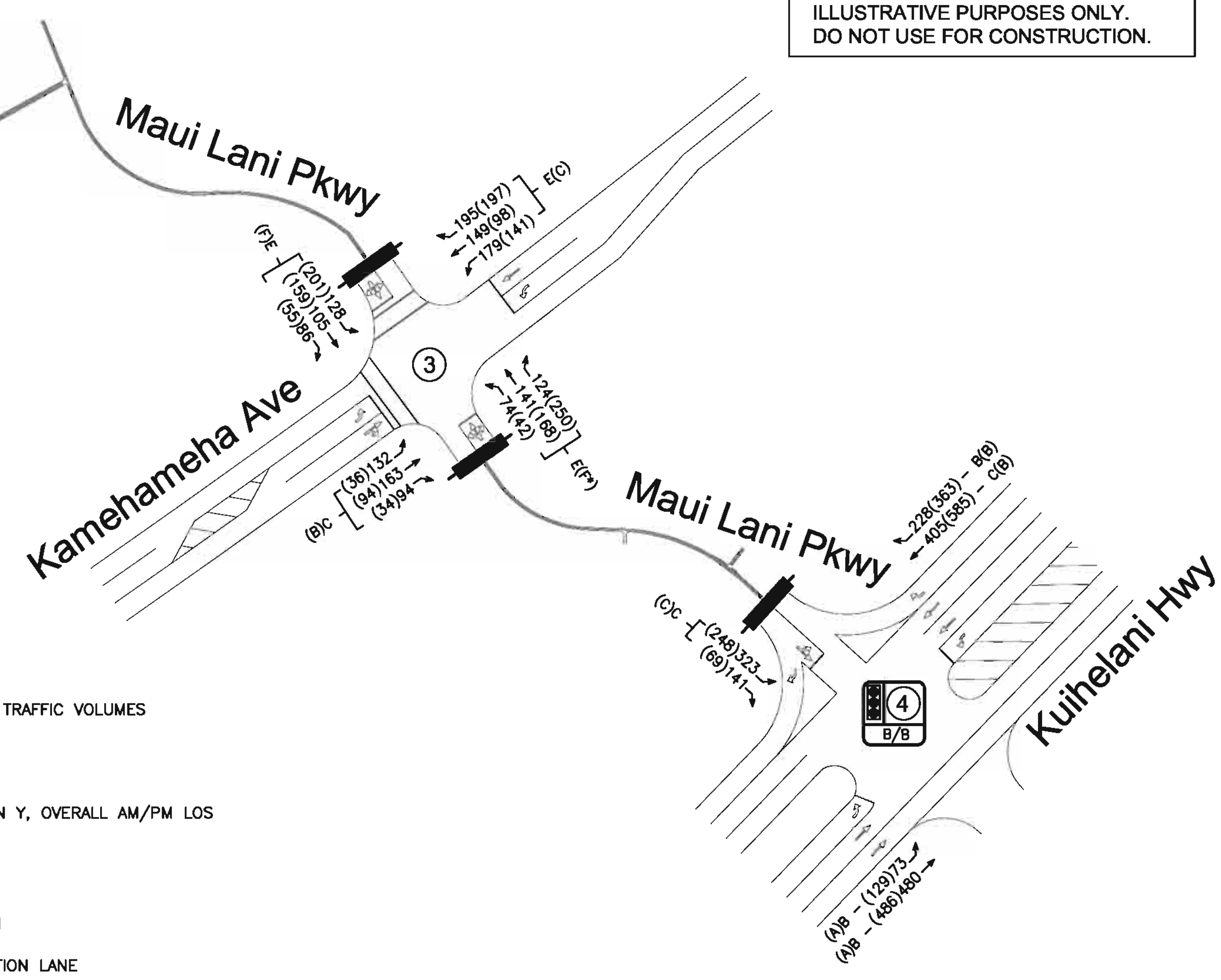

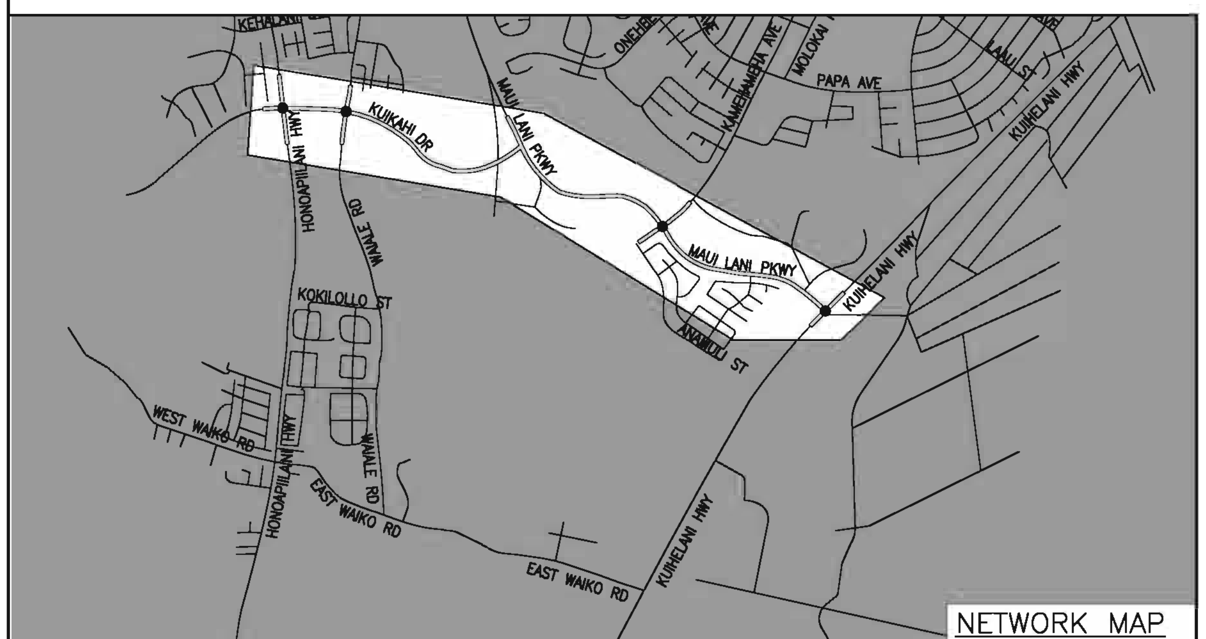

NETWORK MAP

LEGEND

##(##) – AM(PM) PEAK HOUR OF TRAFFIC VOLUMES

X(X) – AM(PM) LOS

Y A/A – SIGNALIZED INTERSECTION Y, OVERALL AM/PM LOS

(Y) – INTERSECTION Y

* – OVERCAPACITY, V/C >=1

– BASE YEAR WITH MITIGATION LANE CONFIGURATION

WAIALE DEVELOPMENT

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EXISTING LEVEL OF SERVICE AND LANE CONFIGURATION

FIGURE 3a

OBSERVATIONS:

5. This intersection's westbound approach operates at LOS E during the AM peak hour of traffic due to the shared lane configuration and existing timing scheme.

6. This unsignalized "tee"-intersection was observed to operate smoothly during the AM(PM) peak hours of traffic.

7. This signalized "tee"-intersection was observed to operate smoothly during both peak hours of traffic.

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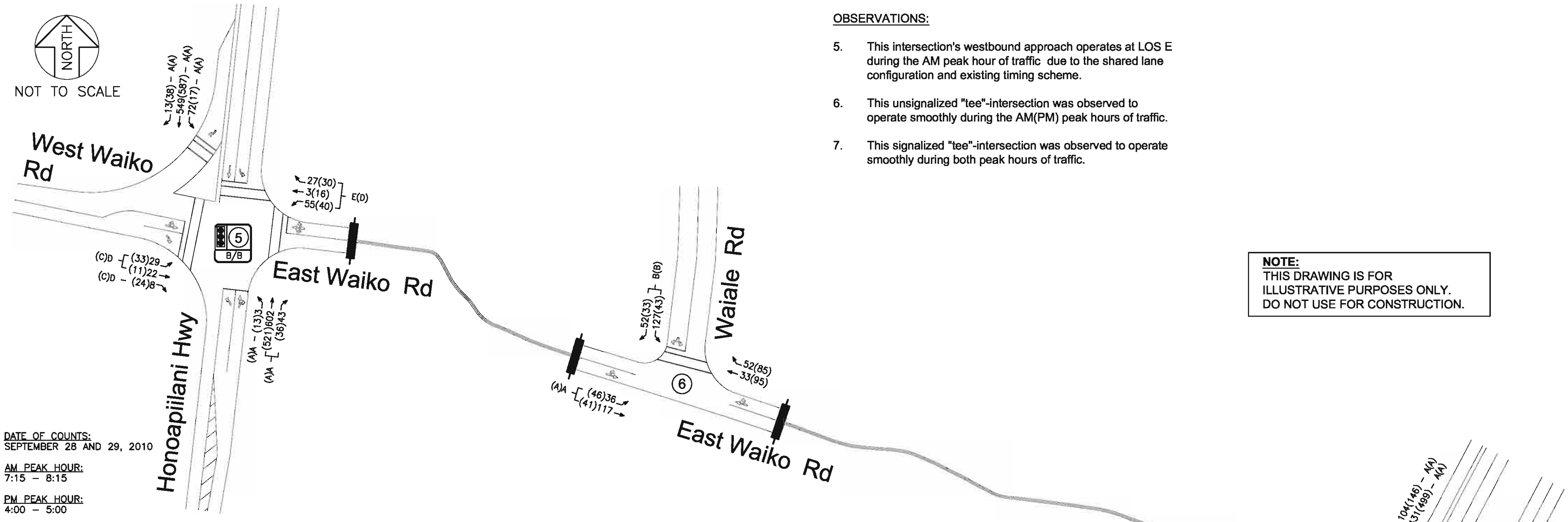
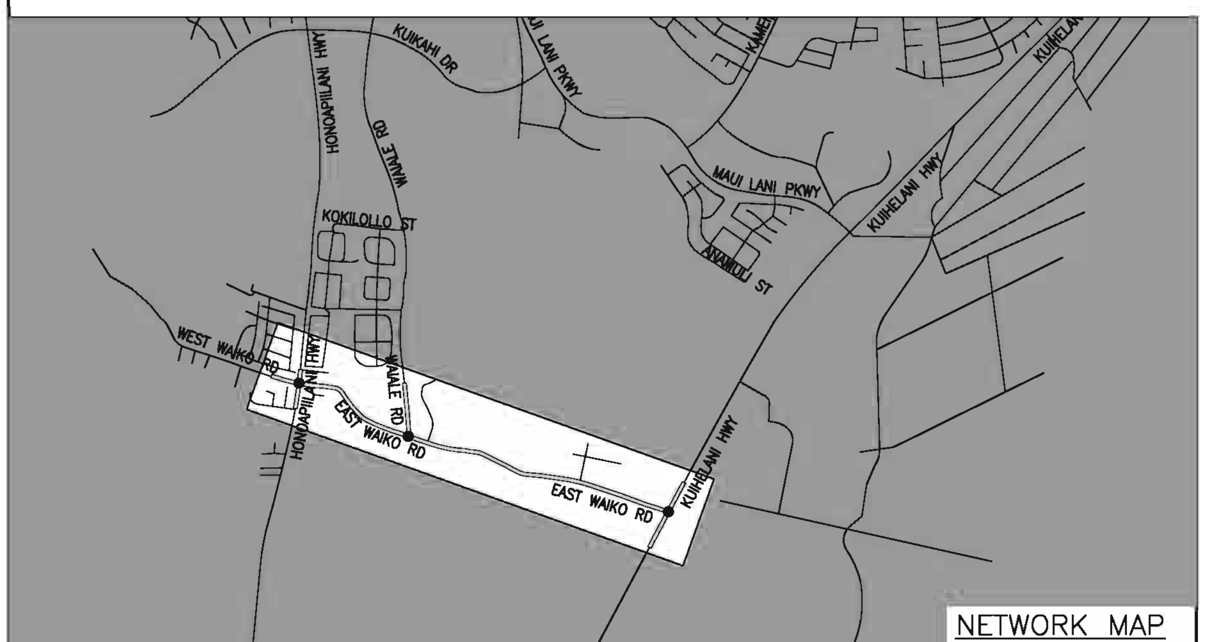




NETWORK MAP

LEGEND

##(##) – AM(PM) PEAK HOUR OF TRAFFIC VOLUMES

X(X) – AM(PM) LOS

Y A/A – SIGNALIZED INTERSECTION Y, OVERALL AM/PM LOS

(Y) – INTERSECTION Y

– BASE YEAR WITH MITIGATION LANE CONFIGURATION

WAIALE DEVELOPMENT	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS • HONOLULU, HAWAII	FIGURE
	EXISTING LEVEL OF SERVICE AND LANE CONFIGURATION	3b

Table 1: Existing Level of Service Summary

Intersection	Existing 2010					
	AM			PM		
	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
Kuikahi Drive & Honoapiilani Highway						
EB LT/TH	18	0.37	B	15	0.14	B
EB RT	10	0.03	B	9	0.01	A
WB LT/TH	31	0.79	C	34	0.85	C
WB RT	11	0.08	B	9	0.05	A
NB LT	11	0.05	B	13	0.12	B
NB TH	18	0.59	B	20	0.55	B
NB RT	14	0.23	B	16	0.15	B
SB LT	11	0.3	B	13	0.24	B
SB TH	16	0.46	B	24	0.71	C
SB RT	12	0.01	B	14	0.03	B
Overall	18	0.65	B	22	0.67	C
Kuikahi Drive & Waiale Road						
EB LT	84	**1.07**	**F***	17	0.56	B
EB TH/RT	21	0.35	C	20	0.32	C
WB LT	23	0.16	C	22	0.19	C
WB TH	28	0.43	C	28	0.51	C
WB RT	26	0.18	C	25	0.11	C
NB LT	18	0.13	B	22	0.09	C
NB TH/RT	32	0.73	C	26	0.46	C
SB LT	14	0.34	B	15	0.46	B
SB TH/RT	21	0.5	C	23	0.63	C
Overall	38	0.81	D	22	0.57	C
Maui Lani Parkway & Kamehameha Avenue						
EB LT/TH/RT	41	0.83	**E**	57	**0.95**	**F**
WB LT/TH/RT	45	0.86	**E**	71	**1.01**	**F***
NB LT/TH/RT	25	0.39	C	15	0.11	B
SB LT/TH/RT	39	0.51	**E**	23	0.38	C
Maui Lani Parkway & Kuihelani Highway						
EB LT/RT	22	0.74	C	25	0.68	C
NB LT	12	0.21	B	9	0.33	A
NB TH	13	0.34	B	9	0.28	A
SB TH	22	0.49	C	20	0.56	B
SB RT	20	0.16	B	17	0.25	B
West Waiko Road/East Waiko Road & Honoapiilani Highway						
EB LT/TH	47	0.39	D	33	0.31	C
EB RT	40	0.01	D	26	0.02	C
WB LT/TH/RT	62	0.69	**E**	35	0.48	C
NB LT	4	0.01	A	4	0.03	A
NB TH/RT	8	0.52	A	7	0.48	A
SB LT	4	0.15	A	7	0.03	A
SB TH	6	0.42	A	9	0.5	A
SB RT	3	0.01	A	8	0.03	A
Overall	12	0.56	B	11	0.44	B

Note: * = overcapacity conditions

Table 1: Exisiting Level of Service Summary Con'd

Intersection	Existing 2010					
	AM			PM		
	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
East Waiko Road & Waiale Road						
EB LT/TH	2	0.03	A	4	0.04	A
SB LT/RT	11	0.25	B	10	0.11	B
East Waiko Road & Kuihelani Highway						
EB LT	15	0.56	B	17	0.37	B
EB RT	8	0.02	A	12	0.01	B
NB LT	21	0.17	C	25	0.4	C
NB TH	6	0.2	A	4	0.26	A
SB TH	10	0.34	A	7	0.31	A
SB RT	1	0.07	A	1	0.1	A
Overall	9	0.45	A	6	0.35	A

Note: * = overcapacity conditions

III. BASE YEAR 2022 SCENARIO *(See Section I.D. for Definition)*

By the year 2022, the Wailuku/Waikapu area will have experienced significant growth, both in its residential population and commercial/industrial/business land uses, primarily as a result of the following developments:

- **Waikapu Country Town (WCT)** – currently in the planning phase; assumed to be completed by 2022.
- **Maui Lani Development** – partially complete; Maui Lani Development and Maui Lani 100 VMX Affordable Housing Project were assumed to be completed by Year 2022 – and therefore the final segment of Maui Lani Parkway between Kuikahi Drive and Waiinu Street were assumed to be complete to support the development.
- **Kehalani** – partially complete; assumed to be complete by Year 2022.
- **Puunani Residences** – not started; assumed to be complete by Year 2022.

These projects, along with other smaller ones combine to represent approximately 4,850 new dwelling units[1] for the Central Maui Region, as well as commercial, industrial, park, school, and other ancillary land uses by year 2030.

The Maui Transportation Demand Forecasting Model (MTDFM)[2] and Trip Generation Methodology (for the WCT only) were used to project (via growth ratios) and assign the traffic generated by these and other Maui developments onto the roadway network. The result was an approximate 60-percent increase in demand[3] along Honoapiilani Highway over existing conditions. Along Kuihelani Highway, the increase was an approximate 70 percent.

Projection Methodology

The MTDFM assigns land use and socioeconomic data to Traffic Analysis Zones (TAZ's). The attributes were obtained from Maui County in 2007 and used to generate and assign traffic across the roadway network.

---

[1] Maui County Department of Planning, Directed Growth Areas Listing and Units (2009).

[2] Socioeconomic/Land use data supplied by Maui County, October 2007.

[3] Based on through movements for the PM Peak Hour at the Honoapiilani Highway/Waiko Street intersection.

Between 2001[4] and 2030[5], the MTDFM assumes an aggregate growth of 6,813[6] residential units and 3,320 employees for the TAZ's that overlap the Waikapu/South Maui Area. A growth factor was derived and applied to existing volume over a 12 year period to year 2022.

Since the MTDFM did not account for the recently opened Kuikahi Drive extension, some Maui Lani trips were diverted onto the Kuikahi Drive extension based on previous reports[7].

The WCT was noticeably absent in the MTDFM's projections; therefore, its traffic was projected using the Trip Generation methodology. See Table 2 for WCT Trip Generation Rates. See Table 3 below for the results of the WCT Trip Generation.

Table 2: WCT Trip Generation Rates

Land Use (ITE Code)	Independent Variable	AM Peak Hour of Traffic		PM Peak Hour of Traffic	
		Trip Rate	% Entering	Trip Rate	% Entering
Single-Family Residential (210)	Dwelling Units	[a]	25%	[b]	63%
Multi-Family (230)	Dwelling Units	[c]	17%	[d]	67%
Shopping Center (820)	1,000 Sq. Ft. GFA	[e]	61%	[f]	49%

Source: Trip Generation, 8th Edition, Institute of Transportation Engineers.

[a] T=0.7 * x + 9.74
[b] T=EXP (0.9 * LN(x) + 0.51)
[c] T=EXP(0.8LN(x)+0.26)
[d] T=EXP(0.82LN(x)+0.32)
[e] T=EXP (0.59 * LN(x) + 2.32)
[f] T=EXP (0.67 * LN(x) + 3.37)
where "x" is the independent variable and T the number of generated trips

4 Base Year for MTDFM; this is the year during which the calibrated data was collected.

5 The MTDFM projects over a 30-year span.

6 Does not include the Waikapu Gardens Subdivision, as the project has already been completed.

7 Parsons Brinckerhoff, Maui Lani Development Roadway Master Plan, November 2002

Parsons Brinckerhoff Quade and Douglas, Inc., Maui Lani 100 VMX/Affordable Housing Development, July 2004

Table 3: WCT Trip Generation

Land Use Designation	Independent Variable	AADT	AM Peak Hour of Traffic		PM Peak Hour of Traffic	
			Enter (vph)	Exit (vph)	Enter (vph)	Exit (vph)
Single-Family Residential (210)	840 DU	8,039	150	449	450	264
Multi-Family (230)	560 DU	3,254	35	171	166	82
Shopping Center	100,000 Sq. Ft. GFA	6,792	95	60	312	325
Total		**18,084**	**280**	**680**	**928**	**671**

A. Planned Roadway Improvements

Waiale Road Extension and East Waiko Road Improvements

The County of Maui is planning two (2) major projects in the Project vicinity:

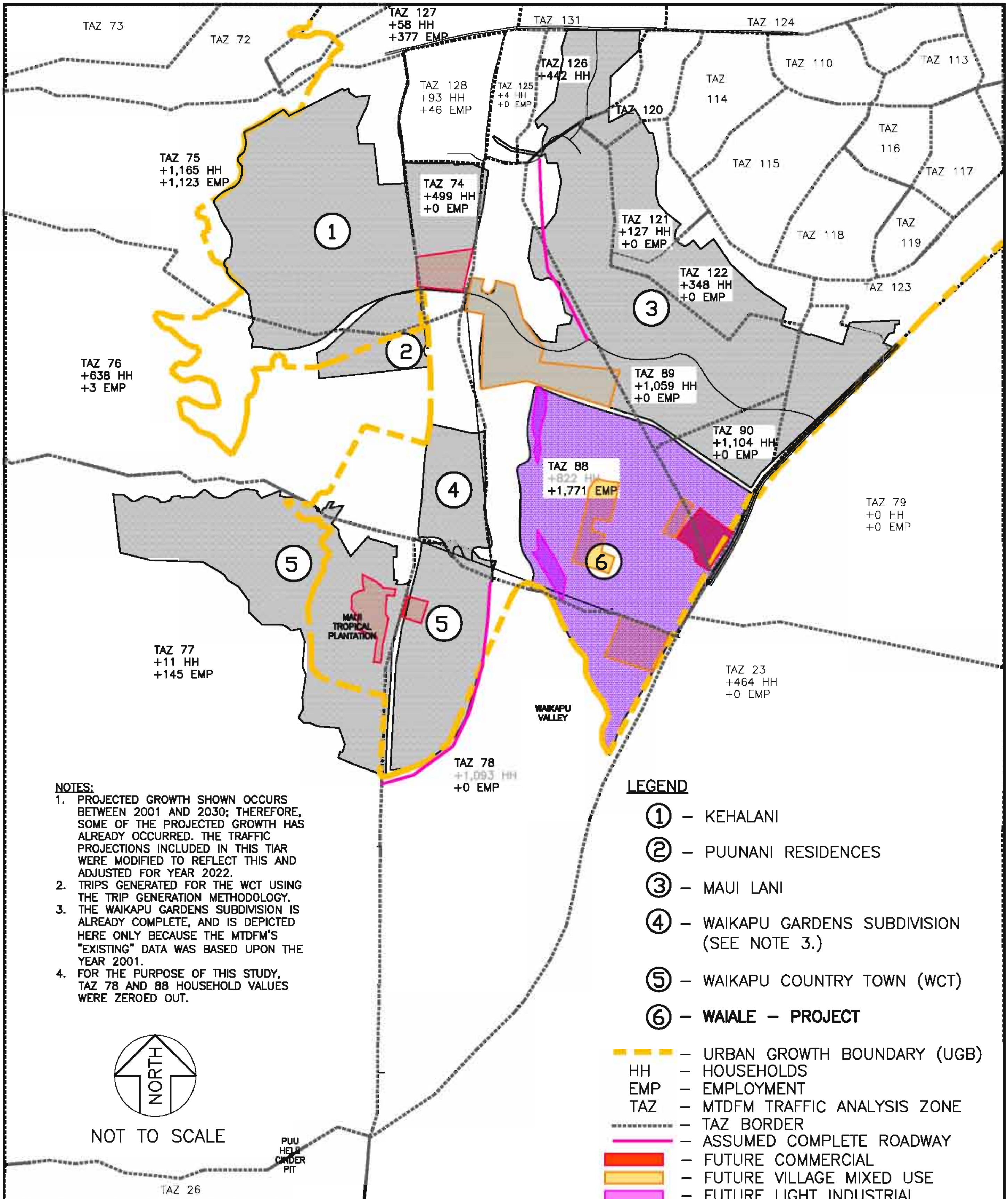
- **Waiale Road Extension**: this project would extend Waiale Road from its existing southern terminus at East Waiko Road to intersect Honoapiilani Highway approximately 1 mile south of its intersection with East Waiko Road.
- **East Waiko Road Improvements**: part of the Waiale Road Extension project described above; would widen and improve East Waiko Road east of its intersection with Waiale Road to its intersection with Kuihelani Highway.

These roadway improvements are anticipated to be completed by year 2022.

Maui Lani Parkway Extension

As mentioned earlier, it was assumed that as part of the Maui Lani development, the final segment of Maui Lani Parkway between Waiinu Street and Kuikahi Drive would be constructed as a two-way, two-lane roadway by year 2022 to accommodate the projected traffic demand along the roadway.

See Figure 4 for the MTDFM TAZ's with their respective household and employment growth, juxtaposed against known nearby developments. See Figure 5 for distribution of trips for new developments as based upon MTDFM analyses.



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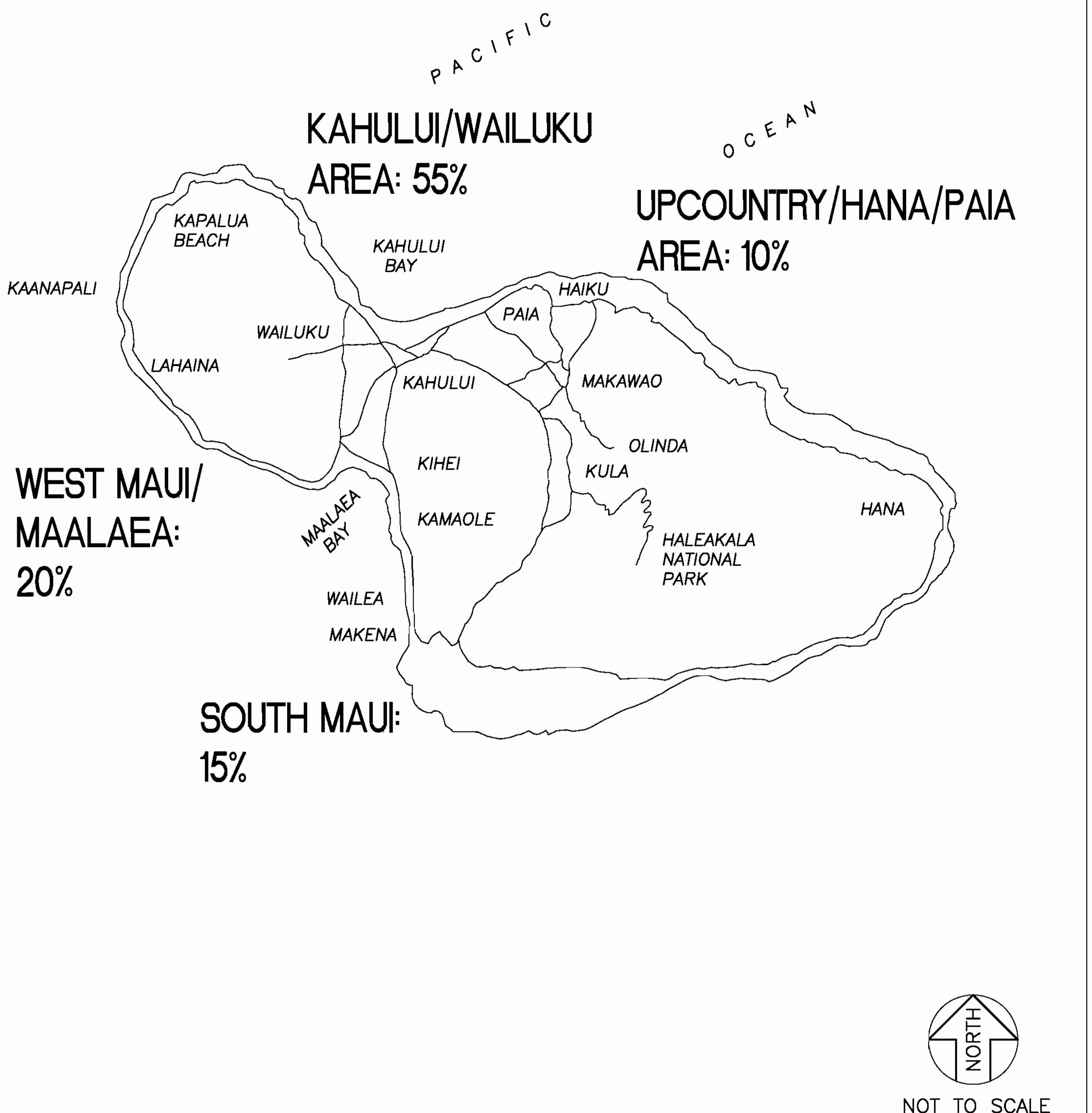
MAJOR PROJECTS IN PROJECT VICINITY

FIGURE 4



WAIALE DEVELOPMENT	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS • HONOLULU, HAWAII	FIGURE
	BASIS OF MTDFM DISTRIBUTION	5

B. Base Year 2022 Analysis

Discussion

As mentioned in Section III, several projects are anticipated to be completed by year 2022. Some of the planned commercial areas will be located along Kuikahi Drive near the intersection of Kuikahi Drive/Waiale Road and south of East/West Waiko Road on either side of Honoapiilani Highway.

The two (2) major commercial areas planned in the vicinity of the Project study area are:

- **Maui Lani Village**: planned as approximately 540,000 square feet of a mix of commercial, business, medical office, and residential with major accesses along Kuikahi Drive.
- **Kehalani Commercial**: planned for 151,000 square feet of commercial area with accesses via Waiale Road and Honoapiilani Highway.

These square footages represent the maximum allowable construction; actual build-out could be significantly less, considering that the entire Queen Kaahumanu Shopping Center currently offers a combined Gross Floor Area of 553,000 square feet.

Nevertheless, if fully built out, these projects would generate approximately 1,140 (3,027) trips during the AM (PM) peak hours of traffic respectively. Refer to Figure 4 for the planned locations of these commercial areas.

The Maui Lani Roadway Master Plan (2002) recommended the following improvements (over current roadway configurations) to accommodate the projected impacts of these projects to Waiale Road, Kuikahi Drive, and Maui Lani Parkway:

- Widen Maui Lani Parkway/Kuikahi Drive to four (4) lanes between Kuihelani Highway and Waiale Road
- Widen Kamehameha Avenue to four (4) lanes between Maui Lani Parkway and Papa Avenue

- Extend Maui Lani Parkway from Kuikahi Drive north to Waiinu Street, ultimately widening it to four (4) lanes

It would appear based upon the Hawaii Geographic Information System (GIS) layers (website: http://hawaii.gov/dbedt/gis/download.htm) that sufficient Right-of-Way (ROW) has been reserved to construct these improvements, inclusive of the relevant intersection improvements recommended below[8], with the exception of the extension of Maui Lani Parkway.

Analysis Results

Throughout this investigation, roundabouts were considered on a planning level. Currently, no actual warrants exist for roundabouts[9]. However, roundabouts are generally considered as an alternative form of intersection control at intersections with balanced flows across all approaches, and where All-Way-Stop Control (AWSC) or traffic signals are warranted[10].

Roundabouts are not recommended at any of the study intersections. The rationale is provided in Appendix D.

Base Year 2022 traffic conditions within the study network without any improvements besides the ones listed in Section III. B would yield LOS E or F and overcapacity conditions at the following intersections:

- Kuikahi Drive/Honoapiilani Highway

  Mitigation:

  - Eastbound and westbound approaches: provide exclusive left-turn, through and right-turn lanes.

[8] In some cases, 10-foot lanes may be required on County Roads.

[9] Transportation Research Board, Roundabouts: An Informational Guide – Second Edition (2010), 3-30.

[10] Only when the roundabout would operate within capacity.

- Kuikahi Drive/Waiale Road

  Mitigation:

  - Northbound approach: provide exclusive left-turn, through and right-turn lanes
  - Southbound approach: provide double left-turn, through and right-turn lanes. This portion of the roadway is currently privately owned.
  - Eastbound approach: provide exclusive left-turn, through and right-turn lanes

- Kuikahi Drive/Maui Lani Parkway (New signalized intersection)

  Mitigation:

  - Northbound approach: provide double left-turn and shared through/right-turn lanes
  - Southbound approach: provide left-turn, through and right-turn lanes
  - Eastbound approach: due to the heavy right-turn movement provide a channelized right-turn lane with an exclusive receiving lane on the westbound approach. Re-stripe the left-turn and through lanes as a shared lane providing two (2) receiving lanes for the double northbound left-turn lanes
  - Westbound approach: this approach will provide access to one of the Maui Lani development subdivisions. It was assumed that this approach would provide a shared left-turn/through and right-turn lanes

- Maui Lani Parkway/Kamehameha Avenue

  Mitigation:

  - Signalize the intersection
  - Northbound and southbound approaches: provide exclusive left-turn, through and right-turn lanes

- Eastbound approach: provide double left-turn, through and right-turn lanes. Currently privately owned.
- Westbound approach: provide left-turn, through and shared through/right-turn lanes. Currently privately owned.

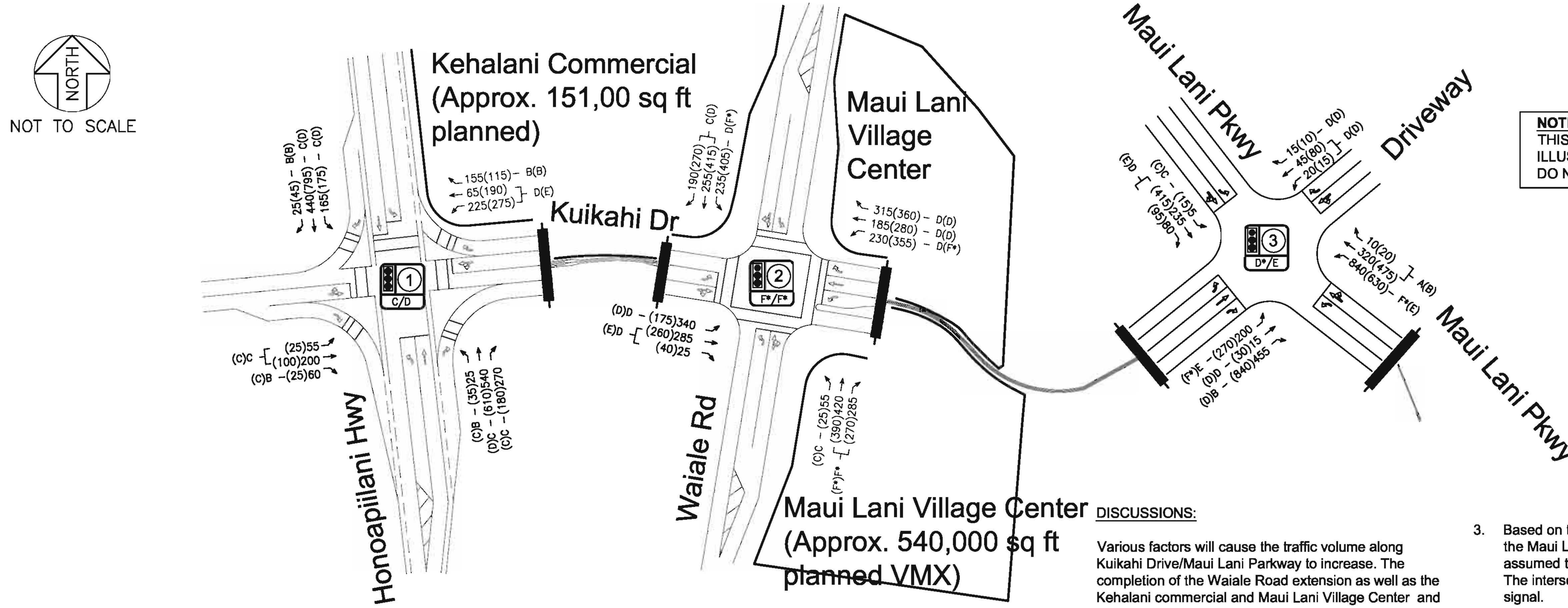
- Maui Lani Parkway/Kuihelani Highway

  Mitigation

  - Northbound approach: provide double left-turn, through and shared through/right-turn lanes.
  - Eastbound approach: provide a left-turn, shared left-turn through and right-turn lanes. The westbound approach which is an agricultural access is likely to continue experiencing low volumes. Therefore, although the intersection would provide for the westbound movement, it is likely that the intersection would operate as a "tee" intersection for the majority of the time

The proposed mitigative measures would improve traffic operations at the study intersections' movements to LOS D or better. However, the Maui Lani Parkway/Kamehameha Avenue intersection will continue to experience LOS (E) on the westbound left-turn during the (PM) peak hour of traffic.

See Figures 6a through 6c for Base Year 2022 lane configuration, volumes, LOS and discussions. See Figure 7a and 7b for Base Year 2022 intersections with Mitigation measures, volumes, LOS and discussions. See Table 4 for a summary of the Existing, Base Year and Base Year with mitigation LOS and volume to capacity ratios.



NOTE:
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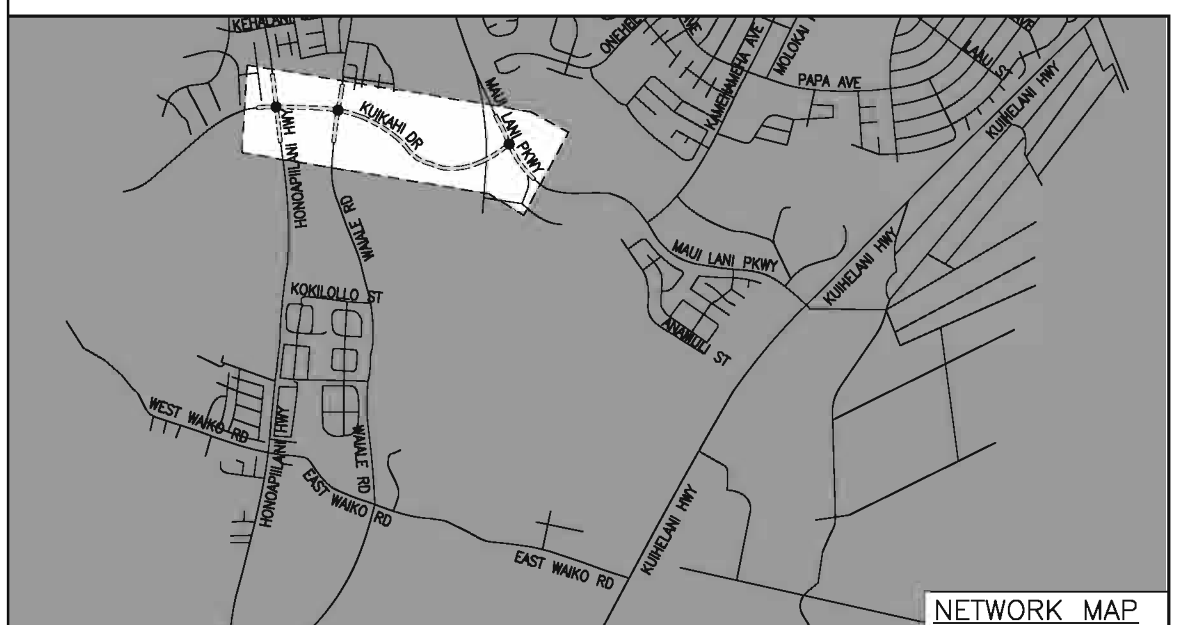

NETWORK MAP

DISCUSSIONS:

Various factors will cause the traffic volume along Kuikahi Drive/Maui Lani Parkway to increase. The completion of the Waiale Road extension as well as the Kehalani commercial and Maui Lani Village Center and other developments will increase traffic volume along the roadway in particular at the (2) intersection.

1. The increase in traffic volume causes the westbound shared left-turn/through movement to operate at LOS (E) during the (PM) peak.

2. It is likely that several of the accesses to the commercial site will be located near this intersection. Therefore, the projected increase in traffic will cause the intersection turning movements to increase and the intersection to operate at overcapacity conditions during both peak hours of traffic.

3. Based on the amount of development assumed for the Maui Lani development, this intersection is assumed to be constructed by year 2022. The intersection will most likely warrant a traffic signal.

With the assumed lane configuration, some movements will experience LOS F and overcapacity conditions during the AM(PM) peak hour of traffic due to the heavy volume along Maui Lani Parkway/Kuikahi Drive.
The heavy westbound left-turn and eastbound right-turn volumes are comprised of vehicles coming from the Kahului area headed towards the Wailuku area as well as Maui Lani Village and Kehalani Commercial area users and Maui Lani residents.
Approximately 35% of the volume on those movement are from the Maui Lani 100 VMX Affordable Housing Project.

LEGEND

##(##)	– AM(PM) PEAK HOUR OF TRAFFIC VOLUMES	(Y)	– INTERSECTION Y
X(X)	– AM(PM) LOS		– EXISTING LANE CONFIGURATION
*	– OVERCAPACITY, V/C >=1		– FUTURE LANE CONFIGURATION
(Y) C/D	– SIGNALIZED INTERSECTION Y, OVERALL AM/PM LOS		

WAIALE DEVELOPMENT

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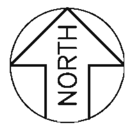
BASE YEAR 2022 LEVEL OF SERVICE AND LANE CONFIGURATION

FIGURE
6a



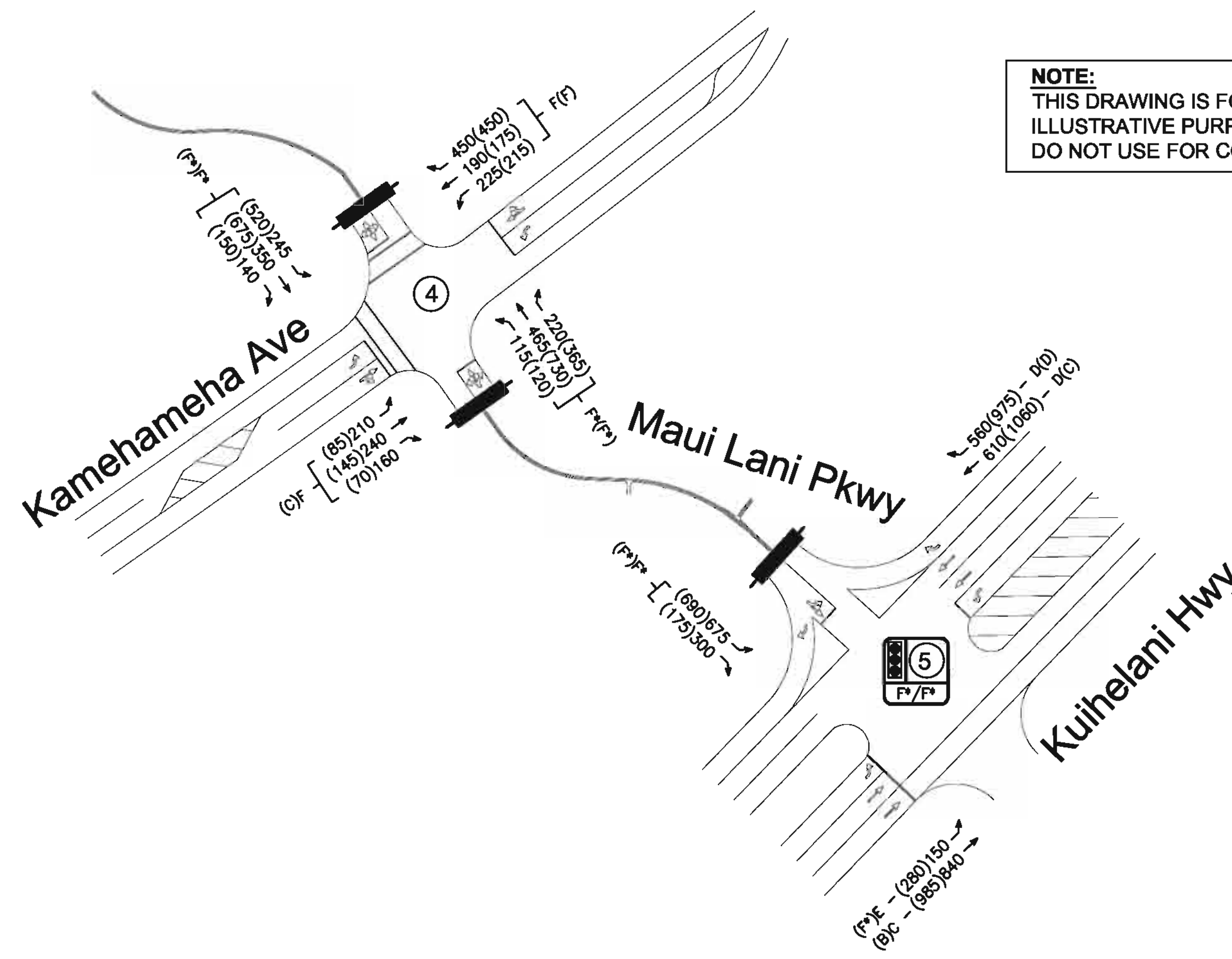
DISCUSSIONS:

Traffic volume at these intersections will increase due to the developments - residential as well as commercial - along Kuikahi Drive/Maui Lani Parkway. The traffic volume would also be comprised of cut-through traffic avoiding the congested areas along Kaahumanu Avenue to access the Wailuku and Kahului areas.

4. Without any improvements, the stop controlled intersection which currently operates with long delays will continue to operate at LOS F and overcapacity conditions on the majority of its movements.

5. Traffic volume along Kuihelani will close to double and along Maui Lani Parkway more than double.

   Therefore, the intersection would operate at LOS F and overcapacity conditions. The eastbound approach and northbound left-turn movement especially will experience long delays.



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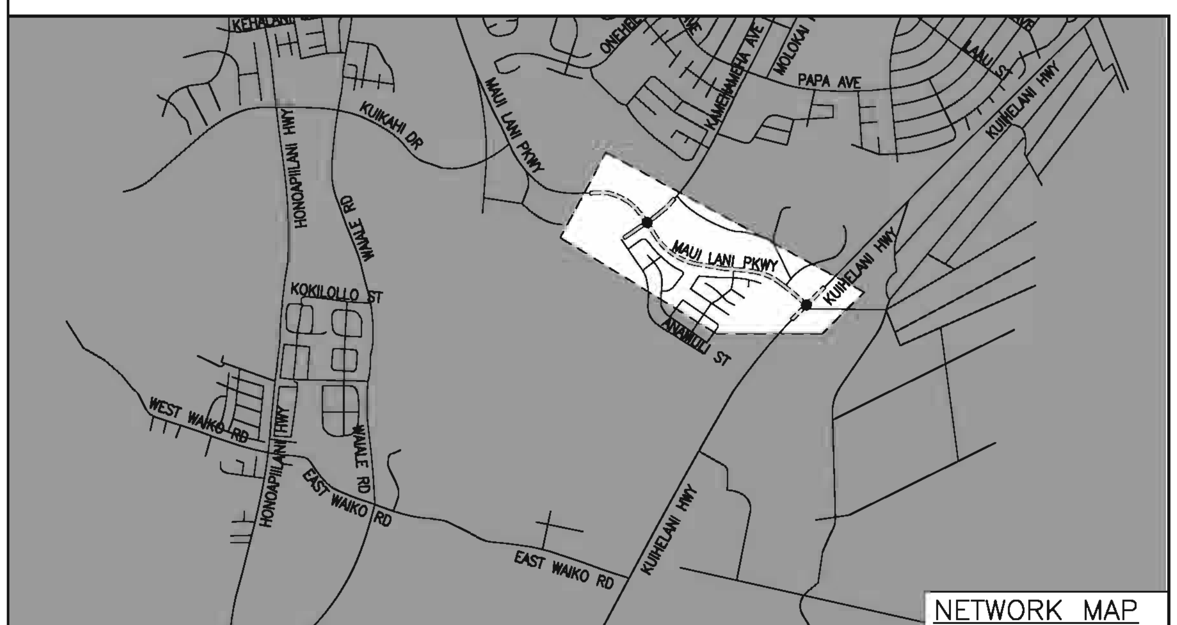

LEGEND

- ##(##) – AM(PM) PEAK HOUR OF TRAFFIC VOLUMES
- X(X) – AM(PM) LOS
- * – OVERCAPACITY, V/C >=1
- SIGNALIZED INTERSECTION Y, OVERALL AM/PM LOS
- (Y) – INTERSECTION Y
- EXISTING LANE CONFIGURATION
- FUTURE LANE CONFIGURATION

WAIALE DEVELOPMENT

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BASE YEAR 2022 LEVEL OF SERVICE AND LANE CONFIGURATION

FIGURE 6b

DISCUSSIONS:

6. By year 2022 the intersection would operate at LOS D or better on all approaches during the AM(PM) peak hours of traffic.

7. With the Waiale Road extension completed, the intersection will most likely warrant a traffic signal. The intersection will operate at LOS C or better with the assumed lane configuration.

8. The intersection will continue to operate at LOS D or better during both peak hours of traffic.

NOTE:
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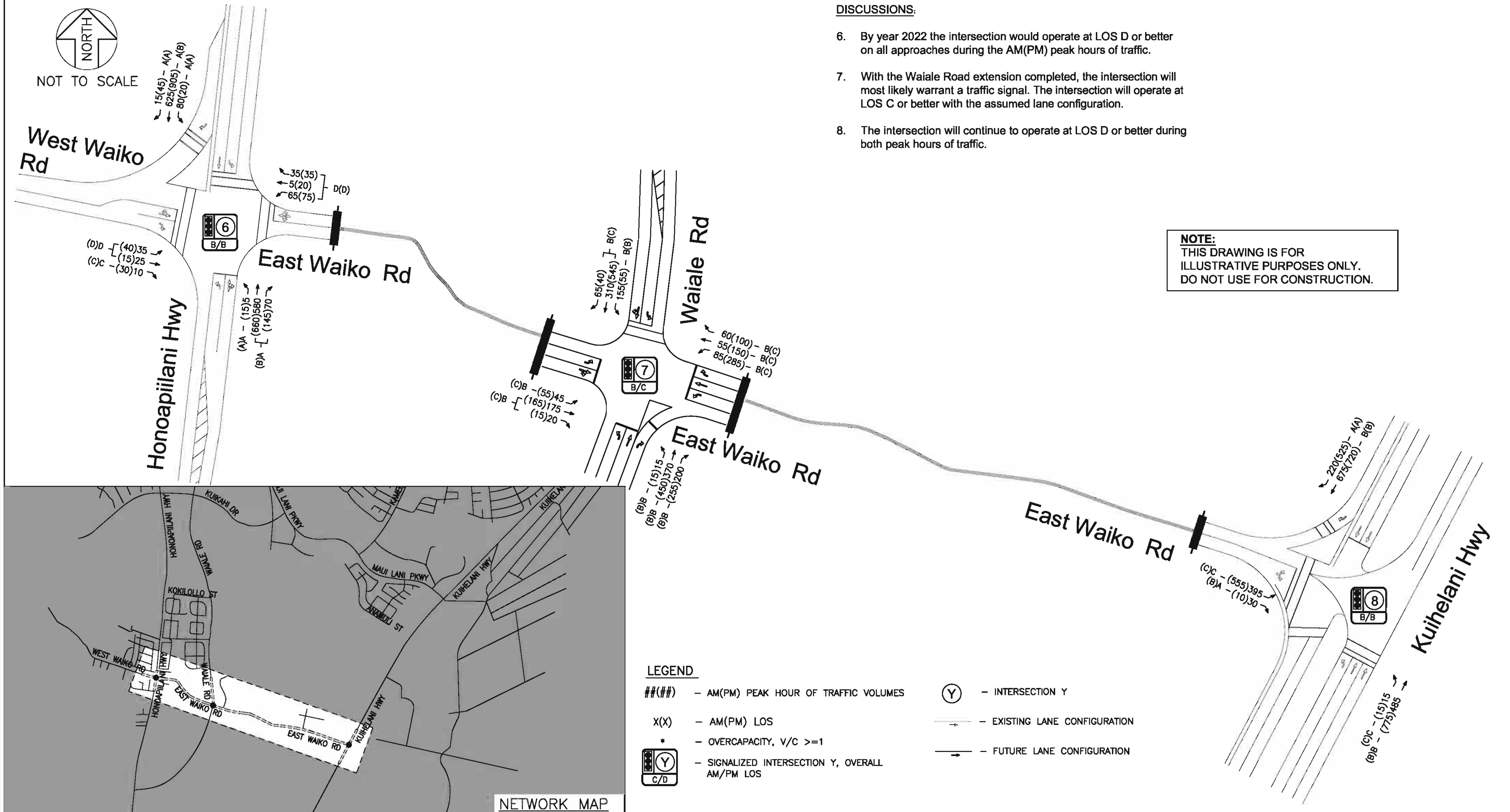

WAIALE DEVELOPMENT

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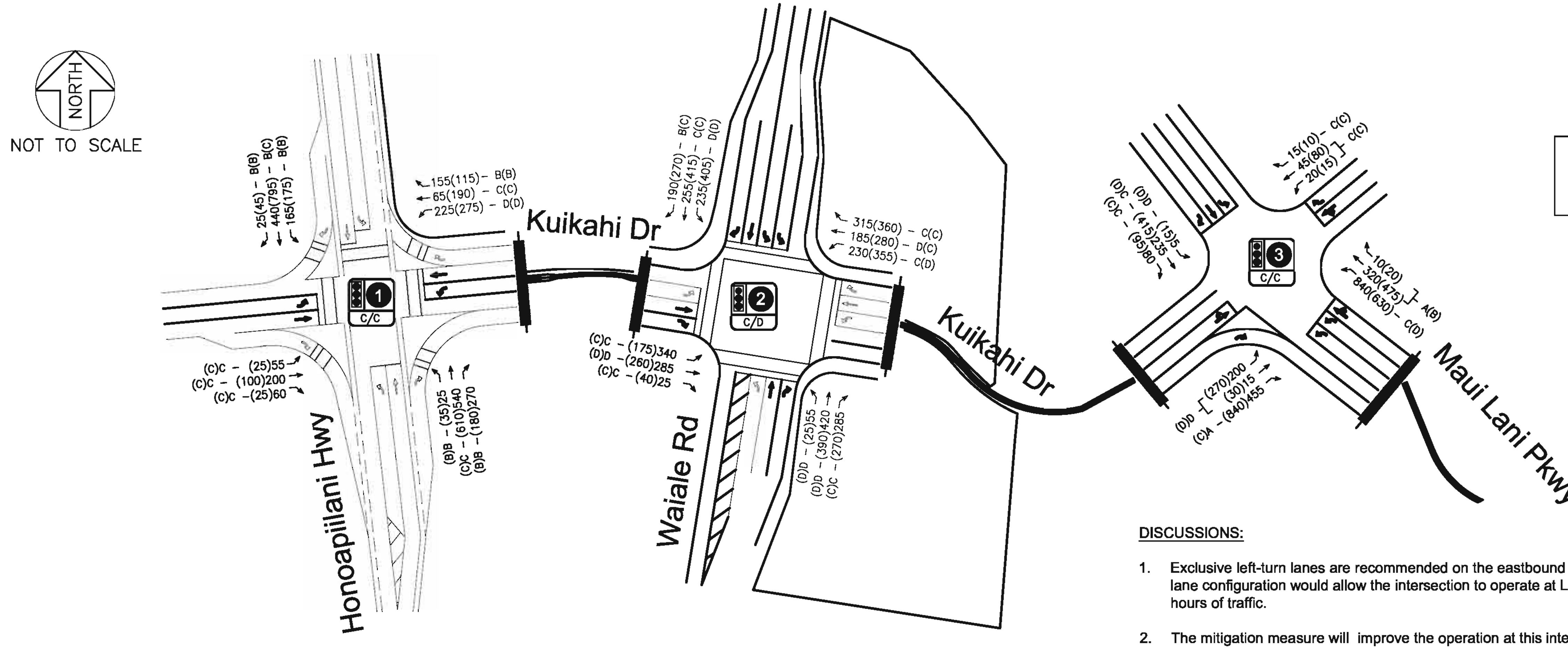
BASE YEAR 2022 LEVEL OF SERVICE AND LANE CONFIGURATION

FIGURE 6c



NOTE:
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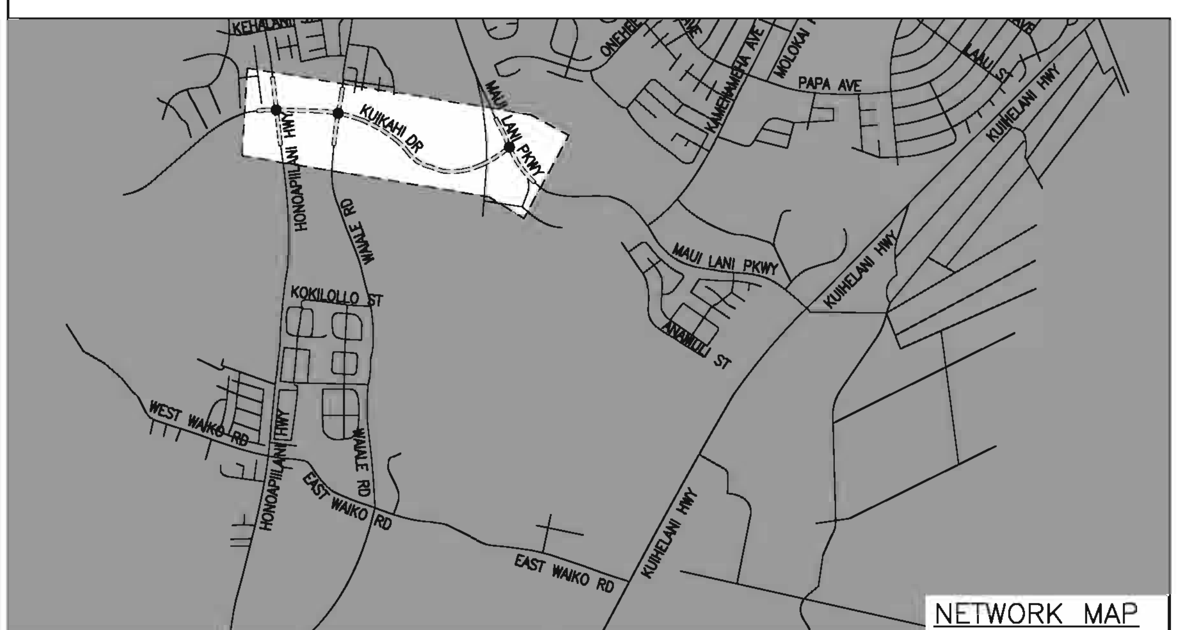
DISCUSSIONS:

1. Exclusive left-turn lanes are recommended on the eastbound and westbound approaches. This lane configuration would allow the intersection to operate at LOS D or better during both peak hours of traffic.

2. The mitigation measure will improve the operation at this intersection. However, ROW on the southbound approach may not be wide enough to provide the required left-turn pockets length. Short southbound left-turn pocket would affect traffic operations during the (PM) peak hour of traffic obstructing the southbound through and right-turn movements. Ultimately, Waiale Road north of the intersection may need to be widened to a four lane section especially with the Kehalani Commercial area developed due to the projected traffic volume.

   For both intersections 1 and 2 the westbound left-turn and eastbound left-turn respectively should be extended to the maximum extent possible - at least 300 feet or more - to reduce the left-turn impact on the through movement lane.

3. With the proposed mitigation measures, the intersection would operate at LOS D or better on all its movements during both peak hours of traffic.



NETWORK MAP

LEGEND

##(##)	– AM(PM) PEAK HOUR OF TRAFFIC VOLUMES
X(X)	– AM(PM) LOS
*	– OVERCAPACITY, V/C >=1
Y C/C	– SIGNALIZED INTERSECTION Y, OVERALL AM/PM LOS
Y	– INTERSECTION Y
Y	– INTERSECTION Y WITH RECOMMENDED IMPROVEMENTS
	– EXISTING LANE CONFIGURATION
	– BASE YEAR 2022 WITH MITIGATION LANE CONFIGURATION

WAIALE DEVELOPMENT

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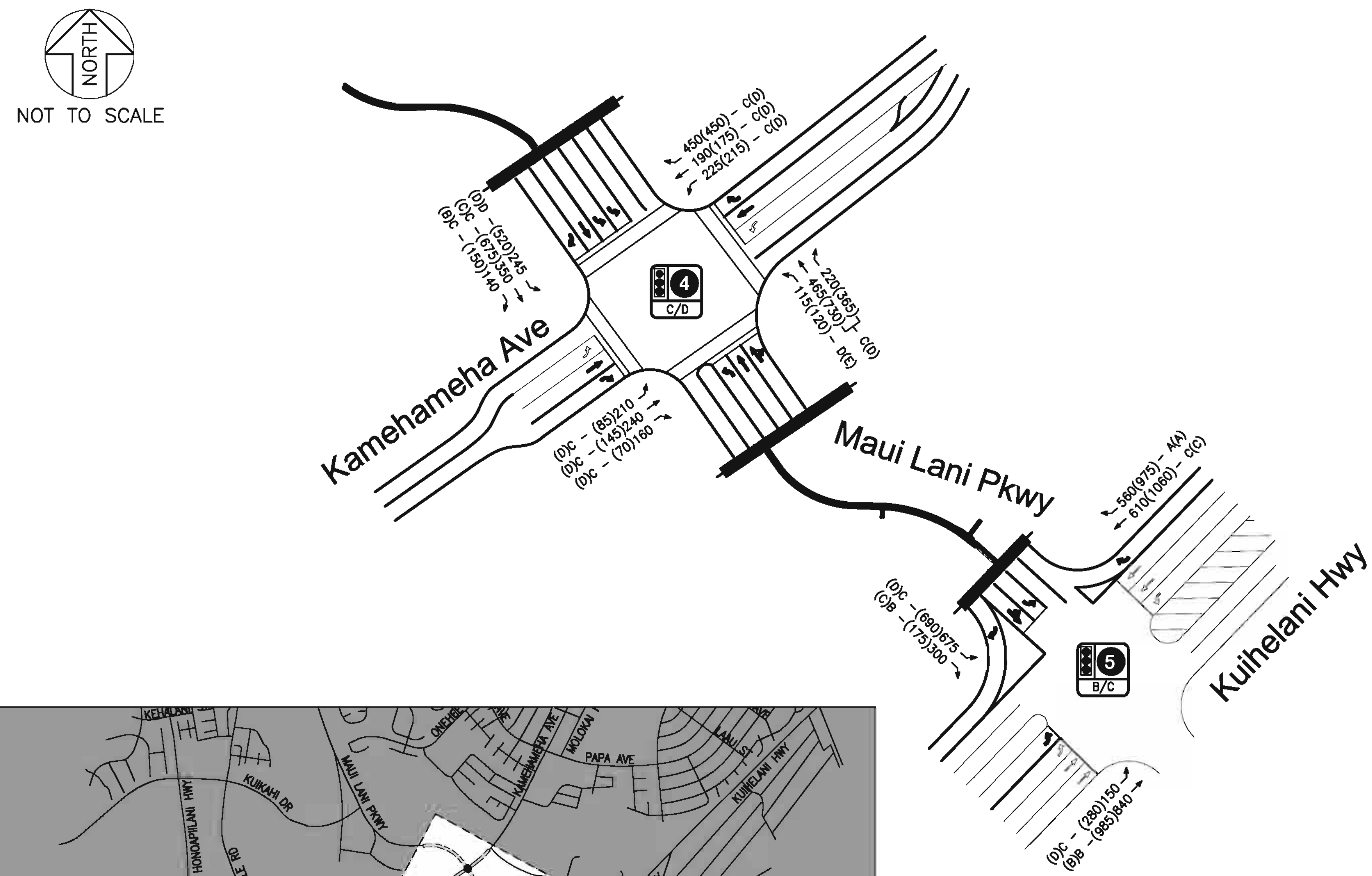
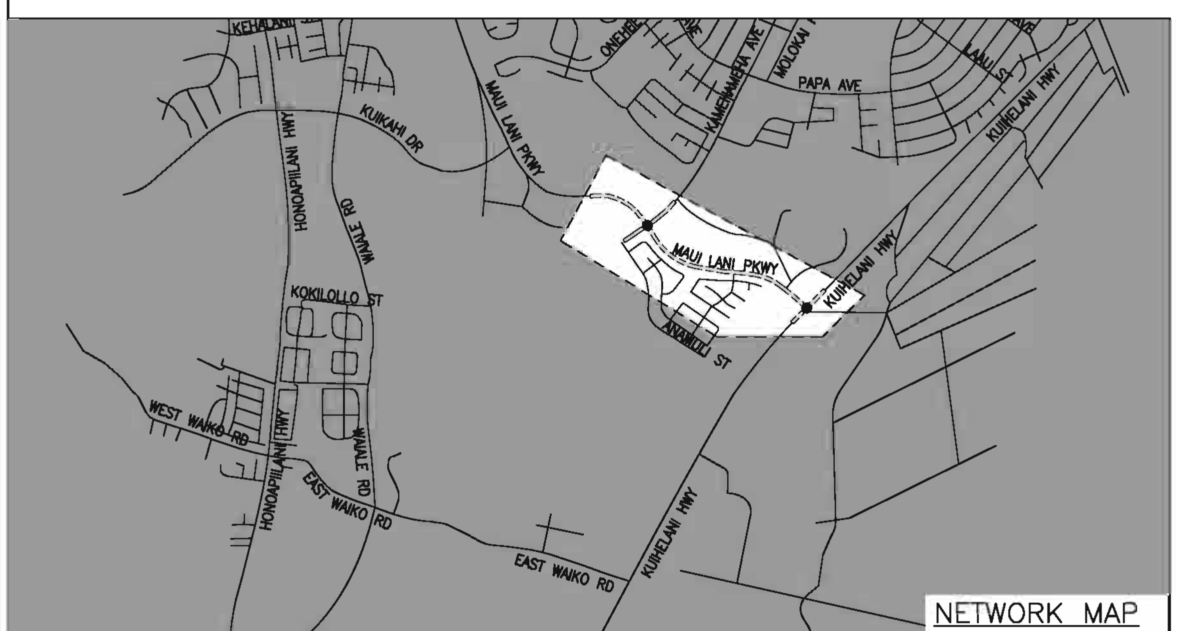
BASE YEAR 2022 WITH MITIGATIONS LEVEL OF SERVICE AND LANE CONFIGURATION

FIGURE 7a





NETWORK MAP

DISCUSSIONS:

As mentioned in the Base Year Analysis Kuikahi Dirve and Maui Lani Parkway would need to be widened to a four lane section between Honoapiilani Highway and Kuihelani Highway. Traffic volume projections show a volume of approximately 2,500 veh/hr during the (PM) peak hour of traffic - bi-directional - along this section of the roadway and therefore would impact driveways along Maui Lani Parkway

4. The widening of Kamehameha Avenue and Maui Lani Parkway along with the signal will improve traffic operations to LOS D or better during both peak hours of traffic except for westbound left-turn movement during the (PM) peak hour of traffic.

   Due to the heavy eastbound left-turn movement, one of the eastbound through lanes would terminate as a left-turn lane to accommodate the left-turn volume.

   Based on available information, it appears that there is enough ROW for the intersection improvements.
   Kamehameha Avenue north of the intersection could potentially be widened to four lanes all the way to Kuuhoa Street where is already is a four lane section.

5. The eastbound double left-turn will improve traffic operations from LOS F and overcapacity conditions to LOS D or better during both peak hours of traffic.

   The increased traffic volume from Kuihelani Highway onto Maui Lani Parkway would impact driveways along Maui Lani Parkway between its intersection with Kamehameha Avenue and Kuihelani Highway. Providing two westbound lanes along Maui Lani Parkway would improve the delay at the driveways and allow northbound double left-turn lanes.

   Note that although a westbound approach exists, the volume on this approach would remain low and therefore, the intersection would operate as a "tee"-intersection.

NOTE:
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LEGEND

- ##(##) – AM(PM) PEAK HOUR OF TRAFFIC VOLUMES
- X(X) – AM(PM) LOS
- * – OVERCAPACITY, V/C >=1
- C/C (Y) – SIGNALIZED INTERSECTION Y, OVERALL AM/PM LOS
- (Y) – INTERSECTION Y
- (Y) – INTERSECTION Y WITH RECOMMENDED IMPROVEMENTS
- – EXISTING LANE CONFIGURATION
- – BASE YEAR 2022 WITH MITIGATION LANE CONFIGURATION

WAIALE DEVELOPMENT	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS,SURVEYORS • HONOLULU,HAWAII	FIGURE
	BASE YEAR 2022 WITH MITIGATIONS LEVEL OF SERVICE AND LANE CONFIGURATION	7b

Table 4: Existing, Base Year 2022 and Base Year 2022 with Mitigation Measures Level of Service Summary

Intersection	Existing 2010						Base Year 2022						Base Year 2022 with Mitigation Measures					
	AM			PM			AM			PM			AM			PM		
	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
													Approach Modified from Existing: EB & WB: LT, TH and RT					
Kuikahi Drive & Honoapiilani Highway																		
EB LT													22	0.14	C	27	0.09	C
EB TH													23	0.37	C	28	0.2	C
EB LT/TH	18	0.37	B	15	0.14	B	25	0.48	C	28	0.27	C						
EB RT	10	0.03	B	9	0.01	A	14	0.06	B	20	0.02	C	21	0.04	C	21	0.02	C
WB LT													35	0.75	D	48	0.83	D
WB TH													22	0.12	C	29	0.39	C
WB LT/TH	31	0.79	C	34	0.85	C	49	0.87	D	74	**0.98**	**E**						
WB RT	11	0.08	B	9	0.05	A	14	0.11	B	17	0.1	B	14	0.11	B	17	0.08	B
NB LT	11	0.05	B	13	0.12	B	17	0.08	B	31	0.42	C	13	0.07	B	18	0.26	B
NB TH	18	0.59	B	20	0.55	B	32	0.77	C	42	0.84	D	24	0.73	C	26	0.75	C
NB RT	14	0.23	B	16	0.15	B	20	0.23	C	23	0.13	C	16	0.23	B	15	0.12	B
SB LT	11	0.3	B	13	0.24	B	25	0.7	C	42	0.81	D	14	0.56	B	16	0.59	B
SB TH	16	0.46	B	24	0.71	C	23	0.59	C	55	**0.97**	D	18	0.55	B	29	0.86	C
SB RT	12	0.01	B	14	0.03	B	16	0.02	B	18	0.04	B	12	0.02	B	11	0.03	B
Overall	18	0.65	B	22	0.67	C	28	0.85	C	48	**0.93**	D	21	0.77	C	27	0.85	C
Kuikahi Drive & Waiale Road																		
													Approach Modified from Existing: NB: LT, TH and RT SB: Double LT, TH and RT EB : LT, TH and RT					
EB LT	84	**1.07**	**F***	17	0.56	B	41	0.85	D	38	0.66	D	31	0.81	C	31	0.53	C
EB TH													37	0.72	D	51	0.79	D
EB TH/RT	21	0.35	C	20	0.32	C	49	0.78	D	58	0.79	**E**						
EB RT													26	0.03	C	34	0.06	C
WB LT	23	0.16	C	22	0.19	C	39	0.72	D	**114**	**1.1**	**F***	34	0.72	C	45	**0.9**	D
WB TH	28	0.43	C	28	0.51	C	47	0.64	D	50	0.7	D	37	0.61	D	33	0.57	C
WB RT	26	0.18	C	25	0.11	C	40	0.28	D	46	0.58	D	31	0.22	C	29	0.25	C
NB LT	18	0.13	B	22	0.09	C	25	0.2	C	32	0.21	C	41	0.43	D	55	0.47	D
NB TH													36	0.8	D	43	0.81	D
NB TH/RT	32	0.73	C	26	0.46	C	**328**	**1.62**	**F***	**278**	**1.5**	**F***						
NB RT													23	0.2	C	28	0.19	C
SB LT	14	0.34	B	15	0.46	B	42	0.81	D	**181**	**1.26**	**F***	39	0.6	D	55	0.85	D
SB TH													22	0.42	C	26	0.6	C
SB TH/RT	21	0.5	C	23	0.63	C	26	0.63	C	44	**0.9**	D						
SB RT													20	0.13	B	20	0.18	C
Overall	38	0.81	D	22	0.57	C	**111**	**1.1**	**F***	**118**	**1.23**	**F***	31	0.79	C	37	0.83	D

Note: * = overcapacity conditions

Table 4: Existing, Base Year 2022 and Base Year 2022 with Mitigation Measures Level of Service Summary Cont'd

	Existing 2010						Base Year 2022						Base Year 2022 with Mitigation Measures					
	AM			PM			AM			PM			AM			PM		
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
Kuikahi Drive & Maui Lani Parkway																		
							Approach Modified from Existing: NB: LT and shared TH/RT SB: LT shared TH/RT EB: LT, TH and RT WB: TH and shared LT/RT						Approach Modified from Existing: NB: Double LT and shared TH/RT SB: LT, TH and RT EB: shared LT/TH and channelized RT WB: shared LT/TH and RT					
EB LT							63	0.8	E	233	1.34	F*						
EB TH							40	0.04	D	43	0.1	D						
EB LT/TH													50	0.82	D	43	0.82	D
EB RT							10	0.4	B	40	**0.93**	D	7	0.31	A	28	0.89	C
WB LT/TH							41	0.2	D	46	0.34	D	29	0.2	C	25	0.19	C
WB RT							39	0.01	D	42	0.01	D	27	0.01	C	23	0.01	C
NB LT							85	1.09	F*	65	**0.99**	E	26	0.71	C	51	**0.9**	D
NB TH/RT							10	0.3	A	10	0.44	B	10	0.33	A	18	0.58	B
SB LT							35	0.02	C	26	0.05	C	49	0.22	D	53	0.39	D
SB TH													34	0.6	C	40	0.81	D
SB TH/RT							51	0.76	D	57	**0.91**	E						
SB RT													27	0.05	C	25	0.13	C
Overall							50	1	D*	62	**0.99**	E	23	0.71	C	35	0.89	C
Maui Lani Parkway & Kamehameha Avenue																		
													Approach Modified from Existing: NB & SB: LT, TH and RT EB: Double LT, TH and RT WB: LT, TH and shared TH/RT					
EB LT													37	0.56	D	50	0.83	D
EB TH													29	0.67	C	29	0.81	C
EB LT/TH/RT	41	0.83	E	57	**0.95**	F	523	2.1	F*	1171	3.55	F*						
EB RT													22	0.18	C	16	0.17	B
WB LT													40	0.58	D	60	0.71	E
WB TH/RT													30	0.71	C	37	0.86	D
WB LT/TH/RT	45	0.86	E	71	1.01	F*	596	2.26	F*	989	3.15	F*						
NB LT													24	0.53	C	39	0.38	D
NB TH													33	0.63	C	45	0.56	D
NB LT/TH/RT	25	0.39	C	15	0.11	B	86	0.64	F	22	0.26	C						
NB RT													27	0.17	C	40	0.05	D
SB LT													25	0.63	C	54	0.82	D
SB TH													30	0.48	C	41	0.53	D
SB LT/TH/RT	39	0.51	E	23	0.38	C	288	0.69	F	235	0.62	F						
SB RT													32	0.59	C	43	0.58	D
Overall	37	0	E	47	0	E	386	0	F	806	0	F	30	0.6	C	39	0.82	D

Note: * = overcapacity conditions

Table 4: Existing, Base Year 2022 and Base Year 2022 with Mitigation Measures Level of Service Summary Cont'd

	Existing 2010						Base Year 2022						Base Year 2022 with Mitigation Measures					
	AM			PM			AM			PM			AM			PM		
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
Maui Lani Parkway & Kuihelani Highway																		
													Approach Modified from Existing: EB: LT, shared LT/THand RT					
EB LT													21	0.58	C	42	0.76	D
EB LT/RT	22	0.74	C	25	0.68	C												
EB LT/TH													21	0.58	C	42	0.76	D
EB LT/TH/RT							205	1.36	F*	455	1.89	F*						
EB RT													18	0.4	B	30	0.28	C
NB LT	12	0.21	B	9	0.33	A	58	0.68	E	335	1.57	F*	32	0.38	C	46	0.61	D
NB TH	13	0.34	B	9	0.28	A												
NB TH/RT							25	0.57	C	13	0.49	B	15	0.55	B	13	0.51	B
SB TH	22	0.49	C	20	0.56	B	40	0.66	D	28	0.7	C	25	0.64	C	30	0.79	C
SB RT	20	0.16	B	17	0.25	B	36	0.38	D	35	0.8	D	1	0.38	A	2	0.67	A
Overall	19	0.63	B	17	0.57	B	87	1.02	F*	136	1.26	F*	17	0.63	B	23	0.72	C
West Waiko Road/East Waiko Road & Honoapiilani Highway																		
EB LT/TH	47.4	0.39	D	33.4	0.31	C	40.5	0.35	D	38.2	0.29	D	40.5	0.35	D	38.2	0.29	D
EB RT	39.7	0.01	D	26.2	0.02	C	33.2	0.01	C	30.9	0.02	C	33.2	0.01	C	30.9	0.02	C
WB LT/TH/RT	61.6	0.69	E	34.7	0.48	C	49.8	0.66	D	52.4	0.72	D	49.8	0.66	D	52.4	0.72	D
NB LT	3.8	0.01	A	3.9	0.03	A	4.9	0.01	A	9.8	0.07	A	4.9	0.01	A	9.8	0.07	A
NB TH/RT	8	0.52	A	7.4	0.48	A	9.8	0.56	A	12.4	0.7	B	9.8	0.56	A	12.4	0.7	B
SB LT	3.7	0.15	A	6.6	0.03	A	4.9	0.18	A	7.4	0.07	A	1.2	0.18	A	3	0.07	A
SB TH	5.7	0.42	A	9.1	0.5	A	7.8	0.51	A	15.2	0.77	B	3.3	0.51	A	11.2	0.77	B
SB RT	3.3	0.01	A	8.1	0.03	A	4.1	0.01	A	5.2	0.04	A	0.3	0.01	A	1.5	0.04	A
Overall	11.6	0.56	B	11	0.44	B	12.7	0.58	B	17	0.75	B	10.7	0.58	B	15.1	0.75	B
East Waiko Road & Waiale Road																		
EB LT							14.1	0.12	B	20.3	0.16	C	12	0.17	B	14.6	0.14	B
EB LT/TH	1.9	0.03	A	4.2	0.04	A												
EB TH/RT							17.7	0.45	B	27.9	0.52	C	13.6	0.5	B	15.6	0.29	B
WB LT							13.3	0.23	B	21.2	0.68	C	13.1	0.37	B	24.6	0.72	C
WB TH							15	0.12	B	23	0.34	C	11.8	0.15	B	15.2	0.24	B
WB RT							14.6	0.04	B	21.1	0.07	C	11.4	0.04	B	14.1	0.07	B
NB LT							11.5	0.06	B	13.3	0.11	B	5.4	0.04	A	10.4	0.08	B
NB TH							15.7	0.6	B	18.2	0.62	B	7.2	0.47	A	14.2	0.57	B
NB RT							12.1	0.18	B	13.5	0.17	B	5.8	0.14	A	10.8	0.18	B
SB LT							17.8	0.6	B	14.2	0.23	B	7	0.38	A	11.1	0.19	B
SB LT/RT	11.3	0.25	B	10.4	0.11	B												
SB TH/RT							16	0.61	B	25	0.81	C	7.3	0.48	A	18.5	0.74	B
Overall	5.5	0.317	A	3.4	0	A	15.5	0.52	B	21.1	0.79	C	8.5	0.49	A	16.5	0.74	B

Note: * = overcapacity conditions

Table 4: Existing, Base Year 2022 and Base Year 2022 with Mitigation Measures Level of Service Summary Cont'd

	Existing 2010						Base Year 2022						Base Year 2022 with Mitigation Measures					
	AM			PM			AM			PM			AM			PM		
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
East Waiko Road & Kuihelani Highway																		
EB LT	15.1	0.56	B	16.9	0.37	B	26.8	0.83	C	32.1	0.86	C	23.8	0.79	C	31.1	0.85	C
EB RT	8.4	0.02	A	11.8	0.01	B	9.3	0.03	A	11.1	0.01	B	9.5	0.03	A	10.8	0.01	B
NB LT	20.7	0.17	C	24.6	0.4	C	31.1	0.21	C	33.9	0.31	C	33.7	0.31	C	33.7	0.32	C
NB TH	5.7	0.2	A	4.2	0.26	A	10.9	0.31	B	11.3	0.47	B	11.8	0.32	B	11.4	0.47	B
SB TH	9.6	0.34	A	6.9	0.31	A	17.3	0.56	B	15.4	0.53	B	17.7	0.55	B	15.5	0.53	B
SB RT	1.2	0.07	A	1	0.1	A	1.1	0.14	A	1.3	0.32	A	0.9	0.14	A	1.2	0.3	A
Overall	8.9	0.45	A	6.1	0.35	A	16.4	0.7	B	14.8	0.71	B	16	0.69	B	14.9	0.71	B

Note: * = overcapacity conditions

IV. YEAR 2022 WITH PROJECT

The Project will consist of approximately 1,420 single-family and 1,130[11] multi-family dwellings as well as 230,000 square feet (sq ft) of commercial, 250,000 sq ft of Village Mixed Used (VMX), 175,000 sq ft of light industrial and a middle school[12].

A. Trip Generation

The institute of Transportation Engineers (ITE) publishes a book based on 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, 8th Edition, provides trip rates and/or formulae based on graphs that correlate vehicular trips (Y axis) with independent variables (X axis). The independent variable can range from Dwelling Units (DU) for single-family attached homes to Gross Floor Area (GFA) for commercial or office 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 Project.

Table 5 summarizes the land use and corresponding trip rates/formulae. Table 6 summarizes the AM(PM) peak hours of traffic trip generation for the Project.

[11] Including the VMX dwellings.

[12] The size of the middle school was determined based on the sizes of other schools in the area.

Table 5: Trip Generation Rates

Land Use (ITE Code)	Independent Variable	AM Peak hour of traffic		PM Peak hour of traffic	
		Trips Rate	% Entering	Trips Rate	% Entering
Single Family (210)	Dwelling Units	a	25%	b	63%
Multi-Family (230)	Dwelling Units	c	17%	d	67%
Commercial (820)	1,000 Sq. Ft. GFA	e	61%	f	49%
Village Mixed Use (815) AM and (814) PM	1,000 Sq. Ft. GFA	1.06	68%	g	44%
General Industrial (130)	1,000 Sq. Ft. GFA	h	82%	i	21%
Middle School (522)	Students	0.54	55%	0.16	49%

[a] T=0.7 * x + 9.74
[b] T=EXP (0.9 * LN(x) + 0.51)
[c] T= EXP (0.8*LN(x) + 0.26)
[d] T = EXP (0.82*LN(x) + 0.32)
[e] T = EXP (0.59 * LN(x) + 2.32)
[f] T = EXP (0.67 * LN(x) + 3.37)
[g] T = 2.4*x+21.48
[h] 0.78 LN(X) + 2.89
[i] 0.72 LN(X) + 3.14

where X is the independent variable and T the number of trips
DU = Dwelling Units
GFA = Gross Floor Area

Source: Trip Generation, 8th Edition, Institute of Transportation Engineers (2008).

Table 6: Year 2022 with Project Trip Generation

Land Use (ITE Code)	Independent Variable	AM Peak hour of traffic		PM Peak hour of traffic	
		Enter (vph)	Exit (vph)	Enter (vph)	Exit (vph)
Single Family (210)	1,420 (DU)	253	760	750	441
SF	*1,240 (DU)*	*219*	*658*	*638*	*375*
County SF	*180 (DU)*	*34*	*102*	*112*	*66*
Multi-Family (230)	1,130 (DU)	76	364	352	174
MF	*481 (DU)*	*31*	*151*	*147*	*72*
VMX MF	*529 (DU)*	*34*	*163*	*158*	*78*
County MF	*120 (DU)*	*11*	*50*	*47*	*24*
Commercial (820)	230,000 (GFA)	154	99	545	567
Village Mixed Use (815) AM and (814) PM	250,000 (GFA)	181	85	274	349
General Industrial (130)	175,000 (GFA)	131	29	38	140
Middle School (522)	820 (Students)	244	199	64	67
Total		***1,039***	***1,536***	***2,024***	***1,738***
Internal Capture	N/A	-	-	164	164
Diverted Link Trip	N/A	-	-	82	82
TOTAL		**1,039**	**1,536**	**1,778**	**1,492**

B. Trip Distribution

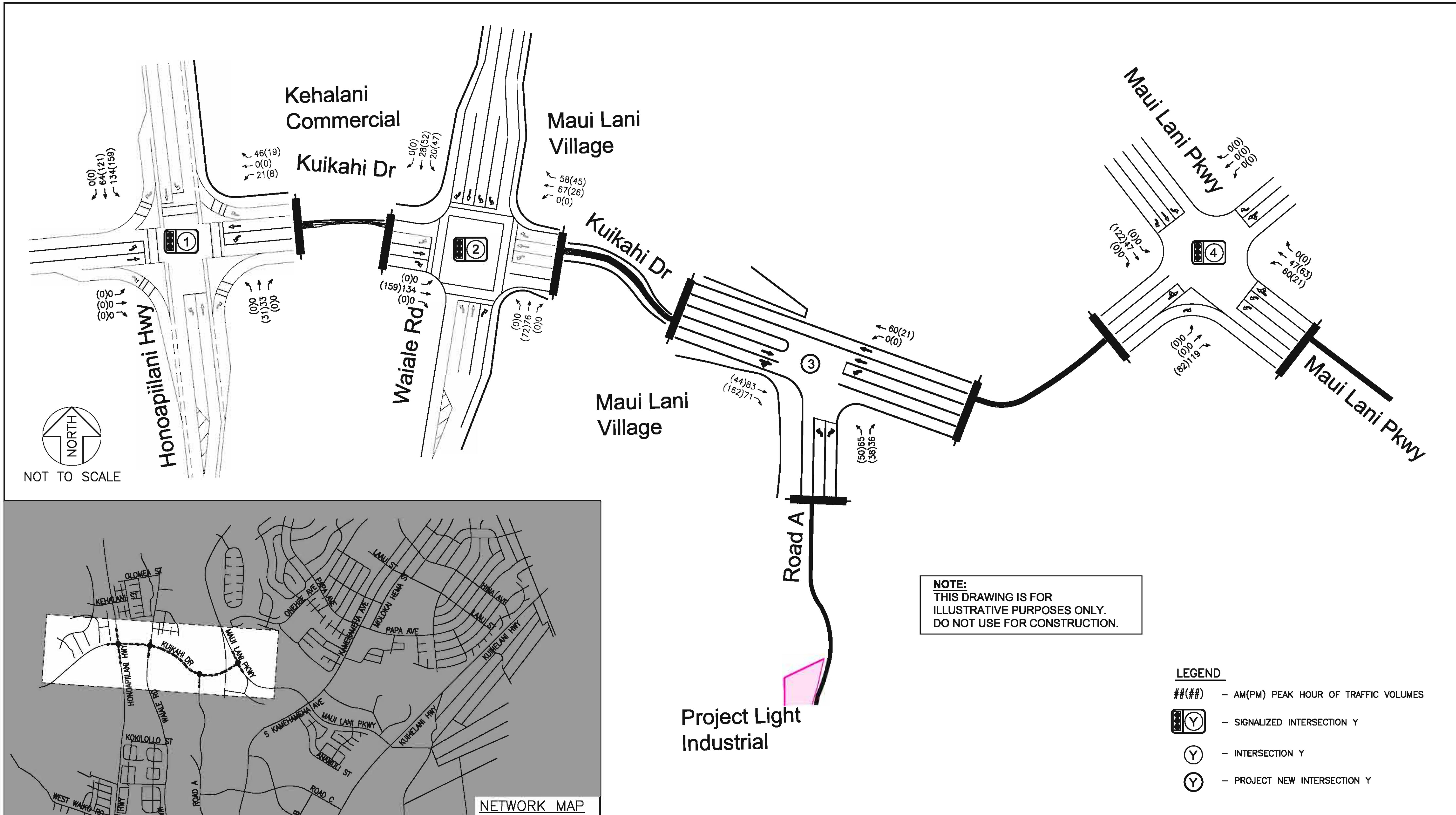
Trips generated by the Project were assigned onto the network based on the future employment zones. Similar to Figure 4 in Section III, trips were assigned to the four (4) major employment areas as follows:

- Kahului/Hana/Upcountry at 35 percent
- Wailuku at 30 percent
- Lahaina/West Maui at 20 percent
- Kihei /South Maui at 15 percent

The project is planned as a mixture of housing, commercial, industrial and school land uses. The multi-use of the Project is aimed at providing close proximity between these land uses to reduce the amount of external trips.

The Institute of Transportation Engineers, Trip Generation Handbook second edition (2004) provides internal capture rates for multi-use developments for the (PM) peak hour of traffic only. Rates provided for retail to/from retail and retail to/from residential were applied. Overall, the internal capture was assumed to account for less than 10 percent of the total Project generated entering and exiting trips during the PM peak hour of traffic. Internal capture was not applied to AM peak hour traffic.

Diverted linked trips were also assumed to occur for 4 percent of the trips generated by the Project during the PM peak hour of traffic. This is where commercial trips are considered existing trips (i.e. on Kuihelani Highway) that make intermediate stops at commercial land uses on their way to their final destinations.



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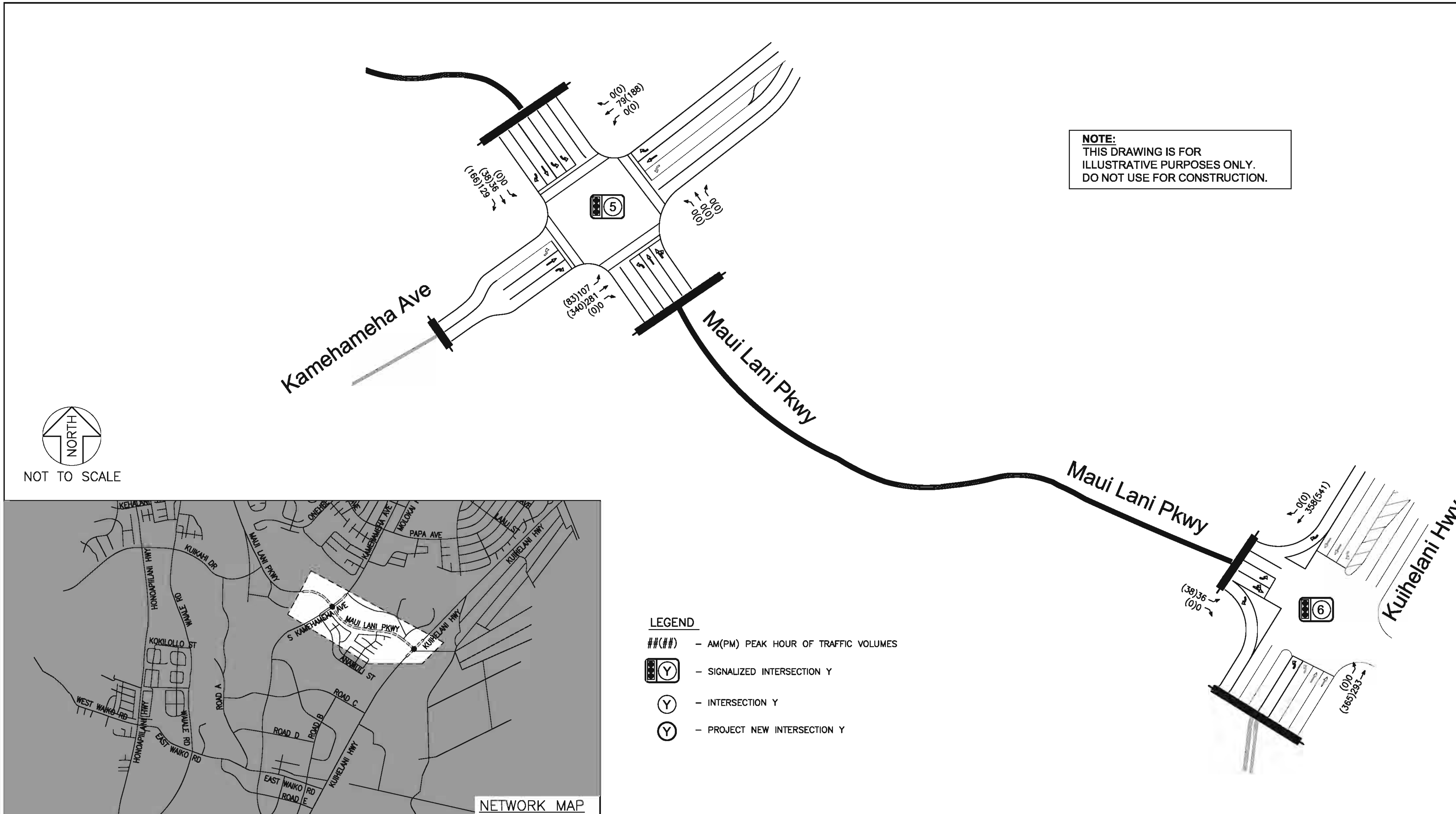
	PROJECT VOLUME ONLY	8a



WAIALE DEVELOPMENT

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PROJECT VOLUME ONLY

FIGURE 8b

LEGEND

##(##) – AM(PM) PEAK HOUR OF TRAFFIC VOLUMES

(Y) – SIGNALIZED INTERSECTION Y

(Y) – INTERSECTION Y

(Y) – PROJECT NEW INTERSECTION Y

NOTE:
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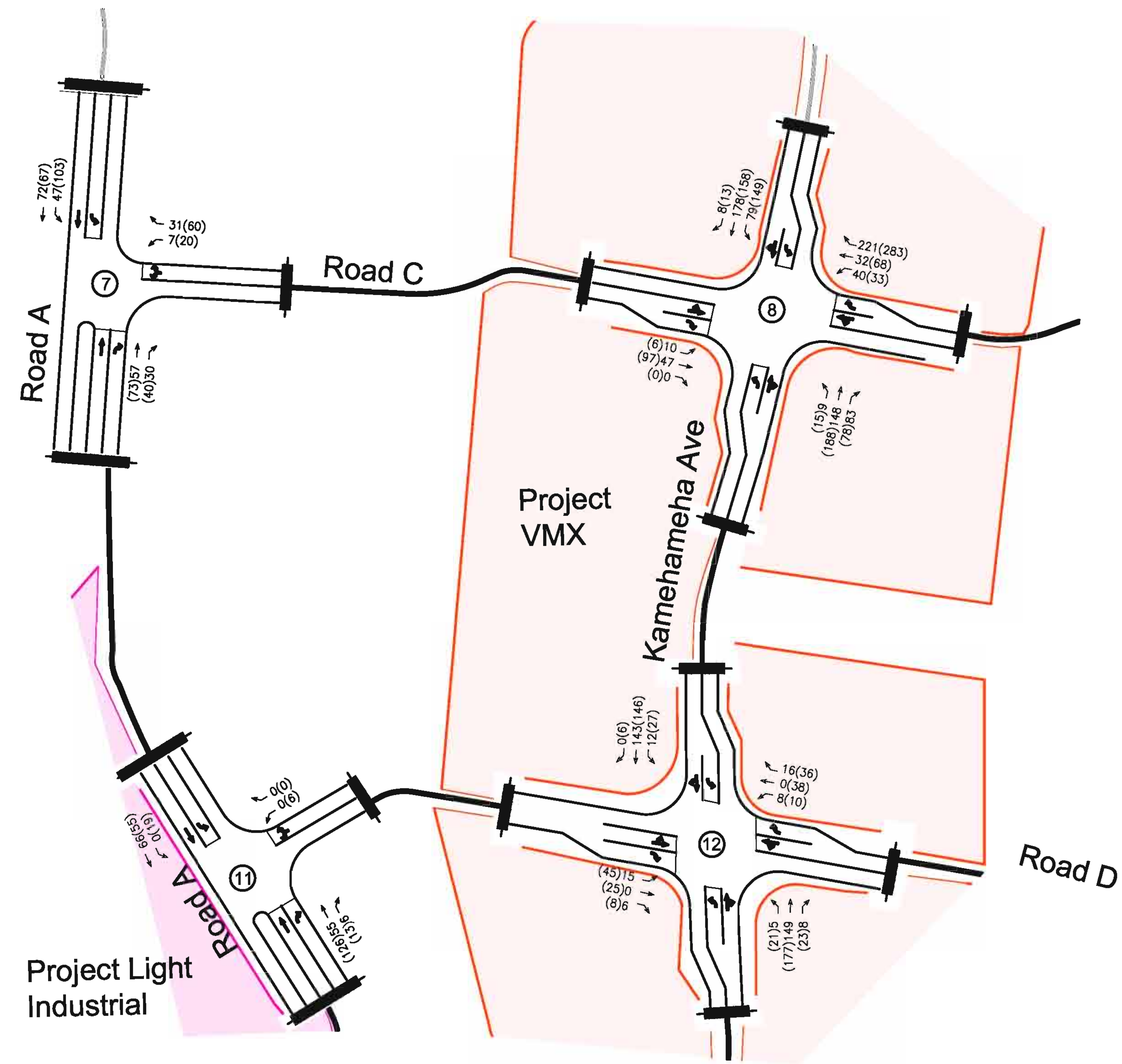
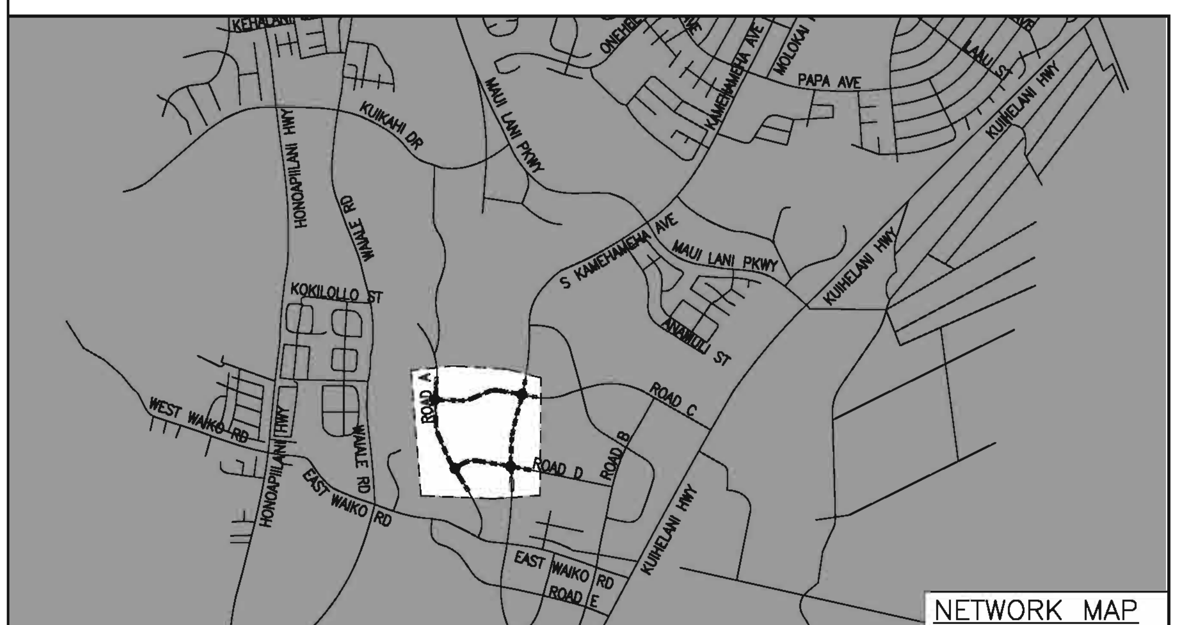
NORTH

NOT TO SCALE





NETWORK MAP

WAIALE DEVELOPMENT

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PROJECT VOLUME ONLY

FIGURE 8c

LEGEND

##(##) – AM(PM) PEAK HOUR OF TRAFFIC VOLUMES

– SIGNALIZED INTERSECTION Y

(Y) – INTERSECTION Y

(Y) – PROJECT NEW INTERSECTION Y

NOTE:
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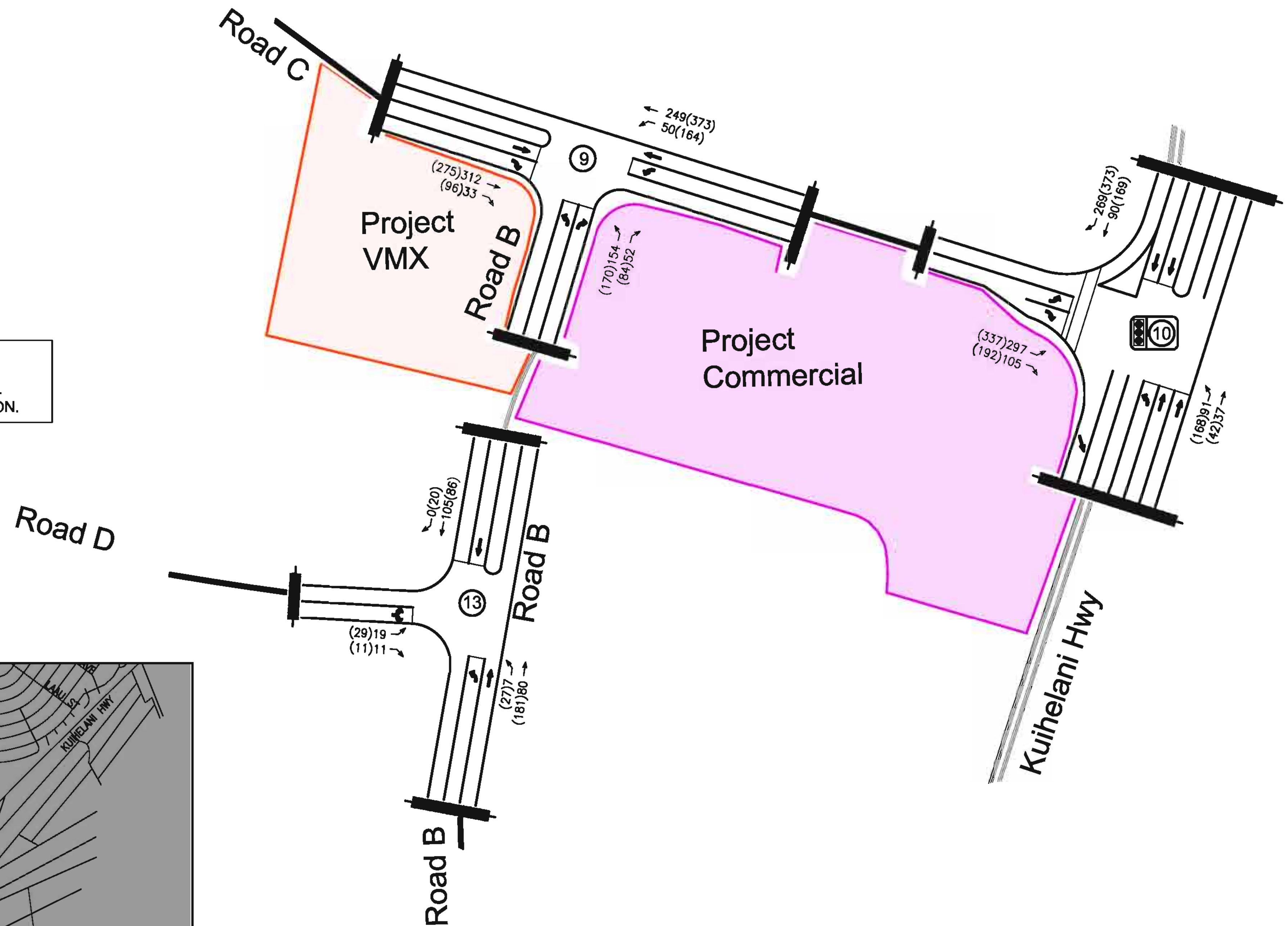

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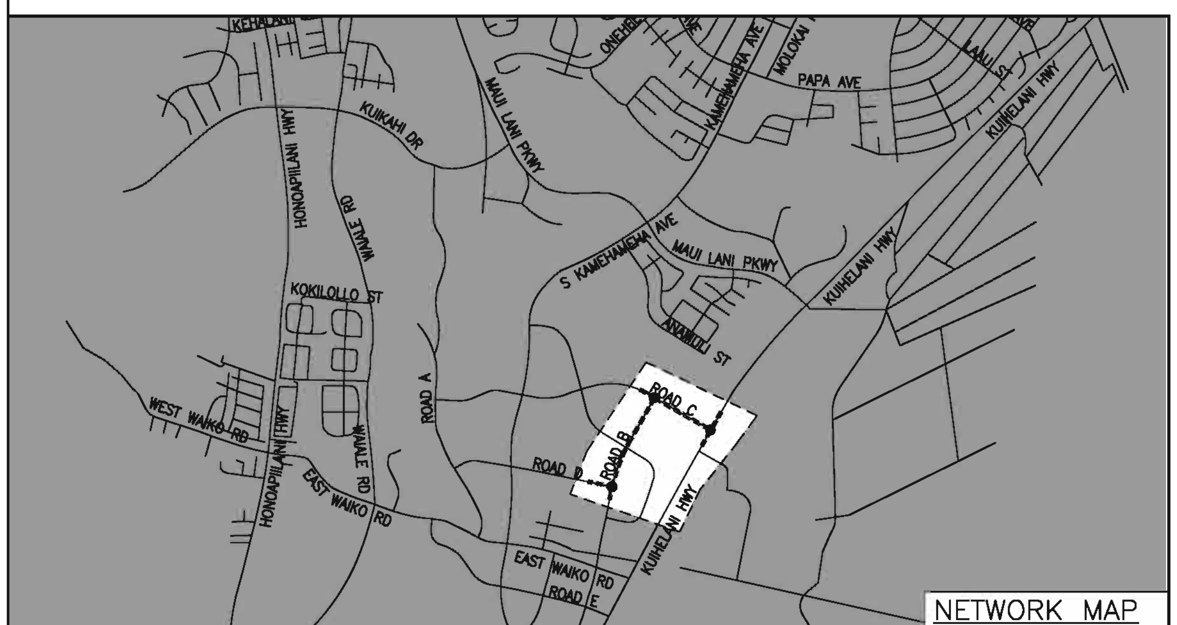
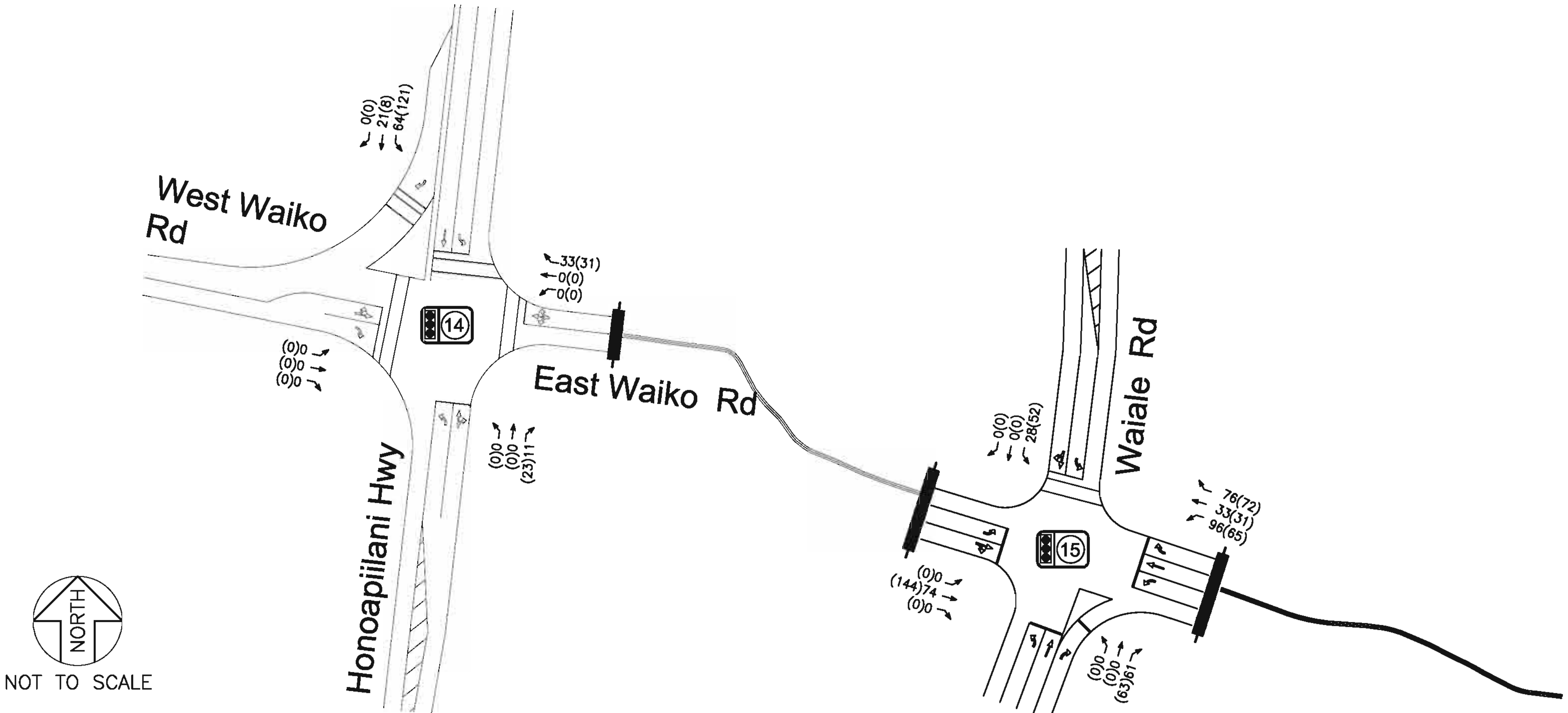


WAIALE DEVELOPMENT	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS • HONOLULU, HAWAII	FIGURE
	PROJECT VOLUME ONLY	8d



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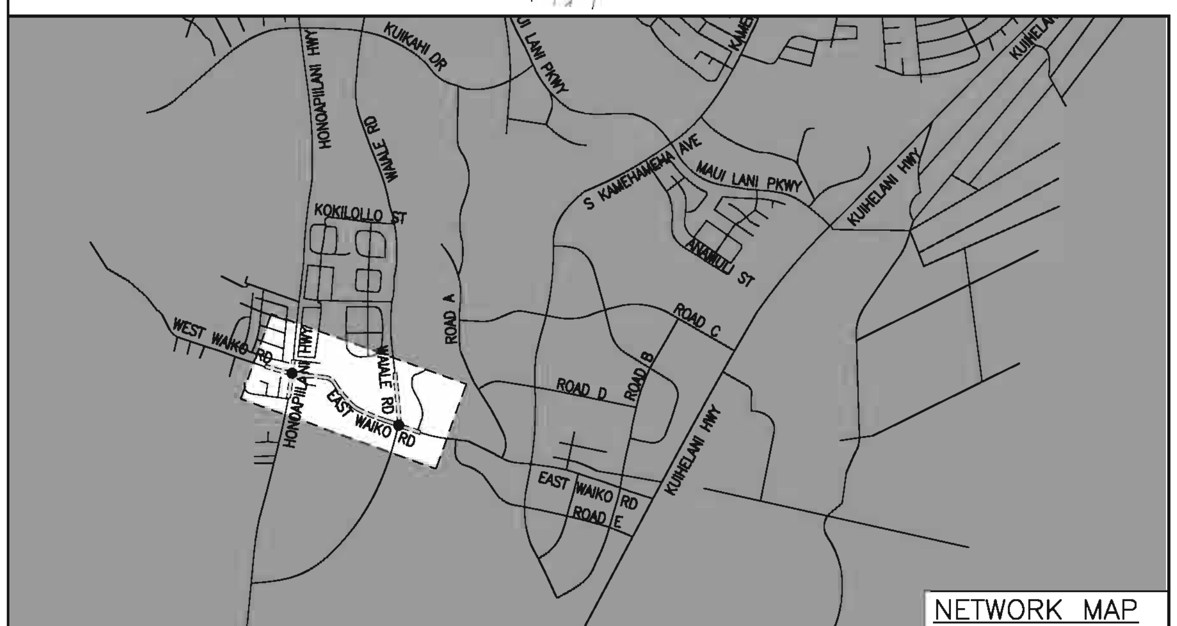


LEGEND

##(##) – AM(PM) PEAK HOUR OF TRAFFIC VOLUMES

(Y) – SIGNALIZED INTERSECTION Y

(Y) – INTERSECTION Y

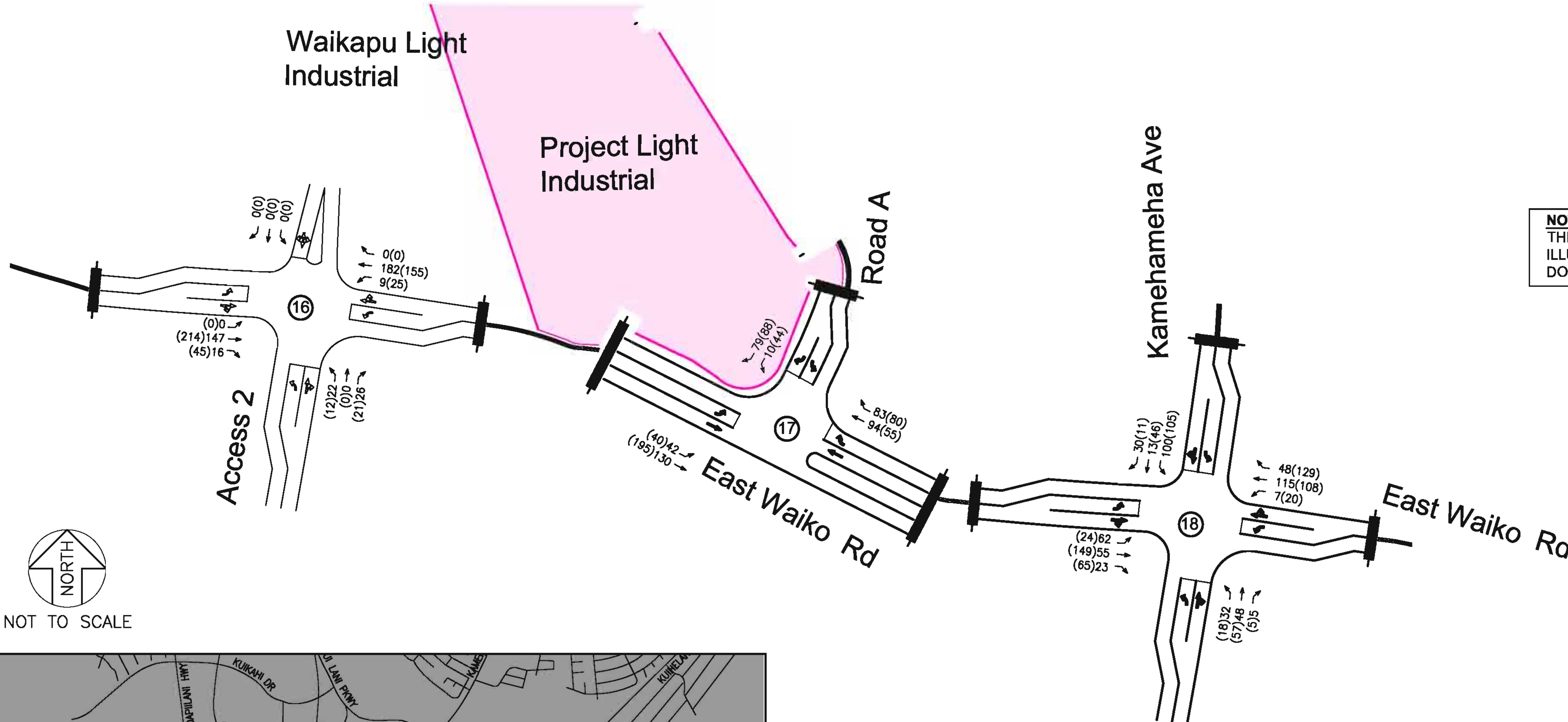
(Y) – PROJECT NEW INTERSECTION Y

WAIALE DEVELOPMENT

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS, SURVEYORS • HONOLULU, HAWAII

PROJECT VOLUME ONLY

FIGURE 8e



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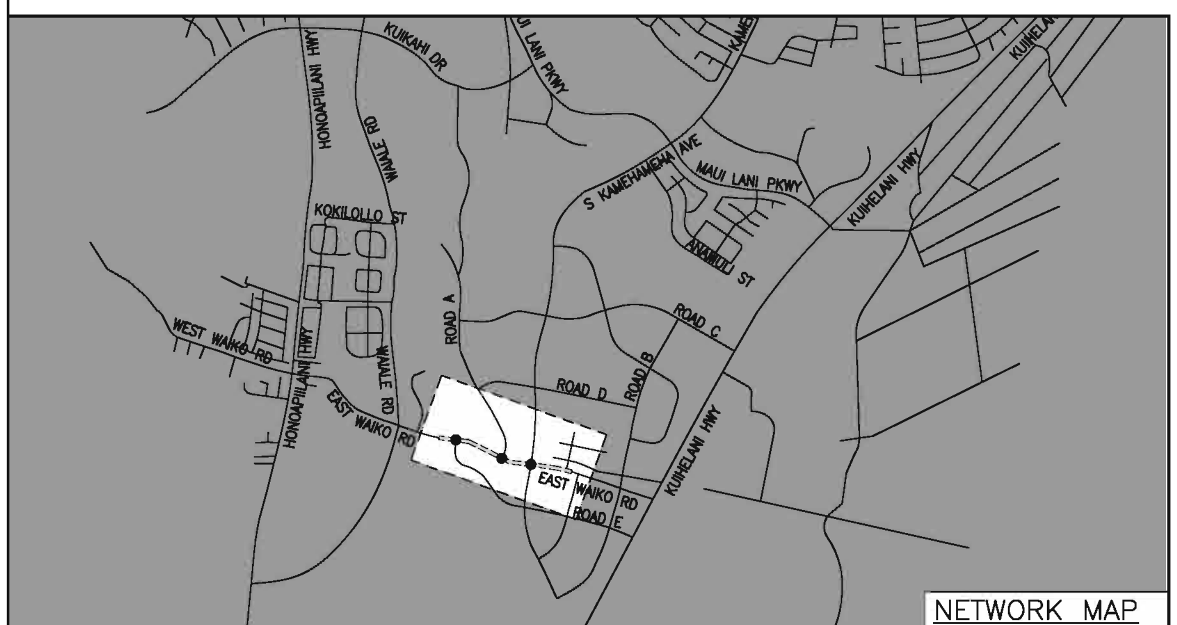

LEGEND

- ##(##) – AM(PM) PEAK HOUR OF TRAFFIC VOLUMES
- Y – SIGNALIZED INTERSECTION Y
- Y – INTERSECTION Y
- Y – PROJECT NEW INTERSECTION Y

WAIALE DEVELOPMENT	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS • HONOLULU, HAWAII	FIGURE
	PROJECT VOLUME ONLY	8f

LEGEND

##(##) – AM(PM) PEAK HOUR OF TRAFFIC VOLUMES

Y – SIGNALIZED INTERSECTION Y

Y – INTERSECTION Y

Y – PROJECT NEW INTERSECTION Y

NOTE:
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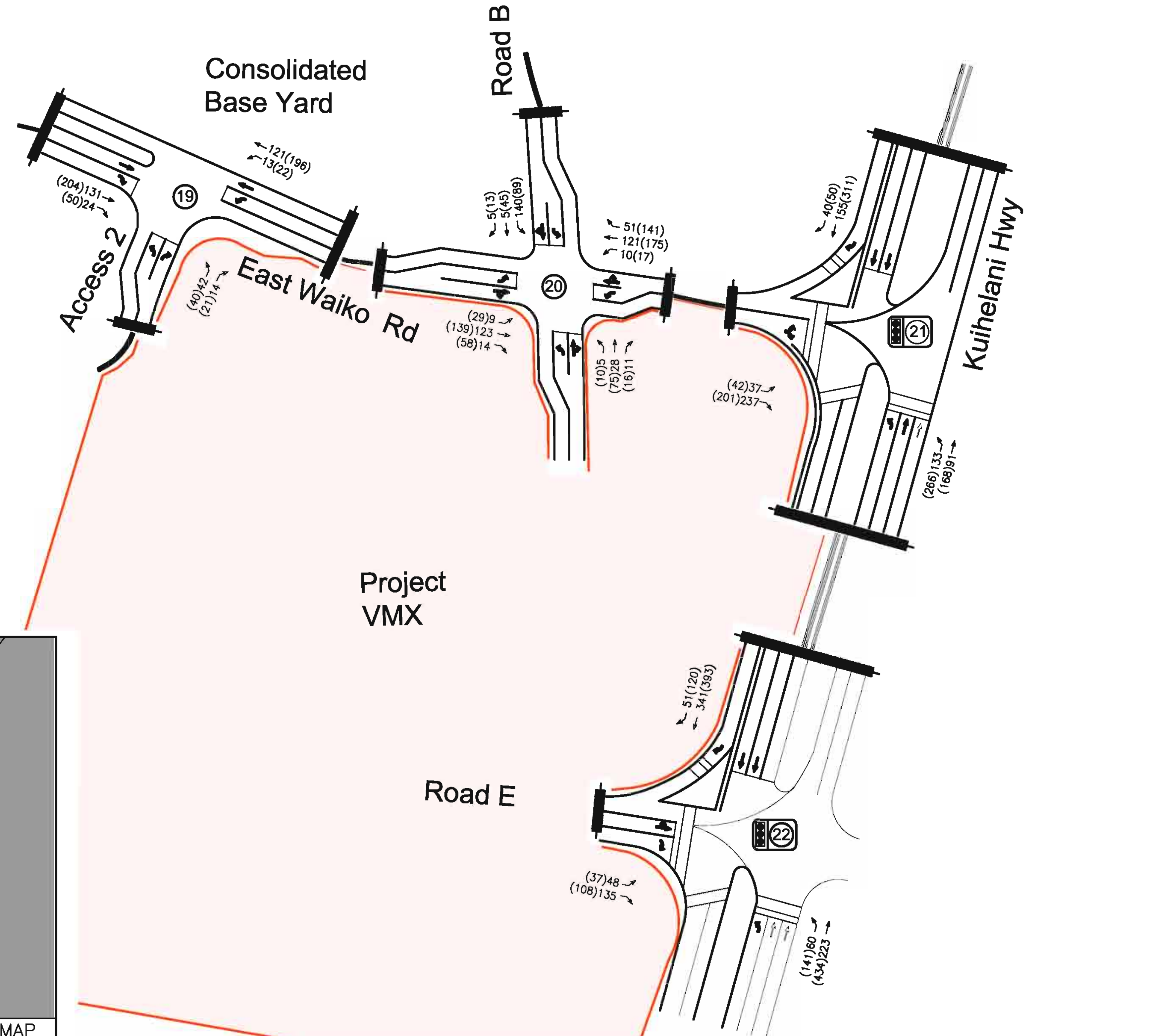
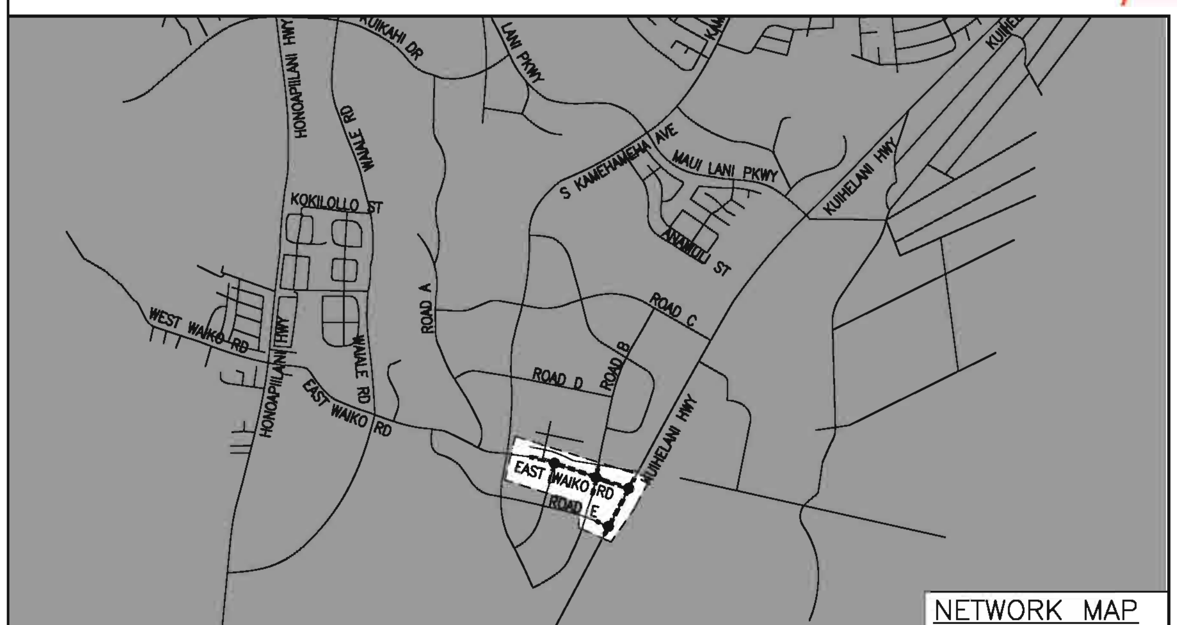
NORTH

NOT TO SCALE





NETWORK MAP

WAIALE DEVELOPMENT

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PROJECT VOLUME ONLY

FIGURE

8g

C. Year 2022 with Project Analysis

As stated earlier, the Project will generate 2,575 (3,270) trips during the AM (PM) peak hours of traffic.

The Project will extend Kamehameha Avenue southward from its existing terminus near Pomaikai Elementary – to pass through and terminate approximately 1,400 feet south of East Waiko Road within the Waiale development.

Additional internal roadways are also planned for the Project with some planned to connect to Kuihelani Highway and East Waiko Road.

As mentioned earlier, roundabouts were considered on a planning level, but were not recommended at any of the study intersections. The rationale is explored further in Appendix D.

By year 2022 with Project and Base Year 2022 improvements, some intersections would operate at LOS E or F and overcapacity conditions. See below for a list of recommended improvements:

Roadway Improvements:

- Extend Kamehameha Avenue southward as a two lane section with turning lanes at major intersections
- Provide turning lanes along East Waiko Road at its unsignalized intersections

Intersection Improvements:

- Kuikahi Drive/Waiale Road:

  <u>Mitigation:</u>

  - o Eastbound approach: re-stripe the right-turn into a shared through/right-turn lane
- Kuikahi Drive/Maui Lani Parkway

  <u>Mitigation:</u>

  - o Eastbound approach: provide a left-turn lane

  - Westbound approach: provide a left-turn lane

- Maui Lani Parkway/Kamehameha Avenue:

  Mitigation:

  - Eastbound approach: re-stripe to provide a shared through/right turn lane
  - Westbound approach: provide a right-turn lane

- East Waiko Road/Kamehameha Avenue:

  Mitigation

  - Signalize the intersection

- East Waiko Road/Road B:

  Mitigation

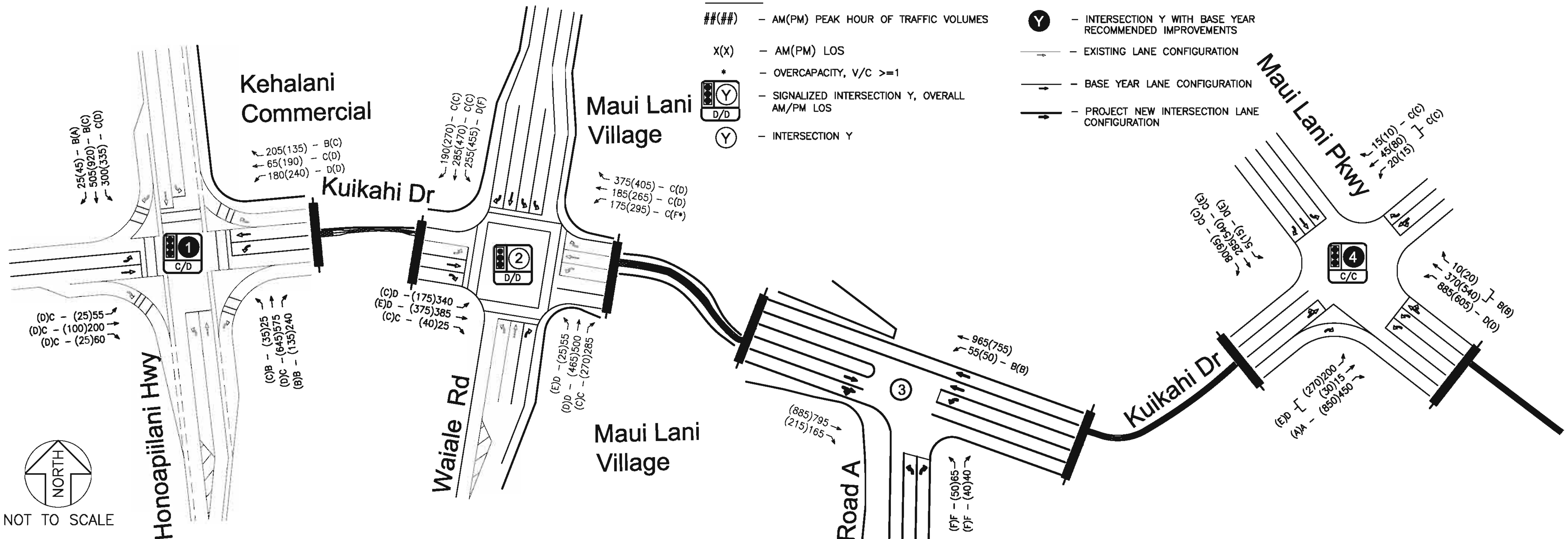
  - Signalize the intersection

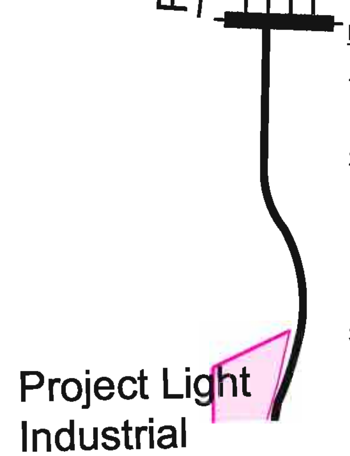
- East Waiko Road/Kuihelani Highway

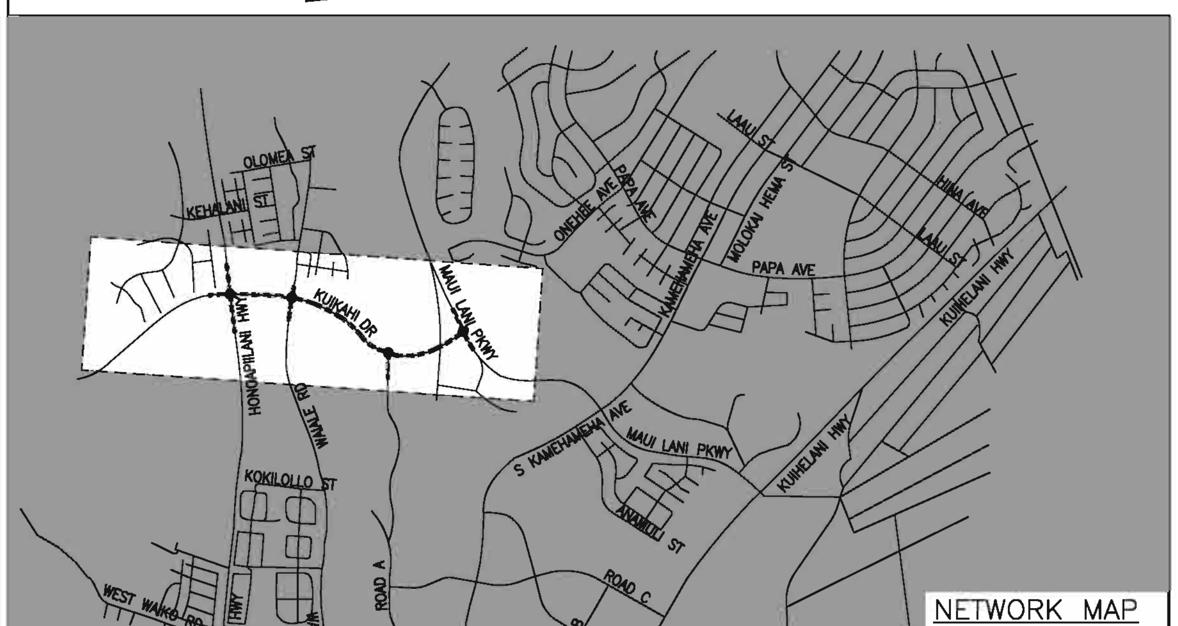
  Mitigation:

  - Eastbound approach: provide double left-turn lanes

See Figures 9a through 9g for Year 2022 with Project volume, LOS and discussion, Figures 10a through 10d for Year 2022 with Project intersections with mitigations volume, LOS and discussion. See Table 7 for a summary of the LOS and v/c ratios.







NETWORK MAP

DISCUSSIONS:

1. The intersection would continue to operate at LOS D or better.
2. The Project additional traffic volume would cause the westbound left-turn approach to operate at LOS (F) and overcapacity conditions during the (PM) peak hour of traffic.
   The northbound and southbound left-turns would also experience longer delays.
3. This new intersection will most likely not warrant a traffic signal. Although it was assumed that an access to the Maui Lani Village VMX would be provided along Road A, the volume entering and exiting Road A would be relatively small due to the other planned accesses to Maui Lani Village VMX along Kuikahi Drive.
   The majority of the Project traffic is likely to access Road A via Kuikahi Drive eastbound right-turn.

   Therefore, although it is not projected that the intersection would warrant a signal, it should be monitored for future warrants.
4. The Project additional trips would increase delays to LOS (E) on some of the movements during the (PM) peak hour of traffic.

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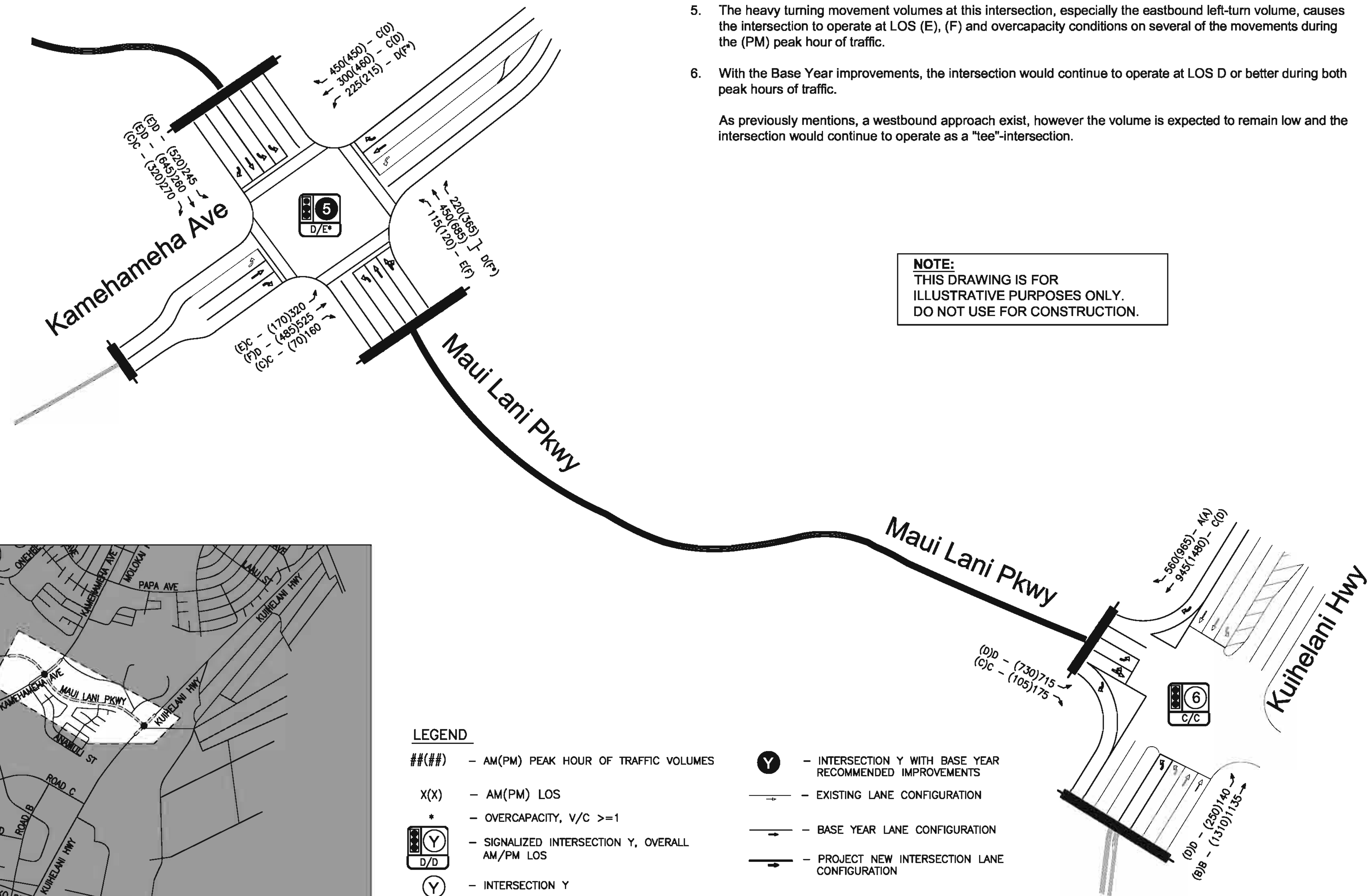
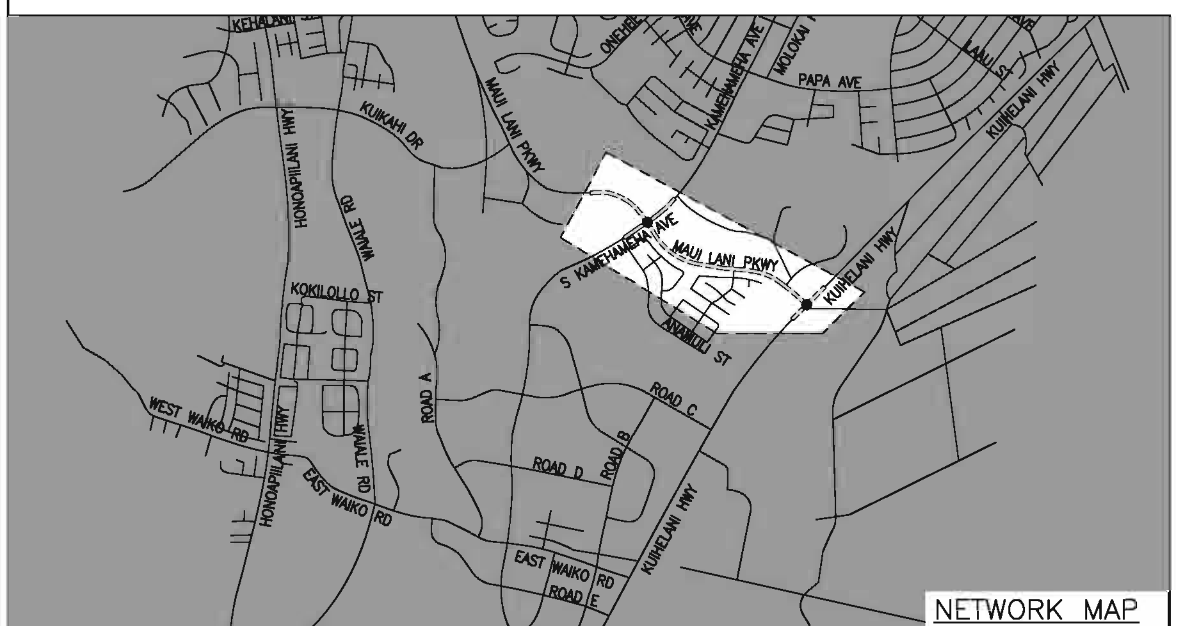
WAIALE DEVELOPMENT	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS,SURVEYORS • HONOLULU,HAWAII	FIGURE
	YEAR 2022 WITH PROJECT VOLUMES AND LEVEL OF SERVICE	9a





DISCUSSIONS:

5. The heavy turning movement volumes at this intersection, especially the eastbound left-turn volume, causes the intersection to operate at LOS (E), (F) and overcapacity conditions on several of the movements during the (PM) peak hour of traffic.

6. With the Base Year improvements, the intersection would continue to operate at LOS D or better during both peak hours of traffic.

   As previously mentions, a westbound approach exist, however the volume is expected to remain low and the intersection would continue to operate as a "tee"-intersection.

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LEGEND

- ##(##) – AM(PM) PEAK HOUR OF TRAFFIC VOLUMES
- X(X) – AM(PM) LOS
- * – OVERCAPACITY, V/C >=1
- Y D/D – SIGNALIZED INTERSECTION Y, OVERALL AM/PM LOS
- (Y) – INTERSECTION Y
- Y – INTERSECTION Y WITH BASE YEAR RECOMMENDED IMPROVEMENTS
- – EXISTING LANE CONFIGURATION
- – BASE YEAR LANE CONFIGURATION
- – PROJECT NEW INTERSECTION LANE CONFIGURATION

WAIALE DEVELOPMENT

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YEAR 2022 WITH PROJECT VOLUMES AND LEVEL OF SERVICE

FIGURE 9b

DISCUSSIONS:

Kamehameha Avenue, similar to Waiale Drive, will provide access to both Kuikahi Drive/Maui Lani Parkway and East Waiko Road. Additionally, Kamehameha Avenue, will also provide access to the Project VMX. This analysis only took into account the major cross-intersection. Specific accesses are not determined at this point and therefore were not analyzed.

These new intersections are proposed to be two-way stop controlled on the eastbound and westbound approach. The exact accesses and businesses are not yet known and therefore, it was assumed that the Project major new intersections would provide turning lanes.

7, 11 & 12. These new intersections would operate satisfactorily during both peak hours of traffic.

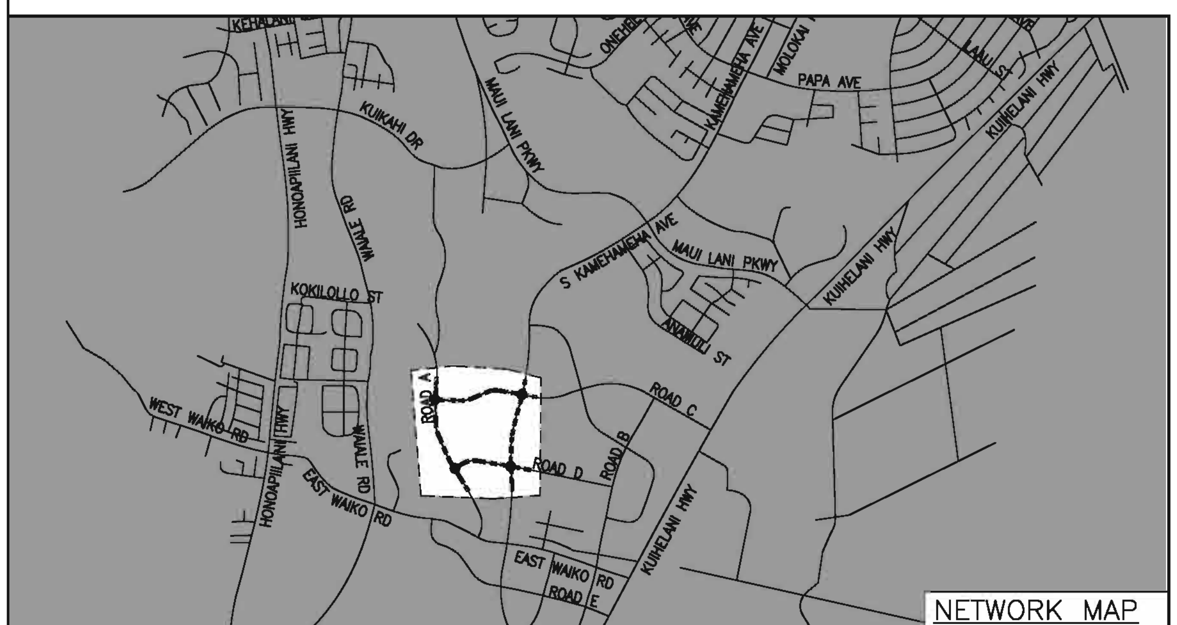
8. These two intersections along Kamehameha Avenue would also be stop controlled on the eastbound and westbound approaches. Some of the movements on the minor approach would operate at LOS F or E. However, the volume would not warrant a traffic signal. The intersection should be monitored and signalized when warranted.

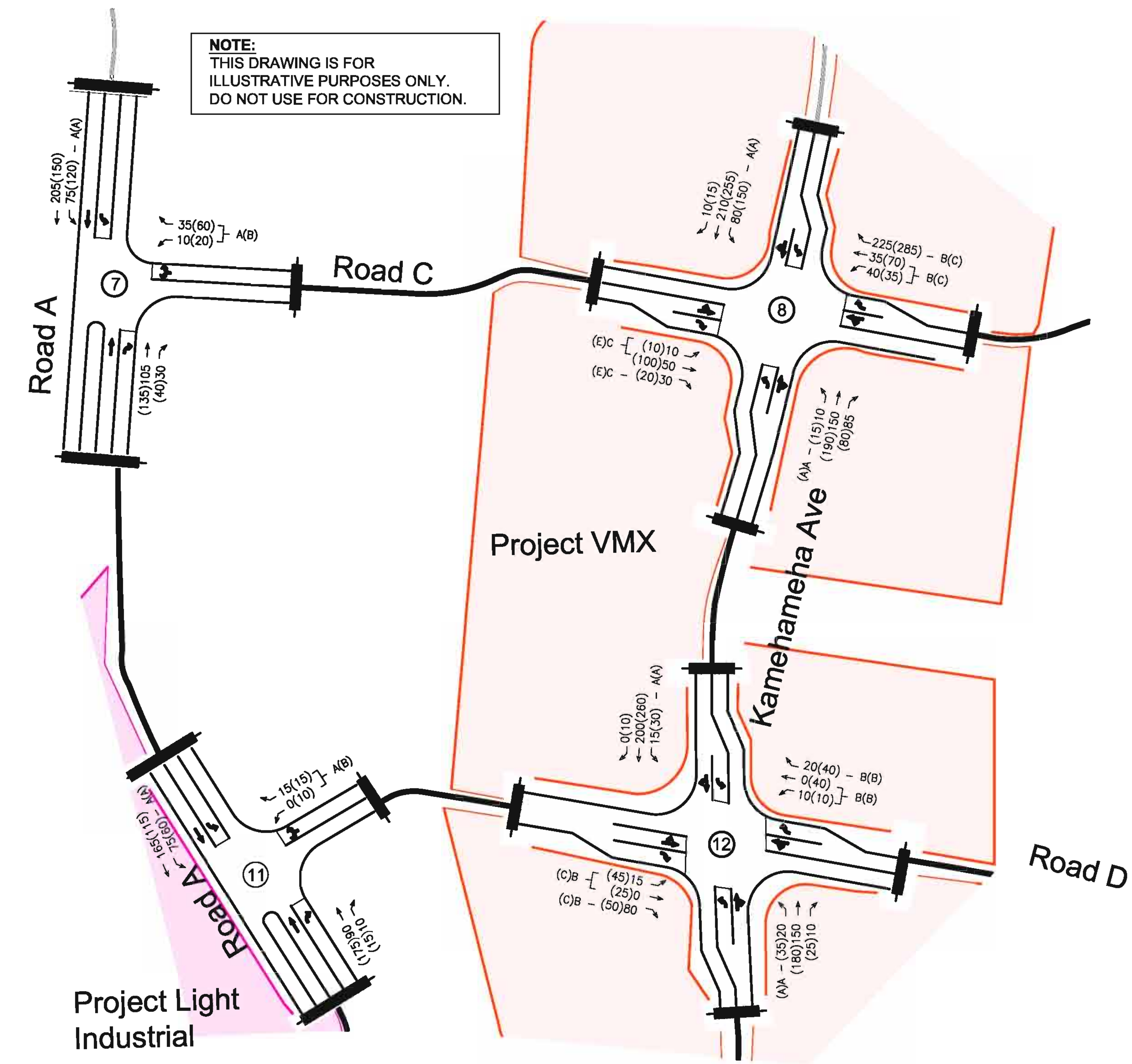
NORTH

NOT TO SCALE

LEGEND

- ##(##) – AM(PM) PEAK HOUR OF TRAFFIC VOLUMES
- X(X) – AM(PM) LOS
- * – OVERCAPACITY, V/C >=1
- SIGNALIZED INTERSECTION Y, OVERALL AM/PM LOS (D/D)
- (Y) – INTERSECTION Y
- (Y) – INTERSECTION Y WITH BASE YEAR RECOMMENDED IMPROVEMENTS
- – EXISTING LANE CONFIGURATION
- – BASE YEAR LANE CONFIGURATION
- – PROJECT NEW INTERSECTION LANE CONFIGURATION





WAIALE DEVELOPMENT

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YEAR 2022 WITH PROJECT VOLUMES AND LEVEL OF SERVICE

FIGURE 9c

DISCUSSIONS:

9. The northbound left-turn will operate at LOS (F) during the (PM) peak hour of traffic. All other movements will operate at LOS C or better.
Most likely this intersection would not warrant a traffic signal.

10. This new intersection will provide access to the Project Commercial area as well as other internal roadways. The turning movement volume is not expected to be as heavy as along other intersection along Kuihelani Highway therefore, the intersection would operate at LOS D or better during both peak hours of traffic.

13. This intersection located at the junction between Road B and D will operate at LOS B or better during both peak hours of traffic.

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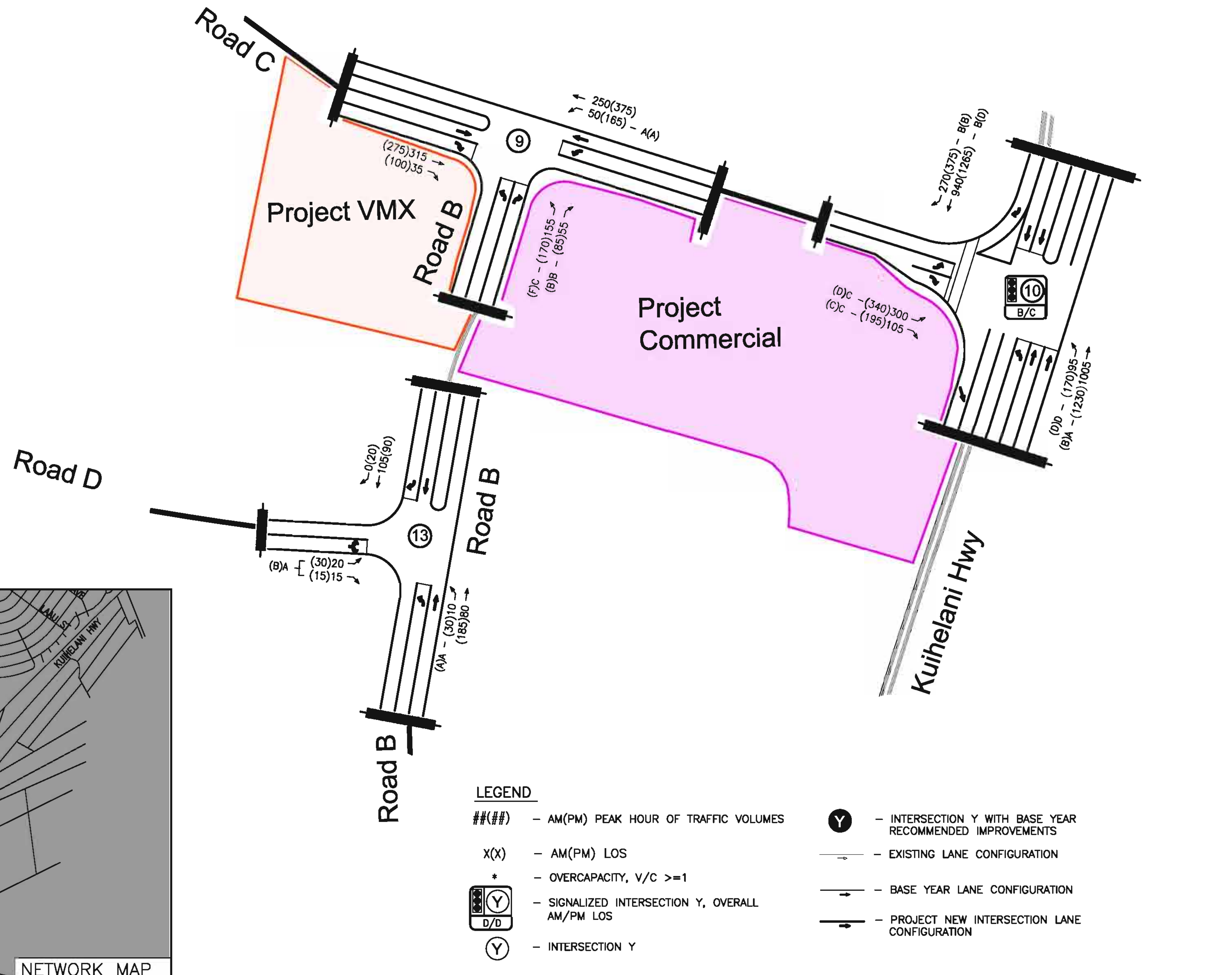

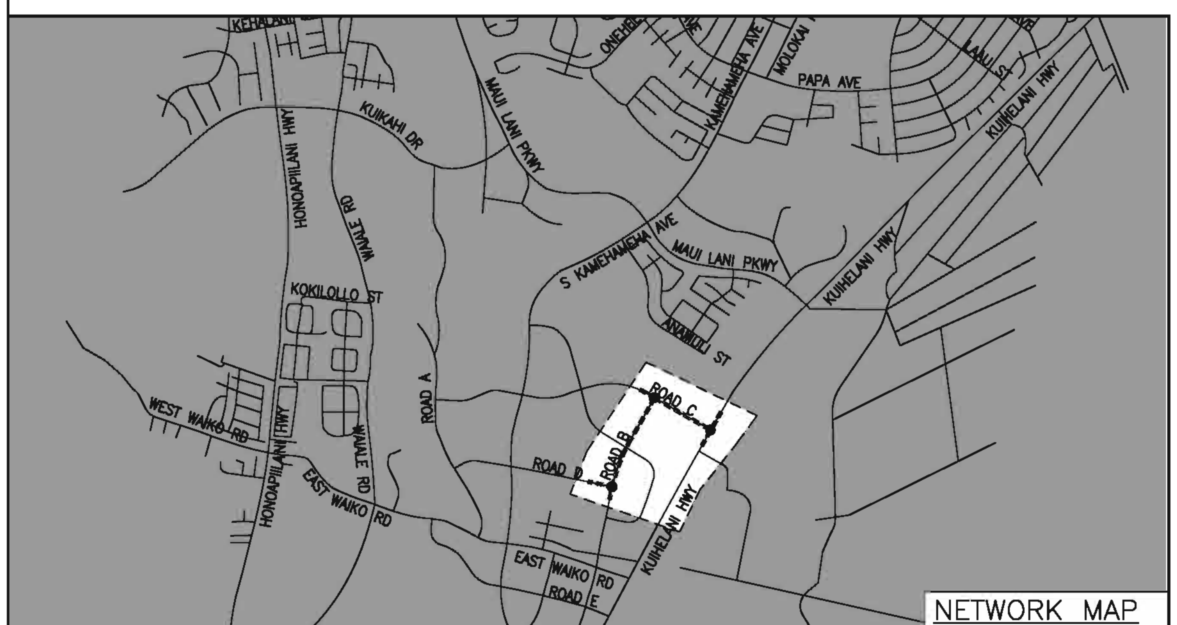

WAIALE DEVELOPMENT

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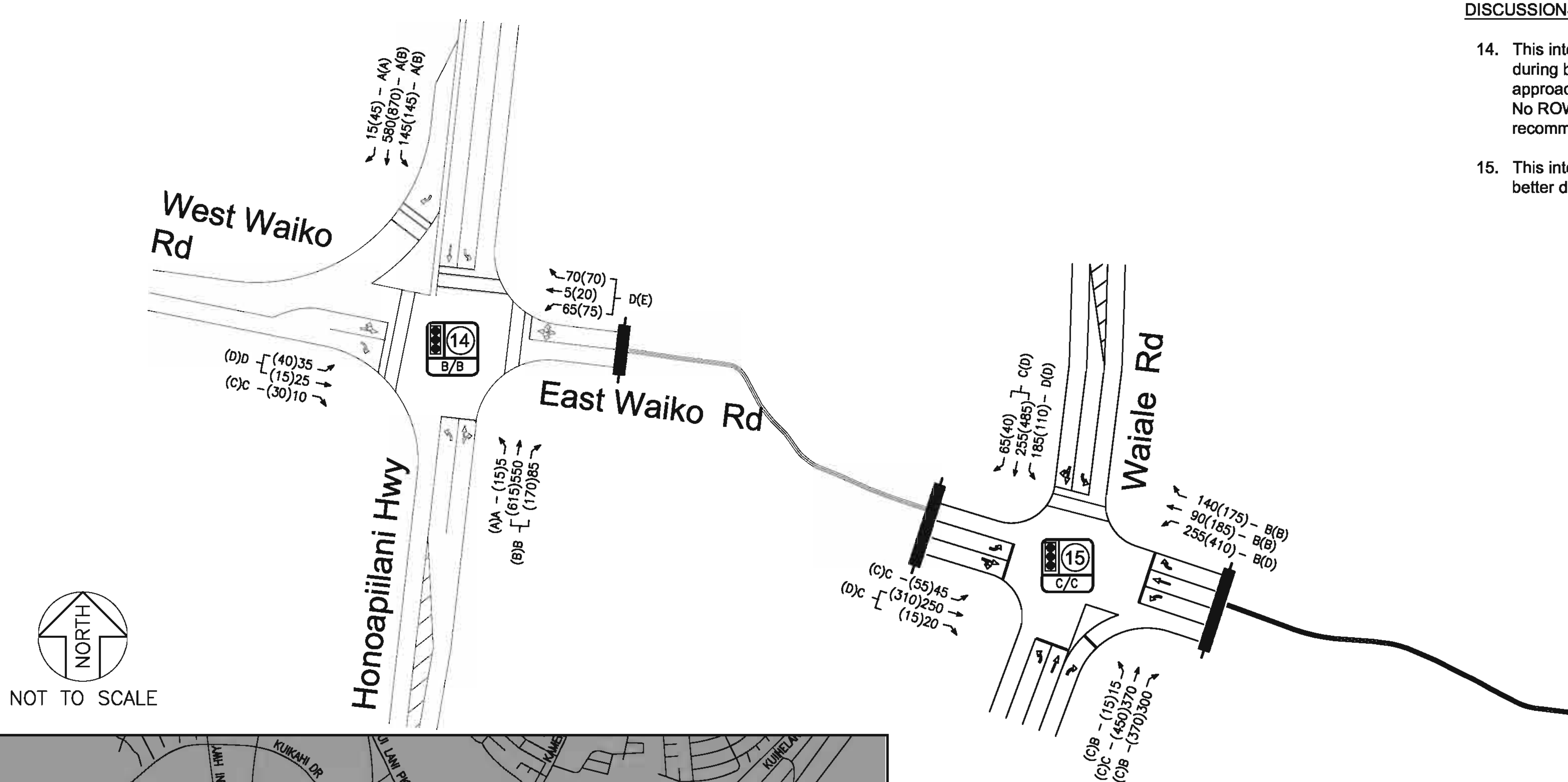
YEAR 2022 WITH PROJECT VOLUMES AND LEVEL OF SERVICE

FIGURE 9d



DISCUSSIONS:

14. This intersection will continue to operate at LOS D or better during both peak hours of traffic except for the westbound approach at LOS E due to the shared movements.
No ROW is available, therefore no improvements are recommended.

15. This intersection will also continue to operate at LOS D or better during both peak hours of traffic.

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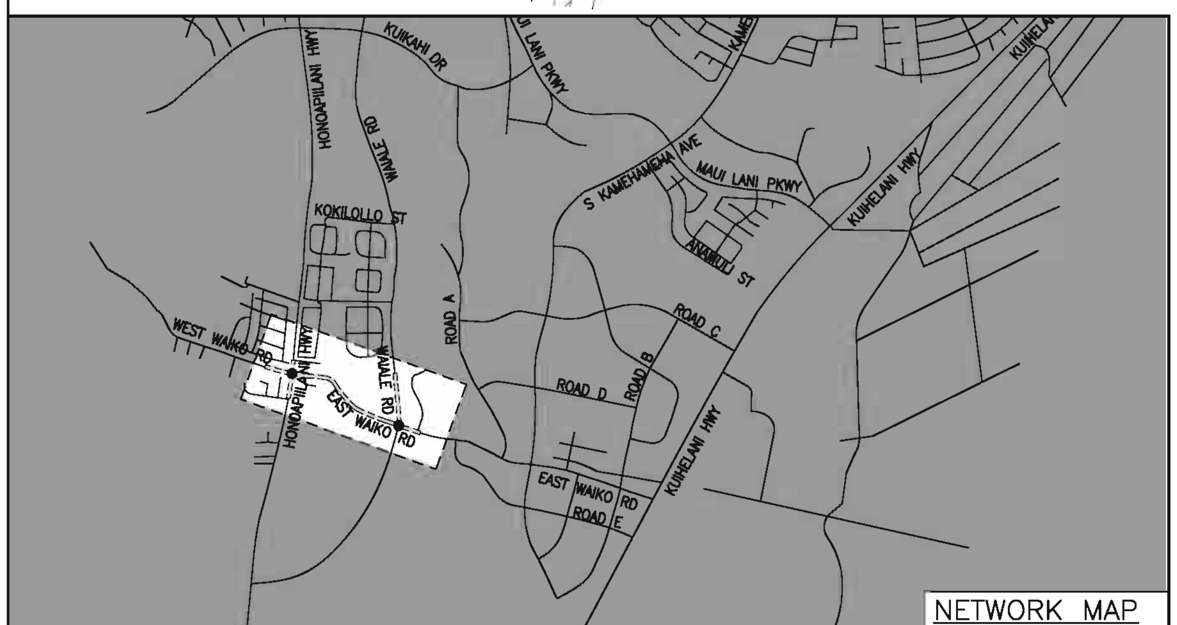
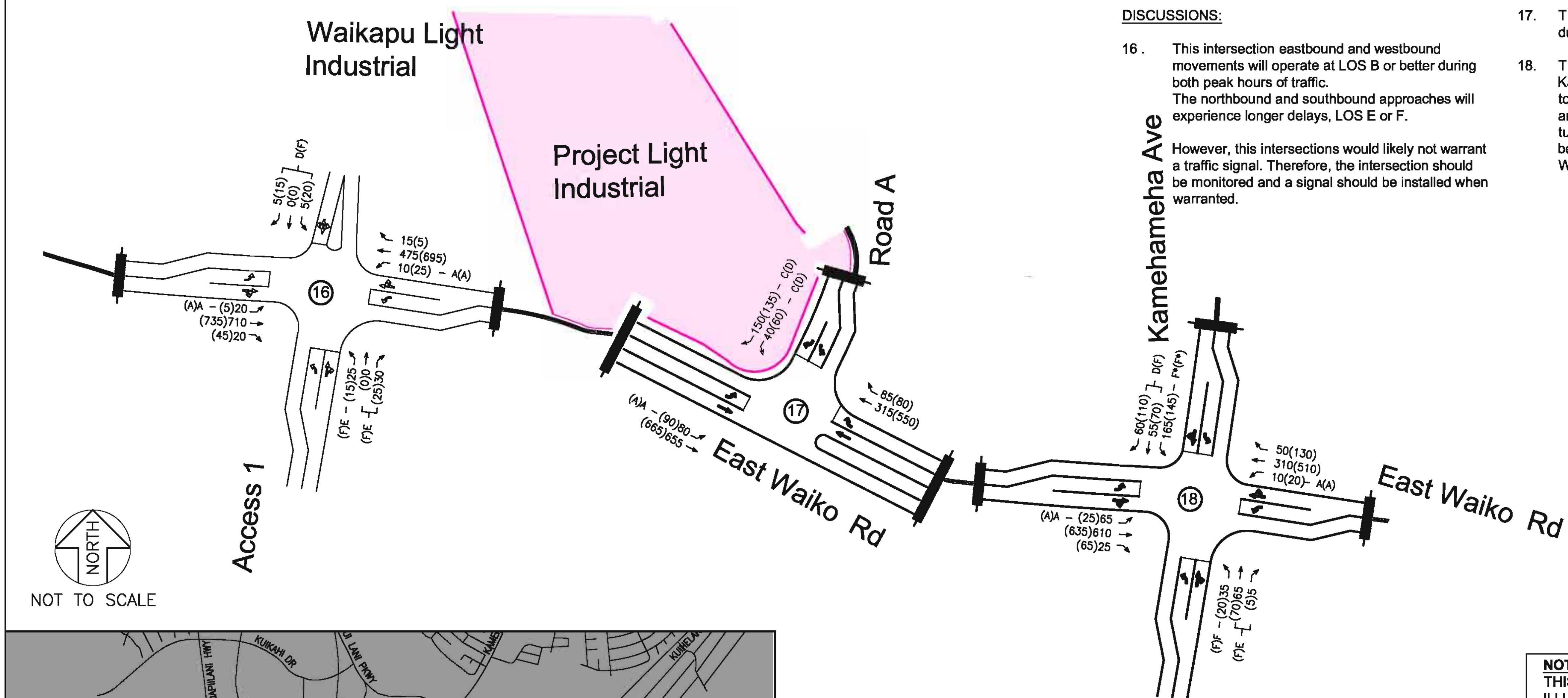


NETWORK MAP

LEGEND

- ##(##) – AM(PM) PEAK HOUR OF TRAFFIC VOLUMES
- X(X) – AM(PM) LOS
- • – OVERCAPACITY, V/C >=1
- Y, D/D – SIGNALIZED INTERSECTION Y, OVERALL AM/PM LOS
- (Y) – INTERSECTION Y
- Y – INTERSECTION Y WITH BASE YEAR RECOMMENDED IMPROVEMENTS
- – EXISTING LANE CONFIGURATION
- – BASE YEAR LANE CONFIGURATION
- – PROJECT NEW INTERSECTION LANE CONFIGURATION

WAIALE DEVELOPMENT	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS • HONOLULU, HAWAII	FIGURE
	YEAR 2022 WITH PROJECT VOLUMES AND LEVEL OF SERVICE	9e



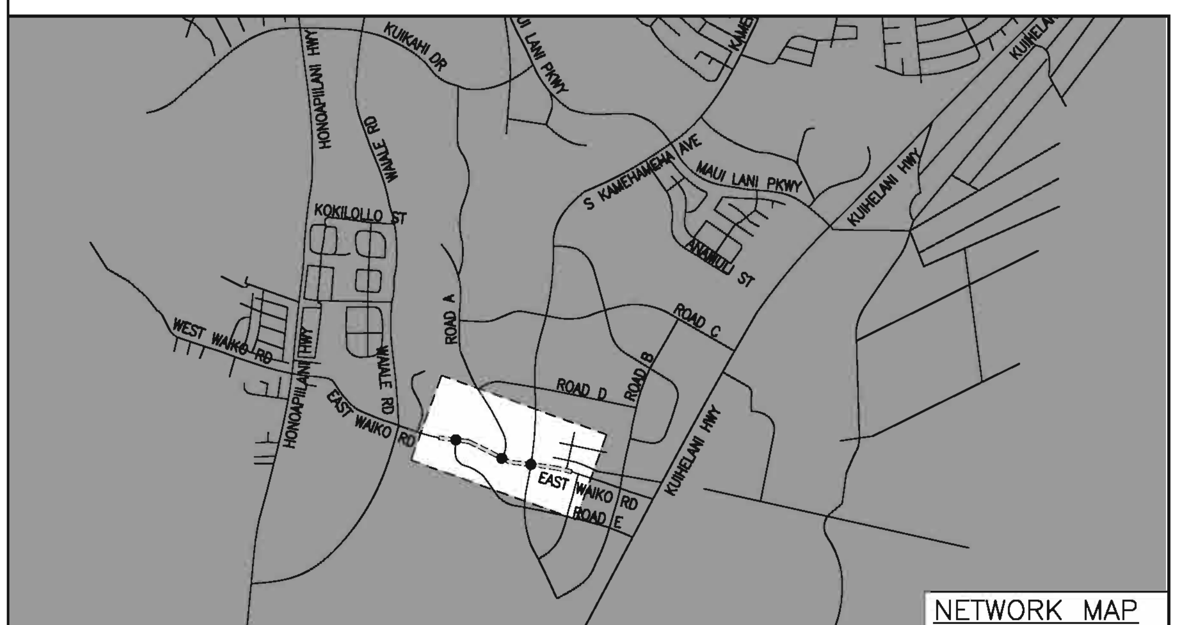
DISCUSSIONS:

16 . This intersection eastbound and westbound movements will operate at LOS B or better during both peak hours of traffic.
The northbound and southbound approaches will experience longer delays, LOS E or F.

However, this intersections would likely not warrant a traffic signal. Therefore, the intersection should be monitored and a signal should be installed when warranted.

17. This intersection would operate at LOS D or better during both peak hours of traffic.

18. This intersection would provide access to Kamehameha Avenue which would provide access to some of the Project's commercial areas as well as areas beyond the Project study area. Therefore, turning movement volume at this intersection would be greater than at other new intersections along East Waiko Road.



NOTE:
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DO NOT USE FOR CONSTRUCTION.

LEGEND

- ##(##) – AM(PM) PEAK HOUR OF TRAFFIC VOLUMES
- X(X) – AM(PM) LOS
- * – OVERCAPACITY, V/C >=1
- Y D/D – SIGNALIZED INTERSECTION Y, OVERALL AM/PM LOS
- (Y) – INTERSECTION Y
- Y – INTERSECTION Y WITH BASE YEAR RECOMMENDED IMPROVEMENTS
- – EXISTING LANE CONFIGURATION
- – BASE YEAR LANE CONFIGURATION
- – PROJECT NEW INTERSECTION LANE CONFIGURATION

WAIALE DEVELOPMENT	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS • HONOLULU, HAWAII	FIGURE
	YEAR 2022 WITH PROJECT VOLUMES AND LEVEL OF SERVICE	9f

DISCUSSIONS:

19. The intersection would operate satisfactorily during both peak hours of traffic.

20. The intersection northbound and southbound approaches will experience long delays.

21. The increase in traffic volume would cause the eastbound left-turn movement to operate with long delays and overcapacity conditions during both peak hours of traffic.

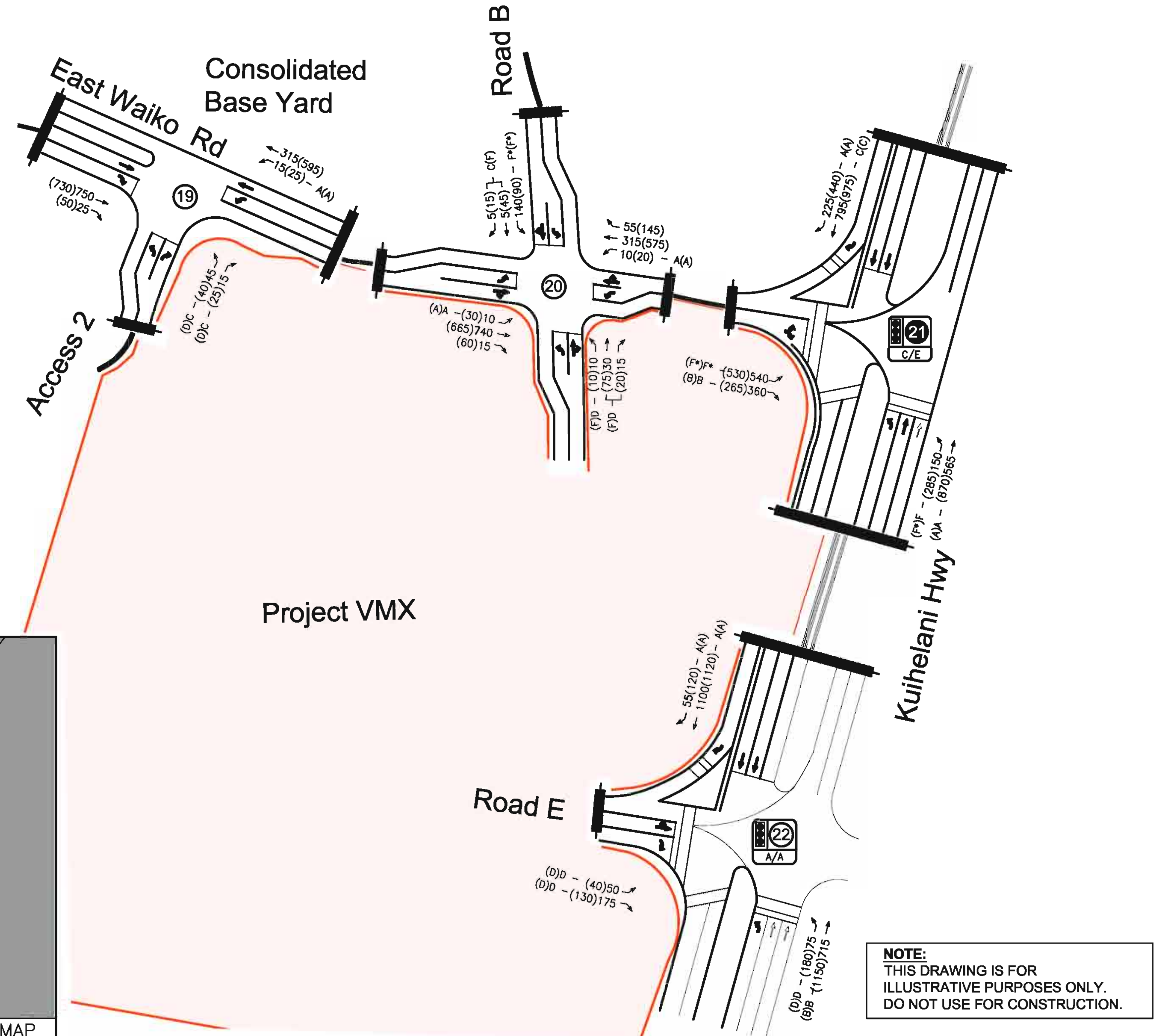
22. This existing intersection would provide access to the Project. It would provide an alternate access into the commercial area of the Project while reducing traffic at the 21 intersection.

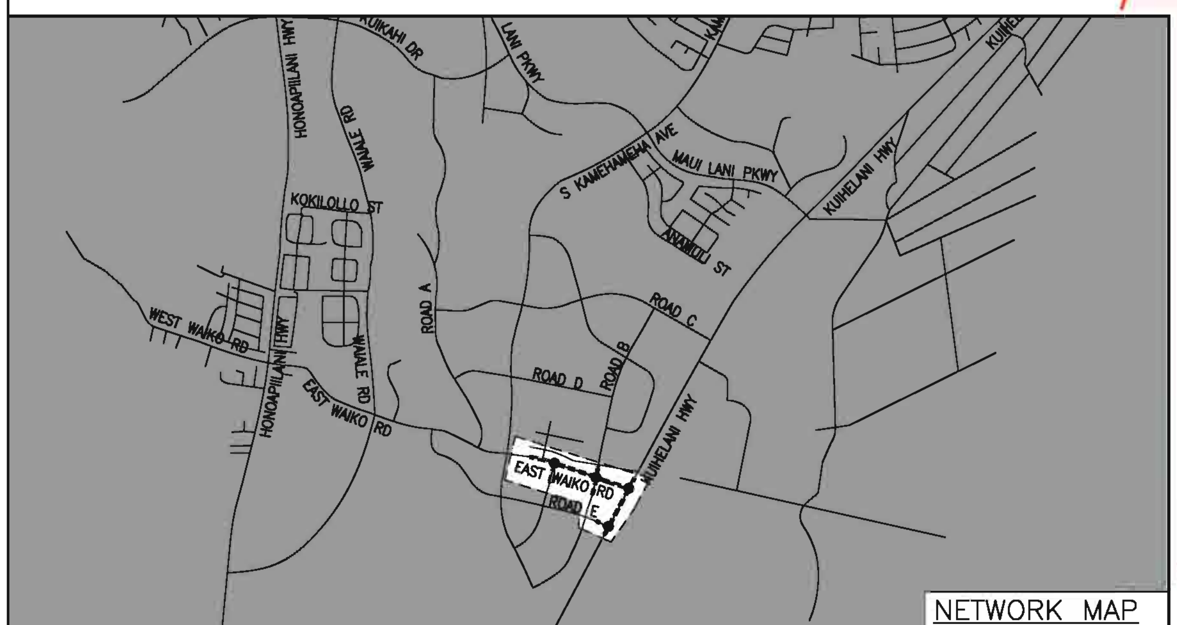
NORTH

NOT TO SCALE

LEGEND

- ##(##) – AM(PM) PEAK HOUR OF TRAFFIC VOLUMES
- X(X) – AM(PM) LOS
- * – OVERCAPACITY, V/C >=1
- Y, D/D – SIGNALIZED INTERSECTION Y, OVERALL AM/PM LOS
- (Y) – INTERSECTION Y
- Y – INTERSECTION Y WITH BASE YEAR RECOMMENDED IMPROVEMENTS
- EXISTING LANE CONFIGURATION
- BASE YEAR LANE CONFIGURATION
- PROJECT NEW INTERSECTION LANE CONFIGURATION





NETWORK MAP

NOTE: THIS DRAWING IS FOR ILLUSTRATIVE PURPOSES ONLY. DO NOT USE FOR CONSTRUCTION.

WAIALE DEVELOPMENT

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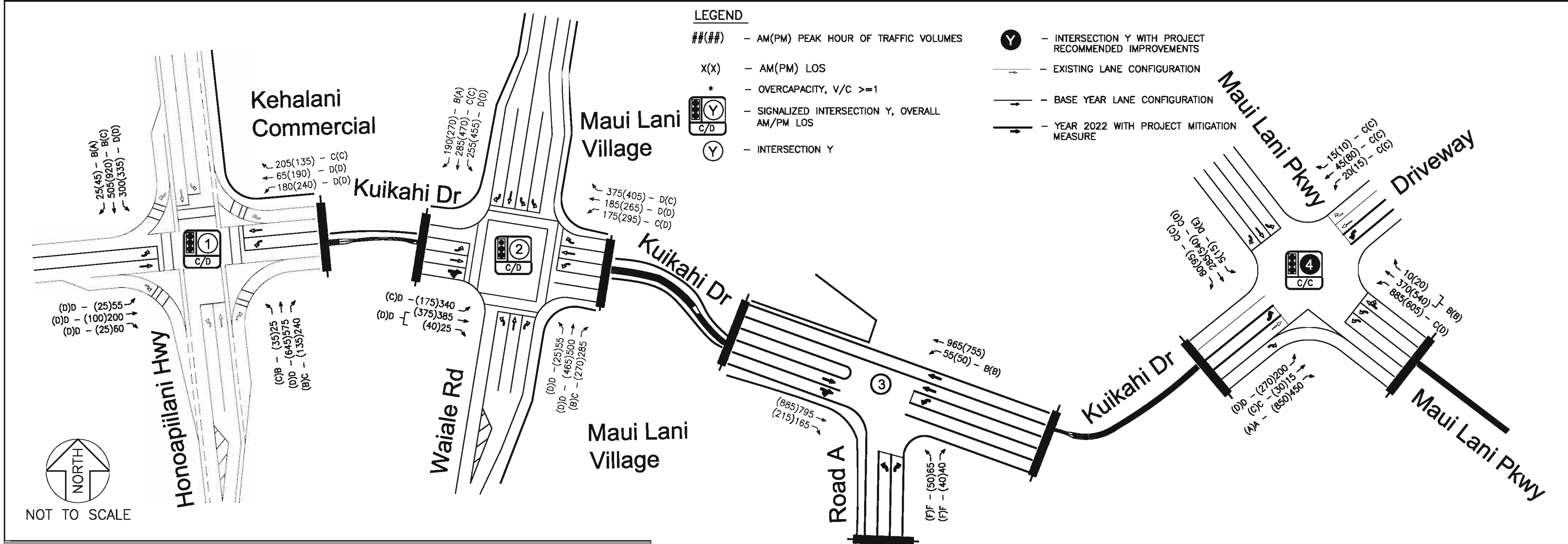
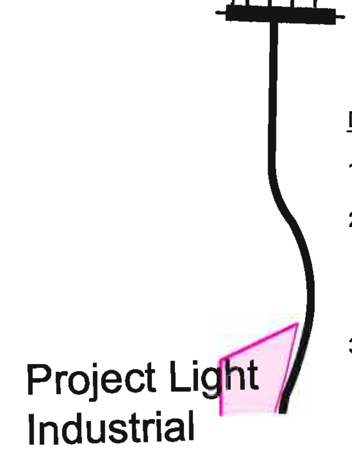
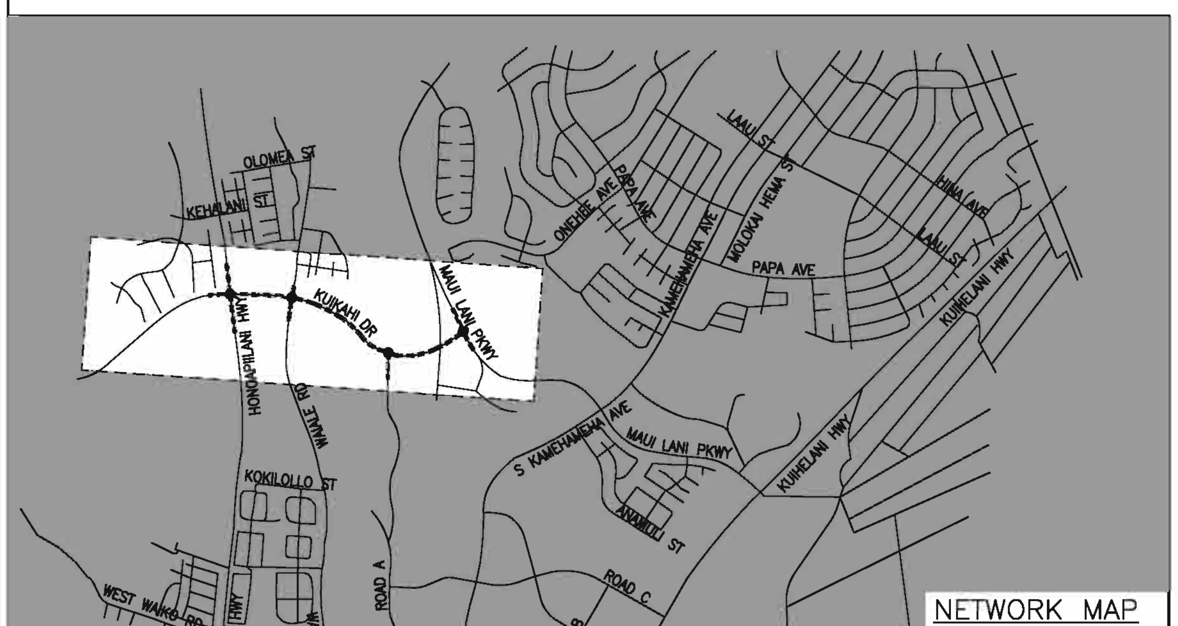
YEAR 2022 WITH PROJECT VOLUMES AND LEVEL OF SERVICE

FIGURE 9g







DISCUSSIONS:

1. No additional improvements recommended.
2. The eastbound right-turn should be re-striped as a shared through/right-turn lane. This would allow the intersection to continue operating at LOS D or better during both peak hours of traffic.
3. NO additional improvements recommended
4. The proposed improvements would improve the intersection operations. The southbound left-turn will continue to operate at LOS (E) during the (PM) peak hour of traffic. However, the volume will be relatively low.

NOTE:
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WAIALE DEVELOPMENT

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS,SURVEYORS • HONOLULU,HAWAII

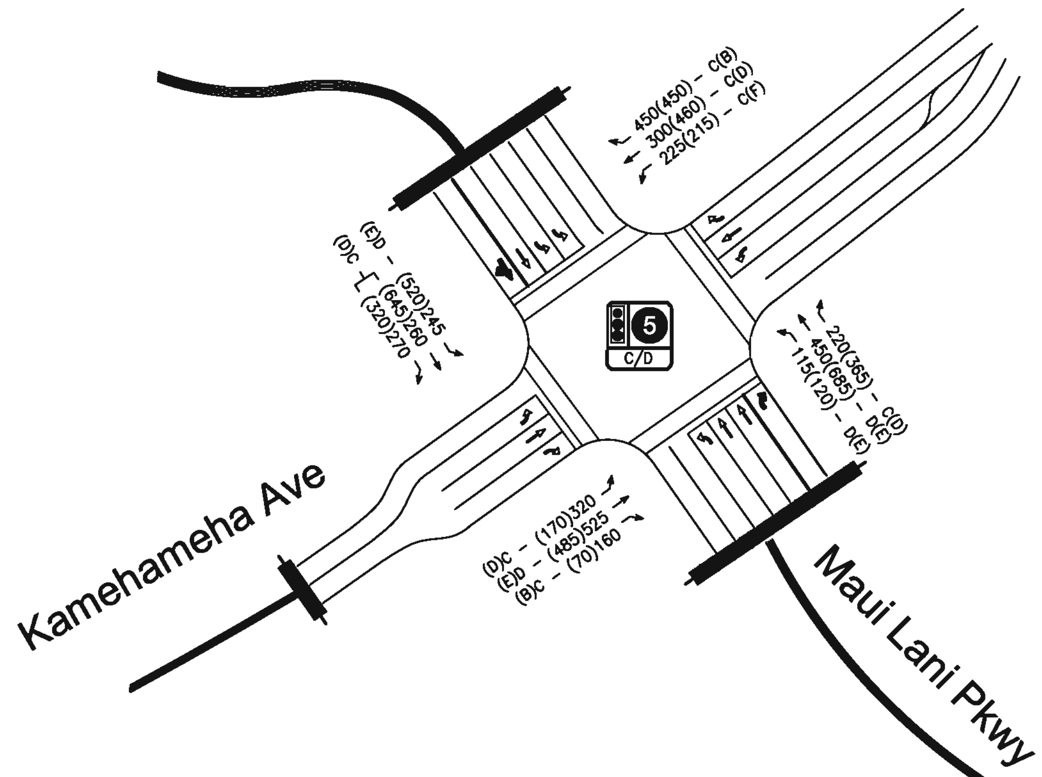
FIGURE 10a

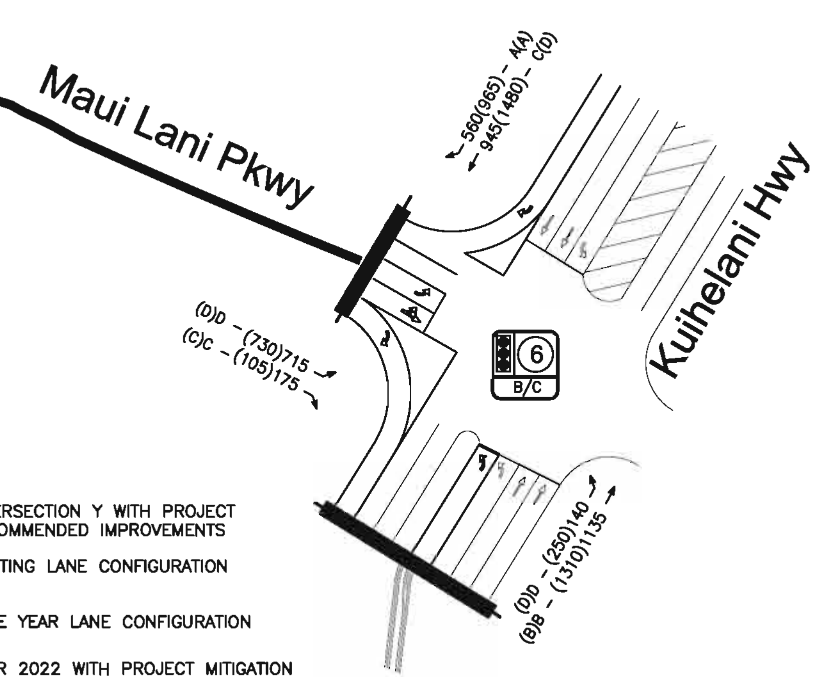
YEAR 2022 WITH PROJECT AND MITIGATION MEASURES VOLUMES AND LEVEL OF SERVICE

DISCUSSIONS:

5. Mitigations at this intersection would be to re-stripe the eastbound right-turn lane as a shared through/right-turn lane and to provide a right-turn lane on the westbound approach. Some movements would continue to operate at LOS E or F however additional improvements would require the acquisition of additional ROW.

6. No additional improvements recommended.





NOTE:
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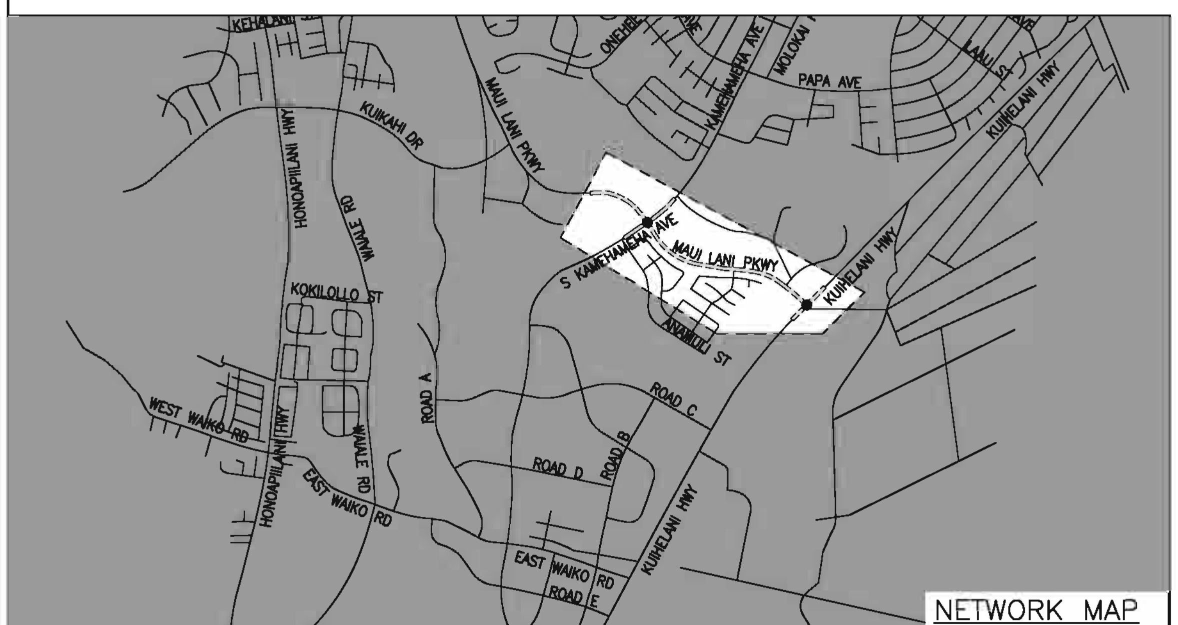
DO NOT USE FOR CONSTRUCTION.

NORTH
NOT TO SCALE



NETWORK MAP

LEGEND

- ##(##) – AM(PM) PEAK HOUR OF TRAFFIC VOLUMES
- X(X) – AM(PM) LOS
- * – OVERCAPACITY, V/C >=1
- C/D – SIGNALIZED INTERSECTION Y, OVERALL AM/PM LOS
- (Y) – INTERSECTION Y
- (Y) – INTERSECTION Y WITH PROJECT RECOMMENDED IMPROVEMENTS
- EXISTING LANE CONFIGURATION
- BASE YEAR LANE CONFIGURATION
- YEAR 2022 WITH PROJECT MITIGATION MEASURE

WAIALE DEVELOPMENT

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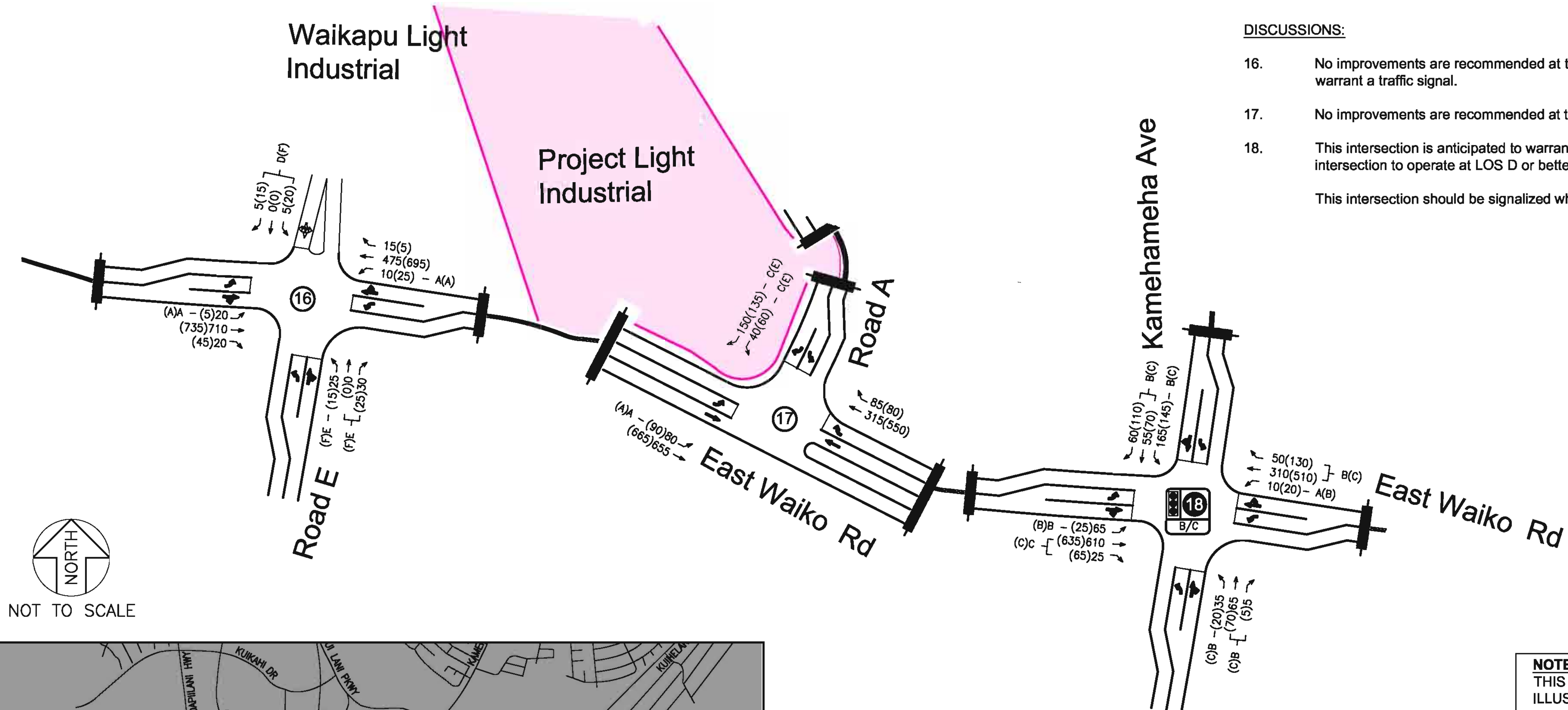
YEAR 2022 WITH PROJECT AND MITIGATION MEASURES VOLUMES AND LEVEL OF SERVICE

FIGURE 10b



DISCUSSIONS:

16. No improvements are recommended at this intersection. The volume would not warrant a traffic signal.

17. No improvements are recommended at this intersection.

18. This intersection is anticipated to warrant a traffic signal. A signal would allow the intersection to operate at LOS D or better during both peak hours of traffic.

This intersection should be signalized when warranted.

NOTE:
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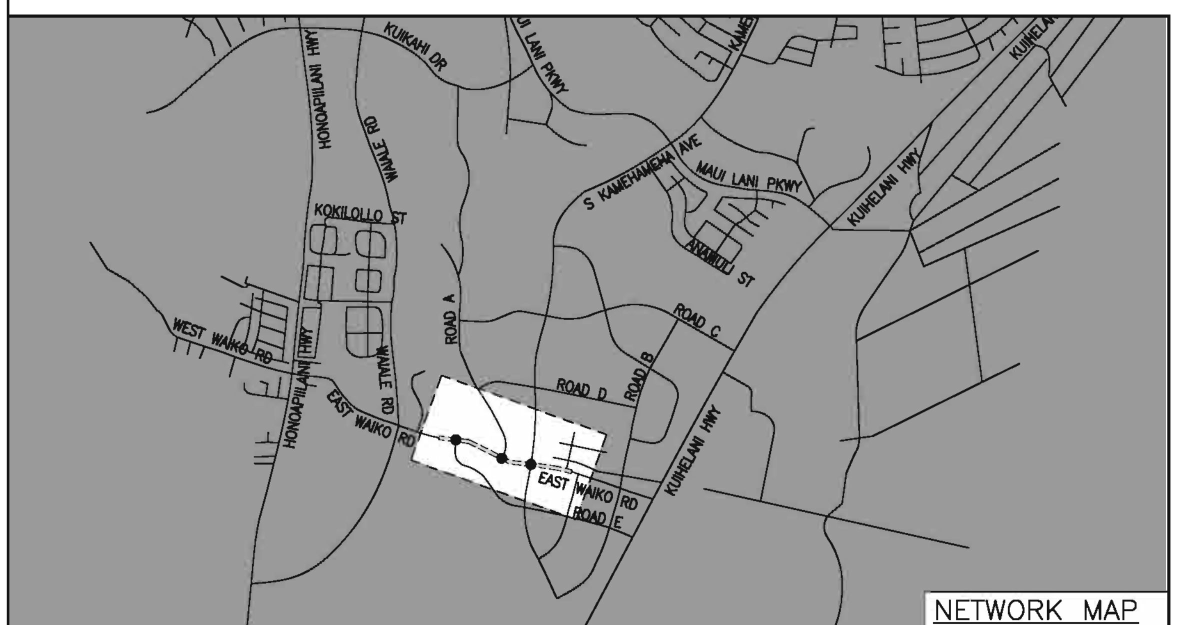

LEGEND

- ##(##) – AM(PM) PEAK HOUR OF TRAFFIC VOLUMES
- X(X) – AM(PM) LOS
- * – OVERCAPACITY, V/C >=1
- SIGNALIZED INTERSECTION Y, OVERALL AM/PM LOS
- (Y) – INTERSECTION Y
- Y – INTERSECTION Y WITH PROJECT RECOMMENDED IMPROVEMENTS
- EXISTING LANE CONFIGURATION
- BASE YEAR LANE CONFIGURATION
- YEAR 2022 WITH PROJECT MITIGATION MEASURE

WAIALE DEVELOPMENT

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS, SURVEYORS • HONOLULU, HAWAII

YEAR 2022 WITH PROJECT AND MITIGATION MEASURES VOLUMES AND LEVEL OF SERVICE

FIGURE 10c

DISCUSSIONS:

19. The intersection would operate at LOS D during or better during both peak hours of traffic.

20. With a traffic signal at this intersection, the movements would operate at LOS D or better during both peak hours of traffic.

The intersection should be signalized when warranted.

21. With the eastbound double left-turn lanes, the intersection will operate at LOS D or better during both peak hours of traffic.

22. No additional improvements recommended.

NORTH

NOT TO SCALE

NOTE:
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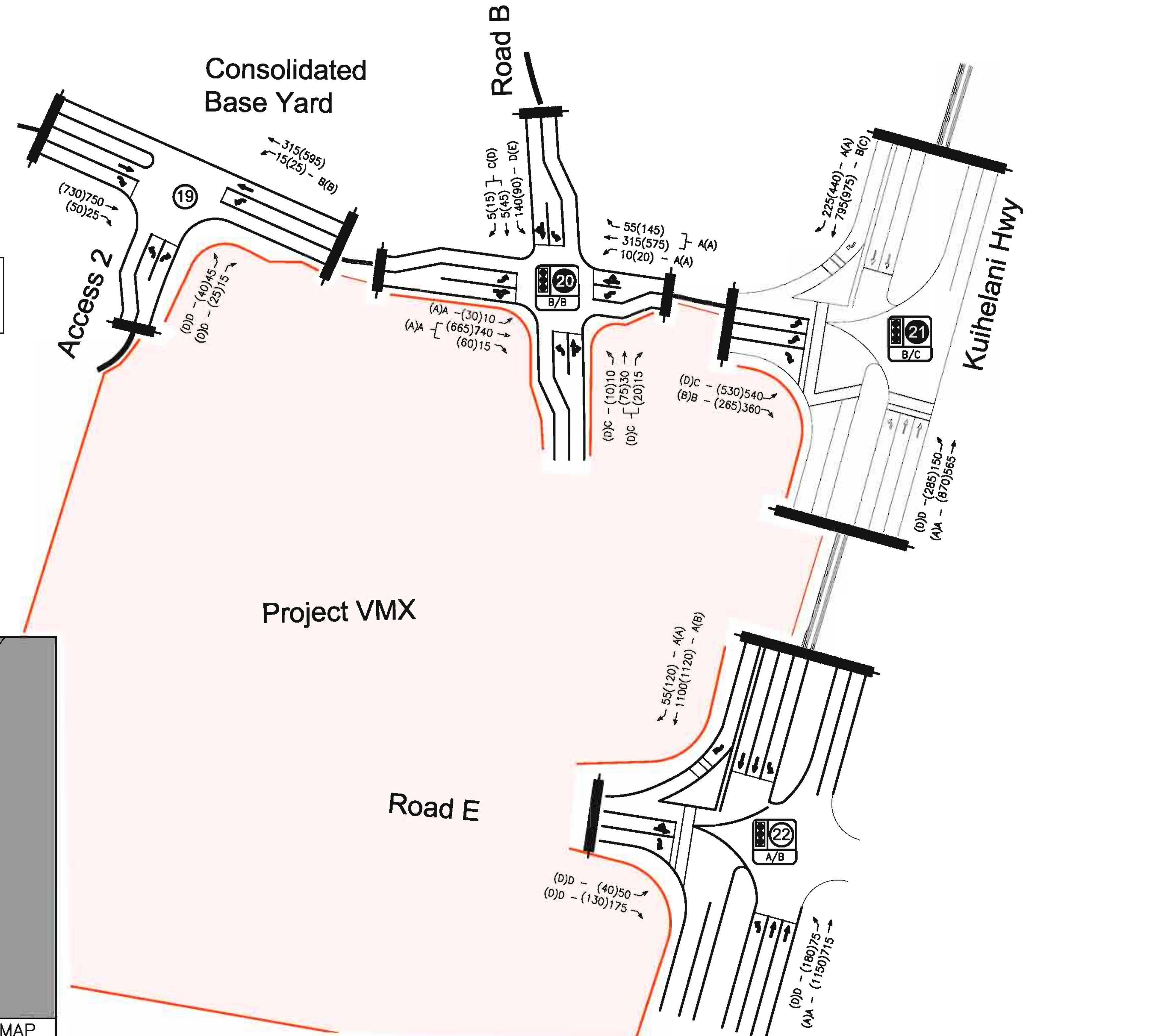
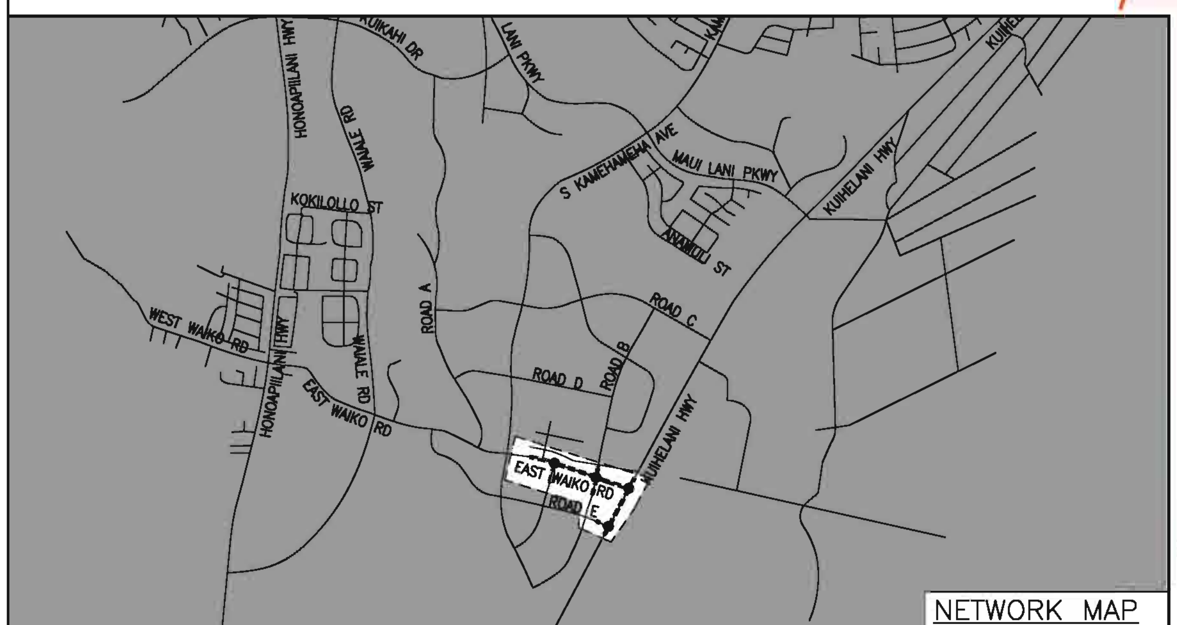
LEGEND

##(##)	– AM(PM) PEAK HOUR OF TRAFFIC VOLUMES
X(X)	– AM(PM) LOS
*	– OVERCAPACITY, V/C >=1
Y C/D	– SIGNALIZED INTERSECTION Y, OCERALL AM/PM LOS
Y	– INTERSECTION Y
Y	– INTERSECTION Y WITH PROJECT RECOMMENDED IMPROVEMENTS
	– EXISTING LANE CONFIGURATION
	– BASE YEAR LANE CONFIGURATION
	– YEAR 2022 WITH PROJECT MITIGATION MEASURE





WAIALE DEVELOPMENT	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS • HONOLULU, HAWAII	FIGURE
	YEAR 2022 WITH PROJECT AND MITIGATION MEASURES VOLUMES AND LEVEL OF SERVICE	10d

Table 7: Base Year 2022 with Mitigations, Year 2022 with Project and Year 2022 with Project and Mitigations Level of Service Summary

Intersection	Base Year 2022 with Mitigation Measures						Year 2022 with Project						Year 2022 with Proejct and Mitigation Measures					
	AM			PM			AM			PM			AM			PM		
	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
Kuikahi Drive & Honoapiilani Highway																		
	Approach Modified from Existing: EB & WB: LT, TH and RT						Approach Modified from Existing: EB & WB: LT, TH and RT						Approach Modified from Existing: EB & WB: LT, TH and RT					
EB LT	22	0.14	C	27	0.09	C	25	0.17	C	43	0.12	D	36	0.20	D	43	0.12	D
EB TH	23	0.37	C	28	0.2	C	27	0.43	C	51	0.51	D	47	0.67	D	51	0.51	D
EB RT	21	0.04	C	21	0.02	C	24	0.04	C	40	0.02	D	39	0.14	D	40	0.02	D
WB LT	35	0.75	D	48	0.83	D	39	0.74	D	53	0.8	D	46	0.75	D	53	0.8	D
WB TH	22	0.12	C	29	0.39	C	25	0.15	C	49	0.63	D	36	0.19	D	49	0.63	D
WB RT	14	0.11	B	17	0.08	B	15	0.15	B	22	0.09	C	21	0.15	C	22	0.09	C
NB LT	13	0.07	B	18	0.26	B	12	0.07	B	25	0.35	C	18	0.07	B	25	0.35	C
NB TH	24	0.73	C	26	0.75	C	25	0.75	C	41	0.86	D	38	0.83	D	41	0.86	D
NB RT	16	0.23	B	15	0.12	B	15	0.21	B	11	0.11	B	22	0.24	C	11	0.09	B
SB LT	14	0.56	B	16	0.59	B	34	0.88	C	54	0.89	D	41	0.86	D	54	0.89	D
SB TH	18	0.55	B	29	0.86	C	16	0.57	B	32	**0.9**	C	19	0.56	B	32	**0.9**	C
SB RT	12	0.02	B	11	0.03	B	10	0.02	B	6	0.03	A	12	0.02	B	6	0.03	A
Overall	21	0.77	C	27	0.85	C	23	0.80	C	39	0.83	D	32	0.82	C	39	0.83	D
Kuikahi Drive & Waiale Road																		
	Approach Modified from Existing: NB: LT, TH and RT SB: Double LT, TH and RT EB: LT, TH and RT						Approach Modified from Existing: NB: LT, TH and RT SB: Double LT, TH and RT EB: LT, TH and RT						Approach Modified from Existing: NB: LT, TH and RT SB: Double LT, TH and RT EB: LT, TH and **TH/RT**					
EB LT	31	0.81	C	31	0.53	C	37	0.81	D	29	0.5	C	52	**0.91**	D	33	0.59	C
EB TH	37	0.72	D	51	0.79	D	52	0.87	D	56	0.85	**E**						
EB TH/RT													37	0.62	D	44	0.7	D
EB RT	26	0.03	C	34	0.06	C	29	0.04	C	34	0.07	C						
WB LT	34	0.72	C	45	**0.9**	D	34	0.69	C	111	**1.09**	**F***	29	0.56	C	53	**0.91**	D
WB TH	37	0.61	D	33	0.57	C	35	0.45	C	40	0.58	D	39	0.60	D	43	0.7	D
WB RT	31	0.22	C	29	0.25	C	34	0.42	C	37	0.37	D	37	0.50	D	21	0.49	C
NB LT	41	0.43	D	55	0.47	D	49	0.47	D	60	0.39	**E**	45	0.45	D	51	0.36	D
NB TH	36	0.80	D	43	0.81	D	51	**0.90**	D	53	0.87	D	38	0.83	D	47	0.87	D
NB RT	23	0.20	C	28	0.19	C	26	0.22	C	31	0.25	C	22	0.21	C	15	0.32	B
SB LT	39	0.60	D	55	0.85	D	48	0.67	D	81	**0.96**	**F**	44	0.65	D	51	0.83	D
SB TH	22	0.42	C	26	0.6	C	25	0.45	C	30	0.65	C	21	0.42	C	24	0.62	C
SB RT	20	0.13	B	20	0.18	C	22	0.13	C	22	0.21	C	18	0.13	B	9	0.19	A
Overall	31	0.79	C	37	0.83	D	38	0.84	D	51	**0.94**	D	35	0.84	C	35	0.85	D
Kuikahi Drive & Road A																		
WB LT							11	0.09	B	12	0.09	B	11	0.09	B	12	0.09	B
NB LT							85	0.80	**F**	60	0.62	**F**	85	0.80	**F**	60	0.62	**F**
NB RT							85	0.80	**F**	60	0.62	**F**	85	0.80	**F**	60	0.62	**F**

Note: * = overcapacity conditions

Table 7: Base Year 2022 with Mitigations, Year 2022 with Project and Year 2022 with Project and Mitigations Level of Service Summary Cont'd

Intersection	Base Year 2022 with Mitigation Measures						Year 2022 with Project						Year 2022 with Proejct and Mitigation Measures					
	AM			PM			AM			PM			AM			PM		
	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
Kuikahi Drive & Maui Lani Parkway																		
	Approach Modified from Existing: NB: Double LT and shared TH/RT SB: LT, TH and RT EB: shared LT/TH and channelized RT WB: TH and shared LT/RT						Approach Modified from Existing: NB: Double LT and shared TH/RT SB: LT, TH and RT EB: shared LT/TH and channelized RT WB: shared LT/TH and RT						Approach Modified from Existing: NB: Double LT and shared TH/RT SB: LT, TH and RT EB: **LT, TH** and channelized RT WB: **LT, TH** and RT					
EB LT													37	0.70	D	50	0.8	D
EB TH													26	0.04	C	30	0.06	C
EB LT/TH	50	0.82	D	43	0.82	D	40	0.75	D	58	0.87	E						
EB RT	7	0.31	A	28	0.89	C	0	0.31	A	1	0.58	A	0	0.31	A	1	0.58	A
WB LT													26	0.07	C	30	0.04	C
WB TH													27	0.11	C	31	0.17	C
WB LT/TH	29	0.20	C	25	0.19	C	27	0.18	C	31	0.2	C						
WB RT	27	0.01	C	23	0.01	C	25	0.01	C	29	0.01	C	26	0.01	C	30	0.01	C
NB LT	26	0.71	C	51	**0.9**	D	35	0.87	D	49	0.81	D	33	0.85	C	52	0.85	D
NB TH/RT	10	0.33	A	18	0.58	B	11	0.39	B	19	0.6	B	10	0.39	B	18	0.59	B
SB LT	49	0.22	D	53	0.39	D	50	0.25	D	66	0.46	E	49	0.25	D	60	0.36	E
SB TH	34	0.60	C	40	0.81	D	33	0.66	C	64	**0.95**	E	32	0.65	C	49	0.89	D
SB RT	27	0.05	C	25	0.13	C	25	0.09	C	28	0.15	C	25	0.09	C	25	0.14	C
Overall	23	0.71	C	35	0.89	C	24	0.77	C	32	0.86	C	23	0.74	C	29	0.82	C
Maui Lani Parkway & Kamehameha Avenue																		
	Approach Modified from Existing: NB & SB: LT, TH and RT EB: Double LT, TH and RT WB: LT, TH and shared TH/RT						Approach Modified from Existing: NB & SB: LT, TH and RT EB: Double LT, TH and RT WB: LT, TH and shared TH/RT						Approach Modified from Existing: NB & SB: LT, TH and RT EB: Double LT, TH **and TH/RT** WB: LT, **2 TH and RT**					
EB LT	37	0.56	D	50	0.83	D	50	0.70	D	65	0.89	E	46	0.67	D	79	**0.98**	E
EB TH	29	0.67	C	29	0.81	C	36	0.60	D	64	**0.97**	E						
EB TH/RT													35	0.55	C	43	0.86	D
EB RT	22	0.18	C	16	0.17	B	32	0.30	C	30	0.45	C						
WB LT	40	0.58	D	60	0.71	E	57	0.71	E	120	0.95	F	51	0.66	D	71	0.76	E
WB TH													38	0.66	D	63	**0.93**	E
WB TH/RT	30	0.71	C	37	0.86	D	44	0.82	D	129	1.16	F*						
WB RT													32	0.15	C	47	0.65	D
NB LT	24	0.53	C	39	0.38	D	29	0.75	C	80	**0.93**	E	23	0.71	C	51	0.82	D
NB TH	33	0.63	C	45	0.56	D	49	**0.90**	D	81	**0.99**	F	42	0.87	D	74	**0.97**	E
NB RT	27	0.17	C	40	0.05	D	25	0.23	C	34	0.12	C	23	0.22	C	20	0.07	B
SB LT	25	0.63	C	54	0.82	D	52	0.88	D	112	1.05	F*	34	0.80	C	85	**0.98**	F
SB TH	30	0.48	C	41	0.53	D	28	0.51	C	52	0.85	D	25	0.49	C	49	0.85	D
SB RT	32	0.59	C	43	0.58	D	28	0.50	C	43	0.7	D	25	0.49	C	15	0.51	B
Overall	30	0.60	C	39	0.82	D	39	0.85	D	79	1.08	E*	34	0.78	C	54	**0.92**	D

Note: * = overcapacity conditions

Table 7: Base Year 2022 with Mitigations, Year 2022 with Project and Year 2022 with Project and Mitigations Level of Service Summary Cont'd

Intersection	Base Year 2022 with Mitigation Measures						Year 2022 with Project						Year 2022 with Proejct and Mitigation Measures					
	AM			PM			AM			PM			AM			PM		
	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
Maui Lani Parkway & Kuihelani Highway																		
	Approach Modified from Existing: **NB: double LT, 2 TH** EB: LT, shared LT/TH and RT						Approach Modified from Existing: **NB: double LT, 2 TH** EB: LT, shared LT/TH and RT						Approach Modified from Existing: **NB: double LT, 2 TH** EB: LT, shared LT/TH and RT					
EB LT	21	0.58	C	42	0.76	D	43	0.80	D	50	0.81	D	36	0.76	D	50	0.81	D
EB LT/TH	21	0.58	C	42	0.76	D	43	0.80	D	50	0.81	D	36	0.76	D	50	0.81	D
EB RT	18	0.40	B	30	0.28	C	29	0.28	C	33	0.17	C	25	0.25	C	33	0.17	C
NB LT	32	0.38	C	46	0.61	D	47	0.63	D	55	0.65	D	41	0.43	D	55	0.65	D
NB TH/RT	15	0.55	B	13	0.51	B	12	0.57	B	15	0.64	B	13	0.59	B	15	0.64	B
SB TH	25	0.64	C	30	0.79	C	24	0.66	C	46	**0.96**	D	22	0.65	C	46	**0.96**	D
SB RT	1	0.38	A	2	0.67	A	4	0.41	A	9	0.77	A	3	0.42	A	9	0.77	A
Overall	17	0.63	B	23	0.72	C	22	0.70	C	31	0.87	C	20	0.71	B	31	0.87	C
Road C & Road A																		
WB LT/RT							10	0.06	A	11	0.12	B	10	0.06	A	11	0.12	B
SB LT							8	0.06	A	8	0.09	A	8	0.06	A	8	0.09	A
Road C & Kamehameha Avenue																		
EB LT/TH							16	0.20	C	36	0.56	**E**	16	0.20	C	36	0.56	**E**
EB RT							16	0.20	C	36	0.56	**E**	16	0.20	C	36	0.56	**E**
WB LT/TH							13	0.29	B	21	0.56	C	13	0.29	B	21	0.56	C
WB RT							13	0.29	B	21	0.56	C	13	0.29	B	21	0.56	C
NB LT							8	0.01	A	8	0.01	A	8	0.01	A	8	0.01	A
SB LT							8	0.07	A	8	0.13	A	8	0.07	A	8	0.13	A
Road C & Road B																		
WB LT							8	0.05	A	9	0.16	A	8	0.05	A	9	0.16	A
NB LT							22	0.45	C	84	0.89	**F**	19	0.45	C	84	0.89	**F**
NB RT							11	0.09	B	11	0.12	B	19	0.45	C	11	0.12	B
Road C & Kuihelani Highway																		
EB LT							34	0.74	C	53	0.87	D	34	0.74	C	45	0.84	D
EB RT							23	0.07	C	29	0.13	C	23	0.07	C	26	0.13	C
NB LT							39	0.59	D	47	0.7	D	39	0.59	D	52	0.79	D
NB TH							9	0.51	A	11	0.6	B	9	0.51	A	11	0.62	B
SB TH							20	0.68	B	35	**0.92**	D	20	0.68	B	30	0.89	C
SB RT							14	0.18	B	18	0.26	B	14	0.18	B	16	0.26	B

Note: * = overcapacity conditions

Table 7: Base Year 2022 with Mitigations, Year 2022 with Project and Year 2022 with Project and Mitigations Level of Service Summary Cont'd

Intersection	Base Year 2022 with Mitigation Measures						Year 2022 with Project						Year 2022 with Proejct and Mitigation Measures					
	AM			PM			AM			PM			AM			PM		
	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
Road D & Road A																		
WB LT/RT							9	0.02	A	10	0.04	B	9	0.02	A	10	0.04	B
SB LT							8	0.06	A	8	0.05	A	8	0.06	A	8	0.05	A
Road D & Kamehameha Avenue																		
EB LT/TH							10	0.11	B	16	0.23	C	10	0.11	B	16	0.23	C
EB RT							10	0.11	B	16	0.23	C	10	0.11	B	16	0.23	C
WB LT/TH							11	0.03	B	14	0.15	B	11	0.03	B	14	0.15	B
WB RT							11	0.03	B	14	0.15	B	11	0.03	B	14	0.15	B
NB LT							8	0.02	A	8	0.03	A	8	0.02	A	8	0.03	A
SB LT							8	0.01	A	8	0.02	A	8	0.01	A	8	0.02	A
Road D & Road B																		
EB LT/RT							10	0.05	A	11	0.07	B	10	0.05	A	11	0.07	B
NB LT							8	0.01	A	8	0.02	A	8	0.01	A	8	0.02	A
West Waiko Road/East Waiko Road & Honoapiilani Highway																		
EB LT/TH	41	0.35	D	38	0.29	D	40	0.35	D	37	0.29	D	40	0.35	D	37	0.29	D
EB RT	33	0.01	C	31	0.02	C	32	0.01	C	30	0.02	C	32	0.01	C	30	0.02	C
WB LT/TH/RT	50	0.66	D	52	0.72	D	50	0.69	D	57	0.78	**E**	50	0.69	D	57	0.78	**E**
NB LT	5	0.01	A	10	0.07	A	6	0.01	A	10	0.06	A	6	0.01	A	10	0.06	A
NB TH/RT	10	0.56	A	12	0.7	B	12	0.58	B	18	0.76	B	12	0.58	B	16	0.73	B
SB LT	1	0.18	A	3	0.07	A	6	0.33	A	11	0.46	B	6	0.33	A	10	0.48	B
SB TH	3	0.51	A	11	0.77	B	8	0.48	A	15	0.75	B	8	0.48	A	15	0.75	B
SB RT	0	0.01	A	2	0.04	A	5	0.01	A	6	0.04	A	5	0.01	A	6	0.04	A
Overall	11	0.58	B	15	0.75	B	15	0.62	B	20	0.76	B	15	0.62	B	19	0.75	B
East Waiko Road & Waiale Road																		
EB LT	12	0.17	B	15	0.14	B	20	0.12	C	23	0.15	C	20	0.12	C	23	0.15	C
EB TH/RT	14	0.50	B	16	0.29	B	28	0.60	C	40	0.77	D	28	0.60	C	40	0.77	D
WB LT	13	0.37	B	25	0.72	C	14	0.56	B	41	**0.92**	D	14	0.56	B	41	**0.92**	D
WB TH	12	0.15	B	15	0.24	B	16	0.14	B	19	0.28	B	16	0.14	B	19	0.28	B
WB RT	11	0.04	B	14	0.07	B	16	0.10	B	18	0.12	B	16	0.10	B	18	0.12	B
NB LT	5	0.04	A	10	0.08	B	18	0.06	B	21	0.15	C	18	0.06	B	21	0.15	C
NB TH	7	0.47	A	14	0.57	B	23	0.61	C	30	0.74	C	23	0.61	C	30	0.74	C
NB RT	6	0.14	A	11	0.18	B	19	0.21	B	21	0.25	C	19	0.21	B	21	0.25	C
SB LT	7	0.38	A	11	0.19	B	51	0.86	D	40	0.73	D	51	0.86	D	40	0.73	D
SB TH/RT	7	0.48	A	19	0.74	B	22	0.53	C	39	0.86	D	22	0.53	C	39	0.86	D
Overall	9	0.49	A	17	0.74	B	24	0.66	C	32	0.87	C	24	0.66	C	32	0.87	C

Note: * = overcapacity conditions

Table 7: Base Year 2022 with Mitigations, Year 2022 with Project and Year 2022 with Project and Mitigations Level of Service Summary Cont'd

	Base Year 2022 with Mitigation Measures						Year 2022 with Project						Year 2022 with Proejct and Mitigation Measures					
	AM			PM			AM			PM			AM			PM		
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
East Waiko Road & Waikapu Light Industrial & Access 1																		
EB LT							9	0.02	A	9	0.01	A	9	0.02	A	9	0.01	A
WB LT							10	0.01	A	10	0.04	A	10	0.01	A	10	0.04	A
NB LT							45	0.23	**E**	85	0.27	**F**	45	0.23	**E**	85	0.27	**F**
NB TH/RT							45	0.23	**E**	85	0.27	**F**	45	0.23	**E**	85	0.27	**F**
SB LT/TH/RT							27	0.06	D	67	0.41	**F**	27	0.06	D	67	0.41	**F**
East Waiko Road & Road A																		
EB LT							9	0.08	A	9	0.11	A	9	0.08	A	10	0.11	A
SB LT							16	0.24	C	32	0.56	D	16	0.24	C	42	0.7	**E**
SB RT							16	0.24	C	32	0.56	D	16	0.24	C	42	0.7	**E**
East Waiko Road & Kamehameha Avenue																		
													Singalized					
EB LT							8	0.06	A	9	0.03	A	10	0.19	B	12	0.12	B
EB TH/RT							0	0.41	0	0	0.45	0	23	0.84	C	23	0.75	C
WB LT							9	0.01	A	9	0.03	A	10	0.08	A	13	0.13	B
WB TH/RT							0	0.23	0	0	0.41	0	12	0.47	B	20	0.69	C
NB LT							72	0.42	**F**	**230**	0.65	**F**	13	0.08	B	22	0.05	C
NB TH/RT							41	0.44	**E**	86	0.69	**F**	13	0.11	B	22	0.11	C
SB LT							**501**	**1.87**	**F***	**Err**	**3.39**	**F***	15	0.38	B	24	0.32	C
SB TH/RT							28	0.45	D	82	0.89	**F**	13	0.14	B	23	0.24	C
Overall							63	0.63	B	**818**	0.61	B	17	0.63	B	22	0.57	C
East Waiko Road & Consolidated Base Yard & Access 2																		
WB LT							10	0.02	A	10	0.03	A	10	0.02	B	10	0.04	B
NB LT							25	0.24	C	34	0.33	D	30	0.29	D	35	0.34	D
NB RT							25	0.24	C	34	0.33	D	30	0.29	D	35	0.34	D
East Waiko Road & Road B																		
													Singalized					
EB LT							8	0.01	A	10	0.04	A	3	0.02	A	4	0.07	A
EB TH/RT							0	0.48	0	0	0.46	0	7	0.60	A	7	0.53	A
WB LT							10	0.01	A	9	0.03	A	5	0.03	A	3	0.05	A
WB TH/RT							0	0.24	0	0	0.46	0	9	0.29	A	5	0.54	A
NB LT							30	0.07	D	88	0.2	**F**	31	0.05	C	42	0.06	D
NB TH/RT							28	0.24	D	**140**	**0.93**	**F**	32	0.12	C	45	0.41	D
SB LT							**244**	**1.28**	**F***	**Err**	**5.01**	**F***	42	0.66	D	58	0.68	**E**
SB TH/RT							19	0.04	C	63	0.53	**F**	31	0.02	C	43	0.23	D
Overall							27	0.61	B	**525**	0.57	B	12	0.61	B	12	0.56	B

Note: * = overcapacity conditions

Table 7: Base Year 2022 with Mitigations, Year 2022 with Project and Year 2022 with Project and Mitigations Level of Service Summary Cont'd

Intersection	Base Year 2022 with Mitigation Measures						Year 2022 with Project						Year 2022 with Proejct and Mitigation Measures					
	AM			PM			AM			PM			AM			PM		
	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
East Waiko Road & Kuihelani Highway																		
													Approach Modified from Existing: EB: Double LT and RT					
EB LT	24	0.79	C	31	0.85	C	88	**1.07**	**F***	82	**1.05**	**F***	31	0.73	C	43	0.8	D
EB RT	10	0.03	A	11	0.01	B	17	0.48	B	16	0.37	B	16	0.53	B	18	0.38	B
NB LT	34	0.31	C	34	0.32	C	80	**0.92**	**F**	**395**	**1.75**	**F***	40	0.68	D	53	0.84	D
NB TH	12	0.32	B	11	0.47	B	8	0.30	A	9	0.46	A	5	0.26	A	7	0.39	A
SB TH	18	0.55	B	16	0.53	B	21	0.56	C	23	0.69	C	17	0.51	B	25	0.68	C
SB RT	1	0.14	A	1	0.3	A	2	0.16	A	2	0.34	A	3	0.16	A	6	0.34	A
Overall	16	0.69	B	15	0.71	B	33	0.79	C	58	**0.95**	**E**	18	0.60	B	23	0.75	C
Road E & Kuihelani Highway																		
EB LT/TH							39	0.32	D	40	0.31	D	40	0.34	D	50	0.34	D
EB RT							38	0.12	D	39	0.09	D	38	0.12	D	48	0.09	D
NB LT							52	0.65	D	47	0.74	D	47	0.59	D	55	0.73	D
NB TH/RT							3	0.28	A	4	0.45	A	3	0.28	A	3	0.43	A
SB TH							5	0.51	A	6	0.58	A	5	0.52	A	12	0.54	B
SB RT							2	0.04	A	1	0.08	A	2	0.04	A	8	0.08	A
Overall							10	0.50	A	10	0.58	A	9	0.50	A	13	0.56	B

Note: * = overcapacity conditions

V. CONCLUSIONS

Existing Conditions

Traffic within the study area was observed to operate relatively smoothly along Honoapiilani Highway and Kuihelani Highway. However, during the AM peak hour of traffic, congestion occurred in the northbound direction headed towards Wailuku; the queue was observed to extend to Kehalani Parkway.

Congestion also occurred at the Kuikahi Drive/Waiale Road and Maui Lani Parkway/Kamehameha Avenue intersections during the AM peak hour of traffic.

Along East Waiko Road and Waiale Road, no congestion was observed during the peak hours of traffic.

Base Year 2022

Traffic demand will increase significantly, primarily as a result of the new and/or continuing development of:

- **Waikapu Country Town** – currently in the planning phase; assumed to be completed by 2022.
- **Maui Lani Development** – partially complete; Maui Lani Development and Maui Lani 100 VMX Affordable Housing Project were assumed to be completed by Year 2022 – and therefore the final segment of Maui Lani Parkway between Kuikahi Drive and Waiinu Street were assumed to be complete to support the development.
- **Kehalani** – partially complete (commercial portion not started yet); assumed to be complete by Year 2022.
- **Puunani Residences** – not started; assumed to be complete by Year 2022.

These nearby projects will develop residential, commercial, industrial, park, school and other ancillary land uses. The Maui Lani VMX as well as the Kehalani Commercial will contribute significantly to the increases in traffic along Kuikahi Drive and Maui Lani Parkway; improvements are recommended – most notably, widening Maui Lani Parkway and Kuikahi Drive to four (4) lanes between Waiale Road and Kuihelani Highway.

Year 2022 with Project

The Project will construct new internal east-west and north-south roadways that will run parallel and perpendicular to Kuihelani Highway. Access will be provided via the Project's internal collector roadways' connections with Kuihelani Highway, Waiko Road, Kamehameha Avenue, and Kuikahi Drive.

In addition, Kamehameha Avenue will be extended from its existing terminus near Pomaikai Elementary School to 1,400 feet south of East Waiko Road and serve as an alternate (to Kuihelani Highway) north-south connection between the Project and Kahului.

The project will generate 2,575 (3,270) trips during the AM (PM) peak hours of traffic, with approximately 10 percent being assumed to be internal to the Project and 4 percent being assumed as diverted linked trips. As such, improvements are recommended at the study intersections.

VI. RECOMMENDATIONS

Base Year 2022

As recommended by the Maui Lani Development Roadway Master Plan (2002) to accommodated traffic generated by the remaining Maui Lani Development:

Kuikahi Drive*: Widen to four (4) lanes between Waiale Road and Maui Lani Parkway.*

Maui Lani Parkway:

- *Widen to four (4) lanes between Kuikahi Drive and Kuihelani Highway.*
- *Extend to four (4) lanes between Kuikahi Drive and Waiinu Street.*

Kamehameha Avenue:

- *Widen to four (4) lanes between Maui Lani Parkway and Papa Avenue.*

Additional Mitigative Measures:

Kuikahi Drive/Honoapiilani Highway:

- *Eastbound and Westbound Approaches: provide exclusive left-turn, through, and right-turn lanes.*

Kuikahi Drive/Waiale Road:

- *Northbound Approach: provide exclusive left-turn, through, and right-turn lanes.*
- *Southbound Approach: provide double left-turn, through, and right-turn lanes.*
- *Eastbound Approach: provide exclusive left-turn, through, and right-turn lanes.*

Kuikahi Drive/Maui Lani Parkway:

- *Northbound Approach: provide double left-turn and shared through/right-turn lanes*
- *Eastbound Approach: provide a channelized right-turn lane with an exclusive receiving land on the westbound approach; provided a shared through/left-turn lane.*

Maui Lani Parkway/Kamehameha Avenue:

- *It is recommended that this intersection be signalized when warranted.*
- *Northbound and Southbound Approaches: provide* exclusive *left-turn, through, and right-turn lanes.*
- *Eastbound Approach: provide double left-turn, through, and right-turn lanes.*
- *Westbound Approach: provide left-turn, through, and shared through/right-turn lanes.*

Maui Lani Parkway/Kuihelani Highway:

- *Northbound Approach: provide double left-turn lanes.*
- *Eastbound Approach: provide left-turn, shared left-turn, and right-turn lanes.*

Year 2022 with Project

Kamehameha Avenue: *extend southward as a two-lane section with turning lanes at major intersections*

East Waiko Road: *provide turning lanes at unsignalized intersections.*

Kuikahi Drive/Waiale Road:

- *Eastbound approach:* *re-stripe to provide a shared through/right-turn lane.*

Kuikahi Drive/Maui Lani Parkway:

- *Eastbound Approach: provide an exclusive left-turn lane*
- *Westbound Approach: provide an exclusive left-turn lane*

Maui Lani Parkway/Kamehameha Avenue:

- *Eastbound Approach: re-stripe to provide a shared through/right-turn lane.*
- *Westbound Approach: provide exclusive right-turn lane.*

East Waiko Road/Kamehameha Avenue:

- *It is recommended that this intersection be signalized when warranted.*

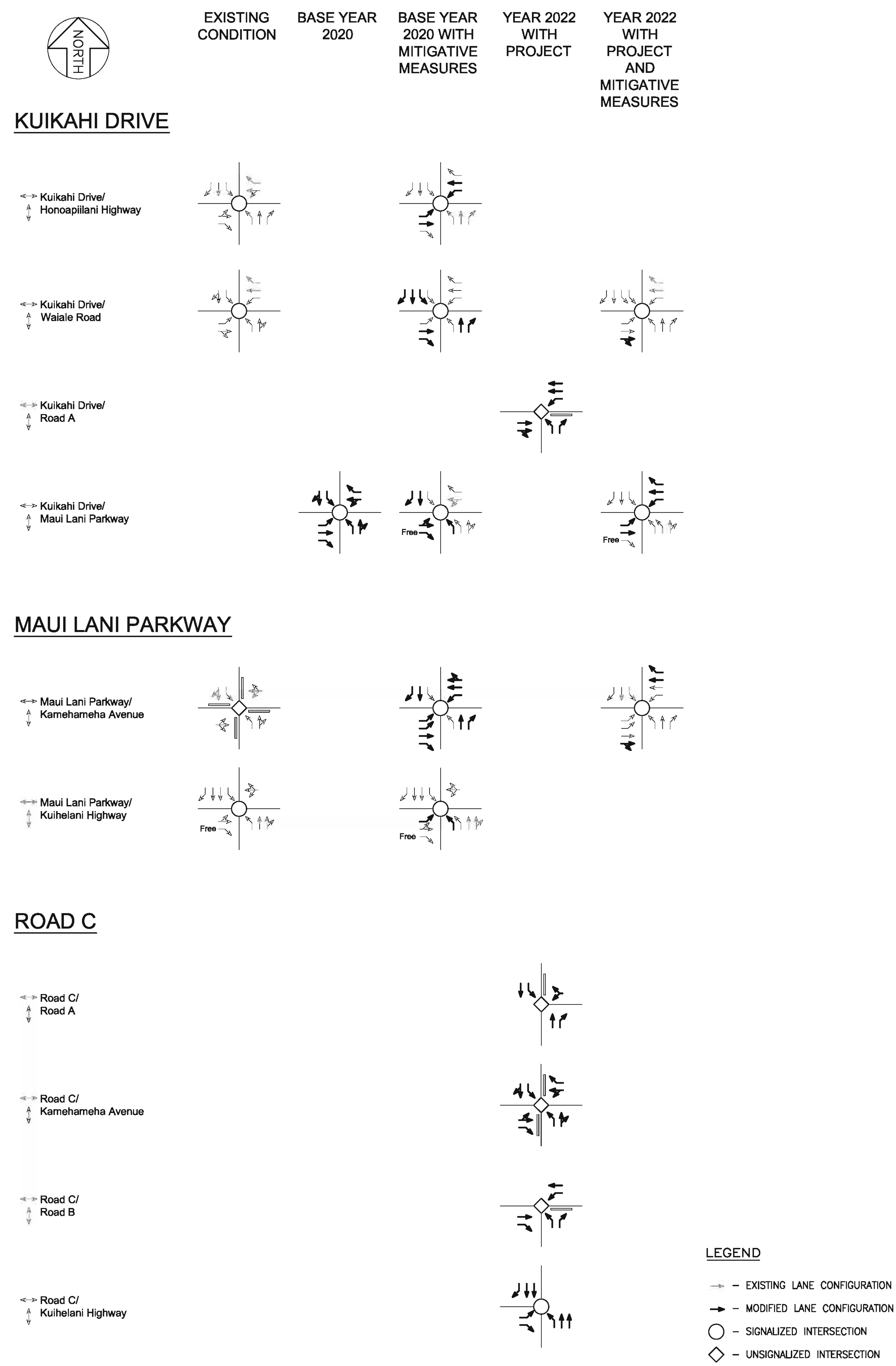
East Waiko Road/Road B:

- *It is recommended that this intersection be signalized when warranted..*

East Waiko Road/Kuihelani Highway

- *Eastbound Approach: provide double left-turn lanes.*

See Figures 11a, 11b, and 11c for a summary of recommended improvements.

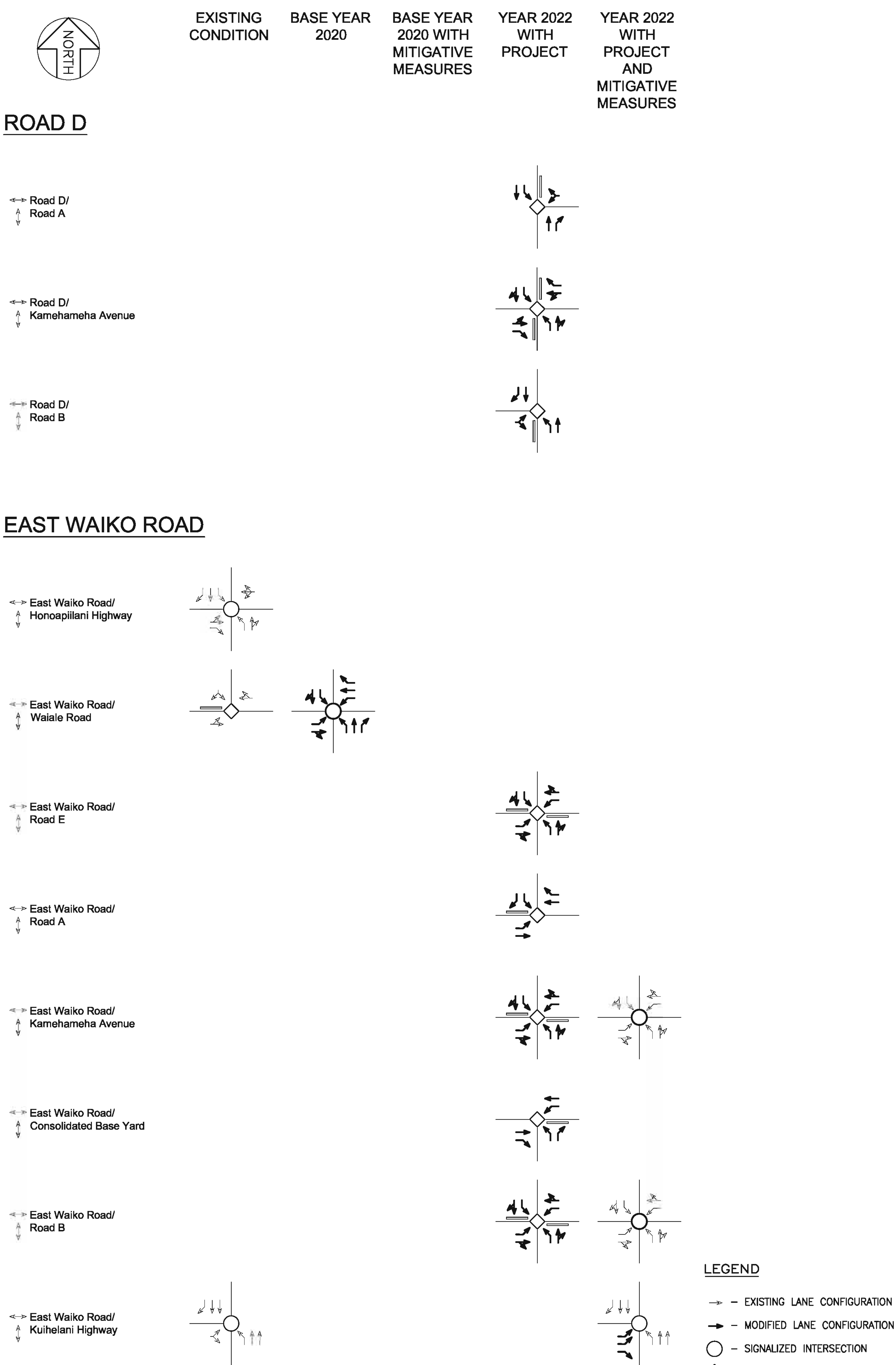


WAIALE DEVELOPMENT

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS, SURVEYORS • HONOLULU, HAWAII

LANEAGE RECOMMENDATION SUMMARY

FIGURE 11a

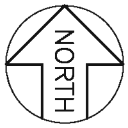


WAIALE DEVELOPMENT

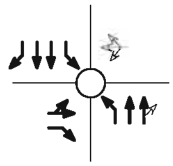
AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS, SURVEYORS • HONOLULU, HAWAII

FIGURE 11b

LANEAGE RECOMMENDATION SUMMARY



ROAD E

	EXISTING CONDITION	BASE YEAR 2020	BASE YEAR 2020 WITH MITIGATIVE MEASURES	YEAR 2022 WITH PROJECT	YEAR 2022 WITH PROJECT AND MITIGATIVE MEASURES
Road E/ Kuihelani Highway					

LEGEND

- EXISTING LANE CONFIGURATION
- MODIFIED LANE CONFIGURATION
- SIGNALIZED INTERSECTION
- UNSIGNALIZED INTERSECTION

WAIALE DEVELOPMENT	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS • HONOLULU, HAWAII	FIGURE
	LANEAGE RECCOMMENDATION SUMMARY	11c

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8. Transportation Research Board, Highway Capacity Manual, 2000.

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APPENDICES

APPENDIX A

TRAFFIC COUNT DATA

Austin, Tsutsumi & Associates

501 Sumner Street, Suite 521
Honolulu, HI 96817
Phone: 533-3646 Fax: 526-1267

File Name : AM_Honoapiilani - Kuikahi
Site Code : 00000000
Start Date : 9/29/2010
Page No : 1

Groups Printed- Unshifted

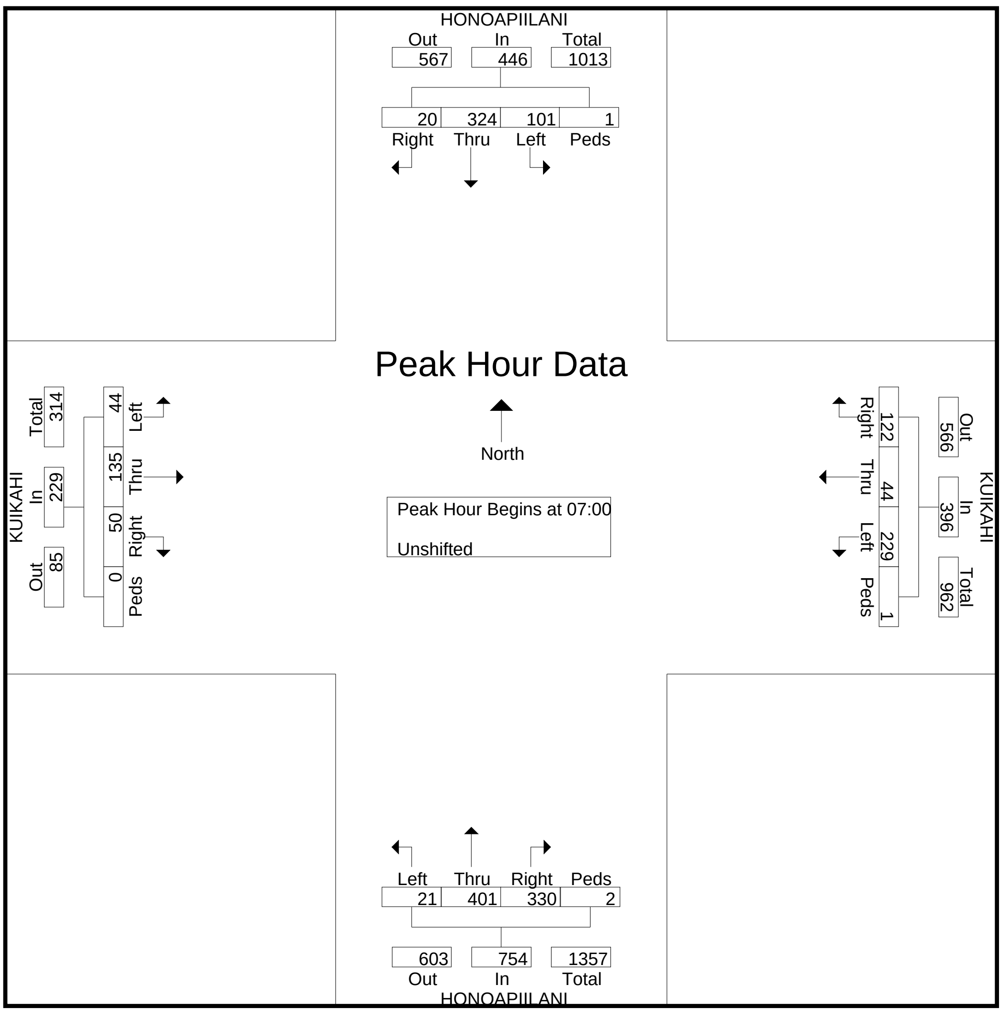
	HONOAPIILANI From North					KUIKAHI From East					HONOAPIILANI From South					KUIKAHI From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
06:45	3	83	16	0	102	15	10	49	0	74	59	53	6	0	118	9	32	9	0	50	344
Total	3	83	16	0	102	15	10	49	0	74	59	53	6	0	118	9	32	9	0	50	344
07:00	2	85	25	0	112	23	11	50	1	85	65	88	6	0	159	12	39	7	0	58	414
07:15	14	72	24	0	110	28	4	51	0	83	100	123	5	2	230	13	42	22	0	77	500
07:30	2	85	21	0	108	38	13	71	0	122	89	98	4	0	191	15	29	12	0	56	477
07:45	2	82	31	1	116	33	16	57	0	106	76	92	6	0	174	10	25	3	0	38	434
Total	20	324	101	1	446	122	44	229	1	396	330	401	21	2	754	50	135	44	0	229	1825
08:00	3	73	12	0	88	17	11	59	0	87	50	69	7	1	127	7	19	9	0	35	337
08:15	1	58	13	0	72	10	13	39	0	62	55	80	6	0	141	9	29	8	0	46	321
08:30	2	76	8	0	86	13	9	39	0	61	50	97	4	0	151	6	16	7	0	29	327
Grand Total	29	614	150	1	794	177	87	415	1	680	544	700	44	3	1291	81	231	77	0	389	3154
Apprch %	3.7	77.3	18.9	0.1		26	12.8	61	0.1		42.1	54.2	3.4	0.2		20.8	59.4	19.8	0		
Total %	0.9	19.5	4.8	0	25.2	5.6	2.8	13.2	0	21.6	17.2	22.2	1.4	0.1	40.9	2.6	7.3	2.4	0	12.3	

Austin, Tsutsumi & Associates

501 Sumner Street, Suite 521
Honolulu, HI 96817
Phone: 533-3646 Fax: 526-1267

File Name : AM_Honoapiilani - Kuikahi
Site Code : 00000000
Start Date : 9/29/2010

	HONOAPIILANI From North					KUIKAHI From East					HONOAPIILANI From South					KUIKAHI From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:45 to 08:30 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00																					
07:00	2	**85**	25	0	112	23	11	50	**1**	85	65	88	**6**	0	159	12	39	7	0	58	414
07:15	**14**	72	24	0	110	28	4	51	0	83	**100**	**123**	5	**2**	**230**	13	**42**	**22**	0	**77**	**500**
07:30	2	85	21	0	108	**38**	13	**71**	0	**122**	89	98	4	0	191	**15**	29	12	0	56	477
07:45	2	82	**31**	**1**	**116**	33	**16**	57	0	106	76	92	6	0	174	10	25	3	0	38	434
Total Volume	20	324	101	1	446	122	44	229	1	396	330	401	21	2	754	50	135	44	0	229	1825
% App. Total	4.5	72.6	22.6	0.2		30.8	11.1	57.8	0.3		43.8	53.2	2.8	0.3		21.8	59	19.2	0		
PHF	.357	.953	.815	.250	.961	.803	.688	.806	.250	.811	.825	.815	.875	.250	.820	.833	.804	.500	.000	.744	.913



Peak Hour Analysis From 06:45 to 08:30 - Peak 1 of 1

Peak Hour for Each Approach Begins at:

	07:00					**07:15**					**07:00**					**06:45**				
+0 mins.	**2**	85	25	0	112	28	4	51	0	83	65	88	6	0	159	9	32	9	0	50
+15 mins.	14	72	24	0	110	38	13	**71**	0	**122**	**100**	**123**	5	**2**	**230**	12	39	7	0	58
+30 mins.	2	85	21	0	108	33	**16**	57	0	106	89	98	4	0	191	13	**42**	**22**	0	**77**
+45 mins.	2	82	**31**	**1**	**116**	17	11	59	0	87	76	92	6	0	174	**15**	29	12	0	56
Total Volume	20	324	101	1	446	116	44	238	0	398	330	401	21	2	754	49	142	50	0	241
% App. Total	4.5	72.6	22.6	0.2		29.1	11.1	59.8	0		43.8	53.2	2.8	0.3		20.3	58.9	20.7	0	
PHF	.357	.953	.815	.250	.961	.763	.688	.838	.000	.816	.825	.815	.875	.250	.820	.817	.845	.568	.000	.782

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File Name : AM_Waiale - Kuikahi
Site Code : 00000000
Start Date : 9/29/2010
Page No : 1

Groups Printed- Unshifted

	WAIALE From North					KUIKAHI From East					WAIALE From South					KUIKAHI From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
06:45	48	34	36	0	118	55	16	6	0	77	12	36	5	1	54	10	38	54	1	103	352
Total	48	34	36	0	118	55	16	6	0	77	12	36	5	1	54	10	38	54	1	103	352
07:00	55	20	35	0	110	46	18	5	0	69	28	37	16	0	81	5	51	74	0	130	390
07:15	45	25	39	0	109	80	25	9	0	114	43	47	13	0	103	5	42	114	0	161	487
07:30	66	27	26	0	119	79	41	12	0	132	16	51	10	0	77	5	29	129	0	163	491
07:45	47	24	32	0	103	61	43	20	0	124	5	43	4	1	53	6	33	94	0	133	413
Total	213	96	132	0	441	266	127	46	0	439	92	178	43	1	314	21	155	411	0	587	1781
08:00	57	23	27	0	107	45	34	4	0	83	9	19	7	0	35	2	25	59	0	86	311
08:15	35	14	20	0	69	21	17	9	0	47	7	19	5	0	31	3	28	80	0	111	258
08:30	35	13	26	0	74	22	21	8	0	51	4	17	4	0	25	0	20	48	0	68	218
Grand Total	388	180	241	0	809	409	215	73	0	697	124	269	64	2	459	36	266	652	1	955	2920
Apprch %	48	22.2	29.8	0		58.7	30.8	10.5	0		27	58.6	13.9	0.4		3.8	27.9	68.3	0.1		
Total %	13.3	6.2	8.3	0	27.7	14	7.4	2.5	0	23.9	4.2	9.2	2.2	0.1	15.7	1.2	9.1	22.3	0	32.7	

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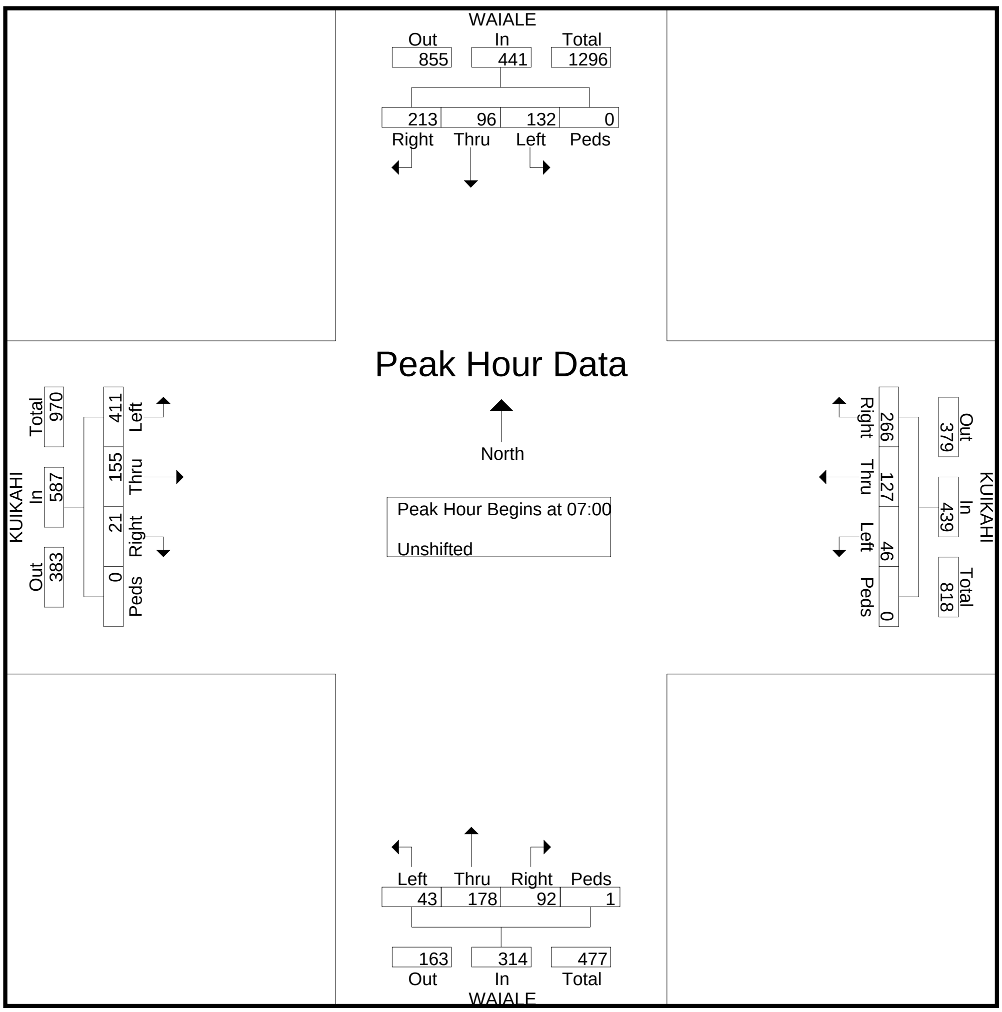
File Name : AM_Waiale - Kuikahi
Site Code : 00000000
Start Date : 9/29/2010
Page No : 3

	WAIALE From North					KUIKAHI From East					WAIALE From South					KUIKAHI From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 to 07:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00																					
07:00	55	20	35	0	110	46	18	5	0	69	28	37	**16**	0	81	5	**51**	74	0	130	390
07:15	45	25	**39**	0	109	**80**	25	9	0	114	**43**	47	13	0	**103**	5	42	114	0	161	487
07:30	**66**	**27**	26	0	**119**	79	41	12	0	**132**	16	**51**	10	0	77	5	29	**129**	0	**163**	**491**
07:45	47	24	32	0	103	61	**43**	**20**	0	124	5	43	4	**1**	53	**6**	33	94	0	133	413
Total Volume	213	96	132	0	441	266	127	46	0	439	92	178	43	1	314	21	155	411	0	587	1781
% App. Total	48.3	21.8	29.9	0		60.6	28.9	10.5	0		29.3	56.7	13.7	0.3		3.6	26.4	70	0		
PHF	.807	.889	.846	.000	.926	.831	.738	.575	.000	.831	.535	.873	.672	.250	.762	.875	.760	.797	.000	.900	.907



Peak Hour Analysis From 07:00 to 07:45 - Peak 1 of 1

Peak Hour for Each Approach Begins at:

	07:00					**07:00**					**07:00**					**07:00**				
+0 mins.	**55**	**20**	**35**	**0**	**110**	**46**	**18**	**5**	**0**	**69**	**28**	**37**	16	0	81	5	51	74	0	130
+15 mins.	45	25	39	0	109	80	25	9	0	114	**43**	47	13	0	**103**	5	42	114	0	161
+30 mins.	**66**	**27**	26	0	**119**	79	41	12	0	**132**	16	**51**	10	0	77	5	29	**129**	0	**163**
+45 mins.	47	24	32	0	103	61	**43**	**20**	0	124	5	43	4	**1**	53	**6**	33	94	0	133
Total Volume	213	96	132	0	441	266	127	46	0	439	92	178	43	1	314	21	155	411	0	587
% App. Total	48.3	21.8	29.9	0		60.6	28.9	10.5	0		29.3	56.7	13.7	0.3		3.6	26.4	70	0	
PHF	.807	.889	.846	.000	.926	.831	.738	.575	.000	.831	.535	.873	.672	.250	.762	.875	.760	.797	.000	.900

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File Name : AM_S Kamehameha - Maui Lani
Site Code : 00000000
Start Date : 9/29/2010

Groups Printed- Unshifted

	S KAMEHAMEHA From North					MAUI LANI From East					S KAMEHAMEHA From South					MAUI LANI From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
06:45	37	21	54	0	112	23	33	15	0	71	9	11	11	1	32	10	30	35	1	76	291
Total	37	21	54	0	112	23	33	15	0	71	9	11	11	1	32	10	30	35	1	76	291
07:00	40	45	50	0	135	25	31	22	0	78	21	33	17	0	71	11	26	41	1	79	363
07:15	51	48	45	0	144	34	35	28	0	97	18	45	28	0	91	36	25	36	0	97	429
07:30	59	43	35	0	137	35	36	20	0	91	32	57	61	1	151	34	19	26	2	81	460
07:45	45	13	49	0	107	30	39	4	0	73	23	28	26	0	77	5	35	25	0	65	322
Total	195	149	179	0	523	124	141	74	0	339	94	163	132	1	390	86	105	128	3	322	1574
08:00	30	6	39	0	75	20	36	7	0	63	5	5	6	1	17	3	28	25	0	56	211
08:15	19	4	26	0	49	33	25	6	0	64	0	2	3	0	5	4	34	23	0	61	179
08:30	24	4	28	0	56	25	26	1	0	52	2	6	0	0	8	4	23	19	0	46	162
Grand Total	305	184	326	0	815	225	261	103	0	589	110	187	152	3	452	107	220	230	4	561	2417
Apprch %	37.4	22.6	40	0		38.2	44.3	17.5	0		24.3	41.4	33.6	0.7		19.1	39.2	41	0.7		
Total %	12.6	7.6	13.5	0	33.7	9.3	10.8	4.3	0	24.4	4.6	7.7	6.3	0.1	18.7	4.4	9.1	9.5	0.2	23.2	

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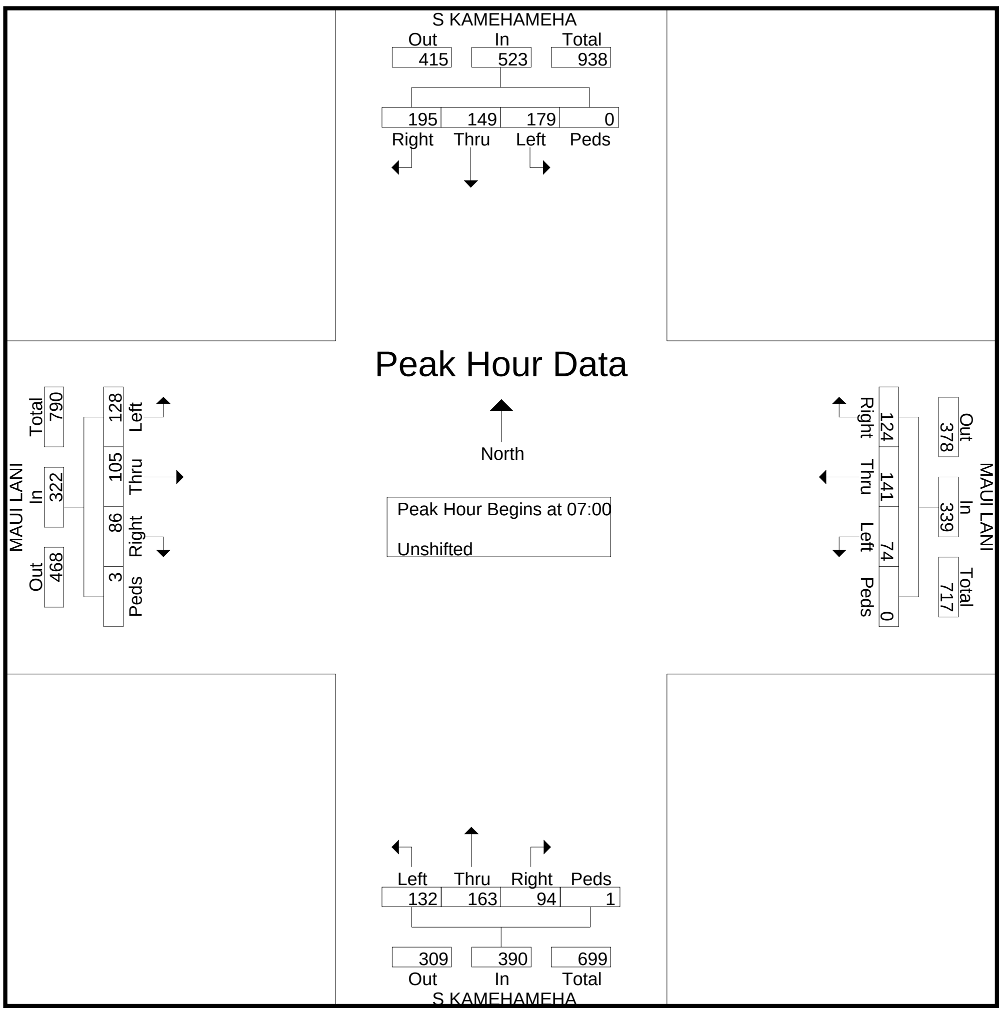
	S KAMEHAMEHA From North					MAUI LANI From East					S KAMEHAMEHA From South					MAUI LANI From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:45 to 08:30 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00																					
07:00	40	45	**50**	0	135	25	31	22	0	78	21	33	17	0	71	11	26	**41**	1	79	363
07:15	51	**48**	45	0	**144**	34	35	**28**	0	**97**	18	45	28	0	91	**36**	25	36	0	**97**	429
07:30	**59**	43	35	0	137	**35**	36	20	0	91	**32**	**57**	**61**	**1**	**151**	34	19	26	**2**	81	**460**
07:45	45	13	49	0	107	30	**39**	4	0	73	23	28	26	0	77	5	**35**	25	0	65	322
Total Volume	195	149	179	0	523	124	141	74	0	339	94	163	132	1	390	86	105	128	3	322	1574
% App. Total	37.3	28.5	34.2	0		36.6	41.6	21.8	0		24.1	41.8	33.8	0.3		26.7	32.6	39.8	0.9		
PHF	.826	.776	.895	.000	.908	.886	.904	.661	.000	.874	.734	.715	.541	.250	.646	.597	.750	.780	.375	.830	.855



Peak Hour Analysis From 06:45 to 08:30 - Peak 1 of 1

Peak Hour for Each Approach Begins at:

	06:45					**07:00**					**07:00**					**06:45**				
+0 mins.	**37**	**21**	54	0	112	25	31	22	0	78	21	33	17	0	71	10	30	35	1	76
+15 mins.	40	45	50	0	135	34	35	28	0	97	18	45	28	0	91	11	26	**41**	1	79
+30 mins.	51	**48**	45	0	**144**	**35**	36	20	0	91	**32**	**57**	**61**	**1**	**151**	**36**	25	36	0	**97**
+45 mins.	**59**	43	35	0	137	30	**39**	4	0	73	23	28	26	0	77	34	19	26	**2**	81
Total Volume	187	157	184	0	528	124	141	74	0	339	94	163	132	1	390	91	100	138	4	333
% App. Total	35.4	29.7	34.8	0		36.6	41.6	21.8	0		24.1	41.8	33.8	0.3		27.3	30	41.4	1.2	
PHF	.792	.818	.852	.000	.917	.886	.904	.661	.000	.874	.734	.715	.541	.250	.646	.632	.833	.841	.500	.858

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File Name : Kuihelani @ Maui Lani AM
Site Code : 00000000
Start Date : 9/29/2010
Page No : 1

Groups Printed- Unshifted

	KUIHELANI From North					MAUILANI From East					KUIHELANI From South					MAUILANI From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
06:45	63	115	0	0	178	0	0	0	0	0	0	79	11	0	90	45	0	74	0	119	387
Total	63	115	0	0	178	0	0	0	0	0	0	79	11	0	90	45	0	74	0	119	387
07:00	48	100	0	0	148	0	0	0	1	1	0	98	14	0	112	47	0	61	0	108	369
07:15	67	84	0	0	151	0	0	0	0	0	0	98	30	0	128	36	0	80	0	116	395
07:30	58	117	0	0	175	0	0	0	0	0	0	143	22	0	165	23	0	82	0	105	445
07:45	55	104	0	0	159	0	0	0	0	0	0	141	7	0	148	35	0	100	0	135	442
Total	228	405	0	0	633	0	0	0	1	1	0	480	73	0	553	141	0	323	0	464	1651
08:00	53	109	0	0	162	0	0	0	0	0	0	114	10	0	124	26	0	56	0	82	368
08:15	40	94	0	0	134	0	0	0	0	0	0	105	14	0	119	16	0	49	3	68	321
08:30	45	111	1	0	157	0	0	0	0	0	0	110	15	0	125	9	0	47	1	57	339
Grand Total	429	834	1	0	1264	0	0	0	1	1	0	888	123	0	1011	237	0	549	4	790	3066
Apprch %	33.9	66	0.1	0		0	0	0	100		0	87.8	12.2	0		30	0	69.5	0.5		
Total %	14	27.2	0	0	41.2	0	0	0	0	0	0	29	4	0	33	7.7	0	17.9	0.1	25.8	

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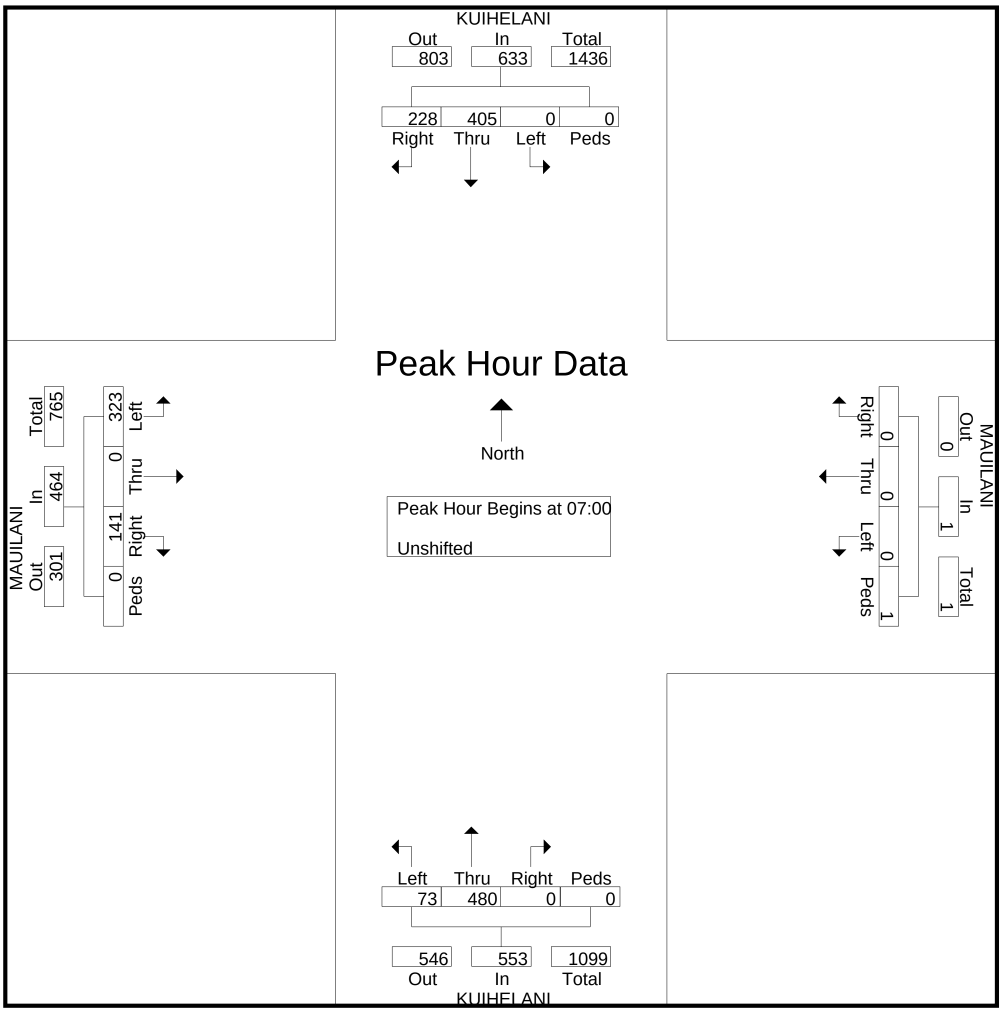
File Name : Kuihelani @ Maui Lani AM
Site Code : 00000000
Start Date : 9/29/2010

	KUIHELANI From North					MAUILANI From East					KUIHELANI From South					MAUILANI From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:45 to 08:30 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00																					
07:00	48	100	0	0	148	0	0	0	**1**	**1**	0	98	14	0	112	**47**	0	61	0	108	369
07:15	**67**	84	0	0	151	0	0	0	0	0	0	98	**30**	0	128	36	0	80	0	116	395
07:30	58	**117**	0	0	**175**	0	0	0	0	0	0	**143**	22	0	**165**	23	0	82	0	105	**445**
07:45	55	104	0	0	159	0	0	0	0	0	0	141	7	0	148	35	0	**100**	0	**135**	442
Total Volume	228	405	0	0	633	0	0	0	1	1	0	480	73	0	553	141	0	323	0	464	1651
% App. Total	36	64	0	0		0	0	0	100		0	86.8	13.2	0		30.4	0	69.6	0		
PHF	.851	.865	.000	.000	.904	.000	.000	.000	.250	.250	.000	.839	.608	.000	.838	.750	.000	.808	.000	.859	.928



Peak Hour Analysis From 06:45 to 08:30 - Peak 1 of 1

Peak Hour for Each Approach Begins at:

	06:45					**06:45**					**07:15**					**07:00**				
+0 mins.	**63**	**115**	**0**	**0**	178	0	0	0	0	0	0	98	30	0	128	47	0	61	0	108
+15 mins.	48	100	0	0	148	0	0	0	1	**1**	0	**143**	22	0	**165**	36	0	80	0	116
+30 mins.	**67**	84	0	0	151	0	0	0	0	0	0	141	7	0	148	23	0	82	0	105
+45 mins.	58	**117**	0	0	175	0	0	0	0	0	0	114	10	0	124	35	0	**100**	0	**135**
Total Volume	236	416	0	0	652	0	0	0	1	1	0	496	69	0	565	141	0	323	0	464
% App. Total	36.2	63.8	0	0		0	0	0	100		0	87.8	12.2	0		30.4	0	69.6	0	
PHF	.881	.889	.000	.000	.916	.000	.000	.000	.250	.250	.000	.867	.575	.000	.856	.750	.000	.808	.000	.859

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File Name : AM_Honoapiilani - Waiko
Site Code : 00000000
Start Date : 9/29/2010

Groups Printed- Unshifted

	HONOAPIILANI From North					WAIKO From East					HONOAPIILANI From South					WAIKO From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
06:45	2	147	6	2	157	4	1	18	0	23	6	99	3	0	108	2	5	2	0	9	297
Total	2	147	6	2	157	4	1	18	0	23	6	99	3	0	108	2	5	2	0	9	297
07:00	2	137	12	0	151	10	1	20	0	31	7	103	1	0	111	3	7	12	0	22	315
07:15	2	132	25	0	159	5	0	12	0	17	13	193	0	0	206	2	5	7	0	14	396
07:30	5	137	20	0	162	7	1	11	0	19	11	159	0	0	170	2	5	6	0	13	364
07:45	4	143	15	0	162	5	1	12	0	18	12	147	2	0	161	1	5	4	0	10	351
Total	13	549	72	0	634	27	3	55	0	85	43	602	3	0	648	8	22	29	0	59	1426
08:00	4	130	7	0	141	7	3	12	0	22	9	107	1	0	117	2	4	2	0	8	288
08:15	3	97	8	0	108	7	0	16	0	23	4	116	0	0	120	0	1	3	0	4	255
08:30	1	102	5	0	108	7	2	10	0	19	2	133	0	0	135	0	2	4	0	6	268
Grand Total	23	1025	98	2	1148	52	9	111	0	172	64	1057	7	0	1128	12	34	40	0	86	2534
Apprch %	2	89.3	8.5	0.2		30.2	5.2	64.5	0		5.7	93.7	0.6	0		14	39.5	46.5	0		
Total %	0.9	40.4	3.9	0.1	45.3	2.1	0.4	4.4	0	6.8	2.5	41.7	0.3	0	44.5	0.5	1.3	1.6	0	3.4	

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File Name : AM_Honoapiilani - Waiko
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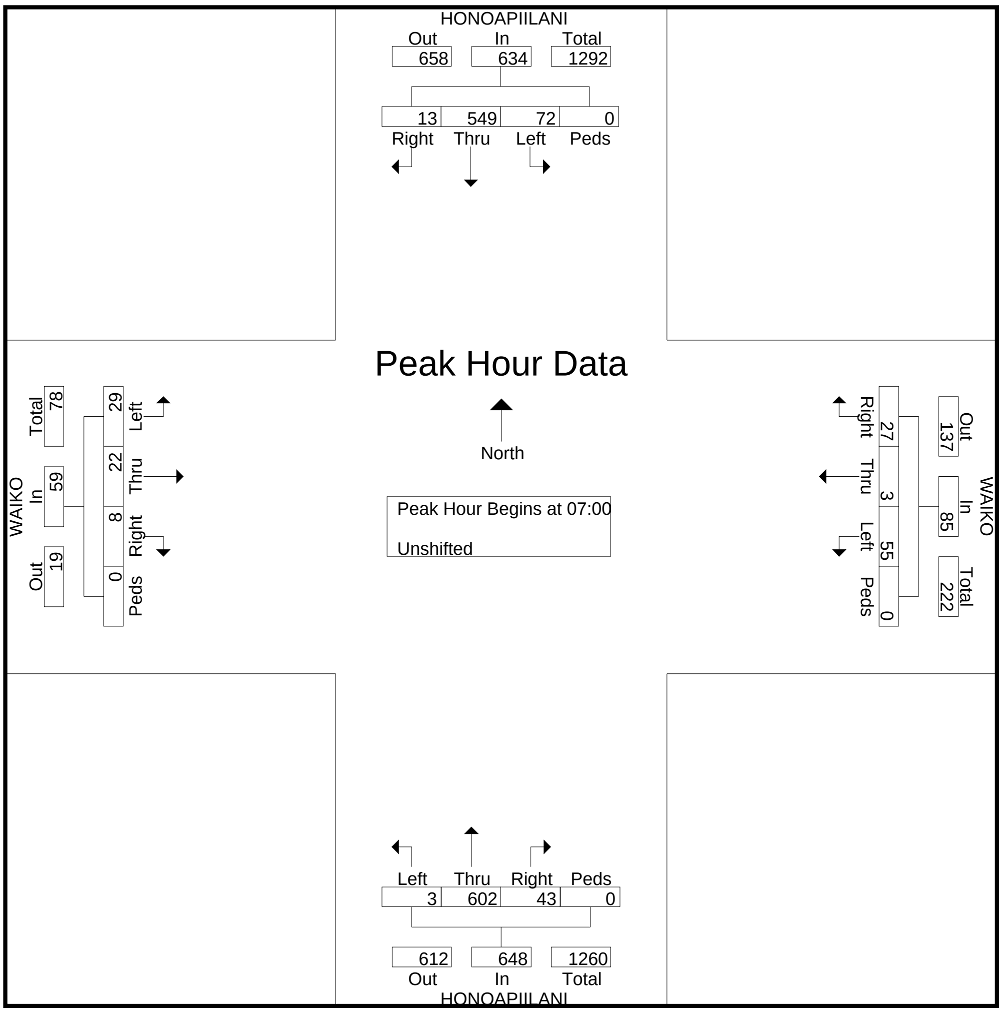
Start Date : 9/29/2010

	HONOAPIILANI From North					WAIKO From East					HONOAPIILANI From South					WAIKO From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:45 to 08:30 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00																					
07:00	2	137	12	0	151	**10**	**1**	**20**	0	**31**	7	103	1	0	111	**3**	**7**	**12**	0	**22**	315
07:15	2	132	**25**	0	159	5	0	12	0	17	**13**	**193**	0	0	**206**	2	5	7	0	14	**396**
07:30	**5**	137	20	0	**162**	7	1	11	0	19	11	159	0	0	170	2	5	6	0	13	364
07:45	4	**143**	15	0	162	5	1	12	0	18	12	147	**2**	0	161	1	5	4	0	10	351
Total Volume	13	549	72	0	634	27	3	55	0	85	43	602	3	0	648	8	22	29	0	59	1426
% App. Total	2.1	86.6	11.4	0		31.8	3.5	64.7	0		6.6	92.9	0.5	0		13.6	37.3	49.2	0		
PHF	.650	.960	.720	.000	.978	.675	.750	.688	.000	.685	.827	.780	.375	.000	.786	.667	.786	.604	.000	.670	.900



Peak Hour Analysis From 06:45 to 08:30 - Peak 1 of 1

Peak Hour for Each Approach Begins at:

	07:00					06:45					07:15					07:00				
+0 mins.	**2**	**137**	**12**	**0**	**151**	**4**	1	18	0	23	13	193	0	0	206	**3**	**7**	**12**	0	**22**
+15 mins.	2	132	**25**	0	159	**10**	1	**20**	0	**31**	11	159	0	0	170	2	5	7	0	14
+30 mins.	**5**	137	20	0	**162**	5	0	12	0	17	12	147	**2**	0	161	2	5	6	0	13
+45 mins.	4	**143**	15	0	162	7	1	11	0	19	9	107	1	0	117	1	5	4	0	10
Total Volume	13	549	72	0	634	26	3	61	0	90	45	606	3	0	654	8	22	29	0	59
% App. Total	2.1	86.6	11.4	0		28.9	3.3	67.8	0		6.9	92.7	0.5	0		13.6	37.3	49.2	0	
PHF	.650	.960	.720	.000	.978	.650	.750	.763	.000	.726	.865	.785	.375	.000	.794	.667	.786	.604	.000	.670

Austin, Tsutsumi & Associates

501 Sumner Street, Suite 521
Honolulu, HI 96817
Phone: 533-3646 Fax: 526-1267

File Name : AM_Waiale - E Waiko
Site Code : 00000000
Start Date : 9/29/2010
Page No : 1

Groups Printed- Unshifted

	WAIALE From North					E WAIKO From East					WAIALE From South					E WAIKO From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
06:45	19	0	37	0	56	15	9	0	0	24	0	0	0	0	0	0	11	6	0	17	97
Total	19	0	37	0	56	15	9	0	0	24	0	0	0	0	0	0	11	6	0	17	97
07:00	23	0	28	0	51	10	9	0	0	19	0	0	0	0	0	0	22	6	0	28	98
07:15	11	1	44	0	56	16	5	0	0	21	0	0	0	0	0	1	39	10	0	50	127
07:30	11	0	35	0	46	13	11	0	0	24	0	0	0	0	0	0	32	11	0	43	113
07:45	7	0	20	1	28	13	8	0	0	21	0	0	0	0	0	0	24	9	0	33	82
Total	52	1	127	1	181	52	33	0	0	85	0	0	0	0	0	1	117	36	0	154	420
08:00	9	0	14	0	23	15	13	0	0	28	0	0	0	0	0	0	12	7	0	19	70
08:15	10	0	19	0	29	9	9	0	0	18	0	0	0	0	0	0	13	0	0	13	60
08:30	8	0	17	0	25	3	13	0	0	16	0	0	0	0	0	0	6	2	0	8	49
Grand Total	98	1	214	1	314	94	77	0	0	171	0	0	0	0	0	1	159	51	0	211	696
Apprch %	31.2	0.3	68.2	0.3		55	45	0	0		0	0	0	0		0.5	75.4	24.2	0		
Total %	14.1	0.1	30.7	0.1	45.1	13.5	11.1	0	0	24.6	0	0	0	0	0	0.1	22.8	7.3	0	30.3	

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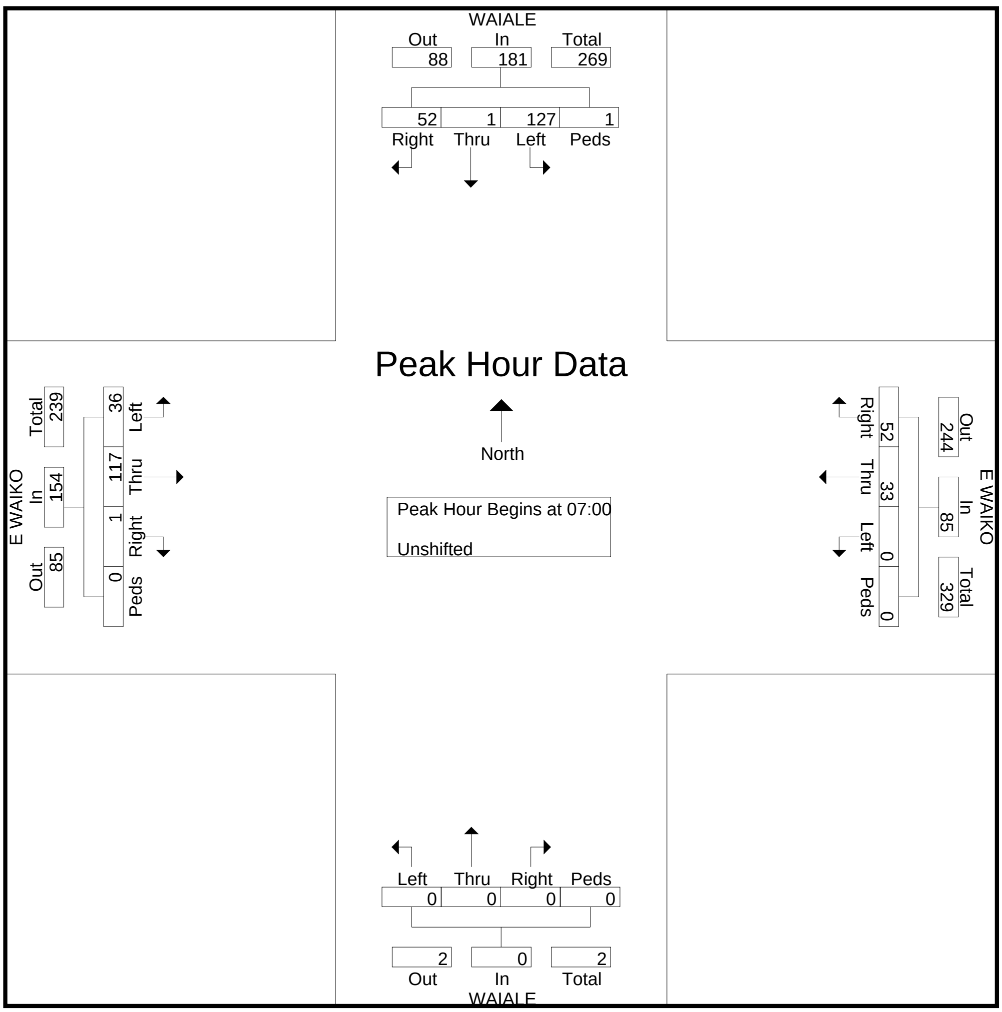
File Name : AM_Waiale - E Waiko
Site Code : 00000000
Start Date : 9/29/2010
Page No : 3

	WAIALE From North					E WAIKO From East					WAIALE From South					E WAIKO From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 to 07:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00																					
07:00	**23**	0	28	0	51	10	9	0	0	19	0	0	0	0	0	0	22	6	0	28	98
07:15	11	**1**	**44**	0	**56**	**16**	5	0	0	21	0	0	0	0	0	**1**	**39**	10	0	**50**	**127**
07:30	11	0	35	0	46	13	**11**	0	0	**24**	0	0	0	0	0	0	32	**11**	0	43	113
07:45	7	0	20	**1**	28	13	8	0	0	21	0	0	0	0	0	0	24	9	0	33	82
Total Volume	52	1	127	1	181	52	33	0	0	85	0	0	0	0	0	1	117	36	0	154	420
% App. Total	28.7	0.6	70.2	0.6		61.2	38.8	0	0		0	0	0	0		0.6	76	23.4	0		
PHF	.565	.250	.722	.250	.808	.813	.750	.000	.000	.885	.000	.000	.000	.000	.000	.250	.750	.818	.000	.770	.827



Peak Hour Analysis From 07:00 to 07:45 - Peak 1 of 1

Peak Hour for Each Approach Begins at:

	07:00					07:00					07:00					07:00				
+0 mins.	23	0	28	0	51	10	9	0	0	19	0	0	0	0	0	0	22	6	0	28
+15 mins.	11	1	44	0	56	**16**	5	0	0	21	0	0	0	0	0	**1**	**39**	10	0	**50**
+30 mins.	11	0	35	0	46	13	**11**	0	0	**24**	0	0	0	0	0	0	32	**11**	0	43
+45 mins.	7	0	20	**1**	28	13	8	0	0	21	0	0	0	0	0	0	24	9	0	33
Total Volume	52	1	127	1	181	52	33	0	0	85	0	0	0	0	0	1	117	36	0	154
% App. Total	28.7	0.6	70.2	0.6		61.2	38.8	0	0		0	0	0	0		0.6	76	23.4	0	
PHF	.565	.250	.722	.250	.808	.813	.750	.000	.000	.885	.000	.000	.000	.000	.000	.250	.750	.818	.000	.770

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File Name : AM_Kuihelani - E Waiko
Site Code : 00000000
Start Date : 9/29/2010
Page No : 1

Groups Printed- Unshifted

	KUIHELANI From North					E WAIKO From East					KUIHELANI From South					E WAIKO From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
06:45	39	129	0	0	168	0	0	0	0	0	0	59	3	0	62	2	0	34	0	36	266
Total	39	129	0	0	168	0	0	0	0	0	0	59	3	0	62	2	0	34	0	36	266
07:00	25	117	0	0	142	0	0	0	0	0	0	64	3	1	68	10	0	50	0	60	270
07:15	18	119	0	1	138	0	0	0	0	0	0	65	2	0	67	3	0	64	0	67	272
07:30	26	102	0	0	128	0	0	0	0	0	0	96	3	0	99	6	0	68	0	74	301
07:45	35	93	0	0	128	0	0	0	0	0	0	109	3	0	112	5	0	43	0	48	288
Total	104	431	0	1	536	0	0	0	0	0	0	334	11	1	346	24	0	225	0	249	1131
08:00	36	111	0	0	147	0	0	0	0	0	0	89	2	0	91	4	0	26	0	30	268
08:15	19	104	0	3	126	0	0	0	0	0	0	96	0	0	96	4	0	32	0	36	258
08:30	19	103	0	2	124	0	0	0	0	0	0	116	2	0	118	5	0	15	0	20	262
Grand Total	217	878	0	6	1101	0	0	0	0	0	0	694	18	1	713	39	0	332	0	371	2185
Apprch %	19.7	79.7	0	0.5		0	0	0	0		0	97.3	2.5	0.1		10.5	0	89.5	0		
Total %	9.9	40.2	0	0.3	50.4	0	0	0	0	0	0	31.8	0.8	0	32.6	1.8	0	15.2	0	17	

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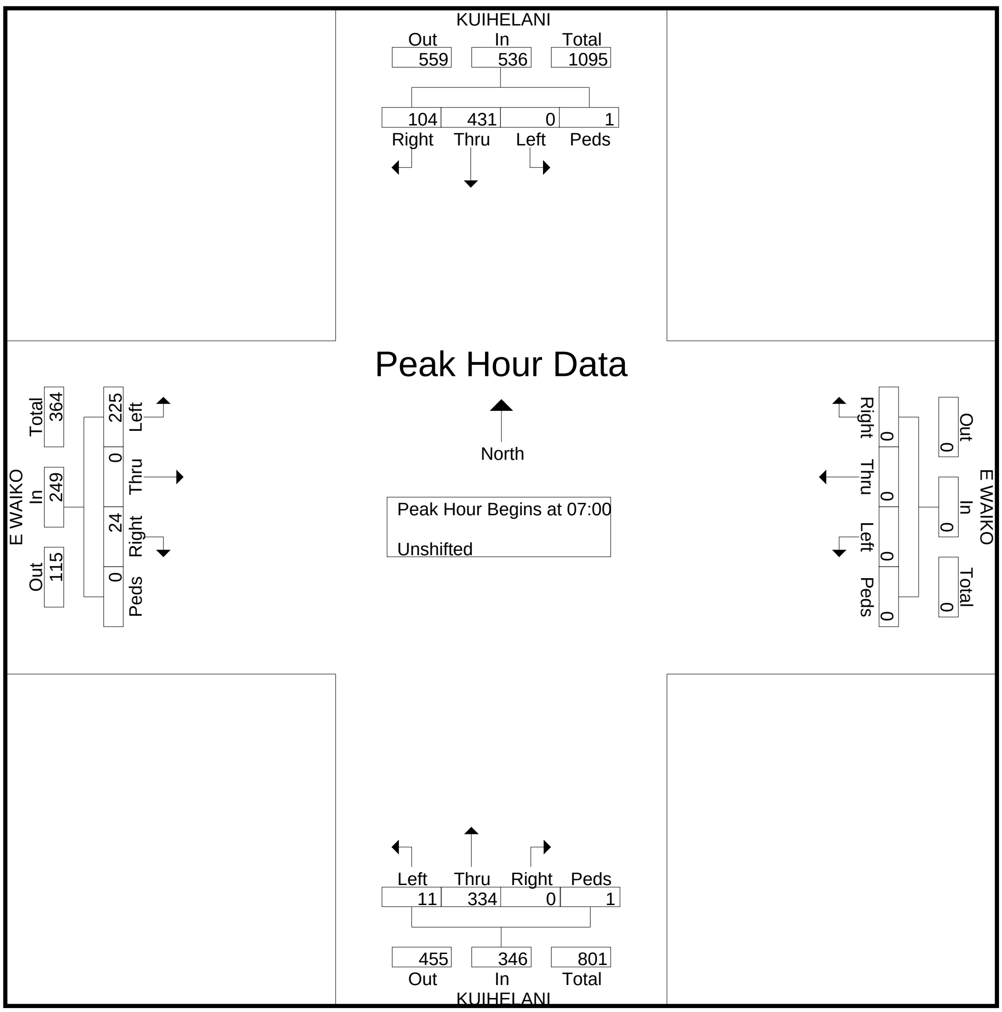
File Name : AM_Kuihelani - E Waiko
Site Code : 00000000
Start Date : 9/29/2010

	KUIHELANI From North					E WAIKO From East					KUIHELANI From South					E WAIKO From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:45 to 08:30 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00																					
07:00	25	117	0	0	**142**	0	0	0	0	0	0	64	**3**	**1**	68	**10**	0	50	0	60	270
07:15	18	**119**	0	**1**	138	0	0	0	0	0	0	65	2	0	67	3	0	64	0	67	272
07:30	26	102	0	0	128	0	0	0	0	0	0	96	3	0	99	6	0	**68**	0	**74**	**301**
07:45	**35**	93	0	0	128	0	0	0	0	0	0	**109**	3	0	**112**	5	0	43	0	48	288
Total Volume	104	431	0	1	536	0	0	0	0	0	0	334	11	1	346	24	0	225	0	249	1131
% App. Total	19.4	80.4	0	0.2		0	0	0	0		0	96.5	3.2	0.3		9.6	0	90.4	0		
PHF	.743	.905	.000	.250	.944	.000	.000	.000	.000	.000	.000	.766	.917	.250	.772	.600	.000	.827	.000	.841	.939



Peak Hour Analysis From 06:45 to 08:30 - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	06:45					06:45					07:45					07:00				
+0 mins.	39	129	0	0	168	0	0	0	0	0	0	109	3	0	112	**10**	0	50	0	60
+15 mins.	25	117	0	0	142	0	0	0	0	0	0	89	2	0	91	3	0	64	0	67
+30 mins.	18	119	0	**1**	138	0	0	0	0	0	0	96	0	0	96	6	0	**68**	0	**74**
+45 mins.	26	102	0	0	128	0	0	0	0	0	0	**116**	2	0	**118**	5	0	43	0	48
Total Volume	108	467	0	1	576	0	0	0	0	0	0	410	7	0	417	24	0	225	0	249
% App. Total	18.8	81.1	0	0.2		0	0	0	0		0	98.3	1.7	0		9.6	0	90.4	0	
PHF	.692	.905	.000	.250	.857	.000	.000	.000	.000	.000	.000	.884	.583	.000	.883	.600	.000	.827	.000	.841

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File Name : PM_Honoapiilani - Kuikahi
Site Code : 00000000
Start Date : 9/28/2010

Groups Printed- Unshifted

	HONOAPIILANI From North					KUIKAHI From East					HONOAPIILANI From South					KUIKAHI From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
15:15	4	73	14	0	91	19	22	54	2	97	35	89	9	2	135	5	15	7	0	27	350
15:30	9	83	21	0	113	17	21	70	0	108	45	84	7	0	136	6	16	2	0	24	381
15:45	8	88	23	0	119	17	28	54	0	99	59	115	12	0	186	5	15	4	0	24	428
Total	21	244	58	0	323	53	71	178	2	304	139	288	28	2	457	16	46	13	0	75	1159
16:00	10	90	23	0	123	23	27	61	0	111	51	81	7	0	139	5	21	5	0	31	404
16:15	5	95	21	1	122	17	38	68	0	123	55	87	9	0	151	5	18	6	0	29	425
16:30	12	113	27	0	152	20	27	63	0	110	52	82	10	0	144	4	10	4	0	18	424
16:45	12	140	16	0	168	19	24	73	0	116	62	83	6	0	151	4	14	2	0	20	455
Total	39	438	87	1	565	79	116	265	0	460	220	333	32	0	585	18	63	17	0	98	1708
17:00	11	104	34	0	149	24	27	65	0	116	54	68	11	0	133	8	17	1	0	26	424
Grand Total	71	786	179	1	1037	156	214	508	2	880	413	689	71	2	1175	42	126	31	0	199	3291
Apprch %	6.8	75.8	17.3	0.1		17.7	24.3	57.7	0.2		35.1	58.6	6	0.2		21.1	63.3	15.6	0		
Total %	2.2	23.9	5.4	0	31.5	4.7	6.5	15.4	0.1	26.7	12.5	20.9	2.2	0.1	35.7	1.3	3.8	0.9	0	6	

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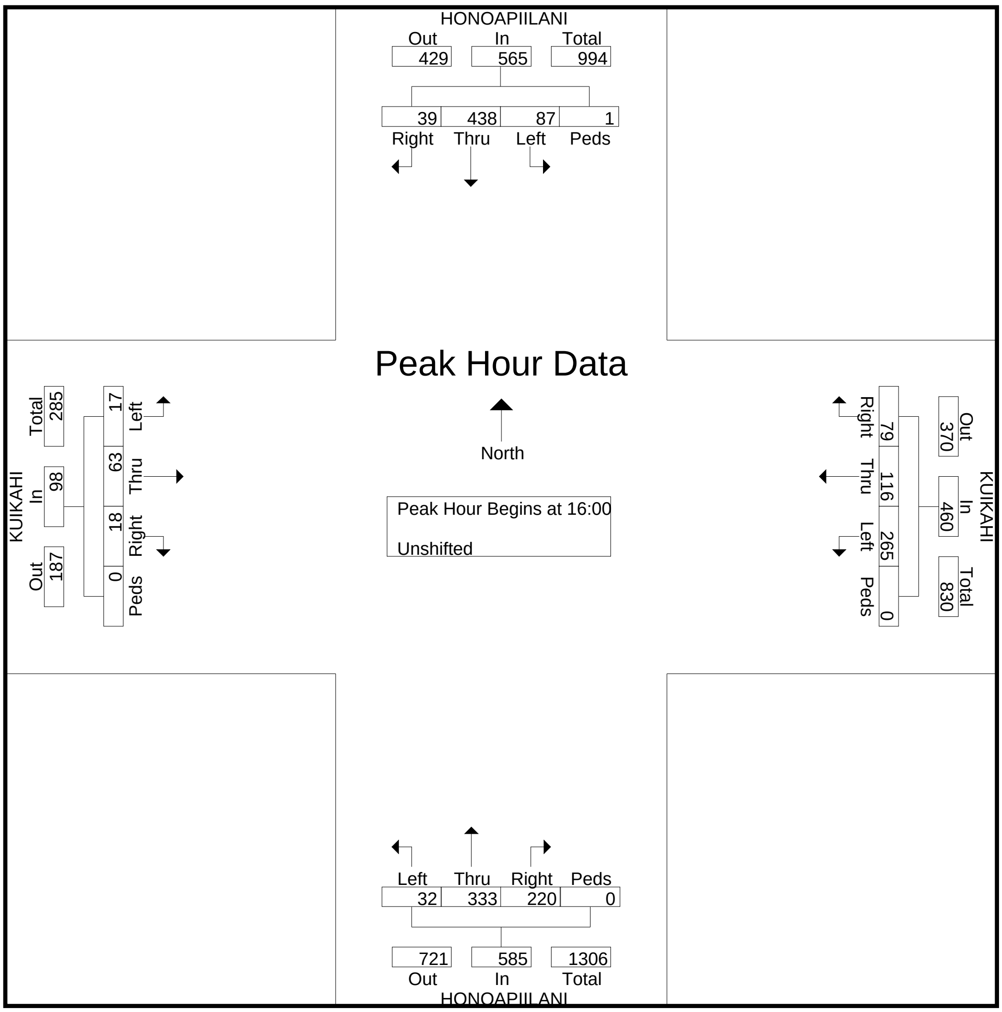
	HONOAPIILANI From North					KUIKAHI From East					HONOAPIILANI From South					KUIKAHI From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 16:00 to 16:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 16:00																					
16:00	10	90	23	0	123	**23**	27	61	0	111	51	81	7	0	139	**5**	**21**	5	0	**31**	404
16:15	5	95	21	**1**	122	17	**38**	68	0	**123**	55	**87**	9	0	**151**	5	18	**6**	0	29	425
16:30	**12**	113	**27**	0	152	20	27	63	0	110	52	82	**10**	0	144	4	10	4	0	18	424
16:45	12	**140**	16	0	**168**	19	24	**73**	0	116	**62**	83	6	0	151	4	14	2	0	20	**455**
Total Volume	39	438	87	1	565	79	116	265	0	460	220	333	32	0	585	18	63	17	0	98	1708
% App. Total	6.9	77.5	15.4	0.2		17.2	25.2	57.6	0		37.6	56.9	5.5	0		18.4	64.3	17.3	0		
PHF	.813	.782	.806	.250	.841	.859	.763	.908	.000	.935	.887	.957	.800	.000	.969	.900	.750	.708	.000	.790	.938



Peak Hour Analysis From 16:00 to 16:45 - Peak 1 of 1

Peak Hour for Each Approach Begins at:

	16:00					**16:00**					**16:00**					**16:00**				
+0 mins.	**10**	**90**	**23**	**0**	**123**	23	27	61	0	111	51	81	7	0	139	5	21	5	0	31
+15 mins.	5	95	21	**1**	122	17	**38**	68	0	**123**	55	**87**	9	0	**151**	5	18	**6**	0	29
+30 mins.	**12**	113	**27**	0	152	20	27	63	0	110	52	82	**10**	0	144	4	10	4	0	18
+45 mins.	12	**140**	16	0	**168**	19	24	**73**	0	116	**62**	83	6	0	151	4	14	2	0	20
Total Volume	39	438	87	1	565	79	116	265	0	460	220	333	32	0	585	18	63	17	0	98
% App. Total	6.9	77.5	15.4	0.2		17.2	25.2	57.6	0		37.6	56.9	5.5	0		18.4	64.3	17.3	0	
PHF	.813	.782	.806	.250	.841	.859	.763	.908	.000	.935	.887	.957	.800	.000	.969	.900	.750	.708	.000	.790

Austin, Tsutsumi, and Associates

501Sumner Street, Suite 521
Honolulu, HI 96817-5031

Kuikahi Dr & Waiale
PM peak
weather: overcast

File Name : REDO Waiale @ Kuikahi PM
Site Code : 00000000
Start Date : 12/23/2010
Page No : 1

Groups Printed- Unshifted - Bank 1

	Waiale From North				Kuikahi From East				Waiale From South				Kuikahi From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
04:00 PM	64	27	42	0	43	33	9	0	19	29	10	0	10	35	45	0	366
04:15 PM	68	24	50	0	36	54	13	0	11	26	3	0	7	40	58	0	390
04:30 PM	61	36	77	0	41	45	16	0	12	26	4	0	8	37	39	0	402
04:45 PM	73	39	55	0	43	39	21	0	9	25	4	0	5	26	67	0	406
Total	266	126	224	0	163	171	59	0	51	106	21	0	30	138	209	0	1564
Grand Total	266	126	224	0	163	171	59	0	51	106	21	0	30	138	209	0	1564
Apprch %	43.2	20.5	36.4	0	41.5	43.5	15	0	28.7	59.6	11.8	0	8	36.6	55.4	0	
Total %	17	8.1	14.3	0	10.4	10.9	3.8	0	3.3	6.8	1.3	0	1.9	8.8	13.4	0	
Unshifted	266	126	224	0	163	171	59	0	51	106	21	0	30	138	209	0	1564
% Unshifted	100	100	100	0	100	100	100	0	100	100	100	0	100	100	100	0	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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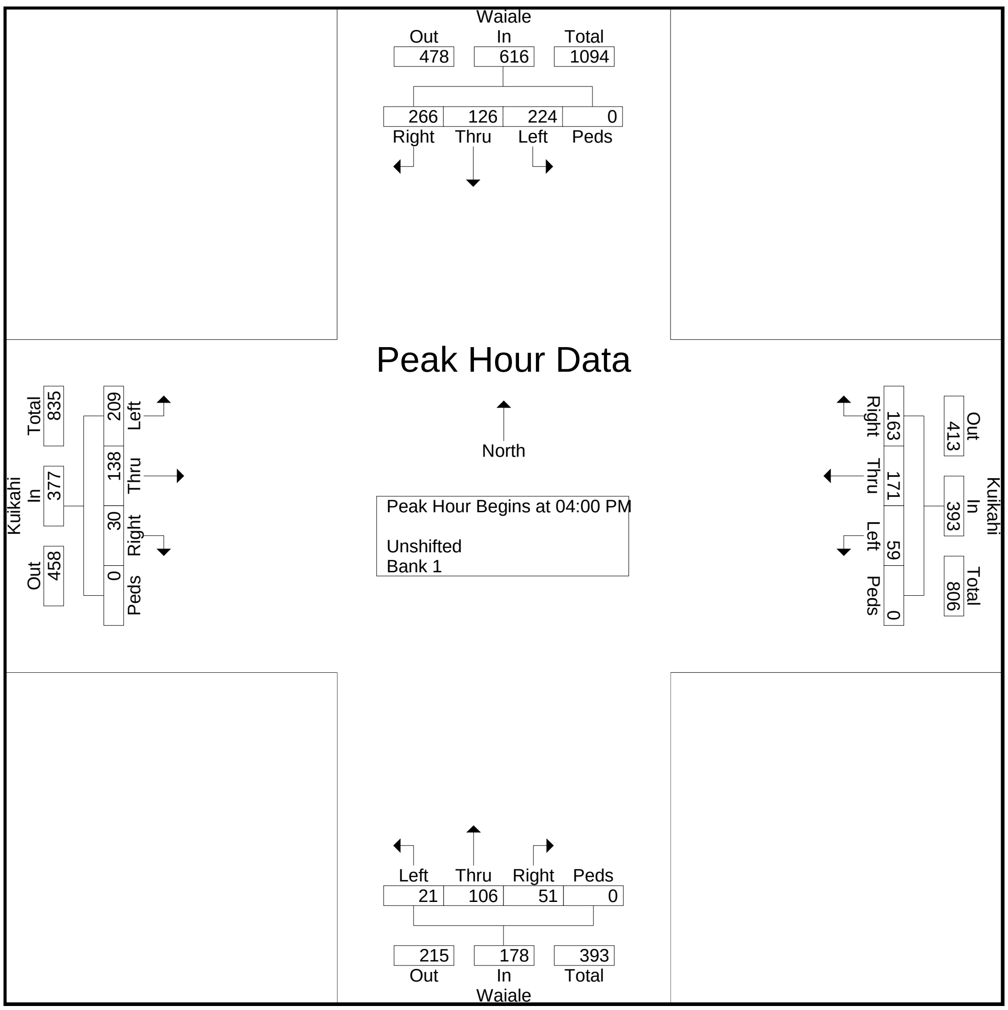
501Sumner Street, Suite 521
Honolulu, HI 96817-5031

Kuikahi Dr & Waiale
PM peak
weather: overcast

File Name : REDO Waiale @ Kuikahi PM
Site Code : 00000000
Start Date : 12/23/2010

	Waiale From North					Kuikahi From East					Waiale From South					Kuikahi From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 04:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:00 PM																					
04:00 PM	64	27	42	0	133	43	33	9	0	85	19	29	10	0	58	10	35	45	0	90	366
04:15 PM	68	24	50	0	142	36	54	13	0	103	11	26	3	0	40	7	40	58	0	105	390
04:30 PM	61	36	77	0	174	41	45	16	0	102	12	26	4	0	42	8	37	39	0	84	402
04:45 PM	73	39	55	0	167	43	39	21	0	103	9	25	4	0	38	5	26	67	0	98	406
Total Volume	266	126	224	0	616	163	171	59	0	393	51	106	21	0	178	30	138	209	0	377	1564
% App. Total	43.2	20.5	36.4	0		41.5	43.5	15	0		28.7	59.6	11.8	0		8	36.6	55.4	0		
PHF	.911	.808	.727	.000	.885	.948	.792	.702	.000	.954	.671	.914	.525	.000	.767	.750	.863	.780	.000	.898	.963



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File Name : PM_S Kamehameha - Maui Lani
Site Code : 00000000
Start Date : 9/28/2010
Page No : 1

Groups Printed- Unshifted

	S KAMEHAMEHA From North					MAUI LANI From East					S KAMEHAMEHA From South					MAUI LANI From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
15:15	35	17	33	0	85	50	40	7	0	97	9	21	11	0	41	9	25	23	1	58	281
15:30	37	11	29	0	77	56	49	3	0	108	13	19	5	1	38	9	38	45	1	93	316
15:45	42	19	35	0	96	76	34	8	0	118	5	18	8	0	31	5	27	39	0	71	316
Total	114	47	97	0	258	182	123	18	0	323	27	58	24	1	110	23	90	107	2	222	913
16:00	30	26	30	0	86	60	48	10	0	118	6	20	6	1	33	11	41	46	0	98	335
16:15	60	33	42	0	135	57	38	13	0	108	8	23	10	0	41	15	39	43	0	97	381
16:30	56	21	43	0	120	63	40	10	0	113	14	26	12	2	54	16	41	58	4	119	406
16:45	51	18	26	0	95	70	42	9	0	121	6	25	8	0	39	13	38	54	0	105	360
Total	197	98	141	0	436	250	168	42	0	460	34	94	36	3	167	55	159	201	4	419	1482
17:00	46	15	44	0	105	50	43	11	0	104	6	16	8	2	32	8	40	47	0	95	336
Grand Total	357	160	282	0	799	482	334	71	0	887	67	168	68	6	309	86	289	355	6	736	2731
Apprch %	44.7	20	35.3	0		54.3	37.7	8	0		21.7	54.4	22	1.9		11.7	39.3	48.2	0.8		
Total %	13.1	5.9	10.3	0	29.3	17.6	12.2	2.6	0	32.5	2.5	6.2	2.5	0.2	11.3	3.1	10.6	13	0.2	26.9	

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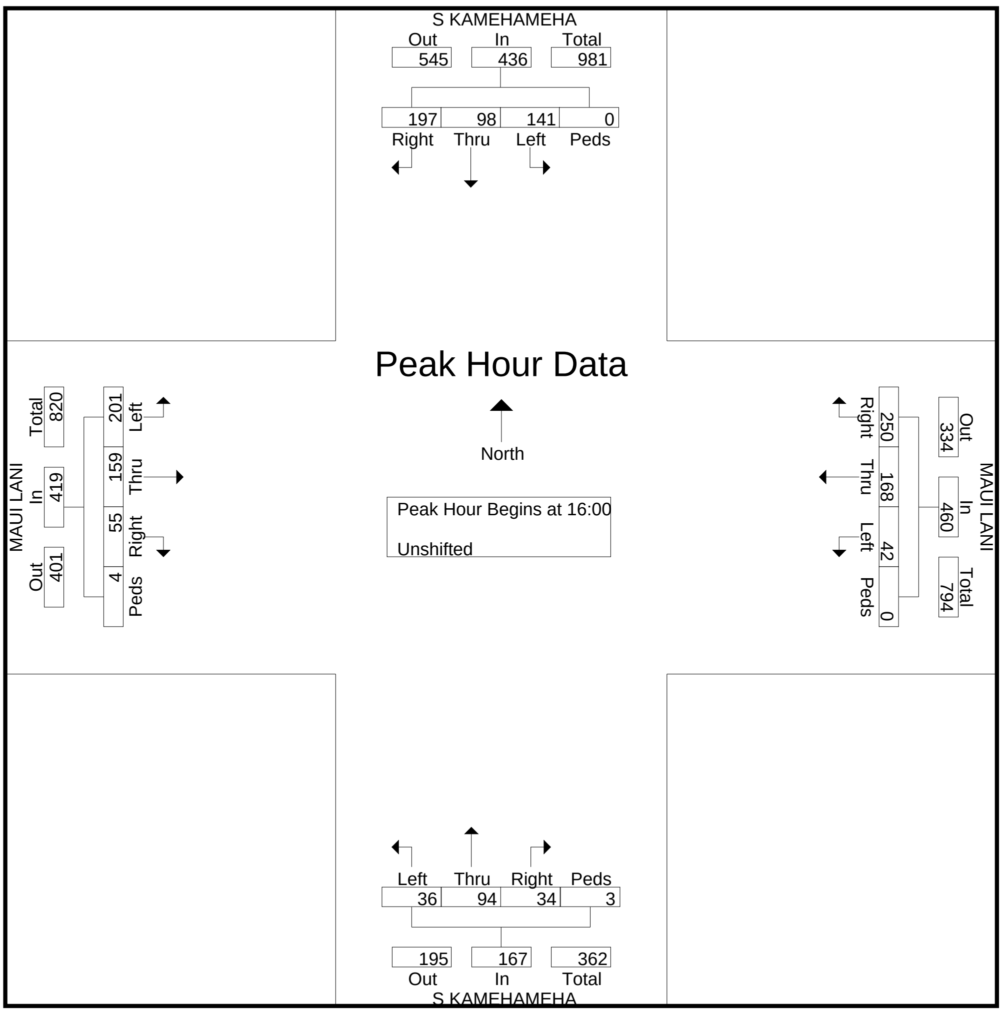
File Name : PM_S Kamehameha - Maui Lani
Site Code : 00000000
Start Date : 9/28/2010
Page No : 3

	S KAMEHAMEHA From North					MAUI LANI From East					S KAMEHAMEHA From South					MAUI LANI From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 16:00 to 16:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 16:00																					
16:00	30	26	30	0	86	60	**48**	10	0	118	6	20	6	1	33	11	**41**	46	0	98	335
16:15	**60**	**33**	42	0	**135**	57	38	**13**	0	108	8	23	10	0	41	15	39	43	0	97	381
16:30	56	21	**43**	0	120	63	40	10	0	113	**14**	**26**	**12**	**2**	**54**	**16**	41	**58**	**4**	**119**	**406**
16:45	51	18	26	0	95	**70**	42	9	0	**121**	6	25	8	0	39	13	38	54	0	105	360
Total Volume	197	98	141	0	436	250	168	42	0	460	34	94	36	3	167	55	159	201	4	419	1482
% App. Total	45.2	22.5	32.3	0		54.3	36.5	9.1	0		20.4	56.3	21.6	1.8		13.1	37.9	48	1		
PHF	.821	.742	.820	.000	.807	.893	.875	.808	.000	.950	.607	.904	.750	.375	.773	.859	.970	.866	.250	.880	.913



Peak Hour Analysis From 16:00 to 16:45 - Peak 1 of 1

Peak Hour for Each Approach Begins at:

	16:00					**16:00**					**16:00**					**16:00**				
+0 mins.	**30**	**26**	**30**	**0**	**86**	**60**	48	10	0	118	6	20	6	1	33	11	41	46	0	98
+15 mins.	60	33	42	0	**135**	57	38	**13**	0	108	8	23	10	0	41	15	39	43	0	97
+30 mins.	56	21	**43**	0	120	63	40	10	0	113	**14**	**26**	**12**	**2**	**54**	**16**	41	**58**	**4**	**119**
+45 mins.	51	18	26	0	95	**70**	42	9	0	**121**	6	25	8	0	39	13	38	54	0	105
Total Volume	197	98	141	0	436	250	168	42	0	460	34	94	36	3	167	55	159	201	4	419
% App. Total	45.2	22.5	32.3	0		54.3	36.5	9.1	0		20.4	56.3	21.6	1.8		13.1	37.9	48	1	
PHF	.821	.742	.820	.000	.807	.893	.875	.808	.000	.950	.607	.904	.750	.375	.773	.859	.970	.866	.250	.880

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File Name : PM_Kuihelani - Maui Lani
Site Code : 00000000
Start Date : 9/28/2010

Groups Printed- Unshifted

	KUIHELANI From North					MAUI LANI From East					KUIHELANI From South					MAUI LANI From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
15:15	73	154	0	0	227	0	0	0	0	0	0	99	26	0	125	18	0	44	0	62	414
15:30	89	146	0	0	235	0	0	0	0	0	0	103	34	0	137	13	0	74	0	87	459
15:45	86	135	0	0	221	0	0	0	0	0	0	109	42	0	151	19	0	39	0	58	430
Total	248	435	0	0	683	0	0	0	0	0	0	311	102	0	413	50	0	157	0	207	1303
16:00	88	149	0	0	237	0	0	0	0	0	0	135	31	0	166	19	0	65	0	84	487
16:15	79	146	0	0	225	0	0	0	0	0	0	113	32	0	145	19	0	60	0	79	449
16:30	103	132	0	0	235	0	0	0	0	0	0	106	31	0	137	24	0	67	0	91	463
16:45	93	158	0	0	251	0	0	0	0	0	0	132	35	0	167	7	0	56	0	63	481
Total	363	585	0	0	948	0	0	0	0	0	0	486	129	0	615	69	0	248	0	317	1880
17:00	79	126	0	0	205	0	0	0	0	0	0	108	30	0	138	14	0	69	0	83	426
Grand Total	690	1146	0	0	1836	0	0	0	0	0	0	905	261	0	1166	133	0	474	0	607	3609
Apprch %	37.6	62.4	0	0		0	0	0	0		0	77.6	22.4	0		21.9	0	78.1	0		
Total %	19.1	31.8	0	0	50.9	0	0	0	0	0	0	25.1	7.2	0	32.3	3.7	0	13.1	0	16.8	

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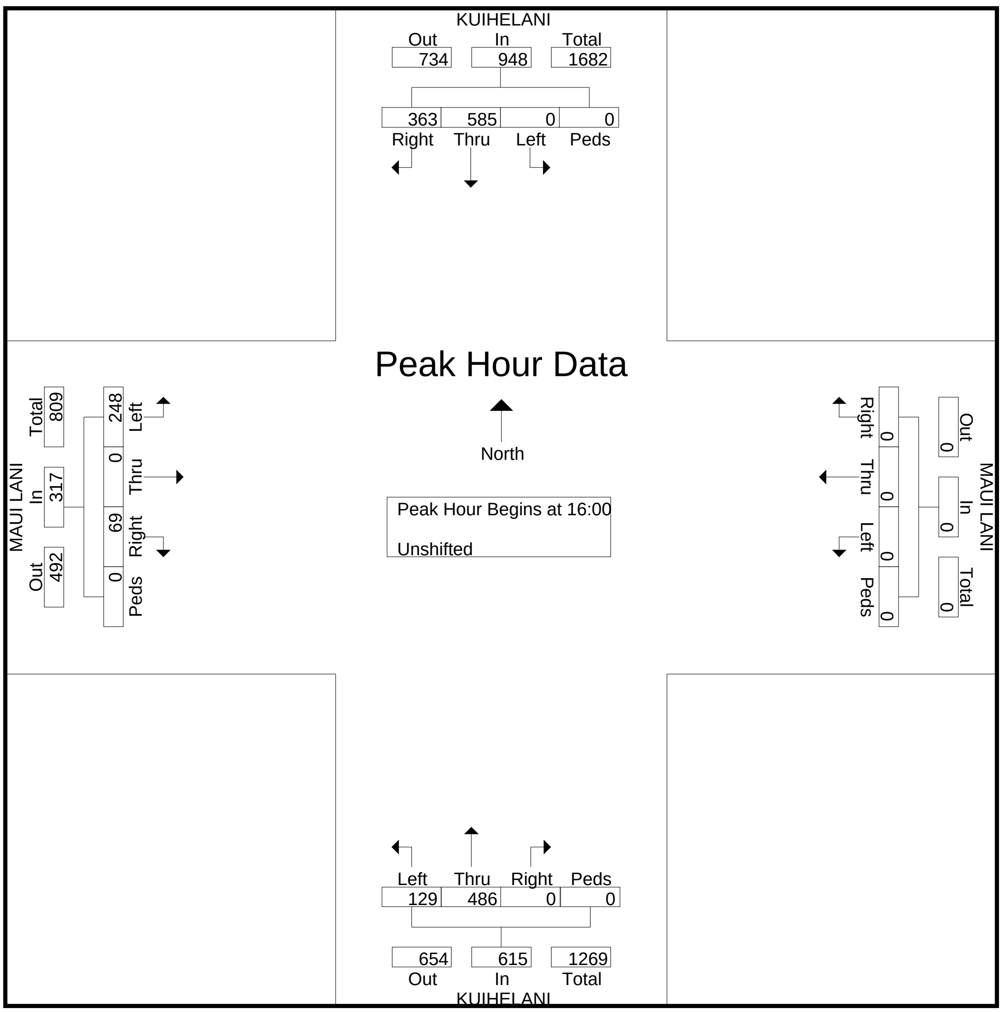
File Name : PM_Kuihelani - Maui Lani
Site Code : 00000000
Start Date : 9/28/2010

	KUIHELANI From North					MAUI LANI From East					KUIHELANI From South					MAUI LANI From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 16:00 to 16:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 16:00																					
16:00	88	149	0	0	237	0	0	0	0	0	0	**135**	31	0	166	19	0	65	0	84	**487**
16:15	79	146	0	0	225	0	0	0	0	0	0	113	32	0	145	19	0	60	0	79	449
16:30	**103**	132	0	0	235	0	0	0	0	0	0	106	31	0	137	**24**	0	**67**	0	**91**	463
16:45	93	**158**	0	0	**251**	0	0	0	0	0	0	132	**35**	0	**167**	7	0	56	0	63	481
Total Volume	363	585	0	0	948	0	0	0	0	0	0	486	129	0	615	69	0	248	0	317	1880
% App. Total	38.3	61.7	0	0		0	0	0	0		0	79	21	0		21.8	0	78.2	0		
PHF	.881	.926	.000	.000	.944	.000	.000	.000	.000	.000	.000	.900	.921	.000	.921	.719	.000	.925	.000	.871	.965



Peak Hour Analysis From 16:00 to 16:45 - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	16:00					**16:00**					**16:00**					**16:00**				
+0 mins.	**88**	**149**	**0**	**0**	**237**	**0**	**0**	**0**	**0**	**0**	**0**	135	31	0	166	19	0	65	0	84
+15 mins.	79	146	0	0	225	0	0	0	0	0	0	113	32	0	145	19	0	60	0	79
+30 mins.	103	132	0	0	235	0	0	0	0	0	0	106	31	0	137	24	0	67	0	**91**
+45 mins.	93	**158**	0	0	**251**	0	0	0	0	0	0	132	**35**	0	**167**	7	0	56	0	63
Total Volume	363	585	0	0	948	0	0	0	0	0	0	486	129	0	615	69	0	248	0	317
% App. Total	38.3	61.7	0	0		0	0	0	0		0	79	21	0		21.8	0	78.2	0	
PHF	.881	.926	.000	.000	.944	.000	.000	.000	.000	.000	.000	.900	.921	.000	.921	.719	.000	.925	.000	.871

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File Name : PM_Honoapiilani - Waiko
Site Code : 00000000
Start Date : 9/28/2010

Groups Printed- Unshifted

	HONOAPIILANI From North					WAIKO From East					HONOAPIILANI From South					WAIKO From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
15:15	12	119	0	0	131	1	2	2	0	5	3	129	8	1	141	9	4	5	1	19	296
15:30	7	125	2	0	134	0	3	3	0	6	5	129	7	0	141	13	8	14	1	36	317
15:45	15	162	1	0	178	1	2	6	3	12	2	125	9	2	138	15	2	11	2	30	358
Total	34	406	3	0	443	2	7	11	3	23	10	383	24	3	420	37	14	30	4	85	971
16:00	13	129	1	0	143	1	3	8	0	12	4	122	6	0	132	6	1	10	0	17	304
16:15	16	125	2	0	143	1	1	2	0	4	3	142	5	4	154	12	6	14	0	32	333
16:30	3	151	6	3	163	11	4	12	0	27	12	131	1	0	144	1	1	6	1	9	343
16:45	6	182	8	0	196	17	8	18	0	43	17	126	1	0	144	5	3	3	0	11	394
Total	38	587	17	3	645	30	16	40	0	86	36	521	13	4	574	24	11	33	1	69	1374
17:00	10	154	7	3	174	12	2	23	0	37	9	120	3	0	132	1	0	1	0	2	345
Grand Total	82	1147	27	6	1262	44	25	74	3	146	55	1024	40	7	1126	62	25	64	5	156	2690
Apprch %	6.5	90.9	2.1	0.5		30.1	17.1	50.7	2.1		4.9	90.9	3.6	0.6		39.7	16	41	3.2		
Total %	3	42.6	1	0.2	46.9	1.6	0.9	2.8	0.1	5.4	2	38.1	1.5	0.3	41.9	2.3	0.9	2.4	0.2	5.8	

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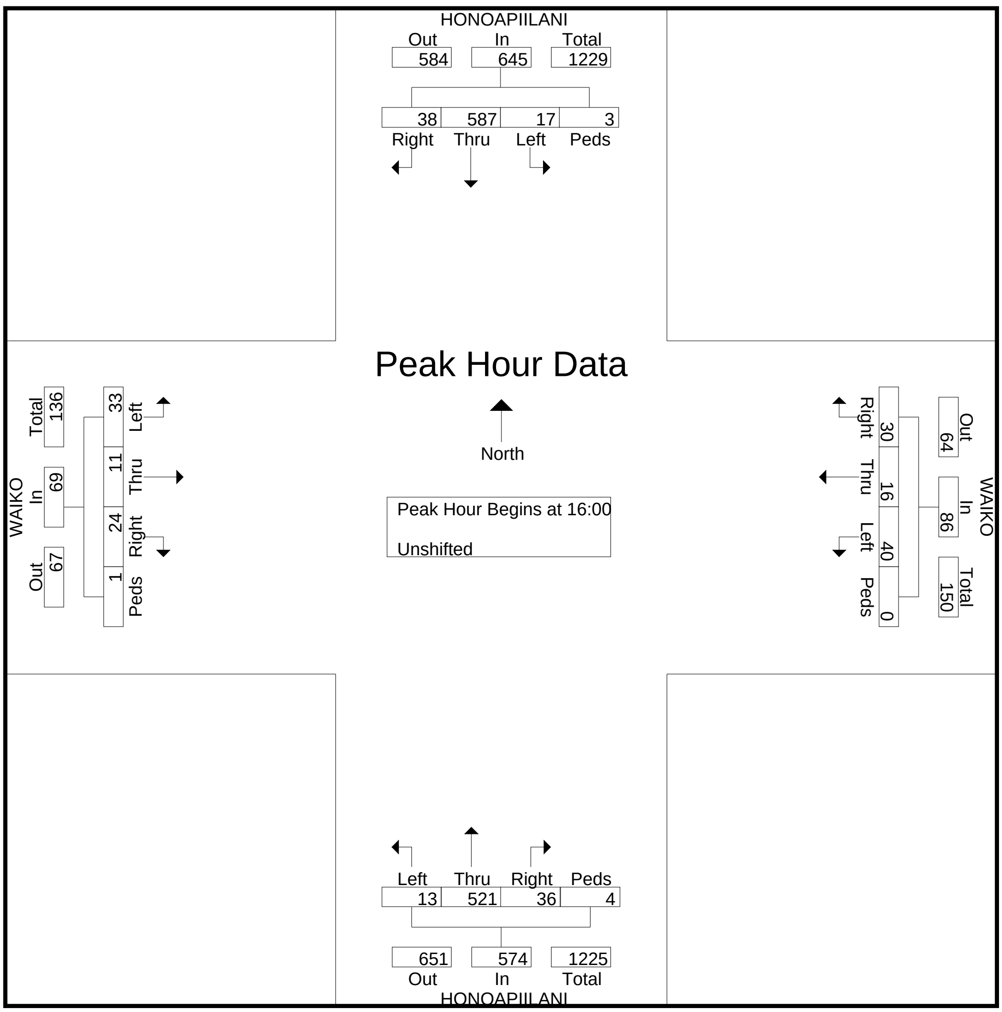
	HONOAPIILANI From North					WAIKO From East					HONOAPIILANI From South					WAIKO From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 16:00 to 16:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 16:00																					
16:00	13	129	1	0	143	1	3	8	0	12	4	122	**6**	0	132	6	1	10	0	17	304
16:15	**16**	125	2	0	143	1	1	2	0	4	3	**142**	5	**4**	**154**	**12**	**6**	**14**	0	**32**	333
16:30	3	151	6	**3**	163	11	4	12	0	27	12	131	1	0	144	1	1	6	**1**	9	343
16:45	6	**182**	**8**	0	**196**	**17**	**8**	**18**	0	**43**	**17**	126	1	0	144	5	3	3	0	11	**394**
Total Volume	38	587	17	3	645	30	16	40	0	86	36	521	13	4	574	24	11	33	1	69	1374
% App. Total	5.9	91	2.6	0.5		34.9	18.6	46.5	0		6.3	90.8	2.3	0.7		34.8	15.9	47.8	1.4		
PHF	.594	.806	.531	.250	.823	.441	.500	.556	.000	.500	.529	.917	.542	.250	.932	.500	.458	.589	.250	.539	.872



Peak Hour Analysis From 16:00 to 16:45 - Peak 1 of 1

Peak Hour for Each Approach Begins at:

	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total
	16:00					**16:00**					**16:00**					**16:00**				
+0 mins.	**13**	**129**	**1**	**0**	**143**	**1**	**3**	**8**	**0**	**12**	**4**	**122**	6	0	132	6	1	10	0	17
+15 mins.	16	125	2	0	143	1	1	2	0	4	3	142	5	4	**154**	**12**	**6**	**14**	0	**32**
+30 mins.	3	151	6	**3**	163	11	4	12	0	27	12	131	1	0	144	1	1	6	**1**	9
+45 mins.	6	**182**	**8**	0	**196**	**17**	**8**	**18**	0	**43**	**17**	126	1	0	144	5	3	3	0	11
Total Volume	38	587	17	3	645	30	16	40	0	86	36	521	13	4	574	24	11	33	1	69
% App. Total	5.9	91	2.6	0.5		34.9	18.6	46.5	0		6.3	90.8	2.3	0.7		34.8	15.9	47.8	1.4	
PHF	.594	.806	.531	.250	.823	.441	.500	.556	.000	.500	.529	.917	.542	.250	.932	.500	.458	.589	.250	.539

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File Name : PM_Waiale - E Waiko
Site Code : 00000000
Start Date : 9/28/2010
Page No : 1

Groups Printed- Unshifted

	WAIALE From North					E WAIKO From East					WAIALE From South					E WAIKO From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
15:15	6	1	21	0	28	13	16	0	0	29	0	0	0	0	0	0	14	6	0	20	77
15:30	13	0	17	0	30	23	23	0	1	47	0	0	0	0	0	0	13	5	0	18	95
15:45	6	0	19	0	25	30	23	0	0	53	0	0	0	0	0	0	15	11	0	26	104
Total	25	1	57	0	83	66	62	0	1	129	0	0	0	0	0	0	42	22	0	64	276
16:00	3	0	13	0	16	23	12	0	0	35	0	0	0	0	0	0	12	11	0	23	74
16:15	8	0	9	0	17	20	30	0	0	50	0	0	0	0	0	0	9	12	0	21	88
16:30	7	1	9	0	17	20	27	0	0	47	0	0	0	0	0	0	7	13	0	20	84
16:45	15	0	12	0	27	22	26	0	0	48	0	0	0	0	0	0	13	10	0	23	98
Total	33	1	43	0	77	85	95	0	0	180	0	0	0	0	0	0	41	46	0	87	344
17:00	4	1	16	0	21	23	21	0	0	44	0	0	0	0	0	0	10	6	0	16	81
Grand Total	62	3	116	0	181	174	178	0	1	353	0	0	0	0	0	0	93	74	0	167	701
Apprch %	34.3	1.7	64.1	0		49.3	50.4	0	0.3		0	0	0	0		0	55.7	44.3	0		
Total %	8.8	0.4	16.5	0	25.8	24.8	25.4	0	0.1	50.4	0	0	0	0	0	0	13.3	10.6	0	23.8	

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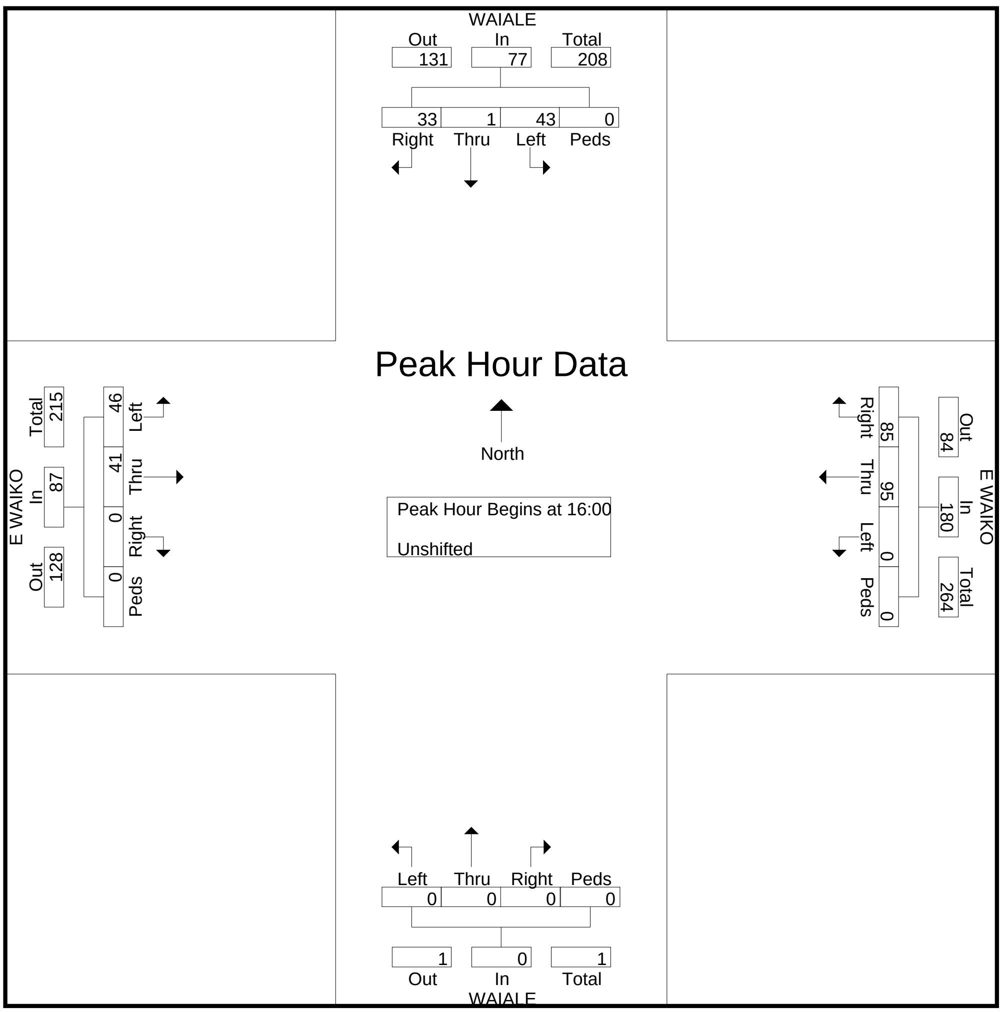
File Name : PM_Waiale - E Waiko
Site Code : 00000000
Start Date : 9/28/2010
Page No : 3

	WAIALE From North					E WAIKO From East					WAIALE From South					E WAIKO From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 16:00 to 16:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 16:00																					
16:00	3	0	**13**	0	16	**23**	12	0	0	35	0	0	0	0	0	0	12	11	0	**23**	74
16:15	8	0	9	0	17	20	**30**	0	0	**50**	0	0	0	0	0	0	9	12	0	21	88
16:30	7	**1**	9	0	17	20	27	0	0	47	0	0	0	0	0	0	7	**13**	0	20	84
16:45	**15**	0	12	0	**27**	22	26	0	0	48	0	0	0	0	0	0	**13**	10	0	23	**98**
Total Volume	33	1	43	0	77	85	95	0	0	180	0	0	0	0	0	0	41	46	0	87	344
% App. Total	42.9	1.3	55.8	0		47.2	52.8	0	0		0	0	0	0		0	47.1	52.9	0		
PHF	.550	.250	.827	.000	.713	.924	.792	.000	.000	.900	.000	.000	.000	.000	.000	.000	.788	.885	.000	.946	.878



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Phone: 533-3646 Fax: 526-1267

File Name : PM_Kuihelani - E Waiko
Site Code : 00000000
Start Date : 9/28/2010

Groups Printed- Unshifted

	KUIHELANI From North					E WAIKO From East					KUIHELANI From South					E WAIKO From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
15:15	33	137	0	0	170	0	0	0	0	0	0	88	3	0	91	4	0	24	0	28	289
15:30	32	124	0	0	156	0	0	0	0	0	0	115	5	0	120	10	0	38	0	48	324
15:45	40	119	0	0	159	0	0	0	0	0	0	100	7	0	107	4	0	30	0	34	300
Total	105	380	0	0	485	0	0	0	0	0	0	303	15	0	318	18	0	92	0	110	913
16:00	33	145	0	0	178	0	0	0	0	0	0	141	6	0	147	2	0	28	0	30	355
16:15	39	115	0	0	154	0	0	0	0	0	0	129	3	0	132	4	0	22	0	26	312
16:30	36	127	0	1	164	0	0	0	0	0	0	122	1	0	123	1	0	25	0	26	313
16:45	38	112	0	0	150	0	0	0	0	0	0	125	3	0	128	1	0	26	0	27	305
Total	146	499	0	1	646	0	0	0	0	0	0	517	13	0	530	8	0	101	0	109	1285
17:00	36	119	0	1	156	0	0	0	0	0	0	117	5	0	122	3	0	31	0	34	312
Grand Total	287	998	0	2	1287	0	0	0	0	0	0	937	33	0	970	29	0	224	0	253	2510
Apprch %	22.3	77.5	0	0.2		0	0	0	0		0	96.6	3.4	0		11.5	0	88.5	0		
Total %	11.4	39.8	0	0.1	51.3	0	0	0	0	0	0	37.3	1.3	0	38.6	1.2	0	8.9	0	10.1	

Austin, Tsutsumi & Associates

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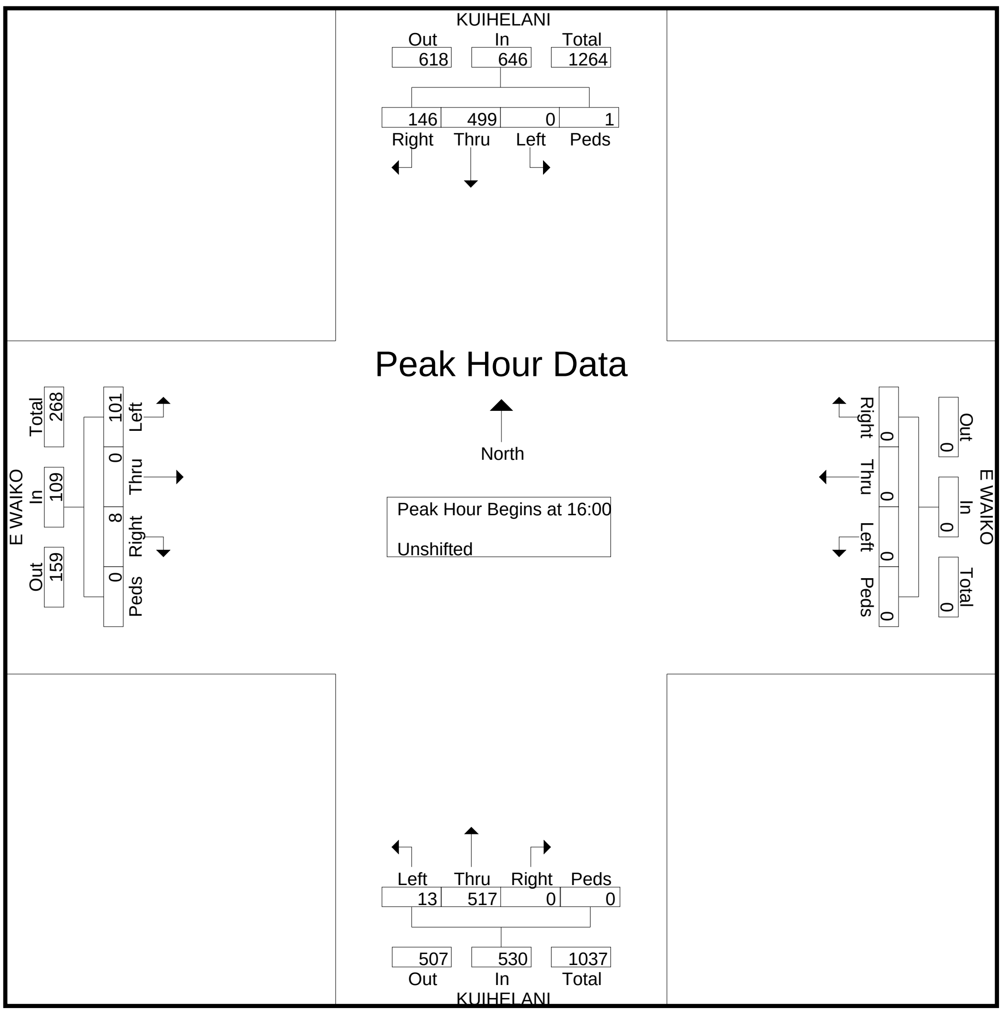
Phone: 533-3646 Fax: 526-1267

File Name : PM_Kuihelani - E Waiko
Site Code : 00000000
Start Date : 9/28/2010

	KUIHELANI From North					E WAIKO From East					KUIHELANI From South					E WAIKO From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 16:00 to 16:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 16:00																					
16:00	33	**145**	0	0	**178**	0	0	0	0	0	0	**141**	**6**	0	**147**	2	0	**28**	0	**30**	**355**
16:15	**39**	115	0	0	154	0	0	0	0	0	0	129	3	0	132	**4**	0	22	0	26	312
16:30	36	127	0	**1**	164	0	0	0	0	0	0	122	1	0	123	1	0	25	0	26	313
16:45	38	112	0	0	150	0	0	0	0	0	0	125	3	0	128	1	0	26	0	27	305
Total Volume	146	499	0	1	646	0	0	0	0	0	0	517	13	0	530	8	0	101	0	109	1285
% App. Total	22.6	77.2	0	0.2		0	0	0	0		0	97.5	2.5	0		7.3	0	92.7	0		
PHF	.936	.860	.000	.250	.907	.000	.000	.000	.000	.000	.000	.917	.542	.000	.901	.500	.000	.902	.000	.908	.905



Peak Hour Analysis From 16:00 to 16:45 - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	16:00					**16:00**					**16:00**					**16:00**				
+0 mins.	**33**	145	0	0	178	0	0	0	0	0	0	141	6	0	**147**	2	0	**28**	0	**30**
+15 mins.	**39**	115	0	0	154	0	0	0	0	0	0	129	3	0	132	**4**	0	22	0	26
+30 mins.	36	127	0	**1**	164	0	0	0	0	0	0	122	1	0	123	1	0	25	0	26
+45 mins.	38	112	0	0	150	0	0	0	0	0	0	125	3	0	128	1	0	26	0	27
Total Volume	146	499	0	1	646	0	0	0	0	0	0	517	13	0	530	8	0	101	0	109
% App. Total	22.6	77.2	0	0.2		0	0	0	0		0	97.5	2.5	0		7.3	0	92.7	0	
PHF	.936	.860	.000	.250	.907	.000	.000	.000	.000	.000	.000	.917	.542	.000	.901	.500	.000	.902	.000	.908

APPENDIX B

LEVEL OF SERVICE CRITERIA

APPENDIX B – LEVEL OF SERVICE (LOS) CRITERIA

LEVEL OF SERVICE FOR SIGNALIZED INTERSECTIONS (HCM 2000)

Level of service for 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 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.

LEVEL OF SERVICE CRITERIA FOR UNSIGNALIZED INTERSECTIONS (HCM 2000)

The level of service criteria for 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

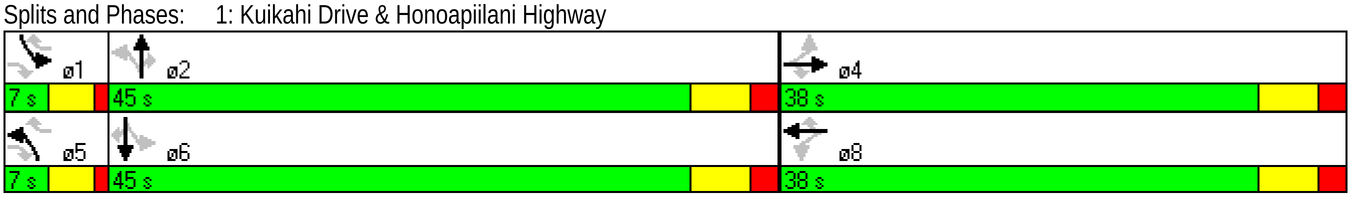
LEVEL OF SERVICE CALCULATIONS

- Existing Conditions AM

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	44	135	50	229	44	122	21	401	330	101	324	20
Turn Type	Perm		custom	Perm		custom	pm+pt		Perm	pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 1 5	8		8 5 1	2		2	6		6
Detector Phase	4	4	4 1 5	8	8	8 5 1	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	6.0	6.0		6.0	6.0		3.0	10.0	10.0	3.0	10.0	10.0
Minimum Split (s)	27.0	27.0		27.0	27.0		7.0	24.0	24.0	7.0	24.0	24.0
Total Split (s)	38.0	38.0	52.0	38.0	38.0	52.0	7.0	45.0	45.0	7.0	45.0	45.0
Total Split (%)	42.2%	42.2%	57.8%	42.2%	42.2%	57.8%	7.8%	50.0%	50.0%	7.8%	50.0%	50.0%
Yellow Time (s)	4.0	4.0		4.0	4.0		3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	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 Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag							Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?												
Recall Mode	None	None		None	None		None	Min	Min	None	Min	Min

Intersection Summary
Cycle Length: 90
Actuated Cycle Length: 68.4
Natural Cycle: 60
Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Kuikahi Drive & Honoapiilani Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	44	135	50	229	44	122	21	401	330	101	324	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-5%			0%			0%			0%	
Total Lost time (s)		6.0	6.0		6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.99	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1886	1623		1788	1583	1770	1863	1583	1770	1863	1583
Flt Permitted		0.85	1.00		0.63	1.00	0.49	1.00	1.00	0.36	1.00	1.00
Satd. Flow (perm)		1629	1623		1180	1583	917	1863	1583	678	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	48	147	54	249	48	133	23	436	359	110	352	22
RTOR Reduction (vph)	0	0	29	0	0	73	0	0	216	0	0	13
Lane Group Flow (vph)	0	195	25	0	297	60	23	436	143	110	352	9
Turn Type	Perm		custom	Perm		custom	pm+pt		Perm	pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 1 5	8		8 5 1	2		2	6		6
Actuated Green, G (s)		22.0	31.2		22.0	31.2	29.7	27.4	27.4	31.5	28.3	28.3
Effective Green, g (s)		22.0	31.2		22.0	31.2	29.7	27.4	27.4	31.5	28.3	28.3
Actuated g/C Ratio		0.32	0.45		0.32	0.45	0.43	0.40	0.40	0.46	0.41	0.41
Clearance Time (s)		6.0			6.0		4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)		2.0			2.0		2.0	5.0	5.0	2.0	5.0	5.0
Lane Grp Cap (vph)		522	738		378	720	426	744	632	362	769	653
v/s Ratio Prot							0.00	c0.23		c0.01	0.19	
v/s Ratio Perm		0.12	0.02		c0.25	0.04	0.02		0.09	0.13		0.01
v/c Ratio		0.37	0.03		0.79	0.08	0.05	0.59	0.23	0.30	0.46	0.01
Uniform Delay, d1		18.0	10.4		21.2	10.6	11.2	16.2	13.6	11.2	14.6	11.9
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		0.2	0.0		9.5	0.0	0.0	1.8	0.4	0.2	0.9	0.0
Delay (s)		18.1	10.4		30.7	10.6	11.3	18.0	14.0	11.4	15.5	11.9
Level of Service		B	B		C	B	B	B	B	B	B	B
Approach Delay (s)		16.5			24.5			16.0			14.4	
Approach LOS		B			C			B			B	

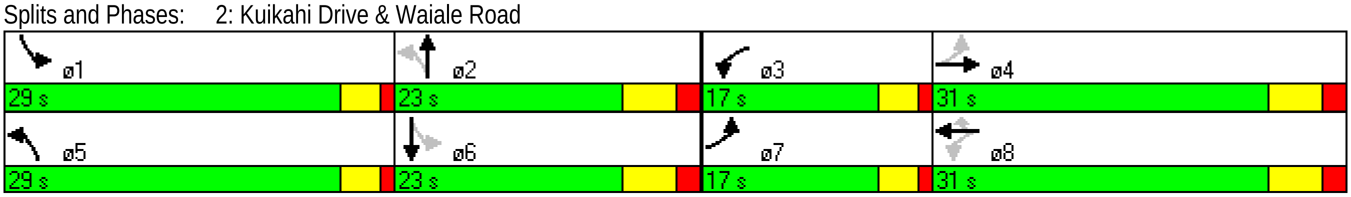
Intersection Summary			
HCM Average Control Delay	17.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	68.6	Sum of lost time (s)	16.0
Intersection Capacity Utilization	69.6%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations									
Volume (vph)	411	155	46	127	266	43	178	132	96
Turn Type	pm+pt		pm+pt		Perm	pm+pt		pm+pt	
Protected Phases	7	4	3	8		5	2	1	6
Permitted Phases	4		8		8	2		6	
Detector Phase	7	4	3	8	8	5	2	1	6
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	27.0	8.0	27.0	27.0	8.0	23.0	8.0	23.0
Total Split (s)	17.0	31.0	17.0	31.0	31.0	29.0	23.0	29.0	23.0
Total Split (%)	17.0%	31.0%	17.0%	31.0%	31.0%	29.0%	23.0%	29.0%	23.0%
Yellow Time (s)	3.0	4.0	3.0	4.0	4.0	3.0	4.0	3.0	4.0
All-Red Time (s)	1.0	2.0	1.0	2.0	2.0	1.0	2.0	1.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	4.0	6.0	6.0	4.0	6.0	4.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?									
Recall Mode	None	None	None	None	None	None	Min	None	Min

Intersection Summary
Cycle Length: 100
Actuated Cycle Length: 70.4
Natural Cycle: 75
Control Type: Actuated-Uncoordinated

Splits and Phases: 2: Kuikahi Drive & Waiale Road



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	411	155	21	46	127	266	43	178	92	132	96	213
Ideal Flow (vphpl)	1500	1900	1900	1900	1900	1900	1900	1600	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	4.0	6.0		4.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	1.00	0.85	1.00	0.95		1.00	0.90	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1397	1829		1770	1863	1583	1770	1488		1770	1670	
Flt Permitted	0.51	1.00		0.64	1.00	1.00	0.54	1.00		0.36	1.00	
Satd. Flow (perm)	749	1829		1187	1863	1583	1007	1488		669	1670	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	447	168	23	50	138	289	47	193	100	143	104	232
RTOR Reduction (vph)	0	5	0	0	0	239	0	16	0	0	66	0
Lane Group Flow (vph)	447	186	0	50	138	50	47	277	0	143	270	0
Turn Type	pm+pt			pm+pt		Perm	pm+pt			pm+pt		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)	29.9	21.7		17.0	12.8	12.8	23.0	18.8		31.9	23.7	
Effective Green, g (s)	29.9	21.7		17.0	12.8	12.8	23.0	18.8		31.9	23.7	
Actuated g/C Ratio	0.41	0.29		0.23	0.17	0.17	0.31	0.25		0.43	0.32	
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	4.0	6.0		4.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	418	538		307	323	275	357	379		425	536	
v/s Ratio Prot	c0.19	0.10		0.01	0.07		0.01	c0.19		c0.04	0.16	
v/s Ratio Perm	c0.24			0.03		0.03	0.03			0.10		
v/c Ratio	1.07	0.35		0.16	0.43	0.18	0.13	0.73		0.34	0.50	
Uniform Delay, d1	20.4	20.5		22.5	27.2	26.0	18.0	25.2		13.5	20.3	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	63.7	0.4		0.3	0.9	0.3	0.2	6.9		0.5	0.7	
Delay (s)	84.2	20.9		22.7	28.1	26.4	18.1	32.1		14.0	21.0	
Level of Service	F	C		C	C	C	B	C		B	C	
Approach Delay (s)		65.2			26.5			30.1			18.9	
Approach LOS		E			C			C			B	

Intersection Summary			
HCM Average Control Delay	38.0	HCM Level of Service	D
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	73.8	Sum of lost time (s)	14.0
Intersection Capacity Utilization	77.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
3: Maui Lani Parkway & Kamehameha Avenue

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	128	105	86	74	141	124	132	163	94	179	149	195
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	139	114	93	80	153	135	143	177	102	195	162	212

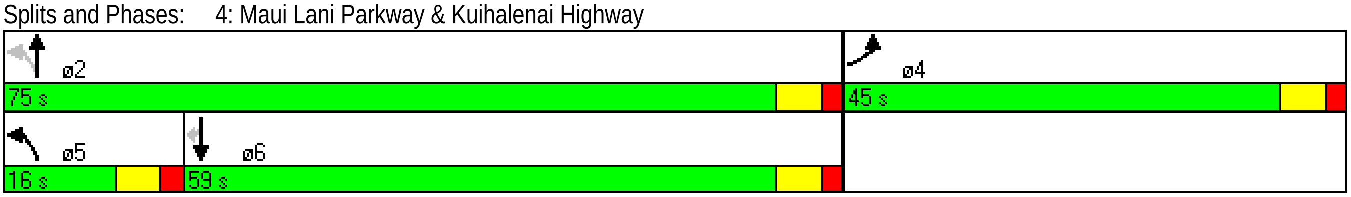
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total (vph)	347	368	143	279	195	374
Volume Left (vph)	139	80	143	0	195	0
Volume Right (vph)	93	135	0	102	0	212
Hadj (s)	-0.05	-0.14	0.53	-0.22	0.53	-0.36
Departure Headway (s)	8.6	8.4	9.7	8.9	9.5	8.5
Degree Utilization, x	0.83	0.86	0.39	0.69	0.51	0.89
Capacity (veh/h)	405	415	346	383	373	406
Control Delay (s)	41.4	45.4	17.6	28.7	20.8	48.4
Approach Delay (s)	41.4	45.4	25.0		38.9	
Approach LOS	E	E	C		E	

Intersection Summary			
Delay	37.4		
HCM Level of Service	E		
Intersection Capacity Utilization	75.6%	ICU Level of Service	D
Analysis Period (min)	15		

Lane Group	EBL	NBL	NBT	SBT	SBR
Lane Configurations					
Volume (vph)	323	73	480	405	228
Turn Type		pm+pt			Perm
Protected Phases	4	5	2	6	
Permitted Phases		2			6
Detector Phase	4	5	2	6	6
Switch Phase					
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	10.0	10.0	10.0	10.0	10.0
Total Split (s)	45.0	16.0	75.0	59.0	59.0
Total Split (%)	37.5%	13.3%	62.5%	49.2%	49.2%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0
Lead/Lag		Lead		Lag	Lag
Lead-Lag Optimize?					
Recall Mode	None	None	Min	Min	Min

Intersection Summary
Cycle Length: 120
Actuated Cycle Length: 67
Natural Cycle: 55
Control Type: Actuated-Uncoordinated

Splits and Phases: 4: Maui Lani Parkway & Kuihalenai Highway



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	323	141	73	480	405	228
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0	6.0	6.0	6.0
Lane Util. Factor	1.00		1.00	0.95	0.95	1.00
Frt	0.96		1.00	1.00	1.00	0.85
Flt Protected	0.97		0.95	1.00	1.00	1.00
Satd. Flow (prot)	1726		1770	3539	3539	1583
Flt Permitted	0.97		0.34	1.00	1.00	1.00
Satd. Flow (perm)	1726		626	3539	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	351	153	79	522	440	248
RTOR Reduction (vph)	12	0	0	0	0	185
Lane Group Flow (vph)	492	0	79	522	440	63
Turn Type			pm+pt			Perm
Protected Phases	4		5	2	6	
Permitted Phases			2			6
Actuated Green, G (s)	26.0		29.4	29.4	17.0	17.0
Effective Green, g (s)	26.0		29.4	29.4	17.0	17.0
Actuated g/C Ratio	0.39		0.44	0.44	0.25	0.25
Clearance Time (s)	6.0		6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	666		382	1544	893	399
v/s Ratio Prot	c0.29		0.02	c0.15	c0.12	
v/s Ratio Perm			0.07			0.04
v/c Ratio	0.74		0.21	0.34	0.49	0.16
Uniform Delay, d1	17.8		11.7	12.6	21.5	19.6
Progression Factor	1.00		1.00	1.00	1.00	1.00
Incremental Delay, d2	4.3		0.3	0.1	0.4	0.2
Delay (s)	22.1		11.9	12.7	21.9	19.8
Level of Service	C		B	B	C	B
Approach Delay (s)	22.1			12.6	21.2	
Approach LOS	C			B	C	

Intersection Summary			
HCM Average Control Delay	18.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	67.4	Sum of lost time (s)	18.0
Intersection Capacity Utilization	56.7%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations										
Volume (vph)	29	22	8	55	3	3	602	72	549	13
Turn Type	Perm		custom	Perm		pm+pt		pm+pt		Perm
Protected Phases		4			8	5	2	1	6	
Permitted Phases	4		4 5	8		2		6		6
Detector Phase	4	4	4 5	8	8	5	2	1	6	6
Switch Phase										
Minimum Initial (s)	6.0	6.0		6.0	6.0	3.0	10.0	3.0	10.0	10.0
Minimum Split (s)	23.0	23.0		27.0	27.0	7.0	31.0	7.0	26.0	26.0
Total Split (s)	29.0	29.0	36.0	29.0	29.0	7.0	71.0	10.0	74.0	74.0
Total Split (%)	26.4%	26.4%	32.7%	26.4%	26.4%	6.4%	64.5%	9.1%	67.3%	67.3%
Yellow Time (s)	4.0	4.0		4.0	4.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	6.0	4.0	6.0	6.0
Lead/Lag						Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?										
Recall Mode	None	None		None	None	None	C-Max	None	C-Max	C-Max

Intersection Summary
Cycle Length: 110
Actuated Cycle Length: 110
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 65
Control Type: Actuated-Coordinated

Splits and Phases: 5: Waiko Road & Honoapiilani Highway

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	29	22	8	55	3	27	3	602	43	72	549	13
Ideal Flow (vphpl)	1900	1900	1900	1600	1600	1600	1900	1900	1900	1900	1900	1900
Grade (%)		-8%			0%			0%			0%	
Total Lost time (s)		5.0	5.0		5.0		4.0	6.0		4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	0.97
Flpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt		1.00	0.85		0.96		1.00	0.99		1.00	1.00	0.85
Flt Protected		0.97	1.00		0.97		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1883	1647		1454		1767	1844		1770	1863	1537
Flt Permitted		0.79	1.00		0.77		0.42	1.00		0.32	1.00	1.00
Satd. Flow (perm)		1529	1647		1155		777	1844		597	1863	1537
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	32	24	9	60	3	29	3	654	47	78	597	14
RTOR Reduction (vph)	0	0	8	0	17	0	0	2	0	0	0	2
Lane Group Flow (vph)	0	56	1	0	75	0	3	699	0	78	597	12
Confl. Peds. (#/hr)							3					3
Turn Type	Perm		custom	Perm			pm+pt			pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 5	8			2			6		6
Actuated Green, G (s)		10.4	16.6		10.4		81.3	80.1		87.9	83.4	83.4
Effective Green, g (s)		10.4	16.6		10.4		81.3	80.1		87.9	83.4	83.4
Actuated g/C Ratio		0.09	0.15		0.09		0.74	0.73		0.80	0.76	0.76
Clearance Time (s)		5.0			5.0		4.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)		2.0			2.0		2.0	5.0		2.0	5.0	5.0
Lane Grp Cap (vph)		145	249		109		585	1343		525	1412	1165
v/s Ratio Prot							0.00	c0.38		c0.01	c0.32	
v/s Ratio Perm		0.04	0.00		c0.06		0.00			0.11		0.01
v/c Ratio		0.39	0.01		0.69		0.01	0.52		0.15	0.42	0.01
Uniform Delay, d1		46.8	39.7		48.2		3.8	6.5		3.7	4.7	3.2
Progression Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2		0.6	0.0		13.3		0.0	1.4		0.0	0.9	0.0
Delay (s)		47.4	39.7		61.6		3.8	8.0		3.7	5.7	3.3
Level of Service		D	D		E		A	A		A	A	A
Approach Delay (s)		46.4			61.6			8.0			5.4	
Approach LOS		D			E			A			A	

Intersection Summary			
HCM Average Control Delay	11.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	63.2%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	36	117	33	52	127	52
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	39	127	36	57	138	57
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	92				270	64
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	92				270	64
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	97				80	94
cM capacity (veh/h)	1502				701	1000

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	166	92	195
Volume Left	39	0	138
Volume Right	0	57	57
cSH	1502	1700	768
Volume to Capacity	0.03	0.05	0.25
Queue Length 95th (ft)	2	0	25
Control Delay (s)	1.9	0.0	11.3
Lane LOS	A		B
Approach Delay (s)	1.9	0.0	11.3
Approach LOS			B

Intersection Summary			
Average Delay	5.5		
Intersection Capacity Utilization	31.7%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	225	24	11	334	431	104
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Detector Phase	4	4 5	5	2	6	6 4
Switch Phase						
Minimum Initial (s)	6.0		4.0	10.0	10.0	
Minimum Split (s)	28.0		8.0	16.0	24.0	
Total Split (s)	29.0	39.0	10.0	51.0	41.0	70.0
Total Split (%)	36.3%	48.8%	12.5%	63.8%	51.3%	87.5%
Yellow Time (s)	3.0		3.0	4.0	4.0	
All-Red Time (s)	1.0		1.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?						
Recall Mode	None		None	Min	Min	

Intersection Summary
Cycle Length: 80
Actuated Cycle Length: 41.4
Natural Cycle: 60
Control Type: Actuated-Uncoordinated

Splits and Phases: 7: Waiko Road & Kuihelani Highway

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	225	24	11	334	431	104
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	3539	3539	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	3539	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	245	26	12	363	468	113
RTOR Reduction (vph)	0	16	0	0	0	25
Lane Group Flow (vph)	245	10	12	363	468	88
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Actuated Green, G (s)	10.8	16.5	1.7	22.7	17.0	33.8
Effective Green, g (s)	10.8	16.5	1.7	22.7	17.0	33.8
Actuated g/C Ratio	0.25	0.38	0.04	0.52	0.39	0.78
Clearance Time (s)	4.0		4.0	6.0	6.0	
Vehicle Extension (s)	2.0		2.0	5.0	5.0	
Lane Grp Cap (vph)	439	600	69	1847	1383	1230
v/s Ratio Prot	c0.14		0.01	c0.10	c0.13	
v/s Ratio Perm		0.01				0.06
v/c Ratio	0.56	0.02	0.17	0.20	0.34	0.07
Uniform Delay, d1	14.3	8.4	20.2	5.5	9.3	1.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.9	0.0	0.4	0.1	0.3	0.1
Delay (s)	15.1	8.4	20.7	5.7	9.6	1.2
Level of Service	B	A	C	A	A	A
Approach Delay (s)	14.5			6.1	8.0	
Approach LOS	B			A	A	

Intersection Summary			
HCM Average Control Delay	8.9	HCM Level of Service	A
HCM Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	43.5	Sum of lost time (s)	16.0
Intersection Capacity Utilization	32.7%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Existing Conditions PM

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	17	63	18	265	116	79	32	333	220	87	438	39
Turn Type	Perm		custom	Perm		custom	pm+pt		Perm	pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 1 5	8		8 5 1	2		2	6		6
Detector Phase	4	4	4 1 5	8	8	8 5 1	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	6.0	6.0		6.0	6.0		3.0	10.0	10.0	3.0	10.0	10.0
Minimum Split (s)	27.0	27.0		27.0	27.0		7.0	24.0	24.0	7.0	24.0	24.0
Total Split (s)	30.0	30.0	50.0	30.0	30.0	50.0	10.0	40.0	40.0	10.0	40.0	40.0
Total Split (%)	37.5%	37.5%	62.5%	37.5%	37.5%	62.5%	12.5%	50.0%	50.0%	12.5%	50.0%	50.0%
Yellow Time (s)	4.0	4.0		4.0	4.0		3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	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 Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag							Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?												
Recall Mode	None	None		None	None		None	Min	Min	None	Min	Min

Intersection Summary
Cycle Length: 80
Actuated Cycle Length: 68.7
Natural Cycle: 60
Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Kuikahi Drive & Honoapiilani Highway

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	17	63	18	265	116	79	32	333	220	87	438	39
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-5%			0%			0%			0%	
Total Lost time (s)		6.0	6.0		6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.99	1.00		0.97	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1890	1623		1800	1583	1770	1863	1583	1770	1863	1583
Flt Permitted		0.89	1.00		0.74	1.00	0.30	1.00	1.00	0.42	1.00	1.00
Satd. Flow (perm)		1692	1623		1377	1583	558	1863	1583	778	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	18	68	20	288	126	86	35	362	239	95	476	42
RTOR Reduction (vph)	0	0	10	0	0	43	0	0	155	0	0	27
Lane Group Flow (vph)	0	86	10	0	414	43	35	362	84	95	476	15
Turn Type	Perm		custom	Perm		custom	pm+pt		Perm	pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 1 5	8		8 5 1	2		2	6		6
Actuated Green, G (s)		24.5	35.0		24.5	35.0	28.4	24.4	24.4	29.4	24.9	24.9
Effective Green, g (s)		24.5	35.0		24.5	35.0	28.4	24.4	24.4	29.4	24.9	24.9
Actuated g/C Ratio		0.35	0.50		0.35	0.50	0.41	0.35	0.35	0.42	0.36	0.36
Clearance Time (s)		6.0			6.0		4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)		2.0			2.0		2.0	5.0	5.0	2.0	5.0	5.0
Lane Grp Cap (vph)		597	819		486	798	298	655	557	394	668	568
v/s Ratio Prot							0.01	0.19		c0.02	c0.26	
v/s Ratio Perm		0.05	0.01		c0.30	0.03	0.04		0.05	0.09		0.01
v/c Ratio		0.14	0.01		0.85	0.05	0.12	0.55	0.15	0.24	0.71	0.03
Uniform Delay, d1		15.3	8.6		20.8	8.8	13.0	18.1	15.4	12.5	19.2	14.4
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		0.0	0.0		13.0	0.0	0.1	1.7	0.3	0.1	4.5	0.0
Delay (s)		15.3	8.6		33.8	8.8	13.1	19.8	15.7	12.6	23.6	14.4
Level of Service		B	A		C	A	B	B	B	B	C	B
Approach Delay (s)		14.1			29.5			17.9			21.3	
Approach LOS		B			C			B			C	

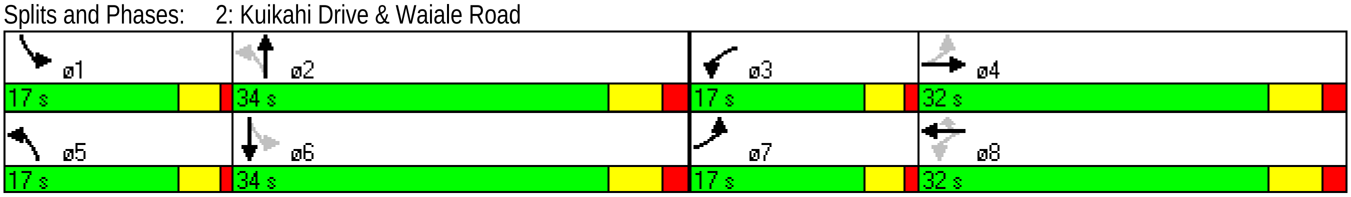
Intersection Summary			
HCM Average Control Delay	21.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	69.4	Sum of lost time (s)	10.0
Intersection Capacity Utilization	67.2%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations									
Volume (vph)	209	138	59	171	163	21	106	224	126
Turn Type	pm+pt		pm+pt		Perm	pm+pt		pm+pt	
Protected Phases	7	4	3	8		5	2	1	6
Permitted Phases	4		8		8	2		6	
Detector Phase	7	4	3	8	8	5	2	1	6
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	27.0	8.0	27.0	27.0	8.0	23.0	8.0	23.0
Total Split (s)	17.0	32.0	17.0	32.0	32.0	17.0	34.0	17.0	34.0
Total Split (%)	17.0%	32.0%	17.0%	32.0%	32.0%	17.0%	34.0%	17.0%	34.0%
Yellow Time (s)	3.0	4.0	3.0	4.0	4.0	3.0	4.0	3.0	4.0
All-Red Time (s)	1.0	2.0	1.0	2.0	2.0	1.0	2.0	1.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	4.0	6.0	6.0	4.0	6.0	4.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?									
Recall Mode	None	None	None	None	None	None	Min	None	Min

Intersection Summary
Cycle Length: 100
Actuated Cycle Length: 70.7
Natural Cycle: 70
Control Type: Actuated-Uncoordinated

Splits and Phases: 2: Kuikahi Drive & Waiale Road



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	209	138	30	59	171	163	21	106	51	224	126	266
Ideal Flow (vphpl)	1500	1900	1900	1900	1900	1900	1900	1600	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	4.0	6.0		4.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.97		1.00	1.00	0.85	1.00	0.95		1.00	0.90	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1397	1812		1770	1863	1583	1770	1493		1770	1673	
Flt Permitted	0.47	1.00		0.64	1.00	1.00	0.50	1.00		0.52	1.00	
Satd. Flow (perm)	694	1812		1196	1863	1583	931	1493		968	1673	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	227	150	33	64	186	177	23	115	55	243	137	289
RTOR Reduction (vph)	0	8	0	0	0	142	0	19	0	0	69	0
Lane Group Flow (vph)	227	175	0	64	186	35	23	151	0	243	357	0
Turn Type	pm+pt			pm+pt		Perm	pm+pt			pm+pt		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)	31.2	22.9		19.0	14.7	14.7	18.7	16.4		31.6	25.3	
Effective Green, g (s)	31.2	22.9		19.0	14.7	14.7	18.7	16.4		31.6	25.3	
Actuated g/C Ratio	0.42	0.31		0.25	0.20	0.20	0.25	0.22		0.42	0.34	
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	4.0	6.0		4.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	407	555		337	366	311	259	327		529	566	
v/s Ratio Prot	c0.09	0.10		0.01	0.10		0.00	0.10		c0.07	c0.21	
v/s Ratio Perm	c0.14			0.04		0.02	0.02			0.13		
v/c Ratio	0.56	0.32		0.19	0.51	0.11	0.09	0.46		0.46	0.63	
Uniform Delay, d1	15.4	19.9		21.6	26.8	24.7	21.3	25.4		14.6	20.8	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.7	0.3		0.3	1.1	0.2	0.1	1.0		0.6	2.2	
Delay (s)	17.0	20.3		21.9	27.9	24.8	21.5	26.4		15.2	23.0	
Level of Service	B	C		C	C	C	C	C		B	C	
Approach Delay (s)		18.5			25.7			25.8			20.2	
Approach LOS		B			C			C			C	

Intersection Summary			
HCM Average Control Delay	21.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	74.8	Sum of lost time (s)	14.0
Intersection Capacity Utilization	66.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	201	159	55	42	168	250	36	94	34	141	98	197
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	218	173	60	46	183	272	39	102	37	153	107	214

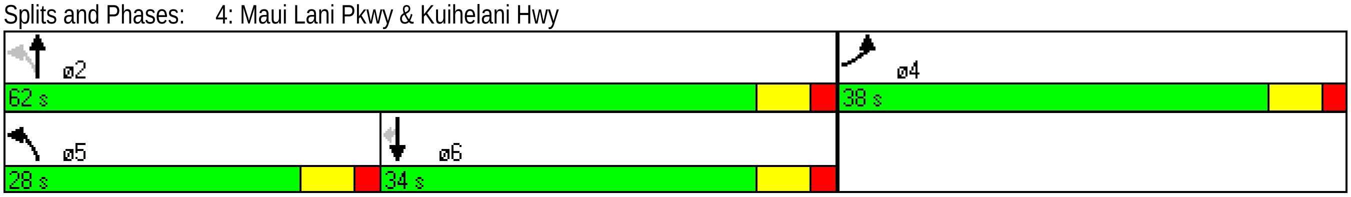
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total (vph)	451	500	39	139	153	321
Volume Left (vph)	218	46	39	0	153	0
Volume Right (vph)	60	272	0	37	0	214
Hadj (s)	0.05	-0.27	0.53	-0.15	0.53	-0.43
Departure Headway (s)	7.6	7.3	9.7	9.0	8.9	7.9
Degree Utilization, x	0.95	1.01	0.11	0.35	0.38	0.70
Capacity (veh/h)	451	487	359	386	395	441
Control Delay (s)	57.2	71.0	12.6	15.6	16.0	26.5
Approach Delay (s)	57.2	71.0	14.9		23.1	
Approach LOS	F	F	B		C	

Intersection Summary			
Delay	46.7		
HCM Level of Service	E		
Intersection Capacity Utilization	91.1%	ICU Level of Service	F
Analysis Period (min)	15		

Lane Group	EBL	NBL	NBT	SBT	SBR
Lane Configurations					
Volume (vph)	248	129	486	585	363
Turn Type		pm+pt			Perm
Protected Phases	4	5	2	6	
Permitted Phases		2			6
Detector Phase	4	5	2	6	6
Switch Phase					
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	10.0	10.0	10.0	10.0	10.0
Total Split (s)	38.0	28.0	62.0	34.0	34.0
Total Split (%)	38.0%	28.0%	62.0%	34.0%	34.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0
Lead/Lag		Lead		Lag	Lag
Lead-Lag Optimize?					
Recall Mode	None	None	Min	Min	Min

Intersection Summary
Cycle Length: 100
Actuated Cycle Length: 67.3
Natural Cycle: 55
Control Type: Actuated-Uncoordinated

Splits and Phases: 4: Maui Lani Pkwy & Kuihelani Hwy



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	248	69	129	486	585	363
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0	6.0	6.0	6.0
Lane Util. Factor	1.00		1.00	0.95	0.95	1.00
Frt	0.97		1.00	1.00	1.00	0.85
Flt Protected	0.96		0.95	1.00	1.00	1.00
Satd. Flow (prot)	1740		1770	3539	3539	1583
Flt Permitted	0.96		0.26	1.00	1.00	1.00
Satd. Flow (perm)	1740		477	3539	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	270	75	140	528	636	395
RTOR Reduction (vph)	11	0	0	0	0	268
Lane Group Flow (vph)	334	0	140	528	636	127
Turn Type			pm+pt			Perm
Protected Phases	4		5	2	6	
Permitted Phases			2			6
Actuated Green, G (s)	19.1		36.5	36.5	21.8	21.8
Effective Green, g (s)	19.1		36.5	36.5	21.8	21.8
Actuated g/C Ratio	0.28		0.54	0.54	0.32	0.32
Clearance Time (s)	6.0		6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	492		424	1911	1141	510
v/s Ratio Prot	c0.19		0.04	c0.15	c0.18	
v/s Ratio Perm			0.14			0.08
v/c Ratio	0.68		0.33	0.28	0.56	0.25
Uniform Delay, d1	21.5		8.8	8.4	18.9	16.9
Progression Factor	1.00		1.00	1.00	1.00	1.00
Incremental Delay, d2	3.7		0.5	0.1	0.6	0.3
Delay (s)	25.2		9.2	8.5	19.5	17.1
Level of Service	C		A	A	B	B
Approach Delay (s)	25.2			8.6	18.6	
Approach LOS	C			A	B	

Intersection Summary			
HCM Average Control Delay	16.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	67.6	Sum of lost time (s)	18.0
Intersection Capacity Utilization	56.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations										
Volume (vph)	33	11	24	40	16	13	521	17	587	38
Turn Type	Perm		custom	Perm		pm+pt		pm+pt		Perm
Protected Phases		4			8	5	2	1	6	
Permitted Phases	4		4 5	8		2		6		6
Detector Phase	4	4	4 5	8	8	5	2	1	6	6
Switch Phase										
Minimum Initial (s)	6.0	6.0		6.0	6.0	3.0	10.0	3.0	10.0	10.0
Minimum Split (s)	23.0	23.0		27.0	27.0	7.0	31.0	7.0	26.0	26.0
Total Split (s)	27.0	27.0	34.0	27.0	27.0	7.0	43.0	10.0	46.0	46.0
Total Split (%)	33.8%	33.8%	42.5%	33.8%	33.8%	8.8%	53.8%	12.5%	57.5%	57.5%
Yellow Time (s)	4.0	4.0		4.0	4.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	6.0	4.0	6.0	6.0
Lead/Lag						Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?										
Recall Mode	None	None		None	None	None	C-Max	None	C-Max	C-Max

Intersection Summary
Cycle Length: 80
Actuated Cycle Length: 80
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 65
Control Type: Actuated-Coordinated

Splits and Phases: 5: Waiko Road & Honoapiilani Highway

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	33	11	24	40	16	30	13	521	36	17	587	38
Ideal Flow (vphpl)	1900	1900	1900	1600	1600	1600	1900	1900	1900	1900	1900	1900
Grade (%)		-8%			0%			0%			0%	
Total Lost time (s)		5.0	5.0		5.0		4.0	6.0		4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	0.97
Flpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt		1.00	0.85		0.95		1.00	0.99		1.00	1.00	0.85
Flt Protected		0.96	1.00		0.98		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1867	1647		1460		1768	1845		1770	1863	1541
Flt Permitted		0.77	1.00		0.83		0.36	1.00		0.38	1.00	1.00
Satd. Flow (perm)		1482	1647		1237		676	1845		706	1863	1541
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	36	12	26	43	17	33	14	566	39	18	638	41
RTOR Reduction (vph)	0	0	21	0	29	0	0	2	0	0	0	9
Lane Group Flow (vph)	0	48	5	0	64	0	14	603	0	18	638	32
Confl. Peds. (#/hr)							3					3
Turn Type	Perm		custom	Perm			pm+pt			pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 5	8			2			6		6
Actuated Green, G (s)		8.5	15.3		8.5		56.3	54.5		56.7	54.7	54.7
Effective Green, g (s)		8.5	15.3		8.5		56.3	54.5		56.7	54.7	54.7
Actuated g/C Ratio		0.11	0.19		0.11		0.70	0.68		0.71	0.68	0.68
Clearance Time (s)		5.0			5.0		4.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)		2.0			2.0		2.0	5.0		2.0	5.0	5.0
Lane Grp Cap (vph)		157	315		131		500	1257		527	1274	1054
v/s Ratio Prot							0.00	0.33		c0.00	c0.34	
v/s Ratio Perm		0.03	0.00		c0.05		0.02			0.02		0.02
v/c Ratio		0.31	0.02		0.48		0.03	0.48		0.03	0.50	0.03
Uniform Delay, d1		33.0	26.2		33.7		3.9	6.0		3.8	6.1	4.1
Progression Factor		1.00	1.00		1.00		1.00	1.00		1.76	1.28	1.98
Incremental Delay, d2		0.4	0.0		1.0		0.0	1.3		0.0	1.3	0.0
Delay (s)		33.4	26.2		34.7		3.9	7.4		6.6	9.1	8.1
Level of Service		C	C		C		A	A		A	A	A
Approach Delay (s)		30.9			34.7			7.3			9.0	
Approach LOS		C			C			A			A	

Intersection Summary			
HCM Average Control Delay	11.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.44		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	55.0%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	46	41	95	85	43	33
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	50	45	103	92	47	36
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	196				294	149
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	196				294	149
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	96				93	96
cM capacity (veh/h)	1377				672	897

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	95	196	83
Volume Left	50	0	47
Volume Right	0	92	36
cSH	1377	1700	754
Volume to Capacity	0.04	0.12	0.11
Queue Length 95th (ft)	3	0	9
Control Delay (s)	4.2	0.0	10.4
Lane LOS	A		B
Approach Delay (s)	4.2	0.0	10.4
Approach LOS			B

Intersection Summary			
Average Delay	3.4		
Intersection Capacity Utilization	29.3%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	101	8	13	517	499	146
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Detector Phase	4	4 5	5	2	6	6 4
Switch Phase						
Minimum Initial (s)	6.0		4.0	10.0	10.0	
Minimum Split (s)	28.0		8.0	16.0	24.0	
Total Split (s)	29.0	39.0	10.0	51.0	41.0	70.0
Total Split (%)	36.3%	48.8%	12.5%	63.8%	51.3%	87.5%
Yellow Time (s)	3.0		3.0	4.0	4.0	
All-Red Time (s)	1.0		1.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?						
Recall Mode	None		None	Min	Min	

Intersection Summary
Cycle Length: 80
Actuated Cycle Length: 42.2
Natural Cycle: 60
Control Type: Actuated-Uncoordinated

Splits and Phases: 7: Waiko Road & Kuihelani Highway

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	101	8	13	517	499	146
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	3539	3539	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	3539	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	110	9	14	562	542	159
RTOR Reduction (vph)	0	6	0	0	0	31
Lane Group Flow (vph)	110	3	14	562	542	128
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Actuated Green, G (s)	7.7	12.6	0.9	27.6	22.7	36.4
Effective Green, g (s)	7.7	12.6	0.9	27.6	22.7	36.4
Actuated g/C Ratio	0.17	0.28	0.02	0.61	0.50	0.80
Clearance Time (s)	4.0		4.0	6.0	6.0	
Vehicle Extension (s)	2.0		2.0	5.0	5.0	
Lane Grp Cap (vph)	301	440	35	2156	1773	1272
v/s Ratio Prot	c0.06		0.01	c0.16	c0.15	
v/s Ratio Perm		0.00				0.08
v/c Ratio	0.37	0.01	0.40	0.26	0.31	0.10
Uniform Delay, d1	16.6	11.8	21.9	4.1	6.7	1.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.3	0.0	2.7	0.1	0.2	0.1
Delay (s)	16.9	11.8	24.6	4.2	6.9	1.0
Level of Service	B	B	C	A	A	A
Approach Delay (s)	16.5			4.7	5.5	
Approach LOS	B			A	A	

Intersection Summary			
HCM Average Control Delay	6.1	HCM Level of Service	A
HCM Volume to Capacity ratio	0.35		
Actuated Cycle Length (s)	45.3	Sum of lost time (s)	16.0
Intersection Capacity Utilization	28.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

APPENDIX C

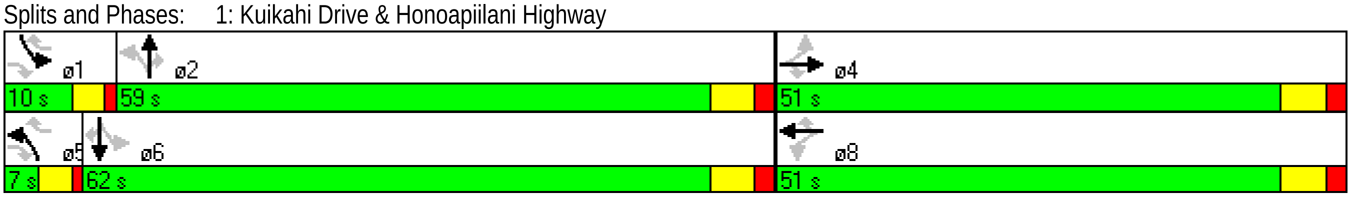
LEVEL OF SERVICE CALCULATIONS

- Base Year 2022 AM

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	200	60	225	65	155	25	540	270	165	440	25
Turn Type	Perm		custom	Perm		custom	pm+pt		Perm	pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 1 5	8		8 5 1	2		2	6		6
Detector Phase	4	4	4 1 5	8	8	8 5 1	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	6.0	6.0		6.0	6.0		3.0	10.0	10.0	3.0	10.0	10.0
Minimum Split (s)	27.0	27.0		27.0	27.0		7.0	24.0	24.0	7.0	24.0	24.0
Total Split (s)	51.0	51.0	68.0	51.0	51.0	68.0	7.0	59.0	59.0	10.0	62.0	62.0
Total Split (%)	42.5%	42.5%	56.7%	42.5%	42.5%	56.7%	5.8%	49.2%	49.2%	8.3%	51.7%	51.7%
Yellow Time (s)	4.0	4.0		4.0	4.0		3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	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 Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag							Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?												
Recall Mode	None	None		None	None		None	Min	Min	None	Min	Min

Intersection Summary
Cycle Length: 120
Actuated Cycle Length: 103.4
Natural Cycle: 80
Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Kuikahi Drive & Honoapiilani Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	200	60	225	65	155	25	540	270	165	440	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-5%			0%			0%			0%	
Total Lost time (s)		6.0	6.0		6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.99	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1889	1623		1793	1583	1770	1863	1583	1770	1863	1583
Flt Permitted		0.81	1.00		0.52	1.00	0.35	1.00	1.00	0.18	1.00	1.00
Satd. Flow (perm)		1552	1623		963	1583	657	1863	1583	340	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	60	217	65	245	71	168	27	587	293	179	478	27
RTOR Reduction (vph)	0	0	20	0	0	85	0	0	143	0	0	15
Lane Group Flow (vph)	0	277	45	0	316	83	27	587	150	179	478	12
Turn Type	Perm		custom	Perm		custom	pm+pt		Perm	pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 1 5	8		8 5 1	2		2	6		6
Actuated Green, G (s)		38.6	50.8		38.6	50.8	45.1	42.0	42.0	51.3	45.1	45.1
Effective Green, g (s)		38.6	50.8		38.6	50.8	45.1	42.0	42.0	51.3	45.1	45.1
Actuated g/C Ratio		0.38	0.49		0.38	0.49	0.44	0.41	0.41	0.50	0.44	0.44
Clearance Time (s)		6.0			6.0		4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)		2.0			2.0		2.0	5.0	5.0	2.0	5.0	5.0
Lane Grp Cap (vph)		583	802		362	782	322	761	647	256	817	694
v/s Ratio Prot							0.00	c0.32		c0.04	0.26	
v/s Ratio Perm		0.18	0.03		c0.33	0.05	0.03		0.10	0.31		0.01
v/c Ratio		0.48	0.06		0.87	0.11	0.08	0.77	0.23	0.70	0.59	0.02
Uniform Delay, d1		24.4	13.5		29.8	13.9	17.1	26.3	19.9	18.7	21.8	16.3
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		0.2	0.0		19.5	0.0	0.0	5.7	0.4	6.6	1.7	0.0
Delay (s)		24.6	13.5		49.3	13.9	17.2	31.9	20.3	25.3	23.4	16.3
Level of Service		C	B		D	B	B	C	C	C	C	B
Approach Delay (s)		22.5			37.0			27.7			23.7	
Approach LOS		C			D			C			C	

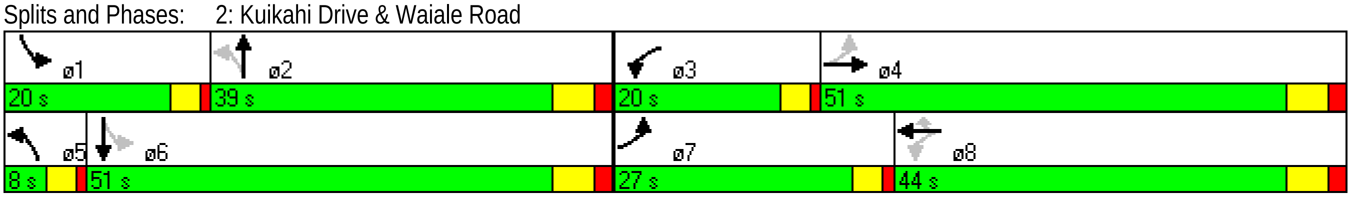
Intersection Summary			
HCM Average Control Delay	27.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	102.8	Sum of lost time (s)	20.0
Intersection Capacity Utilization	85.3%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations									
Volume (vph)	340	285	230	185	315	55	420	235	255
Turn Type	pm+pt		pm+pt		Perm	pm+pt		pm+pt	
Protected Phases	7	4	3	8		5	2	1	6
Permitted Phases	4		8		8	2		6	
Detector Phase	7	4	3	8	8	5	2	1	6
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	27.0	8.0	27.0	27.0	8.0	23.0	8.0	23.0
Total Split (s)	27.0	51.0	20.0	44.0	44.0	8.0	39.0	20.0	51.0
Total Split (%)	20.8%	39.2%	15.4%	33.8%	33.8%	6.2%	30.0%	15.4%	39.2%
Yellow Time (s)	3.0	4.0	3.0	4.0	4.0	3.0	4.0	3.0	4.0
All-Red Time (s)	1.0	2.0	1.0	2.0	2.0	1.0	2.0	1.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	4.0	6.0	6.0	4.0	6.0	4.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?									
Recall Mode	None	None	None	None	None	None	Min	None	Min

Intersection Summary
Cycle Length: 130
Actuated Cycle Length: 108.3
Natural Cycle: 120
Control Type: Actuated-Uncoordinated

Splits and Phases: 2: Kuikahi Drive & Waiale Road



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	340	285	25	230	185	315	55	420	285	235	255	190
Ideal Flow (vphpl)	1700	1900	1900	1900	1900	1900	1900	1600	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	4.0	6.0		4.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.94		1.00	0.94	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1583	1840		1770	1863	1583	1770	1474		1770	1743	
Flt Permitted	0.36	1.00		0.36	1.00	1.00	0.42	1.00		0.10	1.00	
Satd. Flow (perm)	608	1840		680	1863	1583	778	1474		195	1743	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	370	310	27	250	201	342	60	457	310	255	277	207
RTOR Reduction (vph)	0	3	0	0	0	269	0	17	0	0	18	0
Lane Group Flow (vph)	370	334	0	250	201	73	60	750	0	255	466	0
Turn Type	pm+pt			pm+pt		Perm	pm+pt			pm+pt		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)	43.7	25.3		32.7	18.3	18.3	37.3	34.2		53.5	46.4	
Effective Green, g (s)	43.7	25.3		32.7	18.3	18.3	37.3	34.2		53.5	46.4	
Actuated g/C Ratio	0.40	0.23		0.30	0.17	0.17	0.34	0.31		0.49	0.42	
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	4.0	6.0		4.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	434	426		347	312	265	294	462		316	741	
v/s Ratio Prot	c0.17	0.18		0.09	0.11		0.01	c0.51		c0.11	0.27	
v/s Ratio Perm	c0.17			0.12		0.05	0.06			0.28		
v/c Ratio	0.85	0.78		0.72	0.64	0.28	0.20	1.62		0.81	0.63	
Uniform Delay, d1	26.3	39.4		31.4	42.4	39.7	24.6	37.5		28.2	24.6	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	14.9	9.1		7.2	4.5	0.6	0.3	290.2		14.0	1.7	
Delay (s)	41.1	48.5		38.6	46.9	40.2	25.0	327.7		42.1	26.3	
Level of Service	D	D		D	D	D	C	F		D	C	
Approach Delay (s)		44.7			41.4			305.7			31.8	
Approach LOS		D			D			F			C	

Intersection Summary			
HCM Average Control Delay	111.1	HCM Level of Service	F
HCM Volume to Capacity ratio	1.10		
Actuated Cycle Length (s)	109.2	Sum of lost time (s)	14.0
Intersection Capacity Utilization	107.4%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	245	350	140	115	465	220	210	240	160	225	190	450
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	266	380	152	125	505	239	228	261	174	245	207	489

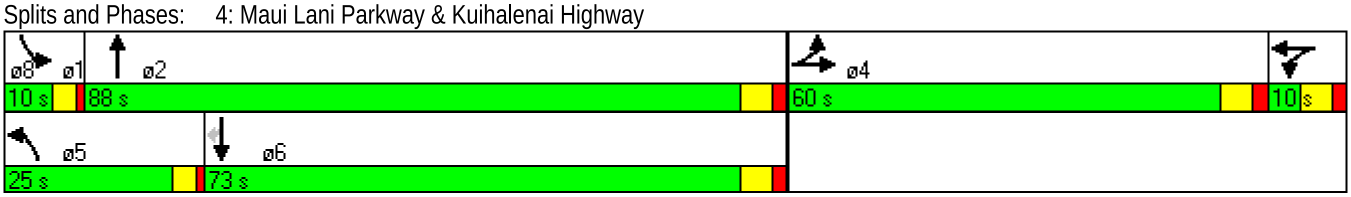
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total (vph)	799	870	228	435	245	696
Volume Left (vph)	266	125	228	0	245	0
Volume Right (vph)	152	239	0	174	0	489
Hadj (s)	-0.01	-0.10	0.53	-0.25	0.53	-0.46
Departure Headway (s)	9.4	9.4	10.2	9.4	10.2	9.2
Degree Utilization, x	2.10	2.26	0.64	1.13	0.69	1.77
Capacity (veh/h)	388	392	347	396	348	397
Control Delay (s)	523.0	595.7	28.6	116.6	31.8	378.6
Approach Delay (s)	523.0	595.7	86.3		288.4	
Approach LOS	F	F	F		F	

Intersection Summary			
Delay	386.4		
HCM Level of Service	F		
Intersection Capacity Utilization	154.1%	ICU Level of Service	H
Analysis Period (min)	15		

Lane Group	EBT	NBL	NBT	SBT	SBR	ø1	ø8
Lane Configurations							
Volume (vph)	0	150	840	610	560		
Turn Type		Prot			Perm		
Protected Phases	4	5	2	6		1	8
Permitted Phases					6		
Detector Phase	4	5	2	6	6		
Switch Phase							
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	10.0	8.0	10.0	27.0	27.0	8.0	10.0
Total Split (s)	60.0	25.0	88.0	73.0	73.0	10.0	10.0
Total Split (%)	35.7%	14.9%	52.4%	43.5%	43.5%	6%	6%
Yellow Time (s)	4.0	3.0	4.0	4.0	4.0	3.0	4.0
All-Red Time (s)	2.0	1.0	2.0	2.0	2.0	1.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		
Total Lost Time (s)	6.0	4.0	6.0	6.0	6.0		
Lead/Lag		Lead	Lag	Lag	Lag	Lead	
Lead-Lag Optimize?							
Recall Mode	None	None	Min	Min	Min	None	None

Intersection Summary
Cycle Length: 168
Actuated Cycle Length: 121.9
Natural Cycle: 150
Control Type: Actuated-Uncoordinated

Splits and Phases: 4: Maui Lani Parkway & Kuihalenai Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	675	0	300	0	0	0	150	840	0	0	610	560
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0					4.0	6.0			6.0	6.0
Lane Util. Factor		1.00					1.00	0.95			0.95	1.00
Frt		0.96					1.00	1.00			1.00	0.85
Flt Protected		0.97					0.95	1.00			1.00	1.00
Satd. Flow (prot)		1726					1770	3539			3539	1583
Flt Permitted		0.97					0.95	1.00			1.00	1.00
Satd. Flow (perm)		1726					1770	3539			3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	734	0	326	0	0	0	163	913	0	0	663	609
RTOR Reduction (vph)	0	8	0	0	0	0	0	0	0	0	0	435
Lane Group Flow (vph)	0	1052	0	0	0	0	163	913	0	0	663	174
Turn Type	Split			Split			Prot			Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases												6
Actuated Green, G (s)		54.5					16.5	55.3			34.8	34.8
Effective Green, g (s)		54.5					16.5	55.3			34.8	34.8
Actuated g/C Ratio		0.45					0.14	0.45			0.29	0.29
Clearance Time (s)		6.0					4.0	6.0			6.0	6.0
Vehicle Extension (s)		3.0					3.0	3.0			3.0	3.0
Lane Grp Cap (vph)		772					240	1607			1011	452
v/s Ratio Prot		c0.61					c0.09	0.26			c0.19	
v/s Ratio Perm												0.11
v/c Ratio		1.36					0.68	0.57			0.66	0.38
Uniform Delay, d1		33.6					50.1	24.5			38.2	34.9
Progression Factor		1.00					1.00	1.00			1.00	1.00
Incremental Delay, d2		171.7					7.4	0.5			1.5	0.5
Delay (s)		205.3					57.6	24.9			39.8	35.5
Level of Service		F					E	C			D	D
Approach Delay (s)		205.3			0.0			29.9			37.7	
Approach LOS		F			A			C			D	

Intersection Summary			
HCM Average Control Delay	87.4	HCM Level of Service	F
HCM Volume to Capacity ratio	1.02		
Actuated Cycle Length (s)	121.8	Sum of lost time (s)	16.0
Intersection Capacity Utilization	95.6%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations										
Volume (vph)	35	25	10	65	5	5	580	80	625	15
Turn Type	Perm		custom	Perm		pm+pt		pm+pt		Perm
Protected Phases		4			8	5	2	1	6	
Permitted Phases	4		4 5	8		2		6		6
Detector Phase	4	4	4 5	8	8	5	2	1	6	6
Switch Phase										
Minimum Initial (s)	6.0	6.0		6.0	6.0	3.0	10.0	3.0	10.0	10.0
Minimum Split (s)	23.0	23.0		27.0	27.0	7.0	31.0	7.0	26.0	26.0
Total Split (s)	27.0	27.0	34.0	27.0	27.0	7.0	64.0	9.0	66.0	66.0
Total Split (%)	27.0%	27.0%	34.0%	27.0%	27.0%	7.0%	64.0%	9.0%	66.0%	66.0%
Yellow Time (s)	4.0	4.0		4.0	4.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	6.0	4.0	6.0	6.0
Lead/Lag						Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?										
Recall Mode	None	None		None	None	None	C-Max	None	C-Max	C-Max

Intersection Summary
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 70
Control Type: Actuated-Coordinated

Splits and Phases: 5: Waiko Road & Honoapiilani Highway

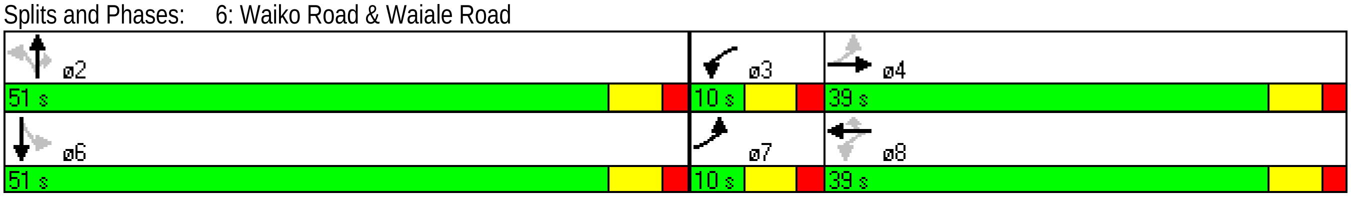
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	35	25	10	65	5	35	5	580	70	80	625	15
Ideal Flow (vphpl)	1900	1900	1900	1600	1600	1600	1900	1900	1900	1900	1900	1900
Grade (%)		-8%			0%			0%			0%	
Total Lost time (s)		5.0	5.0		5.0		4.0	6.0		4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	0.97
Flpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt		1.00	0.85		0.95		1.00	0.98		1.00	1.00	0.85
Flt Protected		0.97	1.00		0.97		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1882	1647		1453		1768	1833		1770	1863	1539
Flt Permitted		0.77	1.00		0.77		0.36	1.00		0.30	1.00	1.00
Satd. Flow (perm)		1488	1647		1157		663	1833		562	1863	1539
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	38	27	11	71	5	38	5	630	76	87	679	16
RTOR Reduction (vph)	0	0	9	0	20	0	0	3	0	0	0	3
Lane Group Flow (vph)	0	65	2	0	94	0	5	703	0	87	679	13
Confl. Peds. (#/hr)							3					3
Turn Type	Perm		custom	Perm			pm+pt			pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 5	8			2			6		6
Actuated Green, G (s)		12.4	18.6		12.4		69.8	68.6		75.4	71.4	71.4
Effective Green, g (s)		12.4	18.6		12.4		69.8	68.6		75.4	71.4	71.4
Actuated g/C Ratio		0.12	0.19		0.12		0.70	0.69		0.75	0.71	0.71
Clearance Time (s)		5.0			5.0		4.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)		2.0			2.0		2.0	5.0		2.0	5.0	5.0
Lane Grp Cap (vph)		185	306		143		476	1257		472	1330	1099
v/s Ratio Prot							0.00	c0.38		c0.01	0.36	
v/s Ratio Perm		0.04	0.00		c0.08		0.01			0.13		0.01
v/c Ratio		0.35	0.01		0.66		0.01	0.56		0.18	0.51	0.01
Uniform Delay, d1		40.1	33.2		41.8		4.9	8.0		4.8	6.4	4.1
Progression Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2		0.4	0.0		8.0		0.0	1.8		0.1	1.4	0.0
Delay (s)		40.5	33.2		49.8		4.9	9.8		4.9	7.8	4.1
Level of Service		D	C		D		A	A		A	A	A
Approach Delay (s)		39.5			49.8			9.8			7.4	
Approach LOS		D			D			A			A	

Intersection Summary			
HCM Average Control Delay	12.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	19.0
Intersection Capacity Utilization	65.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations										
Volume (vph)	45	175	85	55	60	15	370	200	155	310
Turn Type	pm+pt		pm+pt		Perm	Perm		Perm	Perm	
Protected Phases	7	4	3	8			2			6
Permitted Phases	4		8		8	2		2	6	
Detector Phase	7	4	3	8	8	2	2	2	6	6
Switch Phase										
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	10.0	27.0	10.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0
Total Split (s)	10.0	39.0	10.0	39.0	39.0	51.0	51.0	51.0	51.0	51.0
Total Split (%)	10.0%	39.0%	10.0%	39.0%	39.0%	51.0%	51.0%	51.0%	51.0%	51.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag					
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes					
Recall Mode	None	None	None	None	None	None	None	None	None	None

Intersection Summary
Cycle Length: 100
Actuated Cycle Length: 52.5
Natural Cycle: 65
Control Type: Actuated-Uncoordinated

Splits and Phases: 6: Waiko Road & Waiale Road



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	45	175	20	85	55	60	15	370	200	155	310	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1834		1770	1863	1583	1770	1863	1583	1770	1814	
Flt Permitted	0.72	1.00		0.59	1.00	1.00	0.41	1.00	1.00	0.42	1.00	
Satd. Flow (perm)	1337	1834		1093	1863	1583	764	1863	1583	778	1814	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	49	190	22	92	60	65	16	402	217	168	337	71
RTOR Reduction (vph)	0	4	0	0	0	47	0	0	114	0	9	0
Lane Group Flow (vph)	49	208	0	92	60	18	16	402	103	168	399	0
Turn Type	pm+pt			pm+pt		Perm	Perm		Perm	Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)	15.8	13.7		17.6	14.6	14.6	19.4	19.4	19.4	19.4	19.4	
Effective Green, g (s)	15.8	13.7		17.6	14.6	14.6	19.4	19.4	19.4	19.4	19.4	
Actuated g/C Ratio	0.29	0.25		0.33	0.27	0.27	0.36	0.36	0.36	0.36	0.36	
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	407	464		393	503	427	274	668	568	279	650	
v/s Ratio Prot	0.00	c0.11		c0.01	0.03			0.22			c0.22	
v/s Ratio Perm	0.03			0.06		0.01	0.02		0.07	0.22		
v/c Ratio	0.12	0.45		0.23	0.12	0.04	0.06	0.60	0.18	0.60	0.61	
Uniform Delay, d1	13.9	17.0		13.0	14.9	14.6	11.4	14.2	11.9	14.2	14.3	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.1	0.7		0.3	0.1	0.0	0.1	1.5	0.2	3.6	1.7	
Delay (s)	14.1	17.7		13.3	15.0	14.6	11.5	15.7	12.1	17.8	16.0	
Level of Service	B	B		B	B	B	B	B	B	B	B	
Approach Delay (s)		17.0			14.2			14.4			16.5	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM Average Control Delay	15.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	54.1	Sum of lost time (s)	18.0
Intersection Capacity Utilization	63.2%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	500	30	15	485	675	205
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Detector Phase	4	4 5	5	2	6	6 4
Switch Phase						
Minimum Initial (s)	6.0		4.0	10.0	10.0	
Minimum Split (s)	28.0		8.0	16.0	24.0	
Total Split (s)	29.0	39.0	10.0	51.0	41.0	70.0
Total Split (%)	36.3%	48.8%	12.5%	63.8%	51.3%	87.5%
Yellow Time (s)	3.0		3.0	4.0	4.0	
All-Red Time (s)	1.0		1.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?						
Recall Mode	None		None	Min	Min	

Intersection Summary
Cycle Length: 80
Actuated Cycle Length: 64.9
Natural Cycle: 60
Control Type: Actuated-Uncoordinated

Splits and Phases: 7: Waiko Road & Kuihelani Highway

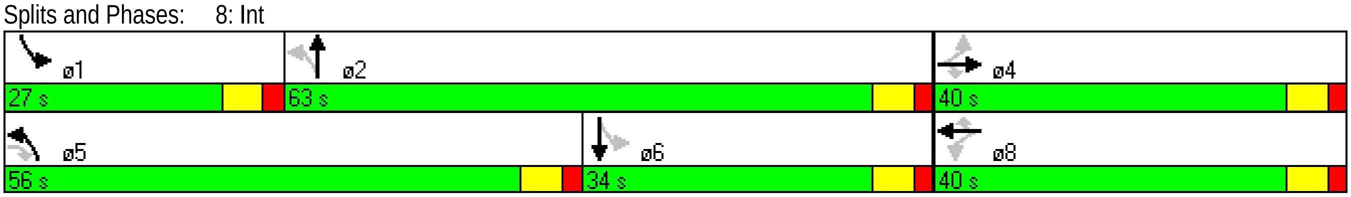
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	500	30	15	485	675	205
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	3539	3539	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	3539	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	543	33	16	527	734	223
RTOR Reduction (vph)	0	8	0	0	0	37
Lane Group Flow (vph)	543	25	16	527	734	186
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Actuated Green, G (s)	24.7	31.6	2.9	31.7	24.8	55.5
Effective Green, g (s)	24.7	31.6	2.9	31.7	24.8	55.5
Actuated g/C Ratio	0.37	0.48	0.04	0.48	0.37	0.84
Clearance Time (s)	4.0		4.0	6.0	6.0	
Vehicle Extension (s)	2.0		2.0	5.0	5.0	
Lane Grp Cap (vph)	658	753	77	1690	1322	1323
v/s Ratio Prot	c0.31		0.01	c0.15	c0.21	
v/s Ratio Perm		0.02				0.12
v/c Ratio	0.83	0.03	0.21	0.31	0.56	0.14
Uniform Delay, d1	18.9	9.3	30.6	10.7	16.4	1.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	7.9	0.0	0.5	0.2	0.9	0.1
Delay (s)	26.8	9.3	31.1	10.9	17.3	1.1
Level of Service	C	A	C	B	B	A
Approach Delay (s)	25.8			11.5	13.5	
Approach LOS	C			B	B	

Intersection Summary			
HCM Average Control Delay	16.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	66.4	Sum of lost time (s)	16.0
Intersection Capacity Utilization	54.7%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations										
Volume (vph)	200	15	455	20	45	15	840	320	5	235
Turn Type	Perm		custom	Perm		Perm	pm+pt		pm+pt	
Protected Phases		4			8		5	2	1	6
Permitted Phases	4		4 5	8		8	2		6	
Detector Phase	4	4	4 5	8	8	8	5	2	1	6
Switch Phase										
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	27.0	27.0		27.0	27.0	27.0	27.0	27.0	27.0	27.0
Total Split (s)	40.0	40.0	96.0	40.0	40.0	40.0	56.0	63.0	27.0	34.0
Total Split (%)	30.8%	30.8%	73.8%	30.8%	30.8%	30.8%	43.1%	48.5%	20.8%	26.2%
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag							Lead	Lag	Lead	Lag
Lead-Lag Optimize?							Yes	Yes		
Recall Mode	None	None		None	None	None	None	None	None	None

Intersection Summary
Cycle Length: 130
Actuated Cycle Length: 119.2
Natural Cycle: 105
Control Type: Actuated-Uncoordinated

Splits and Phases: 8: Int



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	200	15	455	20	45	15	840	320	10	5	235	80
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85		1.00	0.85	1.00	1.00		1.00	0.96	
Flt Protected	0.95	1.00	1.00		0.98	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1863	1583		1834	1583	1770	1854		1770	1792	
Flt Permitted	0.71	1.00	1.00		0.92	1.00	0.22	1.00		0.55	1.00	
Satd. Flow (perm)	1324	1863	1583		1709	1583	408	1854		1018	1792	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	217	16	495	22	49	16	913	348	11	5	255	87
RTOR Reduction (vph)	0	0	79	0	0	13	0	1	0	0	9	0
Lane Group Flow (vph)	217	16	416	0	71	3	913	358	0	5	333	0
Turn Type	Perm		custom	Perm		Perm	pm+pt			pm+pt		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 5	8		8	2			6		
Actuated Green, G (s)	25.3	25.3	81.7		25.3	25.3	86.7	79.6		31.4	30.3	
Effective Green, g (s)	25.3	25.3	81.7		25.3	25.3	86.7	79.6		31.4	30.3	
Actuated g/C Ratio	0.20	0.20	0.66		0.20	0.20	0.70	0.64		0.25	0.24	
Clearance Time (s)	6.0	6.0			6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	270	380	1043		349	323	839	1190		264	438	
v/s Ratio Prot		0.01					c0.44	0.19		0.00	0.19	
v/s Ratio Perm	c0.16		0.26		0.04	0.00	c0.32			0.00		
v/c Ratio	0.80	0.04	0.40		0.20	0.01	1.09	0.30		0.02	0.76	
Uniform Delay, d1	47.0	39.6	9.8		41.0	39.4	26.9	9.9		34.7	43.5	
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	15.8	0.0	0.3		0.3	0.0	57.9	0.1		0.0	7.6	
Delay (s)	62.7	39.7	10.0		41.3	39.4	84.7	10.0		34.8	51.1	
Level of Service	E	D	B		D	D	F	A		C	D	
Approach Delay (s)		26.4			40.9			63.6			50.8	
Approach LOS		C			D			E			D	

Intersection Summary			
HCM Average Control Delay	49.9	HCM Level of Service	D
HCM Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	124.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	96.5%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

APPENDIX C

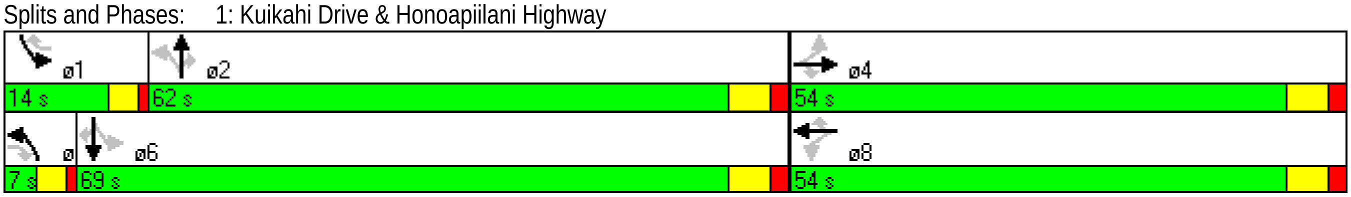
LEVEL OF SERVICE CALCULATIONS

- Base Year 2022 PM

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	25	100	25	275	190	115	35	610	180	175	795	45
Turn Type	Perm		custom	Perm		custom	pm+pt		Perm	pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 5	8		8 1	2		2	6		6
Detector Phase	4	4	4 5	8	8	8 1	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	6.0	6.0		6.0	6.0		3.0	10.0	10.0	3.0	10.0	10.0
Minimum Split (s)	27.0	27.0		27.0	27.0		7.0	24.0	24.0	7.0	24.0	24.0
Total Split (s)	54.0	54.0	61.0	54.0	54.0	68.0	7.0	62.0	62.0	14.0	69.0	69.0
Total Split (%)	41.5%	41.5%	46.9%	41.5%	41.5%	52.3%	5.4%	47.7%	47.7%	10.8%	53.1%	53.1%
Yellow Time (s)	4.0	4.0		4.0	4.0		3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	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 Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag							Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?												
Recall Mode	None	None		None	None		None	None	None	None	None	None

Intersection Summary
Cycle Length: 130
Actuated Cycle Length: 126.8
Natural Cycle: 110
Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Kuikahi Drive & Honoapiilani Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	25	100	25	275	190	115	35	610	180	175	795	45
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-5%			0%			0%			0%	
Total Lost time (s)		6.0	6.0		6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.99	1.00		0.97	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1891	1623		1809	1583	1770	1863	1583	1770	1863	1583
Flt Permitted		0.69	1.00		0.73	1.00	0.07	1.00	1.00	0.12	1.00	1.00
Satd. Flow (perm)		1314	1623		1368	1583	138	1863	1583	223	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	27	109	27	299	207	125	38	663	196	190	864	49
RTOR Reduction (vph)	0	0	15	0	0	46	0	0	108	0	0	21
Lane Group Flow (vph)	0	136	12	0	506	79	38	663	88	190	864	28
Turn Type	Perm		custom	Perm		custom	pm+pt		Perm	pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 5	8		8 1	2		2	6		6
Actuated Green, G (s)		48.1	56.4		48.1	63.8	56.1	53.8	53.8	67.5	61.2	61.2
Effective Green, g (s)		48.1	56.4		48.1	63.8	56.1	53.8	53.8	67.5	61.2	61.2
Actuated g/C Ratio		0.38	0.44		0.38	0.50	0.44	0.42	0.42	0.53	0.48	0.48
Clearance Time (s)		6.0			6.0		4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)		2.0			2.0		2.0	5.0	5.0	2.0	5.0	5.0
Lane Grp Cap (vph)		495	717		516	792	90	785	667	236	894	759
v/s Ratio Prot							0.01	0.36		c0.06	c0.46	
v/s Ratio Perm		0.10	0.01		c0.37	0.05	0.18		0.06	0.37		0.02
v/c Ratio		0.27	0.02		0.98	0.10	0.42	0.84	0.13	0.81	0.97	0.04
Uniform Delay, d1		27.6	20.0		39.3	16.8	29.7	33.1	22.6	24.6	32.2	17.6
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		0.1	0.0		34.4	0.0	1.2	9.1	0.2	16.9	22.4	0.0
Delay (s)		27.7	20.0		73.7	16.8	30.9	42.3	22.8	41.5	54.6	17.6
Level of Service		C	C		E	B	C	D	C	D	D	B
Approach Delay (s)		26.5			62.4			37.5			50.7	
Approach LOS		C			E			D			D	

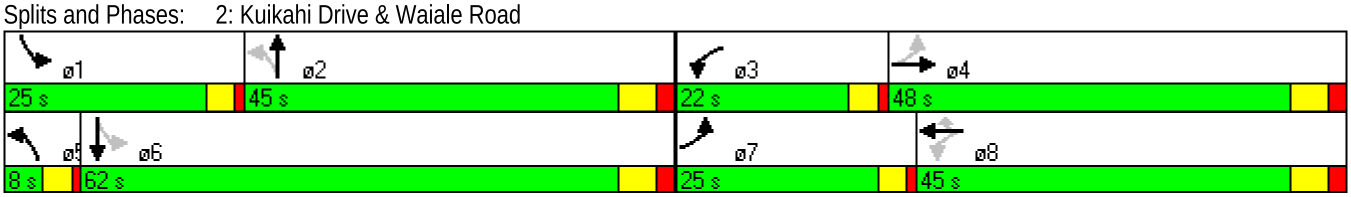
Intersection Summary			
HCM Average Control Delay	47.7	HCM Level of Service	D
HCM Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	127.6	Sum of lost time (s)	10.0
Intersection Capacity Utilization	90.4%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations									
Volume (vph)	175	260	355	280	360	25	390	405	415
Turn Type	pm+pt		pm+pt		Perm	pm+pt		pm+pt	
Protected Phases	7	4	3	8		5	2	1	6
Permitted Phases	4		8		8	2		6	
Detector Phase	7	4	3	8	8	5	2	1	6
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	27.0	8.0	27.0	27.0	8.0	23.0	8.0	23.0
Total Split (s)	25.0	48.0	22.0	45.0	45.0	8.0	45.0	25.0	62.0
Total Split (%)	17.9%	34.3%	15.7%	32.1%	32.1%	5.7%	32.1%	17.9%	44.3%
Yellow Time (s)	3.0	4.0	3.0	4.0	4.0	3.0	4.0	3.0	4.0
All-Red Time (s)	1.0	2.0	1.0	2.0	2.0	1.0	2.0	1.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	4.0	6.0	6.0	4.0	6.0	4.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?									
Recall Mode	None	None	None	None	None	None	Min	None	Min

Intersection Summary
Cycle Length: 140
Actuated Cycle Length: 126.9
Natural Cycle: 130
Control Type: Actuated-Uncoordinated

Splits and Phases: 2: Kuikahi Drive & Waiale Road



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	175	260	40	355	280	360	25	390	270	405	415	270
Ideal Flow (vphpl)	1500	1900	1900	1900	1900	1900	1900	1600	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	4.0	6.0		4.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	1.00	0.85	1.00	0.94		1.00	0.94	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1397	1826		1770	1863	1583	1770	1472		1770	1753	
Flt Permitted	0.32	1.00		0.23	1.00	1.00	0.16	1.00		0.09	1.00	
Satd. Flow (perm)	470	1826		434	1863	1583	299	1472		166	1753	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	190	283	43	386	304	391	27	424	293	440	451	293
RTOR Reduction (vph)	0	5	0	0	0	176	0	17	0	0	15	0
Lane Group Flow (vph)	190	321	0	386	304	215	27	700	0	440	729	0
Turn Type	pm+pt			pm+pt		Perm	pm+pt			pm+pt		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)	45.2	28.5		48.0	29.9	29.9	43.2	40.9		66.0	59.7	
Effective Green, g (s)	45.2	28.5		48.0	29.9	29.9	43.2	40.9		66.0	59.7	
Actuated g/C Ratio	0.35	0.22		0.37	0.23	0.23	0.34	0.32		0.51	0.46	
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	4.0	6.0		4.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	286	405		350	433	368	127	468		348	814	
v/s Ratio Prot	0.09	0.18		c0.16	0.16		0.00	c0.48		c0.21	0.42	
v/s Ratio Perm	0.15			c0.26		0.14	0.07			0.44		
v/c Ratio	0.66	0.79		1.10	0.70	0.58	0.21	1.50		1.26	0.90	
Uniform Delay, d1	32.1	47.3		34.8	45.3	43.8	31.1	43.8		41.2	31.6	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	5.7	10.2		78.7	5.1	2.4	0.8	234.1		140.0	12.4	
Delay (s)	37.8	57.5		113.5	50.4	46.2	31.9	277.9		181.2	44.0	
Level of Service	D	E		F	D	D	C	F		F	D	
Approach Delay (s)		50.3			71.4			269.0			95.0	
Approach LOS		D			E			F			F	

Intersection Summary			
HCM Average Control Delay	117.9	HCM Level of Service	F
HCM Volume to Capacity ratio	1.23		
Actuated Cycle Length (s)	128.6	Sum of lost time (s)	14.0
Intersection Capacity Utilization	118.8%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	520	675	150	120	730	365	85	145	70	215	175	450
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	565	734	163	130	793	397	92	158	76	234	190	489

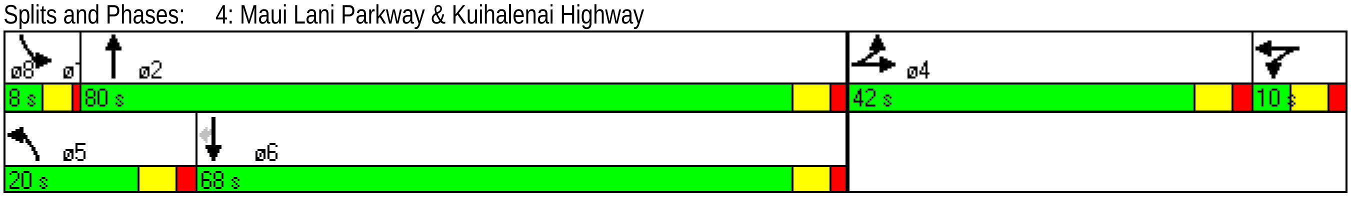
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total (vph)	1462	1321	92	234	234	679
Volume Left (vph)	565	130	92	0	234	0
Volume Right (vph)	163	397	0	76	0	489
Hadj (s)	0.04	-0.13	0.53	-0.19	0.53	-0.47
Departure Headway (s)	8.7	8.6	10.2	9.4	9.5	8.6
Degree Utilization, x	3.55	3.15	0.26	0.61	0.62	1.61
Capacity (veh/h)	416	423	350	372	364	425
Control Delay (s)	1171.2	989.3	15.5	25.1	25.7	307.5
Approach Delay (s)	1171.2	989.3	22.3		235.4	
Approach LOS	F	F	C		F	

Intersection Summary			
Delay	805.9		
HCM Level of Service	F		
Intersection Capacity Utilization	217.1%	ICU Level of Service	H
Analysis Period (min)	15		

Lane Group	EBT	NBL	NBT	SBT	SBR	ø1	ø8
Lane Configurations							
Volume (vph)	0	280	985	1060	975		
Turn Type		Prot			Perm		
Protected Phases	4	5	2	6		1	8
Permitted Phases					6		
Detector Phase	4	5	2	6	6		
Switch Phase							
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	10.0	10.0	10.0	27.0	27.0	8.0	10.0
Total Split (s)	42.0	20.0	80.0	68.0	68.0	8.0	10.0
Total Split (%)	30.0%	14.3%	57.1%	48.6%	48.6%	6%	7%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	3.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	1.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0		
Lead/Lag		Lead	Lag	Lag	Lag	Lead	
Lead-Lag Optimize?			Yes			Yes	
Recall Mode	None	None	None	None	None	None	None

Intersection Summary
Cycle Length: 140
Actuated Cycle Length: 127.5
Natural Cycle: 140
Control Type: Actuated-Uncoordinated

Splits and Phases: 4: Maui Lani Parkway & Kuihalenai Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	690	0	175	0	0	0	280	985	0	0	1060	975
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0					6.0	6.0			6.0	6.0
Lane Util. Factor		1.00					1.00	0.95			0.95	1.00
Frt		0.97					1.00	1.00			1.00	0.85
Flt Protected		0.96					0.95	1.00			1.00	1.00
Satd. Flow (prot)		1742					1770	3539			3539	1583
Flt Permitted		0.96					0.95	1.00			1.00	1.00
Satd. Flow (perm)		1742					1770	3539			3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	750	0	190	0	0	0	304	1071	0	0	1152	1060
RTOR Reduction (vph)	0	6	0	0	0	0	0	0	0	0	0	468
Lane Group Flow (vph)	0	934	0	0	0	0	304	1071	0	0	1152	592
Turn Type	Split			Split			Prot			Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases												6
Actuated Green, G (s)		36.1					14.0	79.4			59.4	59.4
Effective Green, g (s)		36.1					14.0	79.4			59.4	59.4
Actuated g/C Ratio		0.28					0.11	0.62			0.47	0.47
Clearance Time (s)		6.0					6.0	6.0			6.0	6.0
Vehicle Extension (s)		3.0					3.0	3.0			3.0	3.0
Lane Grp Cap (vph)		493					194	2204			1649	737
v/s Ratio Prot		c0.54					c0.17	0.30			0.33	
v/s Ratio Perm												c0.37
v/c Ratio		1.89					1.57	0.49			0.70	0.80
Uniform Delay, d1		45.7					56.8	13.0			27.0	29.1
Progression Factor		1.00					1.00	1.00			1.00	1.00
Incremental Delay, d2		409.7					278.6	0.2			1.3	6.3
Delay (s)		455.4					335.4	13.2			28.3	35.4
Level of Service		F					F	B			C	D
Approach Delay (s)		455.4			0.0			84.4			31.7	
Approach LOS		F			A			F			C	

Intersection Summary			
HCM Average Control Delay	135.7	HCM Level of Service	F
HCM Volume to Capacity ratio	1.26		
Actuated Cycle Length (s)	127.5	Sum of lost time (s)	18.0
Intersection Capacity Utilization	108.7%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations										
Volume (vph)	40	15	30	75	20	15	660	20	905	45
Turn Type	Perm		custom	Perm		pm+pt		pm+pt		Perm
Protected Phases		4			8	5	2	1	6	
Permitted Phases	4		4 5	8		2		6		6
Detector Phase	4	4	4 5	8	8	5	2	1	6	6
Switch Phase										
Minimum Initial (s)	6.0	6.0		6.0	6.0	3.0	10.0	3.0	10.0	10.0
Minimum Split (s)	23.0	23.0		27.0	27.0	7.0	31.0	7.0	26.0	26.0
Total Split (s)	27.0	27.0	34.0	27.0	27.0	7.0	66.0	7.0	66.0	66.0
Total Split (%)	27.0%	27.0%	34.0%	27.0%	27.0%	7.0%	66.0%	7.0%	66.0%	66.0%
Yellow Time (s)	4.0	4.0		4.0	4.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	6.0	4.0	6.0	6.0
Lead/Lag						Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?										
Recall Mode	None	None		None	None	None	C-Max	None	C-Max	C-Max

Intersection Summary
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated

Splits and Phases: 5: Waiko Road & Honoapiilani Highway

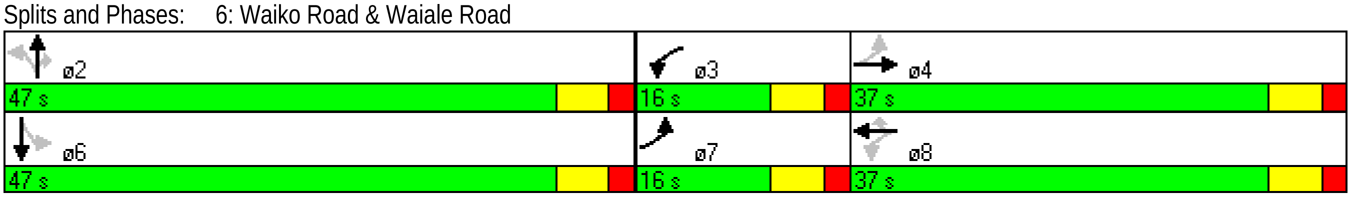
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	40	15	30	75	20	35	15	660	145	20	905	45
Ideal Flow (vphpl)	1900	1900	1900	1600	1600	1600	1900	1900	1900	1900	1900	1900
Grade (%)		-8%			0%			0%			0%	
Total Lost time (s)		5.0	5.0		5.0		4.0	6.0		4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	0.97
Flpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt		1.00	0.85		0.96		1.00	0.97		1.00	1.00	0.85
Flt Protected		0.96	1.00		0.97		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1869	1647		1470		1770	1812		1770	1863	1539
Flt Permitted		0.71	1.00		0.79		0.16	1.00		0.23	1.00	1.00
Satd. Flow (perm)		1371	1647		1192		300	1812		421	1863	1539
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	43	16	33	82	22	38	16	717	158	22	984	49
RTOR Reduction (vph)	0	0	26	0	14	0	0	6	0	0	0	7
Lane Group Flow (vph)	0	59	7	0	128	0	16	869	0	22	984	42
Confl. Peds. (#/hr)							3					3
Turn Type	Perm		custom	Perm			pm+pt			pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 5	8			2			6		6
Actuated Green, G (s)		14.8	21.6		14.8		70.8	69.0		69.6	68.4	68.4
Effective Green, g (s)		14.8	21.6		14.8		70.8	69.0		69.6	68.4	68.4
Actuated g/C Ratio		0.15	0.22		0.15		0.71	0.69		0.70	0.68	0.68
Clearance Time (s)		5.0			5.0		4.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)		2.0			2.0		2.0	5.0		2.0	5.0	5.0
Lane Grp Cap (vph)		203	356		176		239	1250		309	1274	1053
v/s Ratio Prot							c0.00	0.48		0.00	c0.53	
v/s Ratio Perm		0.04	0.00		c0.11		0.05			0.05		0.03
v/c Ratio		0.29	0.02		0.72		0.07	0.70		0.07	0.77	0.04
Uniform Delay, d1		37.9	30.9		40.7		9.8	9.2		7.4	10.6	5.1
Progression Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2		0.3	0.0		11.8		0.0	3.2		0.0	4.6	0.1
Delay (s)		38.2	30.9		52.4		9.8	12.4		7.4	15.2	5.2
Level of Service		D	C		D		A	B		A	B	A
Approach Delay (s)		35.6			52.4			12.4			14.5	
Approach LOS		D			D			B			B	

Intersection Summary			
HCM Average Control Delay	17.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	74.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations										
Volume (vph)	55	165	285	150	100	15	450	255	55	545
Turn Type	pm+pt		pm+pt		Perm	Perm		Perm	Perm	
Protected Phases	7	4	3	8			2			6
Permitted Phases	4		8		8	2		2	6	
Detector Phase	7	4	3	8	8	2	2	2	6	6
Switch Phase										
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	10.0	27.0	10.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0
Total Split (s)	16.0	37.0	16.0	37.0	37.0	47.0	47.0	47.0	47.0	47.0
Total Split (%)	16.0%	37.0%	16.0%	37.0%	37.0%	47.0%	47.0%	47.0%	47.0%	47.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag					
Lead-Lag Optimize?										
Recall Mode	None	None	None	None	None	None	None	None	None	None

Intersection Summary
Cycle Length: 100
Actuated Cycle Length: 73.6
Natural Cycle: 70
Control Type: Actuated-Uncoordinated

Splits and Phases: 6: Waiko Road & Waiale Road



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	165	15	285	150	100	15	450	255	55	545	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1840		1770	1863	1583	1770	1863	1583	1770	1844	
Flt Permitted	0.65	1.00		0.45	1.00	1.00	0.19	1.00	1.00	0.33	1.00	
Satd. Flow (perm)	1218	1840		847	1863	1583	355	1863	1583	617	1844	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	60	179	16	310	163	109	16	489	277	60	592	43
RTOR Reduction (vph)	0	4	0	0	0	81	0	0	159	0	2	0
Lane Group Flow (vph)	60	191	0	310	163	28	16	489	118	60	633	0
Turn Type	pm+pt			pm+pt		Perm	Perm		Perm	Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)	20.8	15.0		29.2	19.2	19.2	31.7	31.7	31.7	31.7	31.7	
Effective Green, g (s)	20.8	15.0		29.2	19.2	19.2	31.7	31.7	31.7	31.7	31.7	
Actuated g/C Ratio	0.28	0.20		0.39	0.26	0.26	0.42	0.42	0.42	0.42	0.42	
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	382	369		455	479	407	151	791	672	262	783	
v/s Ratio Prot	0.01	0.10		c0.09	0.09			0.26			c0.34	
v/s Ratio Perm	0.03			c0.18		0.02	0.05		0.07	0.10		
v/c Ratio	0.16	0.52		0.68	0.34	0.07	0.11	0.62	0.17	0.23	0.81	
Uniform Delay, d1	20.1	26.6		17.1	22.6	21.0	13.0	16.8	13.4	13.7	18.8	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.2	1.2		4.2	0.4	0.1	0.3	1.4	0.1	0.4	6.1	
Delay (s)	20.3	27.9		21.2	23.0	21.1	13.3	18.2	13.5	14.2	25.0	
Level of Service	C	C		C	C	C	B	B	B	B	C	
Approach Delay (s)		26.1			21.7			16.4			24.0	
Approach LOS		C			C			B			C	

Intersection Summary			
HCM Average Control Delay	21.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	74.7	Sum of lost time (s)	18.0
Intersection Capacity Utilization	79.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

7: Waiko Road & Kuihelani Highway

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	485	10	15	775	720	470
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Detector Phase	4	4 5	5	2	6	6 4
Switch Phase						
Minimum Initial (s)	6.0		4.0	10.0	10.0	
Minimum Split (s)	28.0		8.0	16.0	24.0	
Total Split (s)	29.0	39.0	10.0	51.0	41.0	70.0
Total Split (%)	36.3%	48.8%	12.5%	63.8%	51.3%	87.5%
Yellow Time (s)	3.0		3.0	4.0	4.0	
All-Red Time (s)	1.0		1.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?						
Recall Mode	None		None	Min	Min	

Intersection Summary
Cycle Length: 80
Actuated Cycle Length: 66.4
Natural Cycle: 60
Control Type: Actuated-Uncoordinated

Splits and Phases: 7: Waiko Road & Kuihelani Highway

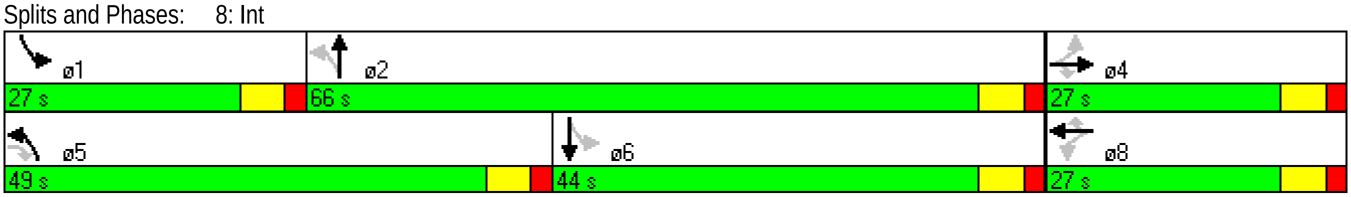
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	485	10	15	775	720	470
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	3539	3539	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	3539	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	527	11	16	842	783	511
RTOR Reduction (vph)	0	3	0	0	0	74
Lane Group Flow (vph)	527	8	16	842	783	437
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Actuated Green, G (s)	23.8	29.8	2.0	34.9	28.9	58.7
Effective Green, g (s)	23.8	29.8	2.0	34.9	28.9	58.7
Actuated g/C Ratio	0.35	0.43	0.03	0.51	0.42	0.85
Clearance Time (s)	4.0		4.0	6.0	6.0	
Vehicle Extension (s)	2.0		2.0	5.0	5.0	
Lane Grp Cap (vph)	613	687	52	1798	1489	1353
v/s Ratio Prot	c0.30		0.01	c0.24	c0.22	
v/s Ratio Perm		0.01				0.28
v/c Ratio	0.86	0.01	0.31	0.47	0.53	0.32
Uniform Delay, d1	20.9	11.1	32.7	10.9	14.8	1.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	11.2	0.0	1.2	0.4	0.6	0.3
Delay (s)	32.1	11.1	33.9	11.3	15.4	1.3
Level of Service	C	B	C	B	B	A
Approach Delay (s)	31.6			11.7	9.9	
Approach LOS	C			B	A	

Intersection Summary			
HCM Average Control Delay	14.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	68.7	Sum of lost time (s)	16.0
Intersection Capacity Utilization	56.6%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations										
Volume (vph)	270	30	840	15	80	10	630	475	15	415
Turn Type	Perm		custom	Perm		Perm	pm+pt		pm+pt	
Protected Phases		4			8		5	2	1	6
Permitted Phases	4		4 5	8		8	2		6	
Detector Phase	4	4	4 5	8	8	8	5	2	1	6
Switch Phase										
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	27.0	27.0		27.0	27.0	27.0	27.0	27.0	27.0	27.0
Total Split (s)	27.0	27.0	76.0	27.0	27.0	27.0	49.0	66.0	27.0	44.0
Total Split (%)	22.5%	22.5%	63.3%	22.5%	22.5%	22.5%	40.8%	55.0%	22.5%	36.7%
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag							Lead	Lag	Lead	Lag
Lead-Lag Optimize?								Yes	Yes	
Recall Mode	None	None		None	None	None	None	None	None	None

Intersection Summary
Cycle Length: 120
Actuated Cycle Length: 119.3
Natural Cycle: 125
Control Type: Actuated-Uncoordinated

Splits and Phases: 8: Int



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	270	30	840	15	80	10	630	475	20	15	415	95
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85		1.00	0.85	1.00	0.99		1.00	0.97	
Flt Protected	0.95	1.00	1.00		0.99	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1863	1583		1848	1583	1770	1851		1770	1811	
Flt Permitted	0.68	1.00	1.00		0.95	1.00	0.10	1.00		0.46	1.00	
Satd. Flow (perm)	1275	1863	1583		1779	1583	189	1851		864	1811	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	293	33	913	16	87	11	685	516	22	16	451	103
RTOR Reduction (vph)	0	0	72	0	0	9	0	1	0	0	7	0
Lane Group Flow (vph)	293	33	841	0	103	2	685	537	0	16	547	0
Turn Type	Perm		custom	Perm		Perm	pm+pt			pm+pt		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 5	8		8	2			6		
Actuated Green, G (s)	21.0	21.0	70.0		21.0	21.0	89.9	81.5		43.3	40.9	
Effective Green, g (s)	21.0	21.0	70.0		21.0	21.0	89.9	81.5		43.3	40.9	
Actuated g/C Ratio	0.17	0.17	0.57		0.17	0.17	0.73	0.66		0.35	0.33	
Clearance Time (s)	6.0	6.0			6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	218	318	902		304	270	691	1227		322	603	
v/s Ratio Prot		0.02					c0.35	0.29		0.00	0.30	
v/s Ratio Perm	c0.23		c0.53		0.06	0.00	c0.38			0.02		
v/c Ratio	1.34	0.10	0.93		0.34	0.01	0.99	0.44		0.05	0.91	
Uniform Delay, d1	51.0	43.0	24.3		44.8	42.3	33.4	9.8		26.3	39.2	
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	182.2	0.1	16.0		0.7	0.0	31.9	0.3		0.1	17.4	
Delay (s)	233.2	43.2	40.2		45.5	42.3	65.4	10.1		26.3	56.6	
Level of Service	F	D	D		D	D	E	B		C	E	
Approach Delay (s)		85.9			45.2			41.0			55.7	
Approach LOS		F			D			D			E	

Intersection Summary			
HCM Average Control Delay	61.5	HCM Level of Service	E
HCM Volume to Capacity ratio	0.99		
Actuated Cycle Length (s)	122.9	Sum of lost time (s)	6.0
Intersection Capacity Utilization	99.7%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Base Year 2022 with Mitigation Measures AM

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	200	60	225	65	155	25	540	270	165	440	25
Turn Type	Perm		Perm	Perm		custom	pm+pt		Perm	pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8 5 1	2		2	6		6
Detector Phase	4	4	4	8	8	8 5 1	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	6.0	6.0	6.0	6.0	6.0		3.0	10.0	10.0	3.0	10.0	10.0
Minimum Split (s)	27.0	27.0	27.0	27.0	27.0		7.0	24.0	24.0	7.0	24.0	24.0
Total Split (s)	51.0	51.0	51.0	51.0	51.0	68.0	7.0	59.0	59.0	10.0	62.0	62.0
Total Split (%)	42.5%	42.5%	42.5%	42.5%	42.5%	56.7%	5.8%	49.2%	49.2%	8.3%	51.7%	51.7%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	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 Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag							Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?												
Recall Mode	None	None	None	None	None		None	None	None	None	None	None

Intersection Summary

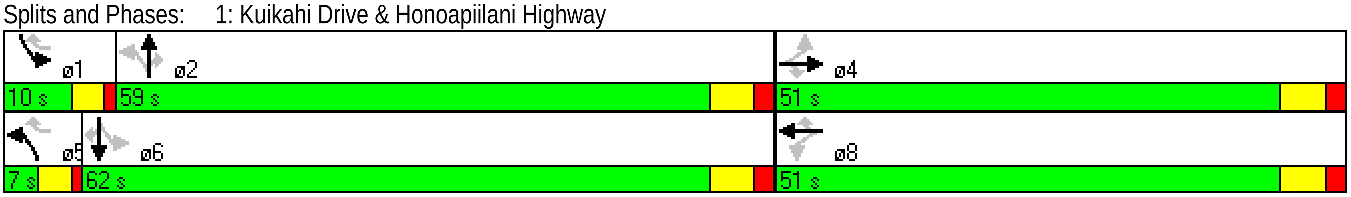
Cycle Length: 120

Actuated Cycle Length: 87

Natural Cycle: 60

Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Kuikahi Drive & Honoapiilani Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	200	60	225	65	155	25	540	270	165	440	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-5%			0%			0%			0%	
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1814	1909	1623	1770	1863	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.71	1.00	1.00	0.57	1.00	1.00	0.39	1.00	1.00	0.21	1.00	1.00
Satd. Flow (perm)	1357	1909	1623	1064	1863	1583	734	1863	1583	400	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	60	217	65	245	71	168	27	587	293	179	478	27
RTOR Reduction (vph)	0	0	45	0	0	92	0	0	137	0	0	14
Lane Group Flow (vph)	60	217	20	245	71	76	27	587	156	179	478	13
Turn Type	Perm		Perm	Perm		custom	pm+pt		Perm	pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8 5 1	2		2	6		6
Actuated Green, G (s)	26.3	26.3	26.3	26.3	26.3	38.7	40.3	37.1	37.1	46.7	40.3	40.3
Effective Green, g (s)	26.3	26.3	26.3	26.3	26.3	38.7	40.3	37.1	37.1	46.7	40.3	40.3
Actuated g/C Ratio	0.31	0.31	0.31	0.31	0.31	0.45	0.47	0.43	0.43	0.54	0.47	0.47
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0		4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)	2.0	2.0	2.0	2.0	2.0		2.0	5.0	5.0	2.0	5.0	5.0
Lane Grp Cap (vph)	416	585	497	326	571	714	383	806	684	320	875	744
v/s Ratio Prot		0.11			0.04		0.00	c0.32		c0.04	0.26	
v/s Ratio Perm	0.04		0.01	c0.23		0.05	0.03		0.10	0.26		0.01
v/c Ratio	0.14	0.37	0.04	0.75	0.12	0.11	0.07	0.73	0.23	0.56	0.55	0.02
Uniform Delay, d1	21.6	23.3	20.9	26.8	21.4	13.6	12.6	20.2	15.3	13.1	16.2	12.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	0.1	0.0	8.4	0.0	0.0	0.0	4.1	0.4	1.2	1.2	0.0
Delay (s)	21.6	23.4	20.9	35.2	21.5	13.6	12.6	24.2	15.7	14.3	17.5	12.2
Level of Service	C	C	C	D	C	B	B	C	B	B	B	B
Approach Delay (s)		22.6			25.7			21.1			16.4	
Approach LOS		C			C			C			B	

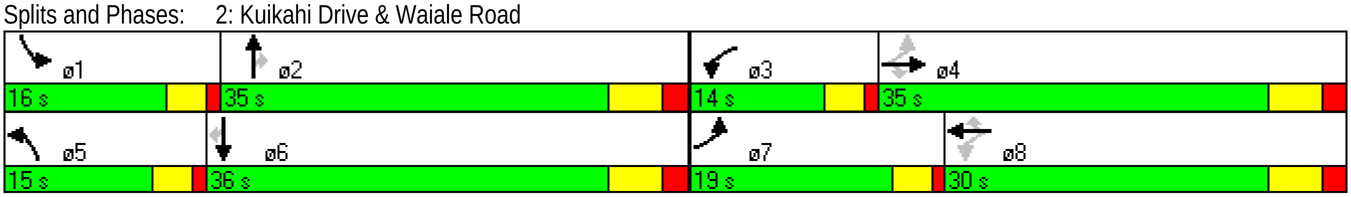
Intersection Summary			
HCM Average Control Delay	20.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	85.8	Sum of lost time (s)	20.0
Intersection Capacity Utilization	78.9%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	340	285	25	230	185	315	55	420	285	235	255	190
Turn Type	pm+pt		Perm	pm+pt		Perm	Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	30.0	30.0	8.0	30.0	30.0	8.0	30.0	30.0	8.0	30.0	30.0
Total Split (s)	19.0	35.0	35.0	14.0	30.0	30.0	15.0	35.0	35.0	16.0	36.0	36.0
Total Split (%)	19.0%	35.0%	35.0%	14.0%	30.0%	30.0%	15.0%	35.0%	35.0%	16.0%	36.0%	36.0%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	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 Lost Time (s)	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?												
Recall Mode	None	None	None	None	None	None	None	None	None	None	None	None

Intersection Summary
Cycle Length: 100
Actuated Cycle Length: 87.7
Natural Cycle: 80
Control Type: Actuated-Uncoordinated

Splits and Phases: 2: Kuikahi Drive & Waiale Road



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	340	285	25	230	185	315	55	420	285	235	255	190
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1863	1583	3433	1863	1583
Flt Permitted	0.40	1.00	1.00	0.45	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	751	1863	1583	833	1863	1583	1770	1863	1583	3433	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	370	310	27	250	201	342	60	457	310	255	277	207
RTOR Reduction (vph)	0	0	17	0	0	281	0	0	215	0	0	134
Lane Group Flow (vph)	370	310	10	250	201	61	60	457	95	255	277	73
Turn Type	pm+pt		Perm	pm+pt		Perm	Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)	34.2	20.4	20.4	25.5	15.7	15.7	6.9	27.2	27.2	10.9	31.2	31.2
Effective Green, g (s)	34.2	20.4	20.4	25.5	15.7	15.7	6.9	27.2	27.2	10.9	31.2	31.2
Actuated g/C Ratio	0.39	0.23	0.23	0.29	0.18	0.18	0.08	0.31	0.31	0.12	0.35	0.35
Clearance Time (s)	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	458	430	366	345	331	281	138	574	488	424	658	559
v/s Ratio Prot	c0.13	0.17		0.08	0.11		0.03	c0.25		c0.07	c0.15	
v/s Ratio Perm	c0.18		0.01	0.13		0.04			0.06			0.05
v/c Ratio	0.81	0.72	0.03	0.72	0.61	0.22	0.43	0.80	0.20	0.60	0.42	0.13
Uniform Delay, d1	21.4	31.3	26.3	26.3	33.5	31.0	38.8	28.0	22.5	36.6	21.7	19.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	10.1	5.9	0.0	7.4	3.1	0.4	2.2	7.5	0.2	2.4	0.4	0.1
Delay (s)	31.4	37.2	26.3	33.6	36.6	31.4	41.0	35.5	22.7	39.0	22.1	19.5
Level of Service	C	D	C	C	D	C	D	D	C	D	C	B
Approach Delay (s)		33.8			33.4			31.1			27.2	
Approach LOS		C			C			C			C	

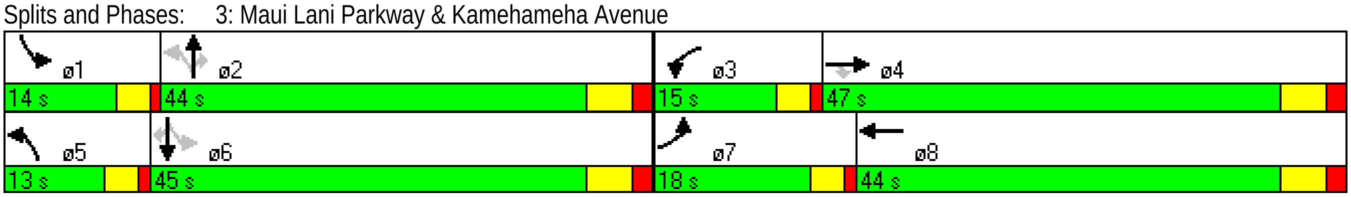
Intersection Summary			
HCM Average Control Delay	31.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	88.3	Sum of lost time (s)	20.0
Intersection Capacity Utilization	74.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

3: Maui Lani Parkway & Kamehameha Avenue

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											
Volume (vph)	245	350	140	115	465	210	240	160	225	190	450
Turn Type	Prot		Perm	Prot		pm+pt		Perm	pm+pt		Perm
Protected Phases	7	4		3	8	5	2		1	6	
Permitted Phases			4			2		2	6		6
Detector Phase	7	4	4	3	8	5	2	2	1	6	6
Switch Phase											
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	10.0	27.0	27.0	10.0	27.0	10.0	27.0	27.0	10.0	27.0	27.0
Total Split (s)	18.0	47.0	47.0	15.0	44.0	13.0	44.0	44.0	14.0	45.0	45.0
Total Split (%)	15.0%	39.2%	39.2%	12.5%	36.7%	10.8%	36.7%	36.7%	11.7%	37.5%	37.5%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	2.0	2.0	1.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	6.0	4.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?											
Recall Mode	None	None	None	None	None	None	None	None	None	None	None

Intersection Summary
Cycle Length: 120
Actuated Cycle Length: 87.6
Natural Cycle: 75
Control Type: Actuated-Uncoordinated

Splits and Phases: 3: Maui Lani Parkway & Kamehameha Avenue



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	245	350	140	115	465	220	210	240	160	225	190	450
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0	6.0	4.0	6.0		4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	0.97	1.00	1.00	1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.95		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	1863	1583	1770	3369		1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.57	1.00	1.00	0.41	1.00	1.00
Satd. Flow (perm)	3433	1863	1583	1770	3369		1058	1863	1583	770	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	266	380	152	125	505	239	228	261	174	245	207	489
RTOR Reduction (vph)	0	0	63	0	49	0	0	0	113	0	0	270
Lane Group Flow (vph)	266	380	89	125	695	0	228	261	61	245	207	219
Turn Type	Prot		Perm	Prot			pm+pt		Perm	pm+pt		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4				2		2	6		6
Actuated Green, G (s)	11.9	26.6	26.6	10.6	25.3		28.8	19.4	19.4	30.4	20.2	20.2
Effective Green, g (s)	11.9	26.6	26.6	10.6	25.3		28.8	19.4	19.4	30.4	20.2	20.2
Actuated g/C Ratio	0.14	0.31	0.31	0.12	0.29		0.33	0.22	0.22	0.35	0.23	0.23
Clearance Time (s)	4.0	6.0	6.0	4.0	6.0		4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	471	571	485	216	982		428	416	354	387	434	368
v/s Ratio Prot	c0.08	0.20		0.07	c0.21		0.06	0.14		c0.07	0.11	
v/s Ratio Perm			0.06				0.12		0.04	c0.15		0.14
v/c Ratio	0.56	0.67	0.18	0.58	0.71		0.53	0.63	0.17	0.63	0.48	0.59
Uniform Delay, d1	35.0	26.2	22.1	36.0	27.5		22.3	30.4	27.2	21.6	28.7	29.7
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.6	2.9	0.2	3.7	2.4		1.3	2.9	0.2	3.4	0.8	2.6
Delay (s)	36.6	29.2	22.3	39.7	29.8		23.5	33.4	27.4	24.9	29.6	32.2
Level of Service	D	C	C	D	C		C	C	C	C	C	C
Approach Delay (s)		30.3			31.2			28.4			29.7	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM Average Control Delay	30.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	86.8	Sum of lost time (s)	14.0
Intersection Capacity Utilization	72.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	NBL	NBT	SBT	SBR	ø1	ø8
Lane Configurations									
Volume (vph)	675	0	300	150	840	610	560		
Turn Type	Split		Perm	Prot			Free		
Protected Phases	4	4		5	2	6		1	8
Permitted Phases			4				Free		
Detector Phase	4	4	4	5	2	6			
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0
Minimum Split (s)	10.0	10.0	10.0	10.0	10.0	27.0		10.0	10.0
Total Split (s)	42.0	42.0	42.0	24.0	88.0	74.0	0.0	10.0	10.0
Total Split (%)	28.0%	28.0%	28.0%	16.0%	58.7%	49.3%	0.0%	7%	7%
Yellow Time (s)	4.0	4.0	4.0	3.0	4.0	4.0		4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	1.0	2.0	2.0		2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Total Lost Time (s)	6.0	6.0	6.0	4.0	6.0	6.0	4.0		
Lead/Lag				Lead	Lag	Lag		Lead	
Lead-Lag Optimize?					Yes			Yes	
Recall Mode	None	None	None	None	None	None		None	None

Intersection Summary

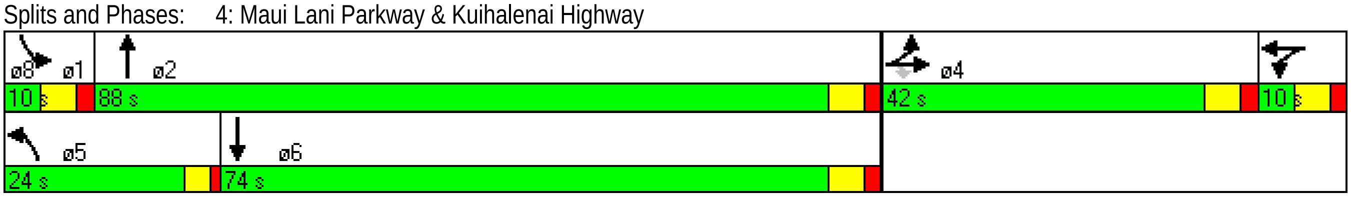
Cycle Length: 150

Actuated Cycle Length: 77.4

Natural Cycle: 70

Control Type: Actuated-Uncoordinated

Splits and Phases: 4: Maui Lani Parkway & Kuihalenai Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	675	0	300	0	0	0	150	840	0	0	610	560
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0				4.0	6.0			6.0	4.0
Lane Util. Factor	0.95	0.95	1.00				0.97	0.95			0.95	1.00
Frt	1.00	1.00	0.85				1.00	1.00			1.00	0.85
Flt Protected	0.95	0.95	1.00				0.95	1.00			1.00	1.00
Satd. Flow (prot)	1681	1681	1583				3433	3539			3539	1583
Flt Permitted	0.95	0.95	1.00				0.95	1.00			1.00	1.00
Satd. Flow (perm)	1681	1681	1583				3433	3539			3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	734	0	326	0	0	0	163	913	0	0	663	609
RTOR Reduction (vph)	0	0	88	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	367	367	238	0	0	0	163	913	0	0	663	609
Turn Type	Split		Perm	Split			Prot			Prot		Free
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			4									Free
Actuated Green, G (s)	28.8	28.8	28.8				9.6	36.2			22.6	77.0
Effective Green, g (s)	28.8	28.8	28.8				9.6	36.2			22.6	77.0
Actuated g/C Ratio	0.37	0.37	0.37				0.12	0.47			0.29	1.00
Clearance Time (s)	6.0	6.0	6.0				4.0	6.0			6.0	
Vehicle Extension (s)	3.0	3.0	3.0				3.0	3.0			3.0	
Lane Grp Cap (vph)	629	629	592				428	1664			1039	1583
v/s Ratio Prot	c0.22	0.22					0.05	c0.26			c0.19	
v/s Ratio Perm			0.15									0.38
v/c Ratio	0.58	0.58	0.40				0.38	0.55			0.64	0.38
Uniform Delay, d1	19.3	19.3	17.8				31.0	14.6			23.6	0.0
Progression Factor	1.00	1.00	1.00				1.00	1.00			1.00	1.00
Incremental Delay, d2	1.4	1.4	0.5				0.6	0.4			1.3	0.7
Delay (s)	20.7	20.7	18.2				31.5	14.9			24.9	0.7
Level of Service	C	C	B				C	B			C	A
Approach Delay (s)		19.9			0.0			17.5			13.3	
Approach LOS		B			A			B			B	

Intersection Summary			
HCM Average Control Delay	16.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	77.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	60.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations										
Volume (vph)	35	25	10	65	5	5	580	80	625	15
Turn Type	Perm		custom	Perm		pm+pt		pm+pt		Perm
Protected Phases		4			8	5	2	1	6	
Permitted Phases	4		4 5	8		2		6		6
Detector Phase	4	4	4 5	8	8	5	2	1	6	6
Switch Phase										
Minimum Initial (s)	6.0	6.0		6.0	6.0	3.0	10.0	3.0	10.0	10.0
Minimum Split (s)	23.0	23.0		27.0	27.0	7.0	31.0	7.0	26.0	26.0
Total Split (s)	27.0	27.0	34.0	27.0	27.0	7.0	64.0	9.0	66.0	66.0
Total Split (%)	27.0%	27.0%	34.0%	27.0%	27.0%	7.0%	64.0%	9.0%	66.0%	66.0%
Yellow Time (s)	4.0	4.0		4.0	4.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	6.0	4.0	6.0	6.0
Lead/Lag						Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?										
Recall Mode	None	None		None	None	None	C-Max	None	C-Max	C-Max

Intersection Summary
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 23 (23%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 70
Control Type: Actuated-Coordinated

Splits and Phases: 5: Waiko Road & Honoapiilani Highway

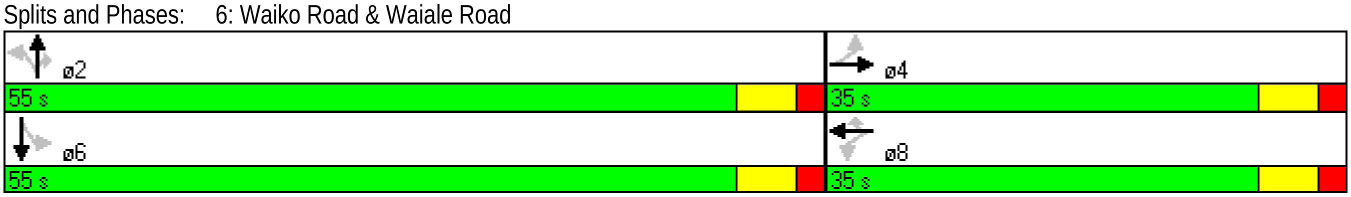
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	35	25	10	65	5	35	5	580	70	80	625	15
Ideal Flow (vphpl)	1900	1900	1900	1600	1600	1600	1900	1900	1900	1900	1900	1900
Grade (%)		-8%			0%			0%			0%	
Total Lost time (s)		5.0	5.0		5.0		4.0	6.0		4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	0.97
Flpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt		1.00	0.85		0.95		1.00	0.98		1.00	1.00	0.85
Flt Protected		0.97	1.00		0.97		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1882	1647		1453		1768	1833		1770	1863	1539
Flt Permitted		0.77	1.00		0.77		0.36	1.00		0.30	1.00	1.00
Satd. Flow (perm)		1488	1647		1157		663	1833		562	1863	1539
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	38	27	11	71	5	38	5	630	76	87	679	16
RTOR Reduction (vph)	0	0	9	0	20	0	0	3	0	0	0	3
Lane Group Flow (vph)	0	65	2	0	94	0	5	703	0	87	679	13
Confl. Peds. (#/hr)							3					3
Turn Type	Perm		custom	Perm			pm+pt			pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 5	8			2			6		6
Actuated Green, G (s)		12.4	18.6		12.4		69.8	68.6		75.4	71.4	71.4
Effective Green, g (s)		12.4	18.6		12.4		69.8	68.6		75.4	71.4	71.4
Actuated g/C Ratio		0.12	0.19		0.12		0.70	0.69		0.75	0.71	0.71
Clearance Time (s)		5.0			5.0		4.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)		2.0			2.0		2.0	5.0		2.0	5.0	5.0
Lane Grp Cap (vph)		185	306		143		476	1257		472	1330	1099
v/s Ratio Prot							0.00	c0.38		c0.01	0.36	
v/s Ratio Perm		0.04	0.00		c0.08		0.01			0.13		0.01
v/c Ratio		0.35	0.01		0.66		0.01	0.56		0.18	0.51	0.01
Uniform Delay, d1		40.1	33.2		41.8		4.9	8.0		4.8	6.4	4.1
Progression Factor		1.00	1.00		1.00		1.00	1.00		0.24	0.31	0.07
Incremental Delay, d2		0.4	0.0		8.0		0.0	1.8		0.1	1.3	0.0
Delay (s)		40.5	33.2		49.8		4.9	9.8		1.2	3.3	0.3
Level of Service		D	C		D		A	A		A	A	A
Approach Delay (s)		39.5			49.8			9.8			3.0	
Approach LOS		D			D			A			A	

Intersection Summary			
HCM Average Control Delay	10.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	19.0
Intersection Capacity Utilization	65.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations										
Volume (vph)	45	175	85	55	60	15	370	200	155	310
Turn Type	Perm		Perm		Perm	Perm		Perm	Perm	
Protected Phases		4		8			2			6
Permitted Phases	4		8		8	2		2	6	
Detector Phase	4	4	8	8	8	2	2	2	6	6
Switch Phase										
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	24.0	24.0	24.0	24.0	24.0	27.0	27.0	27.0	27.0	27.0
Total Split (s)	35.0	35.0	35.0	35.0	35.0	55.0	55.0	55.0	55.0	55.0
Total Split (%)	38.9%	38.9%	38.9%	38.9%	38.9%	61.1%	61.1%	61.1%	61.1%	61.1%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag										
Lead-Lag Optimize?										
Recall Mode	None	None	None	None	None	None	None	None	None	None

Intersection Summary
Cycle Length: 90
Actuated Cycle Length: 35.7
Natural Cycle: 55
Control Type: Actuated-Uncoordinated

Splits and Phases: 6: Waiko Road & Waiale Road



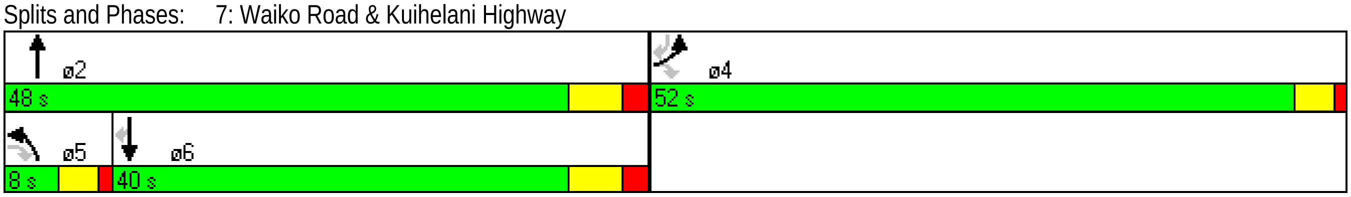
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	45	175	20	85	55	60	15	370	200	155	310	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1832		1770	1863	1583	1770	1863	1583	1770	1814	
Flt Permitted	0.72	1.00		0.63	1.00	1.00	0.52	1.00	1.00	0.53	1.00	
Satd. Flow (perm)	1337	1832		1181	1863	1583	974	1863	1583	979	1814	
Peak-hour factor, PHF	0.92	1.00	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	49	175	22	92	60	65	16	402	217	168	337	71
RTOR Reduction (vph)	0	6	0	0	0	51	0	0	118	0	10	0
Lane Group Flow (vph)	49	191	0	92	60	14	16	402	99	168	398	0
Turn Type	Perm			Perm		Perm	Perm		Perm	Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)	7.6	7.6		7.6	7.6	7.6	16.5	16.5	16.5	16.5	16.5	
Effective Green, g (s)	7.6	7.6		7.6	7.6	7.6	16.5	16.5	16.5	16.5	16.5	
Actuated g/C Ratio	0.21	0.21		0.21	0.21	0.21	0.46	0.46	0.46	0.46	0.46	
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	281	386		249	392	333	445	852	724	447	829	
v/s Ratio Prot		c0.10			0.03			0.22			c0.22	
v/s Ratio Perm	0.04			0.08		0.01	0.02		0.06	0.17		
v/c Ratio	0.17	0.50		0.37	0.15	0.04	0.04	0.47	0.14	0.38	0.48	
Uniform Delay, d1	11.7	12.6		12.2	11.6	11.3	5.4	6.8	5.7	6.4	6.8	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.3	1.0		0.9	0.2	0.1	0.0	0.4	0.1	0.5	0.4	
Delay (s)	12.0	13.6		13.1	11.8	11.4	5.4	7.2	5.8	7.0	7.3	
Level of Service	B	B		B	B	B	A	A	A	A	A	
Approach Delay (s)		13.3			12.2			6.7			7.2	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM Average Control Delay	8.5	HCM Level of Service	A
HCM Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	36.1	Sum of lost time (s)	12.0
Intersection Capacity Utilization	63.2%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	500	30	15	485	675	205
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Detector Phase	4	4 5	5	2	6	6 4
Switch Phase						
Minimum Initial (s)	6.0		4.0	10.0	10.0	
Minimum Split (s)	28.0		8.0	16.0	24.0	
Total Split (s)	52.0	60.0	8.0	48.0	40.0	92.0
Total Split (%)	52.0%	60.0%	8.0%	48.0%	40.0%	92.0%
Yellow Time (s)	3.0		3.0	4.0	4.0	
All-Red Time (s)	1.0		1.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?						
Recall Mode	None		None	Min	Min	

Intersection Summary
Cycle Length: 100
Actuated Cycle Length: 67.5
Natural Cycle: 60
Control Type: Actuated-Uncoordinated

Splits and Phases: 7: Waiko Road & Kuihelani Highway



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	500	30	15	485	675	205
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	3539	3539	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	3539	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	543	33	16	527	734	223
RTOR Reduction (vph)	0	8	0	0	0	33
Lane Group Flow (vph)	543	25	16	527	734	190
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Actuated Green, G (s)	26.7	32.7	2.0	31.7	25.7	58.4
Effective Green, g (s)	26.7	32.7	2.0	31.7	25.7	58.4
Actuated g/C Ratio	0.39	0.48	0.03	0.46	0.38	0.85
Clearance Time (s)	4.0		4.0	6.0	6.0	
Vehicle Extension (s)	2.0		2.0	5.0	5.0	
Lane Grp Cap (vph)	691	757	52	1640	1330	1352
v/s Ratio Prot	c0.31		0.01	c0.15	c0.21	
v/s Ratio Perm		0.02				0.12
v/c Ratio	0.79	0.03	0.31	0.32	0.55	0.14
Uniform Delay, d1	18.3	9.5	32.5	11.6	16.8	0.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	5.4	0.0	1.2	0.2	0.8	0.1
Delay (s)	23.8	9.5	33.7	11.8	17.7	0.9
Level of Service	C	A	C	B	B	A
Approach Delay (s)	22.9			12.5	13.8	
Approach LOS	C			B	B	

Intersection Summary			
HCM Average Control Delay	16.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	68.4	Sum of lost time (s)	16.0
Intersection Capacity Utilization	54.7%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Configurations											
Volume (vph)	200	15	455	20	45	15	840	320	5	235	80
Turn Type	Perm		custom	Perm		Perm	Prot		Prot		Perm
Protected Phases		4			8		5	2	1	6	
Permitted Phases	4		4 5	8		8					6
Detector Phase	4	4	4 5	8	8	8	5	2	1	6	6
Switch Phase											
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	24.0	24.0		24.0	24.0	24.0	24.0	24.0	22.0	24.0	24.0
Total Split (s)	26.0	26.0	64.0	26.0	26.0	26.0	38.0	74.0	30.0	66.0	66.0
Total Split (%)	20.0%	20.0%	49.2%	20.0%	20.0%	20.0%	29.2%	56.9%	23.1%	50.8%	50.8%
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	1.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	4.0	6.0	4.0	6.0	6.0
Lead/Lag							Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?							Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None		None	None	None	None	None	None	None	None

Intersection Summary
Cycle Length: 130
Actuated Cycle Length: 87.1
Natural Cycle: 75
Control Type: Actuated-Uncoordinated

Splits and Phases: 8: Kuikahi Drive & Maui Lani Parkway

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	200	15	455	20	45	15	840	320	10	5	235	80
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0		6.0	6.0	4.0	6.0		4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00	1.00	0.97	1.00		1.00	1.00	1.00
Frt		1.00	0.85		1.00	0.85	1.00	1.00		1.00	1.00	0.85
Flt Protected		0.96	1.00		0.98	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1780	1583		1834	1583	3433	1854		1770	1863	1583
Flt Permitted		0.69	1.00		0.86	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)		1284	1583		1599	1583	3433	1854		1770	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	217	16	495	22	49	16	913	348	11	5	255	87
RTOR Reduction (vph)	0	0	167	0	0	12	0	1	0	0	0	67
Lane Group Flow (vph)	0	233	328	0	71	4	913	358	0	5	255	20
Turn Type	Perm		custom	Perm		Perm	Prot			Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 5	8		8						6
Actuated Green, G (s)		20.1	59.9		20.1	20.1	33.8	53.1		1.2	20.5	20.5
Effective Green, g (s)		20.1	59.9		20.1	20.1	33.8	53.1		1.2	20.5	20.5
Actuated g/C Ratio		0.22	0.66		0.22	0.22	0.37	0.59		0.01	0.23	0.23
Clearance Time (s)		6.0			6.0	6.0	4.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		285	1049		356	352	1284	1089		23	422	359
v/s Ratio Prot							c0.27	0.19		0.00	c0.14	
v/s Ratio Perm		c0.18	0.21		0.04	0.00						0.01
v/c Ratio		0.82	0.31		0.20	0.01	0.71	0.33		0.22	0.60	0.05
Uniform Delay, d1		33.4	6.5		28.6	27.4	24.1	9.5		44.1	31.3	27.4
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2		16.4	0.2		0.3	0.0	1.9	0.2		4.7	2.4	0.1
Delay (s)		49.8	6.7		28.9	27.4	26.0	9.7		48.9	33.8	27.4
Level of Service		D	A		C	C	C	A		D	C	C
Approach Delay (s)		20.5			28.6			21.4			32.4	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM Average Control Delay	23.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	90.4	Sum of lost time (s)	16.0
Intersection Capacity Utilization	68.2%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

APPENDIX C

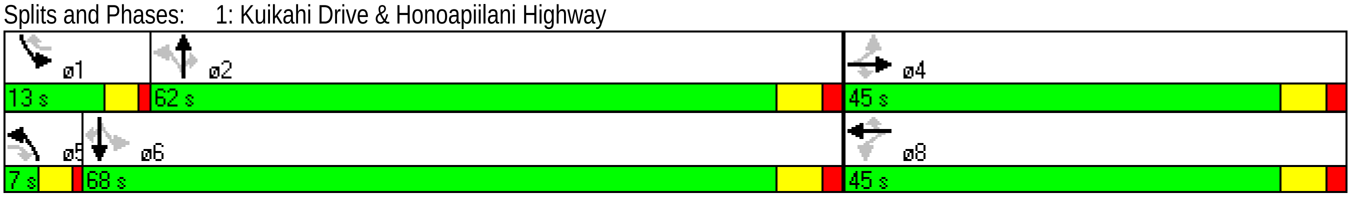
LEVEL OF SERVICE CALCULATIONS

- Base Year 2022 with Mitigation Measures PM

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	25	100	25	275	190	115	35	610	180	175	795	45
Turn Type	Perm		custom	Perm		custom	pm+pt		Perm	pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 5	8		8 1	2		2	6		6
Detector Phase	4	4	4 5	8	8	8 1	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	6.0	6.0		6.0	6.0		3.0	10.0	10.0	3.0	10.0	10.0
Minimum Split (s)	27.0	27.0		27.0	27.0		7.0	24.0	24.0	7.0	24.0	24.0
Total Split (s)	45.0	45.0	52.0	45.0	45.0	58.0	7.0	62.0	62.0	13.0	68.0	68.0
Total Split (%)	37.5%	37.5%	43.3%	37.5%	37.5%	48.3%	5.8%	51.7%	51.7%	10.8%	56.7%	56.7%
Yellow Time (s)	4.0	4.0		4.0	4.0		3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	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 Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag							Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?												
Recall Mode	None	None		None	None		None	None	None	None	None	None

Intersection Summary
Cycle Length: 120
Actuated Cycle Length: 100.8
Natural Cycle: 90
Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Kuikahi Drive & Honoapiilani Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	25	100	25	275	190	115	35	610	180	175	795	45
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-5%			0%			0%			0%	
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1814	1909	1623	1770	1863	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.55	1.00	1.00	0.69	1.00	1.00	0.12	1.00	1.00	0.18	1.00	1.00
Satd. Flow (perm)	1056	1909	1623	1279	1863	1583	226	1863	1583	344	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	27	109	27	299	207	125	38	663	196	190	864	49
RTOR Reduction (vph)	0	0	17	0	0	72	0	0	103	0	0	21
Lane Group Flow (vph)	27	109	10	299	207	53	38	663	93	190	864	28
Turn Type	Perm		custom	Perm		custom	pm+pt		Perm	pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 5	8		8 1	2		2	6		6
Actuated Green, G (s)	28.6	28.6	36.8	28.6	28.6	42.9	50.4	48.2	48.2	60.5	54.3	54.3
Effective Green, g (s)	28.6	28.6	36.8	28.6	28.6	42.9	50.4	48.2	48.2	60.5	54.3	54.3
Actuated g/C Ratio	0.28	0.28	0.36	0.28	0.28	0.42	0.50	0.48	0.48	0.60	0.54	0.54
Clearance Time (s)	6.0	6.0		6.0	6.0		4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)	2.0	2.0		2.0	2.0		2.0	5.0	5.0	2.0	5.0	5.0
Lane Grp Cap (vph)	299	540	591	362	527	672	146	888	755	323	1001	850
v/s Ratio Prot		0.06			0.11		0.01	0.36		c0.05	c0.46	
v/s Ratio Perm	0.03		0.01	c0.23		0.03	0.12		0.06	0.30		0.02
v/c Ratio	0.09	0.20	0.02	0.83	0.39	0.08	0.26	0.75	0.12	0.59	0.86	0.03
Uniform Delay, d1	26.7	27.6	20.6	33.9	29.2	17.3	18.1	21.5	14.7	14.6	20.2	11.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.0	0.1	0.0	13.6	0.2	0.0	0.3	4.1	0.2	1.8	8.5	0.0
Delay (s)	26.7	27.6	20.6	47.5	29.4	17.4	18.4	25.6	14.9	16.4	28.7	11.1
Level of Service	C	C	C	D	C	B	B	C	B	B	C	B
Approach Delay (s)		26.3			35.6			23.0			25.8	
Approach LOS		C			D			C			C	

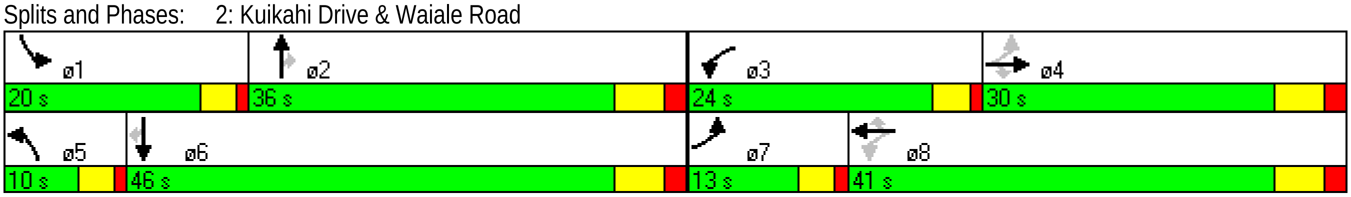
Intersection Summary			
HCM Average Control Delay	27.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	101.1	Sum of lost time (s)	16.0
Intersection Capacity Utilization	80.4%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	175	260	40	355	280	360	25	390	270	405	415	270
Turn Type	pm+pt		Perm	pm+pt		Perm	Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	30.0	30.0	8.0	30.0	30.0	8.0	30.0	30.0	8.0	30.0	30.0
Total Split (s)	13.0	30.0	30.0	24.0	41.0	41.0	10.0	36.0	36.0	20.0	46.0	46.0
Total Split (%)	11.8%	27.3%	27.3%	21.8%	37.3%	37.3%	9.1%	32.7%	32.7%	18.2%	41.8%	41.8%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	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 Lost Time (s)	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?												
Recall Mode	None	None	None	None	None	None	None	None	None	None	None	None

Intersection Summary
Cycle Length: 110
Actuated Cycle Length: 101.2
Natural Cycle: 90
Control Type: Actuated-Uncoordinated

Splits and Phases: 2: Kuikahi Drive & Waiale Road



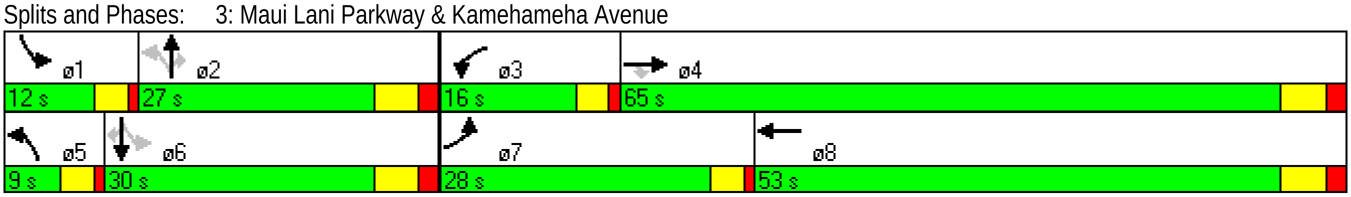
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	175	260	40	355	280	360	25	390	270	405	415	270
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1863	1583	3433	1863	1583
Flt Permitted	0.57	1.00	1.00	0.25	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1071	1863	1583	471	1863	1583	1770	1863	1583	3433	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	190	283	43	386	304	391	27	424	293	440	451	293
RTOR Reduction (vph)	0	0	26	0	0	279	0	0	211	0	0	176
Lane Group Flow (vph)	190	283	17	386	304	112	27	424	82	440	451	117
Turn Type	pm+pt		Perm	pm+pt		Perm	Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)	28.7	19.7	19.7	42.3	29.3	29.3	3.3	28.9	28.9	15.5	41.1	41.1
Effective Green, g (s)	28.7	19.7	19.7	42.3	29.3	29.3	3.3	28.9	28.9	15.5	41.1	41.1
Actuated g/C Ratio	0.28	0.19	0.19	0.41	0.29	0.29	0.03	0.28	0.28	0.15	0.40	0.40
Clearance Time (s)	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	361	357	304	429	532	452	57	524	445	518	746	634
v/s Ratio Prot	0.05	0.15		c0.16	0.16		0.02	c0.23		c0.13	0.24	
v/s Ratio Perm	0.10		0.01	c0.21		0.07			0.05			0.07
v/c Ratio	0.53	0.79	0.06	0.90	0.57	0.25	0.47	0.81	0.19	0.85	0.60	0.18
Uniform Delay, d1	29.9	39.6	33.9	24.1	31.3	28.2	48.8	34.3	28.0	42.5	24.4	20.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.4	11.4	0.1	21.1	1.5	0.3	6.1	9.0	0.2	12.3	1.4	0.1
Delay (s)	31.3	51.0	34.0	45.2	32.8	28.5	54.9	43.3	28.2	54.8	25.8	20.1
Level of Service	C	D	C	D	C	C	D	D	C	D	C	C
Approach Delay (s)		42.3			35.7			37.8			35.2	
Approach LOS		D			D			D			D	

Intersection Summary			
HCM Average Control Delay	36.9	HCM Level of Service	D
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	102.7	Sum of lost time (s)	14.0
Intersection Capacity Utilization	82.1%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											
Volume (vph)	520	675	150	120	730	85	145	70	215	175	450
Turn Type	Prot		Perm	Prot		pm+pt		Perm	pm+pt		Perm
Protected Phases	7	4		3	8	5	2		1	6	
Permitted Phases			4			2		2	6		6
Detector Phase	7	4	4	3	8	5	2	2	1	6	6
Switch Phase											
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	27.0	27.0	8.0	30.0	8.0	27.0	27.0	8.0	30.0	30.0
Total Split (s)	28.0	65.0	65.0	16.0	53.0	9.0	27.0	27.0	12.0	30.0	30.0
Total Split (%)	23.3%	54.2%	54.2%	13.3%	44.2%	7.5%	22.5%	22.5%	10.0%	25.0%	25.0%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	2.0	2.0	1.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	6.0	4.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?											
Recall Mode	None	None	None	None	None	None	None	None	None	None	None

Intersection Summary
Cycle Length: 120
Actuated Cycle Length: 108.3
Natural Cycle: 90
Control Type: Actuated-Uncoordinated

Splits and Phases: 3: Maui Lani Parkway & Kamehameha Avenue



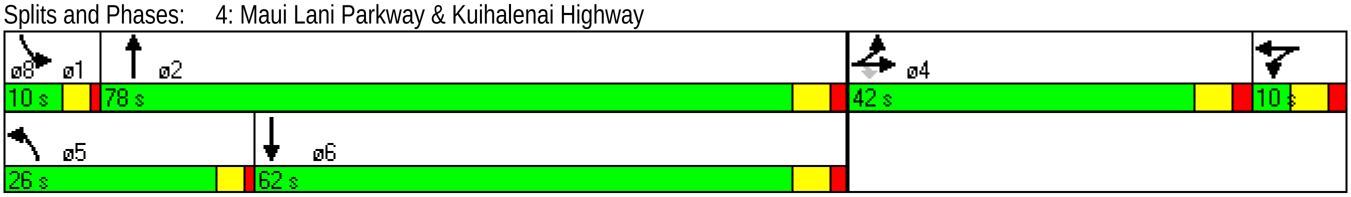
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	520	675	150	120	730	365	85	145	70	215	175	450
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0	6.0	4.0	6.0		4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	0.97	1.00	1.00	1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.95		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	1863	1583	1770	3362		1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.63	1.00	1.00	0.44	1.00	1.00
Satd. Flow (perm)	3433	1863	1583	1770	3362		1181	1863	1583	812	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	565	734	163	130	793	397	92	158	76	234	190	489
RTOR Reduction (vph)	0	0	34	0	52	0	0	0	64	0	0	315
Lane Group Flow (vph)	565	734	129	130	1138	0	92	158	12	234	190	174
Turn Type	Prot		Perm	Prot			pm+pt		Perm	pm+pt		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4				2		2	6		6
Actuated Green, G (s)	21.7	53.1	53.1	11.3	42.7		20.3	16.5	16.5	28.6	20.8	20.8
Effective Green, g (s)	21.7	53.1	53.1	11.3	42.7		20.3	16.5	16.5	28.6	20.8	20.8
Actuated g/C Ratio	0.20	0.49	0.49	0.10	0.39		0.19	0.15	0.15	0.26	0.19	0.19
Clearance Time (s)	4.0	6.0	6.0	4.0	6.0		4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	683	908	771	183	1317		240	282	240	284	356	302
v/s Ratio Prot	c0.16	0.39		0.07	c0.34		0.01	0.08		c0.06	0.10	
v/s Ratio Perm			0.08				0.06		0.01	c0.15		0.11
v/c Ratio	0.83	0.81	0.17	0.71	0.86		0.38	0.56	0.05	0.82	0.53	0.58
Uniform Delay, d1	41.9	23.6	15.6	47.3	30.5		38.1	42.9	39.5	36.9	39.7	40.1
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	8.1	5.4	0.1	12.2	6.1		1.0	2.5	0.1	17.3	1.5	2.7
Delay (s)	50.0	29.0	15.7	59.5	36.6		39.2	45.4	39.6	54.2	41.3	42.8
Level of Service	D	C	B	E	D		D	D	D	D	D	D
Approach Delay (s)		35.6			38.9			42.3			45.4	
Approach LOS		D			D			D			D	

Intersection Summary			
HCM Average Control Delay	39.4	HCM Level of Service	D
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	109.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	82.9%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	NBL	NBT	SBT	SBR	ø1	ø8
Lane Configurations									
Volume (vph)	690	0	175	280	985	1060	975		
Turn Type	Split		Perm	Prot			Free		
Protected Phases	4	4		5	2	6		1	8
Permitted Phases			4				Free		
Detector Phase	4	4	4	5	2	6			
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0
Minimum Split (s)	10.0	10.0	10.0	8.0	10.0	27.0		10.0	10.0
Total Split (s)	42.0	42.0	42.0	26.0	78.0	62.0	0.0	10.0	10.0
Total Split (%)	30.0%	30.0%	30.0%	18.6%	55.7%	44.3%	0.0%	7%	7%
Yellow Time (s)	4.0	4.0	4.0	3.0	4.0	4.0		3.0	4.0
All-Red Time (s)	2.0	2.0	2.0	1.0	2.0	2.0		1.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Total Lost Time (s)	6.0	6.0	6.0	4.0	6.0	6.0	4.0		
Lead/Lag				Lead	Lag	Lag		Lead	
Lead-Lag Optimize?									
Recall Mode	None	None	None	None	None	None		None	None

Intersection Summary
Cycle Length: 140
Actuated Cycle Length: 108.5
Natural Cycle: 90
Control Type: Actuated-Uncoordinated

Splits and Phases: 4: Maui Lani Parkway & Kuihalenai Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	690	0	175	0	0	0	280	985	0	0	1060	975
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0				4.0	6.0			6.0	4.0
Lane Util. Factor	0.95	0.95	1.00				0.97	0.95			0.95	1.00
Frt	1.00	1.00	0.85				1.00	1.00			1.00	0.85
Flt Protected	0.95	0.95	1.00				0.95	1.00			1.00	1.00
Satd. Flow (prot)	1681	1681	1583				3433	3539			3539	1583
Flt Permitted	0.95	0.95	1.00				0.95	1.00			1.00	1.00
Satd. Flow (perm)	1681	1681	1583				3433	3539			3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	750	0	190	0	0	0	304	1071	0	0	1152	1060
RTOR Reduction (vph)	0	0	62	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	375	375	128	0	0	0	304	1071	0	0	1152	1060
Turn Type	Split		Perm	Split			Prot			Prot		Free
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			4									Free
Actuated Green, G (s)	31.7	31.7	31.7				15.6	64.4			44.8	108.1
Effective Green, g (s)	31.7	31.7	31.7				15.6	64.4			44.8	108.1
Actuated g/C Ratio	0.29	0.29	0.29				0.14	0.60			0.41	1.00
Clearance Time (s)	6.0	6.0	6.0				4.0	6.0			6.0	
Vehicle Extension (s)	3.0	3.0	3.0				3.0	3.0			3.0	
Lane Grp Cap (vph)	493	493	464				495	2108			1467	1583
v/s Ratio Prot	0.22	0.22					0.09	0.30			c0.33	
v/s Ratio Perm			0.08									c0.67
v/c Ratio	0.76	0.76	0.28				0.61	0.51			0.79	0.67
Uniform Delay, d1	34.7	34.7	29.4				43.4	12.7			27.5	0.0
Progression Factor	1.00	1.00	1.00				1.00	1.00			1.00	1.00
Incremental Delay, d2	6.8	6.8	0.3				2.3	0.2			2.8	2.3
Delay (s)	41.6	41.6	29.7				45.7	12.9			30.3	2.3
Level of Service	D	D	C				D	B			C	A
Approach Delay (s)		39.2			0.0			20.1			16.9	
Approach LOS		D			A			C			B	

Intersection Summary			
HCM Average Control Delay	22.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	108.1	Sum of lost time (s)	6.0
Intersection Capacity Utilization	69.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations										
Volume (vph)	40	15	30	75	20	15	660	20	905	45
Turn Type	Perm		custom	Perm		pm+pt		pm+pt		Perm
Protected Phases		4			8	5	2	1	6	
Permitted Phases	4		4 5	8		2		6		6
Detector Phase	4	4	4 5	8	8	5	2	1	6	6
Switch Phase										
Minimum Initial (s)	6.0	6.0		6.0	6.0	3.0	10.0	3.0	10.0	10.0
Minimum Split (s)	23.0	23.0		27.0	27.0	7.0	31.0	7.0	26.0	26.0
Total Split (s)	27.0	27.0	34.0	27.0	27.0	7.0	66.0	7.0	66.0	66.0
Total Split (%)	27.0%	27.0%	34.0%	27.0%	27.0%	7.0%	66.0%	7.0%	66.0%	66.0%
Yellow Time (s)	4.0	4.0		4.0	4.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	6.0	4.0	6.0	6.0
Lead/Lag						Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?										
Recall Mode	None	None		None	None	None	C-Max	None	C-Max	C-Max

Intersection Summary
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 22 (22%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated

Splits and Phases: 5: Waiko Road & Honoapiilani Highway

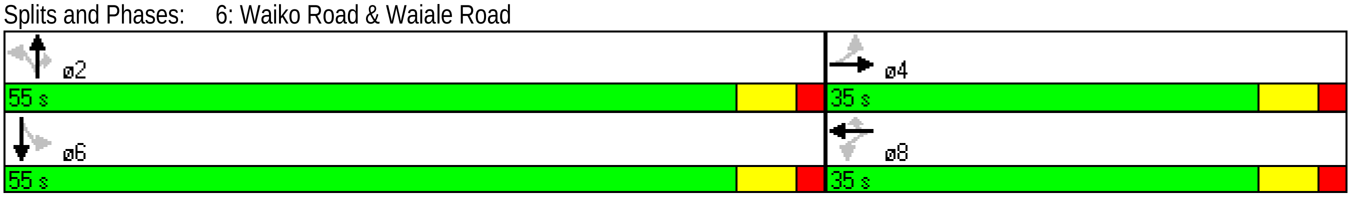
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	40	15	30	75	20	35	15	660	145	20	905	45
Ideal Flow (vphpl)	1900	1900	1900	1600	1600	1600	1900	1900	1900	1900	1900	1900
Grade (%)		-8%			0%			0%			0%	
Total Lost time (s)		5.0	5.0		5.0		4.0	6.0		4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	0.97
Flpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt		1.00	0.85		0.96		1.00	0.97		1.00	1.00	0.85
Flt Protected		0.96	1.00		0.97		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1869	1647		1470		1770	1812		1770	1863	1539
Flt Permitted		0.71	1.00		0.79		0.16	1.00		0.23	1.00	1.00
Satd. Flow (perm)		1371	1647		1192		300	1812		421	1863	1539
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	43	16	33	82	22	38	16	717	158	22	984	49
RTOR Reduction (vph)	0	0	26	0	14	0	0	6	0	0	0	7
Lane Group Flow (vph)	0	59	7	0	128	0	16	869	0	22	984	42
Confl. Peds. (#/hr)							3					3
Turn Type	Perm		custom	Perm			pm+pt			pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 5	8			2			6		6
Actuated Green, G (s)		14.8	21.6		14.8		70.8	69.0		69.6	68.4	68.4
Effective Green, g (s)		14.8	21.6		14.8		70.8	69.0		69.6	68.4	68.4
Actuated g/C Ratio		0.15	0.22		0.15		0.71	0.69		0.70	0.68	0.68
Clearance Time (s)		5.0			5.0		4.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)		2.0			2.0		2.0	5.0		2.0	5.0	5.0
Lane Grp Cap (vph)		203	356		176		239	1250		309	1274	1053
v/s Ratio Prot							c0.00	0.48		0.00	c0.53	
v/s Ratio Perm		0.04	0.00		c0.11		0.05			0.05		0.03
v/c Ratio		0.29	0.02		0.72		0.07	0.70		0.07	0.77	0.04
Uniform Delay, d1		37.9	30.9		40.7		9.8	9.2		7.4	10.6	5.1
Progression Factor		1.00	1.00		1.00		1.00	1.00		0.40	0.64	0.27
Incremental Delay, d2		0.3	0.0		11.8		0.0	3.2		0.0	4.5	0.1
Delay (s)		38.2	30.9		52.4		9.8	12.4		3.0	11.2	1.5
Level of Service		D	C		D		A	B		A	B	A
Approach Delay (s)		35.6			52.4			12.4			10.6	
Approach LOS		D			D			B			B	

Intersection Summary			
HCM Average Control Delay	15.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	74.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations										
Volume (vph)	55	165	285	150	100	15	450	255	55	545
Turn Type	Perm		Perm		Perm	Perm		Perm	Perm	
Protected Phases		4		8			2			6
Permitted Phases	4		8		8	2		2	6	
Detector Phase	4	4	8	8	8	2	2	2	6	6
Switch Phase										
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	24.0	24.0	24.0	24.0	24.0	27.0	27.0	27.0	27.0	27.0
Total Split (s)	35.0	35.0	35.0	35.0	35.0	55.0	55.0	55.0	55.0	55.0
Total Split (%)	38.9%	38.9%	38.9%	38.9%	38.9%	61.1%	61.1%	61.1%	61.1%	61.1%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag										
Lead-Lag Optimize?										
Recall Mode	None	None	None	None	None	None	None	None	None	None

Intersection Summary
Cycle Length: 90
Actuated Cycle Length: 68.1
Natural Cycle: 55
Control Type: Actuated-Uncoordinated

Splits and Phases: 6: Waiko Road & Waiale Road



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	165	15	285	150	100	15	450	255	55	545	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1840		1770	1863	1583	1770	1863	1583	1770	1844	
Flt Permitted	0.65	1.00		0.64	1.00	1.00	0.23	1.00	1.00	0.37	1.00	
Satd. Flow (perm)	1218	1840		1183	1863	1583	437	1863	1583	683	1844	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	60	179	16	310	163	109	16	489	277	60	592	43
RTOR Reduction (vph)	0	3	0	0	0	70	0	0	150	0	3	0
Lane Group Flow (vph)	60	192	0	310	163	39	16	489	127	60	632	0
Turn Type	Perm			Perm		Perm	Perm		Perm	Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)	24.4	24.4		24.4	24.4	24.4	31.0	31.0	31.0	31.0	31.0	
Effective Green, g (s)	24.4	24.4		24.4	24.4	24.4	31.0	31.0	31.0	31.0	31.0	
Actuated g/C Ratio	0.36	0.36		0.36	0.36	0.36	0.46	0.46	0.46	0.46	0.46	
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	441	666		428	674	573	201	857	728	314	848	
v/s Ratio Prot		0.10			0.09			0.26			c0.34	
v/s Ratio Perm	0.05			c0.26		0.02	0.04		0.08	0.09		
v/c Ratio	0.14	0.29		0.72	0.24	0.07	0.08	0.57	0.18	0.19	0.74	
Uniform Delay, d1	14.4	15.3		18.6	15.0	14.1	10.2	13.3	10.7	10.8	15.0	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.1	0.2		6.0	0.2	0.1	0.2	0.9	0.1	0.3	3.6	
Delay (s)	14.6	15.6		24.6	15.2	14.1	10.4	14.2	10.8	11.1	18.5	
Level of Service	B	B		C	B	B	B	B	B	B	B	
Approach Delay (s)		15.3			20.0			12.9			17.9	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM Average Control Delay	16.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	67.4	Sum of lost time (s)	12.0
Intersection Capacity Utilization	79.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	485	10	15	775	720	470
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Detector Phase	4	4 5	5	2	6	6 4
Switch Phase						
Minimum Initial (s)	6.0		4.0	10.0	10.0	
Minimum Split (s)	28.0		8.0	16.0	24.0	
Total Split (s)	29.0	39.0	10.0	51.0	41.0	70.0
Total Split (%)	36.3%	48.8%	12.5%	63.8%	51.3%	87.5%
Yellow Time (s)	3.0		3.0	4.0	4.0	
All-Red Time (s)	1.0		1.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?						
Recall Mode	None		None	None	None	

Intersection Summary
Cycle Length: 80
Actuated Cycle Length: 65.7
Natural Cycle: 60
Control Type: Actuated-Uncoordinated

Splits and Phases: 7: Waiko Road & Kuihelani Highway

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	485	10	15	775	720	470
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	3539	3539	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	3539	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	1.00
Adj. Flow (vph)	527	11	16	842	783	470
RTOR Reduction (vph)	0	5	0	0	0	69
Lane Group Flow (vph)	527	6	16	842	783	401
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Actuated Green, G (s)	23.7	29.6	1.9	34.2	28.3	58.0
Effective Green, g (s)	23.7	29.6	1.9	34.2	28.3	58.0
Actuated g/C Ratio	0.35	0.44	0.03	0.50	0.42	0.85
Clearance Time (s)	4.0		4.0	6.0	6.0	
Vehicle Extension (s)	2.0		2.0	5.0	5.0	
Lane Grp Cap (vph)	618	690	50	1783	1475	1352
v/s Ratio Prot	c0.30		0.01	c0.24	c0.22	
v/s Ratio Perm		0.00				0.25
v/c Ratio	0.85	0.01	0.32	0.47	0.53	0.30
Uniform Delay, d1	20.5	10.8	32.4	11.0	14.8	1.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	10.6	0.0	1.3	0.4	0.7	0.3
Delay (s)	31.1	10.8	33.7	11.4	15.5	1.2
Level of Service	C	B	C	B	B	A
Approach Delay (s)	30.7			11.8	10.1	
Approach LOS	C			B	B	

Intersection Summary			
HCM Average Control Delay	14.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	67.9	Sum of lost time (s)	16.0
Intersection Capacity Utilization	56.6%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Configurations											
Volume (vph)	270	30	840	15	80	10	630	475	15	415	95
Turn Type	Perm		custom	Perm		Perm	Prot		Prot		Perm
Protected Phases		4			8		5	2	1	6	
Permitted Phases	4		4 5	8		8					6
Detector Phase	4	4	4 5	8	8	8	5	2	1	6	6
Switch Phase											
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	27.0	27.0		27.0	27.0	27.0	10.0	27.0	10.0	27.0	27.0
Total Split (s)	37.0	37.0	63.0	37.0	37.0	37.0	26.0	53.0	10.0	37.0	37.0
Total Split (%)	37.0%	37.0%	63.0%	37.0%	37.0%	37.0%	26.0%	53.0%	10.0%	37.0%	37.0%
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	1.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	4.0	6.0	4.0	6.0	6.0
Lead/Lag							Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?											
Recall Mode	None	None		None	None	None	None	None	None	None	None

Intersection Summary
Cycle Length: 100
Actuated Cycle Length: 95.8
Natural Cycle: 80
Control Type: Actuated-Uncoordinated

Splits and Phases: 8: Kuikahi Dr & Maui Lani Parkway

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	270	30	840	15	80	10	630	475	20	15	415	95
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0		6.0	6.0	4.0	6.0		4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00	1.00	0.97	1.00		1.00	1.00	1.00
Frt		1.00	0.85		1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected		0.96	1.00		0.99	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1783	1583		1848	1583	3433	1851		1770	1863	1583
Flt Permitted		0.68	1.00		0.93	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)		1258	1583		1723	1583	3433	1851		1770	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	293	33	913	16	87	11	685	516	22	16	451	103
RTOR Reduction (vph)	0	0	65	0	0	8	0	2	0	0	0	42
Lane Group Flow (vph)	0	326	848	0	103	3	685	536	0	16	451	61
Turn Type	Perm		custom	Perm		Perm	Prot			Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 5	8		8						6
Actuated Green, G (s)		31.1	58.8		31.1	31.1	21.7	48.8		2.3	29.4	29.4
Effective Green, g (s)		31.1	58.8		31.1	31.1	21.7	48.8		2.3	29.4	29.4
Actuated g/C Ratio		0.32	0.60		0.32	0.32	0.22	0.50		0.02	0.30	0.30
Clearance Time (s)		6.0			6.0	6.0	4.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		398	948		546	501	759	920		41	558	474
v/s Ratio Prot							c0.20	0.29		0.01	c0.24	
v/s Ratio Perm		0.26	c0.54		0.06	0.00						0.04
v/c Ratio		0.82	0.89		0.19	0.01	0.90	0.58		0.39	0.81	0.13
Uniform Delay, d1		31.0	17.0		24.4	23.0	37.2	17.5		47.3	31.8	25.1
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2		12.4	10.8		0.2	0.0	14.0	0.9		6.0	8.4	0.1
Delay (s)		43.3	27.9		24.5	23.0	51.2	18.4		53.3	40.2	25.2
Level of Service		D	C		C	C	D	B		D	D	C
Approach Delay (s)		31.9			24.4			36.8			37.9	
Approach LOS		C			C			D			D	

Intersection Summary			
HCM Average Control Delay	34.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	98.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	93.9%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

APPENDIX C

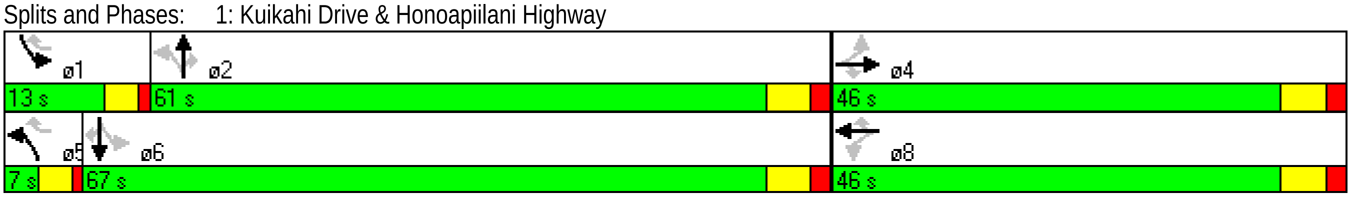
LEVEL OF SERVICE CALCULATIONS

- Year 2022 with Project Traffic AM

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	200	60	180	65	205	25	575	240	300	505	25
Turn Type	Perm		Perm	Perm		custom	pm+pt		Perm	pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8 5 1	2		2	6		6
Detector Phase	4	4	4	8	8	8 5 1	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	6.0	6.0	6.0	6.0	6.0		3.0	10.0	10.0	3.0	10.0	10.0
Minimum Split (s)	27.0	27.0	27.0	27.0	27.0		7.0	24.0	24.0	7.0	24.0	24.0
Total Split (s)	46.0	46.0	46.0	46.0	46.0	66.0	7.0	61.0	61.0	13.0	67.0	67.0
Total Split (%)	38.3%	38.3%	38.3%	38.3%	38.3%	55.0%	5.8%	50.8%	50.8%	10.8%	55.8%	55.8%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	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 Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag							Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?												
Recall Mode	None	None	None	None	None		None	None	None	None	None	None
Act Effct Green (s)	22.9	22.9	22.9	22.9	22.9	36.8	44.4	39.1	39.1	55.1	45.5	45.5
Actuated g/C Ratio	0.26	0.26	0.26	0.26	0.26	0.41	0.50	0.44	0.44	0.62	0.51	0.51
v/c Ratio	0.17	0.44	0.14	0.75	0.15	0.28	0.07	0.76	0.32	0.87	0.57	0.03
Control Delay	28.4	31.4	7.8	50.0	27.6	4.2	9.5	28.8	5.6	37.7	18.8	5.2
Queue Delay	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 Delay	28.4	31.4	7.8	50.0	27.6	4.2	9.5	28.8	5.6	37.7	18.8	5.2
LOS	C	C	A	D	C	A	A	C	A	D	B	A
Approach Delay		26.4			25.9			21.6			25.3	
Approach LOS		C			C			C			C	

Intersection Summary	
Cycle Length: 120	
Actuated Cycle Length: 88.7	
Natural Cycle: 80	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.87	
Intersection Signal Delay: 24.3	Intersection LOS: C
Intersection Capacity Utilization 85.7%	ICU Level of Service E
Analysis Period (min) 15	

Splits and Phases: 1: Kuikahi Drive & Honoapiilani Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	200	60	180	65	205	25	575	240	300	505	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-5%			0%			0%			0%	
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1814	1909	1623	1770	1863	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.71	1.00	1.00	0.54	1.00	1.00	0.39	1.00	1.00	0.19	1.00	1.00
Satd. Flow (perm)	1357	1909	1623	1014	1863	1583	722	1863	1583	357	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	60	217	65	196	71	223	27	625	261	326	549	27
RTOR Reduction (vph)	0	0	48	0	0	121	0	0	115	0	0	13
Lane Group Flow (vph)	60	217	17	196	71	102	27	625	146	326	549	14
Turn Type	Perm		Perm	Perm		custom	pm+pt		Perm	pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8 5 1	2		2	6		6
Actuated Green, G (s)	22.9	22.9	22.9	22.9	22.9	38.5	42.3	39.1	39.1	52.7	45.5	45.5
Effective Green, g (s)	22.9	22.9	22.9	22.9	22.9	38.5	42.3	39.1	39.1	52.7	45.5	45.5
Actuated g/C Ratio	0.26	0.26	0.26	0.26	0.26	0.44	0.48	0.45	0.45	0.60	0.52	0.52
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0		4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)	2.0	2.0	2.0	2.0	2.0		2.0	5.0	5.0	2.0	5.0	5.0
Lane Grp Cap (vph)	355	499	424	265	487	696	387	832	707	370	968	822
v/s Ratio Prot		0.11			0.04		0.00	0.34		c0.10	0.29	
v/s Ratio Perm	0.04		0.01	c0.19		0.06	0.03		0.09	c0.43		0.01
v/c Ratio	0.17	0.43	0.04	0.74	0.15	0.15	0.07	0.75	0.21	0.88	0.57	0.02
Uniform Delay, d1	25.0	27.0	24.1	29.6	24.8	14.7	12.1	20.2	14.8	14.0	14.3	10.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	0.2	0.0	9.0	0.1	0.0	0.0	4.6	0.3	20.4	1.3	0.0
Delay (s)	25.1	27.2	24.2	38.6	24.9	14.7	12.1	24.8	15.1	34.4	15.6	10.2
Level of Service	C	C	C	D	C	B	B	C	B	C	B	B
Approach Delay (s)		26.2			25.8			21.6			22.2	
Approach LOS		C			C			C			C	

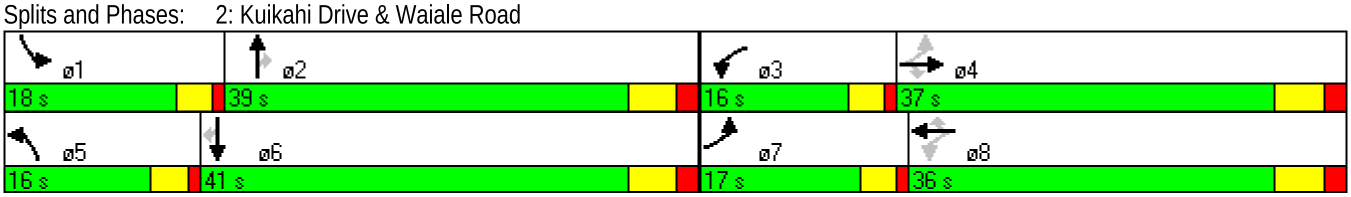
Intersection Summary			
HCM Average Control Delay	23.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	87.6	Sum of lost time (s)	10.0
Intersection Capacity Utilization	85.7%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	340	385	25	175	185	375	55	500	285	255	285	190
Turn Type	pm+pt		Perm	pm+pt		Perm	Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	30.0	30.0	8.0	30.0	30.0	8.0	30.0	30.0	8.0	30.0	30.0
Total Split (s)	17.0	37.0	37.0	16.0	36.0	36.0	16.0	39.0	39.0	18.0	41.0	41.0
Total Split (%)	15.5%	33.6%	33.6%	14.5%	32.7%	32.7%	14.5%	35.5%	35.5%	16.4%	37.3%	37.3%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	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 Lost Time (s)	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?												
Recall Mode	None	None	None	None	None	None	None	None	None	None	None	None
Act Effct Green (s)	42.0	27.0	27.0	37.9	24.9	24.9	8.8	32.7	32.7	12.6	38.8	38.8
Actuated g/C Ratio	0.41	0.26	0.26	0.37	0.24	0.24	0.09	0.32	0.32	0.12	0.37	0.37
v/c Ratio	0.77	0.86	0.06	0.67	0.45	0.65	0.40	0.92	0.44	0.66	0.44	0.29
Control Delay	35.7	55.0	18.2	31.4	36.7	13.1	54.4	58.7	6.5	52.7	29.6	4.9
Queue Delay	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 Delay	35.7	55.0	18.2	31.4	36.7	13.1	54.4	58.7	6.5	52.7	29.6	4.9
LOS	D	D	B	C	D	B	D	E	A	D	C	A
Approach Delay		45.0			23.4			40.7			31.2	
Approach LOS		D			C			D			C	

Intersection Summary	
Cycle Length: 110	
Actuated Cycle Length: 103.5	
Natural Cycle: 90	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.92	
Intersection Signal Delay: 35.3	Intersection LOS: D
Intersection Capacity Utilization 81.7%	ICU Level of Service D
Analysis Period (min) 15	

Splits and Phases: 2: Kuikahi Drive & Waiale Road



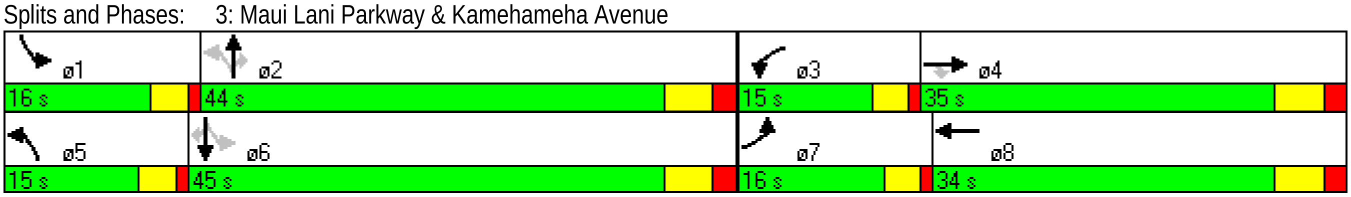
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	340	385	25	175	185	375	55	500	285	255	285	190
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1863	1583	3433	1863	1583
Flt Permitted	0.49	1.00	1.00	0.20	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	912	1863	1583	373	1863	1583	1770	1863	1583	3433	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	370	418	27	190	201	408	60	543	310	277	310	207
RTOR Reduction (vph)	0	0	11	0	0	248	0	0	199	0	0	130
Lane Group Flow (vph)	370	418	16	190	201	160	60	543	111	277	310	77
Turn Type	pm+pt		Perm	pm+pt		Perm	Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)	40.1	27.0	27.0	35.9	24.9	24.9	7.5	33.7	33.7	12.6	38.8	38.8
Effective Green, g (s)	40.1	27.0	27.0	35.9	24.9	24.9	7.5	33.7	33.7	12.6	38.8	38.8
Actuated g/C Ratio	0.38	0.26	0.26	0.34	0.24	0.24	0.07	0.32	0.32	0.12	0.37	0.37
Clearance Time (s)	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	458	482	410	276	445	378	127	602	511	415	693	589
v/s Ratio Prot	c0.10	c0.22		0.07	0.11		0.03	c0.29		c0.08	0.17	
v/s Ratio Perm	0.21		0.01	0.16		0.10			0.07			0.05
v/c Ratio	0.81	0.87	0.04	0.69	0.45	0.42	0.47	0.90	0.22	0.67	0.45	0.13
Uniform Delay, d1	26.7	36.9	28.9	26.5	33.9	33.6	46.5	33.7	25.7	43.8	24.7	21.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	10.1	15.1	0.0	7.0	0.7	0.8	2.8	16.8	0.2	4.0	0.5	0.1
Delay (s)	36.8	52.0	29.0	33.5	34.6	34.4	49.3	50.5	25.9	47.9	25.1	21.7
Level of Service	D	D	C	C	C	C	D	D	C	D	C	C
Approach Delay (s)		44.3			34.2			42.1			32.2	
Approach LOS		D			C			D			C	

Intersection Summary			
HCM Average Control Delay	38.4	HCM Level of Service	D
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	104.3	Sum of lost time (s)	18.0
Intersection Capacity Utilization	81.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											
Volume (vph)	245	260	270	115	450	320	525	160	225	300	450
Turn Type	Prot		Perm	Prot		pm+pt		Perm	pm+pt		Perm
Protected Phases	7	4		3	8	5	2		1	6	
Permitted Phases			4			2		2	6		6
Detector Phase	7	4	4	3	8	5	2	2	1	6	6
Switch Phase											
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	27.0	27.0	8.0	27.0	8.0	27.0	27.0	8.0	27.0	27.0
Total Split (s)	16.0	35.0	35.0	15.0	34.0	15.0	44.0	44.0	16.0	45.0	45.0
Total Split (%)	14.5%	31.8%	31.8%	13.6%	30.9%	13.6%	40.0%	40.0%	14.5%	40.9%	40.9%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	2.0	2.0	1.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	6.0	4.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?											
Recall Mode	None	None	None	None	None	None	None	None	None	None	None
Act Effct Green (s)	11.5	26.5	26.5	10.4	25.4	48.4	35.2	35.2	50.0	36.0	36.0
Actuated g/C Ratio	0.11	0.25	0.25	0.10	0.24	0.46	0.34	0.34	0.48	0.35	0.35
v/c Ratio	0.70	0.60	0.51	0.71	0.83	0.73	0.91	0.30	0.88	0.51	0.64
Control Delay	56.9	40.8	11.9	69.5	43.2	28.5	53.1	16.1	54.0	30.6	13.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	56.9	40.8	11.9	69.5	43.2	28.5	53.1	16.1	54.0	30.6	13.3
LOS	E	D	B	E	D	C	D	B	D	C	B
Approach Delay		35.8			47.1		39.4			28.0	
Approach LOS		D			D		D			C	

Intersection Summary	
Cycle Length: 110	
Actuated Cycle Length: 104.2	
Natural Cycle: 90	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.91	
Intersection Signal Delay: 37.2	Intersection LOS: D
Intersection Capacity Utilization 83.2%	ICU Level of Service E
Analysis Period (min) 15	

Splits and Phases: 3: Maui Lani Parkway & Kamehameha Avenue



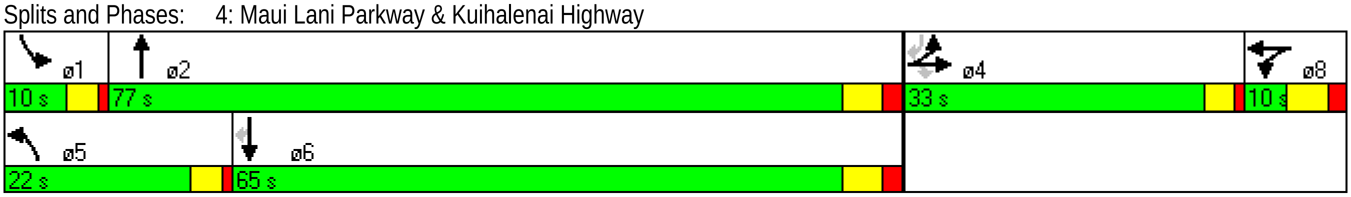
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	245	260	270	115	450	220	320	525	160	225	300	450
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0	6.0	4.0	6.0		4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	0.97	1.00	1.00	1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.95		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	1863	1583	1770	3365		1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.43	1.00	1.00	0.12	1.00	1.00
Satd. Flow (perm)	3433	1863	1583	1770	3365		804	1863	1583	215	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	266	283	293	125	489	239	348	571	174	245	326	489
RTOR Reduction (vph)	0	0	171	0	55	0	0	0	50	0	0	216
Lane Group Flow (vph)	266	283	122	125	673	0	348	571	124	245	326	273
Turn Type	Prot		Perm	Prot			pm+pt		Perm	pm+pt		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4				2		2	6		6
Actuated Green, G (s)	11.5	26.5	26.5	10.4	25.4		46.3	35.2	35.2	47.9	36.0	36.0
Effective Green, g (s)	11.5	26.5	26.5	10.4	25.4		46.3	35.2	35.2	47.9	36.0	36.0
Actuated g/C Ratio	0.11	0.25	0.25	0.10	0.24		0.45	0.34	0.34	0.46	0.35	0.35
Clearance Time (s)	4.0	6.0	6.0	4.0	6.0		4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	380	475	403	177	822		461	631	536	277	645	548
v/s Ratio Prot	c0.08	0.15		0.07	c0.20		0.08	c0.31		c0.10	0.18	
v/s Ratio Perm			0.08				0.26		0.08	0.31		0.17
v/c Ratio	0.70	0.60	0.30	0.71	0.82		0.75	0.90	0.23	0.88	0.51	0.50
Uniform Delay, d1	44.6	34.0	31.3	45.3	37.1		22.1	32.8	24.7	25.2	26.9	26.9
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	5.6	2.0	0.4	12.1	6.4		6.9	16.5	0.2	26.6	0.6	0.7
Delay (s)	50.1	36.1	31.7	57.4	43.5		29.0	49.3	24.9	51.8	27.6	27.6
Level of Service	D	D	C	E	D		C	D	C	D	C	C
Approach Delay (s)		39.0			45.5			38.9			33.2	
Approach LOS		D			D			D			C	

Intersection Summary			
HCM Average Control Delay	38.8	HCM Level of Service	D
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	104.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	83.2%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	NBL	NBT	SBT	SBR	ø1	ø8
Lane Configurations									
Volume (vph)	715	0	175	140	1135	945	560		
Turn Type	Split		Perm	Prot			custom		
Protected Phases	4	4		5	2	6		1	8
Permitted Phases			4				6 4		
Detector Phase	4	4	4	5	2	6	6 4		
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0
Minimum Split (s)	8.0	8.0	8.0	8.0	10.0	27.0		10.0	10.0
Total Split (s)	33.0	33.0	33.0	22.0	77.0	65.0	98.0	10.0	10.0
Total Split (%)	25.4%	25.4%	25.4%	16.9%	59.2%	50.0%	75.4%	8%	8%
Yellow Time (s)	3.0	3.0	3.0	3.0	4.0	4.0		3.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	2.0	2.0		1.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Total Lost Time (s)	4.0	4.0	4.0	4.0	6.0	6.0	6.0		
Lead/Lag				Lead	Lag	Lag		Lead	
Lead-Lag Optimize?									
Recall Mode	None	None	None	None	None	None		None	None
Act Effct Green (s)	29.6	29.6	29.6	13.9	63.0	45.0	78.7		
Actuated g/C Ratio	0.29	0.29	0.29	0.14	0.61	0.44	0.77		
v/c Ratio	0.80	0.80	0.37	0.64	0.57	0.66	0.46		
Control Delay	51.0	51.1	20.8	56.7	12.4	24.9	2.3		
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Total Delay	51.0	51.1	20.8	56.7	12.4	24.9	2.3		
LOS	D	D	C	E	B	C	A		
Approach Delay		45.1			17.3	16.5			
Approach LOS		D			B	B			

Intersection Summary	
Cycle Length: 130	
Actuated Cycle Length: 102.8	
Natural Cycle: 80	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.80	
Intersection Signal Delay: 23.7	Intersection LOS: C
Intersection Capacity Utilization 66.2%	ICU Level of Service C
Analysis Period (min) 15	

Splits and Phases: 4: Maui Lani Parkway & Kuihalenai Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	715	0	175	0	0	0	140	1135	0	0	945	560
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0				4.0	6.0			6.0	6.0
Lane Util. Factor	0.95	0.95	1.00				1.00	0.95			0.95	1.00
Frt	1.00	1.00	0.85				1.00	1.00			1.00	0.85
Flt Protected	0.95	0.95	1.00				0.95	1.00			1.00	1.00
Satd. Flow (prot)	1681	1681	1583				1770	3539			3539	1583
Flt Permitted	0.95	0.95	1.00				0.95	1.00			1.00	1.00
Satd. Flow (perm)	1681	1681	1583				1770	3539			3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	777	0	190	0	0	0	152	1234	0	0	1027	609
RTOR Reduction (vph)	0	0	62	0	0	0	0	0	0	0	0	95
Lane Group Flow (vph)	388	389	128	0	0	0	152	1234	0	0	1027	514
Turn Type	Split		Perm	Split			Prot			Prot		custom
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			4									6 4
Actuated Green, G (s)	29.6	29.6	29.6				13.9	63.0			45.1	80.7
Effective Green, g (s)	29.6	29.6	29.6				13.9	63.0			45.1	80.7
Actuated g/C Ratio	0.29	0.29	0.29				0.14	0.61			0.44	0.79
Clearance Time (s)	4.0	4.0	4.0				4.0	6.0			6.0	
Vehicle Extension (s)	3.0	3.0	3.0				3.0	3.0			3.0	
Lane Grp Cap (vph)	485	485	457				240	2173			1556	1245
v/s Ratio Prot	0.23	c0.23					c0.09	0.35			c0.29	
v/s Ratio Perm			0.08									0.32
v/c Ratio	0.80	0.80	0.28				0.63	0.57			0.66	0.41
Uniform Delay, d1	33.8	33.8	28.3				41.9	11.7			22.7	3.5
Progression Factor	1.00	1.00	1.00				1.00	1.00			1.00	1.00
Incremental Delay, d2	9.2	9.3	0.3				5.4	0.3			1.1	0.2
Delay (s)	42.9	43.1	28.6				47.3	12.1			23.8	3.7
Level of Service	D	D	C				D	B			C	A
Approach Delay (s)		40.2			0.0			15.9			16.3	
Approach LOS		D			A			B			B	

Intersection Summary			
HCM Average Control Delay	22.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	102.6	Sum of lost time (s)	14.0
Intersection Capacity Utilization	66.2%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations										
Volume (vph)	35	25	10	65	5	5	550	145	580	15
Turn Type	Perm		custom	Perm		pm+pt		pm+pt		Perm
Protected Phases		4			8	5	2	1	6	
Permitted Phases	4		4 5	8		2		6		6
Detector Phase	4	4	4 5	8	8	5	2	1	6	6
Switch Phase										
Minimum Initial (s)	6.0	6.0		6.0	6.0	3.0	10.0	3.0	10.0	10.0
Minimum Split (s)	23.0	23.0		27.0	27.0	7.0	31.0	7.0	26.0	26.0
Total Split (s)	27.0	27.0	34.0	27.0	27.0	7.0	60.0	13.0	66.0	66.0
Total Split (%)	27.0%	27.0%	34.0%	27.0%	27.0%	7.0%	60.0%	13.0%	66.0%	66.0%
Yellow Time (s)	4.0	4.0		4.0	4.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	6.0	4.0	6.0	6.0
Lead/Lag						Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?										
Recall Mode	None	None		None	None	None	C-Max	None	C-Max	C-Max
Act Effct Green (s)		13.6	20.6		13.6	69.6	64.6	77.4	72.6	72.6
Actuated g/C Ratio		0.14	0.21		0.14	0.70	0.65	0.77	0.73	0.73
v/c Ratio		0.35	0.03		0.75	0.01	0.58	0.32	0.47	0.01
Control Delay		42.1	14.0		50.2	4.4	14.0	5.3	8.7	4.3
Queue Delay		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		42.1	14.0		50.2	4.4	14.0	5.3	8.7	4.3
LOS		D	B		D	A	B	A	A	A
Approach Delay		38.1			50.2		13.9		7.9	
Approach LOS		D			D		B		A	

Intersection Summary	
Cycle Length: 100	
Actuated Cycle Length: 100	
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green	
Natural Cycle: 70	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.75	
Intersection Signal Delay: 15.4	Intersection LOS: B
Intersection Capacity Utilization 71.0%	ICU Level of Service C
Analysis Period (min) 15	

Splits and Phases: 5: Waiko Road & Honoapiilani Highway

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	35	25	10	65	5	70	5	550	85	145	580	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1600	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-8%			0%			0%			0%	
Total Lost time (s)		5.0	5.0		5.0		4.0	6.0		4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	0.97
Flpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt		1.00	0.85		0.93		1.00	0.98		1.00	1.00	0.85
Flt Protected		0.97	1.00		0.98		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1882	1647		1429		1768	1825		1770	1863	1539
Flt Permitted		0.70	1.00		0.82		0.40	1.00		0.29	1.00	1.00
Satd. Flow (perm)		1363	1647		1198		738	1825		531	1863	1539
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	38	27	11	71	5	76	5	598	92	158	630	16
RTOR Reduction (vph)	0	0	9	0	40	0	0	4	0	0	0	3
Lane Group Flow (vph)	0	65	2	0	112	0	5	686	0	158	630	13
Confl. Peds. (#/hr)							3					3
Turn Type	Perm		custom	Perm			pm+pt			pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 5	8			2			6		6
Actuated Green, G (s)		13.6	19.8		13.6		65.8	64.6		75.4	70.2	70.2
Effective Green, g (s)		13.6	19.8		13.6		65.8	64.6		75.4	70.2	70.2
Actuated g/C Ratio		0.14	0.20		0.14		0.66	0.65		0.75	0.70	0.70
Clearance Time (s)		5.0			5.0		4.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)		2.0			2.0		2.0	5.0		2.0	5.0	5.0
Lane Grp Cap (vph)		185	326		163		498	1179		485	1308	1080
v/s Ratio Prot							0.00	c0.38		c0.02	c0.34	
v/s Ratio Perm		0.05	0.00		c0.09		0.01			0.22		0.01
v/c Ratio		0.35	0.01		0.69		0.01	0.58		0.33	0.48	0.01
Uniform Delay, d1		39.2	32.2		41.2		6.0	10.0		5.9	6.7	4.5
Progression Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2		0.4	0.0		9.3		0.0	2.1		0.1	1.3	0.0
Delay (s)		39.6	32.2		50.4		6.0	12.1		6.0	8.0	4.5
Level of Service		D	C		D		A	B		A	A	A
Approach Delay (s)		38.5			50.4			12.1			7.5	
Approach LOS		D			D			B			A	

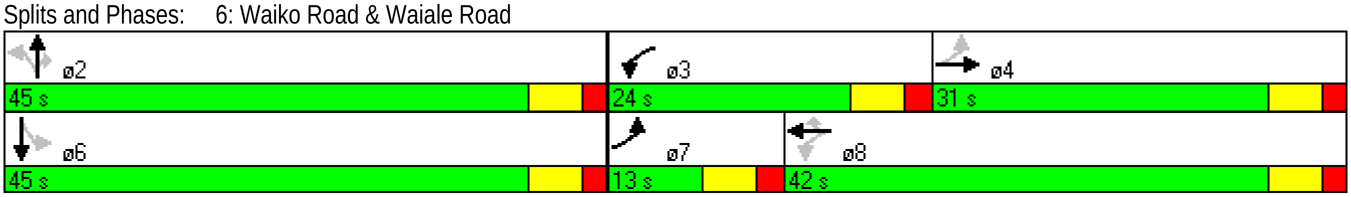
Intersection Summary			
HCM Average Control Delay	14.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	71.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations										
Volume (vph)	45	250	255	90	140	15	370	300	185	255
Turn Type	pm+pt		pm+pt		Perm	Perm		Perm	Perm	
Protected Phases	7	4	3	8			2			6
Permitted Phases	4		8		8	2		2	6	
Detector Phase	7	4	3	8	8	2	2	2	6	6
Switch Phase										
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	10.0	24.0	10.0	24.0	24.0	27.0	27.0	27.0	27.0	27.0
Total Split (s)	13.0	31.0	24.0	42.0	42.0	45.0	45.0	45.0	45.0	45.0
Total Split (%)	13.0%	31.0%	24.0%	42.0%	42.0%	45.0%	45.0%	45.0%	45.0%	45.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag					
Lead-Lag Optimize?										
Recall Mode	None	None	None	None	None	None	None	None	None	None
Act Effct Green (s)	24.6	17.8	37.5	30.9	30.9	28.4	28.4	28.4	28.4	28.4
Actuated g/C Ratio	0.31	0.23	0.48	0.39	0.39	0.36	0.36	0.36	0.36	0.36
v/c Ratio	0.11	0.70	0.57	0.13	0.21	0.06	0.60	0.42	0.84	0.53
Control Delay	14.9	39.9	19.1	20.9	4.8	18.9	25.4	4.2	54.8	22.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.9	39.9	19.1	20.9	4.8	18.9	25.4	4.2	54.8	22.9
LOS	B	D	B	C	A	B	C	A	D	C
Approach Delay		36.3		15.3			16.0			34.6
Approach LOS		D		B			B			C

Intersection Summary

Cycle Length: 100
Actuated Cycle Length: 78.8
Natural Cycle: 65
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.84
Intersection Signal Delay: 23.8 Intersection LOS: C
Intersection Capacity Utilization 78.2% ICU Level of Service D
Analysis Period (min) 15

Splits and Phases: 6: Waiko Road & Waiale Road



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	45	250	20	255	90	140	15	370	300	185	255	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1842		1770	1863	1583	1770	1863	1583	1770	1806	
Flt Permitted	0.69	1.00		0.33	1.00	1.00	0.42	1.00	1.00	0.36	1.00	
Satd. Flow (perm)	1292	1842		618	1863	1583	790	1863	1583	665	1806	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	49	272	22	277	98	152	16	402	326	201	277	71
RTOR Reduction (vph)	0	3	0	0	0	94	0	0	212	0	10	0
Lane Group Flow (vph)	49	291	0	277	98	58	16	402	114	201	338	0
Turn Type	pm+pt			pm+pt		Perm	Perm		Perm	Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)	24.8	21.2		40.5	30.9	30.9	28.4	28.4	28.4	28.4	28.4	
Effective Green, g (s)	24.8	21.2		40.5	30.9	30.9	28.4	28.4	28.4	28.4	28.4	
Actuated g/C Ratio	0.31	0.26		0.50	0.38	0.38	0.35	0.35	0.35	0.35	0.35	
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	417	483		499	712	605	277	654	556	233	634	
v/s Ratio Prot	0.01	0.16		c0.09	0.05			0.22			0.19	
v/s Ratio Perm	0.03			c0.19		0.04	0.02		0.07	c0.30		
v/c Ratio	0.12	0.60		0.56	0.14	0.10	0.06	0.61	0.21	0.86	0.53	
Uniform Delay, d1	20.0	26.2		13.1	16.3	16.0	17.4	21.7	18.4	24.4	21.0	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.1	2.1		1.3	0.1	0.1	0.1	1.7	0.2	26.4	0.9	
Delay (s)	20.1	28.3		14.4	16.4	16.1	17.5	23.4	18.5	50.8	21.8	
Level of Service	C	C		B	B	B	B	C	B	D	C	
Approach Delay (s)		27.1			15.3			21.2			32.4	
Approach LOS		C			B			C			C	

Intersection Summary			
HCM Average Control Delay	23.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	80.9	Sum of lost time (s)	12.0
Intersection Capacity Utilization	78.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	540	360	150	565	795	225
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Detector Phase	4	4 5	5	2	6	6 4
Switch Phase						
Minimum Initial (s)	6.0		4.0	10.0	10.0	
Minimum Split (s)	28.0		8.0	16.0	27.0	
Total Split (s)	32.0	45.0	13.0	58.0	45.0	77.0
Total Split (%)	35.6%	50.0%	14.4%	64.4%	50.0%	85.6%
Yellow Time (s)	3.0		3.0	4.0	4.0	
All-Red Time (s)	1.0		1.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?						
Recall Mode	None		None	C-Max	C-Max	
Act Effct Green (s)	28.0	41.0	9.0	52.0	39.0	71.0
Actuated g/C Ratio	0.31	0.46	0.10	0.58	0.43	0.79
v/c Ratio	1.07	0.51	0.92	0.30	0.56	0.18
Control Delay	89.0	16.5	88.1	8.0	20.9	1.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	89.0	16.5	88.1	8.0	20.9	1.3
LOS	F	B	F	A	C	A
Approach Delay	60.0			24.8	16.9	
Approach LOS	E			C	B	

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 90
Offset: 80 (89%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 65
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.07
Intersection Signal Delay: 33.9 Intersection LOS: C
Intersection Capacity Utilization 71.9% ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 7: Waiko Road & Kuihelani Highway

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	540	360	150	565	795	225
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	3539	3539	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	3539	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	1.00
Adj. Flow (vph)	587	391	163	614	864	225
RTOR Reduction (vph)	0	42	0	0	0	24
Lane Group Flow (vph)	587	349	163	614	864	201
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Actuated Green, G (s)	28.0	41.0	9.0	52.0	39.0	73.0
Effective Green, g (s)	28.0	41.0	9.0	52.0	39.0	73.0
Actuated g/C Ratio	0.31	0.46	0.10	0.58	0.43	0.81
Clearance Time (s)	4.0		4.0	6.0	6.0	
Vehicle Extension (s)	2.0		2.0	5.0	5.0	
Lane Grp Cap (vph)	551	721	177	2045	1534	1284
v/s Ratio Prot	c0.33		c0.09	0.17	c0.24	
v/s Ratio Perm		0.22				0.13
v/c Ratio	1.07	0.48	0.92	0.30	0.56	0.16
Uniform Delay, d1	31.0	17.1	40.1	9.7	19.1	1.8
Progression Factor	1.00	1.00	0.90	0.77	1.00	1.00
Incremental Delay, d2	56.9	0.2	44.1	0.4	1.5	0.0
Delay (s)	87.9	17.3	80.2	7.9	20.6	1.9
Level of Service	F	B	F	A	C	A
Approach Delay (s)	59.7			23.0	16.7	
Approach LOS	E			C	B	

Intersection Summary			
HCM Average Control Delay	33.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	71.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Configurations											
Volume (vph)	200	15	450	20	45	15	885	370	5	285	80
Turn Type	Perm		custom	Perm		Perm	Prot		Prot		Perm
Protected Phases		4			8		5	2	1	6	
Permitted Phases	4		4 5 2	8		8					6
Detector Phase	4	4	4 5 2	8	8	8	5	2	1	6	6
Switch Phase											
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	27.0	27.0		27.0	27.0	27.0	8.0	10.0	8.0	27.0	27.0
Total Split (s)	37.0	37.0	122.0	37.0	37.0	37.0	32.0	53.0	10.0	31.0	31.0
Total Split (%)	37.0%	37.0%	122.0%	37.0%	37.0%	37.0%	32.0%	53.0%	10.0%	31.0%	31.0%
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	1.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	4.0	6.0	4.0	6.0	6.0
Lead/Lag							Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?									Yes		
Recall Mode	None	None		None	None	None	None	None	None	None	None
Act Effct Green (s)		21.5	85.4		21.5	21.5	28.6	49.9	5.8	18.9	18.9
Actuated g/C Ratio		0.25	1.00		0.25	0.25	0.33	0.58	0.07	0.22	0.22
v/c Ratio		0.72	0.31		0.18	0.04	0.84	0.38	0.04	0.75	0.22
Control Delay		43.0	0.5		26.3	11.5	36.9	12.8	43.8	44.1	12.4
Queue Delay		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		43.0	0.5		26.3	11.5	36.9	12.8	43.8	44.1	12.4
LOS		D	A		C	B	D	B	D	D	B
Approach Delay		14.2			23.6			29.7		37.3	
Approach LOS		B			C			C		D	

Intersection Summary	
Cycle Length: 100	
Actuated Cycle Length: 85.4	
Natural Cycle: 80	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.84	
Intersection Signal Delay: 26.3	Intersection LOS: C
Intersection Capacity Utilization 72.1%	ICU Level of Service C
Analysis Period (min) 15	

Splits and Phases: 8: Kuikahi Dr & Kamehameha Ave

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	200	15	450	20	45	15	885	370	10	5	285	80
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0		6.0	6.0	4.0	6.0		4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00	1.00	0.97	1.00		1.00	1.00	1.00
Frt		1.00	0.85		1.00	0.85	1.00	1.00		1.00	1.00	0.85
Flt Protected		0.96	1.00		0.98	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1780	1583		1834	1583	3433	1855		1770	1863	1583
Flt Permitted		0.69	1.00		0.86	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)		1284	1583		1607	1583	3433	1855		1770	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	217	16	489	22	49	16	962	402	11	5	310	87
RTOR Reduction (vph)	0	0	0	0	0	12	0	1	0	0	0	50
Lane Group Flow (vph)	0	233	489	0	71	4	962	412	0	5	310	37
Turn Type	Perm		custom	Perm		Perm	Prot			Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 5 2	8		8						6
Actuated Green, G (s)		21.5	88.4		21.5	21.5	28.6	49.9		1.0	22.3	22.3
Effective Green, g (s)		21.5	88.4		21.5	21.5	28.6	49.9		1.0	22.3	22.3
Actuated g/C Ratio		0.24	1.00		0.24	0.24	0.32	0.56		0.01	0.25	0.25
Clearance Time (s)		6.0			6.0	6.0	4.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		312	1583		391	385	1111	1047		20	470	399
v/s Ratio Prot							c0.28	0.22		0.00	c0.17	
v/s Ratio Perm		c0.18	0.31		0.04	0.00						0.02
v/c Ratio		0.75	0.31		0.18	0.01	0.87	0.39		0.25	0.66	0.09
Uniform Delay, d1		30.9	0.0		26.5	25.4	28.1	10.8		43.3	29.6	25.3
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2		9.4	0.1		0.2	0.0	7.2	0.2		6.5	3.3	0.1
Delay (s)		40.3	0.1		26.7	25.4	35.3	11.0		49.8	33.0	25.4
Level of Service		D	A		C	C	D	B		D	C	C
Approach Delay (s)		13.1			26.5			28.0			31.6	
Approach LOS		B			C			C			C	

Intersection Summary			
HCM Average Control Delay	24.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	88.4	Sum of lost time (s)	16.0
Intersection Capacity Utilization	72.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	795	165	55	965	65	40
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	864	179	60	1049	71	43
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						4
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				1078		
pX, platoon unblocked						
vC, conflicting volume			1043		1598	522
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1043		1598	522
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			91		20	91
cM capacity (veh/h)			662		88	500

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	576	467	60	524	524	114
Volume Left	0	0	60	0	0	71
Volume Right	0	179	0	0	0	43
cSH	1700	1700	662	1700	1700	143
Volume to Capacity	0.34	0.27	0.09	0.31	0.31	0.80
Queue Length 95th (ft)	0	0	7	0	0	125
Control Delay (s)	0.0	0.0	11.0	0.0	0.0	85.3
Lane LOS			B			F
Approach Delay (s)	0.0		0.6			85.3
Approach LOS						F

Intersection Summary			
Average Delay	4.6		
Intersection Capacity Utilization	44.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	10	35	105	30	75	205
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	38	114	33	82	223
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	500	114			147	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	500	114			147	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	98	96			94	
cM capacity (veh/h)	500	938			1435	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	49	114	33	82	223
Volume Left	11	0	0	82	0
Volume Right	38	0	33	0	0
cSH	786	1700	1700	1435	1700
Volume to Capacity	0.06	0.07	0.02	0.06	0.13
Queue Length 95th (ft)	5	0	0	5	0
Control Delay (s)	9.9	0.0	0.0	7.7	0.0
Lane LOS	A			A	
Approach Delay (s)	9.9	0.0		2.1	
Approach LOS	A				

Intersection Summary			
Average Delay	2.2		
Intersection Capacity Utilization	20.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	10	50	30	40	35	225	10	150	85	80	210	10
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	54	33	43	38	245	11	163	92	87	228	11
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)			4			4						
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	734	685	234	677	644	209	239			255		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	734	685	234	677	644	209	239			255		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	95	84	96	85	90	71	99			93		
cM capacity (veh/h)	206	343	805	292	362	831	1328			1310		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	98	326	11	255	87	239
Volume Left	11	43	11	0	87	0
Volume Right	33	245	0	92	0	11
cSH	481	1108	1328	1700	1310	1700
Volume to Capacity	0.20	0.29	0.01	0.15	0.07	0.14
Queue Length 95th (ft)	19	31	1	0	5	0
Control Delay (s)	15.9	13.3	7.7	0.0	7.9	0.0
Lane LOS	C	B	A		A	
Approach Delay (s)	15.9	13.3	0.3		2.1	
Approach LOS	C	B				

Intersection Summary			
Average Delay	6.6		
Intersection Capacity Utilization	40.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	110	175	0	35	205	135	45	0	75	110	0	90
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	120	190	0	38	223	147	49	0	82	120	0	98
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	370			190			826	875	190	883	802	296
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	370			190			826	875	190	883	802	296
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	90			97			79	100	90	45	100	87
cM capacity (veh/h)	1189			1384			228	252	852	218	278	743

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	120	190	38	370	49	82	120	98
Volume Left	120	0	38	0	49	0	120	0
Volume Right	0	0	0	147	0	82	0	98
cSH	1189	1700	1384	1700	228	852	218	743
Volume to Capacity	0.10	0.11	0.03	0.22	0.21	0.10	0.55	0.13
Queue Length 95th (ft)	8	0	2	0	20	8	74	11
Control Delay (s)	8.4	0.0	7.7	0.0	25.0	9.7	40.0	10.6
Lane LOS	A		A		C	A	E	B
Approach Delay (s)	3.2		0.7		15.4		26.8	
Approach LOS					C		D	

Intersection Summary			
Average Delay	8.6		
Intersection Capacity Utilization	47.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	315	35	50	250	155	55
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	342	38	54	272	168	60
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				1270		
pX, platoon unblocked						
vC, conflicting volume			380		723	342
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			380		723	342
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			95		55	91
cM capacity (veh/h)			1178		375	700

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total	342	38	54	272	168	60
Volume Left	0	0	54	0	168	0
Volume Right	0	38	0	0	0	60
cSH	1700	1700	1178	1700	375	700
Volume to Capacity	0.20	0.02	0.05	0.16	0.45	0.09
Queue Length 95th (ft)	0	0	4	0	56	7
Control Delay (s)	0.0	0.0	8.2	0.0	22.2	10.6
Lane LOS			A		C	B
Approach Delay (s)	0.0		1.4		19.2	
Approach LOS					C	

Intersection Summary			
Average Delay	5.2		
Intersection Capacity Utilization	38.5%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	300	105	95	1005	940	270
Turn Type		Perm	Prot			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Detector Phase	4	4	5	2	6	6
Switch Phase						
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	30.0	30.0	10.0	30.0	30.0	30.0
Total Split (s)	31.0	31.0	19.0	69.0	50.0	50.0
Total Split (%)	31.0%	31.0%	19.0%	69.0%	50.0%	50.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	Lag
Lead-Lag Optimize?						
Recall Mode	None	None	None	None	None	None
Act Effct Green (s)	19.9	19.9	10.3	46.4	34.1	34.1
Actuated g/C Ratio	0.25	0.25	0.13	0.58	0.43	0.43
v/c Ratio	0.74	0.24	0.45	0.53	0.68	0.35
Control Delay	42.3	7.6	44.9	10.6	22.3	3.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	42.3	7.6	44.9	10.6	22.3	3.4
LOS	D	A	D	B	C	A
Approach Delay	33.3			13.5	18.1	
Approach LOS	C			B	B	

Intersection Summary	
Cycle Length: 100	
Actuated Cycle Length: 79.7	
Natural Cycle: 70	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.74	
Intersection Signal Delay: 18.5	Intersection LOS: B
Intersection Capacity Utilization 62.9%	ICU Level of Service B
Analysis Period (min) 15	

Splits and Phases: 105: Road C & Kuihelnai Hwy

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	300	105	95	1005	940	270
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	3539	3539	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	3539	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	326	114	103	1092	1022	293
RTOR Reduction (vph)	0	86	0	0	0	168
Lane Group Flow (vph)	326	28	103	1092	1022	125
Turn Type		Perm	Prot			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Actuated Green, G (s)	19.9	19.9	7.9	48.0	34.1	34.1
Effective Green, g (s)	19.9	19.9	7.9	48.0	34.1	34.1
Actuated g/C Ratio	0.25	0.25	0.10	0.60	0.43	0.43
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	441	394	175	2126	1510	676
v/s Ratio Prot	c0.18		0.06	c0.31	c0.29	
v/s Ratio Perm		0.02				0.08
v/c Ratio	0.74	0.07	0.59	0.51	0.68	0.18
Uniform Delay, d1	27.6	22.9	34.4	9.2	18.5	14.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	6.4	0.1	5.0	0.2	1.2	0.1
Delay (s)	34.0	23.0	39.4	9.4	19.7	14.4
Level of Service	C	C	D	A	B	B
Approach Delay (s)	31.2			12.0	18.5	
Approach LOS	C			B	B	

Intersection Summary			
HCM Average Control Delay	17.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	79.9	Sum of lost time (s)	18.0
Intersection Capacity Utilization	62.9%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	0	15	90	10	75	165
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	16	98	11	82	179
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	440	98			109	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	440	98			109	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	98			94	
cM capacity (veh/h)	543	958			1482	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	16	98	11	82	179
Volume Left	0	0	0	82	0
Volume Right	16	0	11	0	0
cSH	958	1700	1700	1482	1700
Volume to Capacity	0.02	0.06	0.01	0.06	0.11
Queue Length 95th (ft)	1	0	0	4	0
Control Delay (s)	8.8	0.0	0.0	7.6	0.0
Lane LOS	A			A	
Approach Delay (s)	8.8	0.0		2.4	
Approach LOS	A				

Intersection Summary			
Average Delay	2.0		
Intersection Capacity Utilization	20.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	15	0	80	10	0	20	20	150	10	15	200	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	16	0	87	11	0	22	22	163	11	16	217	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)			4			4						
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	467	467	217	505	462	168	217			174		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	467	467	217	505	462	168	217			174		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	97	100	89	97	100	98	98			99		
cM capacity (veh/h)	483	480	822	418	483	876	1352			1403		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	103	33	22	174	16	217
Volume Left	16	11	22	0	16	0
Volume Right	87	22	0	11	0	0
cSH	977	1253	1352	1700	1403	1700
Volume to Capacity	0.11	0.03	0.02	0.10	0.01	0.13
Queue Length 95th (ft)	9	2	1	0	1	0
Control Delay (s)	10.3	10.8	7.7	0.0	7.6	0.0
Lane LOS	B	B	A		A	
Approach Delay (s)	10.3	10.8	0.9		0.5	
Approach LOS	B	B				

Intersection Summary			
Average Delay	3.0		
Intersection Capacity Utilization	30.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	20	15	10	80	105	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	22	16	11	87	114	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	223	114	114			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	223	114	114			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	97	98	99			
cM capacity (veh/h)	760	938	1475			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	38	11	87	114	0
Volume Left	22	11	0	0	0
Volume Right	16	0	0	0	0
cSH	827	1475	1700	1700	1700
Volume to Capacity	0.05	0.01	0.05	0.07	0.00
Queue Length 95th (ft)	4	1	0	0	0
Control Delay (s)	9.6	7.5	0.0	0.0	0.0
Lane LOS	A	A			
Approach Delay (s)	9.6	0.8		0.0	
Approach LOS	A				

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	17.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	20	710	20	10	475	15	25	0	30	5	0	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	22	772	22	11	516	16	27	0	33	5	0	5
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		844										
pX, platoon unblocked				0.97			0.97	0.97	0.97	0.97	0.97	
vC, conflicting volume	533			793			1370	1380	783	1394	1383	524
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	533			770			1365	1376	759	1391	1379	524
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	98			99			77	100	92	95	100	99
cM capacity (veh/h)	1035			817			116	136	393	103	135	553

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1
Volume Total	22	793	11	533	27	33	11
Volume Left	22	0	11	0	27	0	5
Volume Right	0	22	0	16	0	33	5
cSH	1035	1700	817	1700	116	393	174
Volume to Capacity	0.02	0.47	0.01	0.31	0.23	0.08	0.06
Queue Length 95th (ft)	2	0	1	0	21	7	5
Control Delay (s)	8.6	0.0	9.5	0.0	45.2	15.0	27.0
Lane LOS	A		A		E	B	D
Approach Delay (s)	0.2		0.2		28.7		27.0
Approach LOS					D		D

Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	50.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	80	655	315	85	40	150
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	87	712	342	92	43	163
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						4
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	435				1228	342
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	435				1228	342
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	92				76	77
cM capacity (veh/h)	1125				181	700

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1
Volume Total	87	712	342	92	207
Volume Left	87	0	0	0	43
Volume Right	0	0	0	92	163
cSH	1125	1700	1700	1700	862
Volume to Capacity	0.08	0.42	0.20	0.05	0.24
Queue Length 95th (ft)	6	0	0	0	23
Control Delay (s)	8.5	0.0	0.0	0.0	15.8
Lane LOS	A				C
Approach Delay (s)	0.9		0.0		15.8
Approach LOS					C

Intersection Summary			
Average Delay	2.8		
Intersection Capacity Utilization	44.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	65	610	25	10	310	50	35	65	5	165	55	60
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	71	663	27	11	337	54	38	71	5	179	60	65
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	391			690			1272	1231	677	1231	1217	364
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	391			690			1272	1231	677	1231	1217	364
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	94			99			58	57	99	0	64	90
cM capacity (veh/h)	1167			904			90	165	453	96	168	681

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	71	690	11	391	38	76	179	125
Volume Left	71	0	11	0	38	0	179	0
Volume Right	0	27	0	54	0	5	0	65
cSH	1167	1700	904	1700	90	172	96	276
Volume to Capacity	0.06	0.41	0.01	0.23	0.42	0.44	1.87	0.45
Queue Length 95th (ft)	5	0	1	0	44	51	373	55
Control Delay (s)	8.3	0.0	9.0	0.0	72.0	41.4	500.8	28.4
Lane LOS	A		A		F	E	F	D
Approach Delay (s)	0.8		0.2		51.6		306.8	
Approach LOS					F		F	

Intersection Summary			
Average Delay	63.2		
Intersection Capacity Utilization	62.8%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	750	25	15	315	45	15
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	815	27	16	342	49	16
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						4
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			842		1190	815
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			842		1190	815
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			98		76	96
cM capacity (veh/h)			793		203	377

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	815	27	16	342	65
Volume Left	0	0	16	0	49
Volume Right	0	27	0	0	16
cSH	1700	1700	793	1700	271
Volume to Capacity	0.48	0.02	0.02	0.20	0.24
Queue Length 95th (ft)	0	0	2	0	23
Control Delay (s)	0.0	0.0	9.6	0.0	24.9
Lane LOS			A		C
Approach Delay (s)	0.0		0.4		24.9
Approach LOS					C

Intersection Summary			
Average Delay	1.4		
Intersection Capacity Utilization	49.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	10	740	15	10	315	55	10	30	15	140	5	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	804	16	11	342	60	11	33	16	152	5	5
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					727							
pX, platoon unblocked												
vC, conflicting volume	402			821			1207	1258	812	1253	1236	372
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	402			821			1207	1258	812	1253	1236	372
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			99			93	80	96	0	97	99
cM capacity (veh/h)	1156			808			152	167	379	119	172	674

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	11	821	11	402	11	49	152	11
Volume Left	11	0	11	0	11	0	152	0
Volume Right	0	16	0	60	0	16	0	5
cSH	1156	1700	808	1700	152	205	119	274
Volume to Capacity	0.01	0.48	0.01	0.24	0.07	0.24	1.28	0.04
Queue Length 95th (ft)	1	0	1	0	6	22	247	3
Control Delay (s)	8.1	0.0	9.5	0.0	30.4	28.0	243.6	18.7
Lane LOS	A		A		D	D	F	C
Approach Delay (s)	0.1		0.3		28.4		228.6	
Approach LOS					D		F	

Intersection Summary			
Average Delay	26.7		
Intersection Capacity Utilization	60.9%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	EBT	EBR	NBL	NBT	SBT	SBR	ø1	ø8
Lane Configurations								
Volume (vph)	0	175	75	715	1100	55		
Turn Type		Perm	Prot			Perm		
Protected Phases	4		5	2	6		1	8
Permitted Phases		4				6		
Detector Phase	4	4	5	2	6	6		
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	10.0	10.0	8.0	10.0	30.0	30.0	8.0	10.0
Total Split (s)	28.0	28.0	12.0	44.0	40.0	40.0	8.0	10.0
Total Split (%)	31.1%	31.1%	13.3%	48.9%	44.4%	44.4%	9%	11%
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	3.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	1.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0		
Total Lost Time (s)	6.0	6.0	4.0	6.0	6.0	6.0		
Lead/Lag			Lead	Lag	Lag	Lag	Lead	
Lead-Lag Optimize?								
Recall Mode	None	None	None	C-Max	C-Max	C-Max	None	None
Act Effct Green (s)	8.5	8.5	7.6	69.5	59.9	59.9		
Actuated g/C Ratio	0.09	0.09	0.08	0.77	0.67	0.67		
v/c Ratio	0.33	0.59	0.55	0.28	0.51	0.06		
Control Delay	42.3	13.9	53.8	3.5	5.7	0.9		
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		
Total Delay	42.3	13.9	53.8	3.5	5.7	0.9		
LOS	D	B	D	A	A	A		
Approach Delay	20.2			8.3	5.5			
Approach LOS	C			A	A			

Intersection Summary	
Cycle Length: 90	
Actuated Cycle Length: 90	
Offset: 88 (98%), Referenced to phase 2:NBT and 6:SBT, Start of Green	
Natural Cycle: 60	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.59	
Intersection Signal Delay: 8.0	Intersection LOS: A
Intersection Capacity Utilization 51.2%	ICU Level of Service A
Analysis Period (min) 15	

Splits and Phases: 114: Kuihelani Highway &

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	50	0	175	0	0	0	75	715	0	0	1100	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0				4.0	6.0			6.0	6.0
Lane Util. Factor		1.00	1.00				1.00	0.95			0.95	1.00
Frt		1.00	0.85				1.00	1.00			1.00	0.85
Flt Protected		0.95	1.00				0.95	1.00			1.00	1.00
Satd. Flow (prot)		1770	1583				1770	3539			3539	1583
Flt Permitted		0.95	1.00				0.95	1.00			1.00	1.00
Satd. Flow (perm)		1770	1583				1770	3539			3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	54	0	190	0	0	0	82	777	0	0	1196	60
RTOR Reduction (vph)	0	0	172	0	0	0	0	0	0	0	0	21
Lane Group Flow (vph)	0	54	18	0	0	0	82	777	0	0	1196	39
Turn Type	Split		Perm	Split			Prot			Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			4									6
Actuated Green, G (s)		8.5	8.5				6.4	69.5			59.1	59.1
Effective Green, g (s)		8.5	8.5				6.4	69.5			59.1	59.1
Actuated g/C Ratio		0.09	0.09				0.07	0.77			0.66	0.66
Clearance Time (s)		6.0	6.0				4.0	6.0			6.0	6.0
Vehicle Extension (s)		3.0	3.0				3.0	3.0			3.0	3.0
Lane Grp Cap (vph)		167	150				126	2733			2324	1040
v/s Ratio Prot		c0.03					c0.05	0.22			c0.34	
v/s Ratio Perm			0.01									0.02
v/c Ratio		0.32	0.12				0.65	0.28			0.51	0.04
Uniform Delay, d1		38.1	37.3				40.7	3.0			8.0	5.4
Progression Factor		1.00	1.00				1.00	1.00			0.58	0.40
Incremental Delay, d2		1.1	0.4				11.4	0.3			0.7	0.1
Delay (s)		39.2	37.7				52.1	3.3			5.3	2.2
Level of Service		D	D				D	A			A	A
Approach Delay (s)		38.0			0.0			7.9			5.2	
Approach LOS		D			A			A			A	

Intersection Summary			
HCM Average Control Delay	9.6	HCM Level of Service	A
HCM Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	51.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

APPENDIX C

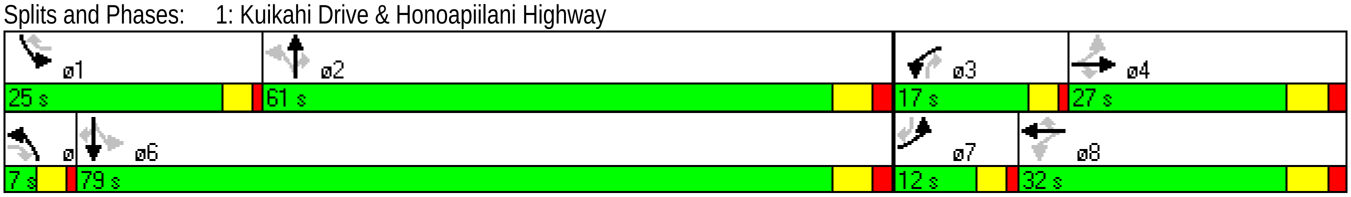
LEVEL OF SERVICE CALCULATIONS

- Year 2022 with Project Traffic PM

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	25	100	25	240	190	135	35	645	135	335	920	45
Turn Type	pm+pt		custom	pm+pt		custom	pm+pt		custom	pm+pt		custom
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4 5	8		8 1	2		2 3	6		6 7
Detector Phase	7	4	4 5	3	8	8 1	5	2	2 3	1	6	6 7
Switch Phase												
Minimum Initial (s)	4.0	6.0		4.0	6.0		3.0	10.0		3.0	10.0	
Minimum Split (s)	8.0	23.0		8.0	27.0		7.0	27.0		7.0	27.0	
Total Split (s)	12.0	27.0	34.0	17.0	32.0	57.0	7.0	61.0	78.0	25.0	79.0	91.0
Total Split (%)	9.2%	20.8%	26.2%	13.1%	24.6%	43.8%	5.4%	46.9%	60.0%	19.2%	60.8%	70.0%
Yellow Time (s)	3.0	4.0		3.0	4.0		3.0	4.0		3.0	4.0	
All-Red Time (s)	1.0	2.0		1.0	2.0		1.0	2.0		1.0	2.0	
Lost Time Adjust (s)	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 Lost Time (s)	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes			Yes								
Recall Mode	None	None		None	None		None	None		None	None	
Act Effct Green (s)	21.2	12.4	19.5	31.4	20.9	46.1	56.0	51.0	67.9	78.2	70.9	81.7
Actuated g/C Ratio	0.18	0.11	0.17	0.27	0.18	0.39	0.48	0.43	0.58	0.66	0.60	0.69
v/c Ratio	0.11	0.54	0.09	0.77	0.63	0.21	0.31	0.87	0.15	0.88	0.89	0.04
Control Delay	34.3	61.1	15.1	54.6	56.2	4.8	17.0	43.7	3.9	50.6	33.2	3.3
Queue Delay	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 Delay	34.3	61.1	15.1	54.6	56.2	4.8	17.0	43.7	3.9	50.6	33.2	3.3
LOS	C	E	B	D	E	A	B	D	A	D	C	A
Approach Delay		49.0			43.2			35.9			36.6	
Approach LOS		D			D			D			D	

Intersection Summary	
Cycle Length: 130	
Actuated Cycle Length: 117.7	
Natural Cycle: 100	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.89	
Intersection Signal Delay: 38.4	Intersection LOS: D
Intersection Capacity Utilization 86.6%	ICU Level of Service E
Analysis Period (min) 15	

Splits and Phases: 1: Kuikahi Drive & Honoapiilani Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	25	100	25	240	190	135	35	645	135	335	920	45
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-5%			0%			0%			0%	
Total Lost time (s)	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1814	1909	1623	1770	1863	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.63	1.00	1.00	0.50	1.00	1.00	0.09	1.00	1.00	0.11	1.00	1.00
Satd. Flow (perm)	1199	1909	1623	923	1863	1583	174	1863	1583	198	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	27	109	27	261	207	147	38	701	147	364	1000	49
RTOR Reduction (vph)	0	0	22	0	0	88	0	0	48	0	0	11
Lane Group Flow (vph)	27	109	5	261	207	59	38	701	99	364	1000	38
Turn Type	pm+pt		custom	pm+pt		custom	pm+pt		custom	pm+pt		custom
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4 5	8		8 1	2		2 3	6		6 7
Actuated Green, G (s)	18.8	13.4	21.7	30.3	20.9	48.1	54.3	52.0	70.9	77.2	70.9	82.3
Effective Green, g (s)	18.8	13.4	21.7	30.3	20.9	48.1	54.3	52.0	70.9	77.2	70.9	82.3
Actuated g/C Ratio	0.16	0.11	0.18	0.25	0.17	0.40	0.45	0.44	0.59	0.65	0.59	0.69
Clearance Time (s)	4.0	6.0		4.0	6.0		4.0	6.0		4.0	6.0	
Vehicle Extension (s)	3.0	2.0		3.0	2.0		2.0	5.0		2.0	5.0	
Lane Grp Cap (vph)	216	214	295	325	326	637	110	811	939	407	1105	1090
v/s Ratio Prot	0.01	0.06		c0.09	0.11		0.01	0.38		c0.16	c0.54	
v/s Ratio Perm	0.01		0.00	c0.12		0.04	0.15		0.06	0.42		0.02
v/c Ratio	0.12	0.51	0.02	0.80	0.63	0.09	0.35	0.86	0.11	0.89	0.90	0.03
Uniform Delay, d1	43.1	50.0	40.1	40.0	45.8	22.2	23.9	30.6	10.5	32.7	21.3	5.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.3	0.7	0.0	13.3	3.0	0.0	0.7	10.3	0.1	20.9	11.1	0.0
Delay (s)	43.3	50.7	40.1	53.3	48.7	22.2	24.6	40.9	10.6	53.6	32.4	6.0
Level of Service	D	D	D	D	D	C	C	D	B	D	C	A
Approach Delay (s)		47.7			44.3			35.2			37.0	
Approach LOS		D			D			D			D	

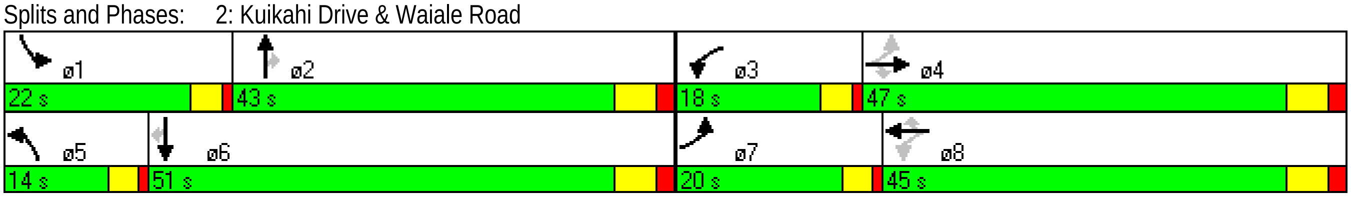
Intersection Summary			
HCM Average Control Delay	38.5	HCM Level of Service	D
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	119.5	Sum of lost time (s)	8.0
Intersection Capacity Utilization	86.6%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	175	375	40	295	265	405	25	465	270	455	470	270
Turn Type	pm+pt		Perm	pm+pt		Perm	Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	30.0	30.0	8.0	30.0	30.0	8.0	30.0	30.0	8.0	30.0	30.0
Total Split (s)	20.0	47.0	47.0	18.0	45.0	45.0	14.0	43.0	43.0	22.0	51.0	51.0
Total Split (%)	15.4%	36.2%	36.2%	13.8%	34.6%	34.6%	10.8%	33.1%	33.1%	16.9%	39.2%	39.2%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	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 Lost Time (s)	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?												
Recall Mode	None	None	None	None	None	None	None	None	None	None	None	None
Act Effct Green (s)	46.4	31.1	31.1	48.0	32.0	32.0	7.4	35.9	35.9	18.1	50.9	50.9
Actuated g/C Ratio	0.39	0.26	0.26	0.40	0.27	0.27	0.06	0.30	0.30	0.15	0.43	0.43
v/c Ratio	0.47	0.84	0.10	1.06	0.58	0.62	0.25	0.90	0.45	0.95	0.64	0.35
Control Delay	25.8	57.6	20.1	96.5	43.3	10.2	61.3	61.7	9.6	80.1	34.8	6.0
Queue Delay	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 Delay	25.8	57.6	20.1	96.5	43.3	10.2	61.3	61.7	9.6	80.1	34.8	6.0
LOS	C	E	C	F	D	B	E	E	A	F	C	A
Approach Delay		45.7			45.7			43.2			45.6	
Approach LOS		D			D			D			D	

Intersection Summary	
Cycle Length: 130	
Actuated Cycle Length: 119.3	
Natural Cycle: 90	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 1.06	
Intersection Signal Delay: 45.1	Intersection LOS: D
Intersection Capacity Utilization 90.2%	ICU Level of Service E
Analysis Period (min) 15	

Splits and Phases: 2: Kuikahi Drive & Waiale Road



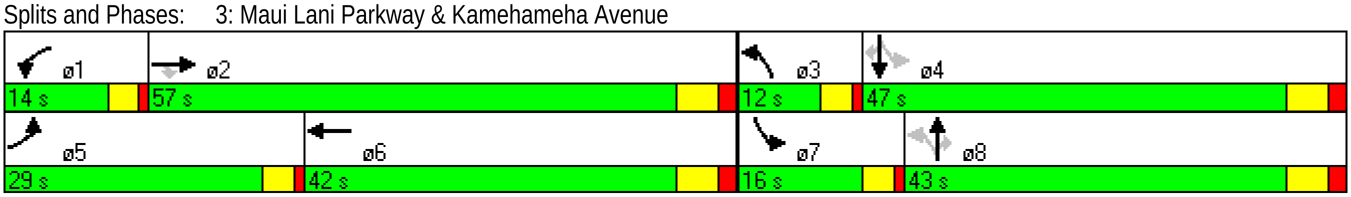
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	175	375	40	295	265	405	25	465	270	455	470	270
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1863	1583	3433	1863	1583
Flt Permitted	0.40	1.00	1.00	0.18	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	737	1863	1583	330	1863	1583	1770	1863	1583	3433	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	190	408	43	321	288	440	27	505	293	495	511	293
RTOR Reduction (vph)	0	0	16	0	0	284	0	0	170	0	0	155
Lane Group Flow (vph)	190	408	27	321	288	156	27	505	123	495	511	138
Turn Type	pm+pt		Perm	pm+pt		Perm	Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)	44.4	31.2	31.2	46.2	32.1	32.1	4.8	37.6	37.6	18.1	50.9	50.9
Effective Green, g (s)	44.4	31.2	31.2	46.2	32.1	32.1	4.8	37.6	37.6	18.1	50.9	50.9
Actuated g/C Ratio	0.37	0.26	0.26	0.38	0.27	0.27	0.04	0.31	0.31	0.15	0.42	0.42
Clearance Time (s)	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	383	480	408	294	494	420	70	579	492	514	784	666
v/s Ratio Prot	0.05	0.22		c0.13	0.15		0.02	c0.27		c0.14	0.27	
v/s Ratio Perm	0.13		0.02	c0.29		0.10			0.08			0.09
v/c Ratio	0.50	0.85	0.07	1.09	0.58	0.37	0.39	0.87	0.25	0.96	0.65	0.21
Uniform Delay, d1	27.7	42.7	33.9	31.4	38.6	36.2	56.7	39.4	31.2	51.1	28.0	22.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.0	13.2	0.1	79.3	1.8	0.6	3.5	13.6	0.3	30.3	2.0	0.2
Delay (s)	28.7	55.9	34.0	110.7	40.4	36.8	60.2	53.0	31.4	81.4	29.9	22.4
Level of Service	C	E	C	F	D	D	E	D	C	F	C	C
Approach Delay (s)		46.4			60.4			45.6			47.8	
Approach LOS		D			E			D			D	

Intersection Summary			
HCM Average Control Delay	50.6	HCM Level of Service	D
HCM Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	121.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	90.2%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											
Volume (vph)	520	645	320	120	685	170	485	70	215	460	450
Turn Type	Prot		Perm	Prot		pm+pt		Perm	pm+pt		Perm
Protected Phases	5	2		1	6	3	8		7	4	
Permitted Phases			2			8		8	4		4
Detector Phase	5	2	2	1	6	3	8	8	7	4	4
Switch Phase											
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	30.0	30.0	8.0	30.0	8.0	34.0	34.0	8.0	34.0	34.0
Total Split (s)	29.0	57.0	57.0	14.0	42.0	12.0	43.0	43.0	16.0	47.0	47.0
Total Split (%)	22.3%	43.8%	43.8%	10.8%	32.3%	9.2%	33.1%	33.1%	12.3%	36.2%	36.2%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	2.0	2.0	1.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	6.0	4.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?											
Recall Mode	None	None	None	None	None	None	None	None	None	None	None
Act Effct Green (s)	24.0	50.2	50.2	10.0	36.2	47.0	37.0	37.0	55.0	41.0	41.0
Actuated g/C Ratio	0.19	0.39	0.39	0.08	0.28	0.36	0.29	0.29	0.43	0.32	0.32
v/c Ratio	0.89	0.97	0.51	0.95	1.15	0.90	0.99	0.16	1.04	0.84	0.77
Control Delay	68.0	65.6	22.6	124.0	118.4	71.1	82.3	23.9	102.7	55.9	32.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	68.0	65.6	22.6	124.0	118.4	71.1	82.3	23.9	102.7	55.9	32.3
LOS	E	E	C	F	F	E	F	C	F	E	C
Approach Delay		57.2			118.9		74.0			55.4	
Approach LOS		E			F		E			E	

Intersection Summary	
Cycle Length: 130	
Actuated Cycle Length: 129.2	
Natural Cycle: 120	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 1.15	
Intersection Signal Delay: 75.5	Intersection LOS: E
Intersection Capacity Utilization 99.6%	ICU Level of Service F
Analysis Period (min) 15	

Splits and Phases: 3: Maui Lani Parkway & Kamehameha Avenue



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	520	645	320	120	685	365	170	485	70	215	460	450
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0	6.0	4.0	6.0		4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	0.97	1.00	1.00	1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.95		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	1863	1583	1770	3355		1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.17	1.00	1.00	0.10	1.00	1.00
Satd. Flow (perm)	3433	1863	1583	1770	3355		316	1863	1583	182	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	565	701	348	130	745	397	185	527	76	234	500	489
RTOR Reduction (vph)	0	0	69	0	54	0	0	0	20	0	0	135
Lane Group Flow (vph)	565	701	279	130	1088	0	185	527	56	234	500	354
Turn Type	Prot		Perm	Prot			pm+pt		Perm	pm+pt		Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases			2				8		8	4		4
Actuated Green, G (s)	24.0	50.2	50.2	10.0	36.2		45.0	37.0	37.0	53.0	41.0	41.0
Effective Green, g (s)	24.0	50.2	50.2	10.0	36.2		45.0	37.0	37.0	53.0	41.0	41.0
Actuated g/C Ratio	0.19	0.39	0.39	0.08	0.28		0.35	0.29	0.29	0.41	0.32	0.32
Clearance Time (s)	4.0	6.0	6.0	4.0	6.0		4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	638	724	615	137	940		200	534	453	222	591	502
v/s Ratio Prot	c0.16	c0.38		0.07	c0.32		0.06	0.28		c0.10	0.27	
v/s Ratio Perm			0.18				0.26		0.04	c0.33		0.22
v/c Ratio	0.89	0.97	0.45	0.95	1.16		0.93	0.99	0.12	1.05	0.85	0.70
Uniform Delay, d1	51.3	38.7	29.3	59.3	46.5		37.2	45.9	34.1	36.6	41.2	38.8
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	13.9	25.5	0.5	60.6	82.9		42.7	35.2	0.1	75.4	10.8	4.5
Delay (s)	65.2	64.2	29.9	120.0	129.4		79.9	81.1	34.2	112.0	51.9	43.3
Level of Service	E	E	C	F	F		E	F	C	F	D	D
Approach Delay (s)		57.1			128.4			76.3			59.9	
Approach LOS		E			F			E			E	

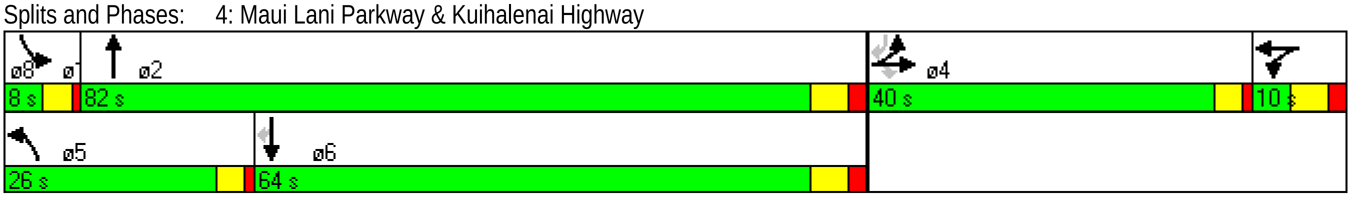
Intersection Summary			
HCM Average Control Delay	79.4	HCM Level of Service	E
HCM Volume to Capacity ratio	1.08		
Actuated Cycle Length (s)	129.2	Sum of lost time (s)	20.0
Intersection Capacity Utilization	99.6%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	NBL	NBT	SBT	SBR	ø1	ø8
Lane Configurations									
Volume (vph)	730	0	105	250	1310	1480	965		
Turn Type	Split		Perm	Prot			custom		
Protected Phases	4	4		5	2	6		1	8
Permitted Phases			4				6 4		
Detector Phase	4	4	4	5	2	6	6 4		
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0
Minimum Split (s)	8.0	8.0	8.0	8.0	10.0	27.0		8.0	10.0
Total Split (s)	40.0	40.0	40.0	26.0	82.0	64.0	104.0	8.0	10.0
Total Split (%)	28.6%	28.6%	28.6%	18.6%	58.6%	45.7%	74.3%	6%	7%
Yellow Time (s)	3.0	3.0	3.0	3.0	4.0	4.0		3.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	2.0	2.0		1.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Total Lost Time (s)	4.0	4.0	4.0	4.0	6.0	6.0	6.0		
Lead/Lag				Lead	Lag	Lag		Lead	
Lead-Lag Optimize?									
Recall Mode	None	None	None	None	None	None		None	None
Act Effct Green (s)	35.9	35.9	35.9	15.0	77.0	58.1	98.0		
Actuated g/C Ratio	0.29	0.29	0.29	0.12	0.63	0.47	0.80		
v/c Ratio	0.81	0.81	0.23	0.65	0.64	0.96	0.79		
Control Delay	54.7	54.9	20.7	59.1	16.0	46.9	10.8		
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Total Delay	54.7	54.9	20.7	59.1	16.0	46.9	10.8		
LOS	D	D	C	E	B	D	B		
Approach Delay		50.5			22.9	32.7			
Approach LOS		D			C	C			

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 123
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.96
Intersection Signal Delay: 32.6 Intersection LOS: C
Intersection Capacity Utilization 79.9% ICU Level of Service D
Analysis Period (min) 15

Splits and Phases: 4: Maui Lani Parkway & Kuihalenai Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	730	0	105	0	0	0	250	1310	0	0	1480	965
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0				4.0	6.0			6.0	6.0
Lane Util. Factor	0.95	0.95	1.00				0.97	0.95			0.95	1.00
Frt	1.00	1.00	0.85				1.00	1.00			1.00	0.85
Flt Protected	0.95	0.95	1.00				0.95	1.00			1.00	1.00
Satd. Flow (prot)	1681	1681	1583				3433	3539			3539	1583
Flt Permitted	0.95	0.95	1.00				0.95	1.00			1.00	1.00
Satd. Flow (perm)	1681	1681	1583				3433	3539			3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	793	0	114	0	0	0	272	1424	0	0	1609	1049
RTOR Reduction (vph)	0	0	35	0	0	0	0	0	0	0	0	54
Lane Group Flow (vph)	396	397	79	0	0	0	272	1424	0	0	1609	995
Turn Type	Split		Perm	Split			Prot			Prot		custom
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			4									6 4
Actuated Green, G (s)	35.9	35.9	35.9				15.0	77.0			58.0	99.9
Effective Green, g (s)	35.9	35.9	35.9				15.0	77.0			58.0	99.9
Actuated g/C Ratio	0.29	0.29	0.29				0.12	0.63			0.47	0.81
Clearance Time (s)	4.0	4.0	4.0				4.0	6.0			6.0	
Vehicle Extension (s)	3.0	3.0	3.0				3.0	3.0			3.0	
Lane Grp Cap (vph)	491	491	462				419	2217			1670	1287
v/s Ratio Prot	0.24	0.24					0.08	c0.40			c0.45	
v/s Ratio Perm			0.05									c0.63
v/c Ratio	0.81	0.81	0.17				0.65	0.64			0.96	0.77
Uniform Delay, d1	40.3	40.3	32.4				51.4	14.3			31.4	5.8
Progression Factor	1.00	1.00	1.00				1.00	1.00			1.00	1.00
Incremental Delay, d2	9.4	9.5	0.2				3.5	0.6			14.3	3.0
Delay (s)	49.7	49.8	32.6				54.9	15.0			45.7	8.7
Level of Service	D	D	C				D	B			D	A
Approach Delay (s)		47.6			0.0			21.4			31.1	
Approach LOS		D			A			C			C	

Intersection Summary			
HCM Average Control Delay	30.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	122.9	Sum of lost time (s)	12.0
Intersection Capacity Utilization	79.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations										
Volume (vph)	40	15	30	75	20	15	615	145	870	45
Turn Type	Perm		custom	Perm		pm+pt		pm+pt		Perm
Protected Phases		4			8	5	2	1	6	
Permitted Phases	4		4 5	8		2		6		6
Detector Phase	4	4	4 5	8	8	5	2	1	6	6
Switch Phase										
Minimum Initial (s)	6.0	6.0		6.0	6.0	3.0	10.0	3.0	10.0	10.0
Minimum Split (s)	23.0	23.0		27.0	27.0	7.0	31.0	7.0	26.0	26.0
Total Split (s)	27.0	27.0	34.0	27.0	27.0	7.0	60.0	13.0	66.0	66.0
Total Split (%)	27.0%	27.0%	34.0%	27.0%	27.0%	7.0%	60.0%	13.0%	66.0%	66.0%
Yellow Time (s)	4.0	4.0		4.0	4.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	6.0	4.0	6.0	6.0
Lead/Lag						Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?										
Recall Mode	None	None		None	None	None	C-Max	None	C-Max	C-Max
Act Effct Green (s)		15.9	22.9		15.9	67.0	62.0	75.1	68.9	68.9
Actuated g/C Ratio		0.16	0.23		0.16	0.67	0.62	0.75	0.69	0.69
v/c Ratio		0.29	0.08		0.81	0.06	0.76	0.45	0.74	0.05
Control Delay		38.6	9.6		57.9	5.3	20.8	8.4	16.8	4.9
Queue Delay		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		38.6	9.6		57.9	5.3	20.8	8.4	16.8	4.9
LOS		D	A		E	A	C	A	B	A
Approach Delay		28.2			57.9		20.5		15.2	
Approach LOS		C			E		C		B	

Intersection Summary

Cycle Length: 100
Actuated Cycle Length: 100
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.81
Intersection Signal Delay: 21.1 Intersection LOS: C
Intersection Capacity Utilization 81.2% ICU Level of Service D
Analysis Period (min) 15

Splits and Phases: 5: Waiko Road & Honoapiilani Highway

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	40	15	30	75	20	70	15	615	170	145	870	45
Ideal Flow (vphpl)	1900	1900	1900	1900	1600	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-8%			0%			0%			0%	
Total Lost time (s)		5.0	5.0		5.0		4.0	6.0		4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	0.97
Flpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt		1.00	0.85		0.94		1.00	0.97		1.00	1.00	0.85
Flt Protected		0.96	1.00		0.98		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1869	1647		1446		1770	1802		1770	1863	1539
Flt Permitted		0.65	1.00		0.83		0.19	1.00		0.18	1.00	1.00
Satd. Flow (perm)		1256	1647		1221		353	1802		330	1863	1539
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	43	16	33	82	22	76	16	668	185	158	946	49
RTOR Reduction (vph)	0	0	26	0	29	0	0	8	0	0	0	8
Lane Group Flow (vph)	0	59	7	0	151	0	16	845	0	158	946	41
Confl. Peds. (#/hr)							3					3
Turn Type	Perm		custom	Perm			pm+pt			pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 5	8			2			6		6
Actuated Green, G (s)		15.9	22.7		15.9		63.8	62.0		73.1	67.3	67.3
Effective Green, g (s)		15.9	22.7		15.9		63.8	62.0		73.1	67.3	67.3
Actuated g/C Ratio		0.16	0.23		0.16		0.64	0.62		0.73	0.67	0.67
Clearance Time (s)		5.0			5.0		4.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)		2.0			2.0		2.0	5.0		2.0	5.0	5.0
Lane Grp Cap (vph)		200	374		194		251	1117		343	1254	1036
v/s Ratio Prot							0.00	0.47		c0.03	c0.51	
v/s Ratio Perm		0.05	0.00		c0.12		0.04			0.30		0.03
v/c Ratio		0.29	0.02		0.78		0.06	0.76		0.46	0.75	0.04
Uniform Delay, d1		37.1	30.0		40.4		9.8	13.6		10.9	10.9	5.5
Progression Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2		0.3	0.0		16.9		0.0	4.8		0.4	4.2	0.1
Delay (s)		37.4	30.0		57.3		9.8	18.4		11.2	15.1	5.6
Level of Service		D	C		E		A	B		B	B	A
Approach Delay (s)		34.8			57.3			18.2			14.2	
Approach LOS		C			E			B			B	

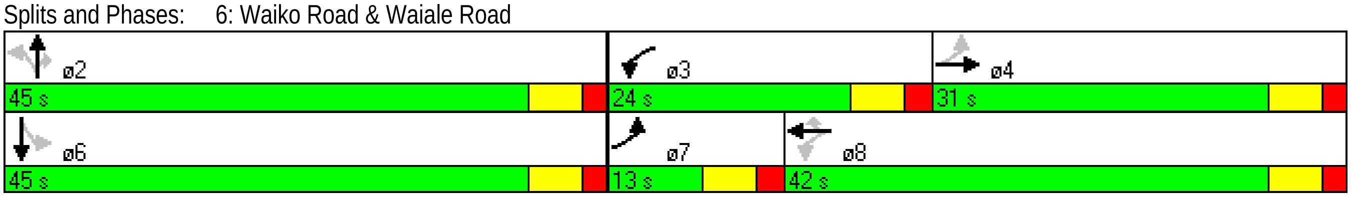
Intersection Summary			
HCM Average Control Delay	19.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	81.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations										
Volume (vph)	55	310	410	185	175	15	450	370	110	485
Turn Type	pm+pt		pm+pt		Perm	Perm		Perm	Perm	
Protected Phases	7	4	3	8			2			6
Permitted Phases	4		8		8	2		2	6	
Detector Phase	7	4	3	8	8	2	2	2	6	6
Switch Phase										
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	10.0	24.0	10.0	24.0	24.0	27.0	27.0	27.0	27.0	27.0
Total Split (s)	13.0	31.0	24.0	42.0	42.0	45.0	45.0	45.0	45.0	45.0
Total Split (%)	13.0%	31.0%	24.0%	42.0%	42.0%	45.0%	45.0%	45.0%	45.0%	45.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag					
Lead-Lag Optimize?										
Recall Mode	None	None	None	None	None	None	None	None	None	None
Act Effct Green (s)	27.7	21.1	45.5	35.8	35.8	32.7	32.7	32.7	32.7	32.7
Actuated g/C Ratio	0.31	0.23	0.50	0.40	0.40	0.36	0.36	0.36	0.36	0.36
v/c Ratio	0.15	0.82	0.92	0.27	0.26	0.15	0.73	0.48	0.72	0.85
Control Delay	15.6	49.6	45.8	22.6	4.4	24.2	32.2	4.3	51.5	40.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	15.6	49.6	45.8	22.6	4.4	24.2	32.2	4.3	51.5	40.1
LOS	B	D	D	C	A	C	C	A	D	D
Approach Delay		44.7		30.8			19.7			42.1
Approach LOS		D		C			B			D

Intersection Summary

Cycle Length: 100
Actuated Cycle Length: 90.5
Natural Cycle: 75
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.92
Intersection Signal Delay: 32.0 Intersection LOS: C
Intersection Capacity Utilization 91.2% ICU Level of Service F
Analysis Period (min) 15

Splits and Phases: 6: Waiko Road & Waiale Road



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	310	15	410	185	175	15	450	370	110	485	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1850		1770	1863	1583	1770	1863	1583	1770	1842	
Flt Permitted	0.63	1.00		0.23	1.00	1.00	0.16	1.00	1.00	0.25	1.00	
Satd. Flow (perm)	1177	1850		421	1863	1583	292	1863	1583	462	1842	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	60	337	16	446	201	190	16	489	402	120	527	43
RTOR Reduction (vph)	0	2	0	0	0	116	0	0	258	0	3	0
Lane Group Flow (vph)	60	351	0	446	201	74	16	489	144	120	567	0
Turn Type	pm+pt			pm+pt		Perm	Perm		Perm	Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)	27.8	22.6		46.9	35.7	35.7	32.7	32.7	32.7	32.7	32.7	
Effective Green, g (s)	27.8	22.6		46.9	35.7	35.7	32.7	32.7	32.7	32.7	32.7	
Actuated g/C Ratio	0.30	0.25		0.51	0.39	0.39	0.36	0.36	0.36	0.36	0.36	
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	391	456		485	726	617	104	665	565	165	658	
v/s Ratio Prot	0.01	0.19		c0.18	0.11			0.26			c0.31	
v/s Ratio Perm	0.04			c0.29		0.05	0.05		0.09	0.26		
v/c Ratio	0.15	0.77		0.92	0.28	0.12	0.15	0.74	0.25	0.73	0.86	
Uniform Delay, d1	23.0	32.1		18.3	19.1	17.9	20.0	25.7	20.8	25.6	27.3	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.2	7.9		22.4	0.2	0.1	0.7	4.2	0.2	14.8	11.2	
Delay (s)	23.2	40.0		40.8	19.3	18.0	20.7	29.9	21.1	40.3	38.5	
Level of Service	C	D		D	B	B	C	C	C	D	D	
Approach Delay (s)		37.5			30.5			25.8			38.8	
Approach LOS		D			C			C			D	

Intersection Summary			
HCM Average Control Delay	32.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	91.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	91.2%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	530	265	285	870	975	440
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Detector Phase	4	4 5	5	2	6	6 4
Switch Phase						
Minimum Initial (s)	6.0		4.0	10.0	10.0	
Minimum Split (s)	28.0		8.0	16.0	27.0	
Total Split (s)	32.0	45.0	13.0	58.0	45.0	77.0
Total Split (%)	35.6%	50.0%	14.4%	64.4%	50.0%	85.6%
Yellow Time (s)	3.0		3.0	4.0	4.0	
All-Red Time (s)	1.0		1.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?						
Recall Mode	None		None	C-Max	C-Max	
Act Effct Green (s)	28.0	41.0	9.0	52.0	39.0	71.0
Actuated g/C Ratio	0.31	0.46	0.10	0.58	0.43	0.79
v/c Ratio	1.05	0.39	1.75	0.46	0.69	0.35
Control Delay	83.0	15.6	385.3	9.1	23.6	3.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	83.0	15.6	385.3	9.1	23.6	3.5
LOS	F	B	F	A	C	A
Approach Delay	60.6			102.0	17.7	
Approach LOS	E			F	B	

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 90
Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.75
Intersection Signal Delay: 57.2 Intersection LOS: E
Intersection Capacity Utilization 83.8% ICU Level of Service E
Analysis Period (min) 15

Splits and Phases: 7: Waiko Road & Kuihelani Highway

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	530	265	285	870	975	440
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	3539	3539	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	3539	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	1.00
Adj. Flow (vph)	576	288	310	946	1060	440
RTOR Reduction (vph)	0	22	0	0	0	3
Lane Group Flow (vph)	576	266	310	946	1060	437
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Actuated Green, G (s)	28.0	41.0	9.0	52.0	39.0	73.0
Effective Green, g (s)	28.0	41.0	9.0	52.0	39.0	73.0
Actuated g/C Ratio	0.31	0.46	0.10	0.58	0.43	0.81
Clearance Time (s)	4.0		4.0	6.0	6.0	
Vehicle Extension (s)	2.0		2.0	5.0	5.0	
Lane Grp Cap (vph)	551	721	177	2045	1534	1284
v/s Ratio Prot	c0.33		c0.18	0.27	c0.30	
v/s Ratio Perm		0.17				0.28
v/c Ratio	1.05	0.37	1.75	0.46	0.69	0.34
Uniform Delay, d1	31.0	16.0	40.5	10.9	20.6	2.2
Progression Factor	1.00	1.00	0.91	0.76	1.00	1.00
Incremental Delay, d2	50.7	0.1	358.5	0.7	2.6	0.1
Delay (s)	81.7	16.1	395.4	9.0	23.2	2.3
Level of Service	F	B	F	A	C	A
Approach Delay (s)	59.9			104.4	17.1	
Approach LOS	E			F	B	

Intersection Summary			
HCM Average Control Delay	57.6	HCM Level of Service	E
HCM Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	83.8%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Configurations											
Volume (vph)	270	30	850	15	80	10	605	540	15	540	95
Turn Type	Perm		custom	Perm		Perm	Prot		Prot		Perm
Protected Phases		4			8		5	2	1	6	
Permitted Phases	4		4 5 2	8		8					6
Detector Phase	4	4	4 5 2	8	8	8	5	2	1	6	6
Switch Phase											
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	27.0	27.0		27.0	27.0	27.0	8.0	10.0	8.0	27.0	27.0
Total Split (s)	44.0	44.0	144.0	44.0	44.0	44.0	34.0	66.0	10.0	42.0	42.0
Total Split (%)	36.7%	36.7%	120.0%	36.7%	36.7%	36.7%	28.3%	55.0%	8.3%	35.0%	35.0%
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	1.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	4.0	6.0	4.0	6.0	6.0
Lead/Lag							Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?									Yes		
Recall Mode	None	None		None	None	None	None	None	None	None	None
Act Effct Green (s)		35.0	114.9		35.0	35.0	27.6	64.0	5.9	36.2	36.2
Actuated g/C Ratio		0.30	1.00		0.30	0.30	0.24	0.56	0.05	0.32	0.32
v/c Ratio		0.85	0.58		0.20	0.02	0.80	0.59	0.18	1.00	0.20
Control Delay		59.4	1.6		31.0	14.1	49.5	21.3	59.3	77.9	21.2
Queue Delay		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		59.4	1.6		31.0	14.1	49.5	21.3	59.3	77.9	21.2
LOS		E	A		C	B	D	C	E	E	C
Approach Delay		16.7			29.4			35.9		69.2	
Approach LOS		B			C			D		E	

Intersection Summary	
Cycle Length: 120	
Actuated Cycle Length: 114.9	
Natural Cycle: 90	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 1.00	
Intersection Signal Delay: 35.5	Intersection LOS: D
Intersection Capacity Utilization 101.1%	ICU Level of Service G
Analysis Period (min) 15	

Splits and Phases: 8: Kuikahi Dr & Maui Lani PArkway

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	270	30	850	15	80	10	605	540	20	15	540	95
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0		6.0	6.0	4.0	6.0		4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00	1.00	0.97	1.00		1.00	1.00	1.00
Frt		1.00	0.85		1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected		0.96	1.00		0.99	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1783	1583		1848	1583	3433	1853		1770	1863	1583
Flt Permitted		0.68	1.00		0.92	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)		1258	1583		1720	1583	3433	1853		1770	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	293	33	924	16	87	11	658	587	22	16	587	103
RTOR Reduction (vph)	0	0	0	0	0	8	0	1	0	0	0	25
Lane Group Flow (vph)	0	326	924	0	103	3	658	608	0	16	587	78
Turn Type	Perm		custom	Perm		Perm	Prot			Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 5 2	8		8						6
Actuated Green, G (s)		35.0	117.3		35.0	35.0	27.6	64.0		2.3	38.7	38.7
Effective Green, g (s)		35.0	117.3		35.0	35.0	27.6	64.0		2.3	38.7	38.7
Actuated g/C Ratio		0.30	1.00		0.30	0.30	0.24	0.55		0.02	0.33	0.33
Clearance Time (s)		6.0			6.0	6.0	4.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		375	1583		513	472	808	1011		35	615	522
v/s Ratio Prot							c0.19	0.33		0.01	c0.32	
v/s Ratio Perm		c0.26	c0.58		0.06	0.00						0.05
v/c Ratio		0.87	0.58		0.20	0.01	0.81	0.60		0.46	0.95	0.15
Uniform Delay, d1		39.0	0.0		30.7	28.9	42.4	18.0		56.9	38.4	27.7
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2		18.8	0.6		0.2	0.0	6.3	1.0		9.2	25.3	0.1
Delay (s)		57.8	0.6		30.9	28.9	48.7	19.0		66.1	63.7	27.8
Level of Service		E	A		C	C	D	B		E	E	C
Approach Delay (s)		15.5			30.7			34.5			58.5	
Approach LOS		B			C			C			E	

Intersection Summary			
HCM Average Control Delay	32.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	117.3	Sum of lost time (s)	12.0
Intersection Capacity Utilization	101.1%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	885	215	50	755	50	40
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	962	234	54	821	54	43
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						4
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				1078		
pX, platoon unblocked						
vC, conflicting volume			1196		1598	598
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1196		1598	598
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			91		38	90
cM capacity (veh/h)			580		88	446

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	641	554	54	410	410	98
Volume Left	0	0	54	0	0	54
Volume Right	0	234	0	0	0	43
cSH	1700	1700	580	1700	1700	158
Volume to Capacity	0.38	0.33	0.09	0.24	0.24	0.62
Queue Length 95th (ft)	0	0	8	0	0	84
Control Delay (s)	0.0	0.0	11.9	0.0	0.0	60.0
Lane LOS			B			F
Approach Delay (s)	0.0		0.7			60.0
Approach LOS						F

Intersection Summary			
Average Delay	3.0		
Intersection Capacity Utilization	48.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	20	60	135	40	120	150
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	22	65	147	43	130	163
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	571	147			190	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	571	147			190	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	95	93			91	
cM capacity (veh/h)	437	900			1384	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	87	147	43	130	163
Volume Left	22	0	0	130	0
Volume Right	65	0	43	0	0
cSH	712	1700	1700	1384	1700
Volume to Capacity	0.12	0.09	0.03	0.09	0.10
Queue Length 95th (ft)	10	0	0	8	0
Control Delay (s)	10.8	0.0	0.0	7.9	0.0
Lane LOS	B			A	
Approach Delay (s)	10.8	0.0		3.5	
Approach LOS	B				

Intersection Summary			
Average Delay	3.4		
Intersection Capacity Utilization	28.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	10	100	20	35	70	285	15	190	80	150	255	15
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	109	22	38	76	310	16	207	87	163	277	16
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)			4			4						
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1043	938	285	951	902	250	293			293		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1043	938	285	951	902	250	293			293		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	87	52	97	71	68	61	99			87		
cM capacity (veh/h)	85	228	754	131	239	789	1268			1268		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	141	424	16	293	163	293
Volume Left	11	38	16	0	163	0
Volume Right	22	310	0	87	0	16
cSH	254	753	1268	1700	1268	1700
Volume to Capacity	0.56	0.56	0.01	0.17	0.13	0.17
Queue Length 95th (ft)	77	89	1	0	11	0
Control Delay (s)	36.2	20.8	7.9	0.0	8.3	0.0
Lane LOS	E	C	A		A	
Approach Delay (s)	36.2	20.8	0.4		2.9	
Approach LOS	E	C				

Intersection Summary			
Average Delay	11.6		
Intersection Capacity Utilization	48.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	30	320	0	85	340	40	25	0	40	40	0	35
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	33	348	0	92	370	43	27	0	43	43	0	38
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	413			348			1005	1011	348	1033	989	391
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	413			348			1005	1011	348	1033	989	391
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			92			86	100	94	76	100	94
cM capacity (veh/h)	1146			1211			191	215	695	182	221	657

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	33	348	92	413	27	43	43	38
Volume Left	33	0	92	0	27	0	43	0
Volume Right	0	0	0	43	0	43	0	38
cSH	1146	1700	1211	1700	191	695	182	657
Volume to Capacity	0.03	0.20	0.08	0.24	0.14	0.06	0.24	0.06
Queue Length 95th (ft)	2	0	6	0	12	5	22	5
Control Delay (s)	8.2	0.0	8.2	0.0	27.0	10.5	30.9	10.8
Lane LOS	A		A		D	B	D	B
Approach Delay (s)	0.7		1.5		16.8		21.5	
Approach LOS					C		C	

Intersection Summary			
Average Delay	3.8		
Intersection Capacity Utilization	42.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	275	100	165	375	170	85
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	299	109	179	408	185	92
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				1270		
pX, platoon unblocked						
vC, conflicting volume			408		1065	299
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			408		1065	299
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			84		11	88
cM capacity (veh/h)			1151		208	741

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total	299	109	179	408	185	92
Volume Left	0	0	179	0	185	0
Volume Right	0	109	0	0	0	92
cSH	1700	1700	1151	1700	208	741
Volume to Capacity	0.18	0.06	0.16	0.24	0.89	0.12
Queue Length 95th (ft)	0	0	14	0	175	11
Control Delay (s)	0.0	0.0	8.7	0.0	84.1	10.6
Lane LOS			A		F	B
Approach Delay (s)	0.0		2.7		59.6	
Approach LOS					F	

Intersection Summary			
Average Delay	14.2		
Intersection Capacity Utilization	43.0%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	340	195	170	1230	1265	375
Turn Type		Perm	Prot			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Detector Phase	4	4	5	2	6	6
Switch Phase						
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	30.0	30.0	10.0	30.0	30.0	30.0
Total Split (s)	31.0	31.0	23.0	69.0	46.0	46.0
Total Split (%)	31.0%	31.0%	23.0%	69.0%	46.0%	46.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	Lag
Lead-Lag Optimize?						
Recall Mode	None	None	None	None	None	None
Act Effct Green (s)	22.7	22.7	14.1	60.3	40.2	40.2
Actuated g/C Ratio	0.24	0.24	0.15	0.63	0.42	0.42
v/c Ratio	0.87	0.39	0.70	0.60	0.92	0.45
Control Delay	57.6	6.7	53.9	11.9	38.4	3.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	57.6	6.7	53.9	11.9	38.4	3.8
LOS	E	A	D	B	D	A
Approach Delay	39.1			17.0	30.5	
Approach LOS	D			B	C	

Intersection Summary	
Cycle Length: 100	
Actuated Cycle Length: 95.1	
Natural Cycle: 90	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.92	
Intersection Signal Delay: 26.5	Intersection LOS: C
Intersection Capacity Utilization 78.2%	ICU Level of Service D
Analysis Period (min) 15	

Splits and Phases: 105: Road C & Kuihelnai Hwy

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	340	195	170	1230	1265	375
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	3539	3539	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	3539	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	370	212	185	1337	1375	408
RTOR Reduction (vph)	0	161	0	0	0	235
Lane Group Flow (vph)	370	51	185	1337	1375	173
Turn Type		Perm	Prot			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Actuated Green, G (s)	22.7	22.7	14.1	60.3	40.2	40.2
Effective Green, g (s)	22.7	22.7	14.1	60.3	40.2	40.2
Actuated g/C Ratio	0.24	0.24	0.15	0.63	0.42	0.42
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	423	378	263	2246	1498	670
v/s Ratio Prot	c0.21		0.10	c0.38	c0.39	
v/s Ratio Perm		0.03				0.11
v/c Ratio	0.87	0.13	0.70	0.60	0.92	0.26
Uniform Delay, d1	34.8	28.4	38.5	10.2	25.8	17.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	17.9	0.2	8.3	0.4	9.2	0.2
Delay (s)	52.6	28.6	46.7	10.6	35.0	17.9
Level of Service	D	C	D	B	D	B
Approach Delay (s)	43.9			15.0	31.1	
Approach LOS	D			B	C	

Intersection Summary			
HCM Average Control Delay	26.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	78.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	10	15	175	15	60	115
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	16	190	16	65	125
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	446	190			207	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	446	190			207	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	98	98			95	
cM capacity (veh/h)	543	852			1365	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	27	190	16	65	125
Volume Left	11	0	0	65	0
Volume Right	16	0	16	0	0
cSH	694	1700	1700	1365	1700
Volume to Capacity	0.04	0.11	0.01	0.05	0.07
Queue Length 95th (ft)	3	0	0	4	0
Control Delay (s)	10.4	0.0	0.0	7.8	0.0
Lane LOS	B			A	
Approach Delay (s)	10.4	0.0		2.7	
Approach LOS	B				

Intersection Summary			
Average Delay	1.9		
Intersection Capacity Utilization	25.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	45	25	50	10	40	40	35	180	25	30	260	10
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	49	27	54	11	43	43	38	196	27	33	283	11
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)			4			4						
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	668	652	288	674	644	209	293			223		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	668	652	288	674	644	209	293			223		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	84	93	93	96	88	95	97			98		
cM capacity (veh/h)	308	366	751	309	370	831	1268			1346		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	130	98	38	223	33	293
Volume Left	49	11	38	0	33	0
Volume Right	54	43	0	27	0	11
cSH	563	645	1268	1700	1346	1700
Volume to Capacity	0.23	0.15	0.03	0.13	0.02	0.17
Queue Length 95th (ft)	22	13	2	0	2	0
Control Delay (s)	15.5	13.6	7.9	0.0	7.7	0.0
Lane LOS	C	B	A		A	
Approach Delay (s)	15.5	13.6	1.2		0.8	
Approach LOS	C	B				

Intersection Summary			
Average Delay	4.8		
Intersection Capacity Utilization	38.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	30	15	30	185	90	20
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	33	16	33	201	98	22
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	364	98	120			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	364	98	120			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	95	98	98			
cM capacity (veh/h)	621	958	1468			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	49	33	201	98	22
Volume Left	33	33	0	0	0
Volume Right	16	0	0	0	22
cSH	704	1468	1700	1700	1700
Volume to Capacity	0.07	0.02	0.12	0.06	0.01
Queue Length 95th (ft)	6	2	0	0	0
Control Delay (s)	10.5	7.5	0.0	0.0	0.0
Lane LOS	B	A			
Approach Delay (s)	10.5	1.0		0.0	
Approach LOS	B				

Intersection Summary			
Average Delay	1.9		
Intersection Capacity Utilization	19.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	5	735	45	25	695	5	15	0	25	20	0	15
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	799	49	27	755	5	16	0	27	22	0	16
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		844										
pX, platoon unblocked				0.87			0.87	0.87	0.87	0.87	0.87	
vC, conflicting volume	761			848			1660	1649	823	1649	1671	758
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	761			752			1684	1672	724	1672	1696	758
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			96			73	100	93	63	100	96
cM capacity (veh/h)	851			748			60	80	371	60	77	407

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1
Volume Total	5	848	27	761	16	27	38
Volume Left	5	0	27	0	16	0	22
Volume Right	0	49	0	5	0	27	16
cSH	851	1700	748	1700	60	371	94
Volume to Capacity	0.01	0.50	0.04	0.45	0.27	0.07	0.41
Queue Length 95th (ft)	0	0	3	0	24	6	41
Control Delay (s)	9.3	0.0	10.0	0.0	85.3	15.5	67.4
Lane LOS	A		A		F	C	F
Approach Delay (s)	0.1		0.3		41.7		67.4
Approach LOS					E		F

Intersection Summary			
Average Delay	2.7		
Intersection Capacity Utilization	56.8%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	90	665	550	80	60	135
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	98	723	598	87	65	147
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						4
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	685				1516	598
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	685				1516	598
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	89				44	71
cM capacity (veh/h)	909				117	502

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1
Volume Total	98	723	598	87	212
Volume Left	98	0	0	0	65
Volume Right	0	0	0	87	147
cSH	909	1700	1700	1700	381
Volume to Capacity	0.11	0.43	0.35	0.05	0.56
Queue Length 95th (ft)	9	0	0	0	82
Control Delay (s)	9.4	0.0	0.0	0.0	31.6
Lane LOS	A				D
Approach Delay (s)	1.1		0.0		31.6
Approach LOS					D

Intersection Summary			
Average Delay	4.4		
Intersection Capacity Utilization	47.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	25	635	65	20	510	130	20	70	5	145	70	110
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	27	690	71	22	554	141	22	76	5	158	76	120
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	696			761			1535	1519	726	1457	1484	625
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	696			761			1535	1519	726	1457	1484	625
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			97			35	32	99	0	36	75
cM capacity (veh/h)	900			851			33	112	425	46	118	485

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	27	761	22	696	22	82	158	196
Volume Left	27	0	22	0	22	0	158	0
Volume Right	0	71	0	141	0	5	0	120
cSH	900	1700	851	1700	33	118	46	219
Volume to Capacity	0.03	0.45	0.03	0.41	0.65	0.69	3.39	0.89
Queue Length 95th (ft)	2	0	2	0	56	92	Err	180
Control Delay (s)	9.1	0.0	9.3	0.0	230.3	85.5	Err	81.7
Lane LOS	A		A		F	F	F	F
Approach Delay (s)	0.3		0.3		116.0		4506.4	
Approach LOS					F		F	

Intersection Summary			
Average Delay	817.7		
Intersection Capacity Utilization	60.6%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	730	50	25	595	40	25
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	793	54	27	647	43	27
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						4
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			848		1495	793
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			848		1495	793
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			97		67	93
cM capacity (veh/h)			790		131	388

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	793	54	27	647	71
Volume Left	0	0	27	0	43
Volume Right	0	54	0	0	27
cSH	1700	1700	790	1700	212
Volume to Capacity	0.47	0.03	0.03	0.38	0.33
Queue Length 95th (ft)	0	0	3	0	35
Control Delay (s)	0.0	0.0	9.7	0.0	33.9
Lane LOS			A		D
Approach Delay (s)	0.0		0.4		33.9
Approach LOS					D

Intersection Summary			
Average Delay	1.7		
Intersection Capacity Utilization	48.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	30	665	60	20	575	145	10	75	20	90	45	15
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	33	723	65	22	625	158	11	82	22	98	49	16
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					727							
pX, platoon unblocked												
vC, conflicting volume	783			788			1530	1647	755	1598	1601	704
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	783			788			1530	1647	755	1598	1601	704
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	96			97			80	12	95	0	51	96
cM capacity (veh/h)	835			831			54	93	408	20	99	437

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	33	788	22	783	11	103	98	65
Volume Left	33	0	22	0	11	0	98	0
Volume Right	0	65	0	158	0	22	0	16
cSH	835	1700	831	1700	54	111	20	123
Volume to Capacity	0.04	0.46	0.03	0.46	0.20	0.93	5.01	0.53
Queue Length 95th (ft)	3	0	2	0	17	144	Err	63
Control Delay (s)	9.5	0.0	9.4	0.0	88.0	139.6	Err	63.4
Lane LOS	A		A		F	F	F	F
Approach Delay (s)	0.4		0.3		134.7		6024.8	
Approach LOS					F		F	

Intersection Summary			
Average Delay	524.8		
Intersection Capacity Utilization	57.4%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	EBT	EBR	NBL	NBT	SBT	SBR	ø1	ø8
Lane Configurations								
Volume (vph)	0	130	180	1150	1120	120		
Turn Type		Perm	Prot			Perm		
Protected Phases	4		5	2	6		1	8
Permitted Phases		4				6		
Detector Phase	4	4	5	2	6	6		
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	10.0	10.0	8.0	27.0	30.0	30.0	8.0	10.0
Total Split (s)	14.0	14.0	19.0	58.0	47.0	47.0	8.0	10.0
Total Split (%)	15.6%	15.6%	21.1%	64.4%	52.2%	52.2%	9%	11%
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	3.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	1.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0		
Total Lost Time (s)	6.0	6.0	4.0	6.0	6.0	6.0		
Lead/Lag			Lead	Lag	Lag	Lag	Lead	
Lead-Lag Optimize?			Yes	Yes	Yes	Yes	Yes	
Recall Mode	None	None	None	C-Max	C-Max	C-Max	None	None
Act Effct Green (s)	7.1	7.1	13.5	70.9	53.3	53.3		
Actuated g/C Ratio	0.08	0.08	0.15	0.79	0.59	0.59		
v/c Ratio	0.31	0.55	0.74	0.45	0.58	0.13		
Control Delay	44.7	16.0	53.3	3.8	6.8	0.5		
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		
Total Delay	44.7	16.0	53.3	3.8	6.8	0.5		
LOS	D	B	D	A	A	A		
Approach Delay	22.7			10.5	6.2			
Approach LOS	C			B	A			

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 90
Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.74
Intersection Signal Delay: 9.3 Intersection LOS: A
Intersection Capacity Utilization 57.6% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 114: Kuihelani Highway &

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	40	0	130	0	0	0	180	1150	0	0	1120	120
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0				4.0	6.0			6.0	6.0
Lane Util. Factor		1.00	1.00				1.00	0.95			0.95	1.00
Frt		1.00	0.85				1.00	1.00			1.00	0.85
Flt Protected		0.95	1.00				0.95	1.00			1.00	1.00
Satd. Flow (prot)		1770	1583				1770	3539			3539	1583
Flt Permitted		0.95	1.00				0.95	1.00			1.00	1.00
Satd. Flow (perm)		1770	1583				1770	3539			3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	43	0	141	0	0	0	196	1250	0	0	1217	130
RTOR Reduction (vph)	0	0	130	0	0	0	0	0	0	0	0	53
Lane Group Flow (vph)	0	43	11	0	0	0	196	1250	0	0	1217	77
Turn Type	Split		Perm	Split			Prot			Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			4									6
Actuated Green, G (s)		7.1	7.1				13.5	70.9			53.4	53.4
Effective Green, g (s)		7.1	7.1				13.5	70.9			53.4	53.4
Actuated g/C Ratio		0.08	0.08				0.15	0.79			0.59	0.59
Clearance Time (s)		6.0	6.0				4.0	6.0			6.0	6.0
Vehicle Extension (s)		3.0	3.0				3.0	3.0			3.0	3.0
Lane Grp Cap (vph)		140	125				266	2788			2100	939
v/s Ratio Prot		c0.02					c0.11	0.35			c0.34	
v/s Ratio Perm			0.01									0.05
v/c Ratio		0.31	0.09				0.74	0.45			0.58	0.08
Uniform Delay, d1		39.1	38.4				36.6	3.1			11.3	7.8
Progression Factor		1.00	1.00				1.00	1.00			0.49	0.16
Incremental Delay, d2		1.2	0.3				10.2	0.5			0.9	0.1
Delay (s)		40.4	38.8				46.7	3.7			6.4	1.4
Level of Service		D	D				D	A			A	A
Approach Delay (s)		39.1			0.0			9.5			5.9	
Approach LOS		D			A			A			A	

Intersection Summary			
HCM Average Control Delay	9.7	HCM Level of Service	A
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	57.6%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Year 2022 with Project Traffic and Mitigation Measures AM

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	200	60	180	65	205	25	575	240	300	505	25
Turn Type	pm+pt		Perm	pm+pt		custom	pm+pt		Perm	pm+pt		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8 5 1	2		2	6		6
Detector Phase	7	4	4	3	8	8 5 1	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	4.0	6.0	6.0	4.0	6.0		3.0	10.0	10.0	3.0	10.0	10.0
Minimum Split (s)	10.0	27.0	27.0	10.0	27.0		7.0	24.0	24.0	7.0	24.0	24.0
Total Split (s)	12.0	36.0	36.0	14.0	38.0	66.0	7.0	59.0	59.0	21.0	73.0	73.0
Total Split (%)	9.2%	27.7%	27.7%	10.8%	29.2%	50.8%	5.4%	45.4%	45.4%	16.2%	56.2%	56.2%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	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 Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes			Yes								
Recall Mode	None	None	None	None	None		None	None	None	None	None	None

Intersection Summary
Cycle Length: 130
Actuated Cycle Length: 108.5
Natural Cycle: 90
Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Kuikahi Drive & Honoapiilani Highway

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	200	60	180	65	205	25	575	240	300	505	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-5%			0%			0%			0%	
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1814	1909	1623	1770	1863	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.71	1.00	1.00	0.34	1.00	1.00	0.42	1.00	1.00	0.14	1.00	1.00
Satd. Flow (perm)	1357	1909	1623	633	1863	1583	790	1863	1583	258	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	60	217	65	196	71	223	27	625	261	326	549	27
RTOR Reduction (vph)	0	0	27	0	0	124	0	0	105	0	0	12
Lane Group Flow (vph)	60	217	38	196	71	99	27	625	156	326	549	15
Turn Type	pm+pt		Perm	pm+pt		custom	pm+pt		Perm	pm+pt		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8 5 1	2		2	6		6
Actuated Green, G (s)	23.2	18.6	18.6	30.4	22.2	44.7	47.5	44.4	44.4	64.9	57.8	57.8
Effective Green, g (s)	23.2	18.6	18.6	30.4	22.2	44.7	47.5	44.4	44.4	64.9	57.8	57.8
Actuated g/C Ratio	0.21	0.17	0.17	0.28	0.20	0.41	0.43	0.40	0.40	0.59	0.53	0.53
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0		4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)	3.0	2.0	2.0	3.0	2.0		2.0	5.0	5.0	2.0	5.0	5.0
Lane Grp Cap (vph)	306	324	275	260	377	645	370	754	641	380	982	834
v/s Ratio Prot	0.01	0.11		c0.06	0.04		0.00	0.34		c0.13	0.29	
v/s Ratio Perm	0.03		0.02	c0.15		0.06	0.03		0.10	c0.38		0.01
v/c Ratio	0.20	0.67	0.14	0.75	0.19	0.15	0.07	0.83	0.24	0.86	0.56	0.02
Uniform Delay, d1	35.3	42.7	38.7	34.3	36.3	20.5	18.0	29.2	21.6	24.3	17.4	12.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.3	4.0	0.1	11.7	0.1	0.0	0.0	8.4	0.4	16.6	1.2	0.0
Delay (s)	35.6	46.7	38.8	46.0	36.4	20.6	18.0	37.6	22.0	40.9	18.6	12.4
Level of Service	D	D	D	D	D	C	B	D	C	D	B	B
Approach Delay (s)		43.3			33.1			32.6			26.5	
Approach LOS		D			C			C			C	

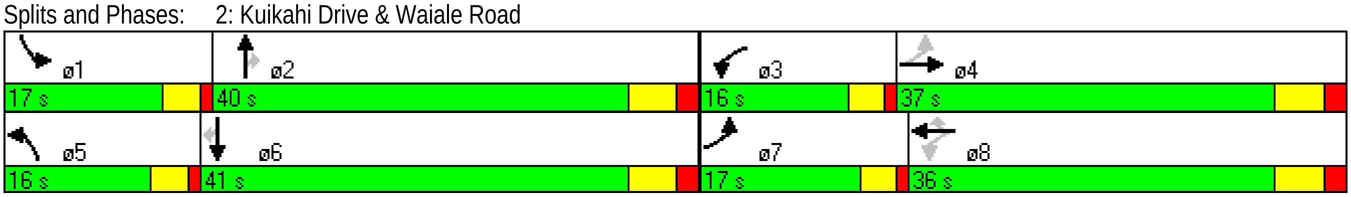
Intersection Summary			
HCM Average Control Delay	32.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	109.7	Sum of lost time (s)	16.0
Intersection Capacity Utilization	85.7%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											
Volume (vph)	340	385	175	185	375	55	500	285	255	285	190
Turn Type	pm+pt		pm+pt		Perm	Prot		Perm	Prot		Perm
Protected Phases	7	4	3	8		5	2		1	6	
Permitted Phases	4		8		8			2			6
Detector Phase	7	4	3	8	8	5	2	2	1	6	6
Switch Phase											
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	30.0	8.0	30.0	30.0	8.0	30.0	30.0	8.0	30.0	30.0
Total Split (s)	17.0	37.0	16.0	36.0	36.0	16.0	40.0	40.0	17.0	41.0	41.0
Total Split (%)	15.5%	33.6%	14.5%	32.7%	32.7%	14.5%	36.4%	36.4%	15.5%	37.3%	37.3%
Yellow Time (s)	3.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?											
Recall Mode	None	None	None	None	None	None	None	None	None	None	None

Intersection Summary
Cycle Length: 110
Actuated Cycle Length: 95
Natural Cycle: 90
Control Type: Actuated-Uncoordinated

Splits and Phases: 2: Kuikahi Drive & Waiale Road



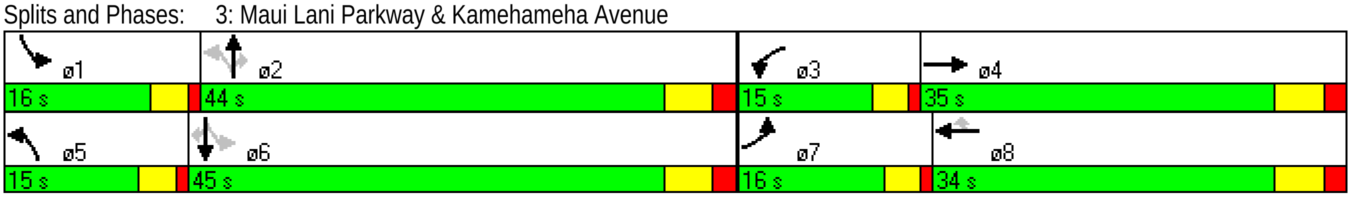
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	340	385	25	175	185	375	55	500	285	255	285	190
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3507		1770	1863	1583	1770	1863	1583	3433	1863	1583
Flt Permitted	0.44	1.00		0.40	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	815	3507		744	1863	1583	1770	1863	1583	3433	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	370	418	27	190	201	408	60	543	310	277	310	207
RTOR Reduction (vph)	0	5	0	0	0	264	0	0	193	0	0	124
Lane Group Flow (vph)	370	440	0	190	201	144	60	543	117	277	310	83
Turn Type	pm+pt			pm+pt		Perm	Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8		8			2			6
Actuated Green, G (s)	32.5	19.4		28.3	17.3	17.3	7.2	33.5	33.5	11.9	38.2	38.2
Effective Green, g (s)	32.5	19.4		28.3	17.3	17.3	7.2	33.5	33.5	11.9	38.2	38.2
Actuated g/C Ratio	0.34	0.20		0.30	0.18	0.18	0.08	0.35	0.35	0.12	0.40	0.40
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	407	710		338	336	286	133	651	554	426	743	631
v/s Ratio Prot	c0.12	0.13		0.06	0.11		0.03	c0.29		c0.08	0.17	
v/s Ratio Perm	c0.18			0.10		0.09			0.07			0.05
v/c Ratio	0.91	0.62		0.56	0.60	0.50	0.45	0.83	0.21	0.65	0.42	0.13
Uniform Delay, d1	28.2	34.8		26.7	36.1	35.4	42.4	28.6	21.9	40.0	20.8	18.3
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	23.6	1.7		2.1	2.9	1.4	2.4	9.0	0.2	3.5	0.4	0.1
Delay (s)	51.7	36.5		28.9	38.9	36.8	44.8	37.6	22.1	43.5	21.2	18.4
Level of Service	D	D		C	D	D	D	D	C	D	C	B
Approach Delay (s)		43.4			35.4			32.8			28.2	
Approach LOS		D			D			C			C	

Intersection Summary			
HCM Average Control Delay	35.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	95.8	Sum of lost time (s)	18.0
Intersection Capacity Utilization	81.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											
Volume (vph)	245	260	115	450	220	320	525	160	225	300	450
Turn Type	Prot		Prot		Perm	pm+pt		Perm	pm+pt		Perm
Protected Phases	7	4	3	8		5	2		1	6	
Permitted Phases					8	2		2	6		6
Detector Phase	7	4	3	8	8	5	2	2	1	6	6
Switch Phase											
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	27.0	8.0	27.0	27.0	8.0	27.0	27.0	8.0	27.0	27.0
Total Split (s)	16.0	35.0	15.0	34.0	34.0	15.0	44.0	44.0	16.0	45.0	45.0
Total Split (%)	14.5%	31.8%	13.6%	30.9%	30.9%	13.6%	40.0%	40.0%	14.5%	40.9%	40.9%
Yellow Time (s)	3.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?											
Recall Mode	None	None	None	None	None	None	None	None	None	None	None

Intersection Summary
Cycle Length: 110
Actuated Cycle Length: 98.3
Natural Cycle: 90
Control Type: Actuated-Uncoordinated

Splits and Phases: 3: Maui Lani Parkway & Kamehameha Avenue



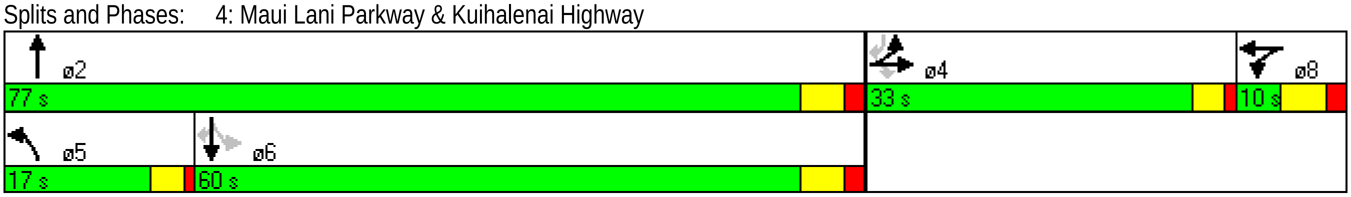
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	245	260	270	115	450	220	320	525	160	225	300	450
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	0.97	0.95		1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.92		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3269		1770	3539	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.44	1.00	1.00	0.14	1.00	1.00
Satd. Flow (perm)	3433	3269		1770	3539	1583	826	1863	1583	260	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	266	283	293	125	489	239	348	571	174	245	326	489
RTOR Reduction (vph)	0	182	0	0	0	189	0	0	49	0	0	213
Lane Group Flow (vph)	266	394	0	125	489	50	348	571	125	245	326	276
Turn Type	Prot			Prot		Perm	pm+pt		Perm	pm+pt		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases						8	2		2	6		6
Actuated Green, G (s)	11.3	21.4		10.4	20.5	20.5	45.6	34.4	34.4	46.8	35.0	35.0
Effective Green, g (s)	11.3	21.4		10.4	20.5	20.5	45.6	34.4	34.4	46.8	35.0	35.0
Actuated g/C Ratio	0.12	0.22		0.11	0.21	0.21	0.47	0.35	0.35	0.48	0.36	0.36
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	396	714		188	740	331	492	654	556	306	665	565
v/s Ratio Prot	c0.08	0.12		0.07	c0.14		0.08	c0.31		c0.10	0.18	
v/s Ratio Perm						0.03	0.25		0.08	0.29		0.17
v/c Ratio	0.67	0.55		0.66	0.66	0.15	0.71	0.87	0.22	0.80	0.49	0.49
Uniform Delay, d1	41.6	34.0		42.1	35.6	31.6	18.6	29.8	22.4	19.7	24.5	24.5
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.4	0.9		8.6	2.2	0.2	4.6	12.3	0.2	13.9	0.6	0.7
Delay (s)	46.0	35.0		50.7	37.8	31.9	23.3	42.1	22.6	33.6	25.1	25.2
Level of Service	D	C		D	D	C	C	D	C	C	C	C
Approach Delay (s)		38.5			38.0			33.0			27.1	
Approach LOS		D			D			C			C	

Intersection Summary			
HCM Average Control Delay	33.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	98.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	79.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	NBL	NBT	SBT	SBR	ø8
Lane Configurations								
Volume (vph)	715	0	175	140	1135	945	560	
Turn Type	Split		Perm	Prot			custom	
Protected Phases	4	4		5	2	6		8
Permitted Phases			4				6 4	
Detector Phase	4	4	4	5	2	6	6 4	
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0
Minimum Split (s)	8.0	8.0	8.0	8.0	10.0	27.0		10.0
Total Split (s)	33.0	33.0	33.0	17.0	77.0	60.0	93.0	10.0
Total Split (%)	27.5%	27.5%	27.5%	14.2%	64.2%	50.0%	77.5%	8%
Yellow Time (s)	3.0	3.0	3.0	3.0	4.0	4.0		4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	2.0	2.0		2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	4.0	4.0	4.0	4.0	6.0	6.0	6.0	
Lead/Lag				Lead		Lag		
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	None	None		None

Intersection Summary
Cycle Length: 120
Actuated Cycle Length: 95
Natural Cycle: 70
Control Type: Actuated-Uncoordinated

Splits and Phases: 4: Maui Lani Parkway & Kuihalenai Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	715	0	175	0	0	0	140	1135	0	0	945	560
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0				4.0	6.0			6.0	6.0
Lane Util. Factor	0.95	0.95	1.00				0.97	0.95			0.95	1.00
Frt	1.00	1.00	0.85				1.00	1.00			1.00	0.85
Flt Protected	0.95	0.95	1.00				0.95	1.00			1.00	1.00
Satd. Flow (prot)	1681	1681	1583				3433	3539			3539	1583
Flt Permitted	0.95	0.95	1.00				0.95	1.00			1.00	1.00
Satd. Flow (perm)	1681	1681	1583				3433	3539			3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	777	0	190	0	0	0	152	1234	0	0	1027	609
RTOR Reduction (vph)	0	0	67	0	0	0	0	0	0	0	0	73
Lane Group Flow (vph)	388	389	123	0	0	0	152	1234	0	0	1027	536
Turn Type	Split		Perm	Split			Prot			Perm		custom
Protected Phases	4	4		8	8		5	2			6	
Permitted Phases			4							6		6 4
Actuated Green, G (s)	28.9	28.9	28.9				9.8	55.9			42.1	77.0
Effective Green, g (s)	28.9	28.9	28.9				9.8	55.9			42.1	77.0
Actuated g/C Ratio	0.30	0.30	0.30				0.10	0.59			0.44	0.81
Clearance Time (s)	4.0	4.0	4.0				4.0	6.0			6.0	
Vehicle Extension (s)	3.0	3.0	3.0				3.0	3.0			3.0	
Lane Grp Cap (vph)	512	512	483				355	2087			1572	1286
v/s Ratio Prot	0.23	c0.23					0.04	c0.35			c0.29	
v/s Ratio Perm			0.08									0.34
v/c Ratio	0.76	0.76	0.25				0.43	0.59			0.65	0.42
Uniform Delay, d1	29.8	29.8	24.8				39.9	12.3			20.6	2.5
Progression Factor	1.00	1.00	1.00				1.00	1.00			1.00	1.00
Incremental Delay, d2	6.3	6.4	0.3				0.8	0.5			1.0	0.2
Delay (s)	36.1	36.2	25.1				40.7	12.7			21.6	2.7
Level of Service	D	D	C				D	B			C	A
Approach Delay (s)		34.0			0.0			15.8			14.6	
Approach LOS		C			A			B			B	

Intersection Summary			
HCM Average Control Delay	19.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	94.8	Sum of lost time (s)	16.0
Intersection Capacity Utilization	67.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations										
Volume (vph)	35	25	10	65	5	5	550	145	580	15
Turn Type	Perm		custom	Perm		pm+pt		pm+pt		Perm
Protected Phases		4			8	5	2	1	6	
Permitted Phases	4		4 5	8		2		6		6
Detector Phase	4	4	4 5	8	8	5	2	1	6	6
Switch Phase										
Minimum Initial (s)	6.0	6.0		6.0	6.0	3.0	10.0	3.0	10.0	10.0
Minimum Split (s)	23.0	23.0		27.0	27.0	7.0	31.0	7.0	26.0	26.0
Total Split (s)	27.0	27.0	34.0	27.0	27.0	7.0	60.0	13.0	66.0	66.0
Total Split (%)	27.0%	27.0%	34.0%	27.0%	27.0%	7.0%	60.0%	13.0%	66.0%	66.0%
Yellow Time (s)	4.0	4.0		4.0	4.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	6.0	4.0	6.0	6.0
Lead/Lag						Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?										
Recall Mode	None	None		None	None	None	C-Max	None	C-Max	C-Max

Intersection Summary
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 70
Control Type: Actuated-Coordinated

Splits and Phases: 5: Waiko Road & Honoapiilani Highway

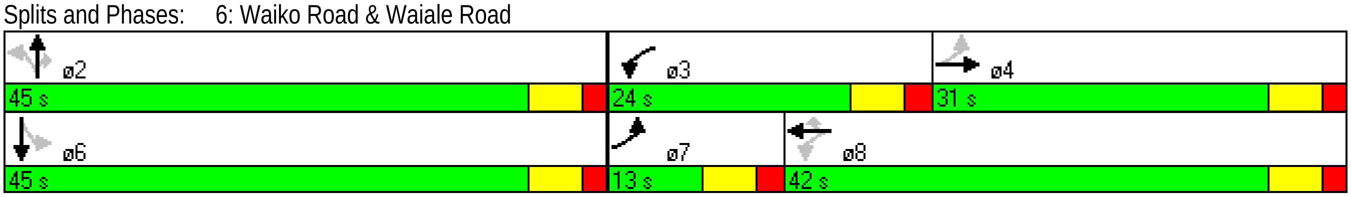
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	35	25	10	65	5	70	5	550	85	145	580	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1600	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-8%			0%			0%			0%	
Total Lost time (s)		5.0	5.0		5.0		4.0	6.0		4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	0.97
Flpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt		1.00	0.85		0.93		1.00	0.98		1.00	1.00	0.85
Flt Protected		0.97	1.00		0.98		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1882	1647		1429		1768	1825		1770	1863	1539
Flt Permitted		0.70	1.00		0.82		0.40	1.00		0.29	1.00	1.00
Satd. Flow (perm)		1363	1647		1198		738	1825		531	1863	1539
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	38	27	11	71	5	76	5	598	92	158	630	16
RTOR Reduction (vph)	0	0	9	0	40	0	0	4	0	0	0	3
Lane Group Flow (vph)	0	65	2	0	112	0	5	686	0	158	630	13
Confl. Peds. (#/hr)							3					3
Turn Type	Perm		custom	Perm			pm+pt			pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 5	8			2			6		6
Actuated Green, G (s)		13.6	19.8		13.6		65.8	64.6		75.4	70.2	70.2
Effective Green, g (s)		13.6	19.8		13.6		65.8	64.6		75.4	70.2	70.2
Actuated g/C Ratio		0.14	0.20		0.14		0.66	0.65		0.75	0.70	0.70
Clearance Time (s)		5.0			5.0		4.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)		2.0			2.0		2.0	5.0		2.0	5.0	5.0
Lane Grp Cap (vph)		185	326		163		498	1179		485	1308	1080
v/s Ratio Prot							0.00	c0.38		c0.02	c0.34	
v/s Ratio Perm		0.05	0.00		c0.09		0.01			0.22		0.01
v/c Ratio		0.35	0.01		0.69		0.01	0.58		0.33	0.48	0.01
Uniform Delay, d1		39.2	32.2		41.2		6.0	10.0		5.9	6.7	4.5
Progression Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2		0.4	0.0		9.3		0.0	2.1		0.1	1.3	0.0
Delay (s)		39.6	32.2		50.4		6.0	12.1		6.0	8.0	4.5
Level of Service		D	C		D		A	B		A	A	A
Approach Delay (s)		38.5			50.4			12.1			7.5	
Approach LOS		D			D			B			A	

Intersection Summary			
HCM Average Control Delay	14.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	71.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations										
Volume (vph)	45	250	255	90	140	15	370	300	185	255
Turn Type	pm+pt		pm+pt		Perm	Perm		Perm	Perm	
Protected Phases	7	4	3	8			2			6
Permitted Phases	4		8		8	2		2	6	
Detector Phase	7	4	3	8	8	2	2	2	6	6
Switch Phase										
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	10.0	24.0	10.0	24.0	24.0	27.0	27.0	27.0	27.0	27.0
Total Split (s)	13.0	31.0	24.0	42.0	42.0	45.0	45.0	45.0	45.0	45.0
Total Split (%)	13.0%	31.0%	24.0%	42.0%	42.0%	45.0%	45.0%	45.0%	45.0%	45.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag					
Lead-Lag Optimize?										
Recall Mode	None	None	None	None	None	None	None	None	None	None

Intersection Summary
Cycle Length: 100
Actuated Cycle Length: 78.8
Natural Cycle: 65
Control Type: Actuated-Uncoordinated

Splits and Phases: 6: Waiko Road & Waiale Road



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	45	250	20	255	90	140	15	370	300	185	255	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1842		1770	1863	1583	1770	1863	1583	1770	1806	
Flt Permitted	0.69	1.00		0.33	1.00	1.00	0.42	1.00	1.00	0.36	1.00	
Satd. Flow (perm)	1292	1842		618	1863	1583	790	1863	1583	665	1806	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	49	272	22	277	98	152	16	402	326	201	277	71
RTOR Reduction (vph)	0	3	0	0	0	94	0	0	212	0	10	0
Lane Group Flow (vph)	49	291	0	277	98	58	16	402	114	201	338	0
Turn Type	pm+pt			pm+pt		Perm	Perm		Perm	Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)	24.8	21.2		40.5	30.9	30.9	28.4	28.4	28.4	28.4	28.4	
Effective Green, g (s)	24.8	21.2		40.5	30.9	30.9	28.4	28.4	28.4	28.4	28.4	
Actuated g/C Ratio	0.31	0.26		0.50	0.38	0.38	0.35	0.35	0.35	0.35	0.35	
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	417	483		499	712	605	277	654	556	233	634	
v/s Ratio Prot	0.01	0.16		c0.09	0.05			0.22			0.19	
v/s Ratio Perm	0.03			c0.19		0.04	0.02		0.07	c0.30		
v/c Ratio	0.12	0.60		0.56	0.14	0.10	0.06	0.61	0.21	0.86	0.53	
Uniform Delay, d1	20.0	26.2		13.1	16.3	16.0	17.4	21.7	18.4	24.4	21.0	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.1	2.1		1.3	0.1	0.1	0.1	1.7	0.2	26.4	0.9	
Delay (s)	20.1	28.3		14.4	16.4	16.1	17.5	23.4	18.5	50.8	21.8	
Level of Service	C	C		B	B	B	B	C	B	D	C	
Approach Delay (s)		27.1			15.3			21.2			32.4	
Approach LOS		C			B			C			C	

Intersection Summary			
HCM Average Control Delay	23.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	80.9	Sum of lost time (s)	12.0
Intersection Capacity Utilization	78.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	540	360	150	565	795	225
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Detector Phase	4	4 5	5	2	6	6 4
Switch Phase						
Minimum Initial (s)	6.0		4.0	10.0	10.0	
Minimum Split (s)	28.0		8.0	16.0	27.0	
Total Split (s)	32.0	45.0	13.0	58.0	45.0	77.0
Total Split (%)	35.6%	50.0%	14.4%	64.4%	50.0%	85.6%
Yellow Time (s)	3.0		3.0	4.0	4.0	
All-Red Time (s)	1.0		1.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?						
Recall Mode	None		None	C-Max	C-Max	

Intersection Summary
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 89 (99%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 65
Control Type: Actuated-Coordinated

Splits and Phases: 7: Waiko Road & Kuihelani Highway

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	540	360	150	565	795	225
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lane Util. Factor	0.97	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	3433	1583	1770	3539	3539	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	3433	1583	1770	3539	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	1.00
Adj. Flow (vph)	587	391	163	614	864	225
RTOR Reduction (vph)	0	45	0	0	0	28
Lane Group Flow (vph)	587	346	163	614	864	197
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Actuated Green, G (s)	21.0	37.1	12.1	59.0	42.9	69.9
Effective Green, g (s)	21.0	37.1	12.1	59.0	42.9	69.9
Actuated g/C Ratio	0.23	0.41	0.13	0.66	0.48	0.78
Clearance Time (s)	4.0		4.0	6.0	6.0	
Vehicle Extension (s)	2.0		2.0	5.0	5.0	
Lane Grp Cap (vph)	801	653	238	2320	1687	1229
v/s Ratio Prot	c0.17		c0.09	0.17	c0.24	
v/s Ratio Perm		0.22				0.12
v/c Ratio	0.73	0.53	0.68	0.26	0.51	0.16
Uniform Delay, d1	31.9	19.9	37.1	6.5	16.3	2.6
Progression Factor	0.90	0.77	0.91	0.72	1.00	1.00
Incremental Delay, d2	2.5	0.3	6.2	0.3	1.1	0.0
Delay (s)	31.3	15.5	40.1	4.9	17.4	2.6
Level of Service	C	B	D	A	B	A
Approach Delay (s)	25.0			12.3	14.4	
Approach LOS	C			B	B	

Intersection Summary			
HCM Average Control Delay	17.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	57.4%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Configurations											
Volume (vph)	200	15	450	20	45	15	885	370	5	285	80
Turn Type	Perm		custom	Perm		Perm	Prot		Prot		Perm
Protected Phases		4			8		5	2	1	6	
Permitted Phases	4		4 5 2	8		8					6
Detector Phase	4	4	4 5 2	8	8	8	5	2	1	6	6
Switch Phase											
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	27.0	27.0		27.0	27.0	27.0	8.0	10.0	8.0	27.0	27.0
Total Split (s)	37.0	37.0	122.0	37.0	37.0	37.0	32.0	53.0	10.0	31.0	31.0
Total Split (%)	37.0%	37.0%	122.0%	37.0%	37.0%	37.0%	32.0%	53.0%	10.0%	31.0%	31.0%
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	1.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	4.0	6.0	4.0	6.0	6.0
Lead/Lag							Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?											
Recall Mode	None	None		None	None	None	None	None	None	None	None

Intersection Summary
Cycle Length: 100
Actuated Cycle Length: 83.7
Natural Cycle: 80
Control Type: Actuated-Uncoordinated

Splits and Phases: 8: Kuikahi Dr & Maui Lani Parkway

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	200	15	450	20	45	15	885	370	10	5	285	80
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	4.0	6.0		4.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	3433	1855		1770	1863	1583
Flt Permitted	0.73	1.00	1.00	0.75	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1351	1863	1583	1392	1863	1583	3433	1855		1770	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	217	16	489	22	49	16	962	402	11	5	310	87
RTOR Reduction (vph)	0	0	0	0	0	12	0	1	0	0	0	50
Lane Group Flow (vph)	217	16	489	22	49	4	962	412	0	5	310	37
Turn Type	Perm		custom	Perm		Perm	Prot			Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 5 2	8		8						6
Actuated Green, G (s)	20.0	20.0	86.7	20.0	20.0	20.0	28.6	49.7		1.0	22.1	22.1
Effective Green, g (s)	20.0	20.0	86.7	20.0	20.0	20.0	28.6	49.7		1.0	22.1	22.1
Actuated g/C Ratio	0.23	0.23	1.00	0.23	0.23	0.23	0.33	0.57		0.01	0.25	0.25
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0	4.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	312	430	1583	321	430	365	1132	1063		20	475	404
v/s Ratio Prot		0.01			0.03		c0.28	0.22		0.00	c0.17	
v/s Ratio Perm	c0.16		0.31	0.02		0.00						0.02
v/c Ratio	0.70	0.04	0.31	0.07	0.11	0.01	0.85	0.39		0.25	0.65	0.09
Uniform Delay, d1	30.6	25.9	0.0	26.1	26.3	25.7	27.1	10.2		42.5	28.9	24.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	6.6	0.0	0.1	0.1	0.1	0.0	6.1	0.2		6.5	3.2	0.1
Delay (s)	37.1	25.9	0.1	26.2	26.5	25.7	33.2	10.4		49.0	32.1	24.7
Level of Service	D	C	A	C	C	C	C	B		D	C	C
Approach Delay (s)		11.8			26.3			26.3			30.7	
Approach LOS		B			C			C			C	

Intersection Summary			
HCM Average Control Delay	23.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	86.7	Sum of lost time (s)	16.0
Intersection Capacity Utilization	71.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	795	165	55	965	65	40
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	864	179	60	1049	71	43
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						4
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				1078		
pX, platoon unblocked						
vC, conflicting volume			1043		1598	522
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1043		1598	522
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			91		20	91
cM capacity (veh/h)			662		88	500

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	576	467	60	524	524	114
Volume Left	0	0	60	0	0	71
Volume Right	0	179	0	0	0	43
cSH	1700	1700	662	1700	1700	143
Volume to Capacity	0.34	0.27	0.09	0.31	0.31	0.80
Queue Length 95th (ft)	0	0	7	0	0	125
Control Delay (s)	0.0	0.0	11.0	0.0	0.0	85.3
Lane LOS			B			F
Approach Delay (s)	0.0		0.6			85.3
Approach LOS						F

Intersection Summary			
Average Delay	4.6		
Intersection Capacity Utilization	44.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	10	35	105	30	75	205
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	38	114	33	82	223
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	500	114			147	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	500	114			147	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	98	96			94	
cM capacity (veh/h)	500	938			1435	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	49	114	33	82	223
Volume Left	11	0	0	82	0
Volume Right	38	0	33	0	0
cSH	786	1700	1700	1435	1700
Volume to Capacity	0.06	0.07	0.02	0.06	0.13
Queue Length 95th (ft)	5	0	0	5	0
Control Delay (s)	9.9	0.0	0.0	7.7	0.0
Lane LOS	A			A	
Approach Delay (s)	9.9	0.0		2.1	
Approach LOS	A				

Intersection Summary			
Average Delay	2.2		
Intersection Capacity Utilization	20.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	10	50	30	40	35	225	10	150	85	80	210	10
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	54	33	43	38	245	11	163	92	87	228	11
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)			4			4						
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	734	685	234	677	644	209	239			255		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	734	685	234	677	644	209	239			255		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	95	84	96	85	90	71	99			93		
cM capacity (veh/h)	206	343	805	292	362	831	1328			1310		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	98	326	11	255	87	239
Volume Left	11	43	11	0	87	0
Volume Right	33	245	0	92	0	11
cSH	481	1108	1328	1700	1310	1700
Volume to Capacity	0.20	0.29	0.01	0.15	0.07	0.14
Queue Length 95th (ft)	19	31	1	0	5	0
Control Delay (s)	15.9	13.3	7.7	0.0	7.9	0.0
Lane LOS	C	B	A		A	
Approach Delay (s)	15.9	13.3	0.3		2.1	
Approach LOS	C	B				

Intersection Summary			
Average Delay	6.6		
Intersection Capacity Utilization	40.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	110	175	0	35	205	135	45	0	75	110	0	90
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	120	190	0	38	223	147	49	0	82	120	0	98
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	370			190			826	875	190	883	802	296
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	370			190			826	875	190	883	802	296
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	90			97			79	100	90	45	100	87
cM capacity (veh/h)	1189			1384			228	252	852	218	278	743

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	120	190	38	370	49	82	120	98
Volume Left	120	0	38	0	49	0	120	0
Volume Right	0	0	0	147	0	82	0	98
cSH	1189	1700	1384	1700	228	852	218	743
Volume to Capacity	0.10	0.11	0.03	0.22	0.21	0.10	0.55	0.13
Queue Length 95th (ft)	8	0	2	0	20	8	74	11
Control Delay (s)	8.4	0.0	7.7	0.0	25.0	9.7	40.0	10.6
Lane LOS	A		A		C	A	E	B
Approach Delay (s)	3.2		0.7		15.4		26.8	
Approach LOS					C		D	

Intersection Summary			
Average Delay	8.6		
Intersection Capacity Utilization	47.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	315	35	50	250	155	55
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	342	38	54	272	168	60
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						4
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				1270		
pX, platoon unblocked						
vC, conflicting volume			380		723	342
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			380		723	342
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			95		55	91
cM capacity (veh/h)			1178		375	700

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	342	38	54	272	228
Volume Left	0	0	54	0	168
Volume Right	0	38	0	0	60
cSH	1700	1700	1178	1700	508
Volume to Capacity	0.20	0.02	0.05	0.16	0.45
Queue Length 95th (ft)	0	0	4	0	57
Control Delay (s)	0.0	0.0	8.2	0.0	19.2
Lane LOS			A		C
Approach Delay (s)	0.0		1.4		19.2
Approach LOS					C

Intersection Summary			
Average Delay	5.2		
Intersection Capacity Utilization	38.5%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	300	105	95	1005	940	270
Turn Type		Perm	Prot			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Detector Phase	4	4	5	2	6	6
Switch Phase						
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	30.0	30.0	10.0	30.0	30.0	30.0
Total Split (s)	31.0	31.0	19.0	69.0	50.0	50.0
Total Split (%)	31.0%	31.0%	19.0%	69.0%	50.0%	50.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	Lag
Lead-Lag Optimize?						
Recall Mode	None	None	None	None	None	None

Intersection Summary
Cycle Length: 100
Actuated Cycle Length: 79.7
Natural Cycle: 70
Control Type: Actuated-Uncoordinated

Splits and Phases: 105: Road C & Kuihelnai Hwy

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	300	105	95	1005	940	270
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	3539	3539	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	3539	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	326	114	103	1092	1022	293
RTOR Reduction (vph)	0	86	0	0	0	168
Lane Group Flow (vph)	326	28	103	1092	1022	125
Turn Type		Perm	Prot			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Actuated Green, G (s)	19.9	19.9	7.9	48.0	34.1	34.1
Effective Green, g (s)	19.9	19.9	7.9	48.0	34.1	34.1
Actuated g/C Ratio	0.25	0.25	0.10	0.60	0.43	0.43
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	441	394	175	2126	1510	676
v/s Ratio Prot	c0.18		0.06	c0.31	c0.29	
v/s Ratio Perm		0.02				0.08
v/c Ratio	0.74	0.07	0.59	0.51	0.68	0.18
Uniform Delay, d1	27.6	22.9	34.4	9.2	18.5	14.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	6.4	0.1	5.0	0.2	1.2	0.1
Delay (s)	34.0	23.0	39.4	9.4	19.7	14.4
Level of Service	C	C	D	A	B	B
Approach Delay (s)	31.2			12.0	18.5	
Approach LOS	C			B	B	

Intersection Summary			
HCM Average Control Delay	17.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	79.9	Sum of lost time (s)	18.0
Intersection Capacity Utilization	62.9%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	0	15	90	10	75	165
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	16	98	11	82	179
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	440	98			109	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	440	98			109	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	98			94	
cM capacity (veh/h)	543	958			1482	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	16	98	11	82	179
Volume Left	0	0	0	82	0
Volume Right	16	0	11	0	0
cSH	958	1700	1700	1482	1700
Volume to Capacity	0.02	0.06	0.01	0.06	0.11
Queue Length 95th (ft)	1	0	0	4	0
Control Delay (s)	8.8	0.0	0.0	7.6	0.0
Lane LOS	A			A	
Approach Delay (s)	8.8	0.0		2.4	
Approach LOS	A				

Intersection Summary			
Average Delay	2.0		
Intersection Capacity Utilization	20.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	15	0	80	10	0	20	20	150	10	15	200	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	16	0	87	11	0	22	22	163	11	16	217	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)			4			4						
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	467	467	217	505	462	168	217			174		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	467	467	217	505	462	168	217			174		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	97	100	89	97	100	98	98			99		
cM capacity (veh/h)	483	480	822	418	483	876	1352			1403		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	103	33	22	174	16	217
Volume Left	16	11	22	0	16	0
Volume Right	87	22	0	11	0	0
cSH	977	1253	1352	1700	1403	1700
Volume to Capacity	0.11	0.03	0.02	0.10	0.01	0.13
Queue Length 95th (ft)	9	2	1	0	1	0
Control Delay (s)	10.3	10.8	7.7	0.0	7.6	0.0
Lane LOS	B	B	A		A	
Approach Delay (s)	10.3	10.8	0.9		0.5	
Approach LOS	B	B				

Intersection Summary			
Average Delay	3.0		
Intersection Capacity Utilization	30.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	20	15	10	80	105	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	22	16	11	87	114	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	223	114	114			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	223	114	114			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	97	98	99			
cM capacity (veh/h)	760	938	1475			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	38	11	87	114	0
Volume Left	22	11	0	0	0
Volume Right	16	0	0	0	0
cSH	827	1475	1700	1700	1700
Volume to Capacity	0.05	0.01	0.05	0.07	0.00
Queue Length 95th (ft)	4	1	0	0	0
Control Delay (s)	9.6	7.5	0.0	0.0	0.0
Lane LOS	A	A			
Approach Delay (s)	9.6	0.8		0.0	
Approach LOS	A				

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	17.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	20	710	20	10	475	15	25	0	30	5	0	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	22	772	22	11	516	16	27	0	33	5	0	5
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		844										
pX, platoon unblocked				0.97			0.97	0.97	0.97	0.97	0.97	
vC, conflicting volume	533			793			1370	1380	783	1394	1383	524
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	533			770			1365	1376	759	1391	1379	524
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	98			99			77	100	92	95	100	99
cM capacity (veh/h)	1035			817			116	136	393	103	135	553

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1
Volume Total	22	793	11	533	27	33	11
Volume Left	22	0	11	0	27	0	5
Volume Right	0	22	0	16	0	33	5
cSH	1035	1700	817	1700	116	393	174
Volume to Capacity	0.02	0.47	0.01	0.31	0.23	0.08	0.06
Queue Length 95th (ft)	2	0	1	0	21	7	5
Control Delay (s)	8.6	0.0	9.5	0.0	45.2	15.0	27.0
Lane LOS	A		A		E	B	D
Approach Delay (s)	0.2		0.2		28.7		27.0
Approach LOS					D		D

Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	50.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	80	655	315	85	40	150
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	87	712	342	92	43	163
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						4
Median type		None	None			
Median storage veh)						
Upstream signal (ft)			564			
pX, platoon unblocked						
vC, conflicting volume	435				1228	342
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	435				1228	342
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	92				76	77
cM capacity (veh/h)	1125				181	700

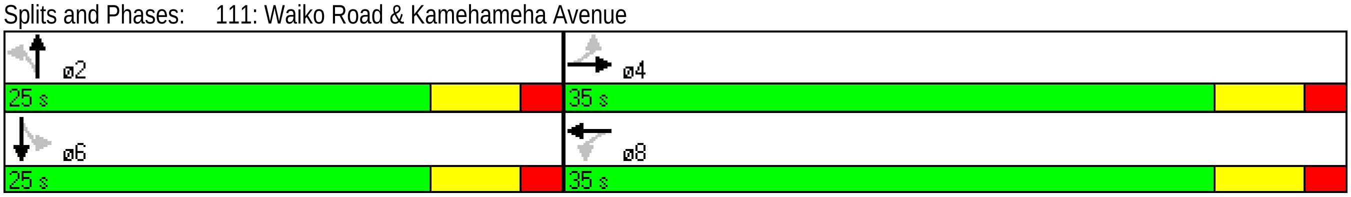
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1
Volume Total	87	712	342	92	207
Volume Left	87	0	0	0	43
Volume Right	0	0	0	92	163
cSH	1125	1700	1700	1700	862
Volume to Capacity	0.08	0.42	0.20	0.05	0.24
Queue Length 95th (ft)	6	0	0	0	23
Control Delay (s)	8.5	0.0	0.0	0.0	15.8
Lane LOS	A				C
Approach Delay (s)	0.9		0.0		15.8
Approach LOS					C

Intersection Summary			
Average Delay	2.8		
Intersection Capacity Utilization	44.5%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	65	610	10	310	35	65	165	55
Turn Type	Perm		Perm		Perm		Perm	
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0
Total Split (s)	35.0	35.0	35.0	35.0	25.0	25.0	25.0	25.0
Total Split (%)	58.3%	58.3%	58.3%	58.3%	41.7%	41.7%	41.7%	41.7%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	C-Max	C-Max	None	None

Intersection Summary
Cycle Length: 60
Actuated Cycle Length: 60
Offset: 0 (0%), Referenced to phase 2:NBTL, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated

Splits and Phases: 111: Waiko Road & Kamehameha Avenue



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	65	610	25	10	310	50	35	65	5	165	55	60
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.98		1.00	0.99		1.00	0.92	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1852		1770	1824		1770	1844		1770	1717	
Flt Permitted	0.46	1.00		0.18	1.00		0.68	1.00		0.71	1.00	
Satd. Flow (perm)	866	1852		330	1824		1261	1844		1318	1717	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	71	663	27	11	337	54	38	71	5	179	60	65
RTOR Reduction (vph)	0	3	0	0	11	0	0	3	0	0	42	0
Lane Group Flow (vph)	71	687	0	11	380	0	38	73	0	179	83	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	26.5	26.5		26.5	26.5		21.5	21.5		21.5	21.5	
Effective Green, g (s)	26.5	26.5		26.5	26.5		21.5	21.5		21.5	21.5	
Actuated g/C Ratio	0.44	0.44		0.44	0.44		0.36	0.36		0.36	0.36	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	382	818		146	806		452	661		472	615	
v/s Ratio Prot		c0.37			0.21			0.04			0.05	
v/s Ratio Perm	0.08			0.03			0.03			c0.14		
v/c Ratio	0.19	0.84		0.08	0.47		0.08	0.11		0.38	0.14	
Uniform Delay, d1	10.2	14.9		9.7	11.8		12.7	12.9		14.3	13.0	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.2	7.8		0.2	0.4		0.4	0.3		0.5	0.1	
Delay (s)	10.4	22.6		9.9	12.3		13.1	13.2		14.8	13.1	
Level of Service	B	C		A	B		B	B		B	B	
Approach Delay (s)		21.5			12.2			13.2			14.1	
Approach LOS		C			B			B			B	

Intersection Summary			
HCM Average Control Delay	17.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	67.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	750	25	15	315	45	15
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	815	27	16	342	49	16
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						4
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	845			769		
pX, platoon unblocked			0.68		0.68	0.68
vC, conflicting volume			842		1190	815
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			528		1042	488
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			98		71	96
cM capacity (veh/h)			703		168	392

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	815	27	16	342	65
Volume Left	0	0	16	0	49
Volume Right	0	27	0	0	16
cSH	1700	1700	703	1700	224
Volume to Capacity	0.48	0.02	0.02	0.20	0.29
Queue Length 95th (ft)	0	0	2	0	29
Control Delay (s)	0.0	0.0	10.2	0.0	29.9
Lane LOS			B		D
Approach Delay (s)	0.0		0.5		29.9
Approach LOS					D

Intersection Summary			
Average Delay	1.7		
Intersection Capacity Utilization	49.5%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	10	740	10	315	10	30	140	5
Turn Type	Perm		Perm		Perm		Perm	
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0
Total Split (s)	63.0	63.0	63.0	63.0	27.0	27.0	27.0	27.0
Total Split (%)	70.0%	70.0%	70.0%	70.0%	30.0%	30.0%	30.0%	30.0%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	C-Max	C-Max	C-Max	C-Max	None	None	None	None

Intersection Summary
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 27 (30%), Referenced to phase 4:EBTL and 8:WBTL, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated

Splits and Phases: 113: Waiko Road & Road B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	10	740	15	10	315	55	10	30	15	140	5	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	0.98		1.00	0.95		1.00	0.93	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1857		1770	1821		1770	1772		1770	1723	
Flt Permitted	0.50	1.00		0.27	1.00		0.75	1.00		0.73	1.00	
Satd. Flow (perm)	939	1857		510	1821		1399	1772		1351	1723	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	11	804	16	11	342	60	11	33	16	152	5	5
RTOR Reduction (vph)	0	1	0	0	5	0	0	13	0	0	4	0
Lane Group Flow (vph)	11	819	0	11	397	0	11	36	0	152	6	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	66.7	66.7		66.7	66.7		15.3	15.3		15.3	15.3	
Effective Green, g (s)	66.7	66.7		66.7	66.7		15.3	15.3		15.3	15.3	
Actuated g/C Ratio	0.74	0.74		0.74	0.74		0.17	0.17		0.17	0.17	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	696	1376		378	1350		238	301		230	293	
v/s Ratio Prot		c0.44			0.22			0.02			0.00	
v/s Ratio Perm	0.01			0.02			0.01			c0.11		
v/c Ratio	0.02	0.60		0.03	0.29		0.05	0.12		0.66	0.02	
Uniform Delay, d1	3.1	5.4		3.1	3.9		31.2	31.6		34.9	31.1	
Progression Factor	1.00	1.00		1.52	2.16		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.0	1.9		0.1	0.5		0.1	0.2		6.9	0.0	
Delay (s)	3.1	7.3		4.8	8.9		31.3	31.8		41.9	31.1	
Level of Service	A	A		A	A		C	C		D	C	
Approach Delay (s)		7.2			8.8			31.7			41.2	
Approach LOS		A			A			C			D	

Intersection Summary			
HCM Average Control Delay	12.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	60.9%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	EBR	NBL	NBT	SBT	SBR	ø1	ø8
Lane Configurations								
Volume (vph)	0	175	75	715	1100	55		
Turn Type		Perm	Prot			Perm		
Protected Phases	4		5	2	6		1	8
Permitted Phases		4				6		
Detector Phase	4	4	5	2	6	6		
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	10.0	10.0	8.0	27.0	30.0	30.0	8.0	10.0
Total Split (s)	17.0	17.0	13.0	55.0	50.0	50.0	8.0	10.0
Total Split (%)	18.9%	18.9%	14.4%	61.1%	55.6%	55.6%	9%	11%
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	3.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	1.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0		
Total Lost Time (s)	6.0	6.0	4.0	6.0	6.0	6.0		
Lead/Lag			Lead	Lag	Lag	Lag	Lead	
Lead-Lag Optimize?								
Recall Mode	None	None	None	C-Max	C-Max	C-Max	None	None

Intersection Summary
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated

Splits and Phases: 114: Kuihelani Highway &

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	50	0	175	0	0	0	75	715	0	0	1100	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0				4.0	6.0			6.0	6.0
Lane Util. Factor		1.00	1.00				1.00	0.95			0.95	1.00
Frt		1.00	0.85				1.00	1.00			1.00	0.85
Flt Protected		0.95	1.00				0.95	1.00			1.00	1.00
Satd. Flow (prot)		1770	1583				1770	3539			3539	1583
Flt Permitted		0.95	1.00				0.95	1.00			1.00	1.00
Satd. Flow (perm)		1770	1583				1770	3539			3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	54	0	190	0	0	0	82	777	0	0	1196	60
RTOR Reduction (vph)	0	0	173	0	0	0	0	0	0	0	0	21
Lane Group Flow (vph)	0	54	17	0	0	0	82	777	0	0	1196	39
Turn Type	Split		Perm	Split			Prot			Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			4									6
Actuated Green, G (s)		8.2	8.2				7.0	69.8			58.8	58.8
Effective Green, g (s)		8.2	8.2				7.0	69.8			58.8	58.8
Actuated g/C Ratio		0.09	0.09				0.08	0.78			0.65	0.65
Clearance Time (s)		6.0	6.0				4.0	6.0			6.0	6.0
Vehicle Extension (s)		3.0	3.0				3.0	3.0			3.0	3.0
Lane Grp Cap (vph)		161	144				138	2745			2312	1034
v/s Ratio Prot		c0.03					c0.05	0.22			c0.34	
v/s Ratio Perm			0.01									0.02
v/c Ratio		0.34	0.12				0.59	0.28			0.52	0.04
Uniform Delay, d1		38.3	37.6				40.1	2.9			8.2	5.5
Progression Factor		1.00	1.00				1.00	1.00			0.57	0.41
Incremental Delay, d2		1.2	0.4				6.7	0.3			0.7	0.1
Delay (s)		39.6	38.0				46.8	3.2			5.4	2.3
Level of Service		D	D				D	A			A	A
Approach Delay (s)		38.3			0.0			7.3			5.2	
Approach LOS		D			A			A			A	

Intersection Summary			
HCM Average Control Delay	9.4	HCM Level of Service	A
HCM Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	51.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

APPENDIX C

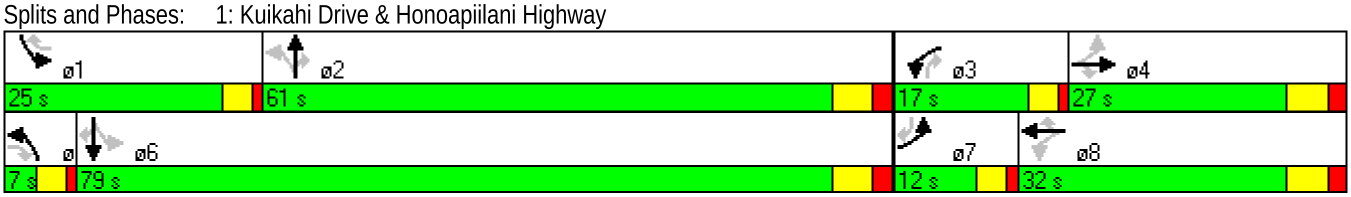
LEVEL OF SERVICE CALCULATIONS

- Year 2022 with Project Traffic and Mitigation Measures PM

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	25	100	25	240	190	135	35	645	135	335	920	45
Turn Type	pm+pt		custom	pm+pt		custom	pm+pt		custom	pm+pt		custom
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4 5	8		8 1	2		2 3	6		6 7
Detector Phase	7	4	4 5	3	8	8 1	5	2	2 3	1	6	6 7
Switch Phase												
Minimum Initial (s)	4.0	6.0		4.0	6.0		3.0	10.0		3.0	10.0	
Minimum Split (s)	10.0	27.0		10.0	27.0		7.0	27.0		7.0	27.0	
Total Split (s)	12.0	27.0	34.0	17.0	32.0	57.0	7.0	61.0	78.0	25.0	79.0	91.0
Total Split (%)	9.2%	20.8%	26.2%	13.1%	24.6%	43.8%	5.4%	46.9%	60.0%	19.2%	60.8%	70.0%
Yellow Time (s)	3.0	4.0		3.0	4.0		3.0	4.0		3.0	4.0	
All-Red Time (s)	1.0	2.0		1.0	2.0		1.0	2.0		1.0	2.0	
Lost Time Adjust (s)	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 Lost Time (s)	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Recall Mode	None	None		None	None		None	None		None	None	

Intersection Summary
Cycle Length: 130
Actuated Cycle Length: 117.7
Natural Cycle: 100
Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Kuikahi Drive & Honoapiilani Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	25	100	25	240	190	135	35	645	135	335	920	45
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-5%			0%			0%			0%	
Total Lost time (s)	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1814	1909	1623	1770	1863	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.63	1.00	1.00	0.50	1.00	1.00	0.09	1.00	1.00	0.11	1.00	1.00
Satd. Flow (perm)	1199	1909	1623	923	1863	1583	174	1863	1583	198	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	27	109	27	261	207	147	38	701	147	364	1000	49
RTOR Reduction (vph)	0	0	22	0	0	88	0	0	60	0	0	15
Lane Group Flow (vph)	27	109	5	261	207	59	38	701	87	364	1000	34
Turn Type	pm+pt		custom	pm+pt		custom	pm+pt		custom	pm+pt		custom
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4 5	8		8 1	2		2 3	6		6 7
Actuated Green, G (s)	18.8	13.4	21.7	30.3	20.9	48.1	54.3	52.0	70.9	77.2	70.9	82.3
Effective Green, g (s)	18.8	13.4	21.7	30.3	20.9	48.1	54.3	52.0	70.9	77.2	70.9	82.3
Actuated g/C Ratio	0.16	0.11	0.18	0.25	0.17	0.40	0.45	0.44	0.59	0.65	0.59	0.69
Clearance Time (s)	4.0	6.0		4.0	6.0		4.0	6.0		4.0	6.0	
Vehicle Extension (s)	3.0	2.0		3.0	2.0		2.0	5.0		2.0	5.0	
Lane Grp Cap (vph)	216	214	295	325	326	637	110	811	939	407	1105	1090
v/s Ratio Prot	0.01	0.06		c0.09	0.11		0.01	0.38		c0.16	c0.54	
v/s Ratio Perm	0.01		0.00	c0.12		0.04	0.15		0.06	0.42		0.02
v/c Ratio	0.12	0.51	0.02	0.80	0.63	0.09	0.35	0.86	0.09	0.89	0.90	0.03
Uniform Delay, d1	43.1	50.0	40.1	40.0	45.8	22.2	23.9	30.6	10.5	32.7	21.3	5.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.3	0.7	0.0	13.3	3.0	0.0	0.7	10.3	0.1	20.9	11.1	0.0
Delay (s)	43.3	50.7	40.1	53.3	48.7	22.2	24.6	40.9	10.5	53.6	32.4	5.9
Level of Service	D	D	D	D	D	C	C	D	B	D	C	A
Approach Delay (s)		47.7			44.3			35.1			37.0	
Approach LOS		D			D			D			D	

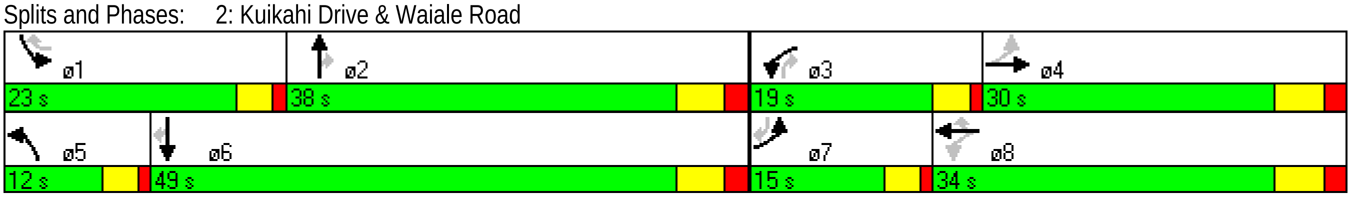
Intersection Summary			
HCM Average Control Delay	38.5	HCM Level of Service	D
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	119.5	Sum of lost time (s)	8.0
Intersection Capacity Utilization	86.6%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											
Volume (vph)	175	375	295	265	405	25	465	270	455	470	270
Turn Type	pm+pt		pm+pt		custom	Prot		custom	Prot		custom
Protected Phases	7	4	3	8		5	2		1	6	
Permitted Phases	4		8		8 1			2 3			6 7
Detector Phase	7	4	3	8	8 1	5	2	2 3	1	6	6 7
Switch Phase											
Minimum Initial (s)	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	8.0	30.0	8.0	30.0		8.0	30.0		8.0	30.0	
Total Split (s)	15.0	30.0	19.0	34.0	57.0	12.0	38.0	57.0	23.0	49.0	64.0
Total Split (%)	13.6%	27.3%	17.3%	30.9%	51.8%	10.9%	34.5%	51.8%	20.9%	44.5%	58.2%
Yellow Time (s)	3.0	4.0	3.0	4.0		3.0	4.0		3.0	4.0	
All-Red Time (s)	1.0	2.0	1.0	2.0		1.0	2.0		1.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?											
Recall Mode	None	None	None	None		None	None		None	None	

Intersection Summary
Cycle Length: 110
Actuated Cycle Length: 102.4
Natural Cycle: 90
Control Type: Actuated-Uncoordinated

Splits and Phases: 2: Kuikahi Drive & Waiale Road



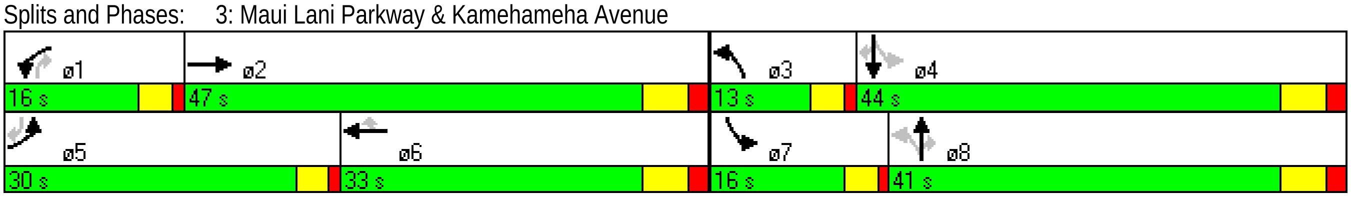
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	175	375	40	295	265	405	25	465	270	455	470	270
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3489		1770	1863	1583	1770	1863	1583	3433	1863	1583
Flt Permitted	0.42	1.00		0.26	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	779	3489		478	1863	1583	1770	1863	1583	3433	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	190	408	43	321	288	440	27	505	293	495	511	293
RTOR Reduction (vph)	0	7	0	0	0	90	0	0	32	0	0	117
Lane Group Flow (vph)	190	444	0	321	288	350	27	505	261	495	511	176
Turn Type	pm+pt			pm+pt		custom	Prot		custom	Prot		custom
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8		8 1			2 3			6 7
Actuated Green, G (s)	29.4	18.9		37.5	23.0	47.1	4.4	32.5	53.1	18.1	46.2	62.7
Effective Green, g (s)	29.4	18.9		37.5	23.0	47.1	4.4	32.5	53.1	18.1	46.2	62.7
Actuated g/C Ratio	0.28	0.18		0.36	0.22	0.45	0.04	0.31	0.51	0.17	0.44	0.60
Clearance Time (s)	4.0	6.0		4.0	6.0		4.0	6.0		4.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	320	633		353	412	716	75	582	807	597	827	953
v/s Ratio Prot	0.06	0.13		c0.13	0.15		0.02	c0.27		c0.14	0.27	
v/s Ratio Perm	0.11			c0.20		0.22			0.16			0.11
v/c Ratio	0.59	0.70		0.91	0.70	0.49	0.36	0.87	0.32	0.83	0.62	0.19
Uniform Delay, d1	30.2	39.9		27.0	37.4	20.0	48.5	33.8	15.0	41.5	22.2	9.3
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.9	3.5		26.2	5.1	0.5	2.9	12.9	0.2	9.3	1.4	0.1
Delay (s)	33.1	43.5		53.2	42.5	20.6	51.4	46.7	15.2	50.8	23.6	9.4
Level of Service	C	D		D	D	C	D	D	B	D	C	A
Approach Delay (s)		40.4			36.6			35.7			30.7	
Approach LOS		D			D			D			C	

Intersection Summary			
HCM Average Control Delay	35.0	HCM Level of Service	D
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	104.1	Sum of lost time (s)	14.0
Intersection Capacity Utilization	82.1%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											
Volume (vph)	520	645	120	685	365	170	485	70	215	460	450
Turn Type	Prot		Prot		Perm	pm+pt		custom	pm+pt		custom
Protected Phases	5	2	1	6		3	8		7	4	
Permitted Phases					6	8		8 1	4		4 5
Detector Phase	5	2	1	6	6	3	8	8 1	7	4	4 5
Switch Phase											
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Minimum Split (s)	8.0	30.0	8.0	30.0	30.0	8.0	34.0		8.0	34.0	
Total Split (s)	30.0	47.0	16.0	33.0	33.0	13.0	41.0	57.0	16.0	44.0	74.0
Total Split (%)	25.0%	39.2%	13.3%	27.5%	27.5%	10.8%	34.2%	47.5%	13.3%	36.7%	61.7%
Yellow Time (s)	3.0	4.0	3.0	4.0	4.0	3.0	4.0		3.0	4.0	
All-Red Time (s)	1.0	2.0	1.0	2.0	2.0	1.0	2.0		1.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?											
Recall Mode	None	None	None	None	None	None	None		None	None	

Intersection Summary
Cycle Length: 120
Actuated Cycle Length: 119.9
Natural Cycle: 100
Control Type: Actuated-Uncoordinated

Splits and Phases: 3: Maui Lani Parkway & Kamehameha Avenue



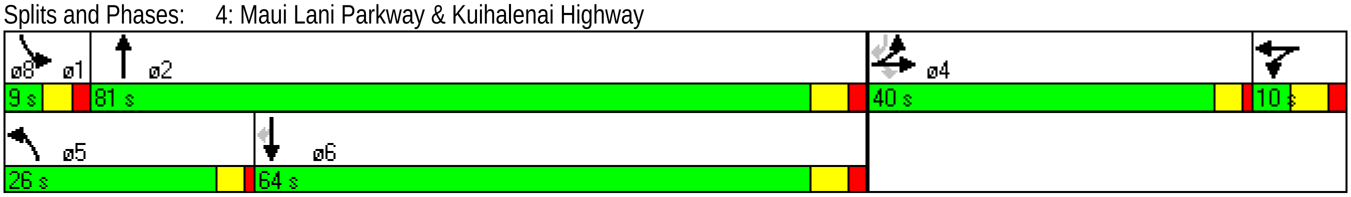
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	520	645	320	120	685	365	170	485	70	215	460	450
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	*0.75	0.95		1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.95		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	2654	3363		1770	3539	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.17	1.00	1.00	0.11	1.00	1.00
Satd. Flow (perm)	2654	3363		1770	3539	1583	317	1863	1583	197	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	565	701	348	130	745	397	185	527	76	234	500	489
RTOR Reduction (vph)	0	51	0	0	0	164	0	0	30	0	0	21
Lane Group Flow (vph)	565	998	0	130	745	233	185	527	46	234	500	468
Turn Type	Prot			Prot		Perm	pm+pt		custom	pm+pt		custom
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases						6	8		8 1	4		4 5
Actuated Green, G (s)	26.0	41.5		11.5	27.0	27.0	43.9	34.9	52.4	49.9	37.9	69.9
Effective Green, g (s)	26.0	41.5		11.5	27.0	27.0	43.9	34.9	52.4	49.9	37.9	69.9
Actuated g/C Ratio	0.22	0.35		0.10	0.23	0.23	0.37	0.29	0.44	0.42	0.32	0.58
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	4.0	6.0		4.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	576	1164		170	797	356	225	542	692	239	589	923
v/s Ratio Prot	c0.21	c0.30		0.07	0.21		0.06	0.28		c0.10	0.27	
v/s Ratio Perm						0.15	0.24		0.03	c0.31		0.30
v/c Ratio	0.98	0.86		0.76	0.93	0.65	0.82	0.97	0.07	0.98	0.85	0.51
Uniform Delay, d1	46.7	36.4		52.9	45.6	42.2	29.6	42.0	19.6	32.9	38.3	14.8
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	32.5	6.4		18.3	17.9	4.3	20.9	31.5	0.0	51.7	11.0	0.4
Delay (s)	79.2	42.9		71.2	63.4	46.5	50.5	73.5	19.6	84.6	49.3	15.2
Level of Service	E	D		E	E	D	D	E	B	F	D	B
Approach Delay (s)		55.6			58.9			62.9			42.4	
Approach LOS		E			E			E			D	

Intersection Summary			
HCM Average Control Delay	54.4	HCM Level of Service	D
HCM Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	119.9	Sum of lost time (s)	12.0
Intersection Capacity Utilization	88.8%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	NBL	NBT	SBT	SBR	ø1	ø8
Lane Configurations									
Volume (vph)	730	0	105	250	1310	1480	965		
Turn Type	Split		Perm	Prot			custom		
Protected Phases	4	4		5	2	6		1	8
Permitted Phases			4				6 4		
Detector Phase	4	4	4	5	2	6	6 4		
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0
Minimum Split (s)	8.0	8.0	8.0	8.0	10.0	27.0		9.0	10.0
Total Split (s)	40.0	40.0	40.0	26.0	81.0	64.0	104.0	9.0	10.0
Total Split (%)	28.6%	28.6%	28.6%	18.6%	57.9%	45.7%	74.3%	6%	7%
Yellow Time (s)	3.0	3.0	3.0	3.0	4.0	4.0		3.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	2.0	2.0		2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Total Lost Time (s)	4.0	4.0	4.0	4.0	6.0	6.0	6.0		
Lead/Lag				Lead	Lag	Lag		Lead	
Lead-Lag Optimize?									
Recall Mode	None	None	None	None	None	None		None	None

Intersection Summary
Cycle Length: 140
Actuated Cycle Length: 123
Natural Cycle: 90
Control Type: Actuated-Uncoordinated

Splits and Phases: 4: Maui Lani Parkway & Kuihalenai Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	730	0	105	0	0	0	250	1310	0	0	1480	965
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0				4.0	6.0			6.0	6.0
Lane Util. Factor	0.95	0.95	1.00				0.97	0.95			0.95	1.00
Frt	1.00	1.00	0.85				1.00	1.00			1.00	0.85
Flt Protected	0.95	0.95	1.00				0.95	1.00			1.00	1.00
Satd. Flow (prot)	1681	1681	1583				3433	3539			3539	1583
Flt Permitted	0.95	0.95	1.00				0.95	1.00			1.00	1.00
Satd. Flow (perm)	1681	1681	1583				3433	3539			3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	793	0	114	0	0	0	272	1424	0	0	1609	1049
RTOR Reduction (vph)	0	0	35	0	0	0	0	0	0	0	0	56
Lane Group Flow (vph)	396	397	79	0	0	0	272	1424	0	0	1609	993
Turn Type	Split		Perm	Split			Prot			Prot		custom
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			4									6 4
Actuated Green, G (s)	35.9	35.9	35.9				15.0	77.0			58.0	99.9
Effective Green, g (s)	35.9	35.9	35.9				15.0	77.0			58.0	99.9
Actuated g/C Ratio	0.29	0.29	0.29				0.12	0.63			0.47	0.81
Clearance Time (s)	4.0	4.0	4.0				4.0	6.0			6.0	
Vehicle Extension (s)	3.0	3.0	3.0				3.0	3.0			3.0	
Lane Grp Cap (vph)	491	491	462				419	2217			1670	1287
v/s Ratio Prot	0.24	0.24					0.08	c0.40			c0.45	
v/s Ratio Perm			0.05									c0.63
v/c Ratio	0.81	0.81	0.17				0.65	0.64			0.96	0.77
Uniform Delay, d1	40.3	40.3	32.4				51.4	14.3			31.4	5.8
Progression Factor	1.00	1.00	1.00				1.00	1.00			1.00	1.00
Incremental Delay, d2	9.4	9.5	0.2				3.5	0.6			14.3	2.9
Delay (s)	49.7	49.8	32.6				54.9	15.0			45.7	8.7
Level of Service	D	D	C				D	B			D	A
Approach Delay (s)		47.6			0.0			21.4			31.1	
Approach LOS		D			A			C			C	

Intersection Summary			
HCM Average Control Delay	30.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	122.9	Sum of lost time (s)	12.0
Intersection Capacity Utilization	79.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations										
Volume (vph)	40	15	30	75	20	15	615	145	870	45
Turn Type	Perm		custom	Perm		pm+pt		pm+pt		Perm
Protected Phases		4			8	5	2	1	6	
Permitted Phases	4		4 5	8		2		6		6
Detector Phase	4	4	4 5	8	8	5	2	1	6	6
Switch Phase										
Minimum Initial (s)	6.0	6.0		6.0	6.0	3.0	10.0	3.0	10.0	10.0
Minimum Split (s)	23.0	23.0		27.0	27.0	7.0	31.0	7.0	26.0	26.0
Total Split (s)	27.0	27.0	34.0	27.0	27.0	7.0	64.0	9.0	66.0	66.0
Total Split (%)	27.0%	27.0%	34.0%	27.0%	27.0%	7.0%	64.0%	9.0%	66.0%	66.0%
Yellow Time (s)	4.0	4.0		4.0	4.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	6.0	4.0	6.0	6.0
Lead/Lag						Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?										
Recall Mode	None	None		None	None	None	C-Max	None	C-Max	C-Max

Intersection Summary
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated

Splits and Phases: 5: Waiko Road & Honoapiilani Highway

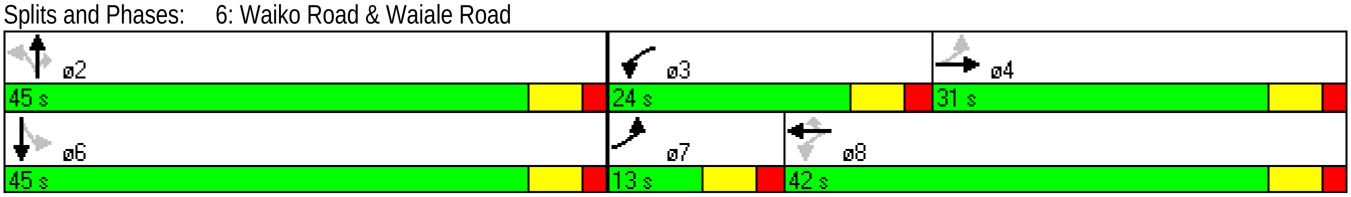
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	40	15	30	75	20	70	15	615	170	145	870	45
Ideal Flow (vphpl)	1900	1900	1900	1600	1600	1600	1900	1900	1900	1900	1900	1900
Grade (%)		-8%			0%			0%			0%	
Total Lost time (s)		5.0	5.0		5.0		4.0	6.0		4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	0.97
Flpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt		1.00	0.85		0.94		1.00	0.97		1.00	1.00	0.85
Flt Protected		0.96	1.00		0.98		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1869	1647		1446		1770	1802		1770	1863	1539
Flt Permitted		0.65	1.00		0.83		0.18	1.00		0.19	1.00	1.00
Satd. Flow (perm)		1256	1647		1221		341	1802		361	1863	1539
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	43	16	33	82	22	76	16	668	185	158	946	49
RTOR Reduction (vph)	0	0	26	0	29	0	0	9	0	0	0	8
Lane Group Flow (vph)	0	59	7	0	151	0	16	844	0	158	946	41
Confl. Peds. (#/hr)							3					3
Turn Type	Perm		custom	Perm			pm+pt			pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 5	8			2			6		6
Actuated Green, G (s)		15.9	22.7		15.9		65.9	64.1		72.3	67.3	67.3
Effective Green, g (s)		15.9	22.7		15.9		65.9	64.1		72.3	67.3	67.3
Actuated g/C Ratio		0.16	0.23		0.16		0.66	0.64		0.72	0.67	0.67
Clearance Time (s)		5.0			5.0		4.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)		2.0			2.0		2.0	5.0		2.0	5.0	5.0
Lane Grp Cap (vph)		200	374		194		250	1155		331	1254	1036
v/s Ratio Prot							0.00	0.47		c0.02	c0.51	
v/s Ratio Perm		0.05	0.00		c0.12		0.04			0.32		0.03
v/c Ratio		0.29	0.02		0.78		0.06	0.73		0.48	0.75	0.04
Uniform Delay, d1		37.1	30.0		40.4		9.6	12.1		10.0	10.9	5.5
Progression Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2		0.3	0.0		16.9		0.0	4.1		0.4	4.2	0.1
Delay (s)		37.4	30.0		57.3		9.7	16.2		10.4	15.1	5.6
Level of Service		D	C		E		A	B		B	B	A
Approach Delay (s)		34.8			57.3			16.1			14.1	
Approach LOS		C			E			B			B	

Intersection Summary			
HCM Average Control Delay	19.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	81.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations										
Volume (vph)	55	310	410	185	175	15	450	370	110	485
Turn Type	pm+pt		pm+pt		Perm	Perm		Perm	Perm	
Protected Phases	7	4	3	8			2			6
Permitted Phases	4		8		8	2		2	6	
Detector Phase	7	4	3	8	8	2	2	2	6	6
Switch Phase										
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	10.0	24.0	10.0	24.0	24.0	27.0	27.0	27.0	27.0	27.0
Total Split (s)	13.0	31.0	24.0	42.0	42.0	45.0	45.0	45.0	45.0	45.0
Total Split (%)	13.0%	31.0%	24.0%	42.0%	42.0%	45.0%	45.0%	45.0%	45.0%	45.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag					
Lead-Lag Optimize?										
Recall Mode	None	None	None	None	None	None	None	None	None	None

Intersection Summary
Cycle Length: 100
Actuated Cycle Length: 90.5
Natural Cycle: 75
Control Type: Actuated-Uncoordinated

Splits and Phases: 6: Waiko Road & Waiale Road



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	310	15	410	185	175	15	450	370	110	485	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1850		1770	1863	1583	1770	1863	1583	1770	1842	
Flt Permitted	0.63	1.00		0.23	1.00	1.00	0.16	1.00	1.00	0.25	1.00	
Satd. Flow (perm)	1177	1850		421	1863	1583	292	1863	1583	462	1842	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	60	337	16	446	201	190	16	489	402	120	527	43
RTOR Reduction (vph)	0	2	0	0	0	116	0	0	258	0	3	0
Lane Group Flow (vph)	60	351	0	446	201	74	16	489	144	120	567	0
Turn Type	pm+pt			pm+pt		Perm	Perm		Perm	Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)	27.8	22.6		46.9	35.7	35.7	32.7	32.7	32.7	32.7	32.7	
Effective Green, g (s)	27.8	22.6		46.9	35.7	35.7	32.7	32.7	32.7	32.7	32.7	
Actuated g/C Ratio	0.30	0.25		0.51	0.39	0.39	0.36	0.36	0.36	0.36	0.36	
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	391	456		485	726	617	104	665	565	165	658	
v/s Ratio Prot	0.01	0.19		c0.18	0.11			0.26			c0.31	
v/s Ratio Perm	0.04			c0.29		0.05	0.05		0.09	0.26		
v/c Ratio	0.15	0.77		0.92	0.28	0.12	0.15	0.74	0.25	0.73	0.86	
Uniform Delay, d1	23.0	32.1		18.3	19.1	17.9	20.0	25.7	20.8	25.6	27.3	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.2	7.9		22.4	0.2	0.1	0.7	4.2	0.2	14.8	11.2	
Delay (s)	23.2	40.0		40.8	19.3	18.0	20.7	29.9	21.1	40.3	38.5	
Level of Service	C	D		D	B	B	C	C	C	D	D	
Approach Delay (s)		37.5			30.5			25.8			38.8	
Approach LOS		D			C			C			D	

Intersection Summary			
HCM Average Control Delay	32.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	91.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	91.2%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	530	265	285	870	975	440
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Detector Phase	4	4 5	5	2	6	6 4
Switch Phase						
Minimum Initial (s)	6.0		4.0	10.0	10.0	
Minimum Split (s)	28.0		8.0	16.0	27.0	
Total Split (s)	28.0	57.0	29.0	72.0	43.0	71.0
Total Split (%)	28.0%	57.0%	29.0%	72.0%	43.0%	71.0%
Yellow Time (s)	3.0		3.0	4.0	4.0	
All-Red Time (s)	1.0		1.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?						
Recall Mode	None		None	C-Max	C-Max	

Intersection Summary
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 80
Control Type: Actuated-Coordinated

Splits and Phases: 7: Waiko Road & Kuihelani Highway

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	530	265	285	870	975	440
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lane Util. Factor	0.97	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	3433	1583	1770	3539	3539	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	3433	1583	1770	3539	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	1.00
Adj. Flow (vph)	576	288	310	946	1060	440
RTOR Reduction (vph)	0	12	0	0	0	62
Lane Group Flow (vph)	576	276	310	946	1060	378
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Actuated Green, G (s)	21.1	46.0	20.9	68.9	44.0	71.1
Effective Green, g (s)	21.1	46.0	20.9	68.9	44.0	71.1
Actuated g/C Ratio	0.21	0.46	0.21	0.69	0.44	0.71
Clearance Time (s)	4.0		4.0	6.0	6.0	
Vehicle Extension (s)	2.0		2.0	5.0	5.0	
Lane Grp Cap (vph)	724	728	370	2438	1557	1126
v/s Ratio Prot	c0.17		c0.18	0.27	c0.30	
v/s Ratio Perm		0.17				0.24
v/c Ratio	0.80	0.38	0.84	0.39	0.68	0.34
Uniform Delay, d1	37.4	17.7	37.9	6.6	22.4	5.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	5.7	0.1	14.5	0.5	2.4	0.1
Delay (s)	43.1	17.8	52.5	7.1	24.8	5.5
Level of Service	D	B	D	A	C	A
Approach Delay (s)	34.6			18.3	19.2	
Approach LOS	C			B	B	

Intersection Summary			
HCM Average Control Delay	22.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	69.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Configurations											
Volume (vph)	270	30	850	15	80	10	605	540	15	540	95
Turn Type	Perm		custom	Perm		Perm	Prot		Prot		Perm
Protected Phases		4			8		5	2	1	6	
Permitted Phases	4		4 5 2	8		8					6
Detector Phase	4	4	4 5 2	8	8	8	5	2	1	6	6
Switch Phase											
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	27.0	27.0		27.0	27.0	27.0	8.0	10.0	8.0	27.0	27.0
Total Split (s)	43.0	43.0	138.0	43.0	43.0	43.0	31.0	64.0	13.0	46.0	46.0
Total Split (%)	35.8%	35.8%	115.0%	35.8%	35.8%	35.8%	25.8%	53.3%	10.8%	38.3%	38.3%
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	1.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	4.0	6.0	4.0	6.0	6.0
Lead/Lag							Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?											
Recall Mode	None	None		None	None	None	None	None	None	None	None

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 112.2
Natural Cycle: 90
Control Type: Actuated-Uncoordinated

Splits and Phases: 8: Kuikahi Dr & Maui Lani Parkway

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	270	30	850	15	80	10	605	540	20	15	540	95
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	4.0	6.0		4.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	3433	1853		1770	1863	1583
Flt Permitted	0.70	1.00	1.00	0.74	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1305	1863	1583	1370	1863	1583	3433	1853		1770	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	293	33	924	16	87	11	658	587	22	16	587	103
RTOR Reduction (vph)	0	0	0	0	0	8	0	1	0	0	0	25
Lane Group Flow (vph)	293	33	924	16	87	3	658	608	0	16	587	78
Turn Type	Perm		custom	Perm		Perm	Prot			Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 5 2	8		8						6
Actuated Green, G (s)	32.2	32.2	114.4	32.2	32.2	32.2	25.7	63.3		2.9	40.5	40.5
Effective Green, g (s)	32.2	32.2	114.4	32.2	32.2	32.2	25.7	63.3		2.9	40.5	40.5
Actuated g/C Ratio	0.28	0.28	1.00	0.28	0.28	0.28	0.22	0.55		0.03	0.35	0.35
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0	4.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	367	524	1583	386	524	446	771	1025		45	660	560
v/s Ratio Prot		0.02			0.05		c0.19	0.33		0.01	c0.32	
v/s Ratio Perm	c0.22		c0.58	0.01		0.00						0.05
v/c Ratio	0.80	0.06	0.58	0.04	0.17	0.01	0.85	0.59		0.36	0.89	0.14
Uniform Delay, d1	38.1	30.1	0.0	29.9	31.0	29.6	42.5	17.0		54.8	34.8	25.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	11.5	0.1	0.6	0.0	0.2	0.0	9.1	0.9		4.8	13.9	0.1
Delay (s)	49.6	30.1	0.6	29.9	31.1	29.6	51.6	17.9		59.6	48.7	25.2
Level of Service	D	C	A	C	C	C	D	B		E	D	C
Approach Delay (s)		12.8			30.8			35.4			45.5	
Approach LOS		B			C			D			D	

Intersection Summary			
HCM Average Control Delay	28.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	114.4	Sum of lost time (s)	12.0
Intersection Capacity Utilization	99.4%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	885	215	50	755	50	40
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	962	234	54	821	54	43
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						4
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				1079		
pX, platoon unblocked						
vC, conflicting volume			1196		1598	598
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1196		1598	598
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			91		38	90
cM capacity (veh/h)			580		88	446

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	641	554	54	410	410	98
Volume Left	0	0	54	0	0	54
Volume Right	0	234	0	0	0	43
cSH	1700	1700	580	1700	1700	158
Volume to Capacity	0.38	0.33	0.09	0.24	0.24	0.62
Queue Length 95th (ft)	0	0	8	0	0	84
Control Delay (s)	0.0	0.0	11.9	0.0	0.0	60.0
Lane LOS			B			F
Approach Delay (s)	0.0		0.7			60.0
Approach LOS						F

Intersection Summary			
Average Delay	3.0		
Intersection Capacity Utilization	48.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	20	60	135	40	120	150
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	22	65	147	43	130	163
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	571	147			190	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	571	147			190	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	95	93			91	
cM capacity (veh/h)	437	900			1384	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	87	147	43	130	163
Volume Left	22	0	0	130	0
Volume Right	65	0	43	0	0
cSH	712	1700	1700	1384	1700
Volume to Capacity	0.12	0.09	0.03	0.09	0.10
Queue Length 95th (ft)	10	0	0	8	0
Control Delay (s)	10.8	0.0	0.0	7.9	0.0
Lane LOS	B			A	
Approach Delay (s)	10.8	0.0		3.5	
Approach LOS	B				

Intersection Summary			
Average Delay	3.4		
Intersection Capacity Utilization	28.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	10	100	20	35	70	285	15	190	80	150	255	15
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	109	22	38	76	310	16	207	87	163	277	16
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)			4			4						
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1043	938	285	951	902	250	293			293		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1043	938	285	951	902	250	293			293		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	87	52	97	71	68	61	99			87		
cM capacity (veh/h)	85	228	754	131	239	789	1268			1268		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	141	424	16	293	163	293
Volume Left	11	38	16	0	163	0
Volume Right	22	310	0	87	0	16
cSH	254	753	1268	1700	1268	1700
Volume to Capacity	0.56	0.56	0.01	0.17	0.13	0.17
Queue Length 95th (ft)	77	89	1	0	11	0
Control Delay (s)	36.2	20.8	7.9	0.0	8.3	0.0
Lane LOS	E	C	A		A	
Approach Delay (s)	36.2	20.8	0.4		2.9	
Approach LOS	E	C				

Intersection Summary			
Average Delay	11.6		
Intersection Capacity Utilization	48.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	30	320	0	85	340	40	25	0	40	40	0	35
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	33	348	0	92	370	43	27	0	43	43	0	38
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	413			348			1005	1011	348	1033	989	391
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	413			348			1005	1011	348	1033	989	391
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			92			86	100	94	76	100	94
cM capacity (veh/h)	1146			1211			191	215	695	182	221	657

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	33	348	92	413	27	43	43	38
Volume Left	33	0	92	0	27	0	43	0
Volume Right	0	0	0	43	0	43	0	38
cSH	1146	1700	1211	1700	191	695	182	657
Volume to Capacity	0.03	0.20	0.08	0.24	0.14	0.06	0.24	0.06
Queue Length 95th (ft)	2	0	6	0	12	5	22	5
Control Delay (s)	8.2	0.0	8.2	0.0	27.0	10.5	30.9	10.8
Lane LOS	A		A		D	B	D	B
Approach Delay (s)	0.7		1.5		16.8		21.5	
Approach LOS					C		C	

Intersection Summary			
Average Delay	3.8		
Intersection Capacity Utilization	42.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	275	100	165	375	170	85
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	299	109	179	408	185	92
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				1270		
pX, platoon unblocked						
vC, conflicting volume			408		1065	299
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			408		1065	299
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			84		11	88
cM capacity (veh/h)			1151		208	741

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total	299	109	179	408	185	92
Volume Left	0	0	179	0	185	0
Volume Right	0	109	0	0	0	92
cSH	1700	1700	1151	1700	208	741
Volume to Capacity	0.18	0.06	0.16	0.24	0.89	0.12
Queue Length 95th (ft)	0	0	14	0	175	11
Control Delay (s)	0.0	0.0	8.7	0.0	84.1	10.6
Lane LOS			A		F	B
Approach Delay (s)	0.0		2.7		59.6	
Approach LOS					F	

Intersection Summary			
Average Delay	14.2		
Intersection Capacity Utilization	43.0%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	340	195	170	1230	1265	375
Turn Type		Perm	Prot			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Detector Phase	4	4	5	2	6	6
Switch Phase						
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	30.0	30.0	10.0	27.0	30.0	30.0
Total Split (s)	30.0	30.0	16.0	60.0	44.0	44.0
Total Split (%)	33.3%	33.3%	17.8%	66.7%	48.9%	48.9%
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	4.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	Lag
Lead-Lag Optimize?						
Recall Mode	None	None	None	None	None	None

Intersection Summary
Cycle Length: 90
Actuated Cycle Length: 86.7
Natural Cycle: 80
Control Type: Actuated-Uncoordinated

Splits and Phases: 105: Road C & Kuihelnai Hwy

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	340	195	170	1230	1265	375
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	4.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	3539	3539	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	3539	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	370	212	185	1337	1375	408
RTOR Reduction (vph)	0	159	0	0	0	231
Lane Group Flow (vph)	370	53	185	1337	1375	177
Turn Type		Perm	Prot			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Actuated Green, G (s)	21.5	21.5	11.5	53.2	37.7	37.7
Effective Green, g (s)	21.5	21.5	11.5	53.2	37.7	37.7
Actuated g/C Ratio	0.25	0.25	0.13	0.61	0.43	0.43
Clearance Time (s)	6.0	6.0	4.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	439	393	235	2172	1539	688
v/s Ratio Prot	c0.21		c0.10	0.38	c0.39	
v/s Ratio Perm		0.03				0.11
v/c Ratio	0.84	0.13	0.79	0.62	0.89	0.26
Uniform Delay, d1	31.0	25.4	36.4	10.4	22.6	15.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	13.7	0.2	15.9	0.5	7.0	0.2
Delay (s)	44.7	25.5	52.3	10.9	29.7	15.8
Level of Service	D	C	D	B	C	B
Approach Delay (s)	37.7			15.9	26.5	
Approach LOS	D			B	C	

Intersection Summary			
HCM Average Control Delay	24.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	86.7	Sum of lost time (s)	16.0
Intersection Capacity Utilization	76.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	10	15	175	15	60	115
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	16	190	16	65	125
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	446	190			207	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	446	190			207	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	98	98			95	
cM capacity (veh/h)	543	852			1365	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	27	190	16	65	125
Volume Left	11	0	0	65	0
Volume Right	16	0	16	0	0
cSH	694	1700	1700	1365	1700
Volume to Capacity	0.04	0.11	0.01	0.05	0.07
Queue Length 95th (ft)	3	0	0	4	0
Control Delay (s)	10.4	0.0	0.0	7.8	0.0
Lane LOS	B			A	
Approach Delay (s)	10.4	0.0		2.7	
Approach LOS	B				

Intersection Summary			
Average Delay	1.9		
Intersection Capacity Utilization	25.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	45	25	50	10	40	40	35	180	25	30	260	10
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	49	27	54	11	43	43	38	196	27	33	283	11
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)			4			4						
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	668	652	288	674	644	209	293			223		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	668	652	288	674	644	209	293			223		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	84	93	93	96	88	95	97			98		
cM capacity (veh/h)	308	366	751	309	370	831	1268			1346		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	130	98	38	223	33	293
Volume Left	49	11	38	0	33	0
Volume Right	54	43	0	27	0	11
cSH	563	645	1268	1700	1346	1700
Volume to Capacity	0.23	0.15	0.03	0.13	0.02	0.17
Queue Length 95th (ft)	22	13	2	0	2	0
Control Delay (s)	15.5	13.6	7.9	0.0	7.7	0.0
Lane LOS	C	B	A		A	
Approach Delay (s)	15.5	13.6	1.2		0.8	
Approach LOS	C	B				

Intersection Summary			
Average Delay	4.8		
Intersection Capacity Utilization	38.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	30	15	30	185	90	20
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	33	16	33	201	98	22
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	364	98	120			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	364	98	120			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	95	98	98			
cM capacity (veh/h)	621	958	1468			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	49	33	201	98	22
Volume Left	33	33	0	0	0
Volume Right	16	0	0	0	22
cSH	704	1468	1700	1700	1700
Volume to Capacity	0.07	0.02	0.12	0.06	0.01
Queue Length 95th (ft)	6	2	0	0	0
Control Delay (s)	10.5	7.5	0.0	0.0	0.0
Lane LOS	B	A			
Approach Delay (s)	10.5	1.0		0.0	
Approach LOS	B				

Intersection Summary			
Average Delay	1.9		
Intersection Capacity Utilization	19.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	5	735	45	25	695	5	15	0	25	20	0	15
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	799	49	27	755	5	16	0	27	22	0	16
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		844										
pX, platoon unblocked				0.87			0.87	0.87	0.87	0.87	0.87	
vC, conflicting volume	761			848			1660	1649	823	1649	1671	758
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	761			752			1684	1672	724	1672	1696	758
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			96			73	100	93	63	100	96
cM capacity (veh/h)	851			748			60	80	371	60	77	407

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1
Volume Total	5	848	27	761	16	27	38
Volume Left	5	0	27	0	16	0	22
Volume Right	0	49	0	5	0	27	16
cSH	851	1700	748	1700	60	371	94
Volume to Capacity	0.01	0.50	0.04	0.45	0.27	0.07	0.41
Queue Length 95th (ft)	0	0	3	0	24	6	41
Control Delay (s)	9.3	0.0	10.0	0.0	85.3	15.5	67.4
Lane LOS	A		A		F	C	F
Approach Delay (s)	0.1		0.3		41.7		67.4
Approach LOS					E		F

Intersection Summary			
Average Delay	2.7		
Intersection Capacity Utilization	56.8%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	90	665	550	80	60	135
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	98	723	598	87	65	147
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						4
Median type		None	None			
Median storage veh)						
Upstream signal (ft)			564			
pX, platoon unblocked	0.80				0.80	0.80
vC, conflicting volume	685				1516	598
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	484				1520	375
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	89				30	73
cM capacity (veh/h)	866				93	538

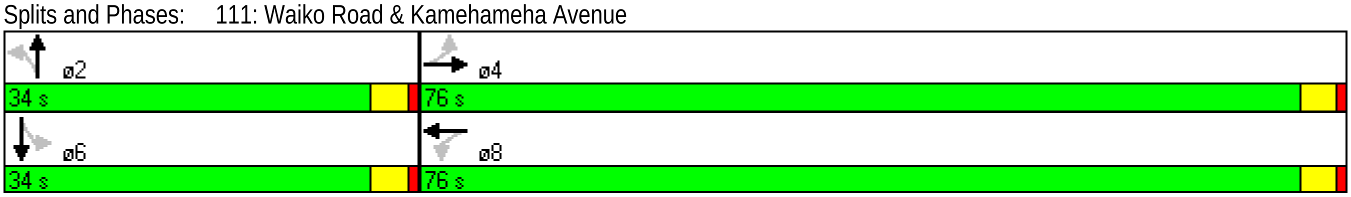
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1
Volume Total	98	723	598	87	212
Volume Left	98	0	0	0	65
Volume Right	0	0	0	87	147
cSH	866	1700	1700	1700	302
Volume to Capacity	0.11	0.43	0.35	0.05	0.70
Queue Length 95th (ft)	10	0	0	0	123
Control Delay (s)	9.7	0.0	0.0	0.0	42.4
Lane LOS	A				E
Approach Delay (s)	1.2		0.0		42.4
Approach LOS					E

Intersection Summary			
Average Delay	5.8		
Intersection Capacity Utilization	47.3%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	25	635	20	510	20	70	145	70
Turn Type	Perm		Perm		Perm		Perm	
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0
Total Split (s)	76.0	76.0	76.0	76.0	34.0	34.0	34.0	34.0
Total Split (%)	69.1%	69.1%	69.1%	69.1%	30.9%	30.9%	30.9%	30.9%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	C-Max	C-Max	None	None

Intersection Summary
Cycle Length: 110
Actuated Cycle Length: 110
Offset: 0 (0%), Referenced to phase 2:NBTL, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated

Splits and Phases: 111: Waiko Road & Kamehameha Avenue



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	25	635	65	20	510	130	20	70	5	145	70	110
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.97		1.00	0.99		1.00	0.91	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1837		1770	1806		1770	1845		1770	1692	
Flt Permitted	0.22	1.00		0.17	1.00		0.57	1.00		0.70	1.00	
Satd. Flow (perm)	405	1837		320	1806		1061	1845		1312	1692	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	27	690	71	22	554	141	22	76	5	158	76	120
RTOR Reduction (vph)	0	5	0	0	11	0	0	2	0	0	44	0
Lane Group Flow (vph)	27	756	0	22	684	0	22	79	0	158	152	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	60.0	60.0		60.0	60.0		42.0	42.0		42.0	42.0	
Effective Green, g (s)	60.0	60.0		60.0	60.0		42.0	42.0		42.0	42.0	
Actuated g/C Ratio	0.55	0.55		0.55	0.55		0.38	0.38		0.38	0.38	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	221	1002		175	985		405	704		501	646	
v/s Ratio Prot		c0.41			0.38			0.04			0.09	
v/s Ratio Perm	0.07			0.07			0.02			c0.12		
v/c Ratio	0.12	0.75		0.13	0.69		0.05	0.11		0.32	0.24	
Uniform Delay, d1	12.2	19.3		12.2	18.3		21.5	22.0		23.9	23.1	
Progression Factor	1.00	1.00		1.06	0.99		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.2	3.3		0.3	1.9		0.3	0.3		0.4	0.2	
Delay (s)	12.4	22.6		13.2	20.1		21.7	22.3		24.3	23.3	
Level of Service	B	C		B	C		C	C		C	C	
Approach Delay (s)		22.2			19.9			22.2			23.7	
Approach LOS		C			B			C			C	

Intersection Summary			
HCM Average Control Delay	21.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	60.6%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	730	50	25	595	40	25
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	793	54	27	647	43	27
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						4
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	845			769		
pX, platoon unblocked			0.69		0.72	0.69
vC, conflicting volume			848		1495	793
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			554		1284	475
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			96		66	93
cM capacity (veh/h)			701		126	406

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	793	54	27	647	71
Volume Left	0	0	27	0	43
Volume Right	0	54	0	0	27
cSH	1700	1700	701	1700	206
Volume to Capacity	0.47	0.03	0.04	0.38	0.34
Queue Length 95th (ft)	0	0	3	0	36
Control Delay (s)	0.0	0.0	10.3	0.0	34.9
Lane LOS			B		D
Approach Delay (s)	0.0		0.4		34.9
Approach LOS					D

Intersection Summary			
Average Delay	1.7		
Intersection Capacity Utilization	48.4%	ICU Level of Service	A
Analysis Period (min)	15		

113: Waiko Road & Road B

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	30	665	20	575	10	75	90	45
Turn Type	Perm		Perm		Perm		Perm	
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0
Total Split (s)	84.0	84.0	84.0	84.0	26.0	26.0	26.0	26.0
Total Split (%)	76.4%	76.4%	76.4%	76.4%	23.6%	23.6%	23.6%	23.6%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	C-Max	C-Max	C-Max	C-Max	None	None	None	None

Intersection Summary
Cycle Length: 110
Actuated Cycle Length: 110
Offset: 26 (24%), Referenced to phase 4:EBTL and 8:WBTL, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated

Splits and Phases: 113: Waiko Road & Road B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	30	665	60	20	575	145	10	75	20	90	45	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.97		1.00	0.97		1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1840		1770	1806		1770	1804		1770	1794	
Flt Permitted	0.31	1.00		0.31	1.00		0.71	1.00		0.60	1.00	
Satd. Flow (perm)	585	1840		581	1806		1331	1804		1115	1794	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	33	723	65	22	625	158	11	82	22	98	49	16
RTOR Reduction (vph)	0	2	0	0	6	0	0	10	0	0	11	0
Lane Group Flow (vph)	33	786	0	22	777	0	11	94	0	98	54	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	87.8	87.8		87.8	87.8		14.2	14.2		14.2	14.2	
Effective Green, g (s)	87.8	87.8		87.8	87.8		14.2	14.2		14.2	14.2	
Actuated g/C Ratio	0.80	0.80		0.80	0.80		0.13	0.13		0.13	0.13	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	467	1469		464	1442		172	233		144	232	
v/s Ratio Prot		0.43			c0.43			0.05			0.03	
v/s Ratio Perm	0.06			0.04			0.01			c0.09		
v/c Ratio	0.07	0.53		0.05	0.54		0.06	0.41		0.68	0.23	
Uniform Delay, d1	2.4	3.9		2.3	3.9		42.1	44.0		45.7	43.0	
Progression Factor	1.48	1.43		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.2	1.2		0.2	1.4		0.2	1.2		12.4	0.5	
Delay (s)	3.8	6.8		2.5	5.4		42.2	45.2		58.3	43.4	
Level of Service	A	A		A	A		D	D		E	D	
Approach Delay (s)		6.7			5.3			44.9			52.4	
Approach LOS		A			A			D			D	

Intersection Summary			
HCM Average Control Delay	12.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	57.4%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	EBR	NBL	NBT	SBT	SBR	ø1	ø8
Lane Configurations								
Volume (vph)	0	130	180	1150	1120	120		
Turn Type		Perm	Prot			Perm		
Protected Phases	4		5	2	6		1	8
Permitted Phases		4				6		
Detector Phase	4	4	5	2	6	6		
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	10.0	10.0	8.0	10.0	27.0	27.0	8.0	10.0
Total Split (s)	16.0	16.0	24.0	76.0	60.0	60.0	8.0	10.0
Total Split (%)	14.5%	14.5%	21.8%	69.1%	54.5%	54.5%	7%	9%
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	3.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	1.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0		
Total Lost Time (s)	6.0	6.0	4.0	6.0	6.0	6.0		
Lead/Lag			Lead	Lag	Lag	Lag	Lead	
Lead-Lag Optimize?								
Recall Mode	None	None	None	C-Max	C-Max	C-Max	None	None

Intersection Summary
Cycle Length: 110
Actuated Cycle Length: 110
Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated

Splits and Phases: 114: Road E & Kuihelani Highway

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	40	0	130	0	0	0	180	1150	0	0	1120	120
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0				4.0	6.0			6.0	6.0
Lane Util. Factor		1.00	1.00				1.00	0.95			0.95	1.00
Frt		1.00	0.85				1.00	1.00			1.00	0.85
Flt Protected		0.95	1.00				0.95	1.00			1.00	1.00
Satd. Flow (prot)		1770	1583				1770	3539			3539	1583
Flt Permitted		0.95	1.00				0.95	1.00			1.00	1.00
Satd. Flow (perm)		1770	1583				1770	3539			3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	43	0	141	0	0	0	196	1250	0	0	1217	130
RTOR Reduction (vph)	0	0	131	0	0	0	0	0	0	0	0	48
Lane Group Flow (vph)	0	43	10	0	0	0	196	1250	0	0	1217	82
Turn Type	Split		Perm	Split			Prot			Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			4									6
Actuated Green, G (s)		7.9	7.9				16.6	90.1			69.5	69.5
Effective Green, g (s)		7.9	7.9				16.6	90.1			69.5	69.5
Actuated g/C Ratio		0.07	0.07				0.15	0.82			0.63	0.63
Clearance Time (s)		6.0	6.0				4.0	6.0			6.0	6.0
Vehicle Extension (s)		3.0	3.0				3.0	3.0			3.0	3.0
Lane Grp Cap (vph)		127	114				267	2899			2236	1000
v/s Ratio Prot		c0.02					c0.11	0.35			c0.34	
v/s Ratio Perm			0.01									0.05
v/c Ratio		0.34	0.09				0.73	0.43			0.54	0.08
Uniform Delay, d1		48.6	47.7				44.6	2.8			11.4	7.9
Progression Factor		1.00	1.00				1.00	1.00			1.00	1.00
Incremental Delay, d2		1.6	0.3				10.0	0.5			1.0	0.2
Delay (s)		50.2	48.0				54.6	3.3			12.3	8.0
Level of Service		D	D				D	A			B	A
Approach Delay (s)		48.5			0.0			10.2			11.9	
Approach LOS		D			A			B			B	

Intersection Summary			
HCM Average Control Delay	13.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	57.6%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

APPENDIX D

ROUNDABOUT CONSIDERATIONS

APPENDIX D – CONSIDERATION OF ROUNDABOUTS

Currently no formalized warrant exists for roundabouts. However, according to the NCHRP Report 672 – Roundabouts: An Informational Guide, Second Edition (2010):

- "A roundabout will always provide a higher capacity and lower delays than all-way stop-control (AWSC) operating with the same traffic volumes."
- "A roundabout is unlikely to offer better performance in terms of lower overall delays than TWSC[1] at intersections with minor movements (including cross-street entry and major-street left turns) that are not experiencing, nor predicted to experience, operation problems under TWSC."
- "A single-lane roundabout may be assumed to operate within its capacity at any intersection that does not exceed the peak-hour volume warrant for signals."
- "A roundabout **that operates within its capacity** will generally produce lower delays than a signalized intersection operating with the same traffic volumes."
- "The decision to install a roundabout as a safety improvement should be based on a demonstrated safety problem of the type susceptible to correction by a roundabout. A review of crash reports and the type of crashes occurring is essential."
- "For locations with a high volume of truck traffic, special consideration may be given to the size of the roundabout to require the use of the truck apron by only the largest of vehicles. [At a roundabout in Florence, Kansas], the high volume of truck traffic traversing through the intersection dictated the use of a larger inscribed diameter."
- "Intersections of a major arterial and minor arterial or local road could introduce excessive delay or speed inconsistencies to flow on the major arterial."

This guidance would imply that roundabouts:

- Could be recommended where AWSC is warranted, given that operational considerations, proximity to flow impediments, pedestrian issues, bicycle issues, accessibility issues, etc. are considered.

[1] TWSC: two-way-stop-control

- May not necessarily be recommended where TWSC would operate satisfactorily.
- Would require large inscribed diameters if constructed in industrial areas; the aforementioned roundabout in Florence, Kansas was built with an approximate 220-foot inscribed diameter – 76 percent larger than a typical 130-foot single-lane roundabout.

Therefore, in lieu of a roundabout warrant, the above statements were compiled to provide a decision matrix. In general it was assumed that intersections that operate satisfactorily with TWSC and/or do not warrant AWSC would not be recommended for roundabout treatment. See Figure D for the decision matrix.

In the matrix, roundabouts were not recommended in industrial areas. This stems from the idea that where a relatively higher volume of heavy vehicles circulate, roundabouts would be required to be larger than normal, (regular roundabouts are approximately 130 feet in diameter while those accommodating heavy vehicles could be as large a 220 feet in diameter) – possibly increasing travel speeds compared to a regular roundabout. Furthermore, in this particular case due to ROW constraints along East Waiko Road, the roadway would likely have to shift southwards into the Project's property by approximately 100 feet or more – effectively realigning the roadway into an "S" curve in order to accommodate heavy vehicles.

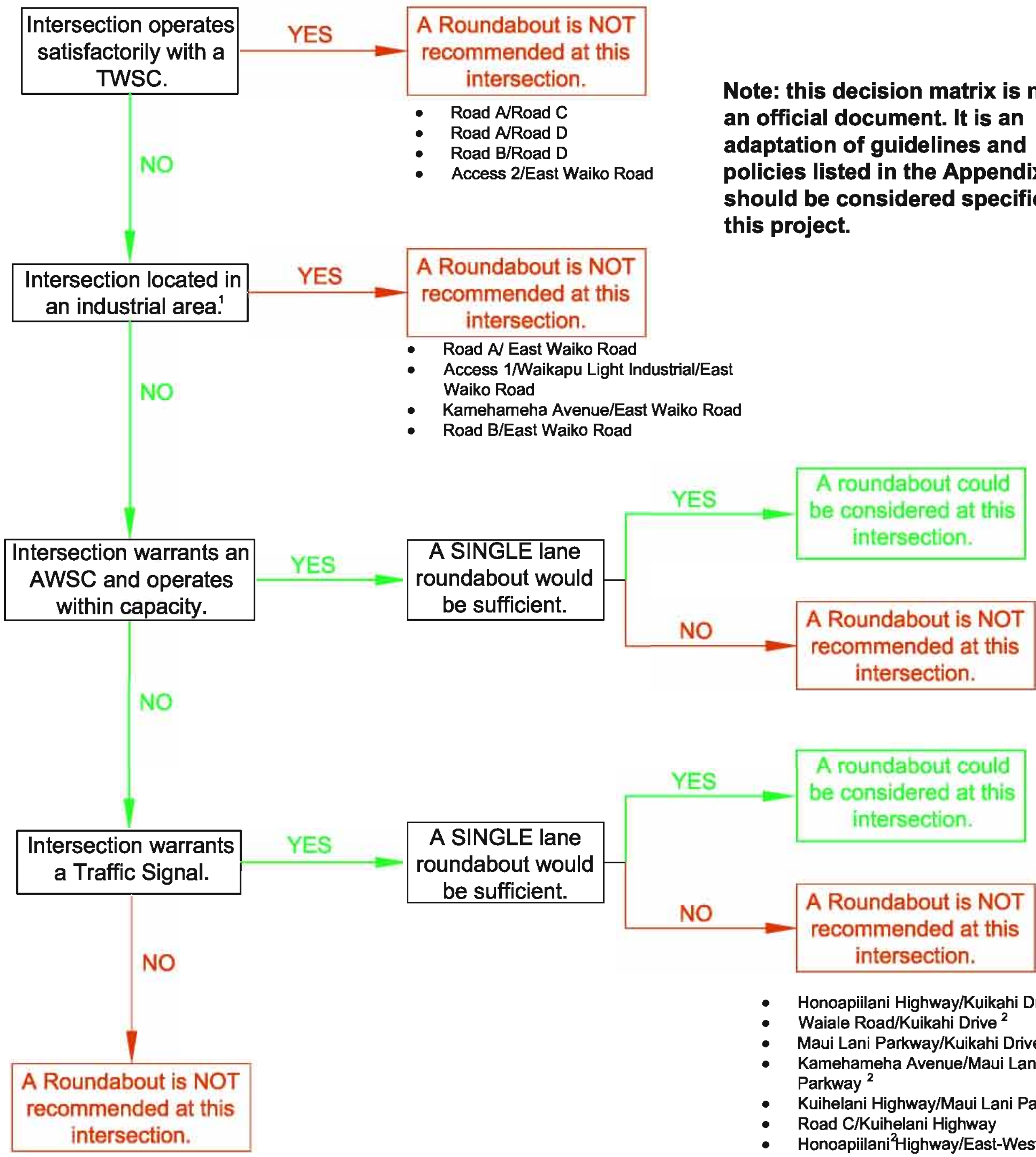
In addition to the "Roundabouts: An Informational Guide", the Hawaii Department of Transportation (HDOT) December, 2008 "Modern Roundabouts Policy Guidance" provides additional guidance:

> *"Until both agency and motorist gain greater experience, it is the policy of the department to generally limit consideration to modern single-lane roundabouts only."*

Analyses performed by RODEL were used to determine the operational viability of a single-lane roundabout at the intersections warranting a signal.

Based on the above listed guidance, roundabouts are not recommended at any of the study intersections as shown on Figure D.

Note: this decision matrix is not an official document. It is an adaptation of guidelines and policies listed in the Appendix and should be considered specific to this project.



- Road A/Road C
- Road A/Road D
- Road B/Road D
- Access 2/East Waiko Road

- Road A/ East Waiko Road
- Access 1/Waikapu Light Industrial/East Waiko Road
- Kamehameha Avenue/East Waiko Road
- Road B/East Waiko Road

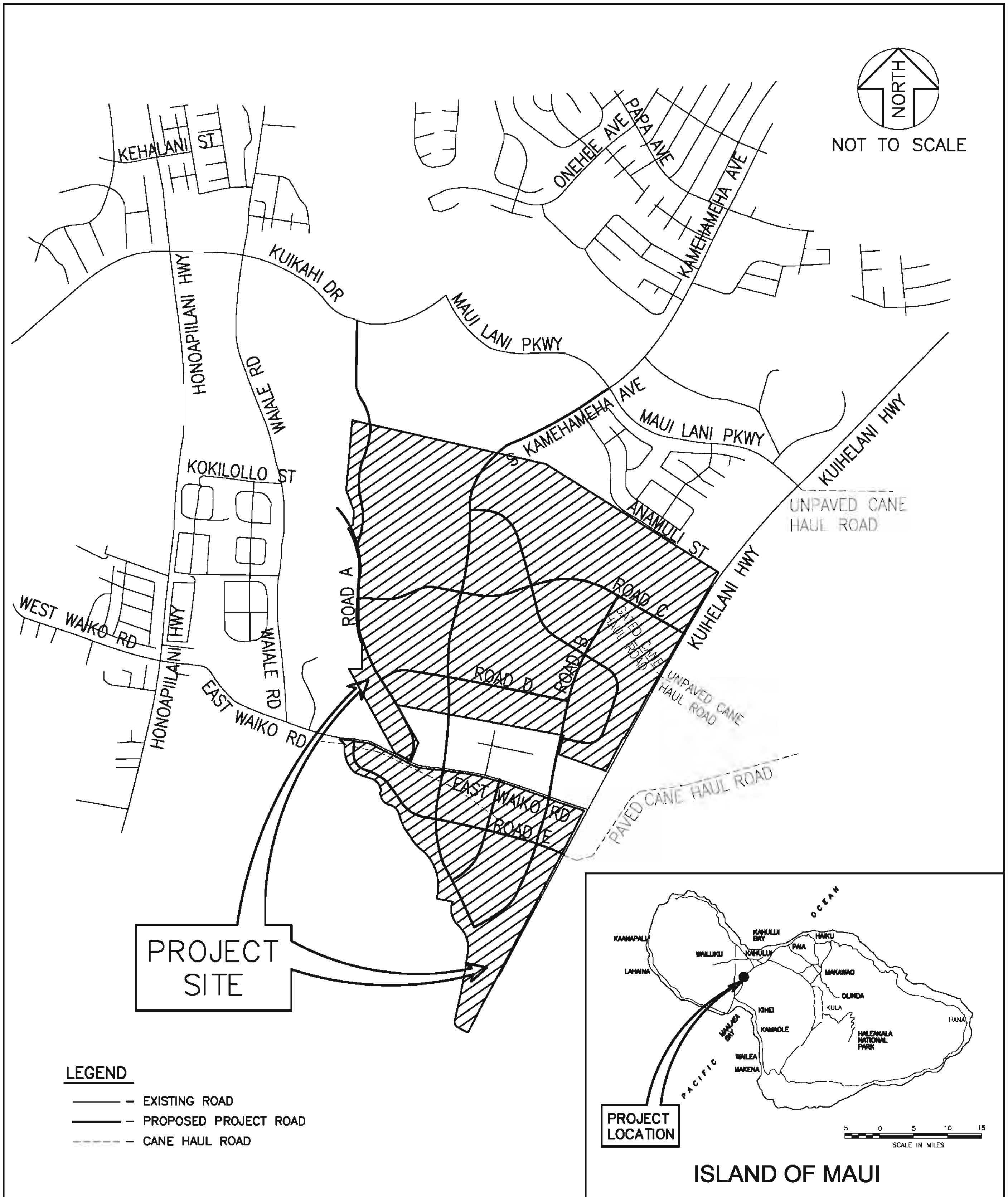
- Honoapiilani Highway/Kuikahi Drive [2]
- Waiale Road/Kuikahi Drive [2]
- Maui Lani Parkway/Kuikahi Drive
- Kamehameha Avenue/Maui Lani Parkway [2]
- Kuihelani Highway/Maui Lani Parkway
- Road C/Kuihelani Highway
- Honoapiilani Highway/East-West Waiko Road [2]
- Waiale Road/East Waiko Road
- Kuihelani Highway/East Waiko Road
- Road E/Kuihelani Highway

- Road A/Kuikahi Drive [2]
- Road C/Road D
- Kamehameha Avenue/Road C
- Kamehameha Avenue/Road D

[1] See discussion in Appendix D.
[2] In the absence of County guidelines on roundabouts, the State policy on roundabouts were applied to County roads.

WAIALE DEVELOPMENT	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS • HONOLULU, HAWAII	FIGURE
	ROUNDABOUT DECISION MATRIX	D

Appendix J-1: Traffic Impact Analysis Report - Addendum 1



WAIALE DEVELOPMENT	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS • HONOLULU, HAWAII	FIGURE
	LOCATION MAP	1

Appendix K: Noise Study

WAI'ALE PROJECT NOISE STUDY

taha
environmental planners

Prepared for

A&B PROPERTIES, INC.

Prepared by

TERRY A. HAYES ASSOCIATES INC.

MAY 2011

taha 2010-058

WAI'ALE PROJECT
NOISE STUDY

Prepared for

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May 12, 2011

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1.0 SUMMARY OF FINDINGS

Terry A. Hayes Associates Inc. has completed a Noise Study for the proposed Wai'ale Project. Key findings are listed below.

- Construction activity would result in temporary increases in ambient noise levels in the project area on an intermittent basis. Construction noise levels would exceed the allowable noise levels listed in the Maui County *Noise Reference Manual* and the Hawaii Administrative Rules. Therefore, without noise control, the proposed project would result in an adverse effect related to construction noise. The following noise control measures would eliminate adverse effects.

  N1 The project applicant shall obtain a noise permit associated with exceeding a noise level of 78 dBA L_{eq} as discussed in the Maui County *Noise Reference Manual*.

  N2 The project applicant shall obtain a noise permit associated with exceeding the maximum permissible noise levels discussed in the Hawaii Administrative Rules.

  N3 All mobile construction equipment shall be equipped with properly operating mufflers or other noise reduction devices.

  N4 Grading and construction contractors shall use quieter equipment as opposed to noisier equipment (such as rubber-tired equipment rather than metal-tracked equipment) where feasible.

  N5 The construction contractor shall use on-site electrical sources to power equipment rather than diesel generators where feasible.

- Construction activity can result in varying degrees of ground-borne vibration, depending on the equipment and methods employed. Construction vibration levels would not exceed the relevant standards. Therefore, the proposed project would not result in adverse effect related to construction vibration.

- Mobile source noise would be generated by 2,575 AM peak hour vehicle trips and 3,270 PM peak hour vehicle trips. Mobile source noise levels would not exceed the 3-dBA operational mobile source noise criteria. Therefore, the proposed project would not result in adverse effects related to off-site vehicular noise.

- Stationary noise sources would potentially exceed the Hawaii Administrative Rules maximum permissible noise levels. Therefore, without noise control, the proposed project would result in an adverse effect related to stationary noise. The following noise control measures would eliminate adverse effects.

  N6 The project applicant shall require mechanical equipment (e.g., ventilation and air conditioning systems) to be enclosed in equipment rooms such that noise levels do not exceed the maximum permissible noise levels listed in the Hawaii Administrative Rules.

N7 Truck loading/unloading activities at light industrial and commercial land uses shall be limited to between the hours of 7:00 a.m. and 10:00 p.m.

- Exterior and interior noise level standards would potentially be exceeded at residences that face Kuihelani Highway and East Waiko Road. In addition, the interior standard would be exceeded at residences that face Kamehameha Avenue. Therefore, without noise control, the proposed project would result in an adverse effect related to residential land use compatibility. The following noise control measures would eliminate adverse effects.

N8 Residents of units with exterior useable space facing Kuihelani Highway and East Waiko Road shall be given notice of possible incompatible exterior noise levels.

N9 All residential units shall be designed to minimize interior noise levels. These design measures shall be established to maintain noise levels at interior spaces to less than an L_{dn} of 45 dBA. Measures to meet the 45 dBA L_{dn} standard may include, but are not be limited to, using perimeter walls, sound-rated interior walls between uses, or other site planning and building placement that could reduce or eliminate the light-of-sight between the noise source and residential units. The project applicant shall utilize an acoustical engineer to demonstrate that the 45 dBA L_{dn} interior noise standard has been achieved within a sample of residential units facing Kuihelani Highway, East Waiko Road, and Kamehameha Avenue.

- Interior noise levels at the proposed school would potentially exceed the applicable standards. Therefore, without noise control, the proposed project would result in an adverse effect related to school land use compatibility. The following noise control measure would eliminate adverse effects.

N10 All educational classrooms shall be designed in compliance with the State of Hawaii Department of Education *Educational Specifications (EDSPECS) for Middle/Intermediate Schools*. In accordance with the guidelines, general school space shall meet a background ambient noise level of 45 dBA L_{eq} and libraries and main reading rooms shall meet a background ambient noise level of 50 dBA L_{eq}. Prior to occupancy, an acoustical engineer shall demonstrate that the applicable noise standards have been achieved in classrooms.

- The proposed project would include a regional park that borders Kuihelani Highway and Road C, a neighborhood park that borders Kuihelani Highway, and a cultural preserve in the northeastern portion of the project site. Daily use of the neighborhood park along Kuihelani Highway may be affected by loud noise levels. Therefore, without noise control, the proposed project would result in adverse effect related to the neighborhood park. The following noise control measure would eliminate adverse effects.

N11 The 300 feet closest to Kuihelani Highway on the southern portion of the project site shall be developed with active recreational land uses (e.g., ball fields or basketball courts) as opposed to passive recreational land uses (e.g., art garden).

2.0 INTRODUCTION

2.1 PURPOSE

The purpose of this report is to evaluate the potential for noise impacts of the Wai'ale Project (proposed project). Potential noise levels are analyzed for construction and operational activities. Noise control measures for potentially significant impacts are recommended when appropriate to reduce noise and vibration levels.

2.2 PROJECT DESCRIPTION

Wai'ale is envisioned to be a community for residents to live, work, learn and play. Residential communities, including single-family homes and multi-family dwellings, will be connected to Village Mixed-Use areas supported with commercial, retail, office, civic and other public facilities through a system of pedestrian/bicycle paths and greenways. Approximately 2,550 residential units are proposed for Wai'ale, including approximately 300 residential units within the 50 acres to be contributed to the County of Maui.

Proposed land uses are shown in the conceptual master plan for Wai'ale (**Figure 2-1**) and are generally described below. The approximate land use areas are summarized generally and may be adjusted as the master plan is refined through the land use review and approval process.

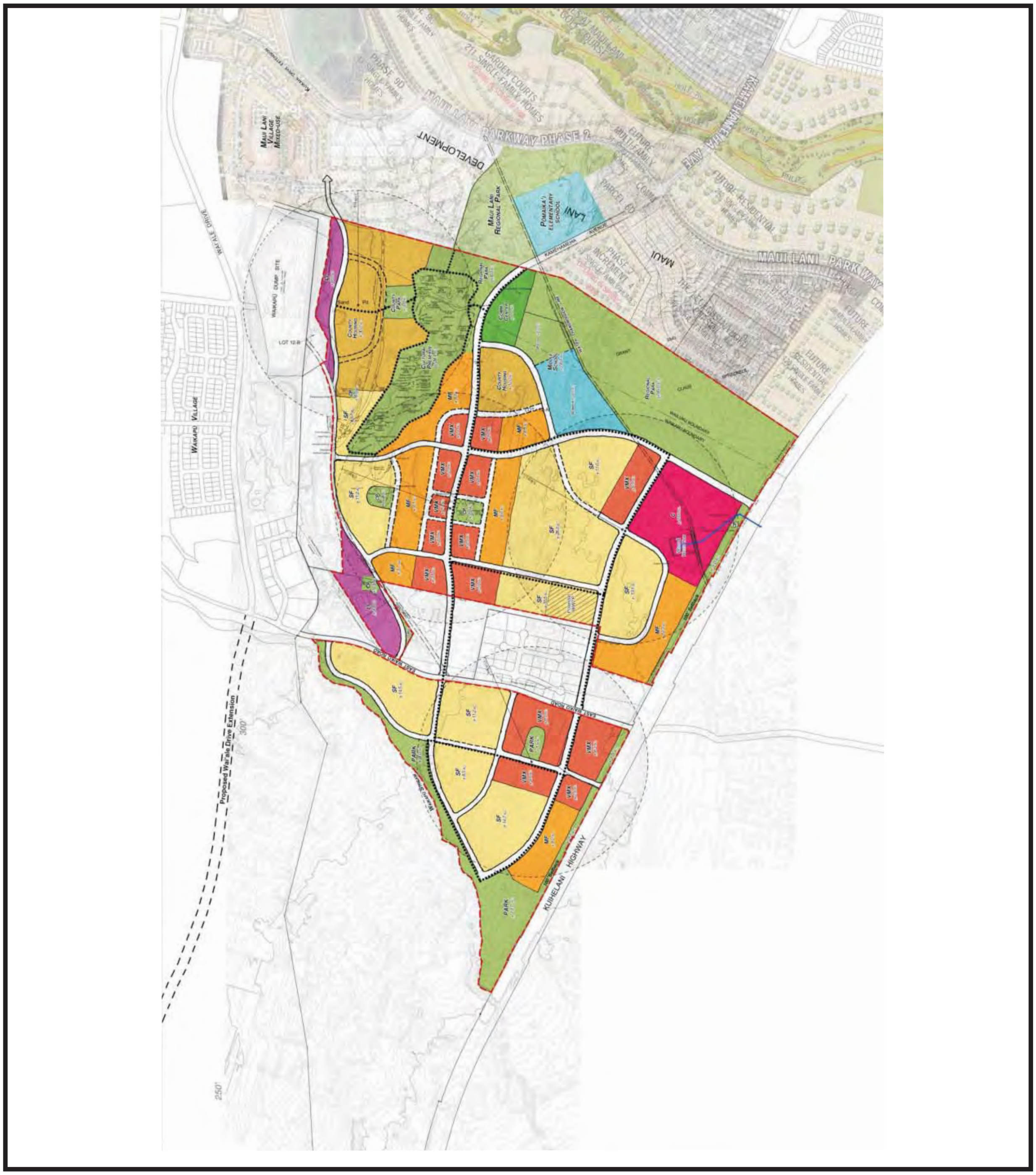
Village Mixed Use. Commercial, office, retail, business, civic, social services and multi-family residential uses would be located on several parcels of land near the Kuihelani Highway/Waiko Road intersection, as well as along the extension of Kamehameha Avenue. Pedestrian and bicycle paths connecting these uses with the rest of the Wai'ale community (including schools and places of employment) encourage multi-modal transportation.

Commercial. A commercial area is planned along Kuihelani Highway to provide a variety of services and employment opportunities within Wai'ale. The 23-acre area is envisioned for commercial, office, retail, and business uses.

Business/Light Industrial. Approximately 16 acres are planned to provide an area for light industrial users and businesses. These land uses will meet regional and area demands by providing an additional employment center for Wai'ale.

Residential. Single-family homes and multi-family dwellings with a variety of live-work opportunities are planned residential land uses. Consistent with the Draft Maui Island Plan's Directed Growth Strategy for Central Maui, a total of approximately 2,550 residential units are planned at Wai'ale.

County of Maui Lands. Fifty acres of land will be contributed to the County of Maui and is integrated into the conceptual master plan. This land is located in the vicinity of the current terminus of Kamehameha Avenue in the north-western portion of Wai'ale. The land is to be used as follows: 40 acres of affordable housing, 7 acres of community center, and 3 acres of neighborhood park. Approximately 300 residential units, including both multi- and single-family residences, are assumed for the affordable housing.



LEGEND:

- Single Family
- Multi-Family
- Village Mixed-Use
- Commercial
- Business/Light Industrial
- Regional Park/Cultural Preserve
- Community Center
- Institutional/School
- County Housing (Single Family & Multi-Family)
- Wai'ale Project Area
- Greenway Path (Pedestrian/Bike)
- Potential Waste Water Treatment Plant

N

APPROX. SCALE

0 0.175 0.35 MILES

SOURCE: A&B Properties, Inc.

FIGURE 2-1

CONCEPTUAL COMMUNITY MASTER PLAN

Schools. One middle school site, totaling approximately 18 acres, may be needed to accommodate the educational needs of children living in Wai'ale. The school will be located on the northern portion of the project site.

Public Support Facilities & Regional Community Center. Public support and civic-related facilities and a regional community center would be located in the center of the Wai'ale community along the extension of Kamehameha Avenue. The regional community center is envisioned to be developed by the County of Maui on seven acres, as part of the County of Maui lands.

Parks and Cultural Preserves. A regional park is proposed along the northern boundary of Wai'ale, providing a spatial separation between the neighborhoods of Wai'ale and Maui Lani. This park is intended to support regional and Wai'ale recreational activities and would be within walking distance or a bicycle ride from residential communities and schools. Additional neighborhood parks are provided within residential areas, as well as along the perimeter of Wai'ale. Parks, cultural preserves, and open space planned within Wai'ale total nearly 142 acres.

Greenways and Open Space. The conceptual master plan for Wai'ale includes greenways and open space along Kuihelani Highway, within residential communities, and along Waikapü Stream to enhance the visual character of the community.

Bicycle/Pedestrian Paths. Wai'ale is designed as a bikeable/walkable community. A system of linked paths will provide pedestrians and bicyclists with an option for transportation other than automobiles throughout the community. Residents would be able to travel from their homes to the Village Mixed Use, Commercial Center, parks, school, and other public uses on pedestrian and bicycle pathways that would run through a network of open spaces and greenways.

Landmark Buildings. There are opportunities to create buildings that have "landmark" qualities at prominent locations within a community. These buildings could include civic or other institutional uses such as churches and will contribute to the overall character and visual orientation of the community.

3.0 NOISE AND VIBRATION CHARACTERISTICS AND REGULATIONS

3.1 NOISE

Characteristics of Sound

Sound is technically described in terms of the loudness (amplitude) and frequency (pitch) of the sound. The standard unit of measurement for sound is the decibel (dB). The human ear is not equally sensitive to sound at all frequencies. The "A-weighted scale," abbreviated dBA, reflects the normal hearing sensitivity range of the human ear. On this scale, the range of human hearing extends from approximately 3 to 140 dBA. **Figure 3-1** provides examples of A-weighted noise levels from common sounds.

Noise Definitions

This noise analysis discusses sound levels in terms of Equivalent Noise Level (L_{eq}) and Day-Night Noise Level (L_{dn}).

Equivalent Noise Level. L_{eq} is the average noise level on an energy basis for any specific time period. The L_{eq} for one hour is the energy average noise level during the hour. The average noise level is based on the energy content (acoustic energy) of the sound. L_{eq} can be thought of as the level of a continuous noise which has the same energy content as the fluctuating noise level. The equivalent noise level is expressed in units of dBA.

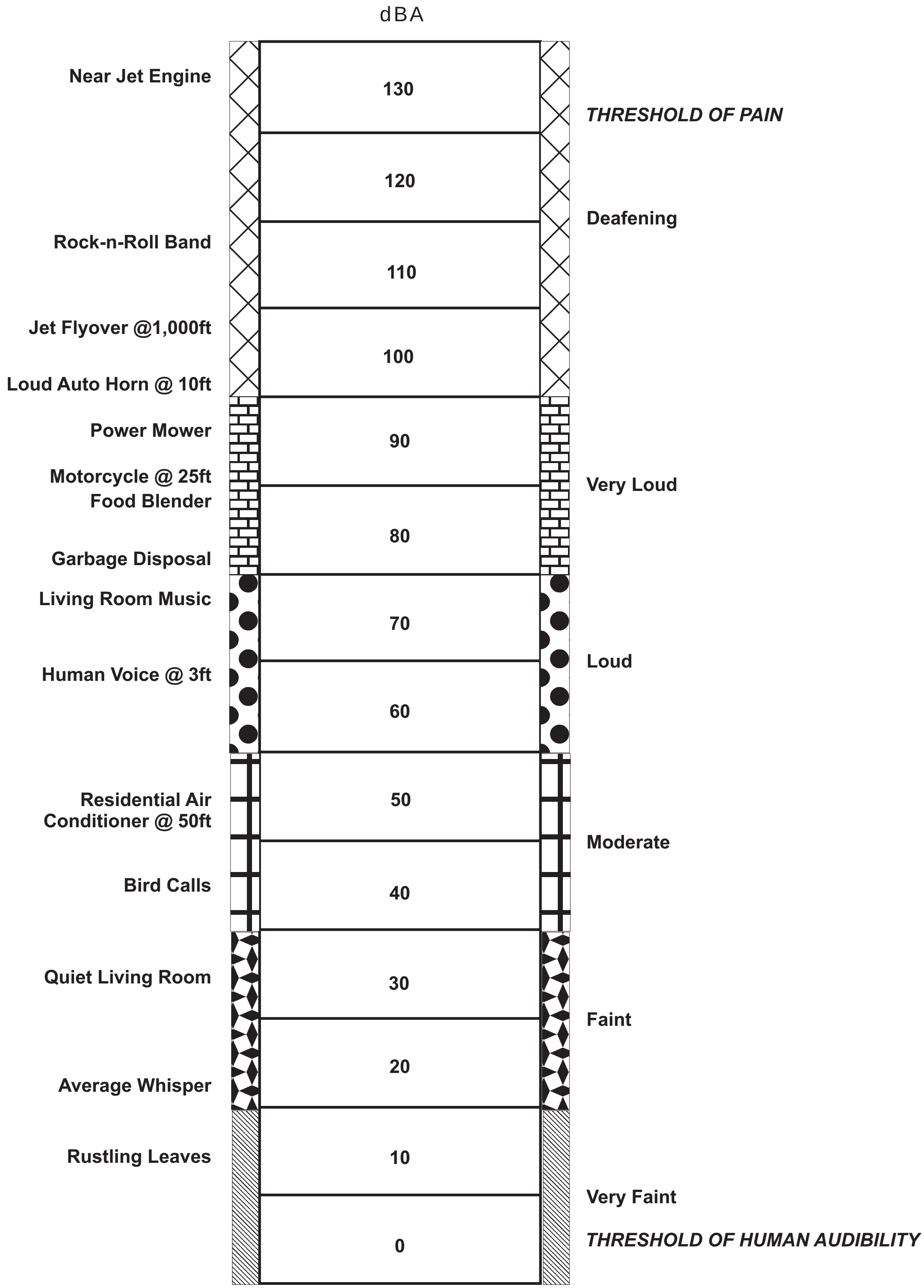
Day-Night Noise Level. L_{dn} is basically a 24-hour L_{eq} with an adjustment to reflect the greater sensitivity of most people to nighttime noise. The adjustment is a 10-dBA penalty for all sound that occurs in the nighttime hours of 10:00 p.m. to 7:00 a.m. The effect of the penalty is that in the calculation of L_{dn}, any event that occurs during the nighttime hours is equivalent to ten of the same event during the daytime hours.

Effects of Noise

Noise is generally defined as unwanted sound. The degree to which noise can impact the human environment ranges from levels that interfere with speech and sleep (annoyance and nuisance) to levels that cause adverse health effects (hearing loss and psychological effects). Human response to noise is subjective and can vary greatly from person to person. Factors that influence individual response include the intensity, frequency, and pattern of noise, the amount of background noise present before the intruding noise, and the nature of work or human activity that is exposed to the noise source.

Audible Noise Changes

Studies have shown that the smallest perceptible change in sound level for a person with normal hearing sensitivity is approximately 3 dBA. A change of at least 5 dBA would be noticeable and would likely evoke a community reaction. A 10-dBA increase is subjectively heard as a doubling in loudness and would cause a community response.



SOURCE: Cowan, James P., *Handbook of Environmental Acoustics.*

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FIGURE 3-1

A-WEIGHTED DECIBEL SCALE

Noise levels decrease as the distance from the noise source to the receiver increases. Noise generated by a stationary noise source, or "point source," will decrease by approximately 6 dBA over hard surfaces (e.g., reflective surfaces such as parking lots or smooth bodies of water) and 7.5 dBA over soft surfaces (e.g., absorptive surfaces such as soft dirt, grass, or scattered bushes and trees) for each doubling of the distance. For example, if a noise source produces a noise level of 89 dBA at a reference distance of 50 feet, then the noise level would be 83 dBA at a distance of 100 feet from the noise source, 77 dBA at a distance of 200 feet, and so on. Noise generated by a mobile source will decrease by approximately 3 dBA over hard surfaces and 4.5 dBA over soft surfaces for each doubling of the distance.

Generally, noise is most audible when traveling by direct line-of-sight.[1] Barriers, such as walls, berms, or buildings that break the line-of-sight between the source and the receiver greatly reduce noise levels from the source since sound can only reach the receiver by bending over the top of the barrier (diffraction). Sound barriers can reduce sound levels by up to 20 dBA. However, if a barrier is not high or long enough to break the line-of-sight from the source to the receiver, its effectiveness is greatly reduced.

Applicable Regulations

County of Maui. The Hawaii State Department of Health Maui County *Noise Reference Manual* discusses local rules for various noise sources. Relevant information includes a discussion of construction noise. A Community Noise Permit may be required for construction projects exceeding the noise code and that have total cost of more than $250,000 (based on the value on the building permit). Construction is allowed from 7:00 a.m. to 6:00 p.m., Monday through Friday, and 9:00 a.m. to 6:00 p.m. on Saturdays. The use of certain demolition and construction equipment (such as pile drivers, hydraulic hammers, jackhammers, etc.) is limited to 9:00 a.m. to 5:30 p.m., Monday through Friday. Construction projects exceeding the maximum permissible sound levels (78 dBA) before 7:00 a.m. and after 6:00 p.m., Monday through Friday, or before 9:00 a.m. and after 6:00 p.m. on Saturdays, or at any time on Sundays and holidays are allowed only with an approved Community Noise Variance issued by the State Department of Health.[2]

Hawaii Department of Health. The Hawaii Administrative Rules (HAR) includes a section on noise control (Title 11 - Department of Health, Chapter 46 – Community Noise Control). The purpose is to define maximum permissible sounds levels, and to provide for the prevention, control, and abatement of noise pollution in Hawaii from stationary noise, construction and agricultural equipment, and industrial activities. The maximum permissible sound levels are shown in **Table 3-1**. Backup alarm devices on construction equipment that is required by federal or State occupational safety and health regulations are exempt from complying with the maximum noise levels. The HAR also state that all construction equipment should include mufflers, except pile hammers and pneumatic hand tools.

The Director of the Department of Health may grant a permit to operate excessive noise sources that exceed the maximum permissible noise levels. The permit application should include, but is not limited to, an assessment of best available control technology and disclosure of nighttime impacts.

[1] Line-of-sight is an unobstructed visual path between the noise source and the noise receptor.
[2] Hawaii State Department of Health, *Noise Reference Manual*, Maui County Edition, February, 2008.

TABLE 3-1: MAXIMUM PERMISSIBLE SOUND LEVELS		
Zoning District	**Daytime (dBA) (7:00 a.m. to 10:00 p.m.)**	**Nighttime (dBA) (10:00 p.m. to 7:00 a.m.)**
Class A	55	45
Class B	60	50
Class C	70	70

Notes:
Class A: Lands zoned residential, conservation, preservation, public space, open space, or similar type.
Class B: Lands zoned for multi-family dwellings, apartment, business, commercial, hotel, resort, or similar type.
Class C: Lands zoned agriculture, country, industrial, or similar type.
The sound levels apply to any excessive noise source emanating within the specified zoning district, and at any point at or beyond the property line.
Noise levels shall not exceed the maximum permissible sound levels for more than ten percent of the time within any twenty minute period, except by permit or variance.
For mixed zoning districts, the primary land use designation shall be used to determine the applicable zoning district.
The maximum permissible sound level for impulsive noise shall be ten dBA above the maximum permissible sound levels.
SOURCE: Hawaii Administrative Rules, Title 11, Chapter 45.

Hawaii Board of Education (BOE). Regarding noise levels at educational land uses, BOE has stated that facilities should be located, orientated, and designed to provide a learning environment free from distracting noise.[3] In addition, State of Hawaii Department of Business, Economic Development, and Tourism has stated that air conditioning shall be installed at classrooms and administration areas when the exterior noise level exceeds an L_{10} of 65 dBA at windows or other potential natural ventilation openings, and the external noise sources cannot be mitigated with reasonable measures such as installing sound barriers along roadways or relocating equipment or other noise sources.[4] The State of Hawaii Department of Education has published *Educational Specification (EDSPECS) for Middle/Intermediate Schools*.[5] These guidelines state that interior noise levels in general school spaces should not exceed 50 dBA L_{eq} and the noise level in libraries and reading rooms should not exceed 45 dBA L_{eq}. The EDSPECS provides specific construction guidelines to meet the interior noise level standards.

Hawaii Department of Transportation (HDOT). Regarding noise in recreational parks, HDOT has adopted the Federal Highway Administration's (FHWA) design goals for exterior noise levels. The FHWA standards are most applicable to new highway construction. However, they are based on assuring land use compatibility and are relevant to the siting of new sensitive receptors near heavily traveled roadways. The FHWA has indicated that exterior noise levels at park land uses should not exceed 67 dBA L_{eq}.[6]

United States Housing and Urban Development (HUD). The State of Hawaii has not adopted land use/noise compatibility guidelines. In the absence of local residential noise standards, HUD guidelines were utilized to determine acceptable noise levels for residential land uses. The HUD standards for interior and exterior noise levels are 45 and 65 dBA L_{dn}, respectively.

[3] State of Hawaii Board of Education, *Policy 6700 – Facility Standards*, Amended December 6, 2007.
[4] State of Hawaii Department of Business, Economic Development, and Tourism, *Hawaii High Performance School Guidelines*, March 31, 2005.
[5] State of Hawaii Department of Education, *Educational Specifications (EDSPECS) for Middle/Elementary Schools*, March 2006.
[6] Federal Highway Administration, *Highway Traffic Noise Analysis and Abatement Policy and Guidance*, June 1995.

3.2 VIBRATION

Characteristics of Vibration

Vibration is an oscillatory motion through a solid medium in which the motion's amplitude can be described in terms of displacement, velocity, or acceleration. Vibration can be a serious concern, causing buildings to shake and rumbling sounds to be heard. In contrast to noise, vibration is not a common environmental problem. Some common sources of vibration are trains, buses on rough roads, and construction activities, such as blasting, pile driving, and heavy earth-moving equipment.

Vibration Definitions

There are several different methods that are used to quantify vibration. The peak particle velocity (PPV) is defined as the maximum instantaneous peak of the vibration signal. The PPV is most frequently used to describe vibration impacts to buildings and is usually measured in inches per second. The root mean square (RMS) amplitude is most frequently used to describe the effect of vibration on the human body. The RMS amplitude is defined as the average of the squared amplitude of the signal. Decibel notation (Vdb) is commonly used to measure RMS. The decibel notation acts to compress the range of numbers required to describe vibration.[7]

Effects of Vibration

High levels of vibration may cause physical personal injury or damage to buildings. However, ground-borne vibration levels rarely affect human health. Instead, most people consider ground-borne vibration to be an annoyance that may affect concentration or disturb sleep. In addition, high levels of ground-borne vibration may damage fragile buildings or interfere with equipment that is highly sensitive to ground-borne vibration (e.g., electron microscopes).

Perceptible Vibration Changes

In contrast to noise, ground-borne vibration is not a phenomenon that most people experience every day. The background vibration velocity level in residential areas is usually 50 RMS or lower, well below the threshold of perception for humans which is around 65 RMS.[8] Most perceptible indoor vibration is caused by sources within buildings, such as operation of mechanical equipment, movement of people, or slamming of doors. Typical outdoor sources of perceptible ground-borne vibration are construction equipment, steel-wheeled trains, and traffic on rough roads. If the roadway is smooth, the vibration from traffic is rarely perceptible.

Applicable Regulations

Neither the State of Hawaii nor the County of Maui has vibration standards. To counter the effects of ground-borne vibration, the Federal Transit Administration (FTA) has published guidance relative to vibration impacts. According to the FTA, fragile buildings can be exposed to ground-borne vibration levels of 0.2 inches per second without experiencing structural damage. Buildings extremely susceptible to vibration damage can be exposed to ground-borne vibration levels of 0.12 inches per second without experiencing structural damage.[9]

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[7] Federal Transit Administration, Transit Noise and Vibration Impact Assessment, May 2006.
[8] *Ibid*.
[9] *Ibid*.

4.0 EXISTING SETTING

4.1 EXISTING NOISE ENVIRONMENT

Noise generators in the vicinity of the proposed project include nearby agricultural, industrial, and construction activities. Other noise sources in the project area include vehicle traffic along Kuihelani Highway, Waiko Road, and Wai'ale Drive.

A series of 15-minute sound measurements were taken using a SoundPro DL Sound Level Meter between 7:30 a.m. and 9:30 a.m., and again between 10:30 a.m. and 11:30 a.m., on February 1, 2011 to determine existing ambient daytime peak and off-peak noise levels. A 24-hour measurement was conducted between 12:30 p.m. on February 1, 2011 and 12:30 p.m. on February 2, 2011. These readings were used to establish existing ambient noise conditions and to provide a baseline for evaluating construction and operational noise impacts. Noise monitoring locations are shown in **Figure 4-1**. As shown in **Table 4-1**, existing ambient sound levels range between 49.2 and 65.9 dBA L_{eq} during peak traffic hour, and 49.6 and 66.8 dBA L_{eq} during off-peak traffic hour. The 24-hour L_{dn} was 62 dBA.

TABLE 4-1: EXISTING MONITORED NOISE LEVELS

Key to Figure 4-2	Noise Monitoring Location	Peak Hour (dBA, L_{eq})	Off-Peak Hour (dBA, L_{eq})
1	Wai'ale Drive at Kokilolio Street	63.2	60.1
2	Pomaikai Elementary School	49.2	49.6
3	Anamuli Street	51.7	51.4
4	Highway 380 at Waiko Road	65.9	66.8

SOURCE: TAHA, 2011.

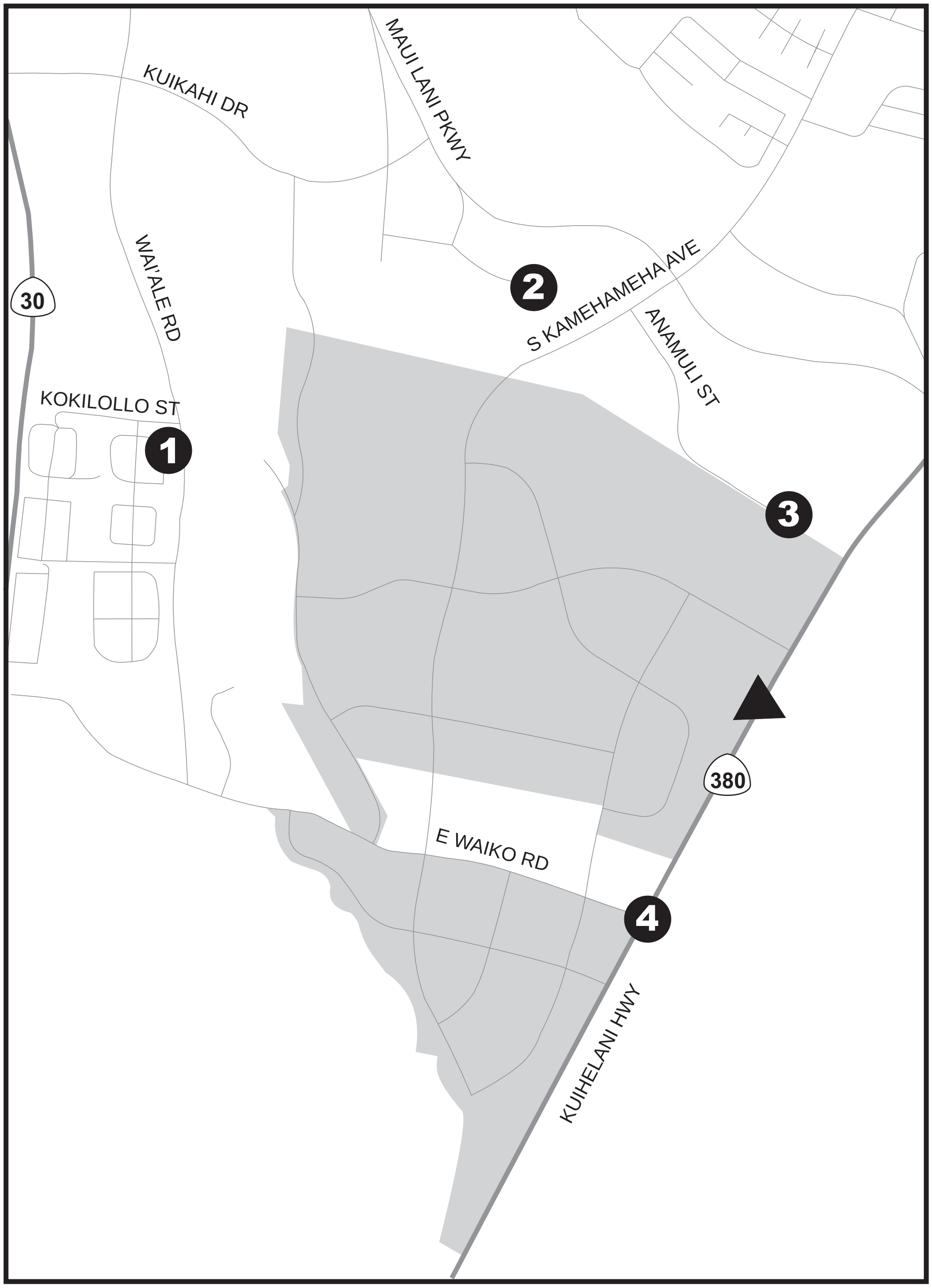
4.2 MODELED VEHICULAR NOISE

Using existing traffic volumes provided by the traffic consultant and the FHWA Traffic Noise Model (TNM) Look-Up Program, the L_{eq} was calculated for roadway segments in the project area. As shown in **Table 4-2**, existing AM peak-hour mobile noise levels range from 58.4 to 70.5 dBA L_{eq}. Existing PM peak-hour mobile noise levels range from 59.4 to 70.4 dBA L_{eq}. Modeled vehicle noise levels are typically lower than noise measurements along similar roadway segments as modeled noise levels do not take into account additional noise sources (e.g., sirens, helicopters, etc.).

TABLE 4-2: EXISTING MODELED MOBILE SOURCE NOISE LEVELS

Roadway Segment	AM Peak Hour (dBA, L_{eq})	PM Peak Hour (dBA, L_{eq})
Kuihelani Highway from Waiko Road to Maui Lani Parkway	68.9	69.6
East Waiko Road from Kamehameha Avenue to Wai'ale Drive	61.5	60.6
East Waiko Road from Kuihelani Highway to Kamehameha Avenue	62.0	60.6
Maui Lani Parkway from Kuihelani Highway to Kamehameha Avenue	59.2	59.6
Maui Lani Parkway from Kamehameha Avenue to Kuikahi Drive	59.5	59.6
East Waiko Road from Wai'ale Drive to Honoapiilani Highway	58.4	59.4
Wai'ale Drive from East Waiko Road to Kuikahi Drive	61.1	60.2
Honoapiilani Highway from East Waiko Road to Kuikahi Drive	70.5	70.4

SOURCE: TAHA, 2011.



LEGEND: Project Area # Noise Monitoring Positions 24-Hour Monitoring Location

1. Single-Family Residences
2. Pomaikai Elementary School
3. Single-Family Residences
4. Kuihelani Highway at East Waiko Road

APPROX. SCALE 0 0.15 0.3 MILES

SOURCE: TAHA, 2011

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FIGURE 4-1

NOISE MONITORING LOCATIONS

4.3 EXISTING VIBRATION ENVIRONMENT

There are no stationary sources of vibration located near the project site. Heavy-duty trucks can generate ground-borne vibrations that vary depending on vehicle type and weight, and pavement conditions. Based on site visits, vibration levels from adjacent roadways are not typically perceptible at the project site.

4.4 SENSITIVE RECEPTORS

Noise- and vibration-sensitive land uses are locations where people reside or where the presence of unwanted sound could adversely affect the use of the land. Residences, schools, hospitals, guest lodging, libraries, and some passive recreation areas would each be considered noise- and vibration-sensitive and may warrant unique measures for protection from intruding noise.

As shown in **Figure 4-2**, sensitive receptors near the project site include the following:

- Single-family housing adjacent and to the north
- Maui Lani Regional Park Adjacent and to the north
- Pomaikai Elementary School approximately 350 feet to the north
- Single-family housing approximately 1,200 feet to the west

The above sensitive receptors represent the nearest noise sensitive receptors with the potential to be impacted by the proposed project. Additional sensitive receptors are located further from the project site in the surrounding community within one-quarter mile of the project site and would be less impacted by the proposed project than the above sensitive receptors.

In addition to the off-site sensitive receptors listed above, sensitive receptors would be located on the project site during construction activity. The large project site would be developed over phases and newly constructed residences would potentially be located adjacent to ongoing construction activity. These residences would be sensitive to construction noise and vibration.

LEGEND: Project Area # Noise Sensitive Receptors

1. Single-Family Residences
2. Maui Lani Regional Park
3. Pomaikai Elementary School
4. Single-Family Residences

APPROX. SCALE 0 0.15 0.3 MILES

N

SOURCE: TAHA, 2011.

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FIGURE 4-2

NOISE SENSITIVE RECEPTOR LOCATIONS

5.0 METHODOLOGY AND SIGNIFICANCE CRITERIA

5.1 METHODOLOGY

The analysis considers construction and operational sources of noise and vibration. The noise level during the construction period at each receptor location was calculated by (1) making a distance adjustment to the construction source sound level and (2) logarithmically adding the adjusted construction noise source level to the ambient noise level. Operational noise levels were calculated based on information provided in the traffic study and stationary noise sources located on the project site (e.g., mechanical equipment). Mobile source noise levels were calculated using the FHWA TNM Version 2.5 Look-Up Program. The FHWA TNM Version 2.5 Look-Up Tables provide a reference of pre-calculated FHWA TNM results for simple highway geometries. The calculations are for an infinitely long, straight roadway over flat ground, with a receiver set at a height of five feet (1.5 meters) above the ground. If desired, an infinitely long straight barrier may also be included in the calculations. Vibration levels were estimated based on information provided by the FTA.[10]

5.2 SIGNIFICANCE CRITERIA

According to the Council on Environmental Quality regulations (40 CFR §§ 1500-1508), the determination of a significant impact is a function of both context and intensity. Context means that the significance of an action must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality. Both short- and long-term effects are relevant. Intensity refers to the severity of impact. To determine significance, the severity of the impact must be examined in terms of the type, quality and sensitivity of the resource involved; the location of the proposed project; the duration of the effect (short- or long-term) and other consideration of context. Adverse impacts will vary with the setting of the proposed action and the surrounding area. Specific construction and operational impact criteria are listed below.

Construction Noise Adverse Effect Criteria

The proposed project would result in an adverse construction noise effect if:

- Construction activities prior to 7:00 a.m. and after 6:00 p.m., Monday through Friday, or before 9:00 a.m. and after 6:00 p.m. on Saturdays, or at any time on Sundays;
- Noise levels exceed the Maui County *Noise Reference Manual* maximum noise level of 78 dBA without first obtaining a noise variance; and/or
- Noise levels exceed the maximum Hawaii Administrative Rules noise levels shown in **Table 3-1** without first obtaining a permit from the Director of the Department of Health.

Operational Noise Adverse Effect Criteria

The proposed project would result in a significant operational noise impact if:

- Mobile sources cause a 3-dBA or more noise increase along off-site roadway segments;

[10]Federal Transit Administration, *Transit Noise and Vibration Impact Assessment*, May 2006.

- Stationary source noise levels exceed the maximum Hawaii Administrative Rules noise levels shown in **Table 3-1** without first obtaining a permit from the Director of the Department of Health;
- Noise levels at proposed residential land uses exceed the HUD interior and exterior noise standards of 45 and 65 dBA L_{dn}, respectively;
- Noise levels at proposed school land uses exceed the BOE exterior standard of 65 dBA L_{10}; and/or
- Noise levels at proposed park land uses exceed FHWA exterior standard of 67 dBA L_{eq}.

Ground-Borne Vibration Adverse Effect Criteria

The proposed project would result in a significant vibration impact if:

- Sensitive receptors would be exposed to vibration levels that exceed 0.2 inches per second.

6.0 ENVIRONMENTAL EFFECTS

6.1 CONSTRUCTION NOISE

Construction activity would result in temporary increases in ambient noise levels in the project area on an intermittent basis. Noise levels would fluctuate depending on the construction phase, equipment type and duration of use, distance between the noise source and receptor, and presence or absence of noise attenuation barriers. Typical noise levels from various types of equipment that may be used during construction are listed in **Table 6-1**. The table shows noise levels at distances of 50 and 100 feet from the construction noise source.

TABLE 6-1: MAXIMUM NOISE LEVELS OF COMMON CONSTRUCTION MACHINES

	Noise Level (dBA)	
Noise Source	**50 Feet /a/**	**100 Feet /a/**
Front Loader	80	72.5
Trucks	89	81.5
Cranes (derrick)	88	80.5
Jackhammers	90	82.5
Generators	77	69.5
Back Hoe	84	76.5
Tractor	88	80.5
Scraper/Grader	87	79.5
Paver	87	79.5
Impact Pile Driving	101	93.5
Auger Drilling	77	69.5

/a/ Assumes a 7.5-dBA drop-off rate for noise generated by a "point source" and traveling over soft surfaces. Actual measured noise levels of the equipment listed in this table were taken at distances of 10 and 30 feet from the noise source.
SOURCE: USEPA, *Noise from Construction Equipment and Operations, Building Equipment and Home Appliances*, PB 206717, 1971.

The noise levels shown in **Table 6-2** take into account the likelihood that more than one piece of construction equipment would be in operation at the same time and lists the typical overall noise levels that would be expected for each phase of construction. The highest noise levels are expected to occur during the grading/excavation and finishing phases of construction. A typical piece of noisy equipment is assumed to be active for 40 percent of the eight-hour workday (consistent with the USEPA studies of construction noise), generating a noise level of 89 dBA L_{eq} at a reference distance of 50 feet.

TABLE 6-2: TYPICAL CONSTRUCTION NOISE LEVELS BY PHASE

Construction Phase	Noise Level At 50 Feet (dBA)	Noise Level At 100 Feet (dBA)	Noise Level At 200 Feet (dBA)
Ground Clearing	84	76.5	69.0
Grading/Excavation	89	81.5	74.0
Foundations	78	70.5	63.0
Structural	85	77.5	70.0
Finishing	89	81.5	74.0

SOURCE: USEPA, *Noise from Construction Equipment and Operations, Building Equipment and Home Appliances*, PB 206717, 1971.

General Construction Noise

Construction activity would occur over the entire 545-acre project site. The majority of construction would take place central to the project site and away from off-site sensitive receptors. Construction activity on the western and northern boundaries of the project site would be located near off-site sensitive receptors. **Table 6-3** presents the estimated noise levels these off-site sensitive receptors during construction activity. Construction noise levels would exceed the 78-dBA Maui County *Noise Reference Manual* standard at the single-family housing to the north of the project site and at Maui Lani Regional Park. Construction levels would also exceed the maximum permissible noise levels listed in the Hawaii Administrative Rules (**Table 3-1**) at each of the identified receptors. It is important to note that construction noise will be short-term and intermittent. In addition, construction activity would only occur from 7:00 a.m. to 6:00 p.m., Monday through Friday and 9:00 a.m. to 6:00 p.m. on Saturdays. Nonetheless, without noise control for a noise variance or a permit as required by the Director of the Department of Health, the proposed project would result in an adverse effect related to construction noise.

TABLE 6-3: ESTIMATED CONSTRUCTION NOISE LEVELS

Sensitive Receptor	Distance (feet) /a/	Maximum Construction Noise Level (dBA) /b/	Existing Ambient (dBA, L_{eq}) /c/	New Ambient (dBA, L_{eq}) /d/
Single-Family Housing (North)	50	89	51.4	89.0
Maui Lani Regional Park	50	89	51.4	89.0
Pomaikai Elementary School	350	89	49.6	68.0
Waikapu Village	1,200	89	60.1	61.2

/a/ Distance of noise source from receptor.
/b/ Construction noise source's sound level at receptor location with distance adjustment.
/c/ Pre-construction activity ambient sound level at receptor location.
/d/ New sound level at receptor location during the construction period, including noise from construction activity.
SOURCE: TAHA, 2011.

Residential land uses constructed on the project site may be occupied during the ongoing construction process. They would potentially be exposed to excessive construction noise levels during daytime hours. New residents would be well aware of ongoing construction activity prior to occupying the project site. In addition, construction noise will be short-term and intermittent. Construction noise exposure to on-site sensitive receptors is not considered to be an adverse effect.

Construction Noise Control Measures

N1 The project applicant shall obtain a noise permit associated with exceeding a noise level of 78 dBA L_{eq} as discussed in the Maui County *Noise Reference Manual*.

N2 The project applicant shall obtain a noise permit associated with exceeding the maximum permissible noise levels discussed in the Hawaii Administrative Rules.

N3 All mobile construction equipment shall be equipped with properly operating mufflers or other noise reduction devices.

N4 Grading and construction contractors shall use quieter equipment as opposed to noisier equipment (such as rubber-tired equipment rather than metal-tracked equipment) where feasible.

N5 The construction contractor shall use on-site electrical sources to power equipment rather than diesel generators where feasible.

Impacts After Control Measures

Noise Control Measures **N1** and **N2** would ensure compliance with State rules and regulations for construction noise. Noise Control Measure **N3** would reduce on-site construction noise levels by at least 3 dBA and, while difficult to quantify, Noise Control Measures **N4** and **N5** would assist in attenuating construction noise levels. Implementation of Noise Control Measures **N1** through **N5** would reduce the construction noise effects to less than adverse.

6.2 CONSTRUCTION VIBRATION

Construction activity can result in varying degrees of ground-borne vibration, depending on the equipment and methods employed. As shown in **Table 6-4**, use of heavy equipment (e.g., a large bulldozer) typically generates vibration levels of 0.089 inches per second at a distance of 25 feet. Construction equipment would typically operate at least 25 feet from off- and on-site structures. This would generate a vibration level of approximately 0.089 inches per second, which would be less than the FTA standard of 0.2 inches per second. Therefore, the proposed project would not result in adverse effect related to construction vibration. Construction vibration levels would not exceed the relevant standards. Therefore, the proposed project would not result in adverse effect related to construction vibration.

TABLE 6-4: VIBRATION VELOCITIES FOR CONSTRUCTION EQUIPMENT

Equipment	PPV at 25 feet (Inches/Second) /a/
Caisson Drilling	0.089
Large Bulldozer	0.089
Loaded Trucks	0.076

/a/ Fragile buildings can be exposed to ground-borne vibration levels of 0.2 inches per second without experiencing structural damage.
SOURCE: Federal Transit Administration, *Transit Noise and Vibration Impact Assessment*, May 2006.

Construction Vibration Control Measures

Construction vibration effects would not be adverse. No noise control measures are required.

Impacts After Control Measures

No adverse effects related to construction vibration would occur.

6.3 OPERATIONAL NOISE

Vehicular Noise

According to the traffic analysis, 1,039 vehicles would enter the project site and 1,536 vehicles would exit the project site during the AM peak hour.[11] During the PM peak hour, 1,778 vehicles would enter the project site and 1,492 vehicles would exit the project site. Mobile source noise levels are shown in **Tables 6-5** and **6-6**. Some roadway segments show a decrease in noise levels. This is a result of new roadway segments that redistribute traffic. The greatest project-related noise increase would be 2.7 dBA L_{eq} along East Waiko Road between Kuihelani Highway and Kamehameha Avenue. Mobile source noise levels would not exceed the 3-dBA operational mobile source significance noise criteria. Therefore, the proposed project would not result in adverse effect related to off-site vehicular noise.

TABLE 6-5: MOBILE SOURCE NOISE LEVELS – AM PEAK HOUR

Roadway Segment	Estimated dBA, L_{eq}		
	No Project	Project	Project Increase
Kuihelani Highway from East Waiko Road to Maui Lani Parkway	71.2	72.1	0.9
East Waiko Road from Kamehameha Avenue to Wai'ale Drive	65.1	67.0	1.9
East Waiko Road from Kuihelani Highway to Kamehameha Avenue	64.6	67.3	2.7
Maui Lani Parkway from Kuihelani Highway to Kamehameha Avenue	62.6	62.3	(0.3)
Maui Lani Parkway from Kamehameha Avenue to Kuikahi Drive	63.2	63.6	0.4
East Waiko Road from Wai'ale Drive to Honoapiilani Highway	61.5	62.8	1.3
Wai'ale Drive from East Waiko Road to Kuikahi Drive	66.0	66.3	0.3
Honoapiilani Highway from East Waiko Road to Kuikahi Drive	71.0	71.0	0.0
SOURCE: TAHA, 2011.			

TABLE 6-6: MOBILE SOURCE NOISE LEVELS – PM PEAK HOUR

Roadway Segment	Estimated dBA, L_{eq}		
	No Project	Project	Project Increase
Kuihelani Highway from East Waiko Road to Maui Lani Parkway	72.6	73.3	0.7
East Waiko Road from Kamehameha Avenue to Wai'ale Drive	66.5	68.0	1.5
East Waiko Road from Kuihelani Highway to Kamehameha Avenue	66.8	68.1	1.3
Maui Lani Parkway from Kuihelani Highway to Kamehameha Avenue	63.9	63.7	(0.2)
Maui Lani Parkway from Kamehameha Avenue to Kuikahi Drive	64.5	64.8	0.3
East Waiko Road from Wai'ale Drive to Honoapiilani Highway	62.2	60.3	(1.9)
Wai'ale Drive from East Waiko Road to Kuikahi Drive	66.8	67.0	0.2
Honoapiilani Highway from East Waiko Road to Kuikahi Drive	71.9	72.1	0.2
SOURCE: TAHA, 2011.			

Stationary Noise

The proposed project would develop industrial and residential land uses adjacent to residences of the Maui Lani Village Mixed Use area. In addition, on-site residential land uses would be located adjacent to commercial and industrial land uses. Therefore, it is important to assess stationary source noise levels at sensitive receptors.

[11] Austin, Tsutsumi & Associates, Inc., *Wai'ale Development Traffic Impact Analysis Report*, March 21, 2011.

It is assumed that the majority of stationary noise would be generated by ventilation and air conditioning systems. The precise location of these systems is unknown at this time as detailed site plans have not been developed. Possible locations include street level and rooftops. Mechanical equipment such as ventilation and air conditioning systems typically generate noise levels of approximately 60 dBA L_{eq} at 50 feet. This noise level would exceed the Hawaii Administrative Rules maximum permissible noise levels shown in **Table 3-1** for Class A and B land uses. Therefore, without noise control, the proposed project would result in an adverse effect related to mechanical equipment noise.

Light industrial and commercial land uses may generate truck loading/unloading noise (e.g., back-up safety alarms) at residential land uses. Back-up safety alarms could generate a single event noise level of approximately 79 dBA at 50 feet.[12] Loading/unloading noise is typical in an urban environment but, nonetheless, it would exceed the allowable noise levels. Therefore, without noise control, the proposed project would result in an adverse effect related to loading/unloading noise.

Land Use Compatibility

Residential. Residential land uses would be located throughout the 545-acre project site. A 24-hour noise measurement indicated that the ambient noise level at the project site is 62 dBA L_{dn}. This noise level is less than the 65-dBA L_{dn} HUD standard for exterior noise. In general, the project site is compatible with residential land uses.

A detailed land use compatibility analysis was completed for residential land uses along heavily traveled roadways. The mobile source noise levels were estimated using the FHWA TNM Lookup Tables. The HUD standards for interior and exterior noise levels are 45 and 65 dBA L_{dn}, respectively. As shown in **Table 6-7**, exterior and interior noise level standards would be exceeded at residences that face Kuihelani Highway and East Waiko Road. In addition, the interior standard would be exceeded at residences that face Kamehameha Avenue. Therefore, without noise control, the proposed project would result in an adverse effect related to residential land use compatibility.

Light Industrial land uses are located along East Waiko Road adjacent to proposed residential land uses. These land uses generate noise from various sources, including mechanical equipment and medium-duty trucks. Light industrial activity would potentially generate noise levels that exceed the FHWA standards at the planned residential land uses. Therefore, without noise control, the proposed project would result in an adverse effect related to noise compatibility between existing light industrial land uses and planned residences.

[12]The back-up safety alarm noise level was based on regulations set forth b the Occupational Safety and Health Administration.

TABLE 6-7: RESIDENTIAL LAND USE COMPATIBILITY ANALYSIS		
Roadway Segment	**Exterior Noise Level (L_{dn} dBA) /a/**	**Interior Noise Level (L_{dn} dBA) /b/**
Kuihelani Highway	**75.3**	**58.3**
East Waiko Road	**70.1**	**53.1**
Kamehameha Avenue	63.5	**46.5**
Road A	58.6	41.6
Road B	56.3	39.3
Road C	61.5	44.5
Road D	54.3	37.3

/a/ The L_{dn} is typically within 2 dBA of the L_{eq}. The L_{dn} presented in this table was based on the peak hour L_{eq} calculated using the TNM Lookup Tables plus 2 dBA.
/b/ Typical single-pane windows (i.e., 1/16 inches) provide a minimum noise reduction of approximately 17 dBA with windows closed.
SOURCE: TAHA, 2011.

School. The proposed project would include a school located along Road C. The BOE has stated that school should not be located at sites where exterior noise levels exceed 65 dBA L_{10}. For mobile noise, the L_{10} is typically 3 dBA higher than the L_{eq}.[13] Therefore, the equivalent acceptable L_{eq} would be 62 dBA. The mobile noise level along Road C would be approximately 61.6 dBA L_{eq} during the AM peak hour. This is the maximum anticipated noise levels and noise levels throughout the school day would be less than 61.6 dBA L_{eq}. This exterior noise level would not exceed the BOE standard. In addition, the proposed project would need to comply with the Department of Education EDSPECS that state that interior noise levels in general school spaces should not exceed 50 dBA L_{eq} and the noise level in libraries and reading rooms should not exceed 45 dBA L_{eq}. Detailed site plans were not available to complete an interior noise level analysis. It is assumed that interior noise levels could exceed the State standards. Therefore, without noise control, the proposed project would result in an adverse effect related to school land use compatibility.

Park. The proposed project would include a regional park that borders Kuihelani Highway and Road C, a neighborhood park that borders Kuihelani Highway, and a cultural preserve in the northeastern portion of the project site. The FHWA has indicated that exterior noise levels at park land uses should not exceed 67 dBA L_{eq}.[14]

Regarding the regional park, peak hour noise levels along Kuihelani Highway and Road C would be approximately 73.3 and 59.5 dBA, L_{eq} respectively. Peak hour noise levels along Kuihelani Highway would exceed the noise standard for parks. Mobile source noise attenuates at a rate of 4.5 dBA over soft land every doubling of distance. As a result, the noise levels would be less than 67 dBA L_{eq} at 300 feet. The 300 feet nearest to Kuihelani Highway represents less than ten percent of the 65 acre regional park. More than 58 acres of the regional park would be compatible with the ambient noise environment. The incompatible noise levels along Kuihelani Highway would not substantially affect use of the park. Therefore, the proposed project would not result in adverse effect related to the regional park.

A neighborhood park would also be located along Kuihelani Highway. The noise levels would be less than 67 dBA L_{eq} at 300 feet. The 300 feet nearest to Kuihelani Highway represents about 50 percent of the neighborhood park. This is a substantial percentage of the park and

[13] Federal Highway Administration, Highway Traffic Noise Analysis and Abatement Policy and Guidance, June 1995.
[14] *Ibid*.

would affect daily use. Therefore, without noise control, the proposed project would result in adverse effect related to the neighborhood park.

A cultural preserve would be located in the northeastern portion of the project site. Mobile source noise levels at the cultural preserve would be less than 62 dBA L_{eq}. This would be less than the 67-dBA L_{eq} standard. Therefore, the proposed project would not result in adverse effect related to the cultural preserve.

Operational Noise Control Measures

N6 The project applicant shall require mechanical equipment (e.g., ventilation and air conditioning systems) to be enclosed in equipment rooms such that noise levels do not exceed the maximum permissible noise levels listed in the Hawaii Administrative Rules.

N7 Truck loading/unloading activities at light industrial and commercial land uses shall be limited to between the hours of 7:00 a.m. and 10:00 p.m.

N8 Residents of units with exterior useable space facing Kuihelani Highway and East Waiko Road shall be given notice of possible incompatible exterior noise levels.

N9 All residential units shall be designed to minimize interior noise levels. These design measures shall be established to maintain noise levels at interior spaces to less than an L_{dn} of 45 dBA. Measures to meet the 45 dBA L_{dn} standard may include, but are not be limited to, using perimeter walls, sound-rated interior walls between uses, or other site planning and building placement that could reduce or eliminate the light-of-sight between the noise source and residential units. The project applicant shall utilize an acoustical engineer to demonstrate that the 45 dBA L_{dn} interior noise standard has been achieved within a sample of residential units facing Kuihelani Highway, East Waiko Road, and Kamehameha Avenue.

N10 All educational classrooms shall be designed in compliance with the State of Hawaii Department of Education *Educational Specifications (EDSPECS) for Middle/Intermediate Schools*. In accordance with the guidelines, general school space shall meet a background ambient noise level of 45 dBA L_{eq} and libraries and main reading rooms shall meet a background ambient noise level of 50 dBA L_{eq}. Prior to occupancy, an acoustical engineer shall demonstrate that the applicable noise standards have been achieved in classrooms.

N11 The 300 feet closest to Kuihelani Highway on the southern portion of the project site shall be developed with active recreational land uses (e.g., ball fields or basketball courts) as opposed to passive recreational land uses (e.g., art garden).

Impacts After Control Measures

Noise Control Measures **N6** and **N7** would ensure compliance with State rule and regulations for stationary noise. Noise Control Measures **N8** through **N11** would ensure that new land uses would be compatible with ambient noise environments. Implementation of Noise Control Measures **N6** through **N11** would reduce the construction noise effects to less than adverse.

6.4 OPERATIONAL VIBRATION

The proposed project would not include significant stationary sources of ground-borne vibration. It is not anticipated that light industrial land uses would have vibration-generating activities such as heavy equipment operations. Operational ground-borne vibration in the project vicinity would be generated by vehicular travel on the local roadways. However, similar to existing conditions, project-related traffic vibration levels would not be perceptible by sensitive receptors. Therefore, the proposed project would not result in adverse effect related to the operational vibration.

Operational Vibration Control Measures

Operational vibration effects would not be adverse. No noise control measures are required.

Impacts After Control Measures

No adverse effects related to operational vibration would occur.

7.0 CUMULATIVE EFFECTS

An adequate discussion of significant cumulative impacts involves analyzing either (1) a list of past, present, and probable future projects producing related or cumulative impacts, including, if necessary, those projects outside the control of the agency, or (2) a summary of projections contained in an adopted general plan or related planning document, or in a prior environmental document which has been adopted or certified, which described or evaluated regional or area wide conditions contributing to the cumulative impact.

By the year 2022, the Wailuku/Waikapu area will have experienced significant growth, both in its residential population and commercial/industrial/business land uses, primarily as a result of the following developments:

- Waikapu Country Town – currently in the planning phase; assumed to be completed by 2022.
- Maui Lani Development – partially complete; Maui Lani Development and Maui Lani 100 VMX Affordable Housing Project were assumed to be completed by Year 2022 – and therefore the final segment of Maui Lani Parkway between Kuikahi Drive and Waiinu Street was assumed to be complete to support the development.
- Kehalani – partially complete; assumed to be complete by Year 2022.
- Puunani Residences – not started; assumed to be complete by Year 2022.

These projects, along with other smaller ones combine to represent approximately 4,850 new dwelling units for the Central Maui Region, as well as commercial, industrial, park, school, and other ancillary land uses by year 2030. The traffic assessment used in the mobile noise analysis accounted for this growth in the baseline conditions. The Maui Transportation Demand Forecasting Model and Trip Generation Methodology were used to project (via growth ratios) and assign the traffic generated by these and other Maui developments onto the roadway network. The result was an approximate 60-percent increase in demand along Honoapiilani Highway over existing conditions. Along Kuihelani Highway, the increase was an approximate 70 percent.

Noise is a local effect that is generally limited to the immediate area surrounding the source. For this reason, project-related stationary noise would not be audible outside of the project site and would not contribute to a cumulative impact. The proposed project would combine with related projects to increase mobile source noise levels on the roadway network. A 10-dBA increase is subjectively heard as a doubling in loudness and would cause a community response. As shown in **Table 7-1**, the greatest cumulative noise increase during morning peak hour would be 5.5 dBA L_{eq} along East Waiko Road between Kamehameha Avenue and Wai'ale Drive. As shown in **Table 7-2**, the greatest cumulative noise increase during evening peak hour would be 7.5 dBA L_{eq} along East Waiko Road between Kuihelani Highway and Kamehameha Avenue. Neither of these increases would exceed the 10-dBA noise criteria. Therefore, the proposed project would not contribute to a cumulatively considerable impact related to mobile source noise.

TABLE 7-1: CUMULATIVE MOBILE SOURCE NOISE LEVELS – AM PEAK HOUR

Roadway Segment	Estimated dBA, L_{eq} Existing	Future With Project	Cumulative Impact
Kuihelani Highway from East Waiko Road to Maui Lani Parkway	68.9	72.1	3.2
East Waiko Road from Kamehameha Avenue to Wai'ale Drive	61.5	67.0	5.5
East Waiko Road from Kuihelani Highway to Kamehameha Avenue	62.0	67.3	5.3
Maui Lani Parkway from Kuihelani Highway to Kamehameha Avenue	59.2	62.3	3.1
Maui Lani Parkway from Kamehameha Avenue to Kuikahi Drive	59.5	63.6	4.1
East Waiko Road from Wai'ale Drive to Honoapiilani Highway	58.4	62.8	4.4
Wai'ale Drive from East Waiko Road to Kuikahi Drive	61.1	66.3	5.2
Honoapiilani Highway from East Waiko Road to Kuikahi Drive	70.5	71.0	0.5
SOURCE: TAHA, 2011.			

TABLE 7-2: CUMULATIVE MOBILE SOURCE NOISE LEVELS – PM PEAK HOUR

Roadway Segment	Estimated dBA, L_{eq} Existing	Future With Project	Cumulative Impact
Kuihelani Highway from East Waiko Road to Maui Lani Parkway	69.9	73.3	3.4
East Waiko Road from Kamehameha Avenue to Wai'ale Drive	60.6	68.0	7.4
East Waiko Road from Kuihelani Highway to Kamehameha Avenue	60.6	68.1	7.5
Maui Lani Parkway from Kuihelani Highway to Kamehameha Avenue	59.6	63.7	4.1
Maui Lani Parkway from Kamehameha Avenue to Kuikahi Drive	59.6	64.8	5.2
East Waiko Road from Wai'ale Drive to Honoapiilani Highway	59.4	60.3	0.9
Wai'ale Drive from East Waiko Road to Kuikahi Drive	60.2	67.0	6.8
Honoapiilani Highway from East Waiko Road to Kuikahi Drive	70.4	72.1	1.7
SOURCE: TAHA, 2011.			

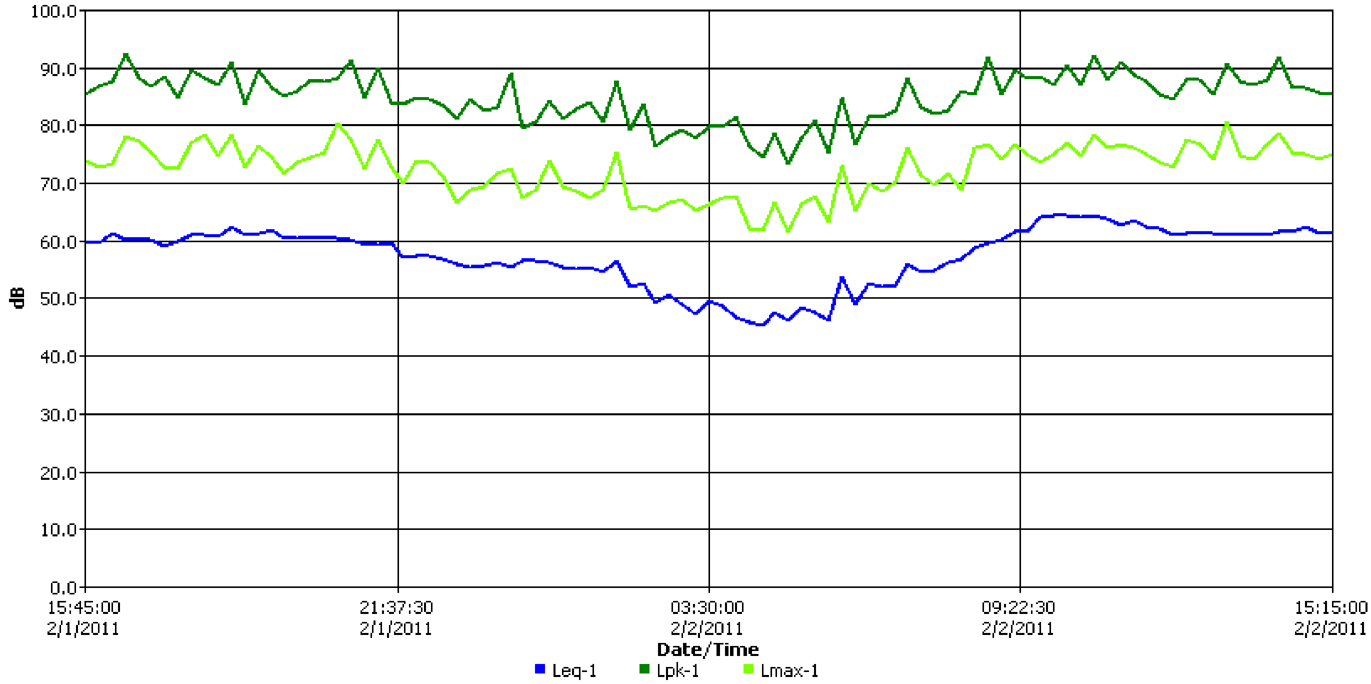
The predominant vibration source near the project site is heavy trucks traveling on the local roadways. Neither the proposed project nor related projects would substantially increase heavy-duty vehicle traffic near the project site and would not cause a substantial increase in heavy-duty trucks on local roadways. The proposed project would not contribute to a cumulatively considerable impact related to vibration.

Appendix A

24-Hour Noise Monitoring Data

Wai'Ale Noise Monitoring

Logged Data Chart



General Data Panel

Description	Meter	Value	Description	Meter	Value
Lmin	1	25 dB	Lmax	1	80.4 dB
Lpk	1	99.7 dB	Leq	1	59.4 dB
CNEL	1	62.7 dB	LDN	1	62 dB

Timestamp	Leq-1	Lpk-1	Lmax-1	Lmin-1
2/1/2011 3:45:00 PM	59.9	85.3	73.8	38.4
2/1/2011 4:00:00 PM	59.6	86.7	72.6	42.6
2/1/2011 4:15:00 PM	61.1	87.6	73.2	41.5
2/1/2011 4:30:00 PM	60.2	92.4	78.1	41.3
2/1/2011 4:45:00 PM	60.4	88.1	77.1	43.8
2/1/2011 5:00:00 PM	60.1	86.8	75.3	41.3
2/1/2011 5:15:00 PM	59.1	88.3	72.7	39.8
2/1/2011 5:30:00 PM	59.9	84.7	72.3	41.4
2/1/2011 5:45:00 PM	60.8	89.4	76.9	42.0
2/1/2011 6:00:00 PM	61.0	88.0	78.3	40.9
2/1/2011 6:15:00 PM	60.7	87.1	74.6	41.4
2/1/2011 6:30:00 PM	62.3	90.8	78.4	41.0
2/1/2011 6:45:00 PM	60.8	83.7	72.6	40.1
2/1/2011 7:00:00 PM	61.1	89.6	76.3	40.6
2/1/2011 7:15:00 PM	61.8	86.3	74.4	41.2
2/1/2011 7:30:00 PM	60.4	85.0	71.7	40.7
2/1/2011 7:45:00 PM	60.3	85.9	73.6	41.6
2/1/2011 8:00:00 PM	60.7	87.7	74.3	42.2
2/1/2011 8:15:00 PM	60.4	87.6	75.3	42.5
2/1/2011 8:30:00 PM	60.5	88.1	80.2	39.8
2/1/2011 8:45:00 PM	60.0	91.3	77.5	40.6
2/1/2011 9:00:00 PM	59.3	84.6	72.3	41.9
2/1/2011 9:15:00 PM	59.3	89.8	77.5	40.0
2/1/2011 9:30:00 PM	59.5	83.9	72.6	40.7
2/1/2011 9:45:00 PM	56.9	83.7	70.0	41.1
2/1/2011 10:00:00 PM	57.4	84.7	73.8	42.2
2/1/2011 10:15:00 PM	57.4	84.5	73.6	36.0
2/1/2011 10:30:00 PM	56.7	83.3	71.1	41.6
2/1/2011 10:45:00 PM	55.8	81.0	66.6	40.0
2/1/2011 11:00:00 PM	55.3	84.4	68.7	38.9
2/1/2011 11:15:00 PM	55.7	82.5	69.3	34.8
2/1/2011 11:30:00 PM	56.3	83.1	71.5	39.3
2/1/2011 11:45:00 PM	55.4	88.8	72.4	35.3
2/2/2011 12:00:00 AM	56.4	79.3	67.4	37.8
2/2/2011 12:15:00 AM	56.5	80.5	68.7	38.4

Timestamp	Leq-1	Lpk-1	Lmax-1	Lmin-1
2/2/2011 12:30:00 AM	56.2	84.3	73.7	33.7
2/2/2011 12:45:00 AM	55.3	81.1	69.3	35.6
2/2/2011 1:00:00 AM	55.1	82.7	68.4	29.9
2/2/2011 1:15:00 AM	55.3	83.9	67.3	31.0
2/2/2011 1:30:00 AM	54.6	80.4	68.9	39.1
2/2/2011 1:45:00 AM	56.4	87.6	75.1	33.8
2/2/2011 2:00:00 AM	52.1	79.2	65.5	29.4
2/2/2011 2:15:00 AM	52.4	83.6	66.0	28.5
2/2/2011 2:30:00 AM	49.1	76.3	65.2	26.4
2/2/2011 2:45:00 AM	50.6	77.9	66.5	28.6
2/2/2011 3:00:00 AM	49.0	79.1	67.1	26.8
2/2/2011 3:15:00 AM	47.3	77.6	65.1	26.9
2/2/2011 3:30:00 AM	49.3	79.6	66.2	29.1
2/2/2011 3:45:00 AM	48.5	79.8	67.3	26.9
2/2/2011 4:00:00 AM	46.5	81.5	67.7	26.4
2/2/2011 4:15:00 AM	45.7	76.3	62.0	26.6
2/2/2011 4:30:00 AM	45.1	74.4	61.8	25.9
2/2/2011 4:45:00 AM	47.4	78.7	66.6	26.5
2/2/2011 5:00:00 AM	46.2	73.2	61.5	25.9
2/2/2011 5:15:00 AM	48.4	77.8	66.2	26.0
2/2/2011 5:30:00 AM	47.4	80.8	67.7	25.2
2/2/2011 5:45:00 AM	46.2	75.2	63.2	25.0
2/2/2011 6:00:00 AM	53.6	84.7	73.1	25.1
2/2/2011 6:15:00 AM	48.8	76.7	65.0	25.6
2/2/2011 6:30:00 AM	52.6	81.3	69.8	26.1
2/2/2011 6:45:00 AM	52.0	81.4	68.6	26.1
2/2/2011 7:00:00 AM	52.2	82.5	70.3	25.4
2/2/2011 7:15:00 AM	55.8	88.2	76.1	26.8
2/2/2011 7:30:00 AM	54.4	83.0	71.3	29.5
2/2/2011 7:45:00 AM	54.7	82.0	69.7	29.3
2/2/2011 8:00:00 AM	56.2	82.6	71.5	28.5
2/2/2011 8:15:00 AM	56.7	85.8	68.7	33.8
2/2/2011 8:30:00 AM	58.6	85.2	76.0	35.6
2/2/2011 8:45:00 AM	59.5	91.7	76.7	39.4
2/2/2011 9:00:00 AM	60.0	85.3	74.2	38.7
2/2/2011 9:15:00 AM	61.4	89.5	76.5	46.4
2/2/2011 9:30:00 AM	61.6	88.0	74.8	43.0
2/2/2011 9:45:00 AM	63.9	88.4	73.5	47.7
2/2/2011 10:00:00 AM	64.2	86.9	74.8	50.3
2/2/2011 10:15:00 AM	64.2	90.4	76.9	50.8
2/2/2011 10:30:00 AM	63.9	86.9	74.6	52.4
2/2/2011 10:45:00 AM	64.2	92.0	78.3	53.5
2/2/2011 11:00:00 AM	63.8	87.8	76.0	50.1
2/2/2011 11:15:00 AM	62.7	90.9	76.7	44.4
2/2/2011 11:30:00 AM	63.4	88.6	76.1	45.3
2/2/2011 11:45:00 AM	62.3	87.6	75.0	38.3
2/2/2011 12:00:00 PM	62.1	85.3	73.4	41.1
2/2/2011 12:15:00 PM	60.9	84.5	72.7	38.0
2/2/2011 12:30:00 PM	61.1	87.7	77.5	38.2
2/2/2011 12:45:00 PM	61.2	87.7	76.6	38.3
2/2/2011 1:00:00 PM	61.1	85.4	74.2	36.2
2/2/2011 1:15:00 PM	60.9	90.7	80.4	37.8
2/2/2011 1:30:00 PM	60.8	87.4	74.6	37.9
2/2/2011 1:45:00 PM	60.8	86.9	74.0	34.2
2/2/2011 2:00:00 PM	60.8	87.9	76.7	34.9
2/2/2011 2:15:00 PM	61.6	91.6	78.7	37.4
2/2/2011 2:30:00 PM	61.6	86.4	75.2	35.1
2/2/2011 2:45:00 PM	62.3	86.5	74.9	37.9
2/2/2011 3:00:00 PM	61.2	85.5	74.0	36.6
2/2/2011 3:15:00 PM	61.4	85.3	74.8	38.5

Appendix B

Construction Noise

CONSTRUCTION NOISE

Reference Noise Distance	**50**
Reference Noise Level	**89**

Sensitive Receptor	**Distance (feet)**	**Attenuation Factors**	**Maximum Construction Noise Level (dBA)**	**Existing Ambient (dBA, Leq)**	**New Ambient (dBA, Leq)**	**Increase**
Single-Family Housing (North)	50	0	**89.0**	**62.7**	**89.0**	**26.3**
Maui Lani Regional Park	50	0	**89.0**	**49.6**	**89.0**	**39.4**
Pomaikai Elementary School	350	0	**67.9**	**51.4**	**68.0**	**16.6**
Waikapu Village	1,200	0	**54.5**	**60.1**	**61.2**	**1.1**

Appendix C

Traffic Noise Model Output Files

AM Honoapiilani Waiko Kuikahi

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM Existing Honoapiilani from Waiko to Kuikahi

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	1297.0
Average automobile speed (mph):	45.0
Medium truck volume (v/h):	26.0
Average medium truck speed (mph):	45.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	45.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	70.5

AM Kuihelani Waiko Maui Lani

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM Existing Kuihelani from Waiko to Maui Lani

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	998.0
Average automobile speed (mph):	55.0
Medium truck volume (v/h):	66.0
Average medium truck speed (mph):	55.0
Heavy truck volume (v/h):	33.0
Average heavy truck speed (mph):	55.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	100.0
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	68.9

AM Maui Lani Kamehameha to Kuikahi

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM Existing Maui Lani from Kamehameha to Kuikahi

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	771.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	16.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	59.5

AM Maui Lani Kuihelani Kamehameha

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM Existing Maui Lani from Kuihelani to Kamehameha

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	726.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	15.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface:	hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	59.2

AM Waiale Waiko Kuikahi

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM Existing Waiale from Waiko to Kuikahi

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	338.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	22.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	11.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	61.1

AM Waiko Kamehameha Waiale

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM Existing Waiko from Kamehameha to Waiale

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	299.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	13.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	16.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	61.5

AM Waiko Kuihelani Kamehameha

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM Existing Waiko from Kuihelani to Kamehameha

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	331.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	15.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	18.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	62.0

AM Waiko Waiale Honoapiilani

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM Existing Waiko from Waiale to Honoapiilani

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	140.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	6.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	8.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface:	hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	58.4

AM Honoapiilani Waiko Kuikahi

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM 2022 Base Honoapiilani from Waiko to Kuikahi

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	1436.0
Average automobile speed (mph):	45.0
Medium truck volume (v/h):	29.0
Average medium truck speed (mph):	45.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	45.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	71.0

AM Kuihelani Waiko Maui Lani

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM 2022 Base Kuihelani from Waiko to Maui Lani

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	1672.0
Average automobile speed (mph):	55.0
Medium truck volume (v/h):	110.0
Average medium truck speed (mph):	55.0
Heavy truck volume (v/h):	55.0
Average heavy truck speed (mph):	55.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	100.0
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	71.2

AM Maui Lani Kamehameha Kuikahi

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM 2022 Base Maui Lani from Kamehameha to Kuikahi

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	1833.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	37.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	63.2

AM Maui Lani Kuihelani Kamehameha

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM 2022 Base Maui Lani from Kuihelani to Kamehameha

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	1578.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	32.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	62.6

AM Waiale Waiko Kuikahi

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM 2022 Base Waiale from Waiko to Kuikahi

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	1035.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	68.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	34.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface:	hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	66.0

AM Waiko Kamehameha Waiale

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM 2022 Base Waiko from Kamehameha to Waiale

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	664.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	29.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	37.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	65.1

AM Waiko Kuihelani Kamehameha

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM 2022 Base Waiko from Kuihelani to Kamehameha

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	601.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	26.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	33.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	64.6

AM Waiko Waiale Honoapiilani

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM 2022 Base Waiko from Waiale to Honoapiilani

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	298.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	13.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	16.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	61.5

AM Honoapiilani Waiko Kuikahi

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM 2022 Project Honoapiilani from Waiko to Kuikahi

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	1446.0
Average automobile speed (mph):	45.0
Medium truck volume (v/h):	30.0
Average medium truck speed (mph):	45.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface:	hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	71.0

AM Kamehameha Road C Maui Lani

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM 2022 Project Kamehameha from Road C to Maui Lani

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	365.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	7.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	56.2

AM Kamehameha Waiko South

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM 2022 Project Kamehameha from Waiko South

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	191.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	4.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	53.5

AM Kuihelani Waiko Maui Lani

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM 2022 Project Kuihelani from Waiko to Maui Lani

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	2057.0
Average automobile speed (mph):	55.0
Medium truck volume (v/h):	136.0
Average medium truck speed (mph):	55.0
Heavy truck volume (v/h):	68.0
Average heavy truck speed (mph):	55.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	100.0
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	72.1

AM Kuikahi Maui Lani Road A

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM 2022 Project Kuikahi from Maui Lani to Road A

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	1730.0
Average automobile speed (mph):	30.0
Medium truck volume (v/h):	35.0
Average medium truck speed (mph):	30.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	66.7

AM Kuikahi Road A Waiale

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM 2022 Project Kuikahi from Road A to Waiale

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	1789.0
Average automobile speed (mph):	30.0
Medium truck volume (v/h):	37.0
Average medium truck speed (mph):	30.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	66.9

AM Maui Lani Kamehameha Kuikahi

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM 2022 Project Maui Lani from Kamehameha to Kuikahi

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	1967.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	40.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	63.6

AM Maui Lani Kuihelani Kamehameha

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM 2022 Project Maui Lani from Kuihelani to Kamehameha

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	1480.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	30.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	62.3

AM Road A Road C Kuikahi

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM 2022 Project Road A from Road C to Kuikahi

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	365.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	7.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface:	hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	56.2

AM Road A Road D Road C

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM 2022 Project Road A from Road D to Road C

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	341.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	7.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	56.0

AM Road B Waiko South

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM 2022 Project Road B from Waiko South

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	83.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	2.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	50.0

AM Road C Kamehameha Road B

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM 2022 Project Road C from Kamehameha to Road B

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	622.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	13.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	58.6

AM Road C Road A Kamehameha

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM 2022 Project Road C from Road A to Kamehameha

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	145.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	3.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	52.3

AM Road D Kamehameha Road B

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM 2022 Project Road D from Kamehameha to Road B

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	49.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	1.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	47.5

AM Road D Road A Kamehameha

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM 2022 Project Road D from Road A to Kamehameha

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	83.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	2.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	50.0

AM Waiale Waiko Kuikahi

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM 2022 Project Waiale from Waiko to Kuikahi

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	1085.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	72.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	36.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface:	hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER #   1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	66.3

AM Waiko Kamehameha Waiale

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM 2022 Project Waiko from Kamehameha to Waiale

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	1058.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	47.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	58.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER #   1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	67.0

AM Waiko Kuihelani Kamehameha

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM 2022 Project Waiko from Kuihelani to Kamehameha

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	1103.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	49.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	61.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface:	hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	67.3

AM Waiko Road B Kamehameha

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM 2022 Project Waiko from Road B to Kamehameha

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	1021.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	45.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	56.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	66.9

AM Waiko Waiale Honoapiilani

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

AM 2022 Project Waiko from Waiale to Honoapiilani

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	400.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	18.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	22.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	62.8

PM Honoapiilani Waiko Kuikahi

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM Existing Honoapiilani from Waiko to Kuikahi

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	1241.0
Average automobile speed (mph):	45.0
Medium truck volume (v/h):	25.0
Average medium truck speed (mph):	45.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	45.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	70.4

PM Kuihelani Waiko Maui Lani

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM Existing Kuihelani from Waiko to Maui Lani

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	1152.0
Average automobile speed (mph):	55.0
Medium truck volume (v/h):	76.0
Average medium truck speed (mph):	55.0
Heavy truck volume (v/h):	38.0
Average heavy truck speed (mph):	55.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	100.0
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	69.6

PM Maui Lani Kamehameha Kuikahi

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM Existing Maui Lani from Kamehameha to Kuikahi

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	800.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	16.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface:	hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER #   1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	59.6

PM Maui Lani Kuihelani Kamehameha

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM Existing Maui Lani from Kuihelani to Kamehameha

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	785.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	16.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface:	hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	59.6

PM Waiale Waiko Kuikahi

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM Existing Waiale from Waiko to Kuikahi

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	273.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	18.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	9.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	60.2

PM Waiko Kamehameha Waiale

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM Existing Waiko from Kamehameha to Waiale

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	240.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	11.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	13.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	60.6

PM Waiko Kuihelani Kamehameha

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM Existing Waiko from Kuihelani to Kamehameha

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	244.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	11.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	13.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	60.6

PM Waiko Waiale Honoapiilani

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM Existing Waiko from Waiale to Honoapiilani

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	175.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	8.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	10.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	59.4

PM Honoapiilani Waiko to Kuikahi

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM 2022 Base Honoapiilani Waiko to Kuikahi

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	1776.0
Average automobile speed (mph):	45.0
Medium truck volume (v/h):	36.0
Average medium truck speed (mph):	45.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	45.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface:	hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	71.9

PM Kuihelani Waiko Maui Lani

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM 2022 Base Kuihelani from Waiko to Maui Lani

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	2309.0
Average automobile speed (mph):	55.0
Medium truck volume (v/h):	152.0
Average medium truck speed (mph):	55.0
Heavy truck volume (v/h):	76.0
Average heavy truck speed (mph):	55.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	100.0
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	72.6

PM Maui Lani Kamehameha Kuikahi

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM 2022 Base Maui Lani Kamehameha to Kuikahi

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	2452.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	50.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	64.5

PM Maui Lani Kuihelani Kamehameha

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM 2022 Base Maui Lani Kuihelani to Kamehameha

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	2105.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	43.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	63.9

PM Waiale Waiko Kuikahi

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM 2022 Base Waiale Waiko to Kuikahi

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	1247.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	82.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	41.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	66.8

PM Waiko Kamehameha Waiale

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM 2022 Base Waiko Kamehameha to Waiale

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	919.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	40.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	51.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	66.5

PM Waiko Kuihelani Kamehameha

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM 2022 Base Waiko from Kuihelani to Kamehameha

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	1006.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	44.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	55.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface:	hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER #   1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	66.8

PM Waiko Waiale Honoapiilani
* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM 2022 Base Waiko from Waiale to Honoapiilani

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	341.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	15.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	19.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	62.2

PM Honoapiilani Waiko Kuikahi

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM 2022 Project Honoapiilani from Waiko to Kuikahi

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	1855.0
Average automobile speed (mph):	45.0
Medium truck volume (v/h):	38.0
Average medium truck speed (mph):	45.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	45.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	72.1

PM Kamehameha Road C Maui Lani

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM 2022 Project Kamehameha from Road C to Maui Lani

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	1240.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	25.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	61.5

PM Kamehameha Waiko South

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM 2022 Project Kamehameha from Waiko South

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	245.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	5.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	54.5

PM Kuihelani Waiko Maui Lani

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM 2022 Project Kuihelani Waiko at Maui Lani

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	2712.0
Average automobile speed (mph):	55.0
Medium truck volume (v/h):	179.0
Average medium truck speed (mph):	55.0
Heavy truck volume (v/h):	89.0
Average heavy truck speed (mph):	55.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	100.0
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	73.3

PM Kuikahi Maui Lani Road A

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM 2022 Project Kuikahi from Maui Lani to Road A

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	1793.0
Average automobile speed (mph):	30.0
Medium truck volume (v/h):	37.0
Average medium truck speed (mph):	30.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	30.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	66.9

PM Kuikahi Road A Waiale

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM 2022 Project Kuikahi from Road A to Waiale

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	1945.0
Average automobile speed (mph):	30.0
Medium truck volume (v/h):	40.0
Average medium truck speed (mph):	30.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	30.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface:	hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	67.2

PM Maui Lani Kamehameha Kuikahi

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM 2022 Project Maui Lani Kamehameha Kuikahi

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	2626.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	54.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface:	hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER #   1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	64.8

PM Maui Lani Kuihelani Kamehameha

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM 2022 Project Maui Lani from Kuihelani to Kamehameha

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	2034.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	42.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	63.7

PM Road A Road C Kuikahi

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM 2022 Project Road A from Road C to Kuikahi

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	402.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	8.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	56.6

PM Road A Road D Road C

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM 2022 Project Road A from Road D to Road C

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	348.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	7.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface:	hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	56.0

PM Road B Waiko South

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM 2022 Project Road B from Waiko South

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	225.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	5.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface:	hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	54.3

PM Road C Kamehameha Road B

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM 2022 Project Road C from Kamehameha to Road B

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	779.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	16.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	59.5

PM Road C Road A Kamehameha

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM 2022 Project Road C from Road A to Kamehameha

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	230.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	5.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	54.3

PM Road D Kamehameha Road B

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM 2022 Project Road D from Kamehameha to Road B

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	130.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	3.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface:	hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	51.9

PM Road D Road A Kamehameha

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM 2022 Project Road D from Road A to Kamehameha

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	149.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	3.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	52.3

PM Waiale Waiko Kuikahi

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM 2022 Project Waiale from Waiko to Kuikahi

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	1310.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	86.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	43.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface:	hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER #   1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	67.0

PM Waiko Kamehameha Waiale

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM 2022 Project Waiko from Kamehameha to Waiale

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	1331.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	59.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	73.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	68.0

PM Waiko Kuihelani Kamehameha

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM 2022 Project Waiko from Kuihelani to Kamehameha

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	1349.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	59.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	74.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface:	hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER #   1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	68.1

PM Waiko Road B Kamehameha

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM 2022 Project Waiko from Road B to Kamehameha

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	1263.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	56.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	69.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	67.8

PM Waiko Waiale Honoapiilani

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

PM 2022 Project Waiko from Waiale to Honoapiilani

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	507.0
Average automobile speed (mph):	20.0
Medium truck volume (v/h):	22.0
Average medium truck speed (mph):	20.0
Heavy truck volume (v/h):	5.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

Nearest Residential

Distance from center of 12-ft wide, single lane roadway (ft):	32.8
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	60.3

Appendix L: Air Quality Study

WAI'ALE PROJECT
AIR QUALITY STUDY

Prepared for

A&B PROPERTIES, INC.

Prepared by

TERRY A. HAYES ASSOCIATES INC.

MAY 2011

taha 2010-058

WAI'ALE PROJECT
AIR QUALITY STUDY

Prepared for

A&B PROPERTIES, INC.
11 Puunene Avenue
Kahului, HI 96732

Prepared by

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8522 National Boulevard, Suite 102
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May 12, 2011

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1.0 SUMMARY OF FINDINGS

Terry A. Hayes Associates Inc. has completed an Air Quality Study for the proposed Wai'ale Project. Key findings are listed below.

- Construction activity would result in temporary emissions from construction vehicle exhaust, as well as fugitive dust emissions due to ground disturbance. The proposed project would not result in adverse effect related to construction air quality. However, the following control measures are recommended to reduce fugitive dust emissions.

  AQ1 The construction contractor shall use water or suitable chemicals to control fugitive dust in the demolition of any existing buildings or structures, construction operations, the grading of roads, or the clearing of land.

  AQ2 The construction contractor shall apply asphalt, water, or suitable chemicals on roads, material stockpiles, and other surfaces which may result in fugitive dust.

  AQ3 The construction contractor shall cover all moving, open-bodied trucks transporting materials which may result in fugitive dust.

  AQ4 The construction contractor shall maintain roadways in a clean manner.

  AQ5 The construction contractor shall promptly remove earth or other materials from paved streets which have been transported there by trucking, earth-moving equipment, erosion, or other means.

- Regional operational emissions would be generated from vehicle trips, including approximately 29,225 average daily trips. Project daily emissions would represent approximately 0.35 percent of State emissions. These low percentages of emissions are not considered substantial. Therefore, the proposed project would not result in adverse effect related to regional operational emissions.

- The proposed project would generate approximately 125,293 metric tons of greenhouse gas emissions from direct and indirect sources. The proposed project represents approximately 0.51 percent of Statewide GHG emissions. This percentage is not considered to be substantial. Therefore, the proposed project would not result in an adverse effect related to GHG emissions.

- The primary source of localized emissions would be diesel particulate matter (DPM) emitted during truck loading/unloading activity. These emissions are of particular concern because DPM is a carcinogenic compound and light industrial land uses would be located along East Waiko Road adjacent to proposed residential land uses. Without a control measure to limit idling, the proposed project would result in an adverse effect related to operational emissions. The following air quality control measure would eliminate adverse effects.

  AQ6 Diesel-fueled trucks shall be prohibited from idling in excess of ten minutes at land uses associated with the proposed project, except under the following conditions:

- When forced to remain motionless due to adverse weather conditions;
- When verifying that the vehicle is in safe operating condition;
- When the vehicle is positioning or providing a power source for equipment or operations; or
- While operating air conditioning or any other device to prevent a health or safety emergency.

- The proposed project may include an on-site wastewater treatment plant. The following air quality control measure would eliminate adverse effects.

AQ7 A detailed Odor Management Plan shall be completed during the final design phase of the wastewater treatment plant. The Odor Management Plan will focus on minimizing nuisance odors.

2.0 INTRODUCTION

2.1 PURPOSE OF REPORT

The purpose of the Air Quality Study is to evaluate the potential for adverse air quality effects associated with the Wai'ale Project (proposed project). Air quality emissions are assessed for construction and operational activities. Air quality control measures are recommended when appropriate to reduce emissions.

The analysis examines the degree to which the proposed project alternatives may cause significant adverse changes to air quality. Both short-term construction emissions occurring from activities such as site grading and haul truck trips, and long-term effects related to the ongoing operation are discussed in this section. This analysis focuses on air pollution from two perspectives: daily emissions and pollutant concentrations. "Emissions" refer to the quantity of pollutant released into the air, measured in pounds per day (ppd). "Concentrations" refer to the amount of pollutant material per volumetric unit of air, measured in parts per million (ppm) or micrograms per cubic meter ($\mu g/m^3$).

2.2 PROJECT DESCRIPTION

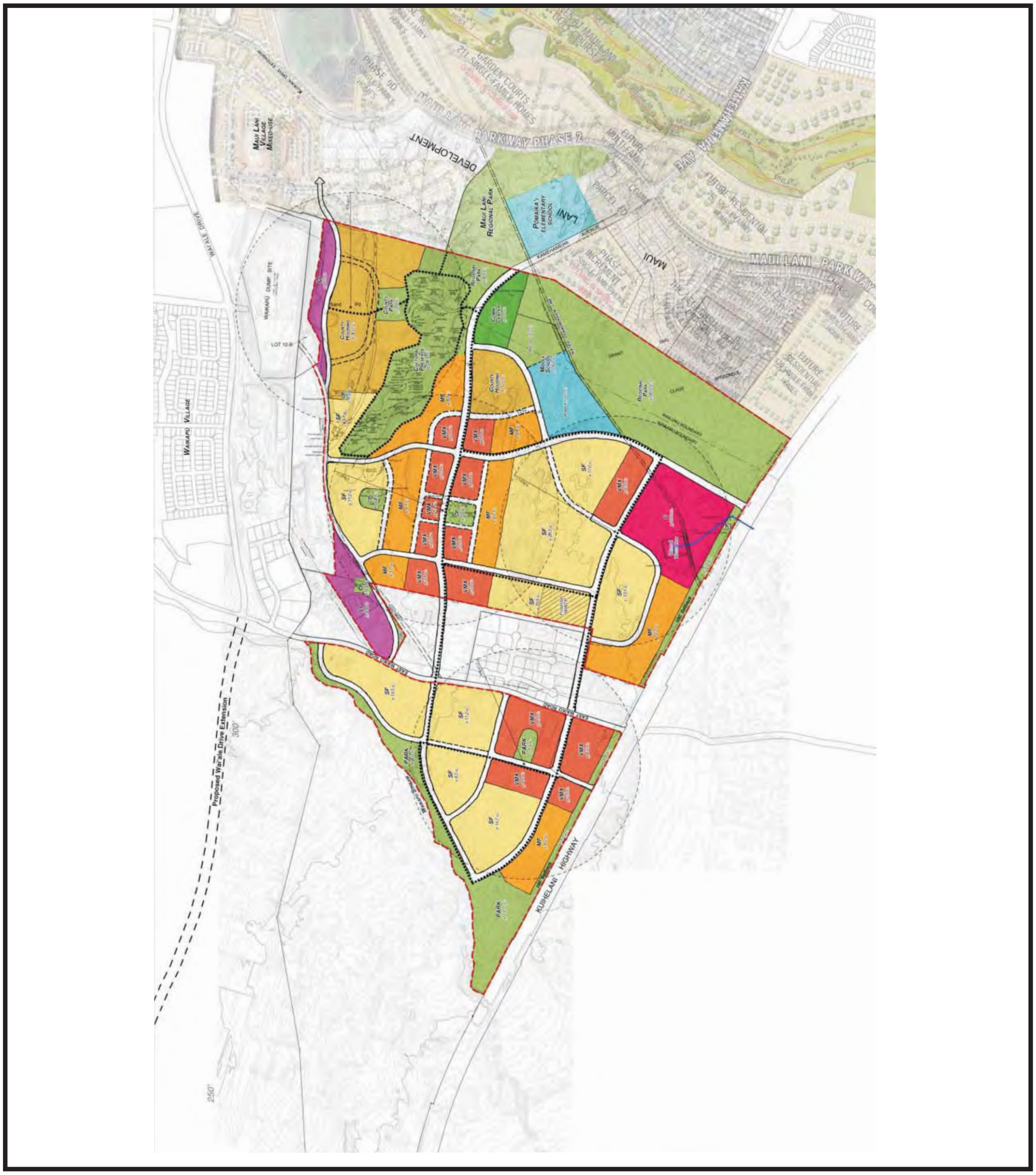
Wai'ale is envisioned to be a community for residents to live, work, learn, shop and play. Residential communities, including single-family homes and multi-family dwellings, will be connected to Village Mixed-Use areas supported with commercial, retail, office, civic and other public facilities through a system of pedestrian/bicycle paths and greenways. Approximately 2,550 residential units are proposed for Wai'ale, including approximately 300 residential units within the 50 acres to be contributed to the County of Maui.

Proposed land uses are shown in the conceptual master plan for Wai'ale (**Figure 2-1**) and are generally described below. The approximate land use areas are summarized generally and may be adjusted as the master plan is refined through the land use review and approval process.

Village Mixed Use. Commercial, office, retail, business, civic, social services and multi-family residential uses would be located on several parcels of land near the Kuihelani Highway/Waiko Road intersection, as well as along the extension of Kamehameha Avenue. Pedestrian and bicycle paths connecting these uses with the rest of the Wai'ale community (including schools and places of employment) encourage multi-modal transportation.

Commercial. A commercial area is planned along Kuihelani Highway to provide a variety of services and employment opportunities within Wai'ale. The 23-acre area is envisioned for commercial, office, retail, and business uses.

Business/Light Industrial. Approximately 16 acres are planned to provide an area for light industrial users and businesses. These land uses will meet regional and area demands by providing an additional employment center for Wai'ale.



LEGEND:

Single Family	Business/Light Industrial	County Housing (Single Family & Multi-Family)
Multi-Family	Regional Park/Cultural Preserve	Wai'ale Project Area
Village Mixed-Use	Community Center	Greenway Path (Pedestrian/Bike)
Commercial	Institutional/School	Potential Waste Water Treatment Plant

N

APPROX. SCALE

0 0.175 0.35 MILES

SOURCE: A&B Properties, Inc.

taha

Wai'ale Project
Air Quality Study
A&B PROPERTIES, INC.

taha 2010-058

FIGURE 2-1

CONCEPTUAL COMMUNITY MASTER PLAN

Residential. Single-family homes and multi-family dwellings with a variety of live-work opportunities are planned residential land uses. Consistent with the Draft Maui Island Plan's Directed Growth Strategy for Central Maui, a total of approximately 2,550 residential units are planned at Wai'ale.

County of Maui Lands. Fifty acres of land will be contributed to the County of Maui and is integrated into the conceptual master plan. This land is located in the vicinity of the current terminus of Kamehameha Avenue in the northwestern portion of Wai'ale. The land is to be used as follows: 40 acres of affordable housing, 7 acres of community center, and 3 acres of neighborhood park. Approximately 300 residential units, including both multi- and single-family residences, are assumed for the affordable housing.

Schools. One middle school site, totaling approximately 18 acres, may be needed to accommodate the educational needs of children living in Wai'ale. The school will be located on the northern portion of the project site.

Public Support Facilities & Regional Community Center. Public support and civic-related facilities and a regional community center would be located in the center of the Wai'ale community along the extension of Kamehameha Avenue. The regional community center is envisioned to be developed by the County of Maui on seven acres, as part of the County of Maui lands.

Parks and Cultural Preserves. A regional park is proposed along the northern boundary of Wai'ale, providing a spatial separation between the neighborhoods of Wai'ale and Maui Lani. This park is intended to support regional and Wai'ale recreational activities and would be within walking distance or a bicycle ride from residential communities and schools. Additional neighborhood parks are provided within residential areas, as well as along the perimeter of Wai'ale. Parks, cultural preserves, and open space planned within Wai'ale total nearly 142 acres.

Greenways and Open Space. The conceptual master plan for Wai'ale includes greenways and open space along Kuihelani Highway, within residential communities, and along Waikapü Stream to enhance the visual character of the community.

Bicycle/Pedestrian Paths. Wai'ale is designed as a bikeable/walkable community. A system of linked paths will provide pedestrians and bicyclists with an option for transportation other than automobiles throughout the community. Residents would be able to travel from their homes to the Village Mixed Use, Commercial Center, parks, school, and other public uses on pedestrian and bicycle pathways that would run through a network of open spaces and greenways.

Landmark Buildings. There are opportunities to create buildings that have "landmark" qualities at prominent locations within a community. These buildings could include civic or other institutional uses such as churches and will contribute to the overall character and visual orientation of the community.

3.0 POLLUTANTS AND REGULATORY SETTING

3.1 POLLUTANTS

The U.S. Environmental Protection Agency (USEPA) currently focus on the following air pollutants as indicators of ambient air quality: ozone (O3), particulate matter (PM), nitrogen dioxide (NO_2), carbon monoxide (CO), sulfur dioxide (SO_2), and lead (Pb). These "criteria air pollutants" are considered harmful to public health and the environment.[1] These pollutants are discussed below.

Carbon Monoxide. CO is an odorless, colorless gas formed by the incomplete combustion of fuels. The single largest source of CO is motor vehicles. Emissions are highest during cold starts, hard acceleration, stop-and-go driving, and when a vehicle is moving at low speeds. New findings indicate that CO emissions per mile are lowest at about 45 miles per hour (mph) for the average light-duty motor vehicle and begin to increase again at higher speeds. When inhaled at high concentrations, CO combines with hemoglobin in the blood and reduces the oxygen carrying capacity of the blood. This results in reduced oxygen reaching the brain, heart and other body tissues. This condition is especially critical for people with cardiovascular diseases, chronic lung disease or anemia, as well as fetuses. Even healthy people exposed to high CO concentrations can experience headaches, dizziness, fatigue, unconsciousness, and even death.

Ozone. O_3, or smog, is not emitted directly into the environment, but is formed in the atmosphere by complex chemical reactions between reactive organic gases (ROG) and nitrogen oxides (NO_X) in the presence of sunlight. Ozone formation is greatest on warm, windless, sunny days. The main sources of NO_X and ROG, often referred to as ozone precursors, are combustion processes (including motor vehicle engines) the evaporation of solvents, paints, and fuels, and biogenic sources. Automobiles are the single largest source of ozone precursors. Tailpipe emissions of ROG are highest during cold starts, hard acceleration, stop-and-go conditions, and slow speeds. They decline as speeds increase up to about 50 mph, then increase again at high speeds and high engine loads. ROG emissions associated with evaporation of unburned fuel depend on vehicle and ambient temperature cycles. Nitrogen oxide emissions exhibit a different curve; emissions decrease as the vehicle approaches 30 mph and then begin to increase with increasing speeds.

Ozone levels usually build up during the day and peak in the afternoon hours. Short-term exposure can irritate the eyes and cause constriction of the airways. Besides causing shortness of breath, it can aggravate existing respiratory diseases such as asthma, bronchitis and emphysema. Chronic exposure to high ozone levels can permanently damage lung tissue. Ozone can also damage plants and trees, and materials such as rubber and fabrics.

Nitrogen Dioxide. NO_2 is a reddish-brown gas that is a by-product of combustion processes. Automobiles and industrial operations are the main sources of NO_2. Aside from its contribution to ozone formation, nitrogen dioxide can increase the risk of acute and chronic respiratory disease and reduce visibility. NO_2 may be visible as a coloring component of a brown cloud on high pollution days, especially in conjunction with high ozone levels.

[1]USEPA, http://www.epa.gov/air/criteria.html, accessed February 15, 2011.

Sulfur Dioxide. SO_2 is a colorless acid gas with a pungent odor. It has potential to damage materials and it can have health effects at high concentrations. It is produced by the combustion of sulfur-containing fuels, such as oil, coal and diesel. SO_2 can irritate lung tissue and increase the risk of acute and chronic respiratory disease.

Particulate Matter. Particulate matter refers to a wide range of solid or liquid particles in the atmosphere, including smoke, dust, aerosols, and metallic oxides. Respirable particulate matter with an aerodynamic diameter of 10 micrometers or less is referred to as PM_{10}. $PM_{2.5}$ includes a subgroup of finer particles that have an aerodynamic diameter of 2.5 micrometers or less. Some particulate matter, such as pollen, is naturally occurring. Most particulate matter is caused by combustion, factories, construction, grading, demolition, agricultural activities, and motor vehicles. Extended exposure to particulate matter can increase the risk of chronic respiratory disease. PM_{10} is of concern because it bypasses the body's natural filtration system more easily than larger particles, and can lodge deep in the lungs. The USEPA revised their PM standards to apply only to these fine particles. $PM_{2.5}$ poses an increased health risk because the particles can deposit deep in the lungs and contain substances that are particularly harmful to human health.

Lead. Pb is a metal found naturally in the environment as well as in manufactured products. The major sources of lead emissions have historically been mobile and industrial sources. As a result of the phase-out of leaded gasoline, metal processing is currently the primary source of lead emissions. The highest levels of lead in air are generally found near lead smelters. Other stationary sources are waste incinerators, utilities, and lead-acid battery manufacturers.

Twenty years ago, mobile sources were the main contributor to ambient lead concentrations in the air. In the early 1970s, the USEPA set national regulations to gradually reduce the lead content in gasoline. In 1975, unleaded gasoline was introduced for motor vehicles equipped with catalytic converters. The USEPA banned the use of leaded gasoline in highway vehicles in December 1995. As a result of the USEPA's regulatory efforts to remove lead from gasoline, emissions of lead from the transportation sector and levels of lead in the air decreased dramatically.

Toxic Air Contaminants. In addition to the criteria air pollutants listed above, another group of pollutants, commonly referred to as toxic air contaminants (TACs) or hazardous air pollutants can result in health effects that can be quite severe. Many TACs are confirmed or suspected carcinogens, or are known or suspected to cause birth defects or neurological damage. In addition, many TACs can be toxic at very low concentrations. For some chemicals, such as carcinogens, there are no thresholds below which exposure can be considered risk-free.

Industrial facilities and mobile sources are significant sources of TACs. The electronics industry, including semiconductor manufacturing, has the potential to contaminate both air and water due to the highly toxic chlorinated solvents commonly used in semiconductor production processes. Sources of TACs go beyond industry. Various common urban facilities also produce TAC emissions, such as gasoline stations (benzene), hospitals (ethylene oxide), and dry cleaners (perchloroethylene). Automobile exhaust also contains TACs such as benzene and 1,3-butadiene.

Odors and Dust. Other air quality issues of concern include nuisance impacts of odors and dust. Objectionable odors may be associated with a variety of pollutants. Common sources of odors include wastewater treatment plants, landfills, composting facilities, refineries and chemical plants. Similarly, nuisance dust may be generated by a variety of sources including quarries, agriculture, grading and construction. Odors rarely have direct health impacts, but they can be very unpleasant and can lead to anger and concern over possible health effects among the public.

3.2 REGULATORY SETTING

Federal Regulations

United States Environmental Protection Agency. At the federal level, USEPA has been charged with implementing national air quality programs. USEPA's air quality mandates are drawn primarily from the Federal Clean Air Act (FCAA), which was enacted in 1963. The FCAA was amended in 1970, 1977, and 1990.

The FCAA required USEPA to establish primary and secondary National Ambient Air Quality Standards (NAAQS). The FCAA also required each state to prepare an air quality control plan referred to as a State Implementation Plan (SIP). The Federal Clean Air Act Amendments of 1990 (FCAAA) added requirements for states with nonattainment areas to revise their SIPs to incorporate additional control measures to reduce air pollution. The SIP is periodically modified to reflect the latest emissions inventories, planning documents, and rules and regulations of the air basins as reported by their jurisdictional agencies. USEPA has responsibility to review all state SIPs to determine conformation to the mandates of the FCAAA and determine if implementation will achieve air quality goals. If the USEPA determines a SIP to be inadequate, a Federal Implementation Plan (FIP) may be prepared for the nonattainment area that imposes additional control measures. Failure to submit an approvable SIP or to implement the plan within the mandated timeframe may result in sanctions being applied to transportation funding and stationary air pollution sources in the air basin.

Federal Hazardous Air Pollutant Program. Title III of the FCAAA requires the USEPA to promulgate National Emissions Standards for Hazardous Air Pollutants (NESHAPs). The emissions standards were promulgated in two phases. In the first phase, the USEPA developed technology-based emission standards designed to produce maximum emission reductions. These standards are generally referred to as requiring Maximum Achievable Control Technology (MACT). In the second phase, the USEPA set health risk–based emissions standards to address risks remaining after implementation of the technology-based NESHAP standards. The FCAAA required the USEPA to promulgate vehicle or fuel standards containing reasonable requirements that control toxic emissions, at a minimum to benzene and formaldehyde. Performance criteria were established to limit mobile-source emissions of toxics, including benzene, formaldehyde, and 1,3-butadiene.

Mobile Source Air Toxics (MSAT). The USEPA issued a Final Rule on Controlling Emissions of Hazardous Air Pollutants from Mobile Sources on March 29, 2001. USEPA examined the impacts of existing and newly promulgated mobile source control programs, including: reformulated gasoline; national low emission vehicle standards; Tier 2 motor vehicle emissions standards and gasoline sulfur control requirements; proposed heavy duty engine and vehicle standards; and on-highway diesel fuel sulfur control requirements. The Federal Highway Administration Projects that even with a substantial increase in vehicle miles traveled between 2000 and 2020 that these programs will reduce on-highway emissions of benzene, formaldehyde, 1,3-butadiene, and acetaldehyde by 57 to 65 percent, and will reduce on-highway diesel particulate matter emissions by 87 percent. As a result, USEPA concluded that no further motor vehicle emissions standards or fuel standards were necessary to further control MSATs.

State Regulations

State of Hawaii Department of Health. The State of Hawaii Department of Health Clean Air Branch is responsible for air pollution control in the State. The primary services of the branch are provided by its three sections: Engineering, Monitoring, and Enforcement. These sections conduct engineering analysis and permitting, perform monitoring and investigations, and enforce the federal and State air pollution control laws and regulations. The Department of Health Administrative Rules includes two chapters representing the Clean Air Branch. Chapter 59 identifies ambient air quality standards (**Table 3-1**), and Chapter 60 discusses air pollution control methodology. Chapter 60 includes air permitting, sampling, modeling, and fugitive dust and motor vehicle provisions.

Chapter 60 §11-60.1-33 includes the following fugitive dust prohibitions:

- No person shall cause or permit visible fugitive dust to become airborne without taking reasonable precautions. Examples of reasonable precautions are:

  - Use of water or suitable chemicals for control of fugitive dust in the demolition of any buildings or structures, construction operations, the grading of roads, or the clearing of land;
  - Application of asphalt, water, or suitable chemicals on roads, material stockpiles, and other surfaces which may result in fugitive dust;
  - Installation and use of hoods, fans, and fabric filters to enclose and vent the handling of dusty materials. Reasonable containment methods shall be employed during sandblasting or other similar operations;
  - Covering all moving, open-bodied trucks transporting materials which may result in fugitive dust;
  - Conducting agricultural operations, such as tilling of land and the application of fertilizers, in such manner as to reasonably minimize fugitive dust;
  - Maintenance of roadways in a clean manner; and
  - Prompt removal of earth or other materials from paved streets which have been transported there by trucking, earth-moving equipment, erosion, or other means.

- Except for persons engaged in agricultural operations or persons who can demonstrate to the director that the best practical operation or treatment is being implemented, no person shall cause or permit the discharge of visible fugitive dust beyond the property lot line on which the fugitive dust originates.

TABLE 3-1: STATE AND NATIONAL AMBIENT AIR QUALITY STANDARDS AND ATTAINMENT STATUS FOR THE COUNTY OF MAUI

Pollutant	Averaging Period	Hawaii		Federal	
		Standards	Attainment Status	Standards	Attainment Status
Ozone (O_3)	1-hour	--	Attainment	--	--
	8-hour	0.08 ppm	Attainment	0.075 ppm (147 µg/m^3)	Attainment
Respirable Particulate Matter (PM_{10})	24-hour	150 µg/m^3	Attainment	150 µg/m^3	Attainment
	Annual Arithmetic Mean	50 µg/m^3	Attainment	--	--
Fine Particulate Matter ($PM_{2.5}$)	24-hour	--	--	35 µg/m^3	Attainment
	Annual Arithmetic Mean	--	--	15 µg/m^3	Attainment
Carbon Monoxide (CO)	8-hour	4.4 ppm	Attainment	9 ppm (10 mg/m^3)	Attainment
	1-hour	9 ppm	Attainment	35 ppm (40 mg/m^3)	Attainment
Nitrogen Dioxide (NO_2)	Annual Arithmetic Mean	0.04 ppm	Attainment	53 ppb (100 µg/m^3)	Attainment
	1-hour	--	Attainment	100 ppb (188 µg/m^3)	Unclassified
Sulfur Dioxide (SO_2)	24-hour	0.14 ppm	Attainment		--
	3-hour	0.5 ppm	--	0.5 ppm (1,300 µg/m^3)	--
	1-hour	--	--	75 ppb (196 µg/m^3)	Attainment
	Annual Arithmetic Mean	0.03 ppm	Attainment	--	--
Lead (Pb)	30-day average	1.5 µg/m^3	Attainment	--	--
	Calendar Quarter	1.5 µg/m^3	--	1.5 µg/m^3	Attainment
	Rolling 3-Month Average	--	--	0.15 µg/m^3	--
Hydrogen Sulfide	1-hour	0.025 ppm	Attainment	--	--

SOURCE: State of Hawaii Department of Health, *State of Hawaii Annual Summary 2009 Air Quality Data,* September 2010.

In regards to motor vehicles, Chapter 60 §11-60.1-34 includes the following:

- No person shall operate a gasoline-powered motor vehicle which emits visible smoke while upon streets, roads, or highways.
- No person shall operate a diesel-powered motor vehicle which emits visible smoke for a period of more than five consecutive seconds while upon streets, roads, or highways.
- No person shall cause, suffer, or allow any engine to be in operation while the motor vehicle is stationary at a loading zone, parking or servicing area, route terminal, or other off street areas, except:

  - During adjustment or repair of the engine at a garage or similar place of repair;
  - During operation of ready-mix trucks, cranes, hoists, and certain bulk carriers, or other auxiliary equipment built onto the vehicle or equipment that require power take-off from the engine, provided that there is no visible discharge of smoke and the equipment is being used and operated for the purposes as originally designed and intended. This exception shall not apply to operations of air conditioning equipment or systems;
  - During the loading or unloading of passengers, not to exceed three minutes; and
  - During the buildup of pressure at the startup and cooling down at the closing down of the engine for a period of not more than three minutes.

- No person shall remove, dismantle, fail to maintain, or otherwise cause to be inoperative any equipment or feature constituting an operational element of the air pollution control system or mechanism of a motor vehicle as required by the provisions of the Act except as permitted or authorized by law.

4.0 EXISTING SETTING

4.1 Air Pollution Climatology

Regional point sources of air pollution include the Maui Electric Company Kanaha Power Plant and the Hawaii Commercial and Sugar Company. Local point sources near the project site include adjacent industrial land uses to the west, and agricultural land uses to the east. Mobile sources of air pollution in the project area include adjacent local streets and traffic on State Highway 380 (Kuihelani Highway). Pollutant concentrations on the Island of Maui typically disperse quickly due to the consistent exposure to relatively high winds.

4.2 Local Climate

The annual average temperature in the project area is 75.6 degrees Fahrenheit (ºF). The project area experiences an average winter temperature of approximately 72.2ºF and an average summer temperature of approximately 78.5ºF. Annual average wind speed in the project area is approximately 12.8 miles per hour. Total precipitation in the project area averages approximately 18.5 inches annually. Precipitation occurs mostly during the winter and relatively infrequently during the summer. Precipitation averages approximately 9.1 inches during the winter, approximately 4.6 inches during the spring, approximately 3.7 inches during the fall, and less than one inch during the summer.[2]

4.3 Air Monitoring Data

The Island of Maui has one air monitoring station in Kihei, which only monitors $PM_{2.5}$ concentrations. From 2007 to 2009 there were no annual or 24-hour exceedances of $PM_{2.5}$ recorded at Kihei.[3] The 3-year average of the 98th percentile values (the daily $PM_{2.5}$ value in a year below which 98% of all values fall) from 2007 to 2009 at the Kihei air monitoring station was 14 µg/m^3. The 3-year average annual mean value from 2007 to 2009 at the Kihei air monitoring station was 4.8 µg/m^3.[4]

4.4 Sensitive Receptors

Some land uses are considered more sensitive to changes in air quality than others, depending on the population groups and the activities involved. The following groups are most likely to be affected by air pollution: children under 14, the elderly over 65 years of age, athletes, and people with cardiovascular and chronic respiratory diseases. Typically, sensitive receptors include residences, schools, playgrounds, child-care centers, athletic facilities, long-term health care facilities, rehabilitation centers, convalescent centers, and retirement homes.

As shown in **Figure 4-1**, sensitive receptors near the project site include the following:

- Single-family housing adjacent and to the northeast
- Maui Lani Regional Park Adjacent and to the north
- Pomaikai Elementary School approximately 350 feet to the north

[2] Western Regional Climate Center, Historical Climate Information (http://www.wrcc.dri.edu), February 1, 2011.

[3] State of Hawaii Department of Health, *State of Hawaii Annual Summary 2009 Air Quality Data*. September, 2010.

[4] *Ibid*.

- Single-family housing approximately 1,200 feet to the west

The above sensitive receptors represent the nearest air quality sensitive receptors with the potential to be impacted by the proposed project. Additional sensitive receptors are located further from the project site in the surrounding community within one-quarter mile of the project site and would be less impacted by the proposed project than the above sensitive receptors.

In addition to the off-site sensitive receptors listed above, sensitive receptors would be located on the project site during construction activity. The large project site would be developed over phases and newly constructed residences would potentially be located adjacent to ongoing construction activity. These residences would be sensitive to construction pollutant emissions.

LEGEND: Project Area # Air Quality Sensitive Receptors

1. Single-Family Residences
2. Maui Lani Regional Park
3. Pomaikai Elementary School
4. Single-Family Residences

APPROX. SCALE 0 0.15 0.3 MILES

SOURCE: TAHA, 2011.

taha Wai'ale Project Air Quality Study
A&B PROPERTIES, INC.
taha 2010-058

FIGURE 4-1

AIR QUALITY SENSITIVE RECEPTOR LOCATIONS

5.0 METHODOLOGY AND SIGNIFICANCE CRITERIA

5.1 Methodology

The analysis considers construction and operational sources of air emissions. The main sources of construction emissions would be fugitive dust from site preparation, equipment exhaust, on-road truck exhaust, and worker commute exhaust. Detailed construction information was not available when this analysis was completed. Estimating equipment hours and truck trips would be entirely speculative. The construction analysis instead focuses on fugitive dust emissions based on reasonable amount of land disturbed per day and emission factors obtained from the USPEA AP-42 Handbook, Compilation of Air Pollutant Emission Factors.

The main source of operational emissions would be on-road vehicles. The proposed project would generate approximately 29,225 average daily trips. This was estimated by assuming that the average AM and PM peak hour traffic volumes would be ten percent of the average daily traffic.[5] Emissions from these trips were estimated using the USEPA MOVES Motor Vehicle Emissions Simulator Model. MOVES allows the user to obtain emission rates by specifying vehicles types, time periods, geographical areas, pollutants, vehicle operating characteristics, and road types. Project emissions were compared to State emissions also obtained from MOVES.

5.2 Significance Criteria

According to the Council on Environmental Quality regulations (40 CFR §§ 1500-1508), the determination of a significant impact is a function of both context and intensity. Context means that the significance of an action must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality. Both short- and long-term effects are relevant. Intensity refers to the severity of impact. To determine significance, the severity of the impact must be examined in terms of the type, quality and sensitivity of the resource involved; the location of the proposed project; the duration of the effect (short- or long-term) and other consideration of context. Adverse effects will vary with the setting of the proposed action and the surrounding area.

[5] Austin, Tsutsumi & Associates, Inc., *Traffic Impact Analysis Report Waiale Development*, March 2011.

6.0 ENVIRONMENTAL EFFECTS

6.1 Construction Emissions

Construction activity would generate emissions through the use of heavy-duty construction equipment and through vehicle trips generated by construction workers traveling to and from the project site. Fugitive dust emissions would primarily result from site preparation (e.g., grading) activities. Nitrogen oxide emissions would primarily result from the use of construction equipment. Construction emissions can vary substantially from day to day, depending on the level of activity, the specific type of operation and, for dust, the prevailing weather conditions.

Construction activity would occur over the entire 545-acre project site. It was reasonably assumed that 15 scrapers or graders would operate simultaneously on the project site. This equipment would potentially disturb between 7.5 to 15 acres per day. Using USEPA AP-42 emission factors, construction activity would generate up to 16 pounds per day of fugitive dust emissions. Construction emissions would be temporary and are not considered adverse. It is recommended that Air Quality Control Measures **AQ1** through **AQ5** be implemented to ensure accordance with Hawaii Administrative Rules.

Construction Air Quality Control Measures

AQ1 The construction contractor shall use water or suitable chemicals to control fugitive dust in the demolition of any existing buildings or structures, construction operations, the grading of roads, or the clearing of land.

AQ2 The construction contractor shall apply asphalt, water, or suitable chemicals on roads, material stockpiles, and other surfaces which may result in fugitive dust.

AQ3 The construction contractor shall cover all moving, open-bodied trucks transporting materials which may result in fugitive dust.

AQ4 The construction contractor shall maintain roadways in a clean manner.

AQ5 The construction contractor shall promptly remove earth or other materials from paved streets which have been transported there by trucking, earth-moving equipment, erosion, or other means.

Impacts After Control Measures

Air Quality Control Measures **AQ1** and **AQ5** would ensure compliance with State rules and regulations for construction emissions. Implementation of Control Measures **AQ1** through **AQ5** would reduce the construction air quality effects to less than adverse.

6.2 Operational Emissions

Regional Emissions

Operational emissions for the proposed project would be emitted primarily from passenger vehicles. The proposed project would generate approximately 29,225 daily trips. **Table 6-1** shows mobiles source emissions based on the USEPA MOVES Motor Vehicle Emissions

Simulator Model. Project daily emissions would represent 0.35 percent of State emissions. These emissions are not considered substantial. Therefore, the proposed project would not result in adverse effect related to regional operational emissions.

TABLE 6-1: 2022 ESTIMATED OPERATIONAL EMISSIONS						
	ROG	**NO_X**	**CO**	**SO_2**	**PM_{10}**	**$PM_{2.5}$**
Project Daily Emissions	52	113	1,089	2	3	3
State Daily Emissions	14,645	32,015	307,955	444	857	811
Project Contribution to State Emissions	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%
SOURCE: TAHA, 2011.						

Greenhouse gas (GHG) emissions refer to a group of emissions that are generally believed to affect global climate conditions. GHGs, such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), keep the average surface temperature of the Earth close to 60 degrees Fahrenheit. Greenhouse gas emissions were calculated for on-road mobile vehicle operations, general electricity consumption, electricity consumption associated with the use and transport of water, and solid waste decomposition. The proposed project would indirectly emit GHG from fuel combustion related to 4,095,000 kilowatt-hours per month of electricity generation. GHG emissions associated with the collecting, moving, and treating potable water and disposing of wastewater were based on the use of 1.9 million gallon of water per day and the generation of 910,000 gallons per day of wastewater. It was estimated that the proposed project would generate 23,715 pounds per day of solid waste.

As shown in **Table 6-2**, indirect electricity emissions would generate 94,101 metric tons per year of GHG emissions. Direct sources would generate 31,192 metric tons per year for a total of 125,293 tons per year of GHG emissions. The State of Hawaii estimated that Statewide GHG emissions were 24,384,123 metric tons of CO_2e in 2005.[6,7] The proposed project represents 0.51 percent of Statewide GHG emissions. This percentage is not considered to be substantial. Therefore, the proposed project would not result in an adverse effect related to indirect and direct GHG emissions.

TABLE 6-2: ESTIMATED ANNUAL GREENHOUSE GAS EMISSIONS	
Source	**Carbon Dioxide Equivalent (Metric Tons per Year) /a/**
Mobile	17,775
Electricity – General	32,695
Electricity – Water Cycle	61,406
Solid Waste Decomposition	13,417
/a/ The carbon dioxide equivalent notation accounts for the fact that other GHGs are less abundant but have higher global warming potential than CO_2. **SOURCE**: TAHA, 2011.	

[6]State of Hawaii Department of Business, Economic Development and Tourism Strategic Industries Division, *Hawaii's Greenhouse Gas Emissions Inventory*, June 8, 2007.

[7]The State emission inventory estimated 26,795,740 tons of CO_2e. This was converted into 24,384,123 metric tons of CO_2e

Localized Emissions

The primary source of localized emissions would be diesel particulate matter (DPM) emitted during truck loading/unloading activity. These emissions are of particular concern because DPM is a carcinogenic compound and light Industrial land uses would be located along East Waiko Road adjacent to proposed residential land uses. The amount of DPM emitted on the project site would be directly related to truck idling times at light industrial and commercial facilities. Detailed land use information was not available when this analysis was completed and estimating truck emissions would be entirely speculative. Without a control measure to limit idling, the proposed project would result in an adverse effect related to operational emissions.

Odors

Land uses that are associated with odor complaints include agricultural uses, wastewater treatment plants, food processing plants, chemical plants, composting, refineries, landfills, dairies and fiberglass molding. An existing agricultural area is located on the east side of the project site off East Waiko Road. The agricultural land uses include confined animals but are small scale operations unlike a feed lot or a large-scale dairy. Depending on wind conditions, agricultural odors may be detectable at project-related land uses adjacent to the agricultural area. These odors are not considered substantial based on the scale of the generating activities. Therefore, the proposed project would not result in adverse effect related to odors.

The proposed project may include an on-site waste water treatment plant (WWTP). Any place or process in which wastewater is collected, conveyed or treated has the potential to generate and release nuisance odors to the surrounding area. Most odor problems occur in the collection system, primary treatment facilities, and solids handling facilities.[8] In most instances, the odors associated with collection systems and primary treatment facilities are generated as a result of an anaerobic or "septic" condition. This condition occurs when oxygen transfer to the wastewater is limited such as in a force main. In the anaerobic state, the microbes present in the wastewater have no dissolved oxygen available for respiration. This allows microbes known as "sulfate-reducing bacteria" to thrive. These bacteria utilize the sulfate ion that is naturally abundant in most waters as an oxygen source for respiration. The byproduct of this activity is hydrogen sulfide. This byproduct has a low solubility in the wastewater and a strong, offensive, rotten-egg odor. The state of the art facility would be constructed using Best Available Control Technology to meet USEPA and Hawaii hydrogen sulfide regulations. Variable meteorological conditions may occasionally lead to on-site nuisance odors. These odors would generally be short-term and are not considered adverse. However, a control measure is recommended to ensure regulatory compliance.

Air Quality Control Measures

AQ6 Diesel-fueled trucks shall be prohibited from idling in excess of ten minutes at land uses associated with the proposed project, except under the following conditions:

- When forced to remain motionless due to adverse weather conditions;
- When verifying that the vehicle is in safe operating condition;
- When the vehicle is positioning or providing a power source for equipment or operations; or

[8] Vaughan Harshman, P.E., and Tony Barnette, *Wastewater Odor Control: An Evaluation of Technologies*, Water Engineering & Management, May 2000

- While operating air conditioning or any other device to prevent a health or safety emergency.

AQ7 A detailed Odor Management Plan shall be completed during the final design phase of the wastewater treatment plant. The Odor Management Plan will focus on minimizing nuisance odors.

Impacts After Control Measures

Implementation of Control Measures **AQ6** and **AQ7** would reduce the operational air quality effects to less than adverse.

7.0 CUMULATIVE EFFECTS

An adequate discussion of significant cumulative impacts involves analyzing either (1) a list of past, present, and probable future projects producing related or cumulative impacts, including, if necessary, those projects outside the control of the agency, or (2) a summary of projections contained in an adopted general plan or related planning document, or in a prior environmental document which has been adopted or certified, which described or evaluated regional or area wide conditions contributing to the cumulative impact.

By the year 2022, the Wailuku/Waikapu area will have experienced significant growth, both in its residential population and commercial/industrial/business land uses, primarily as a result of the following developments:

- Waikapu Country Town – currently in the planning phase; assumed to be completed by 2022.
- Maui Lani Development – partially complete; Maui Lani Development and Maui Lani 100 VMX Affordable Housing Project were assumed to be completed by Year 2022 – and therefore the final segment of Maui Lani Parkway between Kuikahi Drive and Waiinu Street was assumed to be complete to support the development.
- Kehalani – partially complete; assumed to be complete by Year 2022.
- Puunani Residences – not started; assumed to be complete by Year 2022.

These projects along with other smaller ones combine to represent approximately 4,850 new dwelling units for the Central Maui Region, as well as commercial, industrial, park, school, and other ancillary land uses by year 2030. The traffic assessment accounted for this growth in the baseline conditions. The Maui Transportation Demand Forecasting Model and Trip Generation Methodology were used to project (via growth ratios) and assign the traffic generated by these and other Maui developments onto the roadway network. The result was an approximate 60-percent increase in demand along Honoapiilani Highway over existing conditions. Along Kuihelani Highway, the increase was an approximate 70 percent.

The proposed project and related projects would combine to increase long-term regional emissions in Maui. As previously discussed, Maui is a federal attainment area for all criteria pollutants. The only pollutant of concern that is monitored on Maui by the State Department of Health is $PM_{2.5}$. As shown in **Table 6-1**, project-related $PM_{2.5}$ emissions would represent less than one percent of Statewide emissions. Based on this small percentage, the proposed project would not contribute to a cumulatively considerable impact.

Appendix A

Wind and Climate Information

KAHULUI WSO AP 398, HAWAII

Period of Record General Climate Summary - Temperature

Station:(512572) KAHULUI WSO AP 398													
From Year=1954 To Year=2010													
	Monthly Averages			Daily Extremes				Monthly Extremes				Max. Temp.	
	Max.	Min.	Mean	High	Date	Low	Date	Highest Mean	Year	Lowest Mean	Year	>= 90 F	<= 32
	F	F	F	F	dd/yyyy or yyyymmdd	F	dd/yyyy or yyyymmdd	F	-	F	-	# Days	# Da
January	80.1	63.5	71.8	90	10/1959	48	20/1969	75.1	1996	68.8	1969	0.0	0
February	80.1	63.2	71.7	89	26/1961	50	05/1973	74.6	1981	67.9	1965	0.0	0
March	81.1	64.4	72.7	90	26/1981	51	16/2005	75.9	1984	69.1	1965	0.0	0
April	82.1	66.0	74.0	91	17/1981	54	04/1985	77.0	1984	70.8	1985	0.1	0
May	84.0	67.2	75.6	92	02/1978	57	06/1968	78.9	1980	72.4	1987	0.8	0
June	85.7	69.3	77.5	94	12/1996	58	02/1985	80.7	1981	74.3	1955	1.5	0
July	86.5	70.8	78.6	95	22/1996	58	30/1965	81.4	1996	74.7	1955	2.9	0
August	87.3	71.3	79.3	97	31/1994	61	31/1971	81.5	1982	75.3	1955	5.0	0
September	87.5	70.2	78.8	96	19/1995	59	15/2009	81.2	1997	75.1	1955	5.9	0
October	86.4	69.4	77.9	96	05/1973	58	13/1964	80.5	1984	74.4	1964	4.2	0
November	83.7	67.7	75.7	93	07/1984	55	28/1972	79.0	1984	72.2	1964	1.1	0
December	81.1	65.2	73.2	90	07/1956	52	18/1983	75.9	1980	70.6	1965	0.1	0
Annual	83.8	67.3	75.6	97	19940831	48	19690120	77.8	1980	73.1	1955	21.8	0
Winter	80.4	64.0	72.2	90	19561207	48	19690120	75.1	1981	70.1	1966	0.1	0
Spring	82.4	65.9	74.1	92	19780502	51	20050316	77.1	1984	71.5	1985	0.9	0
Summer	86.5	70.4	78.5	97	19940831	58	19650730	81.0	1996	74.8	1955	9.5	0
Fall	85.9	69.1	77.5	96	19731005	55	19721128	79.6	1984	74.5	1955	11.2	0

Table updated on Jan 14, 2011
For monthly and annual means, thresholds, and sums:
Months with 5 or more missing days are not considered
Years with 1 or more missing months are not considered
Seasons are climatological not calendar seasons
Winter = Dec., Jan., and Feb. Spring = Mar., Apr., and May
Summer = Jun., Jul., and Aug. Fall = Sep., Oct., and Nov.

KAHULUI WSO AP 398, HAWAII

Period of Record General Climate Summary - Precipitation

Station:(512572) KAHULUI WSO AP 398															
From Year=1954 To Year=2010															
	Precipitation											Total Snowfall			
	Mean	High	Year	Low	Year	1 Day Max.		>= 0.01 in.	>= 0.10 in.	>= 0.50 in.	>= 1.00 in.	Mean	High	Year
	in.	in.	-	in.	-	in.	dd/yyyy or yyyymmdd	# Days	# Days	# Days	# Days	in.	in.	-
January	3.56	14.46	1980	0.02	2001	4.70	10/1980	10	5	2	1	0.0	0.0	1955
February	2.42	8.31	1972	0.06	2000	4.76	14/2003	9	4	1	1	0.0	0.0	1955
March	2.55	10.90	1967	0.01	2008	4.94	14/1968	11	4	1	1	0.0	0.0	1955
April	1.37	14.29	1989	0.01	2003	3.95	07/1989	10	3	1	0	0.0	0.0	1954
May	0.65	4.36	1987	0.00	1972	2.41	05/1987	6	1	0	0	0.0	0.0	1954
June	0.21	2.50	1967	0.00	1957	2.22	29/1967	5	0	0	0	0.0	0.0	1954
July	0.45	1.65	1989	0.01	1999	1.04	22/1989	7	1	0	0	0.0	0.0	1954
August	0.46	1.54	1982	0.00	2002	1.13	01/1982	6	1	0	0	0.0	0.0	1954
September	0.34	1.43	1987	0.00	2002	1.16	23/1965	5	1	0	0	0.0	0.0	1954
October	1.04	5.66	1985	0.00	1984	3.26	16/2006	7	2	0	0	0.0	0.0	1954
November	2.27	9.27	1965	0.00	2004	5.48	12/1965	9	4	1	1	0.0	0.0	1954
December	3.13	10.21	1996	0.01	1975	5.82	21/1955	11	5	2	1	0.0	0.0	1954
Annual	18.46	40.63	1989	6.76	1998	5.82	19551221	95	33	9	4	0.0	0.0	1955
Winter	9.11	23.30	1980	1.10	2001	5.82	19551221	30	15	5	2	0.0	0.0	1955
Spring	4.57	19.10	1989	0.70	2001	4.94	19680314	26	9	2	1	0.0	0.0	1955
Summer	1.13	4.95	1967	0.12	1973	2.22	19670629	18	3	0	0	0.0	0.0	1954
Fall	3.65	12.37	1965	0.02	2004	5.48	19651112	21	7	2	1	0.0	0.0	1954

Table updated on Jan 14, 2011
For monthly and annual means, thresholds, and sums:
Months with 5 or more missing days are not considered
Years with 1 or more missing months are not considered
Seasons are climatological not calendar seasons
Winter = Dec., Jan., and Feb.   Spring = Mar., Apr., and May
Summer = Jun., Jul., and Aug. Fall = Sep., Oct., and Nov.

HAWAII

AVERAGE WIND SPEED - MPH

STATION	ID	Years	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
BRADSHAW ARMY AIRFIELD	PHSF	1996-2006	12.0	11.5	12.0	12.3	11.0	11.7	13.0	12.1	10.8	11.1	11.8	13.5	11.9
HILO INTL AIRPORT ASOS	PHTO	1996-2006	6.5	7.1	7.0	6.9	6.6	6.6	6.4	6.2	6.2	6.1	6.1	6.3	6.5
HONOLULU INTL AP ASOS	PHNL	1996-2006	8.8	9.5	9.9	11.6	10.6	12.1	12.5	12.0	10.7	10.2	9.5	9.4	10.6
KAHULUI AIRPORT ASOS	PHOG	1996-2006	11.1	11.6	11.6	13.3	12.8	15.2	15.2	14.6	13.4	12.3	11.4	11.3	12.8
KAILUA-KONA INTL AP ASOS	PHKO	1996-2006	8.4	8.4	8.4	8.2	8.1	8.1	8.2	8.3	8.0	7.8	7.9	8.0	8.1
KANEOHE BAY MCAS	PHNG	1996-2006	7.4	8.4	8.4	9.4	8.1	9.3	9.7	8.7	8.2	8.0	7.7	7.8	8.4
KAPOLEI-KALAELOA AP ASOS	PHJR	1999-2006	8.6	7.8	8.4	8.6	7.9	8.2	9.0	8.8	7.8	7.5	7.4	7.6	8.1
LAHAINA-KAPALUA AP AWOS	PHJH	1996-2006	14.4	15.1	14.9	16.7	15.7	16.9	17.1	16.8	15.8	15.1	14.2	14.6	15.6
LANAI AIRPORT	PHNY	1996-2006	9.5	10.4	10.1	11.4	10.0	10.5	12.1	11.1	10.3	9.5	10.1	9.5	10.4
LIHUE AIRPORT ASOS	PHLI	1996-2006	12.0	12.5	12.5	14.4	12.8	14.2	14.8	13.6	13.0	12.7	12.8	12.5	13.1
MOLOKAI AIRPORT ASOS	PHMK	1996-2006	10.2	10.7	10.6	12.5	11.3	13.2	14.0	13.3	11.8	11.4	10.8	10.3	11.7
WAHIAWA-WHEELER ARMY AF	PHHI	1996-2006	8.9	9.2	9.3	9.9	9.4	10.1	10.0	9.8	9.3	8.1	7.6	8.3	9.1

Appendix B

Ambient Air Data

Table 4-3. 2009 Summary of 24-Hour $PM_{2.5}$: SLAMS Stations

	Annual Statistics																	
	Maximum		Annual Mean	24-hour Occurrences Greater than 35 µg/m³														
	1st High	98th %	All Hours	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Possible Periods	Valid Periods	Percent Recovery
OAHU																		
Honolulu	21	13	4.8	0	0	0	0	0	0	0	0	0	0	0	0	305[1]	305	100
Kapolei	25	13	5.5	0	0	0	0	0	0	0	0	0	0	0	0	365	358	98
Pearl City	23[2]	12	4.9	0	0	0	0	0	0	0	0	0	0	0	0	365	348	95
Sand Island	23	12	6.9	0	0	0	0	0	0	0	0	0	0	0	0	365	357	98
MAUI																		
Kihei	26	16	3.9	0	0	0	0	0	0	0	0	0	0	0	0	365	358	98

[1] Combination of manual (1 in 3 day from 1/1/09 to 3/31/09) and continuous sampling which began 4/1/09
[2] New Year's fireworks

Table 4-4. Attainment of the 24-Hour $PM_{2.5}$ NAAQS: SLAMS Stations

Station	2007 98th value	2008 98th value	2009 98th value	3-Year Average	Sites in violation of the NAAQS
Honolulu	8	13	13	11	0
Kapolei	8	21	13	14	0
Pearl City	7	13	12	11	0
Sand Island	10	13	12	12	0
Kihei	10	15	16	14	0

Attainment: The 3-year average of the 98th percentile values must be less than or equal to 35 µg/m³.
In 2009, Hawaii was in attainment with the 24-hour $PM_{2.5}$ NAAQS.

Table 4-5. Attainment of the Annual $PM_{2.5}$ NAAQS: SLAMS Stations

Station	2007 Ann. Ave	2008 Ann. Ave	2009 Ann. Ave	3-Year Average	Sites in violation of the NAAQS
Honolulu	3.9	4.7	4.8	4.5	0
Kapolei	3.5	4.9	5.5	4.6	0
Pearl City	3.7	4.5	4.9	4.4	0
Sand Island	5.0	5.7	6.9	5.9	0
Kihei	5.0	5.5	3.9	4.8	0

Attainment: The 3-year average of annual mean values must be less than 15 µg/m³.
In 2009, Hawaii was in attainment with the annual $PM_{2.5}$ NAAQS.

Appendix C

Construction Emissions

Table 11.9-1 (English Units). EMISSION FACTOR EQUATIONS FOR UNCONTROLLED OPEN DUST SOURCES AT WESTERN SURFACE COAL MINES[a]

		Emissions By Particle Size Range (Aerodynamic Diameter)[b,c]					
		Emission Factor Equations		Scaling Factors			EMISSION FACTOR RATING
Operation	Material	TSP ≤30 µm	≤15 µm	≤10 µm[d]	≤2.5 µm/TSP[e]	Units	
Blasting[f]	Coal or overburden	$0.000014(A)^{1.5}$	ND	0.52[e]	0.03	lb/blast	C_DD
Truck loading	Coal	$\frac{1.16}{(M)^{1.2}}$	$\frac{0.119}{(M)^{0.9}}$	0.75	0.019	lb/ton	BBCC
Bulldozing	Coal	$\frac{78.4\ (s)^{1.2}}{(M)^{1.3}}$	$\frac{18.6\ (s)^{1.5}}{(M)^{1.4}}$	0.75	0.022	lb/hr	CCDD
	Overburden	$\frac{5.7\ (s)^{1.2}}{(M)^{1.3}}$	$\frac{1.0\ (s)^{1.5}}{(M)^{1.4}}$	0.75	0.105	lb/hr	BCDD
Dragline	Overburden	$\frac{0.0021\ (d)^{1.1}}{(M)^{0.3}}$	$\frac{0.0021\ (d)^{0.7}}{(M)^{0.3}}$	0.75	0.017	lb/yd^3	BCDD
Vehicle traffic[g]							
Grading		$0.040\ (S)^{2.5}$	$0.051\ (S)^{2.0}$	0.60	0.031	lb/VMT	CCDD
Active storage pile[h] (wind erosion and maintenance)	Coal	0.72 u	ND	ND	ND	$\frac{lb}{(acre)(hr)}$	C[i]_ _ _

[a] Reference 1, except as noted. VMT = vehicle miles traveled. ND = no data. Quality ratings coded where "Q, X, Y, Z" are ratings for ≤30 µm, ≤15 µm, ≤10 µm, and ≤2.5 µm, respectively. See also note below.

[b] Particulate matter less than or equal to 30 µm in aerodynamic diameter is sometimes termed "suspendable particulate" and is often used as a surrogate for TSP (total suspended particulate). TSP denotes what is measured by a standard high volume sampler (see Section 13.2).

[c] Symbols for equations:

A = horizontal area (ft^2), with blasting depth ≤ 70 ft. Not for vertical face of a bench.
M = material moisture content (%)
s = material silt content (%)
u = wind speed (mph)
d = drop height (ft)
W = mean vehicle weight (tons)
S = mean vehicle speed (mph)
w = mean number of wheels

Table 11.9-1 (cont.).

[d] Multiply the $\leq$15-µm equation by this fraction to determine emissions, except as noted.
[e] Multiply the TSP predictive equation by this fraction to determine emissions.
[f] Blasting factor taken from a reexamination of field test data reported in Reference 1. See Reference 4.
[g] To estimate emissions from traffic on unpaved surfaces by vehicles such as haul trucks, light-to-medium duty vehicles, or scrapers in the travel mode, see the unpaved road emission factor equation in AP-42 Section 13.2.2.
[h] Coal storage pile factor taken from Reference 5. To estimate emissions on a shorter time scale (e. g., worst-case day), see the procedure presented in Section 13.2.5.
[i] Rating applicable to mine types I, II, and IV (see Tables 11.9-5 and 11.9-6).

Note: Section 234 of the Clean Air Act of 1990 required EPA to review and revise the emission factors in this Section (and models used to evaluate ambient air quality impact), to ensure that they did not overestimate emissions from western surface coal mines. Due to resource and technical limitations, the haul road emission factors were isolated to receive the most attention during these studies, as the largest contributor to emissions. Resultant model evaluation with revised emission factors have improved model prediction for total suspended particulate (TSP); however, there is still a tendency for overprediction of particulate matter impact for PM-10, for as yet undetermined causes, prompting the Agency to make a policy decision not to use them for regulatory applications to these sources. However, the technical consideration exists that no better alternative data are currently available and the information should be made known. Users should accordingly use these factors with caution and awareness of their likely limitations.

Table 11.9-2 (Metric Units). EMISSION FACTOR EQUATIONS FOR UNCONTROLLED OPEN DUST SOURCES AT WESTERN SURFACE COAL MINES[a]

Operation	Material	Emissions By Particle Size Range (Aerodynamic Diameter)[b,c]				Units	EMISSION FACTOR RATING
		Emission Factor Equations		Scaling Factors			
		TSP ≤30 µm	≤15 µm	≤10 µm[d]	≤2.5 µm/TSP[e]		
Blasting[f]	Coal or overburden	$0.00022(A)^{1.5}$	ND	0.52[e]	0.03	kg/blast	C_DD
Truck loading	Coal	$\frac{0.580}{(M)^{1.2}}$	$\frac{0.0596}{(M)^{0.9}}$	0.75	0.019	kg/Mg	BBCC
Bulldozing	Coal	$\frac{35.6\ (s)^{1.2}}{(M)^{1.3}}$	$\frac{8.44\ (s)^{1.5}}{(M)^{1.4}}$	0.75	0.022	kg/hr	CCDD
	Overburden	$\frac{2.6\ (s)^{1.2}}{(M)^{1.3}}$	$\frac{0.45\ (s)^{1.5}}{(M)^{1.4}}$	0.75	0.105	kg/hr	BCDD
Dragline	Overburden	$\frac{0.0046\ (d)^{1.1}}{(M)^{0.3}}$	$\frac{0.0029\ (d)^{0.7}}{(M)^{0.3}}$	0.75	0.017	kg/m^3	BCDD
Vehicle traffic[g]							
Grading		$0.0034\ (S)^{2.5}$	$0.0056\ (S)^{2.0}$	0.60	0.031	kg/VKT	CCDD
Active storage pile[h] (wind erosion and maintenance)	Coal	1.8 u	ND	ND	ND	$\frac{kg}{(hectare)(hr)}$	C[i]_ _ _

[a] Reference 1, except as noted. VKT = vehicle kilometers traveled. ND = no data. Quality ratings coded as "QXYZ", where Q, X, Y, and Z are quality ratings for ≤30 µm, ≤15 µm, ≤10 µm, and ≤2.5 µm, respectively. See also note below.

[b] Particulate matter less than or equal to 30 µm in aerodynamic diameter is sometimes termed "suspendable particulate" and is often used as a surrogate for TSP (total suspended particulate). TSP denotes what is measured by a standard high volume sampler (see Section 13.2).

[c] Symbols for equations:

- A = horizontal area (m^2), with blasting depth ≤ 21 m. Not for vertical face of a bench.
- M = material moisture content (%)
- s = material silt content (%)
- u = wind speed (m/sec)
- d = drop height (m)
- W = mean vehicle weight (Mg)
- S = mean vehicle speed (kph)
- w = mean number of wheels

Table 11.9-2 (cont.).

[d] Multiply the $\leq$ 15-µm equation by this fraction to determine emissions, except as noted.
[e] Multiply the TSP predictive equation by this fraction to determine emissions.
[f] Blasting factor taken from a reexamination of field test data reported in Reference 1. See Reference 4.
[g] To estimate emissions from traffic on unpaved surfaces by vehicles such as haul trucks, light-to-medium duty vehicles, or scrapers in the travel mode, see the unpaved road emission factor equation in AP-42 Section 13.2.2
[h] Coal storage pile factor taken from Reference 5. To estimate emissions on a shorter time scale (e. g., worst-case day), see the procedure presented in Section 13.2.5.
[i] Rating applicable to mine types I, II, and IV (see Tables 11.9-5 and 11.9-6).

Note: Section 234 of the Clean Air Act of 1990 required EPA to review and revise the emission factors in this Section (and models used to evaluate ambient air quality impact), to ensure that they did not overestimate emissions from western surface coal mines. Due to resource and technical limitations, the haul road emission factors were isolated to receive the most attention during these studies, as the largest contributor to emissions. Resultant model evaluation with revised emission factors have improved model prediction for total suspended particulate (TSP); however, there is still a tendency for overprediction of particulate matter impact for PM-10, for as yet undetermined causes, prompting the Agency to make a policy decision not to use them for regulatory applications to these sources. However, the technical consideration exists that no better alternative data are currently available and the information should be made known. Users should accordingly use these factors with caution and awareness of their likely limitations.

Table 11.9-3 (Metric And English Units). TYPICAL VALUES FOR CORRECTION FACTORS APPLICABLE TO THE PREDICTIVE EMISSION FACTOR EQUATIONS[a]

Source	Correction Factor	Number Of Test Samples	Range	Geometric Mean	Units
Blasting	Area blasted	17	100 - 6,800	1,590	m^2
	Area blasted	17	1100 - 73,000	17,000	ft^2
Coal loading	Moisture	7	6.6 - 38	17.8	%
Bulldozers					
Coal	Moisture	3	4.0 - 22.0	10.4	%
	Silt	3	6.0 - 11.3	8.6	%
Overburden	Moisture	8	2.2 - 16.8	7.9	%
	Silt	8	3.8 - 15.1	6.9	%
Dragline	Drop distance	19	1.5 - 30	8.6	m
	Drop distance	19	5 - 100	28.1	ft
	Moisture	7	0.2 - 16.3	3.2	%
Scraper	Silt	10	7.2 - 25.2	16.4	%
	Weight	15	33 - 64	48.8	Mg
	Weight	15	36 - 70	53.8	ton
Grader	Speed	7	8.0 - 19.0	11.4	kph
	Speed		5.0 - 11.8	7.1	mph
Haul truck	Silt content	61	1.2 - 19.2	4.3	%
	Moisture	60	0.3 - 20.1	2.4	%
	Weight	61	20.9 - 260	110	mg
	Weight	61	23.0 - 290	120	ton

[a] Reference 1,6.

Fugitive Dust Emissions

EF_{PM15} =	$0.051*7.1^{2.0}$	=	2.57091
EF_{PM10} =	$0.051*7.1^{2.0}*0.6$	=	1.542546
VMT =	15/12*43560/5280	=	10.3125
E =	1.542546*10.3125	=	**15.90751**

Fugitive Dust Emissions are estimated using the following formula:
$EF_{PM15} = 0.051 \times (S)^{2.0}$, and $EF_{PM10} = EF_{PM15} \times F_{PM10}$

Where:
EF = emission factor (lb/VMT)
S = mean vehicle speed (mph). The AP-42 default value is 7.1 mph.
F_{PM10} = PM_{10} scaling factor. The AP-42 default value is 0.6.

The VMT is estimated using the following formula:
E = EF x VMT, and
VMT = As/Wb x 43,560(sqft/acre)/5,280(ft/mile)

Where:
E = emissions (lb)
EF = emission factor (lb/VMT)
VMT: vehicle miles traveled (mile)
As: the acreage of the grading site (acre)
Wb: Blade width of the grading equipment. A width of 12 ft was used based on Caterpillar's 140 Motor Grader.

Source: AP-42 Section 11.9, Western Surface Coal Mining. Available at http://www.epa.gov/ttn/chief/ap42/ch11/final/c11s09.pdf

Appendix D

Operation Emissions

Wai'ale Vehicle Emissions

MOVES VMT FOR HI PER DAY
28,916,334

Project ADT[a]
29225

Project VMT[b]
102287.5

	State TOG	State CO	State NOX	State SO2	State PM10	State PM2.5	State CO2e
Grams Per Day	6,642,719	139,687,662	14,521,838	201,584	388,524	367,760	13,575,182,045
Pounds Per Day	14,645	307,955	32,015	444	857	811	29,927,846
Pounds Per Mile Per Hour Rate	0.00050645	0.01064988	0.00110715	0.00001537	0.00002962	0.00002804	1.03498067

	Project TOG	Project CO	Project NOX	Project SO2	Project PM10	Project PM2.5	Project CO2e
Daily Pounds	51.80	1,089.35	113.25	1.57	3.03	2.87	105,865.59
Difference Between Project and State AM + PM Peak	**0.35%**	**0.35%**	**0.35%**	**0.35%**	**0.35%**	**0.35%**	**0.35%**

[a] Project ADT assume peak hour ADT is 10% of total ADT. This is calculated by adding AM and PM peak hour volumes, dividing by 2, and then multiplying by 10.

[b] Assumes that the average trip length is approximately 3.5 miles.

Yearly CO2e	State CO2e
Pounds Per Day	29,927,846
Tons Per Year	5,024,885
Tons Per Year Rate	1.03498067
	Project CO2e Metric Tons Per Year
Pounds Per Day	105,865.59
Tons Per Year	17,775
Difference Between Project and State AM + PM Peak	**0.35%**

MOVES Output File

Year	Month	Day	Hour	State	Road	Run	CO2	CO2_Equiv	CO	CH4	N2O	NOx	Total_PM10	Total_PM25	SO2	TOG	Distance
2022	7	2	7	15	1	2	6742160	7408508	693229	6110	1741	32212	697	644	113	77223	
2022	7	2	7	15	2	2	3726680	3729669	16561	63	5	4397	138	132	42	415	6165
2022	7	2	7	15	3	2	67881200	67976040	323036	1202	225	65965	1991	1894	951	9297	162337
2022	7	2	7	15	4	2	65105000	65215364	363965	1249	272	57491	2112	2002	925	9561	138157
2022	7	2	7	15	5	2	96966200	97170832	511340	1778	541	70724	2510	2375	1477	15703	213043
2022	7	2	8	15	1	2	11335800	12299772	1085830	9362	2483	48254	1019	942	191	122197	
2022	7	2	8	15	2	2	5720090	5724648	26790	96	8	6650	207	198	65	637	9371
2022	7	2	8	15	3	2	104335000	104479432	517333	1840	342	100949	2953	2811	1461	14249	246766
2022	7	2	8	15	4	2	93975904	94128408	555085	1776	373	84962	2915	2764	1336	13582	200984
2022	7	2	8	15	5	2	140764000	141053344	767835	2551	762	105004	3477	3292	2144	22528	309925
2022	7	2	9	15	1	2	15371900	17100524	1610922	14210	4626	81787	1444	1334	260	186051	
2022	7	2	9	15	2	2	8371570	8378165	42735	140	12	9528	292	280	95	932	13480
2022	7	2	9	15	3	2	153070000	153278432	812466	2680	492	147659	4131	3936	2144	20800	354963
2022	7	2	9	15	4	2	124044000	124226768	816196	2285	436	115784	3661	3472	1764	17568	272748
2022	7	2	9	15	5	2	192860992	193244400	1114866	3442	1005	148963	4476	4242	2938	30402	420588

	CO2	CO2_Equiv	CO	CH4	N2O	NOx	Total_PM10	Total_PM25	SO2	TOG	Distance
Total Average Statewide Emissions	13,492,922,861	13,575,182,045	139,687,662	587,750	225,954	14,521,838	388,524	367,760	201,584	6,642,719	28,916,334

1. The above data represents the AM Peak hour during the month of July. This data is presented as an example of the MOVES output file. The entire output file is available upon request.
2. Total Average Statewide Emissions were calculated by summarizing the average day per month, and dividing by total months. This represents an average day based on average total annual emissions in the State of Hawaii.

Electricity GHG Emissions

Electricity Usage (Kwh/Mo)[a]	Electricity Usage (Kwh/Yr)
4.10E+06	4.91E+07

Emission Factor (pounds/Kwh)[b]			
	N_2O	**CH_4**	**CO_2**
	1.83E-05	2.14E-05	1.46E+00

Estimated Greenhouse Gas Emissions (Electricity)			
	N_2O	**CH_4**	**CO2**
	Metric Tons	Metric Tons	Metric Tons
Project	0.41	0.48	32,558

OUTPUTS

Estimated Carbon Equivalent (Electricity)			
	N_2O	**CH_4**	**CO2**
Carbon Equivalent	**310**	**21**	**1**
Project	127	10	32,558

a) Electricity use provided by the Applicant.

b) California Climate Action Registry, *General Reporting Protocol* , January 2009.

Solid Waste GHG Emissions

INPUTS		
Scenario	**Waste (pounds/day)[a]**	**Waste (tons/yr)**
Proposed Project	23,715	4,328

	Rate[a](Metric Tons Per Short Ton CO2e)	**Project Emissions**
Emisions	3.1	13,417

a) Waste provided by the Applicant.

b) U.S. Environmental Protection Agency. 2009. Waste Reduction Model (WARM), (Step 5: View Emission/Energy Factors).

Natural Gas GHG Emissions

INPUTS

Scenario	**Natural Gas Use (cubic ft./month)**[a]	**Natural Gas Use (mmBTU/year)**
Proposed Project	10,099,820	121,198
Existing	4,286,470	51,438

Emission Factor (kg/mmBTU)[b]		
	N_2O	**CH_4**
	0.0001	0.01

Estimated Greenhouse Gas Emissions (Natural Gas)		
Land Use	**N_2O**	**CH_4**
	tons	tons
Project	0.012119784	7.15E-01
Existing	0.0051438	0.303482

OUTPUTS

Estimated Carbon Equivalent (Natural Gas)			
Land Use	**CO_2** [c]	**N_2O**	**CH_4**
Carbon Equivalent	**1**	**310**	**21**
	tonnes	tonnes	tonnes
Project	4,451	3.4	14
Existing	1,615	1.5	6

a) Natural gas use obtained from Section IV.Q (Utilities and Service Systems) of the DEIR.

b) California Climate Action Registry,*General Reporting Protocol* , March, 2007.

c) CO_2 emissions from URBEMIS2007 and converted to metric tons.

Water Cycle Electrical GHG Emissions

INPUTS

Scenario	Potable Water (GPD)[a]	Waste Water (GPD)[a]	Water Use (MG/yr)	Kwh/Yr
Proposed Project	19,000,000	910,000	7,267.15	92,292,805.0000

Water Cycle Usage Factor	
Unit	**Usage Factor**[b]
Kilowatt-Hour/Million Gallons/Year	12,700

Emission Factor (pounds/Kwh)[c]			
	N_2O	**CH_4**	**CO_2**
	1.83E-05	2.14E-05	1.46E+00

Estimated Greenhouse Gas Emissions			
Land Use	**N_2O**	**CH_4**	**CO2**
	Metric Tons	Metric Tons	Metric Tons
Project	0.77	0.90	61,149

OUTPUTS

Estimated Carbon Equivalent (Electricity)			
Land Use	**N_2O**	**CH_4**	**CO2**
Carbon Equivalent	**310**	**21**	**1**
	Metric Tons	Metric Tons	Metric Tons
Project	238	19	61,149

a) Water use provided by the Applicant.

b) Water cycle electricity rate obtained from California Energy Comission *2005 Integrated Energy Policy Report*, November 2005.

c) California Climate Action Registry, General Reporting Protocol, January 2009.

Appendix M: Phase I Environmental Site Assessment

Phase I Environmental Site Assessment

Proposed Waiale Development Project
(TMK Nos.: [2] 3-8-007: Parcels 071, 101 and 104, and
[2] 3-8-005: Parcels 023 and 037)
Waikapu, Maui, Hawaii

April 25, 2011
Project No. 17010-010200.00

Prepared for:

A&B PROPERTIES, INC.
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Move Forward with Confidence

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(Continued)

Executive Summary

A&B Properties, Inc. (A&B) retained Bureau Veritas North America, Inc. (Bureau Veritas) to conduct a Phase I Environmental Site Assessment of the Proposed Waiale Development Project property (Tax Map Key [TMK] Numbers: [2] 3-8-005: Parcels 023 [portion] and 037, and [2] 3-8-007: Parcels 071, 101 [portion], and 104), located in Waikapu, Maui, Hawaii (the "subject property").

The objective of the assessment was to provide an independent, professional opinion regarding recognized environmental conditions (RECs), as defined by ASTM, associated with the subject property. This assessment was requested in association with a proposed redevelopment project.

This assessment was performed under the conditions of, and in accordance with Bureau Veritas' Proposal No. 1709.10.349, dated November 12, 2010, and American Society for Testing and Materials (ASTM) E1527-05, *Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process*. Any exceptions to, additions to, or deletions from the ASTM guidelines are described in the report. Details of the work performed, sources of information, and findings are presented in the report. Limitations of the assessment are described in Sections 1.1 and 1.2.

The subject property, currently owned by Alexander & Baldwin, Inc., comprises approximately 545 acres of land area covering all or a portion of five parcels. The current use of the subject property includes fallow sugar cane fields, a plant nursery, portions of a cattle feed lot, sand stockpiles, and vacant land. The subject property is divided into two lots: Petition Area A, located north of Waiko Road, and Petition Area B, located south of Waiko Road.

Petition Area A, located north of Waiko Road, is currently leased to several tenants. Approximately an 162-acre portion of Petition Area A is leased to Brendan Balthazar, Gary Vares, and Manuel Lopes for cattle and horse grazing. Ameron International Corporation and T.J. Gomes occupy approximately 17 acres of the subject property for sand stockpiling. Hawaiian Cement previously occupied a portion of Petition Area A for sand mining operations. Sand mining operations are no longer conducted on the subject property. Nobriga's Ranch, Inc. occupies a 15-acre portion of Petition Area A and is a cattle feed lot. Tom's Backhoe lease area occupies 2 acres and storage yard for construction and asphalt paving equipment. A portion of the property was previously used as a turf sod farm.

Petition Area B, located to the south of Waiko Road, is currently fallow sugar cane fields, with an orchid farm and a former scrap yard. The Hawaiian Commercial & Sugar Company formerly used most of Petition Area B land for sugar cane cultivation. Melia Orchards Maui is a 10-acre portion of Petition Area B and specializes in orchid flowers used for hotels and restaurants. A portion of the property was formerly leased to a scrap metal company and materials from the scrap yard still remain onsite. Additionally, portions of the property were observed with unauthorized dumping of appliances, furniture, automotive parts, and other materials.

The historical research presented in this assessment has established the use of the subject property since 1885. Review of a historical topographic map from 1885 indicated that the subject property and adjacent properties were undeveloped land owned by the Hawaiian Commercial and Sugar Company. The majority of the subject property appeared as undeveloped land with low-lying natural vegetation in a 1950; however, a small portion of Petition Area A was observed as agricultural land. Portions of the subject property appeared grubbed in a 1965 aerial photograph, but appeared similar to the 1950 photograph. A 2004 aerial photograph showed the subject property similar to its current configuration, except that the majority of Petition Area B was observed with agricultural crops.

According to tax assessment records, the subject parcels originated from larger parcels that were owned by Alexander & Baldwin, Inc. since at least 1969. The TMK Nos.: (2) 3-8-005: Parcels 023 and 037 were created in 1971 from the larger Parcel 002, which was owned by Alexander & Baldwin, Inc. and leased to Wailuku Sugar Company. The earliest available records indicated that the subject property located at TMK No.: (2) 3-8-007: Parcel 071 was owned by Alexander & Baldwin, Inc. in 1969. The records indicated that TMK No.: (2) 3-8-007: Parcel 101 was created from Parcel 073 in 1975 and was leased to Orchards Hawaii, Ltd. The earliest available records for the portion of the subject property located at TMK No.: (2) 3-8-007: Parcel 104 indicated that the parcel was created from Parcel 102 in 1975 and was leased to Schenk.

This assessment has revealed the following evidence of *recognized environmental conditions*, as defined by the ASTM, in connection with the subject property:

- The western portion of Petition Area B on the subject property was formerly licensed and occupied by Maui Scrap Metal, Inc. During Bureau Veritas' onsite inspection, the property was observed with metal scraps, automobile parts, and various waste materials buried deep within the soil. Petroleum hydrocarbon impacted soil is currently stored on the subject property and is pending disposal. Alexander and Baldwin stated that they were in the process of planning a site investigation for the Maui Scrap Metal license area, per the DOH Notification of Corrective Action. A Work Plan has been submitted and approved by the DOH. Execution of the Work Plan is pending removal of the remaining solid waste from the site.

  This finding is considered a REC because there is evidence of releases from scrap materials stored on the subject property.

- Several large piles of abandoned/waste materials including household appliances, automobile parts, and household garbage, were observed on the northwestern portion of Petition Area B. These materials have accumulated on the subject property from unauthorized dumping by outside parties. Although no staining or other evidence of releases was observed at this dump site, there is a potential that releases from the wastes have impacted the underlying soil.

  This finding is considered a REC because there is evidence of the unauthorized dumping may include hazardous materials and chemicals, with the potential to impact the subject property. Bureau Veritas recommends the proper removal and disposal of these materials from the subject property. Any stained soils should be excavated and disposed of properly. For significantly stained areas, Bureau Veritas recommends confirmation soil sampling with laboratory analyses following cleanup activities to ensure that proper cleanup has been completed.

- The Waikapu Landfill is located on the adjoining and upgradient property to the northwest of the subject property. The landfill was owned and operated by the County of Maui. The Waikapu Landfill did not receive waste after 1989 and was closed in 1991. The United States Environmental Protection Agency (USEPA) 40 Code of Federal Regulations (CFR) Part 258, Criteria for Municipal Solid Waste Landfills (MSWLFs), requires post-closure monitoring by owners or operators of MSWLFs. These regulations took effect in October 9, 1993. Therefore, because the Waikapu Landfill did not receive waste after 1989, it is exempt from these regulations.

  This finding is considered a recognized environmental condition because there is a potential for contamination from the adjacent property to impact the subject property.

- The Petition Area B portion of the subject property has been used as agricultural land for the cultivation of sugar cane crops since the 1990s. Agricultural operations typically utilize chemicals such as herbicides and pesticides, which have a potential to impact the subject property. Based on the cultivation date, it is unlikely that residues of arsenic, dioxins, and organochlorine compounds would be present on these fields because these chemicals were not used on sugarcane in the recent past. Additionally, Bureau Veritas' onsite inspection and historical research did not reveal evidence of storage, mixing, or excessive use of pesticides/herbicides with the potential to impact the subject property.

  The State of Hawaii Department of Health (DOH) *Technical Guidance Manual for the Implementation of the State Contingency Plan Interim Final,* dated June 21, 2009, recommends that sites with known pesticide-related contamination, and sites where pesticides were regularly applied, be evaluated for residual contamination prior to re-development.

  This finding is considered a REC because there is a potential that agricultural chemicals exist in the soil at concentrations above the DOH action levels, and redevelopment of the subject property is planned. Therefore, Bureau Veritas recommends that soil samples be collected in accordance with DOH recommendations on the subject property to assess chemical impacts from historical agricultural operations. Since the subject property was not cultivated for sugarcane until the 1990s, certain tests recommended in the DOH guidance manual may not be applicable.

The following historical *recognized environmental condition* was revealed during this assessment:

- The environmental database report and State of Hawaii Department of Health (DOH) files reviewed by Bureau Veritas listed the former Maui Sod facility with a diesel release and an abandonment of an estimated 5,500 pounds of hazardous waste. Although both of these release sites received a status of "No Further Action," the DOH file did not include soil sampling and analyses data, and there is a potential for releases from the items stored onsite.

  This finding is considered an historical REC because there is potential for releases from past operations at the former Maui Sod facility. Bureau Veritas recommends further investigation of this area to assess chemical impacts to the soil from historical operations.

The following environmental conditions, which are not considered to be *recognized environmental condition*s, as defined by ASTM, were revealed during this assessment:

- Several adjacent properties, including the Wailuku Agribusiness Company, Inc., Consolidated Baseyards, LLC, and ABC Development, Inc., utilize and store hazardous materials onsite. Bureau Veritas observed these sites from the perimeter of the subject property and noted poor housekeeping practices at several of the adjoining areas.

  This finding is not considered a REC because there are no reported releases from these sites. However, there is a potential for hazardous chemical and material releases from these sites to impact the subject property.

- An aboveground storage tank (AST) was observed without secondary containment at the Ameron International facility on the subject property. Additionally, drums containing oils, solvents, and other liquids were observed throughout the subject property and appeared in good condition, with no evidence of significant leaks or spills. Some of the 55-gallon drums were stored on spill pallets, but some of the drums were not stored within secondary containment.

This finding is not considered a recognized environmental condition because no significant leaks or spills were observed around the AST or the drums. However, all ASTs, drums, and larger liquid containers should be placed within secondary containment to prevent leaks and spills from impacting the underlying ground.

1.0 INTRODUCTION

A&B Properties, Inc. (A&B) retained Bureau Veritas North America, Inc. (Bureau Veritas) to conduct a Phase I Environmental Site Assessment of the Proposed Waiale Development Project property (Tax Map Key [TMK] Numbers: [2] 3-8-005: Parcels 023 [portion] and 037, and [2] 3-8-007: Parcels 071, 101 [portion], and 104), located in Waikapu, Maui, Hawaii (the “subject property”).

The objective of the assessment was to provide an independent, professional opinion regarding recognized environmental conditions (RECs), as defined by ASTM, associated with the subject property. This assessment was requested in association with a proposed redevelopment project.

1.1 METHODOLOGY AND EXCEPTIONS

Good commercial and customary practice for conducting environmental site assessments has the goal of providing an independent, professional opinion regarding recognized environmental conditions, as defined by ASTM, associated with the subject property. The term *recognized environmental conditions* (RECs) is defined as the presence or likely presence of any hazardous substances or petroleum products on a property under conditions that indicate an existing release, a past release, or a material threat of a release of any hazardous substances or petroleum products into structures on the property or into the ground, groundwater, or surface water of the property. The term includes hazardous substances or petroleum products even under conditions in compliance with laws. The term is not intended to include *de minimis* conditions that generally do not present a material risk of harm to public health or the environment and that generally would not be the subject of an enforcement action if brought to the attention of appropriate governmental agencies. Conditions determined to be *de minimis* are not RECs.

This assessment was performed under the conditions of, and in accordance with Bureau Veritas' Proposal No. 1709.10.349, dated November 12, 2010, and American Society for Testing and Materials (ASTM) E1527-05, *Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process*.

The assessment included the following components:

- A site walkthrough inspection of the property for visual evidence of potential environmental concerns including existing or potential soil and groundwater contamination, as evidenced by soil or pavement staining or discoloration, stressed vegetation; indications of waste dumping or burial, pits, ponds, or lagoons; containers of hazardous substances or petroleum products; electrical and hydraulic equipment that may contain polychlorinated biphenyls (PCBs), such as electrical transformers and hydraulic hoists; and underground and aboveground storage tanks.

- An investigation of historical use of the subject property through reasonably ascertainable historical information (e.g., aerial photographs, fire insurance maps, city directories) for evidence of prior land use that could have led to *recognized environmental conditions*.

- A review of information available on general geology and topography of the subject property, local groundwater conditions, sources of water, power, and sewer, and proximity to ecologically sensitive receptors, such as streams, that might be impacted by *recognized environmental conditions* and environmental issues.

- A review of environmental records available from the property owner or site contact including regulatory agency reports, permits, registrations, and consultants' reports for evidence of *recognized environmental conditions* and activity and use limitations (AULs).

- A site property line visual assessment of adjacent properties for evidence of potential offsite environmental conditions that may affect the subject property.

- A review of a commercial database summary of federal, state and tribal regulatory agency records pertinent to the subject property and offsite facilities located within ASTM-specified search distances from the subject property.

- Review of reasonably ascertainable Federal, State and Local environmental agency case files for the subject property. This will also include interviewing agency project managers (if available) regarding the status of the subject property (e.g., LUST incident closure, etc.).

- Interviews with the subject property owner, key site personnel, and others, regarding current and previous uses of the property, particularly activities involving hazardous substances and petroleum products.

- Evaluation of information gathered during the assessment to reach conclusions concerning RECs, and development of this report.

This assessment also included the following non-ASTM items:

- Asbe stos-Containing Materials (ACM)
- Lead -Based Paint (LBP)
- Rad on
- Wetlan ds

This assessment did not include sampling or analysis of suspect ACM, LBP, soil, groundwater or other materials.

Mr. Dan Ford, Professional Geologist and Environmental Professional as defined in Section 312.10 of 40 CFR 312, and Ms. Meredith Gibe, Environmental Scientist from Bureau Veritas' Honolulu Regional Office, conducted the site walkthrough portion of the assessment on December 8, 2010, accompanied by Mr. Jason Koga, Land & Environmental Manager, and Mr. Sean O'Keefe, Director of Environmental Affairs, with Alexander & Baldwin, Inc.

See the table of contents for a list of appendices. Resumes for environmental professionals involved in this assessment are included in the appendices. Photographs taken at the time of the assessment are included behind the *Photographs* tab.

1.2 LIMITING CONDITIONS OF ASSESSMENT

Portions of the subject property were covered with dense vegetation and could not be thoroughly inspected. However, based on the history of the subject parcel and other information obtained, lack of access to the heavily vegetated areas did not prevent an evaluation of the subject property with respect to *RECs*.

Information for the assessment was obtained from sources listed in the appendices. This information, to the extent it was relied on to form our opinion, is assumed to be correct and complete. Bureau Veritas is not responsible for the quality or content of information from these sources.

1.2.1 Data Gaps/Data Failure

Historical subject property ownership and/or use information was obtained for the time period, 1885 to the present. Bureau Veritas has established the history of previous uses at the subject property since 1940 or first development.

Several data gaps greater than 5-year intervals were encountered during this assessment. However, based on the historical research conducted, the historical use of the subject property, and general knowledge of the area, these data gaps do not appear to be significant.

1.3 RELIANCE

The information and opinions rendered in this report are exclusively for use by A&B Properties, Inc. Bureau Veritas will not distribute or publish this report without consent except as required by law or court order. The information and opinions expressed in this report are given in response to a limited assignment and should be considered and implemented only in light of that assignment. The services provided by Bureau Veritas in completing this project were consistent with normal standards of the profession. No other warranty, expressed or implied, is made.

2.0 USER PROVIDED INFORMATION

ASTM E 1527 defines "user" as the party seeking to use Practice E 1527 to complete an ESA of the subject property, and in this case, the user is A&B. ASTM E 1527 specifies that certain tasks associated with identifying potential *RECs* at the subject property should be performed by the user and provided to the environmental professional. This section documents the information obtained from the user.

Mr. Dan Yasui, Director of Planning and Entitlement for A & B Properties, Inc., completed an ASTM Practice E 1527-05 User/Client Questionnaire regarding environmental issues at the subject property.

2.1 SPECIALIZED KNOWLEDGE

Alexander & Baldwin indicated that it has specialized knowledge or experience of environmental issues of concern associated with the subject property.

2.2 COMMONLY KNOWN OR REASONABLY ASCERTAINABLE INFORMATION

Alexander & Baldwin indicated that it is aware of commonly known or reasonably ascertainable information within the local community about the subject property that is material to identifying environmental issues of concern associated with the subject property. Alexander & Baldwin is aware the subject property is located adjacent to the Waikapu Landfill and other industrial businesses. They are also aware that several former tenants stored hazardous materials on the subject property and portions of the subject property are targeted with unauthorized dumping of materials.

2.3 VALUATION REDUCTION FOR ENVIRONMENTAL ISSUES

Alexander & Baldwin, Inc., indicated that this assessment was requested for a potential redevelopment; therefore, valuation reduction for environmental issues does not apply.

2.4 OWNER, PROPERTY MANAGER, AND OCCUPANT INFORMATION

Alexander & Baldwin indicated that it has provided specific information that is material to *RECs* in connection with the subject property. Alexander & Baldwin indicated that several former tenants stored hazardous materials on the subject property and portions of the subject property are targeted with unauthorized dumping of materials.

2.5 REASON FOR PERFORMING PHASE I

Alexander & Baldwin, Inc. indicated that this assessment was requested in association with a proposed redevelopment project.

3.0 SUBJECT PROPERTY DESCRIPTION

3.1 LOCATION AND LEGAL DESCRIPTION

The subject property is located to the west of Kuihelani Highway in Waikapu, Maui, Hawaii. Petition Area A is located to the northwest of the intersection of Kuihelani Highway and Waiko Road. Petition Area B is located to the southwest of this intersection. Both Petition areas are located in an area of undeveloped land and light industrial facilities (Figures 1 and 2, *Figures* tab).

The subject property located at Petition Area A is comprised of 422 acres and is described as the three parcels of land lying in TMK Numbers: (2) 3-8-007: Parcels 071, 101 (portion), and 104. The subject property located at Petition Area B is comprised of approximately 123 acres and is described as the two parcels of land lying in TMK Numbers: (2) 3-8-005: Parcels 023 (portion) and 037.
According to the Maui County Real Property Assessment Office, the subject property is located on land classified as "Agricultural."

A&B provided Bureau Veritas with a copy of a title report for the subject property, prepared by Title Guaranty of Hawaii, Inc. According to the report, no environmental liens or activity and use limitations (AULs) were found regarding the subject property.

3.2 CURRENT USE OF SUBJECT PROPERTY

The subject property, currently owned by Alexander & Baldwin, Inc., comprises approximately 545 acres of land area covering all or a portion of five parcels. The current use of the subject property includes fallow sugar cane fields, a plant nursery, portions of a cattle feed lot, sand stockpiles, and vacant land. The subject property is divided into two lots: Petition Area A, located north of Waiko Road, and Petition Area B, located south of Waiko Road.

Petition Area A, located north of Waiko Road, is currently leased to several tenants. Approximately an 162-acre portion of Petition Area A is leased to Brendan Balthazar, Gary Vares, and Manuel Lopes for cattle and horse grazing. Ameron International Corporation and T.J. Gomes occupy approximately 17 acres of the subject property for sand stockpiling. Hawaiian Cement previously occupied a portion of Petition Area A for sand mining operations. Sand mining operations are no longer conducted on the subject property. Nobriga's Ranch, Inc. occupies a 15-acre portion of Petition Area A and is a cattle feed lot. Tom's Backhoe lease area occupies 2 acres and storage yard for construction and asphalt paving equipment. A portion of the property was previously used as a turf sod farm.

Petition Area B, located to the south of Waiko Road, is currently fallow sugar cane fields, with an orchid farm and a former scrap yard. The Hawaiian Commercial & Sugar Company formerly used most of Petition Area B land for sugar cane cultivation. Melia Orchards Maui is a 10-acre portion of Petition Area B and specializes in orchid flowers used for hotels and restaurants. A portion of the property was formerly leased to a scrap metal company and materials from the scrap yard still remain onsite. Additionally, portions of the property were observed with unauthorized dumping of appliances, furniture, automotive parts, and other materials.

The current business tenants at the subject property are listed in the following table:

Business Tenants

Tenant	Acreage	Lease Date	Description
Melia Orchards Maui	10.00	1/1/1972	Orchard Farm
Nobriga's Ranch, Inc.	5.043	3/1/1969	Cattle Feed Lot
Ameron International	14.851	7/1/2005	Sand Stockpiling
Brendan Balthazar	105	1/1/1995	Cattle/Horse Grazing
Hawaiian Cement	58.827	10/1/199 8	Sand Mining (Mining Suspended)
Christopher and Manuel Lopes	15.00	4/1/1986	Cattle/Horse Grazing
Tom's Backhoe	2.00	3/1/2005	Asphalt Paving and Construction
Gary Vares	41	10/1/2005	Cattle/Horse Grazing
T.J. Gomes Trucking Co., Inc.	2.3	2/1/2008	Sand Stockpiling

Based on observations made and information obtained during Bureau Veritas' site visit, the following information was ascertained:

- The following companies provide subject property utilities:
  - Electricity: Maui Electric Company, Inc. (MECO)
  - Water: Maui County Board of Water Supply and Wailuku Water Company
  - Sewer: No sewer service is currently provided to the subject property

Based on observations made during Bureau Veritas' site visit, the following information was ascertained:

- The storm water runoff from the subject site flows via sheet flow to the east and northeast, based on the existing topography.

- The planned long-term use for the subject property is to create a residential and commercial community.

3.3 CURRENT USES OF ADJOINING/NEARBY PROPERTIES

The area surrounding the subject property consists of residential, industrial, and agricultural properties. Adjoining properties were observed (from the subject property or from public access areas) for signs of recognized environmental conditions and their potential to pose an environmental concern to the subject property (Figure 2, *Figures* tab). The uses and features of adjoining properties are described below.

North: Residential area

East: Kuihelani Highway, beyond which are sugar cane fields

South: Waikapu Stream, beyond which are sugar cane fields

West: Waikapu Landfill (closed), Wailuku Agribusiness Company, Inc., Maui Scrap Metal Company, Inc. Facility

Between Petition Areas: Waiko Road**,** Consolidated Baseyards, ABC Development, Inc., former Campaign Recycle Maui green waste facility

The Waikapu Landfill is located adjacent to the northwest of the subject property. Two releases for the landfill were reported in the Hazard Evaluation and Emergency Response (HEER) database. Both releases received a status of "No Further Action." According to the Maui County, Solid Waste Division, the landfill was owned by Maui County and did not receive waste after 1989 and was closed in 1991. The United States Environmental Protection Agency 40 Code of Regulations Part 258, Criteria for Municipal Solid Waste Landfills (MSWLFs), requires post-closure monitoring by owners or operators of MSWLFs. These regulations took effect in October 9, 1993. Therefore, because the Waikapu Landfill did not receive waste after 1989, it is exempt from these regulations. The County of Maui, Solid Waste Division told Bureau Veritas via a telephone interview that they do not conduct any post-closure monitoring at the Waikapu Landfill (see Section 5.4).

The Maui Scrap Metal facility is located adjacent to the west of Petition Area A. Bureau Veritas reviewed several environmental reports and documents and are summarized in Section 4.7.

Several adjoining properties are associated with the use and storage of hazardous materials. Several of the adjoining properties were observed with poor housekeeping practices including abandoned vehicles, heavy equipment, and construction materials. Releases from these sites have the potential to impact the subject property.

3.4 PHYSICAL SETTING

The subject property is located in the Kahului Isthmus Region of the island of Maui, Hawaii. According to the United States Geological Survey (USGS), Wailuku, Hawaii, 7.5-minute topographic quadrangle map, a small portion of the subject property is located in the Wailuku District and the remaining subject property is located in the Waikapu District. The general area is characterized as a low land link between former islands. A stream is located on the southwestern boundary of the subject property. Elevations at and around the subject property range from approximately 160 to 300 feet above mean sea level (msl) (USGS, 1997).

Soil

According to the Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai (Foote, D.E. et. al., 1972) the subject property consists of two soil types, Puuone Series Soils and Jaucas Series Soils. The Puuone Series Soils occupy approximately 94% of Petition Area A and 44% of Petition Area B. The remaining areas are comprised mostly of Jaucas Series Soils. These soils form on smooth, low uplands, and low bedrock outcrops are associated with these soils.

Puuone sand series is characterized as excessively drained soils formed from material derived from coral seashells. Puuone soils are found on sand hills. Specifically, the subject property consists of Puuone sand, 7 to 30 percent slopes (mapping unit PZUE). It is formed in wind-deposited sand from coral and seashells. The surface layer is a grayish sand approximately 20 inches thick. The subsurface layer is a cemented, grayish-brown sand. This soil is moderately alkaline, runoff is slow, and permeability is rapid.

The Jaucas sand soil series is described as a very deep, excessively drained, very rapidly permeable soil type. Specifically, the subject property consists of Jaucas sand, 0 to 15 percent slopes soils (mapping unit JaC). It is described with a surface layer, approximately 6 inches thick, of a grayish brown, single-grained, sand. The subsurface is approximately 54 inches thick and is described as a brown, single-grained sand. This soil is moderately alkaline, runoff is slow, and permeability is rapid.

Groundwater

Bureau Veritas reviewed the Aquifer Identification and Classification Technical Report No. 185, published by the Water Resources Research Center at the University of Hawaii, for information on groundwater conditions below the subject property. The report describes the aquifer below the subject property as a part of the Kahului aquifer system of the Central sector. The groundwater system below the subject property consists of an upper and lower aquifer.

The upper aquifer is described as an unconfined, high level (fresh water not in contact with seawater) aquifer of the sedimentary (nonvolcanic lithology) type. It is currently used as a drinking water source and is considered ecologically important. The salinity is low (less than 250 milligrams per liter [mg/L] chloride). This aquifer has a high vulnerability to contamination and is replaceable.

The lower aquifer is an unconfined basal aquifer of the flank type, occurring in horizontally extensive lavas. Its status is described as an irreplaceable water supply with a fresh salinity that is currently used. This aquifer has a moderate vulnerability to contamination. The utility of the aquifer is listed as a drinking water source.

However, the subject property is located below the State of Hawaii Department of Health (DOH) defined Underground Injection Control (UIC) line. Areas above the UIC line denote potential underground drinking water aquifers. Areas below the UIC line generally denote groundwater that is unsuitable for drinking water purposes.

The depth to groundwater is estimated to be approximately 150 to 290 feet below ground surface (bgs). The regional groundwater flow direction is inferred to the southwest toward the Pacific Ocean, based on the surface topography. However, topography is not always a reliable basis for predicting groundwater flow direction. The local gradient and flow direction under the subject property may be influenced naturally by zones of higher or lower permeability, or artificially by nearby pumping or recharge, and may deviate from the regional trend.

4.0 HISTORICAL REVIEW

4.1 SUMMARY OF HISTORICAL REVIEW

The historical research presented in this section has established the use of the subject property since 1885. Review of a historical topographic map from 1885 indicated that the subject property and adjacent properties were undeveloped land owned by the Hawaiian Commercial and Sugar Company. The majority of the subject property appeared as undeveloped land with low-lying natural vegetation in 1950; however, a small portion of Petition Area A was observed as agricultural land. Portions of the subject property appeared grubbed in a 1965 aerial photograph, but appeared similar to the 1950 photograph. A 2004 aerial photograph showed the subject property similar to its current configuration, except that the majority of Petition Area B was observed with agricultural crops.

According to tax assessment records, the subject parcels originated from larger parcels that were owned by Alexander & Baldwin, Inc. since at least 1969. The TMK Nos.: (2) 3-8-005: Parcels 023 and 037 were created in 1971 from the larger Parcel 002, which was owned by Alexander & Baldwin, Inc. and leased to Wailuku Sugar Company. The earliest available records indicated that the subject property located at TMK No.: (2) 3-8-007: Parcel 071 was owned by Alexander & Baldwin, Inc. in 1969. The records indicated that TMK No.: (2) 3-8-007: Parcel 101 was created from Parcel 073 in 1975 and was leased to Orchards Hawaii, Ltd. The earliest available records for the portion of the subject property located at TMK No.: (2) 3-8-007: Parcel 104 indicated that the parcel was created from Parcel 102 in 1975 and was leased to Schenk.

4.2 AERIAL PHOTOGRAPHS

Aerial photographs, which include the subject and adjoining properties, were reviewed at the Hawaii State Archives, Kekauluohi Building, located on the Iolani Palace grounds in Honolulu, Hawaii. Photographs from the years 1950, 1965, and 2004 were available for review and are summarized as follows:

Date: 1950 Aerial Photograph No. GS-MF 4-42

- Petition Areas A and B were observed as mostly undeveloped land with natural, low-lying vegetation. The northeastern portion of Petition Area A was observed with agricultural crops. Waiko Road was observed in its current configuration. Several unpaved roads were observed on the subject property. The areas to the east, west, and south of the subject property were observed with sugar cane crops.

Date: 1965 Aerial Photograph No. 1-CC-30

- No significant changes were observed on the subject property and surrounding areas from the 1950 aerial photograph, except portions of Petition Area B appeared as grubbed land.

Date: 2004 Aerial Photograph No. GoogleEarth™

- This photograph appeared similar to the current subject property configuration, except that the majority of Petition Area B was observed with agricultural crops. The northwestern portion of Petition Area B was observed as the Maui Scrap Metal license area. Some of the adjacent properties were observed with industrial operations.

No readily apparent evidence of recognized environmental conditions at the subject or adjoining properties was noted on the aerial photographs reviewed, except for the Maui Scrap Metal license area observed in the 2004 photograph on the northwestern portion of Petition Area B.

4.3 USGS TOPOGRAPHIC MAPS

Historic topographic maps for the subject property and vicinity were reviewed at Hawaii State Archives, Kekauluohi Building, located on the Iolani Palace grounds in Honolulu, Hawaii, and from Bureau Veritas' private collection. Maps dated 1885, 1933, 1955, 1983, and 1997 were available for review and depicted the following:

Hawaiian Government Survey, Maui, Hawaii **Scale: 1:64,000**

1885: The subject and adjacent properties were depicted as undeveloped land. The Hawaiian Commercial and Sugar Company was indicated as the owner of the subject property and surrounding areas. The map also indicated the subject property was part of the Wailuku region.

U.S. Geological Survey, Island of Maui, Hawaii **Scale: 1:62,500**

1933: The subject and adjacent properties were depicted similar to the 1855 topographic map.

Quadrangle: Wailuku, Maui, Hawaii **Scale: 1:24,000 Series: 7.5 Minute**

1955: The subject property appeared as undeveloped land. A water pipeline was depicted on the northeastern portion of the subject property. Waiale Reservoirs were shown to the north of the subject property. Waikapu Road was depicted between Petition Areas A and B.

1983: No significant changes were observed from the 1955 topographic map. Petition Area A was shaded green to indicate natural vegetation. Petition Area B was not shaded.

1997: No significant changes were observed from the 1983 topographic map, except a pit was shown on Petition Area A in the location of the former sand mining operations.

No readily apparent evidence of recognized environmental conditions at the subject or adjoining properties was noted on the topographic maps reviewed.

4.4 FIRE INSURANCE MAPS

Fire insurance maps typically depict either the locations of manufacturing and industrial facilities within the city limits or potential hazards existing within individual building structures. In many cases, evidence of environmental concern, such as locations of USTs, can be found by reviewing fire insurance maps.

Fire insurance maps were not available for the subject or adjoining properties.

4.5 PRIOR OWNERSHIP

As part of this assessment, Bureau Veritas reviewed reasonably ascertainable recorded land title records that are filed under federal, state, tribal, or local law. Bureau Veritas' review of the land title records did not reveal environmental liens or AULs associated with the subject property.

According to available records at the Maui County Real Property Assessment Office, the subject parcels are designated as TMK Numbers: (2) 3-8-005: Parcels 023 and 037 and (2) 3-8-007: Parcels 071, 101, and 104. A summary of historical ownership and lease records for the subject property is presented in Appendix D.

No readily apparent evidence of potential recognized environmental conditions at the subject property was noted in the ownership records reviewed, except that portions of the subject property originated from the Wailuku Sugar Cane Co.

4.6 AGENCY CONTACTS

4.6.1 Building, Planning, and/or Zoning Departments

The County of Maui website was reviewed to obtain historical use information on the subject property. Permit records for the subject property were reviewed through the Land and Permit Information section. No permits were on file for the subject property located at TMK Number: (2) 3-8-005: Parcel 037. One permit was reviewed for the subject property located at TMK Numbers: (2) 3-8-007: Parcels 104 and 071 for the Maui Lani subdivision. Eleven permits were reviewed for the subject property located at TMK Number: (2) 3-8-007: Parcel 101, dating from November 20, 2003 to March 3, 2011. Four permits were issued to the Maui Lani subdivision for grading, grubbing, and subdivision plans. Two permits were issued to Ameron International, Inc., and T.J. Gomes Co., Inc. for sand stockpiles. Hawaiian Cement was issued a permit for unspecified work. Four permits were issued to Waiale Wells and Transfer Line for work that included constructing a pump control and chlorination building, installing a fence, and installing a 6,000-gallon water tank.

No readily apparent evidence of potential *RECs* at the subject property was noted in the Maui County permit records reviewed. According to the County of Maui Real Property Tax Division, the subject property is zoned “Agricultural” and the State Land Use is identified as “Agricultural District.”

4.6.2 Fire Department

The County of Maui Fire Department was contacted to obtain information regarding any fires, complaints, permits, or violations involving hazardous material use, USTs, or ASTs on record for the subject and/or adjoining properties.

According to the County of Maui Fire Department, there are no records on file for the subject property. According to Mr. Jason Koga, there was at least one brush fire within the last few years on the Petition Area A.

4.6.3 Department of Health/Solid and Hazardous Waste Branch

Bureau Veritas performed a database review of the State of Hawaii Department of Health (DOH), Solid and Hazardous Waste Branch (SHWB) records regarding Underground Storage Tanks (USTs) and Leaking Underground Storage Tanks (LUSTs) at the subject property. According to the database, the subject property was not listed as a UST or LUST site.

4.6.4 Department of Health/Hazard Evaluation and Emergency Response Branch

Bureau Veritas performed a database review of the DOH, Hazard Evaluation and Emergency Response (HEER) Office records regarding environmental concerns or violations at the subject property.

Subject Property

The subject property was listed in the HEER database reviewed as “Former Maui Sod Farm” located at Kuihelani Highway, Kihei, Maui, Hawaii. Following Bureau Veritas’ request for a file review, the HEER office faxed a copy of the file to Bureau Veritas on November 29, 2010. This site is located on the northeastern portion of the subject property. According to the DOH file, a diesel fuel spill was reported on January 30, 2004. Unattended materials were reported on the site after the tenant was evicted. The file stated that a spill caused by vandalization was observed, and three cylinders of methyl bromide were found along with pesticides, an oil drum, lubricant oil, and other materials. The date of the release was listed as “unknown.” No additional documents or information were included in the DOH file. The HEER database listed the site with the status of “State On-Scene Coordinator (SOSC), No Further Action.” Mr. O’Keefe stated that upon the licensee vacating the former Maui Sod license area, Alexander & Baldwin properly managed and disposed of all pesticides, petroleum, and other chemicals.

Bureau Veritas reviewed the HEER file for another release at the Maui Sod license area (HEER Office database site Kuihelani Highway near Waiko Road, Release ID Number 20030729-1051) reported in July 2003. The file included a notification from Alexander & Baldwin that an estimated 5,500 pounds of hazardous waste was abandoned onsite by the former tenant. Most of the materials were stored in a metal container crate, and there were no reports of any releases. Although the responsible party was identified, no action was taken by the regulatory agency. The file included documentation of Waste Manifests showing that Alexander & Baldwin repackaged and properly disposed of all of the indentified materials.

A property was listed in the HEER database reviewed as “Maui Scrap Metal Tire Pile Fire” located at 109 East Waiko Road, Waikapu, Maui, Hawaii. According to the file, a tire pile fire occurred on October 16, 1998. Fire fighters were called to the site and air monitoring was conducted by Maui Fire. The site was issued a status of “No Further Action.” According to Mr. O’Keefe, this tire pile fire occurred on an adjacent property and was not located on the subject property.

Mr. O’Keefe indicated that an additional release involving petroleum products at the Maui Scrap Metal license area was reported to the DOH in writing in September 2007, but does not appear in the HEER office database. According to Mr. O’Keefe, this release was the source of petroleum-impacted soil currently stockpiled on the subject property. The release report described areas of apparent petroleum releases that were discovered when Alexander & Baldwin took possession of the license area from the former licensee. The petroleum release associated with the scrap metal baler formerly located on the subject property (which was managed by the owner of the baler) was apparently not reported to the DOH by the responsible party.

Waikapu Landfill

The Waikapu Landfill located adjacent to the northwest of the subject property was listed in the HEER database with two releases. Following Bureau Veritas’ request for a file review, the HEER office faxed a copy of the file contents to Bureau Veritas. According to the DOH file, five-gallon buckets of an unknown substance were reportedly buried in the landfill on July 3, 1989. After an investigation, the buckets were not observed and the site received a status of “SOSC, No Further Action.”

The second reported release listed the site as the Wailuku Landfill, Wailuku Baseyard Soils release and was reported on March 15, 1992. A report prepared by the Robert Thomas Environmental Group, Inc., was included in the file. According to the report, soil stockpiles from the Wailuku Baseyard were stockpiled at the Waikapu Landfill for approximately 19 months. Five soil samples were collected from random stockpile locations and sent for laboratory analysis on December 19, 1991. The results indicated that total petroleum hydrocarbon (TPH) levels ranged from 354 parts per million (ppm) to 2,510 ppm.

According to the report, the only clean-up goals identified by the DOH were associated with USTs, with the cleanup goal set at 50 ppm. The report indicated that the Full Total Characteristic Leaching Potential (TCLP) analysis results were below regulatory levels. Several treatment and disposal options were listed in the report and stated that a meeting with the DOH was necessary to determine the proper steps to obtain closure. No other documents were included in the file. However, the site did obtain a status of "No Further Action."

Because the TCLP analysis results were below regulatory levels, it is unlikely that these soil stockpiles would impact the subject property. However, the Waikapu Landfill is not required to conduct post-closure monitoring and there is a potential for contamination of the subject property from the storage of other materials.

4.7 PREVIOUS ENVIRONMENTAL REPORTS OR OTHER DOCUMENTS

Bureau Veritas reviewed several environmental reports and documents relating to the Maui Scrap Metal Company, Inc. facility located adjacent and to the west of the subject property, which are summarized below. This discussion does not pertain to the former Maui Scrap Metal license area located on the subject property.

Maui Scrap Metal Facility

Maui Scrap Metal Company, Inc. (Maui Scrap Metal) moved its operation to the current site located west of the property in 1989. Maui Scrap Metal accepted cars, appliances, and other types of scrap metal for dismantling and eventual shipment off-island. Vehicles and equipment processed for scrap metal were relocated throughout the facility until they were sheared and baled.

The State of Hawaii Department of Health Solid and Hazardous Waste Branch issued an order to Maui Scrap Metal, dated April 9, 2004. The order required the following actions:

1. Immediately cease and desist accepting solid waste.
2. Remove existing solid waste and transport it to permitted solid waste facilities.
3. Prepare a Site Closure Plan.
4. Perform a site assessment including surface and subsurface sampling.

In July 2004, Bureau Veritas North America (Bureau Veritas, formerly known as Clayton Group Services; 2004) conducted a limited Phase II investigation of surface and near surface soils at the site. To facilitate the collection of soil samples, three boreholes were advanced at the site and eight test pits were excavated. Laboratory analytical results indicated that site soils in the area of the former baler were impacted with Total Petroleum Hydrocarbons as heavy oil (TPH-O) and polychlorinated biphenyls (PCBs) at concentrations above the Hawaii Department of Health (HDOH) Soil Action Levels (SALs) in effect at that time.

In March 2010, ABC Development Company completed the scrap removal operation, during which the scrap metal was removed from the site, shipped to Oahu, and processed by Hawaii Metals Recycling. The removal action was conducted in response to the order issued by the Hawaii Department of Health Solid Waste and Hazardous Waste Branch. Soil piles were generated on the site from a separation process that removed scrap metal from surface soils. The soil piles total approximately 15,655 cubic yards and remain on site.

Following the scrap removal operation, Bureau Veritas conducted a comprehensive environmental investigation to characterize the post-removal condition of the site, including the remaining soil stockpiles. An Environmental Hazard Evaluation and a Closure and Site Restoration Plan were prepared as part of the environmental investigation report to close the site (Bureau Veritas, 2010).

During the environmental investigation, surface soils, subsurface soils, and the soil stockpiles were selectively analyzed for numerous analytes, including: Resource Conservation and Recovery Act (RCRA) Metals, plus zinc; Total Petroleum Hydrocarbons as Gasoline Range Organics (TPH-GRO); Total Petroleum Hydrocarbons as Diesel Range Organics (TPH-DRO); Total Petroleum Hydrocarbons as Residual Range Organics (TPH-RRO); PCBs; polynuclear aromatic hydrocarbons (PAHs); and volatile organic compounds (VOCs). Synthetic Precipitation Leaching Procedure (SPLP) testing was also conducted to evaluate potential leaching of contaminants from soil.

The visibly clean surface soil areas of the site (i.e., surface soil areas of the site that were scraped until the soil appeared visibly free of scrap) were not significantly impacted. Only one contaminant, TPH-RRO, was detected in one of the surface soil samples at a concentration of 1,240 milligrams per kilogram (mg/kg), which exceeded the HDOH Tier 1 Environmental Action Level (EAL) of 500 mg/kg.

Subsurface soils at the site (i.e., approximately 4 feet below ground surface [bgs]) were not significantly impacted. No contaminant concentrations were detected at concentrations exceeding the HDOH Tier 1 Environmental Action Levels (EALs). The subsurface soil sample results confirmed the SPLP results indicating that site contaminants are essentially immobile.

The soil stockpiles were found to be impacted with the following contaminants at concentrations exceeding the HDOH Tier 1 EALs: lead, zinc, TPH-DRO, TPH-RRO, PCBs, and the PAH, benzo(a)pyrene.

An Environmental Hazard Evaluation (EHE) was performed to identify potential environmental hazards specific to this site. The EHE indicated that potential hazards associated with the contaminants present in the soil stockpiles are associated with direct contact with the soil. The contaminants do not pose an environmental hazard related to the leaching of contaminants to the groundwater.

The Closure and Site Restoration Plan for the site, which was approved by the HDOH on November 30, 2010, includes the consolidation and capping of the soil stockpiles in select areas of the site, referred to as containment cells, combined with institutional controls. The institutional controls (i.e., deed restriction) will limit the use of the site and establish conditions on activities such as construction, excavation, underground utility or sewer maintenance, and the installation and/or use of groundwater wells. The deed restriction will also provide appropriate notice to future purchasers of the site of the institutional controls that must be met.

The remedy for the site (i.e., consolidation and capping) is presently in the design phase. The remedy is anticipated to be implemented at the site in mid-2011. Based on these findings, it is unlikely that the subject property has been impacted by this adjoining site.

Maui Lani

Prior to development of the residential area located to the north of the subject property, Maui Lani petitioned to amend the State Land Use District Boundary from an Agricultural District to an Urban District. Bureau Veritas (formerly Clayton Group Services, Inc.) conducted a Phase I ESA of the Maui Lani property and reviewed a groundwater sampling and analyses report prepared by Harding Lawson. The groundwater sample was collected from a well located on the landfill. Eight metals were detected in the samples from the well, but were below EPA and the State of Hawaii maximum contamination levels.

No volatile organic compounds were detected in the groundwater sample. The Phase I ESA indicated that the residential area could proceed with development if a swale system was designed to keep any runoff or leachate from leaving the landfill, and if the area adjacent to the landfill was monitored for runoff or leachate during grading activities.

The State Land Use Commission's decision and order in docket number A04_754 indicated that the DOH has no plans to request or require the County of Maui to update the closure plan for the Waikapu Landfill. The DOH conducted a site visit to the landfill and filed a report on July 6, 2005 recommending that a 30-foot wide maintenance easement should be constructed for monitoring and maintenance of the landfill along its northern boundary. The DOH also requested that nearby sand mining operations should be evaluated to mitigate the potential introduction of air into the landfill. Additionally, the document stated that Mr. Steven Chang with the DOH and Mr. Mike Souza of the County of Maui Department of Public Works and Environmental Management met on July 26,2005, to discuss the Waikapu Landfill and proposed Maui Lani residential area. During this meeting, the DOH stated that the primary concern was to establish a buffer between residential dwellings and the landfill. Maui Lani agreed to establish a 300-foot residential buffer.

5.0 <u>INTERVIEWS</u>

5.1 INTERVIEW WITH OWNERS

During the site visit, on December 8, 2010, Bureau Veritas interviewed Mr. Jason Koga, Environmental and Land Manager with Alexander and Baldwin, Inc. Mr. Koga stated that the majority of Petition Area A was used as cattle and horse grazing land and Petition Area B was mostly used for sugar cane cultivation.

Mr. Koga indicated that there were some issues regarding unauthorized dumping throughout the subject property, especially in the northern portion of Petition Area B. Mr. Koga was unaware of any current or former USTs located on the subject property. Mr. Koga also indicated that there may be environmental concerns with the adjacent properties that practice poor housekeeping practices.

During the site visit, Bureau Veritas interviewed Mr. Sean O'Keefe, Director of Environmental Affairs with Alexander and Baldwin, Inc. Mr. O'Keefe was forthcoming with information for which he has knowledge.

According to Mr. O'Keefe, the subject property consists mostly of cattle and horse grazing land and former sugar cane land. According to Mr. O'Keefe, the former sugar cane production portion of the property (most of Petition Area B) was first cultivated in the 1990s and pesticides, herbicides, and other hazardous chemicals were no longer in use. Mr. O'Keefe stated that metal scraps and debris were still buried on the former Maui Scrap Metal license area. He also indicated that unauthorized dumping of appliances, cars, and other items were currently located on the Petition Area B. Mr. O'Keefe stated that the former Maui Scrap Metal license area was inspected on a regular basis and that any hazardous materials found were removed from the site. Additionally, Mr. O'Keefe indicated that there was oil-impacted soil that was to be removed from the subject property. Mr. O'Keefe noted that a baler with a hydraulic leak was removed from the former Maui Scrap Metal license area. He also stated that a diesel AST spill occurred at the former sod site and that unauthorized dumping is a problem at the subject property. Mr. O'Keefe stated that drums of sonar equipment fluid, paints, and other materials were removed from the Maui Sod Farm license area prior to the tenant vacating the site.

According to Mr. O'Keefe, he has no knowledge of underground storage tanks, hydraulic lifts, oil/water separators currently present at the subject property.

Mr. O'Keefe was asked if he was aware of any of the following:

Any pending, threatened, or past litigation relevant to hazardous substances or petroleum products in, on, or from the property.	Yes	No		X
Any pending, threatened or past administrative proceedings relevant to hazardous substances or petroleum products in, on, or from the property.	Yes		No	X
Any notices from any governmental entity regarding any possible violation of environmental laws or possible liability relating to hazardous substances or petroleum products.	Yes	X	No	

Mr. O'Keefe stated that the former Maui Scrap Metal license area and the Maui Scrap Metal facility were the subject of an October 21, 2003 Warning Letter from the Department of Health to Maui Scrap Metal, Inc. issued for operating without a solid waste management permit. In May 2004, the DOH notified Alexander & Baldwin that enforcement action was being taken against Maui Scrap Metal Inc. for its operations at both facilities (adjacent property and license area), and of the landowner's responsibilities in cases where the operator of a solid waste facility is unable to complete remedial activities. Alexander & Baldwin attempted to compel Maui Scrap Metal Inc. to complete cleanup of the property. In October 2006, Alexander & Baldwin received from the DOH a "Notification for Corrective Action" advising Alexander & Baldwin to take corrective actions to cleanup the site, due to Maui Scrap Metal Inc.'s failure to take corrective actions. Alexander & Baldwin has since removed substantial quantities of solid waste from the site, and provided documentation to the DOH. Alexander & Baldwin prepared a work plan for a site investigation to be executed once all the solid waste has been removed from the site, and was approved by the DOH. The site investigation is required by the DOH corrective action letter.

5.2 INTERVIEW WITH SITE MANAGER

No additional site managers were interviewed for this report except for the interviews with Mr. Koga and Mr. O'Keefe (see Section 5.1 above).

5.3 INTERVIEWS WITH OCCUPANTS

Bureau Veritas interviewed Mr. Jeff Schenk, owner of Melia Orchards Maui. Mr. Schenk was forthcoming with information for which he has knowledge.

According to Mr. Schenk, his family has owned Melia Orchards Maui and has been a leaseholder at the subject property since 1971. Mr. Schenk stated that his family has used the land to grow orchid flowers for restaurants and resorts since 1971. According to Mr. Schenk, orchids are not susceptible to pests and the use of pesticides, herbicides, or insecticides is not necessary. Mr. Schenk stated that he uses a granular fertilizer occasionally on the plants.

According to Mr. Schenk, there are no underground storage tanks, hydraulic lifts, oil/water separators, spills, releases, or hazardous wastes currently present on his portion of the subject property. In addition, Mr. Schenk stated that, to the best of his knowledge, there are no environmental liens, litigation, or violations encumbering the subject property.

Mr. Schenk was asked if he was aware of any of the following:

Any pending, threatened, or past litigation relevant to hazardous substances or petroleum products in, on, or from the property.	Yes	No		X
Any pending, threatened or past administrative proceedings relevant to hazardous substances or petroleum products in, on, or from the property.	Yes		No	X
Any notices from any governmental entity regarding any possible violation of environmental laws or possible liability relating to hazardous substances or petroleum products.	Yes		No	X

Bureau Veritas also interviewed Mr. David Nobriga, Chief Executive Officer of Nobriga's Ranch, Inc., a cattle feeding company. According to Mr. Nobriga, the ranch has been located on the subject property since 1961. Mr. Nobriga stated that the majority of the cattle on the ranch are owned by other ranches. The cattle are sent to Nobriga's Ranch, Inc., for feeding approximately 90 days before slaughter. Mr. Nobriga feeds the cattle a special diet of wheat, oats, and other plants. According to Mr. Nobriga, the ranch does not dip or spray the cattle with pesticides. The cow manure is removed from the subject property and composted on an adjacent property.

According to Mr. Nobriga, there are currently no underground storage tanks, hydraulic lifts, oil/water separators, spills, or releases currently present at the subject property. In addition, Mr. Nobriga stated that, to the best of his knowledge, there are no environmental liens, litigation, or violations encumbering the subject property.

5.4 INTERVIEWS WITH OTHERS

Bureau Veritas conducted an interview with Mr. Eric Yamashigi, with the Maui County, Solid Waste Division, via telephone on January 20, 2011. Bureau Veritas requested information regarding the neighboring Waikapu Landfill. According to Mr. Yamashigi, the Waikapu Landfill was closed prior to current landfill regulations and they do not conduct any environmental monitoring of the site. Additionally, Mr. Yamashigi stated that the housing development located to the north of the subject property installed several gas monitoring wells to determine any impacts from the landfill to their site. However, any laboratory results from these wells are not public information.

6.0 <u>STANDARD ENVIRONMENTAL RECORD SOURCES, FEDERAL, STATE AND LOCAL</u>

Available government database information prepared by Environmental Data Resources, Inc. (EDR) was reviewed to evaluate both the subject property and any listed sites within ASTM-recommended search distances. Federal, state, tribal, and local databases reviewed are included in the appendices.

Subject Property

The subject property was listed with two unmappable sites. The portion of the subject property listed as "Vacant Land TMK No: (2) 3-8-7: 101" was indicated as a Resource Conservation and Recovery Act (RCRA) Non-Generator (NonGen) site. The RCRA-NonGen listing indicates that the facility does not presently generate hazardous waste. According to Mr. O'Keefe, this site obtained an EPA ID Number in order to dispose of approximately 5,500 pounds of hazardous waste that had been abandoned on the property.

The former Maui Scrap Metal license area was also listed as an unmapple site as a RCRA-NonGen site. According to Mr. O'Keefe, an EPA ID Number was obtained to dispose of hazardous waste in the form of broken batteries generated during Alexander & Baldwin's cleanup of the site (see Section 5.1).

Nearby Properties

A total of two underground storage tank sites were identified within the specified search distances from the subject property, and are described in the following table:

Facility	Database	Orientation from Subject Site	Environmental Concern
Maui Community Correctional Center, 600 Waiale Drive	UST	300 feet; west-northwest	No; no reported releases and UST listed as "Permanently Out of Use."
Waiko Baseyard LLC, 255-B East Waiko	UST	459 feet; west	No; no reported releases and USTs listed as "Permanently Out of Use."

A total of 22 unmappable sites were also listed in the EDR report. Unmappable sites are sites that cannot be plotted with confidence, but can be located by zip code or city name. In general, a site cannot be geocoded due to inaccurate or missing information in the environmental database record provided by its applicable agency. Cross-referencing addresses and site names, as well as a visual reconnaissance of surrounding properties, has been completed for the unmappable facility sites in the database report.

All databases reviewed in the EDR report were, in Bureau Veritas' opinion, determined to be sufficiently complete and sufficiently current to serve as the basis for Bureau Veritas' opinions.

7.0 SITE RECONNAISSANCE

7.1 METHODOLOGY AND LIMITATIONS

The subject property was inspected on foot and by car. Bureau Veritas was provided access to most areas of the subject property. Due to dense vegetation, Bureau Veritas was unable to access portions of the cattle and horse grazing land. In addition, Bureau Veritas was not provided access to a fenced enclosed area that was leased to Tom's Backhoe. Photographs taken at the time of the ESA are included behind the *Photographs* tab.

7.2 GENERAL OBSERVATIONS

At the time of Bureau Veritas' site visit, the subject property was observed as a large area of land comprised of various tenants and uses. Petition Area B was observed as mostly fallow sugar cane fields. The west central portion of the field was observed with soil mounds. The northern portion of Petition Area B was observed with multiple unauthorized dump piles. The piles contained household appliances, tires, metal scraps, mattresses, furniture, and other items. The northwestern portion of Petition Area B was previously licensed to Maui Scrap Metal Inc. for storage of trucks and other equipment. The area was observed with automobile parts, metal scraps, and miscellaneous items buried in the ground. Alexander & Baldwin dug trenches to determine the depth of the scraps. Bureau Veritas observed several approximately four-foot deep trenches. Metal scraps were observed on the surfaces of the trenches. Mr. O'Keefe indicated the area where a baler was previously located. According to Mr. O'Keefe, soil was removed due to the leakage of hydraulic fluid from the baler and was excavated, removed, and disposed at the Maui Demolition and Construction landfill by the owner of the baler. Mr. O'Keefe also indicated oil-impacted soil unrelated to the baler that was to be removed from the site. Bureau Veritas observed batteries, empty drum containers, and several abandoned vehicles onsite. According to Mr. O'Keefe, the Maui Scrap Metal license area is routinely inspected for hazardous materials. He stated that all batteries, chemicals, and petroleum hydrocarbon products are removed from the site on a regular basis. Adjacent to the northwest of Petition Area B, beyond Waiko Road, was the location of the Maui Scrap Metal facility used for solid waste management.

Adjacent to the former scrap yard was a concrete scrap pile that was previously used by a tenant to recycle concrete. The northeastern portion of Petition Area B included Melia Orchards Maui, an orchid garden. Several orchid gardens were observed onsite along with a pond, shed, and equipment. The current owner, Mr. Schenk, stated that his father leased the property in 1971 and has used the property to cultivate and grow orchids. Mr. Schenk stated that herbicides and pesticides are not used on the subject property, because orchids, are for the most part, pest-free.

Petition Area A was observed to the north of Waiko Road. The majority of the land was leased for cattle and horse grazing. This portion of the subject property appeared with natural vegetation including trees and shrubs. The west-central portion of the subject property was observed as a former sand mine. Most of the area was cleared of natural vegetation and portions of rock were exposed from the mining activities. Multiple areas were roped-off due to cultural artifact remains identified in the area. Ameron International occupies a lease area on the northwestern portion of Petition Area A. Sand from areas outside the subject property was being stored onsite. This area was observed with an AST and several five-gallon buckets stored in secondary containment. A small stain (de minimis) was observed adjacent to the AST.

A sod-farm was previously located on the eastern portion of the subject property. Mr. O'Keefe indicated an area of a former diesel AST that was associated with a spill. According to Mr. O'Keefe, the impacted soil was removed from the site. Mr. O'Keefe showed Bureau Veritas the location of former non-permanent structure locations and stated that prior to vacating the property, several drums and sonar fluid were removed. He also stated that Alexander & Baldwin removed and properly disposed of the methyl bromide cylinders, pesticides, and various other chemical wastes left behind by the tenant. Three containers of paint thinner were observed on the site due to unauthorized dumping. Mr. O'Keefe confirmed to Bureau Veritas that the containers of paint thinner were removed and disposed of properly.

Tom's Backhoe was observed as a construction and asphalt paving company. This lease area included three large liquid container tanks, 55-gallon drums containing hazardous materials and chemicals, five-gallon buckets, and other items. A small stain appeared adjacent to one of the liquid tank containers.

Bureau Veritas was not provided access into the main portion of this lease area. According to Mr. Koga, the tenant stated that a pit containing emulsified asphalt placed on plastic was located onsite. Mr. Koga confirmed on March 9, 2011, that the asphalt was cleaned up and disposed of properly.

7.3 HAZARDOUS SUBSTANCES AND PETROLEUM PRODUCTS

The subject property was assessed for signs of storage, use, or disposal of hazardous materials. The assessment consisted of noting evidence (e.g., drums, unusual vegetation patterns, staining) indicating that hazardous materials are currently or were previously located on the subject property.

Potentially hazardous materials observed at the subject property are listed in the following table:

Potentially Hazardous Materials

Business Name	Potentially Hazardous Materials
Former Maui Scrap Metal License Area	• Abando ned cars • Abandoned car batteries • Miscellaneous metal materials • Petroleum hydrocarbon-impacted soil
Tom's Backhoe	• Eight, 55-gallon drums of liquid concrete add-mixes (in secondary containment) • Five, 55-gallon drums of gear lubricant • Approximately 30 car batteries • Three large liquid-containing tanks (contents unknown) • Three, 55-gallon drums of oil • Five, 5-gallon drums of Color Pave™ • 11, 5-gallon hydraulic oil canisters • Emulsified asphalt stored on plastic
Nobriga's Ranch, Inc.	• Six, 55-gallon drums of propylene glycol • Four, 55-gallon drums in secondary containment • Three, 55-gallon drums (contents unknown)
Ameron International Corp.	• One, aboveground, approximately 1,000-gallon flammable fuel tank • Four, 5-gallon buckets of lubricating oils

All of the drums and smaller containers were observed in good condition with no evidence of significant leaks or spills. Some of the 55-gallon drums were located within secondary containment (on spill pallets), but some of the drums were stored on pallets with no containment. Although no significant leaks or spills were observed, all of these drums should be placed within secondary containment to prevent future leaks and spills from impacting the underlying ground.

7.3.1 Aboveground Storage Tanks

The subject property was inspected for evidence of ASTs (e.g., concrete foundations or saddles, pedestals or steel support structures).

One AST containing an unknown flammable material was observed at the Ameron International Corp. facility. The AST was not observed in secondary containment. No significant leaks or spills were observed.
According to Mr. O'Keefe, a diesel AST was previously located on the northeastern portion of Petition Area A. Bureau Veritas observed a secondary containment structure still located in this area. This AST was reported as a release site and received a status of "No Further Action" from the DOH, HEER office. According to Mr. O'Keefe, the AST and the impacted soil were removed from the site.

7.3.2 In-Ground Hydraulic Equipment

The subject property was inspected for evidence of in-ground hydraulic equipment (e.g., hydraulic elevators or lifts that have hydraulic fluid-containing reservoirs or jacks below ground surface). Although not regulated as USTs, hydraulic equipment of this type can be of concern due to the potential for oil leaks from the hydraulic cylinders. Hydraulic fluid in equipment installed in 1978 or before may contain PCBs.

In-ground hydraulic equipment was not observed on the subject property.

7.4 WASTES

Currently, non-hazardous solid waste in the form of household-type garbage is generated onsite and disposed of by each tenant.

7.5 POLYCHLORINATED BIPHENYLS (PCBS)

The subject property was inspected for the presence of liquid-cooled electrical units (transformers, light ballasts, and capacitors), and major sources of hydraulic fluid (elevators and lifts). Such units are notable because they may be potential PCB sources.

Bureau Veritas did not observe any evidence of liquid-cooled electrical units or major sources of hydraulic fluid during the site visit. According to Mr. O'Keefe, a hydraulic baler was previously located at the former scrap yard site. He stated that when the baler was removed from the subject property, the impacted soil was removed from the site.

7.6 WASTEWATER AND STORM WATER DISCHARGE

Wastewater is not generated at the subject property.

The storm water runoff from the subject property flows via sheet flow primarily to the east and northeast, based on the existing topography.

7.6.1 Discharge Sources

Evidence of current discharge sources was not observed at the subject property.

7.6.2 Oil/Water Separators, Clarifiers, Sumps, and Trenches

The subject property was inspected for evidence of oil/water separators, clarifiers, sumps and trenches (e.g., hatches, patches on the floor slabs). Although not regulated as USTs, these features can be of concern due to the potential for leaks into the subsurface.

Evidence of oil/water separators, clarifiers, sumps or trenches was not observed.

7.6.3 Septic Systems

The subject property was inspected for evidence of current or former septic systems (e.g., clean out manhole, records, interviews). Evidence of current or former septic systems was not observed during Bureau Veritas' site visit.

7.7 WELLS

Bureau Veritas did not observe evidence of wells (supply, monitoring, or dry well) at the subject property, except for two water wells that were recently drilled and are currently being developed on Parcel 101 in Petition Area A.

According to the State of Hawaii Department of Land and Natural Resources (DLNR), Division of Water Resource Management *Ground Water Index and Summary* database and water well map (2006), there are no water wells located on or near the subject property.

7.8 DRY CLEANING OPERATIONS

There are currently no dry cleaners on the subject property, and research did not reveal that dry cleaning operations have been conducted on the subject property in the past.

8.0 NON-ASTM ISSUES

8.1 ASBESTOS-CONTAINING MATERIALS

During the assessment, the subject property was inspected for the presence of suspect asbestos-containing materials (ACM). The inspection consisted of noting observable materials (*i.e.*, materials that are readily accessible and visible without dismantling elements of the structure, such as carpet, wallboard, or ceiling panels) that may contain asbestos. The inspection was not intended to disclose all possible sources of suspect ACM; rather, it was designed to assess the presence of suspect ACM in the most significant sources observed at the subject property.

Bureau Veritas observed several structures located on the portion of the subject property leased to Nobriga's Ranch, Inc. The structures were constructed of wood with corrugated metal roofs. Suspect ACM was not observed in the structures, but may be present behind permanent structures such as walls and ceilings.

The United States Environmental Protection Agency (USEPA) has limited the asbestos content of some materials to less than 1% and has passed regulations requiring that, with some exceptions, no asbestos-containing products be manufactured for domestic use after 1995. At the present time, however, asbestos has not been eliminated from all manufactured building materials. Therefore, the age of a building or remodeling project cannot be the basis for assuming that a building material does not contain asbestos. The method of assessing the absence or presence of asbestos in building materials is by sampling and laboratory analysis.

Suspect ACM should be sampled and analyzed for possible asbestos content prior to activities (e.g., renovation, demolition) which may damage or disturb the material. If the materials are found to be asbestos-containing, the building owner must comply with applicable United States Environmental Protection Agency (USEPA) National Emissions Standards for Hazardous Air Pollutants (NESHAPS), OSHA, state, and local regulations.

8.2 RADON

Radon is a naturally occurring radioactive gas formed by the decay of uranium in bedrock and soil. The potential adverse health effects associated with radon gas depend on various factors, such as the concentration of the gas and duration of exposure. The concentration of radon gas in a building depends on subsurface soil conditions, the integrity of the building's foundation, and the building's ventilation system.

Due to the relatively young geological age (less than five million years) of the southernmost islands of the Hawaiian archipelago, radon gas does not occur at elevated levels. Therefore, no further investigation of radon is recommended for the subject property.

8.3 LEAD-BASED PAINT

Lead-based paint (LBP) was commonly used for corrosion protection in the 1960s, and in prime, intermediate, and finish coats well into the 1970s. Regulations specifically addressing lead-based paint include Housing and Urban Development (HUD) (1995) guidelines and the Consumer Product Safety Act (1977). These regulations define LBP as containing 0.5% lead by weight (5,000 ppm), and 0.009% lead by weight (90 ppm), respectively, for housing and consumer products. There is no industrial definition. There are specific testing methods for sampling and analyzing lead in paint.

Bureau Veritas did not observe any painted structures on the subject property; however, portions of the cattle/horse grazing land on the subject property were not inspected and may include structures that contain lead-based paint.

Prior to any activities (i.e., repair, renovation, demolition) which may disturb painted surfaces, these paints should be sampled and analyzed for possible lead content. If the paints are found to contain lead, the building owner or leased space tenant may be required to comply with applicable USEPA, NESHAPS, OSHA, and state and local regulations.

8.4 WETLANDS

The subject property was inspected for the presence of sensitive ecological areas by noting environmental indicators (e.g., wetlands vegetation, floodplains) located on or immediately adjoining the subject property.

No sensitive ecological areas were observed on the subject property. The USGS 7.5-Minute Topographic Map for Wailuku, Maui, Hawaii, dated 1997, which includes the subject and adjoining properties, depicts Waikapu Stream along the southwestern boundary of the subject property.

The United States Fish and Wildlife Service (USFWS) National Wetland Map, which includes the subject property, does not depict wetlands on the subject property.

The Federal Emergency Management Agency Flood Insurance Rate Map was reviewed to determine if the subject property was located in a flood hazard area. According to the map, the subject property is located in Flood Zone X, which denotes areas determined to be outside both the 500-year and 100-year flood plains (FEMA Panel Number 15003C0315F, revised September 30, 2004).

9.0 FINDINGS, OPINIONS, CONCLUSIONS, AND RECOMMENDATIONS

Bureau Veritas has performed a Phase I Environmental Site Assessment in conformance with the scope and limitations of ASTM E 1527-05 of the Proposed Waiale Development Project property, (TMK Numbers: [2] 3-8-005: Parcels 023 (portion) and 037, and [2] 3-8-007: Parcels 071, 101 (portion), and 104), Waikapu, Maui, Hawaii, the subject property. Any exceptions to, or deletions from, this practice are described in Sections 1.1 and 1.2 of this report.

This assessment has revealed the following evidence of *recognized environmental conditions*, as defined by the ASTM, in connection with the subject property:

- The western portion of Petition Area B on the subject property was formerly licensed and occupied by Maui Scrap Metal, Inc. During Bureau Veritas' onsite inspection, the property was observed with metal scraps, automobile parts, and various waste materials buried deep within the soil. Petroleum hydrocarbon impacted soil is currently stored on the subject property and is pending disposal. Alexander and Baldwin stated that they were in the process of planning a site investigation for the Maui Scrap Metal license area, per the DOH Notification of Corrective Action. A Work Plan has been submitted and approved by the DOH. Execution of the Work Plan is pending removal of the remaining solid waste from the site.

  This finding is considered a REC because there is evidence of releases from scrap materials stored on the subject property.

- Several large piles of abandoned/waste materials including household appliances, automobile parts, and household garbage, were observed on the northwestern portion of Petition Area B. These materials have accumulated on the subject property from unauthorized dumping by outside parties. Although no staining or other evidence of releases was observed at this dump site, there is a potential that releases from the wastes have impacted the underlying soil.

  This finding is considered a REC because there is evidence of the unauthorized dumping may include hazardous materials and chemicals, with the potential to impact the subject property. Bureau Veritas recommends the proper removal and disposal of these materials from the subject property. Any stained soils should be excavated and disposed of properly. For significantly stained areas, Bureau Veritas recommends confirmation soil sampling with laboratory analyses following cleanup activities to ensure that proper cleanup has been completed.

- The Waikapu Landfill is located on the adjoining and upgradient property to the northwest of the subject property. The landfill was owned and operated by the County of Maui. The Waikapu Landfill did not receive waste after 1989 and was closed in 1991. The United States Environmental Protection Agency (USEPA) 40 Code of Federal Regulations (CFR) Part 258, Criteria for Municipal Solid Waste Landfills (MSWLFs), requires post-closure monitoring by owners or operators of MSWLFs. These regulations took effect in October 9, 1993. Therefore, because the Waikapu Landfill did not receive waste after 1989, it is exempt from these regulations.

This finding is considered a recognized environmental condition because there is a potential for contamination from the adjacent property to impact the subject property.

- The Petition Area B portion of the subject property has been used as agricultural land for the cultivation of sugar cane crops since the 1990s. Agricultural operations typically utilize chemicals such as herbicides and pesticides, which have a potential to impact the subject property. Based on the cultivation date, it is unlikely that residues of arsenic, dioxins, and organochlorine compounds would be present on these fields because these chemicals were not used on sugarcane in the recent past. Additionally, Bureau Veritas' onsite inspection and historical research did not reveal evidence of storage, mixing, or excessive use of pesticides/herbicides with the potential to impact the subject property.

  The State of Hawaii Department of Health (DOH) *Technical Guidance Manual for the Implementation of the State Contingency Plan Interim Final,* dated June 21, 2009, recommends that sites with known pesticide-related contamination, and sites where pesticides were regularly applied, be evaluated for residual contamination prior to re-development.

  This finding is considered a REC because there is a potential that agricultural chemicals exist in the soil at concentrations above the DOH action levels, and redevelopment of the subject property is planned. Therefore, Bureau Veritas recommends that soil samples be collected in accordance with DOH recommendations on the subject property to assess chemical impacts from historical agricultural operations. Since the subject property was not cultivated for sugarcane until the 1990s, certain tests recommended in the DOH guidance manual may not be applicable.

The following historical *recognized environmental condition* was revealed during this assessment:

- The environmental database report and State of Hawaii Department of Health (DOH) files reviewed by Bureau Veritas listed the former Maui Sod facility with a diesel release and an abandonment of an estimated 5,500 pounds of hazardous waste. Although both of these release sites received a status of "No Further Action," the DOH file did not include soil sampling and analyses data, and there is a potential for releases from the items stored onsite.

  This finding is considered an historical REC because there is potential for releases from past operations at the former Maui Sod facility. Bureau Veritas recommends further investigation of this area to assess chemical impacts to the soil from historical operations.

The following environmental conditions, which are not considered to be *recognized environmental condition*s, as defined by ASTM, were revealed during this assessment:

- Several adjacent properties, including the Wailuku Agribusiness Company, Inc., Consolidated Baseyards, LLC, and ABC Development, Inc., utilize and store hazardous materials onsite. Bureau Veritas observed these sites from the perimeter of the subject property and noted poor housekeeping practices at several of the adjoining areas.

  This finding is not considered a REC because there are no reported releases from these sites. However, there is a potential for hazardous chemical and material releases from these sites to impact the subject property.

- An aboveground storage tank (AST) was observed without secondary containment at the Ameron International facility on the subject property. Additionally, drums containing oils, solvents, and other liquids were observed throughout the subject property and appeared in good condition, with no evidence of significant leaks or spills. Some of the 55-gallon drums were stored on spill pallets, but some of the drums were not stored within secondary containment.

This finding is not considered a recognized environmental condition because no significant leaks or spills were observed around the AST or the drums. However, all ASTs, drums, and larger liquid containers should be placed within secondary containment to prevent leaks and spills from impacting the underlying ground.

Certification of both Environmental Professionals signing below:

I declare that, to the best of my professional knowledge and belief, I meet the definition of Environmental Professional as defined in §312.10 of 40 CFR 312. I have the specific qualifications based on education, training, and experience to assess a property of the nature, history, and setting of the subject property. I have developed and performed the all appropriate inquiries in conformance with the standards and practices set forth in 40 CFR Part 312.

This report was prepared by:

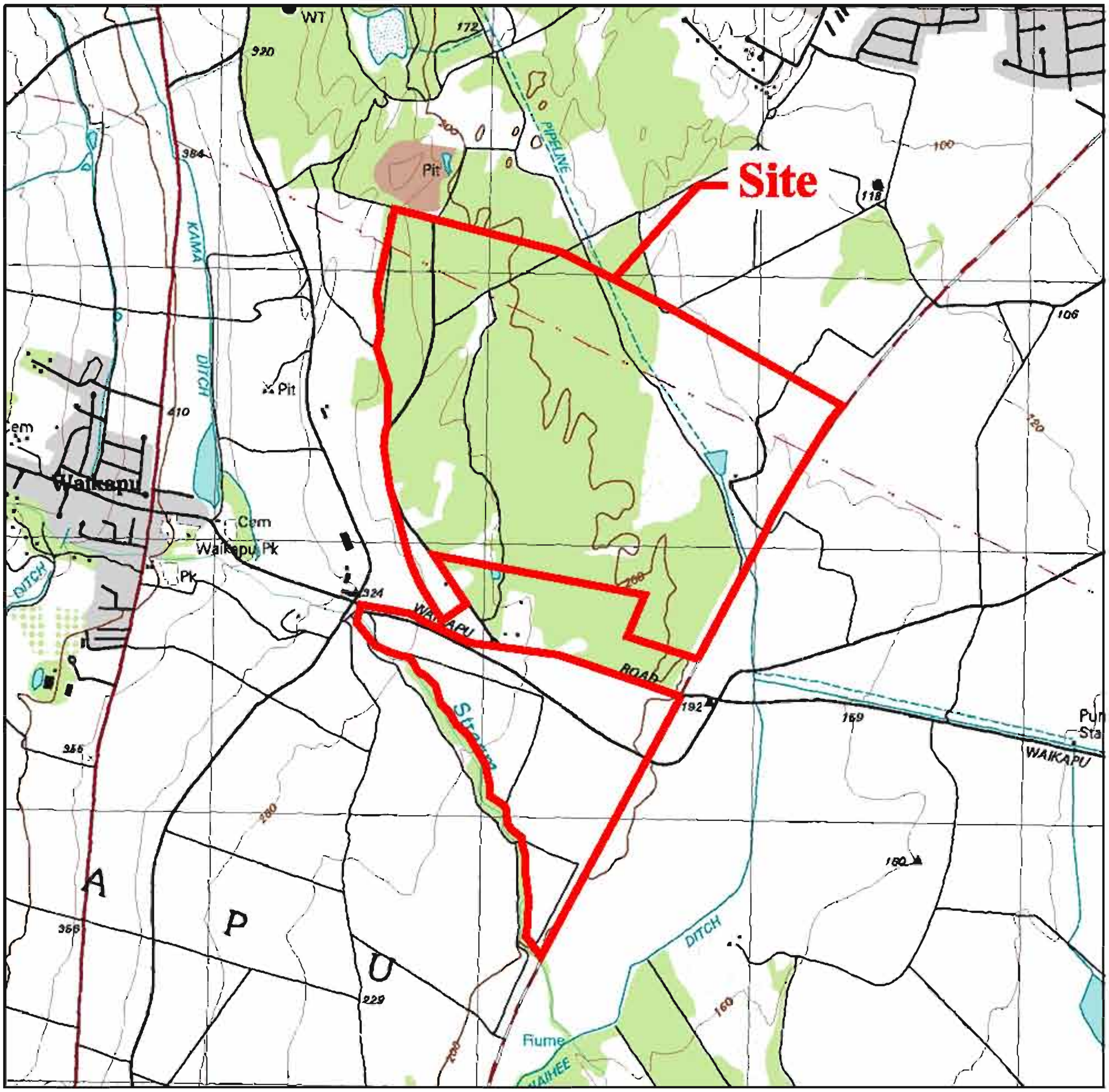
Tim Swartz
Senior Project Manager
Health, Safety, and Environmental Services

This report reviewed by:

Daniel P. Ford, P.G.
Regional Vice President
Health, Safety, and Environmental Services

April 25, 2011
Project No. 17010-010200.00

FIGURES



SCALE 1: 24000

1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

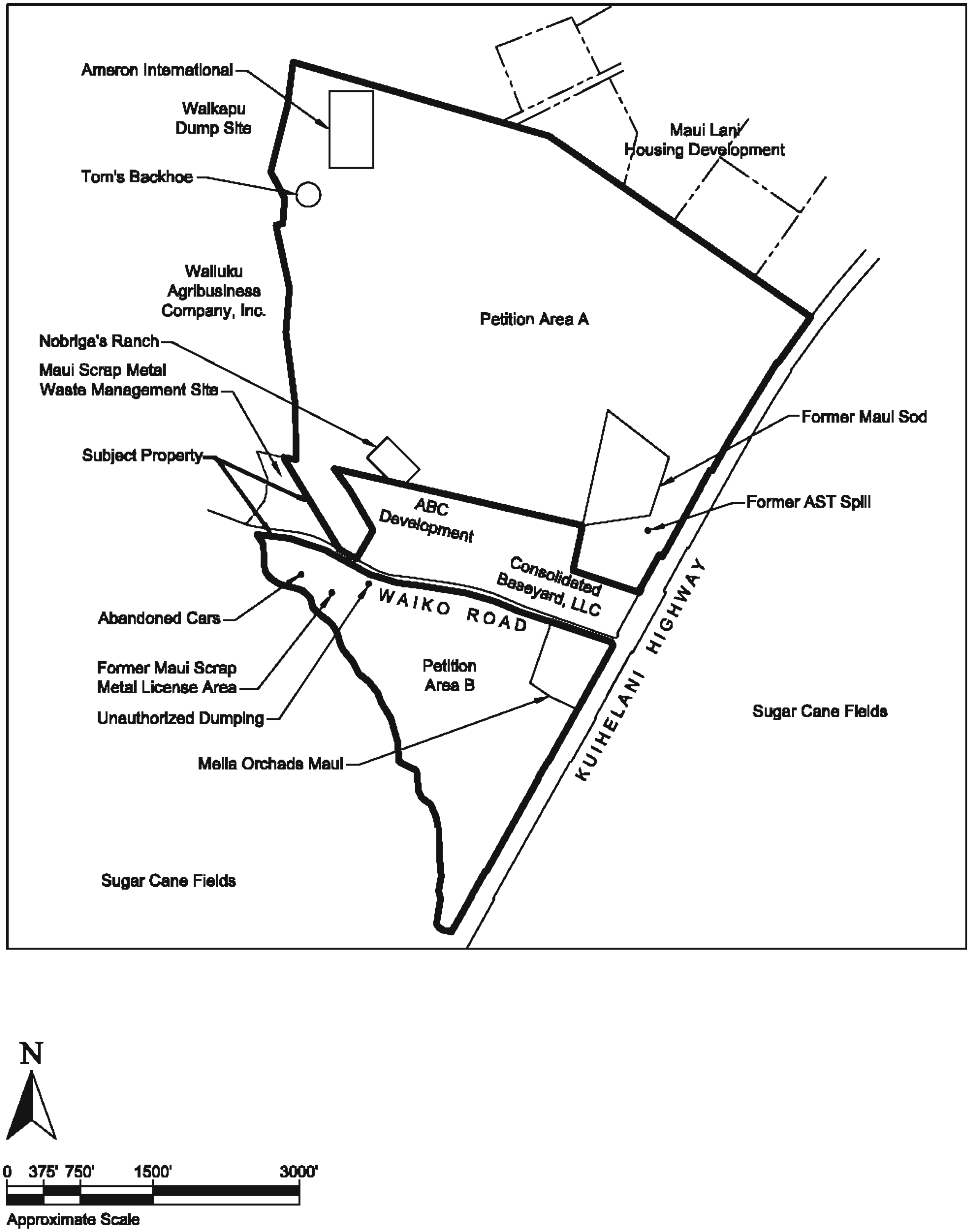
N

Portion of 7.5-minute Series (Topographic) Maps
United States Department of Interior
United States Geological Survey
Wailuku Quadrangle, County of Maui, Hawaii
1996

BUREAU VERITAS 1828

BUREAU VERITAS

Project No.: 17010-010200.00	Title: Site Location Map	FIGURE 1
Date: 01/04/11	Location: Proposed Waiale Development Project Site (TMKs [2] 3-8-007: Parcels 101, 104, 071 and [2] 3-8-005 Parcels 037, 023) Waikapu, Maui, Hawaii	
Revised By: DG		
Checked By: MG	Client: A&B Properties	



Project No.: 17010-010200.00	Title: Site Map	FIGURE 2
Date: 01/04/11	Location: Proposed Waiale Development Project Site (TMKs [2] 3-8-007: Parcels 101, 104, 071 and [2] 3-8-005 Parcels 037, 023) Waikapu, Maui, Hawaii	
Revised By: DG		
Checked By: MG	Client: A&B Properties	

PHOTOGRAPHS

Project No. 17010-010200.00	**Description**	View of former Maui Sod facility, located on the eastern portion of Petition Area A, looking northwest	**Photo 1**
	Site Name	Proposed Waiale Development Project Site, Located in Waikapu, Maui, Hawaii	**Photo Date** December 8, 2010
	Client	Alexander & Baldwin, Inc.	

Project No. 17010-010200.00	**Description**	View of former AST containment structure located at the former Maui Sod facility, looking northeast	**Photo 2**
	Site Name	Proposed Waiale Development Project Site, Located in Waikapu, Maui, Hawaii	**Photo Date** December 8, 2010
	Client	Alexander & Baldwin, Inc.	

	Description	View of Ameron International sand stockpile, located on the northwestern portion of Petition Area A, looking northeast	**Photo 3**
Project No. 17010-010200.00	**Site Name**	Proposed Waiale Development Project Site, Located in Waikapu, Maui, Hawaii	**Photo Date** December 8, 2010
	Client	Alexander & Baldwin, Inc.	

	Description	View of 55-gallon drums stored at Tom's Backhoe facility on the western portion of Petition Area A, looking southwest	**Photo 4**
Project No. 17010-010200.00	**Site Name**	Proposed Waiale Development Project Site, Located in Waikapu, Maui, Hawaii	**Photo Date** December 8, 2010
	Client	Alexander & Baldwin, Inc.	

Project No. 17010-010200.00	**Description**	View of materials stored at Tom's Backhoe facility, looking southeast	**Photo 5**
	Site Name	Proposed Waiale Development Project Site, Located in Waikapu, Maui, Hawaii	**Photo Date** December 8, 2010
	Client	Alexander & Baldwin, Inc.	

Project No. 17010-010200.00	**Description**	View of trench filled with scrap materials located on the northwestern portion of Petition Area B, looking southeast	**Photo 6**
	Site Name	Proposed Waiale Development Project Site, Located in Waikapu, Maui, Hawaii	**Photo Date** December 8, 2010
	Client	Alexander & Baldwin, Inc.	

Project No. 17010-010200.00	Description	View of unauthorized dumping located on the northwestern portion of Petition Area B, looking northeast	Photo 7
	Site Name	Proposed Waiale Development Project Site, Located in Waikapu, Maui, Hawaii	Photo Date December 8, 2010
	Client	Alexander & Baldwin, Inc.	

Project No. 17010-010200.00	Description	Drums stored on the cattle feed lot located on the southern portion of Petition Area A	Photo 8
	Site Name	Proposed Waiale Development Project Site, Located in Waikapu, Maui, Hawaii	Photo Date December 8, 2010
	Client	Alexander & Baldwin, Inc.	

Project No. 17010-010200.00	**Description**	View of abandoned vehicles located on the western portion of Petition Area B, looking northwest	**Photo 9**
	Site Name	Proposed Waiale Development Project Site, Located in Waikapu, Maui, Hawaii	**Photo Date** December 8, 2010
	Client	Alexander & Baldwin, Inc.	

Project No. 17010-010200.00	**Description**	View of soil mounds located on the west-central portion of Petition Area B, looking northeast	**Photo 10**
	Site Name	Proposed Waiale Development Project Site, Located in Waikapu, Maui, Hawaii	**Photo Date** December 8, 2010
	Client	Alexander & Baldwin, Inc.	

Project No. 17010-010200.00	**Description**	View of concrete pile located on the northern portion of Petition Area B, looking northwest	**Photo 11**
	Site Name	Proposed Waiale Development Project Site, Located in Waikapu, Maui, Hawaii	**Photo Date** December 8, 2010
	Client	Alexander & Baldwin, Inc.	

Project No. 17010-010200.00	**Description**	View of west adjacent property, looking northwest	**Photo 12**
	Site Name	Proposed Waiale Development Project Site, Located in Waikapu, Maui, Hawaii	**Photo Date** December 8, 2010
	Client	Alexander & Baldwin, Inc.	

Project No. **17010-010200.00**	**Description**	View of west adjacent property, looking northwest	**Photo 13**
	Site Name	Proposed Waiale Development Project Site, Located in Waikapu, Maui, Hawaii	**Photo Date** December 8, 2010
	Client	Alexander & Baldwin, Inc.	

Project No. **17010-010200.00**	**Description**	View of abandoned vehicles located on the northwestern portion of Petition Area A, and the Waikapu Landfill, looking northwest	**Photo 14**
	Site Name	Proposed Waiale Development Project Site, Located in Waikapu, Maui, Hawaii	**Photo Date** December 8, 2010
	Client	Alexander & Baldwin, Inc.	

APPENDIX A

RESUMES OF ENVIRONMENTAL PROFESSIONALS

Daniel P. Ford, P.G.

Regional Vice President

MBA., With Distinction, 1999
Hawaii Pacific University, Honolulu, Hawaii

BA, Geology, 1985
University of California, Berkeley, California

Registered Professional Geologist (R.G.), State of Kentucky, No. 0864, 1993

Mr. Daniel P. Ford has over 24 years of environmental consulting experience in Hawaii and the Pacific. He has assisted clients on regulatory strategy and has interfaced with U.S. Environmental Protection Agency (EPA) and state agencies on hundreds of projects. He is experienced in preliminary environmental site assessments (ESAs), subsurface investigations for soil and groundwater contamination, water quality studies, National Pollutant Discharge Elimination System (NPDES) sampling programs, Spill Prevention Control and Countermeasure (SPCC) Plans, hydrogeologic studies, site characterizations, risk assessments, hazardous waste management, remedial investigation and feasibility studies, and remediation management. Mr. Ford has managed complex projects for private landowners, financial institutions, governmental agencies, and industrial clients.

Mr. Ford is also responsible for Bureau Veritas' operations in Honolulu, Hawaii and the Pacific Region. He supervises technical and administrative staff, prepares budgets and proposals, manages projects, conducts technical reviews of project submittals, and provides regulatory liaison assistance to clients. Mr. Ford's project experience extends throughout the Hawaiian Islands and the Pacific Basin, Australia, the Philippines, Korea, Japan, Guam, Saipan, the U.S. Mainland, and Central America.

Tim J. Swartz

Senior Project Manager, Environmental Services

Associate of Science Degree (AS) in Occupational and Environmental Safety Management
Honolulu Community College, Honolulu, Hawaii

Studies in Psychology and Biology
University of Kansas, Lawrence, Kansas

AHERA Building Inspector and Management Planner

AHERA Contractor/Supervisor

NIOSH 582 Phase Contrast Microscopy/Asbestos Identification/AAR Participant

SCITEC Radiation Safety Training

OSHA 40-Hour Hazardous Waste, Health, and Safety Accreditation/Annual Update

Lead-Based Paint Inspector

Lead-Based Paint Abatement Worker Awareness Training Course

Tim Swartz has over 18 years of experience in the environmental and industrial hygiene fields. His background includes Phase I environmental site assessments and soil and groundwater sampling, management of asbestos and lead paint assessment surveys, air monitoring and project oversight for asbestos and lead paint abatement projects, and various air quality surveys. Mr. Swartz has extensive project management experience and is familiar with standards and requirements of the American Society for Testing and Materials (ASTM) for Phase I environmental site assessments (ESAs), and Asbestos Hazard Emergency Response Act (AHERA). He is also familiar with Environmental Protection Agency (EPA) regulations for asbestos surveys and air monitoring projects; EPA and Department of Housing and Urban Development (HUD) guidelines for lead-based paint surveys and abatement; and Occupational Safety and Health Administration (OSHA) regulations for projects involving worker health and safety.

APPENDIX B

LIST OF SOURCES/REFERENCES

LIST OF SOURCES/REFERENCES

SOURCES

Agency and division/source:	Alexander & Baldwin, Inc.
Name/title of representative:	Mr. Sean O'Keefe/Director of Environmental Affairs
Agency Telephone Number:	(808) 877-2959
Agency and division/source:	Alexander & Baldwin, Inc.
Name/title of representative:	Mr. Jason Koga / Land & Environmental Manager
Agency Telephone Number:	(808) 877-5523
Agency and division/source:	Nobriga's Ranch, Inc.
Name/title of representative:	Mr. David Nobriga / Chief Executive Officer
Agency and division/source:	Melia Orchards Maui
Name/title of representative:	Mr. Jeff Schenk / Owner
Agency Telephone Number:	(808) 280-7440
Agency and division/source:	Maui County, Solid Waste Division
Name/title of representative:	Mr. Eric Yamashigi
Agency Telephone Number:	(808) 463-3873

REFERENCES

Physical Setting

- *Aquifer Identification and Classification for Oahu: Groundwater Protection Strategy for Hawaii. Technical Report No. 185* , revised February 1990, prepared by Mink, J.F. and L.S. Lau
- *Federal Emergency Management Agency (FEMA), Flood Insurance Rate Map (FIRM) Map Panel No. 15003C0315F, revised September 30, 2004*, prepared by FEMA
- *Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii,* dated August 1972, prepared by Foote, Donald E. et. al., US Department of Agriculture, Soil Conservation Service, in cooperation with the University of Hawaii Agricultural Experiment Station

LIST OF SOURCES/REFERENCES
(Continued)

State and County Agencies

- *The EDR Radius Map Report*, dated November 23, 2010, prepared by Environmental Data Resources, Inc.
- *Hazard Evaluation & Emergency Response (HEER) Office Database*, dated 2010, prepared by the State of Hawaii Department of Health, HEER Office
- Ownership records and Tax Map Key maps, prepared by the Maui County Real Property Tax Assessment Office
- *Underground Storage Tank (UST) Database* and *Leaking Underground Storage Tank (LUST) Database*, dated 2009, prepared by State of Hawaii Department of Health, Solid and Hazardous Waste Branch

Previous Reports and Other Documents

- *Release Notification for Maui Scrap Metal Tire Pile Fire*, prepared by DOH, HEER Office, dated October 17, 1998.
- *Release Notification for Oil Spill at the Alexander & Baldwin Property,* prepared by DOH, HEER Office, dated January 30, 2004.
- Release Notification for
- *Chemical and Oil Emergency Report for Wailuku Landfill, Maui,* prepared by DOH, HEER Office, dated July 3, 1989.
- *Release Notification for Waikapu Landfill Wailuku Baseyard Soils,* prepared by DOH, HEER Office, dated March 15, 1992.
- *Soil Sample Collection and Analysis, Wailuku District Highways Baseyard Soils Stockpiled at Waikapu Landfill,* prepared by Robert Thomas Environmental Group, Inc, dated March 15, 1992.
- *Limited Phase II Site Investigation, Maui Scrap Metal Company, Inc.,* prepared by Clayton, dated September 14, 2004.
- *Site Investigation Report/Site Closure and Restoration Plan, Former Maui Scrap Metal Company, Inc. Waikapu, Maui, Hawaii*, prepared by Bureau Veritas, dated September 3, 2010.
- *Letter from the Mr. Laurence Lau, Deputy Director, Environmental Health Branch, Hawaii Department of Health to Mr. Ian Sandison, Carlsmith Ball LLP approving the Site Investigation Report/Site Closure and Restoration Plan, Former Maui Scrap Metal Company Site, Waikapu, Maui, Hawaii*, prepared by DOH, dated November 30, 2010.

LIST OF SOURCES/REFERENCES
(Continued)

Aerial Photographs

Source: Hawaii State Archives, Kekauluohi Building, located on the Iolani Palace grounds in Honolulu, Hawaii and GoogleEarth™.

Date: 1950 Aerial Photograph No. GS-MF 4-42

Date: 1965 Aerial Photograph No. 1-CC-30

Date: 2004 Aerial Photograph No. GoogleEarth™

Topographic Maps

Source: Hawaii State Archives, Kekauluohi Building, located on the Iolani Palace grounds in Honolulu, Hawaii and Bureau Veritas' private collection.

Hawaiian Government Survey, Maui, Hawaii Scale: 1:64,000

Year: 1885

U.S. Geological Survey, Island of Maui, Hawaii Scale: 1:62,500

Years: 1933

Quadrangle: Wailuku, Maui, Hawaii Scale: 1:24,000 Series: 7.5 Minute

Year: 1955, 1983, 1997

APPENDIX C

REGULATORY DATABASE REPORT

Proposed Waiale Development
Kuihelani Highway
Kahului, HI 96732

Inquiry Number: 2928535.1s
November 23, 2010

The EDR Radius Map™ Report

EDR® Environmental Data Resources Inc

440 Wheelers Farms Road
Milford, CT 06461
Toll Free: 800.352.0050
www.edrnet.com

TABLE OF CONTENTS

SECTION **PAGE**

GEOCHECK ADDENDUM

GeoCheck - Not Requested

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

EXECUTIVE SUMMARY

A search of available environmental records was conducted by Environmental Data Resources, Inc (EDR). The report was designed to assist parties seeking to meet the search requirements of EPA's Standards and Practices for All Appropriate Inquiries (40 CFR Part 312), the ASTM Standard Practice for Environmental Site Assessments (E 1527-05) or custom requirements developed for the evaluation of environmental risk associated with a parcel of real estate.

TARGET PROPERTY INFORMATION

ADDRESS

KUIHELANI HIGHWAY
KAHULUI, HI 96732

COORDINATES

Latitude (North):	20.853600 - 20˚ 51' 13.0''
Longitude (West):	156.488500 - 156˚ 29' 18.6''
Universal Tranverse Mercator:	Zone 4
UTM X (Meters):	761337.9
UTM Y (Meters):	2307848.8
Elevation:	207 ft. above sea level

USGS TOPOGRAPHIC MAP ASSOCIATED WITH TARGET PROPERTY

Target Property Map:	20156-G4 WAILUKU, HI
Most Recent Revision:	Not reported
West Map:	20156-G5 LAHAINA, HI
Most Recent Revision:	Not reported

TARGET PROPERTY SEARCH RESULTS

The target property was not listed in any of the databases searched by EDR.

DATABASES WITH NO MAPPED SITES

No mapped sites were found in EDR's search of available ("reasonably ascertainable ") government records either on the target property or within the search radius around the target property for the following databases:

STANDARD ENVIRONMENTAL RECORDS

Federal NPL site list

NPL ------------------------- National Priority List
Proposed NPL --------------- Proposed National Priority List Sites
NPL LIENS ------------------ Federal Superfund Liens

Federal Delisted NPL site list

Delisted NPL ---------------- National Priority List Deletions

EXECUTIVE SUMMARY

Federal CERCLIS list

CERCLIS - - - - - - - - - - Comprehensive Environmental Response, Compensation, and Liability Information System
FEDERAL FACILITY - - - - - Federal Facility Site Information listing

Federal CERCLIS NFRAP site List

CERC-NFRAP - - - - - - - - CERCLIS No Further Remedial Action Planned

Federal RCRA CORRACTS facilities list

CORRACTS - - - - - - - - - Corrective Action Report

Federal RCRA non-CORRACTS TSD facilities list

RCRA-TSDF - - - - - - - - - RCRA - Treatment, Storage and Disposal

Federal RCRA generators list

RCRA-LQG - - - - - - - - - RCRA - Large Quantity Generators
RCRA-SQG - - - - - - - - - RCRA - Small Quantity Generators
RCRA-CESQG - - - - - - - - RCRA - Conditionally Exempt Small Quantity Generator

Federal institutional controls / engineering controls registries

US ENG CONTROLS - - - - - Engineering Controls Sites List
US INST CONTROL - - - - - Sites with Institutional Controls

Federal ERNS list

ERNS - - - - - - - - - - - - Emergency Response Notification System

State- and tribal - equivalent CERCLIS

SHWS - - - - - - - - - - - - Sites List

State and tribal landfill and/or solid waste disposal site lists

SWF/LF - - - - - - - - - - - Permitted Landfills in the State of Hawaii

State and tribal leaking storage tank lists

LUST - - - - - - - - - - - - Leaking Underground Storage Tank Database
INDIAN LUST - - - - - - - - Leaking Underground Storage Tanks on Indian Land

State and tribal registered storage tank lists

INDIAN UST - - - - - - - - - Underground Storage Tanks on Indian Land
FEMA UST - - - - - - - - - - Underground Storage Tank Listing

State and tribal institutional control / engineering control registries

ENG CONTROLS - - - - - - - Engineering Control Sites
INST CONTROL - - - - - - - Sites with Institutional Controls

EXECUTIVE SUMMARY

State and tribal voluntary cleanup sites

INDIAN VCP .... Voluntary Cleanup Priority Listing
VCP .... Voluntary Response Program Sites

State and tribal Brownfields sites

BROWNFIELDS .... Brownfields Sites

ADDITIONAL ENVIRONMENTAL RECORDS

Local Brownfield lists

US BROWNFIELDS .... A Listing of Brownfields Sites

Local Lists of Landfill / Solid Waste Disposal Sites

DEBRIS REGION 9 .... Torres Martinez Reservation Illegal Dump Site Locations
ODI .... Open Dump Inventory
INDIAN ODI .... Report on the Status of Open Dumps on Indian Lands

Local Lists of Hazardous waste / Contaminated Sites

US CDL .... Clandestine Drug Labs
CDL .... Clandestine Drug Lab Listing
US HIST CDL .... National Clandestine Laboratory Register

Local Land Records

LIENS 2 .... CERCLA Lien Information
LUCIS .... Land Use Control Information System

Records of Emergency Release Reports

HMIRS .... Hazardous Materials Information Reporting System
SPILLS .... Release Notifications

Other Ascertainable Records

RCRA-NonGen .... RCRA - Non Generators
DOT OPS .... Incident and Accident Data
DOD .... Department of Defense Sites
FUDS .... Formerly Used Defense Sites
CONSENT .... Superfund (CERCLA) Consent Decrees
ROD .... Records Of Decision
UMTRA .... Uranium Mill Tailings Sites
MINES .... Mines Master Index File
TRIS .... Toxic Chemical Release Inventory System
TSCA .... Toxic Substances Control Act
FTTS .... FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
HIST FTTS .... FIFRA/TSCA Tracking System Administrative Case Listing
SSTS .... Section 7 Tracking Systems

EXECUTIVE SUMMARY

ICIS	Integrated Compliance Information System
PADS	PCB Activity Database System
MLTS	Material Licensing Tracking System
RADINFO	Radiation Information Database
FINDS	Facility Index System/Facility Registry System
RAATS	RCRA Administrative Action Tracking System
UIC	Underground Injection Wells Listing
DRYCLEANERS	Permitted Drycleaner Facility Listing
AIRS	List of Permitted Facilities
INDIAN RESERV	Indian Reservations
SCRD DRYCLEANERS	State Coalition for Remediation of Drycleaners Listing
COAL ASH EPA	Coal Combustion Residues Surface Impoundments List
COAL ASH DOE	Sleam-Electric Plan Operation Data
PCB TRANSFORMER	PCB Transformer Registration Database

EDR PROPRIETARY RECORDS

EDR Proprietary Records

Manufactured Gas Plants - - - - - EDR Proprietary Manufactured Gas Plants

SURROUNDING SITES: SEARCH RESULTS

Surrounding sites were identified in the following databases.

Elevations have been determined from the USGS Digital Elevation Model and should be evaluated on a relative (not an absolute) basis. Relative elevation information between sites of close proximity should be field verified. Sites with an elevation equal to or higher than the target property have been differentiated below from sites with an elevation lower than the target property.
Page numbers and map identification numbers refer to the EDR Radius Map report where detailed data on individual sites can be reviewed.

Sites listed in ***bold italics*** are in multiple databases.

Unmappable (orphan) sites are not considered in the foregoing analysis.

STANDARD ENVIRONMENTAL RECORDS

State and tribal registered storage tank lists

UST: The Underground Storage Tank database contains registered USTs. USTs are regulated under Subtitle I of the Resource Conservation and Recovery Act (RCRA). The data come from the Department of Health's Listing of Underground Storage Tanks.

A review of the UST list, as provided by EDR, and dated 09/20/2010 has revealed that there are 2 UST sites within approximately 0.25 miles of the target property.

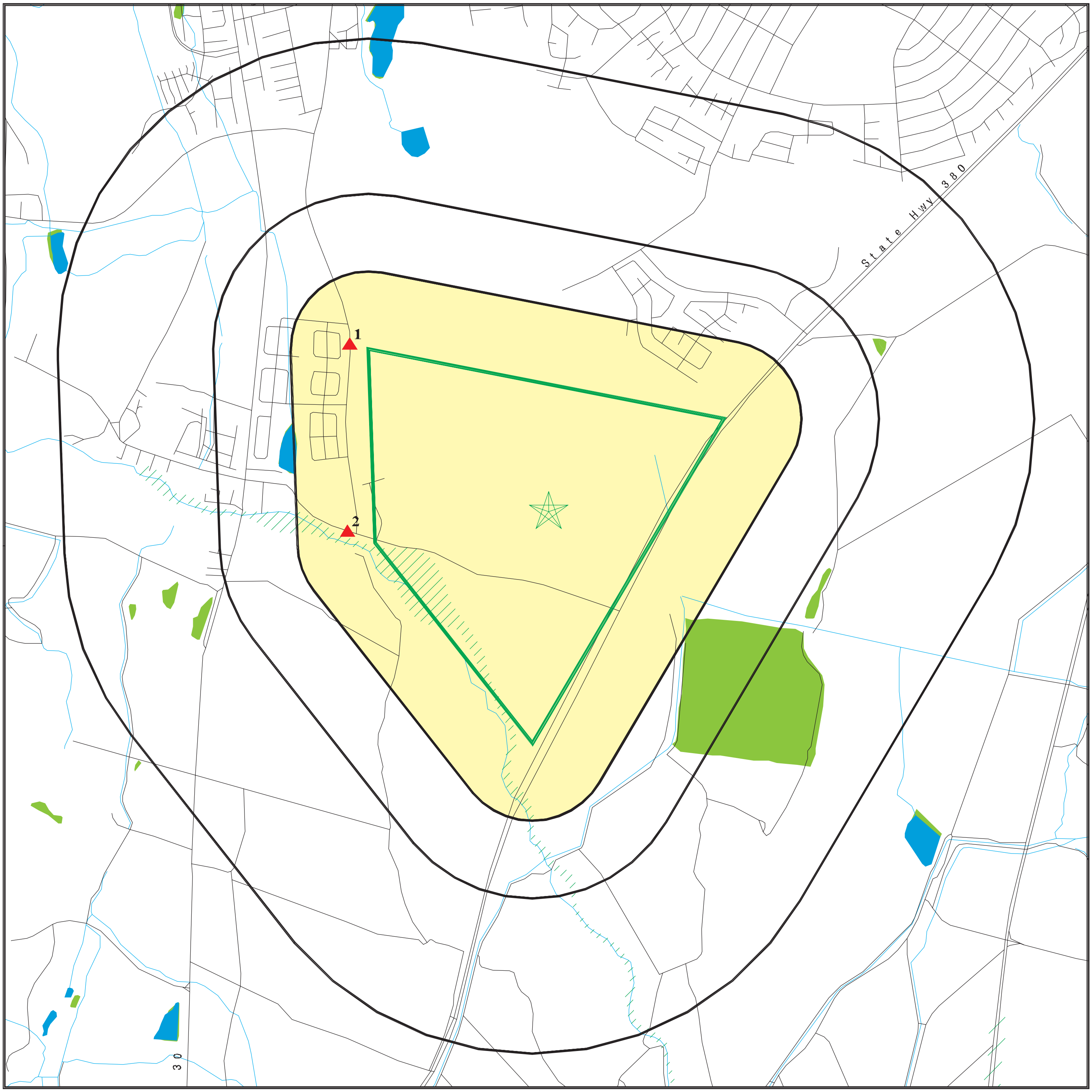
Equal/Higher Elevation	Address	Direction / Distance	Map ID	Page
MAUI COMMUNITY CORRECTIONAL CE	600 WAIALE DR	WNW 0 - 1/8 (0.062 mi.)	1	7
WAIKO BASEYARD LLC	255-B EAST WAIKO ROAD	W 0 - 1/8 (0.087 mi.)	2	7

EXECUTIVE SUMMARY

Due to poor or inadequate address information, the following sites were not mapped:

Site Name	Database(s)
KALAMAULA LANDFILL	SHWS, ENG CONTROLS
VECTOR CONTROL BRANCH, MAUI	SHWS
HOBRON AVE AREA (KAHULUI)	FINDS, SHWS
FONG CONSTRUCTION	SHWS
MCC-AUTOMOTIVE TECHNOLOGY BUILDING	FINDS, SHWS, SPILLS
MAUI PALMS HOTEL UST	SHWS
A&B DUMP SITE	FINDS, SHWS
MAUI MEAT COMPANY FACILITY (FORMER	SHWS, SPILLS
WAIKAPU DUMP-MAUI COUNTY DUMP	FINDS, SHWS
PAIA SUGAR MILL	SHWS
Y HATA- MAUI	SHWS
DAVID PICO CESSPOOL DIGGING	FINDS, LUST
KIHEI WWTP	LUST, UST
MARK MILL34	LUST
HAWAIIAN CEMENT - WAIKAPU QUARRY	FINDS, LUST
DAVID PICO CESSPOOL DIGGING	UST
MARK MILL34	UST
MONSANTO COMPANY	RCRA-SQG
FORMER MAUI SCRAP METAL LICENSE AR	RCRA-SQG
VACANT LAND TMK NO (2) 3-8-7:101	RCRA-NonGen
MAUI ECONOMIC DEVELOPMENT BRD	FINDS
MAALAEA TRIANGLE DEVELOPMENT - IWS	FINDS

OVERVIEW MAP - 2928535.1s



Target Property

Sites at elevations higher than or equal to the target property

Sites at elevations lower than the target property

Manufactured Gas Plants

National Priority List Sites

Dept. Defense Sites

Indian Reservations BIA

Oil & Gas pipelines

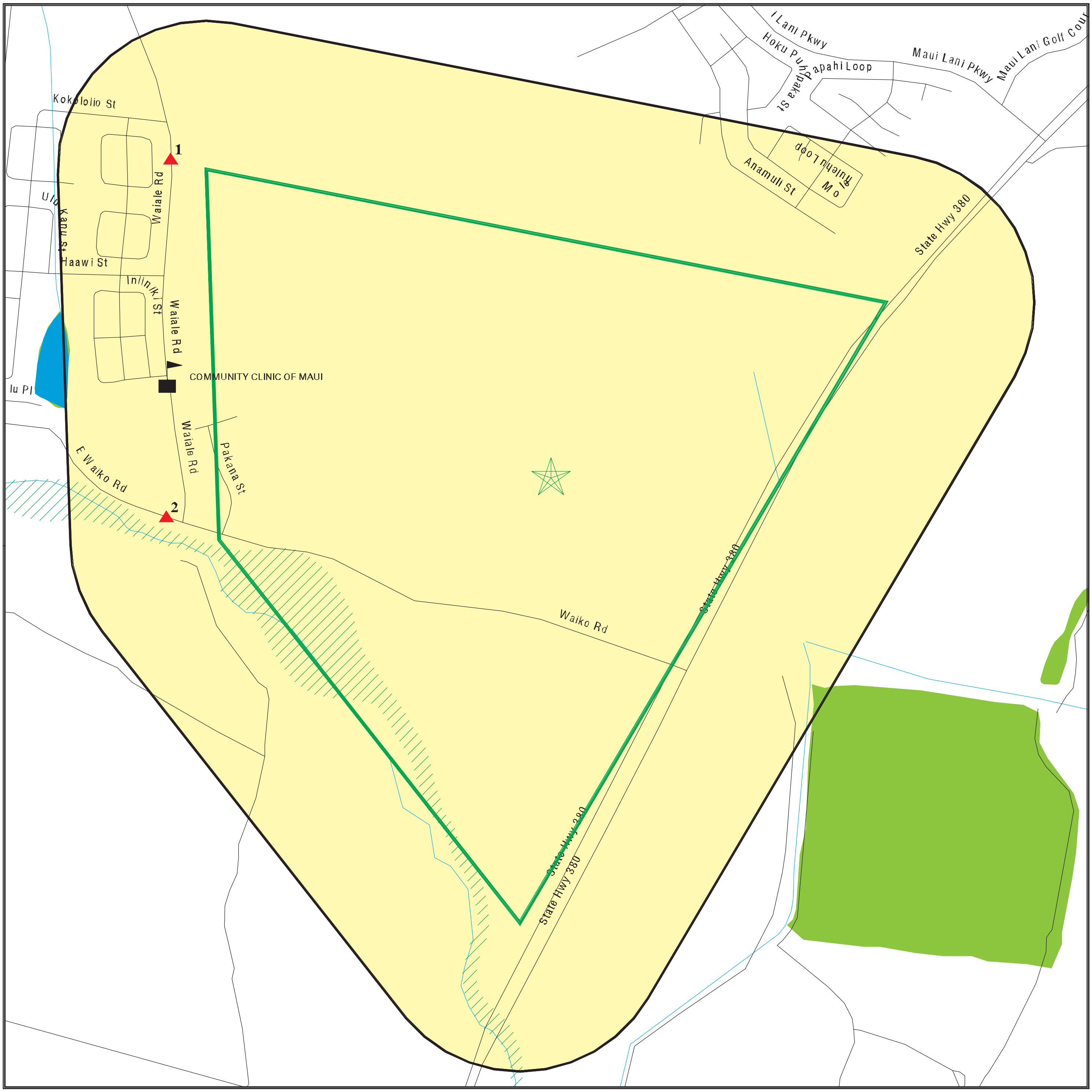
100-year flood zone

500-year flood zone

National Wetland Inventory

SITE NAME: Proposed Waiale Development	CLIENT: Bureau Veritas North America, Inc.
ADDRESS: Kuihelani Highway Kahului HI 96732	CONTACT: Meredith Gibe
	INQUIRY #: 2928535.1s
LAT/LONG: 20.8536 / 156.4885	DATE: November 23, 2010 1:41 pm

DETAIL MAP - 2928535.1s



Target Property
Sites at elevations higher than or equal to the target property
Sites at elevations lower than the target property
Manufactured Gas Plants
Sensitive Receptors
National Priority List Sites
Dept. Defense Sites

0 1/8 1/4 1/2 Miles

Indian Reservations BIA
Oil & Gas pipelines
100-year flood zone
500-year flood zone
National Wetland Inventory

SITE NAME: Proposed Waiale Development ADDRESS: Kuihelani Highway Kahului HI 96732 LAT/LONG: 20.8536 / 156.4885	CLIENT: Bureau Veritas North America, Inc. CONTACT: Meredith Gibe INQUIRY #: 2928535.1s DATE: November 23, 2010 1:41 pm

MAP FINDINGS SUMMARY

Database	Target Property	Search Distance (Miles)	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
STANDARD ENVIRONMENTAL RECORDS								
Federal NPL site list								
NPL		1.000	0	0	0	0	NR	0
Proposed NPL		1.000	0	0	0	0	NR	0
NPL LIENS		TP	NR	NR	NR	NR	NR	0
Federal Delisted NPL site list								
Delisted NPL		1.000	0	0	0	0	NR	0
Federal CERCLIS list								
CERCLIS		0.500	0	0	0	NR	NR	0
FEDERAL FACILITY		1.000	0	0	0	0	NR	0
Federal CERCLIS NFRAP site List								
CERC-NFRAP		0.500	0	0	0	NR	NR	0
Federal RCRA CORRACTS facilities list								
CORRACTS		1.000	0	0	0	0	NR	0
Federal RCRA non-CORRACTS TSD facilities list								
RCRA-TSDF		0.500	0	0	0	NR	NR	0
Federal RCRA generators list								
RCRA-LQG		0.250	0	0	NR	NR	NR	0
RCRA-SQG		0.250	0	0	NR	NR	NR	0
RCRA-CESQG		0.250	0	0	NR	NR	NR	0
Federal institutional controls / engineering controls registries								
US ENG CONTROLS		0.500	0	0	0	NR	NR	0
US INST CONTROL		0.500	0	0	0	NR	NR	0
Federal ERNS list								
ERNS		TP	NR	NR	NR	NR	NR	0
State- and tribal - equivalent CERCLIS								
SHWS		1.000	0	0	0	0	NR	0
State and tribal landfill and/or solid waste disposal site lists								
SWF/LF		0.500	0	0	0	NR	NR	0
State and tribal leaking storage tank lists								
LUST		0.500	0	0	0	NR	NR	0
INDIAN LUST		0.500	0	0	0	NR	NR	0
State and tribal registered storage tank lists								
UST		0.250	2	0	NR	NR	NR	2

MAP FINDINGS SUMMARY

Database	Target Property	Search Distance (Miles)	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
INDIAN UST		0.250	0	0	NR	NR	NR	0
FEMA UST		0.250	0	0	NR	NR	NR	0
State and tribal institutional control / engineering control registries								
ENG CONTROLS		0.500	0	0	0	NR	NR	0
INST CONTROL		0.500	0	0	0	NR	NR	0
State and tribal voluntary cleanup sites								
INDIAN VCP		0.500	0	0	0	NR	NR	0
VCP		0.500	0	0	0	NR	NR	0
State and tribal Brownfields sites								
BROWNFIELDS		0.500	0	0	0	NR	NR	0
ADDITIONAL ENVIRONMENTAL RECORDS								
Local Brownfield lists								
US BROWNFIELDS		0.500	0	0	0	NR	NR	0
Local Lists of Landfill / Solid Waste Disposal Sites								
DEBRIS REGION 9		0.500	0	0	0	NR	NR	0
ODI		0.500	0	0	0	NR	NR	0
INDIAN ODI		0.500	0	0	0	NR	NR	0
Local Lists of Hazardous waste / Contaminated Sites								
US CDL		TP	NR	NR	NR	NR	NR	0
CDL		TP	NR	NR	NR	NR	NR	0
US HIST CDL		TP	NR	NR	NR	NR	NR	0
Local Land Records								
LIENS 2		TP	NR	NR	NR	NR	NR	0
LUCIS		0.500	0	0	0	NR	NR	0
Records of Emergency Release Reports								
HMIRS		TP	NR	NR	NR	NR	NR	0
SPILLS		TP	NR	NR	NR	NR	NR	0
Other Ascertainable Records								
RCRA-NonGen		0.250	0	0	NR	NR	NR	0
DOT OPS		TP	NR	NR	NR	NR	NR	0
DOD		1.000	0	0	0	0	NR	0
FUDS		1.000	0	0	0	0	NR	0
CONSENT		1.000	0	0	0	0	NR	0
ROD		1.000	0	0	0	0	NR	0
UMTRA		0.500	0	0	0	NR	NR	0
MINES		0.250	0	0	NR	NR	NR	0
TRIS		TP	NR	NR	NR	NR	NR	0

MAP FINDINGS SUMMARY

Database	Target Property	Search Distance (Miles)	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
TSCA		TP	NR	NR	NR	NR	NR	0
FTTS		TP	NR	NR	NR	NR	NR	0
HIST FTTS		TP	NR	NR	NR	NR	NR	0
SSTS		TP	NR	NR	NR	NR	NR	0
ICIS		TP	NR	NR	NR	NR	NR	0
PADS		TP	NR	NR	NR	NR	NR	0
MLTS		TP	NR	NR	NR	NR	NR	0
RADINFO		TP	NR	NR	NR	NR	NR	0
FINDS		TP	NR	NR	NR	NR	NR	0
RAATS		TP	NR	NR	NR	NR	NR	0
UIC		TP	NR	NR	NR	NR	NR	0
DRYCLEANERS		0.250	0	0	NR	NR	NR	0
AIRS		TP	NR	NR	NR	NR	NR	0
INDIAN RESERV		1.000	0	0	0	0	NR	0
SCRD DRYCLEANERS		0.500	0	0	0	NR	NR	0
COAL ASH EPA		0.500	0	0	0	NR	NR	0
COAL ASH DOE		TP	NR	NR	NR	NR	NR	0
PCB TRANSFORMER		TP	NR	NR	NR	NR	NR	0

EDR PROPRIETARY RECORDS

EDR Proprietary Records

Manufactured Gas Plants		1.000	0	0	0	0	NR	0

NOTES:

TP = Target Property

NR = Not Requested at this Search Distance

Sites may be listed in more than one database

Map ID Direction Distance Elevation	Site	Database(s)	EDR ID Number EPA ID Number

MAP FINDINGS

1
WNW
< 1/8
0.062 mi.
330 ft.

MAUI COMMUNITY CORRECTIONAL CENTER
600 WAIALE DR
WAILUKU, HI 96793

UST **U003222248** **N/A**

Relative: **Higher**

Actual: **325 ft.**

UST:

Facility ID:	9-501801
Owner:	STATE PSD - MAUI COMMUNITY CORRECTIONAL CENTER
Owner Address:	600 WAIALE DRIVE
Owndet City,St,Zip:	Wailuku, 96793 96793
Tank ID:	R-1
Date Installed:	12/31/1959
Tank Status:	**Permanently Out of Use**
Date Closed:	10/20/1992
Tank Capacity:	550
Substance:	Gasoline

2
West
< 1/8
0.087 mi.
459 ft.

WAIKO BASEYARD LLC
255-B EAST WAIKO ROAD
WAILUKU, HI 96793

UST **U003222207** **N/A**

Relative: **Higher**

Actual: **337 ft.**

UST:

Facility ID:	9-500672
Owner:	WAIKI BASEYARD LLC
Owner Address:	255 -B EAST WAIKO ROAD
Owndet City,St,Zip:	Wailuku, 96793 96793
Tank ID:	r-1
Date Installed:	4/3/1985
Tank Status:	**Permanently out of Use**
Date Closed:	4/2/2007
Tank Capacity:	8000
Substance:	Diesel
Tank ID:	r-2
Date Installed:	4/3/1985
Tank Status:	**Permanently out of Use**
Date Closed:	4/2/2007
Tank Capacity:	8000
Substance:	Diesel

City	EDR ID	Site Name	Site Address	Zip	Database(s)
KAHULUI	S106820852	VECTOR CONTROL BRANCH, MAUI	54 HIGH ST, 641 MUA ST, KAHALE	96793	SHWS
KAHULUI	1006820577	HOBRON AVE AREA (KAHULUI)	HOBRON AVE	96732	FINDS, SHWS
KAHULUI	S106817098	FONG CONSTRUCTION	HUKILIKI ST	96732	SHWS
KAHULUI	1006818999	MCC-AUTOMOTIVE TECHNOLOGY BUILDING	310 E KAAHUMANU AVE	96732	FINDS, SHWS, SPILLS
KAHULUI	S104534290	MAUI PALMS HOTEL UST	150 KAAHUMANU AVE	96732	SHWS
KAHULUI	U001236769	DAVID PICO CESSPOOL DIGGING	OLD HALEAKALA HWY	96732	UST
KAHULUI	1006841969	DAVID PICO CESSPOOL DIGGING	OLD HALEAKALA HWY	96732	FINDS, LUST
KAHULUI	1006820345	A&B DUMP SITE	W PAPA AVE	96732	FINDS, SHWS
KAHULUI	S106819004	MAUI MEAT COMPANY FACILITY (FORMER	601 2ND ST	96732	SHWS, SPILLS
KAHULUI	1006819647	WAIKAPU DUMP-MAUI COUNTY DUMP	WAIKAPU RD	96732	FINDS, SHWS
KANUNAKAKAI	S108859913	KALAMAULA LANDFILL	HOAWA RD	96793	SHWS, ENG CONTROLS
KIHEI	1010316486	MONSANTO COMPANY	2111 PIILANI HWY	96753	RCRA-SQG
KIHEI	1008170106	MAUI ECONOMIC DEVELOPMENT BRD	1151 PUNCHBOWL ST, ROOM 431	96753	FINDS
KIHEI	U001236805	KIHEI WWTP	480 WELEKAHAO RD/PIILANI HWY	96753	LUST, UST
PAIA	S106819555	PAIA SUGAR MILL	BALDWIN AVE	96732	SHWS
WAIKAPU	U004120867	MARK MILL34	1487 / 1488 HONOAPIILANI HWY	96793	UST
WAIKAPU	S109096050	MARK MILL34	1487 / 1488 HONOAPIILANI HWY	96793	LUST
WAIKAPU	1008194955	VACANT LAND TMK NO (2) 3-8-7:101	KUIHELANI HWY NEAR WAIKO RD	96793	RCRA-NonGen
WAIKAPU	1010563215	FORMER MAUI SCRAP METAL LICENSE AR	WAIKO RD NEAR HCS FIELD 920	96793	RCRA-SQG
WAILUKU	1006842014	HAWAIIAN CEMENT - WAIKAPU QUARRY	HONOAPIILANI HWY	96793	FINDS, LUST
WAILUKU	1012144856	MAALAEA TRIANGLE DEVELOPMENT - IWS	MAALAEA HARBOR	96793	FINDS
WAILUKU	S108008644	Y HATA- MAUI	200 WAIEHU BEACH RD	96793	SHWS

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

To maintain currency of the following federal and state databases, EDR contacts the appropriate governmental agency on a monthly or quarterly basis, as required.

Number of Days to Update: Provides confirmation that EDR is reporting records that have been updated within 90 days from the date the government agency made the information available to the public.

STANDARD ENVIRONMENTAL RECORDS

Federal NPL site list

NPL: National Priority List

National Priorities List (Superfund). The NPL is a subset of CERCLIS and identifies over 1,200 sites for priority cleanup under the Superfund Program. NPL sites may encompass relatively large areas. As such, EDR provides polygon coverage for over 1,000 NPL site boundaries produced by EPA's Environmental Photographic Interpretation Center (EPIC) and regional EPA offices.

Date of Government Version: 07/02/2010
Date Data Arrived at EDR: 07/14/2010
Date Made Active in Reports: 10/04/2010
Number of Days to Update: 82

Source: EPA
Telephone: N/A
Last EDR Contact: 10/13/2010
Next Scheduled EDR Contact: 01/24/2011
Data Release Frequency: Quarterly

NPL Site Boundaries

Sources:

EPA's Environmental Photographic Interpretation Center (EPIC)
Telephone: 202-564-7333

EPA Region 1
Telephone 617-918-1143

EPA Region 3
Telephone 215-814-5418

EPA Region 4
Telephone 404-562-8033

EPA Region 5
Telephone 312-886-6686

EPA Region 10
Telephone 206-553-8665

EPA Region 6
Telephone: 214-655-6659

EPA Region 7
Telephone: 913-551-7247

EPA Region 8
Telephone: 303-312-6774

EPA Region 9
Telephone: 415-947-4246

Proposed NPL: Proposed National Priority List Sites

A site that has been proposed for listing on the National Priorities List through the issuance of a proposed rule in the Federal Register. EPA then accepts public comments on the site, responds to the comments, and places on the NPL those sites that continue to meet the requirements for listing.

Date of Government Version: 07/02/2010
Date Data Arrived at EDR: 07/14/2010
Date Made Active in Reports: 10/04/2010
Number of Days to Update: 82

Source: EPA
Telephone: N/A
Last EDR Contact: 10/13/2010
Next Scheduled EDR Contact: 01/24/2011
Data Release Frequency: Quarterly

NPL LIENS: Federal Superfund Liens

Federal Superfund Liens. Under the authority granted the USEPA by CERCLA of 1980, the USEPA has the authority to file liens against real property in order to recover remedial action expenditures or when the property owner received notification of potential liability. USEPA compiles a listing of filed notices of Superfund Liens.

Date of Government Version: 10/15/1991
Date Data Arrived at EDR: 02/02/1994
Date Made Active in Reports: 03/30/1994
Number of Days to Update: 56

Source: EPA
Telephone: 202-564-4267
Last EDR Contact: 11/22/2010
Next Scheduled EDR Contact: 02/28/2011
Data Release Frequency: No Update Planned

Federal Delisted NPL site list

DELISTED NPL: National Priority List Deletions

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) establishes the criteria that the EPA uses to delete sites from the NPL. In accordance with 40 CFR 300.425.(e), sites may be deleted from the NPL where no further response is appropriate.

Date of Government Version: 07/02/2010
Date Data Arrived at EDR: 07/14/2010
Date Made Active in Reports: 10/04/2010
Number of Days to Update: 82

Source: EPA
Telephone: N/A
Last EDR Contact: 10/13/2010
Next Scheduled EDR Contact: 01/24/2011
Data Release Frequency: Quarterly

Federal CERCLIS list

CERCLIS: Comprehensive Environmental Response, Compensation, and Liability Information System

CERCLIS contains data on potentially hazardous waste sites that have been reported to the USEPA by states, municipalities, private companies and private persons, pursuant to Section 103 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). CERCLIS contains sites which are either proposed to or on the National Priorities List (NPL) and sites which are in the screening and assessment phase for possible inclusion on the NPL.

Date of Government Version: 01/29/2010
Date Data Arrived at EDR: 02/09/2010
Date Made Active in Reports: 04/12/2010
Number of Days to Update: 62

Source: EPA
Telephone: 703-412-9810
Last EDR Contact: 10/01/2010
Next Scheduled EDR Contact: 01/10/2011
Data Release Frequency: Quarterly

FEDERAL FACILITY: Federal Facility Site Information listing

A listing of National Priority List (NPL) and Base Realignment and Closure (BRAC) sites found in the Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) Database where EPAa??s Federal Facilities Restoration and Reuse Office is involved in cleanup activities.

Date of Government Version: 06/23/2009
Date Data Arrived at EDR: 01/15/2010
Date Made Active in Reports: 02/10/2010
Number of Days to Update: 26

Source: Environmental Protection Agency
Telephone: 703-603-8704
Last EDR Contact: 10/13/2010
Next Scheduled EDR Contact: 01/24/2011
Data Release Frequency: Varies

Federal CERCLIS NFRAP site List

CERCLIS-NFRAP: CERCLIS No Further Remedial Action Planned

Archived sites are sites that have been removed and archived from the inventory of CERCLIS sites. Archived status indicates that, to the best of EPA's knowledge, assessment at a site has been completed and that EPA has determined no further steps will be taken to list this site on the National Priorities List (NPL), unless information indicates this decision was not appropriate or other considerations require a recommendation for listing at a later time. This decision does not necessarily mean that there is no hazard associated with a given site; it only means that, based upon available information, the location is not judged to be a potential NPL site.

Date of Government Version: 06/23/2009
Date Data Arrived at EDR: 09/02/2009
Date Made Active in Reports: 09/21/2009
Number of Days to Update: 19

Source: EPA
Telephone: 703-412-9810
Last EDR Contact: 10/01/2010
Next Scheduled EDR Contact: 12/13/2010
Data Release Frequency: Quarterly

Federal RCRA CORRACTS facilities list

CORRACTS: Corrective Action Report

CORRACTS identifies hazardous waste handlers with RCRA corrective action activity.

Date of Government Version: 05/25/2010
Date Data Arrived at EDR: 06/02/2010
Date Made Active in Reports: 10/04/2010
Number of Days to Update: 124

Source: EPA
Telephone: 800-424-9346
Last EDR Contact: 11/22/2010
Next Scheduled EDR Contact: 02/28/2011
Data Release Frequency: Quarterly

Federal RCRA non-CORRACTS TSD facilities list

RCRA-TSDF: RCRA - Treatment, Storage and Disposal

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Transporters are individuals or entities that move hazardous waste from the generator offsite to a facility that can recycle, treat, store, or dispose of the waste. TSDFs treat, store, or dispose of the waste.

Date of Government Version: 02/17/2010
Date Data Arrived at EDR: 02/19/2010
Date Made Active in Reports: 05/17/2010
Number of Days to Update: 87

Source: Environmental Protection Agency
Telephone: (415) 495-8895
Last EDR Contact: 10/07/2010
Next Scheduled EDR Contact: 01/17/2011
Data Release Frequency: Quarterly

Federal RCRA generators list

RCRA-LQG: RCRA - Large Quantity Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Large quantity generators (LQGs) generate over 1,000 kilograms (kg) of hazardous waste, or over 1 kg of acutely hazardous waste per month.

Date of Government Version: 02/17/2010
Date Data Arrived at EDR: 02/19/2010
Date Made Active in Reports: 05/17/2010
Number of Days to Update: 87

Source: Environmental Protection Agency
Telephone: (415) 495-8895
Last EDR Contact: 10/07/2010
Next Scheduled EDR Contact: 01/17/2011
Data Release Frequency: Quarterly

RCRA-SQG: RCRA - Small Quantity Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Small quantity generators (SQGs) generate between 100 kg and 1,000 kg of hazardous waste per month.

Date of Government Version: 02/17/2010
Date Data Arrived at EDR: 02/19/2010
Date Made Active in Reports: 05/17/2010
Number of Days to Update: 87

Source: Environmental Protection Agency
Telephone: (415) 495-8895
Last EDR Contact: 10/07/2010
Next Scheduled EDR Contact: 01/17/2011
Data Release Frequency: Quarterly

RCRA-CESQG: RCRA - Conditionally Exempt Small Quantity Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Conditionally exempt small quantity generators (CESQGs) generate less than 100 kg of hazardous waste, or less than 1 kg of acutely hazardous waste per month.

Date of Government Version: 02/17/2010
Date Data Arrived at EDR: 02/19/2010
Date Made Active in Reports: 05/17/2010
Number of Days to Update: 87

Source: Environmental Protection Agency
Telephone: (415) 495-8895
Last EDR Contact: 10/07/2010
Next Scheduled EDR Contact: 01/17/2011
Data Release Frequency: Varies

Federal institutional controls / engineering controls registries

US ENG CONTROLS: Engineering Controls Sites List

A listing of sites with engineering controls in place. Engineering controls include various forms of caps, building foundations, liners, and treatment methods to create pathway elimination for regulated substances to enter environmental media or effect human health.

Date of Government Version: 12/20/2009
Date Data Arrived at EDR: 01/20/2010
Date Made Active in Reports: 04/12/2010
Number of Days to Update: 82

Source: Environmental Protection Agency
Telephone: 703-603-0695
Last EDR Contact: 09/13/2010
Next Scheduled EDR Contact: 12/27/2010
Data Release Frequency: Varies

US INST CONTROL: Sites with Institutional Controls

A listing of sites with institutional controls in place. Institutional controls include administrative measures, such as groundwater use restrictions, construction restrictions, property use restrictions, and post remediation care requirements intended to prevent exposure to contaminants remaining on site. Deed restrictions are generally required as part of the institutional controls.

Date of Government Version: 12/20/2009
Date Data Arrived at EDR: 01/20/2010
Date Made Active in Reports: 04/12/2010
Number of Days to Update: 82

Source: Environmental Protection Agency
Telephone: 703-603-0695
Last EDR Contact: 09/13/2010
Next Scheduled EDR Contact: 12/27/2010
Data Release Frequency: Varies

Federal ERNS list

ERNS: Emergency Response Notification System

Emergency Response Notification System. ERNS records and stores information on reported releases of oil and hazardous substances.

Date of Government Version: 07/09/2010
Date Data Arrived at EDR: 07/09/2010
Date Made Active in Reports: 08/17/2010
Number of Days to Update: 39

Source: National Response Center, United States Coast Guard
Telephone: 202-267-2180
Last EDR Contact: 10/06/2010
Next Scheduled EDR Contact: 01/17/2011
Data Release Frequency: Annually

State- and tribal - equivalent CERCLIS

SHWS: Sites List

Facilities, sites or areas in which the Office of Hazard Evaluation and Emergency Response has an interest, has investigated or may investigate under HRS 128D (includes CERCLIS sites).

Date of Government Version: 12/01/2009
Date Data Arrived at EDR: 12/07/2009
Date Made Active in Reports: 01/08/2010
Number of Days to Update: 32

Source: Department of Health
Telephone: 808-586-4249
Last EDR Contact: 09/10/2010
Next Scheduled EDR Contact: 12/13/2010
Data Release Frequency: Semi-Annually

State and tribal landfill and/or solid waste disposal site lists

SWF/LF: Permitted Landfills in the State of Hawaii

Solid Waste Facilities/Landfill Sites. SWF/LF type records typically contain an inventory of solid waste disposal facilities or landfills in a particular state. Depending on the state, these may be active or inactive facilities or open dumps that failed to meet RCRA Subtitle D Section 4004 criteria for solid waste landfills or disposal sites.

Date of Government Version: 04/01/2010
Date Data Arrived at EDR: 04/08/2010
Date Made Active in Reports: 05/19/2010
Number of Days to Update: 41

Source: Department of Health
Telephone: 808-586-4245
Last EDR Contact: 10/05/2010
Next Scheduled EDR Contact: 01/17/2011
Data Release Frequency: Varies

State and tribal leaking storage tank lists

LUST: Leaking Underground Storage Tank Database

Leaking Underground Storage Tank Incident Reports. LUST records contain an inventory of reported leaking underground storage tank incidents. Not all states maintain these records, and the information stored varies by state.

Date of Government Version: 09/20/2010
Date Data Arrived at EDR: 09/20/2010
Date Made Active in Reports: 10/22/2010
Number of Days to Update: 32

Source: Department of Health
Telephone: 808-586-4228
Last EDR Contact: 09/20/2010
Next Scheduled EDR Contact: 12/20/2010
Data Release Frequency: Semi-Annually

INDIAN LUST R6: Leaking Underground Storage Tanks on Indian Land

LUSTs on Indian land in New Mexico and Oklahoma.

Date of Government Version: 08/05/2010
Date Data Arrived at EDR: 08/06/2010
Date Made Active in Reports: 10/04/2010
Number of Days to Update: 59

Source: EPA Region 6
Telephone: 214-665-6597
Last EDR Contact: 11/01/2010
Next Scheduled EDR Contact: 02/14/2011
Data Release Frequency: Varies

INDIAN LUST R9: Leaking Underground Storage Tanks on Indian Land

LUSTs on Indian land in Arizona, California, New Mexico and Nevada

Date of Government Version: 08/30/2010
Date Data Arrived at EDR: 08/30/2010
Date Made Active in Reports: 10/04/2010
Number of Days to Update: 35

Source: Environmental Protection Agency
Telephone: 415-972-3372
Last EDR Contact: 11/01/2010
Next Scheduled EDR Contact: 02/14/2011
Data Release Frequency: Quarterly

INDIAN LUST R8: Leaking Underground Storage Tanks on Indian Land

LUSTs on Indian land in Colorado, Montana, North Dakota, South Dakota, Utah and Wyoming.

Date of Government Version: 05/24/2010
Date Data Arrived at EDR: 05/27/2010
Date Made Active in Reports: 08/09/2010
Number of Days to Update: 74

Source: EPA Region 8
Telephone: 303-312-6271
Last EDR Contact: 11/01/2010
Next Scheduled EDR Contact: 02/14/2011
Data Release Frequency: Quarterly

INDIAN LUST R7: Leaking Underground Storage Tanks on Indian Land

LUSTs on Indian land in Iowa, Kansas, and Nebraska

Date of Government Version: 11/04/2009
Date Data Arrived at EDR: 05/04/2010
Date Made Active in Reports: 07/07/2010
Number of Days to Update: 64

Source: EPA Region 7
Telephone: 913-551-7003
Last EDR Contact: 11/09/2010
Next Scheduled EDR Contact: 02/14/2011
Data Release Frequency: Varies

INDIAN LUST R4: Leaking Underground Storage Tanks on Indian Land

LUSTs on Indian land in Florida, Mississippi and North Carolina.

Date of Government Version: 08/27/2010
Date Data Arrived at EDR: 08/30/2010
Date Made Active in Reports: 10/04/2010
Number of Days to Update: 35

Source: EPA Region 4
Telephone: 404-562-8677
Last EDR Contact: 11/01/2010
Next Scheduled EDR Contact: 02/14/2011
Data Release Frequency: Semi-Annually

INDIAN LUST R1: Leaking Underground Storage Tanks on Indian Land

A listing of leaking underground storage tank locations on Indian Land.

Date of Government Version: 02/19/2009
Date Data Arrived at EDR: 02/19/2009
Date Made Active in Reports: 03/16/2009
Number of Days to Update: 25

Source: EPA Region 1
Telephone: 617-918-1313
Last EDR Contact: 11/02/2010
Next Scheduled EDR Contact: 02/14/2011
Data Release Frequency: Varies

INDIAN LUST R10: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in Alaska, Idaho, Oregon and Washington.

Date of Government Version: 08/05/2010
Date Data Arrived at EDR: 08/06/2010
Date Made Active in Reports: 10/04/2010
Number of Days to Update: 59

Source: EPA Region 10
Telephone: 206-553-2857
Last EDR Contact: 11/01/2010
Next Scheduled EDR Contact: 02/14/2011
Data Release Frequency: Quarterly

State and tribal registered storage tank lists

UST: Underground Storage Tank Database
Registered Underground Storage Tanks. UST's are regulated under Subtitle I of the Resource Conservation and Recovery Act (RCRA) and must be registered with the state department responsible for administering the UST program. Available information varies by state program.

Date of Government Version: 09/20/2010
Date Data Arrived at EDR: 09/20/2010
Date Made Active in Reports: 10/07/2010
Number of Days to Update: 17

Source: Department of Health
Telephone: 808-586-4228
Last EDR Contact: 09/20/2010
Next Scheduled EDR Contact: 12/20/2010
Data Release Frequency: Semi-Annually

INDIAN UST R9: Underground Storage Tanks on Indian Land
The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 9 (Arizona, California, Hawaii, Nevada, the Pacific Islands, and Tribal Nations).

Date of Government Version: 08/30/2010
Date Data Arrived at EDR: 08/30/2010
Date Made Active in Reports: 10/04/2010
Number of Days to Update: 35

Source: EPA Region 9
Telephone: 415-972-3368
Last EDR Contact: 11/01/2010
Next Scheduled EDR Contact: 02/14/2011
Data Release Frequency: Quarterly

INDIAN UST R8: Underground Storage Tanks on Indian Land
The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 8 (Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming and 27 Tribal Nations).

Date of Government Version: 05/24/2010
Date Data Arrived at EDR: 05/27/2010
Date Made Active in Reports: 08/09/2010
Number of Days to Update: 74

Source: EPA Region 8
Telephone: 303-312-6137
Last EDR Contact: 11/01/2010
Next Scheduled EDR Contact: 02/14/2011
Data Release Frequency: Quarterly

INDIAN UST R1: Underground Storage Tanks on Indian Land
The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 1 (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont and ten Tribal Nations).

Date of Government Version: 02/19/2009
Date Data Arrived at EDR: 02/19/2009
Date Made Active in Reports: 03/16/2009
Number of Days to Update: 25

Source: EPA, Region 1
Telephone: 617-918-1313
Last EDR Contact: 11/02/2010
Next Scheduled EDR Contact: 02/14/2011
Data Release Frequency: Varies

INDIAN UST R7: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 7 (Iowa, Kansas, Missouri, Nebraska, and 9 Tribal Nations).

Date of Government Version: 04/01/2008
Date Data Arrived at EDR: 12/30/2008
Date Made Active in Reports: 03/16/2009
Number of Days to Update: 76

Source: EPA Region 7
Telephone: 913-551-7003
Last EDR Contact: 11/09/2010
Next Scheduled EDR Contact: 02/14/2011
Data Release Frequency: Varies

INDIAN UST R6: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 6 (Louisiana, Arkansas, Oklahoma, New Mexico, Texas and 65 Tribes).

Date of Government Version: 08/03/2010
Date Data Arrived at EDR: 08/04/2010
Date Made Active in Reports: 10/04/2010
Number of Days to Update: 61

Source: EPA Region 6
Telephone: 214-665-7591
Last EDR Contact: 11/01/2010
Next Scheduled EDR Contact: 02/14/2011
Data Release Frequency: Semi-Annually

INDIAN UST R5: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 5 (Michigan, Minnesota and Wisconsin and Tribal Nations).

Date of Government Version: 02/11/2010
Date Data Arrived at EDR: 02/11/2010
Date Made Active in Reports: 04/12/2010
Number of Days to Update: 60

Source: EPA Region 5
Telephone: 312-886-6136
Last EDR Contact: 11/01/2010
Next Scheduled EDR Contact: 02/14/2011
Data Release Frequency: Varies

INDIAN UST R10: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 10 (Alaska, Idaho, Oregon, Washington, and Tribal Nations).

Date of Government Version: 08/05/2010
Date Data Arrived at EDR: 08/06/2010
Date Made Active in Reports: 10/04/2010
Number of Days to Update: 59

Source: EPA Region 10
Telephone: 206-553-2857
Last EDR Contact: 11/01/2010
Next Scheduled EDR Contact: 02/14/2011
Data Release Frequency: Quarterly

INDIAN UST R4: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 4 (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee and Tribal Nations)

Date of Government Version: 08/27/2010
Date Data Arrived at EDR: 08/30/2010
Date Made Active in Reports: 10/04/2010
Number of Days to Update: 35

Source: EPA Region 4
Telephone: 404-562-9424
Last EDR Contact: 11/01/2010
Next Scheduled EDR Contact: 02/14/2011
Data Release Frequency: Semi-Annually

FEMA UST: Underground Storage Tank Listing

A listing of all FEMA owned underground storage tanks.

Date of Government Version: 01/01/2010
Date Data Arrived at EDR: 02/16/2010
Date Made Active in Reports: 04/12/2010
Number of Days to Update: 55

Source: FEMA
Telephone: 202-646-5797
Last EDR Contact: 10/29/2010
Next Scheduled EDR Contact: 01/31/2011
Data Release Frequency: Varies

State and tribal institutional control / engineering control registries

ENG CONTROLS: Engineering Control Sites
A listing of sites with engineering controls in place.

Date of Government Version: 12/01/2009
Date Data Arrived at EDR: 12/07/2009
Date Made Active in Reports: 01/08/2010
Number of Days to Update: 32

Source: Department of Health
Telephone: 404-586-4249
Last EDR Contact: 09/10/2010
Next Scheduled EDR Contact: 12/13/2010
Data Release Frequency: Varies

INST CONTROL: Sites with Institutional Controls
Voluntary Remediation Program and Brownfields sites with institutional controls in place.

Date of Government Version: 12/01/2009
Date Data Arrived at EDR: 12/07/2009
Date Made Active in Reports: 01/08/2010
Number of Days to Update: 32

Source: Department of Health
Telephone: 808-586-4249
Last EDR Contact: 09/10/2010
Next Scheduled EDR Contact: 12/13/2010
Data Release Frequency: Varies

State and tribal voluntary cleanup sites

INDIAN VCP R1: Voluntary Cleanup Priority Listing
A listing of voluntary cleanup priority sites located on Indian Land located in Region 1.

Date of Government Version: 04/02/2008
Date Data Arrived at EDR: 04/22/2008
Date Made Active in Reports: 05/19/2008
Number of Days to Update: 27

Source: EPA, Region 1
Telephone: 617-918-1102
Last EDR Contact: 10/04/2010
Next Scheduled EDR Contact: 01/17/2011
Data Release Frequency: Varies

VCP: Voluntary Response Program Sites
Sites participating in the Voluntary Response Program. The purpose of the VRP is to streamline the cleanup process in a way that will encourage prospective developers, lenders, and purchasers to voluntarily cleanup properties.

Date of Government Version: 12/01/2009
Date Data Arrived at EDR: 12/07/2009
Date Made Active in Reports: 01/08/2010
Number of Days to Update: 32

Source: Department of Health
Telephone: 808-586-4249
Last EDR Contact: 09/10/2010
Next Scheduled EDR Contact: 12/13/2010
Data Release Frequency: Varies

INDIAN VCP R7: Voluntary Cleanup Priority Lisitng
A listing of voluntary cleanup priority sites located on Indian Land located in Region 7.

Date of Government Version: 03/20/2008
Date Data Arrived at EDR: 04/22/2008
Date Made Active in Reports: 05/19/2008
Number of Days to Update: 27

Source: EPA, Region 7
Telephone: 913-551-7365
Last EDR Contact: 04/20/2009
Next Scheduled EDR Contact: 07/20/2009
Data Release Frequency: Varies

State and tribal Brownfields sites

BROWNFIELDS: Brownfields Sites
With certain legal exclusions and additions, the term ‘brownfield site’ means real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant.

Date of Government Version: 12/01/2009
Date Data Arrived at EDR: 12/07/2009
Date Made Active in Reports: 01/08/2010
Number of Days to Update: 32

Source: Department of Health
Telephone: 808-586-4249
Last EDR Contact: 09/10/2010
Next Scheduled EDR Contact: 12/13/2010
Data Release Frequency: Varies

ADDITIONAL ENVIRONMENTAL RECORDS

Local Brownfield lists

US BROWNFIELDS: A Listing of Brownfields Sites

Included in the listing are brownfields properties addresses by Cooperative Agreement Recipients and brownfields properties addressed by Targeted Brownfields Assessments. Targeted Brownfields Assessments-EPA's Targeted Brownfields Assessments (TBA) program is designed to help states, tribes, and municipalities--especially those without EPA Brownfields Assessment Demonstration Pilots--minimize the uncertainties of contamination often associated with brownfields. Under the TBA program, EPA provides funding and/or technical assistance for environmental assessments at brownfields sites throughout the country. Targeted Brownfields Assessments supplement and work with other efforts under EPA's Brownfields Initiative to promote cleanup and redevelopment of brownfields. Cooperative Agreement Recipients-States, political subdivisions, territories, and Indian tribes become Brownfields Cleanup Revolving Loan Fund (BCRLF) cooperative agreement recipients when they enter into BCRLF cooperative agreements with the U.S. EPA. EPA selects BCRLF cooperative agreement recipients based on a proposal and application process. BCRLF cooperative agreement recipients must use EPA funds provided through BCRLF cooperative agreement for specified brownfields-related cleanup activities.

Date of Government Version: 06/24/2010
Date Data Arrived at EDR: 06/25/2010
Date Made Active in Reports: 08/17/2010
Number of Days to Update: 53

Source: Environmental Protection Agency
Telephone: 202-566-2777
Last EDR Contact: 09/29/2010
Next Scheduled EDR Contact: 01/10/2011
Data Release Frequency: Semi-Annually

Local Lists of Landfill / Solid Waste Disposal Sites

ODI: Open Dump Inventory

An open dump is defined as a disposal facility that does not comply with one or more of the Part 257 or Part 258 Subtitle D Criteria.

Date of Government Version: 06/30/1985
Date Data Arrived at EDR: 08/09/2004
Date Made Active in Reports: 09/17/2004
Number of Days to Update: 39

Source: Environmental Protection Agency
Telephone: 800-424-9346
Last EDR Contact: 06/09/2004
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

DEBRIS REGION 9: Torres Martinez Reservation Illegal Dump Site Locations

A listing of illegal dump sites location on the Torres Martinez Indian Reservation located in eastern Riverside County and northern Imperial County, California.

Date of Government Version: 01/12/2009
Date Data Arrived at EDR: 05/07/2009
Date Made Active in Reports: 09/21/2009
Number of Days to Update: 137

Source: EPA, Region 9
Telephone: 415-947-4219
Last EDR Contact: 11/09/2010
Next Scheduled EDR Contact: 01/10/2011
Data Release Frequency: Varies

INDIAN ODI: Report on the Status of Open Dumps on Indian Lands

Location of open dumps on Indian land.

Date of Government Version: 12/31/1998
Date Data Arrived at EDR: 12/03/2007
Date Made Active in Reports: 01/24/2008
Number of Days to Update: 52

Source: Environmental Protection Agency
Telephone: 703-308-8245
Last EDR Contact: 11/09/2010
Next Scheduled EDR Contact: 02/21/2011
Data Release Frequency: Varies

Local Lists of Hazardous waste / Contaminated Sites

US CDL: Clandestine Drug Labs

A listing of clandestine drug lab locations. The U.S. Department of Justice ("the Department") provides this web site as a public service. It contains addresses of some locations where law enforcement agencies reported they found chemicals or other items that indicated the presence of either clandestine drug laboratories or dumpsites. In most cases, the source of the entries is not the Department, and the Department has not verified the entry and does not guarantee its accuracy. Members of the public must verify the accuracy of all entries by, for example, contacting local law enforcement and local health departments.

Date of Government Version: 05/07/2010
Date Data Arrived at EDR: 06/18/2010
Date Made Active in Reports: 08/17/2010
Number of Days to Update: 60

Source: Drug Enforcement Administration
Telephone: 202-307-1000
Last EDR Contact: 10/29/2010
Next Scheduled EDR Contact: 12/20/2010
Data Release Frequency: Quarterly

CDL: Clandestine Drug Lab Listing
A listing of clandestine drug lab site locations.

Date of Government Version: 08/04/2010
Date Data Arrived at EDR: 09/10/2010
Date Made Active in Reports: 10/22/2010
Number of Days to Update: 42

Source: Department of Health
Telephone: 808-586-4249
Last EDR Contact: 09/07/2010
Next Scheduled EDR Contact: 12/20/2010
Data Release Frequency: Varies

US HIST CDL: National Clandestine Laboratory Register
A listing of clandestine drug lab locations. The U.S. Department of Justice ("the Department") provides this web site as a public service. It contains addresses of some locations where law enforcement agencies reported they found chemicals or other items that indicated the presence of either clandestine drug laboratories or dumpsites. In most cases, the source of the entries is not the Department, and the Department has not verified the entry and does not guarantee its accuracy. Members of the public must verify the accuracy of all entries by, for example, contacting local law enforcement and local health departments.

Date of Government Version: 09/01/2007
Date Data Arrived at EDR: 11/19/2008
Date Made Active in Reports: 03/30/2009
Number of Days to Update: 131

Source: Drug Enforcement Administration
Telephone: 202-307-1000
Last EDR Contact: 03/23/2009
Next Scheduled EDR Contact: 06/22/2009
Data Release Frequency: No Update Planned

Local Land Records

LIENS 2: CERCLA Lien Information
A Federal CERCLA ('Superfund') lien can exist by operation of law at any site or property at which EPA has spent Superfund monies. These monies are spent to investigate and address releases and threatened releases of contamination. CERCLIS provides information as to the identity of these sites and properties.

Date of Government Version: 05/06/2010
Date Data Arrived at EDR: 05/11/2010
Date Made Active in Reports: 08/09/2010
Number of Days to Update: 90

Source: Environmental Protection Agency
Telephone: 202-564-6023
Last EDR Contact: 11/01/2010
Next Scheduled EDR Contact: 02/14/2011
Data Release Frequency: Varies

LUCIS: Land Use Control Information System
LUCIS contains records of land use control information pertaining to the former Navy Base Realignment and Closure properties.

Date of Government Version: 12/09/2005
Date Data Arrived at EDR: 12/11/2006
Date Made Active in Reports: 01/11/2007
Number of Days to Update: 31

Source: Department of the Navy
Telephone: 843-820-7326
Last EDR Contact: 11/22/2010
Next Scheduled EDR Contact: 03/07/2011
Data Release Frequency: Varies

Records of Emergency Release Reports

HMIRS: Hazardous Materials Information Reporting System
Hazardous Materials Incident Report System. HMIRS contains hazardous material spill incidents reported to DOT.

Date of Government Version: 04/06/2010
Date Data Arrived at EDR: 04/07/2010
Date Made Active in Reports: 05/27/2010
Number of Days to Update: 50

Source: U.S. Department of Transportation
Telephone: 202-366-4555
Last EDR Contact: 10/07/2010
Next Scheduled EDR Contact: 01/17/2011
Data Release Frequency: Annually

SPILLS: Release Notifications

Releases of hazardous substances to the environment reported to the Office of Hazard Evaluation and Emergency Response since 1988.

Date of Government Version: 03/10/2010
Date Data Arrived at EDR: 03/16/2010
Date Made Active in Reports: 04/13/2010
Number of Days to Update: 28

Source: Department of Health
Telephone: 808-586-4249
Last EDR Contact: 09/10/2010
Next Scheduled EDR Contact: 12/13/2010
Data Release Frequency: Varies

Other Ascertainable Records

RCRA-NonGen: RCRA - Non Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Non-Generators do not presently generate hazardous waste.

Date of Government Version: 02/17/2010
Date Data Arrived at EDR: 02/19/2010
Date Made Active in Reports: 05/17/2010
Number of Days to Update: 87

Source: Environmental Protection Agency
Telephone: (415) 495-8895
Last EDR Contact: 10/07/2010
Next Scheduled EDR Contact: 01/17/2011
Data Release Frequency: Varies

DOT OPS: Incident and Accident Data

Department of Transporation, Office of Pipeline Safety Incident and Accident data.

Date of Government Version: 01/12/2010
Date Data Arrived at EDR: 02/09/2010
Date Made Active in Reports: 04/12/2010
Number of Days to Update: 62

Source: Department of Transporation, Office of Pipeline Safety
Telephone: 202-366-4595
Last EDR Contact: 11/09/2010
Next Scheduled EDR Contact: 02/21/2011
Data Release Frequency: Varies

DOD: Department of Defense Sites

This data set consists of federally owned or administered lands, administered by the Department of Defense, that have any area equal to or greater than 640 acres of the United States, Puerto Rico, and the U.S. Virgin Islands.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 11/10/2006
Date Made Active in Reports: 01/11/2007
Number of Days to Update: 62

Source: USGS
Telephone: 703-692-8801
Last EDR Contact: 10/28/2010
Next Scheduled EDR Contact: 01/31/2011
Data Release Frequency: Semi-Annually

FUDS: Formerly Used Defense Sites

The listing includes locations of Formerly Used Defense Sites properties where the US Army Corps of Engineers is actively working or will take necessary cleanup actions.

Date of Government Version: 12/31/2008
Date Data Arrived at EDR: 09/30/2009
Date Made Active in Reports: 12/01/2009
Number of Days to Update: 62

Source: U.S. Army Corps of Engineers
Telephone: 202-528-4285
Last EDR Contact: 09/14/2010
Next Scheduled EDR Contact: 12/27/2010
Data Release Frequency: Varies

CONSENT: Superfund (CERCLA) Consent Decrees

Major legal settlements that establish responsibility and standards for cleanup at NPL (Superfund) sites. Released periodically by United States District Courts after settlement by parties to litigation matters.

Date of Government Version: 04/11/2010
Date Data Arrived at EDR: 04/19/2010
Date Made Active in Reports: 05/17/2010
Number of Days to Update: 28

Source: Department of Justice, Consent Decree Library
Telephone: Varies
Last EDR Contact: 10/04/2010
Next Scheduled EDR Contact: 01/17/2011
Data Release Frequency: Varies

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

ROD: Records Of Decision

Record of Decision. ROD documents mandate a permanent remedy at an NPL (Superfund) site containing technical and health information to aid in the cleanup.

Date of Government Version: 06/01/2010
Date Data Arrived at EDR: 06/16/2010
Date Made Active in Reports: 08/17/2010
Number of Days to Update: 62

Source: EPA
Telephone: 703-416-0223
Last EDR Contact: 09/15/2010
Next Scheduled EDR Contact: 12/27/2010
Data Release Frequency: Annually

UMTRA: Uranium Mill Tailings Sites

Uranium ore was mined by private companies for federal government use in national defense programs. When the mills shut down, large piles of the sand-like material (mill tailings) remain after uranium has been extracted from the ore. Levels of human exposure to radioactive materials from the piles are low; however, in some cases tailings were used as construction materials before the potential health hazards of the tailings were recognized.

Date of Government Version: 12/14/2009
Date Data Arrived at EDR: 09/29/2010
Date Made Active in Reports: 10/04/2010
Number of Days to Update: 5

Source: Department of Energy
Telephone: 505-845-0011
Last EDR Contact: 09/01/2010
Next Scheduled EDR Contact: 12/13/2010
Data Release Frequency: Varies

MINES: Mines Master Index File

Contains all mine identification numbers issued for mines active or opened since 1971. The data also includes violation information.

Date of Government Version: 05/07/2010
Date Data Arrived at EDR: 06/09/2010
Date Made Active in Reports: 08/30/2010
Number of Days to Update: 82

Source: Department of Labor, Mine Safety and Health Administration
Telephone: 303-231-5959
Last EDR Contact: 09/09/2010
Next Scheduled EDR Contact: 12/20/2010
Data Release Frequency: Semi-Annually

TRIS: Toxic Chemical Release Inventory System

Toxic Release Inventory System. TRIS identifies facilities which release toxic chemicals to the air, water and land in reportable quantities under SARA Title III Section 313.

Date of Government Version: 12/31/2008
Date Data Arrived at EDR: 01/13/2010
Date Made Active in Reports: 02/18/2010
Number of Days to Update: 36

Source: EPA
Telephone: 202-566-0250
Last EDR Contact: 09/01/2010
Next Scheduled EDR Contact: 12/13/2010
Data Release Frequency: Annually

TSCA: Toxic Substances Control Act

Toxic Substances Control Act. TSCA identifies manufacturers and importers of chemical substances included on the TSCA Chemical Substance Inventory list. It includes data on the production volume of these substances by plant site.

Date of Government Version: 12/31/2002
Date Data Arrived at EDR: 04/14/2006
Date Made Active in Reports: 05/30/2006
Number of Days to Update: 46

Source: EPA
Telephone: 202-260-5521
Last EDR Contact: 10/01/2010
Next Scheduled EDR Contact: 01/10/2011
Data Release Frequency: Every 4 Years

FTTS: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)

FTTS tracks administrative cases and pesticide enforcement actions and compliance activities related to FIFRA, TSCA and EPCRA (Emergency Planning and Community Right-to-Know Act). To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 04/09/2009
Date Data Arrived at EDR: 04/16/2009
Date Made Active in Reports: 05/11/2009
Number of Days to Update: 25

Source: EPA/Office of Prevention, Pesticides and Toxic Substances
Telephone: 202-566-1667
Last EDR Contact: 08/30/2010
Next Scheduled EDR Contact: 12/13/2010
Data Release Frequency: Quarterly

FTTS INSP: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
A listing of FIFRA/TSCA Tracking System (FTTS) inspections and enforcements.

Date of Government Version: 04/09/2009
Date Data Arrived at EDR: 04/16/2009
Date Made Active in Reports: 05/11/2009
Number of Days to Update: 25

Source: EPA
Telephone: 202-566-1667
Last EDR Contact: 08/30/2010
Next Scheduled EDR Contact: 12/13/2010
Data Release Frequency: Quarterly

HIST FTTS: FIFRA/TSCA Tracking System Administrative Case Listing
A complete administrative case listing from the FIFRA/TSCA Tracking System (FTTS) for all ten EPA regions. The information was obtained from the National Compliance Database (NCDB). NCDB supports the implementation of FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act) and TSCA (Toxic Substances Control Act). Some EPA regions are now closing out records. Because of that, and the fact that some EPA regions are not providing EPA Headquarters with updated records, it was decided to create a HIST FTTS database. It included records that may not be included in the newer FTTS database updates. This database is no longer updated.

Date of Government Version: 10/19/2006
Date Data Arrived at EDR: 03/01/2007
Date Made Active in Reports: 04/10/2007
Number of Days to Update: 40

Source: Environmental Protection Agency
Telephone: 202-564-2501
Last EDR Contact: 12/17/2007
Next Scheduled EDR Contact: 03/17/2008
Data Release Frequency: No Update Planned

HIST FTTS INSP: FIFRA/TSCA Tracking System Inspection & Enforcement Case Listing
A complete inspection and enforcement case listing from the FIFRA/TSCA Tracking System (FTTS) for all ten EPA regions. The information was obtained from the National Compliance Database (NCDB). NCDB supports the implementation of FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act) and TSCA (Toxic Substances Control Act). Some EPA regions are now closing out records. Because of that, and the fact that some EPA regions are not providing EPA Headquarters with updated records, it was decided to create a HIST FTTS database. It included records that may not be included in the newer FTTS database updates. This database is no longer updated.

Date of Government Version: 10/19/2006
Date Data Arrived at EDR: 03/01/2007
Date Made Active in Reports: 04/10/2007
Number of Days to Update: 40

Source: Environmental Protection Agency
Telephone: 202-564-2501
Last EDR Contact: 12/17/2008
Next Scheduled EDR Contact: 03/17/2008
Data Release Frequency: No Update Planned

SSTS: Section 7 Tracking Systems
Section 7 of the Federal Insecticide, Fungicide and Rodenticide Act, as amended (92 Stat. 829) requires all registered pesticide-producing establishments to submit a report to the Environmental Protection Agency by March 1st each year. Each establishment must report the types and amounts of pesticides, active ingredients and devices being produced, and those having been produced and sold or distributed in the past year.

Date of Government Version: 12/31/2008
Date Data Arrived at EDR: 01/06/2010
Date Made Active in Reports: 02/10/2010
Number of Days to Update: 35

Source: EPA
Telephone: 202-564-4203
Last EDR Contact: 11/01/2010
Next Scheduled EDR Contact: 02/14/2011
Data Release Frequency: Annually

ICIS: Integrated Compliance Information System
The Integrated Compliance Information System (ICIS) supports the information needs of the national enforcement and compliance program as well as the unique needs of the National Pollutant Discharge Elimination System (NPDES) program.

Date of Government Version: 04/24/2010
Date Data Arrived at EDR: 04/29/2010
Date Made Active in Reports: 05/17/2010
Number of Days to Update: 18

Source: Environmental Protection Agency
Telephone: 202-564-5088
Last EDR Contact: 09/27/2010
Next Scheduled EDR Contact: 01/10/2011
Data Release Frequency: Quarterly

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

PADS: PCB Activity Database System

PCB Activity Database. PADS Identifies generators, transporters, commercial storers and/or brokers and disposers of PCB's who are required to notify the EPA of such activities.

Date of Government Version: 02/01/2010
Date Data Arrived at EDR: 04/22/2010
Date Made Active in Reports: 08/09/2010
Number of Days to Update: 109

Source: EPA
Telephone: 202-566-0500
Last EDR Contact: 11/10/2010
Next Scheduled EDR Contact: 01/31/2011
Data Release Frequency: Annually

MLTS: Material Licensing Tracking System

MLTS is maintained by the Nuclear Regulatory Commission and contains a list of approximately 8,100 sites which possess or use radioactive materials and which are subject to NRC licensing requirements. To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 03/18/2010
Date Data Arrived at EDR: 04/06/2010
Date Made Active in Reports: 05/27/2010
Number of Days to Update: 51

Source: Nuclear Regulatory Commission
Telephone: 301-415-7169
Last EDR Contact: 09/13/2010
Next Scheduled EDR Contact: 12/27/2010
Data Release Frequency: Quarterly

RADINFO: Radiation Information Database

The Radiation Information Database (RADINFO) contains information about facilities that are regulated by U.S. Environmental Protection Agency (EPA) regulations for radiation and radioactivity.

Date of Government Version: 07/13/2010
Date Data Arrived at EDR: 07/14/2010
Date Made Active in Reports: 08/09/2010
Number of Days to Update: 26

Source: Environmental Protection Agency
Telephone: 202-343-9775
Last EDR Contact: 10/14/2010
Next Scheduled EDR Contact: 01/24/2011
Data Release Frequency: Quarterly

FINDS: Facility Index System/Facility Registry System

Facility Index System. FINDS contains both facility information and 'pointers' to other sources that contain more detail. EDR includes the following FINDS databases in this report: PCS (Permit Compliance System), AIRS (Aerometric Information Retrieval System), DOCKET (Enforcement Docket used to manage and track information on civil judicial enforcement cases for all environmental statutes), FURS (Federal Underground Injection Control), C-DOCKET (Criminal Docket System used to track criminal enforcement actions for all environmental statutes), FFIS (Federal Facilities Information System), STATE (State Environmental Laws and Statutes), and PADS (PCB Activity Data System).

Date of Government Version: 04/14/2010
Date Data Arrived at EDR: 04/16/2010
Date Made Active in Reports: 05/27/2010
Number of Days to Update: 41

Source: EPA
Telephone: (415) 947-8000
Last EDR Contact: 09/15/2010
Next Scheduled EDR Contact: 12/27/2010
Data Release Frequency: Quarterly

RAATS: RCRA Administrative Action Tracking System

RCRA Administration Action Tracking System. RAATS contains records based on enforcement actions issued under RCRA pertaining to major violators and includes administrative and civil actions brought by the EPA. For administration actions after September 30, 1995, data entry in the RAATS database was discontinued. EPA will retain a copy of the database for historical records. It was necessary to terminate RAATS because a decrease in agency resources made it impossible to continue to update the information contained in the database.

Date of Government Version: 04/17/1995
Date Data Arrived at EDR: 07/03/1995
Date Made Active in Reports: 08/07/1995
Number of Days to Update: 35

Source: EPA
Telephone: 202-564-4104
Last EDR Contact: 06/02/2008
Next Scheduled EDR Contact: 09/01/2008
Data Release Frequency: No Update Planned

BRS: Biennial Reporting System

The Biennial Reporting System is a national system administered by the EPA that collects data on the generation and management of hazardous waste. BRS captures detailed data from two groups: Large Quantity Generators (LQG) and Treatment, Storage, and Disposal Facilities.

Date of Government Version: 12/31/2007
Date Data Arrived at EDR: 02/25/2010
Date Made Active in Reports: 05/12/2010
Number of Days to Update: 76

Source: EPA/NTIS
Telephone: 800-424-9346
Last EDR Contact: 08/24/2010
Next Scheduled EDR Contact: 12/06/2010
Data Release Frequency: Biennially

UIC: Underground Injection Wells Listing
A listing of underground injection well locations.

Date of Government Version: 09/21/2010
Date Data Arrived at EDR: 10/01/2010
Date Made Active in Reports: 10/22/2010
Number of Days to Update: 21

Source: Department of Health
Telephone: 808-586-4258
Last EDR Contact: 09/20/2010
Next Scheduled EDR Contact: 12/20/2010
Data Release Frequency: Varies

DRYCLEANERS: Permitted Drycleaner Facility Listing
A listing of permitted drycleaner facilities in the state.

Date of Government Version: 06/30/2010
Date Data Arrived at EDR: 07/13/2010
Date Made Active in Reports: 08/04/2010
Number of Days to Update: 22

Source: Department of Health
Telephone: 808-586-4200
Last EDR Contact: 10/12/2010
Next Scheduled EDR Contact: 01/24/2011
Data Release Frequency: Varies

AIRS: List of Permitted Facilities
A listing of permitted facilities in the state.

Date of Government Version: 09/30/2010
Date Data Arrived at EDR: 10/20/2010
Date Made Active in Reports: 10/25/2010
Number of Days to Update: 5

Source: Department of Health
Telephone: 808-586-4200
Last EDR Contact: 10/12/2010
Next Scheduled EDR Contact: 01/24/2011
Data Release Frequency: Varies

INDIAN RESERV: Indian Reservations
This map layer portrays Indian administered lands of the United States that have any area equal to or greater than 640 acres.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 12/08/2006
Date Made Active in Reports: 01/11/2007
Number of Days to Update: 34

Source: USGS
Telephone: 202-208-3710
Last EDR Contact: 10/28/2010
Next Scheduled EDR Contact: 01/31/2011
Data Release Frequency: Semi-Annually

SCRD DRYCLEANERS: State Coalition for Remediation of Drycleaners Listing
The State Coalition for Remediation of Drycleaners was established in 1998, with support from the U.S. EPA Office of Superfund Remediation and Technology Innovation. It is comprised of representatives of states with established drycleaner remediation programs. Currently the member states are Alabama, Connecticut, Florida, Illinois, Kansas, Minnesota, Missouri, North Carolina, Oregon, South Carolina, Tennessee, Texas, and Wisconsin.

Date of Government Version: 05/12/2010
Date Data Arrived at EDR: 05/13/2010
Date Made Active in Reports: 08/17/2010
Number of Days to Update: 96

Source: Environmental Protection Agency
Telephone: 615-532-8599
Last EDR Contact: 11/15/2010
Next Scheduled EDR Contact: 02/07/2011
Data Release Frequency: Varies

PCB TRANSFORMER: PCB Transformer Registration Database
The database of PCB transformer registrations that includes all PCB registration submittals.

Date of Government Version: 01/01/2008
Date Data Arrived at EDR: 02/18/2009
Date Made Active in Reports: 05/29/2009
Number of Days to Update: 100

Source: Environmental Protection Agency
Telephone: 202-566-0517
Last EDR Contact: 11/10/2010
Next Scheduled EDR Contact: 02/14/2011
Data Release Frequency: Varies

COAL ASH DOE: Sleam-Electric Plan Operation Data
A listing of power plants that store ash in surface ponds.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 08/07/2009
Date Made Active in Reports: 10/22/2009
Number of Days to Update: 76

Source: Department of Energy
Telephone: 202-586-8719
Last EDR Contact: 10/28/2010
Next Scheduled EDR Contact: 01/31/2011
Data Release Frequency: Varies

COAL ASH EPA: Coal Combustion Residues Surface Impoundments List
A listing of coal combustion residues surface impoundments with high hazard potential ratings.

Date of Government Version: 11/09/2009
Date Data Arrived at EDR: 12/18/2009
Date Made Active in Reports: 02/10/2010
Number of Days to Update: 54

Source: Environmental Protection Agency
Telephone: N/A
Last EDR Contact: 09/15/2010
Next Scheduled EDR Contact: 12/27/2010
Data Release Frequency: Varies

FEDLAND: Federal and Indian Lands
Federally and Indian administrated lands of the United States. Lands included are administrated by: Army Corps of Engineers, Bureau of Reclamation, National Wild and Scenic River, National Wildlife Refuge, Public Domain Land, Wilderness, Wilderness Study Area, Wildlife Management Area, Bureau of Indian Affairs, Bureau of Land Management, Department of Justice, Forest Service, Fish and Wildlife Service, National Park Service.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 02/06/2006
Date Made Active in Reports: 01/11/2007
Number of Days to Update: 339

Source: U.S. Geological Survey
Telephone: 888-275-8747
Last EDR Contact: 10/28/2010
Next Scheduled EDR Contact: 01/31/2011
Data Release Frequency: N/A

EDR PROPRIETARY RECORDS

EDR Proprietary Records

Manufactured Gas Plants: EDR Proprietary Manufactured Gas Plants
The EDR Proprietary Manufactured Gas Plant Database includes records of coal gas plants (manufactured gas plants) compiled by EDR's researchers. Manufactured gas sites were used in the United States from the 1800's to 1950's to produce a gas that could be distributed and used as fuel. These plants used whale oil, rosin, coal, or a mixture of coal, oil, and water that also produced a significant amount of waste. Many of the byproducts of the gas production, such as coal tar (oily waste containing volatile and non-volatile chemicals), sludges, oils and other compounds are potentially hazardous to human health and the environment. The byproduct from this process was frequently disposed of directly at the plant site and can remain or spread slowly, serving as a continuous source of soil and groundwater contamination.

Date of Government Version: N/A
Date Data Arrived at EDR: N/A
Date Made Active in Reports: N/A
Number of Days to Update: N/A

Source: EDR, Inc.
Telephone: N/A
Last EDR Contact: N/A
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

OTHER DATABASE(S)

Depending on the geographic area covered by this report, the data provided in these specialty databases may or may not be complete. For example, the existence of wetlands information data in a specific report does not mean that all wetlands in the area covered by the report are included. Moreover, the absence of any reported wetlands information does not necessarily mean that wetlands do not exist in the area covered by the report.

Oil/Gas Pipelines: This data was obtained by EDR from the USGS in 1994. It is referred to by USGS as GeoData Digital Line Graphs from 1:100,000-Scale Maps. It was extracted from the transportation category including some oil, but primarily gas pipelines.

Electric Power Transmission Line Data
Source: Rextag Strategies Corp.
Telephone: (281) 769-2247
U.S. Electric Transmission and Power Plants Systems Digital GIS Data

Sensitive Receptors: There are individuals deemed sensitive receptors due to their fragile immune systems and special sensitivity to environmental discharges. These sensitive receptors typically include the elderly, the sick, and children. While the location of all sensitive receptors cannot be determined, EDR indicates those buildings and facilities - schools, daycares, hospitals, medical centers, and nursing homes - where individuals who are sensitive receptors are likely to be located.

AHA Hospitals:
Source: American Hospital Association, Inc.
Telephone: 312-280-5991
The database includes a listing of hospitals based on the American Hospital Association's annual survey of hospitals.

Medical Centers: Provider of Services Listing
Source: Centers for Medicare & Medicaid Services
Telephone: 410-786-3000
A listing of hospitals with Medicare provider number, produced by Centers of Medicare & Medicaid Services, a federal agency within the U.S. Department of Health and Human Services.

Nursing Homes
Source: National Institutes of Health
Telephone: 301-594-6248
Information on Medicare and Medicaid certified nursing homes in the United States.

Public Schools
Source: National Center for Education Statistics
Telephone: 202-502-7300
The National Center for Education Statistics' primary database on elementary and secondary public education in the United States. It is a comprehensive, annual, national statistical database of all public elementary and secondary schools and school districts, which contains data that are comparable across all states.

Private Schools
Source: National Center for Education Statistics
Telephone: 202-502-7300
The National Center for Education Statistics' primary database on private school locations in the United States.

Flood Zone Data: This data, available in select counties across the country, was obtained by EDR in 2003 & 2009 from the Federal Emergency Management Agency (FEMA). Data depicts 100-year and 500-year flood zones as defined by FEMA.

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 2002 and 2005 from the U.S. Fish and Wildlife Service.

STREET AND ADDRESS INFORMATION

APPENDIX D

PREVIOUS OWNERSHIP RECORDS

Previous Ownership Records

Tax Map Key	Date	Transaction
TMK Number: (2) 3-8-005: Parcel 023	1971	The parcel was created from TMK Number: (2) 3-8-005: Parcel 002 (see records below). The parcel was owned by Alexander & Baldwin, Inc and consisted of 352 acres.
	1977	Records indicated that parcel was dedicated for 20 years to agricultural sugar cane
TMK Number: (2) 3-8-005: Parcel 037	1971	The parcel was created from TMK Number: (2) 3-8-005: Parcel 002 (see records below). The parcel was owned by Alexander & Baldwin, Inc and consisted of 352 acres.
TMK Number: (2) 3-8-005: Parcel 002	1968	Earliest available records indicated that the 4,515-acre parcel was owned by Alexander & Baldwin, Inc.
	1974	A 352 acre portion of the parcel was dropped into Parcel 023 (see records above).
	1977	A 132-acre portion of the parcel was leased to the Wailuku Sugar Company.
	1986	The parcel was leased to Hawaiian Foliage & Landscape Inc.
TMK Number: (2) 3-8-007: Parcel 071	1969	Earliest available records indicated that the parcel was owned by Alexander & Baldwin, Inc., and a portion was dropped into Parcel 073.
TMK Number: (2) 3-8-007: Parcel 101	1975	Parcel was created from TMK Number: (2) 3-8-007: Parcel 073 (see records below) and was owned by Alexander & Baldwin, Inc. The records indicated that the Hawaiian Sugar Co., Ltd. lease was terminated and the parcel was leased to Orchards Hawaii Ltd.
TMK Number: (2) 3-8-007: Parcel 104	1976	Earliest available records indicated that the parcel was created from TMK Number: (2) 3-8-007: Parcel 102 (see records below). Alexander & Baldwin was listed as the owners of the parcel and a portion was leased to Schenk.
TMK Number: (2) 3-8-007: Parcel 073	1971	Earliest available records indicated that the parcel was owned by Alexander & Baldwin Inc., and leased to RJR Foods, Inc.
	1975	Portions of the parcel were dropped into new Parcels 101, 102, and 103.
TMK Number: (2) 3-8-007: Parcel 102	1975	The 48.9-acre parcel was created from Parcel 073 (see records above) and was owned by Alexander & Baldwin, Inc. and leased to Ichiro Toba.

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Appendix N: Preliminary Engineering and Drainage Report

PRELIMINARY ENGINEERING AND DRAINAGE REPORT FOR WAI'ALE COMMUNITY PROJECT

WAIKAPU AND WAILUKU, MAUI, HAWAII
TMK:(2) 3-8-005: 037, Por.023
(2) 3-8-007: 071, 104, Por.101

April 2011

Prepared for:

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PRELIMINARY ENGINEERING AND DRAINAGE REPORT
FOR
WAI'ALE COMMUNITY PROJECT

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April 2011

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EXHIBITS

APPENDICES

PRELIMINARY ENGINEERING AND DRAINAGE REPORT
FOR
WAI'ALE COMMUNITY PROJECT

I. INTRODUCTION

The purpose of this report is to provide an overview of the preliminary civil engineering design of the Wai'ale Community Project ("Wai'ale"). This report evaluates the existing site conditions and presents proposed, drainage, water, wastewater, roadway, electrical, telephone, and cable improvements.

II. PROPOSED PROJECT

A. LOCATION

The Wai'ale project is located in Waikapu and Wailuku, Maui, Hawaii with TMK Nos. (2) 3-8-005: 023 (portion), and 037; (2) 3-8-007: 071, 101 (por.) and 104. The project is divided into non-contiguous north and south development areas. The north section comprises approximately 422.6 acres and is bordered by the Waiko Baseyard Subdivision, the Waikapu Retention Basin, and the Waikapu Dump to the west; the recently developed Maui Lani residential subdivisions to the north; Kuihelani Highway to the east; and East Waiko Road and various commercial and light industrial developments to the south. The south section comprises approximately 122.6 acres and is bordered by East Waiko Road to the north; Kuihelani Highway to the east; and vacant agricultural land and the Waikapu Stream to the south and west. The overall project area is approximately 545.2 acres and is owned by Alexander & Baldwin, Inc. Refer to Exhibit 1 for the Location and Vicinity Map.

B. PROJECT DESCRIPTION

The Wai'ale Community project is a master planned residential community that includes Village Mixed Use, Commercial, Business/Light Industrial, Multi-Family and Single Family Residential, a Community Center, Regional Park, Neighborhood Parks, Greenways and Open Space, Cultural Preserves, a Middle School, and related infrastructure. Site work will include grading of site, construction of buildings, roadways, walkways; and installation of utility services including water, wastewater, drainage, underground electrical, television, and cable. Access to the site will be provided from Kamehameha Avenue, Kuihelani Highway, and East Waiko Road. Refer to Exhibit 2 for the Conceptual Master Plan.

III. EXISTING CONDITIONS

A. TOPOGRAPHY AND SOIL CONDITIONS

The project area is largely undeveloped with the exception of some sand stockpiling, a small orchid farm, some cane haul roads and the existing Waihee Irrigation Ditch that runs through the northeastern corner of the site. The irrigation ditch is still active, servicing agricultural lands to the south. The ground cover onsite generally consists of fallowed sugar cane fields south of East Waiko Road, and overgrown brush and trees north of East Waiko Road. Some intermediate dirt roads and cane haul roads are found throughout. Cattle and horses are sometimes pastured on the north portion of the site.

The project site generally slopes in an east or northeasterly direction with an average slope of approximately two (2) to three (3) percent. Elevations range from 154 to 308 feet mean sea level (MSL). The south project site has been graded to have fairly consistent land slopes while the north side has more rolling terrain and a few small gulches.

The soil types found in the proposed project area include Puuone Sand (PZUE) and Jaucas Sand (JaC).

Puuone Sand (PZUE) is found on the majority of the site. These well drained soils developed in material derived from coral and seashells. A typical soil profile consists of a layer of loose, grayish-brown sand over a strongly cemented sand layer that is 20-40 inches deep. Permeability is rapid above the cemented layer and the hazard of wind erosion is moderate to severe. The Hydrologic Soil Group (HSG) rating for Puuone Sand is “B”.

Jaucas Sand (JaC) is found on the southern portion of the site. It is a pale brown, single grained, calcareous sand that was also originally formed from coral and seashells. The sand profile is generally more than 60 inches deep. In many places the surface layer is dark brown due to the accumulation of organic matter and alluvium. Permeability is rapid, the erosion hazard is slight, and the HSG rating is “A”. Exposed Jaucas Sand can be susceptible to severe erosion where the vegetation has been removed.

Soil classifications and descriptions are taken from the United States Department of Agriculture (USDA) Soil Conservation Service’s (SCS) publication, *Soil Survey of the Islands of Kauai, Oahu, Molokai, Maui, and Lanai*.

B. CLIMATE AND RAINFALL

Waikapu’s climate is relatively uniform and sunny throughout the year, with temperatures varying from a low of 63 degrees Fahrenheit to a high of 87. Waikapu is generally exposed to prevailing tradewinds coming from the northeast. The tradewinds occur mainly through the dry season months of May through September. Rainy season months of October through April often produce stronger wind conditions, varying from prevailing tradewinds to southerly winds known as “Kona winds”. Average annual rainfall at the site is around 20 inches. The 50-year, 1-hour rainfall is 2.7 inches and the 100-year, 24-hour rainfall is 9.8 inches.

C. INFRASTRUCTURE

1. Roadway

The project site consists of existing cane haul roads and unimproved dirt roads. The area is situated within Waikapu, a primarily residential area with some industrial and commercial uses.

Kuihelani Highway is a four-lane, divided arterial with a posted speed limit of 55 miles per hour (mph) in the vicinity of the project. This highway is owned by the State of Hawaii, Department of Transportation.

Wai’ale Road and East Waiko Road are two-lane, undivided collector roads with posted speed limits of 20 mph. Both roads are owned by the County of Maui.

Kamehameha Avenue is a two-lane collector road with a posted speed limit of 20 mph. It currently terminates at the northerly boundary of the project site. The portion of the roadway from Maui Lani Parkway to its terminus at the project boundary is privately owned at this time.

2. Drainage

As mentioned previously, the site slopes generally in an east or northeasterly direction. Besides the irrigation ditch, there are no onsite drainage-ways or stormdrain systems that carry concentrated stormwater runoff. Any runoff coming from the site is generally widely dispersed and sheet flow in nature.

The south portion of the project drains east to Kuihelani Highway where an existing swale on the mauka side of the road intercepts runoff. Kuihelani Highway has a high point near the center of the south site. The southernmost section of the Kuihelani Highway swale drains into Waikapu Stream. The north section of the highway swale drains north and through a drainline under east Waiko Road where the runoff continues in a northerly direction. There are also two cross culverts under Kuihelani Highway that carry flow to the makai cane fields. Ultimately runoff flows into either the Waikapu Stream or the Waihee Irrigation Ditch. Both drainage-ways flow south to Kealia Pond and Maalaea Bay.

The south project area was used for sugar cane production up until about 2008 but the area now lies fallow. The new groundcover consists of residual sugar cane, grasses, weeds and brush. Most of the groundcover is fairly well established, however, there are a few areas where it is only fair to poor. Runoff from the south site is calculated to be 50 cubic feet per second (cfs).

The portion of the site north of East Waiko Road drains northeasterly to Kuihelani Highway, the Waihee Irrigation Ditch, and adjacent Maui Lani Development lands. In Kuihelani Highway, runoff is intercepted by the existing swale on the mauka side of the highway. The first portion of the swale discharges runoff into the Waihee Irrigation Ditch while the lower portion of the swale continues north along Kuihelani

Highway. A small portion of the site also flows directly into the Waihee Irrigation Ditch. The majority of the north project area, however, does not get intercepted by the irrigation ditch and instead flows north toward Maui Lani Development lands. No open channels are evident in this area and runoff is likely to infiltrate before it becomes concentrated. Overall runoff from the north project area is calculated to be 339 cfs.

Refer to Appendix A for Hydrology Calculations and Exhibit 9 for the Existing Conditions Drainage Area Map.

3. Water

Since the site is currently undeveloped, there are no existing domestic waterlines servicing the project area. The County of Maui, Department of Water Supply (DWS) provides water service within the vicinity of the project. DWS services the nearby Maui Lani Development via an existing 12-inch waterline along Kamehameha Avenue. To the west of the project, DWS services Waikapu, including the Waikapu Gardens housing development between Honoapiilani Highway and Wai'ale Road, from their 300,000-gallon Waikapu Reservoir. The Waikapu distribution system includes an existing 12-inch stub-out along East Waiko Road, and a 12-inch stub-out on Ha'awi Street.

The Consolidated Baseyard Subdivision, which is a development adjacent to the property, has an existing private water system. The components of this system include two small groundwater wells, an on-site 350,000 gallon reservoir sized primarily for fire protection water storage, a domestic water package booster pump and a separate fire pump, and a private water distribution system consisting of 12-inch waterlines.

DWS has two transmission waterlines in the vicinity of the project. The 18-inch Kihei Water Development Project transmission line runs along Wai'ale Road then cuts through the project in a southeasterly direction towards Kihei. (See Exhibit 4, Proposed Water System Alternatives). The 36-inch Central Maui Water Transmission System transmission lines cuts through the eastern portion of the project and head towards Kihei.

Hawaiian Commercial & Sugar Company (HC&S) also has an existing irrigation pipeline that runs through the project, parallel to DWS's 36-inch transmission line.

The following are existing DWS storage tanks in the vicinity of the project:

<u>Waikapu 300,000-gallon Concrete Reservoir</u>
Bottom Elevation = 764.0
Maximum Water Level = 779.5

<u>Kehalani Mauka 1.5 MG Mid-Level Tank</u>
Bottom Elevation = 670
Maximum Water Level = 690

<u>Wailuku Heights 20,000-gallon Steel Tank</u>
Bottom Elevation = 672
Maximum Water Level = 686.5

<u>Wai'ale 3.0 MG Concrete Tank</u>
Bottom Elevation = 270.35
Maximum Water Level = 292.35

4. Wastewater

The project site currently generates no wastewater flow. There are two County sewer lines in the vicinity of the project. The first is an existing County 12-inch gravity line along Kamehameha Avenue that services a portion of the Maui Lani development. The second is a County gravity line that runs through Waikapu Gardens, and then along Wai'ale Road, conveying wastewater to the Wailuku Wastewater Pump Station (WWPS). The Wailuku WWPS pumps the wastewater to the Kahului Wastewater Reclamation Facility for treatment.

Tropical Plantation, Waikapu Gardens and Waiko Baseyard are all serviced by private wastewater collection systems. There are four private WWPSs within these areas – one for Tropical Plantation, two for Waikapu Gardens, and one for Waiko Baseyard. These WWPSs pump the wastewater into the County's gravity line running through Waikapu Gardens. The Consolidated Baseyard Subdivision utilizes on-site individual wastewater treatment systems.

5. Electrical

Maui Electric Company's (MECO) facilities currently consist of a steel pole-line supported 69 kV transmission circuit along Kuihelani Highway. The pole-line crosses Kuihelani Highway and continues south in the cane fields then turns west and generally parallels Waiko Road. MECO primary distribution circuits are available in the Maui Lani Development north of Wai\`ale Community. MECO intends to extend these circuits to Wai\`ale Community to serve as backups.

6. Telephone

Hawaiian Telcom's (HTCOM) facilities currently consist of underground cables installed in a duct and manhole/hand-hole system on Kamehameha Avenue in the Maui Lani Development to the north of Wai\`ale Community. Spare ducts are stubbed out for extension at the end of Kamehameha Avenue at Pomaikai Elementary School.

7. Cable

Oceanic Time Warner Cable (TW) has facilities at the Maui Lani Village Mixed-Use complex near the north-west corner of Wai\`ale Community, with fiber optic (FO) cables installed on Maui Lani Parkway to serve Maui Lani Development. TW's duct line and FO cables are available on Kamehameha Avenue at Pomaikai Elementary School.

D. FLOOD ZONE

The project is situated just north of Waikapu Stream and the portion of the project adjacent to the stream is planned for park use. Waikapu Stream contains a Zone AE 100-year (1-percent annual chance) floodway area with water surface elevations determined. Immediately adjacent to the Waikapu Stream 100-year floodway are small areas designated as Zone X. These shaded Zone X areas are defined as 500-year flood areas, areas of 1-percent annual chance sheet flow flooding where average depths are less than 1 foot or with drainage areas less than 1 square mile, or areas protected by levees. The above mentioned areas represent only a small portion of the site and will remain undeveloped. All developed areas of the project lie within unshaded Flood Zone X, which are areas determined to be outside the 0.2% annual chance floodplain.

Flood zone classifications are based on the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) numbers 1500030391E, 1500030393E, and 1500030394E, effective September 25, 2009. Refer to Exhibit 12 for the Flood Zone Map.

IV. PROPOSED IMPROVEMENT

A. ROADWAYS

The proposed roadway layout plan provides for the extension of Kamehameha Avenue, a collector road from the Maui Lani Development (Road "A"), two collector roads from Kuihelani Highway (Roads C and E), and miscellaneous roadways within the project.

Kamehameha Avenue will extend from Pomaikai Elementary School and terminate at Road E. This road will consist of a two-lane travelway, turning medians, and a pedestrian/bike path.

Roads A through E are collector roads that will consist of a two-lane travelway, turning medians, and a pedestrian/bike pathway. The design of the roadways will be based on standards set forth by the County of Maui. Refer to Exhibit 2A for the Preliminary Roadway Plan.

B. GRADING PLAN

The proposed improvements described herein are based on a preliminary civil engineering evaluation. A more detailed engineering design and analysis will be undertaken during the design phase of the project.

The proposed project will require both excavation and embankment for the construction of the new roadways, building pad areas, and drainage structures. Overall, the site will be graded to maintain the existing drainage patterns. Proposed roadway slopes will vary between 0 and 12 percent. Embankments will have a maximum slope of 2-feet horizontal to 1-foot vertical.

Where elevation drops are required, retaining walls will be installed with heights ranging from 2 to 6 feet. Designated archaeological sites will remain undisturbed as cultural preserves. A park buffer will also be maintained along the project's boundary with Waikapu Stream. Refer to Exhibit 3 for the Preliminary Grading and Drainage Plan.

C. DRAINAGE PLAN

Since the Project area is larger than 100 acres, the NRCS TR-20 Method is used to determine runoff and design detention facilities. The HydroCAD® Stormwater Modeling Program was used to perform the TR-20 method calculations and the calculation data is listed in Appendix A. The Rational Method will be used to design the localized onsite drainage systems (e.g. roadway stormdrains) that serve areas smaller than 100 acres. For these localized onsite drainage systems, the 50-year, 1-hour storm will be used.

The proposed project will contain a mix of residential, commercial, and light industrial uses, as well as a school site. Runoff will be collected by open swales and stormdrain systems and will be routed to one of several detention basins. A brief description of the individual drainage areas follows:

DA-1A: Drainage Area 1A is 94.3 acres and consists of the majority of the south project site. Runoff will be conveyed by stormdrains to Basin 1A, located in the southeast corner of the site. The 24.0 acre-foot (ac-ft) detention basin will have a controlled 100-year outflow of 30 cfs to Waikapu Stream.

DA-1B: Drainage Area 1B is 28.3 acres and is located in the low corner of the south site near the East Waiko Road and Kuihelani Highway intersection. This portion of the south site is too low to drain to Basin 1A. A new culvert will be constructed under Kuihelani Highway that will carry runoff to Basin 1B, located offsite, just east of the highway. The 8.5 acre-foot (ac-ft) detention basin will have a controlled 100-year outflow of 15 cfs to the cane fields east of Kuihelani Highway.

DA-2: Drainage Area 2 consists of the north project site and is 422.6 acres. Runoff will be routed to a 176 ac-ft detention basin located in the northeast corner of the site. Stormwater will slowly be released to the cane fields east of Kuihelani Highway swale at a rate of 72 cfs.

Prior to retention, the south portion of the site will produce a 100-year runoff of 459 cfs and the north portion of the site will produce a 100-year runoff of 1,526 cfs. After retention, the south site runoff will be limited to 45 cfs and the north site runoff will be limited to 72 cfs. This represents a significant decrease in runoff from existing conditions. The 208.5 ac-ft of pond storage capacity more than offsets the runoff volume increase. The Waikapu Stream and Kealia Pond drainage systems will be protected from any peak flow increases. See Appendix A for Hydrology Calculations, Exhibit 10 for the Proposed Conditions Drainage Area Map, and Exhibit11 for the Drainage Flowchart.

D. STORMWATER QUALITY

In addition to reducing peak flow rates, the proposed stormwater management system will provide water quality treatment to reduce the discharge of pollutants to the maximum extent practicable. Instead of just managing the infrequent peak storm events, the more common smaller storms will be targeted for treatment. The goal will be to provide water quality treatment for 90 percent of the average annual rainfall.

The project will incorporate stormwater Best Management Practices (BMPs) to control water quality. Examples of stormwater BMPs that will be employed include:

Grass Swales

Surface stormwater runoff from developed areas will be directed to grass swales and landscaped areas where practical. The grasses and other vegetation provide natural filtration while allowing percolation into the underlying soil.

Open Space/ Reduced Impervious Coverage

Approximately 25 percent of the developed project site will be reserved as park areas, cultural preserves, or other open spaces. Important natural and cultural features will remain undisturbed. A buffer strip will be maintained along Waikapu Stream. Open space and park areas will be maintained with grass or other native vegetative cover. Reducing impervious coverage where possible promotes infiltration and maintains the natural hydrologic cycle.

Stormwater Retention/ Infiltration

The bottom 1 to 2 feet of the stormwater basins will be reserved for retention of the water quality volume. The water quality runoff and potential pollutants will be prevented from flowing to downstream areas such as Waikapu Stream. Stormwater will be held for an extended period allowing suspended solids to settle out. Water will infiltrate into the soils gradually over 24 to 48 hours and recharge groundwater. Since the project will not contain stormwater “hotspot” uses such as heavy industrial, car salvage, car repair or fueling sites, stormwater infiltration is considered acceptable.

Leadership in Energy and Environmental Design (LEED) and the Environmental Protection Agency (EPA) accept the above methods of stormwater quality control as stormwater best management practices that reduce the pollutant loads associated with stormwater runoff. Maui County does not specifically require water quality treatment of stormwater.

A maintenance plan will be developed for managing the BMPs on the future site. The plan will include requirements for removing accumulated sediments and debris, maintaining vegetation, and performing regular inspections so that the BMPs operate effectively into the future.

The northwest corner of the project is within the 10-year time of travel Wellhead Protection Area (WHPA) of sources overlying the Kahului Aquifer (as determined by the County of Maui Department of Water Supply). Additionally, Wai’ale Wells 1 and 2 have a 10-year time of travel radius of 4,500 feet and 4,250 feet respectively, which covers nearly the entire project area (as identified in a report by Tom Nance Water Resource Engineering). To mitigate potential groundwater contamination, best management practices for the future use of the property will be implemented. Covenants will be imposed which inform potential homebuyers that activities at the property could impact the groundwater beneath the property. Covenants will require compliance with all applicable environmental and other governmental laws, rules, and regulations and will require efforts to prevent groundwater contamination from fertilizers, pesticides, metals, petroleum products, solvents and other contaminants. Industrial users will be required to prevent groundwater contamination from metals, petroleum products, solvents and other contaminants, including runoff collection and treatment, and to institute spill prevention containment and control programs.

E. EROSION CONTROL PLAN

Temporary erosion control measures will be incorporated during the construction period to minimize soil loss and erosion hazards. Special care will be taken to protect sensitive areas such as Waikapu Stream and the Cultural Preserves. Temporary Best Management Practices will include sediment basins, diversion berms and swales, silt fences, dust fences, inlet protection, slope protection, stabilized construction entrances and truck wash-down areas. Periodic water spraying on loose soils will take place to minimize airborne dirt particles from reaching adjacent properties. An application for a National Pollution Discharge Elimination System (NPDES) permit will be submitted to the State Department of Health for review and approval.

At the end of construction, all disturbed areas of the site will be permanently stabilized. Permanent sediment control measures, such as those listed in the previous “Stormwater Quality” section”, will be used once construction is completed.

F. WATER SYSTEM PLAN

An Environmental Impact Statement Preparation Notice (EISPN) for the project was prepared by PBR Hawaii & Associates, Inc. in August, 2010. The Maui Department of Water Supply (DWS) reviewed the EISPN, and commented in a letter dated October 27, 2010, that: “There is currently no additional source available to accommodate new customers according to system standards on the Central Maui system.” Therefore, at this time, the intent is to develop a new water source for the project. New water storage facilities and transmission lines will also be required. The project’s water system can be constructed as a private water system, or it can be constructed with the intent of dedicating the system to DWS for incorporation into DWS's water system.

1. Water Demand

The estimated water demand for the project was determined based on the County of Maui, Department of Water Supply's Water System Standards (WSS), dated 2002, as follows:

• Single-Family:	600 gallons per day (gpd) per unit
• Multi-family:	560 gpd/unit
• Village Mixed-use:	560 gpd/unit for Multi-family 140 gal/1000 sf for Commercial
• Light Industrial:	140 gal/1000 sf
• Commercial:	140 gal/1000 sf
• Community Center:	1,700 gpd/acre
• Parks:	1,700 gpd/acre
• Middle School:	60 gpd/student

Based on the above water usages, the projected average daily water demand for the project is estimated to be 1.9 million gallons per day (MGD). In accordance with the WSS, the maximum daily water demand is calculated as being 1.5 times the average daily demand, or 2.8 MGD. Also, the maximum fire demand will be 2,000 gallons per minute (gpm), which is applicable for schools, neighborhood businesses, small shopping centers and light industry. (See Appendix B for Preliminary Water Demand Calculations.)

Water conservation measures, such as low-flow shower heads, will be considered for the project to decrease the water demand. Irrigation of the parks and buffer areas with effluent is also being considered for the project. (See Section IV.G.4 for discussion on effluent reuse.) If irrigation reuse takes place, then approximately 200,000 gpd of potable water demand for the parks could potentially be replaced by non-potable effluent.

2. Water Source

Several potential drinking water source opportunities to serve the project are being considered. These include surface water treatment and new well sources in the Central Maui region. The primary focus has been the development of a surface water treatment plant utilizing water from Maui's ditch system.

The proposed Wai'ale Water Treatment Facility (WTF) is a collaborative effort between A&B Properties, Inc. and DWS. The proposed WTF requires further discussion, review and approvals by various governmental agencies in order to proceed. An agreement with the County of Maui outlining the sharing of development costs for the proposed WTF, terms of use, the allocation of water and other matters will be required. This agreement will ultimately be subject to the review and approval of the Maui County Council. Also, the establishment of interim in-stream flow standards for the four (4) streams which make up the Na Wai Eha, including Waihee Stream, will need to be resolved.

The proposed WTF is planned to be located on about 3.5 acres near the upper Wai'ale Reservoir site in Wailuku, on lands owned by Alexander & Baldwin, Inc. The proposed WTF will treat surface water primarily from Waihee Stream utilizing membrane filtration. As currently planned, the proposed WTF would yield a sustained average production capacity of approximately nine (9) million gallons per day (MGD). Detailed engineering design of the WTF has been undertaken, including designs for piping connections to the County of Maui's Central Maui water system. The plant is about 80 percent designed.

A&B Properties, Inc. continues to work with the County of Maui to address design and regulatory matters relating to the WTF. The design and scale of the final WTF will be subject to other decisions and approvals, including the final interim in-stream flow standards for the streams which make up the Na Wai Eha. These decisions could result in a WTF with a lower capacity than currently planned.

A&B Properties, Inc. is also pursuing other potential drinking water sources, including new water wells in Central Maui. Two wells have recently been constructed within the project area. These wells, Wai'ale Well No. 1 (State No. 5129-04) and Wai'ale Well No. 2 (State Well No. 5129-05) are situated within the Kahului Aquifer. Pump tests of these wells indicated good water quality and capacity. The wells were each approved by the State of Hawaii, Commission on Water Resource Management for a pumping capacity of 550 gpm. While water from these wells is not planned for use by this project, the wells demonstrate the potential for the development of potable water within the Central Maui region. The applicant continues to examine the feasibility of other wells in the region, including partnerships with other parties.

The timing of completion of these potential source development alternatives will, in large part, determine the particular water source for the project. All source alternatives will require further discussion, review, and approval by applicable governmental agencies as the project proceeds.

3. Water Storage

New water storage reservoirs will be required to meet the storage requirements for the project. The reservoir capacity is based on the WSS Criterion 1 for Reservoir Capacity, which is to meet the maximum day consumption, with the reservoir full at the beginning of the 24-hour period with no source input to the reservoir. Based on this criterion, the required storage volume is 2.8 MG. The recommendation is to construct two concrete reservoirs, each approximately 1.5 MG, rather than a single reservoir. Two reservoirs will allow for storage to be constructed as the demand increases, and will allow for more flexibility during maintenance and repair should one of the reservoirs have to be taken out of service.

The following three alternatives are preliminary suggestions for the location of the storage reservoir(s). Further analysis of storage alternatives will be undertaken as part of the detailed engineering design process for this project.

a. Alternative 1:

Alternative 1 would be to construct the reservoir(s) off-site, at an approximate elevation of 440 feet mean sea level (msl), which would allow for the entire project to be serviced by gravity from the reservoir. The project ranges in elevation from approximately 154 feet msl at the northwest corner, to approximately 308 feet msl at the western edge.

b. Alternative 2:

Alternative 2 would be to construct the reservoirs at a higher elevation, to "float" with DWS's existing Iao Tank. The Iao Tank has a bottom elevation of 506 feet, and maximum water level of 536.5 feet. The Iao Tank is servicing a portion of the nearby Maui Lani Development, which has the same approximate elevations as the Wai'ale project.

c. Alternative 3:

Alternative 3 would be to construct one or two 1.5 MG reservoirs on the same site as the existing Kehalani Mauka 1.5 MG Mid-Level Tank. The existing tank could also possibly be used for storage. The new reservoir would have the same bottom and overflow elevations as the existing Kehalani Mauka 1.5 MG Mid-Level Tank, which are 670 feet msl and 690 feet msl, respectively.

Exhibit 4 shows the proposed location of the reservoirs and proposed transmission waterlines for the alternatives. Table 1 on the following page provides a summary of the advantages and disadvantages of the alternatives.

Table 1. Summary of Alternatives

Alt	Advantages	Disadvantages
1	• Reservoirs would be at lowest elevation, so pumping costs would be lower. • Reservoirs could be located closer to project, so there would be shorter waterlines.	• Land would need to be purchased or leased. • Elevation of reservoirs is not the same as existing DWS reservoirs, so would be more difficult to tie into DWS's system.
2	• Reservoirs would float with Iao Tank which makes it easier to incorporate into DWS's system.	• Land would need to be purchased or leased. • Higher elevation means higher pumping cost. • Location further from project, so there would be longer waterlines.
3	• Reservoirs would float with Kehalani Mauka Tank which makes it easier to incorporate into DWS's system. • Land may be available at Kehalani Mauka Tank, or adjacent to tank.	• Highest elevation means highest pumping costs. • Location furthest from project, so there would be longer waterlines. • Pressure would need to be reduced to service project.

4. Transmission and Distribution System

DWS's existing transmission and distribution lines will be utilized, to the extent possible, to convey water needed for the project. However, to be conservative, the assumption at this time is that all new transmission waterlines will be required. Also, it is assumed that a new booster pump system will be required to pump the water from the Wai'ale 3.0 MG Tank to the proposed off-site reservoirs.

Any new transmission lines that will be needed will be sized to handle the maximum day demand for the project plus the maximum fire flow of 2,000 gpm. The waterlines will be of ductile iron and designed to meet the WSS for pipeline sizing.

On-site distribution waterlines will primarily be composed of 12-inch waterlines, with some 16-inch waterlines, and will be located within the project roadways. (See Exhibit 5, Proposed Water Distribution System.) The waterlines will be sized to provide water for potable, irrigation and fire suppression purposes. The waterlines will also be sized to meet the pressure and velocity requirements of the WSS. Fire hydrants will be installed at a maximum of 250 foot intervals within the site, per the WSS.

Further analysis of the water transmission and distribution system will be undertaken as part of the detailed engineering design process for this project.

G. SEWER SYSTEM PLAN

The County of Maui, Department of Environmental Management (DEM) reviewed the EISPN, and commented in a letter dated November 10, 2010, that "The development of this project and others (planned and/or in construction) will exceed the remaining allocation capacity of the Kahului Wastewater Reclamation Facility. Therefore, in our opinion this project needs to include the development of a regional treatment plan to service this project and others in the adjacent area (e.g. Tropical Plantation 1500+ dwelling units, etc.)."

The plant design capacity of the Kahului Wastewater Reclamation Facility (WWRF) is 7.9 million gallons per day (MGD), and the cumulative wastewater flow that has been allocated, as of December 31, 2010, is 7.028 MGD. Therefore, the available capacity is 0.872 MGD. However, in recent discussions with the County of Maui Wastewater Reclamation Division, the County has confirmed that there is probably not enough capacity at the Kahului WWRF for even initial flows from the project, since treatment capacity is allocated on a first come first served basis, and they already have multiple requests for capacity allocation. The County also stated that there may be room to upgrade the Kahului WWRF, but a study needs to be conducted on whether expansion is possible.

Therefore, this PER discusses two main alternatives for treating the wastewater generated by the project. This first alternative involves constructing an on-site wastewater treatment plant (WWTP) for treatment of the wastewater generated by the Wai'ale project only. This alternative would require effluent reuse and/or disposal, options for which are also discussed. The second alternative involves conveying the wastewater from the project to the Kahului WWRF, in the event that there is capacity available to treat the flows, either with or without future expansion of the WWRF.

1. Wastewater Flows

Preliminary wastewater contributions for the project were determined based on the County of Maui, Wastewater Reclamation Division's Wastewater Flow Standards, dated February 2, 2006, as follows:

- Single-Family: 350 gpd/unit
- Multi-family*: 320 gpd/unit
- Village Mixed-use (VMX)*: 320 gpd/unit
- Light Industrial: 25 gpd/employee
- Commercial: 15 gpd/employee
- Community Center: 25 gpd/employee, 10 gpd/visitor
- Parks: 5 gpd/visitor
- Middle School: 25 gpd/student

*Contribution assumed to be less than for single-family residence, but more than 255 gpd/unit for Apartment/Condo units. Village Mixed-use also includes commercial use.

Preliminary assumptions for the building areas for the VMX, Light Industrial and Commercial properties are:

- VMX (commercial): 53 acres 250,000 square feet (sf)
- Light Industrial: 16 acres 175,000 sf
- Commercial: 23 acres 230,000 sf
- Community Center: 7 acres 10,000 sf

In accordance with the Wastewater Flow Standards, the following occupancies were used to calculate the wastewater flow:

- Light Industrial: 1 employee per 500 sf of floor area
- Commercial: 1 employee per 350 sf of floor area
- Community Center: 1 employee per 500 sf of floor area

The wastewater contribution for the park areas was calculated based on an assumed count of 250 visitors per day per park. The wastewater contribution for the middle school was calculated based on a population of 600 students. The wastewater contribution for the community center was based on the number of employees and an assumed count of 300 visitors per day.

Based on the above information, the average daily wastewater flow is approximately 910,000 gpd, and the design average flow, which includes dry weather infiltration, is approximately 980,000 gpd. (See Appendix C for Preliminary Wastewater Contribution Calculations.)

2. On-Site Wastewater Treatment Plant

Based on the design average flow for the project of 980,000 gpd, the WWTP would be designed to treat approximately 1.0 MGD of wastewater. The WWTP would be designed to produce R-1 Water, which could then be reused, mainly for irrigation purposes. The treatment process would consist of secondary treatment followed by filtration and disinfection. Approximately 5 acres of land is expected to be required for the WWTP.

The location for the proposed WWTP is adjacent to the Consolidated Baseyard Subdivision. (See Exhibit 6, Proposed Wastewater System for On-Site WWTP.) An onsite sewer system will be installed to provide wastewater collection service to all proposed lots. The wastewater from the southern half of the project would be conveyed, via gravity flow, directly to the WWTP. The wastewater from the northern half of the project would be conveyed, via gravity flow, to the northeastern portion of the project, where a wastewater pump station (WWPS) would be used to pump the flow to the WWTP.

The sizes of the pipes for the wastewater collection system were estimated based on preliminary design peak flow calculations for the contributing area. The sewer pipes will range in size from a minimum of 8 inches to a maximum of 21 inches. The pipe material for both the gravity pipes and the force main will be polyvinyl chloride (PVC).

3. Off-Site Wastewater Treatment

For this alternative, the wastewater would be conveyed to the existing Kahului WWRF for treatment and disposal. The closest existing sewer line is a 12-inch gravity line in Kamehameha Avenue that services parts of the Maui Lani development and the planned Pomaikai Elementary School. An on-site sewer system will be installed to provide wastewater collection service to all proposed lots. The wastewater from the northwest portion of the project would be conveyed, via gravity flow, to the 12-inch sewer line in Kamehameha Avenue. (See Exhibit 7, Proposed Wastewater System for Off-Site Wastewater Treatment.)

The wastewater from the majority of the project would be conveyed, via gravity flow, to a wastewater pump station (WWPS) in the northeastern portion of the project. One option may be for the WWPS to pump the flow to a discharge manhole near the community center. The wastewater would then flow by gravity to Kamehameha Avenue. Another option may be to pump the wastewater along Kuihelani Highway to a different connection point within the County system.

Further analysis of the existing and proposed wastewater collection systems will be undertaken as part of the detailed engineering design process for this project. In addition, the County will be consulted to discuss what improvements to the existing County collection system may be needed to accommodate the flows from the project.

4. Effluent Reuse/Disposal

If an on-site WWTP is necessary to treat the wastewater generated by the project, then effluent reuse and/or disposal will be necessary. The primary method of effluent reuse would be on-site irrigation. The WWTP would produce approximately 980,000 gpd of R-1 Water quality effluent, which would allow for irrigation reuse with minimal restrictions. Possible on-site areas for irrigation reuse are the parks, open space areas, playing fields associated with the middle school and community center, and roadway landscaping. The reuse of effluent for on-site irrigation would be implemented in consultation with all applicable parties. Separate distribution irrigation waterlines will be required to convey the R-1 Water to the irrigation reuse areas. (See Exhibit 8, Possible Areas of On-Site Irrigation Reuse.)

The total area of the parks and buffers shown on Exhibit 8 is approximately 116 acres. Assuming an average irrigation rate of 5/16 inch per day, the average irrigation demand would be approximately 990,000 gpd. (See Appendix C.)

Effluent may also be used for roadway landscaping areas. The irrigated area for roadway landscaping for the roads shown in Exhibit 8 is approximately 17 acres. Based on an average irrigation rate of 5/16 inch per day, the average irrigation demand would be approximately 140,000 gpd. Thus, the total irrigation for the parks, buffer areas and roadway landscaping would be approximately 1,130,000 gpd. This irrigation demand may vary depending on weather conditions. However, the expectation is that all of the effluent produced by the WWTP will be used for irrigation, except during significant rain events.

During rainy weather when effluent irrigation is not required, a backup system of effluent disposal will be required. One option is to use injection wells, sized to handle the peak effluent flow from the WWTP, for backup disposal of the effluent. The anticipated peak flow to the WWTP is calculated to be approximately 5.3 MGD. However, flow equalization will be incorporated into the design of the WWTP to dampen the peak flow of wastewater into the WWTP, thus reducing the peak flow of effluent out of the WWTP to the injection wells.

The project site is located below the Underground Injection Control (UIC) Line, under which disposal of effluent via an injection well(s) is allowed by the State of Hawaii Department of Health (DOH). However, any injection well(s) would need to be located a minimum of ¼ mile from any existing potable water wells.

Another option for backup disposal of the effluent during periods when the irrigation system is not in operation is to store the effluent in a reservoir. The DOH guidelines state that the storage reservoir should be of adequate size to store 20 days of effluent. However, this time period is subject to reduction, expansion, or elimination if it can be demonstrated to the satisfaction of the DOH that another time period is adequate or that less or no storage is needed.

H. ELECTRICAL SYSTEM

A meeting was held with Maui Electric Company on February 23, 2011. (See Appendix D, Exhibit 1 for meeting minutes). The following was determined at the meeting:

1. Future Facilities

MECO has plans for constructing Kuihelani Substation which will be located east of the intersection of Kuihelani Highway and Maui Lani Parkway, approximately 2800’ north of the northeast entry to the Wai`ale Community Development. Construction of the substation is expected to be completed in 2013. MECO indicated that electrical service for Wai`ale Community will be obtained from Kuihelani Substation. It is proposed that electrical power for Wai`ale Community be obtained from the proposed substation by extending primary distribution circuits underground to the site along Kuihelani Highway. State Department of Transportation approval will be required for this underground line extension.

The back-up circuits for Wai`ale Community will be extended from existing MECO facilities along Kamehameha Avenue from Maui Lani Parkway. A new duct line will be required to be installed for this purpose. The duct lines will form a loop with the ducts originating at Kuihelani Substation.

2. Preliminary Electrical Loads

Preliminary electrical load estimates for the development are included as Appendix D, Exhibit 2.

3. Proposed Electrical Facilities

New primary and secondary distribution lines within the new Wai`ale Community will be placed underground. The main express feeder ducts through the project site will consist of 6-way 5” ducts. Laterals to serve various parcels will consist of 2-way or 4-way 5” ducts depending on parcel location with respect to the main express feeder ducts. The distribution system voltage will be 12.47 kV and the distribution system will include primary and secondary cables in a concrete-encased duct system within the streets and sidewalks and with hand-holes in the sidewalk area, manholes in streets, primary pad-mounted switchgear, and pad-mounted transformers.

Easements will be required for the pad-mounted switchgears, pad-mounted transformers, and cables crossing private property to serve other customers.

Service tails will be provided at the property line for service to the individual property owners.

Refer to Exhibit 13 for the Concept Electrical Master Plan.

I. TELEPHONE SYSTEM

A meeting was held with Hawaiian Telcom representatives on February 23, 2011. (See Appendix D, Exhibit 3 for meeting minutes). At the meeting and with follow-up correspondence, the following was established:

HTCOM has facilities on Kamehameha Avenue at Pomaikai Elementary School that will be extended to serve Wai`ale Community.

The main duct run will consist of 4-way 4” ducts and 5’X10’ manholes. Laterals will consist of 1-way and 2-way ducts and 3’X5’ hand-holes.

HTCOM plans to provide fiber optic (FO) cable for each service instead of copper cables as they have in the past. This will allow the telephone company customer to obtain telephone, data and CATV services.

Fiber distribution hubs (FDH) will be installed in the development. The largest hub will service 864 residences. Three or four FDHs will be required depending on how the project is phased. Each FDH requires a 10'X10' easement.

Easements will be required for the cables crossing private property to serve other customers.

Service tails will be provided at the property line for service to the individual property owners.

J. CABLE SYSTEM

A meeting was held with Oceanic Time Warner Cable on February 23, 2011. (See Appendix D, Exhibit 4 for meeting minutes). The following was determined at the meeting:

Small easements (approximately 6' X 7') will be required for installation of pedestal mounted equipment for providing cable service. These will be required for each group of about 125 homes. Two 3'X5' hand-holes will be required at the pedestal locations for installation of below grade equipment.

The main duct line will consist of 2-way 4" ducts. 1-way 4" ducts will serve as laterals. 3'X5' hand-holes will be required along the main duct line and 2'X4' hand-holes will be required in other areas.

Easements will be required for the power supply cabinets and for cables crossing private property to serve other customers.

Service tails will be provided at the property line for service to the individual property owners.

K. STREET LIGHTING

Conventional street lighting will be utilized for illumination of streets and sidewalks. The streets will be dedicated to the County of Maui and the street lighting poles and fixtures will be provided by MECO.

Illumination of the Kuihelani Highway entries to Wai`ale Community will be illuminated according to State Department of Transportation requirements.

V. CONCLUSION

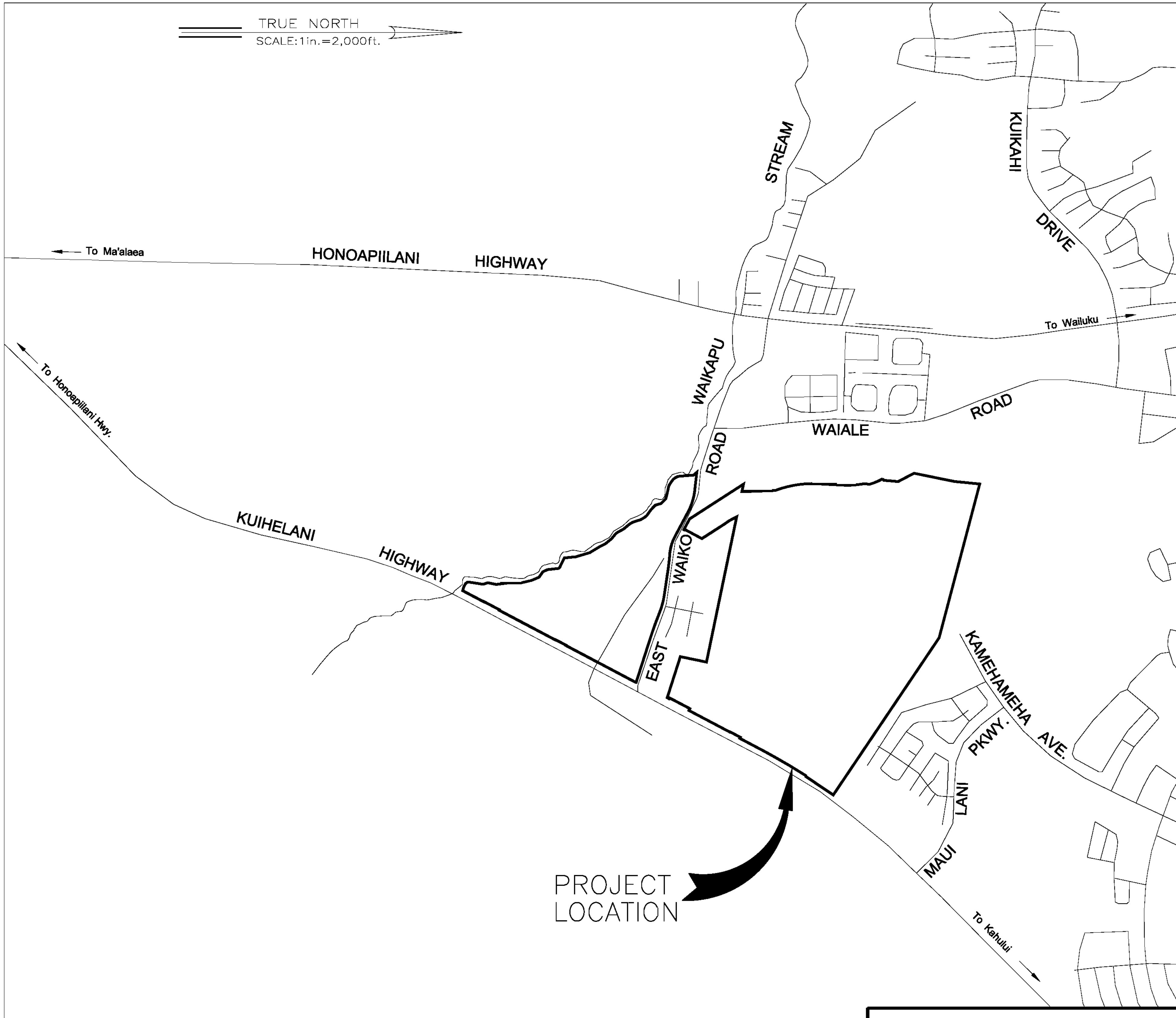
The proposed improvements for this project will be designed in accordance with the applicable rules and regulations of the County of Maui and the State of Hawaii. Utility company infrastructure upgrades will comply with MECO, HTCOM, and TW requirements and regulations. The Department of Public Work (DPW) Storm Drainage Rules require mitigation of the increase in stormwater runoff between the post-development conditions and pre-development conditions. Since the Wai'ale stormwater management plan results in a net decrease in stormwater runoff, the project exceeds DPW requirements. Erosion control and water quality measures will be provided to minimize pollution during and after construction. Water, Sewer, Roadway, and Electrical designs are sufficient to serve the proposed project.

Based on the information presented in this report, this project will have no adverse effects on the existing facilities or on the surrounding environment.

REFERENCES:

1. Department of Public Works & Waste Management, County of Maui. (November, 1995). *Rules for the Design of Storm Drainage Facilities in the County of Maui*, Title MC-15, Subtitle 01, Chapter 4.
2. County of Maui, Wastewater Reclamation Division, Wastewater Flow Standards, February 2, 2000.
3. Water System Standards, State of Hawaii, 2002.
4. Design Standards, Division of Wastewater Management, Vol. 1, February 1984.
5. USDA, Soil Conservation Service in Cooperation with the University of Hawaii Agricultural Experiment Station. (August, 1972). *Soil Survey of Island of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii*.
6. Federal Emergency Management Agency. (September 25, 2009). *Flood and Insurance Rate Map, Maui County, Hawaii.* Map Numbers: 1500030391E, 1500030393E, 1500030394E.
7. National Oceanic and Atmospheric Administration, National Weather Service (Formerly U.S Weather Bureau). (1962). *Technical Paper No. 43, Rainfall-Frequency Atlas of the Hawaiian Islands.*
8. Tom Nance Water Resource Engineering. (September 16, 2009, Revised September 25, 2009). *Engineering Report for Wai'ale Well 2 (State No. 5129-05) as a New Drinking Water Source, Kahului, Maui, Hawaii.*

EXHIBITS



VICINITY MAP

SCALE: 1" = 2,000'

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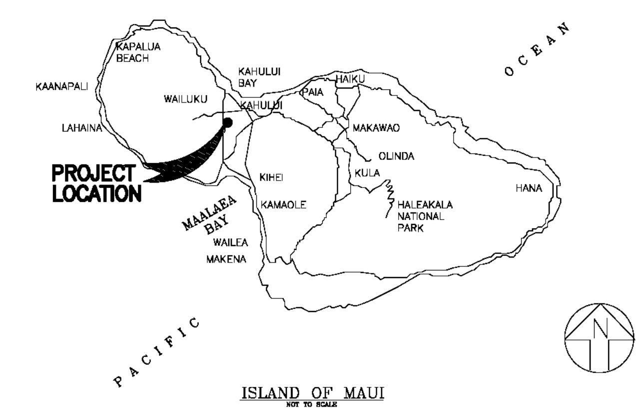
LINE IS 1 INCH AT FULL SIZE
(If NOT 1-Inch : Scale Accordingly)



PROJECT LOCATION

SCALE: NOT TO SCALE

PRELIMINARY ENGINEERING AND DRAINAGE REPORT WAI'ALE COMMUNITY PROJECT WAIKAPU, WAILUKU, MAUI	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS • HONOLULU, WAILUKU, HAWAII LOCATION AND VICINITY MAP	EXHIBIT 1

JOB NO. M-10-518
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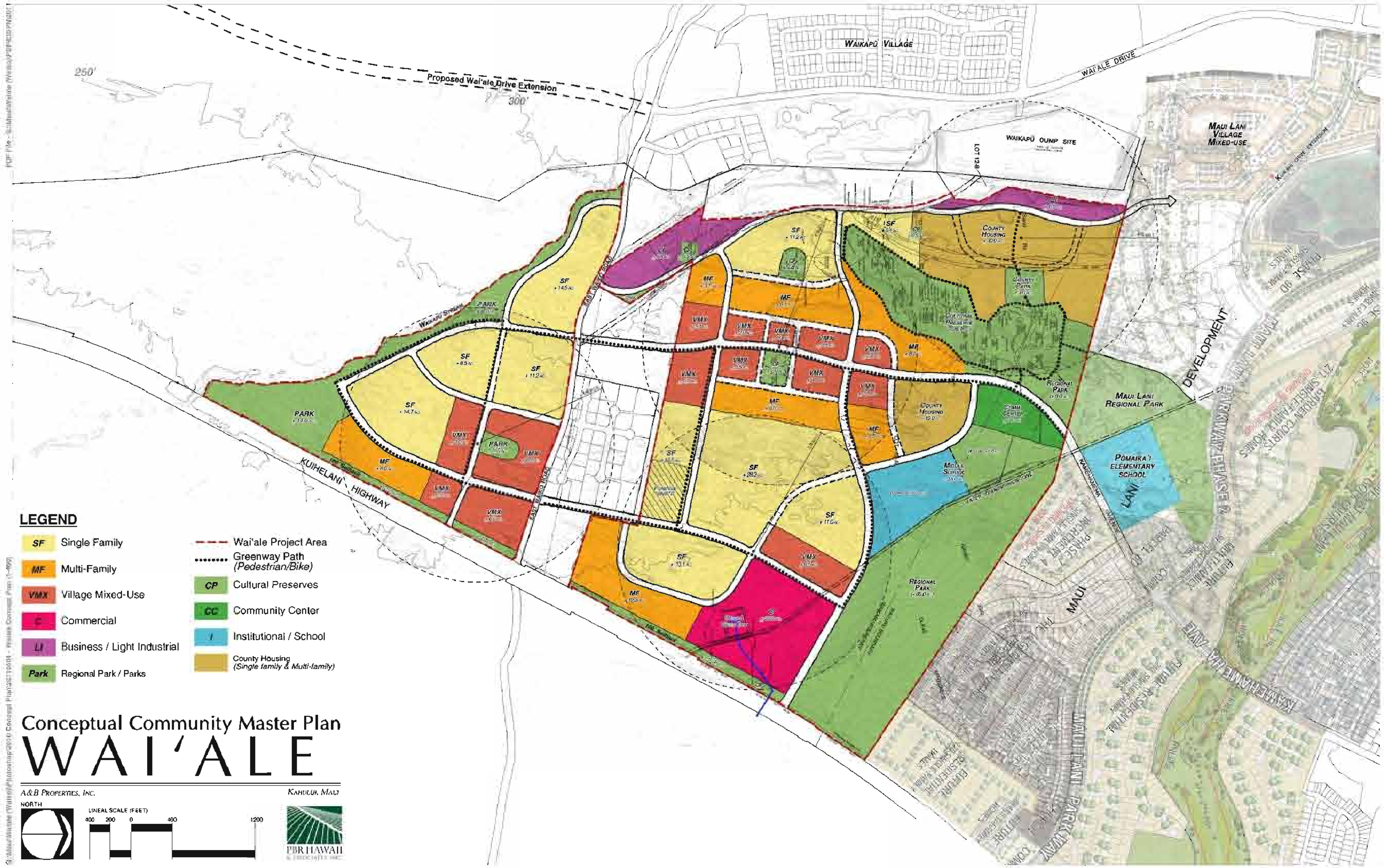
MARCH 2011



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LINE IS 1 INCH AT FULL SIZE
(IF NOT 1-inch : Scale Accordingly)

PRELIMINARY ENGINEERING AND DRAINAGE REPORT
WAI'ALE COMMUNITY PROJECT
WAIKAPU, WAILUKU, MAUI

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS, SURVEYORS • HONOLULU, WAILUKU, HAWAII

CONCEPTUAL MASTER PLAN

EXHIBIT
2

JOB NO. M-10-518
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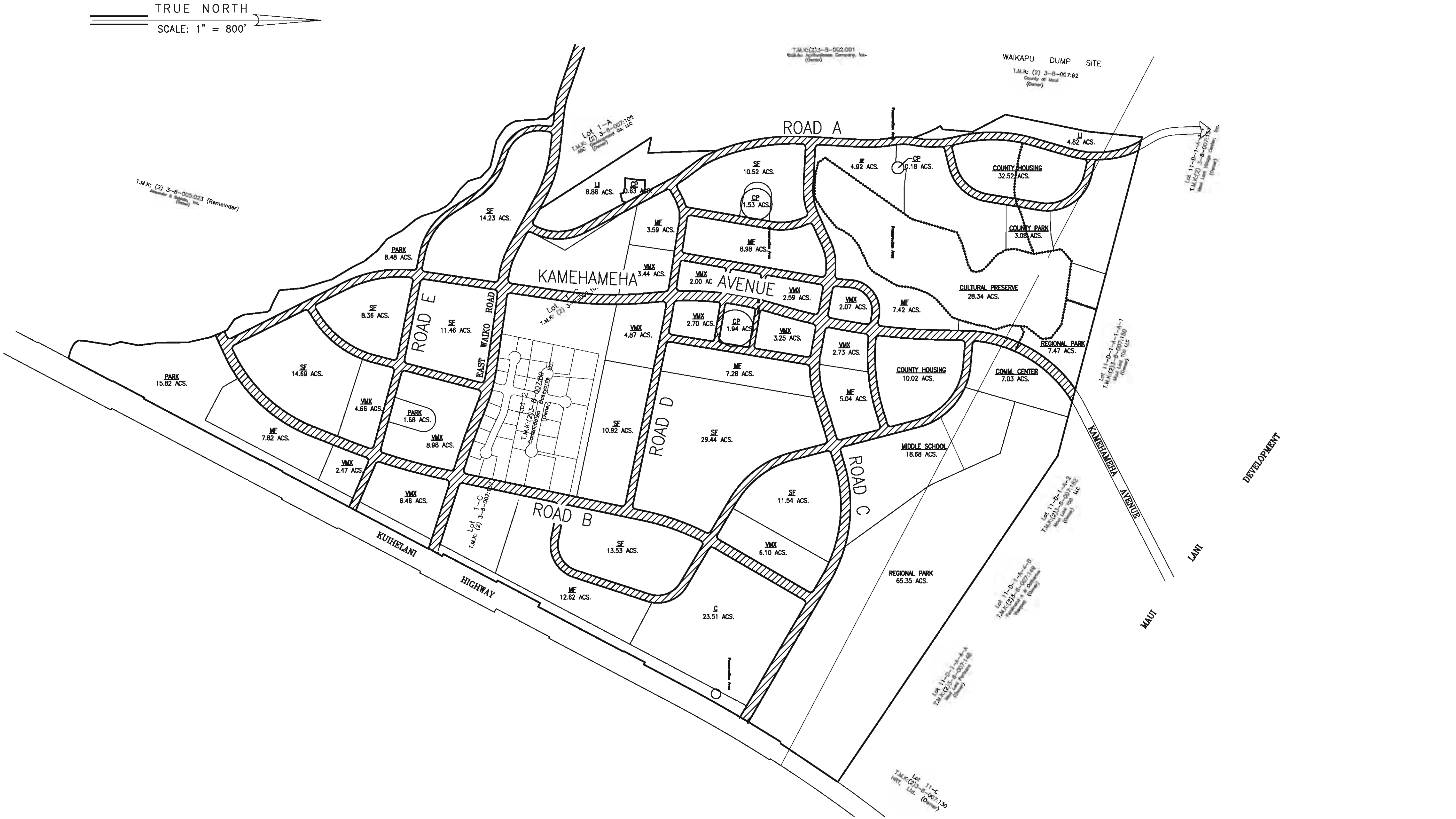
MAY 2011



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(If NOT 1-Inch : Scale Accordingly)

PRELIMINARY ENGINEERING AND DRAINAGE REPORT

WAI'ALE COMMUNITY PROJECT

WAIKAPU, WAILUKU, MAUI

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
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PRELIMINARY ROADWAY PLAN

EXHIBIT

2A

JOB NO. W-10-518
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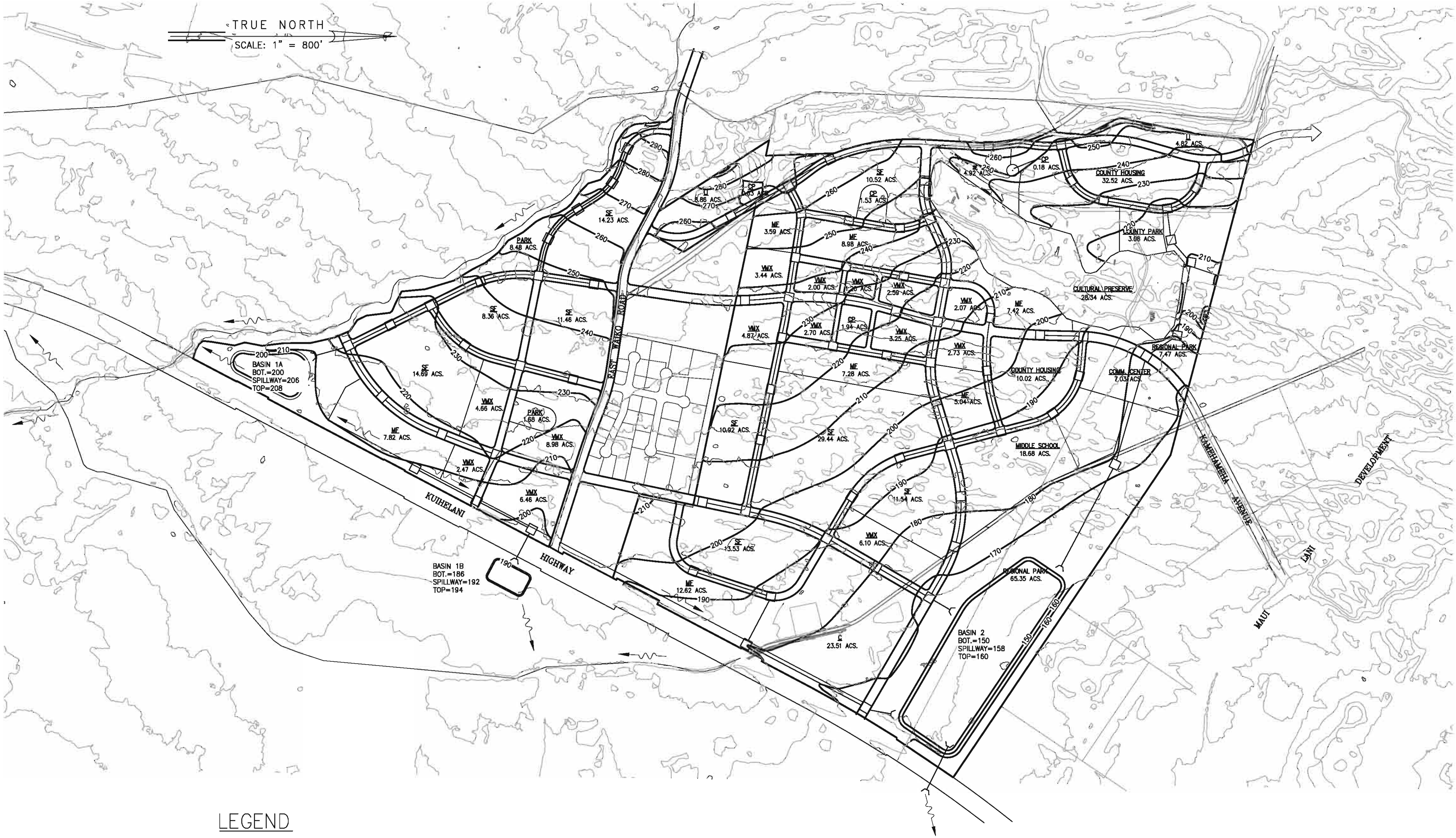
MARCH 2011



LEGEND

STORM DRAIN SYSTEM

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LINE IS 1 INCH AT FULL SIZE
(if NOT 1-inch : Scale Accordingly)

PRELIMINARY ENGINEERING AND DRAINAGE REPORT WAI'ALE COMMUNITY PROJECT WAIKAPU, WAILUKU, MAUI	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS • HONOLULU, WAILUKU, HAWAII PRELIMINARY GRADING AND DRAINAGE PLAN	EXHIBIT 3

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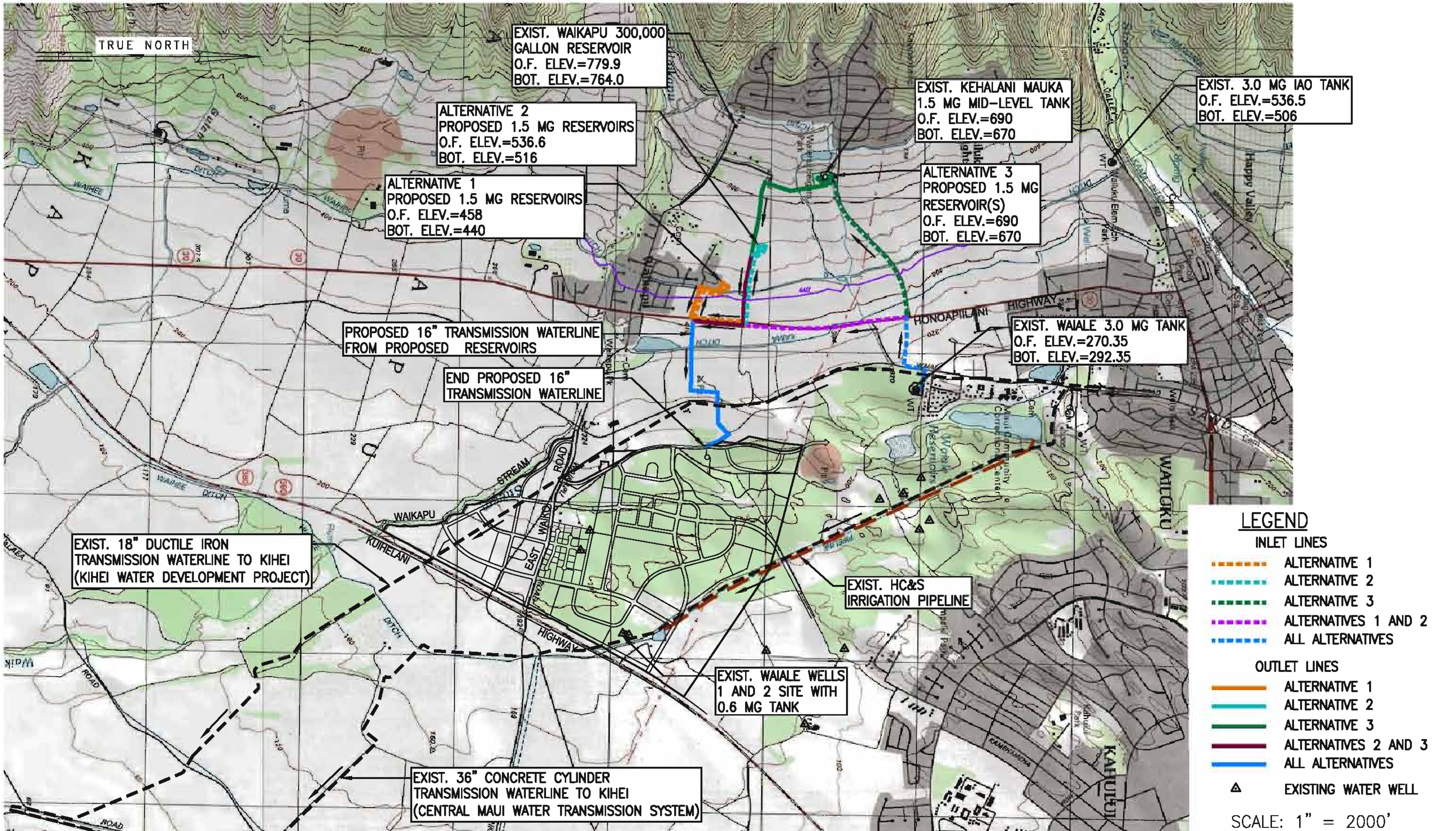
MARCH 2011



PRELIMINARY ENGINEERING AND DRAINAGE REPORT

WAI'ALE COMMUNITY PROJECT

WAIKAPU, WAILUKU, MAUI

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PROPOSED WATER SYSTEM ALTERNATIVES

EXHIBIT

4

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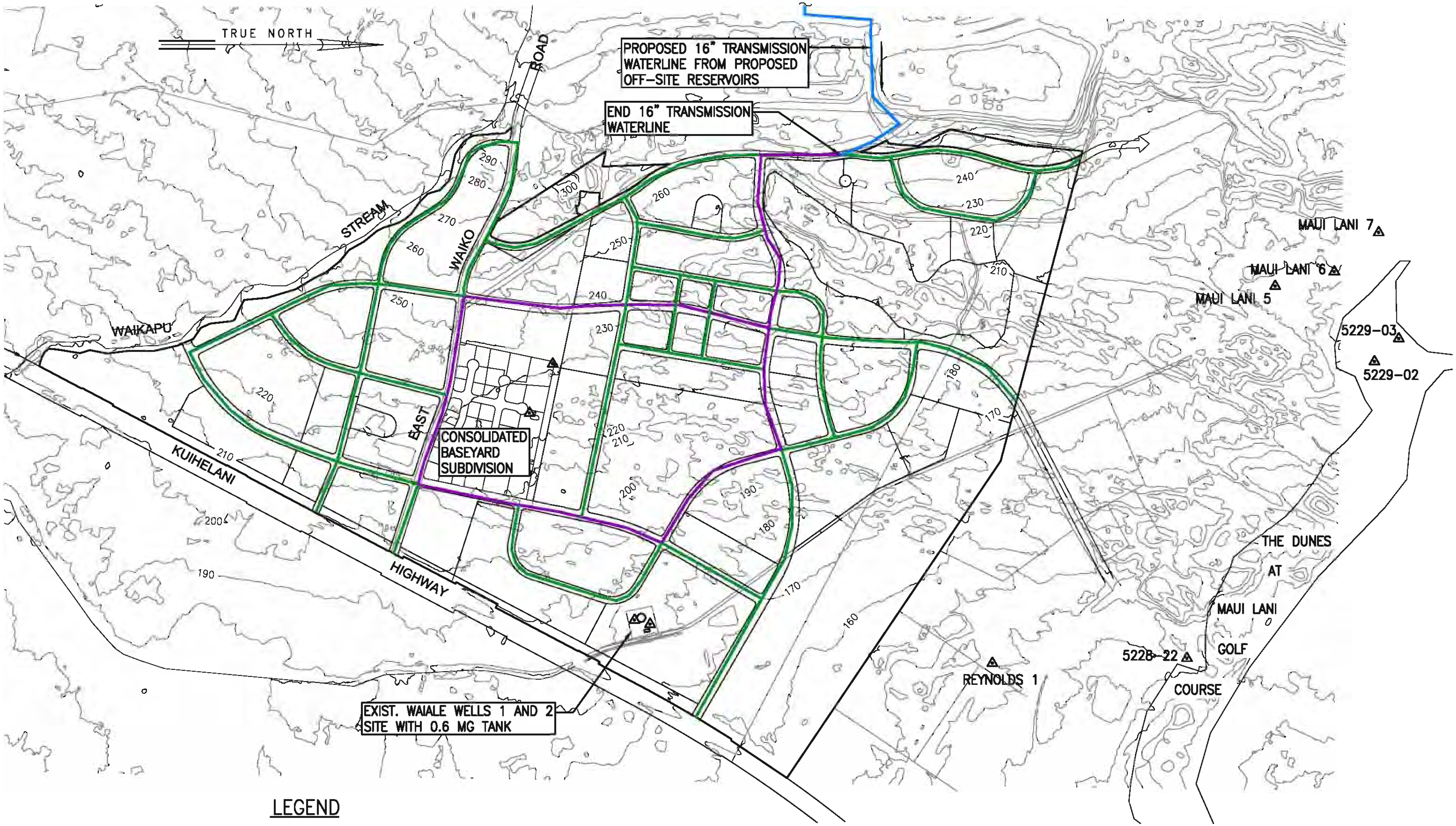
MARCH 2011



LEGEND

12" DISTRIBUTION WATERLINE
16" DISTRIBUTION WATERLINE
EXISTING WELL

SCALE: 1" = 800'

0 1
LINE IS 1 INCH AT FULL SIZE (If NOT 1-Inch : Scale Accordingly)

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WAI'ALE COMMUNITY PROJECT

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PROPOSED WATER DISTRIBUTION SYSTEM

EXHIBIT
5

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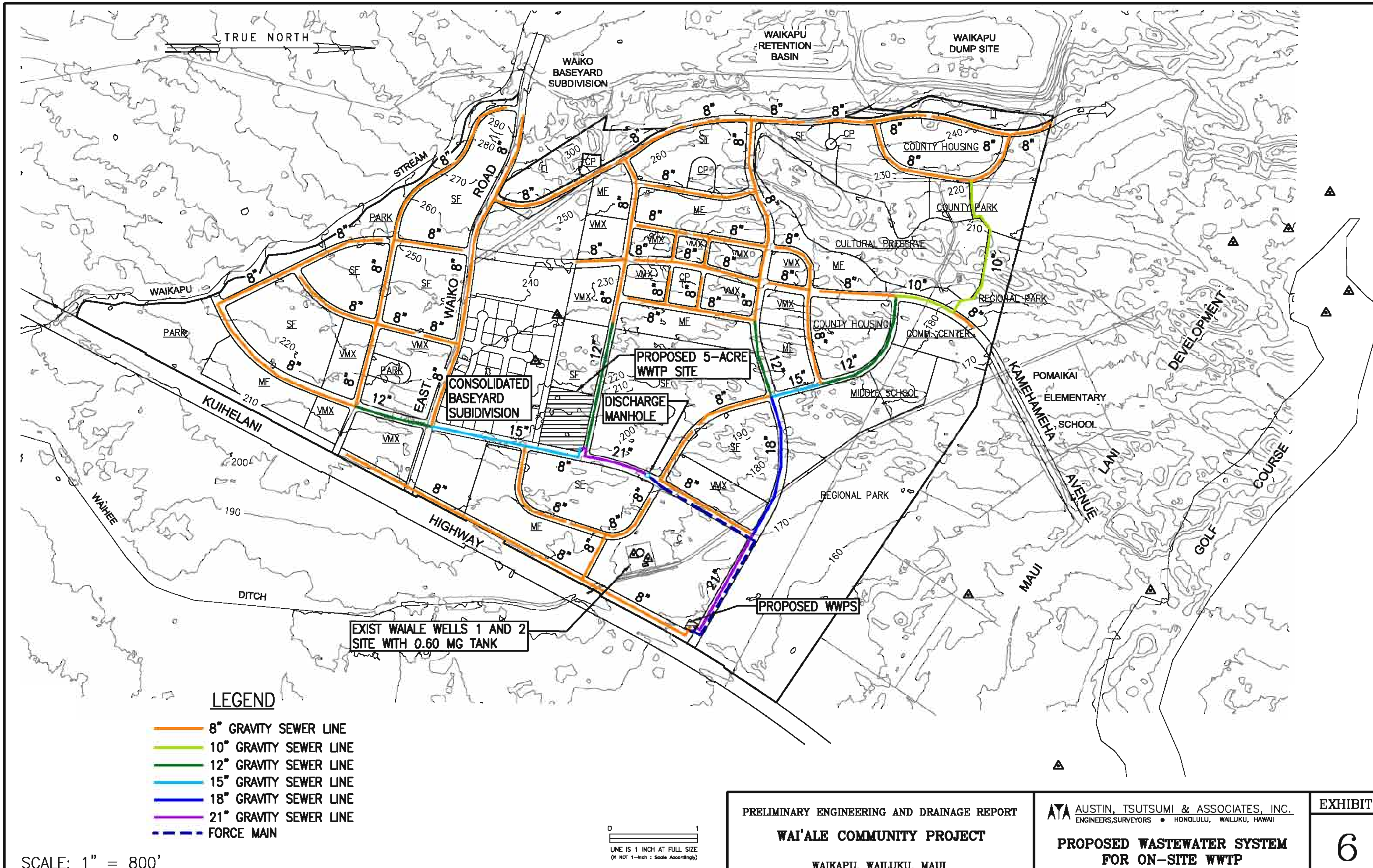
MARCH 2011



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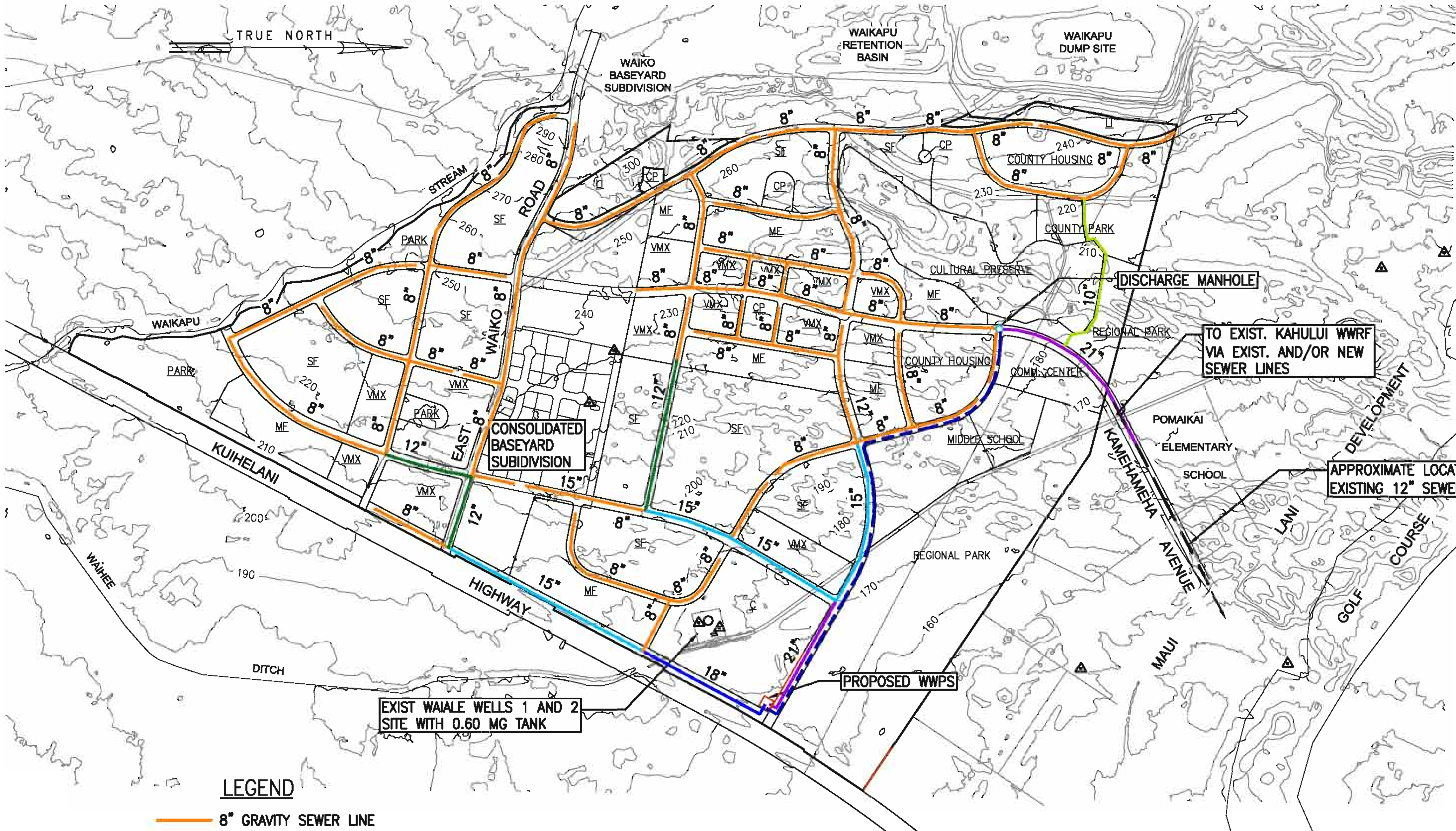
PROPOSED WASTEWATER SYSTEM FOR ON-SITE WWTP

EXHIBIT 6

JOB NO. M-10-518

MARCH 2011



LEGEND

- 8" GRAVITY SEWER LINE
- 10" GRAVITY SEWER LINE
- 12" GRAVITY SEWER LINE
- 15" GRAVITY SEWER LINE
- 18" GRAVITY SEWER LINE
- 21" GRAVITY SEWER LINE
- FORCE MAIN

SCALE: 1" = 800'

0 1
LINE IS 1 INCH AT FULL SIZE (IF NOT 1-Inch : Scale Accordingly)

PRELIMINARY ENGINEERING AND DRAINAGE REPORT

WAI'ALE COMMUNITY PROJECT

WAIKAPU, WAILUKU, MAUI

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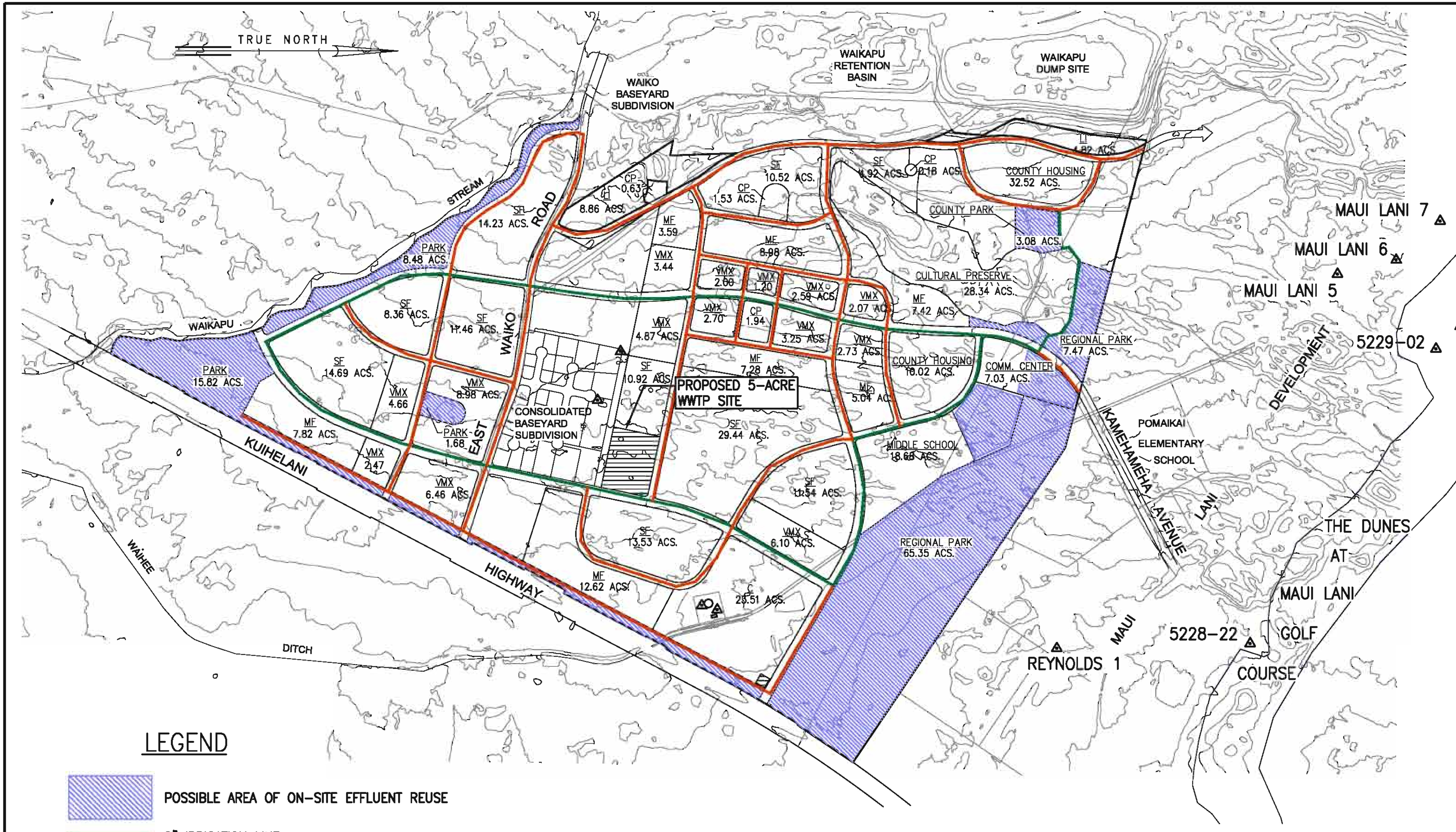
PROPOSED WASTEWATER SYSTEM FOR OFF-SITE WASTEWATER TREATMENT

EXHIBIT

7

JOB NO. M-10-518

MARCH 2011



PRELIMINARY ENGINEERING AND DRAINAGE REPORT

WAI'ALE COMMUNITY PROJECT

WAIKAPU, WAILUKU, MAUI

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
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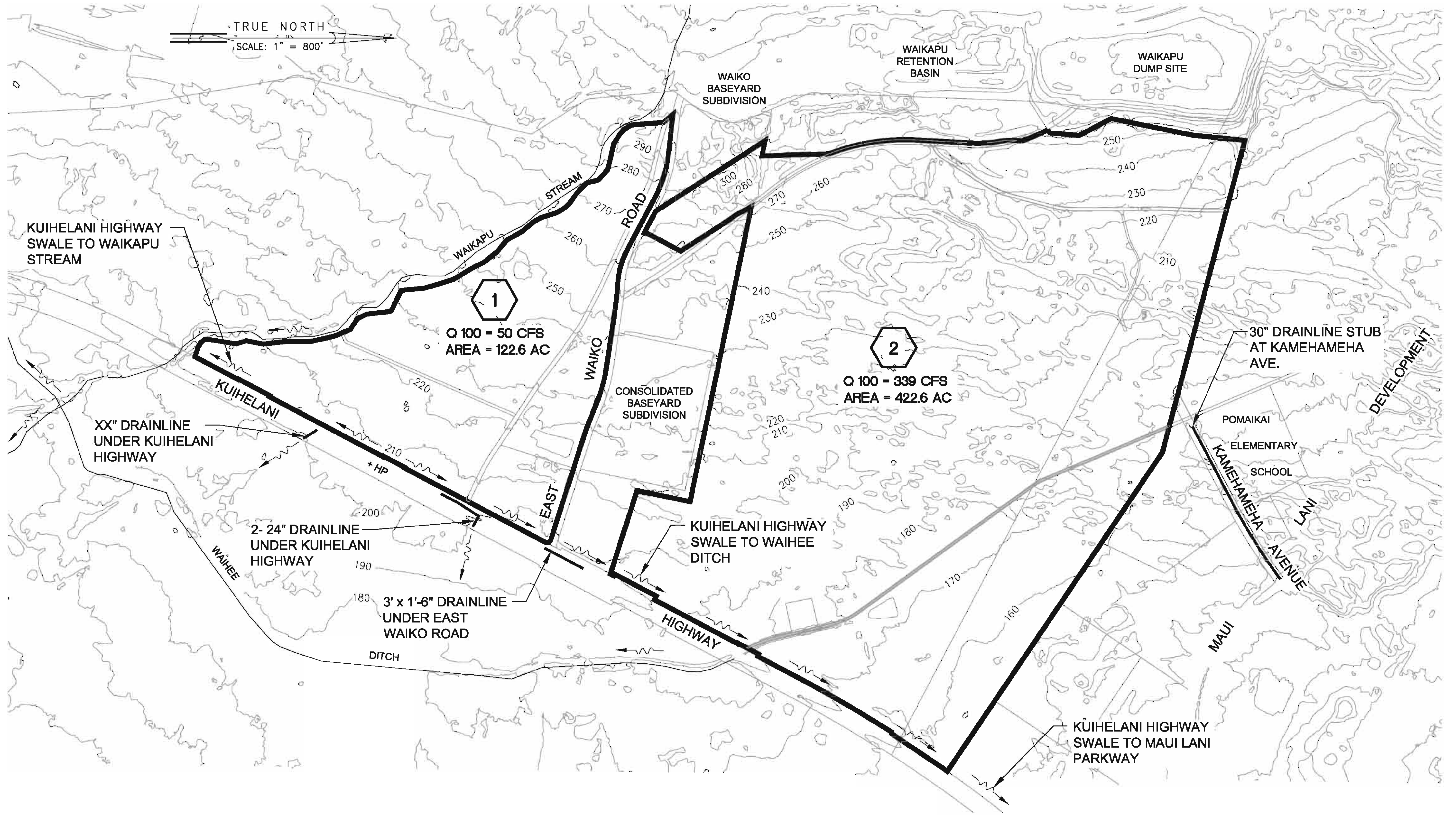
POTENTIAL AREAS OF EFFLUENT REUSE

EXHIBIT 8

JOB NO. M-10-518

APRIL 2011



PRELIMINARY ENGINEERING AND DRAINAGE REPORT

WAI'ALE COMMUNITY PROJECT

WAIKAPU, WAILUKU, MAUI

0 1

LINE IS 1 INCH AT FULL SIZE
(If NOT 1-inch : Scale Accordingly)

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DRAINAGE AREA MAP– EXISTING CONDITIONS

EXHIBIT 9

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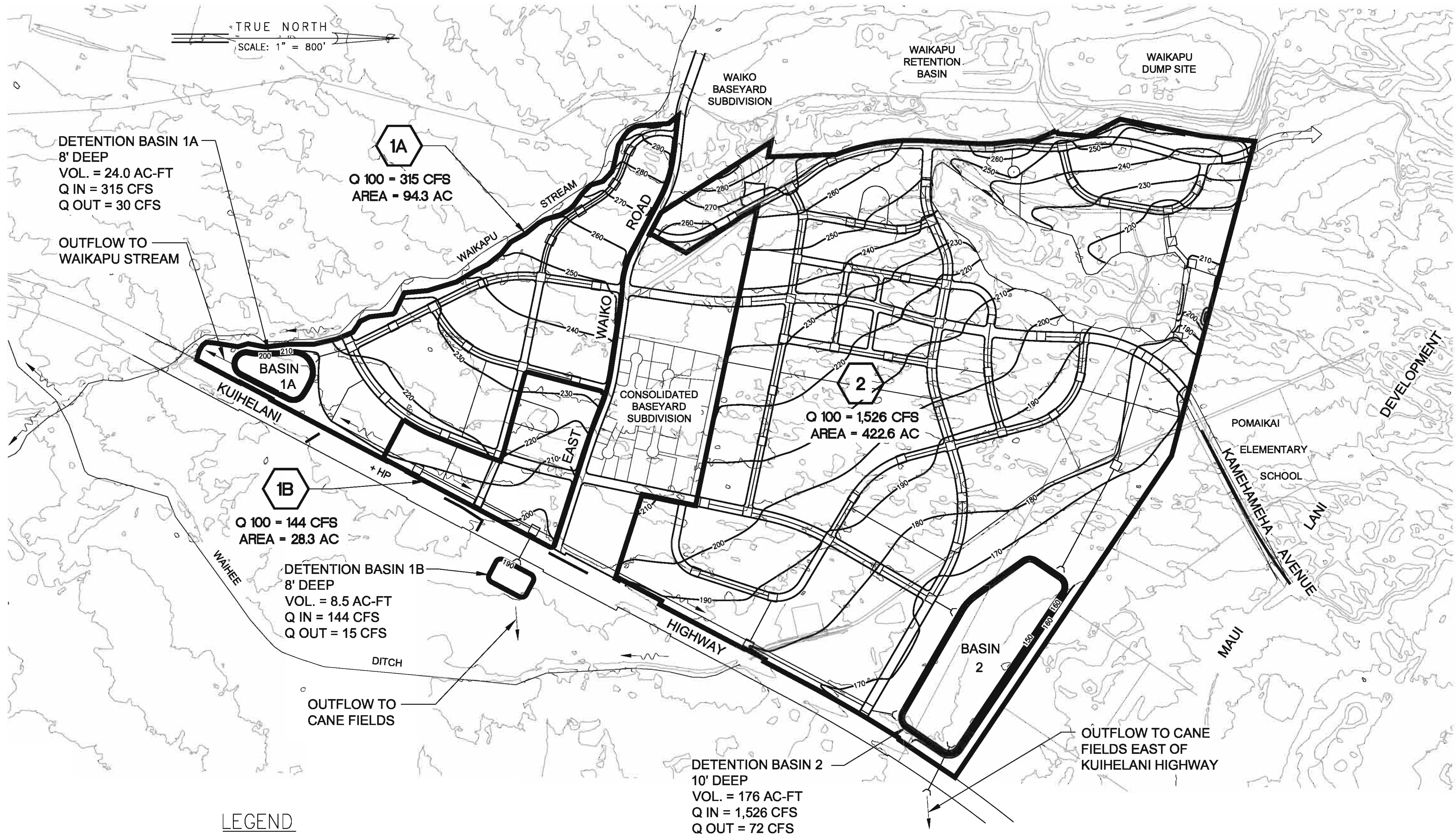
MARCH 2011



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LINE IS 1 INCH AT FULL SIZE
(If NOT 1-Inch : Scale Accordingly)

PRELIMINARY ENGINEERING AND DRAINAGE REPORT

WAI'ALE COMMUNITY PROJECT

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DRAINAGE AREA MAP–
PROPOSED CONDITIONS

EXHIBIT
10

JOB NO. M-10-518
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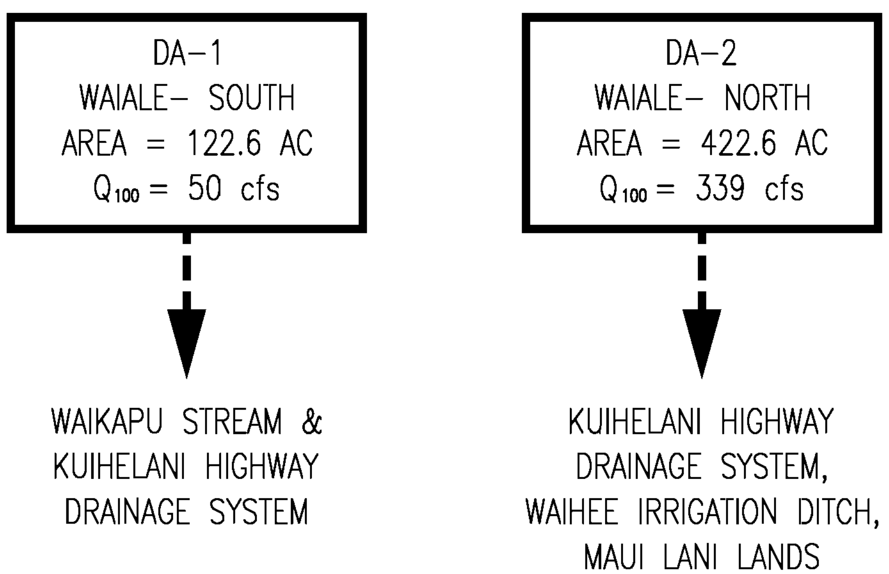
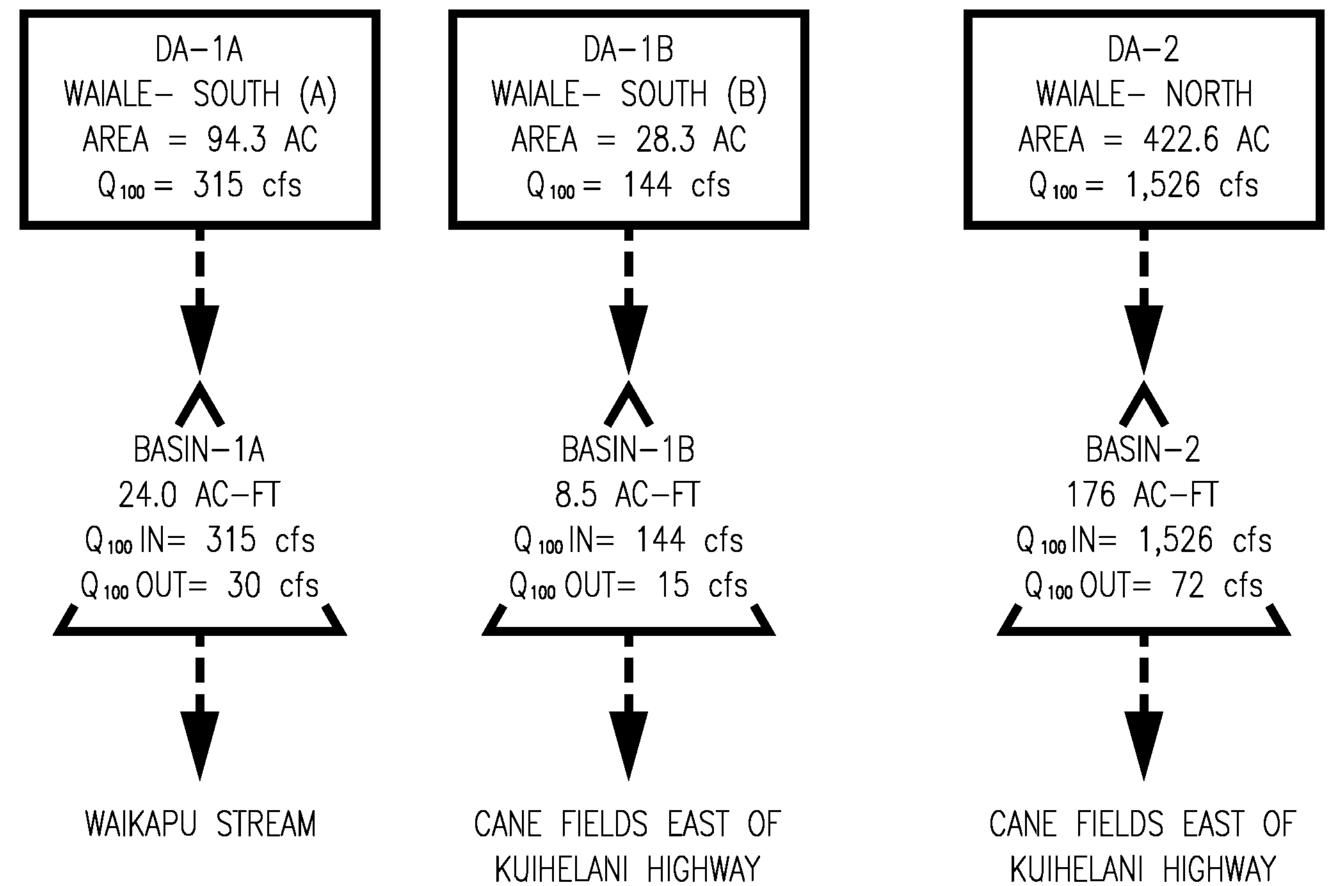
MARCH 2011

PRE-DEVELOPMENT FLOWS
100-YR, 24-HR



POST-DEVELOPMENT FLOWS
100-YR, 24-HR



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(If NOT 1-inch : Scale Accordingly)

PRELIMINARY ENGINEERING AND DRAINAGE REPORT
WAI'ALE COMMUNITY PROJECT
WAIKAPU, WAILUKU, MAUI

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DRAINAGE FLOWCHART

EXHIBIT
11

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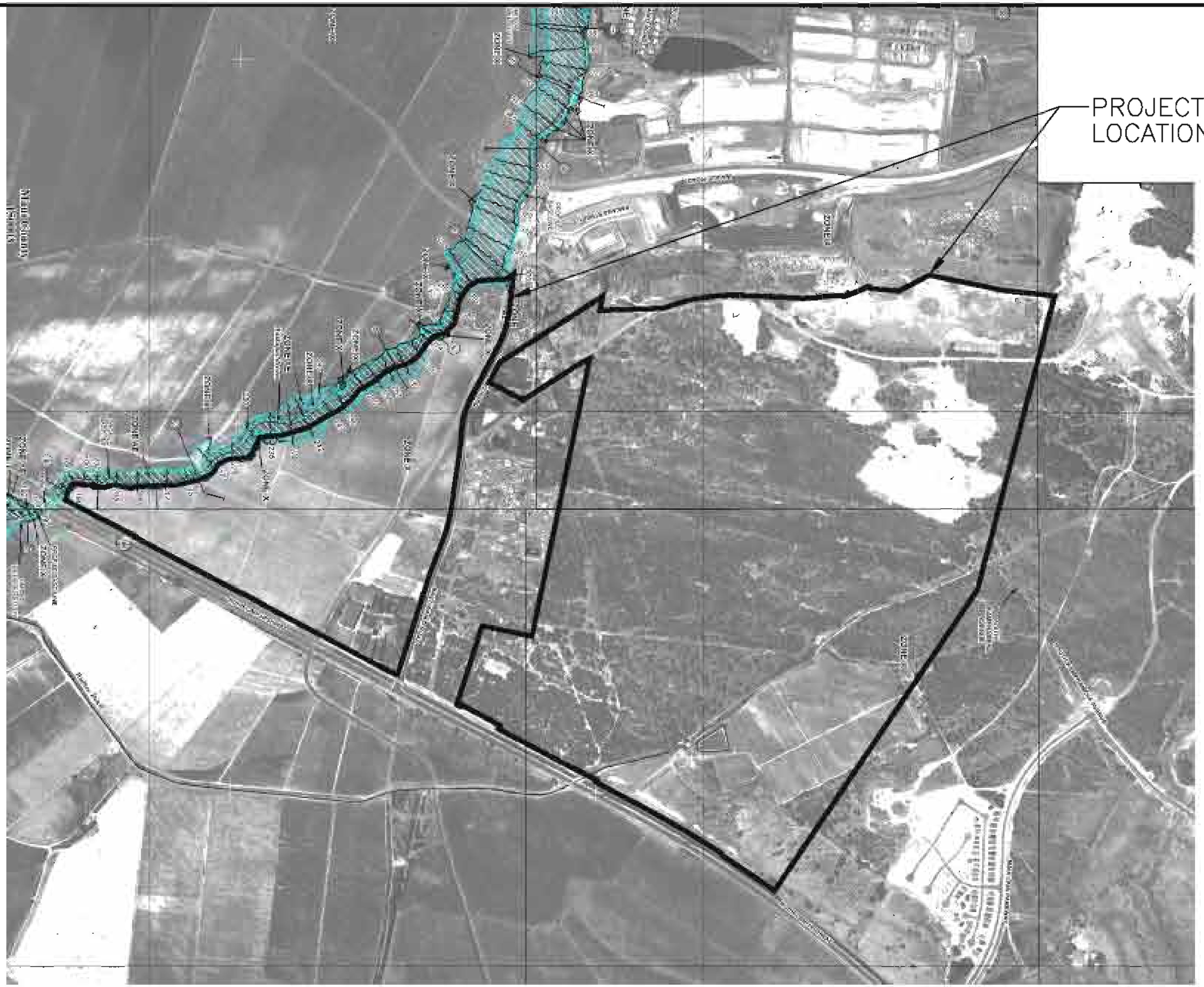
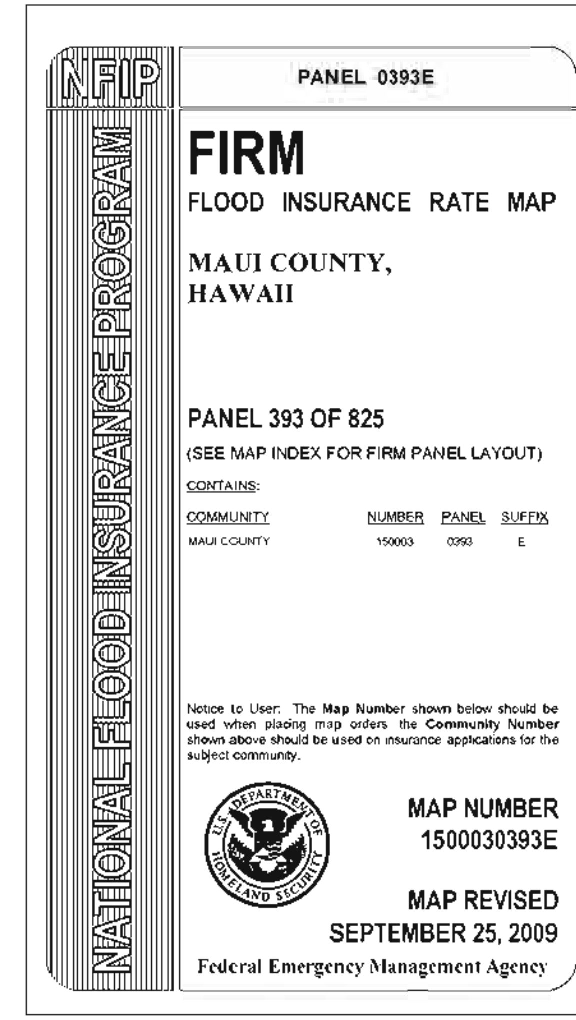
MARCH 2011





NOTE: THE FOLLOWING FLOOD MAPS COVER THE PROJECT AREA:
1500030391E
1500030393E
1500030394E

0 1
LINE IS 1 INCH AT FULL SIZE
(IF NOT 1-inch : Scale Accordingly)

PRELIMINARY ENGINEERING AND DRAINAGE REPORT
WAI'ALE COMMUNITY PROJECT
WAIKAPU, WAILUKU, MAUI

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FLOOD ZONE MAP

EXHIBIT
12

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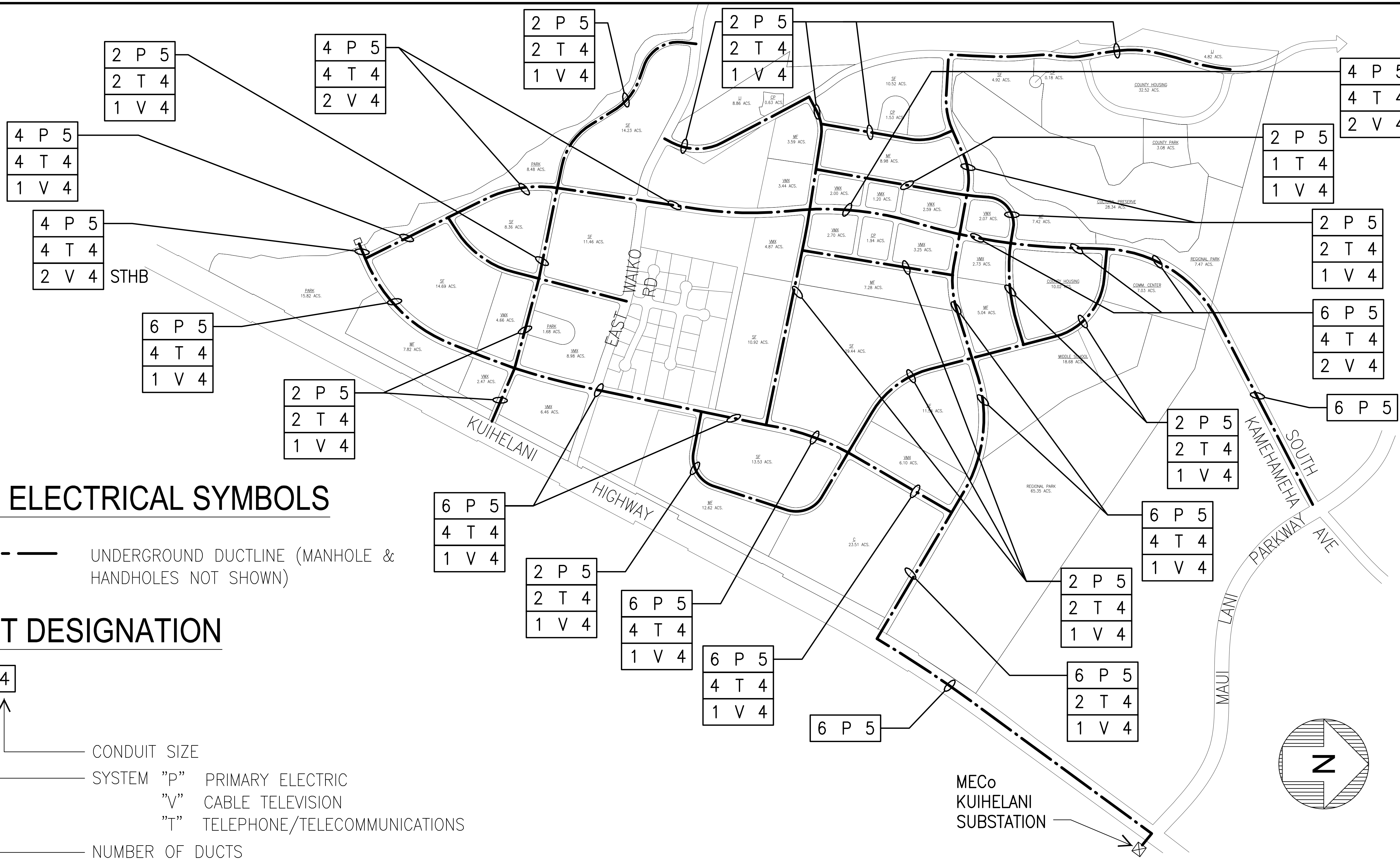
MARCH 2011



SITE ELECTRICAL SYMBOLS

UNDERGROUND DUCTLINE (MANHOLE & HANDHOLES NOT SHOWN)

DUCT DESIGNATION

2 P 4

CONDUIT SIZE

SYSTEM "P" PRIMARY ELECTRIC
"V" CABLE TELEVISION
"T" TELEPHONE/TELECOMMUNICATIONS

NUMBER OF DUCTS

0' 800' 1600' 2400'

PRELIMINARY ELECTRICAL ENGINEERING REPORT

WAI'ALE COMMUNITY PROJECT

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CONCEPT ELECTRICAL MASTER PLAN

EXHIBIT

13

JOB NO. M-10-518

FEBRUARY 2011

APPENDICIES

APPENDIX A

DRAINAGE SYSTEM

PROJECT: WAI'ALE COMMUNITY PROJECT

PRELIMINARY HYDROLOGY CALCULATIONS

TABLE 1

EXISTING RUNOFF SUMMARY

Drainage Area	Description	Area (ac)	Curve Number	Tc (min)	Design Recurrence Interval	24-Hr Rainfall (in)	Peak Runoff (cfs)	24-Hr Runoff Volume (ac-ft)
1	Waiale Development-South of Waiko Road	122.6	40	57.0	100-yr	9.8	50	21.040
2	Waiale Development-North of Waiko Road	422.6	55	104.7	100-yr	9.8	339	137.459
Totals		545.2					389	158.499

TABLE 2

PROPOSED RUNOFF SUMMARY

Drainage Area	Description	Area (ac)	Curve Number	Tc (min)	Design Recurrence Interval	24-Hr Rainfall (in)	Peak Runoff (cfs)	24-Hr Runoff Volume (ac-ft)
1A	Waiale Development-South of Waiko Road (Excluding NE Cor.)	94.3	71	22.3	100-yr	9.8	315 *	48.230
1B	Waiale Development-South of Waiko Road (NE Cor. of S. Site)	28.3	83	14.5	100-yr	9.8	144 *	18.121
2	Waiale Development-North of Waiko Road	422.6	78	25.5	100-yr	9.8	1,526 *	247.545
Totals		545.2					1,985 *	313.896

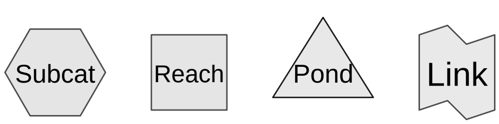
Notes:
1. Rainfall from TP-43, Rainfall Frequency Atlas of the Hawaiian Islands, 1962.
2. See Appendix for HydroCAD TR-20 calculations which include weighted CN and Tc calculations.
3. Runoff rates from proposed drainage areas (marked with "*") are the flow rates prior to detention. Runoff from these areas will be managed so that it does not exceed existing conditions.

TABLE 3

STORAGE SYSTEM SUMMARY

Basin No.	Contributing Drainage Area (ac)	Description	Storage Vol. at Overflow (ac-ft)	Approx. Pond Surface Area (ac)	Q_{in} (cfs)	Q_{out} (cfs)	24-hr Vol. $_{in}$ (ac-ft)	24-hr Vol. $_{out}$ (ac-ft)	Meets Req.?
Basin "1A"	94.3	8' Deep Detention Basin	24.0	4.0	315	30	48.230	30.749	√
Basin "1B"	28.3	8' Deep Detention Basin	8.5	1.4	144	15	18.121	13.488	√
Basin "2"	422.6	10' Deep Detention Basin	176.0	22.0	1,526	72	247.545	74.247	√
Totals	545.2		208.5		1,985	117	313.896	118.484	

Notes: 1. See Appendix for HydroCAD TR-20 calculations.



Routing Diagram for Waiale Existing Cond
Prepared by Austin, Tsutsumi & Associates, Printed 2/28/2011

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1: Waiale- South Area Runoff Area=122.600 ac Runoff Depth>2.06"
Flow Length=3,460' Tc=57.0 min CN=40 Runoff=49.84 cfs 21.040 af

Subcatchment 2: Waiale- North Area Runoff Area=422.600 ac Runoff Depth>3.90"
Flow Length=4,320' Slope=0.0260 '/' Tc=104.7 min CN=55 Runoff=339.35 cfs 137.459 af

Total Runoff Area = 545.200 ac Runoff Volume = 158.498 af Average Runoff Depth = 3.49"

Summary for Subcatchment 1: Waiale- South Area

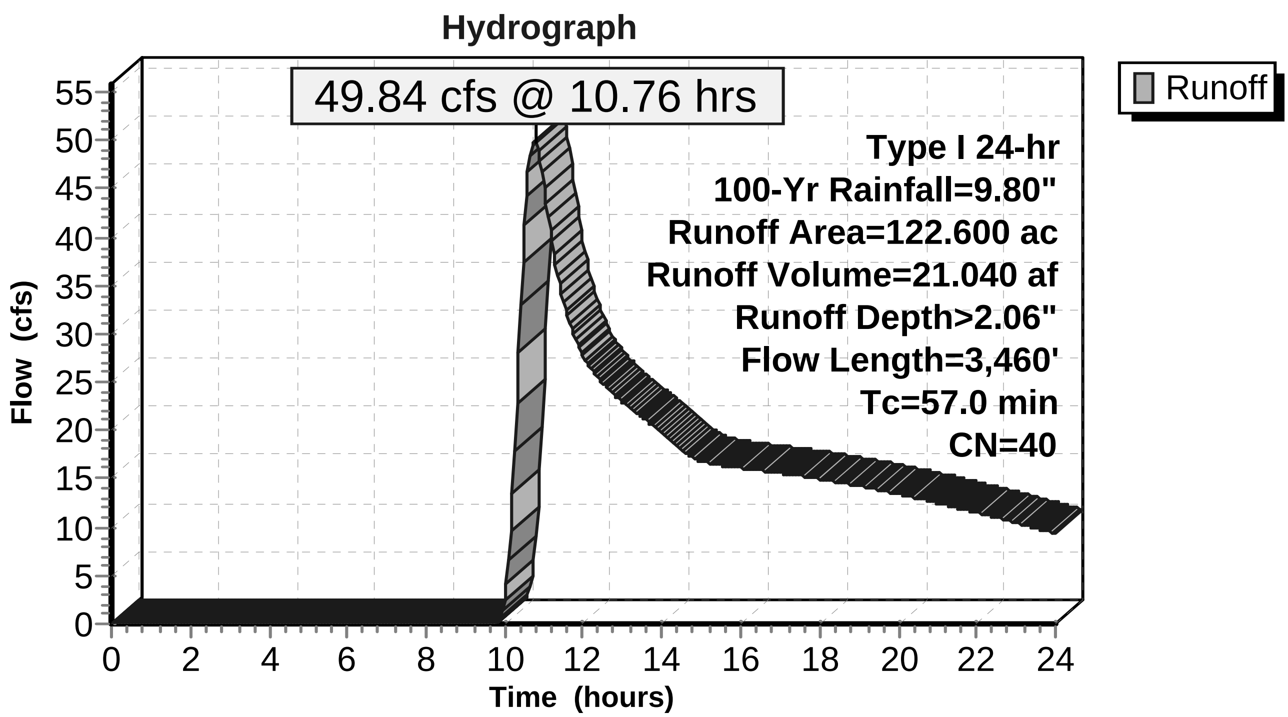
Runoff = 49.84 cfs @ 10.76 hrs, Volume= 21.040 af, Depth> 2.06"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr 100-Yr Rainfall=9.80"

Area (ac)	CN	Description
75.900	30	Brush, Good, HSG A
23.200	48	Brush, Good, HSG B
9.600	56	Brush, Fair, HSG B
4.900	55	Woods, Good, HSG B
5.100	75	Row crops, SR + CR, Good, HSG B
0.900	98	Unconnected pavement, HSG A
3.000	98	Unconnected pavement, HSG B
122.600	40	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.1	100	0.0310	0.54		**Sheet Flow,** Fallow n= 0.050 P2= 3.90"
53.9	3,360	0.0220	1.04		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
57.0	3,460	Total			

Subcatchment 1: Waiale- South Area



Summary for Subcatchment 2: Waiale- North Area

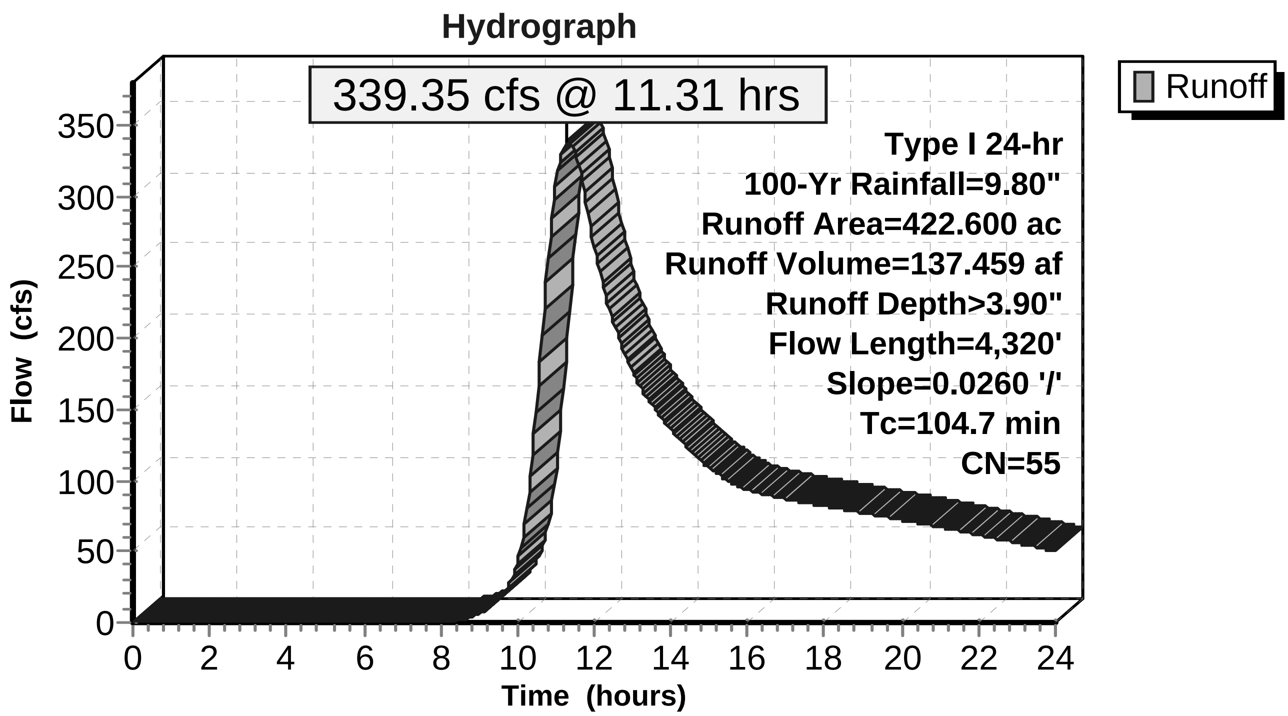
Runoff = 339.35 cfs @ 11.31 hrs, Volume= 137.459 af, Depth> 3.90"

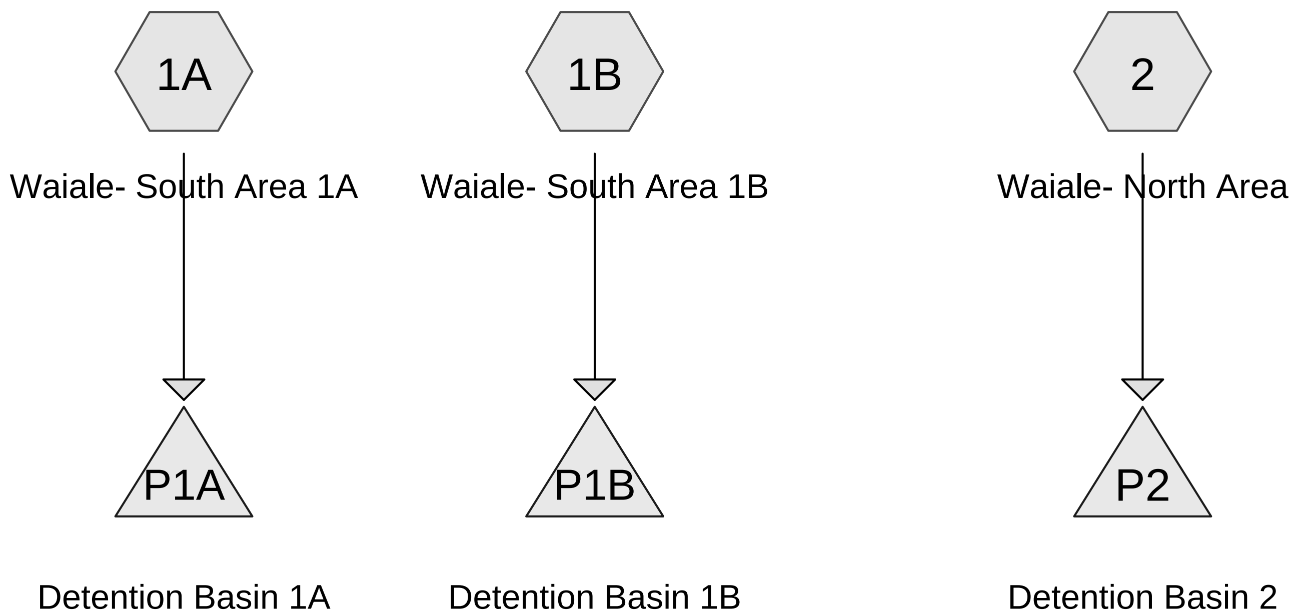
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr 100-Yr Rainfall=9.80"

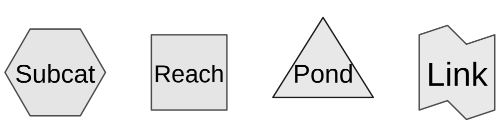
Area (ac)	CN	Description
26.400	56	Brush, Fair, HSG B
325.300	48	Brush, Good, HSG B
67.100	86	Newly graded area, HSG B
3.700	98	Unconnected pavement, HSG B
0.100	98	Unconnected roofs, HSG B
422.600	55	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.5	100	0.0260	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.90"
87.2	4,220	0.0260	0.81		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
104.7	4,320	Total			

Subcatchment 2: Waiale- North Area







Routing Diagram for Waiale Proposed Cond
Prepared by Austin, Tsutsumi & Associates, Printed 2/28/2011
HydroCAD® 9.11 s/n 03149 © 2010 HydroCAD Software Solutions LLC

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1A: Waiale- South Area 1A Runoff Area=94.300 ac Runoff Depth>6.14"
Flow Length=3,740' Tc=22.3 min CN=71 Runoff=315.16 cfs 48.230 af

Subcatchment 1B: Waiale- South Area 1B Runoff Area=28.300 ac Runoff Depth>7.68"
Flow Length=1,080' Tc=14.5 min CN=83 Runoff=143.79 cfs 18.121 af

Subcatchment 2: Waiale- North Area Runoff Area=422.600 ac Runoff Depth>7.03"
Flow Length=5,490' Tc=25.5 min CN=78 Runoff=1,525.59 cfs 247.545 af

Pond P1A: Detention Basin 1A Peak Elev=5.87' Storage=23.495 af Inflow=315.16 cfs 48.230 af
Outflow=29.79 cfs 30.749 af

Pond P1B: Detention Basin 1B Peak Elev=6.00' Storage=8.497 af Inflow=143.79 cfs 18.121 af
Outflow=15.17 cfs 13.488 af

Pond P2: Detention Basin 2 Peak Elev=7.95' Storage=174.902 af Inflow=1,525.59 cfs 247.545 af
Outflow=71.80 cfs 74.247 af

Total Runoff Area = 545.200 ac Runoff Volume = 313.896 af Average Runoff Depth = 6.91"

Summary for Subcatchment 1A: Waiale- South Area 1A

Special Note:
Waiale Land Use and Corresponding TR-55 Standard Land Use Category:

Single-Family =	Residential 1/8 acre average lot size
Multi-Family =	Residential 1/8 acre average lot size
Village Mixed-Use =	Commercial and Business
Commercial =	Commercial and Business
Business/ Lt. Industrial =	Industrial
Regional Park =	Open Space (lawns, parks, etc.)
Cultural Preserves =	Brush, Weed, Grass Mix
Community Center =	Residential 2 acre average lot size
Institutional/ School =	Residential 1/8 acre average lot size
County Housing =	Residential 1/8 acre average lot size
Public Road ROW =	Streets and Roads, Paved, incl. ROW

Runoff = 315.16 cfs @ 10.15 hrs, Volume= 48.230 af, Depth> 6.14"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr 100-Yr Rainfall=9.80"

	Area (ac)	CN	Description
*	26.500	77	Single-Family, HSG A
*	22.200	85	Single-Family, HSG B
*	4.300	77	Multi-Family, HSG A
*	4.700	89	Village Mixed-Use, HSG A
*	22.800	39	Regional Park, HSG A
*	9.000	83	Public Road ROW, HSG A
*	4.800	89	Public Road ROW, HSG B
	94.300	71	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.1	100	0.0100	0.10		**Sheet Flow, Off Residential Lot** Grass: Dense n= 0.240 P2= 3.90"
5.2	3,640	0.0220	11.57	36.35	**Pipe Channel, Roadway Storm Drain System** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.012
22.3	3,740	Total			

Summary for Subcatchment 1B: Waiale- South Area 1B

Special Note:
Waiale Land Use and Corresponding TR-55 Standard Land Use Category:

Single-Family =	Residential 1/8 acre average lot size
Multi-Family =	Residential 1/8 acre average lot size
Village Mixed-Use =	Commercial and Business
Commercial =	Commercial and Business
Business/ Lt. Industrial =	Industrial
Regional Park =	Open Space (lawns, parks, etc.)
Cultural Preserves =	Brush, Weed, Grass Mix
Community Center =	Residential 2 acre average lot size
Institutional/ School =	Residential 1/8 acre average lot size
County Housing =	Residential 1/8 acre average lot size
Public Road ROW =	Streets and Roads, Paved, incl. ROW

Runoff = 143.79 cfs @ 10.06 hrs, Volume= 18.121 af, Depth> 7.68"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr 100-Yr Rainfall=9.80"

	Area (ac)	CN	Description
*	3.500	77	Multi-Family, HSG A
*	3.500	89	Village Mixed-Use, HSG A
*	14.400	92	Village Mixed-Use, HSG B
*	2.500	39	Regional Park, HSG A
*	2.000	61	Regional Park, HSG B
*	0.500	83	Public Road ROW, HSG A
*	1.900	89	Public Road ROW, HSG B
	28.300	83	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.4	100	0.0220	0.13		**Sheet Flow, Off Residential Lot** Grass: Dense n= 0.240 P2= 3.90"
2.1	980	0.0100	7.80	24.51	**Pipe Channel, Roadway Storm Drain System** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.012
14.5	1,080	Total			

Summary for Subcatchment 2: Waiale- North Area

Special Note:
Waiale Land Use and Corresponding TR-55 Standard Land Use Category:

Single-Family =	Residential 1/8 acre average lot size
Multi-Family =	Residential 1/8 acre average lot size
Village Mixed-Use =	Commercial and Business
Commercial =	Commercial and Business
Business/ Lt. Industrial =	Industrial
Regional Park =	Open Space (lawns, parks, etc.)
Cultural Preserves =	Brush, Weed, Grass Mix
Community Center =	Residential 2 acre average lot size
Institutional/ School =	Residential 1/8 acre average lot size
County Housing =	Residential 1/8 acre average lot size
Public Road ROW =	Streets and Roads, Paved, incl. ROW

Runoff = 1,525.59 cfs @ 10.19 hrs, Volume= 247.545 af, Depth> 7.03"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr 100-Yr Rainfall=9.80"

	Area (ac)	CN	Description
*	80.900	85	Single-Family, HSG B
*	44.900	85	Multi-Family, HSG B
*	31.000	92	Village Mixed-Use, HSG B
*	23.500	92	Commercial, HSG B
*	13.700	88	Business/ Lt. Industrial, HSG B
*	86.800	61	Regional Park, HSG B
*	32.600	48	Cultural Preserves, HSG B
*	7.000	65	Community Center, HSG B
*	12.700	85	Institutional/ School, HSG B
*	40.100	85	County Housing, HSG B
*	49.400	89	Public Road ROW, HSG B
	422.600	78	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.1	100	0.0100	0.10		**Sheet Flow, Off Residential Lot** Grass: Dense n= 0.240 P2= 3.90"
8.4	5,390	0.0190	10.75	33.78	**Pipe Channel, Roadway Storm Drain System** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.012
25.5	5,490	Total			

Summary for Pond P1A: Detention Basin 1A

Inflow Area = 94.300 ac, Inflow Depth > 6.14" for 100-Yr event
Inflow = 315.16 cfs @ 10.15 hrs, Volume= 48.230 af
Outflow = 29.79 cfs @ 13.90 hrs, Volume= 30.749 af, Atten= 91%, Lag= 224.6 min
Primary = 29.79 cfs @ 13.90 hrs, Volume= 30.749 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 5.87' @ 13.90 hrs Surf.Area= 0.000 ac Storage= 23.495 af

Plug-Flow detention time= 383.5 min calculated for 30.685 af (64% of inflow)
Center-of-Mass det. time= 222.0 min (1,015.2 - 793.2)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	32.000 af	**8' Deep Detention** Listed below

Elevation (feet)	Cum.Store (acre-feet)
0.00	0.000
6.00	24.000
8.00	32.000

Device	Routing	Invert	Outlet Devices
#1	Primary	2.00'	**18.0" Round Low-Flow Culvert Outlet X 2.00** L= 100.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 2.00' / 1.00' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf
#2	Primary	6.00'	**127.0 deg x 10.0' long Overflow Spillway- Sharp-Crested Trap Weir** Cv= 2.48 (C= 3.10)

Primary OutFlow Max=29.79 cfs @ 13.90 hrs HW=5.87' (Free Discharge)
↑—**1=Low-Flow Culvert Outlet** (Barrel Controls 29.79 cfs @ 8.43 fps)
└—**2=Overflow Spillway- Sharp-Crested Trap Weir** (Controls 0.00 cfs)

Summary for Pond P1B: Detention Basin 1B

Inflow Area = 28.300 ac, Inflow Depth > 7.68" for 100-Yr event
Inflow = 143.79 cfs @ 10.06 hrs, Volume= 18.121 af
Outflow = 15.17 cfs @ 11.92 hrs, Volume= 13.488 af, Atten= 89%, Lag= 111.8 min
Primary = 15.17 cfs @ 11.92 hrs, Volume= 13.488 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 6.00' @ 11.92 hrs Surf.Area= 0.000 ac Storage= 8.497 af

Plug-Flow detention time= 340.6 min calculated for 13.460 af (74% of inflow)
Center-of-Mass det. time= 211.9 min (962.6 - 750.7)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	11.300 af	**8' Deep Detention** Listed below

Elevation (feet)	Cum.Store (acre-feet)
0.00	0.000
6.00	8.500
8.00	11.300

Device	Routing	Invert	Outlet Devices
#1	Primary	2.00'	**18.0" Round Low-Flow Culvert Outlet** L= 100.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 2.00' / 1.00' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf
#2	Primary	6.00'	**127.0 deg x 8.0' long Overflow Spillway- Sharp-Crested Trap Weir** Cv= 2.48 (C= 3.10)

Primary OutFlow Max=15.17 cfs @ 11.92 hrs HW=6.00' (Free Discharge)
1=Low-Flow Culvert Outlet (Barrel Controls 15.17 cfs @ 8.58 fps)
2=Overflow Spillway- Sharp-Crested Trap Weir (Controls 0.00 cfs)

Summary for Pond P2: Detention Basin 2

Inflow Area = 422.600 ac, Inflow Depth > 7.03" for 100-Yr event
Inflow = 1,525.59 cfs @ 10.19 hrs, Volume= 247.545 af
Outflow = 71.80 cfs @ 21.76 hrs, Volume= 74.247 af, Atten= 95%, Lag= 694.5 min
Primary = 71.80 cfs @ 21.76 hrs, Volume= 74.247 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 7.95' @ 21.76 hrs Surf.Area= 0.000 ac Storage= 174.902 af

Plug-Flow detention time= 503.8 min calculated for 74.093 af (30% of inflow)
Center-of-Mass det. time= 281.1 min (1,055.7 - 774.6)

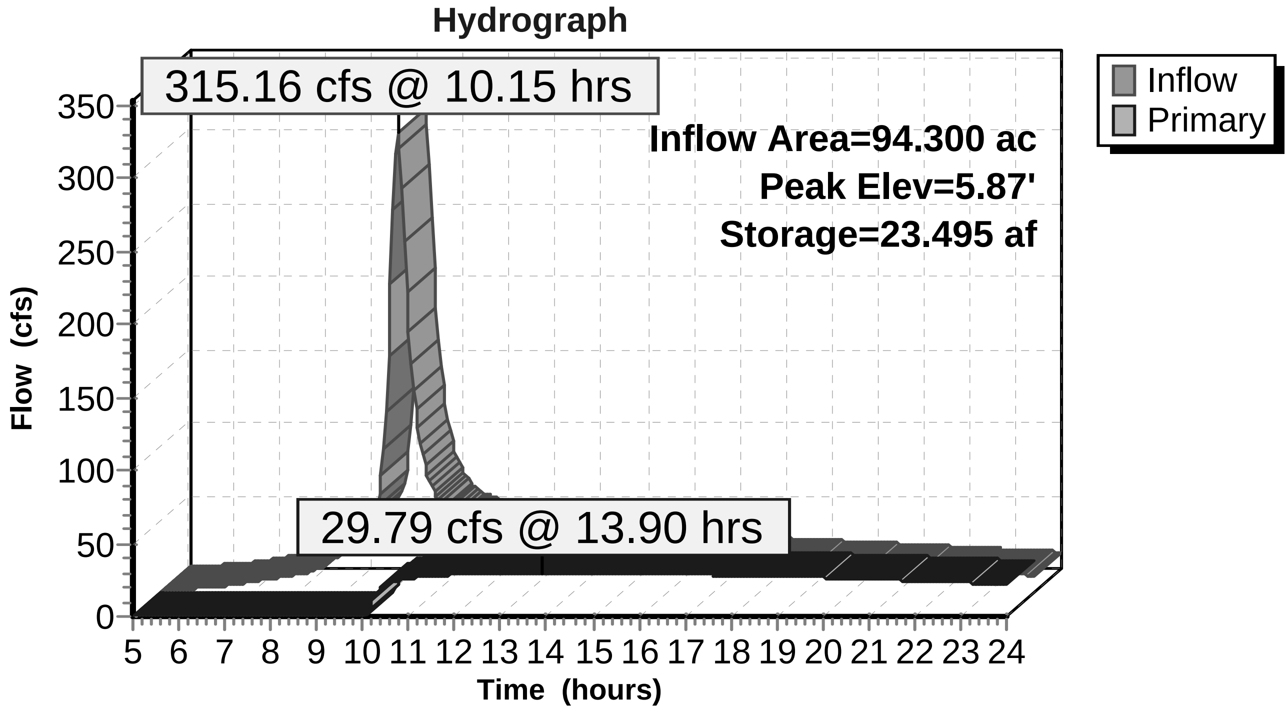
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	220.000 af	**10' Deep Detention** Listed below

Elevation (feet)	Cum.Store (acre-feet)
0.00	0.000
8.00	176.000
10.00	220.000

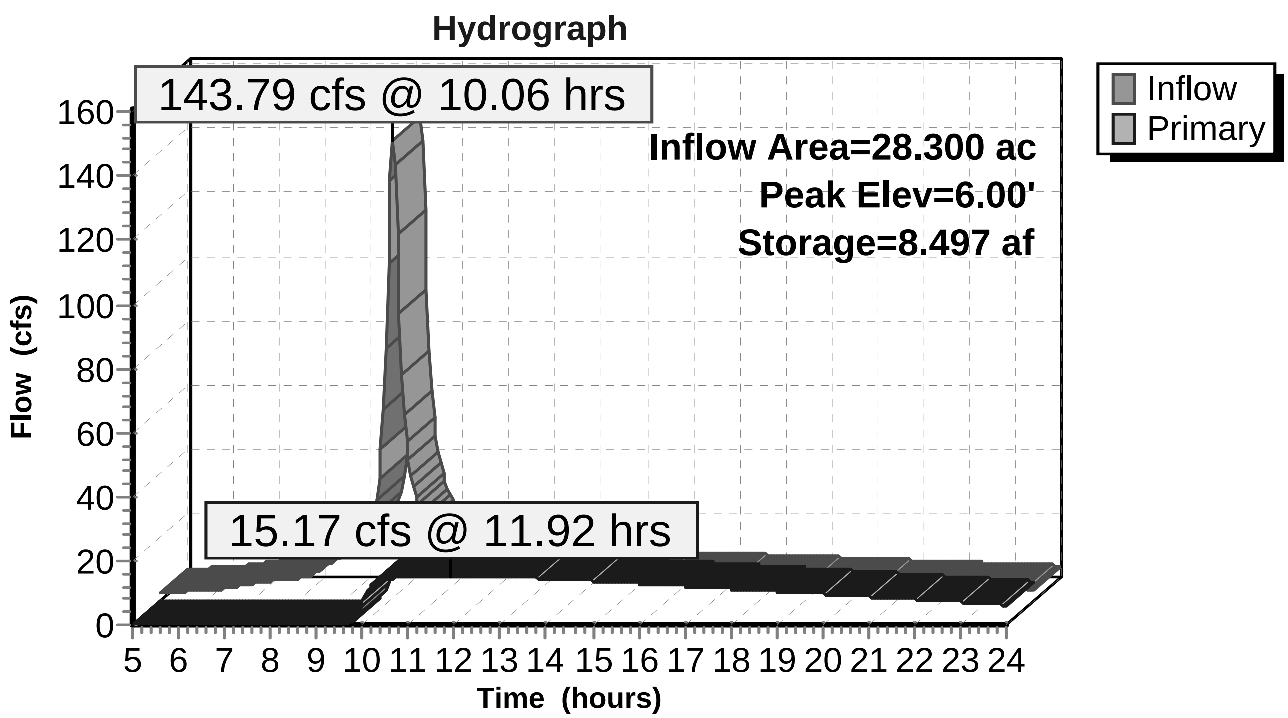
Device	Routing	Invert	Outlet Devices
#1	Primary	2.00'	**36.0" Round Low-Flow Culvert Outlet** L= 100.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 2.00' / 1.00' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 7.07 sf
#2	Primary	8.00'	**127.0 deg x 12.0' long Overflow Spillway- Sharp-Crested Trap Weir** Cv= 2.48 (C= 3.10)

Primary OutFlow Max=71.80 cfs @ 21.76 hrs HW=7.95' (Free Discharge)
1=Low-Flow Culvert Outlet (Inlet Controls 71.80 cfs @ 10.16 fps)
2=Overflow Spillway- Sharp-Crested Trap Weir (Controls 0.00 cfs)

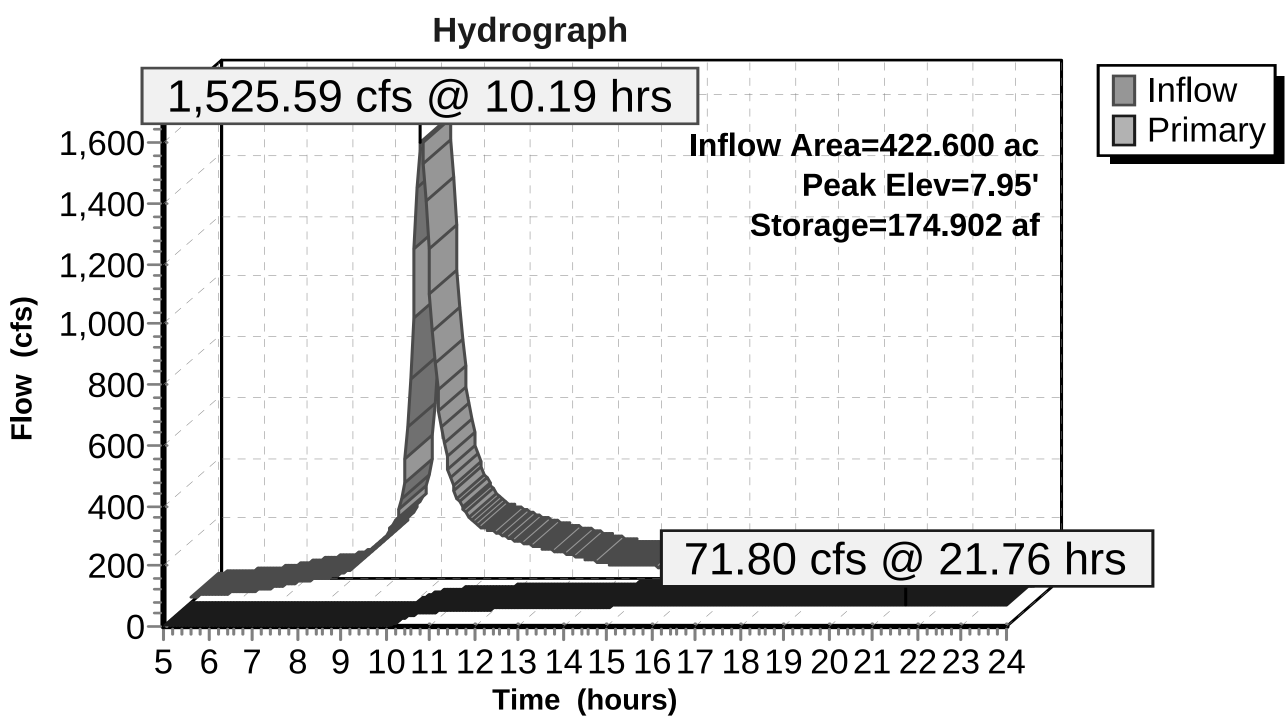
Pond P1A: Detention Basin 1A



Pond P1B: Detention Basin 1B



Pond P2: Detention Basin 2



APPENDIX B

WATER SYSTEM

PROJECT: WAI'ALE COMMUNITY PROJECT

PRELIMINARY WATER DEMAND CALCULATIONS

DEMAND:

Waiale Change in Zoning Water Demands					
Land Use	Area (acres)	No. of Units	Average Unit Demand		Average Total Demand (gpd)
Single Family	128.1	1026	600	gpd/unit	615,600
Multi-Family (53.7 acres)					
Single Family	16.5	214	600	gpd/unit	128,400
Multi-Family	37.0	481	560	gpd/unit	269,360
Village Mix-Use	52.9				
Residential - MF		529	560	gpd/unit	296,240
Commercial (sf)		250,000	140	gpd/1000 sf	35,000
County Residential (40 acres)					
Single Family	24	180	600	gpd/unit	108,000
Multi-Family	16	120	560	gpd/unit	67,200
Business/Light Industrial (sf)	16.3	175,000	140	gpd/1000 sf	24,500
Commercial (sf)	23	230,000	140	gpd/1000 sf	32,200
Community Center	7		1700	gpd/acre	11,900
County Park	3		1700	gpd/acre	5,100
Middle School	18	600	60	gpd/student	36,000
Cultural Preserves/Buffers	4.3		1700	gpd/acre	7,310
Parks/Buffers	33.4		1700	gpd/acre	56,780
Regional Park/Cultural Preserve	101.4		1700	gpd/acre	172,380
Roads	63.9				
Total Average Day Demand					1,865,970 mgd
Total Average Day Demand (rounded)					**1,870,000 mgd**
Max Daily Demand					**2,805,000 mgd**

STORAGE:

Water System Standards - Reservoir Capacity

Reservoir shall be sized as follows:

1. Meet maximum day consumption. Reservoir full at the beginning of the 24-hour period with no source input to the reservoir.

Maximum Day Demand =	2,805,000		
Reservoir Size Required =	**2,805,000**	**MG**	**Use this criterion**

2. Meet maximum day rate plus fire flow for a duration of fire. Reservoir 3/4 full at start of fire, with credit for incoming flow from pumps, one maximum size pump out of service.

Maximum Day Demand =	2,805,000	gpd
Maximum Day Demand =	1,948	gpm
Fire Flow =	2,000	gpm
Total Required Demand =	3,948	gpm
Fire Duration =	2	hours
Required Fire Volume =	233,750	gallons
Required Reservoir volume =	311,667	gallons

APPENDIX C

SEWER SYSTEM

PROJECT: WAI'ALE COMMUNITY PROJECT

PRELIMINARY WASTEWATER CONTRIBUTION CALCULATIONS

Wai`ale Average Wastewater Flows

Land Use	Area (acres)	Area (sf)	Building Area (sf)	No. of Units	Unit	Contribution Unit (gal/unit/day)	Occupancy	Average Wastewater Flow (gpd)
Single Family	128.1			1026	Home	350		359,100
Multi-Family (53.7 acres)								
Single Family	16.5			214	Home	350		74,900
Multi-Family	37.0			481	Home	320		153,920
Village Mix-Use	52.9							
Residential - MF				529	Home	320		169,280
Commercial			250,000		Employee	15	1 per 350 SF	10,714
County Residential (40 acres)								
Single Family	24			180	Home	350		63,000
Multi-Family	16			120	Home	320		38,400
Business/Light Industrial	16.3	710,028	175,000		Employee	25	1 per 500 SF	8,750
Commercial	23	1,001,880	230,000		Employee	15	1 per 350 SF	9,857
Community Center	7	304,920	10,000					
Employees					Employee	25	1 per 500 SF	500
Visitors				300	Visitors	10		3,000
County Park	3	130,680		250	Visitors	5		1,250
Middle School	18	784,080		600	Students	25		15,000
Cultural Preserves/Buffers	4.3	187,308		250	Visitors	5		1,250
Parks/Buffers	33.4	1,454,904		250	Visitors	5		1,250
Regional Park/Cultural Preserve	101.4	4,416,984		250	Visitors	5		1,250
Roads	63.9	2,783,484						
TOTAL	**545**							911,421
Total Average Day Demand (rounded)								**910,000**

Notes:

Community Center area and number of visitors assumed.

Number of students assumed.

SEWER CAPACITIES

Q = (Cm/n)*A*R^2/3*S^1/2

Where:

Cm=	1.486	
n=	0.015	D<=18"
n=	0.013	D>18"
A =	Area of pipe	
R=	D/4 for pipe flowing full	
S =	Slope of pipe	

Diameter (IN)	Min. Slope S	n	A (sf)	R (ft)	Q (cfs)	Q (gpd)
6	0.0060	0.015	0.196	0.125	0.377	243,470
8	0.0044	0.015	0.349	0.167	0.695	449,021
10	0.0032	0.015	0.545	0.208	1.074	694,292
12	0.0028	0.015	0.785	0.250	1.634	1,056,078
15	0.0020	0.015	1.227	0.313	2.504	1,618,299
18	0.0016	0.015	1.767	0.375	3.642	2,353,715
21	0.0010	0.013	2.405	0.438	5.011	3,238,669
24	0.0008	0.013	3.142	0.500	6.399	4,135,773
30	0.0008	0.013	4.909	0.625	11.601	7,498,655

WASTEWATER FLOWS

SINGLE FAMILIY

TOTAL Average Wastewater Flow = 359,100 gpd
TOTAL Number of Units = 1,026
People per unit = 4

Area (acres)	Ratio	Average wastewater (gpd)	No. Units	Number of People	Peak Factor	Max. Flow (gpd)	Dry Weather Infil. (gpd)	Design Avg. Flow (gpd)	Design Max Flow (gpd)	Wet Weather Infil. (gpd)	Design Peak Flow (gpd)
14.70	0.115	41,208	117.7	471	5.00	206,041	2,355	43,563	208,396	18,375	226,771
8.50	0.066	23,828	68.1	272	5.00	119,139	1,362	25,189	120,501	10,625	131,126
14.50	0.113	40,648	116.1	465	5.00	203,238	2,323	42,970	205,560	18,125	223,685
11.20	0.087	31,397	89.7	359	5.00	156,984	1,794	33,191	158,778	14,000	172,778
10.50	0.082	29,434	84.1	336	5.00	147,172	1,682	31,116	148,854	13,125	161,979
13.10	0.102	36,723	104.9	420	5.00	183,615	2,098	38,821	185,713	16,375	202,088
11.20	0.087	31,397	89.7	359	5.00	156,984	1,794	33,191	158,778	14,000	172,778
28.30	0.221	79,333	226.7	907	5.00	**396,664**	4,533	83,866	401,197	35,375	436,572
11.00	0.086	30,836	88.1	352	5.00	154,180	1,762	32,598	155,942	13,750	169,692
5.10	0.040	14,297	40.8	163	5.00	71,484	817	15,114	72,301	6,375	78,676
128.1	1.000	**359,100**	1,026	4,104		1,795,500		**379,620**			**1,976,145**
County											
24.00		**63,000**	180.0	720	5.00	315,000	3,600	**66,600**	318,600	30,000	**348,600**

Multi-family (SINGLE FAMILIY)

TOTAL Average Wastewater Flow = 74,900 gpd
TOTAL Number of Units = 214
People per unit = 4

Area (acres)	Ratio	Average wastewater (gpd)	No. Units	Number of People	Peak Factor	Max. Flow (gpd)	Dry Weather Infil. (gpd)	Design Avg. Flow (gpd)	Design Max Flow (gpd)	Wet Weather Infil. (gpd)	Design Peak Flow (gpd)
16.46		**74,900**	214.0	856	5.00	374,500	4,280	**79,180**	378,780	20,577	**399,357**

MULTI- FAMILIY

TOTAL Average Wastewater Flow = 153,920 gpd
TOTAL Number of Units = 481
People per unit = 2.8

Area (acres)	Ratio	Average wastewater (gpd)	No. Units	Number of People	Peak Factor	Max. Flow (gpd)	Dry Weather Infil. (gpd)	Design Avg. Flow (gpd)	Design Max Flow (gpd)	Wet Weather Infil. (gpd)	Design Peak Flow (gpd)
8.0	0.149	22,930	71.7	201	5.00	114,652	1,003	23,934	115,655	10,000	125,655
12.3	0.229	35,255	110.2	308	5.00	176,277	1,542	36,798	177,820	15,375	193,195
3.1	0.058	8,886	27.8	78	5.00	44,428	389	9,274	44,816	3,875	48,691
9.1	0.169	26,083	81.5	228	5.00	130,416	1,141	27,224	131,558	11,375	142,933
8.0	0.149	22,930	71.7	201	5.00	114,652	1,003	23,934	115,655	10,000	125,655
8.7	0.162	24,937	77.9	218	5.00	124,684	1,091	26,028	125,775	10,875	136,650
4.5	0.084	12,898	40.3	113	5.00	64,492	564	13,463	65,056	5,625	70,681
53.7	1.000	**153,920**	481.0	1,347		769,600	6,734	**160,654**	776,334	67,125	**843,459**
County 16.00		**38,400**	120.0	336	5.00	192,000	1,680	**40,080**	193,680	20,000	**213,680**

VILLAGE MIXED USE - Residential

TOTAL Average Wastewater Flow = 169,280 gpd
TOTAL Number of Units = 529
People per unit = 4.0

Area (acres)	Ratio	Average wastewater (gpd)	No. Units	Number of People	Peak Factor	Max. Flow (gpd)	Dry Weather Infil. (gpd)	Design Avg. Flow (gpd)	Design Max Flow (gpd)	Wet Weather Infil. (gpd)	Design Peak Flow (gpd)
4.6	0.087	14,720	46.00	184	5.00	73,600	920	15,640	74,520	5,750	80,270
2.5	0.047	8,000	25.00	100	5.00	40,000	500	8,500	40,500	3,125	43,625
6.5	0.123	20,800	65.00	260	5.00	104,000	1,300	22,100	105,300	8,125	113,425
8.5	0.161	27,200	85.00	340	5.00	136,000	1,700	28,900	137,700	10,625	148,325
3.1	0.059	9,920	31.00	124	5.00	49,600	620	10,540	50,220	3,875	54,095
5	0.095	16,000	50.00	200	5.00	80,000	1,000	17,000	81,000	6,250	87,250
2.5	0.047	8,000	25.00	100	5.00	40,000	500	8,500	40,500	3,125	43,625
2	0.038	6,400	20.00	80	5.00	32,000	400	6,800	32,400	2,500	34,900
1.3	0.025	4,160	13.00	52	5.00	20,800	260	4,420	21,060	1,625	22,685
2.5	0.047	8,000	25.00	100	5.00	40,000	500	8,500	40,500	3,125	43,625
3.1	0.059	9,920	31.00	124	5.00	49,600	620	10,540	50,220	3,875	54,095
2.1	0.040	6,720	21.00	84	5.00	33,600	420	7,140	34,020	2,625	36,645
2.7	0.051	8,640	27.00	108	5.00	43,200	540	9,180	43,740	3,375	47,115
6.5	0.123	20,800	65.00	260	5.00	104,000	1,300	22,100	105,300	8,125	113,425
52.9	**1**	**169,280**	**529.00**	**2116**		**846,400**	**10,580**	**179,860**	**856,980**	**66,125**	**923,105**

VILLAGE MIXED USE - Commercial

Contribution: 15 gpd per employee
Occupancy (Employees): 1 per 350 SF
Building Area: 250,000 sf per acre

Area (acres)	Area (SF)	Building Area (SF)	No. of employees	Average wastewater (gpd)	Peak Factor	Max. Flow (gpd)	Dry Weather Infil. (gpd)	Design Avg. Flow (gpd)	Design Max Flow (gpd)	Wet Weather Infil. (gpd)	Design Peak Flow (gpd)
52.9	2,304,324	250,000	714	**10,714**	5.00	53,571	3,571	**14,286**	57,143	66,125	**123,268**

LIGHT INDUSTRIAL
Contribution: 25 gpd per employee
Occupancy (Employees): 1 per 500 SF
Building Area: 175,000 sf

Area (acres)	Area (SF)	Building Area (SF)	No. of employees	Average wastewater (gpd)	Peak Factor	Max. Flow (gpd)	Dry Weather Infil. (gpd)	Design Avg. Flow (gpd)	Design Max Flow (gpd)	Wet Weather Infil. (gpd)	Design Peak Flow (gpd)
8.86	385,942	113,341	227	5,667	5.00	28,335	1,133	6,800	29,469	11,075	40,544
4.82	209,959	61,659	123	3,083	5.00	15,415	617	3,700	16,031	6,025	22,056
13.68	**595,901**	**175,000**	**350**	**8,750**		**43,750**	**1,750**	**10,500**	**45,500**	**17,100**	**62,600**

COMMERCIAL
Contribution: 15 gpd per employee
Occupancy (Employees): 1 per 350 SF
Building Area: 230,000 sf per acre

Area (acres)	Area (SF)	Building Area (SF)	No. of employees	Average wastewater (gpd)	Peak Factor	Max. Flow (gpd)	Dry Weather Infil. (gpd)	Design Avg. Flow (gpd)	Design Max Flow (gpd)	Wet Weather Infil. (gpd)	Design Peak Flow (gpd)
23	1,001,880	230,000	657	**9,857**	5.00	49,286	3,286	**13,143**	52,571	28,750	**81,321**

COMMUNITY CENTER

Employees

Contribution:	25	gpd per employee
Occupancy (Employees):	1 per	500 SF
Building Area:	10,000	sf

Visitors

Contribution:	10	gpd per employee
Occupancy (Employees):	350	visitors

Employees											
Area (acres)	Area (SF)	Building Area (SF)	No. of employees	Average wastewater (gpd)	Peak Factor	Max. Flow (gpd)	Dry Weather Infil. (gpd)	Design Avg. Flow (gpd)	Design Max Flow (gpd)	Wet Weather Infil. (gpd)	Design Peak Flow (gpd)
7	304,920	10,000	20	**500**	5.00	2,500	100	**600**	2,600	8,750	**11,350**
Visitors											
Area (acres)	Area (SF)		No. of visitors	Average wastewater (gpd)	Peak Factor	Max. Flow (gpd)	Dry Weather Infil. (gpd)	Design Avg. Flow (gpd)	Design Max Flow (gpd)	Wet Weather Infil. (gpd)	Design Peak Flow (gpd)
7	304,920		300	**3,000**	5.00	15,000	1,500	**4,500**	16,500	8,750	**25,250**

COUNTY PARK

Contribution: 5 gpd per visitor

Occupancy (Park visitors) 250 per day

Area (acres)	Area (SF)		No. of visitors	Average wastewater (gpd)	Peak Factor	Max. Flow (gpd)	Dry Weather Infil. (gpd)	Design Avg. Flow (gpd)	Design Max Flow (gpd)	Wet Weather Infil. (gpd)	Design Peak Flow (gpd)
3	130,680		250	**1,250**	5.00	6,250	1,250	**2,500**	7,500	3,750	**11,250**

MIDDLE SCHOOL

Contribution: 25 gpd per student

Area (acres)	Area (SF)		No. of Students	Average wastewater (gpd)	Peak Factor	Max. Flow (gpd)	Dry Weather Infil. (gpd)	Design Avg. Flow (gpd)	Design Max Flow (gpd)	Wet Weather Infil. (gpd)	Design Peak Flow (gpd)
18	784,080		600	**15,000**	5.00	75,000	3,000	**18,000**	78,000	22,500	**100,500**

PARKS

Contribution: 5 gpd per visitor

Occupancy (Park visitors) 250 per day per park

Area (acres)	Area (SF)		No. of visitors	Average wastewater (gpd)	Peak Factor	Max. Flow (gpd)	Dry Weather Infil. (gpd)	Design Avg. Flow (gpd)	Design Max Flow (gpd)	Wet Weather Infil. (gpd)	Design Peak Flow (gpd)
4.3	187,308		250	**1,250**	5.00	6,250	1,250	**2,500**	7,500	5,375	**12,875**
33.4	1,454,904		250	**1,250**	5.00	6,250	1,250	**2,500**	7,500	41,750	**49,250**
101.4	4,416,984		250	**1,250**	5.00	6,250	1,250	**2,500**	7,500	126,750	**134,250**

TOTALS	**2,130**	**911,421**	4.30	3,917,486	**33,230**	**977,023**	**2,806,688**	**533,427**	**5,316,260**
TOTALS (rounded)		**910,000**				**980,000**			**5,320,000**

Note: Peak factor of 3.93 based on total population. Total Max flow, Design Max Flow and Design Peak Flow based on 3.93 peak factor.

Effluent Irrigation

Parks and Buffers

Description	Area (acres)
County Park	3.08
Regional Park	7.47
Regional Park	65.35
Park	15.82
Park	8.48
Park	1.68
Buffer along Kuihelani Hwy	1.24
Buffer along Kuihelani Hwy	5.04
Sub-total Parks and buffers	**108.16**
Community Center *	**3**
Middle School *	**5**

TOTAL Area= 116.2 acres

Irrigation rate = 0.3125 in/day
Irrigation rate = 8,486 gal/acre-day

Irrigation Demand - Parks and Buffers = 990,000 gpd

*Assumed

Road Irrigation

Average Irrigation:
Irrigated Area = 723,792 sf
Irrigated Area = 16.62 acres

Irrigation Rate = 0.3125 in/day
Irrigation Rate = 8,486 gal/acre-day

Irrigation Demand - Roads = 141,000 gpd

TOTAL - Parks and Roads = 1,131,000 gpd

APPENDIX D

ELECTRICAL SYSTEM

PROJECT: WAI'ALE COMMUNITY PROJECT

PRELIMINARY ELECTRICAL INFORMATION

MK Engineers, Ltd.

Consulting Electrical Engineers
286 Kalihi Street ● Honolulu, Hawaii 96819
Telephone: (808) 848-8622 ● Fax: (808) 848-5574
e-mail address: info@mkhawaii.com

MEETING MINUTES

Project: Wai`ale Community Development
Project No.: 10081

Location of Meeting: Maui Electric Company Office, Kahului, Maui
Date of Meeting: February 23, 2011

Prepared By: Ron Katahara

Attendees: Messrs. Dan Takahata, Ray Okazaki, Fred Oshiro & Kyle Tamori, Maui Electric Company, Ltd.; Ron Katahara

ITEMS OF DISCUSSION:

1. The project is an A&B Properties, Inc. Development and includes approximately 2,550 housing units, and commercial, light industrial, business and village-mixed-use facilities, community centers and parks with electrical load in the 10 MVA range.
2. Maui Electric is in the process of developing and constructing Kuihelani Substation that will be located directly east of the intersection of Kuihelani Highway and Maui Lani Parkway. The substation site is planned for a four unit transformer capacity. Plans are to install two units in 2013. Additional units will be added as future loading dictates.
3. Wai`ale Community will be served from an existing substation and from the proposed Kuihelani Substation. The distribution voltage will be 12.47 kV.
4. One source of power to Wai`ale community will be extended from Kuihelani Substation. The main express feeder ducts through the project site will consist of 6-way 5” ducts. Laterals to serve various parcels will consist of 2-way or 4-way 5” ducts depending on parcel location with respect to the main express feeder ducts. Installation of the primary line extension on Kuihelani Highway will be subject to State Department of Transportation approval.
5. There are existing underground circuits on Kuihelani Avenue that serve wells that are being developed at the Wai`ale Community site.
6. A second source of power may be extended to Wai`ale Community from neighboring Maui Lani Development. This requirement will be assessed and confirmed when service is requested.

7. There are MECO 23 kV sub-transmission and 69 kV overhead transmission circuits on a pole line that generally parallels Waiko Road. The pole line apparently falls largely outside Wai`ale Community; however it crosses the parcel presently designated as “Light Industrial” along the western perimeter of the development north of Waiko Road. The exact location of this line with respect to the development will determine whether its location must be adjusted.
8. MECO requested information about the schedule for the development and about phasing of the construction. Phasing will have an impact on MECO’s master plan for the development.

END.

PREPARED BY: MK ENGINEERS, LTD.					3/21/2011
WAI`ALE DEVELOPMENT LOAD SUMMARY					
DESCRIPTION OF AREA	ACRES	TOTAL UNITS	SF	kVA PER UNIT OR SF	TOTAL kVA
SINGLE FAMILY ALL ELEC WITH A/C	128.1	1420		5	7100
MULTI-FAMILY ALL ELEC WITH A/C	53.7	1130		5	5650
VILLAGE MIXED USE	52.9		250000	0.005	1250
COMMERCIAL	23		230000	0.007	1610
WWTP				500	500
WELLS & WATER TANKS				300	300
BUSINESS/LIGHT INDUSTRIAL	9.8		175000	0.004	700
PARK	8			25	25
PARK	14			25	25
PARK	1.5			25	25
PARK	3			25	25
PARK	8			25	25
PARK	65			25	25
CULTURAL PRESERVE	0.5			25	25
CULTURAL PRESERVE	1.8			25	25
CULTURAL PRESERVE	2			25	25
CULTURAL PRESERVE	28.4			25	25
COMMUNITY CENTER	7			150	150
INTERMEDIATE SCHOOL	12			1000	500
TOTAL ESTIMATED LOAD					18010
DIVERSITY FACTOR					1.6
ESTIMATED COINCIDENT LOAD					11256

MK Engineers, Ltd.

Consulting Electrical Engineers
286 Kalihi Street ● Honolulu, Hawaii 96819
Telephone: (808) 848-8622 ● Fax: (808) 848-5574
e-mail address: info@mkhawaii.com

MEETING MINUTES

Project: Wai`ale Community Development
Project No.: 10081

Location of Meeting: Hawaiian Telcom Office, Wailuku, Maui
Date of Meeting: February 23, 2011

Prepared By: Ron Katahara

Attendees: Ms. Sheriann Tihada, Mr. Grant Torigoe, and Mr. Thomas Hutchinson of Hawaiian Telcom; Ron Katahara

ITEMS OF DISCUSSION:

1. The project is an A&B Properties, Inc. Development and includes approximately 2,550 housing units, and commercial, light industrial, business, village-mixed-use facilities, parks and community centers.
2. Hawaiian Telcom has facilities on Kamehameha Avenue at Pomaikai Elementary School that may be extended to serve Wai`ale Community.
3. The main duct run should consist of 4-way 4” ducts and 5’X10’ manholes. Laterals will consist of 1-way and 2-way ducts and 3’X5’ hand-holes.
4. Hawaiian Telcom plans to provide fiber optic (FO) cable for each service instead of copper cables as they have in the past. This will allow the telephone company customer to obtain telephone, data and CATV services.
5. Fiber distribution hubs (FDH) will be installed in the development. The largest hub will service 864 residences. Three or four FDHs will be required depending on how the project is phased. Each FDH requires a 10’X10’ easement.
6. Hawaiian Telcom requested information on scheduling and phasing for the development. They would also like to know if various parcels will be sold to different developers.

END

MK Engineers, Ltd.

Consulting Electrical Engineers
286 Kalihi Street ● Honolulu, Hawaii 96819
Telephone: (808) 848-8622 ● Fax: (808) 848-5574
e-mail address: info@mkhawaii.com

MEETING MINUTES

Project: Wai`ale Community Development
Project No.: 10081

Location of Meeting: Oceanic Time Warner Cable Office, Kahului, Maui
Date of Meeting: February 23, 2011

Prepared By: Ron Katahara

Attendees: Mr. Bill Hanke, Oceanic Time Warner; Ron Katahara

ITEMS OF DISCUSSION:

1. The project is an A&B Properties, Inc. Development and includes approximately 2,550 housing units, and commercial, light industrial, business, village-mixed-use facilities, parks and community centers.
2. TW Cable has facilities at the Maui Lani Village Mixed-Use complex adjoining the north-west corner of Wai`ale Community, with fiber optic (FO) cables installed on Maui Lani Parkway to serve Maui Lani Development. TW's duct line and FO cables are available on Kamehameha Avenue at Pomaikai Elementary School. The duct line and FO cables will be extended into Wai`ale Community to provide cable service to the development.
3. Small easements (approximately 6' X 7') will be required for installation of pedestal mounted equipment for providing cable service. These will be required for each group of about 125 homes. Two 3'X5' hand-holes will be required at the pedestal locations for installation of below grade equipment.
4. The main duct line should consist of 2-way 4" ducts. 1-way 4" ducts will serve as laterals. 3'X5' hand-holes will be required along the main duct line and 2'X4' hand-holes will be required in other areas.

END.

Appendix O: Market Study

PREPARED FOR: A&B PROPERTIES, INC.
822 Bishop Street
Honolulu, Hawaii 96813

EFFECTIVE DATE: September 15, 2010

A MARKET STUDY OF THE PROPOSED WAI‘ALE MASTER PLAN DEVELOPMENT
KAHULUI, ISLAND OF MAUI, HAWAII

ACM CONSULTANTS, INC.

ACM CONSULTANTS, INC.

A Real Estate Appraisal, Research & Advisory Group

September 30, 2010 10-9067A

Mr. Daniel Yasui
A&B PROPERTIES, INC.
822 Bishop Street
Honolulu, Hawaii 96813

Re: Market Analysis for the proposed Wai'ale Master Plan Development in Kahului, Island and County of Maui

Dear Mr. Yasui:

In accordance with your request, we have inspected the above-referenced property in order to provide a defined scope market study for the proposed Wai'ale Master Plan Development (Wai'ale) in Kahului, Island and County of Maui. This *counseling report*, and the conclusions herein, is based on the on-site inspection of the property, a study of current political and economic conditions, and a historical review of the real estate market in Central Maui and on Maui overall. The effective date of this report is September 15, 2010.

The subject consists of approximately 545 acres of land and is currently zoned State Agricultural District. Wai'ale, which is still in its preliminary planning stage, will be located to the west of Kuihelani Highway. Preliminary plans call for areas of single-family residential, multi-family residential, village mixed-use, commercial, business/light industrial, park, cultural preserve, as well as a regional park, a community center, an intermediate school site with associated recreational fields, greenway paths and roads.

At full build-out, Wai'ale is expected to comprise approximately 2,550 residential units. This will include a mix of single family units and multi family units. It should be noted that approximately 50 acres will be conveyed to the County of Maui for the development of affordable housing (40 acres), park (3 acres) and community center (7 acres). This land contribution is to satisfy Maui County zoning conditions for the Maui Business Park, Phase II project. An estimated 300 affordable residential units are anticipated to be developed on the 40 acres to be conveyed to the County of Maui. Additionally, on-site affordable housing units will also be developed in compliance with the County of Maui's Residential Workforce Housing Policy.

The assignment will include the following:

Market Analysis- The Consultant agrees to provide a market analysis for this proposed project by (1) defining and delineating the market area; (2) identifying and analyzing the current supply and demand conditions that comprise the specific real estate market segment; and (3) identifying, measuring and forecasting the effect of anticipated developments or other changes on future supply in each market segment.

2073 Wells Street, Suite 100 ◆ Wailuku, Maui, HI 96793 ◆ Telephone: (808) 242-6481 ◆ Fax: (808) 242-1852

The following report presents a narrative review of the market study and our analysis of data along with other pertinent materials on which this report is predicated. It contains data and exhibits gathered in our investigations, and will include a description of the analytical process and our conclusions.

Thank you for allowing us the opportunity to work on this interesting assignment.

Respectfully submitted,
ACM Consultants, Inc.

Glenn K. Kunihisa, MAI, CRE
Certified General Appraiser,
State of Hawaii, CGA-039
Expiration: December 31, 2011

Shane M. Fukuda
Certified General Appraiser
State of Hawaii, CGA-810
Expiration: December 31, 2011

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PART I – INTRODUCTION

A. EXECUTIVE SUMMARY

Background

The proposed Waiʻale Master Plan Development is located on the western side of Kuihelani Highway in the District of Kahului, Island and County of Maui. The subject will consist of approximately 545 acres of land and is currently zoned State Agricultural District. The project is still in its preliminary planning stage, but its location is assumed to primarily possess mountain views. According to a Conceptual Community Master Plan Map (**Exhibit B**), prepared by PBR Hawaii, the land use allocations are:

Land Use	Approximate Land Areas
Single-Family Residential (SF)	128.1 Acres
Multi-Family Residential (MF)	53.7 Acres
Village Mixed Use (VMX)	52.9 Acres
Commercial (C)	23 Acres
Business/Light Industrial (LI)	16.3 Acres
Regional Park/Cultural Preserve (Park)	101.4 Acres
Park, Buffers, Preserves	37.7 Acres
Community Center (CC)	7 Acres
Institutional/School (I)	18 Acres
County Housing	40 Acres
County Park	3 Acres
Roads/Greenway Paths	63.9 Acres

Study Objectives

ACM Consultants, Inc. has been retained by A&B Properties, Inc., to analyze each of the specified segments of the real estate market as it relates to this proposed project. In particular, the Consultants studied economic trends and demographics, and supply and demand factors for residential, commercial and industrial properties. Residential properties included single-family residences, single-family house lots, and condominium units. Commercial and industrial properties included vacant developable lots as well as improved properties. In the process, they gathered as much information as possible on real estate activity on Maui while focusing primarily on the Central Maui market.

The objectives of the market analysis were as follows: (1) to define and delineate the market area; (2) to identify and analyze the current supply and demand conditions specific to the subject's market; and (3) identify, measure and forecast the effect of anticipated developments or other factors on future supply.

Summary of Conclusions

Residential Component

Maui in general has seen growth in its population, tourism and economy over the past two decades. Similar to many real estate markets on the mainland, Maui's real estate market had seen significant increases from 2000. During that period, median prices attained record highs in 2005. As a result, the county administration placed the affordable housing issue among its top priorities, from as early as 2004.

The real estate climate has since reversed course, due to economic woes and more stringent lending practices. Through 2009, residential sales statistics showed lower median prices, less sales volume and longer marketing times. However, 2010 is showing some evidence of stability, based on year-to-date sales price medians.

There are numerous ongoing residential projects that should provide the immediate supply to Central Maui for the next few years. The Maui Lani and Kehalani Project Districts continue to build their already entitled units. In addition, there are a few projects in Central Maui that may add inventory to the market in coming years but are still in the process of gaining governmental approvals. However, after five years, it becomes more difficult to determine which future projects will actually be brought to the market. The recommended Directed Growth Areas for Maui, as currently shown in the Draft Maui Island Plan, are estimated to provide additional supply of 11,623 housing units by 2030, with the subject included. However, some of these potential projects will likely meet with governmental or community resistance, leading to long delays; meanwhile, others may never be completed for various financial reasons.

The economic downturn being witnessed across the nation has significantly affected Maui, through a drop in visitor counts and the drastic slowdown of construction. These industries are two of the primary employment forces on the island and their decline has had an adverse impact on the local economy. Unemployment has been on the rise, with many that are still employed stating that job security is a concern. Meanwhile, the heavy losses witnessed in the financial sector since the fourth quarter of 2008 have surely diminished the investment capital for other potential buyers. Combined with a more stringent lending environment, it has become increasingly difficult to purchase real estate, regardless of current market conditions.

At the height of the market, the primary obstacle for buyers was the high asking prices for residential products. Many buyers who did not own a home found it difficult to even come up with enough money for a down payment. Meanwhile, homeowners saw their property values increase to a point where they were able to use their equity appreciation to upgrade to larger, more elaborate accommodations. For many, this option is no longer possible, as the retreat of home prices has caused a significant loss of equity. Currently, the ability of qualified buyers to purchase housing may be more difficult than a few years ago; however, it is fairly safe to assume that as economic conditions improve, housing units within the workforce market segment will continue to be the most sought after. Local economists have varied opinions as to the timing of the economic recovery, but many have pointed to late-2011 or 2012 for this turnaround.

If the Wai'ale Master Plan Development came on-line today, it would likely be facing the same types of sales difficulties that other ongoing projects are witnessing. However, the subject will still need to go through entitlement, design and construction processes before sales can occur. As such, release of the subject's housing units may be very well timed with the economic recovery. Once market conditions improve, the project can expect to see heightened demand, due to its proximity to the island's primary shipping and transportation venues, government and judiciary facilities, financial institutions, secondary education campus, and retail centers. Furthermore, with the lack of new housing starts during this period, there will likely be a strong resurgence in demand, after the short-term supply has been expended.

Most importantly, the Wai'ale Master Plan Development will be primarily targeted toward the workforce market segment. Statistical evidence has clearly shown that regardless of conditions, this market segment has the most demand. Although the pricing of the project units have not been determined, this development will give entry level market participants an opportunity for home ownership.

The Wai'ale Master Plan Development is a primary component of future growth in Central Maui and is being projected to supply greater than 50 percent of the required future housing units for Central Maui. The property owners continue to work diligently with government agencies in an effort to design a master plan community that represents smart-growth for the Central Maui region. As previously discussed, the proposed project is consistent with many of the goals, objectives, policies and implementing actions set forth in the Countywide Policy Plan, which provides a policy framework for the Maui Island Plan and Community Plans. After consideration of current economic and real estate market conditions; forecasts by Hawaii economists; as well as long-term supply and demand recommendations being deliberated for the 2030 General Plan, it is the Consultant's opinion that the Wai'ale Master Plan Development should be well positioned to capitalize on the recovery of the real estate market and be in a position to provide a long-term solution to the housing needs of Central Maui's workforce. Based on these factors, a residential unit absorption range of approximately 200 to 300 units per year could be anticipated for the Wai‘ale project.

Commercial and Industrial Component

Not surprisingly, demand for supporting commercial and industrial space on Maui has followed the same trend as the residential real estate market. Commercial and industrial land values, sales prices for improved properties, and rental rates all saw considerable appreciation from 2000 to 2006. This was followed by a period of decline that has continued to the present.

Market conditions have deteriorated within the past few years, evidenced by decreased land values and longer marketing time. Research revealed that there is approximately 40 acres of commercial and industrial land for sale in Central Maui, with most of the available inventory coming from the Maui Lani Village Center. The 36 acres being offered within this recently completed mixed-use business park is priced at the high end of the asking price range, which may not be affordable to some potential buyers.

Regardless, the 40 acres of available commercial and industrial land will only provide short-term supply for Central Maui, based on historical absorption in the region. Although Central Maui has the lowest ratio of population-to-acres of commercial/industrial subdivision land, the strong demand for this type of property is evidenced by new project absorption rates that are similar or higher than other regions. There is no doubt that this is due to its location with respect to major transportation facilities in Kahului, as well as having the governmental seat in Wailuku Town. On average, land in commercial and industrial business parks in Central Maui have been absorbed within a range of 5 to 19 acres per year. The wide range of absorption rates was attributed cyclical market conditions, in addition to the overall lack of land entitled for such use.

Preliminary plans for the subject’s 92.2 acres of commercial, business/light industrial, and village mixed-use land call for neighborhood commercial retail/office and small-scale light production and distribution uses in support of the neighborhood, as well as the overall Central Maui region. Absorption of the estimated 250,000 square feet of Village Mixed Use floor area is forecasted to be at between 30,000 and 45,000 square feet per year. Meanwhile, it is assumed that 60 percent, or about 138,000 square feet, of the Commercial floor area would be immediately occupied upon completion of the neighborhood commercial retail/office center. The remaining space is forecasted to be absorbed at between 15,000 and 20,000 square feet per year, up to stabilized occupancy. Finally, annual absorption of the Business/Light Industrial floor area is forecasted to be between 15,000 and 25,000 square feet.

B. PURPOSE OF THE REPORT

The purpose of this report, as of September 15, 2010, is to generate a market analysis report with respect to the proposed Wai'ale Master Plan Development.

C. INTENDED USE OF THE REPORT

The intended use or function of this report 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, a change in County of Maui Zoning, and a Wailuku-Kahului Community Plan Amendment.

D. SCOPE OF THE REPORT

The Consultant has agreed to provide a current market analysis of this project by (1) defining and delineating the market area; (2) identifying and analyzing the current supply and demand conditions that make up the specific real estate market; and (3) identifying, measuring and forecasting the effect of anticipated developments or other changes on future supply. The market analysis will be developed and prepared in conformity with, and subject to, the requirements of the Code of Professional Ethics and the Standards of Appraisal Practice of the Appraisal Institute, and the Uniform Standards of Professional Appraisal Practice.

E. STATEMENT OF COMPETENCY

ACM Consultants, Inc. (formerly ACM, Real Estate Appraisers, Inc.) has been actively involved in the real estate appraisal research and consulting business since 1982. Our business emphasis has focused mainly on the counseling and valuation of residential and commercial properties located within the State of Hawaii. The company considers itself competent to conduct a market study for a proposed master plan project in Kahului, Island and County of Maui.

F. EXTRAORDINARY ASSUMPTIONS AND HYPOTHETICAL CONDITIONS

1. As of September 2010, the subject was still in the preliminary stages of planning. A Conceptual Community Master Plan prepared by PBR Hawaii provided a visual indication of the proposed layout of the development. The consultant is not liable for any changes in the project plan past this date, nor for information that has not been released or communicated to the Consultant.

2. The Consultant has no control over economic conditions and other international events that could have an affect upon Hawaii's economy and the Maui real estate market. As a result, this report has not made any assumptions regarding potential conflicts with other nations, or external factors affecting economic conditions here.

3. The counseling report is also subject to standard "Limiting and Contingent Conditions" located in the pages following.

G. CONFIDENTIALITY PROVISION

The contents of this market study are confidential. Release of this counseling report by ACM Consultants, Inc. is limited to you and for your preparation of an Environmental Impact Statement for the proposed Wai'ale Master Plan Development. The intended users of this report include A&B Properties, Inc. and the appropriate government agencies to which this report will be submitted. Any further release of this report, or portions herein, is strictly prohibited and you shall accept the risk and liability for any such release without the previous written consent of ACM Consultants, Inc. Further, you shall indemnify and defend ACM Consultants, Inc., and its individual consultants/appraisers, from any claims arising out of any such unauthorized disclosure.

H. CERTIFICATION

The undersigned does hereby certify that except as otherwise noted in this appraisal report:

1. The Consultants' compensation is not contingent upon the reporting of a predetermined value or direction in value that favors the cause of the client, the amount of the value estimate, the attainment of a stipulated result, or the occurrence of a subsequent event.

2. The Consultants' have no present or prospective interest in the property that is the subject of this report, and no personal interest or bias with respect to the parties involved. The "Estimate of Market Value" in the appraisal report is not based in whole or in part upon the race, color, or national origin of the prospective owners or occupants of the properties in the vicinity of the property appraised.

3. The Consultants have personally inspected the property, and are signatories of this Certification.

4. To the best of the Consultants' knowledge and belief, all statements of fact and information in this report are true and correct, and the Consultants' have not knowingly withheld any significant information.

5. No other person provided significant professional assistance to the persons signing this report.

6. The reported analyses, opinions and conclusions are limited only by the reported assumptions and limiting conditions, and are the Consultants' personal unbiased professional analyses, opinions and conclusions.

7. All analyses, opinions and conclusions were developed, and this report has been prepared, in conformity with the Uniform Standards of Appraisal Practice.

8. This counseling report is subject to and in conformance with the Code of Professional Ethics and Standards of Professional Conduct of the Appraisal Institute. The analyses, opinions and conclusions of this counseling report have been made in conformity with, and subject to, the requirements of Title XI of the Federal Financial Institutions Reform, Recovery, and Enforcement Act of 1989.

9. This counseling report is to be used only in its entirety and no part is to be used without the whole report. All conclusions and opinions concerning the real estate are set forth in the counseling report were prepared by the Consultant(s) whose signature(s) appears on the counseling report. No change of any item in the counseling report shall be made by anyone other than the Consultant, and the Consultant shall have no responsibility for any such unauthorized change.

10. The Appraisal Institute, of which this Consultant is a member, has a legal right to review this report.

11. The qualifications of this Consultant, including completed educational requirements of his/her candidacy are located in the Addendum to this report. Any member signing the report has completed the requirements of the Appraisal Institute's continuing education program.

ACM Consultants, Inc.

Glenn K. Kunihisa, MAI, CRE
Certified General Appraiser,
State of Hawaii, CGA-039
Expiration: December 31, 2011

Shane M. Fukuda
Certified General Appraiser,
State of Hawaii, CGA-810
Expiration: December 31, 2011

I. LIMITING AND CONTINGENT CONDITIONS

1) This is a Counseling Report which is intended to comply with the reporting requirements set forth under Standards Rule 5 of the Uniform Standards of Professional Appraisal Practice for a Counseling Report. The information contained in this report is specific to the needs of the client and for the intended use stated in this report. The Consultant is not responsible for unauthorized use of this report.

This report has not been prepared for federally-related mortgage financing purposes, and has not been prepared in compliance with the requirements of Title XI of the Federal Financial Institutions Reform, Recovery, and Enforcement Act of 1989.

2) No responsibility is assumed for legal or title considerations. Title to the property is assumed to be good and marketable unless otherwise stated in this report.

3) The property analyzed is free and clear of any or all lines and encumbrances unless otherwise stated in this report.

4) Responsible ownership and competent property management are assumed unless otherwise stated in this report.

5) The information furnished by others is believed to be reliable. However, no warranty is given for its accuracy.

6) All engineering is assumed to be correct. Any plot plans and illustrative material in this report are included only to assist the reader in visualizing the property.

7) It is assumed that there are no hidden or unapparent conditions of the property, subsoil, or structures that render it more or less valuable. No responsibility is assumed for such conditions or for arranging for engineering studies that may be required to discover them.

8) It is assumed that there is full compliance with all applicable federal, state, and local environmental regulations and laws unless otherwise stated in this report.

9) It is assumed that all applicable zoning and use regulations and restrictions have been complied with, unless a non-conformity has been stated, defined, and considered in this counseling report.

10) It is assumed that all required licenses, certificates of occupancy or other legislative or administrative authority from any local, state, or national governmental or private entity or organization

have been or can be obtained or renewed for any use on which the value estimates contained in this report are based.

11) Any sketch in this report may show approximate dimensions and is included to assist the reader in visualizing the property. Maps and exhibits found in this report are provided for reader reference purposes only. No guarantee as to accuracy is expressed or implied unless otherwise stated in this report. No survey has been made for the purpose of this report.

12) It is assumed that the utilization of the land and improvements is within the boundaries or property lines of the property described and that there is no encroachment or trespass unless otherwise stated in this report.

13) The Consultant is not qualified to detect hazardous waste and/or toxic materials. Any comment by the Consultant that might suggest the possibility of the presence of such substances should not be taken as confirmation of the presence of hazardous waste and/or toxic materials. Such determination would require investigation by a qualified expert in the field of environmental assessment. The presence of substances such as asbestos, urea-formaldehyde foam insulation, or other potentially hazardous materials may affect the value of the property. The Consultant's value estimate is predicated on the assumption that there is no such material on or in the property that would cause a loss in value unless otherwise stated in this report. No responsibility is assumed for any environmental conditions, or for any expertise or engineering knowledge required to discover them. The Consultant's descriptions and resulting comments are the result of the routine observations made during the analysis process.

14) Unless otherwise stated in this report, the subject property is evaluated without a specific compliance survey having been conducted to determine if the property is or is not in conformance with the requirements of the Americans with Disabilities Act. The presence of architectural and communications barriers that are structural in nature that would restrict access by disabled individuals may adversely affect the property's value, marketability, or utility.

15) Any proposed improvements are assumed to be completed in a good workmanlike manner in accordance with the submitted plans and specification.

16) The distribution, if any, of the total valuation in this report between land and improvements applies only under the stated program of utilization. The separate allocations for land and buildings must not be used in conjunction with any other appraisal and are invalid if so used.

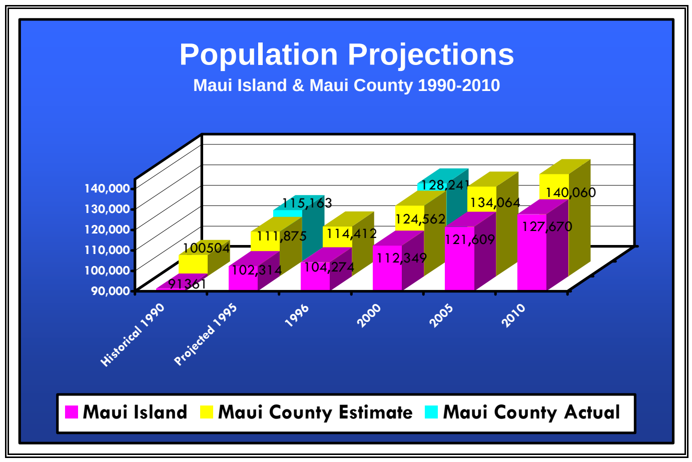
17) Possession of this report, or a copy thereof, does not carry with it the right of publication. It may not be used for any purpose by any person other than the party to whom it is addressed without the written consent of the consultant, and in any event, only with property written qualification and only in its entirety.

18) Neither all nor any part of the contents of this report (especially any conclusions as to value, the identity of the Consultant, or the firm with which the Consultant is connected) shall be disseminated to the public through advertising, public relations, news sales, or other media without prior written consent and approval of the Consultant.

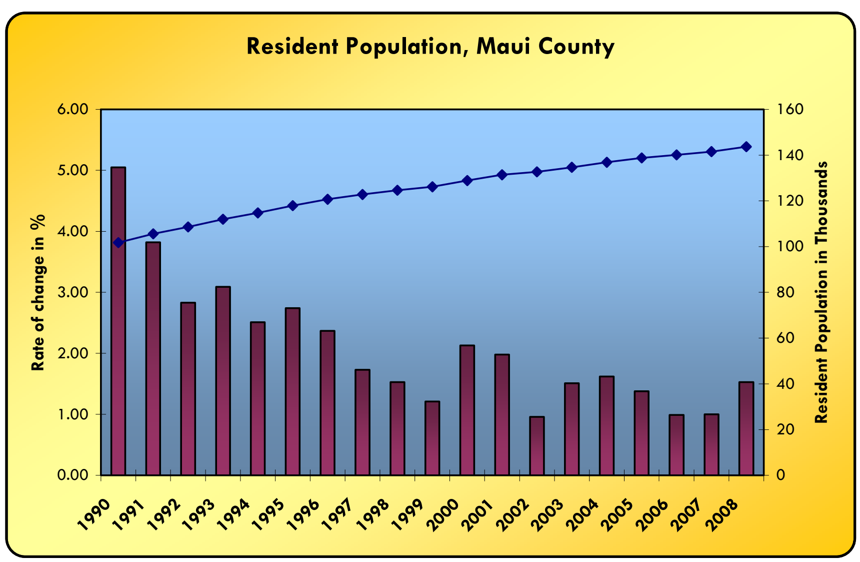
PART II – FACTUAL DATA

A. REGIONAL DATA - MAUI COUNTY

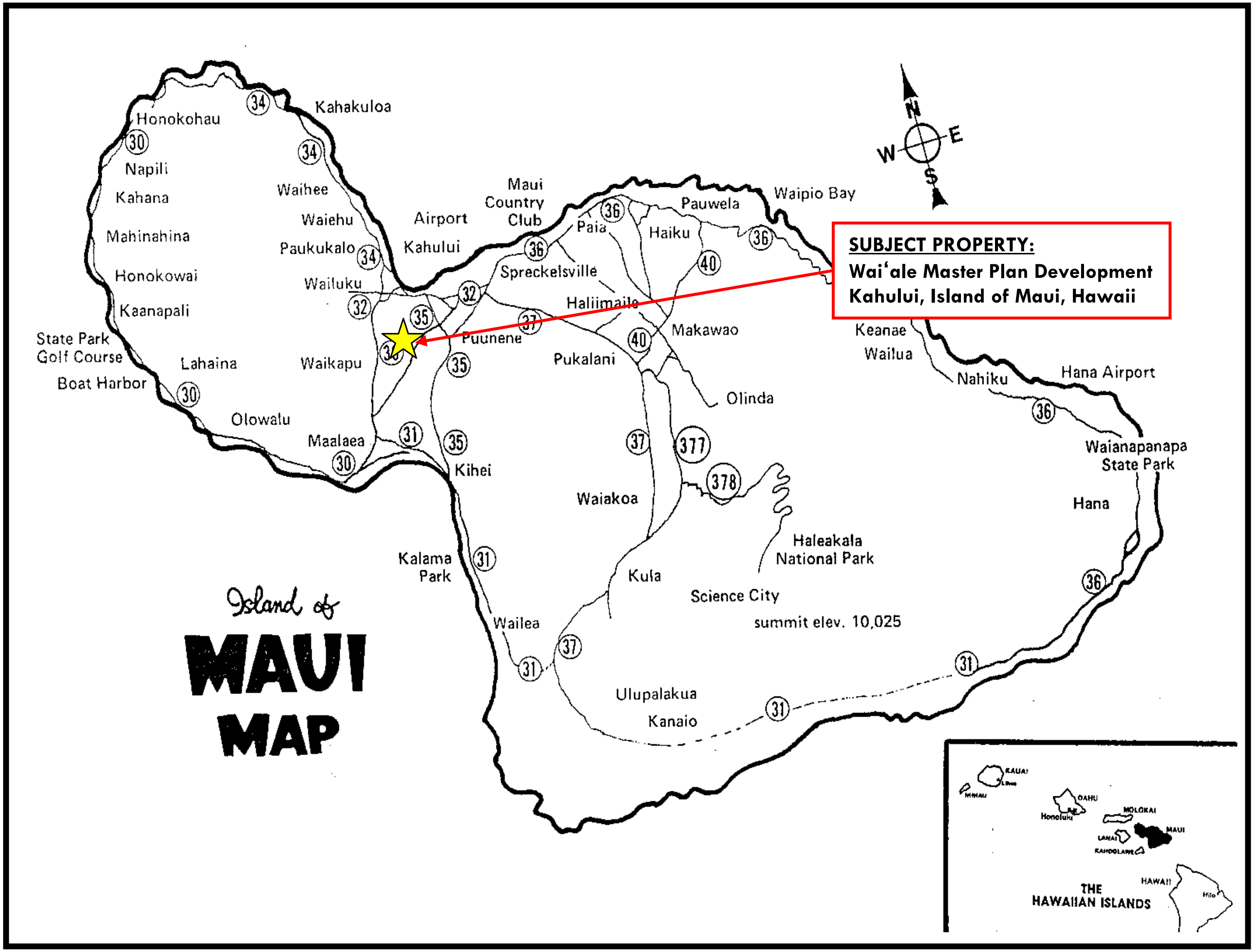
Maui County is the third most populous of the four counties of Hawaii, with a total resident population of 128,241 (2000 Census) and a change of 27.6 percent since 1990. Maui County consists of the islands of Maui, Molokai, Lanai, and Kahoolawe. Ninety percent (90%) of County residents live on Maui; the 2000 U.S. Census of Population reported 7,404 residents on Molokai and 3,193 on Lanai. The Island of Maui consists of a total of 734.5 square miles, or 470,080 acres. Population Projections for Maui County and the Island Maui are illustrated on the table below.



The following graph illustrates the resident population change in Maui County from 1990 through 2008. The graph indicates that although Maui's population has been steadily growing, it now appears to be rising at a decreasing rate.



Source: UHERO Economic Information Service


SUBJECT PROPERTY:
Waiʻale Master Plan Development
Kahului, Island of Maui, Hawaii
Island of
MAUI
MAP
Honokohau
Kahakuloa
Napili
Kahana
Mahinahina
Honokowai
Kaanapali
State Park
Golf Course
Boat Harbor
Lahaina
Olowalu
Maalaea
Waihee
Waiehu
Paukukalo
Wailuku
Waikapu
Airport
Kahului
Maui
Country
Club
Paia
Pauwela
Haiku
Waipio Bay
Spreckelsville
Haliimaile
Puunene
Pukalani
Makawao
Olinda
Keanae
Wailua
Nahiku
Hana Airport
Waianapanapa
State Park
Hana
Kihei
Kalama
Park
Wailea
Waiakoa
Kula
Haleakala
National Park
Science City
summit elev. 10,025
Ulupalakua
Kanaio
N
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S
THE
HAWAIIAN ISLANDS

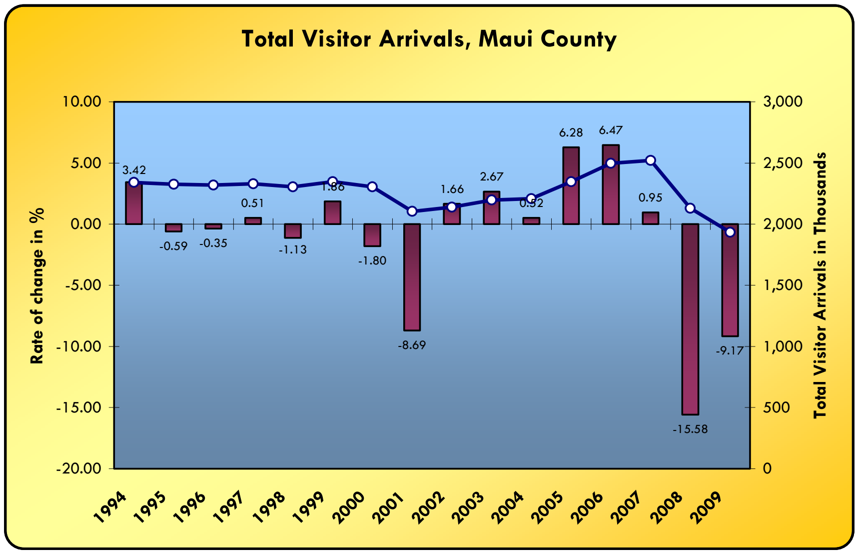
Like all the Hawaiian Islands, Maui, Molokai and Lanai are blessed by warm air temperatures year-round, and ocean waters that range from 72-77°F in winter to 77-81°F in summer. The islands' distance from other continents, the moderating effects of the surrounding water and the tropical location combine to create this pleasant climate. Hawaii's topography, particularly the mountains and valleys and location of each island, contributes to the great variety of microclimates within very small areas. On Maui, the West Maui Mountains and Haleakala are the primary geological features affecting the weather. Due in part to the above geographical factors, Maui, for fifteen out of the last sixteen years, was selected "Best Island in the World" by readers of Condé Nast Traveler magazine.

Visitor Industry

Historically, Maui hotel occupancies typically exceeded any area in the state with the exception of Waikiki. Its high rating is due to a number of factors. First, Maui receives the good fortune of location and climate. Second, Maui has the infrastructure in place to move tourists to a diverse variety of activities with a minimum of inconvenience and down time. The accommodations on Maui are another reason. Maui resort hotels have consistently ranked above other Hawaii resort destinations. In the same Conde Nast Traveler magazine, nine of the "Top 20 Hawaii Resorts" for 2009 were Maui County resorts. The Four Seasons Maui at Wailea topped the list, while other Maui County resorts garnering honors included: Four Seasons Lanai, The Lodge at Koele (3rd); Hotel Hana Maui and Honua Spa (4th); Four Seasons Lanai at Manele Bay (5th); Fairmont Kea Lani, Maui (9th); Grand Wailea (12th); Ritz-Carlton Kapalua (14th); Hyatt Regency Maui Resort & Spa (15th); and Westin Maui Resort & Spa (20th).

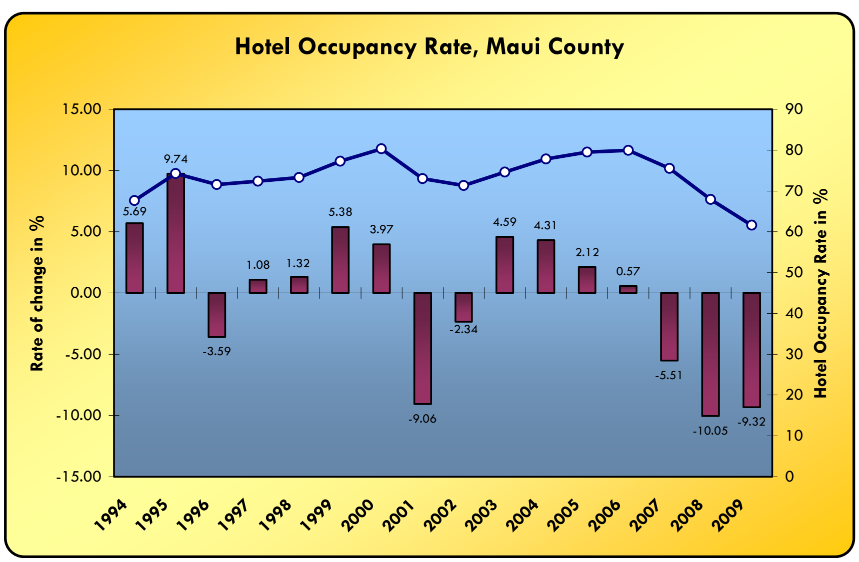
With the possible exception of Kauai, Maui is more dependent on tourism than any of Hawaii's four counties. That sector is not treating Maui very well today. For years, Maui has worked very hard at cultivating a worldwide image as a premier, upscale tropical island destination. In fact, it is the only county government in Hawaii that spends money to support tourism. In the wake of the current financial crisis, Maui's tourism counts and hotel occupancy have fallen significantly. Even the upscale and affluent markets, it appears, have curtailed their spending on trips to the Valley Isle.

Tracking the tourism counts during this decade begins with the effects of the September 11, 2001 terrorist attacks on this country which had a drastic impact on the tourism industry. According to the University of Hawaii Economic Research Organization (UHERO), the final Maui visitor count for 2001 was 2,104,480. In 2002, the visitor count rebounded slightly to 2,139,427 as the visitors slowly returned during the mid to latter part of the year. Visitor totals for 2003 indicate an increase of 2.7 percent over 2002, 2004 total visitor arrivals increased by 0.52 percent over 2003, while 2005 visitor totals showed an increase of 6.28 percent, to 2,346,480. There was a rebound in 2006, with a 6.5 percent jump to 2,498,200, followed by another 1.0 percent gain in 2007 to 2,522,000. The emergence of the economic crisis in 2008 led to a drop of 15.6 percent, to 2,129,000. In 2009, the visitor count dropped an additional 9.2 percent, to 1,933,900. Hawaii and many other visitor destinations worldwide continue to be severely impacted by the current national and global economic conditions.



Source: UHERO Economic Information Service

In addition, for 2009, Maui County's occupancy rate stood at 60.62 percent, followed by Kauai at 59.06 percent. Hawaii Island, at 53.98 percent, had the lowest occupancy, while Oahu occupancy topped the list at 72.84 percent.



Source: UHERO Economic Information Service

Visitor shopping opportunities have increased in recent years with the opening of The Maui Marketplace, a 275,000 square foot shopping complex, modeled after Oahu's successful Waikele Center. The Maui Marketplace is now home to such retail superstores like Lowe's Hardware, Pier One Imports, Borders Books and Music, Sports Authority, Starbucks Coffee, and Office Max, as well as many small local retailers and restaurants. Also opening in the same Kahului area were Home Depot, Wal-Mart, Big K and Costco. In addition, the Shops at Wailea opened in December 2000 and added approximately 150,000 square feet of high-end retail space in the Wailea Resort. At about the same time, the 150,000 square foot Piilani Shopping Center opened in Kihei with Safeway as its anchor tenant. The latest entry into the retail sector is the Lahaina Gateway, which opened in 2007. Dubbed a "lifestyle center", Lahaina Gateway, offers almost 137,000 square feet of gross leasable area.

Maui offers more than any other Neighbor Island in the way of proven vacation experiences. It has a larger tourism activities industry relative to the size of its economy than any other county. Such activities include ocean recreation, helicopter tours, biking down Haleakala, and golfing, among numerous other activities. Maui's well-developed ocean recreation industry ranges from windsurfing to snorkeling, scuba diving and sailing cruises which leave regularly from Lahaina and Maʻalaea Harbors.

Maui also has theme destinations, such as the Maui Tropical Plantation. But the premier theme destination on the island is the Maui Ocean Center. This center, featuring the marine environment of the Hawaiian Islands, is modeled after five other aquarium parks developed elsewhere in the world by Coral World International. This ocean center is located just behind the Maalaea Boat Harbor, and is easily accessible from Kahului/Wailuku, and the resort areas of Lahaina/Kaanapali and Kihei/Wailea. The Maui Ocean Center anchors the 18-acre Maalaea Harbor Village, which also includes a retail strip shopping center, restaurants and other services.

When the United States and the world in general recover from the current economic crisis, it is anticipated that Maui will continue to be a strongly favored destination for Mainland tourists. The island has a large share of condominiums available for families and groups on a budget. The California recovery in the early 2000's fueled higher demand for condominium rentals and this may possibly happen again in the next decade.

Hotels have not been adding much in the way of jobs, in fact, many hotel and other tourism-related industries have cut back their work force. Even when tourism numbers were growing steadily, job creation in the visitor industry was not matching that growth. Today, with tourism waning, the work force is noticeably decreasing. While tourism still dominates the labor force, the profitability problems of the large resorts have led managers to refine their operations.

Real Estate

Residential real estate can be divided into three broad categories (single-family homes, condominiums and residential lots) and four important geographic regions. As a result, there are eight subsections of the market that have proven capable of moving up and down with relatively little correlation with the others. Upcountry has virtually no condominium properties; and two other subsections, South Maui and Central Maui, have few leasehold condominiums. Only West Maui has all three types.

Several neighborhoods have virtually all luxury housing, such as the resort communities of Kapalua, Kaanapali, and Wailea. Meanwhile, urban areas such as Kahului, Wailuku, Kihei and Lahaina consist primarily of workforce housing, with some pockets of luxury housing. Rural residential areas tend to have a mix.

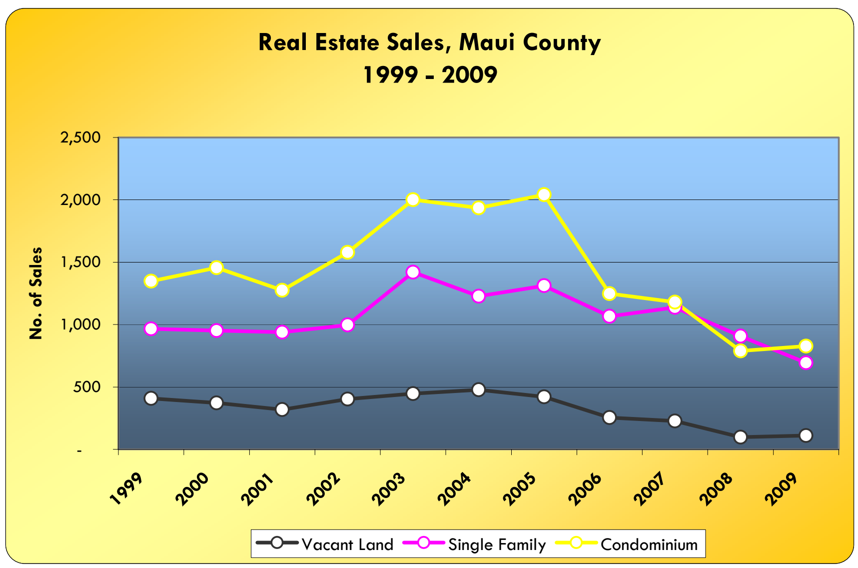
Owner-occupied housing on Maui runs about 56 percent of all occupied housing units. The total housing stock has been growing at a rate of about 1,000 units a year in the 1980's. The total accelerated to 1,500-2,000 new units in the late 1980's, well short of demand. The Maui population has expanded tremendously for the past 10 to 12 years, but housing was not being built at the same pace as the 1980s. As a result, demand for housing during that period outpaced supply and homes prices and rents rose dramatically. The median single-family home price on Maui averaged $498,708 in 2009, which is a drop of 13.2 percent from 2008's average of $574,760. Median sales price for a single family home was $627,887 in 2007, $697,450 in 2006, and $678,321 in 2005. These years were considered the height of the real estate market.

Since then, the real estate market has changed direction, with a less stable economy and more stringent lending practices. In 2009, interest rates averaged 5.04 percent, down from the previous year's average rate of 6.04 percent. The 2009 average interest rate represented the lowest annual average since 1971. While interest rates remain relatively stable, the current economic recession continues to stifle Maui real estate.

The following summarizes a sales volume history for Maui County from 1990 to 2009, which includes resales and new project sales.

Year	Vacant Land	Single Family	Condominium
1990	298	560	1,459
1991	116	430	593

1992	120	382	496
1993	121	361	461
1994	148	404	592
1995	118	331	495
1996	126	451	577
1997	182	507	812
1998	276	641	999
1999	408	965	1,348
2000	372	951	1,456
2001	318	938	1,274
2002	402	997	1,578
2003	447	1,420	2,001
2004	477	1,228	1,935
2005	421	1,311	2,041
2006	255	1,066	1,247
2007	226	1,138	1,179
2008	97	907	788
2009	110	693	826

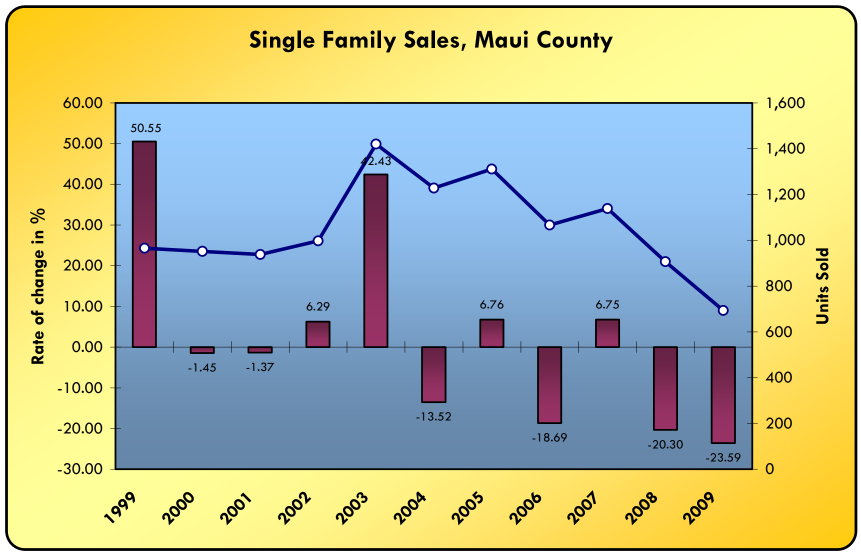


Source: Realtors Association of Maui

The real estate market increased significantly between 2002 and 2006. Single-family sales saw noteworthy increases in 2003, where the number of single-family sales leaped upwards of 42 percent. There was a 13 percent dip in 2004, followed by a rebound of almost 7 percent in 2005. For 2006, there was a decrease of 18 percent, with a subsequent upward bounce of almost 7 percent in 2007. Then, with the eroding economic conditions and financial crisis in 2008, Maui County experienced a 20 percent drop in sales. The continued economic recession in 2009 caused an additional slide of

over 23 percent. This was the biggest decline in sales since 1991, when sales of single-family homes dropped by 25 percent.
The increase in single-family sales volume and simultaneous drop in average median price in 2007 was partially attributed to the closing of numerous units in Waikapu Gardens. This affordable priced subdivision had over 14 percent of the island's single-family home closings in 2007, with 164 units, at an average sales price of $356,876.

The following graph further illustrates the single-family sales volume history for Maui County from 1999 to 2009.



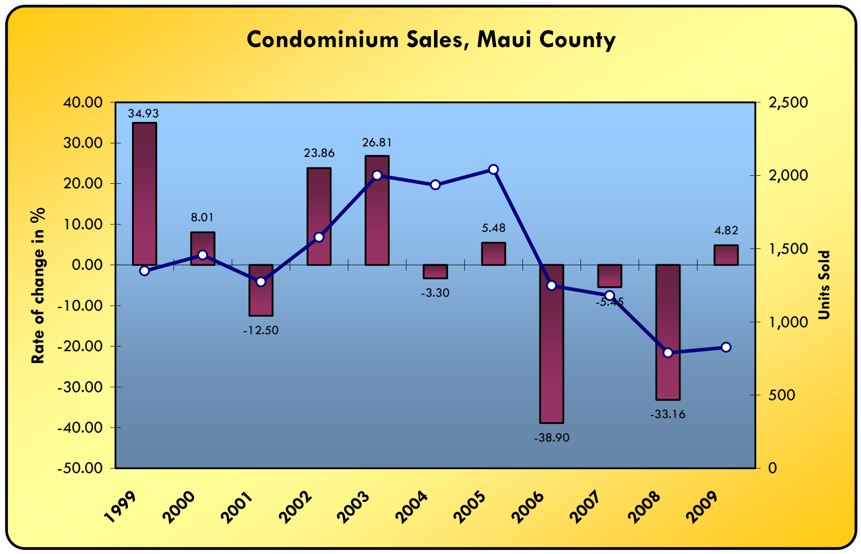
Source: Realtors Association of Maui

Similarly, condominium sales had experienced significant increases since 1999 in terms of units sold, achieving a new high in 2002 and a slight decrease in 2003. In 1999, 1,348 condominium units were sold, registering a 34 percent increase from the prior year. In 2001, the number of sales fell slightly, but rebounded significantly in 2002. In 2003, however, total condominium sales skyrocketed to 2,001, fell slightly to 1,935 units in 2004 and then jumped to 2,041 units in 2005. It appears that 2006 was the turning point for sales volume, as condominium sales plunged over 38 percent, followed by another 5 percent fall in 2007. For 2008, sales volume dived 33 percent; however, a 4 percent increase was seen in 2009. It should be noted that since 2005, there has been little new condominium inventory, with the exception of the resort market.

Meanwhile the plummet of condominium sales volume in 2006 was deemed to be market stabilization from the spike in new inventory between 2003 and 2005. During this time period, Villas at Kenolio and Hale Kanani (Kihei), Villas at Kahana Ridge (Kahana), and

Kehalani Gardens and Iliahi (Wailuku) closed on their units. Since then, there have been few non-resort condominium projects become available.

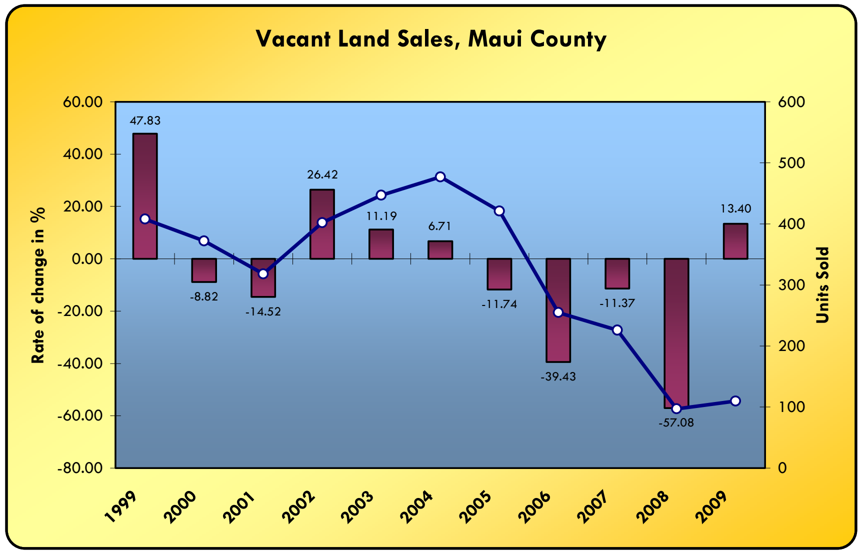
The following graph further illustrates the condominium sales volume history for Maui County from 1999 to 2009.



Source: Realtors Association of Maui

Land sales increased steadily between 2001 and 2004, but dropped 11 percent in 2005 with only 421 sales, then another 39 percent to 255 sales in 2006. This trend continued in 2007, with an 11 percent slide to 226 sales, surpassed by a huge 57 percent plunge in 2008. The first increase in four years was witnessed in 2009, as vacant land sales volume increased by 13 percent. Many developers, realtors and lenders consider the passage of the Workforce Housing Ordinance (December 2006) and the Water Availability Ordinance (December 2007) to have had a significant contribution to the severe decline of sales of vacant land.

The following graph further illustrates the vacant land sales volume history for Maui County from 1999 to 2009.



Source: Realtors Association of Maui

Meanwhile, median prices rose continued to rise until 2006 for all categories of real estate. The average monthly median prices in 2006, for land parcels, single-family homes and condominium units, increased 29 percent, 2 percent and 33 percent, respectively. In 2007, average monthly median prices for land and single-family property decreased 19 percent and 10 percent, respectively, while the average median price for a condominium increased 6 percent. For 2008, the average monthly median prices for single-family homes retreated by approximately 8 percent. Vacant land saw a slight gain of about 4 percent over 2007, while condominiums increased by 19 percent. It should be noted that the average condominium median price were heavily influenced upward by December closings in Honua Kai, a luxury oceanfront property. In 2008, vacant land median price increased by 3 percent. For that year, single-family properties decreased by 13 percent and condominiums saw a 30 percent drop. Similar to 2007, the condominium monthly median was swayed by first quarter closings in Honua Kai.

Construction and Development

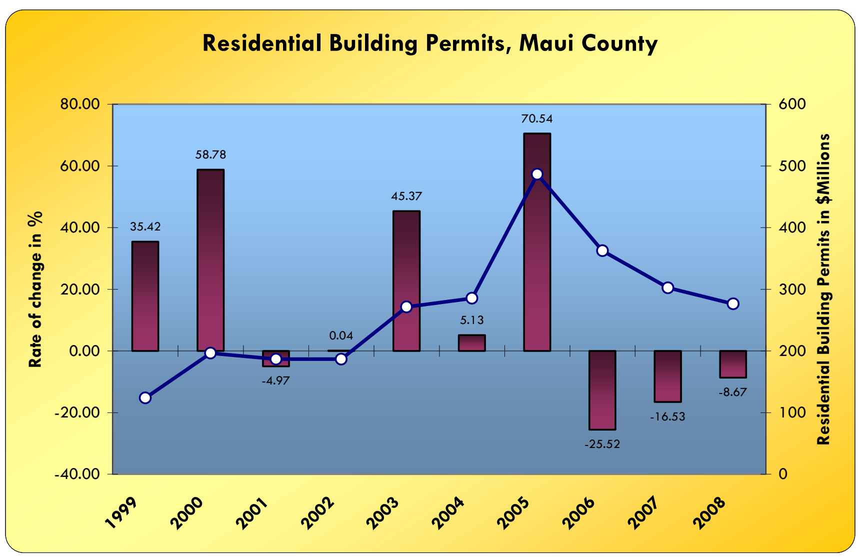
The construction industry, in the mid part of this decade, benefitted from a robust economy and building climate.

Three new commercial centers were built in 2000. The Wailea Shopping Village had been demolished and was replaced with The Shops at Wailea, which includes 150,000 square feet of upscale retail and restaurant space. Also, the 150,000 square foot Piilani Village shopping center was built at the same time and is anchored by a 55,000 square foot Safeway store, one of the largest Safeway in the state. The Ma'alaea Harbor Village shopping complex, where the premier Maui Ocean Center presently stands, was also built during the same period; however, since then, no other project has been attempted and the majority of the lots in this commercial subdivision sit vacant. As previously discussed, the Lahaina Gateway was completed in 2008 and injected an additional 137,000 square feet of retail space.

The effects of the late-2008 financial crisis and subsequent economic recession are still clearly visible across the island, as many new commercial and industrial projects completed during this period remain empty, or are having difficulty selling off/leasing units.

Construction of single-family residential properties has fallen significantly, as developers have curtailed building to meet their anticipated sales levels. As mentioned earlier, the single-family and condominium real estate markets have softened, with sales volume and median prices generally decreasing, while marketing days have increased.

The following graph illustrates the trend of residential building permits (in dollars) in Maui County from 1999 through 2008. As shown in the following graph, residential permits peaked in 2005 at the height of the real estate market. As previously discussed, many feel that the passage of County ordinances relating to development in 2006 and 2007, coupled with increased construction costs, have severely lessened the ability to feasibly create new housing projects.



Source: UHERO Economic Information Service

In Central Maui, the majority of the residential construction is within the Kehalani and Maui Lani project districts, which are being developed with several new subdivisions and condominium projects. Situated in the Kehalani district are Koa, which offers both house lots and single-family homes; Akolea and Cottages, both consisting of house and lot packages; Villas at Kehalani and Milo Court, which are townhouse condominium developments. Presently, there are four ongoing projects at Maui Lani. They include Na Hoku and Traditions (single-family homes), Sand Hills Estates (house lots), and Parkways (both house lots and single-family homes).

The demand for housing in the Central Maui area had been extremely strong up to mid-2006, with projects usually sold out prior to completion of construction. Due to the more recent downward trend of the economy and residential real estate market, developers are now finding themselves holding inventory and most new construction has ceased.

Meanwhile, Spencer Homes completed construction of a 410-unit affordable project in 2008, called Waikapu Gardens. Approximately half of the houses met County affordable housing pricing requirements. This project was welcomed by the community as "affordable" prices were stated to be below $300,000. This project gained approval by the Maui Nui Affordable Housing Taskforce which was set up in response to the growing need for affordable housing on Maui.

The demand for housing in the Central Maui area had been extremely strong up to mid-2006, with projects usually sold out prior to completion of construction. Due to the more recent downward trend of the economy and residential real estate market, developers are now finding themselves holding inventory and most new construction has ceased.

Up to 2006, Kihei had also seen an upswing in residential development brought upon by ongoing residential projects including Ke Aliʻi Ocean Villas (townhouse condominiums) and Moana Estates (single-family homes) by Towne Development, Kamaliʻi Alayna (single-family homes) by Betsill Brothers, Inc., and Signature Homes' Hokulani Golf Villas (residential condominiums). Other current South Maui projects are Kilohana Waena (house lots) and Kai Ani (townhouse condominiums). Similar to Central Maui, the developers of ongoing projects have slowed construction while continuing to market their units; whereas, previous Kihei developments were often sold out prior to construction completion.

In Wailea, the Shops at Wailea and Wailea Town Center are the only established commercial developments. Both centers target the high-end residents of this resort community and Wailea's upscale visitors. Phase I of Wailea Town Center was completed in 2006 while Phase II was completed in 2007. It contains neighborhood services which include retail and office owner-occupants. The second phase included more commercial condominium units and residential units on the second floor. Current condo owners in this project include Coldwell Banker and First Hawaiian Bank. This development was met with high demand as all of the units have already sold and some have even resold. Another commercial retail/office project, Wailea Gateway Center, was completed in 2009; however, this development has not yet been able to secure tenants.

Retailing

In retail, the most significant addition to Maui is the Lahaina Gateway situated along Honoapiilani Highway across from the Lahaina Cannery Mall. It was dubbed as a "lifestyle center" with specialty retail shops, services and restaurants. Opened in late 2007, this 137,000 square foot center includes anchor tenants such as Office Max, Barnes & Noble, Outback Steakhouse, The Melting Pot, and Lahaina Farms, a supermarket owned by Foodland's Sullivan family. Prior to Lahaina Gateway, Maui Marketplace on Dairy Road was the last large retail development to be built, at 275,000 square feet. This center contains the likes of Lowe's Hardware, Office Max, Sports Authority, Borders Books & Music, Pier One Imports, Burger King and Starbucks Coffee.

Wal-Mart and Home Depot are also located on Dairy Road, immediately west of the Maui Marketplace. These outlets joined earlier arrivals Costco and Kmart, as well as Alexander & Baldwin's neighboring Triangle Square, in carving up the Maui retail pie. However, the local malls are answering the challenge with more food and entertainment, and retailers that can compete in their niche. Maui's largest mall, Queen Kaahumanu Center in Kahului, has been challenged by the presence of these large box retailers and vacancies are very noticeable.

In Kaanapali, Whalers Village has taken a turn toward the luxury market popular with the Japanese. After completing a $3 million renovation and a change in its tenant mix, this oceanfront center now aims for both westbound and eastbound visitors. Japanese visitors are targeted with Duty Free Shoppers, Louis Vuitton, Prada, Loewe and other high-end shops.

The 150,000-square foot Shops at Wailea opened in 2000, offering upscale shopping in its high-end retail shops. Tenants include Louis Vuitton, Coach, Bally, Fendi, Tiffany & Co., Banana Republic, and Georgiou. Restaurants in this mall include Ruth Chris Steak House, Tommy Bahama Café and Emporium, and Longhi's. Other retailers include Crazy Shirts, Hot Topix, Gap, Wolf Camera, and Whalers General Store.

Agriculture

Agriculture on Maui is dominated by larger operations like Maui Land & Pineapple Company and Alexander & Baldwin's Hawaii Commercial and Sugar (HC&S).

Pineapple now confronts more foreign competition from places like Thailand. In 2007, the company shut down the canning portion of its operation to rely solely on the more profitable fresh fruit segment. Downsizing of the plantation occurred in 2008, which resulted in a reduction of over 200 employees. In December 2009, Maui Land & Pineapple Company announced that it would be shutting down its agricultural arm, citing continued annual losses. However, a new company, Haliimaile Pineapple Company, was formed the following week and immediately took over pineapple operations.

HC&S survives as Hawaii's only remaining sugar operation due in part to its economies of scale, its land configuration (a relatively compact and contiguous land area in the isthmus of the Valley isle), and its commitment and ability over the years to reinvest and upgrade plant and equipment. But the last active sugar plantation in the state is facing other hardships, namely water. There had been drought conditions on Maui between 2007 and 2009, contributing to low sugar yields. According to HC&S, future viability is dependent on continued stream diversion; however, there has been opposition to this continued practice. HC&S continues to re-evaluate its operations to remain viable, including consideration of potential biofuels and other energy alternatives.

Another of Maui's sugar operation casualties, Pioneer Mill in West Maui, is missed visibly. For years, proponents of maintaining and sustaining Hawaii's sugar industry argued that growing sugarcane imparted to this economy an important, if underestimated, non-pecuniary benefit; sugar kept the land green and attractive, for tourists and locals alike, and its cultivation contributed to the recharge of groundwater resources. Economists call this situation an "externality," an activity that affects others for better or worse, without those others paying or being compensated for activity.

Anyone who doubts that logic now has only to drive the West Maui coast from Olowalu to Kaanapali and look mauka, at an entire mountain side of dry brush and unused fields. As with many cases where sugar plantations have shut down, most diversified agriculture crops are just not land intensive enough to utilize all the vacant land. Coffee and seed corn operations are possibilities, but they make only a small dent.

In addition to sugar and pineapple cultivation, Maui also offers rich opportunities for agricultural diversification by small farmers and large agribusinesses. Top among new agricultural products are:

papaya, cut flowers, coffee, Kula onions and strawberries, and Chinese cabbage from Kula. Molokai offers its sweet potatoes, Molokai lettuce and alfalfa, as well as taro.

High-Tech

Maui's contribution to Hawaii's fledgling high-tech industry remains pre-eminent in the state. It also represents genuine diversification of the economy. The Maui Research and Technology Park in Kihei has all of it's infrastructure in place, and has completed three major building projects. Most important, it houses one of the country's most powerful supercomputers. The park now hosts over 30 companies and over 300 employees on 415 acres.

With access to one of the most powerful supercomputers in the world, funded by the U.S. Air Force, the Maui Research and Technology Park is continuing its efforts to diversify the Maui economy into something fundamentally different from what exists in the county or anywhere else in the state.

An office building was developed by the Maui Economic Development Board in 2006, and contains approximately 31,500 square feet of rentable area on a 2.8-acre site. Another completed project is Park Plaza, a 15-unit commercial office condominium building developed by Goodfellow Brothers and Betsill Brothers. Both Goodfellow and Betsill plan to occupy just over half of the entire building. Since its completion in 2008, sales have been very sluggish.

The park is sticking to its long-run strategic plan to capitalize on its location at the center of the Pacific Basin. Its extensive fiber-optic network to the U.S. Mainland makes it one of the most fiber-rich environments in the world, greater than many facilities actually located on the Mainland.

County Government

Maui County is unique in having several inhabited islands in its jurisdiction: Maui, Molokai, as well as Lanai, and the uninhabited island of Kahoolawe.

Maui County has an elected Mayor and County Council, and the Liquor Control Commission is semi-autonomous with appointed directors. Although all courts are conducted by the State, the County is responsible for prosecution and the Mayor appoints the prosecutor. The council has nine members, each residing in one of nine districts; however, voters cast ballots for all nine seats.

Unlike other states, Hawaii has only two layers of government: State and County. The State is responsible for many functions that elsewhere come under the jurisdiction of municipalities, such as schools, hospitals, and airports. Also, unlike other states, Hawaii has statewide zoning implemented by the State Land Use Commission. The County has zoning authority within the boundaries established by the commission.

The lack of affordable housing continues to be a concern within the County of Maui. Maui is one of the most expensive counties for single-family home buyers. A record high median price of $780,000 was set in July 2006 for a single-family home. Since then, the median single-family price has continued to fall, with an average monthly median sales price of $498,708 in 2009, down from $574,760 in 2008 and $627,137 in 2007. According to the latest State of Hawaii Data Book, 8 percent of the houses are overcrowded on Maui and 41.4 percent of the households pay more than the recommended limit of 30 percent of their income on housing. In fact, 27.1 percent pay more than 40 percent on housing.

This heightened effort by the County resulted in the passage of Ordinance 3418 on December 5, 2006, under which all proposed developments are subject to review if they are to contain five or more units or lots. Under this ordinance, if the average sales price is projected to be less than $600,000, 40 percent of the total units must be priced to meet the various affordable categories. If the average sales price in the project is $600,000 or more, then 50 percent of the units must be affordably priced. An alternative to providing the affordable units is to pay an in-lieu fee equal to 30 percent of the average projected sales price of the market rate units multiplied by the number of affordable units required in the development. Or, the owner may elect to provide land which is equal in value to the in-lieu fee. This ordinance has had a profound effect on residential development since its passage. The subsequent reduction in proposed projects had many in the building and real estate industries questioning whether the ordinance created too much of an obstacle for developers.

In an effort to stimulate residential construction, the ordinance was revised by the County Council on February 26, 2010, as Ordinance No. 3719, reducing the amount of required affordable housing units built on site to 25 percent, provided the average sales price of the market units is projected to be less than $600,000. If the average sales price in the project is $600,000 or more, then 50 percent of the units must be affordably priced. The new law also clarified the calculation of required affordable units built off site; based on 50 percent of the total number of on-site market units, regardless of their projected average sales price. Time will tell if this latest version of the ordinance will help to achieve its intended goal.

The water availability ordinance is another law that has made an impact on the development community. On December 14, 2007, the County of Maui passed into law Ordinance 3502. As a result, the

Department of Water Supply (DWS) is presently restricting the issuance of meters for all uses in the central and south Maui service areas and this bill restricts issuance of any building permits until the DWS can issue a meter consistent with the provisions of the bill. In order to do so, the DWS director needs to provide verifiable, long-term supply of water to the property. Landowners and professionals in the development community have been openly critical of the ordinance, some calling it a de facto moratorium on housing. Not surprisingly, sales of vacant development lands have been impacted.

B. NEIGHBORHOOD DESCRIPTION

Since real estate is fixed in location, its marketability and rentability are strongly influenced by economic and social trends in its immediate environment. The continuing attractiveness of this neighborhood environment to potential users and tenants, and its competitive relation to those of substitute properties, must therefore be evaluated and forecast by the consultant. In particular, perceived neighborhood trends affect both the quality and quantity of the revenues the subject property can reasonably be expected to generate.

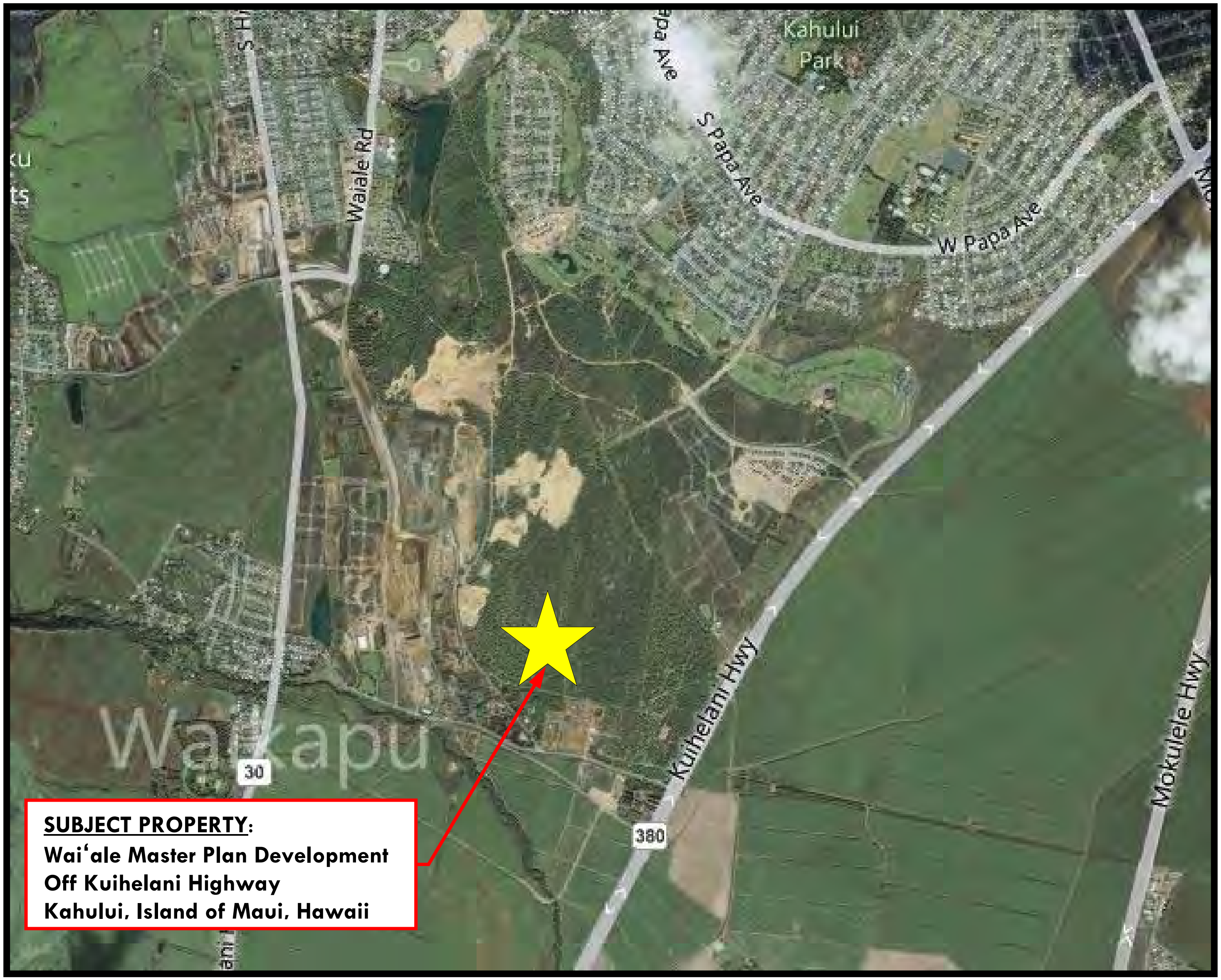
A neighborhood of income-producing properties is a geographic area characterized by similarity of uses and/or users, within which any change has a direct and immediate effect on the subject property and its value.

The geographic area surrounding the subject property is defined by physical and man-made boundaries, and encompasses an area known as Wailuku-Kahului. This region is located on the north shore of the Island of Maui and encompasses the civic and business centers of Wailuku and Kahului. The island's major seaport and primary airport are also contained within the boundaries of this region. The surrounding agricultural land of Central Maui, and the eastern half of the West Maui Mountains, is also within the Wailuku-Kahului neighborhood.

The boundaries of the Wailuku-Kahului region are the northern shoreline from Poelua Bay to Baldwin Park on the north, Kailua Gulch and Lowrie Ditch on the east, Spanish Road to Waikapu Road to Honoapiilani Highway to Pohakea Gulch on the south, and the Wailuku Judicial District boundary on the west.

Population is concentrated in the urban centers of the region. Wailuku has maintained its role as the civic-financial-cultural center while Kahului has strengthened its role in recent years as the business and industrial center.

In addition to the urban centers of Wailuku-Kahului, the region also includes the more rural settlements of Waihee to the north and Waikapu and Puunene to the southeast. Agricultural lands are adjacent on the lower slopes of the West Maui Mountains and in the central plain south and east of Kahului. This green border is a significant part of the settlement pattern because of its open space and economic value. Kahului Harbor and Airport are major land users along the Kahului shoreline. As major ports of entry for people and goods, they serve as an important center of jobs and economic activity.



Not to Scale!

NEIGHBORHOOD MAP

The major thoroughfares through Kahului and Wailuku are Kaahumanu Avenue which begins in Kahului and provides primary access to Wailuku as well as Lahaina and Kihei; Hana Highway, which is actually a continuation of Kaahumanu Avenue, leads from Kahului to the eastern or "upcountry" portions of the island; and Puunene Avenue which provides access to all major areas in Kahului and ultimately leads to the new Kuihelani Highway which provides by-pass access to Lahaina and Kihei. The Kaahumanu Avenue also runs into Main Street, and via secondary access, runs into Waiehu Beach Road and Lower Main Street.

Kahului, adjacent to Wailuku, is situated on the northwest portion of the island of Maui, and is the central commercial, industrial and residential area of Maui. Kahului Town contains Maui's major shopping centers, centralized industrial areas, financial institutions, medical office facilities and business offices. Additionally, the Kahului Airport and Kahului Harbor are located in Kahului proper and houses the majority of firms providing various goods and services throughout the island, as well as to Lanai and Molokai. Consistent with its central location, post office facilities, community library, parks, schools (elementary, intermediate, high school and a community college), churches of various denominations, entertainment facilities, food outlets and a fire station are located in Kahului.

Wailuku, at one time, was the heart of Maui's business activities. Decentralization of business to nearby Kahului and lack of maintenance and modernization of buildings to keep up with the new shopping habits brought about a gradual decline. However, since the creation of the municipal parking area in Wailuku, several new buildings have been built or renovated and a rejuvenation of the Wailuku Town is being experienced. The recently passed Community Plan envisions Wailuku as the "governmental, cultural and professional center of Maui". Located in Wailuku are the various government agencies, courts, hospital, major recreational facilities and police station.

Wailuku's Fire Station sits in the heart of Wailuku Town, and until the opening of the Kahului Fire Station, was the only one in Central Maui. Kahului Fire Station is a 21,300 square foot facility that includes two main buildings and is situated on Dairy Road.

The Maui Memorial Medical Center, which is Maui's primary facility of medical and emergency service, is located between the connecting boundaries of Kahului and Wailuku. Work was recently completed on the addition of a new wing for the hospital. The Police Station is also conveniently located nearby.

Numerous pre-schools, elementary, grade and high schools are located throughout Kahului and Wailuku, with the University of Hawaii Maui College located on Kaahumanu Avenue.

In order to fully understand and appreciate Kahului and Wailuku's potential for expansion, as well as factors that could limit the growth of this region, a brief summary of recent or proposed developments in central Maui, along with a few important issues facing future development are in order.

RESIDENTIAL

The residential districts surrounding these two centers are significantly different in character. Kahului residential areas are newer, with wide curvilinear streets. Wailuku Town, however, is comprised of older residential areas, intermixed with business uses, varying lot sizes, and a more haphazard street pattern representative of older subdivisions. Only within the past three years has development at the Kehalani Project District really picked up.

Kahului

Currently in Kahului, the major residential area is represented by Alexander & Baldwin, Inc.'s Kahului Town Development. This subdivision consists of 14 increments that were built between 1951 and 1981. There are a total of 3,400 lots within the 14 increments. Kahului Town is distinguished as the first planned "new town" in Hawaii to provide quality housing at affordable prices.

Today, Kahului Town is a bustling residential community, and the ongoing Maui Lani project is generating a great deal of interest. This development will include up to 3,000 new residential units, ranging from executive golf homes to affordable units and will span 1,000 acres on the south side of Kahului and Wailuku. The Maui Lani development includes a golf course, churches, schools and a recreational center. Already, several phases have been sold over the past several years including Legends Phase I and II and Na Hoku. Upcoming developments in Maui Lani include Traditions at Maui Lani, a 153 house-and-lot single-family subdivision and Parkways at Maui Lani, a 210-lot single-family subdivision.

Wailuku

In Wailuku, the older residential homes are mixed with small businesses throughout central Wailuku. There are three primary residential subdivisions on the outskirts of the town including Wailuku Heights, Waiehu Terrace and Leisure Estates.

The older Wailuku Heights area was extended by two exclusive and prestigious phases. The first extension offers 270 lots while the second phase offers an additional 130 lots to the subdivision. Once verdant pastureland, Wailuku Heights is nestled in the West Maui

Mountains and offers underground utilities, scenic views and a landscaped park.
Completed single-family residential developments in Wailuku include the Ohia and Maunaleo subdivisions. These projects, by Towne Development and Stanford Carr Development, were sold strictly as house-and-lot packages. Kehalani Gardens and Iliahi at Kehalani, both condominium projects, were also built by the same developers and were completed in 2005.

Two other single-family projects being constructed in Kehalani are The Cottages at Kehalani (114-unit house and lot subdivision) being developed by Stanford Carr Development; and Akolea at Kehalani (97-unit house and lot subdivision), being developed by Towne Development on the north side of Kuikahi Drive. Another project being planned by Towne Development is Milo Court, which will be a 97-unit duplex-style development in Kehalani next to Ohia II. Meanwhile, Stanford Carr Development is moving forward with a 103-unit townhouse condominium project named Villas at Kehalani.

Jesse Spencer completed the last home in Waikapu Gardens at the end of 2008, a 410-unit affordable housing project in Waikapu Town, a small community in Wailuku proper. In 2007, two house lot subdivisions came to market in Waikapu, Waiolani Pikake (37 lots) by KSD Hawaii and Waiolani Mauka (105 lots) by Scott Nunokawa.

Another unique subdivision that was completed is the Wailuku Country Estates Subdivision, which consisted of 184 agriculture lots located near the Puuohala Camp neighborhood.

COMMERCIAL

Commercial development in Kahului is concentrated along the major thoroughfares in strip fashion, while Wailuku's main commercial activity is concentrated in the central core of the town. Due to the central location of these communities, there has historically been strong demand for commercial space in Central Maui, and vacancies within established projects in this region tended to be very low. However, the recent downturn has resulted in less demand for commercial spaces and higher vacancies, as well as reduced rental rates.

Kahului

There are four major shopping centers in Kahului. Maui Mall, opened in late 1971 contains a gross leasable area of 181,500 square feet on a 25-acre site. It is anchored by tenants such as Longs Drug Store, and the Maui Mall Megaplex, by Wallace Theater Corporation. Star Market closed its doors in March 2008, but was replaced by a new Whole Foods super market. The largest center, Queen Kaahumanu Center, opened in 1973 and had 300,000 square feet of gross leasable area. Extensive renovations were completed in 1995, which included a two-level shopping wing, a six-screen movie theater, expanding the major stores, renovating the existing mall and adding a parking structure and access road. The project expanded the center to 500,000 square feet. It is currently anchored by Macy's and Sears. The Maui Marketplace on Dairy Road is home to a number of big-box retailers including Lowes Hardware, Borders Books and Music, Sports Authority, Office Max, Pier One Imports, Starbucks Coffee, Jamba Juice, Bank of Hawaii and Burger King. Finally, Kahului Shopping Center, the oldest major shopping center which opened in 1951, was partially destroyed by fire in 2005 and plans are underway to redevelop the entire block into Kahului Town Center. This development will consist of retail, office and condominium living.

In addition to these centers, Kahului is home to other large retailers including Costco, Home Depot and Kmart. All of the major financial institutions and the large automobile dealerships are also located in Kahului. The Maui Arts and Cultural Center was built here in 1993 and includes a 1,150-seat theater, a 200-to 300-seat theater, an art gallery, administrative offices and a restaurant/gift shop on 12-acres at Maui Central Park, which is located between the Maui Community College and the former Maui Zoo.

Wailuku

The hub of commercial activity in Wailuku is concentrated in an area along Market Street and Main Streets. Known as Old Wailuku Town, this neighborhood is characterized by older, low-rise buildings consisting of small, individual shops and offices. Civic uses surrounding this area of Wailuku include the State Office Building, the County office buildings, and the judicial building.

The town is home to numerous professionals in the fields of architecture, engineering, financial management real estate and banking. All of the major financial institutions have branches in Wailuku Town. Notable office buildings in Wailuku include One Main Plaza, Wailuku Executive Center, Maui Realty Suites, the Trask Building and Wells Professional Plaza. Wailuku's office market is also feeling the affects of the economic slowdown with evidence of higher vacancies and decreasing rents.

INDUSTRIAL

Vacant industrial has typically been difficult to acquire, due to the lack of inventory in the market. Much of the vacant land in Central Maui's industrial parks is being held by business owners, some of whom are waiting for more ideal conditions to build new facilities. Others may be looking for a turn around in the real estate market before putting their property up for sale. However, the same economic downturn that has significantly impacted demand for commercial space in Central Maui has taken its toll on industrial space. Vacancies are on the rise, while at the same time warehouse rents and land prices appear to be headed downward.

Kahului

There are several industrial parks in Kahului, but the largest and most established of them all is the Maui (Kahului) Industrial Park, which is bordered by Hana Highway, Puunene Avenue, Dairy Road and Kamehameha Avenue. It includes low-rise warehouse and commercial uses and is occupied with a mixture of industrial, retail and office tenants.

Maui Business Park, Phase I-A and I-B (76 acres) has also attracted commercial, office and industrial users along Dairy Road and Hookele Street. Phase II of Maui Business Park is currently in design and will ultimately add approximately 179 acres of light industrial land surrounding the first phase.

Other industrial subdivisions include the Airport Triangle on about 13 acres, the 36-lot Kamehameha Parkway No. 2, and the Central Maui Baseyard on Mokulele Highway.

Wailuku

Existing industrial subdivisions in Wailuku include Wailuku Industrial Park, The Millyard, Waiko Baseyard and Consolidated Baseyard. Wailuku Industrial Park is an improved light industrial subdivision with 74 fee simple lots off of Lower Main Street in Wailuku. Lots range from 10,106 square feet to a parcel 3.089 acres in size. This subdivision is approximately 95 percent developed and includes the new Wailuku Town Center anchored by Sack 'n Save.

The Millyard was developed in 1985 as an improved light industrial subdivision located at the old Wailuku Sugar Mill site. This industrial subdivision contains 57 lots, and is home to the Wailuku Post Office which opened there during the late-1990s. Approximately 60 percent of this subdivision has been developed with a mixture of commercial and light industrial uses. The Millyard Plaza is one of the largest additions to this subdivision. Also, several dentists have seen fit to build their own free-standing facilities in The Millyard, which has developed into more of an office park than an industrial center.

Completed in 2006, the Waiko Baseyard in Waikapu consists of 18 lots on approximately 15 acres of land. This subdivision was immediately sold prior to subdivision completion and will be home to relocating local businesses. Construction on Consolidated Baseyard, also in Waikapu, was completed in 2007. Built on about 23 acres of land, the 35 lots in this light industrial park saw very strong interest and were sold quickly.

CONCLUSION

All public utilities including electricity, water, telephone, and sewer service are available in Kahului and Wailuku, as is police, fire and ambulance services. Propane gas is not a public utility, however, is available. All charges for public services are standardized for Kahului as well as for the Island of Maui.

With the increase of public transportation now available on Maui, Kahului and Wailuku are easily accessible from most parts of the island. This and the fact that it is central to airport and harbor facilities, commercial and industrial establishments, properties located in this area are ideal.

Due to this region being the center of County, State and Federal offices, as well as community services, properties in these areas are anticipated to be in greater demand in the years ahead. Based on the desirability of this area and forecasted demand here, property values are expected to continue their appreciation in the long-term future.

C. PROJECT DATA

Environs

The subject is located on the western side of Kuihelani Highway in Kahului, Island and County of Maui. Kuihelani Highway runs in a general north-south direction, and provides primary access to South Maui from Kahului. Waiko Road runs in a general east-west direction through the southern side half of the subject, and connects Kuihelani Highway to Honoapiilani Highway. According to the Conceptual Community Master Plan Map, there will be numerous internal streets within Wai'ale, with one of the primary roads being an extension of Kamehameha Avenue.

To the north of the subject is the Maui Lani Project District (PD/WK-1), consisting of approximately 1,012 acres of land entitled for approximately 3,700 homes. To date, there have been about 1,500 units constructed in this project district. South and east of the subject there are agricultural lands. Light industrial uses are found to the immediate west of the subject, with the residential neighborhood of Waikapu beyond. Several single-family residential neighborhoods have been completed in Waikapu within the past few years, including Waiolani Mauka, Waiolani Pikake, and most recently, Waikapu Gardens. The subject also surrounds Consolidated Baseyards, a light industrial subdivision situated off of Waiko Road.

The subject is situated approximately four miles to the southwest of Kahului Airport and approximately three miles to the south of Kahului Harbor. These two venues are considered to be the primary shipping and transportation hubs on the island. Wai'ale also enjoys proximity to major retail centers in Kahului, in addition to government, judicial and financial services in Wailuku. Police, fire and emergency medical services are all located within a two-mile radius.

Description of the Proposed Project

The subject consists of approximately 545 acres of land and is currently zoned State Agricultural District. Wai'ale, which is still in its preliminary planning stage, will be located to the west of Kuihelani Highway. Preliminary plans call for areas of single-family residential, multi-family residential, village mixed-use, commercial, business/light industrial, park, cultural preserve, as well as a regional park, a community center, an intermediate school site with associated recreation fields, greenway paths and roads.

According to the Conceptual Land Use Plan, the subject will contain the following land uses:

Land Use	Approximate Land Areas
Single-Family Residential (SF)	128.1 Acres
Multi-Family Residential (MF)	53.7 Acres
Village Mixed Use (VMX)	52.9 Acres
Commercial (C)	23 Acres
Business/Light Industrial (LI)	16.3 Acres
Regional Park/Cultural Preserve (Park)	101.4 Acres
Park, Buffers, Preserves	37.7 Acres
Community Center (CC)	7 Acres
Institutional/School (I)	18 Acres
County Housing	40 Acres
County Park	3 Acres
Roads/Greenway Paths	63.9 Acres

PART III – ANALYSIS AND CONCLUSION

For the purpose of estimating the market response to this planned development, a market study was conducted to determine how supply and demand for residential housing units, as well as commercial and industrial properties might be affected by the development of the subject's 545 acres.

OVERVIEW

When determining an absorption rate for an individual project, such as a single-family residential subdivision or one multi-family residential development, there are typically two components: First is the design and pricing of the proposed project. Second is the overall market environment at the time of pre-sale and project completion. The latter is obviously more difficult to define because it involves forecasting such variables as interest rates, overall market conditions, and general and specific sector real estate market conditions.

The added complication with most projects is the time frames and time lags involved. Since most subdivisions or condominium projects take several years between conception and completion, market and interest rate conditions can change significantly. Thus, a project may commence in a favorable environment and be completed in an unfavorable one (or vice versa). Furthermore, real estate is a cyclical industry and sales activity tends to move in spurts. It is not unusual for a new project to sell half its units in the first year of marketing and require 2 to 3 years (or longer) to sell the remaining half.

However, accurately predicting an absorption rate becomes even more challenging for a large-scale planned development, like the subject, where full build-out may take 10 years or longer. Of course, these time periods could expand or contract depending upon market conditions. Thus, the notion of a linear sales rate may be deemed unrealistic for practical purposes, but is a useful and convenient tool for planning.

In light of the significant changes currently underway for numerous County of Maui planning policies, such as the Countywide Policy Plan and Maui Island Plan, the Consultant has primarily focused on long-term supply and demand characteristics to give the reader the best perspective of the overall market.

A. RESIDENTIAL MARKET ANALYSIS

RESIDENTIAL SUPPLY CHARACTERISTICS

Wai'ale is conveniently located and has relatively uniform travel times to each of the other major population centers on Maui. It follows that subject's primary market area is the Central Maui region, while South Maui, Upcountry Maui and West Maui are expected to be secondary markets. Central Maui is home to the County and State government offices and is the industrial center of the island with convenient access to the major transportation facilities. South Maui has become a tourist destination with its expansive beaches and retail establishments targeted towards the visitor industry. The resort neighborhoods of Wailea and Makena are also located in South Maui. Upcountry Maui consists primarily of rural residential subdivisions and agricultural farmland. West Maui is also a major tourist destination and is home to the famous Front Street retail corridor which allows for pedestrian access to numerous retail establishments within Old Lahaina Town. Further north of Lahaina are the Kaanapali and Kapalua master planned resorts.

A survey of the market revealed that there are over 2,300 housing units either for sale within recent, on-going projects or within developments which are planned for construction within the next one to two years. However, it should be noted that there are multiple factors which could result in such units being delayed or not constructed as planned. Based solely on historical annual absorption rates of other new projects (580 units per year), the short-term market supply would be expected to last approximately 4 years. Of course, a multitude of other factors can influence the capture rate. For instance, the larger percentage of affordable units in the future supply points to a faster-than-normal absorption. Also, the number of buyers from the U.S. mainland and from foreign countries can fluctuate from year to year, and their presence in the market is not as predictable as the demand from local residents.

Wai'ale is being created to help fulfill long-term residential supply on the island; however, it is very difficult to accurately predict future residential supply over the long term. As mentioned earlier, many external factors, such as economic or social factors, could affect the supply and demand for real estate in the future. These factors cannot be controlled by developers who must constantly assess market conditions for their prospective construction and sales periods. Many of these projects are still in the initial planning phases and must still complete governmental requirements before bringing their products to the market. Combine these factors with internal events that could affect a developer and predicting which developments will actually make it to market becomes more difficult.

The following information was excerpted from a "Directed Growth Areas Listing and Units" table, dated October 1, 2009. This table listed the long-tem future supply recommendations of the Draft Maui Island Plan, for consideration by the Maui County Council. As shown, the estimated supply for Maui, to the year 2030, is 11,623 housing units. Central Maui has the largest share of future housing units on the island, with 4,850 units planned. The largest component of future growth in Central Maui is the Wai'ale project, which accounts for over 50 percent of the planned units in Central Maui.

Table 1 – Recommended Long-Term Residential Growth Areas

DIRECTED GROWTH AREAS LISTING AND UNITS
Department of Planning, October 1, 2009

Area	Acres	Assumed Density Per Acre	Units
CENTRAL MAUI			
Wailuku Infill			125
Kahului Infill			500
Waikapu Area	42	6.26	263
Wai'ale Area	384	6.65	2,554
Tropical Plantation Homes	260	4.50	1,170
Pu'unani	53	4.49	238
Total Central Maui	739		4,850
WEST MAUI			
Mahinahina Area	116	6.00	696
Ka'anapali Town	563	2.05	1,154
Lahaina Town North	181	4.42	800
Lahaina Infill	22	11.25	248
Kahoma Area	18	4.89	88
Lahaina Town South	136	4.45	605
Makila Area	20	2.00	40
Total West Maui	1,056		3,631
SOUTH MAUI			
Kihei Mauka			1,500
Revitalization Infill			400
Total South Maui	0		1,900
NORTH MAUI			
Pa'ia Town	46	4.50	207
Total North Maui	46		207
UPCOUNTRY MAUI			
Makawao Expansion	98	2.80	274
Pukalani Expansion	101	5.55	561
Total Upcountry Maui	199		835
EAST MAUI			
Hana Area	100		200
Total East Maui	100		200
ISLAND GRAND TOTAL	**2,140**		**11,623**

New Construction

According to the Maui County Data Book 2009, new single-family construction, which fell from its high in 1988, appeared to recover somewhat in the 1990's and was generally stabile between 2004 and 2007.

Table 2 – New Construction Island of Maui

Year	Number of New Single-Family Units	Five-Year Average
1980	803	
1981	398	
1982	530	
1983	547	
1984	638	
Subtotal	2,916	583
1985	984	
1986	911	
1987	1,119	
1988	1,453	
1989	1,136	
Subtotal	5,603	1,121
1990	1,068	
1991	694	
1992	810	
1993	660	
1994	673	
Subtotal	3,905	781
1995	473	
1996	601	
1997	532	
1998	574	
1999	647	
Subtotal	2,827	565
2000	904	
2001	778	
2002	787	
2003	877	
2004	1,104	
Subtotal	4,450	890

2005	967
2006	1,008
2007	1,050
2008	527

Source: Maui County Data Books 2002 through 2009

New single-family construction averaged 583 units during the five years between 1980 and 1984. During the next five years, 1985 to 1989, single-family housing starts increased significantly to an average of 1,121 per year. During 1990, house construction was also good at 1,068 units, but declined significantly following the Persian Gulf War and the economic slowdowns on the U.S. mainland and in Japan. Consequently, between 1990 and 1994, there was an average of 781 new single-family units built per year. From 1995 to 1999, construction of these units declined even more, with an average of only 565 units per year. In 2000, the number increased significantly to 904 units and then declined in 2001 to 778 units. The number of units remained nearly identical in 2002 with 787 units. In 2003 this number increased again to 877 units. Single family building permits in 2004 reached a total of 1,104, which is its highest level since the late 1980's, prior to declining to 967 in 2005. A small rebound to 1,008 was realized in 2006, followed by an increase to 1,050 in 2007. In 2008, there was a huge drop in permits issued, to only 527. (Refer to **Table 2**, starting on Page 32). The average for the past 5 years is 931 units per year.

Currently, revisions to Maui's urban growth boundary are being considered by the County Council. Land located outside the boundary may have a more difficult time becoming entitled, which would translate into less project starts. Without an adequate supply of new construction projects, the resulting shortage of housing typically causes prices in general to move up. As a result, those at the bottom end of the income scale usually find it most difficult to purchase real estate. Historically, supply has lagged demand and is a significant limiting factor in the affordability of real estate in the Maui market.

Maui County Workforce Housing Ordinance

In December 2006, the Maui County Council enacted the Residential Workforce Housing Ordinance. The purpose of the ordinance is to enhance the public welfare by ensuring that the housing needs of the County are addressed. The intent of the policy is to encourage the provision and maintenance of residential workforce housing units, for both purchase and rental, to meet the needs of income-qualified households for the workforce, students, and special housing target groups.

Essentially, all applicable residential development after the passage of this ordinance, including the subdivision of land and/or the construction of single-family dwelling units; two-family dwelling units; multifamily dwelling units; or hotels; shall be subject to the policy upon final subdivision or building permit approval. Applicable residential development includes, in part: five or more dwelling units, excluding farm labor dwellings or a second farm dwelling, not part of a condominium property regime; five or more new lots; a combination of dwelling units and new lots totaling five or more.

Prior to final subdivision approval or issuance of a building permit for a development, the developer was to enter into a residential workforce housing agreement that required forty percent of the total number of units and/or lots to be sold or rented to residents within established income-qualified groups, when more than fifty percent of the dwelling units and/or new lots in the development were to be offered for sale for less than $600,000. When fifty percent or more of the dwelling units and/or new lots in the development were to be offered for sale for $600,000 or more, fifty percent of the total number of units and/or lots was to be sold or rented to residents within established income-qualified groups.

Landowners who had already received entitlements, or were at least in the approval or permitting process, were granted an exemption from these requirements; and clearly have an advantage over those who began their entitlement process post-passage. One of the initial concerns to developers was the reduction in sales revenue. Coupled with unprecedented increases in construction costs, potential projects could become financially unfeasible.

Since the passage of this ordinance, there has been a notable drop in new residential construction project starts. Granted, the downward trend of the real estate market, mixed with declining national and local economic conditions, has also led to less construction. However, many in the building industry are of the opinion that the Workforce Housing Ordinance has had the opposite effect from its original intent.

In February 2010, the Maui County Council revisited this ordinance and made several revisions, including reducing the amount of required affordable housing units built on site to 25 percent, provided the average sales price of the market units is projected to be less than $600,000. If the average sales price in the project is $600,000 or more, then 50 percent of the units must be affordably priced. The amended law also clarified the calculation of required affordable units built off site; based on 50 percent of the total number of on-site market units, regardless of their projected average sales price.

The Wai'ale Master Plan Development calls for approximately 2,550 residential units. Of this total, approximately 300 affordable residential units are planned on 40 acres of land to be conveyed to the County of Maui. The land for this development, to be situated on the northwestern side of the overall Wai'ale project, is being provided to the County to satisfy conditions of zoning for the Maui Business Park, Phase II project. Although the County does did not have formal plans in place for these housing units, some may be built as affordable rental apartments.

Additionally, on-site affordable housing units will also be developed for the Wai`ale project in compliance with the County of Maui's Residential Workforce Housing Policy. Based on the current Residential Workforce Housing Policy, a 25 percent requirement would be applicable for units developed onsite and where the market priced units have an average sales price of less than $600,000.

Maui County Water Availability Ordinance

In December 2007, the Maui County Council enacted the "water availability policy", identified as Title 14 of the Maui County Code. The purpose of the ordinance is to acknowledge and affirm that water is a natural and cultural resource that must be protected, preserved and managed as a public trust, and requires verification of a long-term, reliable supply of water before subdivisions are approved. This policy applies to all new subdivisions with the exception of family subdivisions and subdivisions that will not be regulated by a public water system.

In essence, this policy requires developers who want to build a subdivision or condominiums to first prove to Maui County that they have a long-term source of water. The policy stipulates that no subdivision shall be approved, unless prior to submittal of subdivision construction plans, the director shall provide written verification of a long-term, reliable supply of water. Written verification by the County shall not constitute an assurance, covenant, or warranty by the County of water source from a private, non-County system.

Many developers on Maui have been outspoken critics of the ordinance, even calling it a de facto moratorium on housing. Developers have also complained that the ordinance will halt some much-needed new construction. However, proponents of the policy say that the ordinance is a significant step toward getting Maui's water shortfall under control. The proponents are of the opinion that it closes a long-standing loophole for developers that held the County responsible for providing water service. For example, a developer could go through the entire process of planning, developing and selling the lots in a subdivision without guaranteeing the home buyers that they would receive a water meter from the County.

As of the effective date of this report, the property owner is exploring numerous options regarding water service for Wai'ale. These would include creating additional sources in partnership with the County or other parties. Wastewater disposal is being evaluated through ongoing engineering studies and discussions with the County.

RESIDENTIAL DEMAND CHARACTERISTICS

Demand is analyzed from two perspectives: The first is "demographic" demand, the number of units needed for a given market or employment base. Second is "effective" demand, the financial demand equation which involves looking at the number of buyers who would be qualified and interested in purchasing residential real estate.

Population

Population growth on Maui between 1980 and 1990 had been exceptionally high, and had outpaced the County's ability to provide adequate infrastructure and housing for this added number of people. Overall, population growth for the County of Maui during 1980 to 1990 was 41.67 percent. With this growth in population came a surge in real estate prices in the late-1980s. This increase, driven primarily by foreign and domestic investment and speculation, put the price of homes in Maui County well above the reach of many local residents, and affordable housing became a major concern to everyone.

The downturn in the economy between 1991 and 1997 led to the development of lower-priced housing as large land parcels became more affordable to developers. Zero-lot-line zoning was adopted by the County of Maui and the Meadowlands project in Kihei was among the first to be built. Three smaller zero-lot-line subdivisions were developed in West Maui between 1996 and 1998 and were highly successful.

Meanwhile, the population of Maui County continued to grow during the 1990s. Between the 1990 and 2000 censuses the population increased by 28.5 percent, making Maui the fastest growing County in the State of Hawaii. According to Claritas Market Comparison Report (See **Exhibit A** at the end of this report), leading the growth on Maui was the South Maui (Maalaea-Kihei-Wailea-Makena CDPs) region which reflected growth of 49.0 percent increase over the 10-year period. The Central Maui region of Kahului and Wailuku registered growth of 26.5 percent; while the West Maui region indicated a growth factor of 23.3 percent over the same 10-year period. The growth trend has continued since the end of 2000. The 2010 population estimates have indicated growth rates for South and West Maui in the 18 to 21 percent range, while growth in Central Maui has increased by approximately 14.5 percent over the respective population indicated in the 2000 census.

The growth in the number of households between 1990 and 2000 paralleled the population pattern. Household numbers grew in the south, west and central regions at the respective rates of 46.4, 23.9 and 26.4 percent.

According to Resident Population Projections, by County: 2005 to 2035 (State of Hawaii Data Book 2009, Table 1.28), the projected population of Maui County is expected to be 189,300 by 2030 and 198,727 by the year 2035. The 2030 and 2035 estimates represent 47.8 and 55.1 percent increases over the 2000 census numbers, respectively.

Employment and Household Income

The unemployment rate on Maui had been on a decline since 1992 when unemployment was at 8.0 percent. In 2007, the unemployment rate was 2.8 percent. For 2008, this rate rose to 4.5 percent, after seeing month-over-month gains beginning May 2008. This trend continued in 2009, with the average unemployment rate jumping to 8.7 percent. The unemployment rate was 8.8 percent in January 2010 and had climbed to 8.9 percent by March; however, April through July has showed a stable trend, keeping between 8.2 and 8.5 percent. (*Source: State of Hawaii Department of Business, Economic Development & Tourism Monthly Economic Indicators*).

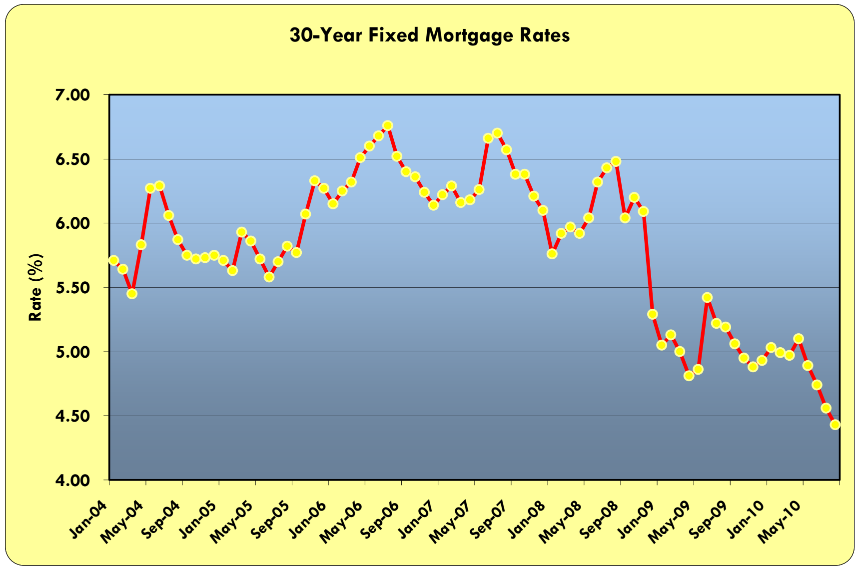
Household income figures have also been increasing. The estimated median annual household income for Maui in 2010 is $76,000 (*Source: U.S. Department of Housing and Urban Development*), a rise of approximately 53 percent over the 1999 median household income of $49,489 (*Source: US Census 2000*) and a 96 percent increase over the 1989 figure of $38,771 (*Source: US Census 1990*). During the 12 year period from 1999 to 2010, this represented an average increase of over 4 percent per year.

By comparison, the average median sales price for a single-family home on Maui went from $252,874 in 1999, up to $498,708 in 2009. This represented an increase of 97 percent over an 11-year period, or an average of over 8 percent per year. Although median prices have fallen since 2006, many potential buyers continue to be priced out of the market.

Mortgage Interest Rates

From late-1991 to 2002, mortgage rates varied from 6.0 to 9.0 percent. In 2003, mortgage rates for a 30-year fixed rate mortgage fell below 6.0 percent for the first time since Freddie Mac began tracking 30-year mortgage rates in 1971. Over the next six years, the monthly interest rate fluctuated between 5.23 and 6.76 percent. However, due to cuts to the Federal Funds Rate in late 2008, interest rates in 2009 dipped below the 5.0 percent level on numerous occasions. The average interest rate for 2009 was 5.04 percent. Through 2010 to-date, the interest rate has averaged 4.84 percent, with the lowest rate seen in August, at 4.43 percent. Records that reach back earlier than Freddie Mac's indicate that this rate is below record lows witnessed in the 1940s, during World War II. (See **Table 3** on following page).

Table 3 – Historical Trend of 30 Year, Fixed Mortgage Rates



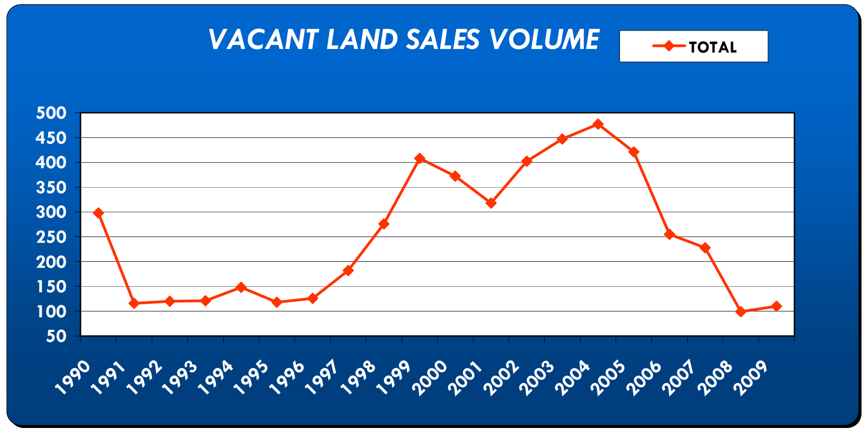
Source: Freddie Mac-Primary Mortgage Survey

General Residential Sales Activity
Island of Maui

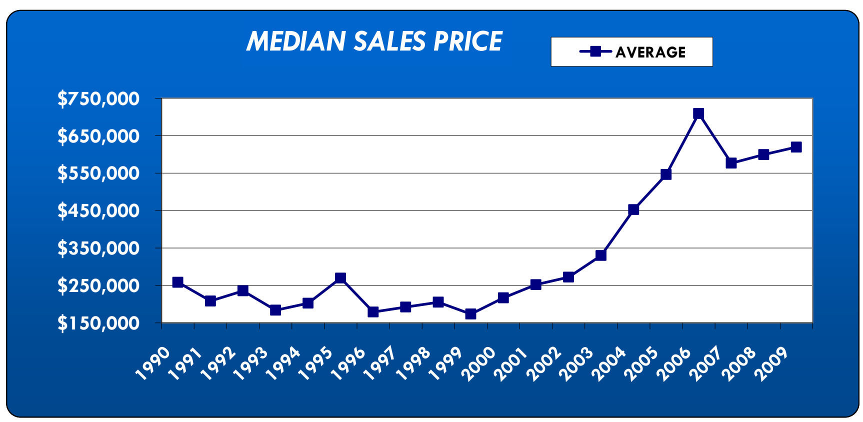
The number of units sold is the most basic indicator of market activity and is useful in helping estimate the number of new units which a specific market segment may be capable of absorbing. The downturn in the economy between 1991 and 1998 led to development of low-priced housing on Maui. Zero-lot-line housing projects were popularized during this period as developers strived to make housing affordable to Maui residents. Since 1998, however, real estate began a strong recovery. As evidenced in the following section, prices and number of sales increased while marketing times decreased, up to 2006. Since then, the market has headed in the opposite direction, with year-to-date 2010 showing some evidence of stabilization. The tables on the following pages illustrate the general market trends over the past 20 years on Maui, from 1990 through 2009.

Vacant Land

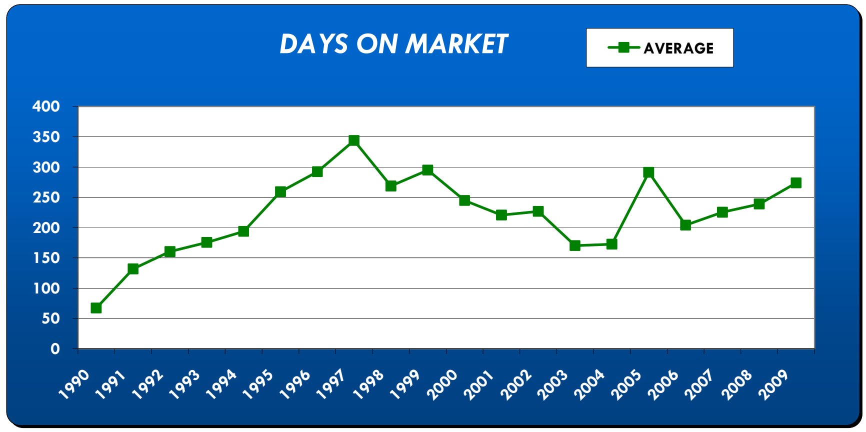
Sales of vacant land fell sharply after 1990 (298) to a level wavering around 100 to 150 sales for the next 6 years. Weakest sales, in terms of units sold, occurred in 1991 when only 116 properties were sold. In 1998, the number of land sales increased to 276 and in 1999, increased again to 408, reflecting a gain of 48 percent. Sales have fallen slightly since 1999 with 372 sales in the year 2000 and 318 sales in 2001; however, these figures rebounded in 2002, 2003 and 2004 to 402, 447 and 477, respectively. Vacant land sales for 2005 showed a slight decrease at 421 transactions, but dropped 39 percent in 2006, with only 255 sales. This trend continued in 2007, albeit with a more stabilized decrease of 11 percent, at 226 sales. However, in 2008, vacant land sales decreased significantly by approximately 56 percent with only 99 sales. For 2009, there was a slight uptick of 11 percent, to 110 sales.



Meanwhile, median prices slowly regained ground from a low of \$173,458 in 1999 to \$269,691 in 2002, and then sharply increased to \$336,690 in 2003, \$446,563 in 2004, and \$546,081 in 2005. In 2006, the median price jumped approximately 30 percent to \$709,000, but retreated by 19 percent in 2007, to \$570,438. In 2008, the median sales price slightly increased by almost 4 percent, to \$609,846. A 3.4 percent gain was seen in 2009, evidenced by a median of \$619,808.

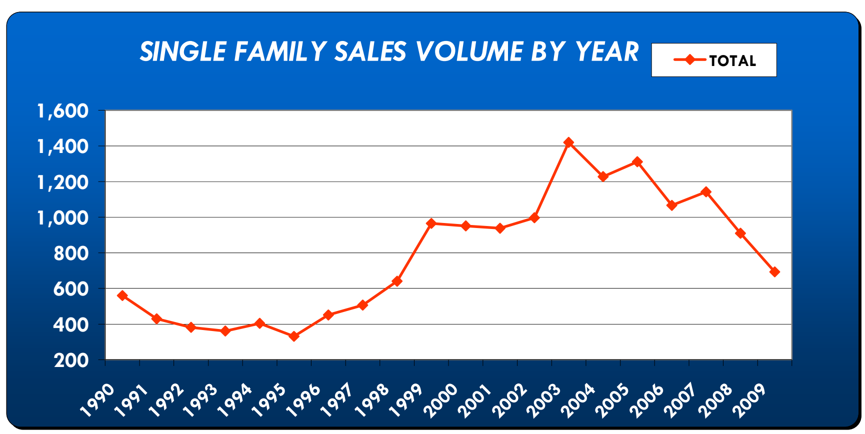


Median monthly days-on-market figures increased steadily from 67 in 1990 to 344 in 1997, but had fallen to 227 in 2002, to 170 days in 2003, increasing slightly to 173 days in 2004. This average escalated in 2005 to 291 days but dropped 29 percent to 204 days in 2006. In 2007, the average marketing time increased 10 percent to 225 days, followed by an increase of 6 percent in 2008 to 239 days. Then, in 2009, marketing time jumped to 274 days, or over 14 percent.

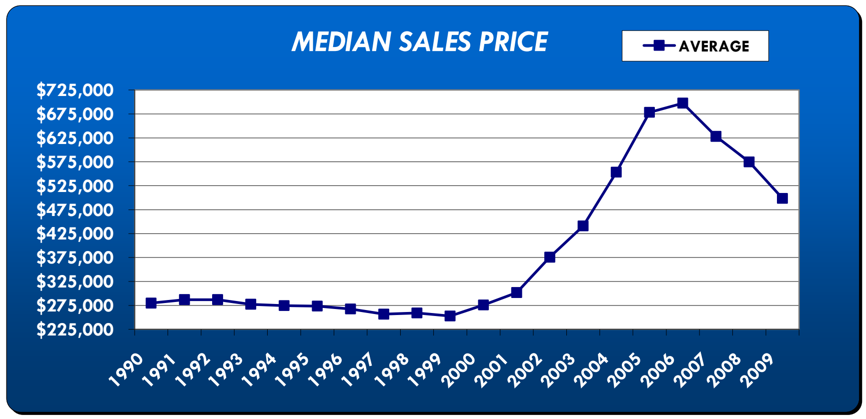


Single-Family

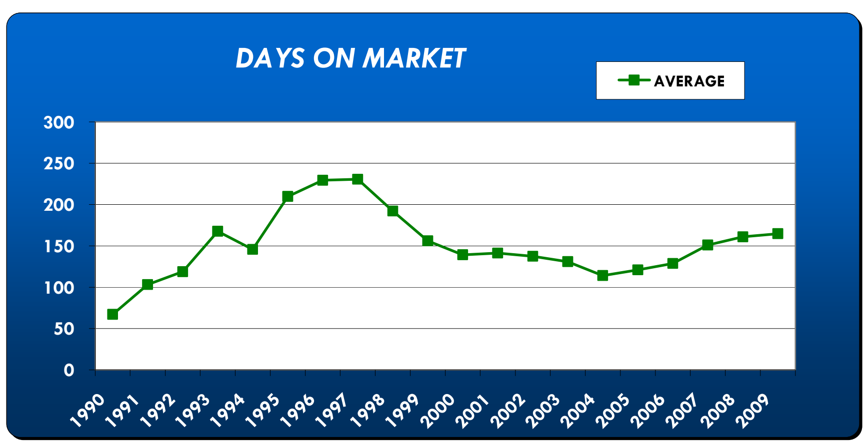
Sales of single-family properties exhibited a decrease after 1990 (560) to a level wavering around 350 to 450 sales for the next 6 years. Weakest sales, in terms of units sold, occurred in 1995 when only 331 properties were sold. In 1997, the number of single-family sales increased to 507 and in 1998, exceeded 1990 results with a figure of 641. The number of sales in 1999 (965 units) was 51 percent more than the number of sales in 1998 (641). Sales were slightly higher in 2000 at 951 units sold, but leveled off in 2001 at 938 units and 997 units in 2002. Sales sharply increased in 2003 to 1,420 transactions, and then decreased slightly in 2004 to 1,228, before climbing to 1,311 transactions in 2005. In 2006, the total sales dropped 18 percent, to 1,066 for the year. A 6 percent increased was realized in 2007, as sales volume totaled 1,138 units. In 2008, sales volume further decreased by 20 percent, to 910 units. A decline of almost 24 percent was seen in 2009, evidenced by only 693 sales.



Median prices in 2001 showed a 9 percent increase from $275,958 in the year 2000, and reached a high for the past decade with a median of $301,886. In 2002, the median price increased even more to a level of $375,810, an enormous increase of 24 percent over 2001. Median prices for 2003 indicated an increase of about 17 percent to $441,062; then another large 25 percent increase to $553,167 in 2004. This trend continued in 2005, with a median sales price of $678,321, translating into a 22 percent increase. For 2006, prices continued their climb with a slight increase of 2 percent over the 2005 median. The median price for 2006 averaged approximately $697,450. A decline of 10 percent was seen in 2007, as the average median price was $627,887. The average price further declined in 2008 by 8 percent to $574,760, then $498,708 in 2009, equating to a 13 percent retreat.



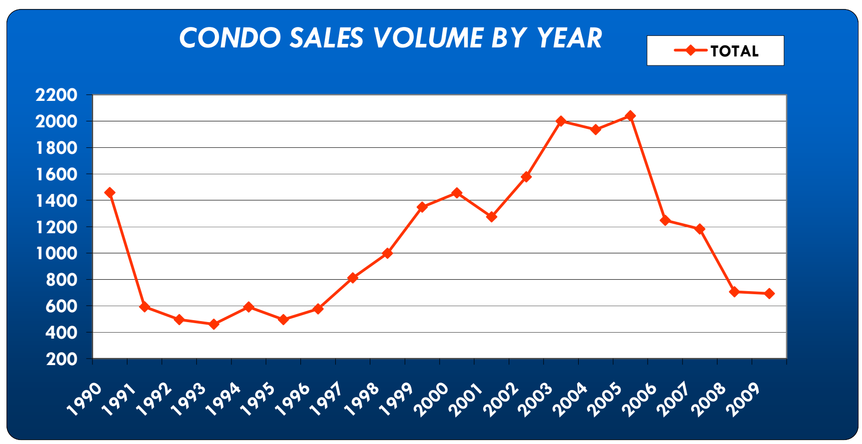
Average monthly days-on-market figures increased steadily from 67 in 1990 to 231 in 1997, but steadily fell to 137 in 2000. It has remained relatively level since that time, except in 2004 when that figure fell to 114 days, before rebounding to 121 days in 2005. The increase continued in 2006 climbing to 129 days, followed by a larger increase to 151 days in 2007. A slight increase was seen in 2008, to 161 days, with 2009 appearing to be stable, at 165 days.



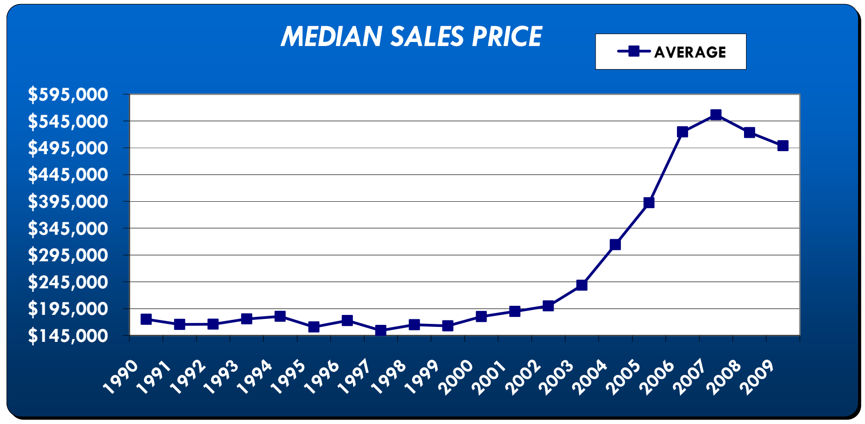
Condominiums

Sales of condominium units fell sharply after 1990 (1,459) to a level wavering between 400 to 600 sales for the next 6 years. Weakest sales, in terms of units sold, occurred in 1993 when only 461 properties were sold. In 1997, however, the number of sales increased to 812 and up to 2,001 units in 2003. 2004 showed a drop in sales, to 1,935 units. This was followed by a record setting year in 2005, with 2,041 units sold. However, sales volume dropped approximately 38 percent to 1,247 units in 2006, followed by a less severe decline of 5 percent in 2007, to 1,183 units. In 2008, sales volume dropped by 40 percent to 707 units, with a further retraction in 2009 of 2 percent.

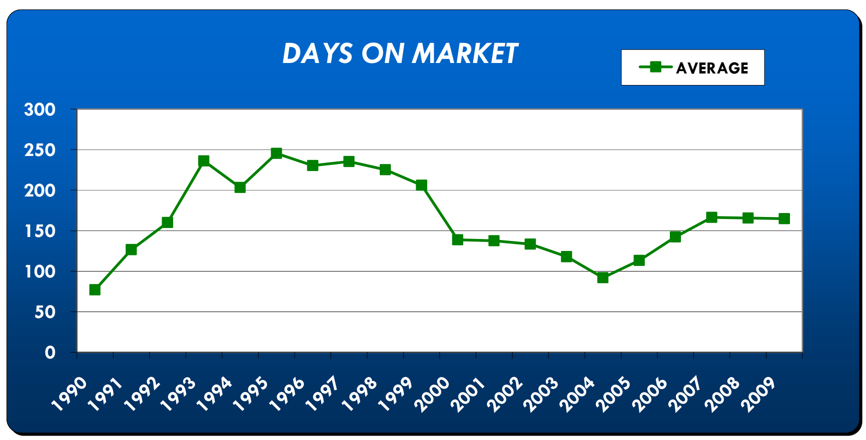
It should be noted that the spike in sales volume between 2003 and 2005 coincides with a flooding of new inventory. During this period, new condominium projects such as Villas at Kenolio and Hale Kanani (Kihei), Villas at Kahana Ridge (Kahana), and Kehalani Gardens and Iliahi (Wailuku) closed on their units.



Median prices remained in a range from $154,296 to $180,392 between 1990 and 2000. However, since then, the average monthly median price increased 5 percent to $189,946 in 2001, 5 percent to $200,020 in 2002, and 19 percent in 2003 to $238,755. 2004 indicated a sharp increase of 31 percent, with an average median price of $314,448, followed by a 24 percent gain in 2005, to $392,314. Despite a drop in sales volume in 2006, the median price increased to $524,758, an approximate 33 percent increase over 2005. This was followed by a more stabilized gain of 6 percent in 2007, to $556,332. In 2008, the averaged median sale price decreased for the first time in 10 years, dropping almost 6 percent, to $523,271. An average median of $498,708 was witnessed in 2009, down almost 5 percent from the previous year.



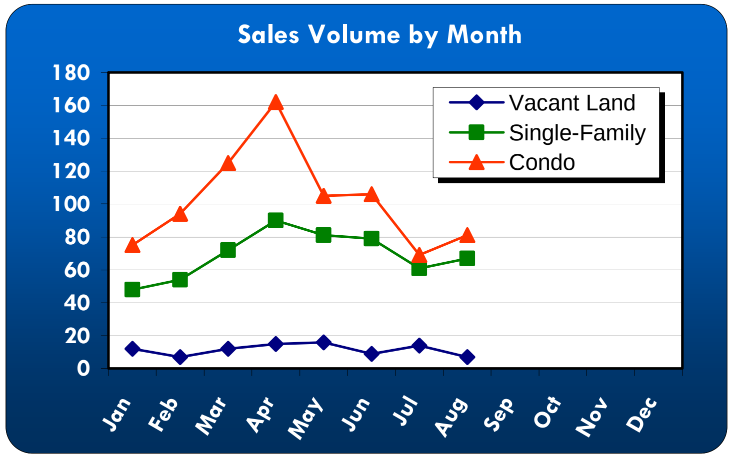
Average monthly days-on-market figures increased steadily from 77 days in 1990 to 230 days in 1996, but had decreased considerably to 133 days by the end of 2002. This figure fell to 118 days in 2003, then to 92 days in 2004, before rebounding to 113 days in 2005. It rose further in 2006, to 142 days, followed by another increase to 166 days in 2007. Days on market remained the same in 2008 and declined by one day, to 165, in 2009.



Year-to-date 2010 Maui sales figures for vacant land, single-family and condominium units are shown on the next page. Unit sales volume for vacant land, single-family, and condominiums are on-pace to surpass 2009 counts. 2010 average median prices for single-family and condominiums would show a slight decline, while the average median for vacant land would decrease. It should be noted that the average for vacant land in 2009 was bolstered by several months of high medians, where there were numerous closings of house lots in resort areas. Average 2010 marketing times would be lower than 2009 for all categories. It should be noted that the 2010 estimates are based solely on year-to-date sales and should not be interpreted as a forecast of the Maui real estate market.

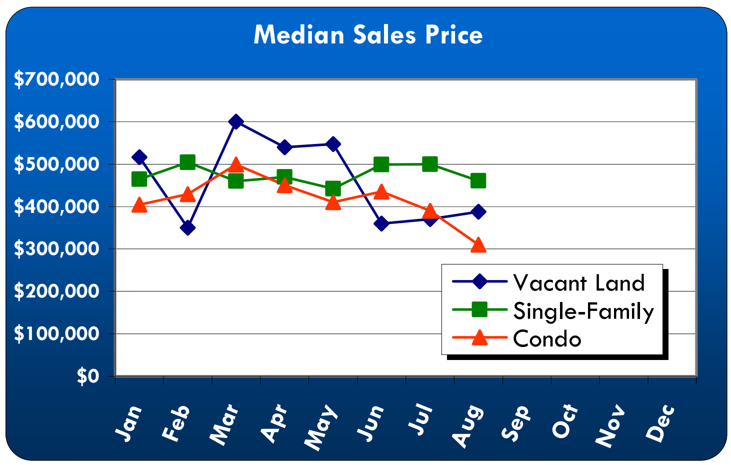
SALES VOLUME BY MONTH

2010	Vacant Land	Single-Family	Condo
Jan	12	48	75
Feb	7	54	94
Mar	12	72	125
Apr	15	90	162
May	16	81	105
Jun	9	79	106
Jul	14	61	69
Aug	7	67	81
Sep			
Oct			
Nov			
Dec			



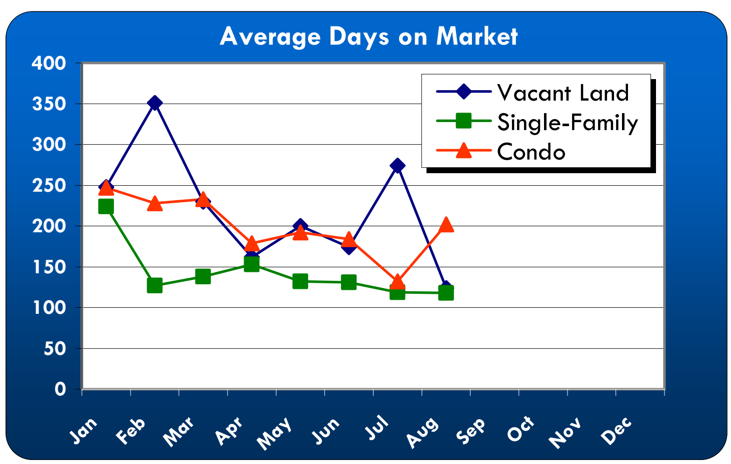
MEDIAN SALES PRICE

2010	Vacant Land	Single-Family	Condo
Jan	$516,300	$464,500	$404,000
Feb	$350,000	$504,150	$429,000
Mar	$600,000	$460,000	$499,000
Apr	$540,000	$470,000	$450,000
May	$547,500	$442,000	$410,000
Jun	$360,000	$499,000	$435,000
Jul	$370,000	$500,000	$390,000
Aug	$387,500	$461,000	$310,000
Sep			
Oct			
Nov			
Dec			



AVERAGE DAYS ON MARKET

2010	Vacant Land	Single-Family	Condo
Jan	248	224	247
Feb	351	127	228
Mar	230	138	233
Apr	162	153	179
May	200	132	192
Jun	174	131	184
Jul	274	119	132
Aug	124	118	202
Sep			
Oct			
Nov			
Dec			



Historical New Project Absorption

In addition to the absorption rates of the individual projects, research was also conducted to give a historical look at the total residential inventory absorbed on a year to year basis. This survey included large projects that are typically put on the open market. These projects included single family residential homes, residential house lots, condominium projects, as well as agricultural subdivisions. It is also known that individual property owners occasionally subdivide tracts of land and sell off the lots to relatives or to a private list of purchasers. These types of projects are difficult to track and have not been included in the survey. The intent of this survey was to provide an indication of the capacity that the real estate market has to absorb new inventory on an annual basis.

In 1999, 671 new units were purchased. This number dropped to 280 in 2000 and steadily climbed each year, up to 2003. In 2003, the real estate market absorbed a total of 852 new housing units, before dropping to 371 units in 2004. However, this drop proved to be temporary as numerous projects in Central and South Maui were completed in 2008, with a total of 850 units closed. These projects included Ohia, Maunaleo, Iliahi, and Kehalani Gardens within the Kehalani Project District as well as the Sand Hills Estates and Legends in the Maui Lani Project District. In addition, Hale Kanani and Wailea Beach Villas were completed in South Maui. There were a few projects in West Maui that were completed in 2005, including Mahanalua Nui Phase IV, Honolua Ridge, Lanikeha, and the Villas at Kahana Ridge.

Subsequent to its peak in mid-2006, the real estate market has been decreasing, in terms of median sales prices. Sales volume has varied, with years of high unit sales volume primarily attributed to affordable housing units entering the market. The most recent example of this was Waikapu Gardens. In 2007 and 2008, this single-family affordable housing project accounted for 20 percent and 29 percent, respectively, of all the new unit closings on Maui.

Over the last 10 years, there has been an average of approximately 580 new project units sold each year. By dividing the supply available in the market by this average, an estimate of the remaining years of current supply can be made. As previously stated, it was determined that current new supply on Maui totaled approximately 2,300 units. Therefore, there would be about 4 years of remaining inventory. The current downturn of the real estate market has led to lower absorption rates than in previous years. However, this is typical of the real estate market, due to its cyclical nature. Due to currently poor economic conditions, there have been very few new project starts. Upon economic recovery, the lack of remaining inventory will likely lead to pent-up demand once again.

Table 4 – New Project Units Absorbed Per Year (Central Maui)

	Type	Units	Year 1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	YTD 2010	Total Closed
KAIMANA	S	179	11	1	1				2						179
GREENS	L	217	104	8											217
IAO PARKSIDE IV-B	C	52	14	5	6	1	1								52
IAO PARKSIDE IV-C	C	52	1	3	5	41									52
NANEA	S	90	70												90
GRAND FAIRWAYS	L	36	31	5											36
IAO PARKSIDE IV-A	C	13	4	7	2										13
GRAND FAIRWAYS NORTH	L	79		57	22										79
WAILUKU PARKSIDE	S	119		31	87	1									119
THE ISLAND SCHULER PHASE I	S	55		1	24	30									55
THE ISLANDMAUI LANI PHASE I	L	44		10	23	10	1								44
OLENA	S	31			7	24									31
THE ISLAND MAUI LANI PH II	L	35				35									35
THE ISLAND SCHULER PH II	S	53				9	44								53
WAILUKU COUNTRY EST	L	184					177	7							184
WAIOLANI ELUA	L	25					22	2							24
BLUFFS - Maui Lani	L	15					6	9							15
- Schuler	S	21						7	14						21
OLENA II	S	32						32							32
LEGENDS	S	143						47	90	3	2				142
OHIA AT KEHALANI	S	140							135	5					140
MAUNALEO AT KEHALANI	S	82							55	27					82
OHIA AT KEHALANI PH II	S	44								44					44
ILIAHI AT KEHALANI	C	92							61	31					92
KEHALANI GARDENS	C	132							83	49					132
LEGENDS PHASE II	S	134								33	99	2			134
WAIOLANI PIKAKE	L/S	36										36			36
WAIKAPU GARDENS	S	411								62	162	180	7		411
KOA AT KEHALANI	L/S	72							16	33	15	5	2	1	72
AKOLEA AT KEHALANI	L/S	97									25	45	21	6	97
SAND HILLS ESTATES	L	108							80	16	1	0	1		98
NA MALA O WAIHEE	L	7									4				4
WAIOLANI MAUKA	L	105									104				104
COTTAGES AT KEHALANI	S	114									6	51	37	19	113
NA HOKU	S	162									22	53	28	20	123
VILLAS AT KEHALANI	C	103										1	13	7	21
MILO COURT AT KEHALANI	C	94												13	13
WAI'OLU ESTATES	L	60													0
HO'OLEA TERRACE	C	174													0

Table 5 – New Project Units Absorbed Per Year (South Maui)

	Type	Units	Year 1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	YTD 2010	Total Closed
MAKENA PLACE	C	10	2	2	2	2	1								10
KAMAOLE HEIGHTS	L	40	40												40
MEADOWLANDS II	L	88	63	25											88
WAILEA FAIRWAY VILLAS	C	118	56	62											118
PIILANI VILLAGE PHASE II	S	114			113	1									114
MALUHIA AT WAILEA	C	14			5		1	3	2	2					13
KE ALII KAI	S	96				61	35								96
KENOLIO (KAONOULU) ESTATES	S	51				45	6								51
NA HALE O MAKENA	C	40				13	24	3							40
KEAHOU AT MAKENA	L	7				6		1							7
PIILANI VILLAGE III	S	117					117								117
HONU ALAHELE	L	64					64								64
KILOHANA RIDGE	S	73					69	4							73
KILOHANA HEMA	L	29					28	1							29
VILLAS AT KENOLIO	C	140					61	78	1						140
ONE PALAUEA	L	17					1	8	8						17
ALII VILLAGE	L	27						27							27
KENOLIO MAUKA		12						12							12
HALE KANANI	C	72							70	2					72
WAILEA BEACH VILLAS	C	98							34	63		1			98
WALAKA MAUI (112 WALAKA)	C	18								18					18
KIHEI KAUHALE	L	23								23					23
KAI MAKANI	C	112									96	16			112
KANANI WAILEA	C	38								9	25				34
KAI MALU	C	150								22	86	27	0	1	136
KILOHANA WAENA	L	30									6	3	0	1	10
HOOLEI	C	120									25	66	13	4	108
KE ALII OCEAN VILLAS	C	144									36	34	31	9	110
KAMALI'I ALAYNA	S	92									44	19	14	10	87
PAPALI	C	24										15	1	1	17
MOANA ESTATES	S	90								18	39	20	2		79
HOKULANI GOLF VILLAS	C	152										24	10	2	36
KAI ANI VILLAGE	C	99											1	7	8
KENOLIO MAKAI	S	18												15	15
MALUAKA	L	13											5		5

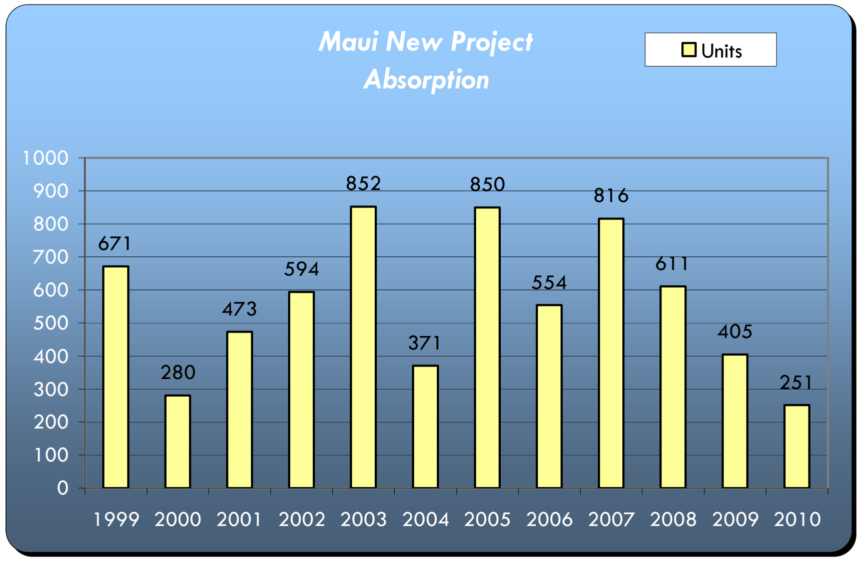
Table 6 – New Project Units Absorbed Per Year (West Maui)

	Type	Units	Year 1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	YTD 2010	Total Closed
KAHANA RIDGE	L	228	195			1									228
KAUHALE MAHINAHINA	S	19	19												19
MAHANALUA NUI (I to III)	L	104	33	10	19		41	1							104
VINTAGE	C	73		3	70										73
KE ALII SUB'D III	L	12		7	1	4									12
PINEAPPLE HILL II	L	30		12	8	9	1								30
MAKILA I	L	19				19									19
OLOWALU MAKAI	L	5			1	4									5
OLOWALU MAUKA	L	14				8	6								14
COCONUT GROVE AT KAPALUA	C	36			36										36
PUUNOA SUBDIVISION	L	14			14										14
KAHANA NUI SUB'D (HUA NUI)	L	17			16	1									17
PINNACLE	C	33			5	8	8	12							33
SUMMIT															0
Phase I	C	18			5	11	2								18
Phase II (Pulled off Market)	C	17						17							17
Phase III	C	19					19								19
NAPILI VILLAS PH I	C	100				100									100
NAPILI VILLAS PH II	C	44				44									44
KE ALII SUB'D I	L	15				12	3								15
KAPUA VILLAGE	L	45				10	35								45
NAPILI VILLAS PHIII	C	40					40								40
MAKILA II	L	24						24							24
HONOLUA RIDGE PH I	L	25						17	8						25
HONOLUA RIDGE PH II	L	25							6	10	8				24
VILLAS AT KAHANA RIDGE	MF	117							83	34					117
MAHANALUA NUI IV	L	36					1		31	4					36
LANIKEHA	L	130							58	42	2	2	1		105
KAANAPALI COFFEE ESTATES	L	52								3	3			1	7
OPUKEA	MF	114											37	12	49
HONUA KAI	MF	700										1	166	113	280
THE BREAKERS (WEST MAUI BREAKERS)	MF	114												2	2
HO'ONANEA	MF	100													0
KAANAPALI 10-H	L	18													

Table 7 – New Project Units Absorbed Per Year (Upcountry/East Maui)

	Type	Units	Year 1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	YTD 2010	Total Closed
HAIKU MAKAI	L	27	4	3											27
MAUNAOLU PLANTATIONS	L	39				27	12								39
RESIDENCES AT KULAMALU	L	57				56	1								57
NORTH SHORE VILLAGE	S	23					22	1							23
RIDGE AT KULAMANU	L	57						57							57
KULAMALU HILLTOP (DOWLING)	L	11							11						11
E PAEPAE PUKOA	L	16									6	6			12
OMAOPIO RIDGE	L	18			1	1	3	1	2	1					9
PIIHOLO SOUTH	L	11										1			1
COTTAGES AT KULAMALU	C	40										3	15	7	25
MAKANI O KULA	L	10													0
OMAOPIO ESTATES	L	20													0
KULA `I`O	L	35													0

Table 8 – Total New Project Absorption 1999 to YTD-2010

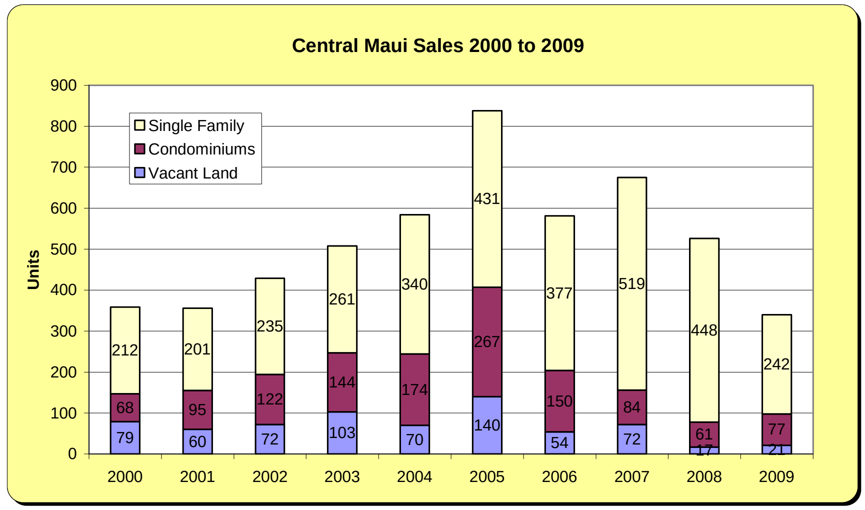


Historical Resale Activity Central Maui (Past 10 Years)

According to the Realtors Association of Maui, Multiple Listing Service, there has been an average of 520 sales of condominium, residential and vacant land properties in Central Maui over the past 10 years. During this period, the number of vacant land sales ranged from 17 in 2008 to 140 in 2005, with an average of approximately 69 sales each year. Condominium units ranged from a low of 61 in 2008 to 267 units in 2005. Single family properties ranged from a high of 519 in 2007 to 201 in 2001.

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Vacant Land	79	60	72	103	70	140	54	72	17	21	688
Condo	68	95	122	144	174	267	150	84	61	77	1,242
Single Family	212	201	235	261	340	431	377	519	448	242	3,266
Total	359	356	429	508	584	838	581	675	526	340	5,196

It is obvious that the economic recession that began in 2008 has had a significant adverse impact on the Central Maui market. However, based on year-to-date sales statistics, unit sales for all property types in 2010 will likely outpace 2009.



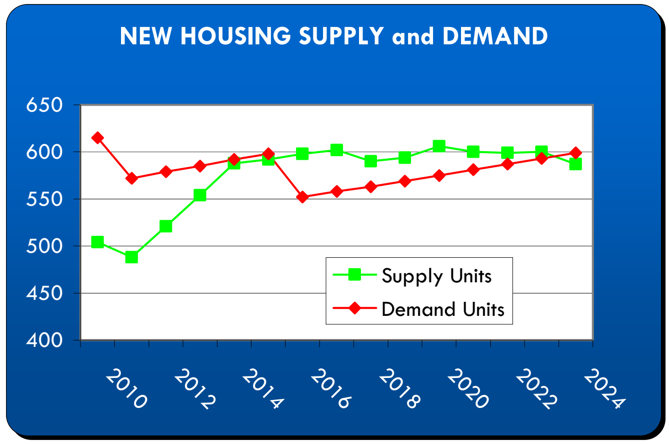
Source: Realtors Association of Maui MLS

County of Maui Housing Demand Model

This model, included as part of the Hawaii Housing Policy Study Update 2003, by SMS Research & Marketing Services, Inc., projected the effect of increasing population and the effect of decreasing household sizes on the supply and demand for residential units. The demand for housing units was calculated by comparing the increase in Maui's population to the average household size during a certain period. As population increases and household sizes remain the same or decrease, this would indicate the need for additional housing units. Conversely, if population decreases while household sizes remain the same; this would indicate a softening in demand for housing units.

According to the projections by SMS, the supply and demand model indicates that up to 2015, demand would be higher than the available supply in the market. However, from 2016 to 2023 this balance will shift and provide a slightly higher supply of product versus demand. Theoretically, only at this point would prices begin to fall due to the oversupply in the market. The total supply that would become available between 2011 and 2024 (the end of the study period) will be 8,119 units, compared with the demand for 8,103 units.

Although the focus of the SMS report was only until 2024, it still emphasizes the overall need for housing units over the long-term future. As a point of comparison, the Draft Maui Island Plan has estimated that by 2030, long term supply and demand will be 11,622 units and 11,154 units, respectively.



Through this study period, the balance between supply and demand does not significantly shift to either side. However, this indicates that the original deficit of 4,170 units, calculated by SMS in 2003, would not be reduced. By the end of the study period there will still be a need for 4,154 additional resident housing units.

It is also noted that resident housing units (RHU) were said to only account for 70 percent of the total housing units in any given year. According to the Hawaii Housing Policy Study 2003, the remaining units include vacant units which is generally 5 percent of the total and non-resident housing units which account for approximately 25 percent of the total housing unit inventory. Non-resident units are defined as units that are set aside for rental pools and are targeted to transient visitors. These units are not available for County residents on an ongoing basis.

Hawaii Housing Policy Study Update 2006

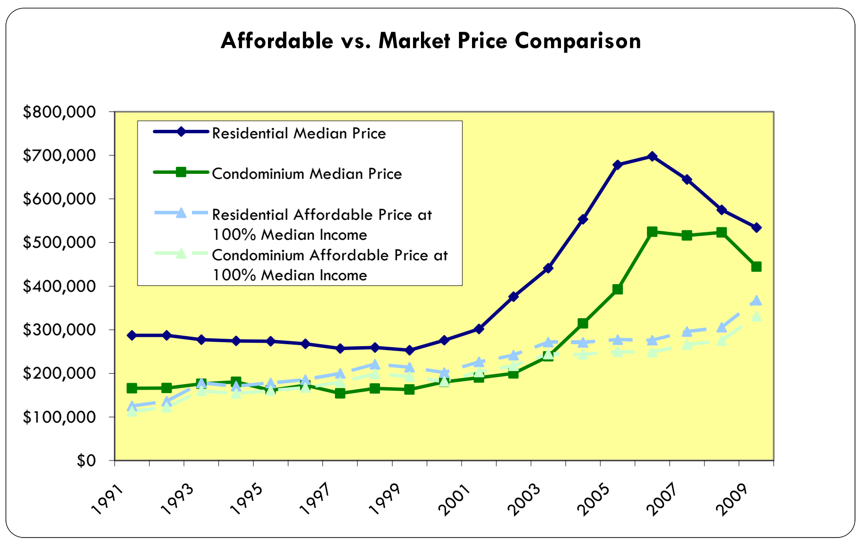
This study, by SMS Research & Marketing Services, Inc., provided evidence of the need for additional housing in Maui County. According to the report, nearly 45 percent of all Maui County households expressed a desire to move to a new home in the near future, of which, approximately 13 percent stated they wanted to move out of state. As such, effective demand was said to be 40 percent of all Maui County households, up from 36 percent from the previous 2003 survey.

Not surprisingly, the report indicated that almost 40 percent of those who expect to move outside of Hawaii made it known that one of their main reasons for leaving was the high price of housing, up from 14 percent in 2003. The 2006 study listed the average monthly mortgage payment for the County of Maui to be $1,820 and an average monthly rent of $1,080. Approximately 46 percent were said to be spending more than 30 percent of their income on housing. Although the study was done during a time of more robust market conditions, prices still appear to be out of reach for many Maui County residents.

Comparison of Affordable And Market Prices

An analysis was done to compare the increase in affordable prices to median prices for residential and condominium units. The affordable price is based on the median income level for the County of Maui and typical mortgage interest rates and loan requirements. This calculation assumed a 95 percent loan-to-value ratio and a 30 percent debt to income level, similar to the assumptions utilized by DHHC. Since 1990, interest rates have dropped from 10.13% to 5.05% as of 2009. As shown in **Table 9**, the single-family and condominium prices which are affordable to earners of the median household income was compared to the median prices of residential and condominium prices in the market.

Table 9 – Comparison of Affordable and Market Prices



As income levels rose from 1990 to 2000, residential properties became more affordable to those earning the County's median income level. Although the disparity significantly narrowed by 1998 and 1999, the median price for a single-family residential property has always been higher than the price that can be afforded by a household earning the County's median income. During this period, the only option was to purchase a condominium unit, which for larger families can be less accommodating. In 2001, the nation's economy hit a recession, which was followed by the lowering of short term interest rates by the government. Consumer money flowed out of the stock market and into bonds and treasuries, which pushed long term interest rates lower. This caused a surge in demand for real estate, which sent prices skyrocketing within a few years.

By 2002, the soaring prices outpaced the County's median income level despite steadily falling interest rates. At the same time, condominium units were found to be a more feasible alternative and sales in this category started to pick up their pace.

By 2004, median sales prices for residential and condominium properties were both higher than what could be afforded by households earning the County's median income level. In 2006, this situation reached critical levels, as prices for both residential and condominium units reached their peak. It did not help that mortgage rates also trended slightly upwards, which lowered the affordability to buyers needing to finance their purchase.

Since 2006, the softening of the real estate market has brought median prices closer to affordable pricing levels; however, as seen in the previous table, there is still a substantial inequality. To help alleviate this situation, more housing units should be brought to the market, especially those geared toward Maui's workforce.

Maui County General Plan 2030

The County of Maui is currently in the process of updating the General Plan, which will establish long-term planning guidelines for Maui County to the year 2030. The first step in this process involved the creation of a Countywide Policy Plan, which provides broad goals, objectives, policies and implementing actions used to develop the Maui Island Plan and Community Plans. The current version of the plan was adopted by the Maui County Council on March 24, 2010.

Although its design is still preliminary in nature, many of the goals, objectives, and policies set forth in the Countywide Policy Plan are inherent in Wai'ale. The following list represents some of the pertinent characteristics that are consistent with the Countywide Policy Plan:

Protect the Natural Environment
Wai'ale will feature extensive greenway paths for pedestrian and bicycle use, which allows residents the opportunity to live, work, learn and play with less dependency on automobiles.

Preserve Local Cultures and Traditions
Cultural sites have been preliminarily identified and will be preserved.

Improve Education
Current plans call for a middle school campus and associated recreational fields. Being located near residential areas and parks affords children the option of walking or bicycling to school.

Furthermore, the site's proximity to the existing Pomaikai Elementary School makes it convenient for families with children of varied ages.

Expand Housing Opportunities for Residents

Wai'ale will feature on-site affordable housing units. Fifty acres are being donated to the County to develop an estimated 300 affordable housing units. Additionally, on-site affordable housing units will also be developed for the Wai`ale project in compliance with the County of Maui's Residential Workforce Housing Policy. Based on the current Residential Workforce Housing Policy, a 25 percent requirement would be applicable for units developed on site and where the market priced units have an average sales price of less than $600,000. Although the specific location of these units has not yet been determined, supportive goods and services providers will be situated nearby. This will present job opportunities for neighborhood residents.

Improve Parks and Public Facilities

The project will provide substantial land areas for parks and greenway paths. In addition to neighborhood parks, a regional park is planned, as well as a community center.

Diversify Transportation Options

A network of pedestrian and bicycle paths is being created to provide safe and efficient transportation, reducing residents' dependency on automobiles and fossil fuels.

Promote Sustainable Land Use and Growth Management

Wai'ale is situated within the Urban Growth Boundary being recommended by the General Plan Advisory Committee, the Maui Planning Commission, and the County of Maui Planning Department. Although the project is situated to the immediate south of the Maui Lani Project District, preliminary plans call for a significant amount of open space between the projects. This will come in the form of parks, fields, and community center areas, enabling both communities to retain their own identities. Additional park areas along the south border would provide a buffer should future revisions to the Urban Growth Boundary be considered.

Alternative transportation corridors, specifically greenway paths, are slated to extend into Wai'ale's business districts. This allows the project to be less auto-centric. In many cases, multi-family residential housing and village mixed-use areas will be set between commercial areas and single-family residential areas. By design, this promotes a sensible transition for both building density and intensity of land uses.

Estimated Absorption Rate for Subject

On a larger scale, the overall lack of new project starts within the past few years has some economists foreseeing a potential shortfall in housing upon recovery of the economy. Many real estate analysts are of the opinion that it has become too difficult to feasibly create new housing projects since the passage of ordinances linked to development. Builders and developers have chosen to withdraw from the Maui market, looking for less costly and time consuming opportunities. Recent housing starts have been about 80 percent less than in the robust years. Due to these factors, there may be less competitive inventory when Wai'ale Master Plan Development's housing units become available. The development will primarily target the workforce market segment, which has seen consistently high demand.

Central Maui has historically housed the largest percentage of the island's workforce population as well as its primary employment base. This is attributed to many factors. First, Kahului Airport and Kahului Harbor are Maui's primary shipping and transportation venues. Furthermore, Kahului has the largest concentration of retail centers, including Kaahumanu Center, Maui Mall, Kahului Shopping Center, and The Maui Marketplace. The University of Hawaii Maui College is also situated in Kahului. Meanwhile, Wailuku is the seat of County government, as well as being home to the State Building and Hoapili Hale, the island's main judicial building. Not coincidently, most of Hawaii's major financial institutions all have their primary branch in Central Maui.

Due to these factors, there has always been more demand for workforce housing in Central Maui than in other regions. However, the overall lack of affordable housing in Central Maui has created the need for many residents to commute daily from outlying areas. This is especially true for Upcountry Maui and South Maui, but also, to some extent, from West Maui.

The Wai'ale Master Plan Development is planned for approximately 545 acres of land. Preliminarily, the development calls for approximately 2,550 single-family and multi family residential units. Of this total, approximately 300 residential units are attributed to the affordable housing component for Maui Business Park, Phase II. Additionally, on-site affordable housing units will also be developed for the Wai`ale project in compliance with the County of Maui's Residential Workforce Housing Policy.

In addition to single-family residential areas and multi-family residential areas, the master plan development will feature areas of village mixed-use, commercial, business/light industrial, park, cultural preserve, as well as a regional park, a community center, an intermediate school site with associated recreation fields, greenway paths and roads.

According to the Department of Planning "Directed Growth Areas Listing and Units" table, dated October 1, 2009, the forecasted demand of units to 2030 for each region on Maui is as follows:

Region	2030 Demand Units
Central Maui	5,073
West Maui	3,456
South Maui	1,482
North Maui	119
Upcountry Maui	824
East Maui	200

Although Central Maui demand to 2030 was forecasted to be 5,073 housing units, the long-term supply was estimated to be only 4,850 housing units, including approximately 2,550 units from the planned Wai'ale project. Based on these figures, even if all of the future supply units were built in Central Maui, there would still be a regional shortfall of 222 housing units by 2030. This factor could contribute to a faster rate of unit absorption.

Based on the aforementioned factors, as well as conclusions drawn from the previous supply and demand analysis, the Wai'ale Master Plan Development is expected to be well received by the market, over the long-term, with especially strong interest foreseen for the affordable units. Based on these factors, a residential unit absorption range of approximately 200 to 300 units per year could be anticipated for the Wai'ale project.

B. COMMERCIAL AND INDUSTRIAL MARKET ANALYSIS

SUPPLY CHARACTERISTICS The following chart represents the existing commercial and industrial developments, as well as proposed projects in Central Maui, South Maui, and West Maui.

Table 10 – Commercial and Industrial Parks in Central Maui, South Maui and West Maui

Project Name	Location	Gross Project Area In Acres	Primary Users
EXISTING (South Maui)			
Kihei Commercial Center	Kihei	16	Commercial, Mixed-use, Light Industrial
Piilani Business Park	Kihei	7	Commercial, Mixed-use, Light Industrial
Kihei Business Park	Kihei	14	Retail & Commercial
	Total	**37**	
EXISTING (Central Maui)			
Maui Industrial Park, Hana Highway and Dairy Road Industrial Subdivisions	Kahului	136	Mixed-Use, Light Industrial
Wailuku Industrial Park	Wailuku	55	Commercial, Mixed-use, Light Industrial
Kamehameha Parkway Subdivision	Kahului	62	Commercial, Mixed-use, Light Industrial
Maui Business Park, Phase 1A & 1-B	Kahului	78	Commercial, Mixed-use, Light Industrial
Traingle Square Subdivision	Kahului	13	Retail & Commercial
Wakea Industrial Subdivision	Kahului	12	Commercial, Mixed-use, Light Industrial
Central Maui Baseyard	Kahului	15	Light Industrial
Millyard Industrial Subdivision	Wailuku	30	Commercial, Mixed-use, Light Industrial
Waiko Industrial Subdivision	Wailuku	15	Light Industrial
Consolidated Baseyard Subdivision	Wailuku	23	Light Industrial
Maui Lani Village Center	Wailuku	110	Commercial, Mixed-use, Light Industrial
	Total	**549**	
EXISTING (West Maui)			
Wili Ko Industrial Subdivision	Lahaina	37	Commercial, Mixed-use, Light Industrial
Lahaina Business Park (Phases I and II)	Lahaina	41	Mixed-Use, Light Industrial
	Total	**78**	
PROPOSED			
Maui Business Park, Phase II	Kahului	179	Commercial, Mixed-Use, Light Industrial
Waikapu Light Industrial	Wailuku	8	Light Industrial
Kaonoulu Business Park	Kihei	75	Commercial, Mixed-Use, Light Industrial
	Total	**262**	

Central Maui's Existing Commercial/Industrial Projects

Central Maui has approximately 83 percent of the island's commercial and industrial park land, with the largest amount situated in Kahului, near the harbor and airport. In Kahului, these subdivisions are the Maui (Kahului) Industrial Park; Kamehameha Parkway Subdivision No. 2; Maui Business Park Phase IA and IB; Airport Triangle; and Wakea Industrial Subdivision. Wailuku's industrial projects include the Wailuku Industrial Park, The Millyard, Waiko Baseyard Subdivision, Consolidated Baseyard Subdivision, and Maui Lani Village Center.

Kahului

Maui (Kahului) Industrial Park

This leasehold industrial subdivision was developed and owned by Alexander and Baldwin, Inc., in the early 1960's. Most of the land in the Kahului Industrial Park was leased on a long-term basis to developers and owner-users that constructed and sub-leased the improvements. Beginning in 1988, A & B began selling the leased fee interest in some of these properties. Since that time several other offerings have been made to the lessees of their properties. In fact, many of the lessees have chosen to purchase the leased fee interest in the land rather than renegotiate their respective ground leases. These leased fee sales, according to a representative of Alexander & Baldwin, reflected their estimate of "fee simple" land value.

On Maui, the Kahului Industrial Park subdivision is by far the most established, and enjoys a superior location with respect to harbor and airport facilities, as well as other supporting commercial activities. Occupancy is high, and demand has spurred the development of additional industrial land along Wakea Avenue within this subdivision, as well as other projects in Kahului. According to officials at A&B Properties, their developments in the Kahului Industrial Park have historically had high occupancy rates.

Kamehameha Parkway Subdivision No. 2

This subdivision contains 36 parcels ranging in size from 12,826 square feet to 2.428 acres. In December 1991, A&B Properties sold approximately 16 fee simple parcels in the light industrial Kamehameha Parkway Subdivision No. 2.

There are currently 31 parcels developed in this subdivision, which includes such projects as the Valley Isle Motors, Tesoro, Spee Dee Lube, the HC&S Federal Credit Union, Kula Produce, Kula Community Federal Credit Union, Maui Community Federal Credit Union, The Fairgrounds office building, three medical office buildings, and Service Rentals and Sales.

Triangle Square

In response to the high demand, A&B Properties developed Triangle Square, located makai of the Hana Highway, across the Maui Industrial Park. Lots range between 7,172 square feet to 2.8 acres. Triangle Square is bound by Haleakala Highway, Dairy Road and Hana Highway. This 13-acre, 11-lot subdivision currently includes a Lexus dealership; a BMW dealership; Gas Express; the Kele building anchored by Denny's Restaurant; a small retail center at the corner of Hana Highway and Dairy Road, and the Triangle Square Apex Building. A Krispy Kreme doughnut outlet was constructed at the corner of Dairy Road and Haleakala Highway. Costco and Kmart are located across Dairy Road from Triangle Square.

Lots in this subdivision were initially offered as ground leases or build-to-suit. However, more recently, the fee interests have been offered for sale.

<u>Maui Business Park</u>
Seventy-six (76) acres were developed starting in 1995 as Phases IA and IB of the Maui Business Park. Phase IA includes 32 light industrial zoned lots ranging in size from 16,801 to 35,522 square feet on about 42 acres of land. Lots were initially priced at an average of $30 to $35 per square foot. Nine (9) parcels immediately sold and ranged from $26.00 to $34.38 per square foot. The only parcel to be sold in 2007 was purchased at a price of $43.77 per square foot for 27,188 square feet. An 8,506 square foot subdivided parcel was sold in October 2008 for $41.15 per square foot; however, there were no sales in 2009. In April 2010, a 16,525 square foot lot sold for $41.45 per square foot.

Improved properties within this phase include a Harley Davidson and automobile dealership; a McDonald's restaurant; a dental practice; a mortuary; a large self-storage center; several commercial office properties; and numerous light industrial facilities. The Maui Marketplace, also part of Phase IA, is patterned after Waikele Center in Oahu and was completed in 1997. It includes tenants such as Lowe's Hardware, Borders Books and Music, Office Max, Old Navy, Pier One Imports and Sports Authority.

Phase IB consists of about 34 acres of land and includes the large Wal Mart and Home Depot sites which were 14.014 acres and 12.701 acres, respectively. The remaining 10 lots are located along Hookele Street and range in size from 17,990 to 45,869 square feet, with an average of 22,817 square feet. Prices for these lots were initially at $26.00 to $27.00 per square foot. In addition to the Wal Mart and Home Depot, some of these parcels have been improved with a veterinary clinic, two professional office buildings, and a self-storage center. A July 2004 conveyance involved the lot at the corner of Puunene Avenue and Hookele Street, which sold for $33.35 per square foot and is now home to Zippy's Restaurant. A 44,823 square foot portion of the Wal Mart site, fronting Pakaula Street, was subdivided and sold in December 2005 for $36.25 per square foot. A three-unit retail center was subsequently built on this lot, with current tenants Panda Express, Verizon Wireless, and Game Stop.

Wailuku

The Millyard

Developed in 1984, all lots in this fee simple, light industrial subdivision have been sold, and improvements have been constructed on 34 parcels. Of the 53 lots in this development, only eight are more than one-half acre in size. The balance of the sites is between 10,055 and 20,119 square feet in size. Due to the unavailability of vacant light industrial land in the Central Maui region, sales in this Wailuku development have increased during the past three years.

Wailuku Industrial Park

This light industrial subdivision was developed by C. Brewer in the late-1970s and it consists of 74 fee simple lots off of Lower Main Street in Wailuku. Lots range from 10,106 square feet to a parcel 3.089 acres in size. Approximately 72 percent of the parcels are less than one-half acre in size. Of the 74 light industrial lots, only two are not utilized for a building or as yard space.

Waiko Baseyard Subdivision

The Waiko Baseyard Subdivision consists of 14.891 acres of land that was subdivided into 19 finished lots in 2005. It is located along Waiko Road in Waikapu Town of Wailuku. The lots range in size from 13,342 to 124,720 square feet. Lot No. 16 was deeded back to Brewer Environmental, Inc. and was not available for sale. Lots No. 17, 18 and 19 were retained by the developer and also not made available for sale. Fourteen (14) lots have sold so far, and only Lot 11 has not sold but is not on the market. It is noted that public records indicate additional sales between $20.00 and $25.00 per square foot; however, according to the developer, these prices were based on an agreement with the prior land owner and considered below-market. The initial sale price in the subdivision was $35.00 per square foot. A July 2008 sale of Lot 1 was at a price of $36.80 per square foot, while the most recent conveyance, in May 2010, was a distress sale of four consolidated lots (Lot 12-A), at $21.25 per square foot.

Consolidated Baseyards Subdivision

This 35-lot light industrial subdivision was completed in 2007 and is located on Waiko Road in the Waikapu area of Wailuku, encompassing 23.164 acres of land. The lots range in size from 10,375 to 85,502 square feet. Twenty-six (26) lots sold in 2006 with prices ranging from $28.16 to $38.00 per square foot with an average price of $32.87. The lowest prices at about $28.00 to $29.00 per square foot were discounted prices offered only to initial buyers. In 2007, eight (8) more lots sold at prices ranging from $27.61 per square foot for a 53,143 square foot lot to $39.97 per square foot for a 13,811 square foot lot. The average price in 2007 was $33.18 per square foot, while the average price in 2008 was

$37.45 per square foot. There was one September 2009 sale; however, this was shown to be between related parties. The next most recent sale was in November 2008, at $36.00 per square foot.

Maui Lani Village Center
Consisting of 78 lots of between 7,545 and 196,185 square feet, Maui Lani Village Center is located off Kuikahi Drive in Wailuku. Completed in 2010, this mixed use subdivision has unique zoning that allows for commercial and residential uses, in addition to industrial uses. There were six closings in late 2009, ranging in price from $50.00 to $55.00 per square foot. There has been one sale in 2010, at $60.00 per square foot. Developer pricing for the remaining inventory is generally between $50 and $60 per square foot.

Commercial/Industrial Listings

Research has indicated there is currently about 621 acres of commercial and industrial land in Central Maui. However, the vast majority is held by the State of Hawaii, and is situated around the Kahului Airport and Kahului Harbor. Furthermore, although not all of the privately owned parcels in Central Maui have been improved, many are being held by their owners for future development. As such, only vacant lots listed for sale were deemed to be "available" and considered current supply in Central Maui.

According to the Maui Multiple Listing Service, there are 75 parcels currently available for sale, totaling approximately 40 acres. There are 64 lots for sale, amounting to over 36 acres, within the recently completed Maui Lani Village Center. Wailuku Town has four parcels available, while none of the remaining Central Maui business/industrial parks had more than 2 lots for sale. The 40 acres represents only 6 percent of the overall commercial and industrial land in Central Maui. Based on historical absorption, the available acreage is not sufficient to support long-term needs in the region.

Central Maui Proposed Commercial/Industrial Projects

The Consultant is aware of two light industrial projects planned for the Central Maui region. The most substantial is Phase II of the Maui Business Park, consisting of approximately 179 acres. This project will be located to the southeast of Maui Business Park Phase I. This development is currently in the design stage. The second is an 8-acre site in Waikapu that was previously utilized by a scrap metal operation. This project will feature seven land condominium units and is currently in the initial planning stage.

A&B Properties, Inc. has long term plans to redevelop the Kahului Shopping Center and surrounding area into a mixed-use community called the Kahului Town Center. Preliminary plans for the 20 acres call for 442 residential units, 140,000 square feet of retail space and 156,000 square feet of office space.

A 12-acre site at the corner of Maui Lani Parkway and Kaahumanu Avenue is planned for the Maui Lani Shopping Center. This retail project is slated to have a Safeway as its anchor tenant. The project is currently in the entitlement phase, with its environmental assessment having been accepted in August 2010. Maui Lani has other small sites within their project district planned for commercial use; however, the majority has been built as part of their Village Center.

The Kehalani Project District has 20 acres on the eastern side of Honoapiilani Highway set aside for their commercial component. A Conceptual Land Use Map listed approximately 200,000 to 210,000 square feet of commercial space is to be built; however, there were no known plans for this area.

DEMAND CHARACTERISTICS

Industrial/Commercial Land Pricing Trend

Up to the Year 2007, there was significant appreciation for commercial/industrial vacant land in Central Maui, as well as the entire island. This rise in prices was attributed primarily to favorable economic conditions, coupled with the lack of entitled land. In Central Maui, a majority of the lots in existing commercial/industrial subdivisions have been built-out or are being held by their owners for development in the short-term future. In this light, the Consultant looked to more recently developed parks, Waiko Baseyard, Consolidated Baseyards, and Maui Business Park, for trend evidence within the industrial/commercial market.

There have been very few sales of lots within these parks since 2009; however it is obvious that there has been a downward trend since 2007. When compared to 2007, sales prices and current listings in 2009 and 2010 indicate a decrease in land values of between 5 and 20 percent.

Vacancy Rates

Most of the industrial development in Central Maui consists of owner-user facilities. Conversations with commercial leasing agents revealed that investment-driven warehouse properties have showed an increase in vacancy, as many businesses have shuttered their operations, or relocated to smaller accommodations.

According to a 2010 Maui Retail Market Report by Colliers Monroe Friedlander, Central Maui was the only submarket on the island to post positive net absorption. The vacancy rate for Central Maui was reported to be 4.44 percent, as compared to the island average which stood at 8.52 percent. This is a testament to the strong demand for retail space in the region. As previously indicated, Central Maui is home to the island's larger retail centers, such as Kaahumanu Shopping Center, Maui Mall, and the Maui Marketplace.

Rental Rate Trends

Our survey of current listings of competing spaces in the Central Maui neighborhood indicates that rents are lower than a year to two years ago. Whereas warehouse or storage spaces were being rented for upwards of $1.25 to $1.50 per square foot per month on an absolute net basis, current available spaces are clustered within a general range of $0.75 to $1.00 per square foot per month.

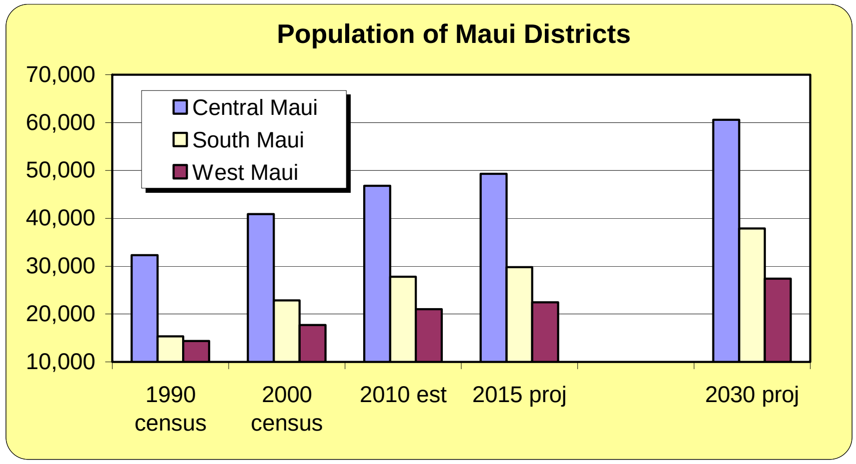
The Colliers Monroe Friedlander report stated monthly absolute net asking rents in Central Maui ranged from $2.39 to $2.93 per square foot. Research of retail center space showed Kahului Shopping Center had units available at between $1.75 and $2.00 per square foot; Maui Mall at between $2.00 and $3.50 per square foot; and Maui Marketplace at $3.25 per square foot. Asking rents were not available for Kaahumanu Center; however, this regional mall typically sets the high end of the range. Not surprisingly, asking rent was found to be lower than current rent levels. Commercial leasing agents indicated that property owners have had to lower expectations and in some cases provide rent reductions, in order to keep their tenants.

Forecasting Demand for Commercial and Industrial Land in Central Maui

Based on our analysis of the interacting supply and demand factors for commercial and industrial land in Central Maui, the Consultant has analyzed the potential market acceptance of the subject's commercial, industrial and village mixed use areas.

<u>Population Comparison</u>

According to demographic statistics by Claritas, Central Maui's population grew by approximately 26 percent from 32,310 people in the 1990 census to 40,867 people in the most recent census in 2000. Central Maui has kept to approximately 32 percent of the total population of Maui County during this period and is still at 32 percent, based on 2010 population estimates. The 2010 estimate indicates a population growth rate of approximately 14 percent over the 2000 census numbers. The population of South Maui and West Maui accounted for approximately 15 and 14 percent of Maui County's population, respectively, in each of the past census counts. It should be noted that while West Maui has remained at approximately 14 percent, South Maui jumped to almost 20 percent by 2010 estimates. The 2015 population projection for Central Maui indicates a growth rate of approximately 5 percent over the 2010 estimate.



To keep up with its very strong demand for commercial or industrial park space, Central Maui has had numerous developments built within the last 10 years. The Waiko Baseyard Subdivision was completed in 2005, with the Consolidated Baseyards Subdivision following in 2006. The Maui Lani Village Center was also completed in early 2010.

The significantly higher amount of land within Central Maui's commercial/industrial parks can be attributed to its proximity to major transportation and shipping facilities located in Kahului. As shown in **Table 11**, based on population estimates for 2010, Central Maui has the lowest number of persons per acre of commercial and/or industrial land (in projects) with a ratio of approximately 85 persons per acre. Meanwhile, West Maui's ratio is approximately 269 persons per acre of land area, while South Maui has the largest ratio, at about 751 persons per acre.

The Consultant is aware of only three proposed commercial industrial parks on Maui that are currently in the planning phase. As previously shown in **Table 10**, A&B Properties' Maui Business Park, Phase II will increase Central Maui's inventory by 179 acres, with the Waikapu Light Industrial Project adding about 8 acres. The Kaonoulu Business Park is slated to add approximately 75 acres of inventory to the South Maui area. When the proposed developments are taken into consideration, both Central Maui's and South Maui's ratio would fall, while West Maui's ratio would remain the same.

Table 11 – Population to Land Area in Commercial/Industrial Parks

	Central Maui	South Maui	West Maui
Population (2010 estimate)	46,795	27,797	20,996
Commercial and Industrial Land Area			
Total acres (in parks)	549	37	78
Persons per acre	**85.2**	**751.3**	**269.2**
Total acres (includes proposed parks)	736	112	78
Persons per Acre (includes proposed parks)	**63.6**	**248.2**	**269.2**

Within the Wai'ale project, Commercial (23 acres), Business/Light Industrial (16.3 acres) and Village Mixed Use (52.9 acres) areas are planned. It should be noted that the planned Village Mixed Use areas would allow for both commercial and residential use similar to that planned at Maui Lani. This will allow flexibility to address future market conditions and the relative demand for commercial and residential uses.

One of the concepts of Village Mixed Use is the blending of commercial and residential uses. Although this type of land use has seen increased popularity in recent years, evidence of this is common in Maui's older rural towns. By having goods and services providers proximate to living accommodations, residents are less dependent on vehicular travel. This helps to create pedestrian-friendly, self-sustained communities, which is consistent with the goals of the Maui Island Plan. A current example of the acceptability of this type of use can be seen at the Kai Ani condominium project in Kihei. Phase I of this 99-unit development consists of 23 units, of which, 11 are "live-work" condominiums. The live-work units feature ground floor retail/office space and living area on the second and third floors. Strong demand was witnessed for these units, with buyers touting convenience and zero-commute living as the primary advantages to this type of housing.

In the following section, the Consultant researched historical absorption of other Central Maui commercial and industrial parks.

<u>Historical Absorption of Commercial & Industrial Land</u>

Recently built subdivisions in Central Maui indicate significant absorption rates. The 11 lots released by the developer of Waiko Baseyard in October 2005 totaled just over five acres and were absorbed within five months. This would indicate an absorption rate of 11.90 acres per year.

Consolidated Baseyards was completed in 2006, with 35 marketable lots totaling approximately 22 acres. There were 27 lots, totaling almost 16 acres, immediately sold between October and December 2006 and January 2007. The remaining eight lots, of approximately 6 acres, were sold in 2007. Overall monthly absorption averaged 1.6 acres, which would translate into about 19 acres per year.

Maui Lani Village Center was completed in early 2010 and features 77 lots, totaling approximately 42 acres. There have been seven closings, amounting to 7.9 acres, within the 19 months that this subdivision has been marketed. This translated into an absorption rate of about five acres per year.

The planned commercial, business/light industrial, and village mixed use lands are anticipated to consist of uses geared more toward neighborhood goods and services providers. These areas are not anticipated to serve as, or compete with, other major centers of regional commercial activity. It is the Consultant's opinion that the areas would be well suited for a neighborhood commercial retail/office centers, featuring a supermarket and/or drug store as the anchor tenant(s). Supplementary businesses would cater to the needs of the residents within the Wai'ale Master Plan Development, as well as the overall Central Maui region. It is highly likely that the subject's neighborhood commercial retail/office centers would also be utilized by residents of the neighboring Maui Lani Project District. Light industrial uses for Wai'ale may include different types of small-scale production and manufacturing operations; however, it is reasonable to assume that typical light industrial users would also gravitate toward the proposed Maui Business Park or nearby Waiko Baseyard and Consolidated Baseyards.

Therefore, although market conditions are currently soft for commercial and industrial segments, it is the Consultant's opinion that there will be good demand for the Wai'ale Master Plan Development's commercial, industrial and village mixed use land upon economic recovery.

Preliminary plans call for approximately 230,000 square feet of saleable/leasable area for the 23 acres of Commercial land. Based on previously stated supply and demand factors, as well as analysis of historical market absorption, it is estimated that 60 percent, or about 138,000 square feet, will be immediately occupied upon completion of the neighborhood commercial retail/office center. The remaining space is forecasted to be absorbed at between 15,000 and 20,000 square feet per year. It is likely that the center will attract retailers and tourism-oriented businesses wanting to capitalize on the site's location along Kuihelani Highway.

The 52.9 acres of Village Mixed-Use land, at an estimated 250,000 square feet of saleable/leasable area, is forecasted to be absorbed at between 30,000 and 45,000 square feet per year. Demand for this type of property is expected to be very good, especially from island-based businesses, community goods and service providers, and those seeking "live/work" housing products.

Finally, annual absorption of the estimated 175,000 square feet of saleable/leasable Business/Light Industrial area is forecasted to be between 15,000 and 25,000 square feet.

C. CONCLUSION

The following points summarize the supply of real estate in Maui at this time.

RESIDENTIAL SUPPLY COMPONENTS

There are approximately 2,300 new housing units (single family residential, condominium and residential house lots) either currently available in the market or will become available in the short-term future. Based on historical annual absorption rates of the real estate markets, the current short term supply of units is expected to last approximately 4 years (2,300 units of supply ÷ 580 units of average annual absorption).

Long term supply, as being recommended by the County of Maui Planning Department, the Maui Planning Commission and the General Plan Advisory Committees, is estimated to be 11,623 housing units. Although this count is based on a 20-year span, it is difficult to gauge the timing of these projects until construction actually begins.

Economic changes, community intervention, market conditions or internal issues with the developers may affect the feasibility of these projects. In reality, some of these projects may never be approved or be built out by 2030. For this reason, the number of units of potential supply that will actually be developed is expected to be lower than the 11,623 units on the list.

COMMERCIAL AND INDUSTRIAL SUPPLY COMPONENTS

Available commercial and industrial land in Central Maui amounted to approximately 40 acres. Most of the availability, about 36 acres, consists of lots within the recently completed Maui Lani Village Center.

Proposed commercial and industrial developments in the Central Maui region, aside from the subject, include the Maui Business Park, Phase II (179 acres), Waikapu Light Industrial (8 acres), Maui Lani Shopping Center (12 acres), and the Kehalani Project District's commercial component (20 acres). In addition, A&B Properties, Inc. has plans to redevelop the Kahului Shopping Center area into the Kahului Town Center.

The following points summarize the demand for real estate in Maui at this time.

RESIDENTIAL DEMAND COMPONENTS

Population on Maui between 1990 and 2000 grew by 28.5 percent. Population is expected to increase by almost 58 percent from 2000 to 2035. From 1990 to 2000, Central Maui had a 26.5 percent increase in population.

Through 2010 to-date, the interest rate on a 30-year, fixed-rate mortgage has averaged 4.84 percent, with the lowest rate seen in August, at 4.43 percent. This would typically mean that real estate becomes more affordable to a larger segment of the population. However, the current state of national and local economies, coupled with rising job losses, have prevented many potential market participants from taking advantage of these historically low rates.

Real estate sales activity in land, single-family and condominium properties dropped considerably in terms of number of sales and median sales price since their peaks in mid-2005. During this same period, marketing times have increased. However, statistics for 2010 appear to show some signs of stabilization.

The Hawaii Housing Policy Study Update 2003 shows that there will be a demand for 8,103 new resident housing units (RHU) from 2011 to 2024.

The Hawaii Housing Policy Study Update 2003 also estimated a deficit of approximately 3,299 needed resident housing units as of 2010. By the end of the study in 2024, this deficit will increase by approximately 26 percent to 4,154 units.

COMMERCIAL AND INDUSTRIAL DEMAND COMPONENTS

Central Maui had a significant increase in population from the 1990 to the 2000 census, with a growth rate of approximately 26 percent. Increasing population must be followed with the availability of professional services and commercial establishments to support the growth.

Although the deficient sales activity in Central Maui can partially be attributed to softened market conditions, there is also a lack of suitable vacant land available for purchase. Vacant land prices in Central Maui have decreased, similar to all commercial and industrial areas on Maui. Upon economic recovery, prices are expected to rebound significantly, due to resurgence in demand.

Rental rates for commercial and industrial space have declined since their peaks in 2007. It can be assumed that this trend will reverse course as the economy gains traction.

Although Central Maui has the lowest ratio of population to acres of finished commercial and industrial land area, unit prices remain comparable to commercial and industrial parks in South Maui and West Maui. This would indicate the continued demand for commercial and industrial land in Central Maui.

The economic downturn being witnessed across the nation has significantly affected Maui, through a drop in visitor counts and the drastic slowdown of construction. These industries are two of the primary employment forces on the island and their decline has had an adverse impact on the local economy. Unemployment has been on the rise, with many who are still employed stating that job security is a concern. Meanwhile, the heavy losses witnessed in the financial sector since the fourth quarter of 2008 have surely diminished the investment capital for other potential buyers. Combined with a more stringent lending environment, it has become increasingly difficult to purchase real estate, regardless of current market conditions.

At the height of the market, the primary obstacle for buyers was the high asking prices for residential products. Many buyers who did not own a home found it difficult to even come up with enough money for a down payment. Meanwhile, homeowners saw their property values increase to a point where they were able to use their equity appreciation to upgrade to larger, more elaborate accommodations. For many, this option is no longer possible, as the retreat of home prices has caused a significant loss of equity. Currently, the ability of qualified buyers to purchase housing may be more difficult than a few years ago; however, it is fairly safe to assume that as economic conditions improve, housing units within the workforce market segment will continue to be the most sought after. Local economists have varied opinions as to the timing of the economic recovery, but many have pointed to late-2011 or 2012 for this turnaround.

If the Wai'ale Master Plan Development came on-line today, it would likely be facing the same types of sales difficulties that other ongoing projects are witnessing. However, the subject will still need to go through entitlement, design and construction processes before sales can occur. As such, release of the subject's housing units may be very well timed with the economic recovery. Once market conditions improve, the project can expect to see heightened demand.

Central Maui is the nucleus of commercial and residential activity in the County of Maui. It is the transportation hub, employment center, and focus of government activities. In addition it is home to the island's secondary education campus and features more commercial, industrial and professional space than any other urban region. There is little doubt that for these reasons, those involved with the development of the Maui Island Plan have recommended that more than 40 percent of Maui's future supply units, to the year 2030, be located in Central Maui.

Most importantly, the Wai'ale Master Plan Development will be primarily targeted toward the workforce market segment. Statistical evidence has clearly shown that regardless of conditions, this market segment has the most demand. Although the pricing of the project units have not been determined, this development will give entry level market participants an opportunity for home ownership.

The Wai'ale Master Plan Development is a primary component of future growth in Central Maui and is being projected to supply greater than 50 percent of the required future housing units for Central Maui. The property owners continue to work diligently with government agencies in an effort to design a master plan community that represents smart-growth for the Central Maui region. As previously discussed, the proposed project is consistent with many of the goals, objectives, policies and implementing actions set forth in the Countywide Policy Plan, which provides a policy framework for the Maui Island Plan and Community Plans. After consideration of current economic and real estate market conditions; forecasts by Hawaii economists; as well as long-term supply and demand recommendations being deliberated for the 2030 General Plan, it is the Consultant's opinion that the Wai'ale Master Plan Development should be well positioned to capitalize on the recovery of the real estate market and play an important role in providing a long-term solution to the housing needs of Central Maui's workforce.

EXHIBITS

EXHIBIT A

Demographic Reports - Claritas, Inc.

Pop-Facts: Demographic Snapshot Report

County, (see appendix for geographies), aggregate

Description	Total County	%
Population		
2015 Projection	153,962	
2010 Estimate	146,193	
2000 Census	128,094	
1990 Census	100,374	
Growth 2010-2015	5.31%	
Growth 2000-2010	14.13%	
Growth 1990-2000	27.62%	
2010 Est. Pop by Single Race Class	146,193	
White Alone	54,988	37.61
Black or African American Alone	1,361	0.93
Amer. Indian and Alaska Native Alone	731	0.50
Asian Alone	40,388	27.63
Native Hawaiian and Other Pac. Isl. Alone	14,700	10.06
Some Other Race Alone	2,443	1.67
Two or More Races	31,582	21.60
2010 Est. Pop Hisp or Latino by Origin	146,193	
Not Hispanic or Latino	131,667	90.06
Hispanic or Latino:	14,526	9.94
Mexican	5,914	40.71
Puerto Rican	4,581	31.54
Cuban	55	0.38
All Other Hispanic or Latino	3,976	27.37
2010 Est. Hisp or Latino by Single Race Class	14,526	
White Alone	3,628	24.98
Black or African American Alone	30	0.21
American Indian and Alaska Native Alone	175	1.20
Asian Alone	1,331	9.16
Native Hawaiian and Other Pacific Islander Alone	804	5.53
Some Other Race Alone	2,224	15.31
Two or More Races	6,334	43.60

Pop-Facts: Demographic Snapshot Report

County, (see appendix for geographies), aggregate

Description	Total County	%
2010 Est. Pop. Asian Alone Race by Cat	40,388	
Chinese, except Taiwanese	1,191	2.95
Filipino	22,491	55.69
Japanese	12,829	31.76
Asian Indian	110	0.27
Korean	812	2.01
Vietnamese	332	0.82
Cambodian	10	0.02
Hmong	0	0.00
Laotian	49	0.12
Thai	81	0.20
All Other Asian Races Including 2+ Category	2,483	6.15
2010 Est. Population by Ancestry	146,193	
Pop, Arab	145	0.10
Pop, Czech	180	0.12
Pop, Danish	485	0.33
Pop, Dutch	1,000	0.68
Pop, English	6,800	4.65
Pop, French (except Basque)	2,059	1.41
Pop, French Canadian	582	0.40
Pop, German	6,384	4.37
Pop, Greek	123	0.08
Pop, Hungarian	666	0.46
Pop, Irish	5,553	3.80
Pop, Italian	5,796	3.96
Pop, Lithuanian	179	0.12
Pop, United States or American	1,540	1.05
Pop, Norwegian	1,106	0.76
Pop, Polish	1,742	1.19
Pop, Portuguese	4,494	3.07
Pop, Russian	566	0.39
Pop, Scottish	1,801	1.23
Pop, Scotch-Irish	1,353	0.93
Pop, Slovak	13	0.01
Pop, Subsaharan African	84	0.06
Pop, Swedish	1,407	0.96
Pop, Swiss	567	0.39
Pop, Ukrainian	65	0.04
Pop, Welsh	857	0.59
Pop, West Indian (exc Hisp groups)	186	0.13
Pop, Other ancestries	93,362	63.86

Pop-Facts: Demographic Snapshot Report

County, (see appendix for geographies), aggregate

Description	Total County	%
2010 Est. Population by Ancestry		
Pop, Ancestry Unclassified	7,098	4.86
2010 Est. Pop Age 5+ by Language Spoken At Home	136,459	
Speak Only English at Home	109,296	80.09
Speak Asian/Pac. Isl. Lang. at Home	20,876	15.30
Speak IndoEuropean Language at Home	2,669	1.96
Speak Spanish at Home	3,585	2.63
Speak Other Language at Home	33	0.02
2010 Est. Population by Sex	146,193	
Male	74,631	51.05
Female	71,562	48.95
2010 Est. Population by Age	146,193	
Age 0 - 4	9,734	6.66
Age 5 - 9	8,979	6.14
Age 10 - 14	8,732	5.97
Age 15 - 17	5,643	3.86
Age 18 - 20	4,645	3.18
Age 21 - 24	6,623	4.53
Age 25 - 34	21,519	14.72
Age 35 - 44	21,211	14.51
Age 45 - 54	22,098	15.12
Age 55 - 64	18,620	12.74
Age 65 - 74	9,895	6.77
Age 75 - 84	5,686	3.89
Age 85 and over	2,808	1.92
Age 16 and over	116,907	79.97
Age 18 and over	113,105	77.37
Age 21 and over	108,460	74.19
Age 65 and over	18,389	12.58
2010 Est. Median Age	38.40	
2010 Est. Average Age	38.60	

Pop-Facts: Demographic Snapshot Report

County, (see appendix for geographies), aggregate

Description	Total County	%
2010 Est. Male Population by Age	74,631	
Age 0 - 4	5,031	6.74
Age 5 - 9	4,610	6.18
Age 10 - 14	4,417	5.92
Age 15 - 17	2,877	3.85
Age 18 - 20	2,416	3.24
Age 21 - 24	3,457	4.63
Age 25 - 34	11,890	15.93
Age 35 - 44	11,278	15.11
Age 45 - 54	10,979	14.71
Age 55 - 64	9,388	12.58
Age 65 - 74	4,740	6.35
Age 75 - 84	2,474	3.31
Age 85 and over	1,074	1.44
2010 Est. Median Age, Male	37.32	
2010 Est. Average Age, Male	37.70	
2010 Est. Female Population by Age	71,562	
Age 0 - 4	4,703	6.57
Age 5 - 9	4,369	6.11
Age 10 - 14	4,315	6.03
Age 15 - 17	2,766	3.87
Age 18 - 20	2,229	3.11
Age 21 - 24	3,166	4.42
Age 25 - 34	9,629	13.46
Age 35 - 44	9,933	13.88
Age 45 - 54	11,119	15.54
Age 55 - 64	9,232	12.90
Age 65 - 74	5,155	7.20
Age 75 - 84	3,212	4.49
Age 85 and over	1,734	2.42
2010 Est. Median Age, Female	39.64	
2010 Est. Average Age, Female	39.50	

Pop-Facts: Demographic Snapshot Report

County, (see appendix for geographies), aggregate

Description	Total County	%
2010 Est. Pop Age 15+ by Marital Status	118,748	
Total, Never Married	37,238	31.36
Males, Never Married	21,914	18.45
Females, Never Married	15,324	12.90
Married, Spouse present	54,591	45.97
Married, Spouse absent	6,861	5.78
Widowed	6,128	5.16
Males Widowed	1,208	1.02
Females Widowed	4,920	4.14
Divorced	13,930	11.73
Males Divorced	6,403	5.39
Females Divorced	7,527	6.34
2010 Est. Pop. Age 25+ by Edu. Attainment	101,837	
Less than 9th grade	5,342	5.25
Some High School, no diploma	6,039	5.93
High School Graduate (or GED)	33,352	32.75
Some College, no degree	22,833	22.42
Associate Degree	9,806	9.63
Bachelor's Degree	16,576	16.28
Master's Degree	5,208	5.11
Professional School Degree	2,101	2.06
Doctorate Degree	580	0.57
2010 Est Pop Age 25+ by Edu. Attain, Hisp. or Lat	101,837	
Less than 9th grade	269	0.26
Some High School, no diploma	1,258	1.24
High School Graduate (or GED)	3,740	3.67
Some College, no degree	1,409	1.38
Associate Degree	569	0.56
Bachelor's Degree	250	0.25
Master's Degree	292	0.29

Pop-Facts: Demographic Snapshot Report

County, (see appendix for geographies), aggregate

Description	Total County	%
Households		
2015 Projection	54,018	
2010 Estimate	50,880	
2000 Census	43,507	
1990 Census	33,145	
Growth 2010-2015	6.17%	
Growth 2000-2010	16.95%	
Growth 1990-2000	31.26%	
2010 Est. Households by Household Type	50,880	
Family Households	34,948	68.69
Nonfamily Households	15,932	31.31
2010 Est. Group Quarters Population	1,608	
2010 HHs by Ethnicity, Hispanic/Latino	3,585	7.05
2010 Est. HHs by HH Income	50,880	
Income Less than $15,000	4,374	8.60
Income $15,000 - $24,999	3,869	7.60
Income $25,000 - $34,999	4,201	8.26
Income $35,000 - $49,999	6,485	12.75
Income $50,000 - $74,999	9,847	19.35
Income $75,000 - $99,999	8,241	16.20
Income $100,000 - $124,999	4,520	8.88
Income $125,000 - $149,999	3,216	6.32
Income $150,000 - $199,999	3,251	6.39
Income $200,000 - $499,999	2,340	4.60
Income $500,000 and more	536	1.05
2010 Est. Average Household Income	$85,521	
2010 Est. Median Household Income	$66,530	
2010 Est. Per Capita Income	$30,004	

Pop-Facts: Demographic Snapshot Report

County, (see appendix for geographies), aggregate

Description	Total County	%
2010 Median HH Inc by Single Race Class. or Ethn		
White Alone	67,201	
Black or African American Alone	57,839	
American Indian and Alaska Native Alone	55,000	
Asian Alone	73,355	
Native Hawaiian and Other Pacific Islander Alone	57,608	
Some Other Race Alone	47,914	
Two or More Races	62,030	
Hispanic or Latino	53,365	
Not Hispanic or Latino	67,580	
2010 Est. Family HH Type, Presence Own Children	34,948	
Married-Couple Family, own children	11,017	31.52
Married-Couple Family, no own children	14,837	42.45
Male Householder, own children	1,152	3.30
Male Householder, no own children	1,686	4.82
Female Householder, own children	3,127	8.95
Female Householder, no own children	3,129	8.95
2010 Est. Households by Household Size	50,880	
1-person household	11,722	23.04
2-person household	15,854	31.16
3-person household	8,725	17.15
4-person household	6,925	13.61
5-person household	3,722	7.32
6-person household	1,988	3.91
7 or more person household	1,944	3.82
2010 Est. Average Household Size	2.84	

Pop-Facts: Demographic Snapshot Report

County, (see appendix for geographies), aggregate

Description	Total County	%
2010 Est. Households by Presence of People	50,880	
Households with 1 or more People under Age 18:	17,967	35.31
Married-Couple Family	12,183	23.94
Other Family, Male Householder	1,657	3.26
Other Family, Female Householder	4,089	8.04
Nonfamily, Male Householder	24	0.05
Nonfamily, Female Householder	14	0.03
Households no People under Age 18:	32,913	64.69
Married-Couple Family	12,978	25.51
Other Family, Male Householder	1,105	2.17
Other Family, Female Householder	1,996	3.92
Nonfamily, Male Householder	8,770	17.24
Nonfamily, Female Householder	8,064	15.85
2010 Est. Households by Number of Vehicles	50,880	
No Vehicles	2,629	5.17
1 Vehicle	15,744	30.94
2 Vehicles	19,766	38.85
3 Vehicles	7,584	14.91
4 Vehicles	3,316	6.52
5 or more Vehicles	1,841	3.62
2010 Est. Average Number of Vehicles	2.01	
Family Households		
2015 Projection	37,102	
2010 Estimate	34,948	
2000 Census	29,899	
1990 Census	23,537	
Growth 2010-2015	6.16%	
Growth 2000-2010	16.89%	
Growth 1990-2000	27.03%	
2010 Est. Families by Poverty Status	34,948	
2010 Families at or Above Poverty	33,167	94.90
2010 Families at or Above Poverty with Children	16,990	48.62
2010 Families Below Poverty	1,781	5.10
2010 Families Below Poverty with Children	1,345	3.85

Pop-Facts: Demographic Snapshot Report

County, (see appendix for geographies), aggregate

Description	Total County	%
2010 Est. Pop Age 16+ by Employment Status	116,907	
In Armed Forces	396	0.34
Civilian - Employed	77,635	66.41
Civilian - Unemployed	3,734	3.19
Not in Labor Force	35,142	30.06
2010 Est. Civ Employed Pop 16+ Class of Worker	74,231	
For-Profit Private Workers	50,672	68.26
Non-Profit Private Workers	4,052	5.46
Local Government Workers	2,815	3.79
State Government Workers	6,815	9.18
Federal Government Workers	1,363	1.84
Self-Emp Workers	8,207	11.06
Unpaid Family Workers	307	0.41
2010 Est. Civ Employed Pop 16+ by Occupation	74,231	
Architect/Engineer	958	1.29
Arts/Entertain/Sports	2,212	2.98
Building Grounds Maint	5,559	7.49
Business/Financial Ops	1,742	2.35
Community/Soc Svcs	1,249	1.68
Computer/Mathematical	501	0.67
Construction/Extraction	6,380	8.59
Edu/Training/Library	4,083	5.50
Farm/Fish/Forestry	880	1.19
Food Prep/Serving	6,994	9.42
Health Practitioner/Tec	2,753	3.71
Healthcare Support	1,620	2.18
Maintenance Repair	2,864	3.86
Legal	539	0.73
Life/Phys/Soc Science	518	0.70
Management	6,545	8.82
Office/Admin Support	8,824	11.89
Production	2,145	2.89
Protective Svcs	2,472	3.33
Sales/Related	8,881	11.96
Personal Care/Svc	2,800	3.77
Transportation/Moving	3,712	5.00

Pop-Facts: Demographic Snapshot Report

County, (see appendix for geographies), aggregate

Description	Total County	%
2010 Est. Pop 16+ by Occupation Classification	74,231	
Blue Collar	15,101	20.34
White Collar	38,805	52.28
Service and Farm	20,325	27.38
2010 Est. Workers Age 16+, Transp. To Work	72,261	
Drove Alone	50,850	70.37
Car Pooled	10,971	15.18
Public Transportation	1,361	1.88
Walked	1,986	2.75
Bicycle	461	0.64
Other Means	1,541	2.13
Worked at Home	5,091	7.05
2010 Est. Workers Age 16+ by Travel Time to Work	72,261	
Less than 15 Minutes	26,723	36.98
15 - 29 Minutes	21,220	29.37
30 - 44 Minutes	12,554	17.37
45 - 59 Minutes	4,876	6.75
60 or more Minutes	3,324	4.60
2010 Est. Avg Travel Time to Work in Minutes	22.72	
2010 Est. Tenure of Occupied Housing Units	50,880	
Owner Occupied	29,265	57.52
Renter Occupied	21,615	42.48
2010 Owner Occ. HUs: Avg. Length of Residence	17	
2010 Renter Occ. HUs: Avg. Length of Residence	8	

Pop-Facts: Demographic Snapshot Report

County, (see appendix for geographies), aggregate

Description	Total County	%
2010 Est. All Owner-Occupied Housing Values	29,265	
Value Less than $20,000	67	0.23
Value $20,000 - $39,999	53	0.18
Value $40,000 - $59,999	130	0.44
Value $60,000 - $79,999	66	0.23
Value $80,000 - $99,999	82	0.28
Value $100,000 - $149,999	300	1.03
Value $150,000 - $199,999	625	2.14
Value $200,000 - $299,999	2,989	10.21
Value $300,000 - $399,999	3,835	13.10
Value $400,000 - $499,999	4,622	15.79
Value $500,000 - $749,999	8,863	30.29
Value $750,000 - $999,999	3,625	12.39
Value $1,000,000 or more	4,008	13.70
2010 Est. Median All Owner-Occupied Housing Value	$552,572	
2010 Est. Housing Units by Units in Structure	66,980	
1 Unit Attached	2,868	4.28
1 Unit Detached	37,488	55.97
2 Units	3,871	5.78
3 or 4 Units	2,482	3.71
5 to 19 Units	8,881	13.26
20 to 49 Units	4,302	6.42
50 or More Units	7,024	10.49
Mobile Home or Trailer	64	0.10
Boat, RV, Van, etc.	0	0.00
2010 Est. Housing Units by Year Structure Built	66,980	
Housing Unit Built 2000 or later	11,064	16.52
Housing Unit Built 1990 to 1999	13,092	19.55
Housing Unit Built 1980 to 1989	14,033	20.95
Housing Unit Built 1970 to 1979	16,550	24.71
Housing Unit Built 1960 to 1969	5,562	8.30
Housing Unit Built 1950 to 1959	2,756	4.11
Housing Unit Built 1940 to 1949	1,645	2.46
Housing Unit Built 1939 or Earlier	2,278	3.40
2010 Est. Median Year Structure Built **	1983	

**1939 will appear when at least half of the Housing Units in this reports area were built in 1939 or earlier.

Pop-Facts: Demographic Snapshot Report

Appendix: Area Listing

Area Name:

Type: List - County   Reporting Detail: Aggregate   Reporting Level: County

Geography Code	Geography Name	Geography Code	Geography Name
15009	Maui County, HI		

Project Information:

Site: 1

Order Number: 969072959

Prepared By:
Nielsen Solution Center 1 800 866 6511

Pop-Facts: Demographic Snapshot 2010 Report

Place, (see appendix for geographies), aggregate

Description	Total *Place*	*%*
Population		
2015 Projection	49,269	
2010 Estimate	46,795	
2000 Census	40,867	
1990 Census	32,310	
Growth 2010-2015	5.29%	
Growth 2000-2010	14.51%	
Growth 1990-2000	26.48%	
2010 Est. Pop by Single Race Class	46,795	
White Alone	7,916	16.92
Black or African American Alone	241	0.52
Amer. Indian and Alaska Native Alone	203	0.43
Asian Alone	20,346	43.48
Native Hawaiian and Other Pac. Isl. Alone	5,222	11.16
Some Other Race Alone	686	1.47
Two or More Races	12,181	26.03
2010 Est. Pop Hisp or Latino by Origin	46,795	
Not Hispanic or Latino	41,668	89.04
Hispanic or Latino:	5,127	10.96
Mexican	1,499	29.24
Puerto Rican	2,135	41.64
Cuban	7	0.14
All Other Hispanic or Latino	1,486	28.98
2010 Est. Hisp or Latino by Single Race Class	5,127	
White Alone	880	17.16
Black or African American Alone	6	0.12
American Indian and Alaska Native Alone	66	1.29
Asian Alone	580	11.31
Native Hawaiian and Other Pacific Islander Alone	307	5.99
Some Other Race Alone	632	12.33
Two or More Races	2,656	51.80

Prepared By:
Nielsen Solution Center 1 800 866 6511 CLARITAS MARKETPLACE

Pop-Facts: Demographic Snapshot 2010 Report

Place, (see appendix for geographies), aggregate

Description	Total Place	%
2010 Est. Pop. Asian Alone Race by Cat	20,346	
Chinese, except Taiwanese	472	2.32
Filipino	10,764	52.90
Japanese	7,319	35.97
Asian Indian	26	0.13
Korean	451	2.22
Vietnamese	131	0.64
Cambodian	3	0.01
Hmong	0	0.00
Laotian	22	0.11
Thai	23	0.11
All Other Asian Races Including 2+ Category	1,135	5.58
2010 Est. Population by Ancestry	46,795	
Pop, Arab	38	0.08
Pop, Czech	25	0.05
Pop, Danish	14	0.03
Pop, Dutch	73	0.16
Pop, English	814	1.74
Pop, French (except Basque)	284	0.61
Pop, French Canadian	145	0.31
Pop, German	801	1.71
Pop, Greek	1	0.00
Pop, Hungarian	76	0.16
Pop, Irish	712	1.52
Pop, Italian	669	1.43
Pop, Lithuanian	14	0.03
Pop, United States or American	209	0.45
Pop, Norwegian	152	0.32
Pop, Polish	183	0.39
Pop, Portuguese	1,514	3.24
Pop, Russian	36	0.08
Pop, Scottish	165	0.35
Pop, Scotch-Irish	156	0.33
Pop, Slovak	1	0.00
Pop, Subsaharan African	19	0.04
Pop, Swedish	187	0.40
Pop, Swiss	18	0.04
Pop, Ukrainian	1	0.00
Pop, Welsh	80	0.17
Pop, West Indian (exc Hisp groups)	41	0.09
Pop, Other ancestries	38,217	81.67

Pop-Facts: Demographic Snapshot 2010 Report

Place, (see appendix for geographies), aggregate

Description	Total Place	%
2010 Est. Population by Ancestry		
Pop, Ancestry Unclassified	2,150	4.59
2010 Est. Pop Age 5+ by Language Spoken At Home	43,428	
Speak Only English at Home	32,768	75.45
Speak Asian/Pac. Isl. Lang. at Home	9,355	21.54
Speak IndoEuropean Language at Home	385	0.89
Speak Spanish at Home	913	2.10
Speak Other Language at Home	7	0.02
2010 Est. Population by Sex	46,795	
Male	23,694	50.63
Female	23,101	49.37
2010 Est. Population by Age	46,795	
Age 0 - 4	3,367	7.20
Age 5 - 9	2,954	6.31
Age 10 - 14	2,937	6.28
Age 15 - 17	1,840	3.93
Age 18 - 20	1,548	3.31
Age 21 - 24	2,157	4.61
Age 25 - 34	7,335	15.67
Age 35 - 44	6,462	13.81
Age 45 - 54	6,062	12.95
Age 55 - 64	5,352	11.44
Age 65 - 74	3,171	6.78
Age 75 - 84	2,419	5.17
Age 85 and over	1,191	2.55
Age 16 and over	36,937	78.93
Age 18 and over	35,697	76.28
Age 21 and over	34,149	72.98
Age 65 and over	6,781	14.49
2010 Est. Median Age	36.95	
2010 Est. Average Age	38.40	

Pop-Facts: Demographic Snapshot 2010 Report

Place, (see appendix for geographies), aggregate

Description	Total Place	%
2010 Est. Male Population by Age	23,694	
Age 0 - 4	1,747	7.37
Age 5 - 9	1,517	6.40
Age 10 - 14	1,485	6.27
Age 15 - 17	937	3.95
Age 18 - 20	856	3.61
Age 21 - 24	1,125	4.75
Age 25 - 34	4,061	17.14
Age 35 - 44	3,425	14.46
Age 45 - 54	3,021	12.75
Age 55 - 64	2,646	11.17
Age 65 - 74	1,423	6.01
Age 75 - 84	1,016	4.29
Age 85 and over	435	1.84
2010 Est. Median Age, Male	35.35	
2010 Est. Average Age, Male	37.10	
2010 Est. Female Population by Age	23,101	
Age 0 - 4	1,620	7.01
Age 5 - 9	1,437	6.22
Age 10 - 14	1,452	6.29
Age 15 - 17	903	3.91
Age 18 - 20	692	3.00
Age 21 - 24	1,032	4.47
Age 25 - 34	3,274	14.17
Age 35 - 44	3,037	13.15
Age 45 - 54	3,041	13.16
Age 55 - 64	2,706	11.71
Age 65 - 74	1,748	7.57
Age 75 - 84	1,403	6.07
Age 85 and over	756	3.27
2010 Est. Median Age, Female	38.76	
2010 Est. Average Age, Female	39.80	

Pop-Facts: Demographic Snapshot 2010 Report

Place, (see appendix for geographies), aggregate

Description	Total *Place*	%
2010 Est. Pop Age 15+ by Marital Status	37,537	
Total, Never Married	11,963	31.87
Males, Never Married	6,997	18.64
Females, Never Married	4,966	13.23
Married, Spouse present	16,993	45.27
Married, Spouse absent	2,676	7.13
Widowed	2,447	6.52
Males Widowed	490	1.31
Females Widowed	1,957	5.21
Divorced	3,458	9.21
Males Divorced	1,569	4.18
Females Divorced	1,889	5.03
2010 Est. Pop. Age 25+ by Edu. Attainment	31,992	
Less than 9th grade	2,757	8.62
Some High School, no diploma	2,365	7.39
High School Graduate (or GED)	11,515	35.99
Some College, no degree	6,245	19.52
Associate Degree	3,065	9.58
Bachelor's Degree	4,389	13.72
Master's Degree	1,127	3.52
Professional School Degree	491	1.53
Doctorate Degree	38	0.12
2010 Est Pop Age 25+ by Edu. Attain, Hisp. or Lat	2,684	
Less than 9th grade	99	3.69
Some High School, no diploma	364	13.56
High School Graduate (or GED)	1,360	50.67
Some College, no degree	444	16.54
Associate Degree	196	7.30
Bachelor's Degree	111	4.14
Graduate or Professional Degree	110	4.10

Pop-Facts: Demographic Snapshot 2010 Report

Place, (see appendix for geographies), aggregate

Description	Total Place	%
Households		
2015 Projection	15,593	
2010 Estimate	14,735	
2000 Census	12,626	
1990 Census	9,953	
Growth 2010-2015	5.82%	
Growth 2000-2010	16.70%	
Growth 1990-2000	26.86%	
2010 Est. Households by Household Type	14,735	
Family Households	10,921	74.12
Nonfamily Households	3,814	25.88
2010 Est. Group Quarters Population	937	
2010 HHs by Ethnicity, Hispanic/Latino	1,186	8.05
2010 Est. HHs by HH Income	14,735	
Income Less than $15,000	1,351	9.17
Income $15,000 - $24,999	1,288	8.74
Income $25,000 - $34,999	1,150	7.80
Income $35,000 - $49,999	1,797	12.20
Income $50,000 - $74,999	2,955	20.05
Income $75,000 - $99,999	2,328	15.80
Income $100,000 - $124,999	1,388	9.42
Income $125,000 - $149,999	928	6.30
Income $150,000 - $199,999	888	6.03
Income $200,000 - $499,999	553	3.75
Income $500,000 and more	109	0.74
2010 Est. Average Household Income	$81,332	
2010 Est. Median Household Income	$65,071	
2010 Est. Per Capita Income	$25,887	

Pop-Facts: Demographic Snapshot 2010 Report

Place, (see appendix for geographies), aggregate

Description	Total Place	%
2010 Median HH Inc by Single Race Class. or Ethn		
White Alone	57,933	
Black or African American Alone	50,466	
American Indian and Alaska Native Alone	60,417	
Asian Alone	73,339	
Native Hawaiian and Other Pacific Islander Alone	57,698	
Some Other Race Alone	73,877	
Two or More Races	61,999	
Hispanic or Latino	44,619	
Not Hispanic or Latino	66,688	
2010 Est. Family HH Type, Presence Own Children	10,921	
Married-Couple Family, own children	3,524	32.27
Married-Couple Family, no own children	4,280	39.19
Male Householder, own children	309	2.83
Male Householder, no own children	572	5.24
Female Householder, own children	1,008	9.23
Female Householder, no own children	1,228	11.24
2010 Est. Households by Household Size	14,735	
1-person household	3,078	20.89
2-person household	3,908	26.52
3-person household	2,610	17.71
4-person household	2,252	15.28
5-person household	1,340	9.09
6-person household	723	4.91
7 or more person household	824	5.59
2010 Est. Average Household Size	3.11	

Pop-Facts: Demographic Snapshot 2010 Report

Place, (see appendix for geographies), aggregate

Description	Total Place	%
2010 Est. Households by Presence of People	14,735	
Households with 1 or more People under Age 18:	5,877	39.88
Married-Couple Family	4,009	68.22
Other Family, Male Householder	472	8.03
Other Family, Female Householder	1,388	23.62
Nonfamily, Male Householder	3	0.05
Nonfamily, Female Householder	5	0.09
Households no People under Age 18:	8,858	60.12
Married-Couple Family	3,664	41.36
Other Family, Male Householder	378	4.27
Other Family, Female Householder	785	8.86
Nonfamily, Male Householder	1,890	21.34
Nonfamily, Female Householder	2,141	24.17
2010 Est. Households by Number of Vehicles	14,735	
No Vehicles	1,015	6.89
1 Vehicle	4,451	30.21
2 Vehicles	5,283	35.85
3 Vehicles	2,300	15.61
4 Vehicles	1,070	7.26
5 or more Vehicles	616	4.18
2010 Est. Average Number of Vehicles	2.03	
Family Households		
2015 Projection	11,589	
2010 Estimate	10,921	
2000 Census	9,312	
1990 Census	7,549	
Growth 2010-2015	6.12%	
Growth 2000-2010	17.28%	
Growth 1990-2000	23.35%	
2010 Est. Families by Poverty Status	10,921	
2010 Families at or Above Poverty	10,291	94.23
2010 Families at or Above Poverty with Children	5,416	49.59
2010 Families Below Poverty	630	5.77
2010 Families Below Poverty with Children	499	4.57

Pop-Facts: Demographic Snapshot 2010 Report

Place, (see appendix for geographies), aggregate

Description	Total Place	%
2010 Est. Pop Age 16+ by Employment Status	36,937	
In Armed Forces	150	0.41
Civilian - Employed	22,730	61.54
Civilian - Unemployed	1,221	3.31
Not in Labor Force	12,836	34.75
2010 Est. Civ Employed Pop 16+ Class of Worker	21,397	
For-Profit Private Workers	14,966	69.94
Non-Profit Private Workers	1,252	5.85
Local Government Workers	1,170	5.47
State Government Workers	2,324	10.86
Federal Government Workers	401	1.87
Self-Emp Workers	1,205	5.63
Unpaid Family Workers	79	0.37
2010 Est. Civ Employed Pop 16+ by Occupation	21,397	
Architect/Engineer	382	1.79
Arts/Entertain/Sports	324	1.51
Building Grounds Maint	1,888	8.82
Business/Financial Ops	498	2.33
Community/Soc Svcs	293	1.37
Computer/Mathematical	110	0.51
Construction/Extraction	1,519	7.10
Edu/Training/Library	1,016	4.75
Farm/Fish/Forestry	315	1.47
Food Prep/Serving	1,478	6.91
Health Practitioner/Tec	807	3.77
Healthcare Support	564	2.64
Maintenance Repair	1,085	5.07
Legal	186	0.87
Life/Phys/Soc Science	146	0.68
Management	1,355	6.33
Office/Admin Support	3,012	14.08
Production	826	3.86
Protective Svcs	807	3.77
Sales/Related	2,824	13.20
Personal Care/Svc	617	2.88
Transportation/Moving	1,345	6.29

Pop-Facts: Demographic Snapshot 2010 Report

Place, (see appendix for geographies), aggregate

Description	Total Place	%
2010 Est. Pop 16+ by Occupation Classification	21,397	
Blue Collar	4,775	22.32
White Collar	10,953	51.19
Service and Farm	5,669	26.49
2010 Est. Workers Age 16+, Transp. To Work	20,957	
Drove Alone	15,014	71.64
Car Pooled	3,830	18.28
Public Transportation	474	2.26
Walked	400	1.91
Bicycle	59	0.28
Other Means	464	2.21
Worked at Home	716	3.42
2010 Est. Workers Age 16+ by Travel Time to Work *		
Less than 15 Minutes	9,000	
15 - 29 Minutes	5,176	
30 - 44 Minutes	3,622	
45 - 59 Minutes	1,772	
60 or more Minutes	889	
2010 Est. Avg Travel Time to Work in Minutes	22.96	
2010 Est. Tenure of Occupied Housing Units	14,735	
Owner Occupied	9,000	61.08
Renter Occupied	5,735	38.92
2010 Owner Occ. HUs: Avg. Length of Residence	19	
2010 Renter Occ. HUs: Avg. Length of Residence	9	

Pop-Facts: Demographic Snapshot 2010 Report

Place, (see appendix for geographies), aggregate

Description	Total Place	%
2010 Est. All Owner-Occupied Housing Values	9,000	
Value Less than $20,000	1	0.01
Value $20,000 - $39,999	26	0.29
Value $40,000 - $59,999	74	0.82
Value $60,000 - $79,999	35	0.39
Value $80,000 - $99,999	38	0.42
Value $100,000 - $149,999	60	0.67
Value $150,000 - $199,999	214	2.38
Value $200,000 - $299,999	878	9.76
Value $300,000 - $399,999	1,430	15.89
Value $400,000 - $499,999	1,927	21.41
Value $500,000 - $749,999	3,104	34.49
Value $750,000 - $999,999	814	9.04
Value $1,000,000 or more	399	4.43
2010 Est. Median All Owner-Occupied Housing Value	$490,482	
2010 Est. Housing Units by Units in Structure	15,348	
1 Unit Attached	984	6.41
1 Unit Detached	10,542	68.69
2 Units	490	3.19
3 or 4 Units	545	3.55
5 to 19 Units	1,892	12.33
20 to 49 Units	468	3.05
50 or More Units	399	2.60
Mobile Home or Trailer	28	0.18
Boat, RV, Van, etc.	0	0.00
2010 Est. Housing Units by Year Structure Built	15,348	
Housing Unit Built 2000 or later	2,402	15.65
Housing Unit Built 1990 to 1999	3,146	20.50
Housing Unit Built 1980 to 1989	2,377	15.49
Housing Unit Built 1970 to 1979	2,586	16.85
Housing Unit Built 1960 to 1969	2,305	15.02
Housing Unit Built 1950 to 1959	1,367	8.91
Housing Unit Built 1940 to 1949	497	3.24
Housing Unit Built 1939 or Earlier	668	4.35
2010 Est. Median Year Structure Built **	1981	

*This row intentionally left blank. No total category data is available.

**1939 will appear when at least half of the Housing Units in this reports area were built in 1939 or earlier.

Pop-Facts: Demographic Snapshot 2010 Report

Appendix: Area Listing

Area Name:

Type: List - Place | Reporting Detail: Aggregate | Reporting Level: Place

Geography Code	Geography Name	Geography Code	Geography Name
1522700	Kahului CDP	1575510	Waihee-Waiehu CDP
1575950	Waikapu CDP	1577450	Wailuku CDP

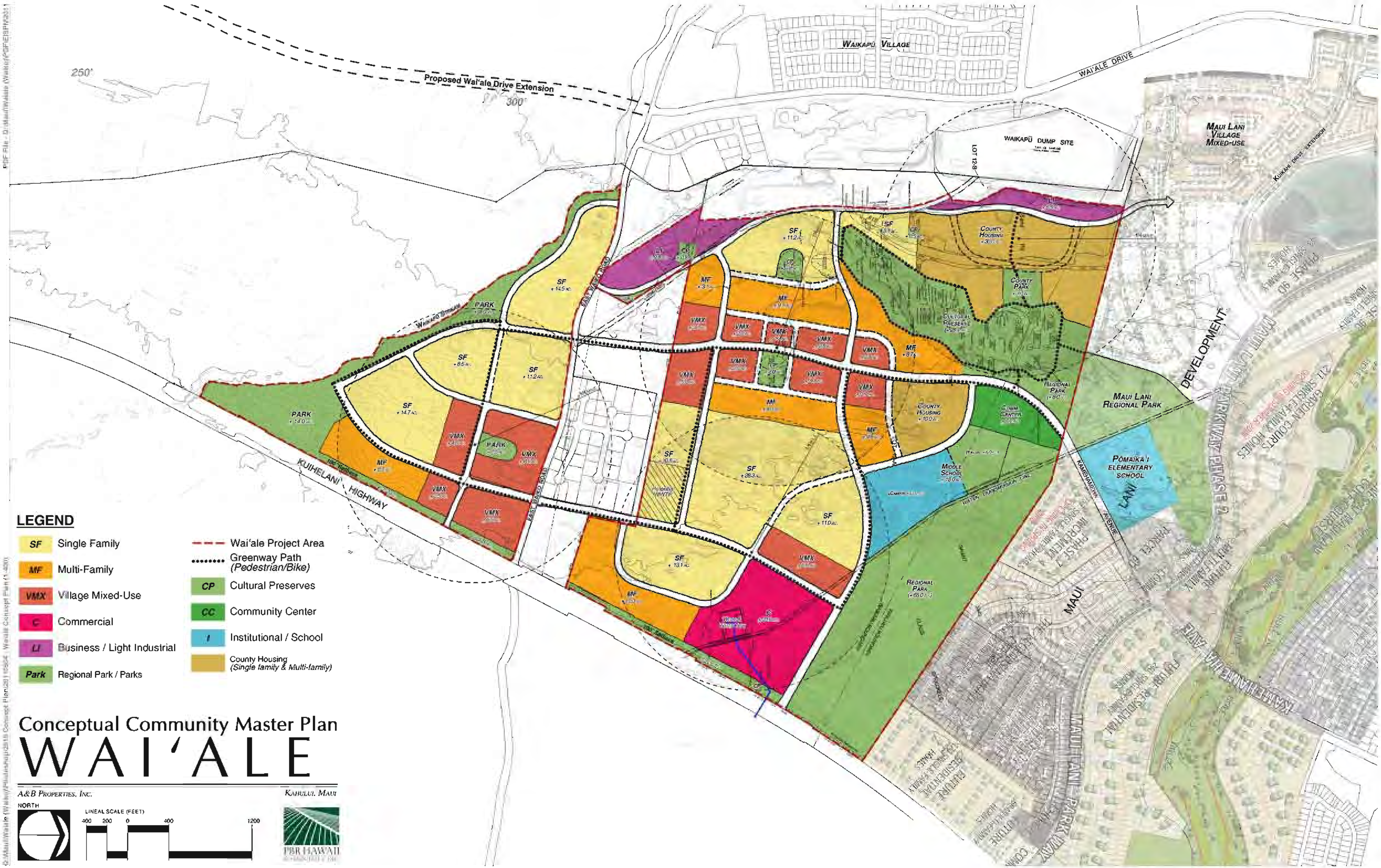
Project Information:

Site: 1

Order Number: 969114179

<u>*EXHIBIT B*</u>

Wai ʻale Conceptual Community Master Plan



Proposed Wai'ale Drive Extension
250'
300'
WAIKAPŪ VILLAGE
WAI'ALE DRIVE
WAIKAPŪ DUMP SITE
LOT 12-8
MAUI LANI VILLAGE MIXED-USE
KUIKAHI DRIVE EXTENSION
DEVELOPMENT
MAUI LANI REGIONAL PARK
PŌMAIKA'I ELEMENTARY SCHOOL
MAUI LANI PARKWAY PHASE 2
MAUI LANI PARKWAY
KAMEHAMEHA AVENUE
KUIHELANI HIGHWAY
MAUI
LANI
LEGEND
SF Single Family
MF Multi-Family
VMX Village Mixed-Use
C Commercial
LI Business / Light Industrial
Park Regional Park / Parks
Wai'ale Project Area
Greenway Path (Pedestrian/Bike)
CP Cultural Preserves
CC Community Center
I Institutional / School
County Housing (Single family & Multi-family)
Conceptual Community Master Plan
WAI'ALE
A&B PROPERTIES, INC.
KAHULUI, MAUI
NORTH
LINEAL SCALE (FEET)
400 200 0 400 1200
PBR HAWAII

ADDENDA

DEFINITIONS

The purpose of this Glossary is to assist the reader in understanding specific terminology used in this report.

Appraisal (noun) the act or process of developing an opinion of value; an opinion of value (adjective) of or pertaining to appraising and related functions such as appraisal practice or appraisal services.

Cash Equivalent A price expressed in terms of cash, as distinguished from a price expressed totally or partly in terms of the face amounts of notes or other securities that cannot be sold at their face amounts.

Counseling Providing competent, disinterested, and unbiased advice and guidance on diverse problems in the broad field of real estate; may involve any or all aspects of the business such as merchandising, leasing, management, acquisition/disposition planning, financing, development, cost-benefit studies, feasibility analysis, and similar services. Counseling services are often associated with evaluation, but they are beyond the scope of appraisal.

Discounting A procedure used to convert periodic incomes, cash flows, and reversions into present value; based on the assumption that benefits received in the future are worth less than the same benefits received now.

Extraordinary Assumption An assumption, directly related to a specific assignment, which, if found to be false, could alter the appraiser's opinions or conclusions. 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. An extraordinary assumption may be used in an assignment only if:

- It is required to properly develop credible opinions and conclusions;
- The appraiser has a reasonable basis for the extraordinary assumption;
- Use of the extraordinary assumption results in a credible analysis; and
- The appraiser complies with the disclosure requirements set forth in USPAP for extraordinary assumptions.

Fair Value The cash price that might reasonably be anticipated in a current sale under all conditions requisite to a fair sale. A fair sale means that buyer and seller are each acting prudently, knowledgeably, and under no necessity to buy or sell-, i.e., other than in a forced or liquidation sale. The appraiser should estimate the cash price that might be received upon exposure to the open market for a reasonable time, considering the property type and local market conditions. ***When a current sale is unlikely-i.e., when it is unlikely that the sale can be completed within 12 months-the appraiser must discount all cash flows generated by the property to obtain the estimate of fair value.*** These cash flows include, but are not limited to, those arising from ownership, development, operating, and sale of the property. The discount applied shall reflect the appraiser's judgment of what a prudent, knowledgeable purchase under o necessity to buy would be willing to pay to purchase the property in a current sale.

Fee Simple Estate Absolute ownership encumbered by any other interest or estate, subject only to the limitations imposed by the governmental powers of taxation, eminent domain, police power, and escheat.

Hawaiian Terms The Hawaiian words "mauka" and "makai" are commonly used in the islands as indicators of direction. The word "mauka" means toward the mountain, and "makai" means toward the ocean.

Highest and Best Use The reasonably probable and legal use of vacant land or an improved property, which is physically possible, appropriately supported, financially feasible, and that results in the highest value. The four criteria the highest and best use must meet are legal permissibility, physical possibility, financial feasibility, and maximum profitability.

Highest and Best Use of Land or a Site as Though Vacant Among all reasonable, alternative uses, the use that yields the highest present land value, after payments are made for labor, capital, and coordination. The use of a property based on the assumption that the parcel of land is vacant or can be made vacant by demolishing any improvements.

Highest and Best Use of Property as Improved The use that should be made of a property as it exists. An existing improvement should be renovated or retained as is so long as it continues to contribute to the total market value of the property, or until the return from a new improvement would more than offset the cost of demolishing the existing building and constructing a new one.

Hypothetical Condition That which is contrary to what exists, but is supposed for the purpose of analysis. Hypothetical conditions assume conditions 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. A hypothetical condition may be used in an assignment only if:

- Use of the hypothetical condition is clearly required for legal purposes, for purposes of reasonable analysis, or for purposes of comparison;
- Use of the hypothetical condition results in a credible analysis; and
- The appraiser complies with the disclosure requirements set forth in USPAP for hypothetical conditions

Leased Fee Interest An ownership interest held by a landlord with the rights of use and occupancy conveyed by lease to others. The rights of the lessor (the leased fee owner) and the lessee are specified by contract terms contained within the lease.

Leasehold Interest The interest held by the lessee (the tenant or renter) through a lease transferring the rights of use and occupancy for a stated term under certain conditions.

Market Rent The most probable rent that a property should bring in a competitive and open market reflecting all conditions and restrictions of the specified lease agreement including term, rental adjustment and revaluation, permitted uses, use restrictions, and expense obligations; the lessee and lessor each acting prudently and knowledgeably, and assuming consummation of a lease contract as of a specified date and the passing of the leasehold from lessor to lessee under conditions whereby:

- Lessee and lessor 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.
- The rent payment is made in terms of cash in United States dollars, and is expressed as an amount per time period consistent with the payment schedule of the lease contract.
- The rental amount represents the normal consideration for the property leased unaffected by special fees or concessions granted by anyone associated with the transaction.

Market Value

The major focus of most real property appraisal assignments. Both economic and legal definitions of market value have been developed and refined. Continual refinement is essential to the growth of the appraisal profession.

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 reasonable exposure in a competitive market under all conditions requisite to a fair sale, with the buyer and seller each acting prudently, knowledgeably, and for self-interest, and assuming that neither is under undue duress."

Market value is 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."

The following definition of market value is used by agencies that regulate federally insured financial institutions in the United States:

"The most probable price which a property should bring in a competitive and open market under all conditions requisite to a fair sale, the buyer and 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.

Prospective Market Value Upon Completion of Construction

The prospective future value of a property on the date that construction is completed, based upon market conditions forecast to exist as of the completion date.

Prospective Value Opinion

A forecast of the value expected at a specified future date. A prospective value opinion is most frequently sought in connection with real estate projects that are proposed, under construction, or under conversion to a new use, or those that have not achieved sellout or a stabilized level of long-term occupancy at the time the appraisal report is written.

Report

Any communication, written or oral, of an appraisal, appraisal review, or appraisal consulting service that is transmitted to the client upon completion of an assignment. The types of written reports listed below apply to real property appraisals:

> <u>Self-Contained Appraisal Report</u>: A written appraisal report prepared under Standards Rule 2-2(a) of the Uniform Standards of Professional Appraisal Practice. A self-contained appraisal report sets forth the data considered, the appraisal procedures followed, and the reasoning employed in the appraisal, addressing each item in the depth and detail required by its significance to the appraisal and providing sufficient information so that the client and the users of the report will understand the appraisal and not be misled or confused.

> <u>Summary Appraisal Report</u>: A written report prepared under Standards Rule 2-2(b) or 8-2(b). A summary appraisal report contains a summary of all information significant to the solution of the appraisal problem. The essential difference between a self-contained appraisal report and a summary appraisal report is the level of detail of presentation.

> <u>Restricted Appraisal Report</u>: A written report prepared under Standards Rule 2-2(c), 8-2(c), or 10-2(b). A restricted use appraisal report is for client use only. The restricted use appraisal report should contain a brief statement of information significant to the solution of the appraisal problem.

Uniform Standards of Professional Appraisal Practice

Current standards of the appraisal profession, developed for appraisers and the users of appraisal services by the Appraisal Standards Board of The Appraisal Foundation. The Uniform Standards set forth the procedures to be followed in developing an appraisal, analysis, or opinion and the manner in which an appraisal, analysis, or opinion is communicated. They are endorsed by the Appraisal Institute and by other professional appraisal organizations.

LIMITING AND CONTINGENT CONDITIONS
ACM Consultants, Inc.

1. The property is appraised as though free and clear of any or all liens and encumbrances unless otherwise stated in this report. The Consultant will not be responsible for matters of a legal nature that affect either the property being appraised or the title to it. The Consultant assumes that the title is good and marketable, and therefore, will not render any opinions about the title.

2. Legal descriptions referenced in the report were obtained from public documents from the State of Hawaii, Bureau of Conveyances, or were furnished by the client, and were assumed to be correct.

3. It is assumed that all applicable zoning and use regulations and restrictions have been complied with, unless a nonconformity has been stated, defined, and considered in this appraisal report.

4. It is assumed that all required licenses, certificates of occupancy or other legislative or administrative authority from any local, state, or national governmental or private entity or organization have been or can be obtained or renewed for any use on which the value estimates contained in this report are based.

5. It is assumed that the utilization of the land and improvements is within the boundaries or property lines of the property described and that there is no encroachment or trespass unless otherwise stated in this report. Responsible ownership and competent property management are assumed unless otherwise stated in this report.

6. The Consultant has inspected as far as possible, by observation, the land and the improvements; however, it was not possible to personally observe conditions beneath the soil or hidden structurally or by other components. The appraisal assumes that there are no hidden, unapparent, or apparent conditions of the property site, subsoil, or structures or toxic material which would render it more or less valuable. The Consultant and firm have no responsibility for any such conditions or for any expertise or engineering to discover them. All mechanical components are assumed to be in operable condition and status standard for properties of the subject type. Conditions of heating, cooling, ventilation, electrical and plumbing equipment is considered to be commensurate with the conditions of the balance of the improvements unless otherwise stated. No judgment may be made by us as to adequacy of insulation, type of insulation, or energy efficiency of the improvements or equipment, and no representations are made herein as to these matters unless specifically stated and considered in the report.

7. Information provided by third parties including government agencies, financial institutions, realtors, buyers, sellers, property owners and others and contained in this report were obtained from sources considered reliable and believed to be true and correct. However, no warranty is assumed for possible misinformation.

8. All engineering is assumed to be correct. Any plot plans and illustrative material in this report are included only to assist the reader in visualizing the property. Any sketch in this report may show approximate dimensions and is included to assist the reader in visualizing the property. Maps and exhibits found in this report are provided for reader reference purposes only. No guarantee as to accuracy is expressed or implied unless otherwise stated in this report. No survey has been made for the purpose of this report.

9. The Consultant is not qualified to detect hazardous waste and/or toxic materials. Any comment by the Consultant that might suggest the possibility of the presence of such substances should not be taken as confirmation of the presence of hazardous waste and/or toxic materials. Such determination would require investigation by a qualified expert in the field of environmental assessment. The presence of substances such as asbestos, urea-formaldehyde foam insulation, or other potentially hazardous materials may affect the value of the property. The Consultant's value estimate is predicated on the assumption that there is no such material on or in the property that would cause a loss in value unless otherwise stated in this report. No responsibility is assumed for any environmental conditions, or for any expertise or engineering knowledge required to discover them. The Consultant's descriptions and resulting comments are the result of the routine observations made during the appraisal process.

10. If analysis contained in this appraisal involves partial interests in real estate, the value of the fractional interest plus the value of all other fractional interests may or may not equal the value of the entire fee simple estate considered as a whole.

11. Unless otherwise stated in this report, the subject property is appraised without a specific compliance survey having been conducted to determine if the property is or is not in conformance with the requirements of the Americans with Disabilities Act. The presence of architectural and communications barriers that are structural in nature that would restrict access by disabled individuals may adversely affect the property's value, marketability, or utility.

12. Possession of this report, or a copy thereof, does not carry with it the right of publication. It may not be used for any purposed by any person other than the party to whom it is addressed without the written consent of the Consultant, and in any event, only with proper written qualification and only in its entirety.

13. The Consultant(s) or those assisting in preparation of the report will not be asked or required to give testimony in court or hearing because of having made the appraisal, in full or in part, nor engage in post appraisal consultation with client or third parties except under separate and special arrangement and at additional fee. If testimony or deposition is required because of subpoena, the client shall be responsible for any additional time, fees, and charges regardless of issuing party.

14. Neither all nor any part of the contents of this report (especially any conclusions as to value, the identity of the Consultant, or the firm with which the Consultant is connected) shall be disseminated to the public through advertising, public relations, news sales, or other media without prior written consent and approval of the Consultant.

ACCEPTANCE OF, AND/OR USE OF THIS APPRAISAL REPORT BY CLIENT OR ANY THIRD PARTY CONSTITUTES ACCEPTANCE OF THE ACM CONSULTANTS, INC., CERTIFICATION, LIMITING AND CONTINGENT CONDITIONS. CONSULTANT LIABILITY EXTENDS ONLY TO STATED CLIENT, NOT SUBSEQUENT PARTIES OR USERS OF ANY TYPE, and the total liability of Consultant(s) and firm is limited to the amount of fee received by Consultant.

PROFESSIONAL QUALIFICATIONS

Glenn K. Kunihisa, MAI, CRE

STATE LICENSING

State Certified General Appraiser,
State of Hawaii, License No. CGA 39, July 17, 1991
Expiration: December 31, 2011

PROFESSIONAL AFFILIATIONS

Member, Appraisal Institute, MAI Designation, Hawaii Chapter No. 67
Member, The Counselors of Real Estate, CRE Designation, Hawaii Chapter
Member, International Right of Way Association
Member, National Association of Realtors, Maui Board of Realtors

PROFESSIONAL INVOLVEMENT

Past President – Hawaii Chapter of the Appraisal Institute – 2009
Vice Chairperson – Hawaii Chapter of The Counselors of Real Estate - 2010
Education Chairperson – Hawaii Chapter of the Appraisal Institute – 2004 and 2005
Former Multiple Listing Service (MLS) Committee Member – Realtors Association of Maui

COMMUNITY AFFILIATIONS

St. Anthony Parish School Board
Board Member 1995 to 2008
Board President 1997 and 1998
Alii Community Care, Inc. – A non-profit health care corporation
Board Member 2004 to 2006

EMPLOYMENT

President
ACM Consultants, Inc.
May, 1997 to present

Previously associated with the following:
ACM, Real Estate Appraisers, Inc. - 1986 to 1997
A&B Commercial Company; a division of Alexander & Baldwin, Inc. - 1979 to 1985
Bank of Hawaii - 1976 to 1979

GENERAL EDUCATION

University of Hawaii at Manoa
Master of Business Administration (MBA) - Executive MBA Program V, 1988
Bachelor of Business Administration (BBA), 1976
Iolani School, 1971

LEGAL & CONSULTING

Qualified as an expert witness in the Second Circuit Court of the State of Hawaii
Qualified as an expert in testimony to the State Land Use Commission
Experienced in real estate arbitration assignments in the State of Hawaii

APPRAISAL EDUCATION

Appraisal Institute

Seminar *Appraisal Curriculum Overview (2-day general)*
Honolulu, Hawaii – July 2010

Seminar	*Online Valuation of Green Residential Properties*	
	Chicago, Illinois – July 2010	
Seminar	*Hotel Valuation*	
	Honolulu, Hawaii – February 2010	
Seminar	*Online Small Hotel/Motel Valuation*	
	Chicago, Illinois – November 2009	
Seminar	*Business Practices and Ethics*	
	Honolulu, Hawaii – September 2009	
Seminar	*Hawaii Lands, Historical Review*	
	Lihue, Hawaii – August 2009	
Seminar	*Appraisal Challenges: Declining Markets and Sales Concessions*	
	Cambria, California – October 2008	
Course	*7-Hour National USPAP Update Course*	
	Honolulu, Hawaii – September 2008	
Course	*Online 7-Hour National USPAP Equivalent Course*	
	Chicago, Illinois – October 2007	
Course	*Valuation of Conservation Easements*	
	Denver, Colorado – October 2007	
Seminar	*Uniform Standards for Federal Land Acquisitions ("Yellow Book") Practical Applications for Fee Appraisers*	
	Honolulu, Hawaii – December 2006	
Seminar	*California Conservation Easements*	
	Sacramento, California – November 2005	
Course 400	*7-Hour National USPAP Update Course*	
	Honolulu, Hawaii – October 2005	
Seminar	*Case Studies in Limited Partnership and Partial Interest Valuation*	
	Honolulu, Hawaii – May 2005	
Seminar	*Appraisal Consulting: A Solutions Approach for Professionals*	
	Honolulu, Hawaii – February 2005	
Seminar	*Real Estate Finance, Value and Investment Performance*	
	Honolulu, Hawaii – February 2005	
Seminar	*Fannie Mae Residential Presentation*	
	Honolulu, Hawaii - July 2004	
Seminar	*Subdivision Analysis*	
	Chicago, Illinois - August 2003	
Seminar	*Supporting Capitalization Rates*	
	Chicago, Illinois - August 2003	
Seminar	*The Technology Assisted Appraiser*	
	Chicago, Illinois - August 2003	
Seminar	*Scope of Work: Expanding Your Range of Services*	
	Chicago, Illinois - August 2003	
Course 400	*National Uniform Standards of Professional Practice*	
	Honolulu, Hawaii - May 2003	
Course 420	*Business Practices and Ethics*	
	Honolulu, Hawaii - May 2003	
Seminar	*The Private Conservation Market*	
	Honolulu, Hawaii - July 2002	
Seminar	*Finance Reporting Valuations Parts I and II*	
	Honolulu, Hawaii - July 2002	
Seminar	*Future of Appraisal Profession from a Global Perspective*	
	Honolulu, Hawaii - July 2002	

Seminar	*Appraisal Office Management*	
		Honolulu, Hawaii - July 2002
Course 540	*Report Writing*	
		Denver, Colorado - December 2000
Seminar	*Partial Interests: Theory and Case Law*	
		Las Vegas, Nevada - July 2000
Seminar	*Easement Valuation*	
		Las Vegas, Nevada - July 2000
Seminar	*Bridging the Gap: Marketability Discounts for Real Estate Interests*	
		Las Vegas, Nevada - July 2000
Course 430	*Standards of Professional Practice, Part C*	
		Honolulu, Hawaii - September 1999
Seminar	*Litigation Skills for the Appraiser: An Overview*	
		Honolulu, Hawaii - May 1998
Seminar	*Special Purpose Properties*	
		Honolulu, Hawaii - September 1997
Seminar	*Highest and Best Use Applications*	
		Honolulu, Hawaii - September 1997
Seminar	*Detrimental Conditions*	
		Honolulu, Hawaii - July 1997
Seminar	*The Appraiser As Expert Witness*	
		Honolulu, Hawaii - August, 1995
Seminar	*How to Appraise FHA-Insured Property*	
		Los Angeles, California - January, 1995
Seminar	*Understanding Limited Appraisals and Reporting Options*	
		Honolulu, Hawaii - August, 1994
Seminar	*Valuation of Leasehold Interests*	
		Honolulu, Hawaii - May, 1993
Seminar	*Valuation of Leased Fee Interests*	
		Honolulu, Hawaii - May, 1993
Seminar	*Valuation Considerations: Appraising Non-Profits*	
		Boston, Massachusetts - July, 1992
Seminar	*Americans With Disabilities Act*	
		Boston, Massachusetts - July, 1992
Seminar	*Valuation in Today's Capital and Financing Markets*	
		Honolulu, Hawaii - June 1992
Seminar	*Arbitration Principles, Procedures and Pitfalls*	
		Honolulu, Hawaii - June, 1992
Seminar	*Institutional Real Estate in the 1990's*	
		Honolulu, Hawaii - June, 1992
Seminar	*FIRREA and its Impact on Appraisers*	
		Honolulu, Hawaii - June, 1992
Course 410/420	*Standards of Professional Practice, Parts A & B*	
		Honolulu, Hawaii - April, 1991

<u>The American Society of Farm Managers and Rural Appraisers, Inc.</u>

Seminar	*Agricultural Lease Valuation*	
		Honolulu, Hawaii – March 2006

<u>Maui Coastal Land Trust</u>

Seminar — *Understanding the New Tax Incentives: Conservation Easements & Other Charitable Contributions*
Wailuku, Hawaii – June 2007

<u>Society of Real Estate Appraisers</u>

Course 101 — *Introduction to Appraising Real Property*
Dallas, Texas – 1987

Course 102 — *Applied Residential Property Valuation*
Honolulu, Hawaii - July 1990

Course 201 — *Principles of Income Property Appraising*
Chicago, Illinois, 1987

Course 202 — *Applied Income Property Valuation*
San Diego, California - 1988

Seminar — *Professional Practice and the Society of Real Estate Appraisers*
Honolulu, Hawaii - 1988

Seminar — *Appraisal Standards Seminar - Federal Home Loan Bank Board Guidelines, Regulations and Policies*
Honolulu, Hawaii - April, 1988

Seminar — *Appraisal Standards Seminar - Federal Home Loan Bank Board Guidelines, Regulations and Policies*
Honolulu, Hawaii - April, 1988

<u>American Institute of Real Estate Appraisers</u>

Seminar — *Rates, Ratios and Reasonableness*
Honolulu, Hawaii - 1989

Seminar — *Discounted Cash Flow Analysis*
Honolulu, Hawaii - 1989

Seminar — *Highest and Best Use*
Honolulu, Hawaii - 1989

Seminar — *Capitalization Overview - Part A*
Honolulu, Hawaii - 1990

Seminar — *Capitalization Overview - Part B*
Honolulu, Hawaii – 1990

Seminar — *Accrued Depreciation*
Honolulu, Hawaii - 1990

<u>International Right of Way Association</u>

Course 101 — *Appraisal*
Las Vegas, Nevada - October, 1998

Course 101 — *Negotiation*
Las Vegas, Nevada - October 1998

<u>National Business Institute, Inc.</u>

Seminar — *Commercial Real Estate Leasing In Hawaii*
Honolulu, Hawaii - 1989

<u>American Arbitration Association</u>

Seminar — *Real Estate Dispute Resolution - Mediation and Arbitration*
Kahului, Maui, Hawaii - October, 1990

PROFESSIONAL QUALIFICATIONS

Shane M. Fukuda

STATE LICENSING

State Certified General Appraiser
State of Hawaii, License No. CGA-810, July 1, 2007
Expiration: December 31, 2011

PROFESSIONAL AFFILIATIONS

General Associate Member - Appraisal Institute

EMPLOYMENT

ACM Consultants, Inc.
November 2009 to Present
Vice President – Commercial Division
July 2007 to October 2009
Staff Appraiser
October 2004 to June 2007
Appraiser Assistant; Appraiser Trainee

Previously associated with the following:

Dollar Thrifty Automotive Group, Inc.
1994 to 2004
Rental Agent; Lead Rental Agent; Station Manager; Senior Station Manager

GENERAL EDUCATION

Maui Community College, 1989-1990
Henry Perrine Baldwin High School, 1989

APPRAISAL EDUCATION

Appraisal Institute

Seminar	*Hotel Valuation* Honolulu, Hawaii – February 2010
Seminar	*Online Subdivision Valuation* Chicago, Illinois – December 2009
Course	*Online Business Practices and Ethics* Chicago, Illinois – December 2009
Seminar	*Online Small Hotel/Motel Valuation* Chicago, Illinois – December 2009
Course	*Online 7 Hour National USPAP Equivalent* Chicago, Illinois – 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

MISCELLANEOUS EDUCATION

REALM Business Solutions

Course	*Argus 12.0* Honolulu, Hawaii – July 2005

Appendix P: Assessment of Economic and Fiscal Impacts

PREPARED FOR: A&B PROPERTIES, INC.
822 Bishop Street
Honolulu, Hawaii 96813

EFFECTIVE DATE: September 15, 2010

ASSESSMENT OF ECONOMIC AND FISCAL IMPACTS, WAIʻALE MASTER PLAN DEVELOPMENT, KAHULUI, ISLAND OF MAUI, HAWAII

ACM CONSULTANTS, INC.

September 30, 2010 10-9067B

Mr. Daniel Yasui
A&B PROPERTIES, INC.
822 Bishop Street
Honolulu, Hawaii 96813

Re: An Assessment of Economic and Fiscal Impacts for the proposed Wai'ale Master Plan Development in Wailuku, Island and County of Maui

Dear Mr. Yasui:

In accordance with your request, we have analyzed the proposed Wai'ale Master Plan Development (Wai'ale) in Kahului, District of Wailuku, Island and County of Maui, in order to provide a study of its potential economic and fiscal impacts. This *counseling report*, and the conclusions herein, is based on the on-site inspection of the property, a study of current political and economic conditions, and a historical review of the real estate market in the Central Maui region.

The subject consists of approximately 545 acres of land and is currently zoned State Agricultural District. Wai'ale, which is still in its preliminary planning stage, will be located to the west of Kuihelani Highway. Preliminary plans call for areas of single-family residential, multi-family residential, village mixed-use, commercial, business/light industrial, park, cultural preserve, as well as a regional park, a community center, an intermediate school site with associated recreational fields, greenway paths and roads.

The focus of this assignment essentially has three parts: (1) to define and delineate the subject and its market area; (2) to identify and analyze potential economic impacts with regard to the project; and (3) identify and analyze potential fiscal impacts with regard to the project.

The following report presents a narrative review of the assessment and our analysis of data along with other pertinent materials on which this report is predicated. It contains data and exhibits gathered in our investigations, and will include a description of the analytical process and our conclusions, as of September 15, 2010.

Thank you for allowing us the opportunity to work on this interesting assignment.

Respectfully submitted,
ACM Consultants, Inc.

Glenn K. Kunihisa, MAI, CRE
Certified General Appraiser,
State of Hawaii, CGA-039
Expiration: December 31, 2011

Shane M. Fukuda
Certified General Appraiser,
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Expiration: December 31, 2011

TABLE OF CONTENTS

PART I – INTRODUCTION

A. EXECUTIVE SUMMARY

Background

The proposed Wai'ale Master Plan Development is located on the western side of Kuihelani Highway in the District of Kahului, Island and County of Maui. The subject will consist of approximately 545 acres of land and is currently zoned State Agricultural District. The project is still in its preliminary planning stage, but its location is assumed to primarily possess mountain views. According to a Conceptual Community Master Plan Map, prepared by PBR Hawaii, the land use allocations are:

Land Use	Approximate Land Areas
Single-Family Residential (SF)	128.1 Acres
Multi-Family Residential (MF)	53.7 Acres
Village Mixed Use (VMX)	52.9 Acres
Commercial (C)	23 Acres
Business/Light Industrial (LI)	16.3 Acres
Regional Park/Cultural Preserve (Park)	101.4 Acres
Park, Buffers, Preserves	37.7 Acres
Community Center (CC)	7 Acres
Institutional/School (I)	18 Acres
County Housing	40 Acres
County Park	3 Acres
Roads/Greenway Paths	63.9 Acres

Study Objectives

ACM Consultants, Inc. has been retained by A&B Properties, Inc. to assess the potential economic and fiscal impacts related to this proposed project. In particular, we studied economic trends and demographics, in addition to supply and demand factors for residential property, which includes single-family house lots and residences.

The objectives of the economic and fiscal impact assessment were as follows: (1) to define and delineate the subject and its market area; (2) to identify and analyze potential economic impacts with regard to the project; and (3) identify and analyze potential fiscal impacts with regard to the project.

Conclusion

The development of this project will generate significant expenditures by the developer of this subdivision, in addition to the eventual homeowners. These investments are expected to favorably impact the Maui economy on a broad scale, and in a multitude of ways.

- ❑ Site work and infrastructure construction for this subdivision will immediately infuse capital into the Maui economy. Numerous consultants will be involved in the initial planning stages, and the construction trades will benefit from the job creation of this project.

- Advertising for the project and marketing of the units will benefit graphic artists, advertising companies, newspapers, real estate sales agents, escrow companies, etc.

- Individual site development will again result in additional work for engineers, architects, material suppliers, equipment rentals and sales, landscaping companies, and other related industries.

- The new housing units will have an indirect affect on retail businesses, restaurants and service establishments as the expanded work force purchases goods and services. This should pass through the entire community, causing a ripple effect and increase the amount of capital flowing through Maui.

- Upkeep of the residential, commercial and light industrial buildings will also translate into work for maintenance companies, painting companies, real estate management and leasing groups, etc.

- Fiscal benefits of this development will include increases in real estate taxes and various fees collected by the County of Maui, as well as additional conveyance tax, income tax and general excise tax inflow for the State of Hawaii.

SUMMARY OF ECONOMIC IMPACTS

From Development Activities

Total Construction Expenditures	$732,413,000
Total Indirect Sales	$921,375,000
Total Employment	7,500 jobs
Total Payroll	$352,443,000
Total Residents Supported	16,100 residents
Total Households Supported	5,500 units
Total Excise Tax	$47,209,000

At Full Build-Out

Annual Taxable Property Values	$278,036,000
Annual Property Tax Revenue	$1,101,000
In-Migrant Residents	338 residents
Annual In-Migrant Resident County Expenditures	$(908,000)
Annual In-Migrant Resident General Excise Tax	$226,000
Annual In-Migrant Resident State Expenditures	$(2,294,000)

SUMMARY OF FISCAL IMPACTS, COUNTY OF MAUI

Net Annual Revenues at Full Build-Out	$192,000

SUMMARY OF FISCAL IMPACTS, STATE OF HAWAII

Cumulative Net Revenues from Development	$47,209,000
Net Annual Revenues at Full Build-Out	$(2,067,000)

B. PURPOSE OF THE REPORT

The purpose of this report, as of September 15, 2010, is to generate an economic and fiscal impact assessment with respect to the proposed Wai‘ale Master Plan Development.

C. INTENDED USE OF THE REPORT

The intended use or function of this report is to provide potential economic and fiscal information and real estate market data to our client to be used in the entitlement process for the Wai‘ale Master Plan Development.

D. SCOPE OF THE REPORT

The Consultant has agreed to provide a current economic and fiscal impact assessment of this project by (1) defining and delineating the market area; (2) identifying and analyzing potential economic impacts with regard to the project; and (3) identifying and analyzing potential fiscal impacts with regard to the project. The assessment will be developed and prepared in conformity with, and subject to, the requirements of the Code of Professional Ethics and the Standards of Appraisal Practice of the Appraisal Institute, and the Uniform Standards of Professional Appraisal Practice.

E. STATEMENT OF COMPETENCY

ACM Consultants, Inc. (formerly ACM Real Estate Appraisers, Inc.) has been actively involved in the real estate appraisal and consulting business since 1982. Our business emphasis has focused mainly on the research, consultation and valuation of residential and commercial properties located within the State of Hawaii. The company considers itself competent to conduct an economic and fiscal impact assessment for a proposed master plan development in Kahului, Island and County of Maui.

F. EXTRAORDINARY ASSUMPTIONS AND HYPOTHETICAL CONDITIONS

As of September 2010, the subject was still in the preliminary stages of planning. A land use map from the Developer provided a visual indication of the proposed layout of the project district. Several discussions were held with the Developer to better understand the housing products and complementary land uses planned for the subject. The Consultant is not liable for any changes in the project plan past this date, nor for information that has not been released or communicated to the Consultant.

The Consultant has no control over economic conditions and other international events that could have an affect upon Hawaii's economy and the Maui real estate market. As a result, this report has not made any assumptions regarding potential conflicts with other nations, or global external factors affecting economic conditions here.

Estimated construction costs, multipliers, tax rates, interest rates, earnings estimates, demographic information and per capita government expenditures were utilized by the Consultant in determining the economic and fiscal impacts of this proposed residential subdivision. These figures and statistics were obtained through conversations with those active in the construction industry, in addition to the review of various construction budgets, demographic and governmental reports. This consulting report has been based on the assumption that all information gleaned from third party sources is accurate for analytical purposes.

All conclusions in this counseling report have been stated in 2010 dollars, rounded to the nearest $1,000. In doing so, the Consultant has assumed that all construction costs, multipliers, tax rates, interest rates, earnings estimates, demographic information and per capita government expenditures will remain constant throughout the build-out period. Although the cyclical nature of the real estate market would undoubtedly produce varied annual assessments and impacts, for the purposes of this report, they have been reported as unweighted averages. Furthermore, total category impacts may not equate to the sum of the respective sub-categories due to rounding.

The counseling report is also subject to standard "Limiting and Contingent Conditions" located in the pages following.

G. CONFIDENTIALITY PROVISION

The contents of this economic and fiscal impact assessment are confidential. Release of this counseling report by ACM Consultants, Inc. is limited to you and for your preparation and submission of an Environmental Impact Statement for the proposed Wai'ale Master Plan Development. The intended users of this report include A&B Properties, Inc. and the appropriate government agencies to which this report will be submitted. Any further release of this report, or portions herein, is strictly prohibited and you shall accept the risk and liability for any such release without the previous written consent of ACM Consultants, Inc. Further, you shall indemnify and defend ACM Consultants, Inc., and its individual consultants/appraisers, from any claims arising out of any such unauthorized disclosure.

H. CERTIFICATION

The undersigned does hereby certify that except as otherwise noted in this appraisal report:

1. The Consultants' compensation is not contingent upon the reporting of a predetermined value or direction in value that favors the cause of the client, the amount of the value estimate, the attainment of a stipulated result, or the occurrence of a subsequent event.

2. The Consultants have no present or prospective interest in the property that is the subject of this report, and no personal interest or bias with respect to the parties involved. Any "Estimate(s) of Market Value" in the consulting report is not based in whole or in part upon the race, color, or national origin of the prospective owners or occupants of the properties in the vicinity of the property appraised.

3. The Consultants have personally inspected the property, and are signatories of this Certification.

4. To the best of the Consultants' knowledge and belief, all statements of fact and information in this report are true and correct, and the Consultants have not knowingly withheld any significant information.

5. No other person provided significant professional assistance to the person(s) signing this report.

6. The reported analyses, opinions and conclusions are limited only by the reported assumptions and limiting conditions, and are the Consultants' personal unbiased professional analyses, opinions and conclusions.

7. All analyses, opinions and conclusions were developed, and this report has been prepared, in conformity with the Uniform Standards of Appraisal Practice.

8. This counseling report is subject to and in conformance with the Code of Professional Ethics and Standards of Professional Conduct of the Appraisal Institute. The analyses, opinions and conclusions of this counseling report have been made in conformity with, and is subject to, the requirements of Title XI of the Federal Financial Institutions Reform, Recovery, and Enforcement Act of 1989.

9. This counseling report is to be used only in its entirety and no part is to be used without the whole report. All conclusions and opinions concerning the real estate are set forth in the counseling report were prepared by the Consultants whose signatures appears on the counseling report. No change of any item in the counseling report shall be made by anyone other than the Consultants, and the Consultants shall have no responsibility for any such unauthorized change.

10. The Appraisal Institute, of which the Consultants are members, has a legal right to review this report.

11. The qualifications of the Consultants, including completed educational requirements of their candidacy are located in the Addendum to this report. Any member signing the report has completed the requirements of the Appraisal Institute's continuing education program.

ACM Consultants, Inc.

Glenn K. Kunihisa, MAI, CRE
Certified General Appraiser,
State of Hawaii, CGA-039
Expiration: December 31, 2011

Shane M. Fukuda
Shane M. Fukuda
Certified General Appraiser,
State of Hawaii, CGA-810
Expiration: December 31, 2011

I. LIMITING AND CONTINGENT CONDITIONS

1) This is a Counseling Report which is intended to comply with the reporting requirements set forth under Standards Rule 5 of the Uniform Standards of Professional Appraisal Practice for a Counseling Report. The information contained in this report is specific to the needs of the client and for the intended use stated in this report. The Consultant is not responsible for unauthorized use of this report.

   This report has <u>not</u> been prepared for federally-related mortgage financing purposes, and has <u>not</u> been prepared in compliance with the requirements of Title XI of the Federal Financial Institutions Reform, Recovery, and Enforcement Act of 1989.

2) No responsibility is assumed for legal or title considerations. Title to the property is assumed to be good and marketable unless otherwise stated in this report.

3) The property analyzed is free and clear of any or all liens and encumbrances unless otherwise stated in this report.

4) Responsible ownership and competent property management are assumed unless otherwise stated in this report.

5) The information furnished by others is believed to be reliable. However, no warranty is given for its accuracy.

6) All engineering is assumed to be correct. Any plot plans and illustrative material in this report are included only to assist the reader in visualizing the property.

7) It is assumed that there are no hidden or unapparent conditions of the property, subsoil, or structures that render it more or less valuable. No responsibility is assumed for such conditions or for arranging for engineering studies that may be required to discover them.

8) It is assumed that there is full compliance with all applicable federal, state, and local environmental regulations and laws unless otherwise stated in this report.

9) It is assumed that all applicable zoning and use regulations and restrictions have been complied with, unless a nonconformity has been stated, defined, and considered in this counseling report.

10) It is assumed that all required licenses, certificates of occupancy or other legislative or administrative authority from any local, state, or national governmental or private entity or organization have been or can be obtained or renewed for any use on which the value estimates contained in this report are based.

11) Any sketch in this report may show approximate dimensions and is included to assist the reader in visualizing the property. Maps and exhibits found in this report are provided for reader reference purposes only. No guarantee as to accuracy is expressed or implied unless otherwise stated in this report. No survey has been made for the purpose of this report.

12) It is assumed that the utilization of the land and improvements is within the boundaries or property lines of the property described and that there is no encroachment or trespass unless otherwise stated in this report.

13) The Consultant is not qualified to detect hazardous waste and/or toxic materials. Any comment by the Consultant that might suggest the possibility of the presence of such substances should not be taken as confirmation of the presence of hazardous waste and/or toxic materials. Such determination would require investigation by a qualified expert in the field of environmental assessment. The presence of substances such as asbestos, urea-formaldehyde foam insulation, or other potentially hazardous materials may affect the value of the property. The Consultant's value estimate is predicated on the assumption that there is no such material on or in the property that would cause a loss in value unless otherwise stated in this report. No responsibility is assumed for any environmental conditions, or for any expertise or engineering knowledge required to discover them. The Consultant's descriptions and resulting comments are the result of the routine observations made during the analysis process.

14) Unless otherwise stated in this report, the subject property is evaluated without a specific compliance survey having been conducted to determine if the property is or is not in conformance with the requirements of the Americans with Disabilities Act. The presence of architectural and communications barriers that are structural in nature that would restrict access by disabled individuals may adversely affect the property's value, marketability, or utility.

15) Any proposed improvements are assumed to be completed in a good workmanlike manner in accordance with the submitted plans and specification.

16) The distribution, if any, of the total valuation in this report between land and improvements applies only under the stated program of utilization. The separate allocations for land and buildings must not be used in conjunction with any other appraisal and are invalid if so used.

17) Possession of this report, or a copy thereof, does not carry with it the right of publication. It may not be used for any purpose by any person other than the party to whom it is addressed without the written consent of the consultant, and in any event, only with property written qualification and only in its entirety.

18) Neither all nor any part of the contents of this report (especially any conclusions as to value, the identity of the Consultant, or the firm with which the Consultant is connected) shall be disseminated to the public through advertising, public relations, news sales, or other media without prior written consent and approval of the Consultant.

PART II – DESCRIPTION OF THE PROPOSED DEVELOPMENT

A. LAND USE

The proposed Waiʻale Master Plan Development is located on the western side of Kuihelani Highway in Kahului, Island and County of Maui. The subject is currently zoned Agricultural District and consists of approximately 545 acres of land. The project, which is still in its planning stage, is planned to comprise single-family residential, multi-family residential, village mixed-use, commercial, business/light industrial, park, cultural preserve, as well as a regional park, a community center, an intermediate school site with associated recreation fields, greenway paths and roads. According to the Developer, the proposed land use is as follows:

Land Use	Approximate Land Areas
Single-Family Residential (SF)	128.1 Acres
Multi-Family Residential (MF)	53.7 Acres
Village Mixed Use (VMX)	52.9 Acres
Commercial (C)	23 Acres
Business/Light Industrial (LI)	16.3 Acres
Regional Park/Cultural Preserve (Park)	101.4 Acres
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Community Center (CC)	7 Acres
Institutional/School (I)	18 Acres
County Housing	40 Acres
County Park	3 Acres
Roads/Greenway Paths	63.9 Acres

B. UNIT TYPES

Preliminary plans called for approximately 1,240 single-family units and approximately 1,010 multi-family units. For purposes of this analysis, the typical single-family unit is assumed to include three bedrooms with an average living area of about 1,100 square feet, and the typical multi-family unit is assumed to include two bedrooms and about 750 square feet.

C. AFFORDABLE PRICE UNITS

Based on the current County of Maui Workforce Housing Ordinance, the subject will be required to offer 25 percent of its proposed 2,250 housing units as on-site affordable units. The current Workforce Housing Ordinance also specifies the following minimum affordable housing unit allocation:

Gap Income (141 to 160% of Maui median income)	20 percent
Above Moderate Income (121 to 140%)	20 percent
Moderate Income (101 to 120%)	30 percent
Below Moderate Income (81 to 100%)	30 percent

Based on the Workforce Housing Ordinance, approximately 563 affordable housing units would be required. For purposes of this analysis, the following breakdown of the affordable units has been assumed. The actual allocation will be based on discussions and agreement with the Maui County Department of Housing and Human Concerns.

Single-Family	
Gap Income	62 units (20 percent)
Above Moderate Income	62 units (20 percent)
Moderate Income	93 units (30 percent)
Below Moderate Income	93 units (30 percent)
Total Affordable Single-family Housing Units	310 units

Multi-Family	
Gap Income	50 units (20 percent)
Above Moderate Income	51 units (20 percent)
Moderate Income	76 units (30 percent)
Below Moderate Income	76 units (30 percent)
Total Affordable Multi-family Housing Units	253 units

D. COMMERCIAL/INDUSTRIAL COMPONENT

Based on preliminary plans, the Wai'ale Master Plan Development will feature approximately 230,000 square feet of Commercial space, 250,000 square feet of Village Mixed-Use space, and 175,000 square feet of Light Industrial space. While some of the economic and fiscal impacts attributed to the development of these areas have been estimated, other impacts are more difficult to account for.

For example, at full build-out, there would be additional revenue to the State of Hawaii in the form of conveyance taxes, should commercial or industrial condominium units be constructed. However, this would not be the case if leasable multi-tenant structures were built. Furthermore, the general excise tax to be paid from ongoing sales within these projects cannot be accurately gauged, without knowing the tenant mix. A retail business would likely have gross revenue very different from a professional office user. Another example might be a light industrial space utilized for storage versus a wholesale distribution warehouse. Many of these factors will be determined by future market conditions. As a result, this analysis has conservatively limited its focus to those primary areas of economic impact, with emphasis on the Wai'ale Master Plan Development's residential component.

PART III – ECONOMIC IMPACTS OF THE PROPOSED DEVELOPMENT

A. ECONOMIC IMPACTS RELATED TO DEVELOPMENT ACTIVITIES

Construction of the Subdivision Improvements

The Developer has estimated that vertical construction costs for the single-family units to be approximately $150 per square foot and about $175 per square foot for the multi-family units. Research of projects offering similar entry level housing units revealed this range to be reasonable. On average, the typical three-bedroom single-family unit will have approximately 1,100 square feet of living area, while the living area for the typical two-bedroom multi-family unit will average approximately 750 square feet. Vertical construction expenditures for the 2,250 proposed housing units totaled approximately $337,163,000. It should be noted that this figure included the residential component of the "live/work" units in the Village Mixed-Use area.

Other estimated vertical construction costs from the Developer were as follows: $46,000,000 for the 230,000 square feet of neighborhood commercial area; $26,250,000 for the 175,000 square feet of light industrial area; and $50,000,000 for the commercial component of the village mixed-use area. Site work and infrastructure costs for the project were estimated by the Developer to be $273,000,000. The construction expenditures for the Wai'ale Master Plan Development totaled approximately $732,413,000.

Indirect Sales

Development and construction activities will also generate indirect sales, through the supply of goods and services to the various construction companies, in addition to the families of their employees. By the same token, these suppliers and their families will purchase goods and services from other companies. This chain reaction continues over and over, with some of the revenues leaking out of Hawaii's economy with each cycle. Based on State economic multipliers, off-island indirect sales were estimated at about $541,985,000 over the term of the project. Meanwhile, Maui indirect sales were estimated at about $379,390,000 over the term of the project. Indirect sales attributed to the development totaled approximately $921,375,000.

Direct and Indirect Employment

New job opportunities created by this development will start with the design and entitlement process, employing architects, engineers, surveyors, and land use planners. Site work, road work and the installation of utility and drainage lines typically utilize heavy equipment operators, tractor-trailer drivers and utility personnel. Vertical construction of the housing units, commercial buildings, village mixed-use projects and light industrial facilities will employ masons, carpenters, sheet metal workers, roofers, drywall installers, plumbers, electricians and painters. Finish work will require cabinet makers, carpet and tile installers, interior decorators, and landscapers. Application of State economic multipliers resulted in a forecasted annual average of 293 jobs directly related to the construction of this development.

The increase in construction will also create the need for supplementary companies to strengthen their labor force. These jobs may be from building supply companies, hardware stores, equipment rental companies, and shipping/warehousing companies. In addition, the construction laborers and their families will patronize local goods and services providers. Grocers, restaurants, service stations, auto repair shops, financial institutions, recreational venues, medical facilities and personal care businesses could be considered potential companies that would need to bolster their employee count. Based on State economic multipliers, indirect jobs on Maui were forecasted to average 300 jobs annually, resulting in an estimated annual average of 593 Maui jobs directly and indirectly tied to the development of the project. Meanwhile, indirect employment on Oahu could possibly add an average 158 jobs per year. Employment attributed to the development totaled approximately 7,500 jobs over the term of the project.

Direct and Indirect Payroll

Payroll directly related to the development of the project was estimated to be $17,132,000 per annum, based on statistics gleaned from the State of Hawaii Department of Labor and Industrial Relations (DLIR) and job counts determined in the previous section. It should be noted that most construction positions are expected to be filled by Maui laborers.

Indirect Maui payroll came out to about $11,358,000 per year, while indirect Oahu payroll was around $6,754,000 annually. Total direct and indirect payroll attributed to the development of the subject was forecasted to be close to $352,443,000 over the term of the project.

Population Supported by Project Development

Statistical information obtained from the DLIR indicated Maui residents supported by construction jobs attributed to this development are forecasted to average of 634 residents per year, while residents supported by indirect jobs may amount to an average of 650 residents per year.

Oahu residents supported by indirect jobs created by this development were estimated to average 326 residents per year. In all, approximately 16,100 residents on Maui and Oahu will potentially be supported by the development of this project.

Housing for Supported Population

Statistical information obtained from the DLIR indicated Maui housing units supported by construction jobs attributed to this development are forecasted to average 216 units per year, while housing units supported through indirect jobs would average about 221 units per year.

Oahu housing units supported through indirect jobs created by this development were estimated to average109 units per year. In all, about 5,500 housing units on Maui and Oahu will potentially be supported by the development of this project. It should be noted that this category does not necessarily represent additional housing units needed for direct and indirect employees, but indicates the potential number of households that would be financially linked to monies earned by such workers.

B. ECONOMIC IMPACTS AT FULL BUILD-OUT

Home Values at Full Build-Out

For this analysis, the average **market value** for the single-family units (1,240 units) was estimated at $450,000, while the average **market value** for the multi-family units (1,010 units) was estimated at $275,000. Based on the unit breakdown provided by the Developer, the total property value of the 2,250 units, at full build-out was estimated at approximately $835,750,000.

Long Term Employment

In addition to construction related employment, the commercial and industrial components will provide long term employment opportunities. At full build-out this could result in approximately 1,000 jobs. It is recognized that not all of these jobs would be new, since existing Maui businesses could be relocating to the project.

PART IV – FISCAL IMPACTS, COUNTY OF MAUI

A. FISCAL IMPACTS RELATED TO DEVELOPMENT ACTIVITIES

Development Activities

Typically, the County accumulates revenue from developments in the form of fees, such as for building permits and impacts attributed to the development. In this case, fee revenue would be generated from the construction of the overall Waiʻale Master Plan Development, as well as from the subsequent development of the individual project lots.

Net Taxable Value, Project Housing Units

The Waiʻale Master Plan Development will feature approximately 1,240 three-bedroom single-family units and 1,010 two-bedroom multi-family units. For this analysis, approximately 85 percent of the single family units and 80 percent of the multi family units were assumed to be owner occupied. Accordingly, about 1,054 market and affordable single-family units and 808 market and affordable multi-family units will be owner-occupied. As such, these homeowners would qualify for the County of Maui homeowner exemption, which currently stands at up to $300,000 per qualified housing unit. The single-family unit owners would be able to claim a $300,000 exemption. Meanwhile, the multi-family unit owners would be exempt for $275,000, or the full value of their property, only owing the County of Maui minimum tax (currently at $150 per year). After deduction of the homeowner exemptions, the net taxable value of the project amounted to approximately $278,036,000.

B. FISCAL IMPACTS AT FULL BUILD-OUT

At full build-out, County revenue would primarily be generated in the form of real property taxes. As previously discussed, the net taxable value of the project was determined to be about $278,036,000. Residential owner-occupants who qualify for the County homeowner exemption are assessed at PITT Code 900 (Homeowner). Currently, this tax class has a mill rate of $2.00 per $1,000 of assessed value. The tax obligation for the owner-occupied single-family units was calculated at $406,000 per year. The unoccupied and renter-occupied single-family units will be assessed at PITT Code 100 (Improved Residential). Currently, this tax class has a mill rate of $5.00 per $1,000 of assessed value. The tax obligation for the unoccupied and renter-occupied single-family units amounted to close to $351,000 per year.

As previously discussed, the owner-occupied multi-family units will be fully exempt, but still pay the $150 minimum annual property tax. Thus, the tax obligation for the owner occupied multi-family units amounted to about $127,000 per year. Meanwhile, the unoccupied and renter-occupied multi-family units will be assessed at PITT Code

200 (Apartment). Currently, this tax class has a mill rate of $5.00 per $1,000 of assessed value. The tax obligation for the unoccupied and renter-occupied multi-family units was forecasted at $226,000 per year. The total estimated annual real property tax attributed to the residential portion of the project is estimated at $1,111,000 per year at full build-out.

The Wai'ale Master Plan Development is slated to be built on the following State of Hawaii Tax Map Keys: (2) 3-8-05-037, (2) 3-8-05-023, (2) 3-8-07-071, (2) 3-8-07-101, and (2) 3-8-07-104. According to the County of Maui Real Property Tax Division, the Developer currently pays approximately $10,000 per year in property taxes for these parcels. This amount was deducted from the annual revenues at full build-out, as the County will no longer receive this income. It should be noted that the project will be built on only portions of some of the aforementioned parcels; however, no breakdown could be calculated, so the current tax obligation for the entire parcel was considered. The resulting net real property tax revenue at full-build out was estimated to be about $1,101,000 annually.

County of Maui annual expenditures at full build-out were considered to be for general services, infrastructure maintenance and public safety. This would also include upkeep of public recreational facilities, such as the parks to be provided by the project. Assuming that the majority of the development's future residents already live on Maui, some of these expenses would be incurred by the County no matter where they live. As such, there would not necessarily be an additional cost to the County for *each* resident moving into the Wai'ale Master Plan Development. Based on demographic statistics for Central Maui, it was estimated that the Wai'ale Master Plan Development will have approximately 6,767 residents. For the purposes of this analysis, it was assumed that 95 percent will be already living on Maui, with the remaining 5 percent, or about 338 residents, being in-migrant residents. The additional cost to the County attributed to these in-migrant residents was estimated to be $841,000 per year, plus debt service of $68,000 per year.

Thus, the net revenue attributed to the project, at full build-out, was estimated to be $192,000 per year. It should be noted that since this project will consist mostly of owner-occupant workforce housing units, its property tax base is significantly reduced by the homeowner exemptions. Furthermore, the County of Maui's property tax system is structured in a way that owner-occupant subdivisions such as the subject are essentially subsidized by revenue received from other property classes. The majority of Maui's property tax revenue is generated by time share, hotel/resort, industrial and commercial properties, which have substantially higher mill rates.

PART V – FISCAL IMPACTS, STATE OF HAWAII

A. FISCAL IMPACTS RELATED TO DEVELOPMENT ACTIVITIES

Although the State of Hawaii will recognize revenue from the project through various taxes, including Conveyance Tax, and Personal Income Tax, this analysis will focus on the Excise Tax as the primary additional revenue source.

Excise tax is based on two rates, 4.166 percent for final sales and 0.5 percent for intermediate sales. The cumulative tax expectancy for final sales amounted to about $41,806,000, while intermediate sales should be close to $5,403,000. Excise tax attributed to the development totaled approximately $47,209,000.

B. FISCAL IMPACTS AT FULL BUILD-OUT

At full build-out, State revenue would be generated by Personal Income Tax, Excise Tax, and Other Revenues. Similar to the previous section, this analysis has focused on Excise Tax. In this case, the Excise Tax to be received from in-migrant residents was estimated to be $226,000 per year.

Annual expenditures to the State were expected to be from the ongoing operation of the middle school, in addition to other services to residents, and debt service attributed to general improvements. It has been estimated for this analysis that the Wai'ale Master Plan Development will have 338 in-migrant residents, in addition to 58 in-migrant students. At full build-out, the additional students are estimated to increase cost to the State by about $712,000 per year. At the same time, annual expenditure for services from in-migrant residents was forecasted at approximately $1,457,000 and annual general improvement debt service came out to close to around $125,000. Examples of services to residents include operation of civic, health and social services; as well as maintenance to highways, parks and recreational areas. General improvement debt service was based on typical per-capita figures currently carried by residents in Hawaii. Total annual expenditure at full build-out attributed to in-migrant residents was approximately $2,294,000. When deducted from the total annual revenues from the previous paragraph, the net annual revenue at full build-out was forecasted to be negative $2,067,000.

The negative net annual revenue at full build-out was primarily attributed to the household income levels within this subdivision. Since The Wai'ale Master Plan Development will be geared toward the workforce market segment, annual household income is expected to be on the lower side of the range. As excise tax estimates were based on percentages of household income, it is not surprising that total annual revenues were outpaced by total annual expenditures. In general, State services to workforce residential communities are subsidized by revenues received from the visitor industry, businesses and communities with higher annual household incomes.

Furthermore, as previously discussed, this assessment has not considered all of the potential impacts from the commercial, village mixed-use and industrial areas upon full build-out. There will need to be a significant number of employees for these areas, which would increase State's personal income tax revenues. Granted, many of these positions would be filled by those already in the workforce, yet those coming of working age and transplants from off-island would also be potential employees. With regard to general excise tax, some sales generated by the subject's commercial, village mixed-use and industrial areas may take away from sales of existing businesses. However, new sales will also contribute to the amount of general excise tax collected by businesses.

PART VI – REFERENCES

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EXHIBITS

<u>EXHIBIT A</u>

Copy of County of Maui

Residential Workforce Housing Policy

Where the department determines that such an agreement will further the purposes of this chapter, the department shall enter into an agreement, on a project-by-project basis, with a qualified housing provider. Such an agreement may provide, without limitation, that the qualified housing provider shall:

A. Receive, own, manage, rent, operate and sell residential workforce housing units provided by developers pursuant to section 2.96.040 of this chapter;

B. Enter into agreements with developers pursuant to section 2.96.040.B.2 of this chapter, subject to the department's approval, pursuant to which residential workforce housing units are developed, constructed, renovated, or otherwise made available to satisfy the purposes of this chapter;

C. Receive land and in-lieu fees provided by developers pursuant to section 2.96.040.B.4 of this chapter;

D. Receive disbursements from the affordable housing fund and other funds provided for the purposes of this chapter; and/or

E. Administer the selection processes under sections 2.96.090 and 2.96.100 of this chapter, subject to the department's oversight.

1. Where a qualified housing provider receives, owns, develops, rents, operates or sells residential workforce housing units, such units shall be rented or sold to applicants qualified under this chapter, as set forth in the qualified housing provider's agreement with the department;
2. Selection of purchasers or renters for a qualified housing provider's units shall be made in accordance with sections 2.96.090 and 2.96.100 of this chapter or with other selection processes permitted under the qualified housing provider's agreement with the department;
3. All qualified housing provider rentals or sales shall be on terms, conditions and restrictions set forth in the agreement, which shall be at least as restrictive as the terms, conditions and restrictions applicable to developer rentals or sales under this chapter, and may be more restrictive; and
4. All qualified housing provider agreements shall require detailed reports to the department, on no less than an annual basis, of the qualified housing provider's implementation of, and compliance with, the agreement. This report shall include an annual financial audit. (Ord. 3418 § 1 (part), 2006)

EXHIBIT B

Selected Pages from County of Maui
2010 Affordable Sales Price Guidelines

Prepared by:
HOUSING DIVISION
DEPARTMENT OF HOUSING AND HUMAN CONCERNS (DHHC)
COUNTY OF MAUI

Effective: **June 1, 2010**

2010
AFFORDABLE SALES PRICE GUIDELINES

MAUI (EXCEPT HANA)
SINGLE FAMILY

		Percent of Median Income											
		Very Low	Low Income			Below Moderate		Moderate		Above Moderate		Gap Income	
		50% & Below	(51% to 80%)			(81% to 100%)		(101% to 120%)		(121% to 140%)		(141% to 160%)	
Prevailing Int. Rate	No. of Bedroom	50% $38,000	60% $45,600	70% $53,200	80% $60,800	90% $68,400	100% $76,000	110% $83,600	120% $91,200	130% $98,800	140% $106,400	150% $114,000	160% $121,600
5.875%	1	$118,370	$142,030	$165,690	$189,350	$213,010	$236,670	$260,330	$283,990	$307,650	$331,310	$355,040	$378,700
	2	$143,735	$172,465	$201,195	$229,925	$258,655	$287,385	$316,115	$344,845	$373,575	$402,305	$431,120	$459,850
	3	$169,100	$202,900	$236,700	$270,500	$304,300	$338,100	$371,900	$405,700	$439,500	$473,300	$507,200	$541,000
	4	$194,465	$233,335	$272,205	$311,075	$349,945	$388,815	$427,685	$466,555	$505,425	$544,295	$583,280	$622,150
6.000%	1	$116,760	$140,070	$163,450	$186,830	$210,140	$233,520	$256,830	$280,210	$303,590	$326,900	$350,280	$373,590
	2	$141,780	$170,085	$198,475	$226,865	$255,170	$283,560	$311,865	$340,255	$368,645	$396,950	$425,340	$453,645
	3	$166,800	$200,100	$233,500	$266,900	$300,200	$333,600	$366,900	$400,300	$433,700	$467,000	$500,400	$533,700
	4	$191,820	$230,115	$268,525	$306,935	$345,230	$383,640	$421,935	$460,345	$498,755	$537,050	$575,460	$613,755
6.125%	1	$115,220	$138,250	$161,280	$184,310	$207,340	$230,440	$253,470	$276,500	$299,530	$322,560	$345,590	$368,690
	2	$139,910	$167,875	$195,840	$223,805	$251,770	$279,820	$307,785	$335,750	$363,715	$391,680	$419,645	$447,695
	3	$164,600	$197,500	$230,400	$263,300	$296,200	$329,200	$362,100	$395,000	$427,900	$460,800	$493,700	$526,700
	4	$189,290	$227,125	$264,960	$302,795	$340,630	$378,580	$416,415	$454,250	$492,085	$529,920	$567,755	$605,705
6.250%	1	$113,680	$136,430	$159,180	$181,930	$204,610	$227,360	$250,110	$272,860	$295,610	$318,360	$341,040	$363,790
	2	$138,040	$165,665	$193,290	$220,915	$248,455	$276,080	$303,705	$331,330	$358,955	$386,580	$414,120	$441,745
	3	$162,400	$194,900	$227,400	$259,900	$292,300	$324,800	$357,300	$389,800	$422,300	$454,800	$487,200	$519,700
	4	$186,760	$224,135	$261,510	$298,885	$336,145	$373,520	$410,895	$448,270	$485,645	$523,020	$560,280	$597,655
6.375%	1	$112,210	$134,610	$157,080	$179,550	$201,950	$224,420	$246,820	$269,290	$291,760	$314,160	$336,630	$359,030
	2	$136,255	$163,455	$190,740	$218,025	$245,225	$272,510	$299,710	$326,995	$354,280	$381,480	$408,765	$435,965
	3	$160,300	$192,300	$224,400	$256,500	$288,500	$320,600	$352,600	$384,700	$416,800	$448,800	$480,900	$512,900
	4	$184,345	$221,145	$258,060	$294,975	$331,775	$368,690	$405,490	$442,405	$479,320	$516,120	$553,035	$589,835
6.500%	1	$110,740	$132,930	$155,050	$177,170	$199,360	$221,480	$243,670	$265,790	$287,910	$310,100	$332,220	$354,410
	2	$134,470	$161,415	$188,275	$215,135	$242,080	$268,940	$295,885	$322,745	$349,605	$376,550	$403,410	$430,355
	3	$158,200	$189,900	$221,500	$253,100	$284,800	$316,400	$348,100	$379,700	$411,300	$443,000	$474,600	$506,300
	4	$181,930	$218,385	$254,725	$291,065	$327,520	$363,860	$400,315	$436,655	$472,995	$509,450	$545,790	$582,245
6.625%	1	$109,340	$131,180	$153,020	$174,930	$196,770	$218,610	$240,520	$262,360	$284,270	$306,110	$327,950	$349,860
	2	$132,770	$159,290	$185,810	$212,415	$238,935	$265,455	$292,060	$318,580	$345,185	$371,705	$398,225	$424,830
	3	$156,200	$187,400	$218,600	$249,900	$281,100	$312,300	$343,600	$374,800	$406,100	$437,300	$468,500	$499,800
	4	$179,630	$215,510	$251,390	$287,385	$323,265	$359,145	$395,140	$431,020	$467,015	$502,895	$538,775	$574,770
6.750%	1	$107,940	$129,500	$151,130	$172,690	$194,250	$215,880	$237,440	$259,000	$280,630	$302,190	$323,750	$345,380
	2	$131,070	$157,250	$183,515	$209,695	$235,875	$262,140	$288,320	$314,500	$340,765	$366,945	$393,125	$419,390
	3	$154,200	$185,000	$215,900	$246,700	$277,500	$308,400	$339,200	$370,000	$400,900	$431,700	$462,500	$493,400
	4	$177,330	$212,750	$248,285	$283,705	$319,125	$354,660	$390,080	$425,500	$461,035	$496,455	$531,875	$567,410
6.875%	1	$106,540	$127,890	$149,170	$170,520	$191,800	$213,080	$234,430	$255,710	$277,060	$298,340	$319,690	$340,970
	2	$129,370	$155,295	$181,135	$207,060	$232,900	$258,740	$284,665	$310,505	$336,430	$362,270	$388,195	$414,035
	3	$152,200	$182,700	$213,100	$243,600	$274,000	$304,400	$334,900	$365,300	$395,800	$426,200	$456,700	$487,100
	4	$175,030	$210,105	$245,065	$280,140	$315,100	$350,060	$385,135	$420,095	$455,170	$490,130	$525,205	$560,165
7.000%	1	$105,210	$126,280	$147,280	$168,350	$189,420	$210,420	$231,490	$252,490	$273,560	$294,630	$315,630	$336,700
	2	$127,755	$153,340	$178,840	$204,425	$230,010	$255,510	$281,095	$306,595	$332,180	$357,765	$383,265	$408,850
	3	$150,300	$180,400	$210,400	$240,500	$270,600	$300,600	$330,700	$360,700	$390,800	$420,900	$450,900	$481,000
	4	$172,845	$207,460	$241,960	$276,575	$311,190	$345,690	$380,305	$414,805	$449,420	$484,035	$518,535	$553,150
7.125%	1	$103,880	$124,670	$145,460	$166,250	$187,040	$207,830	$228,550	$249,340	$270,130	$290,920	$311,710	$332,500
	2	$126,140	$151,385	$176,630	$201,875	$227,120	$252,365	$277,525	$302,770	$328,015	$353,260	$378,505	$403,750
	3	$148,400	$178,100	$207,800	$237,500	$267,200	$296,900	$326,500	$356,200	$385,900	$415,600	$445,300	$475,000
	4	$170,660	$204,815	$238,970	$273,125	$307,280	$341,435	$375,475	$409,630	$443,785	$477,940	$512,095	$546,250

Prepared by:
HOUSING DIVISION
DEPARTMENT OF HOUSING AND HUMAN CONCERNS (DHHC)
COUNTY OF MAUI

Effective: **June 1, 2010**

2010
AFFORDABLE SALES PRICE GUIDELINES

MAUI (EXCEPT HANA)
MULTI-FAMILY

		Percent of Median Income											
		Very Low 50% & Below	Low Income (51% to 80%)			Below Moderate (81% to 100%)		Moderate (101% to 120%)		Above Moderate (121% to 140%)		Gap Income (141% to 160%)	
Prevailing Int. Rate	No. of Bedroom	50% $38,000	60% $45,600	70% $53,200	80% $60,800	90% $68,400	100% $76,000	110% $83,600	120% $91,200	130% $98,800	140% $106,400	150% $114,000	160% $121,600
5.875%	1	$106,540	$127,820	$149,100	$170,450	$191,730	$213,010	$234,290	$255,570	$276,920	$298,200	$319,550	$340,830
	2	$129,370	$155,210	$181,050	$206,975	$232,815	$258,655	$284,495	$310,335	$336,260	$362,100	$388,025	$413,865
	3	$152,200	$182,600	$213,000	$243,500	$273,900	$304,300	$334,700	$365,100	$395,600	$426,000	$456,500	$486,900
	4	$175,030	$209,990	$244,950	$280,025	$314,985	$349,945	$384,905	$419,865	$454,940	$489,900	$524,975	$559,935
6.000%	1	$105,070	$126,070	$147,140	$168,140	$189,140	$210,140	$231,140	$252,210	$273,210	$294,210	$315,280	$336,210
	2	$127,585	$153,085	$178,670	$204,170	$229,670	$255,170	$280,670	$306,255	$331,755	$357,255	$382,840	$408,255
	3	$150,100	$180,100	$210,200	$240,200	$270,200	$300,200	$330,200	$360,300	$390,300	$420,300	$450,400	$480,300
	4	$172,615	$207,115	$241,730	$276,230	$310,730	$345,230	$379,730	$414,345	$448,845	$483,345	$517,960	$552,345
6.125%	1	$103,670	$124,460	$145,180	$165,900	$186,620	$207,410	$228,130	$248,850	$269,570	$290,290	$311,010	$331,800
	2	$125,885	$151,130	$176,290	$201,450	$226,610	$251,855	$277,015	$302,175	$327,335	$352,495	$377,655	$402,900
	3	$148,100	$177,800	$207,400	$237,000	$266,600	$296,300	$325,900	$355,500	$385,100	$414,700	$444,300	$474,000
	4	$170,315	$204,470	$238,510	$272,550	$306,590	$340,745	$374,785	$408,825	$442,865	$476,905	$510,945	$545,100
6.250%	1	$102,340	$122,780	$143,290	$163,730	$184,170	$204,610	$225,120	$245,560	$266,070	$286,510	$306,950	$327,390
	2	$124,270	$149,090	$173,995	$198,815	$223,635	$248,455	$273,360	$298,180	$323,085	$347,905	$372,725	$397,545
	3	$146,200	$175,400	$204,700	$233,900	$263,100	$292,300	$321,600	$350,800	$380,100	$409,300	$438,500	$467,700
	4	$168,130	$201,710	$235,405	$268,985	$302,565	$336,145	$369,840	$403,420	$437,115	$470,695	$504,275	$537,855
6.375%	1	$101,010	$121,170	$141,400	$161,630	$181,790	$201,950	$222,110	$242,340	$262,570	$282,730	$302,960	$323,120
	2	$122,655	$147,135	$171,700	$196,265	$220,745	$245,225	$269,705	$294,270	$318,835	$343,315	$367,880	$392,360
	3	$144,300	$173,100	$202,000	$230,900	$259,700	$288,500	$317,300	$346,200	$375,100	$403,900	$432,800	$461,600
	4	$165,945	$199,065	$232,300	$265,535	$298,655	$331,775	$364,895	$398,130	$431,365	$464,485	$497,720	$530,840
6.500%	1	$99,680	$119,630	$139,580	$159,460	$179,410	$199,360	$219,310	$239,190	$259,140	$279,090	$298,970	$318,990
	2	$121,040	$145,265	$169,490	$193,630	$217,855	$242,080	$266,305	$290,445	$314,670	$338,895	$363,035	$387,345
	3	$142,400	$170,900	$199,400	$227,800	$256,300	$284,800	$313,300	$341,700	$370,200	$398,700	$427,100	$455,700
	4	$163,760	$196,535	$229,310	$261,970	$294,745	$327,520	$360,295	$392,955	$425,730	$458,505	$491,165	$524,055
6.625%	1	$98,420	$118,090	$137,690	$157,430	$177,100	$196,770	$216,440	$236,110	$255,850	$275,520	$295,190	$314,860
	2	$119,510	$143,395	$167,195	$191,165	$215,050	$238,935	$262,820	$286,705	$310,675	$334,560	$358,445	$382,330
	3	$140,600	$168,700	$196,700	$224,900	$253,000	$281,100	$309,200	$337,300	$365,500	$393,600	$421,700	$449,800
	4	$161,690	$194,005	$226,205	$258,635	$290,950	$323,265	$355,580	$387,895	$420,325	$452,640	$484,955	$517,270
6.750%	1	$97,160	$116,550	$136,010	$155,400	$174,860	$194,320	$213,710	$233,100	$252,560	$271,950	$291,410	$310,870
	2	$117,980	$141,525	$165,155	$188,700	$212,330	$235,960	$259,505	$283,050	$306,680	$330,225	$353,855	$377,485
	3	$138,800	$166,500	$194,300	$222,000	$249,800	$277,600	$305,300	$333,000	$360,800	$388,500	$416,300	$444,100
	4	$159,620	$191,475	$223,445	$255,300	$287,270	$319,240	$351,095	$382,950	$414,920	$446,775	$478,745	$510,715
6.875%	1	$95,900	$115,080	$134,260	$153,440	$172,620	$191,800	$210,980	$230,160	$249,340	$268,520	$287,700	$306,880
	2	$116,450	$139,740	$163,030	$186,320	$209,610	$232,900	$256,190	$279,480	$302,770	$326,060	$349,350	$372,640
	3	$137,000	$164,400	$191,800	$219,200	$246,600	$274,000	$301,400	$328,800	$356,200	$383,600	$411,000	$438,400
	4	$157,550	$189,060	$220,570	$252,080	$283,590	$315,100	$346,610	$378,120	$409,630	$441,140	$472,650	$504,160
7.000%	1	$94,710	$113,680	$132,580	$151,550	$170,450	$189,350	$208,320	$227,220	$246,190	$265,160	$284,060	$303,030
	2	$115,005	$138,040	$160,990	$184,025	$206,975	$229,925	$252,960	$275,910	$298,945	$321,980	$344,930	$367,965
	3	$135,300	$162,400	$189,400	$216,500	$243,500	$270,500	$297,600	$324,600	$351,700	$378,800	$405,800	$432,900
	4	$155,595	$186,760	$217,810	$248,975	$280,025	$311,075	$342,240	$373,290	$404,455	$435,620	$466,670	$497,835
7.125%	1	$93,520	$112,210	$130,900	$149,660	$168,350	$187,040	$205,730	$224,420	$243,110	$261,800	$280,560	$299,250
	2	$113,560	$136,255	$158,950	$181,730	$204,425	$227,120	$249,815	$272,510	$295,205	$317,900	$340,680	$363,375
	3	$133,600	$160,300	$187,000	$213,800	$240,500	$267,200	$293,900	$320,600	$347,300	$374,000	$400,800	$427,500
	4	$153,640	$184,345	$215,050	$245,870	$276,575	$307,280	$337,985	$368,690	$399,395	$430,100	$460,920	$491,625

ADDENDA

DEFINITIONS

The purpose of this Glossary is to assist the reader in understanding specific terminology used in this report.

Appraisal (noun) the act or process of developing an opinion of value; an opinion of value (adjective) of or pertaining to appraising and related functions such as appraisal practice or appraisal services.

Cash Equivalent A price expressed in terms of cash, as distinguished from a price expressed totally or partly in terms of the face amounts of notes or other securities that cannot be sold at their face amounts.

Counseling Providing competent, disinterested, and unbiased advice and guidance on diverse problems in the broad field of real estate; may involve any or all aspects of the business such as merchandising, leasing, management, acquisition/disposition planning, financing, development, cost-benefit studies, feasibility analysis, and similar services. Counseling services are often associated with evaluation, but they are beyond the scope of appraisal.

Discounting A procedure used to convert periodic incomes, cash flows, and reversions into present value; based on the assumption that benefits received in the future are worth less than the same benefits received now.

Extraordinary Assumption An assumption, directly related to a specific assignment, which, if found to be false, could alter the consultant's opinions or conclusions. 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. An extraordinary assumption may be used in an assignment only if:

- It is required to properly develop credible opinions and conclusions;
- The consultant has a reasonable basis for the extraordinary assumption;
- Use of the extraordinary assumption results in a credible analysis; and
- The consultant complies with the disclosure requirements set forth in USPAP for extraordinary assumptions.

Fair Value The cash price that might reasonably be anticipated in a current sale under all conditions requisite to a fair sale. A fair sale means that buyer and seller are each acting prudently, knowledgeably, and under no necessity to buy or sell-, i.e., other than in a forced or liquidation sale. The consultant should estimate the cash price that might be received upon exposure to the open market for a reasonable time, considering the property type and local market conditions. ***When a current sale is unlikely-i.e., when it is unlikely that the sale can be completed within 12 months-the consultant must discount all cash flows generated by the property to obtain the estimate of fair value.*** These cash flows include, but are not limited to, those arising from ownership, development, operating, and sale of the property. The discount applied shall reflect the consultant's judgment of what a prudent, knowledgeable purchase under o necessity to buy would be willing to pay to purchase the property in a current sale.

Fee Simple Estate	Absolute ownership encumbered by any other interest or estate, subject only to the limitations imposed by the governmental powers of taxation, eminent domain, police power, and escheat.
Hawaiian Terms	The Hawaiian words "mauka" and "makai" are commonly used in the islands as indicators of direction. The word "mauka" means toward the mountain, and "makai" means toward the ocean.
Highest and Best Use	The reasonably probable and legal use of vacant land or an improved property, which is physically possible, appropriately supported, financially feasible, and that results in the highest value. The four criteria the highest and best use must meet are legal permissibility, physical possibility, financial feasibility, and maximum profitability.
Highest and Best Use of Land or a Site as Though Vacant	Among all reasonable, alternative uses, the use that yields the highest present land value, after payments are made for labor, capital, and coordination. The use of a property based on the assumption that the parcel of land is vacant or can be made vacant by demolishing any improvements.
Highest and Best Use of Property as Improved	The use that should be made of a property as it exists. An existing improvement should be renovated or retained as is so long as it continues to contribute to the total market value of the property, or until the return from a new improvement would more than offset the cost of demolishing the existing building and constructing a new one.
Hypothetical Condition	That which is contrary to what exists, but is supposed for the purpose of analysis. Hypothetical conditions assume conditions 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. A hypothetical condition may be used in an assignment only if: • Use of the hypothetical condition is clearly required for legal purposes, for purposes of reasonable analysis, or for purposes of comparison; • Use of the hypothetical condition results in a credible analysis; and • The consultant complies with the disclosure requirements set forth in USPAP for hypothetical conditions
Leased Fee Interest	An ownership interest held by a landlord with the rights of use and occupancy conveyed by lease to others. The rights of the lessor (the leased fee owner) and the lessee are specified by contract terms contained within the lease.
Leasehold Interest	The interest held by the lessee (the tenant or renter) through a lease transferring the rights of use and occupancy for a stated term under certain conditions.
Market Rent	The most probable rent that a property should bring in a competitive and open market reflecting all conditions and restrictions of the specified lease agreement including term, rental adjustment and revaluation, permitted uses,

use restrictions, and expense obligations; the lessee and lessor each acting prudently and knowledgeably, and assuming consummation of a lease contract as of a specified date and the passing of the leasehold from lessor to lessee under conditions whereby:

- Lessee and lessor 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.
- The rent payment is made in terms of cash in United States dollars, and is expressed as an amount per time period consistent with the payment schedule of the lease contract.
- The rental amount represents the normal consideration for the property leased unaffected by special fees or concessions granted by anyone associated with the transaction.

Market Value

The major focus of most real property appraisal assignments. Both economic and legal definitions of market value have been developed and refined. Continual refinement is essential to the growth of the appraisal profession.

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 reasonable exposure in a competitive market under all conditions requisite to a fair sale, with the buyer and seller each acting prudently, knowledgeably, and for self-interest, and assuming that neither is under undue duress."

Market value is 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 consultant as applicable in an appraisal."

The following definition of market value is used by agencies that regulate federally insured financial institutions in the United States:

"The most probable price which a property should bring in a competitive and open market under all conditions requisite to a fair sale, the buyer and 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.

Prospective Market Value Upon Completion of Construction The prospective future value of a property on the date that construction is completed, based upon market conditions forecast to exist as of the completion date.

Prospective Value Opinion A forecast of the value expected at a specified future date. A prospective value opinion is most frequently sought in connection with real estate projects that are proposed, under construction, or under conversion to a new use, or those that have not achieved sellout or a stabilized level of long-term occupancy at the time the appraisal report is written.

Report Any communication, written or oral, of an appraisal, appraisal review, or appraisal consulting service that is transmitted to the client upon completion of an assignment. The types of written reports listed below apply to real property appraisals:

> Self-Contained Appraisal Report: A written appraisal report prepared under Standards Rule 2-2(a) of the Uniform Standards of Professional Appraisal Practice. A self-contained appraisal report sets forth the data considered, the appraisal procedures followed, and the reasoning employed in the appraisal, addressing each item in the depth and detail required by its significance to the appraisal and providing sufficient information so that the client and the users of the report will understand the appraisal and not be misled or confused.
>
> Summary Appraisal Report: A written report prepared under Standards Rule 2-2(b) or 8-2(b). A summary appraisal report contains a summary of all information significant to the solution of the appraisal problem. The essential difference between a self-contained appraisal report and a summary appraisal report is the level of detail of presentation.
>
> Restricted Appraisal Report: A written report prepared under Standards Rule 2-2(c), 8-2(c), or 10-2(b). A restricted use appraisal report is for client use only. The restricted use appraisal report should contain a brief statement of information significant to the solution of the appraisal problem.

Uniform Standards of Professional Appraisal Practice Current standards of the appraisal profession, developed for consultants and the users of appraisal services by the Appraisal Standards Board of The Appraisal Foundation. The Uniform Standards set forth the procedures to be followed in developing an appraisal, analysis, or opinion and the manner in which an appraisal, analysis, or opinion is communicated. They are endorsed by the Appraisal Institute and by other professional appraisal organizations.

LIMITING AND CONTINGENT CONDITIONS
ACM Consultants, Inc.

1. The property is appraised as though free and clear of any or all liens and encumbrances unless otherwise stated in this report. The Consultant will not be responsible for matters of a legal nature that affect either the property being appraised or the title to it. The Consultant assumes that the title is good and marketable, and therefore, will not render any opinions about the title.

2. Legal descriptions referenced in the report were obtained from public documents from the State of Hawaii, Bureau of Conveyances, or were furnished by the client, and were assumed to be correct.

3. It is assumed that all applicable zoning and use regulations and restrictions have been complied with, unless a nonconformity has been stated, defined, and considered in this appraisal report.

4. It is assumed that all required licenses, certificates of occupancy or other legislative or administrative authority from any local, state, or national governmental or private entity or organization have been or can be obtained or renewed for any use on which the value estimates contained in this report are based.

5. It is assumed that the utilization of the land and improvements is within the boundaries or property lines of the property described and that there is no encroachment or trespass unless otherwise stated in this report. Responsible ownership and competent property management are assumed unless otherwise stated in this report.

6. The Consultant has inspected as far as possible, by observation, the land and the improvements; however, it was not possible to personally observe conditions beneath the soil or hidden structurally or by other components. The appraisal assumes that there are no hidden, unapparent, or apparent conditions of the property site, subsoil, or structures or toxic material which would render it more or less valuable. The Consultant and firm have no responsibility for any such conditions or for any expertise or engineering to discover them. All mechanical components are assumed to be in operable condition and status standard for properties of the subject type. Conditions of heating, cooling, ventilation, electrical and plumbing equipment is considered to be commensurate with the conditions of the balance of the improvements unless otherwise stated. No judgment may be made by us as to adequacy of insulation, type of insulation, or energy efficiency of the improvements or equipment, and no representations are made herein as to these matters unless specifically stated and considered in the report.

7. Information provided by third parties including government agencies, financial institutions, realtors, buyers, sellers, property owners and others and contained in this report were obtained from sources considered reliable and believed to be true and correct. However, no warranty is assumed for possible misinformation.

8. All engineering is assumed to be correct. Any plot plans and illustrative material in this report are included only to assist the reader in visualizing the property. Any sketch in this report may show approximate dimensions and is included to assist the reader in visualizing the property. Maps and exhibits found in this report are provided for reader reference purposes only. No guarantee as to accuracy is expressed or implied unless otherwise stated in this report. No survey has been made for the purpose of this report.

9. The Consultant is not qualified to detect hazardous waste and/or toxic materials. Any comment by the Consultant that might suggest the possibility of the presence of such substances should not be taken as confirmation of the presence of hazardous waste and/or toxic materials. Such determination would require investigation by a qualified expert in the field of environmental assessment. The presence of substances such as asbestos, urea-formaldehyde foam insulation, or other potentially hazardous materials may affect the value of the property. The Consultant's value estimate is predicated on the assumption that there is no such material on or in the property that would cause a loss in value unless otherwise stated in this report. No responsibility is assumed for any environmental conditions, or for any expertise or engineering knowledge required to discover them. The Consultant's descriptions and resulting comments are the result of the routine observations made during the appraisal process.

10. If analysis contained in this appraisal involves partial interests in real estate, the value of the fractional interest plus the value of all other fractional interests may or may not equal the value of the entire fee simple estate considered as a whole.

11. Unless otherwise stated in this report, the subject property is appraised without a specific compliance survey having been conducted to determine if the property is or is not in conformance with the requirements of the Americans with Disabilities Act. The presence of architectural and communications barriers that are structural in nature that would restrict access by disabled individuals may adversely affect the property's value, marketability, or utility.

12. Possession of this report, or a copy thereof, does not carry with it the right of publication. It may not be used for any purposed by any person other than the party to whom it is addressed without the written consent of the Consultant, and in any event, only with proper written qualification and only in its entirety.

13. The Consultant(s) or those assisting in preparation of the report will not be asked or required to give testimony in court or hearing because of having made the appraisal, in full or in part, nor engage in post appraisal consultation with client or third parties except under separate and special arrangement and at additional fee. If testimony or deposition is required because of subpoena, the client shall be responsible for any additional time, fees, and charges regardless of issuing party.

14. Neither all nor any part of the contents of this report (especially any conclusions as to value, the identity of the Consultant, or the firm with which the Consultant is connected) shall be disseminated to the public through advertising, public relations, news sales, or other media without prior written consent and approval of the Consultant.

ACCEPTANCE OF, AND/OR USE OF THIS APPRAISAL REPORT BY CLIENT OR ANY THIRD PARTY CONSTITUTES ACCEPTANCE OF THE ACM CONSULTANTS, INC., CERTIFICATION, LIMITING AND CONTINGENT CONDITIONS. CONSULTANT LIABILITY EXTENDS ONLY TO STATED CLIENT, NOT SUBSEQUENT PARTIES OR USERS OF ANY TYPE, and the total liability of Consultant(s) and firm is limited to the amount of fee received by Consultant.

PROFESSIONAL QUALIFICATIONS

Glenn K. Kunihisa, MAI, CRE

STATE LICENSING

State Certified General Appraiser,
State of Hawaii, License No. CGA 39, July 17, 1991
Expiration: December 31, 2011

PROFESSIONAL AFFILIATIONS

Member, Appraisal Institute, MAI Designation, Hawaii Chapter No. 67
Member, The Counselors of Real Estate, CRE Designation, Hawaii Chapter
Member, International Right of Way Association
Member, National Association of Realtors, Maui Board of Realtors

PROFESSIONAL INVOLVEMENT

Past President – Hawaii Chapter of the Appraisal Institute – 2009
Hawaii Chapter Chair – The Counselors of Real Estate - 2011
Education Committee Chairperson – Hawaii Chapter of the Appraisal Institute – 2004 and 2005
Former Committee Member - Multiple Listing Service (MLS) – Realtors Association of Maui

COMMUNITY AFFILIATIONS

St. Anthony Parish School Board
Board Member 1995 to 2008
Board President 1997 and 1998
Alii Community Care, Inc. – A non-profit health care corporation
Board Member 2004 to 2006

EMPLOYMENT

President
ACM Consultants, Inc.
May, 1997 to present

Previously associated with the following:
ACM, Real Estate Appraisers, Inc. - 1986 to 1997
A&B Commercial Company; a division of Alexander & Baldwin, Inc. - 1979 to 1985
Bank of Hawaii - 1976 to 1979

GENERAL EDUCATION

University of Hawaii at Manoa
Master of Business Administration (MBA) - Executive MBA Program V, 1988
Bachelor of Business Administration (BBA), 1976
Iolani School, 1971

LEGAL & CONSULTING

Qualified as an expert witness in the Second Circuit Court of the State of Hawaii
Qualified as an expert in testimony to the State Land Use Commission
Experienced in real estate arbitration assignments in the State of Hawaii

APPRAISAL EDUCATION

Appraisal Institute
Seminar *Appraisal Curriculum Overview (2-day general)*
Honolulu, Hawaii – July 2010

Seminar	*Online Valuation of Green Residential Properties*	
	Chicago, Illinois – July 2010	
Seminar	*Hotel Valuation*	
	Honolulu, Hawaii – February 2010	
Seminar	*Online Small Hotel/Motel Valuation*	
	Chicago, Illinois – November 2009	
Seminar	*Business Practices and Ethics*	
	Honolulu, Hawaii – September 2009	
Seminar	*Hawaii Lands, Historical Review*	
	Lihue, Hawaii – August 2009	
Seminar	*Appraisal Challenges: Declining Markets and Sales Concessions*	
	Cambria, California – October 2008	
Course	*7-Hour National USPAP Update Course*	
	Honolulu, Hawaii – September 2008	
Course	*Online 7-Hour National USPAP Equivalent Course*	
	Chicago, Illinois – October 2007	
Course	*Valuation of Conservation Easements*	
	Denver, Colorado – October 2007	
Seminar	*Uniform Standards for Federal Land Acquisitions ("Yellow Book") Practical Applications for Fee Appraisers*	
	Honolulu, Hawaii – December 2006	
Seminar	*California Conservation Easements*	
	Sacramento, California – November 2005	
Course 400	*7-Hour National USPAP Update Course*	
	Honolulu, Hawaii – October 2005	
Seminar	*Case Studies in Limited Partnership and Partial Interest Valuation*	
	Honolulu, Hawaii – May 2005	
Seminar	*Appraisal Consulting: A Solutions Approach for Professionals*	
	Honolulu, Hawaii – February 2005	
Seminar	*Real Estate Finance, Value and Investment Performance*	
	Honolulu, Hawaii – February 2005	
Seminar	*Fannie Mae Residential Presentation*	
	Honolulu, Hawaii - July 2004	
Seminar	*Subdivision Analysis*	
	Chicago, Illinois - August 2003	
Seminar	*Supporting Capitalization Rates*	
	Chicago, Illinois - August 2003	
Seminar	*The Technology Assisted Appraiser*	
	Chicago, Illinois - August 2003	
Seminar	*Scope of Work: Expanding Your Range of Services*	
	Chicago, Illinois - August 2003	
Course 400	*National Uniform Standards of Professional Practice*	
	Honolulu, Hawaii - May 2003	
Course 420	*Business Practices and Ethics*	
	Honolulu, Hawaii - May 2003	
Seminar	*The Private Conservation Market*	
	Honolulu, Hawaii - July 2002	
Seminar	*Finance Reporting Valuations Parts I and II*	
	Honolulu, Hawaii - July 2002	
Seminar	*Future of Appraisal Profession from a Global Perspective*	
	Honolulu, Hawaii - July 2002	

Seminar	*Appraisal Office Management*	
		Honolulu, Hawaii - July 2002
Course 540	*Report Writing*	
		Denver, Colorado - December 2000
Seminar	*Partial Interests: Theory and Case Law*	
		Las Vegas, Nevada - July 2000
Seminar	*Easement Valuation*	
		Las Vegas, Nevada - July 2000
Seminar	*Bridging the Gap: Marketability Discounts for Real Estate Interests*	
		Las Vegas, Nevada - July 2000
Course 430	*Standards of Professional Practice, Part C*	
		Honolulu, Hawaii - September 1999
Seminar	*Litigation Skills for the Appraiser: An Overview*	
		Honolulu, Hawaii - May 1998
Seminar	*Special Purpose Properties*	
		Honolulu, Hawaii - September 1997
Seminar	*Highest and Best Use Applications*	
		Honolulu, Hawaii - September 1997
Seminar	*Detrimental Conditions*	
		Honolulu, Hawaii - July 1997
Seminar	*The Appraiser As Expert Witness*	
		Honolulu, Hawaii - August, 1995
Seminar	*How to Appraise FHA-Insured Property*	
		Los Angeles, California - January, 1995
Seminar	*Understanding Limited Appraisals and Reporting Options*	
		Honolulu, Hawaii - August, 1994
Seminar	*Valuation of Leasehold Interests*	
		Honolulu, Hawaii - May, 1993
Seminar	*Valuation of Leased Fee Interests*	
		Honolulu, Hawaii - May, 1993
Seminar	*Valuation Considerations: Appraising Non-Profits*	
		Boston, Massachusetts - July, 1992
Seminar	*Americans With Disabilities Act*	
		Boston, Massachusetts - July, 1992
Seminar	*Valuation in Today's Capital and Financing Markets*	
		Honolulu, Hawaii - June 1992
Seminar	*Arbitration Principles, Procedures and Pitfalls*	
		Honolulu, Hawaii - June, 1992
Seminar	*Institutional Real Estate in the 1990's*	
		Honolulu, Hawaii - June, 1992
Seminar	*FIRREA and its Impact on Appraisers*	
		Honolulu, Hawaii - June, 1992
Course 410/420	*Standards of Professional Practice, Parts A & B*	Honolulu, Hawaii - April, 1991

<u>The American Society of Farm Managers and Rural Appraisers, Inc.</u>

Seminar	*Agricultural Lease Valuation*	
		Honolulu, Hawaii – March 2006

Maui Coastal Land Trust

Seminar	*Understanding the New Tax Incentives: Conservation Easements & Other Charitable Contributions*	
		Wailuku, Hawaii – June 2007

Society of Real Estate Appraisers

Course 101	*Introduction to Appraising Real Property*	
		Dallas, Texas – 1987
Course 102	*Applied Residential Property Valuation*	
		Honolulu, Hawaii - July 1990
Course 201	*Principles of Income Property Appraising*	
		Chicago, Illinois, 1987
Course 202	*Applied Income Property Valuation*	
		San Diego, California - 1988
Seminar	*Professional Practice and the Society of Real Estate Appraisers*	
		Honolulu, Hawaii - 1988
Seminar	*Appraisal Standards Seminar - Federal Home Loan Bank Board Guidelines, Regulations and Policies*	
		Honolulu, Hawaii - April, 1988
Seminar	*Appraisal Standards Seminar - Federal Home Loan Bank Board Guidelines, Regulations and Policies*	
		Honolulu, Hawaii - April, 1988

American Institute of Real Estate Appraisers

Seminar	*Rates, Ratios and Reasonableness*	
		Honolulu, Hawaii - 1989
Seminar	*Discounted Cash Flow Analysis*	
		Honolulu, Hawaii - 1989
Seminar	*Highest and Best Use*	
		Honolulu, Hawaii - 1989
Seminar	*Capitalization Overview - Part A*	
		Honolulu, Hawaii - 1990
Seminar	*Capitalization Overview - Part B*	
		Honolulu, Hawaii – 1990
Seminar	*Accrued Depreciation*	
		Honolulu, Hawaii - 1990

International Right of Way Association

Course 410	*Reviewing Appraisals in Eminent Domain*	
		San Diego, California – February 2011
Course 101	*Appraisal*	
		Las Vegas, Nevada - October 1998
Course 101	*Negotiation*	
		Las Vegas, Nevada - October 1998

National Business Institute, Inc.

Seminar	*Commercial Real Estate Leasing In Hawaii*	
		Honolulu, Hawaii - 1989

American Arbitration Association

Seminar	*Real Estate Dispute Resolution - Mediation and Arbitration*	
		Kahului, Maui, Hawaii - October, 1990

PROFESSIONAL QUALIFICATIONS

Shane M. Fukuda

STATE LICENSING

State Certified General Appraiser
State of Hawaii, License No. CGA-810, July 1, 2007
Expiration: December 31, 2011

PROFESSIONAL AFFILIATIONS

General Associate Member - Appraisal Institute

EMPLOYMENT

ACM Consultants, Inc.
November 2009 to Present
Vice President – Commercial Division
July 2007 to October 2009
Staff Appraiser
October 2004 to June 2007
Appraiser Assistant; Appraiser Trainee

Previously associated with the following:

Dollar Thrifty Automotive Group, Inc.
1994 to 2004
Rental Agent; Lead Rental Agent; Station Manager; Senior Station Manager

GENERAL EDUCATION

Maui Community College, 1989-1990
Henry Perrine Baldwin High School, 1989

APPRAISAL EDUCATION

Appraisal Institute

Seminar	*Hotel Valuation* Honolulu, Hawaii – February 2010
Seminar	*Online Subdivision Valuation* Chicago, Illinois – December 2009
Course	*Online Business Practices and Ethics* Chicago, Illinois – December 2009
Seminar	*Online Small Hotel/Motel Valuation* Chicago, Illinois – December 2009
Course	*Online 7 Hour National USPAP Equivalent* Chicago, Illinois – 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

MISCELLANEOUS EDUCATION

REALM Business Solutions

Course	*Argus 12.0* Honolulu, Hawaii – July 2005

Appendix Q: Solid Waste Management Plan

WAIʻALE COMMUNITY

SOLID WASTE MANAGEMENT PLAN

Waiʻale Community Description

The Waiʻale property is located in the Kahului Isthmus Region of the island of Maui, Hawaiʻi. According to the United States Geological Survey (USGS), Wailuku, Hawaiʻi, 7.5-minute topographic quadrangle map, a small portion of the subject property is located in the Wailuku district and the remaining subject property is located in the Waikapū district. The property comprises approximately 545 acres of land covering all or a portion of five tax map key (TMK) parcels.

- TMK (2) 3-8-005: 023 (portion)/Alexander & Baldwin, Inc.
- TMK (2) 3-8-005: 037/Alexander & Baldwin, Inc.
- TMK (2) 3-8-007: 071/Alexander & Baldwin, Inc.
- TMK (2) 3-8-007: 101 (portion) /Alexander & Baldwin, Inc.
- TMK (2) 3-8-007: 104/Alexander & Baldwin, Inc.

Kuihelani Highway borders the property on the east. East Waiko Road intersects Kuihelani Highway and divides the property into two sections, one section lies north of East Waiko Road comprised of approximately 422 acres and the other south of East Waiko Road comprised of approximately 123 acres. Current access to the property is off of East Waiko Road and Kuihelani Highway.

Waiʻale is envisioned to be a community for residents to live, work, learn and play. Residential communities, including single-family homes and multi-family dwellings, will be connected to village mixed-use areas supported with commercial, retail, office, civic and other public facilities through a system of pedestrian/bicycle paths and greenways. Approximately 2,550 residential units are proposed for Waiʻale, including approximately 300 residential units within the 40 acres to be contributed to the County of Maui.

The Environmental Impact Statement (EIS) process is anticipated to be completed in 2011. State Land Use Commission approval of the subject land use petition (Docket No. A10-789) is anticipated in late 2012, followed by County approvals (Community Plan Amendment, Project District Phases I, II, and III through about 2014). The construction of Waiʻale is expected to commence after Project District Phase II and III applications are approved. Full urban development of the property is anticipated to be substantially completed within 10 years.

Current Solid Waste Generated

Currently, significant quantities of solid waste are not being generated on the subject property from the current uses. As previously noted, the property is divided into two sections by East Waiko Road. The section north of East Waiko Road is comprised of approximately 422 acres and the section south of East Waiko Road is comprised of approximately 123 acres.

The section located north of East Waiko Road is currently leased to several tenants. Approximately 162 acres is leased to Brendan Balthazar, Gary Vares, and Manuel Lopes for cattle and horse grazing. Ameron International Corporation and T.J. Gomes occupy approximately 17 acres of the subject property for sand stockpiling. Hawaiian Cement previously occupied a portion of this land for sand mining operations, however, sand mining operations are no longer conducted at the subject property. Nobriga's Ranch, Inc. occupies approximately five acres for a cattle feed lot. Tom's Backhoe lease area occupies two acres and is used as a storage yard for construction and asphalt paving equipment. A portion of the property was previously used as a turf sod farm.

The section located south of East Waiko Road is currently fallow sugar cane fields, with an orchid farm and a former scrap yard. HC&S used most of this land for sugar cane cultivation until production ceased in about 2008. Melia Orchards Maui leases approximately 10 acres and specializes in orchid flowers used for hotels and restaurants. A portion of the property was formerly leased to a scrap metal company and some materials from the scrap yard still remain onsite. Additionally, portions of the property were observed with unauthorized dumping of appliances, furniture, automotive parts, and other materials.

Current Collection Services

The County provides residential curbside refuse pick up and disposal services in six major districts, including Central Maui (which includes Wailuku, Kahului and South Maui). Curbside refuse is picked up on Wednesdays on West and East Waiko Road manually. In Maui Lani, automated refuse pick up is provided on Anamuli Street on Mondays and Thursdays.

Construction Solid Waste Management

The construction of Wai'ale has the potential to impact the County's solid waste disposal operations. As required by the County, this solid waste management plan addresses waste generated by construction during build out of the Wai'ale project. The review of this solid waste management plan will be coordinated with the County's Department of Environmental Management Solid Waste Division for the disposal of on-site and construction-related waste material. A&B Properties, Inc., and/or its assigns, will work with contractors to minimize the amount of solid waste generated during the construction.

Coordination with the County and its Central Maui Landfill - Refuse & Recycling Center for the disposal/recycling of construction debris may be required. Disposal would be in accordance with appropriate regulations and standards.

Waste from site preparation and construction will be stored, handled, and properly disposed of to divert the maximum amount of waste material produced by the development of Wai‘ale away from the County’s landfill.

Waste generated by site preparation will primarily consist of vegetation, rocks, and debris from clearing, grubbing, and grading. As much as practical, soil and rocks displaced from grading and clearing will be used as fill within the property. This will include proposed open space and park areas.

Green waste from grubbing will either be chipped into mulch for use on the property or will be taken to green waste recycling centers. Currently there are three green waste recycling centers on Maui: Maui Eko Systems, Inc., Maui Earth Compost & Soil Mixes, and Campaign Recycle Maui. All of these are located in Central Maui.

Phasing of the project will minimize the amount of green waste generated at any one time. In addition, if large amounts of green waste are expected from an individual phase, delivery will be coordinated with the green waste recycling centers to ensure that there is adequate capacity among the centers to accept the anticipated amount of green waste.

Construction waste will consist of waste lumber, concrete, and other building materials. Very little demolition material is anticipated, as the site is primarily vacant lands. The project will implement a waste management and recycling program to maintain clean construction sites, maximize material recycling, and minimize disposal truck traffic impacts. The recycling program will incorporate the “Three Rs” of effective construction waste management:

- Reduce: by preventing waste before it happens through efficient design
- Reuse: by using materials removed during demolition (such as rocks and concrete) on site
- Recycling: by separating recyclable materials from non-recyclable materials and supplying these recyclable materials to a recycler for use as new products

During construction, a recycling plan will be implemented and, as much as possible, construction and demolition waste will be recycled. Containers will be provided for separate types of construction waste, which will then be separated from municipal solid waste. Maui Scrap Metal accepts cardboard and metal for recycling. Maui Earth Compost & Soil Mixes accepts drywall. Maui Eko Systems, Inc., and Campaign Recycle Maui accept clean, untreated lumber. Remaining types of wastes may be recycled if a local recycling vendor is available. Otherwise, non-recyclable construction wastes will be disposed in the construction and demolition landfill near Māʻalaea.

Operational Solid Waste Management

As required by the County, this solid waste management plan addresses waste generated by construction during build out of the Waiʻale project. However, recycling will be encouraged after construction, and architects for individual businesses will be encouraged to provide space for individual dumpsters to separate recyclable materials, such as cardboard, plastic, aluminum and glass beverage containers from municipal solid waste.

ACM Consultants, Inc. (ACM) prepared an in-depth market study and economic and fiscal impact assessment for Waiʻale. Based on demographic statistics for Central Maui, ACM estimated that Waiʻale will have approximately 6,767 residents once the project is built out and in full operation. ACM anticipated that 95 percent of Waiʻale residents would be already living on Maui, with the remaining 5 percent, or about 338 residents, being in-migrant residents.

According to the United States Environmental Protection Agency (EPA), in 2006, individuals recycled 1.5 pounds of the individual waste generation rate of 4.6 pounds per day, for a net waste generation amount of 3.1 pounds per day. The EPA's figures include municipal solid waste (MSW) from homes, institutions such as schools and prisons, commercial sources such as restaurants and small businesses, and occasional industrial sources. MSW does not include wastes of other types or from other sources, including automobile bodies, municipal sludges, combustion ash, and industrial process wastes that might also be disposed in municipal waste landfills or combustion units. If all of future residents of the Waiʻale project were from outside of Maui, then the solid waste generated by the project is estimated to average approximately 23,715 pounds per day. However, since ACM estimates that 95 percent of Waiʻale's residents would already be living on Maui, then the estimated 338 residents will generate a total of approximately 1,048 pounds of solid waste per day.

In the *Public Facilities Assessment Update County of Maui (2007)*, R.M. Towill Corporation projected that the Central Maui Landfill (CML) would have adequate capacity to accommodate commercial and residential waste through the year 2025. This projection was arrived at by multiplying the County's de facto population projections by an estimate of pounds per person per day of waste generated and assumes that solid waste generated by industrial and commercial growth will be captured by a corresponding trend in projected population growth. The County's

Integrated Solid Waste Management Plan (ISWMP) (February 2009) indicates that the majority of the County's waste goes to the Central Maui Landfill which is projected to reach capacity in the year 2026. However, as proposed under the ISWMP, through various initiatives, including the increased diversion of waste materials through recycling and composting, the landfill capacity could be extended to the year 2042.

Future Collection Services

A&B Properties, Inc., or its assigns, will need to apply for new service for the single-family residential units by opening a residential solid waste account with the County's Department of Environmental Management. Rules for refuse collection are provided in the Maui County Code, Chapter 15-108.

It is anticipated that in the Village Mixed-Use, multi-family residential, commercial, industrial and institutional areas, private refuse collection services will be relied upon.

O:\Job23\2399.03 Waiale Entitlements\Solid Waste Management Plan\Solid Waste Management Plan FINAL 09-19-2011.doc

Appendix R: Zoning and Flood Confirmation Form

9/15/11

COUNTY OF MAUI
DEPARTMENT OF PLANNING
Kalana Pakui Building
250 South High Street
Wailuku, Hawaii 96793

Zoning Administration and
Enforcement Division (ZAED)
Telephone: (808) 270-7253
Facsimile: (808) 270-7634
E-mail: planning@mauicounty.gov

ZONING AND FLOOD CONFIRMATION FORM

(To be completed by Applicant)

APPLICANT NAME A&B Properties, Inc. TELEPHONE 872-4328

PROJECT NAME Wai'ale Community Master Plan E-MAIL mkaimiola@abprop.com

ADDRESS/LOCATION 11 Puunene Avenue TAX MAP KEY (2) 3-8-005; 023 portion

☐ Yes ■ No Will this Zoning & Flood Confirmation Form be used with a Subdivision Application that is NOT processed under one of the consistency exemptions in *Section 18.04.030(B), Maui County Code*? IF YES, LIST THE PROPOSED LAND USES HERE:

NOTE: 1) Use a separate Zoning & Flood Confirmation Form for each Tax Map Key (TMK) number.
2) If the above "Yes" box is checked AND if the zoning information for the subject property contains multiple State Land Use Districts, Community Plan Designations, or County Zoning, a signed and dated Land Use Designations (LUD) Map, prepared by a licensed surveyor showing all the various districts, designations, zonings, and any subdistricts, shall be submitted for review and approval.
3) If the above "Yes" box is checked AND if there are multiple State Land Use District designations, the applicant shall procure a District Boundary Interpretation from the State Land Use Commission.

FOR COUNTY USE ONLY *(To be completed by ZAED)*

ZONING INFORMATION

STATE LAND USE DISTRICT(S) AG- Agricultural

COMMUNITY PLAN DESIGNATION(S) AG- Agricultural

COUNTY ZONING(S) AG- Agricultural

OTHER DESIGNATION(S)

☐ Yes ☐ No See Additional Comments On Page Two

☐ Yes ☐ No See The Attached Land Use Designation Map

☐ Yes ☑ No SPECIAL MANAGEMENT AREA (SMA)

☐ Yes ☑ No PLANNED DEVELOPMENT

☐ Yes ☑ No PROJECT DISTRICT

FLOOD INFORMATION

FLOOD HAZARD AREA ZONE(S) X, AE (196'-310'), AEF (196'-310'), XS For Flood Zone AO, FLOOD DEPTH

BASE FLOOD ELEVATION(S) feet mean sea level, Local Tidal Datum.

*FLOODWAY ☑ Yes ☐ No *FLOOD DEVELOPMENT PERMIT REQUIRED ☑ Yes ☐ No (portion)

* For flood hazard area zones X or XS, a flood development permit would be required if any work is done in any drainage facility or stream area that would reduce the capacity of the drainage facility, river, or stream, or adversely affect downstream property.

* For subdivisions in ALL FLOOD HAZARD AREA ZONES (including zones X or XS) that involve streams, gulches, low areas, or any type of draingeway, a designation of the 100 year flood inundation limits or a drainage reserve may be required.

SUBDIVISION CONSISTENCY ☐ N/A (Not Applicable)

(Signature)

☐ **The proposed land uses appear to be consistent ________ a unilateral agreement.

Comments:

Except as permitted in Section 18.04.030(B) MCC, property containing Interim Zoning shall NOT be subdivided.

☐ **The proposed land uses appear to NOT be consistent.

Comments:

** All proposed subdivisions will be further reviewed during the subdivision application process to verify consistency, unilateral agreement requirements, and the conditions associated with a unilateral agreement [Section 18.04.030(D), Maui County Code].

REVIEWED & CONFIRMED BY:

(Signature) 9/16/11 (Date)

For: AARON SHINMOTO, Planning Program Administrator, Zoning Administration and Enforcement Division

9/15/11

COUNTY OF MAUI
DEPARTMENT OF PLANNING
Kalana Pakui Building
250 South High Street
Wailuku, Hawaii 96793

Zoning Administration and Enforcement Division (ZAED)
Telephone: (808) 270-7253
Facsimile: (808) 270-7634
E-mail: planning@mauicounty.gov

ZONING AND FLOOD CONFIRMATION FORM

(To be completed by Applicant)

APPLICANT NAME A&B Properties, Inc. **TELEPHONE** 872-4328

PROJECT NAME Wai'ale Community Master Plan **E-MAIL** mkaimiola@abprop.com

ADDRESS/LOCATION 11 Puunene Avenue **TAX MAP KEY** (2) 3-8-005 : 031 portion

☐ Yes ■ No **Will this Zoning & Flood Confirmation Form be used with a Subdivision Application that is NOT processed under one of the consistency exemptions in *Section 18.04.030(B), Maui County Code*?**
IF YES, LIST THE PROPOSED LAND USES HERE:

NOTE: 1) Use a separate Zoning & Flood Confirmation Form for each Tax Map Key (TMK) number.
2) If the above "Yes" box is checked AND if the zoning information for the subject property contains multiple State Land Use Districts, Community Plan Designations, or County Zoning, a signed and dated Land Use Designations (LUD) Map, prepared by a licensed surveyor showing all the various districts, designations, zonings, and any subdistricts, shall be submitted for review and approval.
3) If the above "Yes" box is checked AND if there are multiple State Land Use District designations, the applicant shall procure a District Boundary Interpretation from the State Land Use Commission.

FOR COUNTY USE ONLY *(To be completed by ZAED)*

ZONING INFORMATION

STATE LAND USE DISTRICT(S) AG-Agricultural

COMMUNITY PLAN DESIGNATION(S) AG-Agricultural

COUNTY ZONING(S) AG-Agricultural

OTHER DESIGNATION(S)

☐ Yes ☐ No See Additional Comments On Page Two

☐ Yes ☐ No See The Attached Land Use Designation Map

☐ Yes ☑ No SPECIAL MANAGEMENT AREA (SMA)

☐ Yes ☑ No PLANNED DEVELOPMENT

☐ Yes ☑ No PROJECT DISTRICT

FLOOD INFORMATION

FLOOD HAZARD AREA ZONE(S) X For Flood Zone AO, FLOOD DEPTH

BASE FLOOD ELEVATION(S) N/A feet mean sea level, Local Tidal Datum

*FLOODWAY ☐ Yes ☑ No *FLOOD DEVELOPMENT PERMIT REQUIRED ☐ Yes ☑ No

* For flood hazard area zones X or XS, a flood development permit would be required if any work is done in any drainage facility or stream area that would reduce the capacity of the drainage facility, river, or stream, or adversely affect downstream property.

* For subdivisions in ALL FLOOD HAZARD AREA ZONES (including zones X or XS) that involve streams, gulches, low areas, or any type of draingeway, a designation of the 100 year flood inundation limits or a drainage reserve may be required.

SUBDIVISION CONSISTENCY ☐ N/A (Not Applicable)

☐ **The proposed land uses appear to be consistent ________ a unilateral agreement.

(Signature)

Except as permitted in Section 18.04.030(B) MCC, property containing Interim Zoning shall NOT be subdivided.

Comments:

☐ **The proposed land uses appear to NOT be consistent.

Comments:

** All proposed subdivisions will be further reviewed during the subdivision application process to verify consistency, unilateral agreement requirements, and the conditions associated with a unilateral agreement (Section 18.04.030(D), Maui County Code).

REVIEWED & CONFIRMED BY:

[signature] 9/16/11

(Signature) (Date)

For: AARON SHINMOTO, Planning Program Administrator, Zoning Administration and Enforcement Division

COUNTY OF MAUI
DEPARTMENT OF PLANNING
Kalana Pakui Building
250 South High Street
Wailuku, Hawaii 96793

Zoning Administration and
Enforcement Division (ZAED)
Telephone: (808) 270-7253
Facsimile: (808) 270-7634
E-mail: planning@mauicounty.gov

ZONING AND FLOOD CONFIRMATION FORM

(To be completed by Applicant)

APPLICANT NAME A&B Properties, Inc. **TELEPHONE** 872-4328

PROJECT NAME Wai'ale Community Master Plan **E-MAIL** mkaimiola@abprop.com

ADDRESS/LOCATION 11 Puunene Avenue **TAX MAP KEY** (2) 3-8-007:071

☐ Yes ■ No **Will this Zoning & Flood Confirmation Form be used with a Subdivision Application that is NOT processed under one of the consistency exemptions in *Section 18.04.030(B), Maui County Code*? IF YES, LIST THE PROPOSED LAND USES HERE:**

NOTE: 1) Use a separate Zoning & Flood Confirmation Form for each Tax Map Key (TMK) number.
2) If the above "Yes" box is checked AND if the zoning information for the subject property contains multiple State Land Use Districts, Community Plan Designations, or County Zoning, a signed and dated Land Use Designations (LUD) Map, prepared by a licensed surveyor showing all the various districts, designations, zonings, and any subdistricts, shall be submitted for review and approval.
3) If the above "Yes" box is checked AND if there are multiple State Land Use District designations, the applicant shall procure a District Boundary Interpretation from the State Land Use Commission.

FOR COUNTY USE ONLY *(To be completed by ZAED)*

ZONING INFORMATION

STATE LAND USE DISTRICT(S) AG- Agricultural

COMMUNITY PLAN DESIGNATION(S) AG. Agricultural

COUNTY ZONING(S) AG. Agricultural

OTHER DESIGNATION(S)

☐ Yes ☑ No SPECIAL MANAGEMENT AREA (SMA)

☐ Yes ☑ No PLANNED DEVELOPMENT

☐ Yes ☑ No PROJECT DISTRICT

☐ Yes ☐ No See Additional Comments On Page Two

☐ Yes ☐ No See The Attached Land Use Designation Map

FLOOD INFORMATION

FLOOD HAZARD AREA ZONE(S) X For Flood Zone AO, FLOOD DEPTH

BASE FLOOD ELEVATION(S) N/A feet mean sea level, Local Tidal Datum.

*FLOODWAY ☐ Yes ☑ No *FLOOD DEVELOPMENT PERMIT REQUIRED ☐ Yes ☑ No

* For flood hazard area zones X or XS, a flood development permit would be required if any work is done in any drainage facility or stream area that would reduce the capacity of the drainage facility, river, or stream, or adversely affect downstream property.

* For subdivisions in ALL FLOOD HAZARD AREA ZONES (including zones X or XS) that involve streams, gulches, low areas, or any type of draingeway, a designation of the 100 year flood inundation limits or a drainage reserve may be required.

SUBDIVISION CONSISTENCY ☐ **N/A (Not Applicable)**

(Signature)

☐ **The proposed land uses appear to be consistent ________ a unilateral agreement.
Comments:

☐ **The proposed land uses appear to NOT be consistent.
Comments:

Except as permitted in Section 18.04.030(B) MCC, property containing interim Zoning shall NOT be subdivided.

** All proposed subdivisions will be further reviewed during the subdivision application process to verify consistency, unilateral agreement requirements, and the conditions associated with a unilateral agreement [Section 18.04.030(D), Maui County Code].

REVIEWED & CONFIRMED BY:

[signature] 9/14/11

(Signature) (Date)

For: AARON SHINMOTO, Planning Program Administrator, Zoning Administration and Enforcement Division

COUNTY OF MAUI
DEPARTMENT OF PLANNING
Kalana Pakui Building
250 South High Street
Wailuku, Hawaii 96793

Zoning Administration and
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Telephone: (808) 270-7253
Facsimile: (808) 270-7634
E-mail: planning@mauicounty.gov

ZONING AND FLOOD CONFIRMATION FORM

(To be completed by Applicant)

APPLICANT NAME A&B Properties, Inc. **TELEPHONE** 872-4328

PROJECT NAME Wai'ale Community Master Plan **E-MAIL** mkaimiola@abprop.com

ADDRESS/LOCATION 11 Puunene Avenue **TAX MAP KEY** (2) 3-8-007: 101 portion

☐ Yes ■ No **Will this Zoning & Flood Confirmation Form be used with a Subdivision Application that is NOT processed under one of the consistency exemptions in *Section 18.04.030(B), Maui County Code*?**
IF YES, LIST THE PROPOSED LAND USES HERE:

NOTE: 1) Use a separate Zoning & Flood Confirmation Form for each Tax Map Key (TMK) number.
2) If the above "Yes" box is checked AND if the zoning information for the subject property contains multiple State Land Use Districts, Community Plan Designations, or County Zoning, a signed and dated Land Use Designations (LUD) Map, prepared by a licensed surveyor showing all the various districts, designations, zonings, and any subdistricts, shall be submitted for review and approval.
3) If the above "Yes" box is checked AND if there are multiple State Land Use District designations, the applicant shall procure a District Boundary Interpretation from the State Land Use Commission.

FOR COUNTY USE ONLY *(To be completed by ZAED)*

ZONING INFORMATION

STATE LAND USE DISTRICT(S) AG - Agricultural

COMMUNITY PLAN DESIGNATION(S) AG - Agricultural

COUNTY ZONING(S) AG - Agricultural

OTHER DESIGNATION(S)

☐ Yes ☐ No See Additional Comments On Page Two

☐ Yes ☐ No See The Attached Land Use Designation Map

☐ Yes ☑ No SPECIAL MANAGEMENT AREA (SMA)

☐ Yes ☑ No PLANNED DEVELOPMENT

☐ Yes ☑ No PROJECT DISTRICT

FLOOD INFORMATION

FLOOD HAZARD AREA ZONE(S) X For Flood Zone AO, FLOOD DEPTH

BASE FLOOD ELEVATION(S) N/A feet mean sea level, Local Tidal Datum.

*FLOODWAY ☐ Yes ☑ No *FLOOD DEVELOPMENT PERMIT REQUIRED ☐ Yes ☑ No

* For flood hazard area zones X or XS, a flood development permit would be required if any work is done in any drainage facility or stream area that would reduce the capacity of the drainage facility, river, or stream, or adversely affect downstream property.

* For subdivisions in ALL FLOOD HAZARD AREA ZONES (including zones X or XS) that involve streams, gulches, low areas, or any type of drainageway, a designation of the 100 year flood inundation limits or a drainage reserve may be required.

SUBDIVISION CONSISTENCY ☐ **N/A (Not Applicable)**

(Signature)

☐ **The proposed land uses appear to be consistent ________ a unilateral agreement.

Comments:

Except as permitted in Section 18.04.030(B) MCC, property containing Interim Zoning shall NOT be subdivided.

☐ **The proposed land uses appear to NOT be consistent.

Comments:

** All proposed subdivisions will be further reviewed during the subdivision application process to verify consistency, unilateral agreement requirements, and the conditions associated with a unilateral agreement [Section 18.04.030(D), Maui County Code].

REVIEWED & CONFIRMED BY:

(SB) 9/14/11

(Signature) (Date)

For: AARON SHINMOTO, Planning Program Administrator, Zoning Administration and Enforcement Division

COUNTY OF MAUI
DEPARTMENT OF PLANNING
Kalana Pakui Building
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ZONING AND FLOOD CONFIRMATION FORM

(To be completed by Applicant)

APPLICANT NAME A&B Properties, Inc. **TELEPHONE** 872-4328

PROJECT NAME Wai'ale Community Master Plan **E-MAIL** mkaimiola@abprop.com

ADDRESS/LOCATION 11 Puunene Avenue **TAX MAP KEY** (2) 3-8-007: 104

☐ Yes ■ No **Will this Zoning & Flood Confirmation Form be used with a Subdivision Application that is NOT processed under one of the consistency exemptions in *Section 18.04.030(B), Maui County Code*?**
IF YES, LIST THE PROPOSED LAND USES HERE:

NOTE: 1) Use a separate Zoning & Flood Confirmation Form for each Tax Map Key (TMK) number.
2) If the above "Yes" box is checked AND if the zoning information for the subject property contains multiple State Land Use Districts, Community Plan Designations, or County Zoning, a signed and dated Land Use Designations (LUD) Map, prepared by a licensed surveyor showing all the various districts, designations, zonings, and any subdistricts, shall be submitted for review and approval.
3) If the above "Yes" box is checked AND if there are multiple State Land Use District designations, the applicant shall procure a District Boundary Interpretation from the State Land Use Commission.

FOR COUNTY USE ONLY *(To be completed by ZAED)*

ZONING INFORMATION

STATE LAND USE DISTRICT(S) AG-Agricultural

COMMUNITY PLAN DESIGNATION(S) AG-Agricultural

COUNTY ZONING(S) AG-Agricultural

OTHER DESIGNATION(S)

☐ Yes ☑ No SPECIAL MANAGEMENT AREA (SMA)

☐ Yes ☑ No PLANNED DEVELOPMENT

☐ Yes ☑ No PROJECT DISTRICT

☐ Yes ☐ No See Additional Comments On Page Two

☐ Yes ☐ No See The Attached Land Use Designation Map

FLOOD INFORMATION

FLOOD HAZARD AREA ZONE(S) X For Flood Zone AO, FLOOD DEPTH ____

BASE FLOOD ELEVATION(S) N/A feet mean sea level, Local Tidal Datum.

*FLOODWAY ☐ Yes ☑ No *FLOOD DEVELOPMENT PERMIT REQUIRED ☐ Yes ☑ No

* For flood hazard area zones X or XS, a flood development permit would be required if any work is done in any drainage facility or stream area that would reduce the capacity of the drainage facility, river, or stream, or adversely affect downstream property.

* For subdivisions in ALL FLOOD HAZARD AREA ZONES (including zones X or XS) that involve streams, gulches, low areas, or any type of drainageway, a designation of the 100 year flood inundation limits or a drainage reserve may be required.

SUBDIVISION CONSISTENCY ☐ N/A (Not Applicable)

____ (Signature) ☐ **The proposed land uses appear to be consistent ____ a unilateral agreement.

Except as permitted in Section 18.04.030(B) MCC, property containing Interim Zoning shall NOT be subdivided.

Comments: ____

☐ **The proposed land uses appear to NOT be consistent.

Comments: ____

** All proposed subdivisions will be further reviewed during the subdivision application process to verify consistency, unilateral agreement requirements, and the conditions associated with a unilateral agreement [Section 18.04.030(D), Maui County Code].

REVIEWED & CONFIRMED BY:

[signature] (Signature) 9/14/11 (Date)

For: AARON SHINMOTO, Planning Program Administrator, Zoning Administration and Enforcement Division