

# Archaeological Inventory Survey of the Kawaiiloa Wind Farm Project Area

(TMKs: 1-6-1-05:001, 003, 007, 014, 015, 016, 019, 020, 021, 022; 1-6-1-06:001; 1-6-1-07:001; 1-6-1-08:025; 1-6-2-02:001, 002, 025; 1-6-2-09:001; and 1-6-2-11:001)

Kawaiiloa Ahupua‘a  
Waialua District  
Island of O‘ahu



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**FINAL VERSION**

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ARCHAEOLOGICAL, CULTURAL, AND HISTORICAL STUDIES

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Kawailoa Ahupua‘a  
Waialua District  
Island of O‘ahu

## EXECUTIVE SUMMARY

At the request of CH2M Hill, Inc. Rechtman Consulting, LLC has prepared this archaeological inventory survey for the proposed development of a wind power generation facility (Kawailoa Wind Farm Project) within portions of TMKs: 1-6-1-05:001, 003, 007, 014, 015, 016, 019, 020, 021, 022; 1-6-1-06:001; 1-6-1-07:001; 1-6-1-08:025; 1-6-2-02:001, 002, 025; 1-6-2-09:001; and 1-6-2-11:001) in Kawailoa Ahupua‘a, Waialua District, Island of O‘ahu. The proposed wind power generating facility will occupy land that is owned by Kamehameha Schools and leased to First Wind for the specific purpose of the development of alternative energy. This land has for decades been used for agricultural and grazing purpose and already has much of the needed baseline infrastructure (i.e., roads and HECO subtransmission lines) in place. CH2M Hill, Inc. is preparing an Environmental Impact Statement for the proposed development and the current report is intended to accompany the environmental documentation in compliance with Chapter 343 HRS, as well as fulfilling the requirements of the City and County of Honolulu Planning Department and the Department of Land and Natural Resources with respect to permit approvals for land-altering and development activities. The current study was undertaken in accordance with the Rules Governing Minimal Standards for Archaeological Inventory Surveys and Reports as contained in Hawai‘i Administrative Rules 13§13-284.

Located northeast of Hale‘iwa Town and *mauka* of Kamehameha Highway (Hwy 83), the current study area includes a series of tableland formations arranged in two separate arrays (Western Tableland Array and Eastern Tableland Array) on which the proposed wind turbine towers and appurtenant facilities will be constructed. A new overhead electrical collector line will connect the Eastern and Western Tableland Arrays (Overhead Collector Line Corridor). For construction, operation, and maintenance purposes these tableland locations will be accessed using four existing plantation roads that may need to be improved to support the construction activities. Existing cane field roads will also be used to access a *makai* interconnection facility located in a former sugarcane field (Makai Interconnection Facility Corridor). Given the potential need to improve these roads, the current project area not only includes the tableland formations but also corridors along each roadway extending 20 feet on either side of the roadway. The only wind farm associated development (actually demolition) activities planned for any portions of the involved parcels outside of the defined project area might involve the dismantling of currently abandoned overhead electrical infrastructure. Any such activity will be subject to archaeological monitoring.

The fieldwork for the current project was carried out during two major sessions—between April 12 and May 14, 2010, and between February 15 and February 25, 2011; with follow-up field days on March 30, 2011, April 14, 2011, and April 27, 2011. The field effort was supervised by Robert Rechtman, Ph.D., directed by Johannes Loubser, Ph.D. and Matthew Clark, B.A., and the field crew included Ashton Dircks Ah Sam, B.A., Owen Moore, M.A., Morgan Schmidt, Ph.D., and Mark Winburn, B.A. During the first fieldwork session the areas studied included the Eastern Tableland Array, the Kawailoa Road Corridor, the southern end of the Cane Haul Road Corridor, and the Ashley Road Corridor. The second session of fieldwork focused on the Western Tableland Array, the Mid-Line Road Corridor, and the bulk of Cane Haul Road Corridor. Follow-up fieldwork days were spent surveying the Makai Interconnection Facility Corridor and the Overhead Collector Line Corridor. An estimated total of 1088 labor hours were expended in the field.

As a result of the current study, seventeen archaeological sites were identified within the study area. All of these sites date from the Historic Period and were likely associated with either former military operations (Site 7155, 7156, 7158), or former plantation activities (Sites 7157, 7159, 7160, 7161, 7162, 7163, 7164, 7165, 7166, 7167, 7168, 7169, 7170, 7171). No subsurface testing was deemed necessary at any of these sites to assess age and function. In addition to the sites identified within the study area, six previously identified archaeological sites and nineteen newly identified sites were inspected during the current study nearby, but outside of, the study area. These sites represent both Precontact and Historic use of the general study area.

Sites 7155, 7156, and 7158 are likely interrelated elements associated with a WWII (or slightly older) military communication and fire control network that was established as a warning and response system in the event of a foreign invasion. Although the integrity of the overall system no longer exists, the locational and contextual integrity of these elements are intact, and as such these sites are considered significant under Criteria A and D. Sites 7157, 7159, 7160, 7161, 7162, 7163, 7164, 7165, 7166, 7167, 7168, 7169, 7170, and 7171, although either non-functional (7161, 7162, 7164, 7169, 7171) partly functional (7157, 7159, 7170) or fully functional (7160, 7163, 7165, 7166, 7167, 7168), do retain sufficient integrity to be considered significant under Criterion D for the historical information they have yielded relative to the development of the plantation industry on the north shore of O‘ahu.

It is suggested however, that a reasonable and adequate amount of information has been collected from and about all of these sites as a result of the current study to warrant a no further work recommendation; and thus, a no historic properties affected determination for these sites with respect to the proposed Kawaihoa Wind Power project. It is further recommended that a program of archaeological monitoring be maintained during the construction activities associated with the Kawaihoa Wind Power project. Such a program will help to ensure that any inadvertently discovered resources would receive immediate attention and protection, while their ultimate disposition is being determined by DLNR-SHPD. A monitoring plan in compliance with HAR 13§13-279 has already been prepared and submitted to DLNR-SHPD for review and approval.

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## INTRODUCTION

At the request of CH2M Hill, Inc. Rechtman Consulting, LLC has prepared this archaeological inventory survey for the proposed development of a wind power generation facility (Kawailoa Wind Farm Project) within portions of TMKs: 1-6-1-05:001, 003, 007, 014, 015, 016, 019, 020, 021, 022; 1-6-1-06:001; 1-6-1-07:001; 1-6-1-08:025; 1-6-2-02:001, 002, 025; 1-6-2-09:001; and 1-6-2-11:001) in Kawailoa Ahupua‘a, Waialua District, Island of O‘ahu (Figures 1 and 2). The proposed wind power generating facility will occupy land that is owned by Kamehameha Schools and leased to First Wind for the specific purpose of the development of alternative energy. This land has for decades been used for agricultural and grazing purposes and already has much of the needed baseline infrastructure (i.e., roads and HECO subtransmission lines) in place. CH2M Hill, Inc. is preparing an Environmental Impact Statement (EIS) for the proposed development and the current report is intended to accompany the environmental documentation in compliance with Chapter 343 HRS, as well as fulfilling the requirements of the City and County of Honolulu Planning Department and the Department of Land and Natural Resources with respect to permit approvals for land-altering and development activities. The current study was undertaken in accordance with the Rules Governing Minimal Standards for Archaeological Inventory Surveys and Reports as contained in Hawai‘i Administrative Rules 13§13-284.

An appropriate study area was discussed and agreed upon with DLNR-SHPD Archaeologist Michael Vitousek and Historian Ross Stephenson prior to the completion of this report. It was agreed that for the purposes of a Chapter 6E archaeological study only the areas of direct impact would be surveyed for archaeological sites, and that existing archival information combined with any new oral information (obtained during the Cultural Impact Assessment being prepared for the current project) would be used to identify potential archaeological resources nearby, but outside of, the actual development area. It was also agreed that any future Section 106 compliance (to be undertaken as part of the USFW habitat conservation planning) would also have to take into consideration an Area of Potential Effects (APE) that would include visual impacts (currently discussed in the Chapter 343 EIS being prepared for the current project) to potential historic properties that are situated distant from the current project area (some consideration of such potential impacts is discussed at the end of the current report).

This report contains a physical description of the project area, a discussion of the regional culture-historical context, and a presentation of prior archaeological studies. This background information is used to develop a set of archaeological expectations for the study area as well as provide the contextual information with which to assess the significance of historic properties identified within the project area.

## PROJECT AREA DESCRIPTION

Located northeast of Hale‘iwa Town and *mauka* of Kamehameha Highway (Hwy 83), the current study area (see Figures 1 and 2) includes a series of tableland formations arranged in two separate arrays (Western Tableland Array and Eastern Tableland Array) on which the proposed wind turbine towers (height of individual turbine tower to tip of blade is roughly 490 feet) and appurtenant facilities will be constructed. A new overhead electrical collector line will connect the Eastern and Western Tableland Arrays (Overhead Collector Line Corridor). For construction, operation, and maintenance purposes these tableland locations will be accessed using four existing plantation roads (Kawailoa Road, Mid-Line Road, Ashley Road, and Cane Haul Road) portions of which may need to be improved (widened and reinforced) to support the construction activities. Existing cane field roads will also be used (widened and improved) to access a *makai* interconnection facility located in a former sugarcane field inland and south of Ashley Road (Makai Interconnection Facility Corridor). Given the potential need to improve these roads, the current project area not only includes the tableland formations but also corridors along each roadway extending 20 feet on either side of the roadway. The only wind farm associated development (actually demolition) activities planned for any portions of the involved parcels outside of the defined study area might involve the dismantling of currently abandoned overhead electrical infrastructure. Any such activity will be subject to archaeological monitoring. For the purposes of this report “study area” is defined as that area that was subject to inventory survey (roughly 350 acres), which is distinct from terms used in the EIS that refer to the development area as the area of maximum potential disturbance associated with the construction of the wind farm project (roughly 335 acres), and the final project footprint (roughly 21 acres) that the wind turbines and appurtenant facilities will eventually occupy.

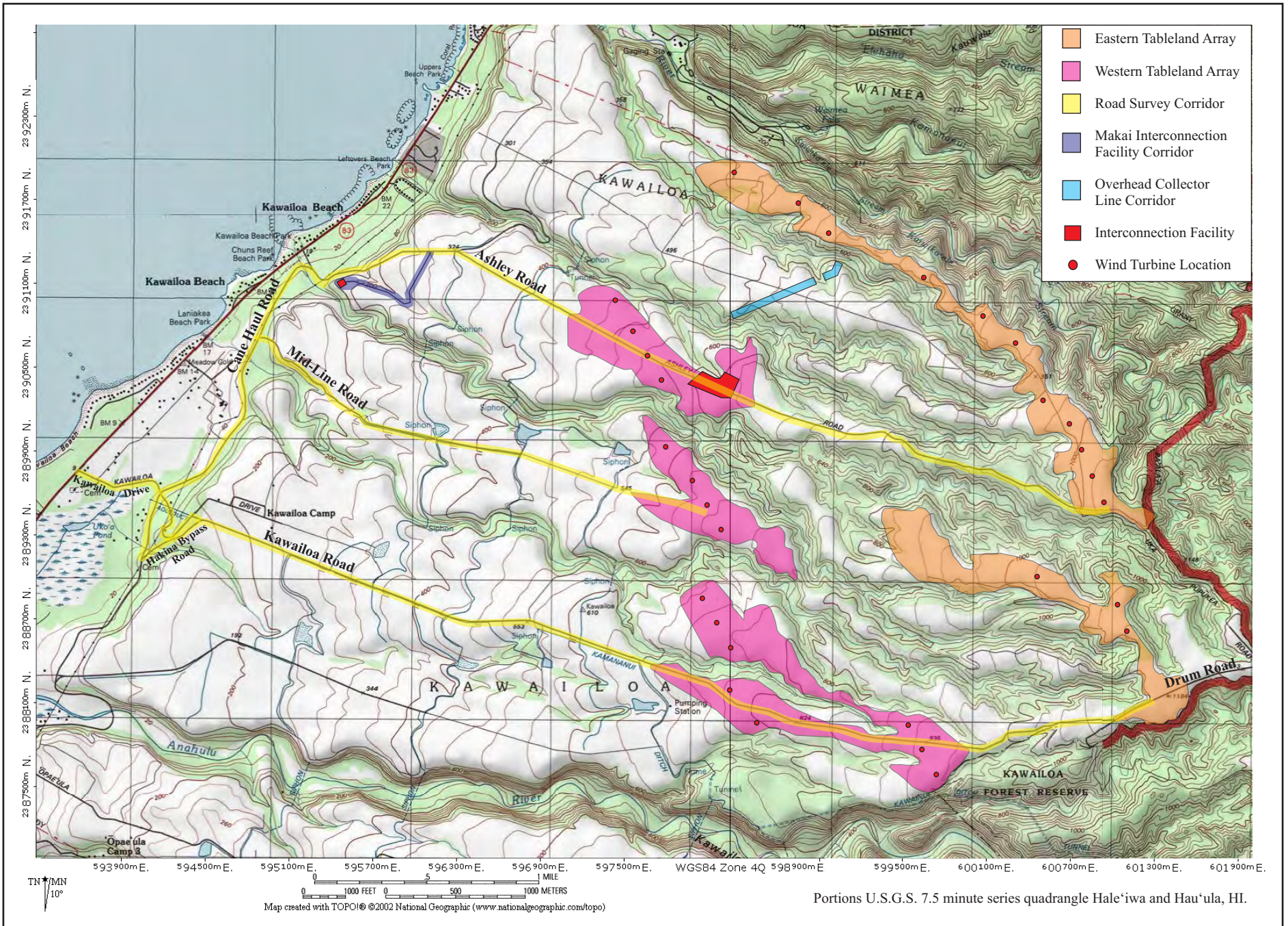


Figure 1. Study area location.

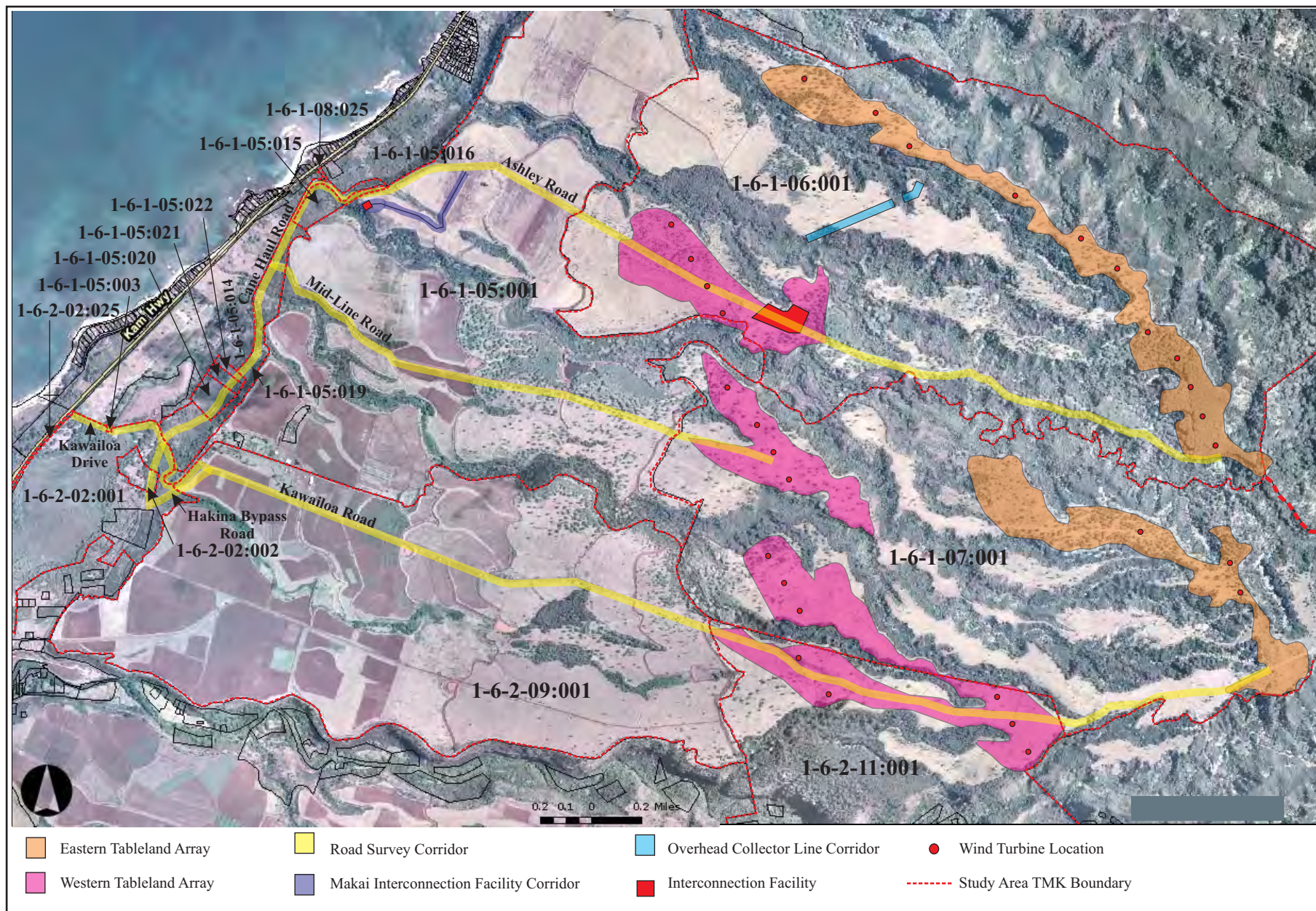


Figure 2. Tax Map parcels and study area.

## Natural Environment

The project area is located within the coastal lowlands of the *ahupua'a* of Kawaioloa in the District of Waialua on the northwest shore of the Island of O'ahu. It is situated along the western edge of the Ko'olau Mountains at the shoreward end of a saddle-like plateau that stretches west to the Wai'anae Mountains (Figure 3). The Wai'anae Mountains are slightly younger than the Ko'olau Mountains, which were formed by the Ko'olau volcanic series roughly 2.2 million years ago (Stearns and Vaksvik 1935). This area receives a median annual rainfall of approximately 1,000 millimeters, mostly falling during the winter months (Foote et al. 1972), and it has an annual temperature range of 65 to 85 degrees Fahrenheit. Elevation within the project area varies from 20 feet above sea level near the coast to 1,200 feet above sea level at the upper ends of the tableland arrays.

At the coast Kawaioloa Ahupua'a has a flat littoral plain fronted by coral reefs and a long narrow sandy beach interspersed with rocky outcrops. The plain is widest at the southern end of the *ahupua'a*, but quickly narrows to the north as it approaches Waimea Bay. Inland of Kamehameha Highway brackish ponds and swampy areas are present on the plain between the project area and Hale'iwa Town. The largest pond, 'Uko'a Pond, is situated below the project area just south of the Kawaioloa Drive access road. Inland of 'Uko'a Pond a low, but steep, escarpment rises above the littoral plain. The escarpment increases in height as it progresses northwards and the littoral plain narrows, becoming a coastal cliff by the time it reaches Waimea Bay. Inland of the escarpment Kawaioloa Ahupua'a gives way to dissected tablelands that rise gently toward the Ko'olau mountain range. The tablelands are flat lands separated from one another by deeply eroded gulches and valleys that were formed by rivers and streams flowing to the ocean. The current project area lies between Kaiwiko'e Stream (to the east) and Anahulu River (to the west) (see Figure 3). Several smaller drainages, with intermittently flowing streams that parallel the permanently flowing streams, dissect the project area, generally running in a northwesterly/southeasterly direction (Figure 3).

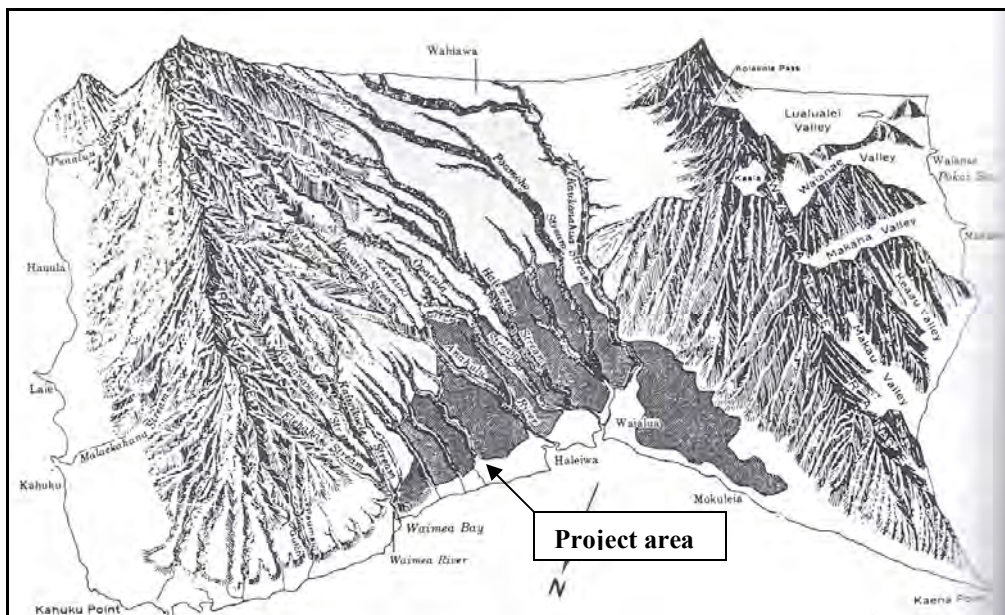


Figure 3. Oblique view of Waialua District (from Kirch 1992:6).

Most of the tablelands consist of deep and well-drained, but acidic, red soils with fine-textured subsoil (Foote et al. 1972). These silty clays are a product of weathered igneous bedrock. Within the current project area silty clays of the Paaloo (PaC) and Leileihua Series (LeB, LeC) occur in the broad upper reaches of the tablelands, while the middle elevations are dominated by of the Wahiawa silty clays (WaB, WaC), and the lower elevations are comprised, above the coastal escarpment, primarily of Lahaina silty clays (LaB, LaC) and, on the littoral plain, of Waialua silty clay (WkA, WkB), Ewa stony slity clay (EwC), and Waialua stony silty clay (WIB). The steep sided gulches adjacent to the survey areas contain predominantly rough mountainous land (rRT) and Helemano silty clay on 30 to 90 percent slopes (HLMG) (Foote et al. 1972).

Vegetation across the project area consists primarily of a thick growth of Guinea grass (*Panicum maximum*) and Albizia trees (*Acacia lebbek*) interspersed with *koa-haole* (*Leucaena glauca*), Christmas-berry (*Schinus teribinthifolius*), guava (*Psidium guajava*), *waiawī* (*Psidium cattleianum*), stands of ironwood trees (*Casuarina equisetifolia*), and various other non-native shrubs, vines, ferns, and grasses. The perennial Guinea grass (*Panicum maximum*), which covers virtually all of the former sugarcane lands within the study area, was introduced from Africa to counteract erosion. Dense tussocks of this grass conceal the ground surface, and in some areas stand as tall as ten feet. Large Indian Banyan trees (*Ficus benghalensis*) can be found growing against cliff faces in the lower and *makai* portion of the project area as well as on the steeper slopes that border the higher *mauka* tablelands. Also, Kamehameha Schools has re-introduced *koa* trees (*Acacia koa*) in certain sections of the tablelands. These endemic trees, traditionally used for a variety of purposes, including canoe production, are gradually spreading and appear to be thriving. Other endemic plants observed during the field study included *‘ōhia*, *ki*, *alaha‘e*, *pukeawe*, *kukui*, *‘iliahi*, *ulu‘he*, and *hapu‘u*. These plants are mostly confined to isolated areas along the upper edges of the deep gullies and valleys that dissect the tablelands. The predominant vegetation within the gulches is *waiawī* (*Psidium cattleianum*).

### Built Environment

Traditionally, in the general vicinity of the project area, Hawaiians lived, practiced aquaculture, and cultivated taro, bananas, and sugarcane on the more *makai* lands, and gathered forest resources from the more *mauka* lands. Historically, the project area was converted into vast plantations of sugarcane and pineapple. Most recently, modern and historic period alteration of the landscape for continued agricultural use has virtually obliterated all material traces left by both traditional Hawaiian and early historical modification and use of the project area lands. Only the gulch areas were left relatively untouched by this last period of mechanized agriculture.

The current project area environment is largely a result of more than a century of use as sugarcane and pineapple fields. The sugar and pineapple companies modified and utilized most of the land within the APE, clearing original vegetation, leveling original landforms, digging ditches, constructing reservoirs, and building roads and railroads. Substantial amounts of foreign laborers (mostly Chinese, Filipino, and Japanese) were imported to work the fields, and labor camps dotted the landscape. The 1929 U.S.G.S. quadrangle maps for Hale‘iwa and Kaipapau (Figure 4) show irrigation ditches, emptying into reservoirs, following contours at roughly every 100-foot change in elevation; railroad tracks running across the plantation lands; numerous roads traversing the length of the tablelands, bounding field edges, and crossing gulches; and workers’ camps scattered throughout. A review of aerial photographs taken on June 4, 1951 (Figure 5), December 4, 1962 (Figure 6), February 9, 1977 (Figure 7), and September 22, 1993 (Figure 8) shows the former extent of the plantation fields and how they developed over time. Virtually all of the project area tablelands were formerly cultivated in either sugarcane or pineapple. An undated map of the Waialua Sugar Company fields shows the field numbers that the current project area corresponds to (Figure 9). The eastern fields are within the Waimea section of the plantation, and the western fields are within the Kaiwailoa section of the plantation. When the Waialua Sugar Company closed its doors in 1998 the lands were reclaimed by Kamehameha Schools. As shown in an aerial photograph taken on June 11, 2000 (Figure 10) most of the upper tableland areas (above the 400 foot contour) were allowed to go fallow, although Kamehameha Schools did plant *koa* trees in some areas.

Portions of the project area below the 400-foot elevation contour are currently farmed (Figure 11). These lands are leased to individuals by Kamehameha Schools for diversified agricultural purposes. Crops grown on the leased lands include corn, lettuce, asparagus, plumeria, banana, tuberose, taro, and *noni*. An irrigation system consisting of a series of interconnected ditches, flumes, and reservoirs that was originally created by the Waialua Agricultural Company to water the sugarcane fields (see Figure 4) has been maintained in the vicinity of the current project area, and it continues to supply water to the diversified agricultural fields. Above the 400-foot contour, the project area tablelands are all former fields that currently lie fallow. These lands were extensively modified during the twentieth century to accommodate agricultural use. Many of the gulch edges are lined with push piles created by bulldozers during field clearing activities, and old roads follow nearly all of the gulch edges and cross the tablelands at field boundaries. At the time of the current inventory survey fieldwork extensive fencing (with associated land altering activities) was being placed within the *mauka* sections of the study area along road and gulch edges as part of a Kamehameha Schools cattle lease.

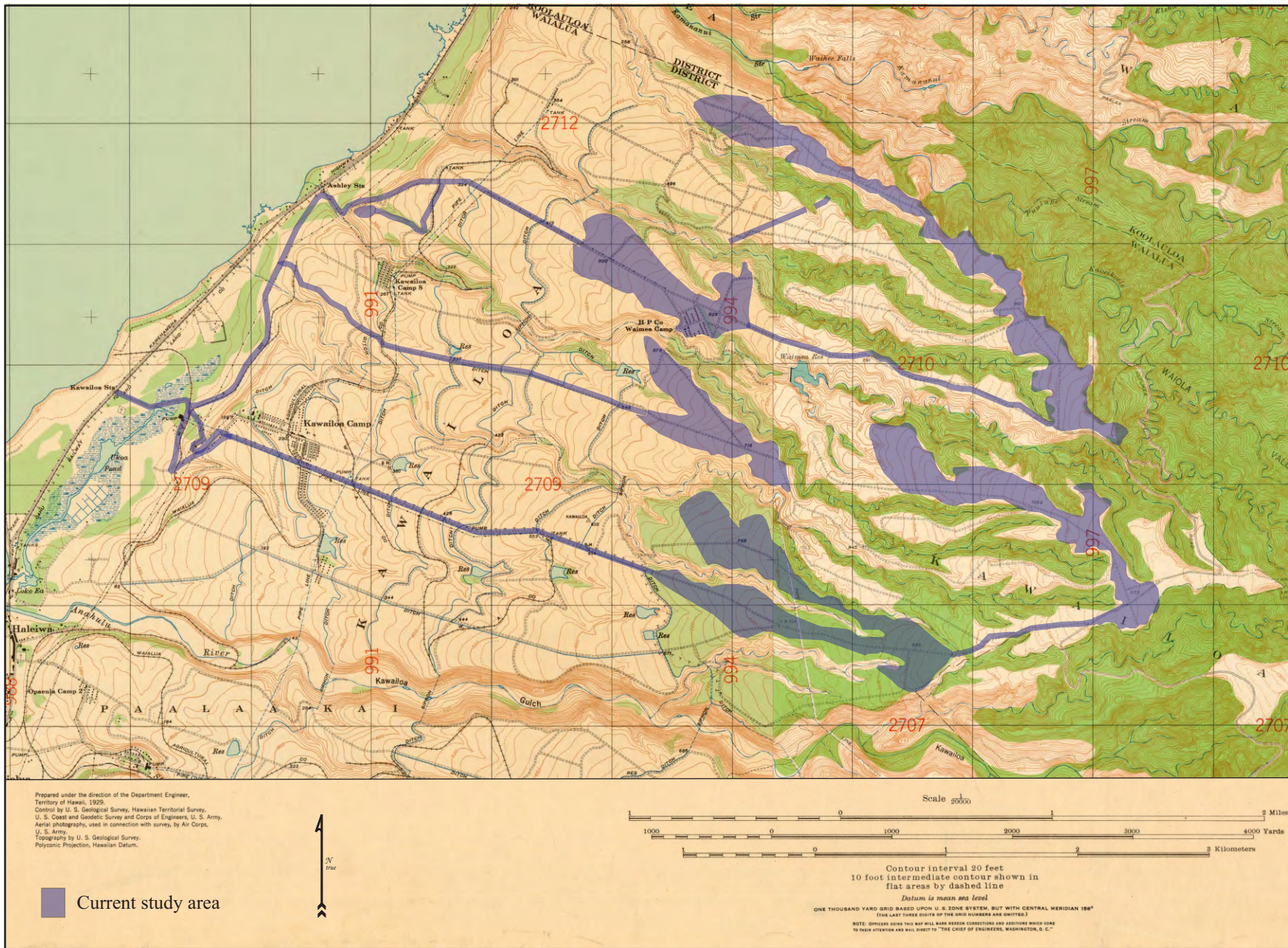


Figure 4. Portion of 1929 U.S.G.S. Hale'iwa (and Kaipapau) quadrangle showing the current study area.



Figure 5. Oblique aerial photograph of a portion of the study area taken on June 4, 1951.

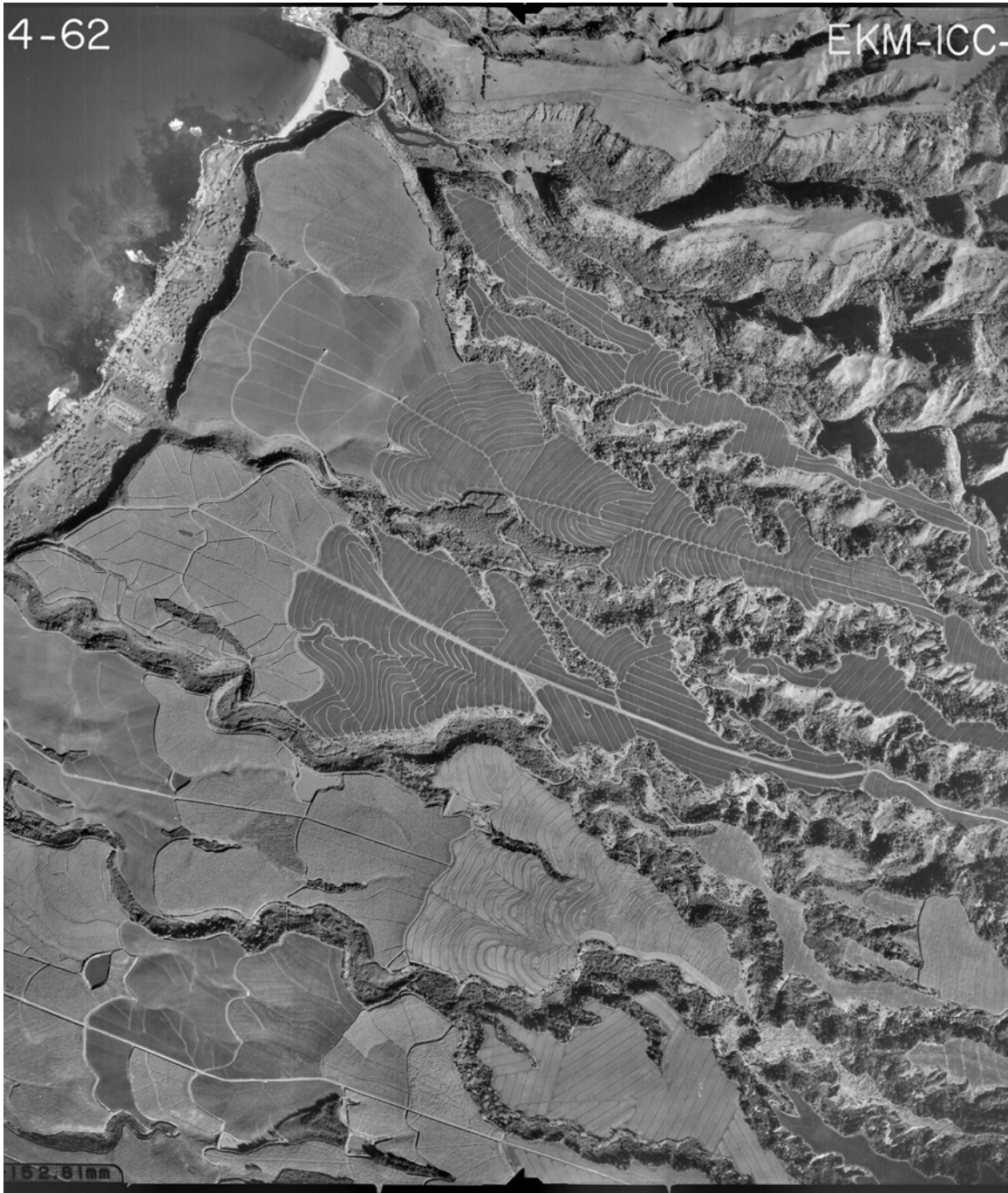


Figure 6. Aerial photograph of a portion of the study area taken on December 4, 1962.

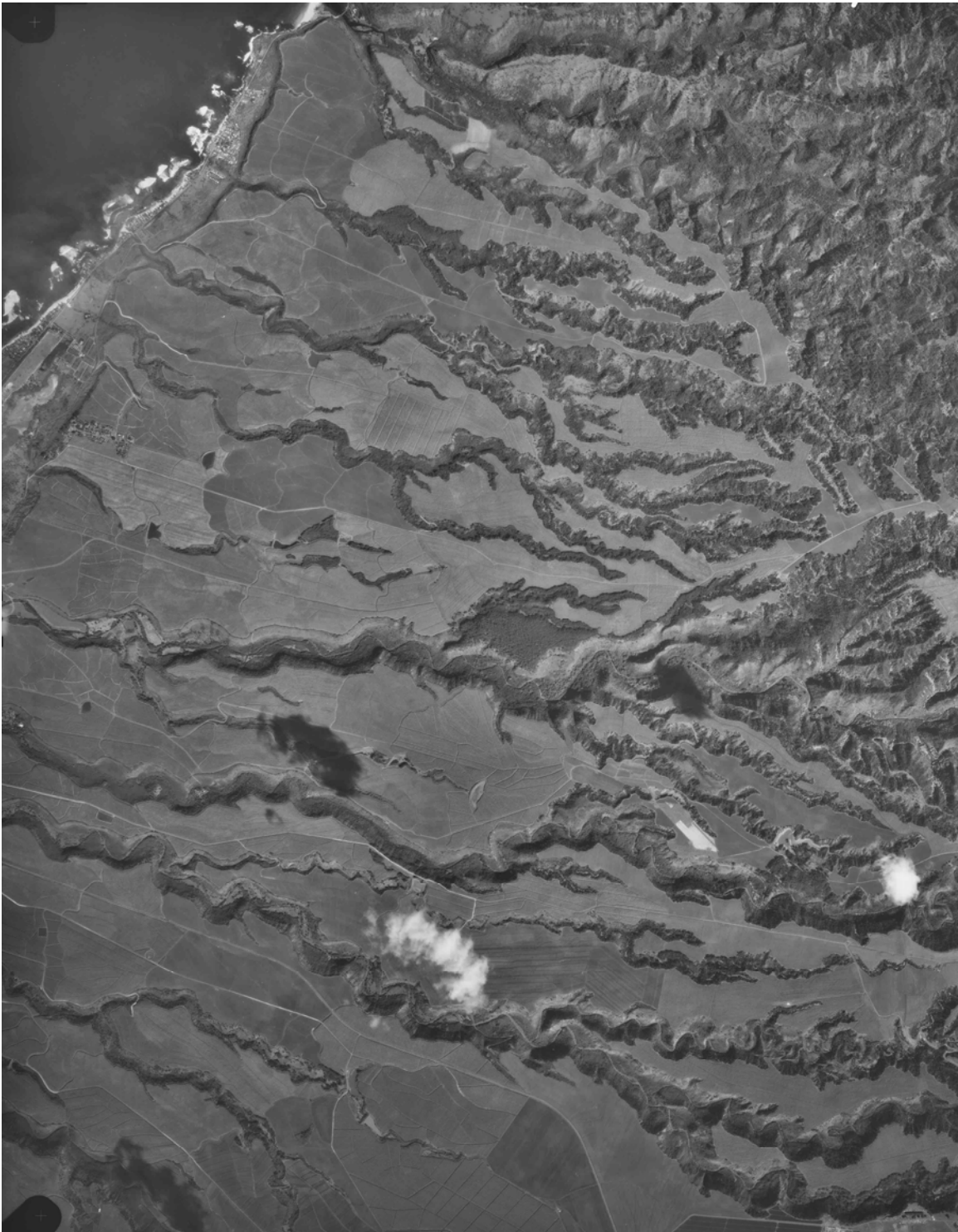


Figure 7. Aerial photograph of a portion of the study area taken on February 9, 1977.



Figure 8. Aerial photograph of a portion of the study area taken on September 22, 1993.

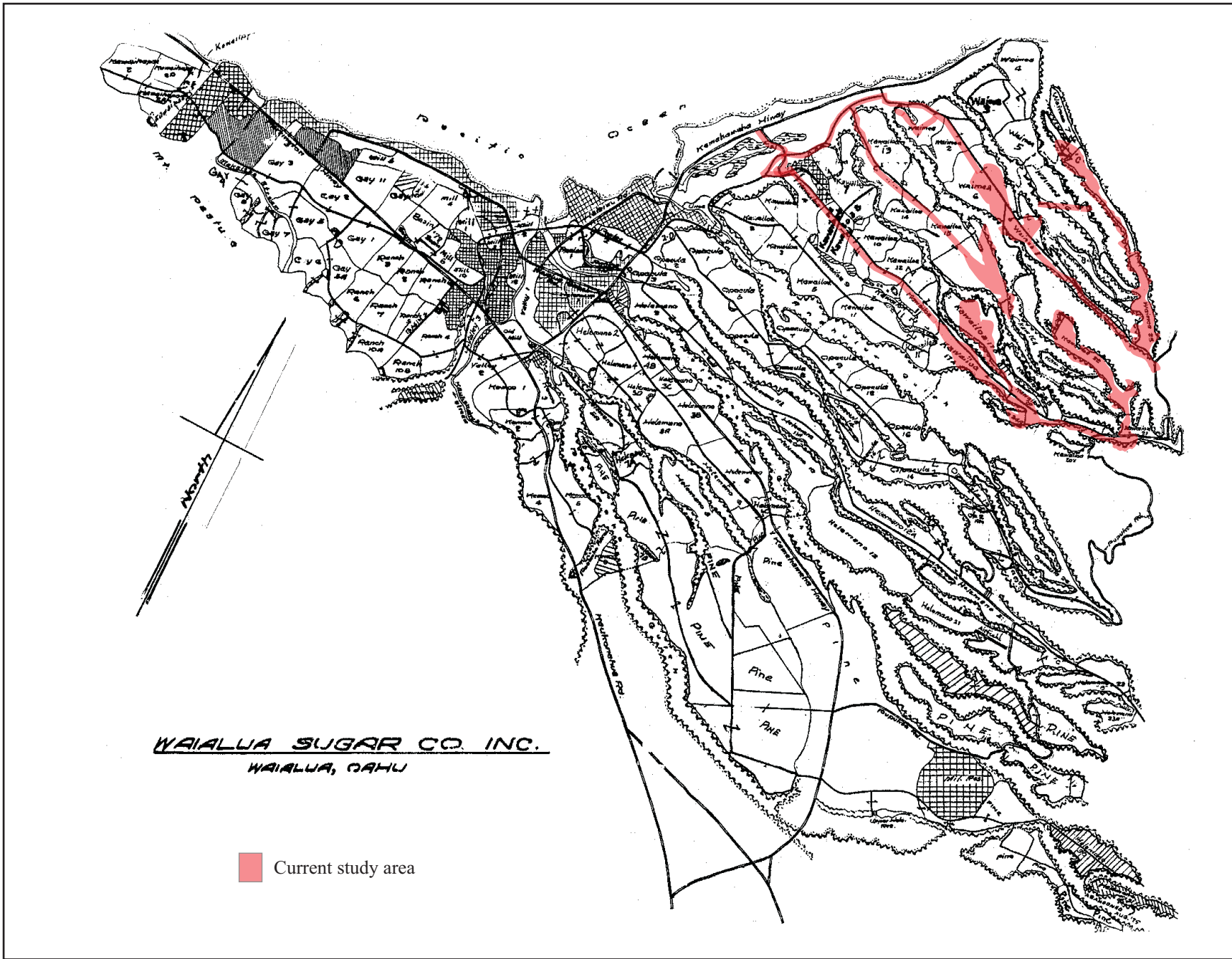


Figure 9. Undated map of the Waiialua Sugar Company's fields showing the current study area.



Figure 10. Aerial photograph of a portion of the study area taken on June 11, 2000.



Figure 11. Current aerial view of the project area (from Google earth).

## Survey Areas

Given the geomorphology of the project area, the history of past land use, and the proposed scope of the wind farm development an appropriate study area was selected for the current archaeological project with input from DLNR-SHPD. This area, which includes four access road corridors, a *makai* interconnection facility and access road, the tableland arrays, and a new overhead collector line between them, includes portions of TMKs: 1-6-1-05:001, 003, 007, 014, 015, 016, 019, 020, 021, 022; 1-6-1-06:001; 1-6-1-07:001; 1-6-1-08:025; 1-6-2-02:001, 002, 025; 1-6-2-09:001; and 1-6-2-11:001. No development activities will take place outside of the study area. For the purposes of the inventory survey the study area was divided into eight survey areas (Western Tableland Array, Eastern Tableland Array, Kawailoa Road Corridor, Cane-Haul Road Corridor, Mid-Line Road Corridor, Ashley Road Corridor, Makai Interconnection Facility Corridor, and Overhead Collector Line Corridor; see Figures 1 and 2). The Eastern and Western Tableland Array survey areas (and their associated infrastructure) include only the flat tablelands and not the steep sided gulches that they border. All of the proposed tower locations within the tableland arrays were marked in the field with lathe and flagging tape at the time of the inventory survey fieldwork. The roadway study corridors include only the roadway surfaces and an additional 20 feet on either side of the existing road surface. Drum Road, which marks the eastern extent of the current project area and extends for 17 miles through the Kawailoa Training Area between the Halemano Military Reservation and the Kahuku Training Area, has been recently improved by the U.S. Army and is nicely paved. A small section of this road is included in the Western Tableland Array and the Kawailoa Road Corridor survey areas, but no further improvements to the road will be undertaken as part of the wind farm development. Each of the study area survey corridors is discussed below.

The Western Tableland Array consists of three distinct survey areas that are slated for the proposed development of sixteen wind turbines, an O & M (office and maintenance) building, a *mauka* point of interconnection and associated infrastructure (see Figure 1). The proposed array of turbines runs in a northwesterly line from Drum Road at an elevation of roughly 1,000 feet above sea level to a point northwest of Ashley Road at an elevation of roughly 500 feet above sea level. The Western Tableland Array crosses TMKs:1-6-2-11:001, 1-6-1-07:001, and 1-6-1-06:001 (see Figure 2). The survey areas correspond to the former Waialua Sugar Company's fields Kawailoa-15, 17a, 17b, 20, 24a, and Waiamea-6 and 8 (see Figure 9). The proposed O & M building and *mauka* point of interconnection are located near the former Hawaiian Pineapple Company's (H. P. Co.) Waimea Camp (see Figure 4). The tablelands that contain the survey areas are separated from one another by steep sided gulches that do not permit interconnected access. The southeastern most survey area is accessed by Kawailoa Road, the central survey area is accessed by Mid-Line Road, and the northwestern survey area that includes the O & M building and *mauka* point of interconnection is accessed by Ashley Road. All of the survey areas in the Western Tableland Array contain a thick growth of Guinea grass (*Panicum maximum*) interspersed with albizia trees (*Acacia lebbek*) and other less frequently occurring species of trees, shrubs, vines, ferns, and grasses (Figures 12, 13, 14, and 15).

The Eastern Tableland Array consists of two distinct survey areas that are slated for the proposed development of fourteen wind turbines (see Figures 1 and 2). The two survey areas are separated from one another by a deep, unnamed gulch that does not permit interconnected access. The southeastern most survey area of the Eastern Tableland Array runs northwest across TMK:1-6-1-07:001 from the edge of Anahulu Gulch near Drum Road at an elevation of roughly 1,200 feet above sea level to a point along the edge of the unnamed gulch at an elevation of roughly 800 feet above sea level. This survey area, which corresponds to the former Waialua Sugar Company's fields Kawailoa-21 and 22 (see Figure 9), contains three proposed turbine locations. It is accessed via Kawailoa Road. The northwestern survey area of the Eastern Tableland Array runs northwest across TMK:1-6-1-06:001 following a narrow tableland formation between the unnamed gulch and southwestern edge of the Kaiwiko'e Stream Gulch from an elevation of roughly 1,000 feet above sea level to an elevation of roughly 400 feet above sea level. This survey area, which contains fourteen proposed wind turbine locations, corresponds to the former Waialua Sugar Company's fields Waiamea-7 and 25 (see Figure 9). It is accessed by Ashley Road. Both survey areas in the Eastern Tableland Array contain a thick growth of Guinea grass (*Panicum maximum*) interspersed with albizia trees (*Acacia lebbek*) and other less frequently occurring species of trees, shrubs, vines, ferns, and grasses (Figures 16 and 17).



Figure 12. Southeastern survey area of the Western Tableland Array, view to the northwest from Kawaiiloa Road.



Figure 13. Southeastern survey area of the Western Tableland Array, view to the south from Kawaiiloa Road.



Figure 14. Central survey area of the Western Tableland Array, view to the southwest from the *makai* most tower location.



Figure 15. Northwestern survey area of the Western Tableland Array, view to the north from Ashley Road.



Figure 16. Southeastern survey area of the Eastern Tableland Array, view to the northwest.



Figure 17. Northwestern survey area of the Eastern Tableland Array, view to the northwest.

The Kawaioloa Road Corridor, which will be used to access the southeastern portion of both the Eastern and Western Tableland Arrays, follows an existing paved/gravel roadway from Kamehameha Highway (Hwy 83) to Drum Road (see Figures 1 and 2). Two alternate routes, following existing roads (Alternatives 1 and 2), were surveyed for the portion of the Kawaioloa Road Corridor that traverses the steep escarpment (*pali*) inland of ‘Uko‘a Pond. Both routes begin at Kawaioloa Drive, a nicely paved road that runs east (*mauka*) from Kamehameha Highway along the northern edge of TMK:1-6-1-02:001, across TMK:1-6-1-05:003, past the Kawaioloa Waste Transfer Station (TMK:1-6-1-05:018), to an intersection with Cane Haul Road where a gate blocks public access. This portion of the Kawaioloa Road Corridor, between the highway and the gate, will not be improved. From the gate the Alternative 1 survey area follows Kawaioloa Drive and the Alternative-2 survey area follows Cane Haul Road. Kawaioloa Drive (Alternative-1) continues southeast along the northern edge of TMK:1-6-1-02:001 and then makes a sharp horseshoe turn to the south as it traverses the *pali* and continues up slope to connect with the bottom of Kawaioloa Road on TMK:1-6-2-09:001. Cane-Haul Road (Alternative-2) crosses Kawaioloa Drive (see Cane-Haul Road Corridor description below) and runs south across TMKs:1-6-1-02:001 and 002 before turning northeast onto Hakina Bypass Road (Figure 18) near the boundary of TMK:1-6-1-02:003 and continuing up the *pali* formation to join with Kawaioloa Road on TMK:1-6-2-09:001, slightly *mauka* of the Kawaioloa Drive (Alternative-1) intersection. Both options then follow Kawaioloa Road as it runs east in a relatively straight line across TMKs:1-6-2-09:001, 1-6-2-11:001, and 1-6-1-07:001. A gate is present across Kawaioloa Road at an elevation of roughly 650 feet above sea level. Kawaioloa Road accesses the southeastern survey area of the Western Tableland Array, and continues on to the southeastern survey area of the Eastern Tableland Array off Drum Road at an elevation of roughly 1,200 feet above sea level. The Kawaioloa Road Corridor passes through the former Waialua Sugar Company’s fields Kawaioloa-4, 6, 7, 9, 10, 12, 17a, and 20 (see Figure 9), and passes through the former Kawaioloa Camp (see Figure 4). Vegetation along the edges of Kawaioloa Road consists primarily of Guinea grass (*Panicum maximum*), *koa-haole* (*Leucaena glauca*), and cultivated fields (Figures 19 and 20).



Figure 18. Hakina Bypass Road (Alternative-2 of the Kawaioloa Road Corridor), view to the southwest.



Figure 19. Kawaiiloa Road Corridor, middle section, view to the west.



Figure 20. Kawaiiloa Road Corridor, *mauka* section, view to the west.

The Cane Haul Road Corridor follows the existing gravel/paved alignment of Cane Haul Road north/south between Hakina Bypass Road (Alternative-2 of the Kawaioloa Road Corridor) and Ashley Road (see Figure 1). Cane Haul Road, which will be used by First Wind to access Mid-Line Road and Ashley Road from Kawaioloa Drive, runs at the base of the steep coastal escarpment and traverses TMKs:1-6-1-05:014, 019, 020, 021, and 022 (see Figure 2). It has two gates across it within the current project area; one at Ashley Road, and another on the north side of the intersection with Kawaioloa Drive (Figure 21). For most of its length, except at its northern end where it joins Ashley Road, Cane Haul Road follows the alignment of an older Waialua Sugar Company railway (see Figure 4). It is lined on either side, by a wire fence lines, and much of the land on both sides of the road was formerly, or is currently, used as pasture. Recently, a section of land on either side of Cane Haul Road (corresponding to TMKs:1-6-1-05:020, 021, and 022 located north of the Kawaioloa Road intersection) has been grubbed and graded and lined with walls of stacked boulders to create lots for residential development (Figure 22). With the exception of the recently developed area, vegetation along the edges of Cane Haul Road consists primarily of Guinea grass (*Panicum maximum*) and *koa-haole* (*Leucaena glauca*).

The Mid-Line Road Corridor, which will be used by First Wind to access four turbine locations of the Western Tableland Array, follows the existing gravel/paved alignment of Mid-Line Road (Figure 23) from Cane Haul Road to the middle survey area of the Western Tableland Array at an elevation of roughly 680 feet above sea level (see Figure 1). Mid-Line Road runs in a relatively straight line across portions of TMKs:1-6-1-05:001, 019 and 1-6-1-07:001 (see Figure 2), and it crosses the former Waialua Sugar Company's fields Kawaioloa-13,14, and 15 (see Figure 9). Only the western (*makai*) portion of this roadway (below the 440-foot contour), which passes through cultivated agricultural fields and feeds into a cross-road, is currently drivable. Above that elevation Mid-Line Road is completely overgrown and not drivable. Between the 440-foot contour and the 540-foot contour, which is marked by a drivable crossroad, the former road bed is lined by an earthen bank along its southern edge and a series of old power poles that follow its northern edge (Figure 24). Above the 540-foot contour the former route of Mid-Line Road is barely discernable through the thick growth of Guinea grass (*Panicum maximum*), *koa-haole* (*Leucaena glauca*), and stands of *albizia* (*Acacia lebbek*).



Figure 21. Cane-Haul Road Corridor, gate at Kawaioloa Drive intersection, view to the south.



Figure 22. Recent residential development along Cane Haul Road, view to the north.



Figure 23. Mid-Line Road Corridor, *makai* section, view to the east.



Figure 24. Mid-Line Road Corridor, view to the west from the crossroad at the 540-foot contour.

The Ashley Road Corridor, which will be used by First Wind to access the northwestern most portions of both the Eastern and Western Tableland Arrays, follows the existing gravel/paved alignment of Ashley Road (Figure 25) from the northern end of Cane Haul Road to the Eastern Tableland Array at an elevation of roughly 1,000 feet above sea level (see Figure 1). Beginning at Kamehameha Highway north of the northern end of Cane Haul Road, Ashley Road runs northeast along the boundaries of TMKs:1-6-1-08:025; 1-6-1-05:015, 016, and 019 as it traverses the steep coastal cliff formation. At the top of the cliff Ashley Road turns east and runs in a relatively straight line across TMKs:1-6-1-05:001 and 1-6-1-06:001 as it crosses the northwestern portion of the Western Tableland Array, accesses the proposed location of the O & M building and *mauka* point of interconnection, and continues on to northwestern portion of the Eastern Tableland Array near Drum Road (see Figure 2). The Ashley Road Corridor runs through the former Waialua Sugar Company's fields Waimea-1, 2, 6, 8 and 25 (see Figure 9), and passes by the location of the former Hawaiian Pineapple Company's (H. P. Co.) Waimea Camp (see Figure 4). Vegetation along the existing roadway consists primarily of Guinea grass (*Panicum maximum*), *koa-haole* (*Leucaena glauca*), *albizia* (*Acacia lebbek*), and a thick growth of non-native vines near its upper reaches.

The Makai Interconnection Facility Corridor consists of a proposed switch building (*makai* point of interconnection) and associated infrastructure located on TMK:1-6-1-05:001 at an elevation of roughly 160 feet above sea level with an access road that leads to it from Ashley Road beginning at an elevation of 280 feet above sea level (see Figures 1 and 2). The entire survey area falls within the former Waialua Sugar Company's field Waimea-1 (see Figure 9), and the access road mostly follows a former field road along the edge of a drainage. The entire area is overgrown with Guinea grass (*Panicum maximum*), but was mowed prior to the fieldwork (Figures 26 and 27).

The Overhead Collector Line Corridor consists of a 50-foot wide corridor that stretches across a tableland formation (at an elevation of roughly 600 feet above sea level) between the gulches bordering the Eastern and Western Tableland Arrays (see Figure 1). Within this corridor poles will be placed that will hold an overhead power line connecting the Eastern Tableland Array with the *mauka* point of interconnection. The corridor crosses TMK:1-6-1-06:001 (see Figure 2) and passes through the former Waialua Sugar Company's field Waimea-26 (see Figure 9). Aerial photographs indicate that this area was cultivated in pineapple during the second half of the twentieth century. Currently vegetation consists of a thick growth of Guinea grass (*Panicum maximum*), *koa-haole* (*Leucaena glauca*), and stands of *albizia* (*Acacia lebbek*).



Figure 25. Ashley Road Corridor, middle section, view to the west.



Figure 26. Makai Interconnection Facility Corridor at Ashley Road, view to the southwest.



Figure 27. Location of the *makai* interconnection facility, view to the southwest.

## BACKGROUND

Whereas at least the deeply dissected and flat-bottomed Waimea River valley to the north and the Anahulu River valley to the south contain intact remnants of Prehistoric and Historic Period Hawaiian occupation and use, the archaeological integrity of the interceding tablelands and the coastal plain behind Waialua Bay have for the most part been compromised by Historic Period ranching, cultivation, silviculture, military activities, and modern habitation. To generate a set of expectations regarding the nature of historic properties that might be encountered within the project area, and to establish an environment within which to assess the significance of any such resources, a general historical context for the region and previous archaeological studies conducted in the vicinity of the study area are summarized.

### Culture-Historical Context and Ahupua‘a Settlement Patterns

In an effort to provide a comprehensive and holistic understanding of the current study area and to generate a set of archaeological expectations, *ahupua‘a* specific archival and historical data along with the general settlement patterns for the Waialua District are presented. The current project area falls within Kawailoa Ahupua‘a (Figure 28), however Dega (1996:7-10) suggests that prior to the *Māhele* the area comprised by Kawailoa was traditionally identified as six *ahupua‘a*: Kapaeha, Punanue, Kuikuiloloa, Lauhulu, Kawailoa, and Pa‘ala‘a (Figure 29). Sahlins (1992:18) refers to the other five land units as *‘ili*. The *Māhele* of 1848 was an event marked by complex land transaction that often resulted in changed names and configurations; this report will refer to the single post-*Māhele* Kawailoa Ahupua‘a. Archaeologically and historically, Kawailoa Ahupua‘a contained important locations that were occupied both in the long and short-terms, and an outline of O‘ahu’s overall prehistory and history highlights the unique characteristics of Kawailoa Ahupua‘a.

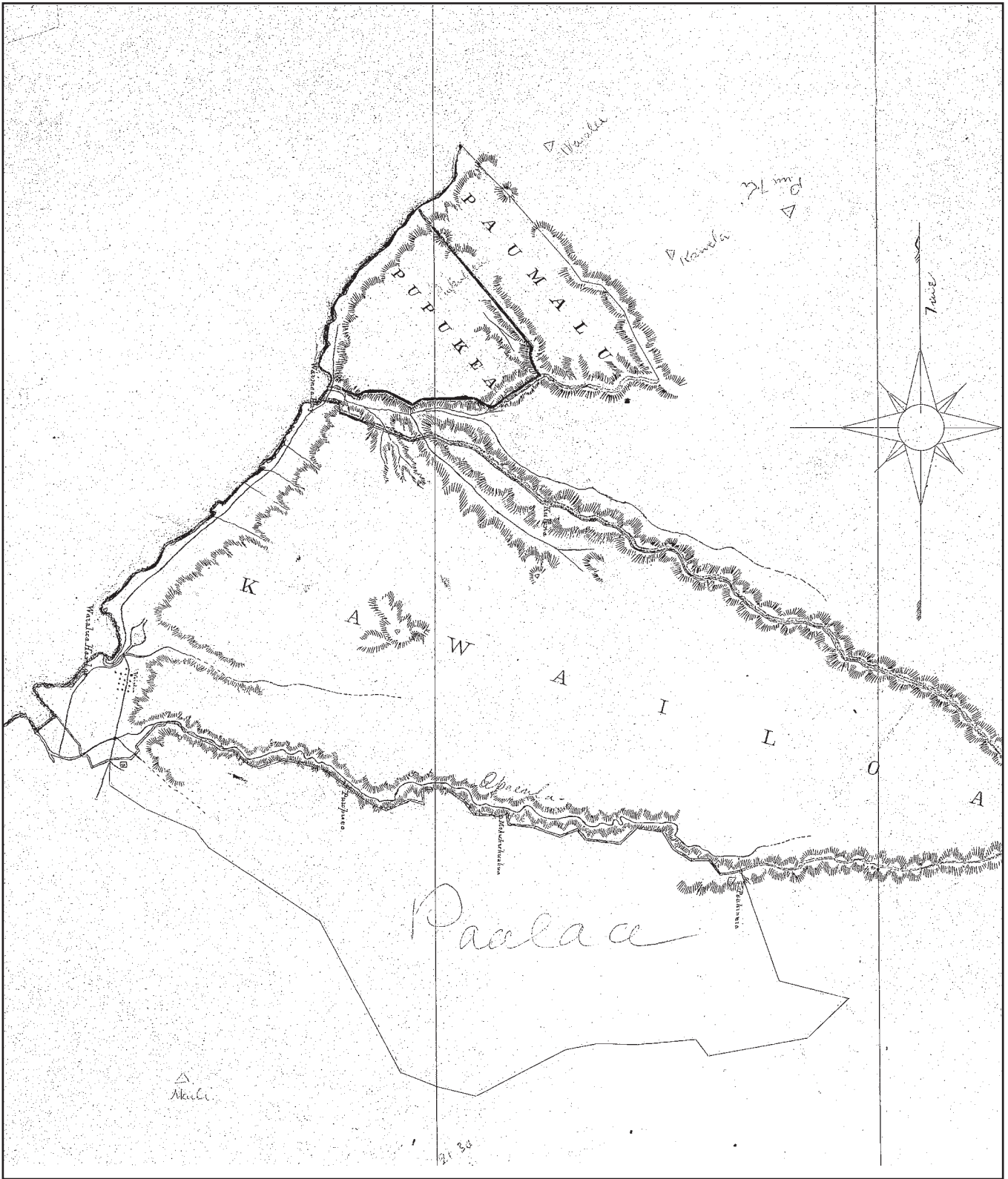


Figure 28. Portion of Hawai'i Registered Map No. 320 dated 1876.



## A Brief Overview of Hawaiian Settlement

A critical review of radiocarbon dates from the windward coast of O‘ahu suggest that significant settlement may not have begun until A.D. 1000, with a steady and rapid expansion up until the time of Western contact (A.D. 1778) (Kirch 2010; c.f. Stride et al. 2003). Settlement likely occurred from the Marquesas and Society Islands (Emory in Tatar 1982:16-18). In these times, Hawai‘i’s inhabitants were primarily engaged in subsistence level agriculture and fishing (Handy and Handy 1972:287). The Settlement Period was a time of great exploitation and environmental modification, when early Hawaiian farmers developed new subsistence strategies by adapting their familiar patterns and traditional tools to their new environment (Kirch 1985; Pogue 1978). Their ancient and ingrained philosophy of life tied them to their environment and kept order. Order was further assured by the conical clan principle of genealogical seniority (Kirch 1984). According to Fornander (1969), the Hawaiians brought from their homeland certain universal Polynesian customs: the major gods *Kane*, *Ku*, and *Lono*; the *kapu* system of law and order; cities of refuge; the ‘*aumakua*’ concept; and various beliefs, including the concept of *mana*.

Following initial settlement, communities in O‘ahu were clustered along the shores which offered sheltered bays from which deep sea fisheries could be easily accessed. The near shore fisheries and coastal fishponds, which were enriched by nutrients carried in the fresh water, also offered opportunities for resource extraction and stewardship. It was in these coastal areas that clusters of houses were found, and where agricultural production first became established. Over a period of several centuries, these areas became populated and perhaps even crowded, and inland elevations began to be used for agriculture and some habitation. Taro would have been the dominant crop in this area with sweet potatoes planted only as a supplement for it (Handy and Handy 1972:282-283). Other crops would have included *wauke*, *noni*, gourds, sugarcane, ‘*awa*, breadfruit, bananas, coconuts, and *ti* (Stride et al. 2003).

The period between A.D. 1400–1650 was characterized by increased social stratification, major socioeconomic changes, and intensive land modification (see Kirch 1985). Most of the ecologically favorable zones of the windward and coastal regions of all major islands were settled and the more marginal leeward areas were being developed. The concept of the *ahupua‘a* was established during this period (Kirch 1985). This land unit became the equivalent of a local community, with its own social, economic, and political significance. *Ahupua‘a* were ruled by *ali‘i ‘ai ahupua‘a* or lesser chiefs; who, for the most part, had complete autonomy over this generally economically self-supporting piece of land, which was managed by a *konohiki*. *Ahupua‘a* were usually wedge or pie-shaped, incorporating all of the eco-zones from the mountains to the sea and for several hundred yards beyond the shore, assuring a diverse subsistence resource base (Hommon 1986).

The *ali‘i* and the *maka‘āinana* (commoners) were not confined to the boundaries of the *ahupua‘a*; when there was a perceived need, they also shared with their neighbor *ahupua‘a ohana*. The *ahupua‘a* was further divided into smaller sections such as the ‘*ili*, *mo‘o‘aina*, *pauku‘aina*, *kihapai*, *koele*, *hakuone*, and *kuakua* (Hommon 1986, Pogue 1978). The chiefs of these land units gave their allegiance to a territorial chief or *mo‘i* (king). *Heiau* building flourished during this period as religion became more embedded in a sociopolitical climate of territorial competition. Monumental architecture, such as *heiau*, “played a key role as visual markers of chiefly dominance” (Kirch 1990:206).

The *ali‘i-‘ai-ahupua‘a* was subject to an *ali‘i ‘ai moku* (chief who claimed the abundance of the entire district). Accordingly, *ahupua‘a* resources supported not only the *maka‘āinana* and ‘*ohana*, who lived on the land, but also contributed to the support of the royalty. This form of district subdividing was integral to Hawaiian life and was the product of strictly adhered to resources management planning. In this system, the land provided fruits and vegetables and some meat in the diet, and the ocean provided a wealth of protein resources. Also, in communities with long-term royal residents, divisions of labor (with specialists in various occupations on land and in procurement of marine resources) came to be strictly adhered to. It is in the general cultural setting outlined above, that we find the *ahupua‘a* of Kawailoa at the time of European contact.

### Indigenous Accounts of Kawailoa and Neighboring Ahupua'a

The current study area is located in the *ahupua'a* of Kawailoa, District of Waialua, Island of O'ahu. Kawailoa is a large *ahupua'a* that occupies the northwestern corner of O'ahu, stretching from the ocean to the Ko'olau mountains. It includes coastal areas rich in fish, a fertile coastal plain, and prominent river valleys (the coastal plain and river valleys are mostly *mauka* of the present day Kamehameha Highway) with numerous rivers, wetlands, and ponds. 'Uko'a and Loko'ea are two well-known ponds located on the coastal flats *makai* and west of the project area. A low escarpment juts up above the coastal flats *mauka* of the ponds and increases in height northwards in the direction of Waimea Bay, where it becomes a sizeable rock cliff with numerous caves. *Mauka* of this basalt ridge, dissected tablelands rise gently toward the Ko'olau mountain range, the ridge line of which serves as a border with the neighboring district of Ko'olau Loa.

Kawailoa Ahupua'a, and many of the places named within it, have traditional legends and historical accounts associated with them. The Waimea River valley to the north and the 'Uko'a Pond *makai* of the project area are particularly associated with legends. The prolific legends most likely relate to this area's long-standing association with very old lines of prominent priests on O'ahu. Whereas the story of the Waimea River valley immediately north of the project area is one based mainly on accounts of the royalty and priestly class, that of the Anahulu River valley to the south is one based primarily on archaeological remains and mid-eighteenth century historical documents. This does not imply, however, that no archaeology or historical documentary research has been done in the Waimea area or that no traditional accounts exist for the Anahulu area. The following discussion starts with a broad historical background of the northern portion of the project area before moving to the record that exists for the area farther west and south.

In the legends of the *ali'i*, the Waimea area is connected originally with the Paoa class of *kahuna*. A pig-like deity, known as Kamapua'a, first gave the Waimea lands to a *kahuna*, known as Lono-a-wohi (Kamakau 1961:230-231). Later on, a certain Kahi-'ula and the older brothers of a certain Kanaua'a, gave the land to the Paoa *kahuna* of the area in perpetuity. However, with the reign of Chief Kahahana, the lands went to the *kahunanui* who were selected by Kahekili in 1783 and later by Kamehameha in 1795. Following King Kamehameha's conquest of O'ahu Island, he gave Waimea to his own high priest, Hewahewa. Hewahewa was the only priest to practice at the Waimea *heiau* who came from outside the area. He was also the last high priest of the Hawaiian kingdom (Mitchell 1986:8).

By the seventeenth century, King Kualii asserted his power over the priests at Waimea as part of his successful campaign to unify the entire Island of O'ahu. Following unification, Kualii continued to rule with the aid of the *kahunanui*. *Kalaimoku* was a special category of *kahunanui* that advised chiefs concerning secular matters. A well-known *kalaimoku* from Waimea, known as Kaepulupulu, became a prominent adviser to powerful rulers, first to Chief Kamahana and later to Chief Kahahana from the Island of Maui. However, the prophetic abilities the charismatic Kaepulupulu lead to his fall-out with both these corrupt chiefs; by 1773 Chief Kamahana was removed in a bloodless coup, while later on the new Chief Kahahana had Kaepulupulu executed (Fornander, II 1969:129). During all this political intrigue that affected the entire Island of O'ahu, Kaepulupulu officiated at both of the prominent *heiau* at Waimea; one being Puu'O'Mahuka on a high bluff north of where the river enters the ocean and the other being Kupopolo near the beach south of the river mouth (Takemoto 1974:5).

Of the two *heiau*, more orally-transmitted information is available for the massive Puu'O'Mahuka than for the smaller Kupopolo. Bingham (McAllister 1933:148) recorded a tradition that huge fires lit on an altar at Puu'O'Mahuka can be seen as far as the Island of Kauai. The same tradition also claims that this *heiau* was the birthplace of prominent *ali'i*. It is said that the much smaller Kupopolo *heiau*, like Puu'O'Mahuka, was used for human sacrifices, among other activities (Luter 1938:29-30).

Considering that many stories centered on fishing in the adjacent ocean, numerous mentioning the fishing deity Kaneaukai, it is conceivable that at least some sacrifices at Kupopolo *heiau* related to fishing deities. There are two stones, one on each bluff above Waimea Bay, named after fishing deities known as Ku and Ahuena (McAllister 1933:150). Being variations around a common theme, the stories related to Kaneaukai, Ku, and Ahuena, all mention fishermen either dreaming of or actually netting a stone from the nearby ocean. In exchange for offerings of 'awa and/or pigs to the stones, the stones reciprocated by

ensuring that the fishermen, including commoners and priests, will be successful in their acquisition of fish (see selected stories in Takemoto 1974:18, 22-27, 29-32, 41). Whereas fish from the ocean supplied life to those working the land, shrines, or *ko'a*, were constructed on land to increase the number of fish in the ocean. Being located at the transition between fertile agricultural soils within the Waimea Valley and rich fishing waters of Waimea Bay, the *heiau* and *ko'a* were physical expressions of the reciprocal relationship that land and sea had for the Hawaiians.

Numerous caves within the high cliffs that separate the bluff-sides of Waimea Valley from the ocean below contained human remains and associated burial goods, including canoes and *tapa* cloth (Takemoto 1974:38-40). The sea-side cliffs marked the line of transition between the land of the living and the land of the dead, the latter being the ocean, also known as *Pō*. The fertile soils of the valley and the water of the river could be modified through human action to form cultivatable terraces and irrigation channels. Prior to the arrival of Europeans to the area, the valley was known for its taro, sweet potatoes, *'awa*, and breadfruit. Following his visit to the Waimea River Valley, McAllister (1933:147) reported the remains of agricultural terraces on both sides of the river for up to a distance of two miles inland from the bay. Irrigation ditches and numerous housing enclosures support Historic Period observations that the valley around Waimea Bay was once heavily populated. Based on claims made to the Land Commission in the mid-nineteenth century, most of the *kuleana* were within the level bottomlands, not far from the coast, although a few occurred near the elevated tablelands over a mile inland from Waimea Bay (Handy and Handy 1972:463).

The narrow coastal plain at Waimea Bay, around 250 meters wide, broadens to approximately 1.5 kilometers wide farther south behind Waialua Bay. According to the records of Thrum (1906) and McAllister (1933), the broader and flatter landscape around Waialua Bay was marked by ponds, irrigated pond fields, irrigation ditches, various *heiau*, and *akua* stones (Kirch 1992:18). Indigenous Hawaiian accounts mention a lizard-like female deity, known as Lanawahine, that used to live in the 'Uko'a pond. The pond was her "long house," connected to the ocean via a narrow tunnel.

Farther south, on Kaiaka Bay, a prominent legendary *heiau*, known as Kapukapuakea, was reputedly the place where high priests inaugurated Ma'ilikūhāhi as paramount chief over the area. If Waimea Bay is primarily remembered for its line of indigenous priests, Waialua Bay is known for its line of indigenous chiefs. Traditional orally transmitted accounts from the Waialua area claim that the Kapukapuakea *heiau* was constructed by *menehune*, the little people of legend (Sahlins 1992:21). Normally seen in visions and dreams, these imaginary people were believed to have built numerous other monumental structures on O'ahu and neighboring islands within the Hawai'i Archipelago.

It was in the highlands southeast of Waialua that the original and indigenous Nanāulu line of chiefs, within which Chief Ma'ilikūhāhi was an early one, is believed to have been born. On the watershed near the present-day Schofield military base was the Kūkaniloko temple, a place that contained a sacred birth stone against which royal women gave birth to future chiefs (Sahlins 1992:23). The line of indigenous chiefs came to an end when King Kahekili from Maui killed Chief Elani of Waialua at Puaena Point on the northern edge of Waialua Bay (Sahlins 1992:25). The new rulers from the Windward Islands, such as Kahekili and later Kamehameha, continued to use the places sacred to the indigenous population in their ceremonies, including the *heiau* in the vicinity of Waialua and Waimea bays.

#### **Historical and Archaeological Accounts of Kawailoa and Neighboring Ahupua'a**

Soon after going ashore at Waimea Bay in 1779, Captain Clerke walked up the Waimea River valley, which he described as "well cultivated and full of villages" (Kuykendall 1938:12-20). When the crew of Captain Vancouver went ashore at Waimea Bay to replenish their water supply in 1792, they allegedly saw an "amphitheater, with hamlets, trees, and plantations" (Brigham 1849: 295). According to local oral traditions, the bodies of two of the crew members of Vancouver's, who were killed by Waimea Bay inhabitants, were taken to Puu'O'Mahuka *heiau* where they were burned and de-boned (Thrum 1912). The chief at Waimea at the time of this incident was the warrior priest Koi.

Roughly 1.5 miles southwest of Waimea Bay are the well-known fish ponds of 'Uko'a and Loko'ea. Unlike the fairly densely populated Waimea Bay area, the ponds, being located close to Waialua Bay, have no prominent habitation sites associated with them (Athens et al. 1995:21). Two separate boulders on the nearby coastline are the closest archaeologically recorded sites; one was used to block the mouth of the Anahulu River and the other was believed to possess curative powers. Moore et al. (1993:70) found three isolated fire pits on the Hale'iwa Beach Park, the charcoal radiocarbon dates averaging to the mid-sixteenth

century. This post-dates by roughly six centuries charcoal evidence from 'Uko'a pond for initial human clearing of the surrounding indigenous coastal forests (Athens et al. 1995:iii). Fish, ducks, and bulrushes used to be abundant within 'Uko'a pond. Although it contained abundant fish, there is no mention in the historical record or any archaeological evidence that the pond was ever enhanced or modified through the construction of walls, gates, or canals (see discussion in Athens et al. 1995). Historic sources, dating back to 1815, describe 'Uko'a pond as the property of the *ali'i*; fish could only be taken out with the local chief's permission (Athens et al. 1995:23-24). However, Land Commission Award documents suggest that by the time of the *Māhele* in 1848, royal control over fishing rights in the pond were virtually non-existent. At this time the *makai* edge of the pond contained seven small house sites and communally cultivated sweet potato plots (Athens et al. 1995:26). Four households made claim to aquatic resources in the pond, which included gobey, surgeon, mullet, fresh water shrimp, and seaweed.

Generally speaking, the coastal lands southwest of the project area and southeast of Waimea Bay were occupied by houses, occasional fishponds, and small cultivation plots containing taro and sweet potato (e.g., Pfeffer and Hammatt 1992:27). *Mauka* of the coastal plain, irrigated taro fields were created in the bottoms of river valleys, such as those within the Anahulu River valley. Higher up the valley slopes were hillside, or *kula*, cultivation of crops and trees. Isolated pockets of planted areas occurred even higher up in the narrower confines of the valleys and their numerous tributaries. Families owned plots in these different zones so that they could utilize the diverse resources. At the very high end of the river valleys Hawaiians collected a variety of wild plants and hunted birds.

Kirch (1992) originally suggested that it is only after the armed forces of Kamehameha I permanently occupied O'ahu in 1804 that the interior of the Anahulu River valley became used and modified more intensively, which included the construction of irrigation canals and terraced fields for as much as three miles up the valley that had up until then only experienced low-intensity cultivation and resource extraction. However, in a more recent reevaluation of dates and sites in Anahulu valley (Dega and Kirch 2002), it is suggested that during the late A.D. 1700s the upper portions of Anahulu valley were abandoned and the middle and lower portions of the valley were the loci of agricultural and residential activity.

By 1810, some 20 years after sandalwood was first exploited on the Hawaiian Islands, King Kamehameha I, and subsequently various powerful chiefs, gained monopoly over the sandalwood trade. Judging from historical documents, people living in the Waialua area were known for cutting sandalwood in the interior mountain forests. In a scramble to obtain foreign goods, chiefs in the area had commoners work very hard to cut and transport the sandalwood to the coast (Kirch 1985:314). Preoccupation with sandalwood extraction resulted in the abandonment of several residential homesteads in the upper Anahulu valley. The return of Kamehameha I with his court to Hawai'i Island in 1812 led to additional abandonment; by 1820 the upper valley was almost deserted.

With the complete collapse of the sandalwood trade in 1829, chiefs who accumulated debt fell back to an earlier strategy of supplying provisions and other materials, such as *wauke* bark for caulking, to visiting ships, especially whalers (Kirch 1985:314). In the early 1830s the *konohiki* in the Waialua area gave land to cultivators with the aim of once again increasing the agricultural output of the area. Archaeological evidence suggests that previously abandoned terraces and canals were re-used and re-arranged to accommodate the newly placed cultivators. Taro, yams, bark cloth, and sweet potatoes were important products aimed to supply ships.

A variety of stone features have been identified on the colluvial and talus slopes of the Anahulu valley uplands. Among these are stone piles, stone walls, stone-lined planting circles, small stone-walled garden plots, and terraces cleared of talus. Judging from *Māhele* documents, these features were probably related to the growing of sweet potato, paper mulberry, yam, and banana (Kirch 1992:174). Handy and Handy (1972:86) maintain that the dry gulches between Anahulu and Waimea Rivers (those within the project area) probably never watered taro.

It is likely that cultivators within the Anahulu valley used the rich tablelands on both sides for shifting cultivation even prior to the settlement of Europeans in the area. In *Māhele* land claims, for example, some of the upper valley claimants refer to swidden-like garden plots in the flat portions of mountains, which could refer to the surrounding tablelands (Kirch 1992:23). Moreover, maps of land claims in upper portion of the valley, known as Kawailoa-uka, show winding trails connecting valley bottom residences and terraced fields with tableland top ridge spurs (Kirch 1992:51). By 1832 missionaries were operating from near the mouth of the

Anahulu River. The increased influence and presence of European ideas and material culture is testified by recovery of glass bottles, musket balls, and iron tools from excavations from the inland house sites (Kirch 1985:314).

The *Māhele* of 1848 marked irreversible changes in the make-up of the traditional Hawaiian political-economy. By the middle of the nineteenth century the ever-growing population of Westerners forced socioeconomic and demographic changes that promoted the establishment of a Euro-American style of land ownership, and the *Māhele* became the vehicle for determining ownership of native lands. During the *Māhele*, land interests of the King (Kamehameha III), the high-ranking chiefs, and the low-ranking chiefs, the *konohiki*, were defined. The chiefs and *konohiki* were required to present their claims to the Land Commission to receive awards for lands provided to them by Kamehameha III. They were also required to provide commutations to the government in order to receive royal patents on their awards. The lands were identified by name only, with the understanding that the ancient boundaries would prevail until the land could be surveyed. This process expedited the work of the Land Commission (Chinen 1961:13). During the *Māhele* all lands were placed in one of three categories: Crown lands (for the occupant of the throne), Government lands, and *konohiki* lands. All three types of land were subject to the rights of the native tenants therein, who could make claims for property they occupied and/or farmed. The native tenant awarded lots are referred to as *kuleana* parcels.

As a result of the *Māhele*, Kawailoa Ahupua‘a was a *konohiki* award to Victoria Kamamalu as LCA # 7713:33, thus ownership eventually fell to the Bishop Estate (now Kamehameha Schools). According to the Waihona ‘Aina database there were ninety-five *kuleana* claims made for Kawailoa Ahupua‘a. Most of these were for land *makai* of the project area and in Anahulu Valley (Figure 30), however, Cane Haul Road, which follows a former railway alignment, traverse five small *kuleana* parcels (LCA # 2727, TMK:1-6-2-02:002; LCA # 10364:2, TMK:1-6-1-05:020; LCA # 8419:1, TMK:1-6-1-05:021; LCA # 7417:1, TMK:1-6-1-05:022, LCA # 7169, TMK:1-6-2-02:3 (por.)). All five of these *kuleana* were house lots obtained during the time of Kamehameha I (post 1795). The locations of all five of these lots afforded the residents access to fishpond resources as well as *kula* planting areas. A sixth *kuleana* parcel (LCA # 8304:3) with a similar land use history as the other five is traversed by Kawailoa Drive.

The change from a labor-based barter system to one based on taxes and money accompanied the division of land during the *Māhele*. The formerly close socio-economic ties between the *ali‘i* and the *maka‘āinana*, that revolved around land rights and tribute, rapidly dissolved. The *maka‘āinana* cultivators increasingly entered the cash economy to pay taxes and meet other obligations. This disintegration of the traditional socio-economic fabric is reflected by the abandonment of house sites, terraced plots, and irrigation ditches in the middle and upper Anahulu valley by 1890.

That the project area has been used for a variety of purposes, including pasture for cattle, becomes evident when historical records are reviewed. Whereas pigs, dogs, and fowl were the main supply of meat for Hawaiians, cattle were brought to the islands in 1798 to supply visiting whaling ships with meat. During the 1830s and 1840s, numerous cattle herds grazed the uplands of the Waialua District (Wyllie 1848:23), most belonging to Robinson and Company. Cattle became a scourge by 1845, damaging houses and garden plots within the Anahulu River valley and degrading indigenous plant life on the adjacent tablelands (Kirch 1992:169).

If the history of the coastal Waimea Bay and Waialua Bay areas focuses on priests and rulers, that of the Anahulu Valley concerns commoners. The *Māhele*-era records show that many of the *maka‘āinana* cultivators were awarded core taro lands within their ancestral estates, the Land Commission generally did not consider the commoners’ dispersed dry land plots (*kula*) or their swidden garden sites (*‘okipū*). This loss of “peripheral” land holdings following the *Māhele* was exacerbated by the emergence of a cash-based economy. Commoner land owners now had to pay cash for land surveys, annual taxes, and implements. It is accordingly not surprising that commoner households in the middle and upper Anahulu valley faded during the 1860-80s (Kirch 1992:167). Most indigenous Hawaiians did not stay on the land after 1900. Intermittent, but severe floods, such as those that occurred in 1894 and 1898, wiped out numerous features in the lower river valleys, particularly above Waimea Bay (Takemoto 1974:12-13).

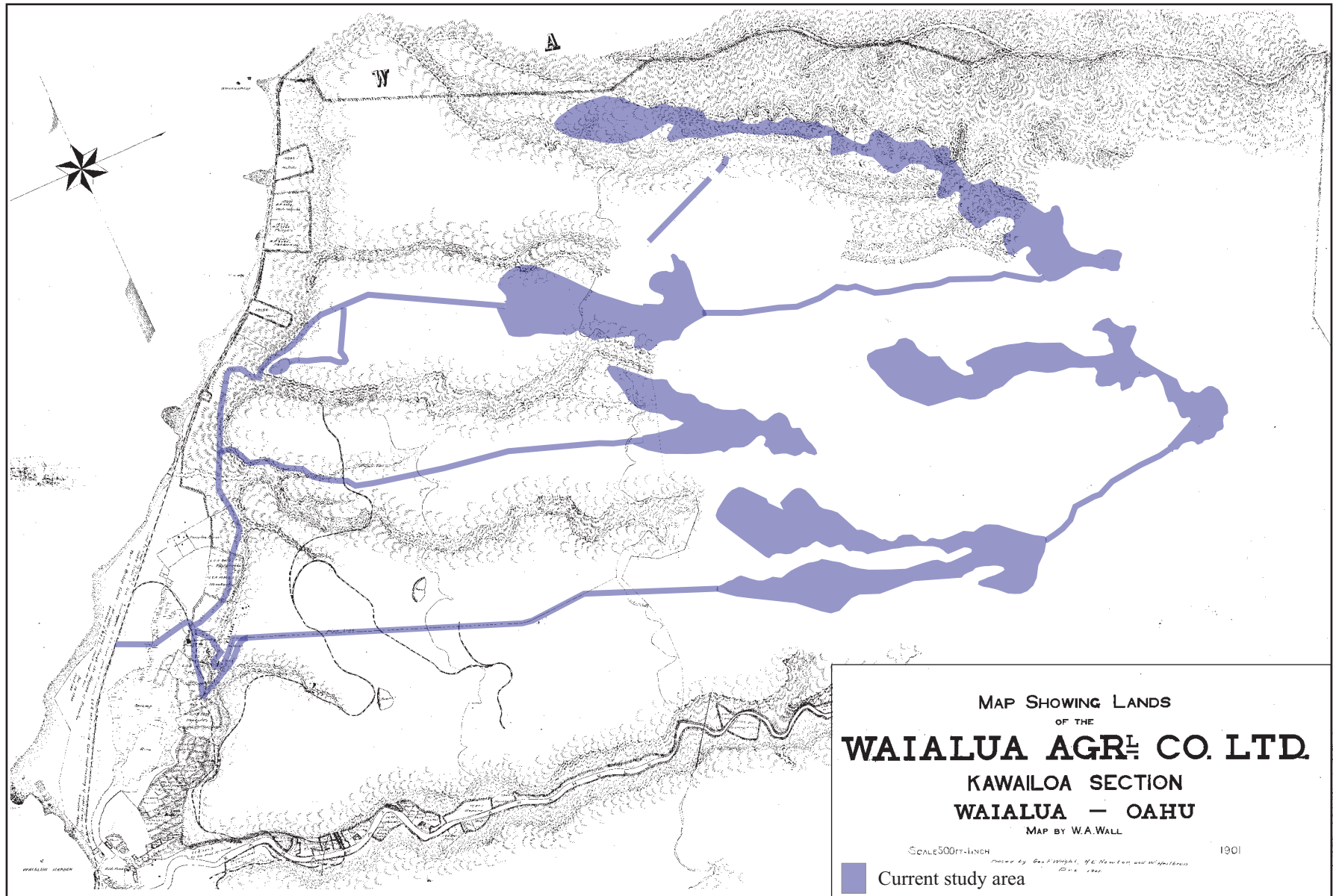


Figure 30. Portion of Hawai'i Registered Map No. 2054 of the Waialua Agricultural Co. lands (prepared by W. Wall in 1901) showing kuleana parcels and the current study area.

### The Sugar Era in Kawailoa Ahupua‘a

A Chinese merchant is credited with the first making of sugar in the Hawaiian Islands in 1802 (Deerr 1949). The first sugarcane milled in the Waialua area dates to ca. 1840 and the missionary Rev. John Emerson, who set up a small mill powered by horses that made sugar and molasses for the natives on shares (Kuykendall 1938). The first commercially grown sugar in Waialua can be traced back to the Levi and Chamberlain Sugar Company in ca. 1865 (Wilcox 1996). In 1875 the sugar plantation at Waialua was purchased by R. Halstead and Gordon, and later owned by the Halstead brothers. In 1898 when the Oahu Railway and Land Company’s (O. R & L. Co.) railroad reached the Halstead brother’s plantation at Waialua, the small mill did not produce much freight and large tracts of the surrounding land remained uncultivated (Dorrance and Morgan 2000). Benjamin Dillingham, who founded the O. R & L. Co., encouraged Castle & Cooke to purchase the Halstead brother’s plantation. In that same year, Castle & Cooke formed the Waialua Agricultural (later changed to Sugar) Company primarily on lands leased from the Bishop Estate and Dillingham (Dorrance and Morgan 2000). Castle & Cooke hired William Goodale from the Onomea Plantation on Hawai‘i Island as the first plantation manager.

Goodale described the plantation's humble beginnings in his final report as manager, writing that, “at the time Waialua Agricultural Co., Ltd., was organized in October, 1898, it took over the old Halstead Plantation with about 600 acres of cane, certain leases of large tracts of unimproved land covered with lantana and stones, several hundred acres of rice and ranch land, a small mill, one five million gallon pumping station, no reservoirs or railroads, one small set of steam plows and other equipment of a small plantation” (Goodale in Clark 2007:57). Early in the plantation’s history sugarcane did not extend higher than the 200-foot contour above sea level.

In the first years of ownership Castle & Cooke expanded the acreage of the plantation, built a new mill, put in a railway system, and developed a reliable water supply, utilizing both ground and surface water (see Figure 30). The strategy resulted in sugar yields increasing from 5,000 tons in 1900 to nearly 20,000 tons in 1905 (Wilcox 1996). The northern portion of the project area was part of the plantation’s Waimea fields, and the southern portion was part of the plantation’s Kawailoa fields. A 1901 map of the Waialua Agricultural Company’s lands in Kawailoa (Hawaii Registered Map No. 2054B; see Figure 30) shows ditches paralleling the 300-foot and 500-foot contours, a railway extending from the main O. R & L. Co. line along the coast into the Kawailoa fields (in the vicinity of the Kawailoa Road and Cane Haul Road Corridors, stretching to the Mid-Line Road Corridor), a collection of buildings and water tanks (an early plantation camp) located above the *pali* and along the railroad tracks in the vicinity of Kawailoa Road Corridor, a pump house (Pump # 4) with a waterline running to the upper ditch line (following the Kawailoa Road corridor), and two reservoirs.

Above the sugarcane fields in Kawailoa pineapples were grown, and below the *pali*, in the swampy areas surrounding ‘Ukoa Pond, rice was grown. The sugar and pineapple companies modified and utilized most of the land within the project area, clearing original vegetation, leveling original landforms, digging ditches, constructing reservoir walls, and building roads and railroads. Substantial amounts of foreign laborers (mostly Chinese, Filipino, and Japanese) were imported to work the fields, with labor camps dotting the landscape (e.g., Pfeffer and Hammatt 1992:36). Many of the *mauka* lands were leased to the Hawaiian Pineapple Company, which was founded by James Dole in 1901. The Waialua Agricultural Co. and Hawaiian Pineapple Co. operated in such close proximity to one another that the field boundaries often changed. Castle & Cooke purchased a 21% share of the pineapple company in 1932, and the entire company in 1961. The name of the company was changed to Dole Food Company, Inc. in 1991.

Waialua Agricultural Company had the largest water storage capacity in Hawai‘i, and arguably the most efficient irrigation system. The distribution system was especially flexible with interconnected ditches that allowed water to be sent to any part of the plantation (Wilcox 1996). The Waialua Agricultural Company also had steam and electric powered pumping stations that sent groundwater from wells in the lower elevations of the plantation to the ditches in the upper elevations (Wilcox 1996). Developed between 1902 and 1911 the plantation had four surface water collection systems — the Wahiawa, Helemano, Opaaula, and Kamananui systems. The lower fields in the vicinity of the current project area were initially watered by Pump # 4 and the Opaaula ditch system, but were later watered by the Kamananui ditch system. The Opaaula Ditch, which carried water from the tree main tributaries of the Anahulu River (Kawainui, Opaaula, and Kawaiiki Streams) to the Opaaula and lower Kawailoa fields, was completed in 1903.

Construction of the Kamananui Ditch, which tapped Kawainui Stream at a higher elevation and carried water to the lower Waimea and upper Kawailoa fields, began in 1903, but was not completed until 1911 (Goodale 1911, 1912).

On February 3, 1911, in the Waialua Agricultural Co. annual report for the year 1910, W. W. Goodale, reported that:

[Kamananui Ditch], referred to in the Annual reports of the years 1902, 1904 and 1909, was commenced in 1903, but abandoned in 1904. At that time 1,068 feet of tunnels had been excavated. On June 10, 1910 we began work again and have carried it on as rapidly as possible since that time.

The ditch will deliver the water of the Kamananui stream at a point at a point 669 feet above sea level on the upper lands of Kawailoa and on the line of the ditch that crosses the plantation carrying the water from the Wahiawa reservoir.

The ditch is 20, 175.5 feet long, with 17,852.5 feet of tunnels, 325 feet of flume and 1,998 feet of open ditch.

On December 31, 1910, 13,832.5 feet of total length, had been completed leaving 6,343 feet unfinished. The entire cost of the work will be about \$69,628.00, of which amount \$35,561.00 had been paid on December 31, 1910. Water should be running in the ditch on or about May 1, 1911. (Goodale 1911:4)

The Kamananui Ditch was actually completed on December 7, 1911 at a total cost of \$76,963.81. From the outset it carried an average of 2,188,471 gallons of water a day to the Kawailoa fields (Goodale 1912). For the year 1910 it was reported that “the Opaepa Ditch system delivered during the year 2,112,401,438 gallons of water, used entirely on Kawailoa” (Goodale 1911:4). The Kamananui ditch system was redesigned and realigned in the mid-1920s to increase its water carrying capacity and to allow it to function independent of the Opaepa ditch system (Wilcox 1996). Due to the innovative efforts of Goodale, a self-propelled drag-line excavator was digging new ditches by 1920. The same machine could also lift harvested cane bundles onto railway cars in the field (Dorrance and Morgan 2000).

When William Goodale retired in 1923, after 25 years as the plantation’s manager, he summarized the growth of the Waialua Agricultural Company in the annual report for that year, writing “we now have 70 million gallons per day pumping capacity, 30 miles of permanent railway, the Wahiawa reservoir, capacity 2,540,000 gallons, and 33 other reservoirs, ditches to bring the water to Poanoho, Halemano, Opaepa, Kawaiiki, Kamananui and Waimea gulches, a good mill, six locomotives, cane cars, six plow engines and plows, tractors, trucks, buildings, and about 9,000 acres of cane” (Goodale in Clark 2007:57-58). Goodale had also installed a 450-kilowatt hydroelectric plant in the uplands of Kawailoa that supplied not only plantation’s needs, but when excess energy was produced, it was sold to the Hawaiian Electric Co. (Dorrance and Morgan 2000). Goodale’s management had made the Waialua plantation one of the most productive in the Hawaiian Islands. In 1925, shortly after his retirement, sugar production had grown to 32,585 tons annually (Dorrance and Morgan 2000).

A 1924 Hawai’i Territory Survey map of the Kawailoa Forest Reserve prepared by C. Murray (HTS Plat 2069; Figure 31) shows the upper limits of the sugarcane fields near the 650-foot contour in the Kawailoa fields and the 400-foot contour in the Waimea fields. The upper Waimea and Kawailoa fields in the northern section of the plantation are shown as planted in pineapples and the upper fields in the southern section of the Kawailoa tablelands (along the Kawailoa Road Corridor) are shown as a eucalyptus forest. Eucalyptus was first introduced from Australia by the Waialua Agricultural Company in the late nineteenth century to counteract deforestation and erosion caused by cattle (Kirch 1992:169). Eucalyptus and other trees were also planted by the plantation as sources of lumber, fencing, and firewood (Goodale 1911, 1912). Drum road, and portions of all three of the project area roads appear on the HTS Plat 2069 map (see Figure 31). Ashley Road closely matches its current alignment, Mid-Line Road is present to the first crossroad near the 440-foot contour, and Kawailoa Drive (Alternative-1 of the Kawailoa Road Corridor) has been built, but only the upper portion of Kawailoa Road, between the upper limits of the sugarcane fields and Drum Road, matches its current alignment.



In 1924 the largest camp in the Kawaiiloa section of the plantation is shown between Mid-Line Road and Ashley Road (see Figure 31). Other camp buildings at this time are located along Kawaiiloa Drive inland of the buildings depicted on the 1901 map of the Waialua Agricultural Company's Kawaiiloa Lands (see Figure 30). These buildings are part of the Kawaiiloa Japanese Camp. One of the buildings is undoubtedly the Kawaiiloa Ryusenji Soto Mission, which was established in 1904 on land provided by the plantation for that purpose (Clark 2007). By 1929, as shown on the U.S.G.S. Hale'iwa and Kaipapau quadrangles (see Figure 4), the camp between Ashley Road and Mid-line Road (Camp 8) has remained the same, but "Kawaiiloa Camp", stretching across the Kawaiiloa Road Corridor, has grown exponentially. This large camp actually comprised the Waialua Agricultural Company's Camps 2, 3, 4, 5, and 6. Kawaiiloa Camp was the largest of the company's villages, which were spread across the plantation to allow workers to walk to the fields. The majority of the residents at Kawaiiloa Camp were Japanese. At its height the camp included over 500 homes, an elementary school, a gym, a swimming pool, a theater, two stores, two barber's shops, three community *furo*, a Japanese-language school, and a Buddhist temple (the Kawaiiloa Ryusenji Soto Mission) (Clark 2007). The plantation built and maintained the homes, but the residents paid monthly rent, and they were owned by the Bishop Estate. A third camp shown along Ashley Road at an elevation of 600 feet above sea level on the 1929 map (see Figure 4) was not depicted on the 1924 map (see Figure 31), and may have been constructed during the intervening time period. This camp (Figure 32), known as the Waimea Camp, was operated by the Hawaiian Pineapple Company until it was removed in ca. 1960.



Figure 32. Aerial photograph taken on June 4, 1951 showing the Waimea Camp along the southern edge of Ashley Road.

In addition to the plantation camps, the 1929 U.S.G.S. quadrangle (see Figure 4) also shows irrigation ditches following contours at roughly every 100-foot change in elevation up to about the 650-foot contour in the Kawaiiloa fields and the 400-foot contour in the Waimea fields, with water pipes (siphons) connecting the various ridgelines, and reservoirs feeding into ditches that are oriented upslope/downslope (see Figure 4). The project area road corridors not yet built are Hakina Bypass Road (portion of Kawaiiloa Road Corridor Alternative-2), and the northern end of Cane Haul Road. The southern portion of Cane Haul Road follows the Waialua Agricultural Company's rail lines. Ditches are shown following the edges of sections of Kawaiiloa Road and Mid-Line Road. Rice paddies are still shown in the swampy area surrounding 'Uko'a Pond. By 1936 improved irrigation and infrastructural development at the plantation had drastically increased sugar production output, which reached 54,671 tons in that year (Dorrance and Morgan 2000).

Prior to the United States involvement in World War II (WWII) the Hawaiian Defense Project revision of 1939 set into motion a large-scale modernization of the defenses of the Hawaiian Islands (Bennett 2002). During 1939 and the early 1940s defenses of O'ahu's north shore were vastly improved. The coastal defenses in the vicinity of the southern portion of the current project area were part of the Kawaiiloa Military Reservation, which operated between 1939 and 1945, and the coastal defenses in the vicinity of the northern portion of the current project area were part of the Waimea Military Reservation, which operated between 1934 and 1945. The Kawaiiloa Military Reservation included Battery Hale'iwa, Battery Ashley, and Battery Kawaiiloa. Battery Hale'iwa, located to the north of Kawaiiloa Drive along the main line of the O. R & L. Co. railroad (Figure 33), consisted of four 8-inch railway guns (Figure 34) with alternate firing positions, a projectile weight of 260 lbs. and a maximum range of 21,000 yds., and two 155mm GPF guns with a projectile weight of 96 lbs and a maximum range of 17,400 yds. that were added in 1944. Battery Ashley, located near Kawaiiloa Beach and Ashley Road, consisted of four 155mm GPF guns on Panama Mounts with a projectile weight of 96 lbs. and a maximum range of 17,400 yds. Battery Kawaiiloa, located near Kawaiiloa Camp north of the Kawaiiloa Road Survey Corridor, also contained four 155mm GPF guns on Panama Mounts, four buildings that made up Fire Control Station "T" of O'ahu's command and fire control cable system, and after 1941 a mobile SCR-270 radar station (Bennett 2002).

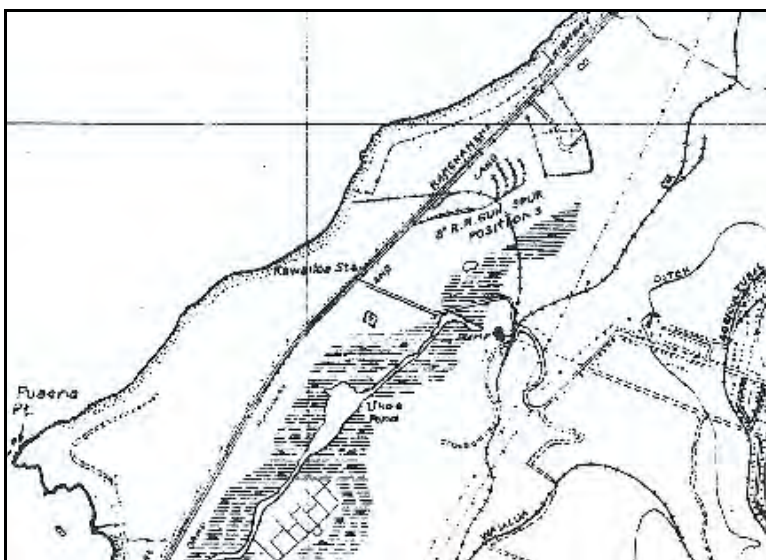


Figure 33. 1940 map showing the location of the 8-inch railroad gun spur positions at Battery Hale'iwa (from Gaines 2002).



Figure 34. 8-inch railroad gun at Battery Hale'iwa (from Gaines 2002).

The Waimea Military Reservation originally consisted of two concrete machine-gun pillboxes were built on either shore of Waimea Bay in 1934. In 1941-1942 four 75mm field guns were emplaced around the bay, and four additional 75mm guns were emplaced inland, along Ashley Road, at Waimea Camp. Construction on a third gun emplacement (Waimea Battery) that was to contain three Panama Mounts with a 180-degree field of fire began in 1942, but was never completed. The earthworks for the Waimea Battery are located three miles inland from Waimea Bay along Kaiwiko'ele Stream to the north of the Eastern Tableland Array (Sugimoto 1996). Inland of Battery Waimea, located northeast of the current project area along Kamananui Stream, was Battery Pupukea II which contained four 155mm GPF guns on Panama Mounts.

Following the Japanese bombing of Pearl Harbor on December 7, 1941 and the United States involvement in WWII, the U. S. military drastically increased its coastal defenses on the north shore of O'ahu. Drum Road, which runs inland from Helemano to the Army's Kahuku training range and was constructed by the United States Army in the 1920s and 30s, was improved in the early years of the war to handle increased military vehicle traffic and to provide an alternative route to the north of the island in the event of potential damage to Kamehameha Highway.

To the south of the project area, in 1942, the United States Army built Battery Carroll Riggs at the location of Opaepala plantation camp (see Figure 4), in an area that is currently known as Opaepala Ranch (Bennett 2002:49). Containing two 8-inch guns salvaged from the U. S. S. Lexington and U. S. S. Saratoga Navy ships, the battery was used to protect the north and west shores of O'ahu during World War II (Takamura 1995). Underground command posts and ammunition supply rooms were complimented by above-ground observation posts and towers. A few anti-aircraft gun emplacements occurred on the periphery of the battery. After the war, the United States government acquired the property from the B. P. Bishop Estate, but returned it to the Estate in 1953.

Located on the level landform south of Battery Riggs and of the Opaepala River, Brodie Camp No. 4 had a cable hut and a 100-pair cable installed prior to 1939 (Bennett 2002:42, 49). This cable was part of a tactical network of subterranean communication cables, or trunk lines, through the northwestern interior portion of O'ahu. Numerous cable huts, concrete pedestals, manholes, and actual cables are physical testimony of this circum-island command and fire control communication system. A map prepared by Bennett (2002) shows that the two main lines of the cable in the vicinity of the project area ran (1) along the coast, and (2) from Brodie Camp No. 4 across the tablelands and gulches to Waimea Valley and then down to Fire Control Station "O" to the north of Waimea Bay. In 1939 an extension from the main cable was connected to Fire Control Station "T" at Battery Kawailoa (Bennett 2002). Other extensions likely connected to Batteries Hale'iwa, Ashley, Waimea, and Pupukea, as well. The cable network was designed so that if any of the trunk lines were cut or damaged, they could be rerouted through other circuits to prevent total shut down of communications while they were fixed (Bennett 2002:44). Although many of the coastal defenses along the north shore were dismantled after 1945, intact segments of this robust command and fire control cable system infrastructure are currently used by Verizon Hawaii.

Following the war, by the end of 1947, the O'ahu Railway and Land Company, with its ailing infrastructure, went out of business, and by 1950 much of the railroad infrastructure had been dismantled. The Waialua Agricultural Co. also dismantled its plantation railways and began hauling the sugarcane by truck. During the modern era the plantation would eventually grow to include over 12,000 acres of cultivated lands. By 1991 the renamed Waialua Sugar Company, which had merged with the Hawaiian Pineapple Company (in 1961), and was now operated by the Dole Food Co., Inc., the successor to Castle & Cook, produced 62,255 tons of sugar (Dorrance and Morgan 2000). By this time sugar production in the Hawaiian Islands had become largely unprofitable. In 1996 the Waialua Sugar Company, the last sugar plantation to operate on O'ahu, harvested its final crop of sugarcane, and by 1998, after 100 years of operation, the company closed its doors for good.

When the Waialua Sugar Co. shut down it voluntarily surrendered its lease of 24,000 acres of agricultural and conservation land to Kamehameha Schools (IMUA 2005). Currently Kamehameha Schools operates the Kawailoa Plantation on this land, leasing plots to individual farmers for diversified agricultural purposes. Roughly 3,600 acres of land, mostly below the 400-foot elevation contour, is suitable for crops that are currently grown there including corn, lettuce, asparagus, plumeria, banana, tuberose, taro, and *noni*. Above the agricultural areas Kamehameha Schools has planted *koa* trees in some areas, and at the time of

the current inventory survey fieldwork extensive fencing was being placed within the *mauka* sections of the study area (above the 650-foot contour) for a new cattle lease. Water and electrical services on the leased lands are still provided by the infrastructure installed by the Waialua Agricultural Co. between 1898 and 1950 (IMUA 2005).

## Previous Archaeological Research

The earliest published descriptions of archaeological sites near the project area were compiled by Thrum (1906) and McAllister (1933). These early descriptions were of sites on O‘ahu that were readily visible on the surface, such as stone *heiau* platforms, stone mounds, caves, ditches, ponds, and unusual-looking stones (Tables 1 and 2). McAllister (1933) compiled, from various sources, stories concerning the sites and plotted them on maps based on actual surface remains or remembered former locations (Figure 35). Smaller and less dramatic stone-walled enclosures or buried structures made from perishable materials were for the most part overlooked in the early studies on the coastal plain. With the exception of a few prominent *heiau* structures of stone and ponds, most archaeological sites on the coastal plain behind Hale‘iwa and Waialua Bay (see Table 1) had been destroyed by sugar mill construction activities and housing for plantation workers by the 1930s. McAllister accordingly had to base his site descriptions mostly on statements made by old Hawaiians who were born and raised in the Waialua and Hale‘iwa area. With additional housing and commercial development since the 1930s, only a handful of the sites witnessed and/or described by McAllister survived (see Table 2; see thorough summary in Hommon 1982).

Instead of being based on excavated features and analyses of excavated materials, McAllister described the sites and features in terms of ethnographic accounts that he and Thrum collected from people familiar with local history. The orally transmitted traditions recall interesting information on chiefs, priests, fishing, cultivation, deities, myths, rituals, and site functions. Among other things, the stories show how interconnected different parts of the landscape were in the minds of the people and how certain rituals were deemed necessary for subsistence purposes. One story recalls a stone near Pump Station 4 of the Waialua Agricultural Company that local people used to leave offerings for the female deity, known as Lehanui (also known as Laniwahine). Among other things, this deity ensured abundant fish in the nearby pond. According to McAllister (1933) the stone was gone by the time of his visit.

*Makai* of the current project area, McAllister (1933:197) also mentions a small *heiau*, reputedly destroyed, near Kawaioloa Gorge (the Anahulu River valley). According to local spokespeople, the small *heiau* was for the purposes of “husbandry,” or, agricultural productivity. Another *heiau*, known as ‘Ili‘ilikea (Site 237) (Sterling and Summers 1978:121), was located northeast of ‘Uko‘a pond in a sugarcane field. This *heiau*, with its well-defined walls, was reputedly destroyed in 1916 by the Waialua Agricultural Company. A third *heiau*, called Puupea (Site 238), which was not well remembered by old Hawaiians during McAllister’s time, was described by Sterling and Summers (1978:121) as a few scattered stones located at Punanue Point not more than fifty feet from the beach. An *akua* stone called Punanue (Site 239) was said to be located at the point near Puupea Heiau. Kohokuwelowelo (Site 240), located on an oval-shaped elevation inland of Cane Haul Road south of its intersection with Ashley Road (see Figure 35), was described by McAllister (1933) as a former dwelling place of priests that the commoners never approached. The site had a steep approach from the north, west and south, but from the east it was gradual. McAllister prepared a sketch map of the site (in Sterling and Summers 1978:122) showing several interconnected, partially enclosed, terraces with dirt floors and a number of small rock platforms. He also noted the presence of low walls and a pavement 200 feet seaward of Kohokuwelowelo at a lower elevation (Sterling and Summers 1978:122).

With the advent of Cultural Resource Management (CRM) work in the 1970s (e.g., Barrera 1979), archaeologists started to record less noticeable sites. Among the sites assessed by Barrera (1979) were a 1880s post-*Māhele* Hawaiian midden, a stone-walled remnant of a *heiau*-like structure, stone-walled cultivation terracing, a nineteenth-century house structure, and an old church (see Table 2). In 1982 Hommon reported a partial enclosure with an attached pavement on top of a bedrock outcrop near the intersection of Kawaioloa Drive and Cane Haul Road. Two long walls that Hommon (1982) interpreted as a possible enclosure remnant, connected to the southeastern and northwestern sides of the platform-like pavement structure and terminated at mechanical disturbance near the edges of both roads. Hommon (1982) interpreted the pavement as a possible foundation for a surface structure that was no longer present, but was not able to determine the age or function of the site based solely upon the surface remains.

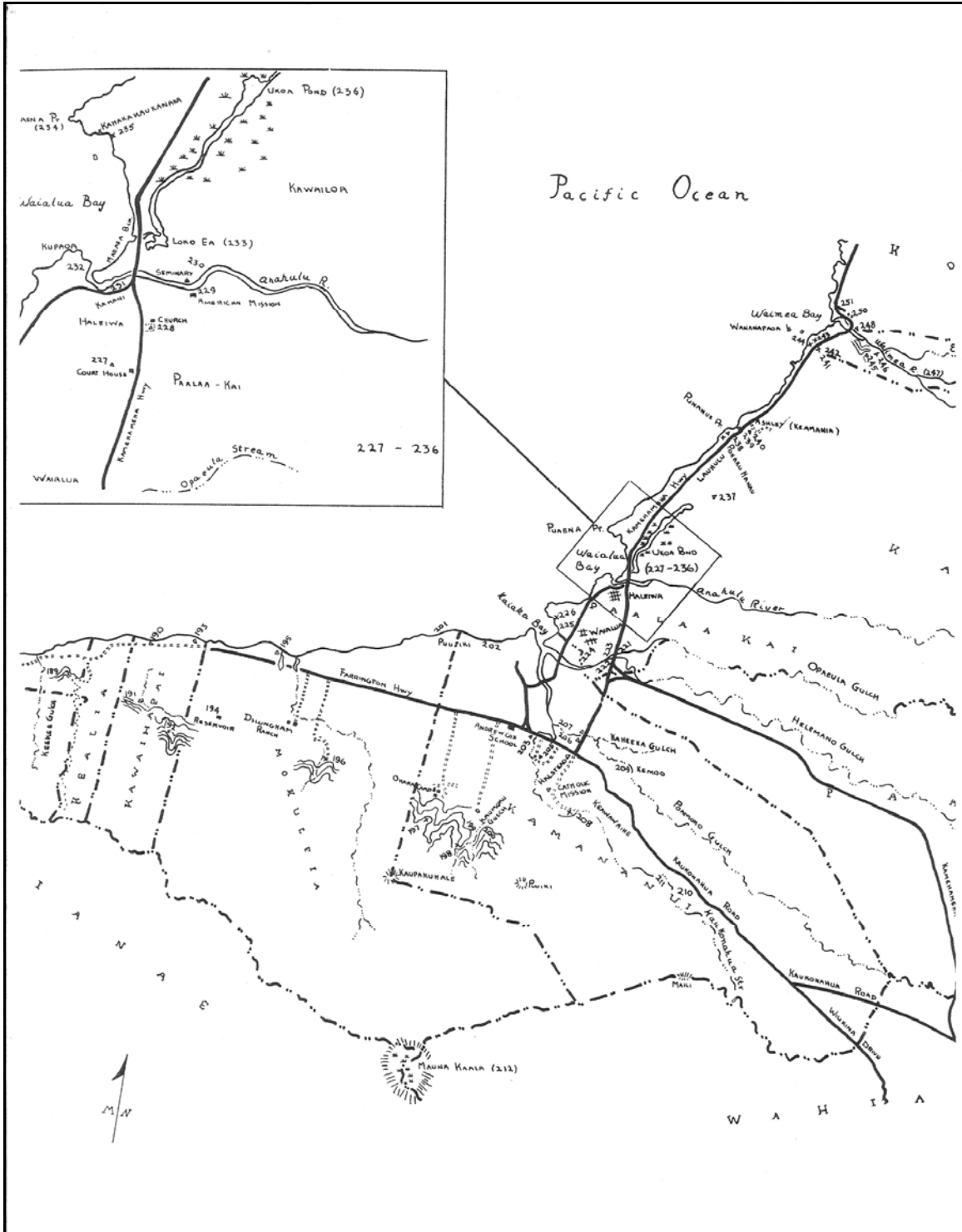


Figure 35. Portion of McAllister's (1933) map of sites located in the vicinity of the current project area (from Sterling and Summers 1978).

**Table 1. Sites located southwest of the project area.**

<i>Site Number</i>	<i>Site Type</i>	<i>Area/Ahupua'a</i>	<i>Author (date)</i>
197	Kalakiki Heiau	Waialua/Kamananui	McAllister (1933)
198	Burial Cave	Waialua/Kamananui	McAllister (1933)
199	Stone Mounds	Waialua/Kamananui	McAllister (1933)
200	Burial Cave	Waialua/Kamananui	McAllister (1933)
201	Keauau Fishing Shrine	Waialua/Kamananui	McAllister (1933)
202	Sand Dune Burials	Waialua/Kamananui	McAllister (1933)
203	Heiau	Waialua/Kamananui	McAllister (1933)
204	Oahunui Stone	Waialua/Kamananui	McAllister (1933)
205	Akua Stone	Waialua/Kamananui	McAllister (1933)
206	Kahakahuna Heiau	Waialua/Pa'ala'a	McAllister (1933)
207	Kawai Heiau	Waialua/Pa'ala'a	McAllister (1933)
208	Irrigation Ditch	Waialua/Kamananui	McAllister (1933)
211	Burial Cave	Waialua/Kamananui	McAllister (1933)
223	Hekili Heiau	Waialua/Kawailoa	McAllister (1933)
225	Kapukapuakea Heiau	Waialua/Kawailoa	McAllister (1933)
226	Pohaku Lanai Stone	Waialua/Kawailoa	McAllister (1933)
227	Puupilo Heiau	Waialua/Kawailoa	McAllister (1933)
228	Kepuwai Heiau	Waialua/Kawailoa	McAllister (1933)
229	Kawaipuolo Spring	Waialua/Kawailoa	McAllister (1933)
231	Anahulu Heiau	Waialua/Kawailoa	McAllister (1933)
232	Akua Stone	Waialua/Kawailoa	McAllister (1933)
235	Stone for Healing	Waialua/Kawailoa	McAllister (1933)

Increasingly detailed CRM surface inspections and excavations on the flat coastal plain behind Waialua Bay resulted in the discovery of highly fragmented surface features and buried remains. Avery and Kennedy (1993), for example, unearthed disturbed human remains near Kawailoa Beach, while Moore et al. (1993) discovered a number of human burial sites, three fire pits, a historic house site, and a posthole with charcoal lens at the Hale'iwa Beach Park (see Table 2). Charcoal from a buried fire pit yielded a radiocarbon assay that calibrated to between A.D. 1400 and 1670. Borthwick et al. (1998) conducted a survey and testing of the area immediately north of Hale'iwa Beach Park. Among the sites they recorded were a prehistoric coral ledge, a human burial, WWII-era concrete features, and disturbed prehistoric cultural layers. During archaeological excavations south of Hale'iwa Beach Park, on the shore of Loko'ea pond, McGerty and Spear (2000) found a stacked basalt boulder wall and a charcoal layer. Charcoal from the layer yielded a radiocarbon assay that calibrated to between A.D. 1420 and 1530. Two charcoal samples collected from a buried feature associated with a posthole, cooking pit, and human burial at the Ali'i Beach Park *makai* of Hale'iwa, dated to between A.D. 1430 and 1680 (McDermott et al. 2001). Directly north of the Anahulu River, not far from where it empties into the ocean, Yeomans (2001) unearthed 11 features that contained charcoal. An un-calibrated assay of a charcoal sample from one feature dated to A.D. 1500-1590. Borthwick et al. (2001) reported a foundation of an O'ahu Railway and Land Company's wooden tank and base of the railway line's right-of-way within the Hale'iwa Beach Skate Park. Nearby, Borthwick et al. (2001) excavated a basalt boulder structure and a cultural layer. In 2005 Pantaleo and Titchenal (2005), during backhoe testing at a parcel south of Ashley Road across the highway from Kawailoa Beach, found the remains of a late nineteenth century female burial in an unmarked pit. In 2007 Moore and Kennedy reported on a traditional modified outcrop and a shrine that were probably associated with agricultural activities in the flatlands south of 'Uko'a pond.

**Table 2. Sites *makai* of the project area.**

<i>Site Number</i>	<i>Site Type</i>	<i>Area/Ahupua'a</i>	<i>Author (date)</i>
236	‘Uko‘a Pond	Waialua/Kawailoa	McAllister (1933)
237	Iiilikea Heiau	Waialua/Kawailoa	McAllister (1933)
238	Puupea Heiau	Waialua/Kawailoa	McAllister (1933)
239	Punanue Akua Stone	Waialua/Kawailoa	McAllister (1933)
240	Kohokuwelowelo	Waialua/Kawailoa	McAllister (1933)
241	Kupopolo Heiau	Waialua/Kawailoa	McAllister (1933)
242	Stone in Rock Shelter	Waialua/Kawailoa	McAllister (1933)
1439	Historic Midden	Waialua/Kawailoa	Barrera (1979)
1440	Stone Wall Remnant	Waialua/Kawailoa	Barrera (1979)
1441	Agricultural Terraces	Waialua/Kawailoa	Barrera (1979)
1442	House Structure	Waialua/Kawailoa	Barrera (1979)
1443	Old Church	Waialua/Kawailoa	Barrera (1979)
50-80-04-4670	Human Burials	Waialua/Kawailoa	Avery and Kennedy (1993)
4589	Historic House	Waialua/Kawailoa	Moore et al. (1993)
4590	Fire Pit	Waialua/Kawailoa	Moore et al. (1993)
4591	Fire Pit	Waialua/Kawailoa	Moore et al. (1993)
4592	Fire Pit	Waialua/Kawailoa	Moore et al. (1993)
4593	Human Burial	Waialua/Kawailoa	Moore et al. (1993)
4594	Human Burial	Waialua/Kawailoa	Moore et al. (1993)
4595	Human Burial	Waialua/Kawailoa	Moore et al. (1993)
4596	Human Burial	Waialua/Kawailoa	Moore et al. (1993)
4597	Human Burial	Waialua/Kawailoa	Moore et al. (1993)
4598	Human Burial	Waialua/Kawailoa	Moore et al. (1993)
4601	Posthole and Lens	Waialua/Kawailoa	Moore et al. (1993)
50-80-04-3400	Stone enclosure/pavement	Waialua/Kawailoa	Hommon (1982)
50-80-04-234	Coral Ledge	Waialua/Kawailoa	Borthwick et al. (1998)
50-80-04-235	Stone	Waialua/Kawailoa	Borthwick et al. (1998)
50-80-04-5495	Human Burial	Waialua/Kawailoa	Borthwick et al. (1998)
50-80-04-5641	WWII Concrete	Waialua/Kawailoa	Borthwick et al. (1998)
50-80-04-5642	WWII Airfield	Waialua/Kawailoa	Borthwick et al. (1998)
50-80-04-5643	WWII Bunker	Waialua/Kawailoa	Borthwick et al. (1998)
50-80-04-5644	Pre-WWII Midden	Waialua/Kawailoa	Borthwick et al. (1998)
50-80-04-5661	Mixed cultural layer	Waialua/Kawailoa	Borthwick et al. (1998)
50-80-04-5795	Charcoal Layers	Waialua/Kawailoa	McGerty and Spear (2000)
50-80-04-5839	Stone Wall Remnant	Waialua/Kawailoa	McGerty and Spear (2000)
50-80-04-5850	Prehistoric Pits	Waialua/Kawailoa	McDermott et al. (2001)
50-80-01-5795	Charcoal Layers	Waialua/Kawailoa	Yeomans (2001)
50-80-04-5791	OR&L Rail ROW	Waialua/Kawailoa	Borthwick et al. (2001)
50-80-04-5915	Stone Foundation	Waialua/Kawailoa	Borthwick et al. (2001)
50-80-04-5916	Cultural Layer	Waialua/Kawailoa	Borthwick et al. (2001)
50-80-10-6768	Human Burial	Waialua/Kawailoa	Pantaleo and Titchenal (2005)
50-80-04-6867	Driveway and Structures	Waialua/Kawailoa	Moore and Kennedy (2007)
50-80-04-6868	C-shape Shrine	Waialua/Kawailoa	Moore and Kennedy (2007)
50-80-04-6869	Modified Outcrops	Waialua/Kawailoa	Moore and Kennedy (2007)

To summarize then, radiocarbon dates of charcoal from buried excavated occupation layers on the fairly narrow coastal plain *makai* of the project area range in age between A.D. 1400 and 1670, which falls well within the so-called Expansion Period prior to the arrival of Captain Cook (e.g., Kirch 1992). It is in this relatively active area of modern urban expansion, centered on Hale'iwa and Waialua, that most CRM archaeological work has been done in the vicinity of the project area. Unfortunately, a clear picture of intra- and inter-settlement layout in the area has not emerged, due to three main reasons. First, only pockets of deposits seem to have survived land alterations in the area. Secondly, only relatively narrow and deep backhoe trenches were used for sampling. And thirdly, no attempt has been made to try link up results from different trenches. Over and above this lack of synthesis has been the absence a coordinated attempt to combine the archaeological sequence with oral histories and documented historical developments in the area. The inter-disciplinary research of the Anahulu Valley hinterland *mauka* of coastal plain, instigated by Kirch and Sahlins, is perhaps a useful model to emulate for future CRM work on the coastal plain.

The earliest radiocarbon evidence for the occupation of sites in Anahulu Valley (Table 3), immediately *mauka* of the coastal plain, comes from the Ke'eke'e rock shelter. Kirch (1992:47-48) found dating and subsistence evidence that this large rock shelter was used as an intermittent camp, sometime after A.D. 1300. By A.D. 1500 two other shelters in the valley, known as Kuolulo and Kē'ae, were also occupied intermittently. A radiocarbon date from an artifact and faunal rich earth oven within the Ke'eke'e Nui rock shelter and from a similarly rich basal layer of the nearby Ke'eke'e Iki rock shelter suggest that by A.D. 1650 these shelters were used as permanent residences. Kuolulo rock shelter shows similar artifact and feature evidence for permanent occupation some time after A.D. 1700. Radiocarbon dates from Kawainui (upper) portion of the valley (Dega and Kirch 2002) indicate use of this area beginning in the middle A.D. 1400s and abandonment by the late A.D. 1700.

Radiocarbon dates and the lack of occupational refuse suggest that in the early nineteenth century the rock shelters in the Anahulu River valley were also abandoned (Kirch 1992:166). These were replaced by a series of open house sites that were constructed in the middle valley in association with taro irrigation terraces. A combination of radiocarbon, artifact, and documentary evidence, show that soon after A.D. 1804, six houses were built on alluvial terraces in the middle valley. Between A.D. 1804 and 1814, the six-kilometer previously barren stretch of interior valley was transformed to irrigated pond fields, associated with at least eight permanent houses. By 1820, with the return of Kamehameha and his retinue to Hawai'i Island, at least four of the houses and many terraced fields were abandoned. However, by 1830 two new houses appeared in the middle valley, most likely in response to supply whaling ships with taro, yams, sweet potato, hogs, and bark cloth. Physical evidence for restructuring the irrigation system occurs as late as 1845 (Kirch 1992:167). Following the *Māhele* in the late 1840s houses and fields in the valley were increasingly abandoned, so by the 1880s the area was virtually deserted.

Earlier CRM work conducted by Rosendahl (1977) showed that prehistoric sites occurred quite high up the Kawaihoa and neighboring gulches; farther removed from the coastal plain than the sites subsequently excavated by Kirch (1992). All five sites reported by Rosendahl (Table 4) occurred either within or on the edges of gulches and at the confluences of streams. The sites included two platforms, a habitation complex, an agricultural complex, and an enclosure. These sites, all of which occur south of the current project area, within the US Army Kawaihoa Training Area, represented the inland limits of Proto-historic and Historic Period occupation of the various stream gulches that open out onto the coastal plain (Dega 1996:32-33).

Partly overlooked or at least downplayed by archaeologists in the study area is rock art. Apart from one incised name on a large boulder inserted into the boundary wall of a site (Kirch 1992:98), only one other rock art site is mentioned for the Kawaihoa Gulch area, through which the Anahulu River flows. Cox and Stasack (1970:97) mention three human figures and two dogs (Site D6-19) that were pecked above the opening of a rock shelter (Site D6-14) on the north side of the Anahulu River (see Table 3). As not all rock surfaces suitable for rock art production have actually been utilized and knowing that most rock art panels occur along trails, on *ahupua'a* boundaries, and on the edges of settlements and structures, the very choice of their placement may contain clues as to their cultural significance.

**Table 3. Sites recorded in Anahulu Valley.**

<i>Site Number*</i>	<i>Site Type</i>	<i>Area/Ili</i>	<i>Author (date)</i>
D6-14	Rockshelter	Anahulu Valley/'Imi'imi	Kirch (1992)
D6-19	Rockshelter petroglyphs	Anahulu Valley/'Imi'imi	Cox (1970)
D6-25	Habitation complex	Anahulu Valley/Kaloala	Kirch (1992)
D6-26	Irrigation complex	Anahulu Valley/Kaloala	Kirch (1992)
D6-27	Habitation terrace	Anahulu Valley/Kaloala	Kirch (1992)
D6-28	Rockshelter	Anahulu Valley/Haka'ai	Kirch (1992)
D6-29	Stone structure	Anahulu Valley/Haka'ai	Kirch (1992)
D6-30	Upright stone	Anahulu Valley/Haka'ai	Kirch (1992)
D6-31	Stone-walled house site	Anahulu Valley/Lahuimoho	Kirch (1992)
D6-32	Earthen terraces	Anahulu Valley/Pulepule	Kirch (1992)
D6-33	Habitation terrace	Anahulu Valley/Pulepule	Kirch (1992)
D6-34	Habitation complex	Anahulu Valley/Pulepule	Kirch (1992)
D6-35	Habitation terrace	Anahulu Valley/Pulepule	Kirch (1992)
D6-36	Rockshelter	Anahulu Valley/Ke'eke'e	Kirch (1992)
D6-37	Habitation complex	Anahulu Valley/Ke'eke'e	Kirch (1992)
D6-38	Habitation terrace	Anahulu Valley/Ke'eke'e	Kirch (1992)
D6-39	Habitation terrace	Anahulu Valley/'Ua'u	Kirch (1992)
D6-40	Habitation complex	Anahulu Valley/Mikiai	Kirch (1992)
D6-41	Irrigation complex	Anahulu Valley/Mikiai	Kirch (1992)
D6-42	Irrigation complex	Anahulu Valley/Koilau	Kirch (1992)
D6-43	Irrigation complex	Anahulu Valley/Pulepule	Kirch (1992)
D6-44	Irrigation complex	Anahulu Valley/Kapuahilua	Kirch (1992)
D6-45	Irrigation complex	Anahulu Valley/Ke'eke'e	Kirch (1992)
D6-46	Irrigation complex	Anahulu Valley/Ke'eke'e	Kirch (1992)
D6-47	Irrigation complex	Anahulu Valley/Ke'eke'e	Kirch (1992)
D6-48	Irrigation complex	Anahulu Valley/'Ua'u	Kirch (1992)
D6-49	Cliff burial	Anahulu Valley/'Ua'u	Kirch (1992)
D6-50	Platform burial	Anahulu Valley/Kaloaloa	Kirch (1992)
D6-51	Habitation complex	Anahulu Valley/Kapuahilua	Kirch (1992)
D6-52	Rockshelter	Anahulu Valley/Ke'ae	Kirch (1992)
D6-53	Irrigation complex	Anahulu Valley/Ke'ae	Kirch (1992)
D6-54	Irrigation complex	Anahulu Valley/Ke'ae	Kirch (1992)
D6-55	Burial Cave	Anahulu Valley/'Imi'imi	Kirch (1992)
D6-56	Rockshelter	Anahulu Valley/'Imi'imi	Kirch (1992)
D6-57	Rockshelter	Anahulu Valley/Kaha'aloa	Kirch (1992)
D6-58	Rockshelter	Anahulu Valley/Ke'kek'e	Kirch (1992)
D6-59	Burial Cave	Anahulu Valley/Ke'eke'e	Kirch (1992)
D6-60	Rockshelter	Anahulu Valley/Ke'eke'e	Kirch (1992)
D6-61	Platform burials	Anahulu Valley/Ke'eke'e	Kirch (1992)
D6-67	Stone enclosure	Anahulu Valley/Ke'eke'e	Kirch (1992)
D6-68	Platform burial	Anahulu Valley/Ke'eke'e	Kirch (1992)

\* Bishop Museum Numbers

**Table 4. Sites recorded by Rosendahl (1977) south of the current project area.**

<i>Site Number</i>	<i>Site Type</i>	<i>Area/Ahupua'a</i>	<i>Author (date)</i>
50-80-05-9510	Platform	Waialua/Kawailoa	Rosendahl (1977)
50-80-05-9511	Agricultural Complex	Waialua/Kawailoa	Rosendahl (1977)
50-80-05-9512	Habitation Complex	Waialua/Kawailoa	Rosendahl (1977)
50-80-05-9513	Enclosure	Waialua/Kawailoa	Rosendahl (1977)
50-80-05-9514	Platform	Waialua/Kawailoa	Rosendahl (1977)

Near the bottom of a cliff line *makai* of the project area, Cluff (1968) found a series of rock art panels with pecked depictions of human figures and dogs (Table 5). This rock art rock shelter is not far from the coast and slightly southeast from the Kupopolo Heiau (Site 241), located on the narrow coastal plain south of Waimea River mouth. Pecked triangular-bodied human figures and dogs with curved tails are depicted within the shelter, as are some incised motifs. The chronological relationship between the rock art and the stacked rock walls in front of the shelter still needs to be researched. Whatever the date of the petroglyphs might turn out to be, they are almost certainly prehistoric in age, based on dates of similar motifs on the Island of Hawai'i (Lee and Stasack 2005, Rechtman et al. 2003).

Slightly to the northwest and across the Kamehameha Highway of Kupopolo Heiau (Site 241) and the petroglyphs, Athens and Shun (1982) found 12 sites on the coastline (see Table 5). The sites included two prehistoric midden areas, two stone-walled enclosures, two small rock shelters, a stone pile complex, a stone platform, a stone wall, a *heiau* platform, a natural water hole, and the O'ahu Railway and Land Company's railroad bed. Taken together, the prehistoric sites recorded by Cluff (1968) Athens and Shun (1982) were probably a southern extension of the Waimea River settlement spilling out of the valley down the coast.

**Table 5. Sites recorded *makai* of the project area (Cluff 1968; Athens and Shun 1982).**

<i>Site Number</i>	<i>Site Type</i>	<i>Area/Ahupua'a</i>	<i>Author (date)</i>
D6-17	Kupopolo Heiau and Rockshelter Petroglyphs	Waialua/Kawailoa	Cluff (1968)
D6-62	Midden	Waialua/Kawailoa	Athens and Shun (1982)
D6-63	Enclosure	Waialua/Kawailoa	Athens and Shun (1982)
D6-64	Midden	Waialua/Kawailoa	Athens and Shun (1982))
D6-65	Stone Piles	Waialua/Kawailoa	Athens and Shun (1982)
D6-66	Stone Platform Complex	Waialua/Kawailoa	Athens and Shun (1982)
D7-2	<i>Heiau</i>	Waialua/Waimea	Athens and Shun (1982)
D7-48	Water Hole	Waialua/Waimea	Athens and Shun (1982)
D7-49	OR&L Rail Bed	Waialua/Waimea-Kawailoa	Athens and Shun (1982)
D7-50	Enclosure	Waialua/Waimea	Athens and Shun (1982)
D7-51	Wall	Waialua/Waimea	Athens and Shun (1982)
D7-52	Rock Shelters	Waialua/Waimea	Athens and Shun (1982)

Sites within the Waimea River Valley are among the first recorded within the vicinity of the project area, considering that many are prominent features and/or features recalled in local oral histories. McAllister (1933) recorded four *heiau*, two fishing shrines, two rock shelters with burials, one rock shelter with a sacred stone, a boundary stone, and a prominent stone-walled agricultural terrace complex within the valley (Table 6; see Figure 35). Moore and Luscomb (1974) recorded an additional 32 sites within the valley, indicating that it was densely populated in both Precontact and early Historic times. Reported excavation results of previously discovered sites within the Waimea River valley comes from two of Mitchell's excavations. The first set of excavations, on a *heiau*-like platform structure and associated walls and piles against the southern slopes of the valley, labeled Site D7-26, were reported by Mitchell (1977). In 1985 and 1986 Mitchell reported work on a separate stepped-platform structure, labeled Site D7-23, near its

northern entrance. Whereas a radiocarbon assay of a coral fragment from the Site D7-23 platform yielded a calibrated date range of A.D. 1470 to 1700, the recovery of ceramic sherds, bottle glass, a nail, and a button from associated midden deposits suggests that the structure dates to the Historic Period.

**Table 6. Sites recorded in the Waimea River Valley.**

<i>Site Number</i>	<i>Site Type</i>	<i>Area/Ahupua'a</i>	<i>Author (date)</i>
242	Rock Shelter Stone	Waialua/Waimea	McAllister (1933)
243	Boundary Stone	Waialua/Waimea	McAllister (1933)
244	Fishing Shrine	Waialua/Waimea	McAllister (1933)
245	Fishing Shrine	Waialua/Waimea	McAllister (1933)
246	Burial Cave	Waialua/Waimea	McAllister (1933)
247	Agricultural Terraces	Waialua/Waimea	McAllister (1933)
248	Heiau Kuhale	Waialua/Waimea	McAllister (1933)
249	Heiau Puu O Mahuku	Waialua/Waimea	McAllister (1933)
250	Kalaku and Kalakoi	Waialua/Waimea	McAllister (1933)
251	Burial Cave	Waialua/Waimea	McAllister (1933)
D7-7	Rock Shelter Burials	Waialua/Waimea	Moore and Luscomb (1974)
D7-8	Enclosure	Waialua/Waimea	Moore and Luscomb (1974)
D7-9	Terrace Complex	Waialua/Waimea	Moore and Luscomb (1974)
D7-10	Enclosure	Waialua/Waimea	Moore and Luscomb (1974)
D7-11	Walls	Waialua/Waimea	Moore and Luscomb (1974)
D7-12	Japanese Shrine	Waialua/Waimea	Moore and Luscomb (1974)
D7-14	Stone Pile	Waialua/Waimea	Moore and Luscomb (1974)
D7-15	Stone Pile	Waialua/Waimea	Moore and Luscomb (1974)
D7-16	Agricultural Complex	Waialua/Waimea	Moore and Luscomb (1974)
D7-17	Terrace Complex	Waialua/Waimea	Moore and Luscomb (1974)
D7-18	Terrace Complex	Waialua/Waimea	Moore and Luscomb (1974)
D7-19	Terrace Complex	Waialua/Waimea	Moore and Luscomb (1974)
D7-20	Stone Pile	Waialua/Waimea	Moore and Luscomb (1974)
D7-21	Terrace Complex	Waialua/Waimea	Moore and Luscomb (1974)
D7-22	Terrace Complex	Waialua/Waimea	Moore and Luscomb (1974)
D7-23	Shrine	Waialua/Waimea	Moore and Luscomb (1974)
D7-24	Wall	Waialua/Waimea	Moore and Luscomb (1974)
D7-25	Walls	Waialua/Waimea	Moore and Luscomb (1974)
D7-26	Walls and Piles	Waialua/Waimea	Moore and Luscomb (1974)
D7-27	Sandstone Pounder	Waialua/Waimea	Moore and Luscomb (1974)
D7-28	Basalt Adze	Waialua/Waimea	Moore and Luscomb (1974)
D7-29	Grinding Stone	Waialua/Waimea	Moore and Luscomb (1974)
D7-30	Ulu Maika Stone	Waialua/Waimea	Moore and Luscomb (1974)
D7-31	Terrace Complex	Waialua/Waimea	Moore and Luscomb (1974)
D7-32	Stone Pile	Waialua/Waimea	Moore and Luscomb (1974)
D7-33	Wall complex	Waialua/Waimea	Moore and Luscomb (1974)
D7-34	Wall	Waialua/Waimea	Moore and Luscomb (1974)
D7-35	Rock Shelter Burials	Waialua/Waimea	Moore and Luscomb (1974)
D7-36	Wall	Waialua/Waimea	Moore and Luscomb (1974)
D7-37	Rock Shelter Burials	Waialua/Waimea	Moore and Luscomb (1974)
D7-38	Rock Shelter	Waialua/Waimea	Moore and Luscomb (1974)
D7-39	Agricultural Complex	Waialua/Waimea	Moore and Luscomb (1974)
D7-41	Historic House	Waialua/Waimea	Mitchell (1985)
D7-42	Burial	Waialua/Waimea	Mitchell (1985)

## PROJECT AREA EXPECTATIONS

Although no formal archaeological work has been conducted within the study area, the results (discussed in detail above) of previously conducted archaeological research in the vicinity of the study area allow for an informed guess as to the types of sites one would expect to encounter given the physical setting. The background knowledge of intensive land-use history and alteration afforded additional predictive information as to the condition and level of disturbance any such sites could have experienced.

Judging from previous ethnohistorical and archaeological work, it was anticipated that most Precontact sites will be located along the *makai* escarpment adjacent to the study area, through which the access road corridors extend. McAllister (1933) and Sterling and Summers (1978) describe a priestly residential area (Site 240) located on an oval-shaped elevation inland of Cane Haul Road south of its intersection with Ashley Road. Locally transmitted oral traditions relate (Genz and Hammatt 2011), and archaeological work (Pantaleo and Titchenal 2005) documents, that the area of the *makai* escarpment and below were a favored place for burial during precontact and early historic times. On the lower slopes of the escarpment along Cane Haul Road, Hommon (1982) found a small platform structure (Site 3400), near the intersection of Kawaioloa Drive and Cane Haul Road, not far northeast of 'Uko'a Pond (Site 236). *Māhele* records also identify a several *kuleana* lots that once extend across the southern and lower portions of what are now Cane Haul Road and Kawaioloa Drive.

As for later Historic Period resources, late nineteenth and early twentieth century maps show several plantation camps (representing multiple ethnicities) located both below and above the *makai* escarpment along with an extensive network of irrigation features farther upslope. The plantation camps and the irrigation features were part of successive plantation efforts associated with large-scale sugarcane and pineapple cultivation. Historical documentation (e.g., see Dorrance and Morgan 2000; Wilcox 1996) indicates that plantation agricultural may have began impacting the Kawaioloa landscape as early as 1898, and that by the late 1920s irrigated fields and associated infrastructure (formal and informal ditches, pipes, tunnels, a few pump houses, several reservoirs, roads, and railway lines) covered vast portions of the study area (see Figure 4). Beginning in ca. 1939 gun emplacements and a military command and fire control communication system were established at key locations in and around the study area (along the shore near Kawaioloa Drive and Ashley Road, at Kawaioloa and Waimea Camps, and along the upper ridges of the Waimea River catchment) as part of O'ahu's coastal defenses (Bennett 2002; Gaines 2002; Sugimoto 1996; Takamura 1995). The defenses were mostly dismantled immediately following World War II (in ca. 1945). By the middle twentieth century the plantation railway system was defunct and was replaced by roads for trucks to haul cane. Within the study area the formal plantation activities persisted until 1996.

Given the extensive and intensive plantation use of the current study area, it is likely that any earlier archaeological features were significantly impacted if not completely destroyed. It is the expectation that within the study area, Historic Period features related to plantation irrigation, transportation, and housing and to military activity, including artillery and communications, will make up the majority of the archaeological features observed. It is possible, however only remotely so, that Precontact features (possible trail routes and temporary habitations associated with forest resource extraction) have survived in the tablelands in spite of the more recent land use activities. Precontact archaeological features (see above) may also be present along the margins of the tablelands and in the areas adjacent to Cane Haul Road and the *makai* escarpment, through which the other study area roadways extend.

## FIELDWORK

The fieldwork for the current project was carried out during two major sessions—between April 12 and May 14, 2010, and between February 15 and February 25, 2011; with follow-up field days on March 30, 2011, April 14, 2011, and April 27, 2011. The field effort was supervised by Robert Rechtman, Ph.D., directed by Johannes Loubser, Ph.D. and Matthew Clark, B.A., and the field crew included Ashton Dircks Ah Sam, B.A., Owen Moore, M.A., Morgan Schmidt, Ph.D., and Mark Winburn, B.A. During the first fieldwork session the areas studied included the Eastern Tableland Array, the Kawaioloa Road Corridor, the southern end of the Cane Haul Road Corridor, and the Ashley Road Corridor. The second session of fieldwork focused on the Western Tableland Array, the Mid-Line Road Corridor, and the bulk of Cane Haul Road Corridor. Follow-up fieldwork days were spent surveying the Makai Interconnection Facility Corridor and the Overhead Collector Line Corridor. An estimated total of 1088 labor hours were expended in the field.

## Methods

As described above, the study area consists of tableland ridges for the placement of wind turbine towers and appurtenant facilities, and the margins of existing roadways that may be widened or graded to facilitate construction transportation. The existing roadways and their margins were subject to intensive surface survey with fieldworks spaced on either side of the existing roadway examining the limits of the survey corridor. While surveying the landforms on which the wind turbine towers are to be erected, every effort was made to maintain regularly spaced survey transects. The spacing interval ranged between 20 and 40 meters depending on terrain and visibility. The tablelands were generally traversed from gulch edge to gulch edge (north/south) or, when *mauka/makai* roads were present, between the roads and the gulch edges. Narrow tableland formations were traversed *mauka/makai*. Thick stands of Guinea grass limited visibility to a few meters in many areas on the tablelands, a factor that required closer spacing and meandering transects to surface inspect specific areas anticipated to be developed. The only un-mechanically disturbed portions on the tablelands appear to have been the outer edges. The comparatively intact rims of the tablelands and the ridge fingers that spread out from them at the drop-off into the surrounding natural gulches were surface inspected in a *mauka/makai* direction independently of the pedestrian transects. These comparatively intact gulch edges and ridge fingers were inspected in the hope of finding features that once might have extended up onto the tablelands from the gulches. However, the upper plateaus on which the turbines are to be erected contained virtually no natural stone, which made the occurrence and identification of surface features unlikely.

During the surface inspection of the survey corridors all encountered archaeological resources, natural boundaries, survey markers, existing plantation infrastructure, and land alterations (e.g., bulldozing, fence lines, roads, etc.) were plotted on a scaled map of the study area using Garmin 76s handheld GPS technology (set to the NAD 83 datum). Potential archaeological features, or groupings of features, identified in the field were sequentially assigned temporary site numbers (T-1, T-2, T-3, etc.), and then cleared of vegetation, mapped (with a tape and compass), photographed, and described using standardized description forms. Long linear features, such as the plantation ditches, were mapped using the Garmin 76s handheld GPS, and then individual plan views of complicated sections where more detail was needed were prepared using a tape and compass. No subsurface testing was deemed necessary at any of the recorded sites to assess age and function. In addition to the archaeological fieldwork, archival cartographic material concerning plantation infrastructure was reviewed and correlated with the field findings.

During the fieldwork an attempt was also made to inspect those sites previously identified outside of the current study area but within the overall subject property to verify their locations relative to the current study area boundary. In addition to this, reconnaissance level survey was undertaken in the areas adjacent to Alternatives-1 and 2 of the Kawaioloa Road Corridor, and near the intersection of Cane Haul Road and Ashley Road, where the study area encroaches on the coastal escarpment, and where any surviving Precontact features were expected to be found. This work helped guide the eventual selection of a project area that would have the least impact on potentially significant archaeological resources. Archaeological features identified nearby, but outside, the study area were also assigned a temporary site number, and basic information was collected to record their locations, condition, possible function, and potential significance. In most cases these features were cleared of thick vegetation and photographed, and a sketch map was prepared with a brief description of the resource.

## FINDINGS

As a result of the current study, seventeen archaeological sites were identified within the study area (Table 7; Figure 36). All of these sites date from the Historic Period and were likely associated with either former military operations (Site 7155, 7156, 7158), or former plantation activities (Sites 7157, 7159, 7160, 7161, 7162, 7163, 7164, 7165, 7166, 7167, 7168, 7169, 7170, 7171). In addition to the sites identified within the study area, six previously identified archaeological sites and nineteen newly identified sites were inspected during the current study (Table 8) nearby, but outside of, the study area. These sites represent both Precontact and Historic use of the general study area. Their locations are shown on Figure 37. Each of the sites identified within the study area is discussed in detail below. For ease of presentation the following presentation of findings is organized by survey area location (Western Tableland Array, Eastern Tableland Array, Kawaioloa Road Corridor, Cane Haul Road Corridor, Mid-Line Road Corridor, Ashley Road Corridor, Makai Interconnection Facility Corridor, and Overhead Collector Line Corridor).

**Table 7. Sites recorded during the current study.**

<i>Site #*</i>	<i>Description</i>	<i>Function</i>	<i>Association</i>	<i>Area**</i>
50-80-04-7155	Concrete pillar	Military communication	WWII	ETA
50-80-04-7156	Concrete pillar	Military communication	WWII	ETA
50-80-04-7157	Concrete marker	Boundary marker	Plantation	ETA
50-80-04-7158	Metal pole/concrete base	Military communication	WWII	ETA
50-80-04-7159	Ditch complex	Agricultural irrigation	Plantation	KRC
50-80-04-7160	Stone abutments	Agricultural transportation	Plantation	KRC 1
50-80-04-7161	Concrete foundations	Stables	Plantation	KRC 1
50-80-04-7162	Kerbstone alignment	Agricultural transportation	Plantation	KRC 1
50-80-04-7163	Stone/concrete culvert	Drainage control	Plantation	KRC 2
50-80-04-7164	Metal pipeline	Agricultural irrigation	Plantation	CHRC
50-80-04-7165	Stone/concrete culvert	Drainage control	Plantation	CHRC
50-80-04-7166	Stone/concrete culvert	Drainage control	Plantation	CHRC
50-80-04-7167	Stone/concrete culvert	Drainage control	Plantation	CHRC
50-80-04-7168	Concrete bridge	Agricultural transportation	Plantation	CHRC
50-80-04-7169	Ditch complex	Agricultural irrigation	Plantation	MLRC
50-80-04-7170	Ditch complex	Agricultural irrigation	Plantation	MLRC
50-80-04-7171	Ditch complex	Agricultural irrigation	Plantation	ARC

\*State (50-Hawai'i)-Island (80-O'ahu)-USGS quad (04-Hale'iwa)-SIHP Site # (71xx)

\*\*ETA-Eastern Tableland Array; KRC 1-Kawailoa Road Corridor (Alternative 1) KRC 2-Kawailoa Road Corridor (Alternative 2); MLRC-Mid-Line Road Corridor, CHRC-Cane Haul Road Corridor; ARC-Ashley Road Corridor.

**Table 8. Sites identified near, but outside, the study area.**

<i>Site #</i>	<i>Description</i>	<i>Study</i>	<i>Proximity</i>
236	'Uko'a Pond	McAllister (1933)	KRC
240	Kohokuwelowelo	McAllister (1933)	CHRC
3400	Stone enclosure/pavement	Hommon (1982)	KRC/CHRC
T-10	Stone and concrete pedestal	Current study	KRC
T-13	Terraced platform	Current study	KRC
T-14	Slab paved pathway	Current study	KRC/CHRC
T-15	Concrete slab foundation	Current study	KRC
T-16	Walled enclosure against cliff	Current study	KRC
T-17	Walled enclosure	Current study	KRC
T-18	Walled enclosure	Current study	KRC
T-19	Wall on bedrock outcrop	Current study	KRC
T-20	Wall on bedrock boulders	Current study	KRC
T-21	Walled enclosures against cliff	Current study	KRC
T-23	Parallel terrace walls	Current study	KRC
T-24	Rock/soil terrace against cliff	Current study	KRC
T-25	Soil-filled terraces (gardens?)	Current study	KRC
T-26	Rock/soil terraces against cliff	Current study	KRC
T-27	Concrete and rock foundation	Current study	KRC
T-28	Concrete and rock foundation	Current study	KRC
T-29	Concrete and rock foundation	Current study	KRC
T-35	Old rail bed (?)	Current study	KRC/CHRC
T-36	Japanese cemetery	Current study; Genz and Hammatt (2011)	KRC
T-37	Modified areas on cliff face	Current study	ARC/MIFC
-	Burials in cliff face	Genz and Hammatt (2011)	ARC
-	Concrete bunker	Beckett and Singer (1999)	CHRC

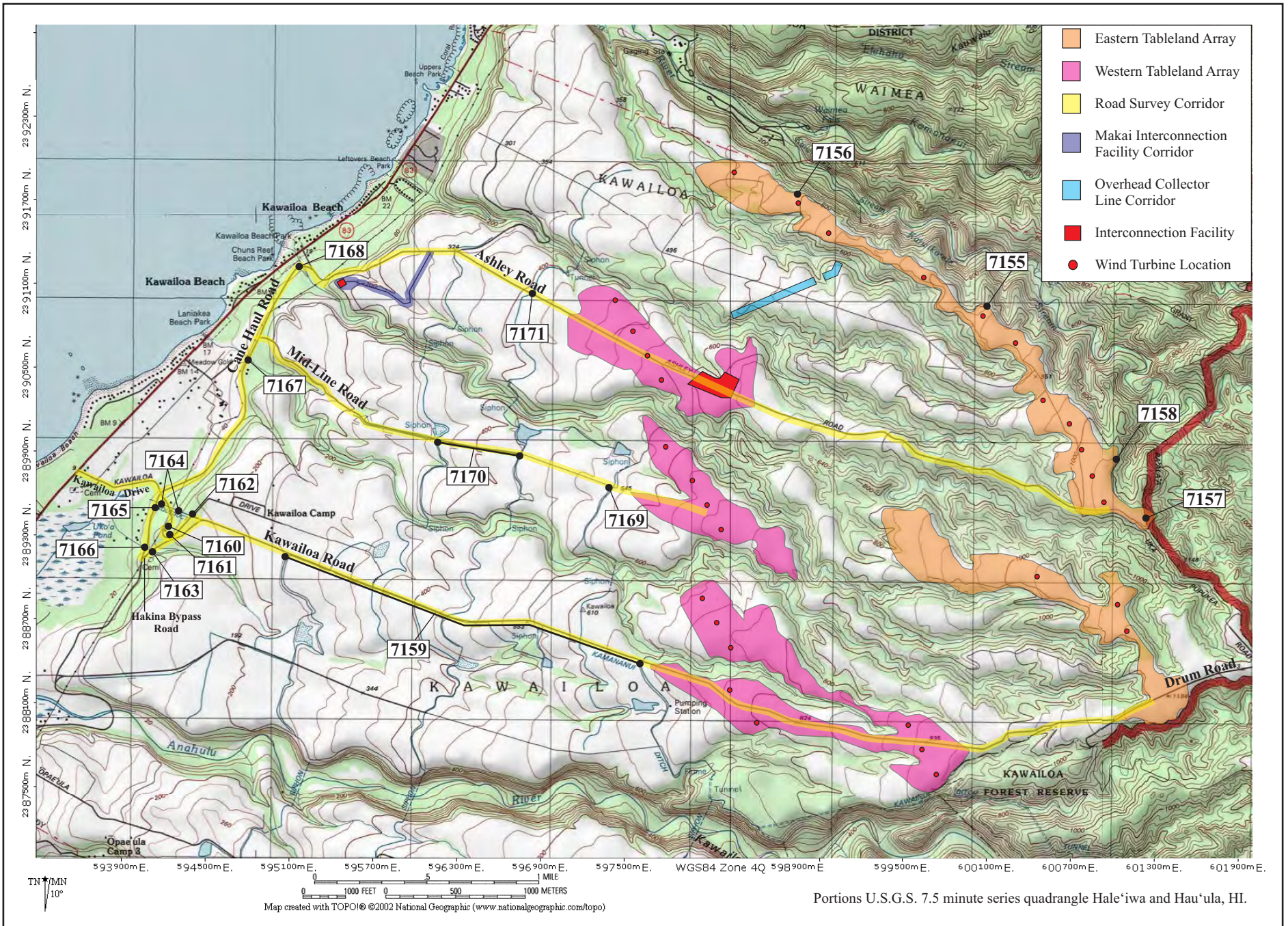


Figure 36. Project area map showing site locations.

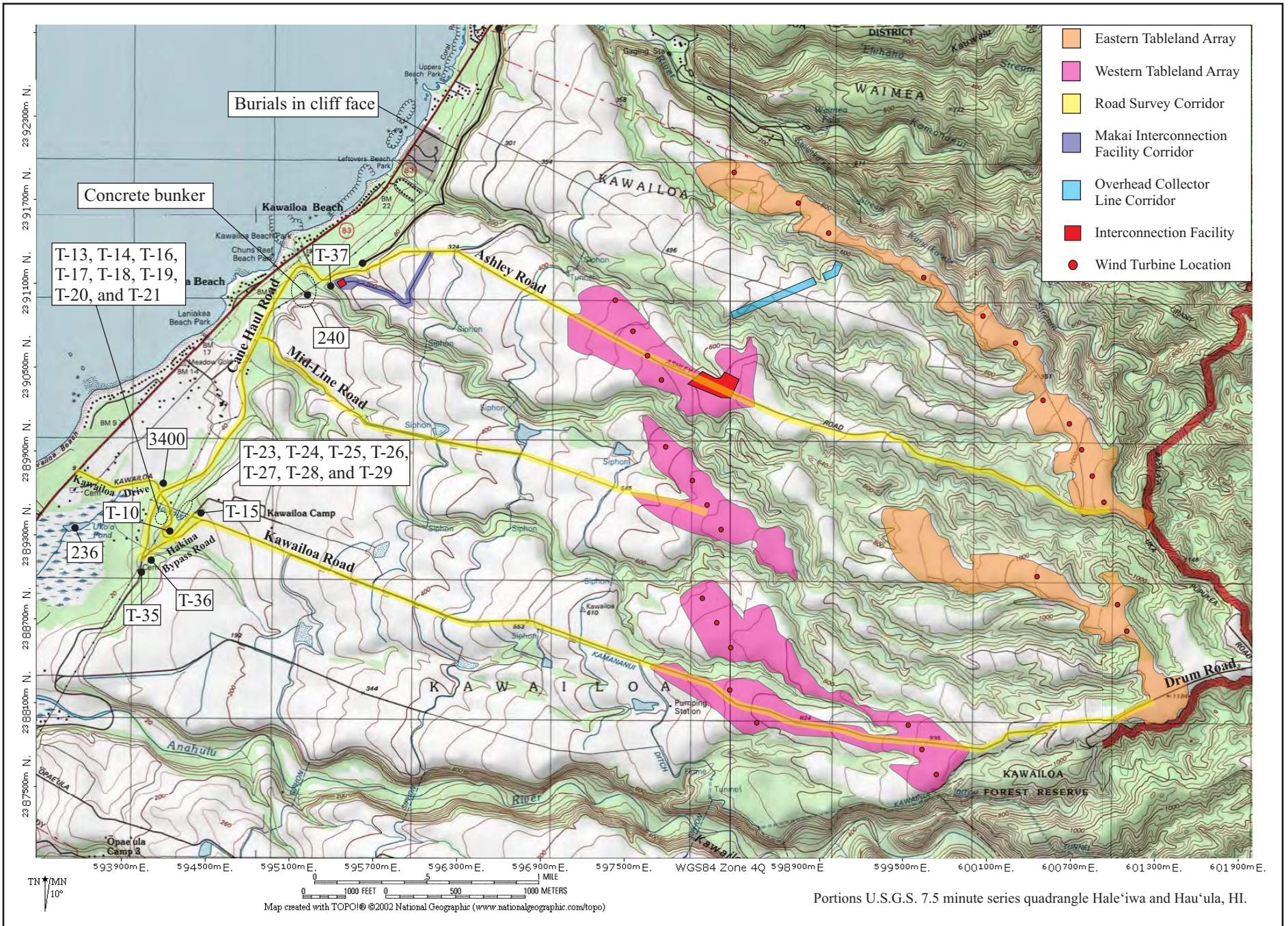


Figure 37. Project area map showing sites nearby, but outside, the current project area.

## Western Tableland Array

The Western Tableland Array consists of three distinct survey areas that are slated for the proposed development of sixteen wind turbines, an O & M (office and maintenance) building, a *mauka* point of interconnection and associated infrastructure. The proposed array of turbines runs in a northwesterly line across TMKs:1-6-2-11:001, 1-6-1-07:001, and 1-6-1-06:001 from Drum Road at an elevation of roughly 1,000 feet above sea level to a point northwest of Ashely Road at an elevation of roughly 500 feet above sea level (see Figures 1 and 2). The tablelands that contain the survey areas are separated from one another by steep sided gulches that do not permit interconnected access. The survey areas included only the flat tablelands and not the steep sided gulches. All of the survey areas in the Western Tableland Array contain a thick growth of Guinea grass (*Panicum maximum*) interspersed with albizia trees (*Acacia lebbek*) and other less frequently occurring species of trees, shrubs, vines, ferns, and grasses. The two southeastern most survey areas are accessed by Kawaihoa Road, the central survey area is accessed by Mid-Line Road, and the northwestern survey area that includes the O & M building is accessed by Ashley Road.

The Western Tableland Array survey areas correspond to the former Waialua Sugar Company's fields Kawaihoa-15, 17a, 17b, 20, 24a, and Waimea-6 and 8 (see Figure 9). As can be seen in aerial photographs (see Figures 5-8), these fields were completely cultivated in sugarcane and pineapple during the second half of the twentieth century. The Hawaiian Pineapple Company's (H. P. Co.) Waimea Camp (see Figure 4) was formerly located within the Western Tableland Array survey area along Ashley Road, at the location of the *mauka* point of interconnection. The camp, which was built prior to 1929, was removed during the 1950s, and by the 1960s the area had been replanted in pineapples. During WWII four 75mm field guns were emplaced at Waimea Camp. Owing to the later use of the Waimea Camp area for agricultural fields, no surface remnants of it or the WWII gun emplacements, were found in the vicinity of the *mauka* point of interconnection. No archaeological sites of any kind were identified within the Western Tableland Array survey areas.

## Eastern Tableland Array

The Eastern Tableland Array consists of two distinct survey areas that are slated for the proposed development of fourteen wind turbines (see Figures 1 and 2). The two survey areas are separated from one another by a deep gulch that does not permit interconnected access. The southeastern most survey area, which is accessed by Kawaihoa Road, runs northwest across TMK:1-6-1-07:001 from the edge of Anahulu Gulch near Drum Road at an elevation of roughly 1,200 feet above sea level to a point along the edge of the unnamed gulch at an elevation of roughly 800 feet above sea level. The northwestern survey area, which is accessed by Ashley Road, runs northwest across TMK:1-6-1-06:001 following a narrow tableland formation between the unnamed gulch and southwestern edge of the Kaiwiko'ele Stream Gulch from an elevation of roughly 1,000 feet above sea level to an elevation of roughly 400 feet above sea level. Both survey areas in the Eastern Tableland Array contain a thick growth of Guinea grass (*Panicum maximum*) interspersed with albizia trees (*Acacia lebbek*) and other less frequently occurring species of trees, shrubs, vines, ferns, and grasses.

The Eastern Tableland Array survey areas correspond to the former Waialua Sugar Company's fields Kawaihoa-21 and 22 and Waimea-7 and 25 (see Figure 9). Aerial photographs of the project area (see Figures 5-8) show that these fields were completely cultivated in sugarcane and pineapple during the second half of the twentieth century. No archaeological sites were identified within the former field areas, but four Historic sites (Sites 7155, 7156, 7157, and 7158) were identified along the edge of the Kaiwiko'ele Stream Gulch in areas that were not formerly cultivated (see Table 7 and Figure 36). All four sites consist of existing or former metal poles held upright by a base of concrete. Site 7157 is interpreted as being a possible boundary marker for the Kawaihoa Forest Reserve placed at its present location during a 1924 survey of the area (see Figure 31). The three remaining sites may have been part of a communications system laid by the U. S. military just prior to the outbreak of World War II. Each of the recorded sites is discussed in detail below and their location relative to one another and the proposed tower locations are shown in Figure 38.

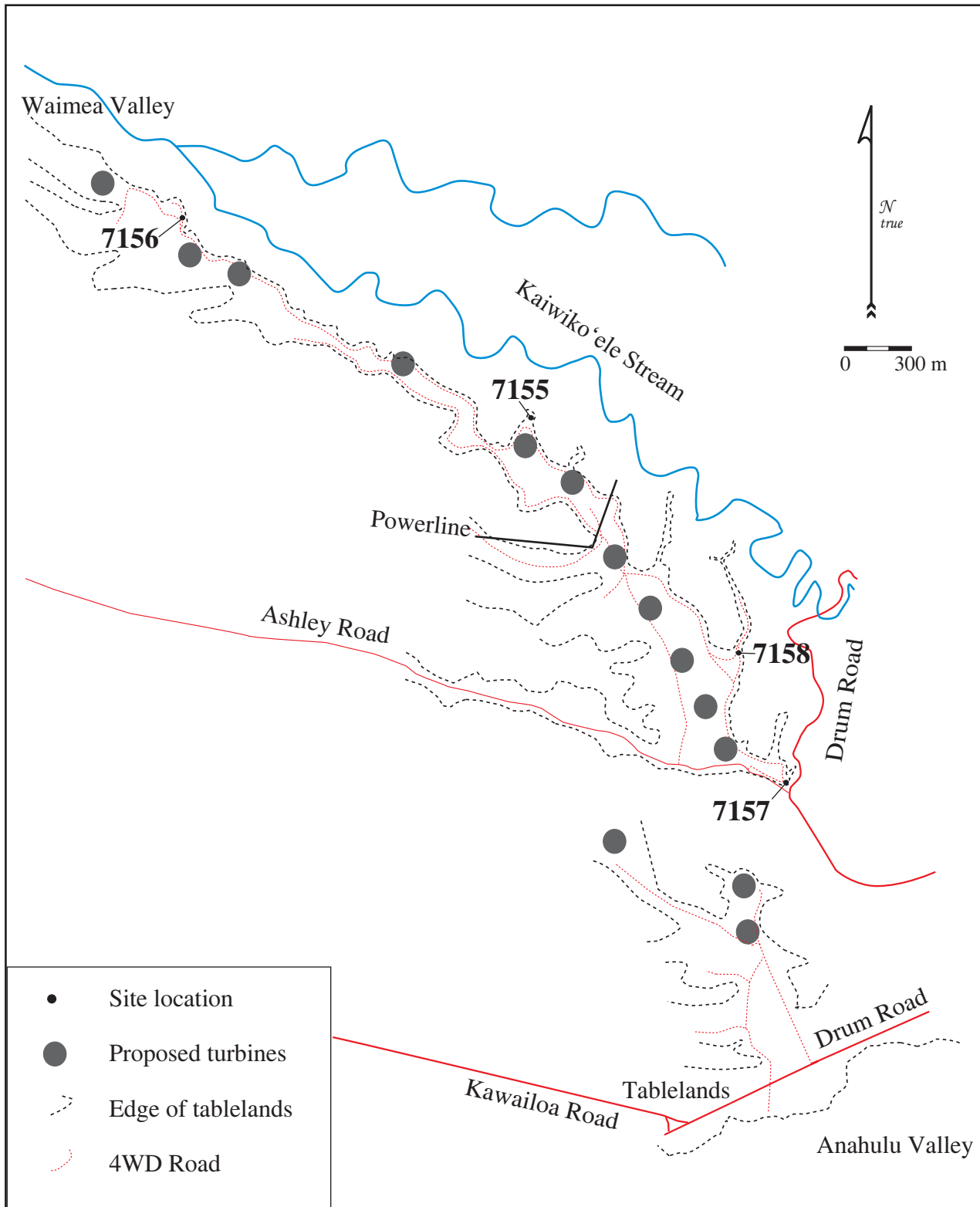


Figure 38. Eastern Tableland Array showing the site locations.

### SIHP Site 50-80-04-7155

This site is a short concrete pillar on a narrow landform at approximately 820 feet above sea level, near the northern edge of the Eastern Tableland Array (see Figure 38). The square pillar, which measures 15 centimeters by 15 centimeters across and 25 centimeters high, consists of poured cement and gravel (Figure 39). Each of the pillar's four corners has been flattened to an edge that measures 2.5 centimeters long. A steel plate covers the top of the pedestal. The four corners of the plate are folded down and were inserted into the pillar when the cement was still wet. Embossed on the steel plate are the following letters and numbers: "MK" and "11 FAB 231." Indented dots and short scattered puncture marks are also visible on the surface of the metal plate. In the center of the plate is a five-centimeter diameter hole that contains the remains of a rusted and truncated galvanized iron pipe. This pipe is most probably the base of a formerly upright pole. The function of the pillar and pole feature is not known, although it may very well had something to do with the military communication system set up immediately prior to the outbreak of World War II (e.g., Bennett 2002). The site offers a commanding view across the Waimea Gulch to the north, stretching from the ocean to the mountains. The area immediately around the pillar is fairly open and clear of vegetation, although the slopes below are covered by guava plants and the plateau behind by *koa* and *albizia* trees.



Figure 39. Site 7155, overview to the north.

### SIHP Site 50-80-04-7156

This site is a short cone-shaped concrete pillar on the northern edge of the Eastern Tableland Array, at approximately 440 feet above sea level, overlooking the steep-sided gulch that contains Kaiwiko'ele Stream (see Figure 38). The pillar, which resembles a truncated cone, has a height of 36 centimeters and a diameter of 35 centimeters (Figure 40). The flat-surfaced apex of the cone-shaped pillar has a diameter of 25 centimeters. Lichen grows on the northward facing side of the pillar. Sticking out from the center of the flat-surfaced apex is a four-centimeter diameter galvanized iron pipe. This pipe, which appears to have been shortened with a hack-saw, was most probably the lower part of a taller upright pole. The feature is located on the *mauka* edge of an old road that leads down into the gulch. The function of the pillar and pole

feature is not known, although it may very well had something to do with the military communication system set up immediately prior to the outbreak of World War II (e.g., Bennett 2002). Alternatively, the hollow pole could have been used to hold a flag, either as a military signal or as an agricultural marker during the days of sugarcane cultivation. The site offers a commanding view across the Waimea catchment to the north, stretching from the ocean to the mountains. The area immediately around the pillar is fairly open and clear of vegetation, although the slopes below are covered by guava plants and the plateau behind by a stand of *koa* trees.



Figure 40. Site 7156, view to the south.

#### **SIHP Site 50-80-04-7157**

This site is a short flat-topped concrete pyramidal block situated at approximately 1,030 feet above sea level on the northern edge of the Eastern Tableland Array at the top of a steep slope that leads down to the Drum Road cut as it descends into the Kaiwiko‘ele Stream drainage (see Figure 38). The pillar, which resembles a typical pier block, has a height of 35 centimeters (Figure 41). The square-shaped pyramid has a base measuring 35 centimeters by 35 centimeters, while its flat-top measures 20 centimeters by 20 centimeters. Incised in the flat-surfaced top of the block, when the cement was still wet, are the following letters and numbers: “K-27” and “FRM” (see Figure 41). In the center of the flat-topped surface is inserted an eight-centimeter diameter rusted and truncated galvanized iron pipe. The area immediately around the pillar is covered by guava plants and the plateau behind by eucalyptus and albizia trees. This concrete feature is similar in construction to Site 7156, but based on its location, may have been erected as a boundary marker. A Hawai‘i Territory Survey map of the Kawaiiloa Forest Reserve (HTS Plat 2069) prepared by C. Murray on May 28, 1924 shows a pipe marking the location of the forest reserve boundary in the general location of Site 7157 (see Figure 31).



Figure 41. Site 7157, overview to the north.

#### SIHP Site 50-80-04-7158

This site consists of a 1.15-meter tall steel pipe (6 cm diameter) which is anchored off-centered into a rectangular-shaped concrete footing (30 x 28 cm and 10 cm deep). The site is located at the beginning of a long and narrow landform on the northern edge of the Eastern Tableland Array (approx. 1,000 ft above mean sea level), overlooking the steep-sided gulch that was formed by the Kaiwiko'ele Stream (see Figure 38). At the top of the pipe is a cast iron cap with an olive green paint coating mounted on a black steel plate (Figure 42). The cap has a two centimeter diameter with a circular protruding opening on one side. A hexagonal bolt within the opening is attached to a rubber-coated wire that descends through the pipe down into the ground. The area immediately around the pipe is covered by a dense stand of guava plants. A tear-drop shaped depression (3.5 m x 2.2 m x 0.45 m) occurs in the ground immediately south of the pipe. An old road runs past the pipe out onto the narrow landform. Machine gun shell casings, a hub cap, and a wooden post occur along the road farther down the same landform outside of the survey corridor.

The function of the pipe feature is not certain, although it may very well had something to do with the military communication and fire control system set up immediately prior to the outbreak of World War II (e.g., Bennett 2002). The placement of the site at the top end of a prominent landform, which once also had a gun emplacement farther downhill, offers a commanding view across the Waimea catchment, stretching from the ocean to the mountains. Roughly 310 meters northwest of the steel pipe feature (outside of the current project area) is the location of a former WWII gun emplacement (Sugimoto 1996:4).



Figure 42. Site 7158, view to the north.

## Kawailoa Road Corridor

The Kawailoa Road Corridor, which will be used to access the southeastern portion of both the Eastern and Western Tableland Arrays, follows existing paved/gravel roadways from Kamehameha Highway (Hwy 83) to Drum Road (see Figure 1). Two alternate routes, both following existing roads (Alternative-1 and Alternative-2), were surveyed for the portion of the Kawailoa Road Corridor that traverses the steep escarpment (*pali*) inland of 'Uko'a Pond. Alternative-1 follows Kawailoa Drive to Kawailoa Road, and then Kawailoa Road to Drum Road. Alternative-2 follows Kawailoa Drive from Kamehameha Highway to Cane Haul Road, and then Cane Haul Road to Hakina Bypass Road, which traverses the *pali* to Kawailoa Road, and then follows that road to Drum Road. The Kawailoa Road Corridor (Alternatives-1 and 2) crosses portions of TMKs:1-6-1-02:001, 002, 003, 025, 1-6-1-07:001, 1-6-2-09:001, and 1-6-2-11:001 (see Figure 2). Kawailoa Drive, *makai* of the Kawailoa Waste Transfer Station, passes by a marshy area located to the north of 'Uko'a Pond (Site 236), and through a small *kuleana* parcel (LCA # 8304:3). This portion of the existing roadway will not be widened or improved as part of the current project. The Cane Haul Road portion of Alternative-2 passes through one *kuleana* parcel (LCA # 2727) and turns onto Hakina Bypass road near the northern boundary of a second *kuleana* (LCA # 7169). A Japanese cemetery (T-36) is located *mauka* of Hakina Bypass Road and the *kuleana* parcel near this turn (Figure 43). The survey corridor, between the *pali* and the roughly 450-foot contour, runs through agricultural fields that are currently cultivated. Vegetation in areas that are not currently cultivated consists primarily of Guinea grass (*Panicum maximum*), *koa-haole* (*Leucaena glauca*), and *albizia* (*Acacia lebbek*).



Figure 43. Japanese cemetery (T-36) located along Hakina Bypass Road outside of the study area, view to the south.

The Kawaioloa Road Corridor, above the *pali*, traverses the former Waiialua Sugar Company's fields Kawaioloa-4, 6, 7, 9, 10, 12, 17a, and 20 (see Figure 9). Aerial photographs of the project area (see Figures 5-8) show that these fields were completely cultivated in sugarcane during the second half of the twentieth century. Near the Kawaioloa Drive/Cane Haul Road intersection the survey corridor passes by the Waiialua Sugar Co.'s Pump # 4. The 1929 U.S.G.S. Hale'iwa quadrangle shows a portion of Kawaioloa Camp within the Kawaioloa Road Corridor, ditches and railways crossing the corridor, and a ditch, waterline, and power poles following the lower portion of Kawaioloa Road (see Figure 4). As indicated on various Historic maps reviewed for this study, the existing roads that the Kawaioloa Road Corridor follows were built during the early to middle twentieth century by the Waiialua Agricultural Company. Kawaioloa Drive, which served as the main access route to Kawaioloa Camp, was built between 1901 and 1924. The upper portion of Kawaioloa Road was in place by 1924 (see Figure 31), and the lower section, following the route of the waterline from Pump # 4 to a ditch near the 500-foot contour, was built between 1924 and 1929 (see Figures 4 and 31). Hakina Bypass Road and Cane Haul Road, the second of which follows the route of a former plantation railway, were both built around ca. 1950 after the railroad shut down (in ca. 1947) and the tracks were dismantled. Both roads are depicted on the 1953 U. S. Army Mapping Service (AMS) Hale'iwa quadrangle (see Genz and Hammatt 2011).

Five archaeological sites were identified within the Kawaioloa Road Corridor (see Table 7 and Figure 36): one along Kawaioloa Road (Site 7159), three along Kawaioloa Drive within the Alternative-1 survey corridor (Sites 7160, 7161, 7162), and one along Hakina Bypass Road within the Alternative-2 survey corridor (Site 7163) (Figure 44). Site 7159 is a ditch complex (still used for irrigation purposes) that follows the southern edge of Kawaioloa Road between roughly the 675-foot contour and the 240-foot contour; Site 7160 consists of two parallel abutment walls that line a portion of the edge of Kawaioloa Drive; Site 7161 consists of three concrete foundations that are a part of the former Kawaioloa Camp stables; Site 7162 is a section of kerbstones that line the *mauka* edge of Kawaioloa Drive near the old Kawaioloa Camp # 2; and Site 7163 is a stone and concrete culvert that passes beneath Hakina Bypass Road. Each of these sites is discussed in detail below. Three additional sites, found within the Cane Haul Road portion of the Alternative-2 survey corridor (Sites 7164, 7165, and 7166; see Table 7), are discussed with the Cane Haul Road Corridor findings (see below).

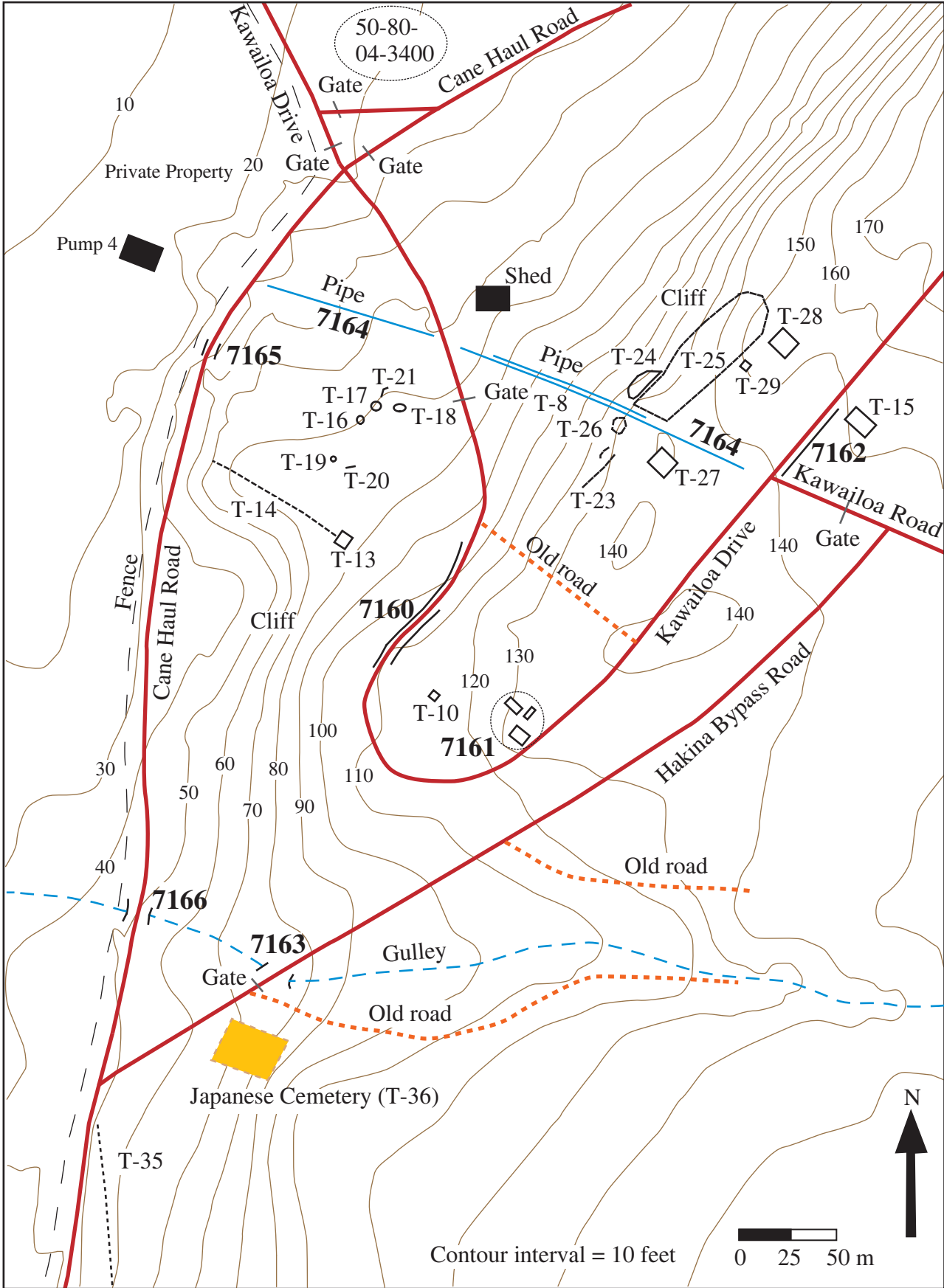


Figure 44. Plan view of archaeological sites identified within (and nearby) the lower portion of the Kawaioloa Road Corridor and the southern section of the Cane Haul Road Corridor.

During the survey of the Kawaioloa Road Corridor the presence of several archaeological sites was noted nearby, but outside, the study area (in the vicinity of Alternatives-1 and 2; see Table 8 and Figure 44). These additional sites, which appear to represent both Precontact and Historic use of the area, are all located on and nearby the steep *pali* formation traversed by Kawaioloa Drive and Hakina Bypass Road. They will not be impacted by any of the proposed road improvements within either of the potential Kawaioloa Road Corridor alternatives. The nearby sites include a remnant enclosure/pavement (Site 50-80-04-3400) previously recorded by Hommon (1982) near the intersection of Cane Haul Road and Kawaioloa Drive; a Japanese cemetery (T-36) located *mauka* of Hakina Bypass Road near its intersection with Cane Haul Road (see Figure 43); a section of old rail bed (T-35) located near the intersection of Cane Haul Road and Hakina Bypass Road; a cluster of eight sites including a terraced platform, a slab paved pathway, three small enclosures, and three short wall segments (T-13, T-14, T-16, T-17, T-18, T-19, T-20, and T-21) located east of Cane Haul Road below the horseshoe in Kawaioloa Drive; a stone and concrete pedestal (T-10) within the Kawaioloa Drive horseshoe; a cluster of seven sites including a set of parallel terrace walls, two rock and soil terraces against the cliff face, an area of soil filled terraces on a steep slope (possible gardens), and three stone and concrete foundations (T-23, T-24, T-25, T-26, T-27, T-28, and T-29) located north of Kawaioloa Drive below its intersection with Kawaioloa Road; and a concrete slab foundation located near the Kawaioloa Drive/Road intersection. As part of the current study brief descriptions and sketch maps of these sites were prepared, photographs were taken, and their locations were plotted on a map of the project area (see Figure 44).

#### **SIHP Site 50-80-04-7159**

Site 7159 designates the irrigation ditch system that runs along Kawaioloa Road, starting near the 675-foot contour and extending roughly 1.5 kilometers down to just above the 240-foot contour (see Figure 36). This irrigation ditch is part of the Kamananui ditch system created by the Waiialua Agricultural Co. during the early to mid-1900s. Portions of the ditch system are still in use today. For the purposes of description, this southeast/northwest trending irrigation ditch has been subdivided into 14 sections, with bridges and culverts separating one section from the next (Figure 45). Starting with Section 1 at the top end, the following description highlights the main features of each section.

Section 1 of Site 7159 originates a few kilometers *mauka* of the current project area, where the ditch is fed by the Kawainui Stream (see Figure 45). The ditch approaches the southern side of the Kawaioloa Road and the project area roughly along the 675-foot contour from the southeast. A side road also follows this contour, directly *makai* and downhill from the ditch channel. Most of the former walls of the Section 1 ditch are destroyed, with a dirt ridge now demarcating the *makai* edge. However, the last two meters of the ditch, immediately south of a sluice gate complex and roughly four meters from the road, still have intact walls. The almost vertical walls consist of four courses of basalt rocks, the biggest blocks being at the bottom. The opposing *mauka/makai* basalt block and cement walls of the ditch are roughly 92 centimeters high and 188 centimeters apart. This was probably the make-up and dimensions of the rest of the Section 1 ditch farther to the southeast.

Section 1 terminates in a sluice-gate complex (Figure 46) four meters south of Kawaioloa Road. The sluice-gate complex abuts a pre-cast concrete bridge that extends beneath Kawaioloa Road. The sluice-gate complex consists of two closely juxtaposed sluices within the *makai* wall of the ditch; each of which allows water to enter a separate 70-centimeter diameter pipe that empties into the main channel. This main channel runs along the southern side of Kawaioloa Road in a *makai* direction. A one-meter long section of wall separates the two pipe intakes. The virtually vertical walls of the sluice-gate complex comprise three courses of cut-stone basalt blocks, with an average measurement of 50 by 50 centimeters pier block. Cement has been used to join and cap the basalt blocks in the wall. The floor of the sluice gate complex is covered by silt. Each of the two sluice gates measures 105 centimeters high, 60 centimeters wide, and is framed on either side with wooden planks (15 x 8 cm), each with two vertical and parallel notches. Wooden sluices are still inserted in the notches of both gates.

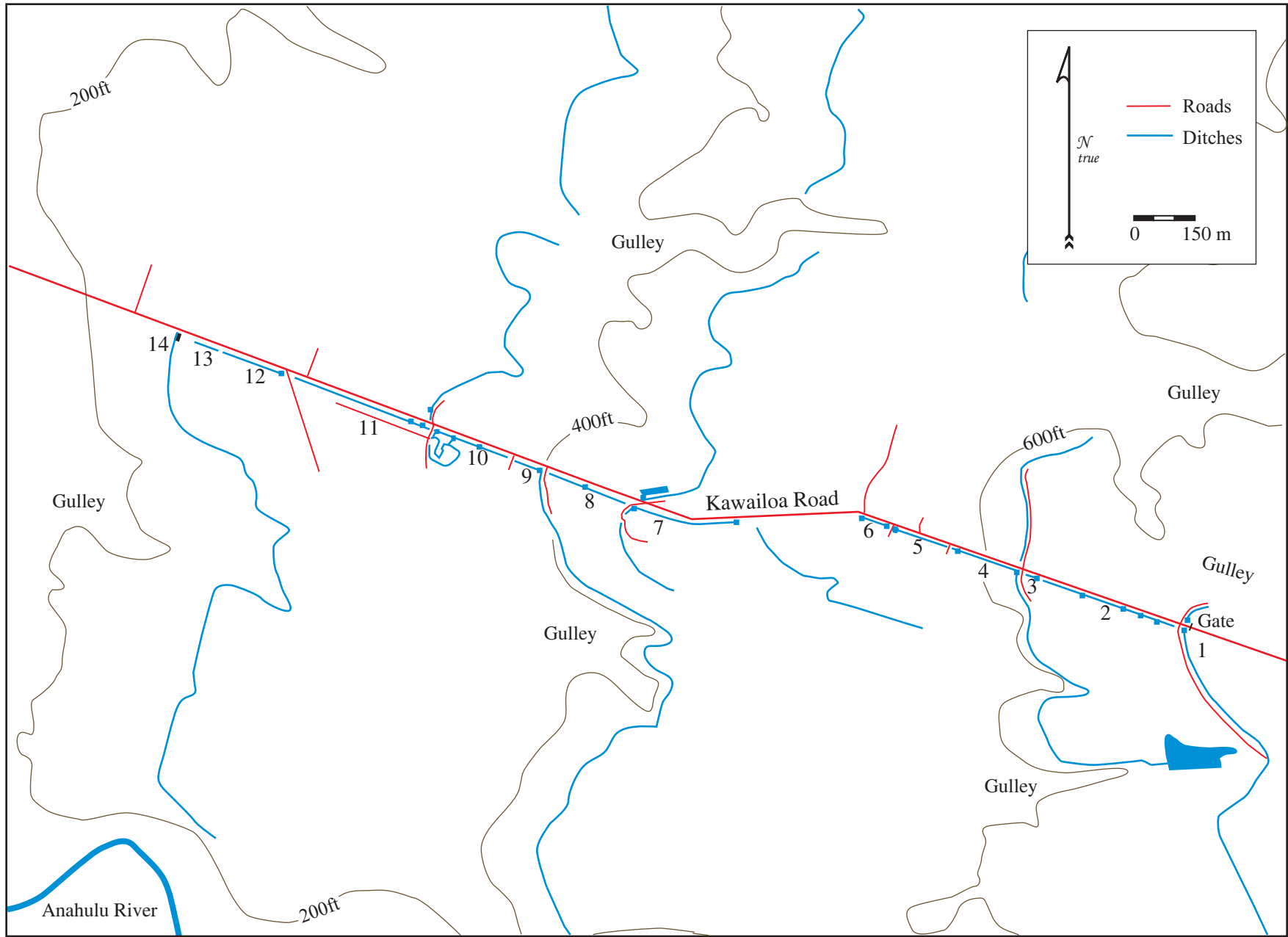


Figure 45. Site 7159 plan view.



Figure 46. Site 7159 Section 1 sluice gate complex, view to the southwest.

Section 1 continues north of the 7.2-meter wide pre-cast concrete bridge that is located underneath Kawailoa Road. This northern extension of the Section 1 ditch has comparatively neatly cut basalt blocks, cemented together to form four courses (Figure 47). The intact portion of the ditch extends for almost 20 meters north of Kawailoa Road and then changes into an earth-lined ditch that continues for another 30 meters before emptying into a gully. The intact portion of the channel measures 1.30 meters deep, 1.80 meters across its top, and 1.65 meters across its bottom. Small sections of metal pipe adjacent to the ditch where it enters the gully suggests that a siphon once occurred in the locality.

At the start of the Section 1 ditch north of Kawailoa Road is another sluice gate complex (Figure 48). Within this concrete-lined complex are two sluice gates; the first within the main channel and the second leading to a pipe branching *makai*. The main sluice gate is 1.07 meters high and 1.85 meters wide, while the side sluice gate is 90 centimeters high and 50 centimeters wide. A surviving wooden sluice still occurs within the side gate. Through a slit behind the sluice can be seen a pipe with a diameter of 50 centimeters. The derelict state of the walls and sluices together with absence of water flow impressions on the bottom of the ditch suggest that Section 1 is no longer operational.

Section 2 of Site 7159 starts at the culvert immediately south of Kawailoa Road (see Figure 45). This culvert is 1.07 meters *makai* of where the two parallel pipes start at the double sluice gates across the side road. Where the pipes exit the culvert on the Section 2 side, the ditch walls are 1.26 meters high and the ditch is 2.34 meters wide. Each pipe is made up of 90-centimeter long sections. The pipe sections are a pre-cast mixture of cement and crushed basalt gravel.

The ditch is at its widest for the first 3.30 meters *makai* from the culvert (i.e., 2.34 m wide) but then narrows to around 80 centimeters. The walls of the narrower channel taper slightly inwards down to a floor, which is roughly 69 centimeters wide. Overall, the first three to five-meter portion of the Section 2 ditch narrows down in a funnel-like fashion. The stones that line the walls and floor of the channel are neatly cut basalt, measuring between 20-40 centimeters wide. At its highest the wall is five courses high, but drops down to three courses. Cement that once bonded the lower courses has eroded away, but cement still occurs within the top courses. Basalt fragments are inserted in the gaps between some of the bigger blocks. Lighter-colored cement in the uppermost course and in the wall capping suggests that the walls were heightened at some time after their initial construction.



Figure 47. Site 7159 Section 1 northern portion of main ditch, view to the south.



Figure 48. Site 7159 Section 1 north side sluice gate complex, view to the south.

Capping each of the 15-centimeter wide walls is cement. The cement that caps the curb above the culvert wall has incised the following two dates: “1927” and “1930.” The “1927” date is north of the “1930” date. A layer of cement that partly covers the “1” in “1927” suggests that a section of the wall was added. However, considering that no structural evidence within the wall exists to suggest that it was lengthened or that a second culvert was added in “1930,” the later date probably reflects a re-plastering episode. A cross-in-circle motif that occurs north of the “1927” date could have served as an original benchmark. A more recent benchmark occurs two meters south of the culvert. This benchmark is a circular metal geodetic marker installed almost at ground level in 1969 by the U.S. Coast and Geodetic Survey.

Four separate sluice gate complexes occur along the Section 2 ditch. Roughly 45 meters *makai* of the culvert is the first sluice gate complex, consisting of two sluices. The 60-centimeter high ditch walls in the vicinity of the sluice gates increase in height to one meter. The main gate allows water to flow down the main channel along Kawailoa Road, whereas prior to being sealed by a thick cement slab the side gate (75 cm high x 75 cm wide) used to allow water flow diagonally southwest out of the main channel (Figure 49). Like the rest of the side gates farther down Section 2, the floor of the side ditch is one course shallower than that of the main channel. Roughly 20 meters *makai* from the first sluice complex is a second one, very much sharing the features of the first, except that the side channel is sealed by a rock and cement wall and faces diagonally northwest (Figure 50). Another 25 meters *makai* of the second sluice complex is the third one. The third sluice complex resembles the first two except that it contains two side gates, both which are sealed (Figure 51). The gates are directly opposite one another, the one in the south wall is sealed with a concrete slab and the one in the north wall is sealed by a rock and cement wall. The fourth sluice gate, which is approximately 200 meters *makai* of the third, differs from the first three in that it is made out of poured concrete (Figure 52). The concrete envelops the top two courses of the ditch, leaving the bottom course exposed. The concrete walls are 77 centimeters high and 3.93 meters long. Within the main channel are two sets of sluice gate slots. Almost 70 centimeters *mauka* of the main gate, within the north wall, is a side sluice gate. This gate, which points diagonally northwest, contains two sets of slots. The entrance to this side canal has been sealed with a stone and cement wall.



Figure 49. Site 7159 Section 2 first sluice gate complex, view to the south.



Figure 50. Site 7159 Section 2 second sluice gate complex, view to the south.



Figure 51. Site 7159 Section 2 third sluice gate complex, view to the south.



Figure 52. Site 7159 Section 2 fourth sluice gate complex, view to the south.

A 22-meter long section of the main channel's northern wall is tilted inwards near the *makai* end of Section 2. A cement repair patch to the *mauka* end of the tilted wall was done most likely to prevent its collapse, knowing that *makai* of the tilted wall section there is an eight-meter long stretch that has collapsed. The walls of the main channel increase in height to 1.10 meters roughly 3.4 meters *mauka* of the culvert. The culvert is a concrete pipe approximately 75 centimeters in diameter. Three rusted railroad ties have been inserted at an angle within the ditch to prevent large objects from blocking the pipe.

The curb above the pipe, which is 1.34 meters long and 26 centimeters wide, is capped with a layer of cement. Incised within the cement is the date "1/26/43." This date is eight years later than the "SEPT. 31 1935" date on the wall of the second side sluice gate. On the north wall of the main ditch channel, a few meters *mauka* of the third sluice gate, are inscribed the names "Pedro + Ayama." On the north wall between the third and fourth sluice gates is the name and date "S. WAKUU 1950."

Section 3 of Site 7159 starts at the exit of the pipe that comes from the *makai* end of Section 2 (see Figure 45). A roughly 18-meter long culvert separates the two sections. A sluice gate complex occurs immediately *makai* of the culvert (Figure 53). Two sluice gates occur within the complex; one allows water to continue down the main channel south of Kawaihoa Road and a side gate allows water to flow underneath the road to the north. Concrete that was poured over the stone and cement wall houses the slotted grooves of both gates. The side gate in the northern wall of the complex has been sealed with a cement slab. Each sluice gate is 80 centimeters high and 50 centimeters wide.

The approximately 70-meter long Section 3 ditch terminates in a culvert catchment section. The walls of the channel are 60 centimeters high and consist of a two course of neatly cut square basalt blocks, each measuring 45-50 centimeters across. Roughly two meters *mauka* of the culvert intake the wall increases in height 80 centimeters. The culvert continues underground for 18 meters *makai*.



Figure 53. Site 7159 Section 3 sluice gate complex, view to the south.

Section 4 of Site 7159 starts where the buried pipe exits 1.4 meters *mauka* of a bridge constructed of concrete and railroad rail (see Figure 45). This bridge covers Section 4 of the main Kawaioloa Road ditch for a distance of 5.22 meters. Where the ditch exists from below the bridge its walls are 1.5 meters high, 1.07 meters wide across the top, and 70 centimeters wide across the bottom. The channel is constructed of neatly cut basalt blocks, cemented together three courses high.

Four meters *makai* of the bridge is a sluice gate complex and the location where a feeder ditch from the south joins the main ditch (Figures 54 and 55). Running roughly along the 620 foot contour, the feeder ditch has its origin in a reservoir to the southeast and outside the project area. The feeder ditch is still active and supplies the main Kawaioloa Road channel with water. The feeder ditch is badly eroded with only a 10 meters section of the *makai* wall of basalt and cement remaining. The partly collapsed soil walls of this channel have widened the U-shaped ditch to 1.75 meters. Within an intact portion of the southern wall, water erosion has removed soil from around a funnel-shaped concrete drain and left it on a pedestal-like soil column.

The sluice complex on the northern end of the eroded feeder ditch includes five gates (see Figure 54). The first sluice gate, which is in the *makai* wall of the feeder ditch, consists of a poured concrete section with three sets of slots for sluices. This first gate has been sealed with a concrete slab, but once allowed water to enter the *makai* fields. One meter north of this gate is a second gate with one set of slots for a sluice. A pipe from this gate runs diagonally northwest, toward the main ditch channel three meters distant. Water would be forced into the pipe when the third sluice gate within the feeder ditch is closed. This third gate is near the T-junction with the main channel. The T-junction terminates in a fourth sluice gate. This gate, with a set of opposing slots for a sluice, allows water to enter a pipe underneath Kawaioloa Road to its north side. The entrance to the pipe has been sealed with a wooden board. The fifth sluice gate is immediately *makai* of the T-junction. This gate allows water to flow down the main channel, which runs parallel to Kawaioloa Road.

Immediately *makai* of the sluice gate within the main channel is a small bridge. Constructed of concrete reinforced by sections of railroad tracks, the 60-centimeter wide bridge allows a person to lift the H-shaped sluice handle from directly above. Fragments of wooden (possibly *koa*) sluices are scattered across the ground south of the bridge.

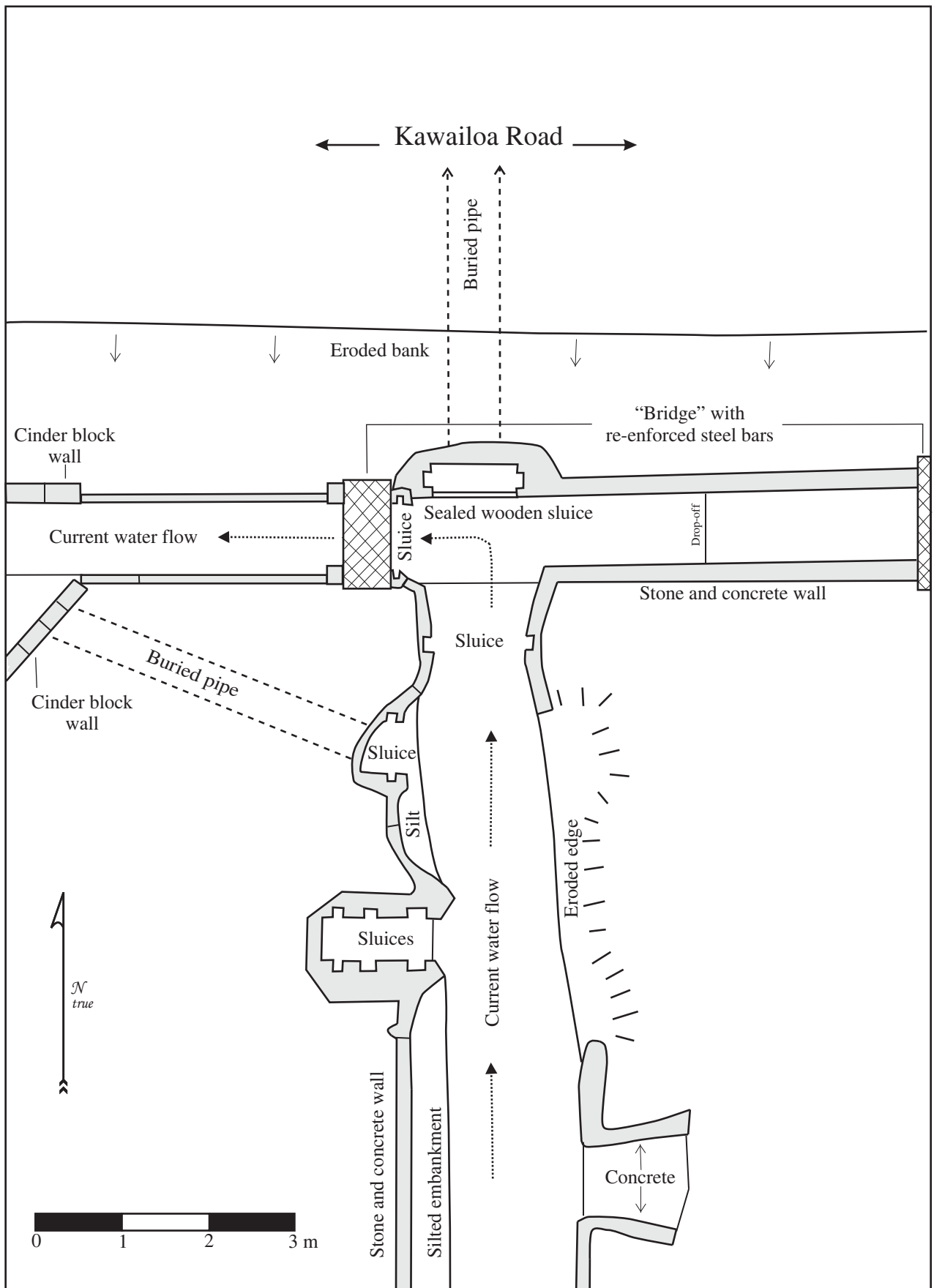


Figure 54. Site 7159 Section 4 sluice gate complex plan view.



Figure 55. Site 7159 Section 4 sluice gate complex, view to north.

Where the feeder ditch and the diagonal side ditch empty into the main channel the walls of the main ditch have been heightened with the addition of a cinder block layer. The elevated height of the walls in the area where the ditches converge could function to prevent rushing water from eroding the ditch's exterior. Below the cinder block capping, the walls of the main channel are 1.3 meters high and includes three courses of neatly cut basalt blocks. The bottom two courses contain bigger blocks, measuring between 25-30 centimeters, with the top layer consisting of smaller and irregular-shaped stones. Smaller stones have also been inserted in the cement where gaps exist between the coursed stones. The flowing action of water has eroded away cement from between the bottom course of stones.

A branch of the feeder ditch extends north of Kawaioloa Road. This section has been sealed-off by the sluice gate immediately south of the road. Evidence of abandonment, neglect, and perhaps even deliberate dismantling are evident at the feeder ditch north of Kawaioloa Road. For example, a huge push pile ridge runs *makai* of the silted ditch, while broken sections of basalt block and cement wall are scattered on the eroded *mauka* edge. Within the northwestern corner of where the northern extension of the ditch meets Kawaioloa Road is a modern pump complex with five metal containers and pipes that are surrounded by a chain link fence (see Figure 55).

The main ditch that runs south of Kawaioloa Road shows signs of deterioration in Section 4. The middle third of the north wall has sections that have collapsed inwards. Within these collapsed sections only the bottom course of the once three course high wall remains. The loose remnants of basalt chunks and concrete have been removed from the canal to prevent blockage. These chunks are now scattered on the ground south of the main canal. Farther *makai*, where a buried metal pipe enters the main canal from the northeast, soil erosion from the road run-off has caused a small section of north wall to collapse.

Fourteen meters before the *makai* termination of Section 4 is a side sluice gate in the southern wall of the main channel (Figure 56). The floor of the side sluice is slightly elevated above the floor level of the main channel. The side sluice gate has been sealed with a thick cement slab. The last two meters before the end of Section 4 has a culvert wall similar to the one at the end of Section 3. Incised in the cement layer that caps the wall above the pipe is the date "1943 Feb. 6."



Figure 56. Site 7159 Section 4 blocked side sluice, view to the south.

Section 5 of Site 7159 begins after a 13-meter long and 30-centimeter thick pre-cast concrete slab bridge across the main Kawaioloa Road ditch (see Figure 45). Immediately *makai* of the bridge the walls of the main channel are 97 centimeters high, 90 centimeters across the top, and 50 centimeters across the bottom.

Almost 20 meters *makai* of the bridge, the walls drop in height to 70 centimeters. Pressure built-up with the accumulation of deposits on the road-side of the wall caused sections of the northern wall to collapse into the ditch. Piles of broken wall fragments south of the ditch testify to attempts to unclog the flow of water. For the most of Section 5 the neatly cut basalt block and cement walls are two courses high. In attempts to prevent water from spilling over the edges of the ditch a layer of cinder blocks has been added. The Section 5 walls appear to be unique in that the smallest layer of stone coursing occurs at the bottom, directly above the level of the floor, instead of at the top as is normally the case.

Near the *makai* termination of Section 5 there are two incisions on top of the cemented wall. On the south wall are the letters “S.F.” and on the north wall is the date “1926.” The ditch walls increase in height to 90 centimeters immediately before the culvert termination of Section 5. The base of the ditch drops down almost 20 centimeters into the culvert. The diameter of the steeply dipping pipe is 70 centimeters.

Almost four meters *makai* of the culvert is an octagonal-shaped cement slab, 4.3 meters wide and 33 centimeters thick (Figure 57). The underside surface of the slab is irregular due to containing protruding basalt cobbles. A slot that extends from the *mauka* edge into the slab is 78 centimeters long and 30 centimeters wide. This slot could be the base for a water tank. A water tank is indeed located on this spot in the 1929 Haleiwa Quadrangle Survey map (see Figure 4). Sheet erosion has washed soil away from below the sides of the slab.



Figure 57. Site 7159 Section 5 octagonal slab, view to the southwest.

Section 6 of Site 7159 commences at the *makai* end of a 30-meter long deeply buried culvert (see Figure 45). Looking at the pipe's exit it is clear that it emerges at a steep angle. The culvert empties into a sluice gate complex that includes two gates (Figures 58 and 59). The gate in the southern wall of the complex has the remains of a 50-centimeter diameter pipe that comes from the southeast, whereas the gate branching diagonally out of the southwestern corner of the complex has the remains of a sectional square channel. The ditch is made up of 93-centimeter long pre-cast sections (concrete flumes) that are 42 centimeters wide across the top and 27 centimeters wide across the bottom. The sluice of the southern gate has been closed with plywood, whereas the southwestern gate has been sealed with two concrete slabs. The square impressions for holding a wooden bridge can be seen immediately *makai* of the southwestern gate.

The walls of the sluice gate complex and the main channel farther *makai* are made up of cut square blocks of basalt and cement. Whereas the sluice gate complex is approximately one meter deep with four courses, the main channel is merely 55 centimeters deep with two courses. The main ditch that runs south of Kawaioloa Road is 92 centimeters across its top and 67 centimeters across its base.

A row of three circular impressions made by the end of a metal pipe occur on the cement capping of where the southern sluice wall transitions into the ditch wall. The incised initials "S.K." occur nearby.

Just over 20 meters *makai* from the sluice gate complex is a bridge of pre-cast concrete. This bridge measures eight meters long by two meters wide by 20 centimeters thick. Raised curbs on the *mauka/makai* edges of the bridge measure 15 centimeters wide by 10 centimeters high. The underside surface of the bridge is irregular due to containing protruding basalt cobbles.

A second bridge that covers the ditch is 4.5 meters *mauka* of Section 6's termination. The bridge is a pre-cast concrete slab that has been inverted; the uneven side faces upwards and the even surface with raised culvert edges faces downwards. The slab measures 3.7 meters wide, 1.86 meters long, and 32 centimeters thick.

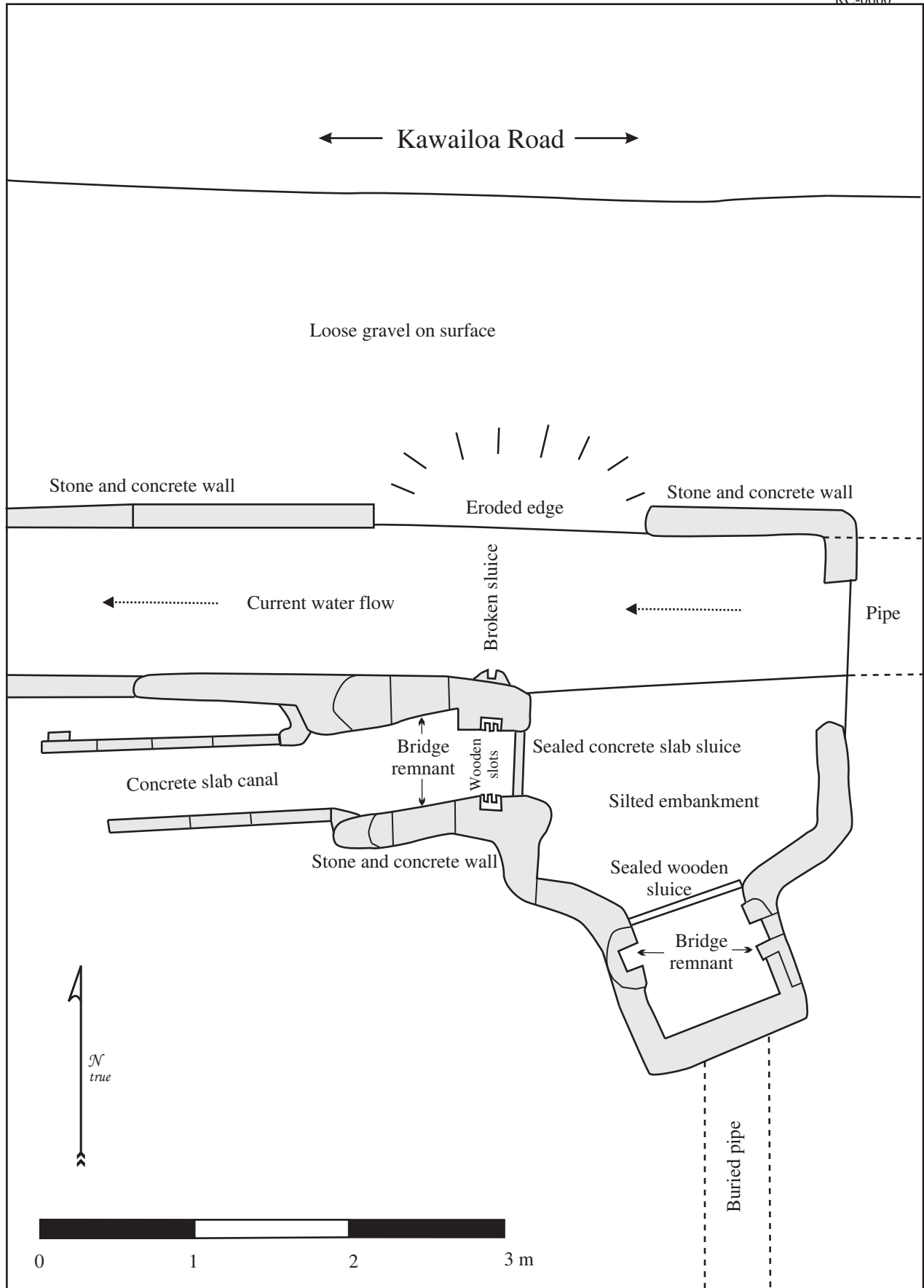


Figure 58. Site 7159 Section 6 sluice gate complex plan view.



Figure 59. Site 7159 Section 6 sluice gate complex, view to the south.

The Section 6 main ditch channel ends in a sluice gate complex (Figure 60). This complex, which has a poured concrete layer on top of a regular basalt and concrete wall, is one meter high and 92 centimeters across. The sluice gate in the main canal allows water to flow *makai*, whereas a side sluice gate allows water to flow underneath Kawaioloa Road to the northern side. Both gates have slots that once held sluices, the slots of the main gate still contain remains of wooden beams. The northern side gate has been sealed by irregular shaped basalt chunks and cement. The walled remains of the side ditch north of the road are barely visible above a layer of silt and loose rock.

*Makai* of the gate the ditch angles down steeply and enters an underground pipe. The last two meters of the ditch are covered with sections of corrugated iron (see Figure 60), presumably to prevent big objects from falling in and clogging the pipe. The 75-centimeter diameter pipe continues underground *makai* for approximately 500 meters.

Roughly 240 meters *makai* from the end of Section 6 is a rectangular-shaped cement structure. Measuring two meters *mauka/makai* by 90 centimeters north/south by 20 centimeters high, the rectangle is covered by two thin concrete slabs, each measuring 90 centimeters by 70 centimeters. The feature probably acts as an access point to the pipe that can be seen through surface slots, roughly 1.5 meters below the surface. The remains of an old side ditch can be seen emanating from the southern side of the surface rectangle.

Section 7 of Site 7159 begins within a sluice gate complex (see Figure 45; Figure 61). The complex contains two sluices; one allowing water to flow down the main channel along the southern side of Kawaioloa Road and a side gate that allows water to flow underneath the road to the northern side. The side gate has been closed with solid concrete (see Figure 61), but remains of slotted wooden beams can still be seen within the concrete slots on both sides of the blocked exit. Concrete walls that have been poured in a mold cover two bottom courses of rock within the sluice gate complex. The 1.9-meter high poured concrete section drops down to 70 centimeters where the complex changes into the main channel.



Figure 60. Site 7159 Section 6 sluice gate complex at end of section, view to the southwest.



Figure 61. Site 7159 Section 7 sluice gate complex at start of section, view to the north.

The rock and concrete walls of the Section 7 ditch differ noticeably from the *mauka* ones described above. First, the wall contains basalt rocks of different shapes and sizes, varying from 10 centimeters to 1.1 meters wide. Secondly, the irregularly surfaced basalt blocks do not appear to be cut. Thirdly, walls vary from one to four courses high. Fourthly, wall height varies from 50 centimeters to 75 centimeters. And fifthly, the width of the main channel varies between 60 centimeters and one meter. The irregular walls of Section 7 also lack the cement capping typically found on top of the other ditch walls.

The northern wall has collapsed in places and it is now only the elevated road surface that serves as a convenient barrier to direct water flow downhill. An anomalous widening and heightening of the south wall halfway down Section 7 could be the remains of a former sluice gate complex. The height of the main channel walls increases to 75 centimeters and its width to one meter. This anomalous wall section is roughly 14 meters *mauka* from Section 7's terminal point.

The sluice gate complex at the terminal point of Section 7 contains two sluices; one in the main channel that allows water to flow *makai* and the other in the northern ditch wall that allows water to flow north of Kawaihoa Road (Figures 62 and 63). The stone and cement walls of the sluice gate complex are 1.4 meters high. An actual H-shaped wooden sluice is still operational within the main sluice. This sluice diverts water to a pond north of the road. A bridge, made from several parallel sections of railroad tracks, occurs immediately *makai* of the sluice. This bridge allows the sluice operator to open and close the sluice from directly above. Three parallel rail line tracks have been diagonally inserted at the *makai* end of the main ditch channel, most likely to prevent debris from blocking the buried outlet pipe.

The sluice gate complex at the end of the Section 7 ditch was probably modified or rebuilt in the early 1950s, bearing in mind that the date and words "March 15 1951 JOB #121-3-50" are inscribed in the cement on top of the north gate. The faint and hardly legible letters "LAWOT RINUL" are also inscribed on the cement of the *makai* gate. The slots of both sluice gates have also recently been modified, as evidenced by the fresh-looking cement inserts.

A tubular-shaped side channel brings water from a feeder ditch from a southwesterly direction, outside the project area. The tubular-shaped side channel is assembled from a series of two conjoined quarter-circle pre-cast concrete sections, each measuring 90 centimeters long by 80 centimeters deep by three centimeters thick. The ditch is 90 centimeters wide across its top and 1.15 meters across its widest central diameter. Where the side ditch joins the main one, there is a 40-centimeter drop.

The pipe leading from the open north sluice gate currently takes water below Kawaihoa Road to the north, where a sluice gate complex diverts water into a retention pond and an adjacent feeder ditch. Both the pond and the feeder ditch extend northward, outside the project area. The sluice complex consists of three sluice gates; one that allows water to flow down the feeder ditch to the north, a sealed sluice that once allowed water to flow into a former side ditch, and one that diverts the water to the pond (Figures 64 and 65). Located four meters north of Kawaihoa Road, the complex includes different sections. Where the pipe exits from the direction of Kawaihoa Road is a core section characterized by walls built from stone and cement. The more recent ditch *makai* of this core is made up of a series of 93-centimeter long pre-cast concrete "Waialua" flumes that are 42 centimeters wide across the top and 27 centimeters wide across the bottom. The side walls contain square openings with slits for small metal sluices. To the north of the sluice gate complex the channel has collapsed walls and a silted-up bottom.

Although sections of the complex are in disrepair, others are indicative of recent use or even ongoing maintenance. Examples of maintenance include: the cement slots still contain slotted wooden beam inserts; a wooden bridge, painted blue, still occurs immediately north of the northern sluice gate; and piles of silt, that include fresh water clams, are the products of channel clearance. Moreover, the gaps on both sides of the concrete slab seal of the blocked side ditch have recently been patched with strips of epoxy resin and a layer of hollow tile has been added to the top of the square canal. Incised on the cement that caps the hollow tiles are the following two names: "Orlando RAFANAN" and "LAYDO RAFANAN."

Section 8 of Site 7159 begins at where the buried pipe exists, roughly 20 meters *makai* from where it goes underground at the end of Section 7 (see Figure 12). The culvert wall is 1.63 meters high and consists of two courses of nicely cut square basalt blocks joined with cement. Comparatively fresh-looking cement has been inserted around the 75-centimeter diameter pipe at the bottom of the wall.

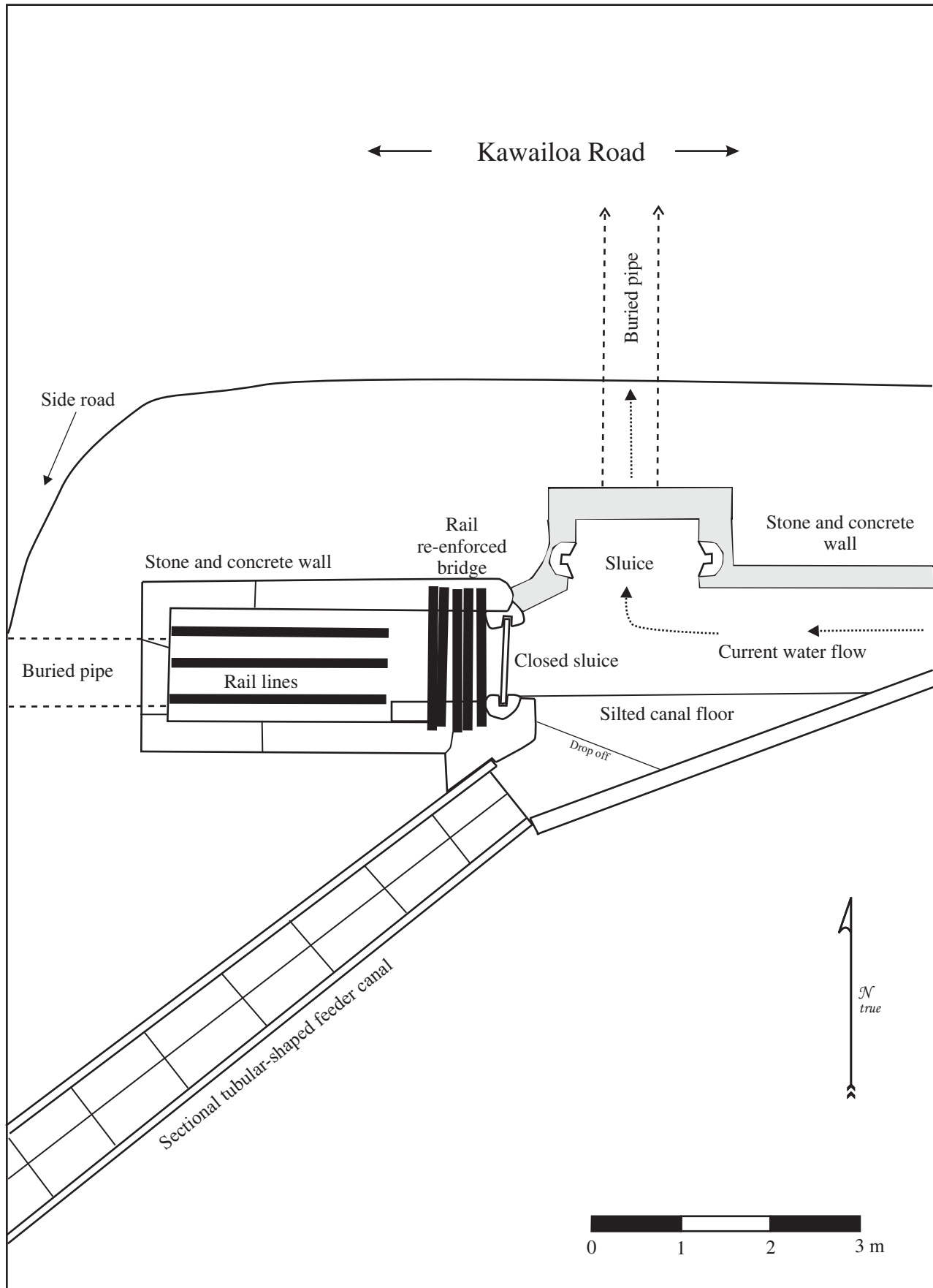


Figure 62. Site 7159 Section 7 terminal sluice gate complex plan view.



Figure 63. Site 7159 Section 7 sluice gate complex at end of section, view to the southwest.

The ditch walls *makai* of the culvert include irregular-shaped rocks that vary in size and number of courses. In many places the channel walls have been plastered over with a thin layer of cement. A section of the main ditch, stretching between 20 and 30 meters from the culvert wall, has walls raised to a height of 1.5 meters and the ditch widened to 1.43 meters. This section is lined with walls made from a series of conjoined rectangular-shaped concrete slabs. The floor of the channel is made from a mixture of cement and crushed rock. Strips of fresh-looking cement have been used to patch the lower wall seams and the corner junctures between the lower walls and the floor. Farther down the main channel are a few single large basalt boulders that are inserted into the wall and so take up the entire height. The cement capping of a portion of the north wall with neatly cut stones has the names “ADAC KIMUA STANLEY” and date “1937” incised in it. The cement in this portion of the ditch has been mixed with crushed shell.

A metal pipe, with a diameter of 31 centimeters, drains into the main channel diagonally from the northeast. The pipe enters the north wall of the pipe roughly 250 meters *makai* from Section 8’s start. This pipe is protected by a rectangular wall of basalt stones and cement. Incised on the cement capping of this wall is pentagon with the numbers and words “370TH A-3 ENGRS.” This is also a point where the floor of the main ditch drops down steeply with the walls increasing in height to 135 centimeters.

Roughly 10 meters *makai* of the culvert, roughly halfway down Section 8, is a sluice gate within the main ditch channel (Figure 66). A rock wall built on top of a cement beam is immediately *makai* of the sluice slots. The 90-centimeter wide wall that crosses the main ditch probably served as a platform for the sluice gate operator to access the sluice from directly above. Incised onto a corner of the bridge is the date “12-28.” Once closed the sluice would have forced water into two side ditch. The north gate goes underneath Kawailoa Road and the southern gate into the fields. Both gates have been sealed with a stone and cement wall. Incised into the cement capping of the wall above the southern gate is “MAR-15-1951.”

Between the sluice gate and the *makai* end of Section 8 the main ditch that runs south of Kawailoa Road is in need of repair; portions of the northern wall have collapsed and *mauka* of the outlet culvert the floor of the channel has disintegrated.

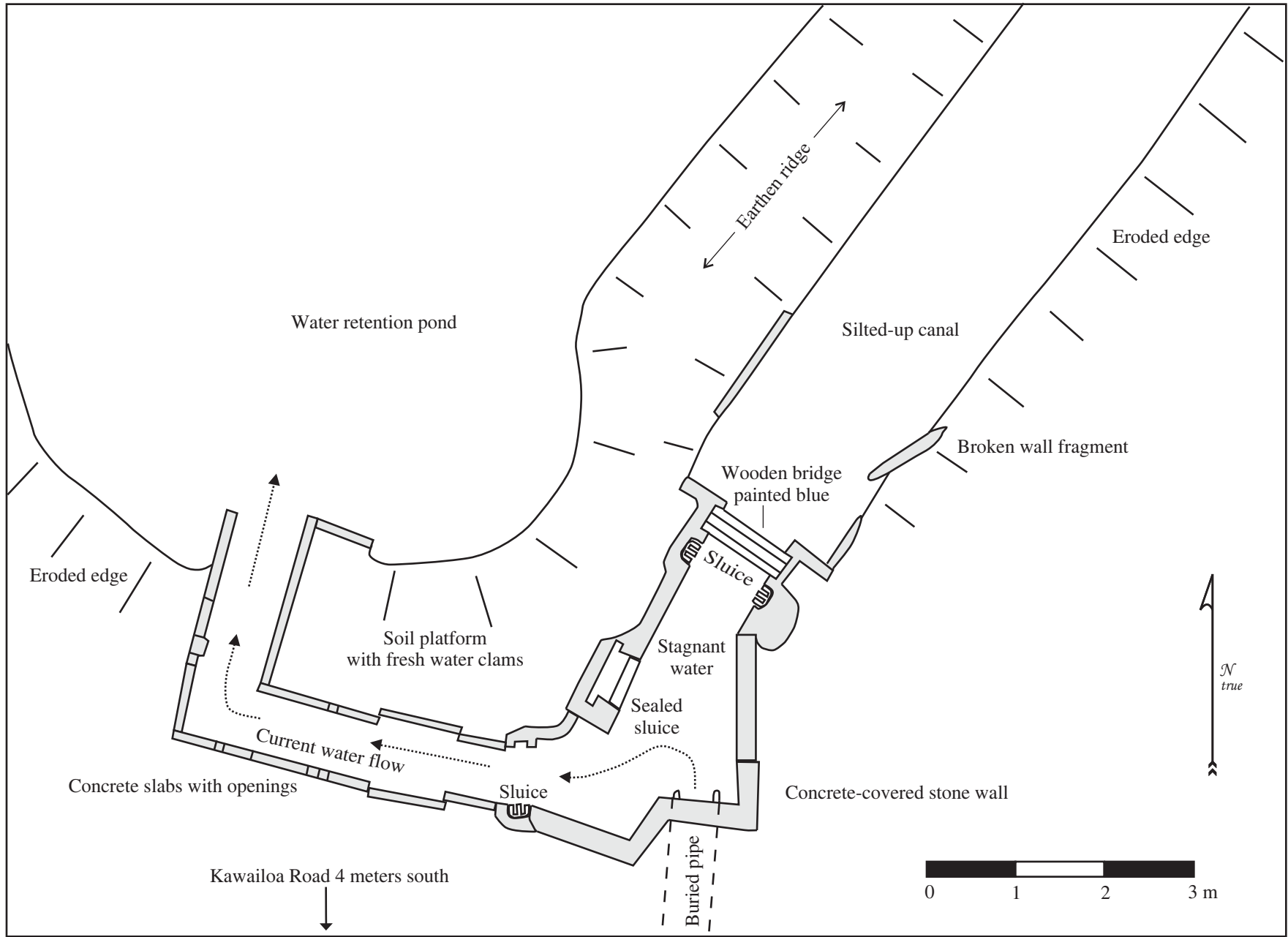


Figure 64. Site 7159 Section 7 north sluice gate complex plan view.



Figure 65. Site 7159 Section 7 sluice gate complex north of Kawailoa Road, view to the north.



Figure 66. Site 7159 Section 8 sluice gate complex at middle of section, view to the southwest.

Section 9 of Site 7159 begins 15 meters *makai* of where the 75-centimeter diameter pipe from Section 8 re-emerges (see Figure 45). A one-meter high rock and cement wall topped by a cement curb has been constructed around the pipe. Inscribed on top of the cement curb is the date “8-5-1953”.

Immediately *makai* of the curb are slots in the cement wall for a sluice gate (Figure 67). When closed this gate would allowed water to flow into a side sluice, the entrance to which has now been sealed with a solid concrete insert. The main ditch walls here are 1.3 meters high.

A feeder ditch from the southeast and outside the project area follows the 405 feet contour and joins the main Kawaihoa Road ditch channel immediately *makai* of the culvert exit. The side ditch measures 2.5 meters wide across its top, 1.15 meters wide across its base, and not more than 90 centimeters deep. The floor and walls of this feeder ditch consist of extremely broken cement and plaster. However, the last two meters of wall and floor from where the feeder ditch enters the main ditch consist of solidly casted cement.

Roughly three meters *makai* of the culvert and ditch intersection, a pre-cast concrete bridge spans the main Kawaihoa Road ditch channel. This bridge is 1.6 meters long by 1.6 meters wide by 15 centimeters thick (see Figure 66). *Makai* of the bridge the south wall drops in height to 90 centimeters and the north wall to one meter. The height of both walls drops to 80 centimeters halfway down the ditch. Although the irregularly-shaped basalt chunks in the walls are not coursed, the walls appear to be in a good state of repair and are covered with a translucent outer plaster-like layer. The floor has a cement bottom with crushed stones. Strips of light-colored cement mark those seams that have been patched fairly recently.



Figure 67. Site 7159 Section 9 sluice gate complex at start of section, view to the southwest.

Section 10 of Site 7159 begins 1.5 meters *mauka* of a sluice complex, at the culvert exit that is 15 meters *makai* of Section 9 (see Figure 45). A wall of neatly cut rectangular basalt and cement extends for 65 centimeters above the culvert exit.

The first sluice complex within Section 10 is cement-covered. This complex, which is 1.04 meters deep and 80 centimeters wide, contains at least three sluice gates (Figure 68). Two of the sluice gates occur in the main Kawaihoa Road channel and a third occurs where a former side ditch exits the main ditch perpendicularly to the south. The former location of a possibly fourth sluice gate occurs in the north wall of the main ditch, directly *makai* of the culvert exit. The possible northern gate is now solidly blocked by a cement insert that is fused with the north wall. The southern gate is sealed with a cement slab insert. When closed, the *mauka* sluice in the main channel would have forced water through the northern gate, whereas the *makai* sluice would have forced water through the southern gate. The original northern wall that was associated with the *makai* gate is gone and has been replaced with a rough stone and cement wall; a wooden beam embedded in the ditch floor probably was the base of the sluice gate.



Figure 68. Site 7159 Section 10 first sluice gate complex, view to the north.

Broken pieces of a dismantled sluice gate bridge and ditch walls are scattered across the ground surface southwest of the sluice complex. In the southwest exterior corner of the complex, where the southern ditch exits from the main one, is a cement patch. This patch, which runs diagonally up the corner, has footprints left by a mongoose when the cement was still wet.

Roughly 1.5 meters *makai* of the sluice gate complex, in the northern wall of the main channel, is a pipe entering diagonally from below Kawaihoa Road to the northeast (see Figure 68). The pipe is protected by a side-walled insert into the main ditch wall.

Seams within the main channel, particularly where the rock and cement walls join the crushed stone and cement floor, has recently been patched by light-colored cement. One patch, on a 2.5-meter long cement section on top of the southern wall, has incised on top of it the date “2-13-81.” Another patch, which occurs on the floor immediately below the southern wall, is the very recent date of “5/22/09.”

The main ditch within Section 10, that runs south of and parallel to Kawaioloa Road, has an average depth of 70 centimeters and is 1.45 meters across the top and 85 centimeters across the bottom. Generally speaking, the walls of the main ditch are made up of irregular shaped basalt chunks with no apparent coursing.

Approximately half-way down Section 10, is the second sluice complex. Here two sluices occur on directly opposite sides of the main channel (Figure 69). The sluice gate in the southern wall points diagonally southwest, while the gate in the northern wall points diagonally northwest. Both sluice gates are made out of thick cement poured over a stone core. The gates are 80 centimeters high and 40 centimeters wide. Incised on top of the cement curb over the northern gate are the following: “Antonio” and “1913.” If this is an actual date, then the side sluice is the oldest recorded surviving feature within Site 7159. Broken and partly cement-filled remains of slots for a former sluice gate on the main ditch can be seen roughly 75 centimeters *makai* of the side sluices. When closed, water from the main ditch would have been forced through one or both the side channels. The side sluices are sealed with heavy slabs of pre-cast cement. Exposed cement pipes that emanate from the sluice gates are now almost completely destroyed.



Figure 69. Site 7159 Section 10 second sluice gate complex, view to the south.

Roughly six meters *mauka* of the second sluice complex the walls of the main ditch have an added layer of hollow tile. This extra layer probably serves to prevent spillage over the edges of the channel and so help minimize soil erosion along the exterior edges.

The next 80 meters of the main ditch along Kawaioloa Road is an intricate succession of sluice gate complexes, side channels, a retention pond, bridges, and culverts (Figure 70). The first sluice gate complex within this stretch (i.e., the third sluice complex within Section 10) serves to divert water from the main ditch into a retention pond that is almost 10 meters to the south (Figure 71). The complex includes two sluice gates; one in the main ditch and one at the beginning of the side ditch which branches off in a southwesterly direction. The gate in the main ditch appears to be still in use, as attested by a wooden foot bridge painted blue and by a wooden sluice with fresh mud and salt stains at roughly 70 centimeters above floor level. Although the side ditch no longer has a sluice gate, slotted wooden inserts still occur within the primary concrete slots.

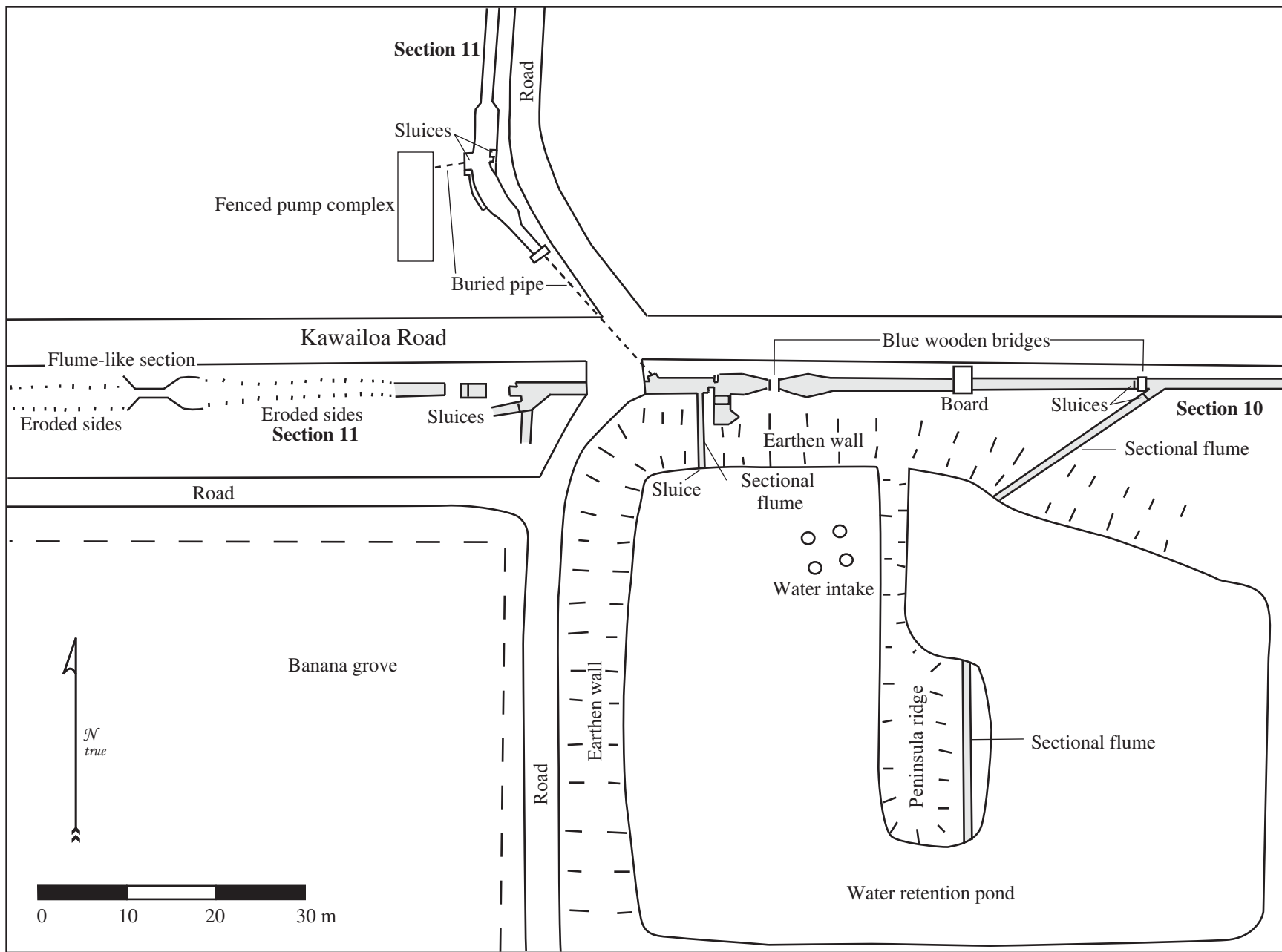


Figure 70. Site 7159 Sections 10 (west end) and Section 11 (east end) plan view showing sluice gate complexes.



Figure 71. Site 7159 Section 10 third sluice gate complex, view to the south.

The side ditch, which consists of sections of square-shaped pre-cast units, connects the main channel with the retention pond. The walls of the sectional side ditch have been heightened by the addition of thin hollow tiles. Incised on the cement cap of the corner section, where the side ditch branches away from the main ditch, are the names “TRONG STRUCE” and date “9-87.” A portion of the sectional side ditch has been truncated by the *mauka* half of the pond, as can be seen by the continuation of the ditch on an extant peninsula in the center of the pond.

Almost forty meters *makai* from the sluice gate complex is another blue wooden footbridge (see Figure 70). This footbridge crosses a narrow section of the ditch, where it takes on an hourglass configuration (Figure 72). The wider *mauka* and *makai* portions on either side of the bridge measure 1.35 meters across, whereas the narrow neck with the bridge is merely 65 centimeters wide. The purpose of the narrow neck in the main channel is not known, although the occurrence of higher walls (i.e., 120 cm high) immediately *mauka* of the neck shows that it can contain a comparatively high level of water. Words incised into the cement capping of the heightened walls include the phrase “ESCAPE to Wisconsin” and “SAVE MONEY GANG WACO.”

Four meters *makai* of the bridge is an intricate sluice complex (the fourth one within Section 10) and a pre-cast triangular-shaped cement water retention facility (see Figure 70). Three sluice gates are currently visible in the complex; an open-one across the main ditch, a closed wooden gate currently blocking water in the triangular-shaped water retention facility from entering the main ditch, and an open-one at the rear of the triangle shaped water retention facility. The cast cement tank-like facility seems to receive its water supply from the big dirt-walled water retention pond 10 meters to the south. The fact that the southern wall of the main ditch has been sealed with concrete slabs immediately *mauka* of the cement tank suggests that pond water once entered the main ditch through a gate here. A blue painted wooden bridge covers a section of the cement water tank. Like most other platform-like bridges of similar dimensions and construction, this platform allows an operator to open and close the sluice gate from directly above. Slotted wooden beams for sluice gates are still present in all the cement slots of the complex



Figure 72. Site 7159 Section 10 fourth sluice gate complex, view to the north.

Words incised on top of the poured cement wall of the water tank near the bridge-like platform includes the name “CENDONG” and the dates “1-21-83” and again “1/21/83.” The two 1983 dates near the functional sluice in front of the concrete tank suggests the day that the job was completed.

Immediately *makai* of the triangular-shaped concrete tank is a square-shaped sectional side ditch (see Figure 70). This side channel, which extends from the retention pond to the main ditch, is made up of 93-centimeter long pre-cast concrete flume sections that are 42 centimeters wide across the top and 27 centimeters wide across the bottom. A PVC pipe currently runs along the bottom of the pre-cast cement flumes. The pipe brings water from the retention pond to Kawaioloa Road and beyond. Roughly six meters *makai* from where the side ditch and pipe enter the main channel, the pipe and the main ditch turn northwest to pass underneath a concrete bridge below Kawaioloa Road (see Figure 70).

This concrete bridge that supports Kawaioloa Road covers the northern branch of the main ditch. The southern branch of the main ditch continues straight *makai* at a fifth sluice gate complex that represents the termination of Section 10 (Figure 73). The bridge that covers the northern branch is 1.25 meters wide, 73 centimeters high, and roughly 17 meters long. The concrete pipe that designates the southern branch and *makai* continuation of the main ditch has a diameter of 50 centimeters. The sluice gate that allows water to enter the pipe and the southern branch of the main ditch has been closed with dirt, rocks, and wooden planks. The sluice gate that allows water to flow northwestwards towards the northern side of Kawaioloa Road is open, but is no longer operational. Slotted wooden beams still exist within the cement slots of both northern and southern sluice gates.

Section 11 of Site 7159 is divided into two branches; one north of Kawaioloa Road and the other south (see Figures 45 and 70). The northern branch starts at least seven meters north of Kawaioloa Road where the ditch and PVC pipe exit from underneath the cement bridge (Figure 74). The first five meters of the ditch are lined by rock walls that have been plastered with a thick layer of cement. Words incised on the cement capping of the *makai* stone and cement wall of the northern ditch includes the phrases “WACO SAVE Money GANG A&B” and “2802 MADE FOR F.K.”



Figure 73. Site 7159 Section 10 fifth sluice gate complex, view to the southwest.



Figure 74. Site 7159 Section 11 north of Kawaihoa Road, view to the north.

After five meters the northern ditch turns northeast to follow the 350 feet contour. From the bend in the ditch onwards the walls alternate between rock and cement constructions to conjoined pre-cast cement flumes. Thereafter the walls are made with cement and chicken wire that are badly broken up. A fenced modern pump facility with three tanks is located five meters *makai* of the northern channel.

Approximately 10 meters from the start of Section 11 north of the road is a sluice complex (see Figure 72). This complex contains two sluice gates, both still containing remnants of wooden slots. The sluice gate in the main ditch allows water to flow along the contour, whereas a slide sluice gate allows water to enter the *makai* orchard. The side sluice gate is currently blocked by a pre-cast cement slab.

The southern branch of the main ditch channel continues along the southern side of Kawailoa Road (see Figure 70). Section 11 of this branch starts six meters *makai* of the termination of Section 10. A culvert running below a side road separates the two sections.

Five meters *makai* from the start of Section 11 is the first sluice complex (see Figure 70; Figure 75). This complex consists of three sluices; one where the main ditch disappears in a culvert, one at the entrance to a three-meter long side ditch exiting diagonally southeast from the main ditch, and one within a three-meter long side channel exiting due south from the main ditch. The two side channels are sealed with pre-cast concrete slabs, while the main sluice gate is open. The sluice gate complex is characterized by 80-centimeter high cement-covered walls and floor, whereas the two side ditches have conjoined concrete slabs as walls. *Makai* of the main sluice gate is an outlet pipe, 50 centimeters in diameter. The culvert *makai* of the sluice gate complex is only 1.8 meters long and exits into a narrow stone-walled channel. The short rectangular box-like section of ditch is 5.15 meters long, 50 centimeters wide and 80 centimeters deep. Two-thirds of the way down each opposing wall are slots of the second sluice gate along Section 11 (Figure 76).



Figure 75. Site 7159 Section 11 first sluice gate complex, view to the south.



Figure 76. Site 7159 Section 11 second sluice gate, view to the south.

The box-like channel enters a 50-centimeter diameter culvert again only to emerge 1.2 meters *makai* in a continuation of the main ditch along Kawailoa Road. The first half of the eight-meter long intact channel is made up of conjoined tubular-shaped walls. Each pre-cast concrete and gravel section within this wall is 92 centimeters long, 60 centimeters wide, and three centimeters thick. The two halves are joined together with strips of cement to form a channel that is 60 centimeters across its widest central diameter. The second half of the intact channel is made up of stone and cement walls, within which no regular shaped stone or coursing is present. The walls end abruptly in an eroded gulley. The gulley is approximately four meters wide across its top and 2.5 meters across its base and one meter deep. The eroded gulley continues for almost 16 meters *makai* before an hourglass-shaped feature, made up of pre-fabricated cement slabs, is located within the main ditch (Figure 77). This feature is three meters long, 1.14 meters wide on both ends, and 55 centimeters across at its narrowest. Three wooden beams, arranged at regularly-spaced intervals along the flume-like feature, appear to hold the outer lips together. *Makai* of the hourglass-shaped feature, the dirt-lined ditch drops off for at least another 85 centimeters. Remnants of a formerly stone-lined channel can still be seen along the sides of the two-meter deep gulley. Roughly halfway down the eroded ditch a corrugated metal culvert enters the northern slope from underneath Kawailoa Road. The pipe is aligned northeast/southwest and probably originates somewhere north of the road. The northern side of the ditch around the pipe is severely eroded.

The Section 11 ditch ends at a 75-centimeter diameter culvert. A 1.8 meters high stone and cement wall has been built around and above the culvert. Intact remnants of stone and cement walls, arranged in a funnel-shape, extend for roughly two meters *mauka*. Together with the intact wall sections, a wooden railway sleeper on the curb above the culvert and two attached rail lines are the only remnants of the original channel at the *makai* end of Section 11.



Figure 77. Site 7159 Section 11 flume feature, view to the south.

Section 12 of Site 7159 starts within an enclosed elongated box-like sluice complex, which is approximately 180 meters *makai* of the end of Section 11 (see Figure 45). Measuring 1.16 meters north/south by 1.8 meters *mauka/makai* by 1.3 meters deep, the complex is rectangular-shaped and made up of walls with four courses of neatly cut basalt blocks joined by cement (Figures 78 and 79). Two pipes enter the complex; one from directly *mauka* and the other diagonally from the northeast. Each pipe has a diameter of 75 centimeters. Two sluice gates are present this section; one that ends in an outlet pipe and one in the southern wall that is partly covered by soil. Both sluices allowed water to flow out from the contained complex; one through the main ditch *makai* and the other into the fields to the south. Each sluice gate has the remains of a slotted wooden beam inserted into concrete slots. Incised into the cement capping of the *mauka* wall is the date “1/28/53,” while a triangle is incised on top of the *makai* wall.

Roughly 1.4 meters *makai* of the stone-walled sluice gate complex the pipe exits into an eroded ditch that is lined with collapsed basalt rocks. Halfway down the eroded channel, resting on the ground surface above the southern edge, is a free-standing two-meter long section of a basalt rock and cement wall.

Section 12 of the ditch ends at a 75-centimeter diameter culvert. A 1.8 meters high stone and cement wall has been built around and above the culvert. Intact remnants of stone and cement side walls, arranged in a funnel-shape, extend for roughly two meters *mauka*.

Section 13 of Site 7159 commences where the culvert exits five meters *makai* of Section 12's end (see Figure 45). The ditch is virtually destroyed in this area and measures roughly 1.5 meters deep and 4 meters wide. Three quarters down the severely eroded Section 13 is a five-meter long remnant of the northern wall. Comprising irregular-shaped basalt rocks cemented together with no apparent coursing, the wall protects a cement pipe that emerges diagonally from underneath Kawailoa Road to the northeast. Here the three-meter deep dirt-sided channel has eroded well below the one meter level of the original cement floor.

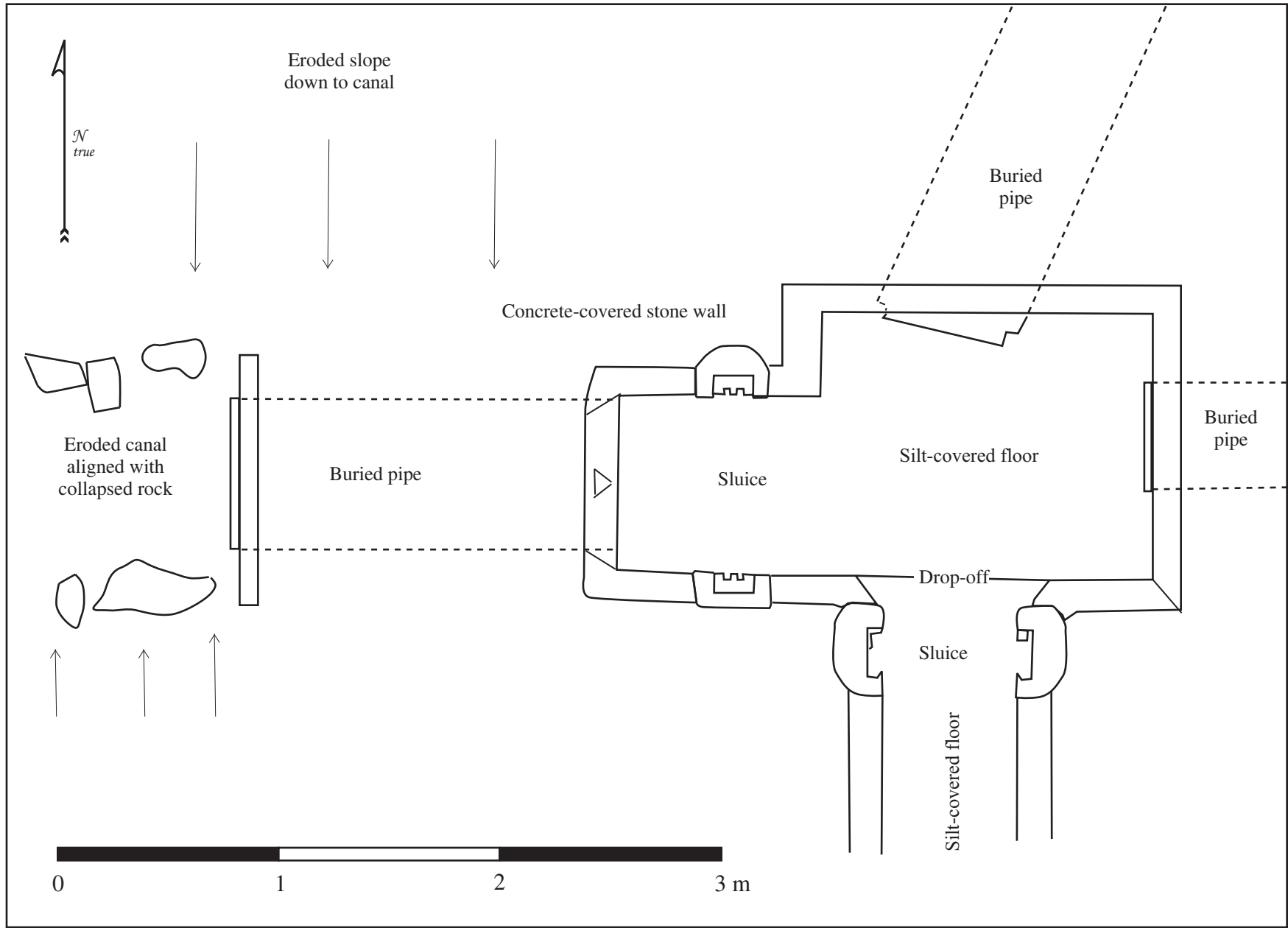


Figure 78. Site 7159 Section 12 sluice gate complex plan view.



Figure 79. Site 7159 Section 12 sluice gate complex, view to the north.

Section 13 terminates in a 75-centimeter diameter culvert. A 1.8 meters high stone and cement wall has been built around and above the culvert. Intact remnants of stone and cement side walls, arranged in a funnel-shape, extend for roughly six meters *mauka*. A cement layer that covers the curbed wall above the culvert outlet has the following incisions: “C65;” “DH;” “EG;” and “JA.”

Approximately five meters south of the ditch and 12 meters *mauka* of Section 13’s termination is a modern pumping station. Similar to other functioning pumping stations in the general project area, this one is enclosed within a chain-link fence. Twelve metal tanks and brightly painted pipes are within the rectangular-shaped fenced area. Slightly upslope and *mauka* of the pumping station are two big metal tanks on metal pedestals.

Section 14 of Site 7159 starts almost 40 meters *makai* of Section 13’s terminal point (see Figure 45). Section 14 contains a side feeder channel and a roofed building. Both features are approximately 10 meters south of Kawailoa Road, which place them immediately outside the project area.

The ditch, which follows the 240 feet contour, extends to the south well outside the project area and in the direction of the Anahulu River. This channel is badly eroded, with only the *makai* stone and cement wall still visible. It terminates immediately *makai* of the roofed building, where it is 1.5 meters wide and lined with a sturdy poured concrete wall. The northern end of the channel terminates in a cement pipe, 75 centimeters in diameter.

The building, which measures 13 meters north/south by five meters *mauka/makai*, has corrugated tin sidings and a pitched roof (Figure 80). There are sliding doors along the narrow north and south ends of the building, while the *mauka* and *makai* sides have two windows each. Two vents, probably containing extraction fans, occur on the two-sided sloping roof of the building. At the bottom of the *makai* side of the building is a large cement tank measuring five meters long by two meters wide by three meters deep. A spillway *makai* of the tank allows water to overflow into the ditch immediately outside the building. Judging from the “Danger Chlorine” sign at the front door of the building, the structure could have functioned as a water purification plant. A chain link fence storage and parking space abuts the *mauka* side of the building.



Figure 80. Site 7159 Section 14 building, view to the northeast.

Roughly 15 meters *makai* of the building is a large north/south aligned pile of stones, cement rubble, and discarded metal. This area appears to be a dump, probably containing pieces of broken flumes and other features, such as houses. The pile is at least five meters south of Kawaioloa Road and extends *makai* for about 20 meters along the road. On the 1929 Haleiwa Quadrangle Survey map (see Figure 4), this is where a street with houses of the Kawaioloa Camp crossed Kawaioloa Road. It could be that the massive pile contains bulldozed remains of the old camp.

The 1929 map also shows a pipe line running along the southern side of Kawaioloa Road. This pipe line was connected to Pump House 4, which is almost one kilometer *makai* of Section 14. This pipeline is identified in the current report as Site 7164 and is described in the subsequent Cane Haul Road Corridor section of this report.

#### SIHP Site 50-80-04-7160

Site 7160 consists of parallel stone abutments located on either side of Kawaioloa Drive (Figure 81), where it follows a straight course below a sharp turn (see Figures 36 and 44). Extending for 30 meters between 100 and 110 feet contours, the abutment walls are made up of basalt stones. The basalt blocks within the upper wall (Figure 82), which is located immediately above the road, are neatly cut, with bigger blocks (each measuring 50 x 50 cm) making up the bottom course. This upper wall varies in height from 1.15 meters to 20 centimeters. The *mauka* wall consists of two outer “casings” with an infill of smaller stones. In certain areas the stones are joined with cement, while in others smaller rocks are stuck within gaps between neighboring stones. In spite of the cement and smaller rocks, the upper courses within the central and southern portions of the *mauka* wall have collapsed. The roots of two Banyan trees that grow upslope of the upper wall, have probably contributed to the collapse of certain sections. A barbed-wire fence runs upslope and parallel with the upper terrace. The wall below, or *makai*, of the road is two meters high. This abutment consists of relatively big stones that are roughly stacked. Although the abutment walls are clearly historic in age, their date of construction is not known. The current alignment of Kawaioloa Drive, which the walls line, is shown on the 1929 U.S.G.S. Hale‘iwa quadrangle (see Figure 4).

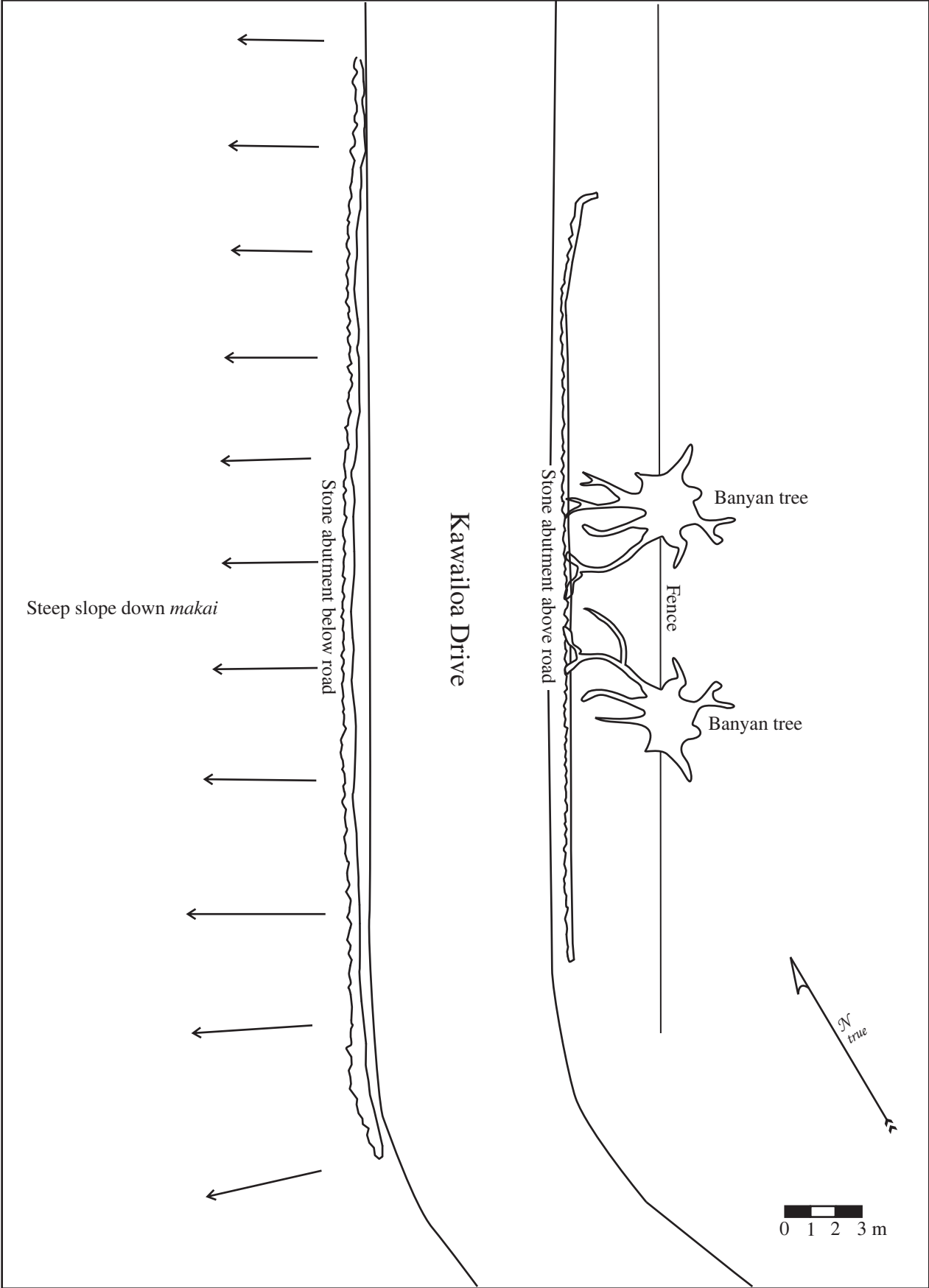


Figure 81. Site 7160 plan view.



Figure 82. Site 7160 upper stone abutment along Kawailoa Drive, view to the south.

#### SIHP Site 50-80-04-7161

Site 7161 consists of three separate rectangular-shaped concrete structures (Features A, B, and C) located three meters *makai* of Kawailoa Drive near the 130-foot contour (see Figures 36 and 44). The total area covered by the three structures measures 22 meters east/west by 19 meters north/south (Figure 83). The site's surface is covered by Guinea grass and a tall Banyan tree.

The largest feature, Feature A, which is closest to the road, is a rectangular-shaped concrete slab that measures 10 meters east/west by 7.5 meters north/south (Figure 84). A low concrete lip on the *makai* edge of the slab is the only part that stands above the otherwise level surface of the slab.

Seven meters north of the slab is Feature B, a rectangular-shaped cinder block wall with a wooden frame. Measuring five meters north/south by 1.8 meters east/west, this feature is made from a one course high wall of conjoined cinder blocks standing on end (i.e., approx. 20 cm high by 5 cm thick). Mounted on this low and thin foundation wall is a wooden frame (Figure 85). The frame presumably served as a base for a former floor and/or walls. A concrete cement pipe, presumably for drainage purposes, emanates from the southwestern corner of the structure, pointing downwards on the exterior end.

Three meters *makai* of this walled structure is Feature C, a rectangular feature. An L-shaped concrete pavement, with block-like incisions, occurs between the two features. The *makai* feature, which measures nine meters east/west by 4.5 meters north/south, has a lowered surface on its southern side and a raised trough-like feature on its northern side (Figure 86). Two ramps of cement, one on each side of the cemented lower surface, are incised with a cross-hatched pattern, presumably to create friction on the slippery slopes. A metal water pipe with a valve overlooks the *mauka* end of the concrete trough. The trough, which is subdivided into three sections, has pipes connecting the sections. An outlet pipe occurs in the western corner of the trough. The names "SHANE-N-SANDY" are incised on the top of the trough wall, near its southeastern corner. The lower section of Feature C is littered with several short sections of PVC pipe.

TMK maps 1-6-2-09 and 1-6-1-05, originally drawn in 1951, both label this portion of the project area, within the tight curve of Kawailoa Drive, as "stables." The presence of a raised trough on the northern side of one rectangular feature within Site 7161 makes this a likely identification of the site's former function. No buildings are shown at this location on the 1929 U.S.G.S. Hale'iwa quadrangle (see Figure 4). A structure first appears at the location of Site 7161 on the 1953 AMS Hale'iwa quadrangle (see Genz and Hammatt 2011).

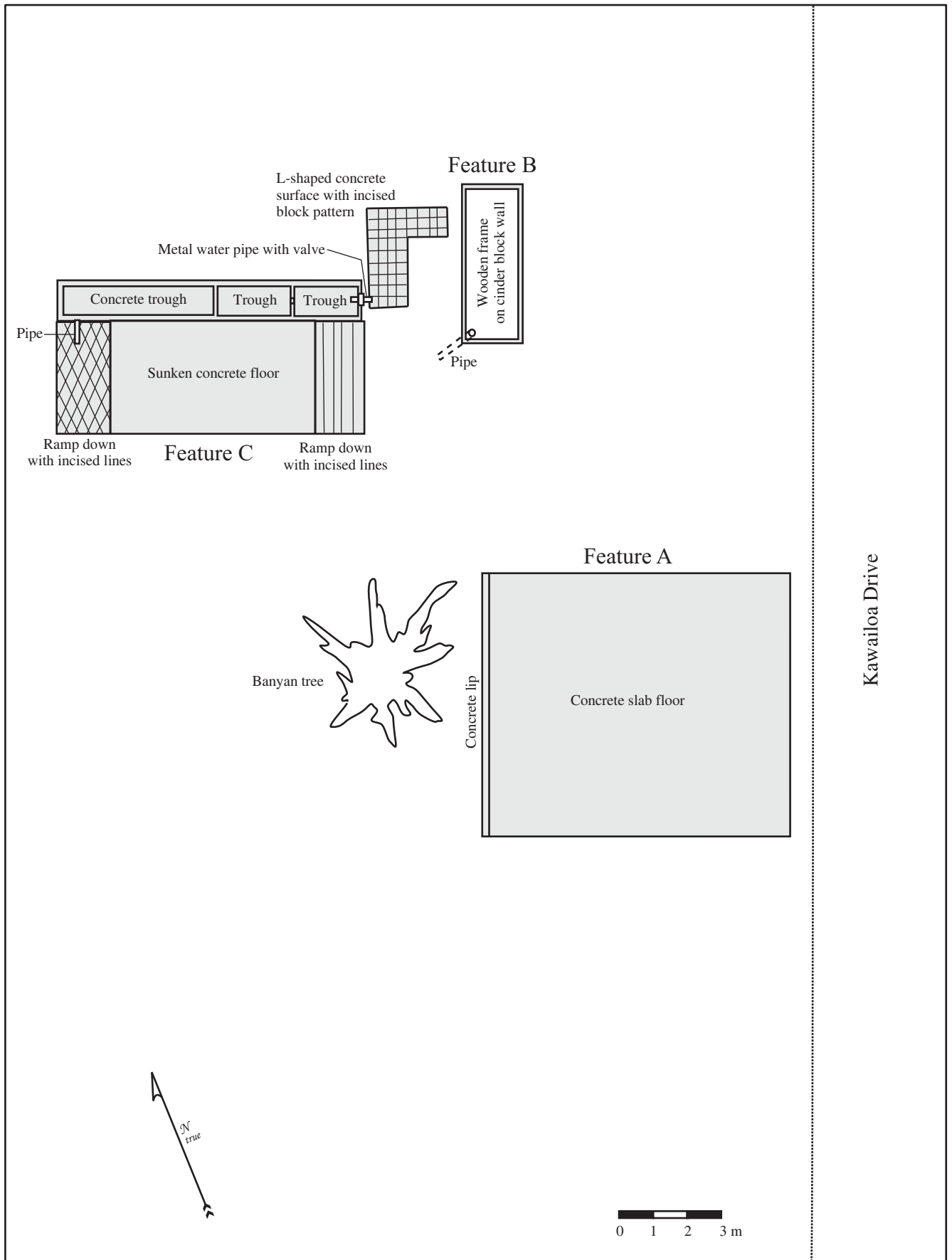


Figure 83. SIHP Site 7161, plan view.



Figure 84. Site 7161 Feature A, view to the north.



Figure 85. Site 7161 Feature B, view to the south.



Figure 86. Site 7161 Feature C, view to the southwest.

#### **SIHP Site 50-80-04-7162**

Site 7162 consists of a kerbstone alignment located along the *mauka* edge of Kawaioloa Drive to the north of its intersection with Kawaioloa Road (see Figures 36 and 44). The kerbstones consist of dressed basalt blocks (12-45 centimeters long by 12-17 centimeters wide) set end to end following the edge of the road alignment northeast/southwest for a distance of roughly 42 meters (Figure 87). The bottom edges of the kerbstones are buried in soil to a depth of 15-25 centimeters. The ground surface to the east (*mauka*) of the alignment is even with the top surfaces of the stones, and in some areas soil has spilled over the kerbing, completely burying some of the stones. The kerbstone alignment is interpreted as a historic construction related to the use of Kawaioloa Drive and Kawaioloa Camp. The exact date of construction for Site 7162 is unknown. This section of Kawaioloa Drive was in use as early as 1901 (see Figure 30). The 1929 U.S.G.S. Hale'iwa quadrangle (see Figure 4) shows houses, part of Kawaioloa Camp # 2, lining the *mauka* edge of the road immediately inland of the kerbing.



Figure 87. Site 7162 kerbstone alignment, view to the northeast.

### SIHP Site 50-80-04-7163

Site 7163, located on either side of the northeast/southwest aligned Hakina Bypass Road, almost 80 meters north of its intersection with Cane Haul Road (see Figures 36 and 44), is a culvert feature similar in design and construction to Sites 7165, 7166, and 7167. The concrete culvert has a diameter of 60 centimeters and extends under the road and serves as a drainage pipe for water from the Kawailoa Gulley. Both revetment walls are built from irregular-shaped basalt blocks that are joined together with cement. The *mauka* wall (Figure 88), which is concave-shaped in plan view, is almost six meters long by 2.1 meters high. The top of this wall is 2.5 meters below the level of the current road, indicating that a lot of fill was brought in to cross the gulch. The straight *makai* wall (Figure 89) is merely three meters long and 1.5 meters high. This wall appears to have been more carefully constructed than the *mauka* one, in that the basalt blocks have been laid down in four courses and the top of the wall is neatly capped with a cement layer. Guinea grass and *koa-haole* grow adjacent to both walls. Site 7167 appears to have been built during the early 1950s. Hakina Bypass Road was built after the railroad was dismantled (in ca. 1947-1950), and it is first depicted on the 1953 AMS Hale'iwa quadrangle (see Genz and Hammatt 2011).



Figure 88. Site 7163 *mauka* revetment, view to the west.



Figure 89. Site 7163 *makai* revetment, view to the east.

## Cane Haul Road Corridor

The Cane Haul Road Corridor follows the existing gravel/paved alignment of Cane Haul Road north/south between Hakina Bypass Road and Ashley Road (see Figure 1). The southern end of the Cane Haul Road Corridor is a portion of Alternative-2 of the Kawaioloa Road Corridor (see above). This existing roadway, which will be used by First Wind to access Mid-Line Road and Ashley Road from Kawaioloa Drive (Alternative-1 of the Kawaioloa Road Corridor), runs at the base of the steep coastal escarpment and traverses portions of TMKs: 1-6-1-05: 019, 020, 021, and 022 (see Figure 2). Three of these parcels (020, 021, and 022) are former *kuleana* (LCA #s 7417:1, 8419:1, and 10364:2). All three have been recently grubbed and graded and lined with walls of stacked boulders to create lots for residential development. For most of its length, except at its northern end where it joins Ashley Road, Cane Haul Road follows the alignment of an older Waiialua Sugar Company railway (see Figure 4). The current alignment of the road was built in ca. 1950 after the railroad shut down (in ca. 1947) and the tracks were dismantled. The road is shown in its present location on the 1953 U. S. Army Mapping Service (AMS) Hale'iwa quadrangle (see Genz and Hammatt 2011). It is lined on either side, by a wire fence lines, and much of the land on both sides of the road was formerly used as pasture. With the exception of the recently developed area, vegetation along the edges of Cane Haul Road consists primarily of Guinea grass (*Panicum maximum*) and *koa-haole* (*Leucaena glauca*).

Five archaeological sites were recorded within the Cane Haul Road Corridor (Sites 7164, 7165, 7166, 7167 and 7168; see Table 7 and Figure 36). These sites, which are all fully or partially located within 20 feet of the existing roadway, include a portion of an old metal water line (Site 7164) that once carried water from Pump # 4 (*makai* of the Cane Haul Road Corridor) to a ditch along Kawaioloa Drive (a portion of Site 7159; see above), three concrete culverts that run beneath Cane Haul Road (Sites 7165, 7166, and 7167), and a concrete bridge that connects Cane Haul Road to Ashley Road (Site 7168). Each of these sites is discussed in detail below.

In addition to the recorded archaeological sites the presence of several sites was noted nearby, but outside, the study area in the vicinity of the Cane Haul Road Corridor (see Table 8). These additional sites represent both Precontact and Historic use of the general project area. As part of the current study brief descriptions and sketch maps of the nearby sites were prepared, photographs were taken, and their locations were plotted on a map of the project area (see Figures 36 and 44). The nearby sites include a remnant enclosure/pavement (Site 50-80-04-3400) previously recorded by Hommon (1982) near the intersection of Cane Haul Road and Kawaioloa Drive; a slab paved pathway (T-14) located east of the Cane Haul Road Corridor below the horseshoe in Kawaioloa Drive; a section of old rail bed (T-35) located near the intersection of Cane Haul Road and Hakina Bypass Road; a complex of walls and other modifications at the location of Kohokuwelowelo (Site 240), the dwelling place of *kahuna* described by McAllister (1933), on an oval-shaped elevation inland of Cane Haul Road south of its intersection with Ashley Road; and an old WWII concrete bunker photographed by Beckett and Singer (1999:103) at the top of a hill within the Kohokuwelowelo complex. These sites will not be impacted by the proposed improvements to Cane Haul Road.

### SIHP Site 50-80-04-7164

Site 7164 consists of a section of large water pipe elevated above the ground surface between Cane Haul Road and the *makai* end of Kawaioloa Road (see Figure 44). Two separate portions of the pipe are visible above the ground surface in the vicinity of the current project area; an upper portion that extends from 10 meters *makai* of the end of Kawaioloa Road to 20 meters *mauka* of a curve in Kawaioloa Drive, and a lower portion (Figure 90) that extends from six meters *makai* of the curve in Kawaioloa Drive to four meters *mauka* of Cane Haul Road. The comparatively steep terrain where the pipeline is visible on the surface is characterized by loose rocks, Guinea grass, *koa-haole* trees, banyan trees, and be-still trees (*Thevetia peruviana*). The 80-centimeter diameter pipe has an outer metal layer and an interior lining of ceramic-like material. The inner lining is roughly four millimeters thick. Aligned northwest/southeast, the pipe consists of seven-meter long sections that are bolted and/or welded together. North of the big pipe is small metal pipe with a diameter of seven centimeters (Figure 91).

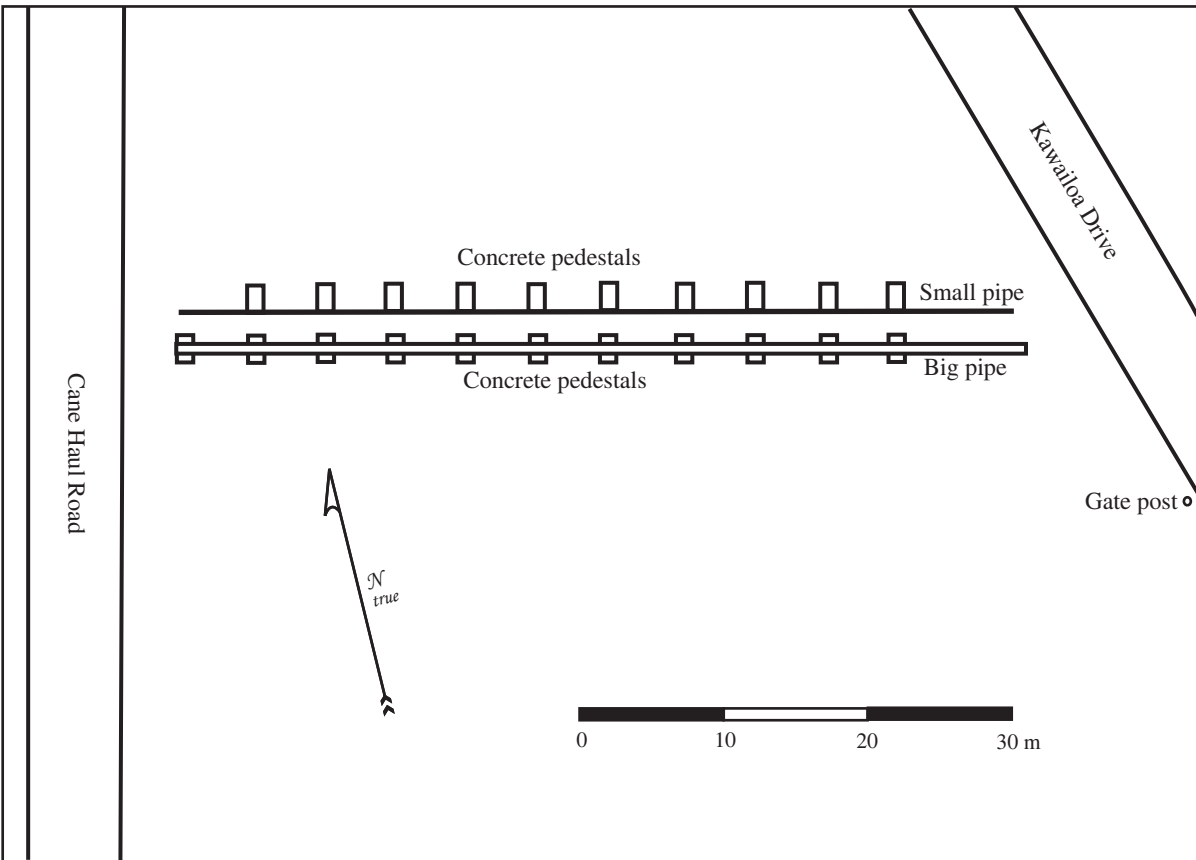


Figure 90. Site 7164 plan view of lower section.



Figure 91. Site 7164 lower portion, view to the southeast.

The 60-meter long exposed portion of the lower pipe, between Cane Haul Road and Kawaiiloa Drive, is supported by 11 concrete piers (see Figure 90). Parallel and 2.2 meters to the north of this line of piers is another line. Whereas the southern line of piers still supports the big pipe, the northern line now only has a small metal pipe attached to it via a bent metal bracket that connects to the upper southern edge of each pier (see Figure 91). The piers are made up of solid concrete that was poured into a wood-framed mold. The tallest pier is the fourth from *mauka*, on terrain *makai* of a steep slope. The rectangular-shaped pier is 1.87 meters high and tapers down towards the top. The *mauka* and *makai* edges of the pier are each 1.65 meters along the base and 90 centimeters along the top, whereas its north and south edges are each 119 centimeters along the base and 69 centimeters along the top. Only the tallest and second tallest piers have a step-like base, the rest have straight bases. Each of the shorter piers is 1.1 meters along the *mauka* and *makai* edges and 75 centimeters along the south and north edges. The upward-facing surfaces of all the piers are U-shaped, aligned *mauka/makai*. These U-shapes act as slots for the big pipe.

The approximately 250-meter long exposed portion of the upper pipe, between Kawaiiloa Drive and the *makai* end of Kawaiiloa Road, is supported by at least five stone and cement piers. Supporting two parallel large pipes down a steep slope, the piers in this section are fused into one. The basalt stones within the piers are neatly cut and dressed into rectangular blocks (Figure 92). The apex of each pier has two protrusions, each with a *mauka/makai*-oriented U-shape to nestle a pipe. The piers vary in height from two to five meters and are five meters long north/south by two meters wide east/west.



Figure 92. Site 7164 piers supporting the upper section of the pipes, view to the northeast.

This pipeline first appears on a 1901 map of the Kawaiiloa Section of the Waialua Agricultural Co.'s lands prepared by W. Wall (Hawai'i Registered Map 2054; see Figure 30). It is shown stretching from Pump # 4 to a plantation ditch at roughly 560 feet above sea level. Pump # 4, which was used by the Waialua Agricultural Co. for irrigation purposes, was formerly located in the swampy area *makai* of Cane Haul Road and the current project area. Kawaiiloa Road follows the route of Site 7164 to the east, but no further sections of pipe are visible on the surface.

#### **SIHP Site 50-80-04-7165**

Site 7165 consists of a culvert located beneath Cane Haul Road, almost 100 meters south of its intersection with Kawaiiloa Drive (see Figures 36 and 44). On either side of the road are two vertical stone revetments and the ends of a concrete culvert with a diameter of 50 centimeters at the bottom center of each wall. The culvert extends for 14.5 meters under the road and serves as a drainage pipe for water from the upslope

*mauka* side. Both walls are built from irregular-shaped basalt blocks that are joined together with cement. The *mauka* wall (Figure 93) is 3.6 meters long by 1.2 meters high, whereas the *makai* wall (Figure 94) is 3.5 meters long and 1.4 meters high. Trash and pieces of collapsed wall block the culvert opening at the bottom of the *mauka* wall. Guinea grass and *koa-haole* grow adjacent to the walls. The 1929 U.S.G.S. Hale‘iwa quadrangle (see Figure 4) indicates that a railway once existed where the Cane Haul Road now extends. It is possible that this drainage control feature was originally built under the rail bed, but the fact that an almost identical feature (Site 7163) exists under a nearby roadway that did not exhibit prior use as a rail bed may indicate that Site 7165 was constructed when Cane Haul Road was built during the middle of the twentieth century, subsequent to the dismantling of the rail line. The current alignment of Cane Haul Road is first depicted on the 1953 AMS Hale‘iwa quadrangle (see Genz and Hammatt 2011).



Figure 93. Site 7165 *mauka* revetment, view to the northwest.

#### SIHP Site 50-80-04-7166

Site 7166, located on either side of Cane Haul Road approximately 75 meters north of its intersection with Hakina Bypass Road (see Figures 36 and 44), is another culvert feature similar to Site 7165, with two vertical stone revetments and a 60 centimeter concrete culvert. The culvert extends under the road and serves as a drainage pipe for water from the upslope *mauka* side. Both revetment walls are built from irregular-shaped basalt blocks that are joined together with cement. The *mauka* wall (Figure 95) is covered with slumped soil and collapsed pieces of wall, so its original dimensions are difficult to determine. Nonetheless, judging from the intact pieces that are visible through the dirt and loose rock, the wall is probably similar in shape and size to the *makai* one. The *makai* wall (Figure 96), which is four meters long by 88 centimeters high, is capped by a neatly finished layer of cement. Guinea grass and *koa-haole* grow adjacent to both walls. The 1929 U.S.G.S. Hale‘iwa quadrangle (see Figure 4) indicates that a railway once existed where the current Cane Haul Road now extends. It is possible that this drainage control feature was originally built under the rail bed, but the fact that an almost identical feature (Site 7163) exists under a nearby roadway that did not exhibit prior use as a rail bed may indicate that Site 7166 was constructed when Cane Haul Road was built during the middle part of the twentieth century, subsequent to the dismantling of the rail line. The current alignment of Cane Haul Road is first depicted on the 1953 AMS Hale‘iwa quadrangle (see Genz and Hammatt 2011).



Figure 94. Site 7165 *makai* revetment, view to the southeast.



Figure 95. Site 7166 *mauka* revetment, view to the west.



Figure 96. Site 7166 *makai* revetment, view to the east.

#### SIHP Site 50-80-04-7167

Site 7167, located on either side of Cane Haul Road, approximately 550 meters south of its intersection with Mid-Line Road (see Figure 36), is another culvert feature similar to Sites 7165 and 7166, with two vertical stone revetments and a 60 centimeter concrete culvert. The culvert extends under the road and serves as a drainage pipe for water from the upslope *mauka* side. Both revetment walls are built from irregular-shaped basalt cobbles that are joined together with cement at the base of the wall on top of the culvert. The *mauka* wall is covered with slumped soil and grass (Figure 97), so its original dimensions are difficult to determine. It appears as though the *mauka* drainage channel has been somewhat recently re-excavated to expose the culvert opening. Judging from the visible section of the revetment immediately adjacent to the culvert, the wall is probably similar in shape and size to the *makai* one. The *makai* wall, which is ten meters long by 56-180 centimeters high, is covered by a layer of cement at the base (from 0-60 centimeters above ground surface), and then constructed of dry-stacked cobbles above (60-180 centimeters above ground surface) (Figure 98). It is highest at the center above the culvert, but tapers downward at each end as the ground surface slopes upward towards the road surface. Guinea grass and *koa-haole* grow adjacent to both walls. The 1929 U.S.G.S. Hale‘iwa quadrangle (see Figure 4) indicates that a railway once existed where the current Cane Haul Road now extends. It is possible that this drainage control feature was originally built under the rail bed, but the fact that an almost identical feature (Site 7163) exists under a nearby roadway that did not exhibit prior use as a rail bed may indicate that Site 7167 was constructed when Cane Haul Road was built during the middle part of the twentieth century, subsequent to the dismantling of the rail line. The current alignment of Cane Haul Road is first depicted on the 1953 AMS Hale‘iwa quadrangle (see Genz and Hammatt 2011).



Figure 97. Site 7167 *mauka* revetment, view to the west.



Figure 98. Site 7167 *makai* revetment, view to the east.

### SIHP Site 50-80-04-7168

Site 7168, located at the northeastern end of Cane Haul Road, where it meets Ashley Road (see Figure 36), is a concrete bridge that crosses an unnamed drainage channel. The bridge (Figure 99), which measures roughly 15 meters long by 7 meters wide, supports the asphalt surface of Cane Haul Road as it slopes up and turns to the east to join Ashley Road (Figure 100). The bridge span is made of poured, reinforced concrete that is 65-74 centimeters thick. The span sits (2 to 2.2 meters above the drainage basin) on poured concrete footings that abut either drainage embankment 3.1-3.6 meters distant from one another. Poured concrete wing walls, 2.5-4.5 meters long by 2.6-3.0 meters tall, extend for each side of both of the abutments, retaining the drainage edge and fill material on both sides of the span. The drainage basin beneath the span is covered with a slab of poured concrete. The *mauka* edge of the bridge span on the road surface (Figure 101) has dumped cobble, boulder, and soil material that acts as a kerb for the roadway. The *makai* edge of the bridge (Figure 102) has an iron I-beam railing, anchored in poured concrete at its northeastern end, and held up by two I-beam supports attached to the edge of the concrete span at its southwestern end. A metal gate, opening outward and upward to allow for debris carried by storm run-off to pass beneath it, but designed to keep livestock in the fenced paddock *makai* of Cane Haul Road, runs between the two wing walls on the *makai* side of the bridge. Guinea Grass, *haole-koa*, and a Banyan Trees are growing on either side of the bridge. The 1929 U.S.G.S. Hale'iwa quadrangle (see Figure 4) indicates that the old Waialua Agricultural Co.'s rail line deviated from the current alignment of Cane-Haul Road to the south of Site 7168, and that no road was present at this location as of yet. The bridge, based on its construction materials and condition, was likely built during the middle part of the twentieth century when Cane-Haul Road was built, subsequent to the dismantling of the rail line. The current alignment of Cane Haul Road is first shown on a 1953 AMS Hale'iwa quadrangle (see Genz and Hammatt 2011). The concrete abutments have recently been covered with colorful, spray painted graffiti.



Figure 99. Site 7168 surface, view to the east.

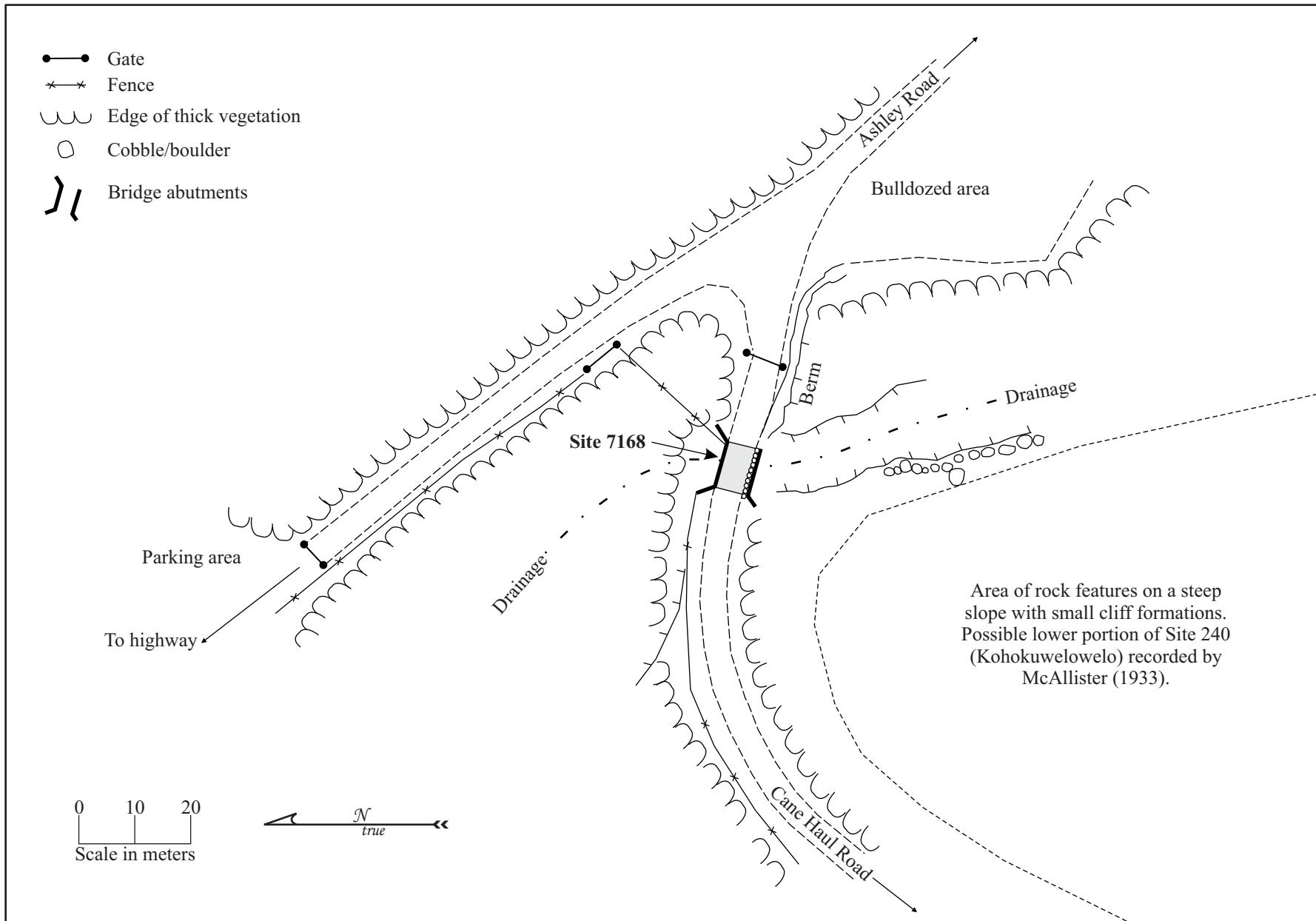


Figure 100. Site 7168 plan view.



Figure 101. Site 7167 mauka edge, view to the north.



Figure 102. Site 7168 makai edge, view to the southwest.

## Mid-Line Road Corridor

The Mid-Line Road Corridor, which will be used by First Wind to access four turbine locations within the Western Tableland Array, follows the preexisting gravel/paved alignment of Mid-Line Road from Cane Haul Road to the middle survey area of the Western Tableland Array at an elevation of roughly 680 feet above sea level (see Figure 1). Mid-Line Road runs in a relatively straight line across portions of TMKs:1-6-1-05:001, 019 and 1-6-1-07:001 (see Figure 2). Only the western (*makai*) portion of this roadway (below the 440-foot contour), which passes through cultivated agricultural fields, is currently drivable. Above that elevation, which is marked by a crossroad, Mid-Line Road is completely overgrown and not drivable. Between the 440-foot contour and the 540-foot contour, which is marked by a second crossroad, the former road bed is lined by an earthen bank along its southern edge and a series of old power poles that follow its northern edge. Above the 540-foot contour the former route of Mid-Line Road is barely discernable through the thick growth of Guinea grass (*Panicum maximum*), *koa-haole* (*Leucaena glauca*), and stands of *albizia* (*Acacia lebbek*).

The Mid-Line Road Corridor crosses the former Waialua Sugar Company's fields Kawailoa-13, 14, and 15 (see Figure 9). Aerial photographs of the project area (see Figures 5-8) show that these fields were completely cultivated in sugarcane and pineapple during the second half of the twentieth century. The middle section of Mid-Line Road, between the 180-foot and 540-foot contours, appears to have been built first by the Waialua Agricultural Company, sometime prior to 1924 (see Figure 31). The upper section of the road, above the 540-foot contour, was added by 1929 (see Figure 4), and the lower section, between Cane Haul Road and the 180-foot contour, was added sometime prior to 1953, likely after the railway was dismantled in ca. 1947-1950. While the lower section of Mid-Line Road is shown on the 1953 AMS Hale'iwa quadrangle (see Genz and Hammatt 2011), the upper section is not. Aerial photographs indicate that the upper section (above 540 feet in elevation) was planted in pineapple during the second half of the twentieth century, and that the road alignments through the pineapple fields, including Mid-Line Road, shifted frequently. The 1929 U.S.G.S. Hale'iwa quadrangle (see Figure 4) shows a ditch following the southern edge of the road between roughly the 340-foot and the 440-foot contours, and the north edge of the road between the 440-foot and 490-foot contours. That map also shows several ditches, a pipe line, and a railway crossing Mid-Line Road.

As a result of the current fieldwork two archaeological sites, both comprised of portions of former plantation ditches, were recorded within the Mid-Line Road Corridor (Sites 7169 and 7170; see Table 7 and Figure 36). Sites 7169 and 7170 are part of the Kamananui ditch system that was created by the Waialua Agricultural Co. during the early to mid-1900s. Site 7169 consists of a feeder ditch that follows the 540-foot contour across the Mid-Line Road Corridor. Site 7170 consists of a feeder ditch that crosses the corridor at the 440-foot contour and supplies a *mauka/makai* ditch that follows the southern edge of Mid-Line Road to a reservoir located near the 330-foot contour. Site 7170 also includes a short section of remnant ditch that follows the north edge of Mid-Line Road *mauka* from the 440-foot contour. Site 7169 no longer functions, but Site 7170 fills resevoirs and retention ponds that water the existing agricultural fields along Mid-Line Road. Each of these sites is discussed in detail below.

### SIHP Site 50-80-04-7169

Site 7169 designates an irrigation ditch that runs across the current project area at Mid-Line Road, following roughly the 540-foot contour (see Figure 36). This irrigation ditch is part of the Kamananui ditch system that was created by the Waialua Agricultural Co. during the early to mid-1900s. The ditch no longer carries water. For the purposes of description, this southwest/northeast trending irrigation ditch was subdivided into two sections separated by a buried pipe that runs beneath Mid-Line Road. Section 1 runs northeast of the road eventually feeding into a buried pipe and a reservoir, and Section 2 runs southwest of the road, once continuing to Site 7159 at Kawailoa Road (Figure 103). Starting with Section 1 at the northeast end, the following description highlights the main features of both sections.

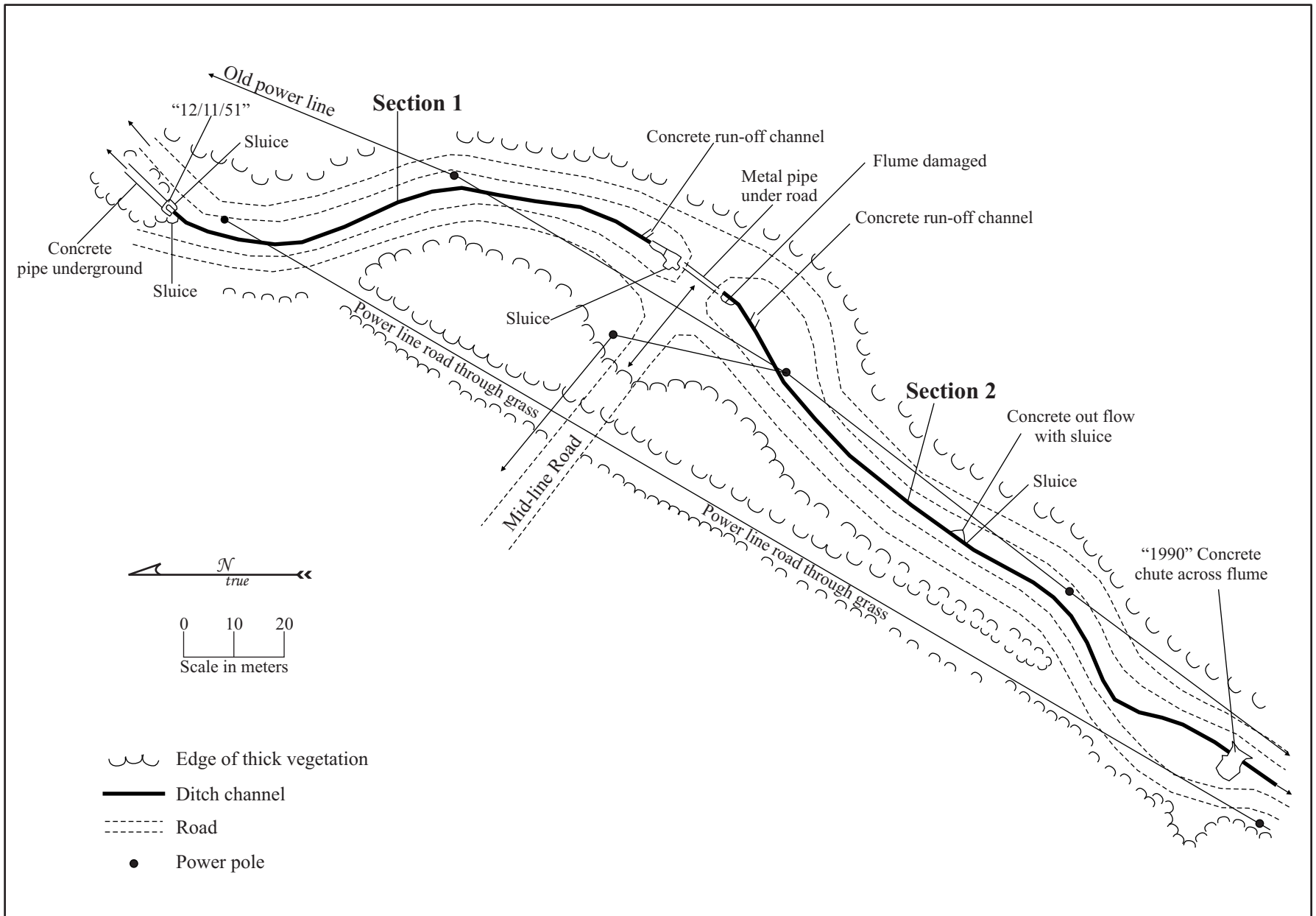


Figure 103. Site 7169 plan view.

Section 1 of Site 7169 originates roughly 100 meters north of the Mid-Line Road Corridor at a buried concrete pipe that runs down slope to the north to an old reservoir located outside of the project area. The pipe, which is labeled “siphon” on the U.S.G.S. Hale‘iwa quadrangle (see Figure 1), has a diameter of 75 centimeters. Where the pipe joins Section 1 there is a dilapidated sluice complex that curves to the north with walls made up of four courses of neatly cut basalt blocks joined by cement and capped with cement (Figure 104). The walls are 1.1 meters distant from one another and the ditch has a depth of 1.2 meters, but it is silted in at the base and portions of the *makai* wall have collapsed. Incised into the cement capping of the wall above the pipe is the date “12/11/51” (Figure 105). Two sluice gates are present at this section; one directly in front of the pipe, and the other in the *makai* wall of the ditch that would have allowed water to flow out to the west. The gate in front of the pipe is missing, and the gate in the *makai* wall has been sealed with a slab of concrete.



Figure 104. Site 7169 Section 1 sluice gate complex at north end, view to the northeast.



Figure 105. Site 7169 Section 1 date incised into the cement above the pipe, overview.

Beyond the sluice complex, as Section 1 meanders north to Mid-Line Road (see Figure 103), it is made up of curved concrete side walls with a separate flat base in-between. The tubular-shaped ditch measures 120 centimeters across its widest central portion, with a 78-centimeter gap between its upper rims, and an 83-centimeter depth from rim to floor. The curved side walls are made-up of separately molded concrete sections, each measuring 92 centimeters long and 4 centimeters thick. Flat rectangular sections, each consisting of concrete and gravel, have been inserted between the curved side walls to form the base of the canal. Each basal section measures 92 centimeters long by 27 centimeters wide by 4.5 centimeters thick. The base sections are completely covered with a layer of soil, and not visible throughout most of Section 1. Joints between sections have been strengthened by adding patches of cement. Gravel roads follow each side of the ditch; a higher road on the *mauka* side, and a lower road on the *makai* side.

As Section 1 nears Mid-Line Road a second sluice complex is present. Just north of the complex, is a concrete surface channel that appears designed to collect run-off from the roadway *mauka* of the ditch (Figure 106). The U-shaped surface channel slopes down toward the ditch. It measures 50 centimeters wide by 20 centimeters deep and 1.5 meters long. The sluice complex is rectangular-shaped and made up of irregular walls with four courses of neatly cut basalt blocks joined by cement. The first gate, which is no longer present, is 2 meters south of the surface channel (Figure 107). This gate would have slid between two sections of railroad track that are covered with cement. A third section of track also crosses the ditch at this location. The second gate, which is also gone, is roughly 4 meters south of the first, directly in front of (2 meters from) a pipe that leads beneath Mid-Line Road. South of this gate the ditch is lined with four courses of cinder block and there is an outflow sluice in the *makai* wall that is sealed with a slab of concrete. This sluice would have allowed water to flow west from Section 1 along the north edge of Mid-Line Road, although no ditch channel is present. The pipe beneath Mid-line Road, which marks the south end of Section 1, measures 75 centimeters in diameter. Its opening is nearly completely buried by soil.

Section 2 of Site 7169 commences where the pipe beneath Mid-Line Road emerges ten meters south of Section 1's south end (see Figure 103). The pipe is nearly completely buried, and the ditch is virtually destroyed in this area (Figure 108), but is once again intact after a distance of 3 meters. From the pipe opening the ditch runs a meandering course southwest. It is the same construction as Section 1, made up of curved concrete side walls with a separate flat base in-between (Figure 109). The tubular-shaped ditch measures 120 centimeters across its widest central portion, with a 78-centimeter gap between its upper rims, and an 83-centimeter depth from rim to floor. The curved side walls are made-up of separately molded concrete sections, each measuring 92 centimeters long and 4 centimeters thick. Flat rectangular sections, each consisting of concrete and gravel, have been inserted between the curved side walls to form the base of the canal. Each basal section measures 92 centimeters long by 27 centimeters wide by 4.5 centimeters thick. The base sections are completely covered with a layer of soil, and not visible throughout most of Section 1. Joints between sections have been strengthened by adding patches of cement. Gravel roads follow each side of the ditch; a higher road on the *mauka* side, and a lower road on the *makai* side.

A concrete surface channel similar to the one on the north side of Mid-Line Road is present 10 meters from the north end of Section 2. This channel also appears designed to collect water run-off from the upper road. Seventy meters from the start of Section 2 a sluice complex is present with two former sluice gates; one across the main channel, and another in the *makai* wall (Figure 110). The wooden gate across the main channel is no longer present. The sluice in the *makai* wall consists of a 0.6 x 0.6 meter concrete slab with a 14 x 10 centimeter metal gate built into it near the top.

Beyond the sluice Section 2 continues a meandering course southwest for 70 meters to a poured concrete construction that crosses the ditch channel (Figure 111). The function of this construction, which slopes *makai* across the ditch is not clear, but it may have been intended to carry water from the upper road across the ditch to the lower road. Dates incised in the construction reveal that it was built in 1990. This feature marks the arbitrary end of Section 2, but Site 7169 continues to the south where it formerly connected to the ditch along Kawailoa Road (Site 7159) near the *makai* end of Section 3.



Figure 106. Site 7169 Section 1 surface drainage channel, view to the north.



Figure 107. Site 7169 Section 1 sluice complex at Mid-Line Road, view to the south.



Figure 108. Site 7169 Section 2 south end at Mid-Line Road, view to north.



Figure 109. Site 7169 Section 2, view to southwest.



Figure 110. Site 7169 Section 2 sluice gate, view to west.



Figure 111. Site 7169 Section 2 south end, view to southwest.

### SIHP Site 50-80-04-7170

Site 7170 designates an irrigation ditch system that runs along the southern edge of Mid-Line Road for roughly 700 meters, extending from a water retention pond near the 440-foot contour to a reservoir near the 330-foot contour (see Figure 36). This irrigation ditch is part of the Kamananui ditch system that was created by the Waialua Agricultural Co. during the early to mid-1900s. It still carries water today. For the purposes of description, this southeast/northwest trending irrigation ditch has been subdivided into 14 sections, with culverts separating one section from the next (Figure 112). At the *mauka* end the Site 7170 ditch system is fed by a north/south running feeder ditch (Sections 1 and 2) that crosses the Mid-line Road Corridor near the 440-foot contour and supplies water to a *mauka/makai* ditch (Sections 4-12) that follows the southern edge of Mid-Line Road to another north/south feeder ditch (Sections 13 and 14) near the 330-foot contour that empties into a reservoir to the north of the Mid-Line Road Corridor. Site 7170 also includes a short section of remnant ditch (Section 3) that follows the north edge of Mid-Line Road *mauka* from the 440-foot contour for roughly 3 meters. Starting with Section 1 at the top end north of Mid-Line Road, and ending with Section 14 at the bottom end where it feeds into the reservoir, the following description highlights the main features of each section of Site 7170.

Section 1 of Site 7170 originates at an outflow pipe leading into a reservoir to the north of the project area at the 440-foot contour (see Figure 112). At the north end of the pipe there is a short section of joined, precast, u-shaped concrete spillway that directs water into the reservoir. On top of the pipe, at the south end of the spillway, is a cement capped cobble retaining wall that has broken in half lengthwise (Figure 113). The cement cap has been inscribed with two dates; the date on the more-intact western side reads “11-18-54,” and the date on the slumped eastern side reads “4-3-54.” The wall retains the edge of a roadway on top of the pipe that leads around the edge of the reservoir. The metal outflow pipe that runs under the roadway measures 75 centimeters in diameter. At the south end of the pipe is a sluice gate complex with two former gates; one directly in front of the pipe, and another in the *makai* edge of the ditch (Figure 114). The sluice gate complex is constructed of stacked basalt rocks joined and capped with cement. The wooden sluice gates are no longer present. The *makai* channel has been blocked with a concrete slab. This section of ditch measures 2 meters long by 1.4 meters wide by roughly 90 centimeters deep.

To the north of the sluice gate complex the Section 1 ditch runs a meandering course southwest to Mid-Line Road. It is made up of curved concrete side walls with a separate flat base in-between. The tubular-shaped ditch measures 120 centimeters across its widest central portion, with a 78-centimeter gap between its upper rims, and an 83-centimeter depth from rim to floor. The curved side walls are made up of separately molded concrete sections, each measuring 92 centimeters long and 4 centimeters thick. Flat rectangular sections, each consisting of concrete and gravel, have been inserted between the curved side walls to form the base of the canal. Each basal section measures 92 centimeters long by 27 centimeters wide by 4.5 centimeters thick. The base sections are covered by a layer of soil and the water running through the ditch, and are not visible. A gravel road follows the *mauka* side of the ditch.

Two meters from the south end of Section 1, where it joins a pipe that runs beneath Mid-Line Road, the ditch is once again lined with stacked basalt rocks. The almost vertical walls consist of four courses of basalt rocks, the biggest blocks being at the bottom (Figure 115). Cement has been used to join and cap the basalt blocks in the wall. The opposing *mauka/makai* basalt block and cement walls of the ditch are roughly 90 centimeters high and 140 centimeters apart. Two concrete over flow pipes (25 centimeters in diameter) are present in the *makai* wall of this section of the ditch. The pipes are set in the second course of cobbles above the waterline immediately adjacent to one another. The date “11-20-53” has been inscribed in the cement topping the wall situated parallel to Mid-Line Road directly above the pipe opening (see Figure 115). The concrete pipe is completely submerged beneath the water on this side of the road.

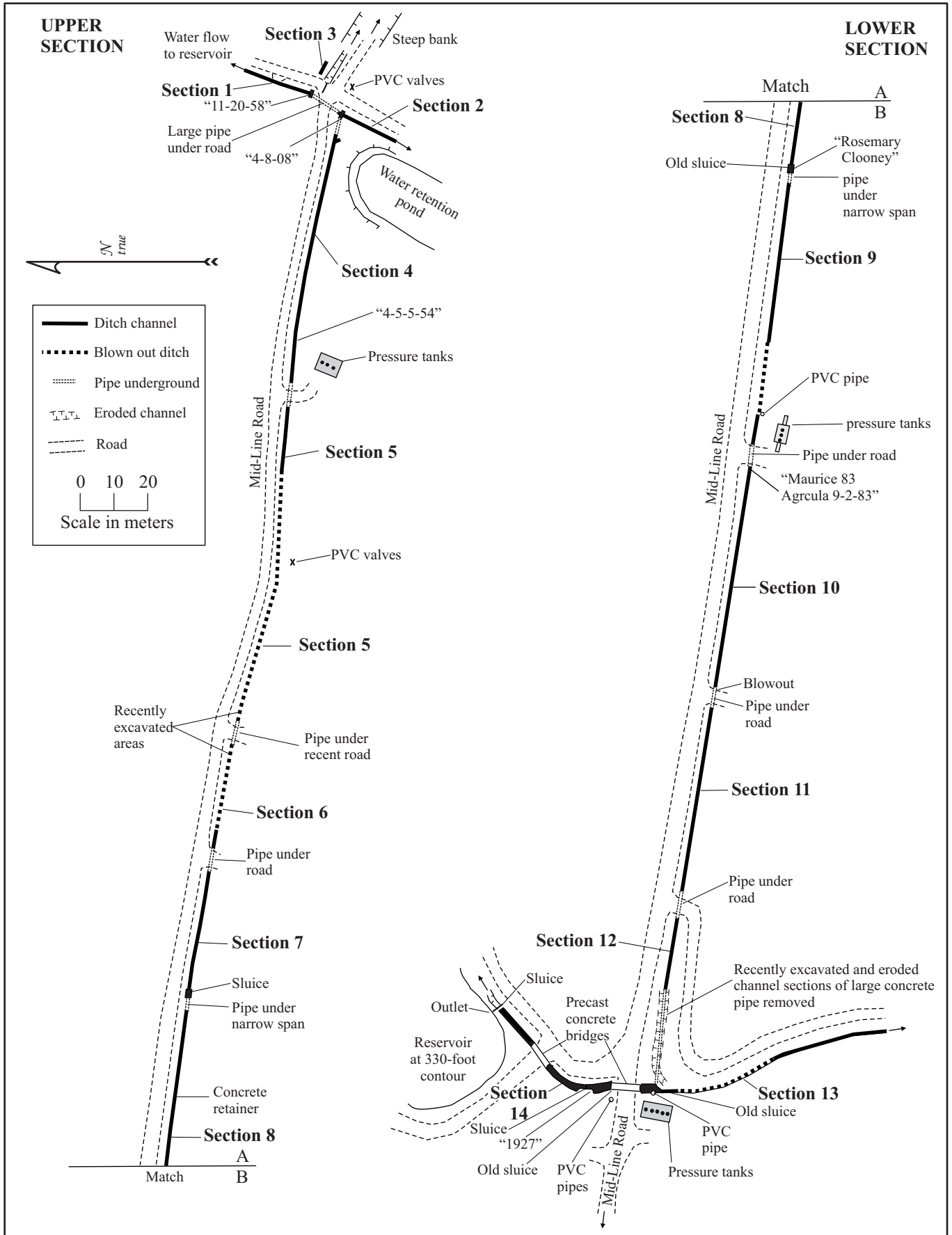


Figure 112. Site 7170 plan view.



Figure 113. Site 7170 Section 1 outlet to reservoir, view to the northeast.



Figure 114. Site 7170 Section 1 sluice complex at north end, view to the north.



Figure 115. Site 7170 Section 1 date inscribed in concrete at south end, view to the northeast.

Section 2 of Site 7170 starts on the south side of Mid-Line Road at the southern end of the pipe that run under the road from Section 1 (see Figure 112). Where the pipe enters Section 2 a sluice complex with three former gates is present (Figure 116). The ditch at this end of Section 2 is lined with stacked basalt rocks. The almost vertical walls consist of four courses of basalt rocks, the biggest blocks being at the bottom. Cement has been used to join and cap the basalt blocks in the wall. The opposing *mauka/makai* basalt block and cement walls of the ditch are roughly 90 centimeters high and 140 centimeters apart. The former wooden sluice gates are located (1) in front of the pipe that runs under Mid-Line Road, (2) in front of a pipe that leads *makai* to Section 4, and (3) to the north of the other two where the cement and basalt ditch transitions to a concrete sectional ditch. All three of the gates are absent, but wooden slats are present in front of the pipe that leads *makai* to Section 4, and a piece of narrow-gauge rail is held in place by cement on top of the ditch near the opening of the pipe beneath Mid-Line Road. A patch of concrete at the ditch corner between the pipe under Mid-Line Road and the *makai* sluice contains the inscription “4-8-08”, suggesting that it was repaired in 2008.

Beyond the third sluice gate the Section 2 ditch runs a meandering course southwest along the *mauka* edge of a small water retention pond (Figure 117), and continues well out of the current project area. South of the sluice complex the ditch is made up of curved concrete side walls with a separate flat base in-between. The tubular-shaped ditch measures 120 centimeters across its widest central portion, with a 78-centimeter gap between its upper rims, and an 83-centimeter depth from rim to floor. The curved side walls are made-up of separately molded concrete sections, each measuring 92 centimeters long and 4 centimeters thick. Flat rectangular sections, each consisting of concrete and gravel, have been inserted between the curved side walls to form the base of the canal. Each basal section measures 92 centimeters long by 27 centimeters wide by 4.5 centimeters thick. The base sections are covered by a layer of soil and the water running through the ditch, and are not visible. Joints between sections have been strengthened by adding patches of cement. A gravel road follows the *mauka* side of the ditch.

Adjacent to the water retention pond two concrete over flow pipes (25 centimeters in diameter) are present in the *makai* wall of Section 2 (Figure 118). The pipes sit above the waterline. Both have been blocked with metal disks, but one of the disks has partially corroded away. Roughly 40 meters from Mid-Line Road, outside of the project area corridor, another sluice gate is present in the Section 2 ditch with a channel that leads *makai* into the water retention pond (Figure 119). To the south of this former sluice gate Section 2 of Site 7170 continues to the southwest, eventually connecting with the *mauka* end of Section 11 of Site 7159.



Figure 116. Site 7170 Section 2 sluice gate complex at Mid-Line Road, view to the northwest.



Figure 117. Site 7170 Section 2 water retention pond, view to the southwest.



Figure 118. Site 7170 Section 2 concrete overflow pipes, view to the west.



Figure 119. Site 7170 Section 2 sluice and channel leading to the water retention pond, view to the west.

Section 3 of Site 7170 consists of two parallel alignments of basalt rocks (Figure 120) located along the north edge of Mid-Line Road, *mauka* of the crossroad that parallels Sections 1 and 2 (see Figure 112). This section appears to represent the top edge of a former ditch that once ran along Mid-Line Road between Section 1 of Site 7170 and the 490-foot contour (see Figure 4). It is completely filled in with soil and gravel, however, and only a three meter long portion of the ditch is visible on the surface. Section 3 consists of two parallel lines of basalt rocks set 95 centimeter apart from one another. Each line contains five rocks that are visible on the surface. To the south of Section 3 a PVC pipe runs beneath the roadway that follows the *mauka* edge of Sections 1 and 2, directing water that flows through a natural water channel adjacent to Mid-Line Road beneath the crossroad. The expected route of the Section 3 ditch was thoroughly inspected between Sites 7169 and 7170, but no additional sections of constructed ditch were observed (Mid-Line Road, *mauka* of Site 7170, is no longer maintained and is overgrown with thick brush).



Figure 120. Site 7170 Section 3, view to the southeast.

Section 4 of Site 7170 runs along the south edge of Mid-Line Road (see Figure 112). This section starts at the exit of the concrete pipe that runs *makai* from the Section 2 sluice complex, six meters distant from that section. Where the pipe exits the ditch walls are constructed of four courses of stacked basalt cobbles held together and capped with cement (Figure 121), and the ditch floor is covered with a layer of cement. The walls of the ditch are sloped outwards giving it a V-shaped appearance. Section 4 measures 60 centimeters wide at the base, 90 centimeters wide at the top, and 70 centimeters deep at its *mauka* end. Immediately adjacent to the exit of the pipe at this end, along the south side of the ditch, is a short segment of U-shaped concrete sectional flume that once acted as a spillway leading from the small water retention pond adjacent to Section 2 into the ditch. The spillway is now buried beneath soil.

Section 4 runs for a total distance of 75 meters. Approximately 60 meters from the *mauka* end of Section 4 a date is inscribed in the cement capping the northern wall of the ditch (Figure 122). The date reads “4-5-5-54”, which may mean that this section was constructed between April and May 5, 1954. Section 4 becomes deeper (as much as 1 meter deep) and more neatly constructed at its *makai* end. Where this section terminates the ditch splits in two (Figure 123) with the main channel continuing *makai* through a pipe along the southern edge of Mid-Line Road to Section 5, and a branch channel diverging to the south, parallel to the main channel. The branch channel is filled in and no longer carries water. The base of the branch channel sits 15 centimeters above the base of the main channel. A sluice gate was formerly present across the main ditch channel at the opening to the pipe. Where Section 4 enters the pipe at its *makai* end a road crosses the ditch channel leading to a concrete slab surrounded by chain link fence that contains four pressure tanks along the route of more modern irrigation pipes. The road appears to have been the cause of the destruction of the branch channel at the *makai* end of Section 4.



Figure 121. Site 7170 Section 4 *mauka* end, view to east.



Figure 122. Site 7170 Section 4 date inscribed in cement capping the northern wall, view to south.



Figure 123. Site 7170 Section 4 *makai* end, view to the west.

Section 5 of Site 7170 begins at the exit of the metal pipe that runs *makai* under the short spur road leading to the modern pressure tanks, six meters from the end of Section 4 (see Figure 112). Section 5 runs along the south edge of Mid-Line Road for a total distance of 135 meters, but only the *mauka* 20 meters are actually intact with stacked basalt and cement walls (Figure 124). Where the pipe exits from beneath the road the ditch walls are constructed of five courses of stacked basalt cobbles held together and capped with cement, and the ditch floor is covered with a layer of cement. The walls of the ditch are sloped outwards giving it a V-shaped appearance. Section 5 measures 60 centimeters wide at the base, 90 centimeters wide at the top, and 100 centimeters deep at its *mauka* end. The ditch quickly becomes shallower, however, with an average depth of 50 to 70 centimeters. The remainder of the ditch, although formerly lined with basalt and cement, is currently an earthen ditch with water flowing through it. The earthen ditch measures approximately 90 centimeters wide by 50 centimeters deep. The *makai* end of Section 5 terminates at a metal culvert capped with concrete that runs beneath what appears to be a recently constructed or repaired roadway. The ditch is wider (roughly 2 meters) for the final 4 meters of Section 5, and appears to have been somewhat recently cleared of sediment using a backhoe. The culvert beneath the roadway, despite the relatively recent clearing, is once again nearly buried beneath sediment.



Figure 124. Site 7170 Section 5 intact *mauka* end, view to the east.

Section 6 of Site 7170 begins six meters from Section 5 at the exit of the metal culvert that runs beneath the roadway (see Figure 112). Section 6 runs along the south edge of Mid-Line Road for a total distance of 30 meters. Only the *makai* end of this section, for 15 meters along the southern ditch wall and 5 meters along the northern ditch wall, is actually intact with stacked basalt and cement walls. The rest of Section 6, like much of the previous section, consists of an earthen ditch that measures approximately 90 centimeters wide by 50-85 centimeters deep. Section 6 is widest (roughly 2 meters wide) at its *mauka* end, and appears to have been somewhat recently cleared of sediment using a backhoe (Figure 125). The intact

portion of Section 6 at the *makai* end is constructed of four courses of stacked basalt cobbles held together and capped with cement, and the ditch floor is covered with a layer of cement (Figure 126). The 15 meter long south wall is fairly vertical and straight, but the 5 meter long section of the north wall bows outward to the north, giving the *makai* end of Section 6, where it enters a concrete pipe under a roadway, a width of 1.3 meters. The pipe is held in cement at the base of the 75 centimeter deep ditch channel and is also capped with cement. A wooden sluice gate was formerly present across the ditch channel at the opening to the pipe.



Figure 125. Site 7170 Section 6 recently excavated *mauka* end, view to the west.

Section 7 of Site 7170 runs along the south edge of Mid-Line Road for a total distance of 37 meters (see Figure 112). This section starts at the exit of the concrete pipe that runs *makai* from Section 6 beneath a roadway, six meters distant from that section. Where the pipe exits, the ditch walls are constructed of three to four courses of stacked basalt cobbles held together and capped with cement, and the ditch floor is covered with a layer of cement. The walls of the ditch are sloped outwards giving it a V-shaped appearance. Section 7 measures 60 centimeters wide at the base, 90 centimeters wide at the top, and averages 70 centimeters deep. The walls are relatively intact with only minimal collapse. At the *makai* termination of Section 7, where the ditch enters a concrete pipe, a sluice gate complex is present. At this end, for the final 2 meters, the stacked cobble walls are covered and capped with a smooth layer of cement, the ditch narrows to 53 centimeters, and becomes 1 meter deep with vertical walls. Two sets of matching vertical slots in the concrete, one 36 centimeters from the pipe and a second immediately in front of the pipe, are present that formerly housed wooden sluice gates (Figure 127). The pipe at the *makai* end of Section 7 runs under a narrow dirt path (2.4 meters wide) that is blocked by boulders placed on its surface. The path is not wide enough for a vehicle, and may have been intended only for foot traffic.



Figure 126. Site 7170 Section 6 intact south wall, view to the south.



Figure 127. Site 7170 Section 7 *makai* sluice complex, over view to the north.

Section 8 of Site 7170 runs along the south edge of Mid-Line Road for a total distance of 67 meters (see Figure 112). This section starts roughly 2.5 meters distant from Section 7 at the exit of the concrete pipe that runs beneath the narrow pathway. Where the pipe exits, the ditch walls are constructed of three to four courses of stacked basalt cobbles held together and capped with cement, and the ditch floor is covered with a layer of cement. The walls of the ditch are sloped outwards giving it a V-shaped appearance. Section 8 measures 60 centimeters wide at the base, 90 centimeters wide at the top, and averages 70 centimeters deep. The walls are mostly intact with a few areas of collapse. Along the southern wall of Section 8, 25 meters from the *mauka* end near an area of collapse a concrete retainer has been placed in the ditch wall (Figure 128), perhaps to prevent further erosion or to block a former side channel that is no longer present.

At the *makai* termination of Section 8, where the ditch enters a concrete pipe, a sluice gate is present. At this end, for the final 2 meters, the stacked cobble walls are covered and capped with a smooth layer of cement, the ditch narrows to 53 centimeters, and becomes 1 meter deep with vertical walls. A set of vertical slots in the concrete, 30 centimeters from the pipe opening formerly housed a wooden sluice gate. The name “Rosemary Clooney” is written in the cement capping the pipe construction (Figure 129). This cement appears to have been added after the original construction, as section of narrow gauge rail, meant to block debris from entering the pipe, runs at an angle from the base of the ditch up to it, and is held in place by it. A second rail was once present to the south of this one, but it broke free of the cement and has been removed. The pipe at the *makai* end of Section 8 runs under a narrow dirt path (2.4 meters wide). The path is not wide enough for a vehicle, and may have been intended only for foot traffic.



Figure 128. Site 7170 Section 8 concrete retainer in south wall of ditch, view to the southwest.

Section 9 of Site 7170 runs along the south edge of Mid-Line Road for a total distance of 80 meters (see Figure 112). This section starts roughly 2.5 meters distant from Section 8 at the exit of the concrete pipe that runs beneath the narrow pathway. Where the pipe exits, the ditch walls are constructed of three to four courses of stacked basalt cobbles held together and capped with cement, and the ditch floor is covered with a layer of cement. The walls of the ditch are sloped outwards giving it a V-shaped appearance. Section 9 measures 60 centimeters wide at the base, 90 centimeters wide at the top, and averages 70 centimeters deep. The walls are mostly intact with a few areas of collapse. One long section of collapse, where the ditch walls become earthen embankments with the cobble and cement material strewn about them, is present between 50 and 70 meters from the *mauka* end.



Figure 129. Site 7170 Section 8 *makai* end with the inscription “Rosemary Clooney”, overview to the east.

Following the section of collapse, the final ten meters of Section 9 are fairly intact. At the *makai* termination of the section, where the ditch enters a metal pipe, a sluice gate is present. At this end, for the final 2 meters, the stacked cobble walls are covered and capped with a smooth layer of cement, the ditch narrows to 53 centimeters and becomes 1 meter deep, and two sections of rusted narrow gauge rail prevent debris from entering the pipe. An angled channel of thick cement covering cobbles is present in the north wall of the sluice complex 80 centimeters from the pipe, and two sets of matching vertical slots in the concrete, one 36 centimeters from the pipe and a second immediately in front of it, are present that formerly housed wooden gates (Figure 130).

The angled channel, which is 40 centimeters wide by 60 centimeters deep, runs a short distance northwest towards Mid-Line Road before terminating at a 13-centimeter deep slot in the cement cap that is wider than the channel at each end. A pipe that was sealed off at a later date may have once run beneath Mid-Line Road at this location. The cement wall opposite the channel is much more eroded than the smooth walls throughout the rest of the sluice complex, suggesting that water may have flowed against it more aggressively. Similar channels (sluices) with pipes running from them were recorded at Site 7159 along Kawailoa Road (see description above), but no pipe opening or ditch was observed within the survey corridor on the opposite side of Mid-Line road at this location.

Where Section 9 enters the pipe at its *makai* end a road crosses the ditch channel leading to a concrete slab surrounded by chain link fence that contains two pressure tanks along the route of more modern irrigation pipes. A PVC pipe runs from the tanks emptying back into the ditch ten meters to the east (Figure 131). The metal pipe beneath the road is fairly corroded, and the concrete capping it at the *makai* end has broken apart causing the roadway to erode.



Figure 130. Site 7170 Section 9 *makai* sluice complex, view to the west.

Section 10 of Site 7170 runs along the south edge of Mid-Line Road for a total distance of 68 meters (see Figure 112). This section starts roughly six meters distant from Section 9 at the exit of the metal pipe that runs beneath the roadway. In the cement cap at the *mauka* end of this section of the ditch, above where the pipe exits, the name “MAURICE AGRILULA 83” and the date “9-2-83” are inscribed. The ditch walls, like previous sections, are constructed of three to four courses of stacked basalt cobbles held together and capped with cement, and the ditch floor is covered with a layer of cement. The walls of the ditch are sloped outwards giving it a V-shaped appearance (Figure 132). Section 10 measures 60 centimeters wide at the base, 90 centimeters wide at the top, and averages 70 centimeters deep. The walls are mostly intact with a single area of severe collapse along the north wall at the *makai* end, where the ditch once had a sluice complex. At this end the north wall becomes an earthen embankment with cement and cobble rubble strewn about. Where the ditch once entered a metal pipe that ran beneath a roadway the soil has eroded, a section of pipe is missing, and the eastern third of the roadway has collapsed into the pipe channel and been swept away.

Section 11 of Site 7170 runs along the south edge of Mid-Line Road for a total distance of 55 meters (see Figure 112). This section starts roughly six meters distant from Section 10 at the exit of the metal pipe that runs beneath the roadway (Figure 133). The ditch walls, like the previous sections, are constructed of three to four courses of stacked basalt cobbles held together and capped with cement, and the ditch floor is covered with a layer of cement. The walls of the ditch are sloped outwards giving it a V-shaped appearance. Section 11 measures 60 centimeters wide at the base, 90 centimeters wide at the top, and averages 70 centimeters deep. The walls are mostly intact with only small areas of collapse. At its *makai* end, where the ditch enters a metal pipe beneath a relatively wide roadway that is well used, the end is capped with an extra layer of cement that holds in place three angled sections of narrow gauge rail meant to keep debris from entering the pipe (Figure 134).



Figure 131. Site 7170 Section 9 PVC pipe and nearby pressure tanks, view to the south.



Figure 132. Site 7170 Section 10 *mauka* end, view to the east.



Figure 133. Site 7170 Section 11 *mauka* end, view to the east.



Figure 134. Site 7170 Section 11 *makai* end, view to the east.

Section 12 of Site 7170 runs along the south edge of Mid-Line Road for roughly 50 meters (see Figure 112). This section starts roughly eight meters distant from Section 10 at the exit of the metal pipe that runs beneath a relatively wide, well traveled roadway (Figure 135). The open ditch is only intact for a distance of 24 meters. Beyond that point Section 12 once entered a buried cement pipe that has been removed, and the ditch channel now consists of an eroded channel that meets with Section 13 near its northern end (Figure 136). The intact ditch walls, like the previous sections, are constructed of three to four courses of stacked basalt cobbles held together and capped with cement, and the ditch floor is covered with a layer of cement. The walls of the ditch are sloped outwards giving it a V-shaped appearance. The ditch channel measures 60 centimeters wide at the base, 90 centimeters wide at the top, and averages 70 centimeters deep. Beginning 24 meters from the *mauka* end, where Section 12 formerly entered the cement pipe, the sluice has been removed and the ditch becomes a somewhat recently excavated channel with earthen embankments. A section of the large diameter cement pipe has also been removed from this channel and deposited on top of the southern embankment. Another section of the pipe is visible at the base of the earthen channel, and a third section is still in place and covered with soil where the pipe entered Section 13. This section of pipe is blocked, however, and water travelling through Site 7170 has eroded a new channel that meets Section 13 two meters south of where the pipe opening is visible in the side wall of that section.



Figure 135. Site 7170 Section 12 from the *makai* end of Section 11, view to the west.

Section 13 of Site 7170 is a portion of a north/south running feeder ditch on the south side of Mid-Line Road (see Figure 112). The ditch runs a meandering course south following the 330-foot contour from a pre-cast concrete bridge that is located underneath the road (Figure 137), out of the Mid-Line Road Corridor, eventually connecting with Site-7159 (at the *mauka* end of Section 11; see description above). Section 13 was not carrying water at the time of the current study, but contained puddles, and may have carried water recently. With the exception of one short section of precast cement panels joined with cement lining the western edge, within the survey corridor, the ditch is constructed of stacked basalt cobbles (3-4 high) held together and capped with cement. It has nearly vertical walls that are 1.5 meters distant from one another and 60 centimeters tall. The floor of the ditch is covered by a layer of sediment and not visible. Four meters from its north end, the pipe from Section 12 enters Section 13. Just beyond where the pipe enters the ditch an old sluice is present that once housed a wooden gate (Figure 138). The gate is missing, but wooden slats are present within grooves in the cement covered walls on either side of the ditch.

Opposite the Section 12 pipe opening, a PVC pipe that runs from a concrete slab surrounded by chain link fence that contains five pressure tanks along the route of more modern irrigation pipes to the ditch. Twelve meters from its north end the east wall of Section 13 is missing and the ditch is lined with an earthen embankment. The west wall remains intact as the ditch exits the survey corridor.



Figure 136. Site 7170 Section 12 eroded *makai* end, view to the east.

Section 14 of Site 7170 begins eight meters north of Section 13 at the outlet of pre-cast concrete bridge that runs under Mid-Line Road (see Figure 112). Section 14 runs a curvilinear path northeast for twenty meters to a second precast concrete bridge beneath a roadway that runs along the edge of a reservoir (Figure 139). At the outset the ditch measures 1.7 meters wide by 70 centimeters deep. The vertical walls are constructed of stacked basalt cobbles (3-4 high) held together and capped with cement. A sluice is present in the west wall immediately adjacent to Mid-Line Road, but it has been blocked with a cement panel and filled in behind with soil. Seven meters from Mid-Line Road an old sluice complex is present (140). At this location the ditch narrows to 1.04 meters wide and the basalt stones are covered with a smooth layer of cement. Three indentations of various sizes and shapes are present in the west wall of the complex that likely once housed wooden gates or associated wooden components. The date “1927 is etched into the smooth cement cap on top of the west wall at the south end of the sluice complex. The east wall consists of smooth cement, with some collapse, but no indentations. Beyond the complex the ditch widens to 1.28 meters as it continues northeast to the precast concrete bridge. It is once again constructed of stacked basalt cobbles held together and capped with cement. Just prior to the bridge, in the east wall of Section 14, two metal pipes are present near the upper edge of the ditch (Figure 141). These pipes may have been for out flow to help control the level of the water travelling beneath the bridge.



Figure 137. Site 7170 Section 13 north end at Mid-Line Road, view to the northwest.



Figure 138. Site 7170 Section 13 where concrete pipe enters from Section 12 and an old sluice is present, view to the east.



Figure 139. Site 7170 Section 14, view to the north.

North of Section 14 (see Figure 112) Site 7170 runs under the roadway and enters an earthen ditch that carries water into a reservoir near the 330-foot contour (Figure 142). This last section of ditch and the reservoir fall outside the Mid-Line Road Corridor and were not recorded in detail. It appears that the overall Site 7170 ditch system once carried water to this reservoir watering sugarcane fields along the way. The reservoir is currently used to water diversified agricultural fields that begin immediately below Sections 13 and 14 of Site 7170. This old irrigation infrastructure in the vicinity of Mid-Line Road has largely been replaced by more modern plantation infrastructure consisting of buried irrigation pipes with pressure tanks to control the water flow.



Figure 140. Site 7170 Section 14 sluice complex in the west wall, view to the west.



Figure 141. Site 7170 Section 14 metal pipes near the northeast end, view to the northeast.



Figure 142. Site 7170 Section 14 northeast end and reservoir beyond, view to the northeast.

## Ashley Road Corridor

The Ashley Road Corridor, which will be used by First Wind to access the northwestern most portions of both the Eastern and Western Tableland Arrays, follows the existing gravel/paved alignment of Ashley Road from the northern end of Cane Haul Road to the Eastern Tableland Array at an elevation of roughly 1,000 feet above sea level (see Figure 1). Beginning at the northern end of Cane Haul Road, Ashley Road runs northeast as it traverses the steep coastal cliff formation. At the top of the cliff Ashley Road turns east and runs in a relatively straight line east as it crosses the northwestern portion of the Western Tableland Array, accesses the proposed location of the O & M building and *mauka* point of interconnection, and continues on to northwestern portion of the Eastern Tableland Array near Drum Road. The Ashley Road Corridor crosses TMKs:1-6-1-05:001, 015 and 019, and 1-6-1-06:001 (see Figure 2). Vegetation along the existing roadway consists primarily of Guinea grass (*Panicum maximum*), *koa-haole* (*Leucaena glauca*), *albizia* (*Acacia lebbek*), and a thick growth of non-native vines near its upper reaches.

The Ashley Road Corridor runs through the former Waiialua Sugar Company's fields Waimea-1, 2, 6, 8 and 25 (see Figure 9), and passes by the location of the former Hawaiian Pineapple Company's (H. P. Co.) Waimea Camp. Aerial photographs of the project area (see Figures 5-8) show that these fields were completely cultivated in sugarcane and pineapple during the second half of the twentieth century. The current alignment Ashley Road, which was built by the Waiialua Agricultural Co. during the early twentieth century, is shown on the 1924 HTS Plat 2069 (see Figure 31). On the 1929 U.S.G.S. Hale'iwa quadrangle (see Figure 4) a ditch, a railway line, and a pipe are shown crossing the road alignment, and a second ditch is shown terminating near its southern edge. Waimea Camp, which is located along Ashley Road at an elevation of 600 feet above sea level where a spur road diverges from it and runs southeast across a gulch, is shown on the 1929 U.S.G.S. Hale'iwa quadrangle, but was not depicted on the 1924 HTS Plat 2069, suggesting that it may have been constructed during the intervening time period. During WWII four 75mm guns, part of Battery Waimea, were emplaced at the Waimea Camp. The camp was removed in ca. 1960, and the camp area was later planted in pineapple. No surface evidence of the camp or the gun emplacements was observed within the Ashley Road Corridor.

A single archaeological site, consisting of a north/south running ditch line (Site 7171) following the 410-foot contour was recorded within the Ashley Road Corridor (see Figure 36). This ditch part of the Kamananui ditch system that was created by the Waialua Agricultural Co. during the early to mid-1900s. In addition to the recorded archaeological site, a rectangular-shaped asphalt pad with a sunken side road along its western edge that is lined with a cinderblock wall was noted within the survey corridor immediately north of Ashley Road, near the 380-foot contour (Figure 143). A review of aerial photographs revealed that these features were of modern origins, constructed sometime between 1977 and 1993 (see Figures 7 and 8). Thirty meters *mauaka* of the pad is a rectangular fenced area that contains five pressure tanks that are connected with pipes. This enclosed area, which also contains an electrical box, is where the upslope power lines originate. Slightly upslope of this pump facility is a machinery storage depot with a utility shed (Figure 144). Judging from the age of the abandoned tractors and combine harvesters, the depot probably does not pre-date the 1980s.

In the vicinity of the coastal escarpment formation nearby, but outside the study area, reconnaissance level survey of the accessible sections of the cliff face inland of Ashley Road revealed the presences of several areas of cobble modification (T-37; see Table 8 and Figure 37). The modification consisted of low walls, cobble alignments, leveled areas, filled areas, and cobble stacking. Some of this modification appears to be modern and is associated with plastic grow pots and wire fencing, but some may be older, dating to the Historic or Precontact Periods. Genz and Hammatt (2011) note that locally transmitted oral traditions relate that the area of the *makai* escarpment below Ashley Road stretching to Waimea Bay was a favored place for burial during Precontact and early Historic times. None of the proposed improvements to the existing road within the Ashley Road Corridor will impact the cliff face. Site 7171 is described in detail below.



Figure 143. Sunken road and cinderblock wall noted below an asphalt pad within the Ashley Road Corridor, view to the northeast.



Figure 144. Machinery storage depot with a utility shed noted within the Ashley Road Corridor, view to the northwest.

#### **SIHP Site 50-80-04-7171**

Site 7171 designates an irrigation ditch that runs northeast/southwest across the Ashley Road Corridor following the 410-foot contour (see Figure 36). South of the road the basalt and cement walls of the ditch can be seen sticking out above re-deposited red soil (Figure 145), while north of the road the entire canal has been covered by soil (Figure 146). Judging from the exposed canal rims, the two-meter wide ditch is constructed from carefully cut basalt blocks joined together and capped with cement. The ditch widens to three meters where it abuts a buried culvert beneath Ashley Road (Figure 147). An elongated water retention pond occurs southwest of the intersection between the ditch and the road. Linking this pond with Site 7171 is a sluice gate complex. This complex, which is 50 meters southwest of Ashley Road and outside the project area, contains two sluice gates, with the wooden gate slots and a slot for a plank still visible in one. On the cement capping of the sluice gate is incised, partly in picture writing, “Victor [arrow and heart symbol] Patience DEC. 3 1987-88.” Cross-hatched incisions frame the top end of the writing. A dirt road follows the *mauka* edge of Site 7171 across the survey corridor. This irrigation ditch is part of the Kamananui ditch system that was created by the Waialua Agricultural Co. during the early to mid-1900s. To the south the ditch once connected with the Mid-Line Road ditch system (Site 7170; see above), and to the south the ditch continued nearly to the Eastern Tableland Array, carrying water the northernmost portion of the Wailua Sugar Co.’s lands (see Figure 4).

### **Makai Interconnection Facility Corridor**

The Makai Interconnection Facility Corridor consists of a proposed switch building (*makai* point of interconnection) and associated infrastructure located on TMK:1-6-1-05:001 at an elevation of roughly 160 feet above sea level with an access road that leads to it from Ashley Road beginning at an elevation of 280 feet above sea level (see Figures 1 and 2). The entire survey area falls within the former Waialua Sugar Company’s field Waimea-1 (see Figure 9), and the access road mostly follows a former field road that is shown on maps in 1901 and 1929 (see Figures 4 and 31) as a road with a rail line next to it. Aerial photographs of the general project area (see Figures 5-8) show that this field was completely cultivated in sugarcane during the second half of the twentieth century. The entire area is overgrown with Guinea grass (*Panicum maximum*), but was mowed prior to the fieldwork. No archaeological sites were identified within the Makai Interconnection Facility Corridor.



Figure 145. Site 7171, view to the south.



Figure 146. Site 7171, view to the north.

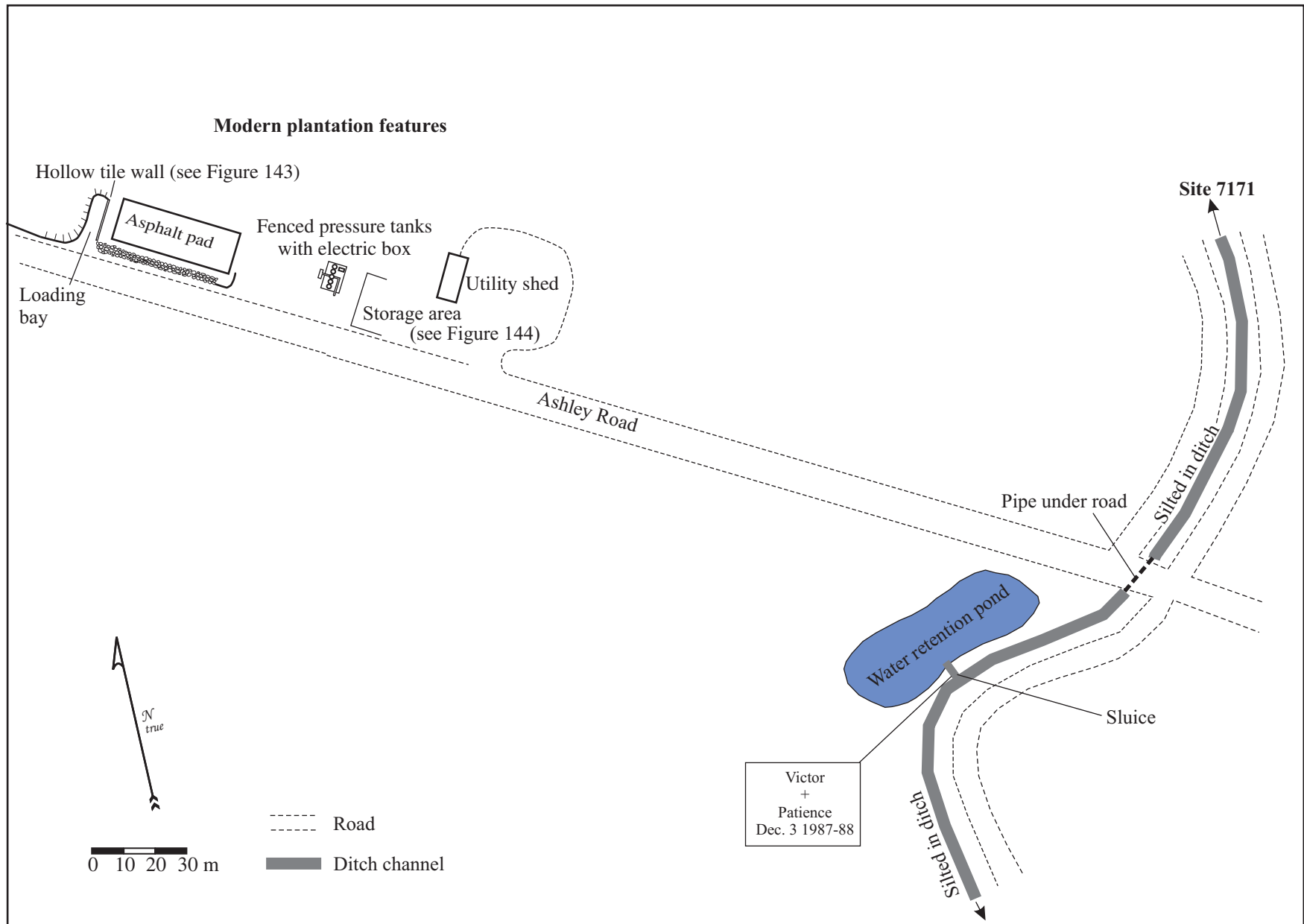


Figure 147. Site 7171 plan view.

In the vicinity of the coastal escarpment formation nearby, but outside the study area, reconnaissance level survey of the accessible sections of the cliff face between Ashley Road and the *makai* point of interconnection, revealed the presences of several areas of cobble modification (T-37; see Table 8 and Figure 37). The modification consisted of low walls, cobble alignments, leveled areas, filled areas, and cobble stacking located on the rocky precipice well below the Makai Interconnection Facility Corridor. Some of the modification appears to be modern and is associated with plastic grow pots and wire fencing, but some may be older, dating to the Historic or Precontact Periods. Genz and Hammatt (2011) note that locally transmitted oral traditions relate that the area of the *makai* escarpment below Ashley Road stretching to Waimea Bay was a favored place for burial during Precontact and early Historic times. Construction of the *makai* interconnection facility, which is located within a former sugarcane field well above T-37, will not impact the cliff face or any of the observed modifications.

## Overhead Collector Line Corridor

The Overhead Collector Line Corridor consists of a 50-foot wide corridor that stretches across a tableland formation (at an elevation of roughly 600 feet above sea level) between the gulches bordering the Eastern and Western Tableland Arrays (see Figure 1). Within this corridor poles will be placed that will hold an overhead power line connecting the Eastern Tableland Array with the *mauka* point of interconnection. The corridor crosses TMK:1-6-1-06:001 (see Figure 2) and passes through the former Waiialua Sugar Company's field Waimea-26 (see Figure 9). Aerial photographs (see Figures 5-8) indicate that this area was cultivated in pineapple during the second half of the twentieth century. Currently vegetation, within this mechanically disturbed area, consists of a thick growth of Guinea grass (*Panicum maximum*), *koa-haole* (*Leucaena glauca*), and stands of albizia (*Acacia lebbek*). Old plastic drip-line and sheets of weed matting were noted on the surface of the survey area. No archaeological sites were observed within or nearby the narrow Overhead Collector Line Corridor.

## SUMMARY OF ARCHAEOLOGICAL FINDS

No Precontact sites were found within the study area. Of the seventeen Historic Period sites recorded within the study area, five are associated with the irrigation of sugarcane. Sites 7159 (Kawailoa Ditch Complex), 7169 (Upper Mid-Line Road Ditch Complex), 7170 (Lower Mid-Line Road Ditch Complex), and 7171 (Ashley Road Ditch Complex) are ditch and pond complexes, and Site 7164 is a water pipe system that connected the Kawailoa ditch complex (Site 7159) with Pump House 4 (an existing facility situated on private land *makai* of the project area). A sixth site (Site 7157) is a possible concrete field marker identifying the location of one of the *mauka*-most agricultural plots within the project area.

Historical documentation (e.g., see Dorrance and Morgan 2000; Wilcox 1996) indicates that plantation agricultural may have began impacting the Kawailoa landscape as early as 1898, and that by the late 1920s irrigated fields and associated infrastructure (formal and informal ditches, pipes, tunnels, a few pump houses, several reservoirs, roads, and railway lines) covered vast portions of the study area and was identified as the Kamananui Ditch System. Beginning in ca. 1939 gun emplacements and a military command and fire control communication system were established at key locations in and around the study area (along the shore near Kawailoa Drive and Ashley Road, at Kawailoa and Waimea Camps, and along the upper ridges of the Waimea River catchment) as part of O'ahu's coastal defenses (Bennett 2002; Gaines 2002; Sugimoto 1996; Takamura 1995). The defenses were mostly dismantled immediately following World War II (in ca. 1945). By the middle twentieth century the plantation railway system was defunct and was replaced by roads for trucks to haul cane. Within the study area the formal plantation activities persisted until 1996.

Dates incised into the cement capping of ditch and sluice gate walls of the four defined ditch complexes (Sites 7159, 7169, 7170, and 7171) (Figure 148) suggest that the Kamananui Ditch System existed by at least 1913, and dates incised in other concrete features suggest that by 1926 and 1927 the main channels were well established. Dates between 1935 and 1943 indicate ongoing maintenance activities. Based on the increased occurrence of the incised dates, a spurt of activity occurred between 1950 and 1954, and further maintenance and update activities occurred between 1981 and 1990. Even though sugarcane cultivation was terminated at the end of 1996, the ditch complex continued to be used and maintained along certain sections, as attested by the 2008 and 2009 dates incised on portions of the lower Mid-Line Road and the main Kawailoa Road ditches.

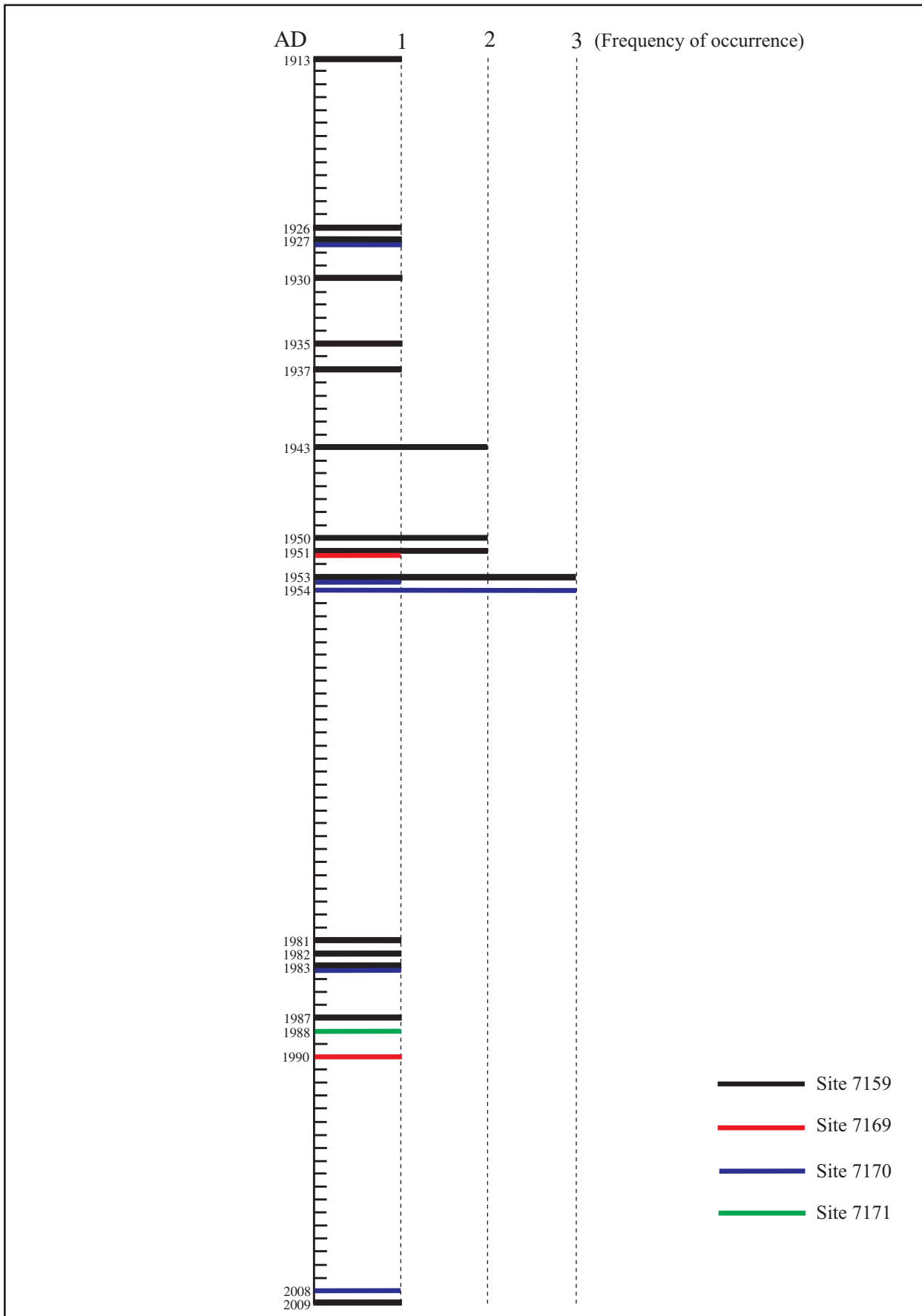


Figure 148. Diagrammatic representation of etched dates within the Kamananui Ditch System.

Features associated with the transport of sugarcane within the study area include the concrete bridge along Cane Haul Road (Site 7168), the four stone-walled road culverts (Sites 7165, 7166 and 7167 on Cane Haul Road, and Site 7163 on Hakina Bypass Road), and stone abutments (Site 7160) and keystone alignment (Site 7162) within the Kawailoa Road corridor. An additional plantation-related site (Site 7161) recorded within the Kawailoa Road Corridor appears to be the location of a former stable.

Sites seemingly associated with World War II era (or slightly earlier) military activities include three separate concrete pillar foundations (Sites 7155, 7156, and 7158) along the northern *mauka*-most ridge within the study area. These three related sites are most probably remnants of a military communication and fire control network. These sites, along with Site 7157, are the only sites that were found in the vicinity of any of the proposed wind turbines tower locations.

## SIGNIFICANCE EVALUATION AND TREATMENT RECOMMENDATIONS

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

- A Be associated with events that have made an important contribution to the broad patterns of our history;
- B Be associated with the lives of persons important in our past;
- C Embody the distinctive characteristics of a type, period, or method of construction; represent the work of a master; or possess high artistic value;
- D Have yielded, or is likely to yield, information important for research on prehistory or history;
- E Have an important traditional cultural value to the native Hawaiian people or to another ethnic group of the state due to associations with traditional cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts—these associations being important to the group's history and cultural identity.

The significance and recommended treatment for the seventeen recorded sites are discussed below and presented in Table 9.

**Table 9. Site significance and treatment recommendations.**

<i>Site #</i>	<i>Description</i>	<i>Association</i>	<i>Significance</i>	<i>Treatment</i>
7155	Concrete pillar	Military	A, D	No further work
7156	Concrete pillar	Military	A, D	No further work
7157	Concrete marker	Plantation	D	No further work
7158	Metal pole/concrete base	Military	A, D	No further work
7159	Ditch complex	Plantation	D	No further work
7160	Stone abutments	Plantation	D	No further work
7161	Concrete foundations	Plantation	D	No further work
7162	Kerbstone Alignment	Plantation	D	No further work
7163	Stone/concrete culvert	Plantation	D	No further work
7164	Metal pipeline	Plantation	D	No further work
7165	Stone/concrete culvert	Plantation	D	No further work
7166	Stone/concrete culvert	Plantation	D	No further work
7167	Stone/concrete culvert	Plantation	D	No further work
7168	Concrete Bridge	Plantation	D	No further work
7169	Ditch complex	Plantation	D	No further work
7170	Ditch complex	Plantation	D	No further work
7171	Ditch complex	Plantation	D	No further work

Sites 7155, 7156, and 7158 are likely interrelated elements associated with a WWII (or slightly older) military communication and fire control network that was established as a warning and response system in the event of a foreign invasion. Although the integrity of the overall system no longer exists, the locational and contextual integrity of these elements are intact, and as such these sites are considered significant under Criteria A and D.

Sites 7157, 7159, 7160, 7161, 7162, 7163, 7164, 7165, 7166, 7167, 7168, 7169, 7170, and 7171, although either non-functional (7161, 7162, 7164, 7169, 7171) partly functional (7157, 7159, 7170) or fully functional (7160, 7163, 7165, 7166, 7167, 7168), do retain sufficient integrity to be considered significant under Criterion D for the historical information they have yielded relative to the development of the plantation industry on the north shore of O‘ahu. Kamehameha Schools (landowner) continues to manage, repair, and upgrade the irrigation systems in these fields as portions of these systems continue to provide their agricultural lessees with much needed water.

It is suggested that a reasonable and adequate amount of information has been collected from and about all of these sites as a result of the current study to warrant a no further work recommendation; and thus, a no historic properties affected determination for these sites with respect to the proposed Kawaihoa Wind Power project.

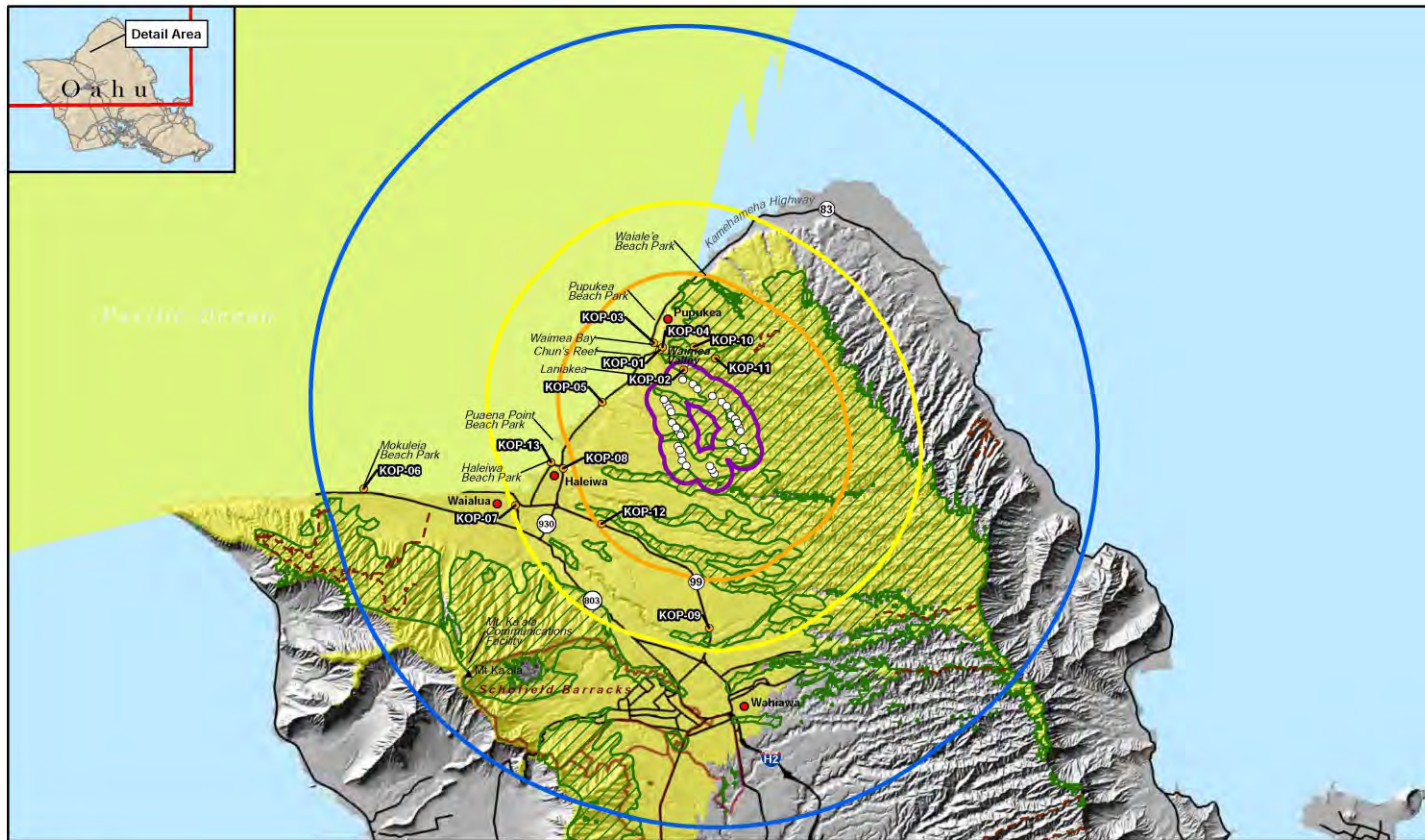
It is further recommended that a program of archaeological monitoring be maintained during the construction activities associated with the Kawaihoa Wind Power project. Such a program will help to ensure that any inadvertently discovered resources would receive immediate attention and protection, while their ultimate disposition is being determined by DLNR-SHPD. A monitoring plan in compliance with HAR 13§13-279 should be prepared and submitted to DLNR-SHPD for review and approval.

## **A CONSIDERATION OF POTENTIAL VISUAL IMPACTS**

Hawai‘i Administrative Rules 13§13-284-7 (b) lists visual impacts as a type of impact that should be considered with respect to historic properties. Potential visual impacts resulting from the development of the Kawaihoa Wind Farm project were a consideration of both the Environmental Impact Statement (EIS) and an accompanying Cultural Impact Assessment (CIA). Visual impacts are typically considered indirect impacts, affected the aesthetic characteristics of a given historic property or landscape, and as such the evaluation of visual impacts is a highly subjective undertaking. The potential exists for visual impacts to historic properties both within the wind farm development area as well as outside of the development area. While the wind turbine towers will be prominently visible from all of the sites identified within the development area (see Table 9), it is suggested here that given the nature of these sites there will be no impact to the aesthetic characteristics of these site.

As a result of an uncritical CIA, Genz and Hammatt (2011) reported that three individuals (it is likely that others feel the same way) of native Hawaiian ancestry within the community felt that the wind turbine towers will have a negative visual impact on the cultural landscape of Kawaihoa, and thus affect the sense of place and the ability of those individuals to maintain their cultural worldview. While we believe this to be somewhat of an overstatement, we do recognize that the wind turbine towers will be visible from a sizeable portion of northwestern O‘ahu (outside of the development area) and will alter the view plane of the Kawaihoa skyline. However, while Kawaihoa as a cultural landscape is conceptually understood; given the documented extensive historic and modern development and use of the area, it would be imprudent to consider Kawaihoa a “cultural landscape” and a definable historic property. Thus, the placement of wind turbine towers while potentially visually distracting could not be considered an impact to a landscape.

In the EIS prepared for this project, CH2M Hill (2011) conducted a detailed visual impact analysis. A map was generated that showed the geographical area within which the wind turbine towers would be visible (Figure 149); and view plane simulations were generated for several Key Observation Points (KOP) within the affected area. The general conclusion of the EIS was that the greatest number of wind turbine towers would be potentially visible from viewpoints located further away from the wind farm site. For viewpoints located closer to the wind farm, the wind turbine towers would be more visually prominent, but a fewer number would be potentially visible. In many cases, views of the wind turbines would be blocked by vegetation, existing structures, and topographical features.



**LEGEND**

**Potential Visibility**

- Areas in which turbines have the potential to be visible
- Areas in which turbine is potentially not visible; line of sight blocked by terrain
- Turbines potentially visible but with year-round screening from forest cover

**Distance Zones**

- Foreground Zone  
0 - 0.5 miles from turbines
- Near Middleground Zone  
0.5 - 3.0 miles from turbines
- Far Middleground Zone  
3.0 - 5.0 miles from turbines
- Near Background Zone  
5.0 - 10.0 miles from turbines

- KOP Location
- Turbine Location
- Major Road
- Na Ala Hele Trail



**Figure 19**  
Zone of Visual Influence (ZVI)  
Kawaiolo Wind Farm Project  
Oahu, Hawaii

**CH2MHILL**

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Figure 149. Wind turbine tower visibility zones.

While not necessary specific to historic properties, this analysis was comprehensive enough to be applicable to a range of known historic properties located throughout the northwestern portion of O‘ahu. Visual simulations were prepared for thirteen KOPs and show the degree to which the wind turbine towers will be seen. For historic properties located in the vicinities of the KOPs the wind turbine towers will comprise an additional visible modern skyline feature. From historic properties situated at the locations more remote (Dole Plantation area; Waialua; Mokulē‘ia; etc.) from the development area the towers will be seen as a collective and more prominently visible from the coastal areas (Figures 150-153). For historic properties situated within the more proximate locations (the Hale‘iwa to Waimea Valley corridor) fewer towers will be seen from any one position and in some cases only portions of towers will be seen (Figures 154-162).

Perhaps the most proximate cultural resource area is that of the greater Waimea Valley, situated immediately to the north of the development area (Figure 163). As can be seen in Figures 159-162, portions of a few of the towers will be visible, but the analysis indicated that views of the wind turbine towers from approximately 95% of the valley are potentially screened by existing vegetation. However, given its close proximity and cultural importance an additional line-of-site analysis was conducted from three viewing locations within Waimea Valley, from the Visitor’s Center (LOS-01), from the location of KOP 02 (LOS-02), and from Waimea Falls (LOS-03) (see Figure 163). Profile diagrams of the topography between the viewing location and nearest wind turbine towers were generated and integrated with the view plane of the viewer, as shown in Figures 164, 165 and 166. The topographic profiles are presented as green contours on the diagram. Potential views of the turbine blades are indicated by a red diagonal dashed line from the viewer’s vantage point to the tower location; the potential views of the lowermost portion from the viewer’s vantage point to the tower location is indicated by a blue diagonal dashed line. Diagrams where no blue dashed lines are shown and where the red dashed line intersects the green topographic profile indicate that the tower will not be visible at all given the existing topography.

From the Waimea Valley Visitor’s Center (LOS-01), the analysis indicated that most of wind turbine tower 13 would be visible and that the upper portion of tower 14 would be visible, while towers 10 and 11 would be obstructed by existing topography (see Figure 164). From KOP-02 (LOS-02), the analysis indicated that the majority of tower 11 would be visible, while only the upper portions of the towers 10, 13, and 14 would be visible (see Figure 165). Lastly, the analysis indicates that from the Waimea Falls location (LOS-03) none of the towers will be visible, all being obstructed by the topographical feature known as South Ridge (see Figure 166).

In conclusion, First Wind recognizes that the wind turbine towers will be a visible and prominent addition to the skyline of northwestern O‘ahu and have taken this recognition into account. The project planning and siting were conducted in a manner so as to best integrate the project components with the natural characteristics of the site and minimize visual impacts to the extent possible. The approach taken relative to these efforts is consistent with design guidelines and best practices that have been developed and implemented based on other wind farm projects worldwide; and is also consistent with the guidelines set forth in the North Shore Sustainable Communities Plan developed by the City and County of Honolulu. Characteristics of the proposed wind farm site, including the topography and vegetative cover, naturally limit views of the site from near viewing locations, particularly those of the upper elevations. The turbines will all be of a single type and size, placed in an orderly fashion (that is, in a series of tightly grouped, straight lines), with all blades rotating in the same direction. A shade of white paint will be used for all of the components, and the towers will be marked with a minimal amount of lighting (only as necessary to meet FAA requirements). The result of these measures will be a series of uniform towers with a consistent and balanced appearance, integrated into the natural environment in as sensitive a manner as feasible.

With respect to visual impacts to specific historic properties, viewplanes from any site to the ocean will not be obscured and the towers will not impede the view of Mount Ka‘ala from any location. It is clear from the visual simulations the towers will primarily been seen from more distant locations; and while it is recognized that modern landscape features do have some impact of the overall setting of historic properties, it is believed that the mitigative efforts in siting and design will help to soften or lessen any such impacts.



Figure 150. Visual simulation from the Dole Plantation Visitor Center (KOP-09).



Figure 151. Visual simulation from the Waialua District Park (KOP-07).



Figure 152. Visual simulation from agricultural plateau along Highway 99 approaching the North Shore coastal area (KOP-12).



Figure 153. Visual simulation from Mokulē‘ia Beach Park (KOP-06).



Figure 154. Visual simulation from Pūpūkea area Maulukua Road (KOP-11).



Figure 155. Visual simulation from Pūpūkea area Holike Road (KOP-10).



Figure 156. Visual simulation from Hale'iwa Ali'i Beach Park (KOP-13).



Figure 157. Visual simulation from Matsumoto Shave Ice in Hale'iwa Town (KOP-08).



Figure 158. Visual simulation from Laniakea (Turtle Beach) along Kamehameha Highway (KOP-05).



Figure 159. Visual simulation from the entrance to Waimea Valley (KOP-01).

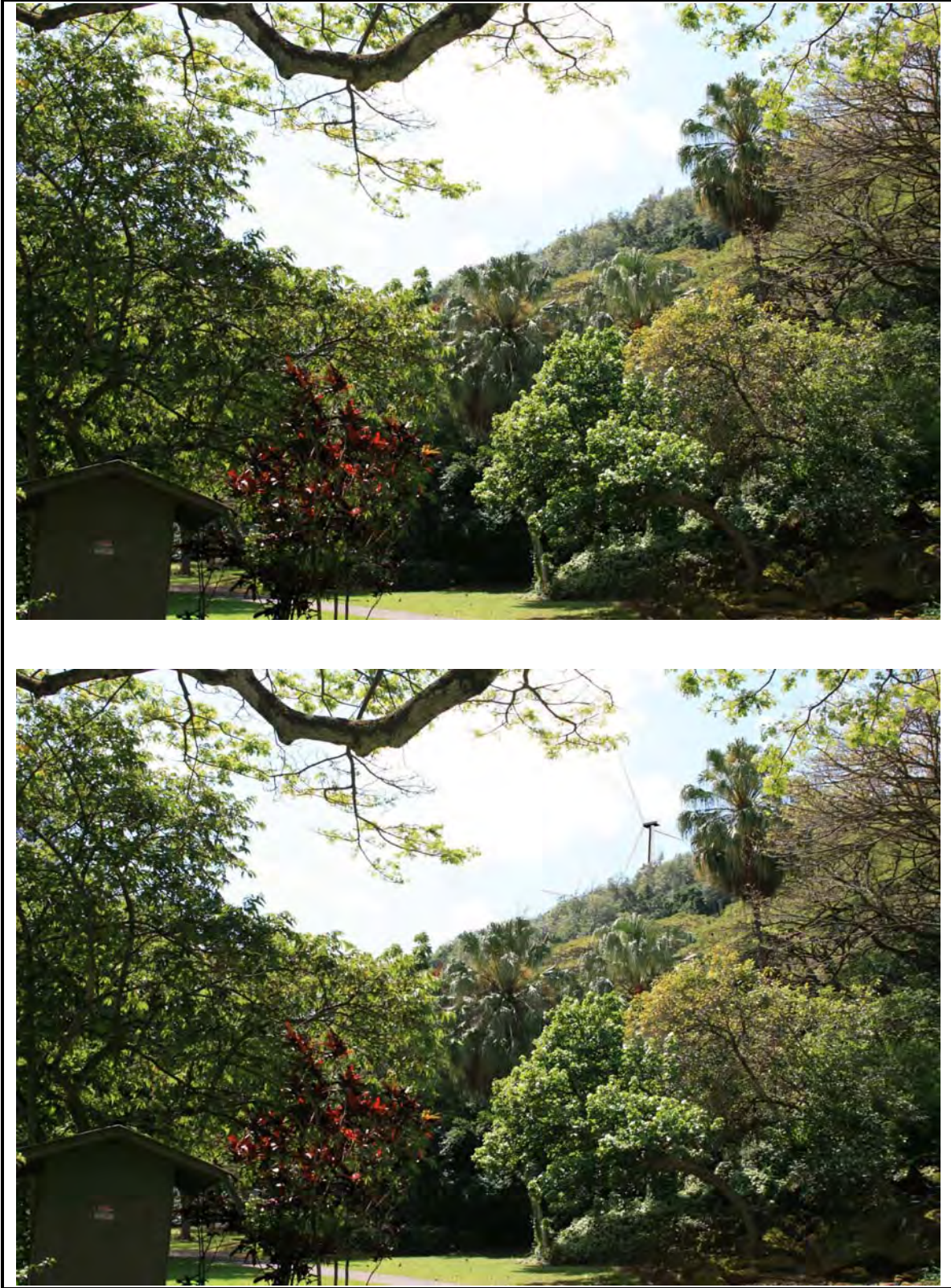


Figure 160. Visual simulation from within Waimea Valley (KOP-02).



Figure 161. Visual simulation from Kamehameha Highway looking back toward Waimea Valley and project area (KOP-03).



Figure 162. Visual simulation from Pu'u o Mahuka Heiau (KOP-04).

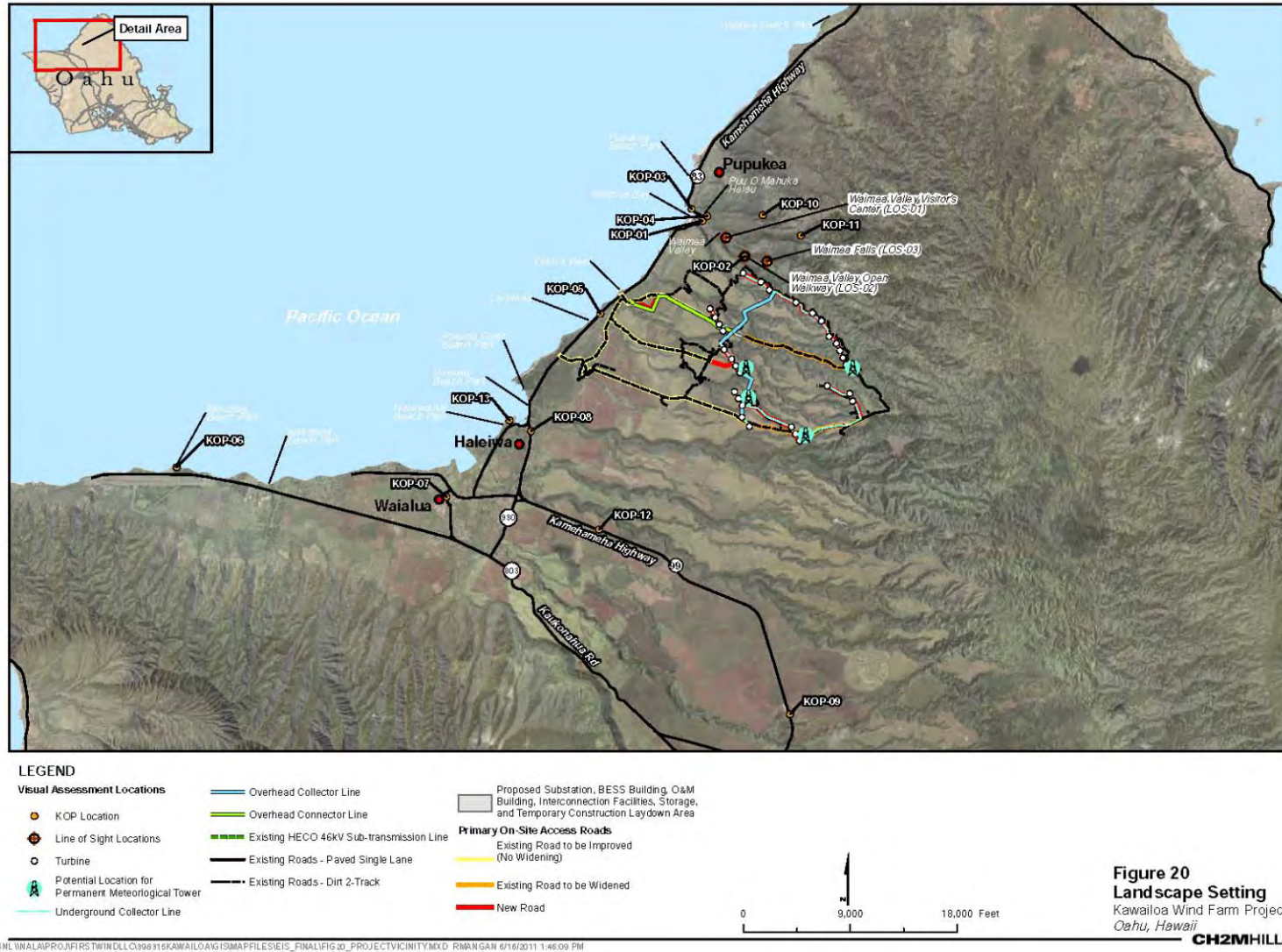


Figure 163. Project setting.

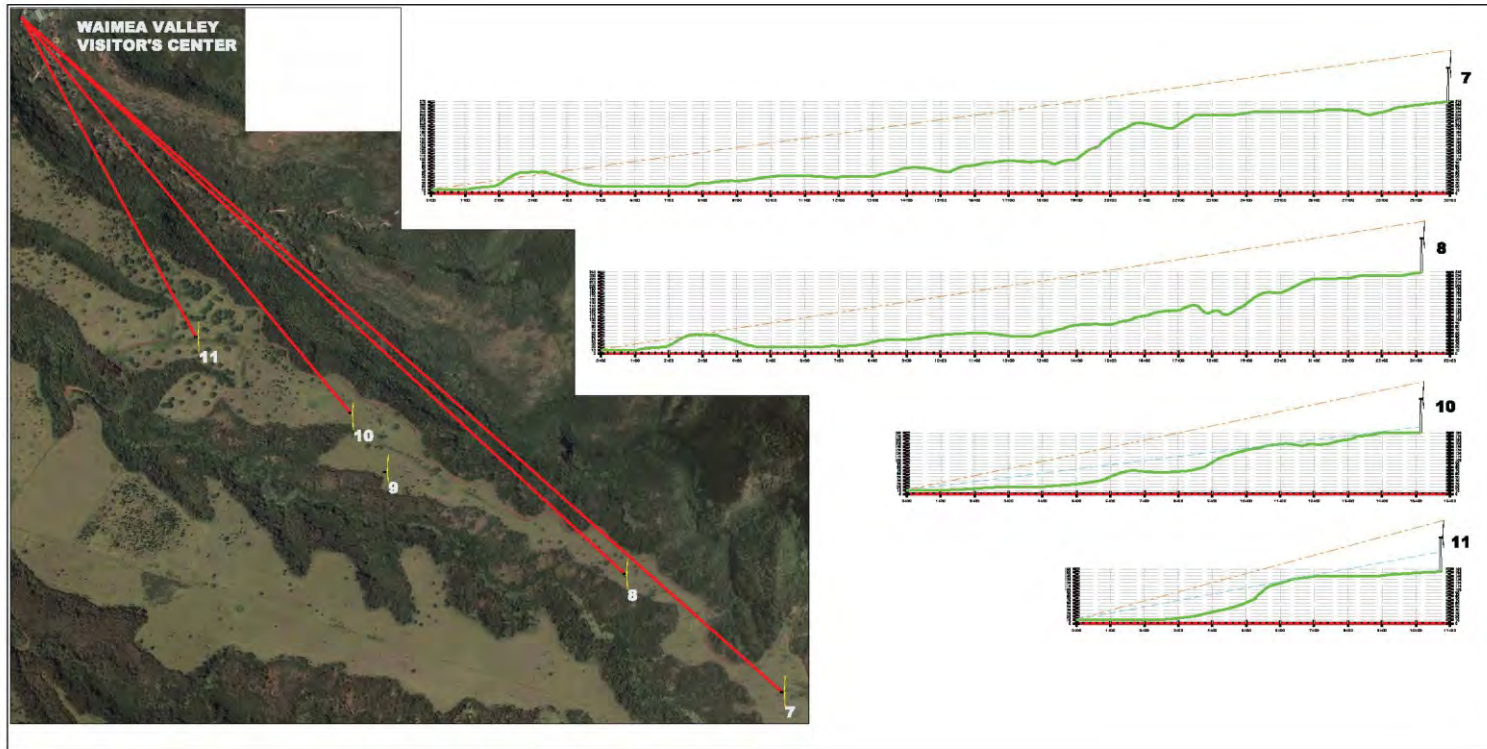


Figure 34  
Line of Sight Profile Assessment for  
Waimea Valley Visitor's Center (LOS-01)  
Kawailoa Wind Farm Project  
Oahu, Hawaii

CH2MHILL

Figure 164. Line of sight assessment from Waimea Valley Visitor Center.

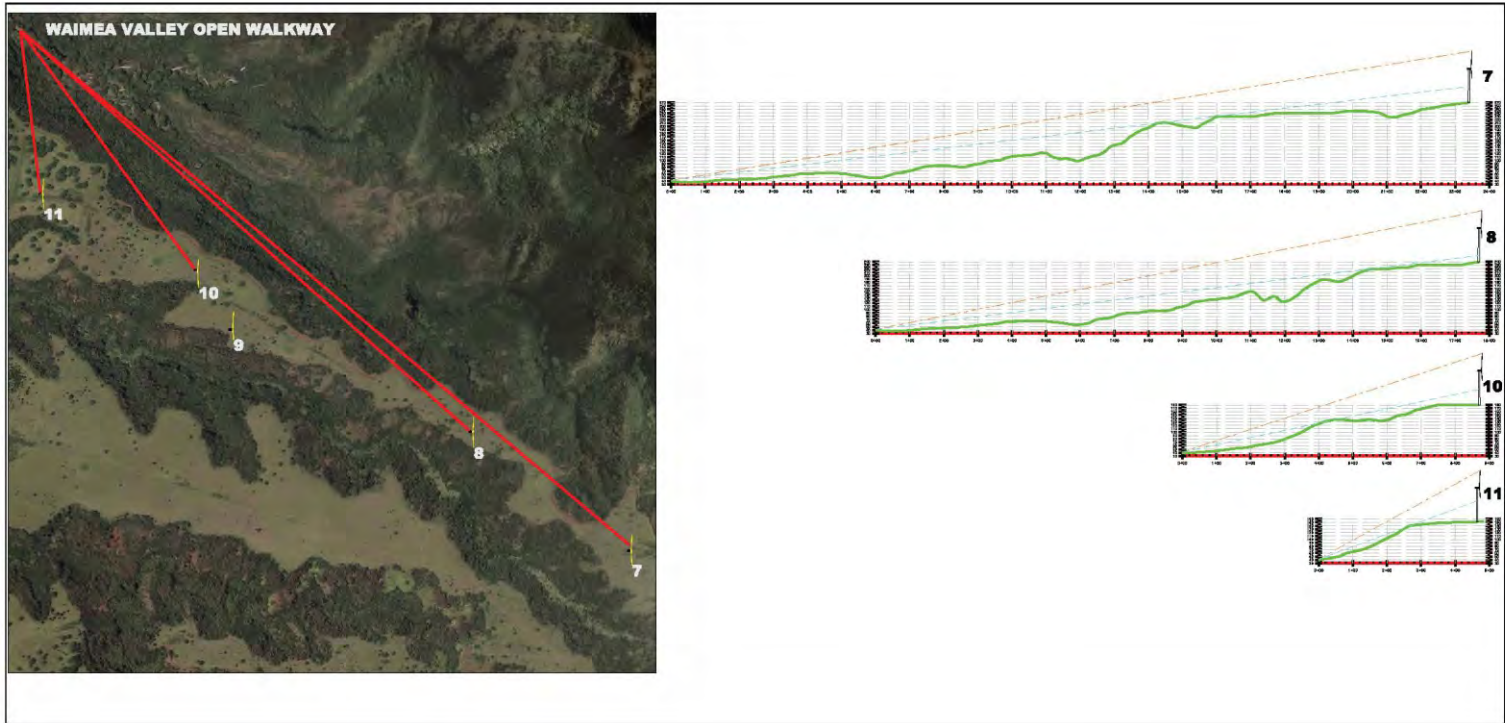


Figure 35  
Line of Sight Profile Assessment for  
Waimea Valley Walkway (LOS-02)  
Kawailoa Wind Farm Project  
Oahu, Hawaii  
CH2MHILL

Figure 165. Line of sight assessment from Waimea Valley KOP-02.

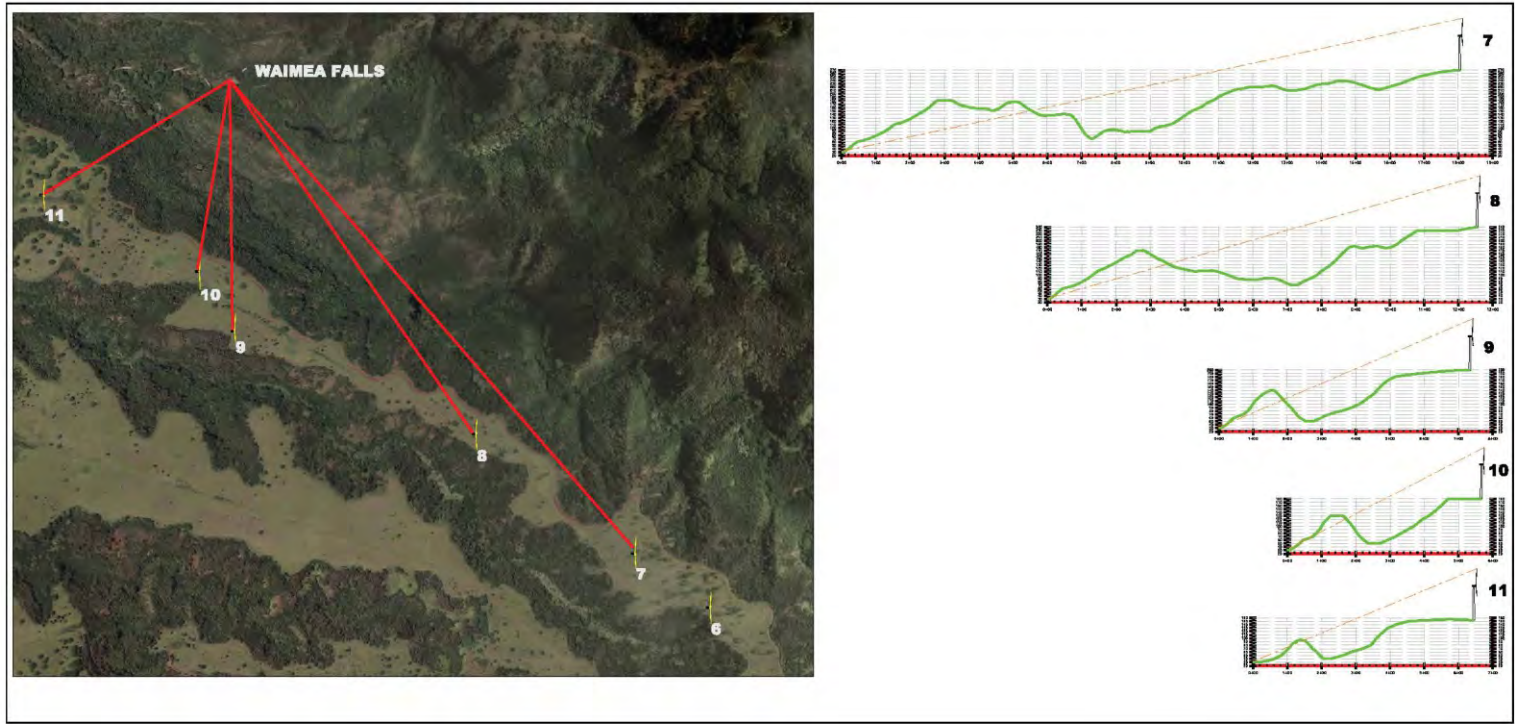


Figure 36  
Line of Sight Profile Assessment  
for Waimea Falls (LOS-03)  
Kawailoa Wind Farm Project  
Oahu, Hawaii  
CH2MHILL

Figure 166. Line of sight assessment from Waimea Falls.

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