

The Waianae Coast Comprehensive Health Center, an outpatient facility, is the closest health care facility to Makua. It is located off Farrington Highway in Waianae, and has access to three ambulances and a helipad for medical evacuation helicopters. There are no police stations located near Makua. The closest police station is the Waianae City Police Station, located off of Farrington Highway in the city of Waianae. A branch of the US Army Military Police is also located in Waianae off of Army Street.

4.9.1.5 Recreation

Makua There are currently no recreational activities occurring east of Farrington Highway at Makua due to the safety hazard of the live impact area and UXO. Four hiking trails (Makua Rim, Ohikilolo, Piko, and West Makua) traverse or border Makua. Only Makua Rim Trail is open to the public; however, the State of Hawaii does not promote use of the trail due to the presence of endangered tree snails. The “Outdoor Recreation Plan Report for US Army Training Areas on Oahu” (Towill Corporation, 1997) concluded that there is no potential for increased recreational opportunity at Makua due to safety hazards.

The Army’s lease with the State of Hawaii requires the Army to ensure that Makua Beach (situated between the ocean and Farrington Highway) is fully available for use by the general public except during periods when the public would interfere with training activities. This long, sandy shore is used in the summer for swimming, diving, sunbathing, and body surfing. A sign warns swimmers that they do so at their own risk, and that there are no lifeguards on duty. There are no lifeguard stations or restroom facilities.

Waianae The Waianae District has one regional park, eight beach parks, four beach/shoreline access points, one district park, four community parks, one neighborhood park, and one cultural park. The Kaena Point State Park is located just north of Makua, and the Keaau Beach Park is located just south of Makua. Makaha Beach, located between Keaau Beach Park and Makaha, is world-renowned for surfing competitions.

4.9.1.6 Protection of children Executive Order (EO) 13045 requires federal agencies consider the effects of their proposed actions on children. Under the Proposed Action there would be no disproportionate effects on children through environmental health or safety risks. The Proposed Action would affect children to the same extent as the general population.

4.9.2 Environmental consequences of No Action The No Action alternative is described in detail in 3.2. During the period between the decision to stop training and the completion of the disposal process, there would be no significant impacts on the socioeconomic environment. Some members of the Waianae community, some native Hawaiians, and various ethnic groups would benefit by fulfillment of their desire that the Army would no longer train at Makua. Community access to Makua would still be limited, but the beach could be used at any time. The staff at Makua might be reduced, but their economic impact on the Waianae community is minimal.

Depending on eventual designated land use of the property, ranging from limited public access to unrestricted public access, the extent of excavation required for UXO cleanup would range from 1-14 feet below the ground surface. The excavation could subject the cleanup area to extreme surface disruption and modify the environment and may negatively impact or significantly disturb cultural resources. As a

result of these impacts to the natural and cultural environment, community and rural values and qualities could also be negatively impacted. Any future economic or recreational activities may be different from current regional opportunities and would need to accommodate the constraints of a modified environment.

The actual type, timing, and location of future reuse activities are not known, and potential impacts to the socioeconomic environment are unknown. After disposal, the Army would no longer require utility services or private contracting work, thus impacting service providers and private contractors by eliminating revenues. Some beneficial impacts that may result could include temporary employment opportunities during UXO cleanup, access to Makua for recreation, enjoyment of the natural and cultural environment, and possible resumption of traditional gathering rights and religious practices after cleanup of the site.

4.9.3 Environmental consequences of Proposed Action The full-time staff at Makua would grow to 20 persons. Soldiers would continue to bivouac on site and bring the majority of supplies with them. The government would not incur the costs of operations and maintenance elsewhere, nor the transport of soldiers and equipment. The Army would continue to be exempt from payment of property taxes.

The Proposed Action would result in minimal changes to population, housing, economy, employment or income figures, the use of facilities and services or recreational opportunities. There would be no additional impact to rural settings, traditional practices, and rural values of the Waianae community. A beneficial impact would be that the Waianae community would be assured that the ITAM program, and other current environmental programs and programs would continue to be implemented to preserve the natural and cultural resources in Makua.

4.9.3.1 Minimization measures The Army would continue an active public involvement program (discussed in detail in Section 5, Public Involvement) to work with the community to better understand ways to reduce the impact of training on their community values, rural values, and qualities and to enhance cooperation and understanding of the Army's mission. Community involvement would also continue to include the public in cultural resource programs (refer to 4.11, Cultural Resources) such as the Ukanipo Heiau Council meetings. The meetings involve the native Hawaiian community on the Waianae coast and the State of Hawaii working with the Army to rehabilitate the Ukanipo Heiau Complex and open the site to native Hawaiian religious practitioners.

4.10 ENVIRONMENTAL JUSTICE Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, directs federal agencies to identify and address as appropriate, disproportional high and adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations. The Presidential Memorandum that accompanied the Executive Order recognizes the importance of procedures under NEPA to identify and address environmental justice concerns. The memorandum states "each Federal agency shall analyze the environmental effects, including human health, economic and social effects, of Federal actions, including effects on minority and low-income communities, when such analysis is required by NEPA."

4.10.1 Affected environment The Waianae community today has a large minority and low-income population. As discussed in 4.9, Socioeconomic Environment, the Waianae District in 1990 was comprised of 78.9 percent minority population, compared to 31.7 percent for all of Oahu. The median household income was \$32,392, compared to \$40,581 for Oahu. Some 24.1 percent of families and 23.9 percent of individuals were below the poverty level in Waianae, compared to 3.2 percent and 2.8 percent, respectively, for Oahu.

4.10.2 Environmental consequences of No Action The No Action alternative is described in detail in 3.2. Some members of the Waianae community, some native Hawaiians, and various ethnic groups would benefit by having their desires met that the Army would no longer train at Makua. If the land were someday preserved as agricultural/open space or preservation land, access to some or all of the reservation would be available. Over time Makua could recover from the disturbance caused by UXO cleanup and be restored to a more natural state. New landowners may not have the same requirement to preserve cultural sites, consult on endangered species, or conduct dialogue with the community as the federal agencies do. Other federal agencies or state agencies may not have the funds to carry out the natural and cultural resource management programs the Army has put in place. Therefore, endangered species and cultural resources could be jeopardized without any preservation or management programs in place to protect them. Potential impacts to these populations would be analyzed and evaluated in the NEPA disposal document. These impacts would not affect the Waianae population disproportionately.

4.10.3 Environmental consequences of Proposed Action Impacts which directly affect a surrounding community, such as noise, air, socioeconomic and transportation, would affect the largely minority and low-income community of Waianae, and all users of the public beaches and hiking trails. As described elsewhere in this Supplemental Environmental Assessment, these effects are not expected to be significant. These effects are also not expected to have disproportionately high and adverse human health or environmental effects on minority and low-income populations. Impacts on community and rural values are of particular concern to native Hawaiians, (as discussed in 4.9, Socioeconomic Environment) who comprise a large part of the Waianae community. Although the Proposed Action includes some potential risks to cultural resources, the Army's extensive cultural resources management program, including involvement with the local community, benefits the community by systematically protecting cultural resources under a program developed with significant community review and input. The following paragraphs provide information on the minority- and low-income-specific impacts of the Proposed Action on each resource area examined in this Supplemental Environmental Assessment.

4.10.3.1 Land use Under the proposed action, Makua would remain in use for training. There are no residential areas immediately adjoining Makua. Public access to Makua Beach and to Kaneana Cave may be restricted occasionally. Army training would continue to impact the Waianae community by restricting beach access at times, and by not allowing the land use to be designated as agricultural/open space or preservation land, and by allowing only limited access throughout Makua Valley. Beneficial impacts to Waianae residents include assurance of environmental stewardship, land management programs to ensure preservation of the valley, and safety to residents from hazardous substances.

4.10.3.2 Endangered species The Army would continue its programs of endangered species management at Makua, including Wildland Fire Management and the Endangered Species Stabilization Plan.

4.10.3.3 Air quality Air quality would not be measurably worsened by modified live-fire training. Training at Makua does not influence local air quality. Emissions and dust would be generated from weapons fire, and truck and helicopter movement to the site and at the site. These air quality problems would be localized and temporary. (Refer to 4.7.)

4.10.3.4 Noise environment The northern portion of the Special Area Plan boundary is adjacent to Noise Zone III, while the beach across from Makua falls within Noise Zone I. Noise studies found that noise generated at Makua normally would not exceed the levels allowed by the local noise ordinance for more than 10 percent of any 20 minute period outside the reservation boundary. Using this standard, users of Makua Beach would be minimally impacted by noise for short periods during training activities. Waianae as a whole may experience some low nuisance level noise. In general, these impacts are not expected to be significant, or have a disproportionate affect on minority and low income population.

4.10.3.5 Socioeconomic The Proposed Action would not negatively or beneficially impact the current or projected population, housing, economy, employment, income, facilities, or services.

4.10.3.6 Cultural resources Makua historic records and oral histories date back to the 19th century and demonstrate both religious and domestic use of Makua by native peoples. Military activities in Makua have prevented unrestricted access by native/indigenous Hawaiians to locations they deem culturally important since the early 1940s. The Proposed Action would continue to prevent unrestricted access. The Army, however, is working closely with the Waianae community through public involvement to protect and conserve cultural resources in Makua and to improve access for native/indigenous Hawaiians as safety and scheduling permit. Such efforts involve the access to and care of Ukanipo Heiau, community involvement of the development of the Section 106 PA for the preservation of cultural sites at Makua and community coordination currently underway concerning Traditional Cultural Properties (discussed in 4.11).

4.10.3.7 Hazardous substances Existing UXO would remain for the near future. Units training at Makua would remove any target equipment they may have provided, gather brass casings from spent rounds, and otherwise make every effort to restore the facility to its condition prior to their use. To the extent they can do so safely, units would remove dud (unexploded) ordnance. Explosive ordnance disposal specialists would be summoned when required. No known dud rounds would be left in place at the conclusion of a training exercise. In 1998 the Army cleared 105 acres in the vicinity of Ukanipo Heiau to facilitate safe access to the site. Available evidence indicates there is no threat to human health or the environment from past ordnance expenditures in Makua. The Proposed Action is not expected to pose any such threats. Additionally in response to public concern, the Army plans to coordinate with the EPA and public to monitor groundwater for hazardous waste contamination (refer to 4.13, Hazardous Substances).

4.10.3.8 Transportation The Army transports soldiers and ammunition along Farrington Highway to access Makua. This transport occurs only while training activities are taking place at Makua, not on a daily basis. As presented later in 4.14 Transportation and Figure 4-14, the 1998 average daily traffic on Farrington Highway was greatest in Waianae and considerably reduced as traffic headed north towards Makua, with fewer than 1,000 vehicles counted per day at Ohikilolo. Figure 4-15 shows existing morning and evening peak hour traffic volumes, and illustrates consistency with the volume of traffic identified in

the 1998 average daily traffic figures. While Army vehicles would occasionally impede traffic flow, the frequency with which this disruption occurs would not be significant. Transport of ammunition (another public concern), would continue to comply with all federal and state laws, and regulations, in addition to Army procedures and regulations, to ensure the safety of the public and military personnel. The transport of ammunition equally affects all populations and communities along the transportation routes.

4.10.3.9 Minimization measures The Army has been involved with the Waianae community for more than 20 years through an extensive community relations program. The Army has worked closely with the community to understand their concerns, issues, and complaints. PAO, Army officers, and representatives have been and continue to be involved with the community through a wide variety of programs, meetings, and events. This involvement keeps the public informed of Army and Makua programs, elicits their involvement and input, and serves as a vehicle for the resolution of community concerns and issues. (This topic is discussed in more detail Section 5, Public Involvement.) The Army has also involved the community in the development of cultural resource management programs as discussed in 4.11, Cultural Resources. The Army would continue community coordination, public involvement, and volunteer programs with the Waianae community through the community relations program. PAO will maintain lines of communication and develop a better understanding of community and rural values and qualities. The Army is committed to working with the community to continue the development and implementation of programs for the protection and preservation of cultural and natural resources in Makua. The Army acknowledges the community's desire for increased access to Makua Valley for native Hawaiian cultural practitioners.

In 1998, the Army began a program in cooperation with members of the Waianae community to open Ukanipo Heiau to native Hawaiian religious practitioners under the American Indian Religious Freedom Act of 1978. Meetings took place over a period of two and a half years, culminating in a PA signed in October 2000, giving access to Ukanipo Heiau to members of the native Hawaiian community. This access is independent of training activities in the valley. Access to other sites within the valley has been given on a case-by-case basis as is consistent with training and safety concerns.

4.10.4 Conclusion The Proposed Action would not result in any disproportionately high and adverse human health effects or environmental effects on minority and low income populations. There would be a minor negative impact on community values, rural values and qualities, stemming from noise, lack of unrestricted access to Makua, and occasional traffic. These impacts fall equally on all elements of the Waianae coast population.

4.11 CULTURAL RESOURCES

4.11.1 Affected environment Makua and Kahanahaiki Valleys are considered *wahipana* or sacred lands. The traditional and cultural use of Makua is extensive. Historic records, oral histories, and archaeological studies dating back to the 19th century document the extensive cultural heritage of the area, including both religious and domestic use of Makua by native peoples.

4.11.1.1 Traditional accounts and legend Makua is associated with a number of legends, and traditional Hawaiian deities, and has religious and social value to local inhabitants. The potential effects are complex. Cultural resources include archeological sites and historic resources, as well as community

values, religious practices, spiritual places, Hawaiian gathering rights and cultural uses of the natural environment. As such, a holistic view of the Makua cultural resources should be considered, since it relates directly to Kanaka Maoli (native) culture. The following paragraphs include transcriptions of two of traditional accounts and legends from two sources: “Archeological Investigations at Proposed MK-19 Range” (Biosystems Analysis Inc, 1995), and a draft of a “Planning Level Oral History Survey Makua and Kahanahaiki Valleys for Traditional Cultural Properties at the US Army Makua Military Reservation Waianae, Oahu Island, Hawaii,” (Prashad and Nunes, 2001).

“He Mo'olelo Ka'ao no Hi'iaka-i-ka-poli-o-Pele, a Legendary Tale of Hi'iaka who is Held in the Bosom of Pele” from “He Mo'olelo Ka'ao no Hi'iaka-i-ka-poli-o-Pele...” for Wai'anae, O'ahu, Ahupua'a of Makua-Kahanahaiki and Vicinity (Kumu Pono Associates, undated).

Archeological Investigations at Proposed MK-19 Range The following discussions of traditional accounts and legends and the history of Makua Valley are quoted directly from “Archaeological Investigations at Proposed MK-19 Range Makua Military Reservation” (Biosystems, 1995). This report is a compilation of historical documentation, oral histories and legendary accounts summarized primarily for Kelley and Quintal’s 1977 report, “Cultural History Report of Makua Military Reservation, Makua Valley, Oahu, Hawaii” (Kelley and Quintal, 1977).

The Naming of Makua

The word *makua* literally means “parent.” Handy *et al*, (1972) used the word *makua* in the context of kinship: “It was at such times that the *keiki* (the little ones), particularly those avid for knowledge of their elders’ ways, learned the most. They were instructed regularly in manners, in the more important of the *kapu*, and in practical manners by *makua* (parents) and *kupuna* (grandparents).” Malo (1951) provides the word *makua* in the following manner which suggest that the term may apply to “grown-ups” or affinal as well as consanguineal kin: “Then Umi privily asked his mother, ‘Have I not other father but this one? Is he my only makua?’.” “After that, on a certain occasion when Umi had consumed the food and his foster father (*makua kolea*) had given him a drubbing, Akahi-a-kuleana expostulated and said, ‘My husband, it is not your own son that you are all the time beating after this fashion’” (1951). And, “The term *makua* was applied to an uncle as well as to one’s own father. It was a common thing for children to roam from one *makua* to another for the most trivial reasons” (1951).

According to one source however, the word *makua* “cannot be better than liberally translated. The word means ‘full grown,’ but whether it was named for some mighty chief of a bygone day, or for the wide and deep valley behind it, none can say” (Honolulu *Star Bulletin*, April 4, 1925, cited in Sterling and Summers, 1978). Another interpretation is that Makua was the name of a fisherman who, with a chief named Kawela, fished off Kaena Point for the Travelling Uhu, a great fish of sacred power (Pukui and Curtis, 1951, Kelly and Quintal, 1977).

An Early Chief

According to Malo, a chief by the name of Hua-nui-i-ka-la-la'i-la'i ruled the area from Ohikilolo to Keawa'ula. Hua-nui-i-ka-la-la'i-la'i appears approximately 35 generations earlier than Kamehameha in the Ulu genealogy. According to Fornander's 30-year generation count, Hua-nui-i-ka-la-la'i-la'i would have ruled in the 8th century, and according to Stokes’ 20-generation count, he would have ruled in the mid 11th century (Malo, 1951; Kelly and Quintal, 1977).

Kaneana or Makua Cave

Kaneana Cave, often referred to as Makua cave, lies at the *makai* end of the large ridge that separates Makua Valley from Ohikilolo Valley. The original entrance to the cave, destroyed in 1950 by road construction, was much smaller and higher than it is today (Kelly and Quintal, 1977). Hawaiian informants advise, “Kaneana means cave of God...for *ana*, a cave, and Kane, supreme deity of the ancient Hawaiian pantheon” and according to an old Hawaiian who was born at Makua village, *kahuna* performed religious ceremonies in the cave as recently as 1875 (Honolulu *Star Bulletin*, April 4, 1925, cited in Sterling and Summers, 1978).

According to McAllister, “Kaneana was the dwelling place of a shark goddess who held sway from Ka’ena Point to Kepuhi Point.” When she would take the form of a woman she would enter the cave through a sea entrance. An inland entrance to the cave was also said to exist but neither a sea entrance nor an inland Sterling and Summers, 1978).

A story related by an informant regarding Kaneana Cave is summarized as follows: Once upon a time there was a shark god known as Kamohoalii, who was king of all sharks. Kamohoalii could change into a dignified and majestic man. He wooed a woman by the name of Kalei, who did not know he was actually the king of sharks, and married her. When it came time for the couple’s child to be born Kamohoalii warned Kalei to guard the child’s body from the sight of man, and never allow it to eat the flesh of any animal. Kamohoalii then disappeared. Kalei bore a man-child, and named it Nanaue. Kalei was very surprised to discover that the child had an opening in its back. She covered the opening with *kapa* and often wondered about it. One day Nanaue plunged into the water and opened the mouth on his back to catch any passing prey. Kalei kept this secret to herself. The boy eventually grew to manhood and began eating with the men in the mens’ house. Nanaue stayed to himself and his dual nature developed. When the people of his village were deep-sea bathing or fishing they would suddenly be visited by a shark that bit and tore at the limbs and dragged them down in the deep water. Then one day a man working beside Nanaue in a taro patch inadvertently tore the *kapa* from Nanaue’s back. A shout went up “See the shark mouth! A shark man!” Nanaue escaped to the sea and wandered from place to place and island to island. The *kahuna* were asked to help, but it was some time later that Nanaue was actually captured and killed. At one time he lived near Kaneana. He would drag his victims into the cave through a subterranean channel at high tide. He would place his victim on a certain slimy stone to await his leisure and appetite (Honolulu *Star Bulletin*, September 9, 1939, cited in Sterling and Summers, 1978).

The Mo'o of Makua Valley

The term of *mo'o* is translated as “lizard.” *Mo'o* were not, however, harmless little geckos, but were large creatures with long and terrifying bodies (Kamakau, 1964, Kelly and Quintal, 1977). Traditionally *mo'o* are associated with fish ponds, and are considered guardian spirits (Kelly and Quintal, 1977). The particular *mo'o* of Kalena stream and pond was said to have once been a beautiful girl who lived in the valley. Her parents changed her into a *mo'o* so she could not marry the shark man of Kaneana (Kelly and Quintal, 1977). The following story related by an informant pertains to the *Mo'o* M-kua, and is summarized as follows:

In heavy rains, the *mo'o* come down the stream from Ko'iahi to meet her boyfriend, the shark from Kaneana Cave. When the stream flows strong, it breaks through the sand beach and flows into the sea.

The *mo'o* goes into the sea and goes on the big rock next to the blow hole at the Wai'anae end of the beach. The rock is called Pohaku-ku-la'i-la'i. On this rock, she would turn herself into a beautiful princess and call to him. The shark would come out of Kaneana Cave through the undersea channel and swim out to the blowhole. He would then swim into the underwater entrance, and be tossed ashore through the blowhole. He would then turn into a man, and he and the princess would make love. When they were ready they would go to live in the stream. And when the water is green the *mo'o* is in the stream. When it is clear, she is not. No swimming is allowed when the *mo'o* is in the stream (Kelly and Quintal, 1977).

The 'Olohe or Ha'a People

The 'Olohe, or Ha'a people, were a class of individuals skilled in the art of wrestling and bone breaking (*lua*). It is said that they used to pull their hair out and smear their bodies with oil to provide no hold to an opponent. Legend represents them as professional robbers with possibly cannibalistic habits, who used to station themselves at a narrow pass along the highway and rob and kill travelers. Makua Valley is a traditional haunt of the 'Olohe or Ha'a. Similar 'olohe legends occur on Maui and Hawai'i (Beckwith, 1940).

Makua Mountain Trail

John Papa Ii relates the following concerning the Makua Mountain Trail: “There was a mountain trail from Makua to Kawaihapai (*ahupua'a* in Waialua) where it joined the trail from Ka'ena. It was said that this was the trail on which the red-eyed one became lost but it might have been another one. The saying was, ‘Red eyed person who strayed to Makua.’” A slightly different version, which was eliminated from the text, read: “A red eyed one went from Mokuieia intending to go to Makaha but he went up by Kawaihapai thinking that was the way to Makaha. He found that it was not his destination and hence the saying for this was, ‘Red eyed one goes by mistake to Makua.’” (John Papa Ii manuscript pp. 218-220, cited in Sterling and Summers, 1978).

Maile of Ko'iahi

“Maile laulii o Ko'iani” the small leaf maile of Ko'iahi was famous, as it was believed to have the finest leaf of any maile on O'ahu. It was said to have been destroyed by goats (Pukui, 1953, cited in Sterling and Summers, 1978).

Planning Level Oral History Survey The following is excerpted from the draft version of this study.

He Mo'olelo Kaa no Hiiaka-i-ka-poli-o-Pele: A Legendary Tale of Hi'iaka who is Held in the Bosom of Pele

One archival resource of particular interest to the study area, and not previously available to researchers, is a recently translated legendary source (ms. Maly 1995, 1997). It is a native Hawaiian version of the legend of Pele and Hi'iaka, which includes a great deal of information not mentioned in the Emerson version of the legend (1915). It will be seen that the texts offer rich descriptions of the communities, natural resources, beach, shoreline, and near shore fisheries of the Makua-Keawa'ula vicinity.

He Mo'olelo Kaa no Hiiaka-i-ka-poli Pele

The goddess Hi'iaka traveled from the island of Hawai'i to Kaua'i with her companions Wahine-'oma'o and Pa'u-o-Pala'a. The purpose of her journey was to fetch the chief Lohi'au-ipo (Lohi'au) from Ha'ena, Kaua'i. On the journey, Hi'iaka and her party visited numerous locations on the islands of Hawai'i, Maui, Moloka'i, and O'ahu. Having reached Kaua'i she found that Lohi'au had died, and following ceremonies, she revived him and began her journey to return with Lohi'au to Pele's domain at Kilauea, Hawai'i. The following narratives come from the section of the legend which describe the companions journey from Kaua'i to O'ahu:

The excerpts below, are from the epic account of the journey to Kaua'i, made by Hi'iaka-i-ka-poli-o-Pele (Hi'iaka), the youngest sister of the goddess Pele. Titled "*He Mo'olelo Kaa no Hiiaka-i-ka-poli-o-Pele*" (A Traditional Tale of Hi'iaka who is Held in the Bosom of Pele), this account was published in the Hawaiian newspaper, *Ka Hoku o Hawai'i* (September 18, 1924 to July 17, 1928); and was compiled by Julia Keonaona, Stephen Desha Sr., and various contributors. While this version of the legend has yet to be translated in its entirety, the following English translations (by Kepa Maly) provide a synopsis of the Hawaiian texts, with emphasis upon the main events of the narratives.

My fine readers of the wondrous tale, this account differs from some others which hold that Hi'iaka departed from the canoe at Ka'ena. But in this account she departed at the place described above, and then traveled overland to Wai'anae. It was while on her journey overland that she did a wondrous thing at the sheltered place near the sea, a little to the north side of Keawa'ula. Let us look at this event as we continue our journey in this story. At this shoreward place, mentioned above (Keawa'ula), is a place called Kilauea, and it was there that Hi'iaka caused the sweet water to appear, thus Keawa'ula had fresh water.

... Having departed from Kaua'i on their canoe, Hi'iaka chanted a greeting to her family at Kilauea, on Hawai'i. When her mele (chant) was finished, the canoe was near ka lae o Ka'ena (the point of Ka'ena). It was then, that Hi'iaka saw her elder relatives Ka-lae-o-Ka'ena and Pohaku-o-Kaua'i, and called out to them:

<i>Aloha 'olua e Kaena me Pohaku-o-Kaua'i</i>	Love to you Ka'ena and Pohaku-o-Kaua'i
<i>E noho mai la i ka /ae kahakai 'ai 'ole</i>	Who dwell at the point, of the foodless shore
<i>I ola no hoi i ka ehua ke kai-e</i>	You live by the mist of the sea
<i>E inu 'ana i kuu wai kumu 'o'e i ka pali e</i>	Drinking my water which has no source dripping from the cliffs
<i>Eia mai hoi wau a pae aku e</i>	I shall land here

Finishing her chant of affection for her elders, Hi'iaka then turned their canoe to the Waialua side of this famous point of Ka'ena. It was near the place called "Ka-leina-a-ka-'uhane" (The soul's leap). Hi'iaka leapt from the canoe, and then told Wahine'oma'o and her companions that they were to continue their journey by sea, while she would travel overland...

As she continued her overland journey, Hi'iaka met with her elders Ka-lae-o-Ka'ena and Pohaku-o-Kaua'i, and asked them where the canoe landing of this land was... [November 16, 1926] They told her that it was there below, where the canoe could be seen in the canoe shed... Hi'iaka bid here relatives *aloha* and then continued her journey overland, till she reached the place called "*Kipuka kai o Kilauea*." There she saw that there were men and women resting at the place, and some of the

people were adorned in garlands of *'ilima*. The activity of many of these people that had gathered there was *le/e kawa* (leaping and diving into the sea).

As Hi'iaka drew near to the diving spot of these people of Makua, they saw her beauty and their voices rose in speculation of where this beautiful stranger had come from. As Hi'iaka drew near to the diving place, called "*Ke-ki'o-kai-o-Kilauea*," the people became quiet, then some of them called out, inviting her to join them in the sport. Hi'iaka declined the kind invitation of the natives, and at that time, one of the beautiful young women of the place, adorned with a lei of *Ilima*, drew near to the leaping spot and leapt. When she fell into the water, she struck a large rock that appeared to push out into the sea. This stone was of a supernatural nature (*kupua*), and the girl was killed in the water.

Seeing the tragedy that had befallen the young native woman, a result of her careless leap, Hi'iaka leapt into the water to retrieve her body. Having gotten her, Hi'iaka swam to the shore at a place close to Makua. The people saw this tragic event and that the stranger had leapt into the body of the girl. The natives drew near to the place where Hi'iaka came on shore, and the girl's family lamented the loss of their cherished child. Hi'iaka instructed them not to cry, telling them that she would try to restore life to their daughter who had carelessly leapt upon the stones. Setting the girl down, Hi'iaka called out in a prayer to restore life to the dead girl:

<i>E ka pua o ka 'ilima e,</i>	Oh blossom of the <i>'ilima</i>
<i>Homai ana hoi he ola</i>	Let life descend
<i>E Makua i ka nua o ke kai-e</i>	Oh Makua of the ocean swells
<i>Ha'awi mai ana hoi ua ola-e</i>	Grant life
<i>E ola kuu kama i ka hua o ke kai-e A o/a hoi ia</i>	That my child of the frothy sea may live
<i>Kane i ka wai o/a-e</i>	That life may be gained by the living waters of Kane

Completing the prayer, Hi'iaka stood up and held her supernatural *pau* (outer skirt) in her hand and struck the girl on her right side and left side with the *pa'u*. Hi'iaka then kneeled down and breathed into the girl's mouth, and she was revived. Some parts of the girl's body were bruised from the fall upon the rock, and Hi'iaka called to the girl's family instructing them in how to care for her wounds. Hi'iaka told them:

There are many leaves in the forest, in the uplands of the mountain, these you must get to apply to the girls wounds. This must be done quickly to lengthen her life. And here is my task, to get the body of the stone which rises out at the place where you leap.

Hearing these words, some of the people were troubled, and asked how Hi'iaka could remove that large stone which rises out of the depths of the sea. Hi'iaka told the multitudes of Makua, "Do not worry about how I will remove the stone, it is for me to do. This stone which brings death will be destroyed. Now, here is what you should do, take the girl to the house, and I will go to destroy this impertinent stone which rises out of the water to your leaping place..." The name of the stone was *Pohakuloa*, and he was a supernatural being who dwelt in the waters of Makua. He was a stone which destroyed canoes and killed people, and at times, he himself also took human form. It was because the young girl had refused his advances, that he caused her death at the leaping place...

This place is *ka ponaha wai o Kilauea* (the swirling water of Kilauea). It is one of three places called Kilauea. The second one is Kilauea on Kaua'i, and the third one is Kilauea on the island of Hawai'i—Hawai'i of the green ridges, in the bosom of Kane. This thing

which causes tragedy here among the stones, actually has the body of a man, and his true name is Pohakuloa. I am going to leap in and fight him so that he will end his treachery at this place. That is, the destroying of canoes, and killing of people. When you look and see the ocean rise in a spout and fall upon Kulaokala (Kuaokala), then you will know that I have killed the human form of Pohakuloa.

Finishing these words, Hi'iaka then leapt into the sea of Kilauea, where the water swirls. The ocean then rose up, as never before, rising upon the shore, with waves breaking upon the land, and the coral washing up with the waves onto the land. On the promontories the roar could be heard, and the people had never before seen such violent seas. When Hi'iaka fell into the swirling sea at Kilauea, she was lost from sight. [November 23, 1926]

The people of Makua thought that this stranger, the woman, had died in the violent sea. They did not know that she was the supernatural being of Kilauea, the youngest sibling of the great goddess and ruler of Kilauea. They felt much compassion for this woman who had been lost to them. While they were their discussing this among themselves, the people saw the water spout rise out of the sea and go directly above Kulaokala. They saw this and then understood that the woman had not died, but the things that she had spoken of prior to diving into the swirling sea of Kilauea had come to pass.

Then, a strong earthquake shook the entire island of O'ahu, and the people of Makua heard a great roar from something nearby their place. Looking to the swirling water of Kilauea, they saw a great black mass rise out of the swirling water of Kilauea, and the people of Makua cried out at the wondrous sight. This great black thing seemed to fly in the direction of the point of Ka'ena.

Now what had happened was that when Hi'iaka leapt into *ponaha kai o Kilauea* (the swirling water of Kilauea), she met with the shark body (*kino mano*) of Pohakuloa. This Pohakuloa was one of the evil dual formed deity of the ocean of Wai'anae. A great battle raged between Hi'iaka and the shark form of Pohakuloa. The two moved out into the depths of the dark sea and Hi'iaka was victorious over the shark form of Pohakuloa. Hi'iaka then returned to *ponaha kai o Kilauea*, where she thrust her had down into the core of that supernatural stone and tossed it into the sky. That is how the earthquake came to shake the whole island of O'ahu. Being thrown from the sea, the stone flew and fell upon the land. Hi'iaka then returned to the shore at *ponaha kai o Kilauea* and stood near the people of Makua. Everyone was filled with awe at what this woman, the stranger had done.

The stone fell on the side of the point of Ka'ena, near to Waialua. To this day, the people of Waialua and Wai'anae still call the stone "Pohakuloa." The people who ride the train can see the long stone among the multitude of stones near the point of Ka'ena... At the time when the ocean became very rough, Wahine'oma'o and Lohi'au landed at the shore of Keawa'ula, and that is how they were saved from the rough seas. Hi'iaka went to meet her companions and then she spoke to the natives of the area, telling them to:

... take the girl who had lost her life and been revived, to bath in the ocean five time-that is kua lima [doing something in fives, symbolic of a full hand, a complete task]. Then, you are to bath her five times in fresh water. In completing the bathing ceremony, take a crab, the 'ohiki-makaloa, and bury it at the foundation of the door to the house in which the girls lives.

Having finished her instructions to the natives of Keawa'ula, one of them spoke out and said:

Ohh! The great trouble of this place, is that there is no water. We have only brackish water which we drink. This is a 'aina wai 'ole (waterless land) in which we live, and it has been this way since the time of our ancestors.

Hearing these words of the native, that there was no fresh water on their land, Hi'iaka spoke to them:

This is a waterless land. When one travels from Waimanalo to Waialua, there is water at Waimanalo, water at Wai'anae, and water at Waialua. Waialua, that is that land of Waia, the child of Haloa and Hinamaouluae. The water of this place is there below the surface of the sandstone flats (papa one). Follow me, and I will show you a place where you can find water for yourselves, a water source that is unknown to you.

Hi'iaka lead the natives of Keawa'ula to the place that she had pointed out, it was on the side of the cliff at Keawa'ula. Upon reaching the place, Hi'iaka told them, "Break open this sandstone and dig a little below it, then you will find sweet water. But indeed, so you will not be burdened in digging, I will dig to the water for you." Hi'iaka then pulled up her supernatural pau (outer skirt), and drew it above her right shoulder, she then struck the base of the sandstone flats, and everyone heard the rumbling as a deep pit opened in the place where Hi'iaka struck. All of the people of that place, spoke in hushed tones among themselves at the astonishing thing done by Hi'iaka. Hi'iaka then told the people:

Here is the mouth of your hue wai (water gourd). You can hear the murmuring of the water below. This water flows below the surface of the land and reaches out to the depths of the sea at Ka'ie'iewaho. This stream branch, and the stream branches of the four mountains of Ka'ena, join together at this spot. Now, I will continue my travels, but don't forget what I told you concerning the girl. Fulfill my instructions for her bathing in the sea five times, and then in the cold fresh water five times.

Finishing these words, Hi'iaka then bid *aloha* to these people and went to join her companions. [November 30, 1926]

She told them, "It is good for you to go by sea, and I by the inland route, to the place where we will meet again." Now, the natives of this place, Keawa'ula, had followed, and met with Hi'iaka at the canoe of Lohi'au. These people told Lohi'au, "Get on your canoe, and we will carry you into the ocean." Wahine'oma'o agreed to these pleasant words of the natives of this place, and the people took up the canoe, carried it, and floated it in the ocean.

When the canoe was in the water, Wahine'oma'o took up her paddle at the stern of the canoe and Pa'u-o-Pala'a took up her paddle at the bow and they set off to continue their journey... Hi'iaka then continued her journey over land, and came to the "*one 'opiopio o Makua*" (clean white sands of Makua). Hi'iaka then saw the people of this place, and they were adorned with the *maile lau li'i o Koiahi* (small leafed maile of Ko'iahi). They were indeed beautiful to behold along the shore, adorned in the famous *maile* of this mountain. Drawing nearer, Hi'iaka also saw her relatives in the uplands, Mailelauli'i and Ko'iahi, and her love for them overflowed. Hi'iaka called out in a chant to them:

<i>Aloha wale hoiolua e na wahine-e</i>	Love to you two women
<i>E na wahine noho kuahiwi, noho</i>	The women who dwell on the mountain
<i>kualono—e</i>	slopes and ridges
<i>E Mailelauli'i me Ko'iahi ho'i—e</i>	Oh Mailelauli'i and Ko'iahi
<i>I ke kilikili hau o Ka'ala e</i>	In the fine dew of Ka'ala
<i>'A'ala mai ana ka maile lau li'i</i>	With the fragrance of the small leafed <i>maile</i>
<i>Ho'olalawe i ke kino o ke aloha</i>	Bearing affection to one's body
<i>Aloha 'olua e noho mai la i ke anu,</i>	Greetings to you two who dwell in the coolness
<i>Eia no ho'i wau la ke ho'i nie—a</i>	Here I have returned
<i>Aloha 'olu-a, a aloha mai hoi a</i>	Love to you, greetings of affection

Then continuing her on her way, she went to the place where the people had gathered on the shore of Makua, and she greeted them, “Affection to you who dwell here upon the clean white sands of this land (*ke one bpiopio o keia 'aina*) - Aloha!”

The people then asked Hi'iaka, “You are a stranger, that has come to visit us here at Makua?” Hi'iaka confirmed this, saying, “Yes, I am a visitor from Hawai'i, having gone to Kaua'i, and now I have arrived here...I travel across the land, while my companions travel by the sea...” The people then inquired “What land do you come from?” Hi'iaka answered, “My land is there in the east, in the fragrant *hala* (pandanus groves) of Kea'au. It is like the place that you call Kea'au. My land is at Puna with it's walls of *hala*...”

The people the asked Hi'iaka to call her companions to land on the shore and partake in a meal before continuing on the long journey. It was agreed, and before long, Wahine'oma'o drew the canoe near to the shore and the people of Makua helped to carry the canoe inland. Looking upon the visitors, the natives of Makua recognized the beauty of their guests, and the most beautiful among them was the one whom they had first met, Hi'iaka... The people of Makua were skilled and quickly had a pig ready for the *imu*, along with chickens, broiled fish, and mixed bowls of *poi 'uwala* (sweet potato poi). Others of the men and women went diving for *wana* (urchins), while others went to gather *'opihi* (limpets), and *'ina and haukeuke* (other varieties of urchins). The *'inamona* (*kukui* nut relish) was set out in a bowl, and the people of Makua had their welcoming feast prepared...

Calling to the *Ali'i wahine* [Chiefess] and people of this land, Hi'iaka said that she would first offer a prayer of thanksgiving for the foods that had been set before them. Hi'iaka chanted:

*O Makua 'aina o Maile-lauli'i,
'Aina aloha o Koiahi i ka uka
Ma uka hoi kau hele ana mai
I ka nopu huffli a ka la
La o lalo o Wai'anae e
O ku'u nae aloha i ke oho o ke kupukupu,*

*O kupu o laua ka manao e ai,
E 'ai i ka 'ai a ke aloha
Ua 'ai iho /a wau e ke hoa e
I ko ai /eo ble, he hookahi no leo
He mai, he ma-i hoi e.
E kamau a hele ae ke kamahele,
Ua 'ike iho la no hoi i ke one 'opiopio.*

O Makua, land of Maile-lauli'i
Land loved by Ko'iahi in the uplands
My journey takes me over land
In the dazzling heat of the sun
Sun which descends below Wai'anae
The fragrant sprouts of the *kupukupu*
fern are loved by me
The thought of them two is to eat
Partake in the food made with love
I have eaten my companions
Of the food without a voice, there is only one voice
Come, come partake
That the journey of the companions may be continued
So seen are the fine clean sands [of Makua].

Finishing her prayer, Hi'iaka invited Lohi'au to eat to his contentment. She called to him to eat of the generosity of the *Ali'i wahine* (chiefess) of Makua, 'Ohikilolo, and Kea'au. Lohi'au then partook of the feast... [December 7, 1926]

... The Chiefess inquired, and learned that her beautiful visitor was Hi'iaka-i-ka-poli-o-Pele, the woman with the lightning skirt of Halema'uma'u. The Chiefess herself was very beautiful, and Hi'iaka compared her beauty to the fine clean sands of Makua (*ka ui o ke one 'opiopio o Makua*). Hi'iaka called out in chant to the Chiefess:

*Onaona wale ka maile lauli'i o Koiahi
He ahi ke aloha, he 'apa ka paku kino...*

The maile-lauli'i of Ko'iahi is very fragrant
Love is like a fire, rolling over the body...

As Hi'iaka chanted, the sweet fragrance of the *maile* and *hala* surrounded the people who had gathered for the feast at Makua. The fragrance of the *maile* came from the uplands of Ko'iahi, and the sweet essence of the *hala* came from the land of Kea'au, which is there on the south side of Makua, next to 'Ohikilolo... Everyone partook in the feast that had been prepared by the natives of the land. And as they ate the *poi 'uwala* (sweet potato poi), the pieces of pig, the *wana* (urchins), the *'ina* (small urchins) in their gravy, poke *uhu momona* (raw fish made of the rich parrot fish), and various foods that had been prepared, three beautiful women arrived at the gathering.

One woman was completely covered with garlands of *maile lauli'i*. Another woman was adorned in garlands of *leh ua*, *lehua* of every color. And the other woman was adorned in garlands of *hala* and *hinano*. These women with all of their adornments were truly beautiful, but the beauty of Hi'iaka surpassed them. Hi'iaka knew that these women were her relatives, who dwelled in the uplands. These women had heard Hi'iaka's chant, and had descended from the uplands to greet her. Hi'iaka called out to her relatives in chant:

*O 'oukou 'ia e na wahine kupaoa i ke 'ala
Onaona hala o Kea'au me Maile laulii
Ku'u lehua nenehiwa pua ho'ohihi a ka manu*

He manu ke aloha, able lala kau 'ole

*Eia wau la o Hi'i
Hi'i pu no me ke aloha o ka ipo*

O kuu ipo, nau anei?

So it is you, the women surrounded in fragrance
The fragrant hala of Kea'au and small leaved *maile*
And my cherished lehua blossoms
 admired by the birds
The birds are beloved, and there is no branch
 that they don't land on
Here I am, it is Hi'i
Hi'i together with the loved one,
 the sweet heart [Pele's lover Lohi'au]
My sweet heart, is he for me?

The three women then entered the area of the feast. They were Mailelauli'i, Ko'iahi, and Hala-i-ka-ipo of Kea'au, Wai'anae. They greeted one another with kisses. Hi'iaka then spoke the following words to Hala-i-ka-ipo-

Hala mai la no 'oe ma keia 'aoao o kahi puu one o 'oukou ae nei, o ka 'anapa mai la no ia o ka wai li'uula i ke kula o 'Ohikilolo, a kau mai la hoi ke one o Makua nei i ka 'olapalapa? (Did you perhaps pass by the side of the sand dunes, that glisten like the mirage forming waters on the plane of 'Ohikilolo, and walk on the rumbling sands of Makua?)

When Hi'iaka said these words to one of her relatives, the Chiefess of Makua then spoke to Hi'iaka...
[December 14, 1926]

Hear me oh kind stranger, this is the place of my birth, where my food has been cooked, and I, along with the natives of Makua have never seen the resonating sands of Makua; sands like those of Nohili, Kaua'i. If we go, and *see* it as you have said, it will truly be a great mystery, for we the multitudes of this land, have never before seen the sands that you describe...

After completing the feast, Hi'iaka took the Chiefess of Makua along with her people, to see the *one kani* (resonating {barking} sands) of Makua. When they arrived at the *puuone* (dunes), Hi'iaka climbed to the top of the dune. As Hi'iaka climbed up the dune, everyone was startled because of the ringing and sounds like purring, that rose from each place where Hi'iaka stepped. It was like the growling of a dog. Then, from atop the dune, Hi'iaka called to the Chiefess of Makua, inviting her to climb up to where she was standing. As she ascended the dune, everyone heard the same sounds as when Hi'iaka had ascended the dune. Seeing this mysterious characteristic of the sands of their land, the natives of Makua began to follow their Chiefess up the dune. From the very top of the dune, Hi'iaka said to the Chiefess:

Say, oh Chiefess of Makua, if you will lay down with your head above and your feet below, I will call the chief (Lohi'au) to come and pull you by your feet, then you will hear a different sound. This sound can be discerned as being different from the one heard when we climbed up the dune.

Hearing this, the chiefess of Makua laid down, with thoughts of pleasure, at being pulled by the ali'i of Kaua'i. Hi'iaka then called to Lohi'au, to get the Chiefess of Makua and to pull her by her feet:

Oh Lohi'au-ipo, from the hala groves of Naue by the sea! Take the chiefess by her feet and pull her down. You will hear again, the resonating of the sands of Makua (*ke kani o ke one o Makua*), and indeed, you will think that it is the sound of the sands at the land of your birth ... With pleasure and desire for the Chiefess of the fine clean sands of Makua, Lohi'au pulled the Chiefess down the *puuone* (dune). A ghostly sound, like that heard in the night (*hanehane o ka po*) rose up when the chiefess was pulled down the dune.

Now Maile-lau-li'i, Ko'iahi, and Hala-i-ka-ipo, adorned in their finery saw this, and in them arose the desire to also be touched by the handsome chief of Kaua'i. So they ascended the resonating dune of Makua (*pu'uone kani o Makua*) and laid down, asking Hi'iaka to call Lohi'au to pull them as well... Hi'iaka cautioned her relatives not to become enamored with Lohi'au, for he was chosen for Pele, and no others could enjoy his affections...Lohi'au first took Maile-lau-li'i and as she was pulled down, her garlands of *mai/e* were ruffled. He then took Ko'iahi, followed by Hala-i-ka-ipo who was adorned in garlands of *ha/a* and *hinano*. As each of the chiefesses were pulled down the dune, the soft crying of the dune (*ka 'uwe hone o ke pu'eone*) was heard by all.

Hi'iaka then descended the *pu'uone*, joining the women and said to them:

You have truly been blessed by the handsome child of Kaua'i, but I say **to** you that it is well to remember the words spoken by our ancestors, "*He 'iimi loa'a a na ha'i na'e e inu ka wal.*" (Searched for, it is found, but indeed, the water will be tasted by another).

Hi'iaka then asked the Chiefess of Makua if she had been mistaken about the resonating sands of the land of her birth. She responded that yes she had been wrong in denying the presence of resonating sands of Makua. But from her youth, she had played at the dune, and leapt down its slopes, and never heard the mysterious sounds...[December 21 I 1926]

Most of the group then returned to the Chiefess' compound, though some of the people of Makua remained at the dune playing in the sands, with fond thoughts of this wondrous place... The Chiefess of Makua invited Hi'iaka to spend the night at Makua so that they could rest prior to continuing their journey. This was agreed to, and while they were talking, everyone was startled at hearing the sounds of wailing coming from along the *ala loa* (trail), from the Wai'anae side. This voice filled with pain, was the cry of a man. His hands were clasped behind him and he was crying out. Hi'iaka asked the people to bring the man to the house, so that they could inquire if they could be of help.

Brought to the house, Hi'iaka asked, "Has someone died?" The man wiped his face, looked at Hi'iaka, and with a trembling voice he said:

Yes, it is I who will die. I have been on a journey seeking knowledge. I have traveled around O'ahu, and not found that thing which I seek. I then thought that perhaps I would find life at the hill of Ha'upu, Kaua'i. Yet traveling around Kaua'i, I did not find that which I seek. I have also been to Maui, Lana'i, and Moloka'i, and not been able to find that which I seek.

Hearing this, Hi'iaka asked, "Is it a riddle that someone has spoken to you that you seek the answer to?" Surprised, the man confirmed this and told Hi'iaka that she was the first one to discern the trouble that had befallen him. "So here perhaps is the place where I can be rid of this trouble, and I will escape the death that awaits me..." [December 28, 1926]

... Hi'iaka then asked the man to tell them the riddle that he had been given. The man said, "Let me tell you a little story and then I will tell you the riddle."

Hi'iaka said, "Before starting your story, let me tell you, 'You are perhaps Kaulana-a-ka-la, a chief of Moloka'i.'" Astonished, the man confirmed this, and asked, "Are you a native of Moloka'i, that you should know my name?" Hi'iaka simply told him that she had traveled through out the islands. She then told Kaulana-a-ka-la:

It was at Waipi'o, Hawai'i, that you received this riddle. And, if you can answer it, you will be awarded one half of Waipio, but, if you are unable to find the answer, you will be killed. Is that not so?

The *Ali'i* of Moloka'i confirmed this, and he was filled with awe at the wisdom of Hi'iaka. Hi'iaka then continued:

You have journeyed around Hawai'i, and yet found no one who could explain the riddle to you. You have traveled around Maui, Kanaloa Kaho'olawe and found no one who could answer it. Now arriving at O'ahu, at the point of Koko, you have traveled and met with us here.

The man confirmed that all of this was true. Hi'iaka then asked Kaulana-a-ka-la to tell them the riddle. Standing up the *Alipi* of Moloka'i began to chant, offering a prayer first. He then spoke the riddle. Hi'iaka then said that she would inquire of the natives of this land, if they could answer the riddle, and found that none could. Hi'iaka then asked the Chiefess of Makua, "Is there not a fishpond at the side of the cliff of Ka'ena, and its name is Manini?" The chiefess answered:

Yes there is a fishpond on the cliff side of Ka'ena, and it is named as you said. In that pond, I have seen all manner of fish, and there is one large fish, Moanawaike'o'o (That is the *moanakai* as it is known from here to Kahuku).

The editor then notes that the paper with the next part of the story has been lost. And he observes that there is perhaps someone still living today, who remembers the riddle, and they might share it with us at *Ka Hoku o Hawaii*... [January 4, 1927 - a reader replied to the request on Jan. 18, 1927]

The account continues in describing a game of *kilu* that was played between the Chiefess of Makua and Lohi'au. In a conversation during the contest, the Chiefess mentioned a place called Pu'uohulu. Hi'iaka asked:

Kilu is a game in which a small coconut or gourd cup (quoit), is tossed at an item in front of an opponent, if the quoit hits the item, the one who tossed the *kilu* wins a kiss from the other contestant.

"Where is this place called Pu'uohulu, is it in Wai'anae." The Chiefess of Makua responded that it was indeed in Wai'anae, a place with which all of the people were familiar... Hi'iaka then chanted:

<i>Lle ka huna kai</i>	The ocean mist flies
<i>Pii a'e la i ka makalae</i>	Rising upon the coastal point
<i>Aloha wale ka lae o Ka'ena i ka e ehū kai</i>	The point of Ka'ena greets the sea
<i>Kai o lalo o Wai'anae</i>	The sea of Wai'anae is there below
<i>Ke he'e nei i ka pu'eone</i>	Sliding across the dunes
<i>'Oia one aloha o Makua e</i>	It is the beloved sands of Makua
<i>Mai ho'omakua ke aloha o hewe au—e</i>	Don't let this affection (for Lohi'au) mature lest you be found at fault
<i>O kou inoa ia la e Pu'u-o-hulu</i>	Your name is Pu'u-o-hulu
<i>Ua 'i-ke-a ho'i e...</i>	So now it is revealed...(January 11, 1927)

Hi'iaka's chant brought great pleasure to the people at Makua, and the game continued for some time... The next day preparations were made, and Wahine'oma'o Pa'u-o-Pala'a, and Lohi'au boarded the canoe to depart from Makua and continue their journey through Wai'anae. With one dip of Pa'u-o-Pala'a's paddle the canoe was out in the deep sea beyond the clean sands of Makua.

Hi'iaka then turned and looked to the uplands of Wai'anae and turning around, she saw two of their cherished elders, Kua and 'Aleikapoki'i. These were shark-formed elders (*kupuna mano*) of her family. These elders saw Hi'iaka, and Kua said to 'Aleikapoki'i. "Behold, here is our descendant (grandchild), Hi'iaka-i-ka-poli-o-Pele." The other shark agreed with the words spoken by its companion. The two continued to speak among themselves, and they feared that perhaps Hi'iaka would be angry with them [Earlier in the account, these two sharks had tried to stop Hi'iaka from going to get Lohi'au at Kaua'i because they did not believe that a human was a good companion for Pele.]. The two sharks were afraid that Hi'iaka might try to kill them, and that they would have no way to escape from her great power. Kua told his companion, "We will not die if we go and hide." The two sharks at first thought that they might go hide in their caves, but then they knew that they could be found, so they then thought that perhaps they should go and hide upon the land (*pae i kula o ka 'aina*). So the two sharks agreed and went inland, where one lies on one side and the other lies near by [to this day]. Hi'iaka saw her shark elders swim away and hide, she called affectionately to them in a chant:

<i>A makani Kaiaulu o lalo o Wai'anae</i>	The kaiaulu breeze blows to the lowlands of Wai'anae
<i>Ke wehe aku la i ka poli o ka hoa</i>	Making known what is in the heart of the companions
<i>Ha'i ka nalu o Kua me 'Aleikapokii</i>	The waves are broken by Kua and 'Aleikapoki'i
<i>hiki i moe aku i uka ka Iuhi o ke kai...</i>	So that they may rest in the uplands away from the burden of the sea...

Hi'iaka's chant was carried to the shore and heard by Poka'i, who saw that Hi'iaka was drawing near. Poka'i bent her head down and thought that perhaps Hi'iaka would kill her. The canoe with Hi'iaka's companions then landed on the sandy shore of Wai'anae, at the landing place called Ke'a'ali'i. Joining them, Hi'iaka looked all about this famous land of the wind *lau-niu*. Hi'iaka's tears then fell from her eyes down her cheeks, and Wahine'oma'o inquired why Hi'iaka was crying (*Ea! He mau waimaka aha hoi keia e helele'i wale mai no i ka lihilihi o ka lehua makanoe-Why are the tears falling from the fringes of the dewy centered lehua blossoms?*). Hi'iaka responded to her companion, you have asked a good question, and the reason is that this is the land of the *kaiaulu* breezes which cause the coconut leaves to sway back and forth, and it is greatly loved. Here before me, I have had a

vision, the there will be great treachery here, and the saying of the children shall be fulfilled. The saying is this, “*No ke kai ka hale, e noho ia e ka puna, no ka puna ka hale e noho ia ana e ke kai a mohala ka lau ke naenae*” (The house is on the shore, situated there on the coral, the house is on the coral rocks there on the shore and the leaves of the *naenae* bloom forth). This is the reason that my tears are shed, my companion.

Hi'iaka stopped speaking for a moment, then resumed her explanation of the prophesy, “*Ke ku ka makaia a ke Ali'i o Oahu nei i keia wahi maluna o ke kanaka o ke akua, alafla, No keia 'aina o Oahu nei i Aina one 'ai ali'i*” (The chief of O'ahu will bring forth treachery upon a man of the gods here, thus this land of O'ahu will become a land in which the sands consume the chiefs)... [January 18, 1927]

Now some people say that this name Poka'i is a recent name, given from the time when Mo'ikeha traveled from Tahiki, when he left his relative Olopana; but it is not so, because it is from the time when Pele came to these islands. Hi'iaka then went a short distance inland, and the *kupua* (supernatural being) Poka'i of Wai'anae came face to face with her and they met with *aloha* (affection). Poka'i instructed her people to go to the uplands to gather *luau* (taro greens) and *kalo* (taro) from the taro lands of Lehano in the uplands of Wai'anae. She also commanded that some of her people bake a pig and prepare food for the chief of Kaua'i and Wahine'oma'o. The sweet, tender *lu'au* of upper Wai'anae was gathered and cooked in the *imu* along with all the other foods. The baked pig, *poi 'uwouwo* (thick poi) of Wai'anae, were among the foods eaten by the Lohi'au and his companions.

Poka'i then said to Hi'iaka, “My lord, I have no other gift to give you.” Hi'iaka responded, telling her that her hospitality had been more than adequate, for great indeed is the food which you have prepared for us to satisfy our hunger. And this is what I give to you o Poka'i, “Your dwelling upon the land shall be relieved by the gentle *kaiulu* breezes. Your name shall be spoken by the generations which are yet to come. And I also tell you that Wai'anae shall become the corner post (*pou kihī*) for this land of O'ahu which consumes its chiefs (*Aina 'ai ali'i o Oahu nei*).”

There will be a day when one who betrays the gods shall stand here [this is a reference to the chief Kahahana who in betrayal ordered the death of his priest and bard, Ka'opulupulu, at Nanakuli (see Kamakau 1961:134).] ... Hi'iaka and her companions then prepared to depart from Poka'i. She told Lohi'au and Wahine'oma'o, that they would travel by canoe, while she would travel for a while over land, and that they would meet again at Kou [Honolulu]....Hi'iaka then continued her journey along the upland trail. Now the trail upon which Hi'iaka chose to travel, is the trail which passes above Pohakea. Hi'iaka passed along the *kula* (plain) of Ma'ili, and then turned to look at the uplands. She saw the dazzling light of the sun on the uplands of Lualualei and Hi'iaka chanted:

Wela ka la e! Wela ka la e!
Ua wela i ka la ke kula o Lualualei
Ua nau ia e ka la a 'okaoka...

The sun is hot! The sun is hot!
The heat of the sun is on the plain of Lualualei
The sun chews it up entirely.

Hi'iaka then continued her ascent on the trail in the stifling heat of the sun and she chanted:

<i>A Waikonene i ke alanui</i>	The path is at Waikonene
<i>Ka piina i Kamo'a'ula</i>	Ascending at Kamo'a'ula
<i>Ka la wela i ka umauma</i>	The heat of the sun is upon the breast
<i>Waha ka 'Ilio i ke kua o Puhamalo'o</i>	'Ilio is born upon the back of Puhamalo'o
<i>Ke hoohaehae mai la i ka naulu</i>	<i>The naulu</i> winds rage
<i>Moku kahawai, miha ka poli o Puhawaj</i>	Breaking the stream, but the breast of Puhawai is quiet
<i>Ua hakaka, kipikipi ke kaiaulu</i>	The <i>kaiaulu</i> breeze seems to fight and
<i>me ke kanaka</i>	rebel against the people
<i>Ua kuikui wale a haena na ihu</i>	Striking and causing the noses to rage
<i>Ua ka wale i ka hupe</i>	The mucus flows freely
<i>Ka la wela o Lualualei e</i>	In the hot sun of Lualualei.

Hi'iaka then continued her journey onto the plains of Lualualei
[January 25, 1927]

(Prashad, U and Nunes, K, 2001)

4.11.1.2 History

Early Post-European Period Levi Chamberlain made the following observation: “Makua is situated on a sand beach and opens to the sea between two bold head lands S.E. and N.W. . . .there are no trees in this place, a few clusters of sugar cane are seen here and there, and potatoes are cultivated but not taro” (Levi Chamberlain Journals, 1822-1849, cited in Sterling and Summers, 1984). Based on a sketch by missionary Hiram Bingham, it appears that there was a “village” near the coast at the mouth of Makua Valley ca. 1822-1830.

There existed a great demand for sandalwood during the period from 1815 to 1826, largely exhausted by 1831 (St. John, 1947; Meyen, 1981). The forests of the Waianae range were harvested of sandalwood and it seems likely that the mountains of Makua were exploited as well (Chamberlain, 1956; Judd, 1932; Kamakau, 1962).

Ranching Period, 1848-1941 The Great Mahele (land division) of 1848 replaced the existing Hawaiian land use practice with a system of private ownership. At this time 202 acres of *kuleana* (small private parcels) lands were awarded in the Makua Valley area as follows: 111 acres awarded to ten claimants in Makua Valley; 70 acres awarded to nine claimants in Kahanahaiki Valley; and 21 acres awarded to two claimants in Keawa'ula Valley (Kelly and Quintal, 1977). The remaining land in the area became property of the Hawaiian government, and would later be leased in large pieces and sold in small parcels as a source of income (Kelly and Quintal, 1977). The first lease of Makua Valley for ranching activities was issued to Joseph and John Booth in 1864, and was to run for 25 years. The lease included Makua, Kahanahaiki and the government portion of Keawa'ula. In 1873 the lease was transferred to Samuel Andrews and extended for another 21 years, terminating in 1910. That year Makua, Kahanahaiki, and the government half of Keawa'ula was leased to L L McCandless, with the lease being up for renewal

in 1920. These properties again became available for lease in 1925, when Big Island rancher James Frank Woods obtained a 21-year lease. This lease covered the Kuaokakala, Makua, Kahanahaiki, and the entirety of Keawa'ula. McCandless had purchased Ohikilolo in 1899 (Kelly and Quintal, 1977). In 1929 Woods assigned the leases to McCandless, and the McCandless estate maintained control of the leases until the Army took over the area in 1941 (Kelly and Quintal, 1977).

Loss of Kuleana lands The acquisition of *kuleana* lands in the vicinity of ranches benefited the lease owner by increasing the extent of ranch land on which no rent was due, and by allowing increased herd sizes, thus maximizing the ranchers' profit (Kelly and Quintal, 1977). Historically, cattle grazing in *kuleana* gardens were instrumental in the alienation of native Hawaiian lands, used as a technique to acquire private lands by adverse possession (Kelly and Quintal, 1977). Makua Valley was apparently no exception in regards to this practice. According to Kelly and Quintal, "One informant said that when she lived with her family in the valley, surrounded by lands leased to the ranch, they kept dogs trained to chase the cattle out of their gardens. They eventually gave up that piece of land to the ranch owner and moved down nearer to the beach." Apparently, after that all houses in Makua were located in the lower valley and in the coastal area (Kelly and Quintal, 1977). By the 1940s, the McCandless estate had acquired 24 out of 28 non-government parcels of land, two were owned by the Makua Protestant Church and The O'ahu Railroad and Land Company, and two parcels remained in possession of Hawaiians, George Pu'u and John Naiwi (Kelly and Quintal, 1977).

Cultivation The most remembered crop in Makua Valley was sweet potato. Post European crops reportedly grown in the valley include watermelon, pumpkin, cucumber, tobacco, and cotton (Kelly and Quintal, 1977). At one time, the *Territory* suggested that there were at least 550 acres of agricultural land in Makua, but in a letter from McCandless to Charles T Bailey, Commissioner of Public Lands, McCandless doubted the presence of 500 acres of agricultural land, and stated that the number of acres farmed at any one time in lower Makua Valley since 1900 was probably 100 acres or less.

Railroad Ben Dillingham started construction of a railroad along leeward portion of the Oahu coast in 1888. It was several years before track was extended into the Waianae District, past Makua Valley and around Kaena Point to Kahuku (Kelly and Quintal, 1977). "The existence of railroad transportation at the early date allowed east movement of cattle and hogs from Makua Ranch to slaughterhouses located in urban centers, as well as transportation for vegetable produce to urban markets. The railroad provided transportation to and from Makua Church at *ho'ike* times for families as far away as Kahana Bay" (Kelly and Quintal, 1977).

Makua Protestant Church Levi Chamberlain notes the existence of mission schools at Makua and Keawa'ula in 1826 and 1828 reports (Chamberlain 1956, cited in Kelly and Quintal,). No mention of Makua parishioners, however, was made until 1860. The first Makua Church was reportedly built of stone by Samuel Andrews (Kelly and Quintal, 1977). The next church was built of wood, was then moved to Pearl City, and later to Kuhio School in Mo'ili'ili. After this church was moved, another was built, and this was the church that was later bombed by the military. Makua Church was one of the Hawaiian Protestant Congregational Churches, but remained independent of the United Church Council. Its official name was Makua Church, but its members referred to it as Ko'iahi Church (Kelly and Quintal, 1977).

4.11.1.3 Archeological sites Previous archaeological research in the vicinity of Makua and within the current project area has been detailed in Eble *et al.* (1993) and Anderson (1996), and is briefly summarized here. The military use of the area as a training facility site has resulted in limited access to Makua since the 1940s. Although several access roads, firebreak clearings, target constructions and gun emplacements have been established in the valley during the period of military use, the investigations conducted at Makua since the 1970s indicate that many of the archaeological deposits and features dating to pre-Contact times have survived in good to excellent condition. A list of sites and reports where they first appeared are given in Table 4-8. These sites have all been protected since they were first located, and all sites have been afforded equal protection no matter what their designation.

Thrum (1906) was the first to document archaeological sites in the area of Makua Valley, when he published descriptions of Ukanipo and Kaahihi Heiau, both located in Kahanahaiki Ahupua'a. In 1929-30, McAllister visited the area and recorded nine sites in the vicinity (McAllister, 1933), including both *heiau* described by Thrum (Sites 181 and 180, respectively), Kumauakuopio Heiau (Site 178), two cave sites (Kaneana Cave, Site 177; Poha Cave, Site 184), three fishing shrines (Sites 179, 183, and 185), and a natural pool reserved for the exclusive use of the chiefs (Site 182). Prior to McAllister's research, five of these nine sites (Sites 178, 179, 180, 182, and 183) had been destroyed; McAllister collected information about the destroyed sites through discussions with local Makua residents.

No further archaeological work was conducted in Makua until 1977, when the Bishop Museum completed a 1,316 acre inventory survey of Makua (Rosendahl, 1977). The Army commissioned the 1977 Rosendahl survey to locate sites on all training ranges on Oahu and the Island of Hawaii. The investigation identified 19 sites, including the nine recorded by McAllister and eleven newly recorded ones (Sites 9519-9526, 9531-9533). The nine previously recorded sites included: the five that had been destroyed (see above); Site 181 (Ukanipo Heiau) that was relocated; and Sites 184 (Poha Cave), 185 (Holua Fishing Shrine), and 9518 (Makua Mountain Trail) that could not be found. Site 177 (Kaneana Cave), originally identified by McAllister, was outside of the Rosendahl's survey area and therefore not relocated. The newly identified sites included several large occupation complexes located along the coast and within the interior valley areas of the three *ahupua'a* of Keawa'ula, Kahanahaiki, and Makua. Most of the 11 new sites appeared to be late pre-Contact (1793) and post-Contact occupation complexes based on evidence of agricultural activities and cattle ranching (Rosendahl, 1977).

In 1980, Hommon conducted an archaeological survey in Kahanahaiki Ahupua'a to record Ukanipo Heiau (Site 181) and investigate the Kahanahaiki Terrace Complex (Site 9533). The study demonstrated the heiau to be of regional importance, as it is only one of five that remains intact in the Waianae district and it can be directly identified in oral tradition as a *heiau luakini* (Hommon, 1980). The terrace complex, situated near the heiau, was more difficult to assess because of its deteriorated condition. Hommon noted that the structure could have been the foundation for another religious site or possibly it dated to post-Contact times, and was associated with the construction of the O'ahu Railroad along the Makua coast (Hommon, 1980). Ukanipo Heiau was listed on the National Register of Historic Places in 1984, based on the work done by Hommon.

The development of the CCAAC in 1985 was undertaken after the SHPO had concluded there would be "no effect" on cultural resources based on the findings of the 1977 survey. Section 106 consultations for subsequent Army undertakings at Makua resulted in the surveys discussed below.

In 1992, Carlson *et al* (1993) conducted a reconnaissance survey for a proposed firebreak road to be constructed in the upper valley area at Makua. The survey was limited to the firebreak road corridor, measuring approximately 5,380 meters long by 15 meters wide. Work in the cleared portions of the roadway identified four sites, including a dry land agricultural complex (4627), a stone mound with a cupboard (4628), a stone mound cluster (4629), and a habitation site (4630). The agricultural complex and the habitation complex were completely recorded, while the other sites were only partially mapped due to heavy vegetation and inaccessibility (Eble *et al*, 1993). Combined, the sites appear to be associated with dry land agricultural activities that developed in the inland portion of Makua valley from pre-Contact to post-Contact times.

Later in the same year Eble *et al* conducted a 477-acre reconnaissance survey of the lower valley area, just west of where Carlson *et al* (1993) conducted their limited survey (Eble *et al*, 1993). The study recorded 12 sites comprised of 153 features. Seven of the sites contain multiple features or complexes (10-45 features), three sites consist of three to four features, and two sites have single features. Feature types within the site complexes vary, but most contain occupation and agricultural related features including stone-lined terraces and retaining walls, basalt cobble walls, rock mounds, enclosures, C-shaped shelters, platforms, cupboards, and fire-pits. The larger multi-feature site complexes range in size from 120-430 meters long by 80-340 meters wide, and most of the complexes were identified close to intermittent stream channels. Two of the sites, 4542 and 4547, were identified in site complex 9524, earlier recorded by Rosendahl (1977). Based on radiocarbon dates and artifact evidence obtained from the survey and subsurface testing, the sites are interpreted as dating to the late pre-Contact or early post-Contact period. Site 4546 was identified as a possible *heiau* based on its size and the presence of what appeared to be an associated shrine. No further work has been done at this site to determine its true function. Site 4544, also located during this survey, contained a petroglyph, which had sustained damage from small arms. Target fans have been modified to avoid any potential direct fire damage at Buffalo Objective, located near this site.

In 1994 and 1995, the archaeological monitoring and survey of the proposed CCAAC modifications (Williams and Patolo, 2000) identified an additional five sites, which revealed important new information regarding the pre-Contact occupation and exploitation of Makua Valley. Most importantly, the data collected during this work suggested that Makua was a valley that must have had enough water resources to support two large complexes of sites in the middle elevations of the valley that included agriculture, permanent habitation, and religious activities, suggesting fairly substantial population. These complexes, referred to as the Ko'iahi Gulch Complex and the Makua Mid-Valley Complex, appear to have been abandoned very early in the post-Contact period, probably as diseases and warfare decimated the Hawaiian population of O'ahu and people began to move to coastal regions to take advantage of Western trade.

The Ko'iahi Gulch sites appear to form one complex of related sites and so are designated the Ko'iahi Gulch Complex here. Sites 4542, 4543, 4544, and 4546 are included in this designation. The associated features of Site 4546 suggested this site could be the remains of a *heiau*. As with the scale of the Makua Mid-Valley Complex, the size and complexity of the Ko'iahi Gulch Complex suggests that a permanent water source must have been available, either as a spring or as stream flow.

Site 5456, consisting of ten *imu*, provided evidence that the middle portion of the valley was being farmed as early as the mid-15th Century, suggesting that the coastal and perhaps the rear, wetter portions of the

valley were being exploited even earlier. The radiocarbon dates from the cooking features at Site 5456 provide the earliest dates yet for use of the valley. Data recovery was undertaken on seven of the *imu*. Three of the *imu* were left intact. These *imu* were located at the former Elk Objective, which was a mortar target objective. The mortar objective has been moved to protect the site.

The evidence gathered to date indicates that Makua Valley once supported both a coastal population, which was historically known as Makua Village, and permanent occupation in the middle elevations. Assuming that Makua has similar settlement patterns as Makaha, Waianae, and Lualualei valleys, it can be expected that more people lived in the back of the valley, at the higher elevations where rainfall was more abundant. The middle elevation occupations represented by the Makua Mid-Valley Complex and the Ko'iahi Gulch Complex are intriguing, since the early historical records suggest no occupations of this area, and by the Mahele the area was claimed only as community kula lands. The first missionary accounts of Makua Valley note that it had a large school, suggesting more population than just the coastal village. Also, the archaeological remains of these two large complexes indicate that they were primarily utilized in the pre-Contact period, or only very early in the post-Contact period before the widespread introduction of Western goods.

Site 4540 (Eble *et al*, 1993) and the nearby surrounding house sites located during this survey (Sites 5587, 5588, 5589, and 5590) appear to form the habitation and gardening focus for a relatively large group of people, who probably represented a kinship group of related people (*ohana*). This group of sites is designated the Makua Mid-Valley Complex. The location of this complex is somewhat surprising, as it is not near any of the known water sources and yet to support the activities that must have occurred there a water source would have been necessary, as it is unlikely that water was hauled to this complex from the coast. Given the presence of the now-dry gully that bisects the site, and its appearance on the 1920s series of aerial photographs, it seems likely that this gully once contained flowing water, at least for a good part of the year. It must have dried up fairly early in the post-Contact period, though, as historic accounts of Makua mention how dry the valley was. Many site features were damaged, either through explosion or by direct impact of dud or inert rounds. The target objectives were changed as soon as this site was reported in 1993 to avoid damaging the site further. This site is located in an area of unexploded ordnance and has not been accessible since 1995. The EOD escort to the archaeological field crew discovered the ordnance, which proved to be ICM.

Another survey was undertaken in 1998/1999 after a fire started off the reservation and burned 105 acres in Kahanahaiki Valley (Cleghorn, 1999). This survey located and mapped additional features contained within four site designations associated with Ukanipo Heiau. This information was incorporated into a PA for the cooperative management of the Ukanipo Heiau site signed in 2000.

Additional surveys were undertaken at Makua by archeologists with the Environmental Division of the Directorate of Public Works in 2000. Seven previously unrecorded features were identified within the south firebreak road. All features were grouped with existing sites. These previously unidentified features are described below and in Table 4-8. No new sites were recorded within south firebreak road.

State Site # 50-80-03-4542

- Feature 44a** a platform with associated walls
- Feature 44b** retaining wall located downslope from Feature 44a
- Feature 44c** retaining wall located downslope from Feature 44a

Feature 51 an *ahu* located on the southern bank of Kalena streambed

State Site # 50-80-03-4543

Feature 23 a stand-alone boulder with a natural bowl on its upper surface.

State Site #50-80-03-4544

Feature 28 rock mound

Feature 29 large rock mound

Reconnaissance surveys during the same period resulted in the discovery of 13 new sites outside the Proposed Action Area. These sites were given Hawaii State Site numbers 50-80-03-5920 through 50-80-03-5932. The sites range from a single feature to complexes with over 30 features. They are distributed from the back of Makua Valley, out along the western boundary, to mid elevations of Kahanahaiki Ridge. These sites are described below and in Table 4-8.

State Site # 50-80-03-5920: Site 5920 is an area with 20-30 rock mounds and low retaining walls found at the back of Makua Valley.

State Site # 50-80-03-5921: This site consists of three mounds, an alignment, and a terrace located on a ridge midway back in Makua Valley.

State Site # 50-80-03-5922: This site is comprised of a mound and a modified outcrop located on a ridge between gulches 4 and 5 off the trail leading to the back of Makua Valley.

State Site # 50-80-03-5923: This site is comprised of 37 features within and on the banks of Ko'iahi Gulch. This represents an extensive agricultural complex.

State Site # 50-80-03-5924: This site is comprised of two alignments located at the base of a large, burnt out monkeypod tree to the east of Site 5595.

State Site # 50-80-03-5925: This site complex consists of more than 20 features. There are at least two enclosures and one stepped platform shrine with an upright. The rest of the features are walls. The features are located on the talus slope on the *makai* (ocean) side of `Ohikilolo Ridge.

State Site # 50-80-03-5926: Site 5926 is located on the northern end of `Ohikilolo Ridge where it drops down into the opening of Makua Valley. This site complex is comprised of three walls and one platform.

State Site # 50-80-03-5927: This site complex is comprised of eight walls, one alignment, and one enclosure. Some of these walls line up with a US Geological Survey 1929 quad map. Most of these features appear as historic *kuleana* or ranching boundaries.

State Site # 50-80-03-5928: Site 5928 is a single feature site. A small retaining wall was identified while following a trail out of Kahanahaiki Valley.

State Site # 50-80-03-5929: This site complex is comprised of coastal gun emplacement, a military bunker and a piled rock platform modified with historic debris. This site is located above Farrington Highway near the northwest corner of MMR.

State Site # 50-80-03-5930: This site is comprised of two adjacent platforms. They are located on a talus slope high above the road cut for Farrington Highway.

State Site # 50-80-03-5931: This single feature site is comprised of a rock wall located at the northwest corner of the MMR boundary.

State Site # 50-80-03-5932: This single feature site is part of an old pathway or early road. This old trail or path is located up on the talus slope, a short distance above the very steep bank that has been cut along Farrington Highway.

All of these sites have been recorded with the Hawaii State Historic Preservation Office. The report containing information about these sites will be given to the State Historic Preservation Office, the community, and the Range Control Office that oversees Makua in accordance with the stipulations of the Programmatic Agreement discussed below.

**Table 4-8:
Known archeological sites at Makua Military Reservation**

Site	Description	Source	Site	Description	Source
178	Kumuakuopio Heiau*	McAllister 1933	4536#	Stone Walls and Well	Eble <i>et al</i> , 1993
179	Fishing Shrine*	McAllister 1933	4537#	Complex of 14 Stone Walls	Eble <i>et al</i> , 1993
180	Kaahihi Heiau*	McAllister 1933	4538#	Enclosure and C-shape	Eble <i>et al</i> , 1993
181	Heiau Ukanipo	McAllister 1933	4539#	Small Retaining Wall	Eble <i>et al</i> , 1993
182	Swimming Pool*	McAllister 1933	4540#	Agricultural/Habitation Site	Eble <i>et al</i> , 1993
9518	Makua Trail	Rosendahl 1977	4541#	Kuleana Plots	Eble <i>et al</i> , 1993
9520	Stone Walls and Enclosure	Rosendahl 1977	4542#	Agricultural/Habitation Site	Eble <i>et al</i> , 1993
9521	Terraces	Rosendahl 1977	4543#	Agricultural/Habitation Site	Eble <i>et al</i> , 1993
9522	Terraces and Walls	Rosendahl 1977	4544#	Agricultural/Habitation Site	Eble <i>et al</i> , 1993
9523	Occupation Complex	Rosendahl 1977	4545#	Agricultural/Habitation Site	Eble <i>et al</i> , 1993
9524	Occupation Complex	Rosendahl 1977	4546#	Enclosure/Platform/Possible heiau	Eble <i>et al</i> , 1993
9525	Stacked Stone Wall	Rosendahl 1977	4547#	Agricultural Complex-Historic	Eble <i>et al</i> , 1993
9526	Occupation Complex	Rosendahl 1977	5456#	Subsurface Habitation Features	Williams and Patolo 1998
9531	Stone Walls and Platforms	Rosendahl 1977	5587#	Agricultural/Habitation Site	Williams and Patolo 1998
9532	Subsurface Deposit	Rosendahl 1977	5588#	Agricultural/Habitation Site	Williams and Patolo 1998
9533	Large Platform	Rosendahl 1977	5589#	Agricultural/Habitation Site	Williams and Patolo 1998
4627	Agricultural Complex	Carlson <i>et al</i> , 1993	5590#	Agricultural/Habitation Site	Williams and Patolo 1998
4629	Several Stone Mounds	Carlson <i>et al</i> , 1993	5775	Complex of 72 features in vicinity of Ukanipo Heiau	Cleghorn, <i>et.al.</i> 1999
4630	Habitation Site	Carlson <i>et al</i> , 1993	5776	Complex of 111 features in vicinity of Ukanipo Heiau	Cleghorn, <i>et.al.</i> 1999

**Table 4-8:
Known archeological sites at Makua Military Reservation**

<i>Site</i>	<i>Description</i>	<i>Source</i>	<i>Site</i>	<i>Description</i>	<i>Source</i>
4628	Stone Mound and Cupboard	Carlson et al, 1993	5777	Shrine/Upright Stone in vicinity of Ukanipo Heiau	Cleghorn, et.al. 1999
			5778	Complex of 10 features in vicinity of Ukanipo Heiau	Cleghorn, et.al. 1999

*Destroyed

#Located within the Piliia'au Range Complex; no sites are located within the live-fire maneuver corridor or mortar or artillery target areas

Previously Unidentified Features and Sites at MMR

<i>State Site #</i>	<i>Feature #</i>	<i>Feature Type</i>	<i>Comment</i>	<i>UTM</i>
50-80-03-4542	44a	platform	ag. / hab. complex	81347999
	44b	retaining wall	ag. / hab. complex	
	44c	retaining wall	ag. / hab. complex	
	51	ahu	ag. / hab. complex	
50-80-03-4543	23	modified boulder	ag. / hab. complex	80828002
50-80-03-4544	28	mound	ag. / hab. complex	
	29	mound	ag. / hab. complex	
	20+ in progress	mounds/terraces	new	
50-80-03-5920	1	mound	new	84568017
	2	alignment	new	82938015
	3	mound	new	
	4	mound	new	
	5	terrace	new	
	50-80-03-5922	1	mound	new
50-80-03-5922	2	modified outcrop	new	82937995
	3	alignment	new	n/a
	4	alignment	new	n/a
	5	alignment	new	n/a
	6	alignment	new	n/a
50-80-03-5923	1	platform	new	81587986
	2	wall	new	
	3	wall	new	
	4	wall	new	
	5	wall	new	
	6	wall	new	
	7	wall	new	
	8	terrace	new	
	9	wall	new	
	10	wall	new	
	11	C-shape	new	
	12	wall	new	81607980

Previously Unidentified Features and Sites at MMR

<i>State Site #</i>	<i>Feature #</i>	<i>Feature Type</i>	<i>Comment</i>	<i>UTM</i>
	13 (fea B)	alignment	new	81577982
	14 (fea B)	modified boulder	new	81577982
	15	enclosure	new	
	16	platform	new	81607980
	17	pit feature	new	
	18	wall	new	
	19	wall	new	
	20	upright stone	new	
	21	wall	new	
	22	wall	new	
	23	wall	new	
	24	wall	new	
	25	mound	new	
	26	upright stone	new	
	27	wall	new	
	28	platform	new	
	29	wall	new	
	30	mound	new	
	31 (temp f7)	wall	new	
	32 (temp f6)	wall	new	
	33	kuleana wall	new	81537993
	34 (fea E)	platform	new	81637987
	35 (fea F)	modified outcrop	new	81637984
	36 (fea G)	wall remnant	new	81637982
	37 (fea H)	mound	new	81717977
50-80-03-5924	1	alignment	new	81307973
	2	alignment	new	81307973
50-80-03-5925	20+ in progress	mostly walls	new	80248003
50-80-03-5926	1	wall	new	80158063
	2	platform	new	80098060
	3	wall	new	80058063
	4	wall	new	80078055
50-80-03-5927	1	retaining wall	new	80058104
	2	wall	new	80038104
	3	wall	new	80018122
	4	wall	new	80018123
	5	wall	new	
	6	wall	new	
	7	wall	new	
	8	enclosure	new	
	9	alignment	new	

Previously Unidentified Features and Sites at MMR

<i>State Site #</i>	<i>Feature #</i>	<i>Feature Type</i>	<i>Comment</i>	<i>UTM</i>
	10	wall	new	
50-80-03-5928	1	retaining wall	new	81648248
50-80-03-5929	1	bunker	new	79468201
	2	gun emplacement	new	79468201
	3	platform	new	79468201
50-80-03-5930	1	platform	new	79368211
	2	platform	new	79368211
50-80-03-5931	1	wall	new	78828272
50-80-03-5932	1	path	new	78728275
50-80-03-9533	5	platform	new	

Source: US Army-Hawaii Directorate of Public Works and US Army 25th ID(L) and USAH, 2000

4.11.2 Cultural Resources Component of the Proposed Action On September 18, 2000, a Section 106 PA was finalized with the SHPO and the Advisory Council on Historic Preservation (ACHP). This PA was developed in consultation with aboriginal/indigenous Hawaiian groups and regulatory agencies over a period of two years. It contains specific programs and efforts to protect and mitigate impacts to cultural resources at Makua.

The PA for Section 106 responsibilities required additional surface surveys of all training and training related activity areas and the initiation of a survey for Traditional Cultural Places (TCP) before training in its proposed modified form could begin. The surface survey of the entire action area has been completed and the report is being reviewed by the SHPO. A contract for the TCP survey was awarded in FY 2000 and is ongoing. In addition, the target objectives have been changed and other actions have been implemented to de-conflict training and archaeological sites. There are 17 archaeological sites within the proposed training area that will be additionally protected by the measures outlined below. Twenty-five percent of the lands at Makua have been surveyed for the presence of archaeological sites. Areas outside the south firebreak road (with the exception of the bivouac area) cannot be surveyed because of the presence of unexploded ordnance. The remaining portion of MMR that may contain historic artifacts is unsafe to survey, without extensive UXO detection [usually preceded by a controlled burn, which also threatens endangered species] and demolition by Explosive Ordnance Disposal experts. The proposed maneuver corridor, the small arms target objectives and the mortar/artillery objectives have been surveyed for both surface and subsurface sites. The area of the 1994 CCAAC modifications was cleared of overburden by bulldozers; subsurface deposits, if present, were examined by archaeologists. The completion of these actions mitigates the potential effects of training on cultural sites to no significant impact.

In addition, to the above actions which permit resumption of training with no significant impact, the Army will undertake other longer term conservation measures in accordance with the PA. The PA for Section 106 compliance over the next five years is appropriate for projects where effects are difficult to define in advance, that would take place over a relatively long period of time, or that involve the routine management of federal installations, facilities, or property.

The additional stipulations of the Makua PA for Section 106 responsibilities for routine training are as follows:

- Additional sub-surface surveys will be done within the training area circumscribed by the south firebreak road. These surveys will be done south of the main live-fire maneuver corridors within the CCAAC. The live-fire maneuver corridors have been surveyed in the past and contain no further subsurface features. Surveys outside the proposed training area will be done as needed after further Section 106 consultation. The presence of UXO in these areas makes survey hazardous. Also, according to the PA, detonation of UXO outside the training area or close to existing sites is subject to consultation under the agreement.
- An annual status report would be provided to the SHPO, the ACHP, and consulting native/indigenous Hawaiian organizations to review implementation of the PA and determine whether amendments are needed.
- The Army would identify native/indigenous Hawaiian organizations, groups, families, and individuals that may ascribe traditional religious and cultural importance to historic properties at Makua. The Office of Hawaiian Affairs and Hui Malama I Na Kupuna O Hawaii Nei would be considered interested parties for the purposes of Section 106 consultation and review.
- Expanded education of Army personnel in cultural resource awareness and protection, as well as avoidance of cultural resources during training, will be undertaken. Instruction could include field trips, classroom training, and printed literature. This information is also included in the cultural resources annex of the range standing operating procedure.
- The Army will actively seek to identify and evaluate cultural resources at Makua. The identification plan is based on a five-year schedule, prioritized according to the potential for the presence of cultural resources and frequency of training activities.
- A database will be prepared using existing cultural data and will be revised as new information becomes available.
- Geographical information system (GIS) mapping of resource locations will be prepared and distributed to the Hawaii SHPO and native Hawaiian groups if requested.
- Cultural resources will be monitored to identify effects from training. For the first year a qualified archeologist will do the monitoring whenever a unit departs the training area immediately following the training exercise. Monitoring records will be kept and included in the annual report to the Hawaii SHPO.
- Cultural resources will be protected from damage during training exercises. Protection measures include managing resources in place as exclusion areas without barriers, establishing physical barriers, and data recovery. Routine detonation of UXO within the training area does not require consultation.

- The Cultural Resources Manager will work with the Wildland Fire Manager to develop acceptable fire containment/control strategies to suppress wildfires while at the same time protecting cultural resources. This coordination will occur during site planning preparation and pre-season fire suppression operations.

In 1998, the Army began a program in cooperation with members of the Waianae community to open Ukanipo Heiau to native Hawaiian religious practitioners under the American Indian Religious Freedom Act of 1978. Meetings took place over a period of two and a half years, culminating in a PA signed in October 2000, giving access to Ukanipo Heiau to members of the native Hawaiian community. This access is independent of training activities in the valley. Access to other sites within the valley has been given on a case-by-case basis as is consistent with training and safety concerns. The potential for increased access to other sites within Makua is being examined.

4.11.3 Environmental consequences of No Action Under the No Action alternative, Makua would be closed to military training. Army maintenance and stewardship programs would continue, but at a much-reduced level due to the absence of Army training activity. The Army would protect resources as required by law. This reduced stewardship would continue until a determination is made that the Army would no longer need the land, at which time a disposal process would be initiated. During the period between the decision to stop training and the completion of the disposal process, the Army would continue to protect cultural resource sites at Makua, and there would be a beneficial impact because the risk of damage from training activities would be reduced. The PA for community access to the Ukanipo Heiau would still be in effect and would be honored by the Army.

Under the disposal process, leased and licensed lands would be returned to the lessor (the State of Hawaii). Land the Army owns in fee simple would be subject to General Services Administration excessing procedure, including screening under the Hawaiian Homelands Recovery Act and the McKinney Act, and for potential use by other agencies. (The Hawaiian Homelands Recovery Act requires federal agencies excessing property to consider uses for the benefit of Hawaiian natives. The McKinney Act requires federal agencies to consider potential use of excess facilities to house the homeless.) Ceded lands would also go through an excessing process. Congress has provided that ceded lands, if not needed by the federal government, would revert to State of Hawaii ownership.

Disposal of Army lands would be subject to its own NEPA process. After completion of the disposal process, care and custody of the property would be the responsibility of the new owner.

The actual type, timing, and location of future reuse activities are not known. Disposal of the property without adequate safeguards for cultural resources written into the property transfer could indirectly lead to impacts to cultural resources. Potential impacts to cultural resources could also include excavation of the ground to clear UXO. Such excavation could include the disturbance of existing cultural resources. Any area with UXO subject to limited public access (e.g., livestock grazing, wildlife preserve) would require UXO cleanup to a minimum of 1 foot below the ground surface over the entire subject area; any area of public access (e.g., agriculture, recreation) must be cleaned to a depth of 4 feet; and any area of unrestricted access (e.g., commercial, residential, utility) to 10 feet, or excavation depth plus 4 feet, whichever is greater, per DoD 6059.9-STD (USDOD, 1999). The excavation would subject the cleanup area to extreme surface disruption and may negatively impact or significantly disturb cultural resources in

the UXO remediation areas. This disturbance would need to be mitigated after cleanup. Under the No Action alternative, there would be a beneficial impact to those who wanted increased access to cultural resources, and traditional cultural properties. The potential impacts to cultural resources would be analyzed and evaluated in the NEPA disposal document and under Section 106 of the NHPA. Any transfer, sale, lease, etc. would constitute a federal action and would require Section 106 compliance.

4.11.4 Environmental consequences of Proposed Action Under the Proposed Action, the Army would continue using Makua Military Reservation as a CCAAC, but at a reduced level. The PA, which is incorporated as part of the Proposed Action, substantially reduces the level of risk to cultural resources. The risks are reduced through the approved PA between the USARHAW, the SHPO, and the ACHP. With the execution of the stipulations outlined in the PA, the potential for destruction or damage to cultural resources at Makua will be greatly reduced and no significant impact to cultural resources is expected.

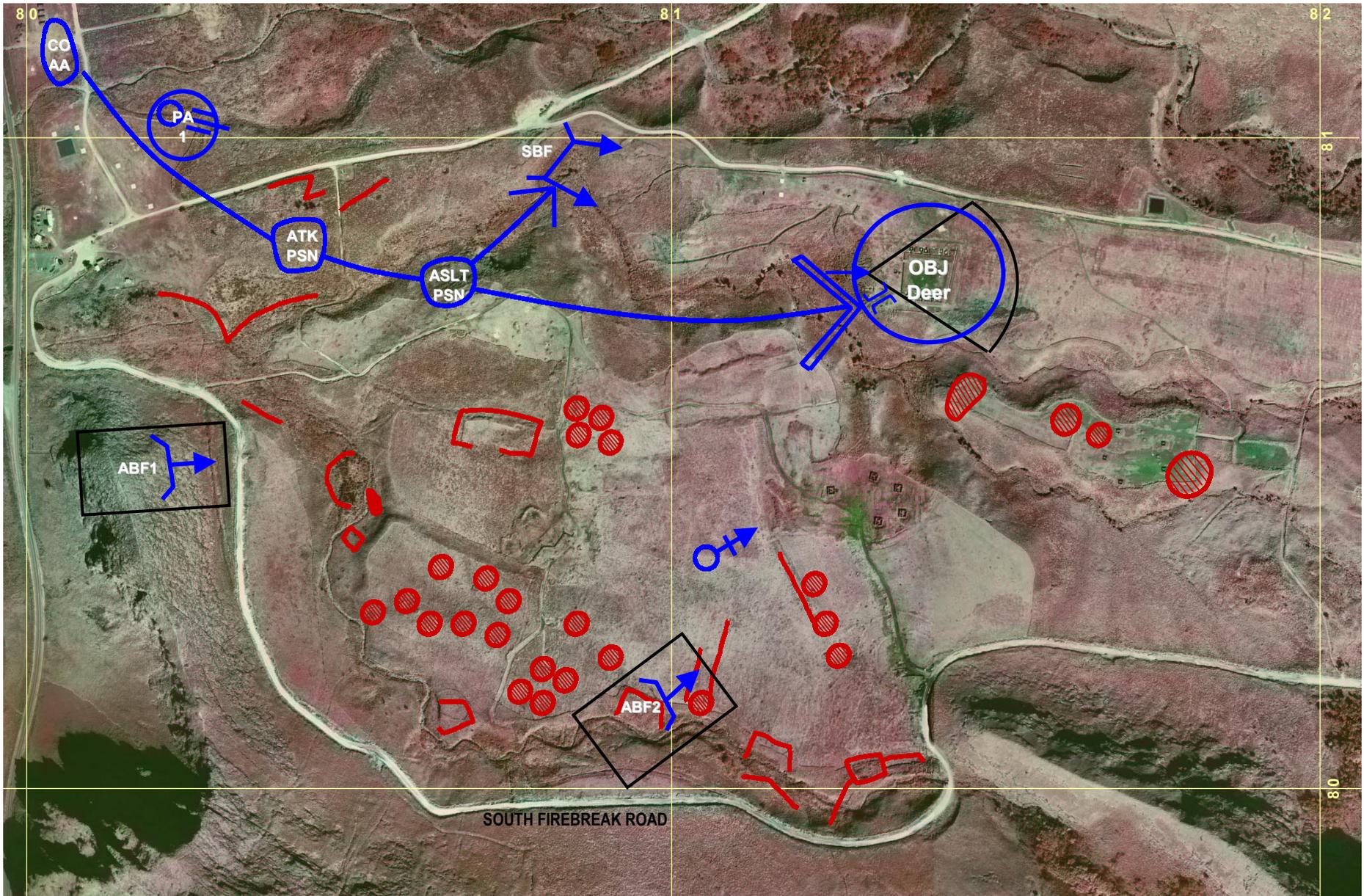
The Army has taken abundant precautions to protect all sites located within the perimeter of the CCAAC. Maneuver corridors and target arrays have been modified to ensure that there is little chance of direct or indirect fire causing damage to the sites (Figure 4-12). The former “Elk” Target Objective, for instance, has been moved to protect the subsurface sites located there. Soldiers training at Makua are thoroughly briefed on existing cultural resources in Makua and protection measures. Standing Operating Procedures have been developed to ensure soldiers will be briefed on these sites and “No Fire Areas” will be annotated on fire control computers for all indirect fire weapons, to ensure the safety of the sites. In addition, tall grass has been allowed to grow around the sites, to signify to soldiers that this is an area they are not permitted to enter.

4.11.5 Conclusion The on-going measures described above (and incorporated by reference in the Programmatic Agreement) will protect the cultural resources found in Makua. There will be no significant impact on these sites from the proposed Army training.

4.12 INFRASTRUCTURE

4.12.1 Affected environment

4.12.1.1 Potable water systems Water is supplied to the western portion of Makua by the City and County of Honolulu’s Board of Water Supply. Drinking water in the Waianae District comes from seven source wells in Makaha: the Makaha shaft, Kamaile Wells, three wells in Waianae Valley, the Waianae Tunnel, and the plantation Tunnel. The collective capacity of potable water from these wells is 7.8 million gallons per day (mgd). When necessary, potable water is imported from the Pearl Harbor aquifer. The reported quantity of water extracted from these wells in 1996 was 4.337 mgd (City and County of Honolulu, 1999). The 5-year average production (1992-1996) from the sources in Makaha and Waianae totaled 4.5 mgd. The remaining demand was supplied by the Pearl Harbor aquifer, which averaged 3.9 mgd over the 5-year period, totaling an average daily demand of 8.4 mgd. The average demand for potable water from the City and County of Honolulu is 3.5 million gallons per year (mgd) or slightly less than 10,000 gallons per day.



-  Cultural resource sites
-  Maneuver corridor



Data source: G3 Range Division and DPW Environmental Division

**Figure 4-12:
Relationship of Maneuver Corridor to
Cultural Resource Sites**

Potable water is transported through a system of water mains following the major roads in the District. One main following Farrington Highway transects the reservation and terminates at the 1-acre lot just past Kepuhi Point. Units training at Makua also bring their own water in 500-gallon tanks and replenish these tanks when necessary with water from the existing 30,000-gallon storage tank east of the administration building.

4.12.1.2 Wastewater collection and treatment systems No public sewer system is available at Makua; wastewater from the administration building is collected in a 13,000-gallon septic tank. The tank is maintained by a contractor and pumped out at various intervals totaling six times per year. The resulting wastewater is transported to and deposited in the Schofield sewage treatment plant at Wheeler Army Airfield for processing, which is operated in accordance with all applicable regulations. Wastewater from training events is collected in portable toilets, six of which are permanently situated near the fence line west of the administration building, and two of which are located to the west. Additional portable toilets are provided if requested by the units to support larger training events. Wastewater from these portable toilets is collected and hauled to the Schofield sewage treatment plant.

4.12.1.3 Electrical power Both Makua and Waianae receive electric power service from the Hawaiian Electric Company. Units in training areas adjacent to the administration building can connect to its power supply. Other units bring portable generators if required.

4.12.1.4 Solid waste handling and disposal There is no solid waste facility at Makua; waste is collected in 40-cubic-yard containers and transported to the Waimanalo Landfill by a contractor. Additional containers are provided when requested by units training at Makua. In addition at the request of the State the Army periodically removes illegally dumped solid waste from the Makua Beach Area. The city of Waianae Refuse Division collects and disposes of domestic solid waste at the Waimanalo Gulch sanitary landfill, and at the HPOWER waste-to-energy facility. The Waianae community has instituted a mandatory recycling program. The PVT Nanakuli Construction and Demolition Material Landfill on Lualualei Naval Station Road acts as a privately-owned solid waste disposal facility, managing more than 20 percent of solid waste generated on Oahu (City and County of Honolulu, 1999).

4.12.2 Environmental consequences of No Action The No Action alternative is described in detail in 3.2. During the period between the decision to stop training and the completion of the disposal process, the Army would continue to maintain and operate existing utility systems it controls, and there would be no significant impacts to infrastructure.

The type, timing, and location of future reuse activities are not known. Potential impacts to infrastructure could include improper maintenance and operation of potable water and septic systems at Makua that are currently Army-owned. Without the Army monitoring the property, illegal dumping could increase and adversely impact public health. Under the No Action alternative, infrastructure services provided by the various utilities and contractors would be discontinued. This would result in an economic loss to those providers. As part of the environmental cleanup associated with the disposal process, impacts to the Makua infrastructure could be negatively impacted.

4.12.3 Environmental consequences of Proposed Action There would be no significant impacts to the existing utilities at Makua or to the Waianae infrastructure. Sanitary sewer contributions would go to the Schofield sewage treatment plant regardless of whether the soldiers were at Schofield Barracks or at Makua. Water use by troops in the field would be minimal and could be easily replenished from the water tank. Solid waste generated by training activities at Makua would be conveyed to an approved landfill. Electricity use would be mainly for purposes of operating communications equipment rather than lighting or operation of heavy equipment, and so would have minimal impact.

4.13 HAZARDOUS SUBSTANCES

4.13.1 Affected environment Past military activities at Makua employed hazardous substances. During the past several decades, site assessments and environmental sampling have been performed at Makua to determine the extent of possible contamination of the environment. In 1985, limited soil sampling performed in the former OB/OD area indicated that low-level concentrations of specific energetic material compounds (explosive residues) were present during this sampling event. This was followed up by subsequent investigations.

4.13.1.1 SAIC study In 1991, Science Applications International Corporation (SAIC, 1991) prepared a “RCRA [Resource Conservation and Recovery Act] Facility Assessment for Makua Military Reservation, Oahu, Hawaii.” In addition to records searches and site visits, this type of study incorporates interviews with facility personnel. The recollections of individuals included in such studies are sometimes difficult or impossible to validate in subsequent research. In this report, several potential sources of hazardous wastes were noted: several disposal pits, a domestic waste landfill, an infectious waste incinerator, an incinerator for classified papers, and a wastewater treatment system. This same report goes on to state that these facilities, with the exception of “Burn Pit No. 1” (the then current OB/OD site), were either proposed/never constructed or “may never have existed at Makua.” The review also states that “also of concern is the possible disposal of excess mustard gas ($C_4H_8Cl_2S$) or other chemicals used during wartime activities. No information regarding use of these chemicals could be obtained during this RFA (RCRA Facility Assessment).” That mustard gas was ever used or disposed of at Makua appears to be pure speculation; review of source documents cited in the SAIC study does not confirm any use or disposal of mustard gas at Makua.

4.13.1.2 University of Hawaii study In 1992, the Environmental Center, University of Hawaii prepared a “Federal Facility Preliminary Assessment/Site Inspection Review” (Environmental Center, University of Hawaii, 1992). This report stated that “approximately 50 percent (2,621.75 tons) of the total potential hazardous waste burned at the Makua Military Reservation can be considered as posing a threat to the population and ecosystem, via migration in one of the pathways: groundwater, surface water, soil, and air.” A subsequent review of the UH report and referenced documents could not validate the source of the claim that 50 percent of the waste burned at Makua posed a threat to the environment. This statement may have been based on the rule of thumb that about half the weight of any ballistic ordnance is made up of explosive material. This study also incorporates recollections of individuals, which may not be infallible. The UH report also states that no groundwater sampling had been done. Subsequent to that report, the Army did conduct a baseline environmental sampling study (Halliburton NUS Corporation, 1994; see below) that was based on a screening approach that did in fact include soil and groundwater sampling data.

4.13.1.3 USAEHA study In 1993, a site assessment was performed by the US Army Environmental Hygiene Agency (USAEHA, 1993) to identify the presence of potential waste sites at Army properties, including Makua. The findings of the site assessments were summarized in a report titled “Site Assessment Survey No. 38-26-K28U-94, 1-19 Nov 93.” The report identified four waste sites at Makua.

- Site 1 is the impact area, and includes the area where OB/OD activity formerly occurred. OB/OD activity, an EPA-approved method of disposing unusable munitions, was discontinued at Makua in 1992 due to the environmental concerns and expense involved in maintaining an OB/OD facility. A summary listing EPA Uniform Hazardous Waste Manifests from 1986 to 1992 is at Appendix J and documents the types of wastes disposed of under the EPA Part A, hazardous waste permit. The types of wastes disposed of are unusable munitions and are hazardous because of their reactive nature. Open burning/open detonation is an EPA-approved method to treat these types of waste materials thermally.
- Site 2 is a dump that was operated from 1942 to 1946 by the government of Honolulu on a parcel of land withdrawn from the federal government lease. Its location is not known and could not be verified in the field. The types of waste present in this former dump are unknown.
- Site 3 is approximately 3,000 feet east of the Administration building and has historically been filled with junk automobiles, metal frames, metal parts, barbed wire, and concertina wire. Site 3 is approximately 30 feet in diameter. The depth could not be determined during the site assessment, but material has not been added to the dump since 1990-1991.
- Site 4, is the septic tank and leaching field where wastewater from the Administration building is discharged (US Army, 1993).

The assessment concluded that Sites 1 and 3 have a low potential to cause contamination in the environment. The site assessment recommended that groundwater quality samples collected from an on-site monitoring well be analyzed to determine if any degradation to groundwater quality has occurred (USAEHA, 1993). According to Kelly and Quintal (1977) Site 2, the former Honolulu landfill, is no longer on the Makua reservation, and is no longer under Army control. Since the septic tank (Site 4) is actively maintained by an Army contractor, and has an alarm system to warn of overflow, it also poses minimal potential for contamination.

4.13.1.4 Halliburton study In 1993, Halliburton NUS Corporation performed a baseline soil and groundwater sampling study at Makua (Halliburton NUS Corporation, 1994). The results of the baseline study are presented in a document titled “Makua Military Reservation Soil and Groundwater Analysis Report Part I, Technical Evaluations,” March 1994. The environmental sampling program’s main focus was to characterize potential impacts associated with the OB/OD operations and to support the RCRA Subpart X permitting process. Although the study was not intended to characterize the impacts of training outside of OB/OD operations, the study also collected soil and groundwater samples outside the OB/OD unit in areas used for military training activities, including the CCAAC. The study provided important information regarding the possible sources, pathways, and receptors of contamination caused by past military training activities.

An excerpt from the Halliburton study is provided at Appendix H and includes a map that shows the locations of these other sampling stations (which were outside the OB/OD site) as well as a table summarizing the analytical results. The samples taken outside of the OB/OD site were taken from locations of past training activities. Although the Halliburton study was not intended to evaluate effects of past training, some soil samples from the study were taken from areas where past live-fire training was conducted. There were five sampling stations located upslope from the OB/OD unit (SP# 1, 2, 5, 6, and 14A). Four of those sampling locations tested to a depth of eighteen inches and one sample to a depth of eight feet. The six sampling stations located down slope from the OB/OD unit (SP# 16, 3, and 4) included three at the installation boundary (SP# 7, 8, and 9). Two of the down slope sampling locations went down eighteen inches, one went down to ten feet, one went down to eight feet, and two of them were at six inches (see table at Appendix H). SP# 8 and 9 were surface sediment samples collected from streambeds that were dry at the time of collection. A total of 35 samples, including a number of subsurface samples, were collected and analyzed for over 40 different chemical constituents. Almost 1,500 tests were conducted. The analytical results showed that none of the almost 1,500 tests done on samples collected outside the OB/OD unit in areas used for past training exceeded the EPA's conservative public health criteria (see table at Appendix H) for semi volatile organics, metals, cyanide, sulfides, energetics, nitrates/nitrites, and nitrites with the exception of one sample for arsenic collected at the 6-12 inch interval at the upslope SP# 2. The standard for arsenic in soil is 24 parts per million. The one sample that exceeded the standard was only 24.4 parts per million (ppm), or 0.4 ppm above the standard. There is also evidence from other investigations in Hawaii, however, that indicates arsenic is a common background constituent found at different locations in the state (Woodward-Clyde Federal Services, 1997, and Harding Lawson Associates, 1995).

The Halliburton study next looked at possible pathways using a computer model. Geophysical information regarding soils and hydrogeological conditions was incorporated into the model, which simulated several different pathways: first, the migration of contaminants from soil from the OB/OD unit (worst-case scenario) to the groundwater; and second, the soil-surface water (Makua Stream)-groundwater pathway.

With regards to the soil-groundwater pathway, the study looked for a wide range of chemicals, including many types of explosive residues that would be expected from disposal of military munitions. Most of these tests were negative. The explosive residues that were detected can be considered indicator parameters for former OB/OD activities. Indicator parameters can be used to track the movement of groundwater between the source and possible receptors. This is similar to putting a dye into the groundwater to track migration. The indicator parameters identified in this study were found only at the OB/OD site and not on lands used for live-fire training. These included 2,4-dinitrotoluene (DNT) and 2,6-DNT (explosives). Additionally, lead was also selected as a candidate indicator because it appeared on-site in samples collected from the OB/OD area at levels higher than its respective health criterion, and was not found in elevated concentrations off the OB/OD site (Halliburton NUS Corporation, 1994). If indicator parameters such as 2,4- and 2,6-DNT are found at the installation boundary, it may indicate that OB/OD contaminants have migrated westward 1.5 miles from the OB/OD site.

Based on modeling, groundwater transport of OB/OD constituents to the installation boundary at levels exceeding public health criteria is predicted to take 2,000 to 7,000 years (Halliburton NUS Corporation, 1994). In light of the lack of shallow groundwater, and the presence of a deep clay overburden that restricts infiltration, the potential for migration of contaminants from the OB/OD unit via groundwater is

low. The same can be said for contaminants originating off the OB/OD site on adjoining lands used for training. Even though soil samples show that the potential for training activities to contaminate the soils is extremely low, it would take many years for these contaminants to reach the installation boundary via the groundwater pathway.

The Halliburton study also looked at the surface water (Makua Stream)-groundwater pathway. The study concluded that there may be a greater near-term migration potential of overland runoff from the OB/OD unit and training activities draining into Makua Stream via the surface water pathway. After that, surface runoff then has the potential for recharging the basal lens aquifer (the groundwater) by infiltrating the younger more permeable sediments of Makua Stream. As a result of this scenario, a monitoring well was installed at location SP-7 in the basal freshwater lens. This groundwater monitoring well “has the potential for being more directly impacted by on-site military operations,” *i.e.*, military training activities, than by the former OB/OD site (Halliburton NUS Corp., 1994) since it receives surface water-groundwater recharge from the entire Makua Valley watershed. The Halliburton study found that the groundwater sample collected at this well was not contaminated. Therefore, the potential for contaminants from past training activities to migrate from the surface water to groundwater pathway to the installation boundary is low. Due to the reduced scope of training on the CCAAC being proposed by this SEA, it can also be concluded that in the future, the potential for contaminants from training activities to migrate to the installation boundary is also very low.

In summary, the Halliburton study provides sufficient information to conclude reasonably that there is no source of contamination exceeding EPA conservative health criteria due to past training activities. The model also showed that the soil to groundwater pathway is very slow. If there were contaminants present that exceeded EPA conservative health criteria, it would take those contaminants 2,000-7,000 years to migrate through the groundwater to the installation boundary. The study also sampled a groundwater well that showed that the surface water to groundwater pathway is not an effective pathway. This is because in the process of transport via surface water in Makua Stream, any contaminants, if present, would be diluted to the “parts-per-billion (or less) range below applicable health criteria.” Furthermore, the stream is dry 95 percent of the time, thus minimizing the potential for this migration pathway to carry contaminants off site (Halliburton NUS Corp., 1994). Finally, the study described a lack of human receptors. In other words, groundwater at or near the installation boundary is not used as a source of drinking by either the military or the public.

4.13.1.5 EPA study In response to continuing community concerns about the surface water pathway as Makua Stream leaves the installation boundary, the Army funded an EPA study in 1999 with sampling assistance from the Hawaii Department of Health (DOH). DOH collected sediment samples from the muliwai at the extreme downstream terminus of the normally dry streams that drain Makua. Muliwai are stagnant ponds that are separated from the ocean by a sandy berm across the stream mouth. The EPA analyzed the sediment samples and prepared a report (EPA, 1999a). The purpose of the study was to perform a screening-level assessment to identify contaminants that would pose a risk to marine life. The study examined 23 metals in the sediments and compared the results to National Oceanographic and Atmospheric Administration (NOAA) sediment screening guidelines for risks to ecological receptors (*e.g.*, fish, mollusks, and algae). Samples were collected from three muliwai fronting Makua and from three “reference” muliwai along the Waianae coast fronting civilian communities (Waikomo, Makaha, and Nanakuli Streams). NOAA has developed sediment-screening values for 8 of the 23 metals analyzed. Of the 8 metals for which screening criteria have been developed, three (cadmium, chromium, and

copper) exceeded NOAA criteria under which 10 percent of ecological receptors would be expected to show adverse effects (“Effects Range – Low”) in both the Makua and reference muliwai. Another metal, nickel, also exceeded NOAA criteria under which 50 percent of ecological receptors would be expected to show adverse effects (“Effects Range – Median”).

Seven out of the eight metals for which NOAA screening guidelines have been established were present in most or all of the samples. Mercury was not detected in all but one sample. Arsenic, nickel, and zinc concentrations were similar between the Makua and reference muliwai. Cadmium, chromium, and copper were slightly elevated in the Makua muliwai as compared to reference muliwai. One Makua muliwai sample (MAK 3) contained lead in excess of that found in reference muliwai, but all 20 samples were below the NOAA Effects Range – Low for lead. Migration of lead, either from the OB/OD site or from lead bullets fired downrange, does not appear to be a problem.

Overall, the data did not show a particular pattern of impacts that would indicate a specific source of metals contamination to either the Makua or reference muliwai. The report concluded that “further investigation does not appear warranted at this time because the overall concentrations of the metals of concern are relatively low, and do not tend to indicate a significant adverse impact on ecoreceptors” (EPA, 1999a).

The OB/OD site is not used now and will not be used under the Proposed Action. Both the EPA and the Hawaii Department of Health (DOH) continue to support delayed closure of the former OB/OD site (EPA and Hawaii DOH, 1998). This proposal follows the Army’s decision not to resume OB/OD activities at Makua after expiration of the EPA permit for OB/OD operations expired in 1992. Both the EPA and the DOH support a delay of cleanup of the unit until closure of the entire reservation. They cite the low risk to health and the environment due to the nature and extent of contamination at the former OB/OD unit, and the fact that the OB/OD unit is inside the boundary of the CCAAC and could potentially be impacted by future training activities (e.g., lead bullets that may inadvertently be deposited there due to the course routine training).

4.13.1.6 Agent Orange and depleted uranium Finally, research prompted by the public’s concern about possible use or disposal of Agent Orange (AO) or depleted uranium (DU) lead to the following findings.

Various Air Force studies (Raytheon, 1994; Holmes & Narver, 1989; Dames and Moore, 1988, Department of the Air Force, 1974) document that in 1971, chemical agents stored in Okinawa were transported to Johnston Island and stored at the Chemical Storage Facility located there. Public Law 91-672, passed in 1972, prohibited the transport of chemical agents from Okinawa to any of the 50 United States, and authorized destruction of AO outside these areas. In 1972, the 1.4-million-gallon stockpile of AO amassed during the Vietnam War was transported directly to Johnston Island and also placed in storage there. By the summer of 1977, AO stored at Johnston Island, as well as AO stored in Mississippi, were destroyed by high-temperature incineration at sea in the South Pacific. There is no record of Agent Orange use, storage or disposal at Makua.

Military installations hosting training with DU rounds must apply for and be granted a license from the Nuclear Regulatory Commission for possession of depleted uranium cartridge penetrators. To date, the only three installations in the United States have such licenses; none are in Hawaii. Army policy calls for

all DU rounds used by Department of Defense installations to be sent to Crane Army Ammunition Activity, Indiana for disposal. A memorandum (Deputy Chief of Staff, Logistics, Munitions, 2000) states that a records search for DU rounds was conducted, and determined that these types of munitions were never a part of the Army's inventory in Hawaii, and that the Army did not and does not have any plans to introduce DU ammunition to the State of Hawaii.

4.13.2 Environmental consequences of No Action The No Action alternative is described in detail in 3.2. During the period between the decision to stop training and completion of the disposal process, the Army would provide care and custody of the lands. No ordnance would be fired, thereby reducing the already insignificant potential for hazardous waste contamination beyond the boundaries of Makua. The Army would retain some responsibility for environmental issues, including UXO cleanup. Any area with UXO subject to limited public access (e.g., livestock grazing, wildlife preserve) would require UXO cleanup to a minimum of 1 foot below the ground surface over the entire subject area; any area of public access (e.g., agriculture, recreation) must be cleaned to a depth of 4 feet; and any area of unrestricted access (e.g., commercial, residential, utility) to 10 feet, or excavation depth plus 4 feet, whichever is greater, per DoD 6059.9-STD (USDoD, 1999). The excavation would subject the cleanup area to extreme surface disruption. This disturbance would need to be mitigated after cleanup. The clean up could create a significant impact to natural and cultural resources on the site. These impacts would be addressed in the NEPA disposal document and clean up decision documents.

4.13.3 Environmental consequences of Proposed Action Under the Proposed Action, the Army would continue using Makua Military Reservation as a CCAAC, but at a reduced level compared with past practices. The types of weapons and ammunition to be used in the Proposed Action are depicted in Table 2-1. In particular, the CCAAC use would not include use of TOW missiles or tracers. An estimate of the amount of munitions to be expended as part of the Proposed Action is provided in Table 4-9.

All current environmental programs would continue, including natural and cultural resource management, wildland fire management, public involvement, and other programs. This alternative would allow the Army to execute its required training missions, and would not involve costs and other effects of range clearance and closure.

Under the Proposed Action, units training at Makua within the CCAAC would remove any target equipment they may have provided, gather brass from spent rounds, and otherwise make every effort to restore the facility to its condition prior to their use. To the extent they can do so safely, units would remove UXO created by their own exercises or discovered in the course of training. When removal of such UXO is beyond the capability of the unit to remove, explosive ordnance disposal specialists would be summoned. No known dud rounds would be left in place at the conclusion of a training exercise.

**Table 4-9:
Estimate of munitions to be expended at Makua**

<i>Equipment</i>	<i>CALFEX at Piliia'au Range Complex Expected Annual Ammunition Expenditures at Piliia'au Range Complex</i>	
	<i>Combined-arms</i>	<i>CALFEX x 18 Companies/Year</i>
Requirements		
TOW	0	0
Dragon or Javelin	0	0
M202 Flash	0	0
81mm Mortar	40 per CO	720
60mm Mortar	36	648
M240B Machine Gun	1200	21,600
M249 SAW	3600	64,800
M24 Sniper Weapon	10 per CO	180
M203/M16A2	228	4,104
M16A2	11880	213,840
M4	2760	49,680
9mm Pistol	0	0
M2 50 Cal	100 per CO	1,800
MK 19	40 per CO	720
AT-4, 84mm Rocket	5 per CO	90
Grenade, Fragmentation	72 (8 per Squad)	1296
M18A1/A2 Claymore	9 per CO	162
Aviation Support: Kiowa Helicopter w/ .50 Cal MG	800	14,400
Engineer Support w/ Bangalore Torpedo	1-2	18-36
Artillery Support: M119, 105mm Howitzer Battery	24 per CO	432

Source: DA PAM 350-38, Standards in Weapons Training, 1997

Although there are no plans to resume the use of munitions there at this time, the area outside the CCAAC firebreak road at Makua also contains a great deal of UXO. Department of Defense Directive 4715.11, August 17, 1999, "Environmental and Explosives Safety Management of Department of Defense Active and Inactive Ranges within the United States," governs management of this UXO. Pursuant to this instruction, the Army must do the following:

- Restrict access to portions of Makua suspected of containing UXO
- Maintain permanent records of all military munitions expended and all UXO clearance operations conducted at Makua
- Conduct hazard assessment before conducting any range clearance operation
- Participate as appropriate, in established national public involvement programs, to include interested members of the public, to discuss and explain explosives hazards associated with Makua
- Establish a program to educate DoD personnel, their dependents, and private citizens living near DoD ranges on explosives hazards associated with UXO and trespassing on Makua

- Respond, in accordance with established explosives safety authority, to a release or substantial threat of a release of munitions constituents from an active or inactive range to off-range areas, when such release poses an imminent and substantial threat to human health or the environment.

Should the use of the range area at Makua change, the Army will be required to conduct appropriate range clearance operations consistent with the proposed new use of the area. The Army must also conduct range clearance operations necessary for safe range operation and maintenance in accordance with AR 385-63.

Historically, the quantities and types of munitions used at Makua have decreased substantially through the years. Prior to 1985, use of Makua Valley was unconstrained, and all conventional weapons systems used by an Army division were fired at Makua, including artillery, air defense artillery, helicopter gunnery, rockets, and tank main guns.

Compared to past activities, the Proposed Action is expected to add less lead from small arms munitions, and residual amounts of RDX and TNT from the detonation upon impact of high explosive artillery and mortar rounds. Burning of excess powder increments would also occur as part of training and as part of the Proposed Action. Burning of powder increments is conducted under strictly controlled conditions and contaminants are precluded from release into the environment (see 2.6). This is done in the field south of the helipad and all ash is removed. The Halliburton study also showed that contaminants from this past use would not migrate off the reservation for two or more millennia. The study showed that soil samples collected from areas to be used for training were not contaminated. If contamination occurs, the migration down to the installation boundary would also be very slow, on the order of thousands of years.

The Proposed Action is a reduction in the types and level of contaminants being introduced into soils, when compared to past training actions. In addition, the Army plans to conduct long-term groundwater monitoring for potential contaminants such as RDX, TNT, and lead in coordination with EPA and the public. The purpose of this new program is to address community concerns regarding groundwater contamination leaving Makua, and to enable the Army to take action when and if necessary. Through coordination with the Waianae community, monitoring data and information will be made available to the public on a routine basis.

4.13.4 Conclusion The Halliburton study relied on extensive soil sampling and geophysical investigation to determine the parameters under which contaminants might migrate from soil to groundwater. The study employed a sophisticated computer model to simulate migration from soil to groundwater. The study also looked at the potential for surface water to transport contaminants to the installation boundary. Soil, sediment from the dry streambed, and a groundwater-monitoring sample from a well that is recharged by Makua Stream were examined. None of those samples exceeded EPA's conservative health criteria. The study showed that contamination from past training activities was low, and that contaminants from the most contaminated site at Makua (the OB/OD unit) would take thousands of years to migrate to the installation boundary. This indicates that the migration of contaminants from adjoining training areas is also a slow process, and that groundwater at the installation boundary is not contaminated. Therefore it is concluded that past training activities, which were largely unconstrained in terms of quantities of ordnance used and the types of weapons employed, have not had a significant impact on the environment. Resuming training at the CCAAC, at a reduced level from its previous uses, would also not have a significant impact on the environment.

Other factors contributing to this conclusion of no significant impact to soil or groundwater are:

- Groundwaters beneath Makua Valley in the Keeau aquifer are not used for drinking, either by the public or the military. The flow of groundwater is from mauka to makai, or from the mountain to the sea. If there were an interconnection with the Makaha aquifer to the south of Makua, the groundwater flow would be north from the wetter Makaha valley to Makua valley, and then west towards the ocean. The likelihood of water from Makua valley contaminating water from Makaha valley (which is used by the public for drinking) is very low or non-existent.
- Both the US EPA and the DOH agree with the findings of the Halliburton study. As recently as September 1998, both EPA and DOH supported delayed closure of the former OB/OD site, indicating that they are not concerned about adverse impacts to human health or the environment.
- As an additional measure, the Army will work with EPA and the community to develop a program to monitor groundwater routinely near the installation boundary, and to make these results available to the public. The groundwater-monitoring program will provide the Army a means for monitoring any increasing contaminant trends. This will allow the Army to be proactive in coordinating with EPA and the Hawaii DOH to take corrective measures if needed.

In summary, soil and groundwater samples are indicative of past military use of Makua. Currently, no scientifically objective information demonstrates that the cumulative impacts of training on soil and groundwater have been significant. It is anticipated that the Proposed Action, returning to training at a reduced level, will not have a significant impact on soil or groundwater because of the release of hazardous substances.

4.14 TRANSPORTATION

4.14.1 Affected environment

4.14.1.1 Makua Vehicular traffic enters Makua from Farrington Highway through a gate controlled by Army personnel. Farrington Highway subsequently comes to a dead end approximately 5 miles northwest of Makua and Makua Valley Road. The only other mode of transportation within Makua is several authorized helicopter-landing sites.

Munitions safety procedures The public has expressed concern regarding transport of ammunition to Makua. To date, there have been no reported cases of transport accidents involving accidental detonation of ammunition on Oahu while moving ammunition to training areas. The September 24, 1999 25th ID(L) and USARHAW memorandum, "Training and Licensing Requirements for Personnel that Handle or Transport Hazardous Material (HAZMAT)," requires that transport of hazardous materials be conducted compliance with all federal laws and regulations outlined and mandated. The following summarizes key requirements addressed in the memorandum:

- All Army personnel who handle or transport HAZMAT must be trained to specific standards mandated by federal law.

- All personnel handling HAZMAT must receive Hazard Communication (HAZCOMM) training. Training should be provided on an annual basis. Newly, assigned personnel must receive training within 90 days of assignment.
- Drivers must receive HAZMAT training, to include as a minimum: General Awareness/Familiarization Training and Function Specific Training (Safe Transportation of Hazardous Materials Course).
- When transporting HAZMAT, all vehicles operators must have on their person a commercial drivers license, and appropriate endorsements, a medical card, HAZMAT card for personnel certified to transport HAZMAT.

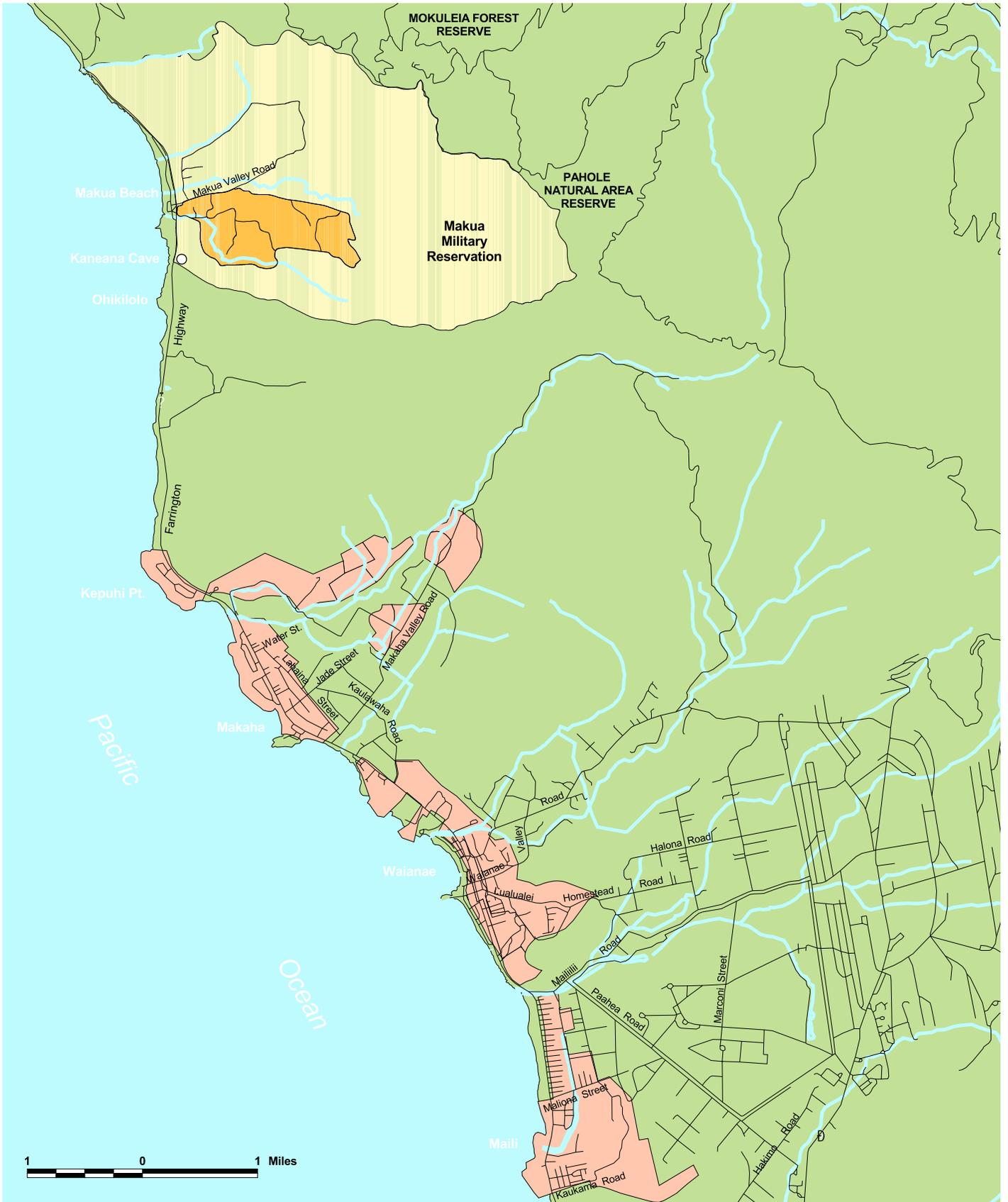
Ammunition and artillery are packed according to Army and federal regulations. The ammunition is stored in specialized packing materials that minimize the risk of accidental explosion. Artillery and mortar ammunition is packed separately from the fuses to make it impossible for the explosive charge in each round of ammunition to be ignited. Because all the vehicles used in movement to Makua are diesel powered, the risk of fire from a wreck is less than would be the case with gasoline-powered vehicles, with their more volatile fuel.

Routes for transporting ammunition Ammunition used for training at Makua is transported from three separate storage facilities locations: Wheeler Army Airfield, the Naval Magazine at Lualualei, and the Naval Magazine at West Loch. The primary routes for ammunition transport are along Farrington Highway, Interstate Highway 1 (H-1) and Interstate Highway 2 (H-2). Descriptions of the routes used for transporting munitions are provided below, and shown in Figure 2-2.

Vehicles transporting ammunition from Wheeler begin at Aerodrome Road at Wheeler, and exit through Kunia Gate onto Kunia Road heading east, then turn onto Wilikina Drive, which transitions into Interstate Highway H-2. At the intersection of Interstate Highways H-2 and H-1, the vehicles proceed west on H-1, which eventually becomes Farrington Highway (Highway 93) just past the city of Kapolei. The vehicles then continue on Farrington Highway to Makua. If a secondary route were necessary, Kunia Road south to H-1 would be used.

The approved route for the transportation of explosives from the Naval Magazine at Lualualei to Makua begins at Lualualei Naval Road (Highway 780) to Farrington Highway (Highway 93) proceeding onto Makua Valley Access Road (Figure 4-13, Major Roads). The approved primary route from the Naval Magazine at West Loch to Makua is Iroquois Road (Highway 764) to Fort Weaver Road (Highway 760) to Kunia Road onto H-1 freeway west to Farrington Highway and proceeding to Makua Valley Access Road. A secondary route begins at Iroquois Road following Geiger Road through the former Naval Air Station Barbers Point to Fort Barrette Road onto Farrington Highway proceeding to Makua Valley Access Road (25th ID[L] and USARHAW Schofield Barracks, 1999).

Vehicle movements A convoy is normally defined as six or more military vehicles moving simultaneously from one point to another over a given period of time. On Oahu, a convoy serial (a group of military vehicles moving together) is limited to 24 vehicles. Per command guidance, USARHAW convoys normally maintain a gap of at least 15 to 30 minutes between serials, and 50 to 100 meters between vehicles. In addition, units must seek permission from the 25th ID(L) for convoys of 25 vehicles or more. Permission must also be granted from the State of Hawaii Department of Transportation (DOT)



-  Road/Trail
-  Stream
-  Makua Military Reservation
-  CCAAC Impact Area
-  Urban Land
-  Other Land

Data Source: Hawaii State
Department of Transportation,
Highway Planning Branch, 1998



Figure 4-13:
Major Roads

to move oversized or outsized cargo over state highways. As long as all federal, state and DOD regulations are followed, no additional permits are required to move munitions. To ensure maximum safety, all convoys must comply with local policies as specified in standing operating procedures which direct such matters as vehicle safety inspections, convoy safety briefing, and that vehicle operators are properly trained and licensed to operate assigned military vehicles.

Per standing operating procedures, military convoys are normally restricted from operating on state highways between the hours of 6:00 AM and 8:00 AM, and 4:00 PM to 6:00 PM during the normal workweek. This is to avoid peak traffic hours and reduce the risk of accident. In addition, convoys and ammunition movements are normally not authorized to pass through a school zone during the hours when students are in-transit to and from school (i.e. school zone lights are flashing).

All military vehicle operators must be trained and licensed to safely operate each specific type vehicle. Drivers transporting munitions, a hazardous material or HAZMAT, are required to pass a 40-hour “Safe Transportation of HAZMAT” class. Upon successful completion of the course it is annotated on their individual OF Form 346 (Military Drivers License), as well as their DA Form 348. Only instructors who have completed a rigorous 80-hour HAZMAT course may teach these classes.

4.14.1.2 Waianae Farrington Highway is the primary north-south arterial highway in the Waianae District (Figure 4-13). Farrington Highway is the only road providing a connection between the Waianae District to Ewa and to Honolulu. It is a four-lane divided highway to Makaha Valley Road, and a two-lane undivided highway to its terminus at Keawaula (City and County of Honolulu, 1999).

The general public can use Makua Beach west of Farrington Highway except when such use interferes with training or endangers the public. In these instances, the Army would publish a notice three days prior to training that restricts public use of the premises and controls traffic over Farrington Highway. The highway is not closed for more than 15 minutes at a time (Information Paper, 1997).

Farrington Highway serves as the primary local coastal road for trips within the District as well as the only commuter highway for trips outside of Waianae. Throughout the length of the route, Farrington Highway is congested during peak periods, limiting its capacity as an arterial road serving both through and local traffic. The segment between Waianae Town Center and Nanakuli, located south of Makua, experiences severe congestion (City and County of Honolulu, 1999).

Traffic counts and existing peak hour traffic volumes for Farrington Highway were obtained from the Hawaii Department of Transportation, Highway Planning Branch. Traffic count data were recorded from April through December 1998. Traffic count and station summary data are summarized in Figure 4-14. Morning (5:00-9:00 am) and evening (3:00-7:00 pm) peak hour traffic volumes from 1998 are summarized in Figure 4-15.

4.14.2 Environmental consequences of No Action The No Action alternative is described in detail in 3.2. The only traffic generated by operations at Makua would be that resulting from staff and contractor personnel commuting to the site. During the period between the decision to stop training and the completion of the disposal process, the already minimal impact and risk of Army traffic on the roadway system would be eliminated. Increased traffic could occur as a result of workers commuting to

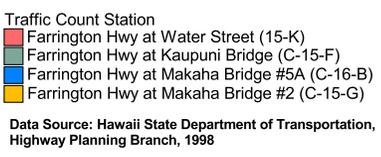
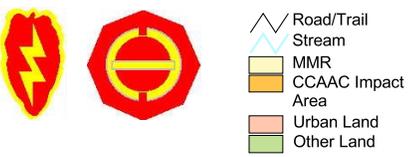
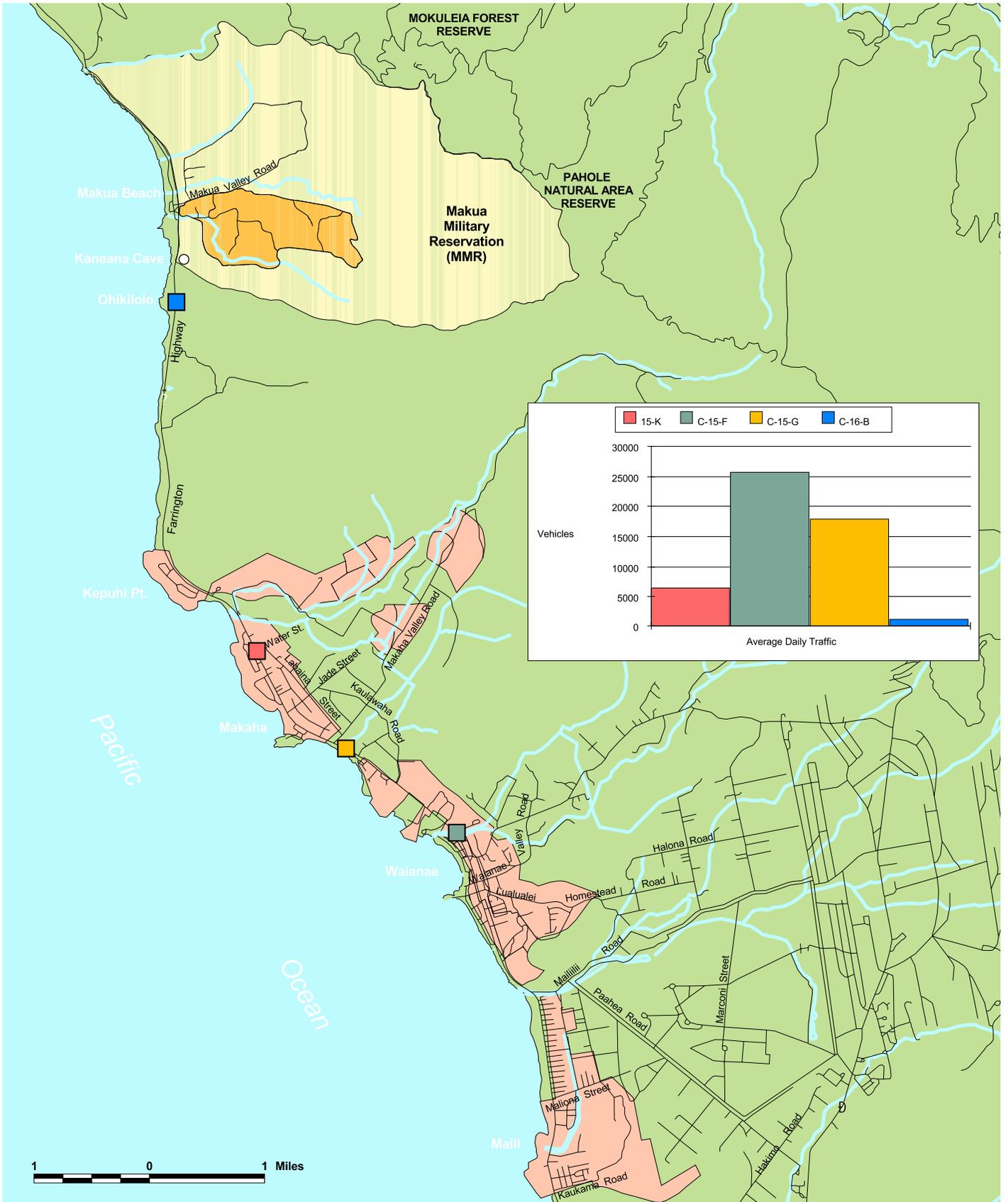
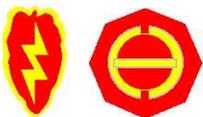
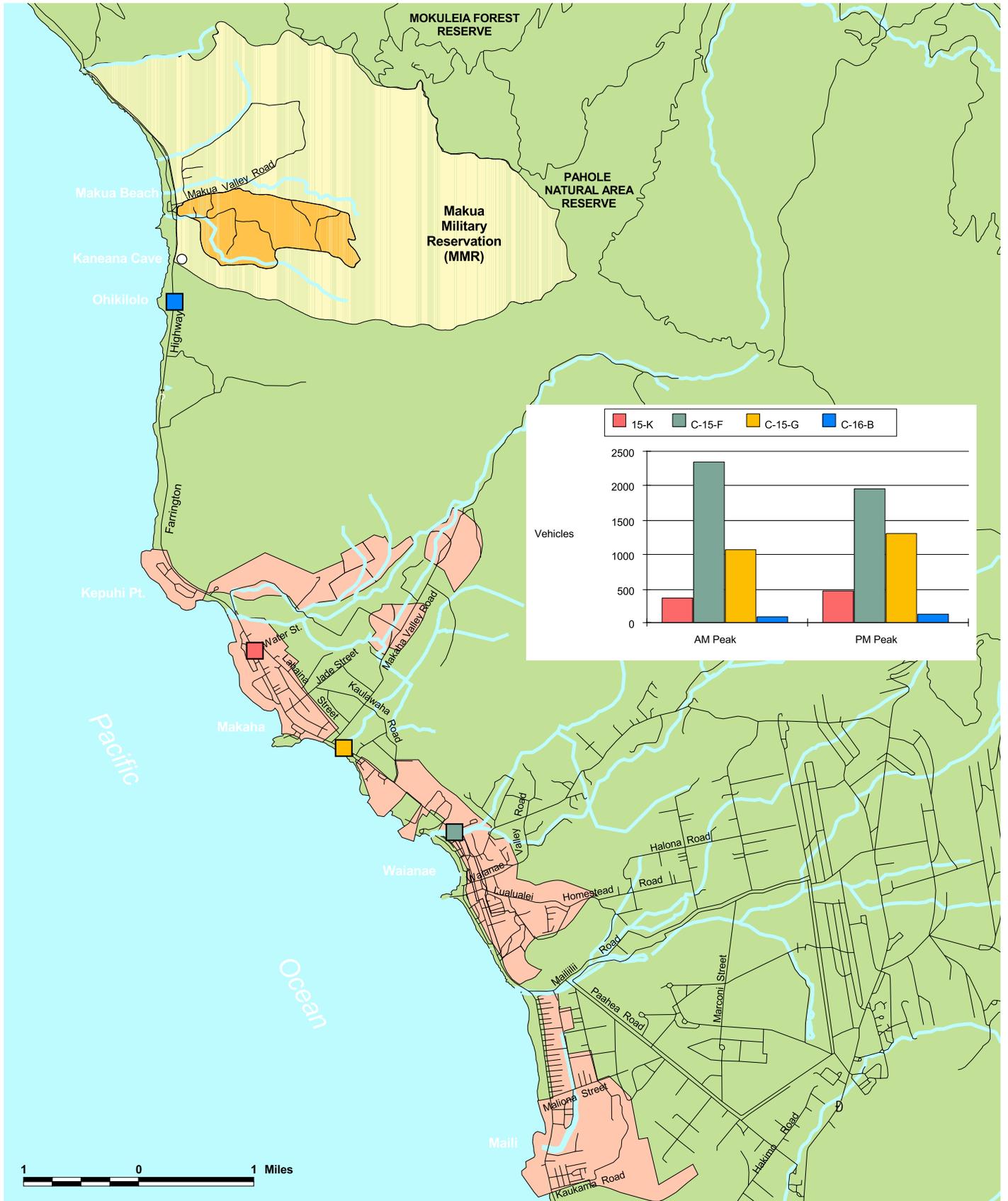


Figure 4-14:
1998 Average Daily Traffic



- Road/Trail
- Stream
- MMR
- CCAAC Impact Area
- Urban Land
- Other Land

- Traffic Count Station
- Farrington Hwy at Water Street (15-K)
- Farrington Hwy at Kaupuni Bridge (C-15-F)
- Farrington Hwy at Makaha Bridge #5A (C-16-B)
- Farrington Hwy at Makaha Bridge #2 (C-15-G)

Data Source: Hawaii State Department of Transportation, Highway Planning Branch, 1998



Figure 4-15:
Existing AM(PM) Peak
Hour Traffic Volumes

Makua to work on the UXO cleanup and increased truck and equipment traffic that will be transporting equipment and supplies to Makua and UXO to an approved disposal site. This traffic increase could result in a substantial impact, but it would also be temporary. All transport would be conducted in accordance to federal and state guidelines. Traffic impacts from future reuse of the land are not known, but would be subject to their own NEPA evaluation.

4.14.3 Environmental consequences of Proposed Action Under the Proposed Action, the Army would continue using Makua Military Reservation as a CCAAC, but at reduced level. There would be minor increases to traffic volumes along Farrington Highway when training occurs at Makua. Army trips make up a very small percentage of all Farrington Highway traffic, and to the extent possible, the Army schedules its movements to and from Makua so as to avoid peak traffic hours. (Figure 4-14, Average Daily Traffic, and Figure 4-15, Existing AM/PM Traffic). Some trips to Makua are also made with vehicles traveling separately, rather than in traditional Army convoy fashion. In accordance with Army Memorandum, 1999, transport of ammunition (HAZMAT) would be in compliance with federal laws and regulations. Transport of ammunition on the public highway usually occurs outside of school hours (7:50 AM to 2:12 PM). Military vehicles moving over public roads to Makua would result in no significant impacts to traffic, safety, or the Waianae community.

4.15 CUMULATIVE IMPACTS According to CEQ regulations and guidelines entitled “Considering Cumulative Effects under the National Environmental Policy Act,” cumulative impacts are defined as: “Impacts on the environment which result from the incremental impact of the action when added to other past, present, and reasonable foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions.” (40 CFR 1508.7)

Cumulative impacts result when impacts associated with an individual action are considered collectively with other actions taking place in a particular area and within a particular period of time. The premise of cumulative impact analysis is the combination of these impacts and any resulting environmental deterioration over a period of time. Consequently, the cumulative impacts are the total impacts on a resource, ecosystem, or community of that action and all other activities affecting that resource (EPA 1999b).

4.15.1 Past military use of Makua Military use of Makua dates back to the 1920s. After the bombing of Pearl Harbor on 7 December 1941, the Army occupied land covering the entire Makua-Kaena Point. In December 1942, the Army issued a Real Estate Directive for 6,600 acres of land at Makua that were already being used. Private parcels within the property were purchased or taken by condemnation, whereas territorial lands were conferred by the territorial governor’s consent.

Past military training at Makua is addressed in 4.13, Hazardous Substances. Records indicate that Makua or portions of Makua have been used for various purposes. Included in operations conducted in the past are OB/OD operations in which 4 acres of Makua were used to dispose of waste materials. An additional site approximately 30 feet in diameter was used as a landfill for junk automobiles, metal frame, metal parts, barbed wire and concertina wire. Another site was also used as septic tank and leaching field. For a period of four years in the early to mid 1940s, the government of Honolulu operated a waste disposal site at Keawaula, adjacent to Makua. The size, location and types of waste disposed of are unknown.

During World War II, use of Makua intensified, and joint Army-Navy maneuvers took place. The number of troops, which lived and trained in this area during the war has been estimated to be between 15,000 and 20,000. Invasion training activities included naval and aerial bombing of the valley, while battleships shelled from the ocean, and troops from amphibious craft landed on the beach. During these operations, several buildings were destroyed, and tombstones in the cemetery were defaced.

Information concerning the use of MMR from 1951 to 1964 is scarce. It appears that continuous use of Makua occurred after 1961 in preparation for Vietnam. Ordnance demolition and artillery firing from nearby installations, tanks, and infantry assault weapons occurred regularly. The Navy conducted final maneuvers at MMR in 1965, and from 1964 through 1977, the Army and Marines trained most regularly at MMR. In 1977 the United States Air Force (USAF) also began to use MMR for training. In 1973, the Army disposed of approximately 1,816 kilograms (kg) of hazardous chemicals from the University of Hawaii at the MMR explosive ordnance disposal (OB/OD) site. Similar activities have continued at MMR to [1976]. (Sox, 1977; Hommon 1980; USASCH, 1976). (OB/OD disposal was discontinued in 1992). (McMaster, Bonds, Carter, *et al*: Installation Assessment of US Army Support Command, Hawaii, Installations Volume II)

4.15.1.2 Present military use of Makua Cumulative impacts from activities at Makua other than Army activities should be minimal, as the Army controls the property and activities thereon. There is no private camping, no commercial development, no ranching or agriculture on site. There is the chance of fire originating off-site and coming onto Makua. There is also the possibility of damage to natural or cultural resources in other places in the state making those at Makua more valuable. Public use of the beach will not have any significant cumulative impact.

4.15.1.3 Effects of other Army activities Generally speaking, effects of other Army activities in Hawaii would not be cumulative with the activities at Makua. Impacts to geology, soils, hydrology, air, noise, infrastructure, and transportation are localized to the area of Army activity. Impacts on natural and cultural resources in the state from Army activities might be cumulative, but this is considered and accounted for during the Section 7 and Section 106 consultations on Army activities. In fact, the implementation of such consultations build on each other, and the fact that the Army does these for one area builds relationships and enhances the overall environmental program and consultations for other areas.

4.15.1.4 Effects of non-Army activities Other lands border Makua, including federal, State, and private lands. This includes Kaena Point Radar Tracking Station (USAF), Yokohama Bay State Park, Pahole Natural Area Reserve, Mokuleia Forest Reserve, and the Ohikilolo Ranch. None of the activities conducted on these lands involves the use of live ammunition. They consist of military use, recreational use, and ranching. Because of Makua's isolation, none of these other activities will have any cumulative effect on Makua.

The activities at Makua will not have an adverse cumulative impact on the environment when considered together with the activities at these adjacent areas. This is in part because of the low impact of those adjacent activities and because of the isolation of Makua and the consequent buffer for the proposed action there.