Waipi‘o Valley
Stream Management Plan

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NRCS

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CHAPTER 1: INTRODUCTION

"There is special *mana* (spiritual power) in Waipi'o. *Mana* from long ago; *Mana* still there; *Mana* still alive". Waipi'o Valley embraces in that *mana* many things. It embraces the *wai*, the inland waters, coursing through the valley floor, or simply falling from the sky, touching, and in the touching, along with '*Aina*, the Land, nourishing all it touches. It embraces *Kalo* (also known as taro) and the many other plants which abound. *Ka po'e,* the people, themselves are embraced by the *Mana* of Waipi'o and over the generations of being embraced, have become kin to the spirit of the valley. Out of this sense of kinship grows the *Aloha* (love) and a sense of *malama 'Aina*, caring for the '*aina*, protecting the integrity of Waipi'o by perpetuating her ability to flow and flourish, and continue to touch the lives of so many more to come. This is the spirit of the valley" (Joint Effort between the Waipi'o Taro Farmers Association and Bishop Museum 1993).

Figure 1: Wailoa River Estuary in Waipi'o Valley

This excerpt from the leases between Bishop Museum and the members of the Waipi'o Valley Taro Farmers Association begins to portray the spirit of Waipi'o and one motivation for the development of a stream management plan for Waipi'o Valley. The connection between the people and the water in Waipi'o is a profound one with a complex auwai system that has been managed for hundreds of years to provide food and preserve culture. In recent history, the decrease in active taro farmers, the increase in invasive species and the evolution of modern regulatory constraints have made managing the streams in Waipi'o exceedingly difficult. The farmers and residents of Waipi'o

One resident intelligently noted, "the greatest accomplishment of the plan would be to help keep "the long lasting breath of Haloa…alive."

need to find a balance between traditional and modern management techniques to provide flood control, improve and maintain water quality and protect native species.

The purpose of the Waipi‘o Stream Management Plan is to assist Waipi‘o taro farmers and residents with maintaining the streams in Waipi‘o and help them successfully operate in a traditional manner but within the constraints of modern law and society. The plan addresses stream activities and the permits and approvals necessary to conduct stream maintenance activities for the protection of the property and livelihood of the residents of Waipi‘o Valley. In addition, the plan also strives to help maintain aquatic habitat for native organisms and preserve the cultural heritage of the Valley. The management plan was developed in a holistic manner with the idea that traditional and customary practices should be preserved, including the traditional taro-growing water management system led by waterhead leaders (see Figure 2).

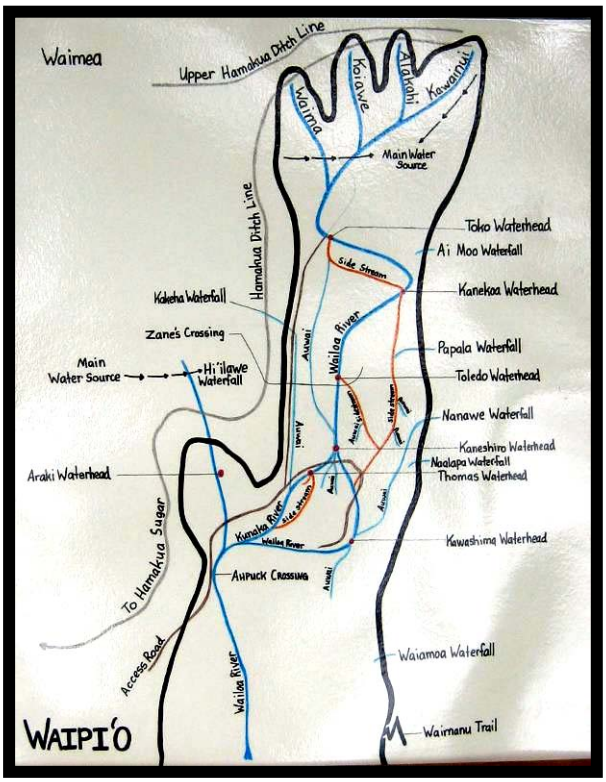

Figure 2: Hand-Drawn Map of Waipio Auwai System.

The Natural Resources Conservation Service (NRCS) agreed to help develop a stream management plan for Waipi‘o Valley after concerns were raised during the planning of the Lower Hamakua Ditch Watershed Project where Waipi‘o farmers vocalized needs for assistance with stream maintenance issues. The plan includes the following basic elements:

1) **a brief description of existing and historical conditions in Waipi‘o Valley,**
2) **a summary of the community’s involvement in a process that identifies stream management needs and activities in the Valley,**
3) **alternatives for maintenance of the stream corridors in Waipi‘o,**
4) **a description of the necessary permit processes for stream management activities,**
5) **proposed strategies for implementation of the Plan and**
6) **possible funding opportunities for stream management activities.**

Another taro farmer remarked that if “the people of Waipi`o work together, the kalo will be better.”

The Waipi‘o Stream Management Plan will serve as a tool for current and future residents and farmers in the area as well as government regulatory agencies. It was developed with an understanding that Waipi‘o is a sacred place that should be preserved for the future, and Waipi‘o is also a place for farmers and residents to enjoy life. The plan is meant to be sensitive to people and wildlife and to aid farmers and residents in balancing their need for water, flooding concerns and value of nature. The Plan will provide a resource to help the community work together and is written in a way that all farmers and residents of Waipi‘o will be able to understand the plan and agree on the basic elements of the plan. The Waipi‘o Community Circle helped the public participate in the development of the plan and will assist with implementation of the plan. A guiding principal in the development of the Stream Management Plan is that is important to include the entire community in the process.

At a meeting with members of the community and a variety of government agency representatives, a Waipi‘o resident, stated “the wisdom and aloha in the room needs to be acted upon – actions taken.”

CHAPTER 2: BACKGROUND

History

Waipi‘o Valley is rich in history. Waipi‘o once supported thousands of Hawaiians who used the valley’s rich soil to cultivate massive amounts of taro. After Western contact taro production as well as the population of Waipi‘o declined. Since the native Hawaiian period, taro farming in Waipi‘o has experienced many cycles with rejuvenation and decline caused by influences like the rise of rice production, the devastating tsunami of 1946, and the Hawaiian renaissance focusing attention on kalo culture. Now Waipi‘o Valley is experiencing an increase in commercial farming activity with new lo‘i being opened or restored and a revival of cultural transmission between generations, based in youth education and Hawaiian taro practices.

Characterization of the Valley

Waipi‘o Valley is most significant in Hawaiian history and culture. The valley was a major population and agricultural center. The primary crop cultivated in the Valley was taro. The Valley was also a royal and religious center and a seat of power. Ancient archaeological sites include trails, heiau, fishponds, lo‘i, ‘auwai, kula lots, house sites, royal residences and compounds, burials, etc.

The legacy of Waipi‘o Valley continues today through the cultivation of taro and the perpetuation of Hawaiian cultural traditions and a familial connection to the ‘aina, the land. The people of Waipi‘o refer to the valley as a “Wahi Pana”, a noted, a celebrated place, and even as a “Wahi Kapu”, or a sacred place. This characterization of Waipi‘o helps residents and farmers to respect and take care of the valley, and to come together even when there are different views of the management and use of the valley.

On December 7, 1778 Captain James Cook’s ships stood within a half-mile of Waipi‘o and Waimanu, briefly exchanging items for pigs and other food and noting “many houses” (Cordy 1994). The Valley has changed over the years but its evocative image persists. Rev. William Ellis described the view of the Valley in 1823:
“Viewed from the great elevation at which we stood, the charming valley, spread out beneath us like a map, appeared in beautiful miniature. Its numerous inhabitants, cottages, plantations, fishponds, and meandering streams, with the light canoe moving to and fro on the surface of the latter, gave an air of animation to the scene, in which the distinct and varied objects were blended with the most delightful harmony” (Ellis 1979 {1842}: 354)

Others visitors provide similar romantic descriptions of a lively valley.

Hiram Bingham in 1830:
From the lofty precipice on the south-east of Waipiʻo, I had an enchanting view of a Hawaiian landscape of singular beauty and grandeur…the dwelling place of twelve or fifteen hundred inhabitants…The numerous garden-like plantations of bananas, sugar cane, potatoes, the cloth plant, and the kalo, in different stage of advancement, from recent planting to maturity, some with narrow, and some with broad green leaves of different shade, embossed upon the silvery water…the unruffled fish ponds; the quiet hamlets near the cliffs, the small scattered thatched huts of the inhabitants… the tents of traveling chiefs, pitched near the sand banks, at the sea shore…. Scarcely a sound was heard from the valley at that soft hour, as the sun was retiring beyond the western heights, except the repeated and reverberating strokes of the cloth mallet, on the bark-beater's beam (Bingham 1969).

Bates in 1853:
"the scenery was grand….The Valley of Waipiʻo may justly be termed the Eden of the Hawaiian Islands…The scene was truly magnificent…It seemed to belong to another world…" (Bates 1854: 383).

Isabella Bird in 1873:
"The prospect below was very charming, a fertile region perfectly level, protected from the sea by sandhills, watered by a winding stream, and bright with fishponds, meadow lands, kalo patches, orange and coffee groves, figs, breadfruit and palms. There were a number of grass houses , and a native church…and another up the valley…" (Bird 1974 {1890}).

Waipiʻo Valley housed and supported in ancient times a significant population base. The Valley may even have been one of the first settlements in Hawaiʻi (c. 0 - 600 A.D.). Some oral traditions place the overall population outside and inside the valley supported by taro farming as high as several thousands.

Corroboration of the sustained high productivity of the Valley and its importance throughout the Hawaiian Islands is reported in oral history. In the early 13th century

Waipiʻo valley was a main source of food during a severe drought in Hawaiʻi. The explanation rests in the reliability of water flow to the cultivated lands in Waipiʻo. Fornander reports:

> **"..during a spell of great drought when a great famine was experienced over all the lands from Hawaii to Kauai, all the wet lands were parched and the crops dried up on account of the drought, so nothing remained even in the mountains. Waipiʻo was the only land where the water had not dried up, and it was the only land where food was in abundance; and the people from all parts of Hawaii and as far as Maui came to this place for food". (Fornander Vol. IV, 1916 in Lennon 1954)**

In ancient times, possibly 800 acres of taro were cultivated in the lower Valley. Altogether, including the upper Valley and the slopes, at least 2 square miles (1,280 acres) were cultivated in taro. Wetland taro fields covered the entire Valley floor (Lennox 1954).

At the time of Western contact in 1778, Waipiʻo may have had a resident population of approximately 2,600 persons (Cordy 1994). In 1823, the Reverend William Ellis, recorded seeing 265 houses, 8 heiau and major ponds in the Valley which he estimated to support approximately 1,325 residents (Ellis, 1979 {1842}: 364). Ellis wrote:

> **"The bottom of the valley was one continuous garden cultivated with taro, bananas, sugar cane, and other production of the islands, all growing luxuriantly. Several large ponds were also seen in different directions, well stocked with excellent fish. A number of small villages, containing from twenty to fifty houses each, stood along the foot of the mountains, at unequal distances on each side, and extended up the valley till projecting cliffs obstructed the view" (Ellis 1979{1842}: 356)**

Ellis counted forty-three houses in the village of Nāpōʻopʻopʻo (Ellis 1979{1842}: 356) The cultivated taro acreage decreased during the post–contact period. By the late 1800s only 200 Native Hawaiians were left in the Valley; it's population reduced by disease and emigration.

Population estimates and censuses of Waipi‘o indicate a steady decline of population post-contact:

YEAR	POPULATION[1]	SOURCE
1778	2, 609	Cordy 1994
1831-32	1,200	Cordy 1994
1842	921	Cordy 1994
1845	824	Lyon 1842 in Cordy 1994
1849	736	Lyon 1842 in Cordy 1994
1850-1860	700-800	Culter 1931
1854	260	Bates 1854
1867	670	Bond in Damon 1927
1873	200	Bird 1974 {1890}
1878	396 in 75 households	Hawaiian Kingdom Census
1890	439	Hawaiian Kingdom Census
1910	399	U.S. Census

Table 1: Estimates of Population in Waipi‘o

In 1940 about 200 people lived in the valley. By 1972, it was estimated that “approximately seven old bachelors lived in the valley” but in 1974 thirty or forty farmers cultivated kalo in the valley (Ethnic Studies Program 1978). Now in 2005 about 30 to 40 people live in the valley. The majority of farmers reside outside of the valley.

During the second half of the 19th century, rice was introduced to the Valley by Chinese immigrants. By 1880, only 580 acres were cultivated in the Valley with both taro and rice. “The cultivation of taro never completely vanished in Waipi‘o, but for a time, rice seemed to eclipse taro – and the Chinese planters outnumbered the native Hawaiians” (Environment Hawai‘i, 1995, p. 4). Emerson’s 1881 map depicts several rice mills. There were five poi factories in the early 1900s (Lebo, 1999)

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[1] **Missionary censuses counting only parishioners may undercount actual population of a district. Hiram Bingham in 1847 estimated the population of Waipi‘o from 1,000 to 1500 inhabitants (Bingham 1981 {1849}).**

Woo and Murray (1994) summarized the data in Wright's Waipi'o Map of 1914:

> **Rice was limited in the makai portion of the valley with a total of 134 acre in rice. Rice fields ranged from 0.25 to 24.2 acre. Only four of the 34 parcels were over 4.0 acres in size.**
>
> **Kalo was cultivated in 57.47 acres:**
>
> - **Makai section: 37.01 acre in 23 kalo parcels ranging from 0.20 to 5.75 acres. Only 3 parcels were larger than 4.0 acres.**
> - **Middle section: 19.31 acres in 14 kalo parcels ranging from 0.10 to 5.9 acres. Only 2 parcels larger than 4.0 acres.**
> - **Mauka section: 1.15 acre in 2 kalo parcels, each less than 1 acre. (Lebo 1999)**

For most of the 20th century, Waipi'o Valley was marked by continued decline in population. At the dawn of the new century, in addition to its residents, the Valley was home to several churches (Catholic, Congregational, Mormon and a small Chinese Temple), stores, and even a school. By mid century, these institutions were gone. The school closed in 1945 and the others closed shortly thereafter. Waipi'o's last rice crop was harvested in 1927 because the crop was not competitive with relatively inexpensive California–grown rice. On April 1, 1946 a tsunami originating from an Alaskan earthquake inundated the lower Valley. NOAA estimated the wave height to be nearly 40 feet. The tsunami destroyed many homes and buildings and swept over most of the taro lo'i.

Lennox reported approximately 300 acres total were utilized for taro cultivation in 1954, but only 150 acres were actively cultivated at any one time, the rest being fallow (Lennox 1954). Resident population at the time was reported to be around 30 - 40 people.

Lennox further assessed the potential for agricultural development of the valley and calculated that under different combinations of crop cultivation (taro, lotus, ginger, misc., passion fruits, macadamia nut, ti) the residents farm population would range between 52 and 65 adults head of family (Lennox, 1954).

A Land Study Bureau report completed in 1960, estimated approximately 100 acres of taro being cultivated along with 11 acres of macadamia nut trees, 5 acres of lotus root and an

orchard of coffee. A permanent resident population was virtually non-existent. Farmers typically resided outside of the Valley and commuted in to work their taro patches.
The ahupua'a of Waipiʻo, as an ancient district, not only included the valley itself and its several branches (Waima, Koiawe, Alakahi and Kawainui) but also the uplands of Muliwai on its Kohala side, and the uplands of Lālākea ili, thus providing its chiefs and tenants the necessary mauka and makai resources (Cordy 1994:10).
The valley sections from the mouth to the back of the valley, all with a school according to the church records of 1830-40s, were: Keone, Naalapa, Nāpōʻopʻopʻo, and Kōāuka (Cordy 1994:33).

<u>Land Ownership</u>

The valley changed ownership periodically until 1896 when it was conveyed to Bishop Museum. Following the Māhele in 1848, Charles Kanaʻina assumed ownership of approximately 5,800 acres in Waipiʻo Valley (Royal Patent no. 7529). Other sources give the acreage of 5815, 4830 and 4291 (Lennox 1954:4). Colonel Sam Parker purchased this land at auction in 1881. Parker in turn, sold this land to Charles Reed Bishop who, recognizing the major cultural and historic significance of Waipiʻo Valley conveyed it to Bishop Museum in 1896.

A total of 114 LCAs were claimed for Waipiʻo Valley during the Māhele period. Of these, 82 were awarded, 26 were not awarded and six were actually outside of Waipiʻo Valley. There were a minimum of 1529 loʻi of which 155 were not awarded. The Nāpōʻopʻopʻo village contained at least 410 loʻi, Kōāuka region had 118 and Lālåkea had at least 191 loʻi. There were a minimum of 27 kula plots. Other claims mention eight loko (fishponds) and a couple of hala patches (Olszewski 2000)

To this day, nearly 60% of the valley from mauka to makai is still owned by the Bishop Museum. The museum leases most of its land to farmers for taro cultivation. Kamehameha Schools Bishop Estate owns a large parcel on the Hamakua side of the Valley beachfront including Lalakea Fishpond. The State of Hawaiʻi also owns three large parcels, one on the Kohala front of the Valley containing the Muliwai Fishpond, one at Nāpōʻopʻopʻo Village, and one on the Hamakua side of the upper Valley. Small private landowners own the rest of the land, many of them are also farmers, some are descendent of owners of Kuleana lands. Their names appear on the Map of Waipiʻo Valley done by J. S. Emerson in 1881.

A Royal and Religious Center

Waipiʻo means "curved water". Hawaiians believe that the water belongs to the God *Kāne*, *Kāne-i-ka-wai-ola*, who is the procreator in the water of life. *Kāne* is the embodiment of the male procreative energy (in fresh water, flowing on or under the earth in springs, in streams, in rivers, in falling rain and also in sunshine) what gives life to plants. Rainwater comes from the God *Lono-wai-makua*, the father of the waters, the Heavens, the clouds, and the storms. He is the provider of rain (Handy and Pukui, 1978; Beckwith, 1970).

Any discussion with Hawaiian cultural practitioners about Waipiʻo evolves around the notion of protecting the water of life. Watershed and stream management have to be cognizant of this indigenous cosmological view and that Waipiʻo Valley is a cultural *kīpuka*, or a place where Hawaiian culture is preserved and propagated (McGregor, December 1995, Minerbi, 2001, p. 2).

In ancient times, Waipiʻo Valley was extremely important as a royal and religious center. The Valley was the residence of a succession of nine Pili line rulers (Cordy, 1994:25), the most noted being Līloa and his son ʻUmi-a-Līloa who united the island of Hawaiʻi under a single chiefdom. He was known as a kind and benevolent ruler, unlike his brother Hakau. ʻUmi relocated the royal residence and power center to Kona after his unification of the island of Hawaiʻi. Despite relocation of the power center away from Waipiʻo, the Valley continued to be important as one of many royal residences up until the time of Kamehameha (Cordy 1994).

A pair of savage attacks on Waipiʻo Valley was indicative of its great importance. Keoua Kuahuʻula, ruler of the Kaʻū kingdom, in a preemptive measure against Keawemaʻuhili and Kamehameha, waged war on Waipiʻo (Kamakau, 1992 (a)). The second attack occurred around 1790 by Kahekili of Maui and Kaʻeo of Kauaʻi. The two chiefs joined forces, overtook Molokaʻi and Maui and made way to attack Waipiʻo. Kaʻeokulani savagely attacked Waipiʻo (Kamakau, 1992a:160). In response, in 1791 Kamehameha assembled "a large fleet, well manned, including double canoes armed with cannons, and the sloop Fair American" and engaged the invading forces in the bay outside Waimanu near Waipiʻo (Kuykendall 1938).

Archaeology

Many of the royal archaeological features in Waipiʻo Valley are attributable to the time of ʻUmi or earlier. Several important heiau were located in the front of the Valley behind the

sandy dunes, including Honua‘ula and Moa‘ula, both luakini heiau. The construction of Honua‘ula is generally attributed to Līloa. Paka‘alana another luakini heiau and pu‘uhonua was considered one of the most important and sacred heiau on the island. Paka‘alana originally may have been constructed as early as 1200-1300s (Cordy, 1994) and underwent several renovations in the succeeding centuries. In 1780, Kalaniopu‘u repaired and reconsecrated Moa‘ula heiau and dedicated it to Kūkā‘ilimoku. It was here that Kalaniopu‘u convened in 1780 a council of chiefs in Waipi‘o to solemnly announce that his son Kiwalo would be heir to the kingdom and that Kamehameha I would be guardian of Kūkā‘ilimoku, the war god to the house of Keawe. With guardianship came the responsibility of tending to heiau dedicated to this god (Kuykendall 1938; Feher 1969). All three heiau were still being utilized when ‘Umi assumed power (c. 1600 - 1620) and continued to be used until the abolition of the kapu system in 1819 (Cordy 1994). Within Paka‘alana heiau was Hale O Līloa, a royal mausoleum built by Hakau at the time of Līloa’s death. Hale O Līloa is said to have held the remains of several rulers (Cordy, 1994).

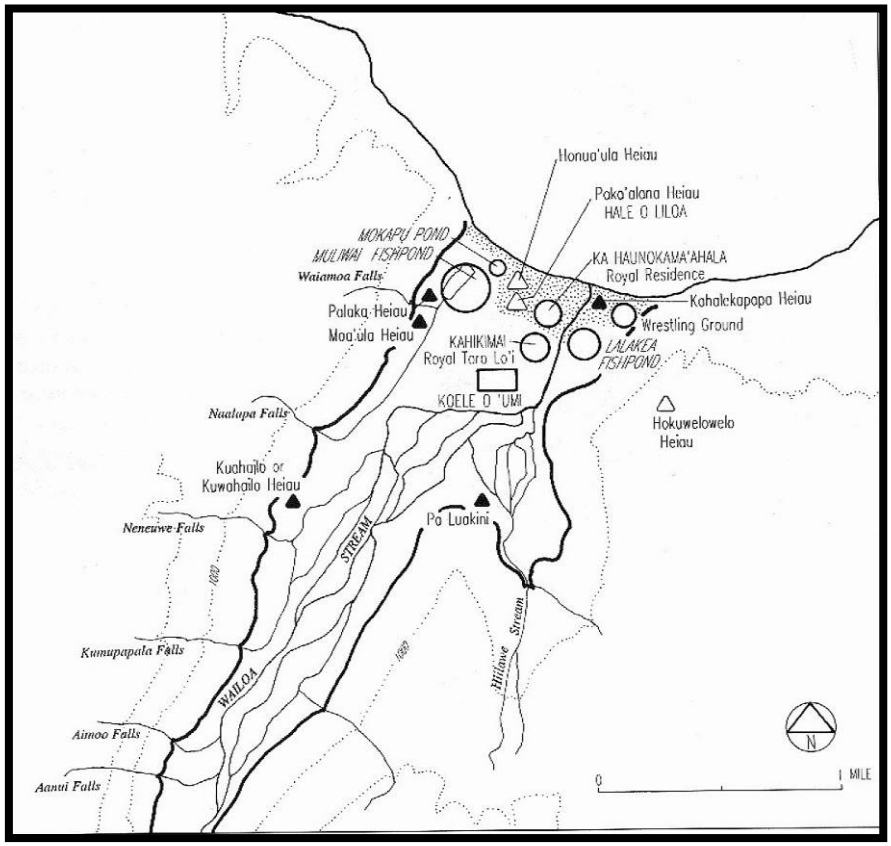

Figure 3: Sites of Waipi‘o (Cordy 1994)

Other heiau and archaeological features are located throughout the Valley. Hōkūwelowelo was located along a cliff on the eastern side of the Valley. A second heiau, Kuahailo was located along the opposite Valley wall about 1.3 miles inland, near Neneuwe Falls (Cordy 1994). Yet another heiau, Palaka, was located closer to the mouth of the Valley near Moa‘ula heiau and Waimoa Falls. Other archaeological features in the area include Mokapu, Muliwai and Lalakea fishponds, Kahikimaiaea (the royal taro patch), and a

wrestling ground. The entire Waipiʻo Valley has been recognized as an archaeological area and given the State Number 7168.

It should be emphasized that Charles Reed Bishop in a letter written in 1897, a year after he conveyed his Valley acreage to the Bishop Museum, wrote:

> **"There is a matter that should not be lost sight of. I mean the acquisition and control of the heiaus and puʻuhonuas, say those of Moʻokini in Kahala [sic], of Puʻukoholā at Kawaihae, of Pakaʻalana in Waipiʻo, …and any other of interest and worth preserving … [O]nce in the control of the Museum they should be protected perpetually" ("From Ancient Times to Today" 1995).**

<u>Mythology and Legends</u>

There are many important associations of Waipi'o Valley with gods, demigods, noted chiefs and personages, making the valley a most important wahi pana for many reasons, including the following:

1) **genealogical connections,**
2) **navigational linkages to Kahiki,**
3) **mythical adventures,**
4) **linkage with the spirit world and underworld,**
5) **supernatural events,**
6) **historical facts,**
7) **sacred sites,**
8) **afterlife,**
9) **poetical narratives and legends,**
10) **hula and chants,**
11) **introduction of Hawaiian ritual and customs and**
12) **important ruling chiefs of Hawai'i.**

The gods Kāne and Kanaloa were believed to have lived in Waipiʻo at Alakahi with other lesser gods. Wākea, who is attributed to be the ancestor of all Hawaiian people was said to have retired to Waipiʻo. Lono's wife Kaikilani was said to be found by his brothers beside Hiʻilawe Falls.

One well–known legend serves as a creation story for Hiʻilawe Falls. As the legend tells it, a beautiful young woman named Hiʻilawe lived in Waipiʻo Valley. One night a young man

named Kakalaoa comes to Hi‘ilawe to romance her. After spending the night together walking and exchanging words of love, the pair comes across a ‘elepaio bird, a bad luck omen. The young couple vow never to be separated and Hi‘ilawe transforms herself into a waterfall and Kakalaoa’s body becomes the large boulder at the base of the cascading waterfall. (Salmoiraghi & Yoshinaga, 1974; “Legends of Waipi‘o Valley”, 1959).

Another prominent legend is the story of ‘Umi, son of Līloa. It is said that Līloa, on a journey to Pau‘uilo, meets a beautiful woman, Akahi. They spend the night together and conceive a child. Līloa tells Akahi that if she has a son, to name him ‘Umi. Before departing, he leaves behind his malo, a whale tooth necklace and his war club as tokens to the unborn child. Umi is born and when he becomes a young man, Akahi tells him of his true heritage and tells him to go to his father in Waipi‘o Valley. She gives ‘Umi the gifts Līloa left and instructs him that upon meeting his father, to sit on his father’s lap and tell him who he is. ‘Umi becomes the favored son and Hakau, Līloa’s other son is enraged with jealousy. Upon Līloa’s death, Hakau inherits the land, but ‘Umi is placed in charge of the gods and the temples. Hakau poorly treats ‘Umi which drives him to leave Waipi‘o Valley. Hakau extends this mistreatment to the people of Waipi‘o, and ‘Umi, upon hearing this, returns to attack Hakau and kills him. Umi then assumes Hakau’s position as chief.

Other significant legends that make Waipi‘o Valley a most storied place mention Kaikilani, a beautiful maiden, the god Lono, the establishment of the Makahiki ritual; L‘ama‘ōma‘o wind and storm deity; the demigod Maui; the gods Kāne and Kanaloa, the lesser gods Maliu, Kaekae, ‘Ouhi; Wākea and Milu as rulers of the underworld; Puapualenalena the yellow dog; the famous conch shell Kihapu; chief Olopana and his wife Lu‘ukia who went to Kahiki after being driven out of Waipi‘o by a flood; Mo‘ikeha who instructed Kila in the art of navigation, who go to Kahiki and established the working days for the chiefs; La‘amaikahiki who introduced image worship, the coconut fiber rope, the kā‘eke drum, and the hula dance; Lu‘ukia who introduced the bark cloth skirt; the network cover for the water gourd, the sacred lashing of the outrigger canoe; the chiefs Līloa, Hi‘ilawe, and Alapai; Ha‘inakolo who brought the drum and kapu ceremonies; Lauka‘ie‘ie the beautiful girl brought up with the birds, flowers and singing shells; (This section abridged from DURP Fall 1999 Practicum: Beckwith 1970 in 5-9; DURP Fall 1999 Practicum: C1-C2).

Geography and Geology

Waipi‘o Valley is a deep erosional valley on the northeast facing slope of the Kohala volcano located in the Hamakua District on the island of Hawai‘i. The area is in the "youthful" stage of the Hawaiian island geomorphic cycle where "V" shaped valleys have formed in the volcanic shield. Steep walls rise 1000 feet above the valley floor near the sea and 3000 feet in the rear of the valley. Much of the original Kohala shield surface remains (MacDonald and Abbott 1970). The Kohala volcano was formed by the Pololu volcanic series about 800,000 years ago. The relatively “soft” volcanic geology through which the valley forming erosion has taken place is thin-bedded, highly vesicular a'a and pahoehoe basalt flows with interbedded ash and tuff layers. In the back of the tributary valleys are accumulations of “hard,” dense basaltic dikes that are generally up to five feet wide and extensively cross-jointed (Stearns and MacDonald 1946). These dike swarms are resistant to erosion and have limited the erosion of the valley to the south. Waipi‘o is about 0.75 mile wide at the mouth with its flat lower valley extending 2.75 miles inland.

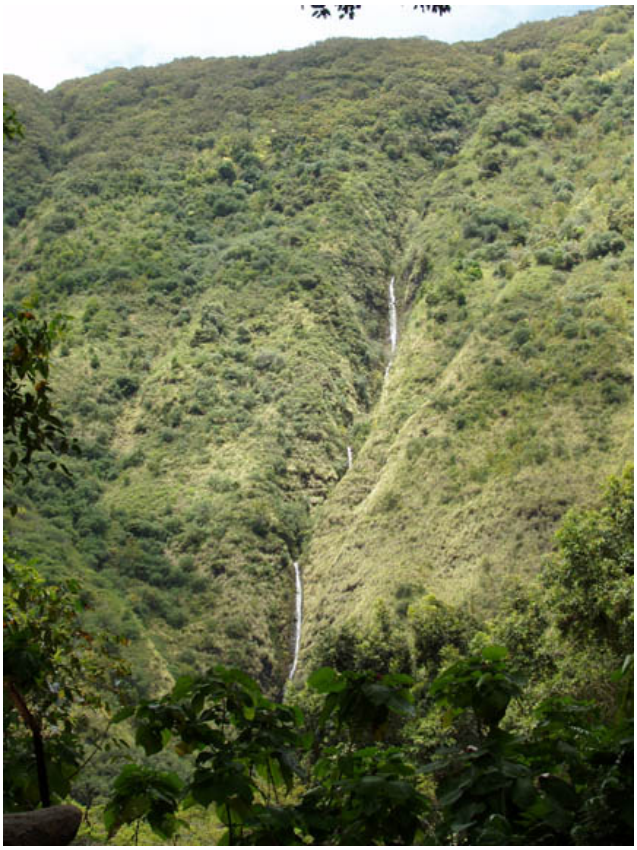

Figure 4: One of numerous waterfalls in this deeply incised valley.

The valley faces into the prevailing Northeast tradewinds. Storm winds from South to Southwest and from a North to Northeast directions have serious effects on vegetation in the valley. Those from the South to Southwest causes defoliation and breaking of branches in the upper valley and along the Southeast wall of the lower valley. Air temperature is strongly influenced by ocean air temperature. Humidity is higher than prevailing in Hawai’i at lower elevations. The rainfall is estimated at 80” or 100” from rainfall maps isohyets (Lennox 1954). The USGS Station no. 16725000 at Alakahi Stream provides real

time data and graph of discharge, in cubic feet per second for the previous 7 days (USGS web page).

Five tributary valleys and their respective named streams feed into Waipi‘o: Hi‘ilawe (*Lift and Carry*), Waimā (*Discolored Water*), Kaiawe (*Move Slowly*), Alakahi (*One Way*) and Kawainui (*Big Water*). The grade of the valley floor is as follows (Lennox 1954):

First mile from the mouth …….. 1/4 %
Second mile from the mouth…….1-1/4 %
Third mile from the mouth……2-1/2 %
Last half mile……5%

The NRCS Soil Survey for the island of Hawaii (1973) shows four major soils types in Waipi‘o Valley that are indicative of the alluvial processes that are at work. Most of the flat bottomland in Waipi‘o is classified as *Tropaquepts* soil. This soil is economically and culturally the most important in Waipi‘o. Agricultural, aquacultural and other economic and social activities have significantly modified the land over hundreds of years. These lands, when flooded, usually receive fine grained sediment deposition. This is the bottomland that is set back from the active river channels.

Land in the Waipi‘o valley bottom that is actively influenced by stream processes, including sediment transport and deposition, stream course changes, and high velocity riverine flooding is classified as Mixed alluvial land.

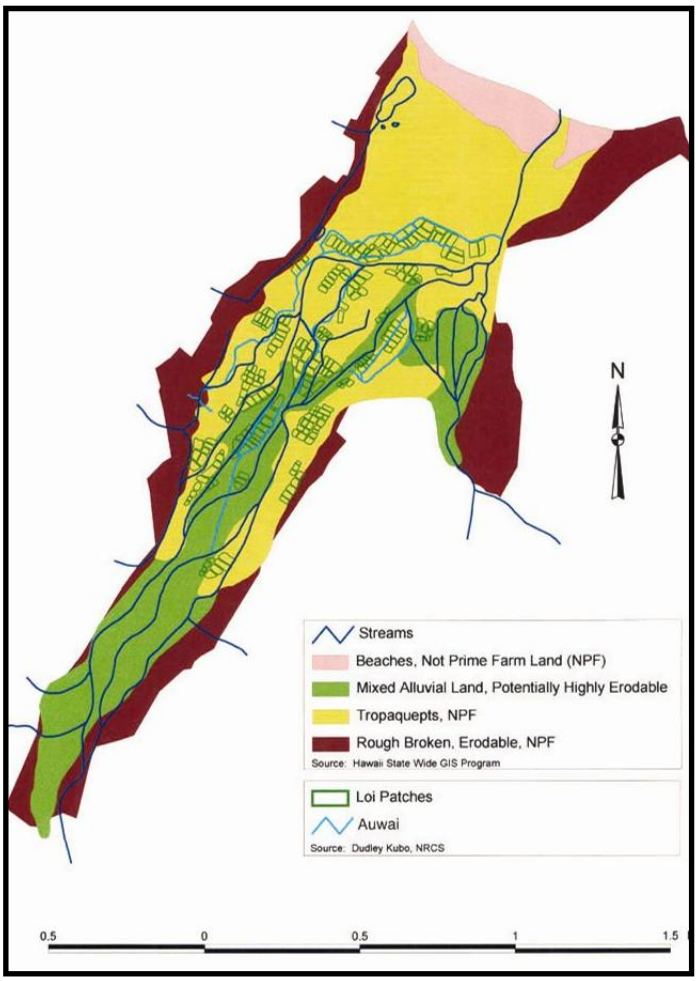

Figure 5: Waipi‘o Valley Soil Types

The valley walls and the back of Waipi‘o Valley are classified as rough broken land. The transition between the uppermost boundary of mixed alluvial land and rough broken land is reflective of the change in sediment transport regime in the valley. Above the boundary is the source area for sediment with little sediment permanently depositing in the streambed. Below the boundary, coarse sediment drops out of the streamflow to create rifflebeds and bars.

At the shoreline, flanking the river mouth are beaches. In Waipi‘o, the beaches extend inland in the form of dunes formed by wind and wave energy. In recent history, Waipi‘o had a coastal black sand dune up to 50 feet high. This sand dune was noted by William Ellis in 1823: “Its entrance from the sea, which was blocked up with sandhills fifty or sixty feet high, appeared to be a mile, or a mile and a half wide” (Ellis 1979 {1842}: 356). The high sand dune is thought to have disappeared after the devastating tsunami of 1946 (Ethnic Studies Program, 1978, pp. 481, 563).

Figure 6: Wailoa River Mouth

Hydrology

The drainage area from which raindrops run on the ground surface toward the Waipi‘o Valley mouth at the ocean is defined as the Waipi‘o Watershed. As such, the Waipi‘o Watershed can be subdivided into Wailoa Subwatershed which includes the Wailoa River and its tributaires, Waima, Koiawe, Alakahi, and Kawainui Streams, and Hiilawe Subwatershed which includes the streams that flow into Hiilawe Valley, at Hiilawe, Hakalaoa, and Ipuu Falls. The Hiilawe Subwatershed terminates where Hiilawe Stream enters Wailoa River.

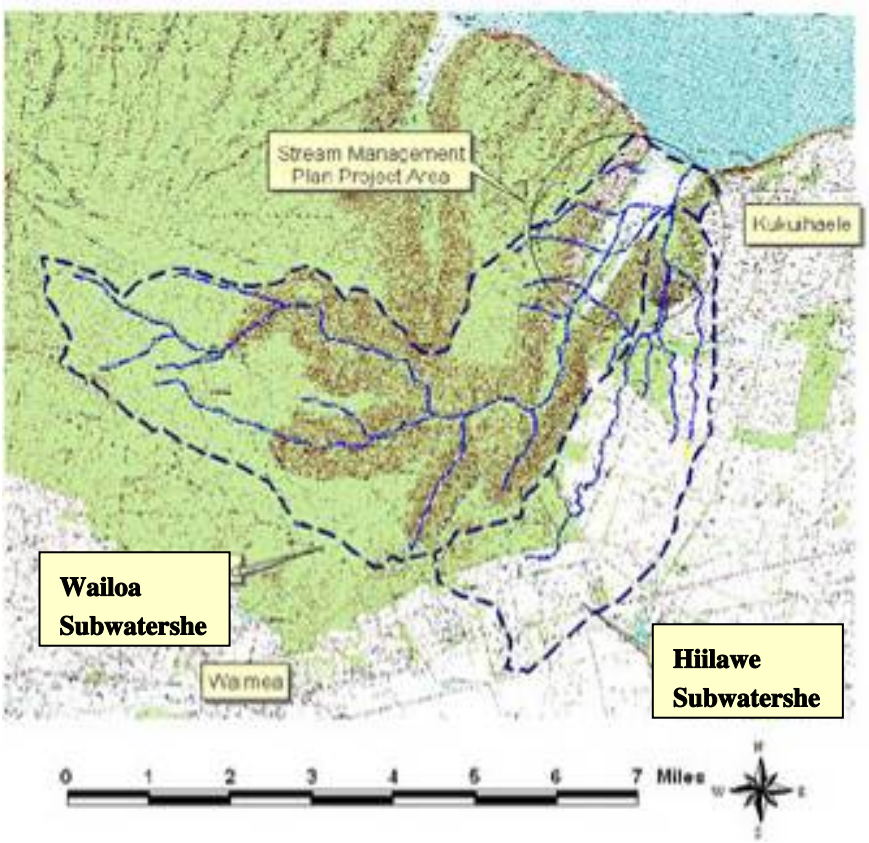

Figure 7: Waipi‘o Subwatersheds

The Wailoa Subwatershed encompasses 18.36 square miles and extends to the 5,300-foot elevation in the Kohala Mountains near Pu'u O Umi. Much of the upper part of the Wailoa Subwatershed is located on the high rainfall northwest-facing slope of Kohala Mountain which receives more than 160 inches of rain on an average annual basis. Groundwater contributions to Wailoa River may have infiltrated into the ground outside of the subwatershed boundary.

The Hi’ilawe Subwatershed extends upward from the confluence of Hi'ilawe Stream with Wailoa River and encompasses 6.37 acres. The watershed extends to Puukapu Homestead in Waimea. Except for the cinder cone of Pu'u Lala which is 3,200 feet in elevation, the Hi’ilawe Subwatershed is entirely below the 3,000-foot elevation. The upper part of the

Hi'ilawe Subwatershed receives between 80 and 120 inches of rainfall on an average annual basis.

The study area includes the lower valley where taro farming and other human activities are located. The study area centers on the Wailoa River and Hiilawe Stream corridors. The Wailoa River is further divided into the lower reach between the river mouth and below the Kawashima farm, the middle reach from below the Kawashima Farm to above the Kunaka Split, and the upper reach which extends from above the Kunaka Split to above the Linda Beach crossing.

The Wailoa River system in Waipi'o is perennial with a significant baseflow of approximately 33 million gallons per day (mgd), even with diversion of 13 to 25 mgd at the back of the valley by the Lower Hamakua Ditch. The dike formations at the back of the valley confine great volumes of ground water in the permeable Pololu lava formation. Seepage of the high elevation water at approximately the 1,000-foot elevation results in perennial streamflow in Waipi'o Valley. Spring sources for Wailoa River continue to issue approximately 40 million gallons per day (MGD) even during drought.

The measurement of streamflow in Waipi'o Valley has been sporadic. The earliest records were collected by J.M. Lydgate in 1889-1890 to establish the feasibility of constructing the Lower Hamakua Ditch. During August 1901 to January 1902 period, A. S. Tuttle, working for the Hawaiian Irrigation Company , made flow measurements along the tributaries and main stem of the Wailoa River before the start of diversion by the Lower Hamakua Ditch in 1910. Although the measurements were made during the winter season, Tuttle characterized the period as unusually dry. Tuttle estimated average and minimum daily flows at various points along Wailoa River in the upper parts of the valley.

Wailoa Stream Confluence with	Elevation (ft)	Average Flow (MGD)	Minimum Flow (MGD)	Average Flow (cfs)	Minimum Flow (cfs)
Kawainui Stream	1,000	19.5	9.7	30.0	14.9
Alakahi Stream	680	>32.1	17.5	>49.4	26.9
Koiawe Stream	560	>40.4	23.0	>62.2	35.4
Waima Stream	360	>63.7	34.0	>90.0	52.3

Table 2: Estimates of Average and Minimum flows of Wailoa River (Mink 1984)

From February 1964 until September 1969, the USGS operated a water-stage recorder on the Wailoa River, one mile downstream from the Waima Stream confluence, at the 150-foot elevation. The Lower Hamakua Ditch's intakes on all four tributary streams were operational during this period diverting an average of 30 MGD from the Wailoa Stream tributaries. During the five-year period, the average discharge was 48.4 MGD. The peak instantaneous discharge rate during the five year period was 8,500 cfs on January 11, 1967.

	Million Gallons per Day (MGD)	Cubic Feet per Second (cfs)
Average Diversion by LHD (1960s)	30.0	46.1
Average Flow in Wailoa River	48.4	74.5
Peak Discharge (1/11/67)	5,525	8,500
Minimum Discharge (10/16/68)	22	34

Table 3: USGS 1964 – 1968 Stream Records

Droughts

Flow in the Wailoa River during periods of extended drought remains fairly consistent compared to other streams in the vicinity. The spring sources of the river in the Kawainui, Alakahi, Koiawe, and Waima tributaries connect to large elevated water reservoirs confined in the Kohala basalt by the extensive dike matrix. Hiilawe Stream and other streams along the Hamakua coast are reduced to dry streambeds during such periods. The minimum discharge recorded by USGS during their five year record keeping period was approximately 22 MGD with the Lower Hamakua Ditch diversion in operation.

Tsunamis

Tidal waves occurred in 1819 and 1837 (Lennon 1954:11). In 1946 a 55-foot tidal wave inundated the Valley and destroyed many homes and taro patches. (Salmoiraghi & Yoshinaga, 1974). The tidal wave proved to be extremely devastating. The wave rolled inland more than 3000 feet. Many of the farmers who lived in the Valley left Waipi'o and found residence in the uplands of Hamakua. After the tidal wave, less then two dozen people remained.

Flooding

Waipi'o Valley's history is marked by periodic flooding caused by overflowing rivers resulting from heavy rains. Between 1916 and 1950 flooding occurred almost bi-annually; flood damage to crops was reported in 1918, 1932, 1936, 1938, 1941, 1942, 1958 and 1963.

Damaging floods occurred in all months of the year except July and August. (Lennox 1954; Honolulu Advertiser, June 24, 1956). A major flood occurred in 1979 and many taro farms were destroyed. The destruction required a huge cooperative repair effort in which County, State and federal agencies, private businesses and Valley residents participated.

During November 14 to 19, 1979, Waipi‘o Valley was badly damaged by flooding from rainfall that totaled 36 inches during the storm period and over 14 inches in a 24-hour period. Two miles of channel were filled with sediment, all 20 homes in the valley were damaged by floodwater. Approximately 110 acres of taro were destroyed by scour or deposition. Changes in the stream system rendered thirty auwai sections inoperable. The damage repair consisted mainly of pushing the deposited material to the sides to create channel capacity and the use of the local material to rebuild destroyed sections of levee. NRCS (formerly SCS) repair work for the 1979 storm cost was noted as $105,000 or $250,000 in 2005 dollars.

Figure 8: Photos of Waipio after 1979 Flood

NRCS estimated the 100-year, 24-hour rainfall at 18 inches. The 1979 storm’s recurrence interval was between a 50-year and 100-year storm. The rainfall data correlate well with the annual peak streamflow records taken at the Kawainui, Kawaiki, and Alakahi stream gages on the Kohala volcanic shield before these streams tumble into Waipi‘o Valley. While these streams are partially diverted by the Upper Hamakua Ditch, the 100 to 1 magnitude difference between the storm flow compared to the diversion rate makes the diverted amount insignificant in flood flow

analysis. The Kawainui, Kawaiki, and Alakahi Streams have 41, 41, and 31 years of record, respectively. The peak discharges for November 18, 1979 in the three streams are slightly less than the 100-year peak discharge for Kawainui Stream and approximately 50-year events at the Kawaiki and Alakahi Stream gages.[2]

During April 8 to 11, 1986, floodwater damaged properties along the Wailoa River. A rough analysis, based on rainfall records in the Waimea area, indicated that the storm was a 2-year storm. Damage from the storm was concentrated in a sand bar area near the Linda Beech crossing, the Kunaka split and multiple areas where fallen java plums obstructed the stream. NRCS repair work for the 1986 storm cost $95,000 (or $170,000 in 2005 dollars). A November 21, 1987 storm damaged Waipi‘o Valley prompting another request for emergency assistance. The damaged locations were the same locations as damaged in the earlier storms. EWP assistance was denied by the SCS State Conservationist due to the repeating nature of the storm damage. The denial letter also stated that "the flooding problems are caused by a continuous deposition of rocks and gravel in the streambed minimizing its carrying capacity rather than by a single event."

Between April 7 and April 8, 1989 storm rainfall that neared a 50-year storm at Kukuihaele rain gauges damaged the Wailoa River and Hiilawe Streams. Hiilawe was especially hard hit by this storm. Nearly one-half mile of Hiilawe Stream channel was filled with sediment six feet deep. One home on the upstream side of the Hiilawe Stream crossing was completely destroyed. SCS again denied the request for post-flood assistance.

In February 2002 a flood through Waipi‘o caused considerable damage primarily by felling large trees in a number of areas which redirected the stream into lo'i and other developed farmland. Considerable movement of gravel and cobbles in the upper reach occurred. According to accounts a flood of this magnitude had not occurred since the late 1980s. This flood opened the beach dune at the river mouth and lowered the stream water surface elevation by as much as five feet in the lower reach of the stream. The opening of the river mouth relieved many of the problems being experienced by farmers in the lower reach, including saturation of lowlying areas, frequent flooding during minor rainfall events, and inefficient auwai operation. NRCS engaged in an emergency effort with the County of Hawaii to remove trees from the stream channel in the upper and middle reaches.

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[2] **A log Pearson III flood frequency analysis was conducted using the annual peak discharges.**

In March 2004 a flood event severely damaged the upper reach, felling numerous trees along the flood corridor perimeter and breaching the levees on both sides of the corridor. The flood relocated the channel over 100 feet laterally in some areas and mobilized tremendous quantities of coarse sediment. Well-vegetated gravel bars that had been identified for removal in 2001 remained stable with new channels forming around them. NRCS again engaged in an emergency program with the County of Hawaii, removing fallen trees, reestablishing channel capacity and repairing banks along some reaches.

A study overlaying old maps of Waipi'o Valley from 1881 to 1994 gives an overview of the changes over time in the stream bed and reveals a general stream channel and flooding area (Bunjamin and Minerbi (2001). Emerson's Map dated 1881 and Wright's Map of 1914 of Waipi'o Valley do not show Kuleana plots and Land Commissioner Awards within the braided stream bed and the flood plain of the valley. The land claims are mainly on the side of the valley below the cliffs and in the village of Nāpōʻopʻopʻo. It can be inferred that Hawaiians stayed out of the main floodway.

Hydraulic Analysis

A hydraulic modeling analysis of the streams in Waipiʻo Valley was conducted to provide insight into stream dynamic processes. The stream information gathered through this survey was used to develop a one-dimensional stream model using the U.S. Army Corps of Engineers HEC-RAS hydraulic analysis software. The model provides stream depths, average velocities, and stream energy. The stream channel model does not model flood events as once flooding begins flood plain variability requires a more intensive survey of the areas away from the stream corridor. The stream velocities in the Waipiʻo stream system generally decrease toward the ocean primarily due to the decrease in stream gradient from the back of the valley toward the ocean.

A stream stationing scheme was applied to the Wailoa River with the rivermouth being Station 0. Upstream stations extended to Station 12018 along the Wailoa River. A Cross Section Survey of Wailoa River and Kunaka Stream was conducted in 2001 with 55 cross sections that extended approximately 2 miles upstream from the rivermouth.

Three characteristic slope reaches exist along Wailoa River in the lower portion of Waipiʻo Valley. The lowest reach, extending about 4,000 feet from the beach dune to the confluence with the Kunaka braid has an average hydraulic gradient of 0.0003, meaning that the water surface at Station 4000 is 1.2 feet higher in elevation than at the rivermouth.

Average velocities for normal flow periods, less than 100 cubic feet per second (cfs), are about 1 foot per second (fps). During storm flows exceeding 1,000 cfs, stream velocities increase to 2 to 3 fps. These velocities will mobilize bedload of less than 1 inch in diameter.

The middle reach of the Wailoa River, approximately 5,000 feet between the Kunaka confluence (approximately Station 4000) and the Kunaka split (approximately Station 9000), has segments of varied stream gradients. This reach has several chutes and pools in its profile. This reach includes the areas of severe streambank erosion/fallen trees and the main stream crossing. Average velocities in this reach during low flow periods ranges from less than 1 fps to over 4 fps. During flood flows the average channel velocities can exceed 8 fps in some segments. Stones that are approximately 6 inches in diameter can be mobilized by these flows.

The upper reach from Station 9000 to Station 12000 is uniformly steep with a stream channel slope which averages .013. The stream channel in this reach appears to transport into the valley a tremendous amount of coarse sediment. The dramatic changes in the stream cross section due to the storms in 2002 and 2004 demonstrate the stream power to mobilize large coarse sediment in this reach. Average velocities in this reach during low flows range from 2 fps to 5 fps. During flood flows average velocities can exceed12 fps. These velocities can move stones with an approximate diameter of 12 inches. Transient and velocity gradient peaks will probably mobilize considerably larger particles.

Geomorphology

Fluvial geomorphology is the study of river forms and processes. Rivers are dynamic systems with processes of sediment yield, transport, and deposition. They accumulate and dissipate energy accumulation and dissipation. While the discipline is entering its maturing stages for continental rivers, the study of fluvial processes for Hawaiian streams is in its beginnings.

The major factors influencing the geomorphology of the Waipi‘o Streams are high coarse sediment discharge and transport, relatively steep channel gradients, and frequent channel avulsions during storm discharges. The average channel width, measured at the bottom of the permanent vegetation line, is about 60 feet in the sections of the channel that have not been recently disturbed. Maximum channel depth at these sections is about 3.5 to 4 feet. Average channel depth through the section is about 2.8 feet. (Castro).

The average size particle in the Wailoa Stream is about 6 inches. Maximum transported particle size is greater than 20 inches. Material size is fairly well graded down to about 1/2 to 1/4 inch. Either the smaller particles are regularly transported, or there is very little source for material this size. Some backwater deposits of coarse sand were observed, but these were the exception rather than the rule. Gravel bar deposits showed fine veneers of sand and some silt, but these were neither thick nor extensive. (Castro)

In the upper and middle reach, the current channel is fairly straight with an average sinuosity of about 1.15. This straight pattern, given the average channel grade of under 1%, is indicative of a large supply of bedload. Low gradient channels with large bedload inputs typically change pattern rapidly through avulsion. Channel avulsions occur when the main thread of the channel suddenly shifts to another part of the floodplain due to a number of causes. These avulsions create a new main channel, leaving the abandoned channel often filled with coarse sediment. (Castro) These avulsions often mean that the stream has gone outside of the boundaries of its corridor and into land that is developed in lo'i or other improvements.

After reviewing the aerial photos and field verifying landscape patterns, it appears that the numerous 'auwais in the valley are occupying old side channels of the river. Because the 'auwais are kept open to maintain channel capacity, and because the water is raised by a small dam (manowai) at the head of the 'auwai, they are vulnerable to channel capture during high flow periods. Assuming that the entire valley floor is floodplain, the channel could become established anywhere within the valley. (Castro) However, the hydraulic attraction to the 'auwais will have a major impact on the location of the channel, likely capturing the flow of the main channel. There is a similar risk of avulsion through the taro lo'is. The lo'is are hydraulically smooth compared to the roughness in the floodplain and in the mature riparian vegetation. If the lo'i levees were overtopped and breached, the main channel may be realigned through the lo'is. (Castro)

The creation and maintenance of manowais can create nick points or headcuts because of the overfall caused by the structure. The more permanent the structure, and the higher the water surface is raised, the deeper and less stable the headcut becomes. Vertical instability often leads to induced lateral instability. For example, the failure of the manowais during high flow events, causes a slug of sediment to be introduced into the channel, both from the failed dams and material mined from the upstream migrating headcut. This material does not move far (100 to 1000 feet) before it is deposited, causing the flow to go around the deposit possibly causing bank erosion on either or both sides of the channel.

The sections of stream at road crossings are distinctly wider than other parts of the channel. The wide sections induce higher rates of gravel deposition, causing the main thrust of the stream to move to one side of the channel or another causing some bank erosion and possible channel avulsion. Overall, the bank erosion rate along the Wailoa River is very low, with overall lateral recession rates probably less than 0.01 feet per year. There are, however, locations where bank erosion problems are caused by the deflection of flow currents against the bank, by fallen trees or establishment of gravel bars.

The transition between the uppermost boundary of mixed alluvial land and rough broken land, approximately 3 miles into the valley, is reflective of the change in sediment transport regime in the valley. Above the boundary is the source area for sediment with little sediment permanently depositing in the streambed. Below the boundary, coarse sediment is seen as dropping out of the streamflow to create riffle beds and bars. Approximately 2 miles into the valley, floodplains of fine sediment flanking the river corridor begin.

Ecology

A variety of native and non-native organisms thrive within the intensive network of stream channels in Waipiʻo. These organisms include plants and animals within the stream and in areas adjacent to the stream where seepage of stream water influences the vegetation types. Much of the information considered in this plan with regards to the ecology of Waipiʻo Valley is based on a Native and Exotic Organism Study conducted by the Hawaii Biological Survey (HBS 2001). The full Bishop Museum survey report can be found at the following website: http://hbs.bishopmuseum.org/pdf/waipio.pdf .

Fish and Invertebrates

Within the lower Wailoa River, six species of native fish, two species of native crustaceans and one species of native mollusk have been documented. These native aquatic species spend part of their lifecycle in the ocean and part of their life in the stream and/or estuary. The lower part of the streams and rivers are home to some of these species while others depend on this section of the stream as an important passageway to the upper stream system.

The native fish include three types of gobies, uniquely adapted for Hawaii's streams. The native goby, which is the largest and most prolific throughout the lower and middle reaches of the Wailoa River is the ʻoʻopu nākea (*Awaous guamensis*). This species is omnivorous,

eating algae, worms, crustaceans and insects (Yamamoto and Tagawa 2000). Another omnivorous goby, the ‘o‘opu naniha (*Stenogobius hawaiiensis*) spends its life in the estuary and lower stream reaches, digging in lose sediments for food. The ‘o‘opu nōpili (Sicyopterus stimpsoni), prefers the faster flowing middle reaches of streams and feeds mainly on algae and other plants growing on rocks.

Figure 9: ‘O‘opu seeking shelter in Wailoa River
Photo by Carolyn Wong

Two other types of native fish were sighted in the Lower Wailoa River. The first, āholehole (*Kuhlia xenura*), can be found in the lower sections of the river as well as in the estuary and nearshore reefs. They eat mostly crustaceans and insects. The ‘ama‘ama (*Mugil cephalus*), also known as a striped mullet, spends some of its juvenile life in the lower part of the stream and estuary and most of its adult life in the ocean. These mullets are bottom-feeders, eating mostly algae and diatoms.

The native shrimp, ‘ōpaekala‘ole (*Atyoida bisulcata*), were found passing through the Lower Wailoa River toward its preferred habitat in the upper reaches of the stream system. A native prawn that spends most of its life in the lower reaches of the river and estuary was also sighted, ‘opae‘oeha‘a (*Macrobrachium grandimanus*). A few native snails, Hīhīwai (*Neritina granosa*), were also identified.

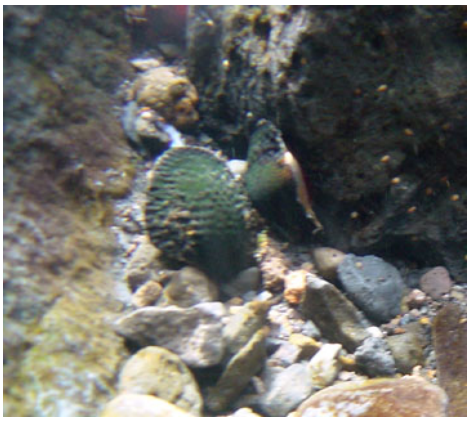

Figure 10: Hīhīwai clinging to rocks
Photo by K. Henderson

A number of native insects were noted during the Bishop Museum survey, including three species of dragonflies and two species of damselflies as well as native true bugs, flies and gnats.

Many non-native fish and insects were also documented in the stream. These species compete for the resources of native species. Non-native fish also carry diseases and parasites that can spread to native fish populations.

Plants

The Bishop Museum survey also provided baseline information on plant species adjacent to the stream and NRCS supplemented this information with a qualitative survey of riparian plant species from January to August of 2005. Non-native plants dominated the plant community; however, some native plants were also documented.

Eight native species were documented in the combined studies of NRCS and Bishop museum. One native fern, Neke (*Cyclosorus interruptus)* was documented as well as a sedge known as Pycreus (*Cyperus polystachyos).* Two types of morning glory were sighted, koali ‘awa (*Ipomoea indica)* and pōhuehue (*Ipomoea pes-caprae* subsp. *Brasiliensis).* Māmaki *(Pipturus albidus)* is a non-stinging nettle, whose leaves provide a food source for the Kamehameha Butterfly. *Paspalum scrobiculatum*, mau‘u laiki, ricegrass and *Schoenoplectus juncoides*, kaluhā, type of bulrush sedge were also documented.

There is still some debate as to whether, *Hibiscus tiliaceus*, also known as hau, is native or a polynesian introduction. Recent thinking is that Hau is native; however, early Polynesians spread the plant throughout the islands well beyond its natural range. The plant is known throughout the islands for multiplying rapidly and creating a dense thicket that blocks stream channels and can cause significant flooding problems.

A number of plants introduced by Polynesians were also noted: *Aleurites moluccana*, kukui, candlenut tree, *Alocasia macrorrhizos*, ‘ape, elephant’s-ear, *Cocos nucifera*, niu, coconut, *Colocasia esculenta*, kalo, taro, *Ludwigia octovalvis*, kāmole, primrose willow, Musa xparadisiaca, mai‘a, banana and *Syzygium malaccense*, ‘ōhia ‘ai, mountain apple.

Many of these plants could be utilized with care to revegetate eroding areas and replace non-native species that are the ecosystem and exacerbating flooding issues.

CHAPTER 3: PUBLIC PARTICIPATION

A number of previous work groups and task forces have addressed stream management issues in Waipi‘o based on public input. In the 1970’s, the Waipi‘o Valley Master Plan addressed stream issues along with many of the other areas of concern still problematic today. Some U.S. Army Corps studies were conducted even prior to the Master Plan. The public participation for the development of this particular Stream Management Plan occurred over a span of approximately seven years with farmers of Waipi‘o initially seeking the help of the USDA Natural Resources Conservation Service (NRCS); however, historical documents and lessons from the past were also considered in the development of alternatives and implementation strategies for this Plan.

Activities from 1999 to 2002

During the development of the Draft Environmental Impact Statement for Lower Hamakua Ditch Watershed by the NRCS and the Hawaii Department of Agriculture, the Waipi‘o Taro Farmers Association asserted that the diversion of the Waipi‘o streams for agricultural water supply to Hamakua farmers resulted in impacts to their stream management activities. The NRCS and the HDOA agreed to assist the Waipi‘o community by funding a University of Hawaii, Department of Urban and Regional Planning graduate practicum to develop a shared understanding of resource issues in the valley and to identify ways to attain community-developed objectives. NRCS also agreed to assist with a Waipi‘o Stream Management Plan and extended the Lower Hamakua Ditch Watershed land treatment program to Waipi‘o Valley.

Students from the University of Hawaii at Manoa Department of Urban and Regional Planning provided much of the groundwork for the development of the Plan in the completion of two practicum reports.[3,4] The two graduate planning courses began to compile information from the community and historical documents on the history, agriculture, cultural values, natural resource management and public access/tourism in the Valley. Students in the course also combined stream overlays from various points in history to evaluate changes in the stream system and created multiple computerized maps. Dr. Luciano Minerbi, the professor for these practicums, helped to establish and support the Waipi‘o Community Circle and aid in the community building process in Waipi‘o. As a result a draft Waipi‘o Valley Community Action Plan was also developed in Spring 2003.

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[3] Minerbi et al. 1999. *Waipi`o Valley: Towards Community Planning and Ahupua`a Management.*
[4] Minerbi et al. 2001. *Waipi`o Valley: Towards Community Planning and Ahupua`a Management Phase II.*

In November 2000, the Natural Resource Conservation Service (NRCS) brought in two geomorphologists to report on stream behavior in terms of landscape setting and provide recommendations for treatments in tune with natural dynamic processes. In November 2001, the Hawaii Biological Survey conducted a Native and Exotic Organism Study of the Lower Wailoa River in Waipi‘o Valley. The study provided information on native and alien aquatic plants and animals in lower valley as well as stream management options to improve habitat for native species. Stream cross-section surveys were also completed in December 2001 and February 2002.

In August of 2002, NRCS and the Bishop Museum sponsored a conference in Waipi‘o that was intended to develop dialogue between scientists and community. In October 2002, the Commission on Water Resources Management (CWRM) approved a Stream Channel Alteration Permit for the Waipi‘o Taro Farmers Association to remove gravel bars in the stream, which established a process that farmers and residents of Waipi‘o could follow in the future for obtaining CWRM permits. In December 2002, the U.S. Army Corps of Engineers mapped taro lo`i and problem areas.

Activities from 2004-2005

Based on this strong foundation of technical information, the Natural Resources Conservation Service (NRCS) and the Waipi‘o Community Circle conducted additional meetings from 2004-2005 with individuals and groups in the Waipi‘o community to identify specific problems that needed to be addressed in the plan.

A community meeting was held at the Waipi‘o Lookout in December 2004 to brainstorm problems and opportunities with respect to stream management in Waipi‘o. This brainstorming helped define the scope of the Stream Management Plan and renew community involvement in the development of the Plan.

Figure 11: December 2004 Community Meeting

Another community meeting was held at the Honoka‘a School Cafeteria in February 2005 to discuss stream permitting processes with a variety of regulators and government representatives, and a biology workshop was held in the Valley in August 2005 with farmers and residents to discuss the biological resources of the stream.

Figure 12: Participants in the August 2005 Biology Workshop

Farmers, residents and representatives from County and Federal government also met to review proposed alternatives for Waipi‘o stream management in September 2005. A number of additional meetings were scheduled with individual farmers and residents in May through September of 2005 to discuss the traditional practices in Waipi‘o and current needs. Meetings were also conducted, regarding the Emergency Watershed Protection work in Waipi‘o. Finally, meetings were held with Waterhead Leaders in October 2005 and with the general public in November 2005 to elicit feedback on the draft management plan. Subsequent meetings were held with Waipi‘o community members to answer questions and receive comments on the Draft Management Plan.

Stakeholders

Many stakeholders were identified and involved throughout the development of this plan. The U.S. Department of Agriculture, Natural Resources Conservation Service along with the Mauna Kea Soil and Water Conservation District and the Waipi‘o Community Circle led efforts to incorporate thoughts and suggestions from a variety of groups and individuals for the development of the Waipi‘o Stream Management Plan. Individual taro farmers and residents of the Valley contributed the majority of information for the Plan; however, a number of agencies and organizations contributed as well, including the following groups:

Nonprofit and Community Organizations	**Major Landowners**
Waipi‘o Taro Farmers Association	**Bishop Museum**
Waipi‘o Valley Community Association	**Kamehameha Schools**
Earthjustice Legal Defense Fund	
Hawaii Biological Survey	**County Government**
	Departments of Public Works
State Government	**Departments of Planning**
Hawaii Department of Land and Natural Resources	**Departments of Research and Economic Development**
Division of Aquatic Resources	
Commission on Water Resources Management	**Federal Government**
Hawaii Department of Health	**U.S. Fish and Wildlife Service**
Clean Water Branch	**U.S. Army Corps of Engineers**
Hawaii Department of Business, Economic Development and Tourism	**Regulatory Section**
Coastal Zone Management	**Civil Works Branch**
University of Hawaii	**U.S. Geological Survey**
Stream Research Center	**Water Resources Division**
Dept. of Urban and Reg. Planning	**Biological Resources Division**

Table 4: Agencies and Organization Contributing to Plan Development (along with NRCS, Waimea Community Circle and Mauna Kea SWCD)

CHAPTER 4: NEED FOR THE MANAGEMENT PLAN

As traditional practices began to intersect modern activities in Waipi‘o Valley, the need for a stream management plan emerged. The urgency of these needs has grown over the years. A great deal of information was collected prior to the development of this plan that set the stage for plan development.

Native Hawaiian farmers have cultivated Waipi‘o Valley for a millennium, supporting populations that numbered in the thousands. Stream management activities during those periods were likely to have been both intensive and extensive. Constant attention was probably given to the individual farm plots and water structures to ensure productivity and water system operation. A broad framework of cropland allocation and water management was also necessary to optimize the use of the resources to feed the population and to maintain sustainability through the generations. The specialized knowledge of the konohiki was built over centuries to be able to manage the widespread agricultural water system. The traditional social organization could amass labor quickly to conduct maintenance on the water systems, respond to flood damage on the river or lo’i, or to clear the river mouth following a period of high surf.

In the modern period, the number of farmers has declined considerably. However, their ability to use machinery to replace the muscle power of the earlier farmers has increased their ability to manage the agricultural water system. For some, the use of machinery can also exceed the boundary of what is appropriate in striking the balance between a functioning natural stream system and the use of the streams in a culturally-sensitive way to produce a culturally-important crop.

Historically, the taro-farming community has implemented a management framework consisting of waterhead leaders who are responsible for the operation of auwai systems. However, in modern times, the waterhead leaders’ organization does not appear to have the same authority as the konohiki. Much of the group knowledge of the waterhead leaders has been developed during the modern mechanized period. Stream management practices have relied heavily on earthmoving and channelization.

During the 1980s and 1990s, with the increased awareness of environmental values, community clashes arose over stream activities using bulldozers and heavy equipment to clear channels and rebuild banks. Federal and state laws protecting water quality and natural resources were invoked to limit the management activities within the streams. The

taro farmers were hampered by economic and social factors in their ability to apply for and acquire the permits necessary to conduct stream management practices.

Stream Issues Identified through Community Meetings

The following discussion provides a summary of the problems and needs that have been identified to date through community outreach. Many problems were identified and the need for being able to conduct regular maintenance was stressed by the residents.

One major concern of the Waipi‘o community is flooding in the valley, and the effects of that flooding on crops, structures and residents of the valley. Invasive trees worsen this concern; for instance, many Java Plum trees that grow near the stream are often toppled during floods, blocking the stream channel and thereby diverting flows that are often difficult and expensive to rectify. Gravel bars also develop into islands, constricting and sometimes redirecting the flow of the stream, causing streambank erosion and dangerous flood conditions. Also, when the sand bar "closes" the river mouth, water backs up and damage from flooding during high rainfall events is often worse. Dumping of water from the Upper Hamakua Ditch during the wet season is thought to increase flood flows as well.

Several comments from participants were made regarding the flood situation in Waipi`o. A Corps study of a flood diversion channel through the taro growing area to the ocean was requested by one of the community members. A similar study was apparently conducted in the 1970s, but no follow up actions were taken. Lolly Silva will discuss the request with the Corps Civil Works branch. Alternatives to a flood diversion channel were also discussed. One topic that most of the community agreed on was the need to keep the muliwai (estuary) and river mouth open to the ocean. Many thought that there is a need to clean the river and open the river mouth, at least annually. There was also discussion that a caretaker, like that from plantation times, may be needed to clean and manage the Lower Hamakua Ditch and Upper Hamakua Ditch intakes and result in less flooding in the Valley.

Waipi‘o has an intricate network of auwais (or taro ditches) that transport water out of the stream and back into the stream at various points in the stream channel. Members of the Waipi‘o community wanted the plan to address auwai management, incorporating the traditional waterhead system of management. Water distribution and auwai system capture are important components of this management. Many community members believe that taro production in the valley needs to be expanded, using auwai maps from

1800's and before. They believe this is culturally important and also that auwais could be used to help control flood flows.

Many concerns were expressed, regarding water flows at the Kunaka split. Some residents believe water quality is poor in Kunaka stream due to a low rate of water flow, and the low water flow in Kunaka limits the land that can be put into taro production. Additionally, less water in Kunaka means more water in the main channel and possibly more severe damage during storm events.

Another important issue that concerns the community is erosion of the stream banks. Erosional areas near Kunaka split and above the Kawashima farm were identified, during outreach sessions as important areas to address.

Minimizing the environmental impacts of stream maintenance is important to many Waipi'o community members. Low populations of native species and high populations of invasive, alien species both in the stream and adjacent to the stream are concerns.

Currently, the Bishop Museum leads area schools in conducting monitoring of stream life and water quality. The community would like to be able to use this resource better perhaps for permit monitoring or helping to understand the impacts of stream maintenance activities.

The Waipi'o community also voiced concerns about the cost of stream maintenance and requested help with identifying funding sources. They also thought agency over-regulation was a problem and requested help reducing the paperwork necessary to attain permits and guidance on what permits needed to be obtained.

Other Issues

A number of other issues may impact stream management in Waipi'o Valley but are not fully addressed in this plan. These issues include access, historical and cultural resources, tourism, agriculture and natural resources (DURP 2001). The stream management plan is only one piece of the puzzle that will hopefully lead to a more comprehensive watershed management plan with full community support. Consensus on how to address the following issues will require further discussions between the community members of Waipi'o.

First, many historical and cultural sites of the valley are known, and the valley is still rich with sites that have not yet been uncovered or examined. There is agreement that preservation needs to take place, but exactly how is yet to be determined. These sites continue to be deemed sacred and storied places and are part of the native Hawaiians cultural heritage.

Waipiʻo Valley has been historically and is currently an ideal place for wet taro cultivation and perpetuation of Hawaiian culture. Soil types and vegetation patterns for the valley explain its agricultural productivity potential. There is an untapped market for taro that can guarantee the successful continuation and expansion of taro production in the valley. The wellness of cultural and commercial taro farming depends on the ability of farmers to undertake regular stream management with full financial, technical, and permitting support of the pertinent agencies and other parties.

A variety of access issues occur because it is not clear (or not adequately enforced) which pathways are for the public and which pathways belong exclusively to the landowners and lessees. Related to these issues of access is the topic of tourism. The level of tourism that should occur in the valley is an issue of much contention in the Valley. This issue is also interrelated with many other areas of the discussion in the Valley, including management, respect, and responsibility and equity in terms of sharing revenues, costs and impacts.

Finally, the stream management plan only peripherally addresses water quality and wildlife issues. A more comprehensive plan that looks at on-farm and residential management is desirable. A few of the items to be addressed would include wastewater management, pesticide and nutrient management as well as wildlife habitat management. Invasive species in particular are a growing concern. These threats range from a plant community dominated by invasive species to the threats to crops from species such as the apple snail to nuisances such as the coqui frog.

CHAPTER 5: ALTERNATIVES

Generalized treatments for the Waipi‘o streams were developed that balanced the need for preventing flooding and sediment damage to the taro lo’i and other structures with the desire to accommodate stream processes and maintain high water quality and biological stream value. Site-specific discussions for the identified problem areas are also included below to indicate the range of treatments that should be considered at the problem site. Treatments for road crossings, auwai systems, and streambank protection are also discussed. These treatments are presented for further discussion and refinement by the Waipi‘o community. It is hoped that an inclusive decisionmaking process can be used by the community to develop details for the preferred treatments. These, then, will be adapted into designs that will reflect community acceptance, funding level and risk.

Actual installation of treatments at the sites should be according to engineering designs that have been reviewed by the stakeholder agencies and community. The designs will normally include topographic mapping, dimensions, standards and specifications for materials and work, and approval by permitting and regulatory agencies. Installation work will require funding agreements, project staking, approval of materials and contractors, project inspections, best management practices, and monitoring.

Stream Corridor Establishment

The primary alternative involves the establishment of a stream corridor which incorporates the understanding of stream geomorphology and hydraulic processes. The intention is to maintain a wide active channel area within which most stream functions, including transport and deposition of sediment can occur. During floods when the water surface rises above the banks, an adequate floodplain to contain frequently occurring floods can be developed using setback levees along the perimeter. Small trees and shrubs vegetating the floodplain can slow velocities in the floodplain and keep the main channel the preferred pathway for the floodwater.

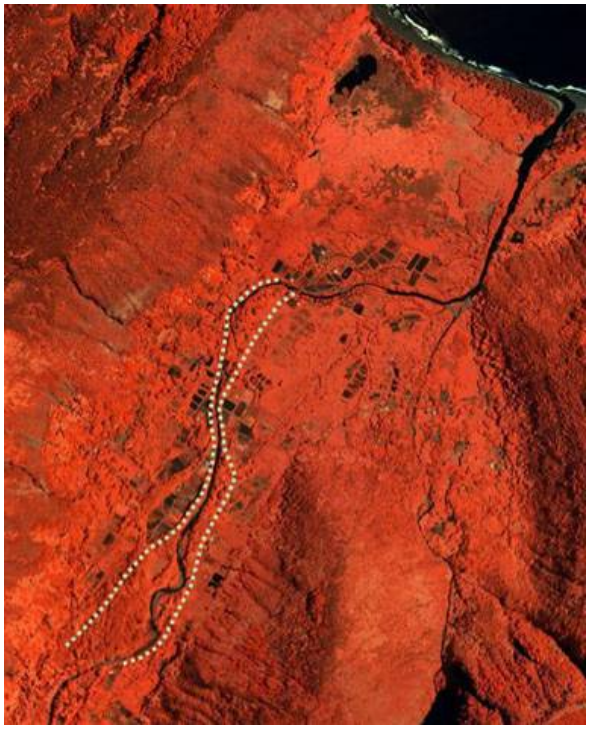


Figure 13: Potential Wailoa River Corridor

An important consideration is the transport of sediment through the corridor without long term positive deposition in the corridor which will result in continued aggradation within the corridor but not outside. The corridor is not intended to completely exclude flood water from the area outside of the corridor but is intended to restrict the damaging bedload flows to within the channels. The perimeter levees should be constructed to allow occasional overtopping to spread the floodwater and to distribute fine sediment. The levees should also be designed to resist collapse the case of overtopping.

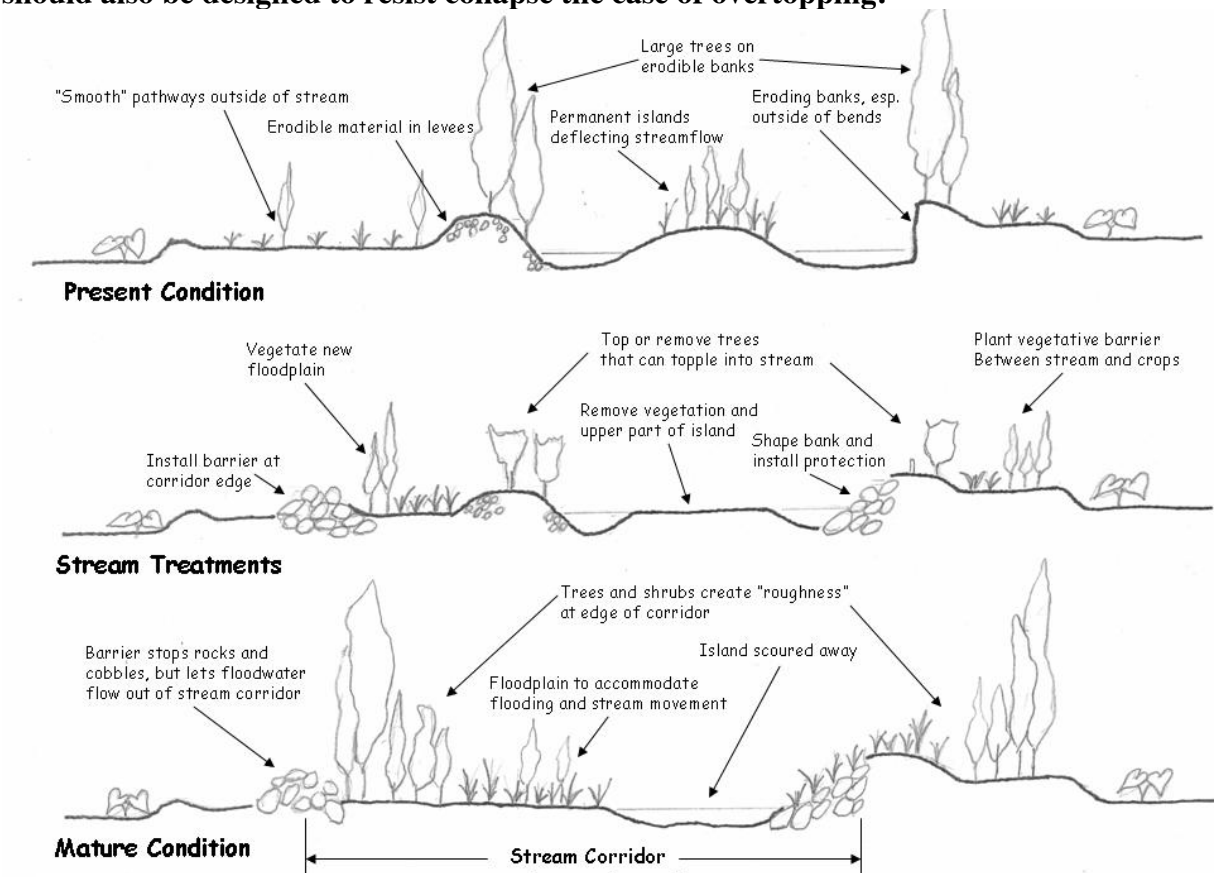


Figure 14: Stream Corridor Concept

Auwai

Lo'i that are repeatedly damaged by floods should be identified and considered for relocation. In this way, a widened flood corridor, within which dynamic movement of the stream can be accommodated, can be established. This alternative is already being successfully implemented to some degree in an area above the Toledo farm and on the Kohala side of the Mock Chew farm. The corridor edges can be established with setback levees and dense vegetation. Another alternative to levees are screens such as fences, fallen trees or gabions to allow water to flow through but trap the bedload in the flood corridor.

The pattern of kuleana parcels in the valley supports the establishment of a flood corridor. The Hawaiian Government Map of Waipi‘o compiled by J.S. Emerson in 1881 shows the approximately 80 Land Commission Awards or kuleana granted during the 1848 Mahele. During the Mahele, the traditional users and owners of these parcels were able to petition the government for ownership rights to these lands which were used for lo’i, dryland farming, and house lots.

Figure 15: Gabion Barrier

The pattern of LCA parcels leaves a wide corridor of unclaimed land in the central part of the valley. These lands which reverted to the crown and which became a part of the C. Kanaina Estate, may have been less intensively used and less valued than the claimed parcels. However, this is not to say that the land in the stream corridor was not cultivated at all. An account by William Ellis in 1823 stated “The bottom of the valley was one continuous garden, cultivated with taro, bananas, sugar-cane, and other productions…”

Early maps indicate “kula” lands along the stream and within the stream braids. These lands appear not to be intensively used with establishment of lo’i. These lands were probably planted with crops other than taro requiring less cultivation and management effort. The loss of such crops in a flood would be less of an impact than the loss of a taro crop and damage to lo’i structures.

Nearly all of the land that is needed to establish a stream corridor is owned by Bishop Museum. However, land within the corridor is leased to taro farmers. A reassignment of parcels may be needed if some of the existing taro lo’i is converted to the stream corridor. A strategy would be not to repair taro lo’i located in the corridor damaged in future floods.

Bedload Management

Many of the stream-related problems facing the Waipi‘o Community are the result of the high bedload discharge of the Wailoa River. Bedload is the rocky material that the stream transports by rolling along the stream bed. It is the gravel, cobbles and boulders that normally make up the stream bed and is moved downstream during high flow events. The bedload in Wailoa River is generally deposited by size as the river approaches the ocean. As the valley slope and the stream gradient flatten once the stream reaches the bottomland of the valley, the boulders and larger cobbles are deposited at the upper end of the taro growing area. Smaller bedload sizes are deposited further down the river. Stormflows can remobilize these deposits.

The lower area of the Waipi‘o watershed where the lo’i and dwellings are located is the depositional zone of the Wailoa River. Where the upstream zones are the source of the stream-borne sediments or serve to transport the sediment without appreciable net loss or accretion, the depositional zone is the sink for most of the coarse sediment transported by the river. Fine sediments, and some coarse sediments during stormflows, are carried by the stream into the ocean. The broad and flat Waipi‘o bottomland was developed through deposition by an efficient sediment-dispersing stream system over tens of thousands of years.

In a natural state, it is expected that the stream in the upper reach of the study area, where it emerges from confinement by the valley walls, would continually adjust as coarse sediment is deposited due to the decrease in valley slope. The frequent changes in stream deposition and meander in this area near the Rathbun and Toledo farms is an indication of the dynamic processes at this location. A solution to the problem may be providing a location where the sediment can be deposited by the stream and removed from the stream corridor easily. The larger stones deposited in this area can be used in the lower reaches for stream stabilization.

Typically, bedload is managed by deposition in a sediment or debris basin. Such basins slow streamflow to cause deposition of the bedload mobilized by the stream. The basins have a dedicated storage volume to retain the deposited bedload. As the storage volume is filled the effectiveness of the basin will decline. Removal of the accumulated sediment when the basin is filled is critical for the operation of the basin. Sediment basins normally have an outlet structure that is capable of safely passing through severe storm discharges without movement or erosion. Such outlets are generally significant structures to handle the hydraulic forces generated by flood flows. The sediment basin should be designed to

avoid "sediment starvation" of lower stream reaches to prevent an erosion problem due to an upset of the sediment transport budget. The coarse sediment trapped in an upstream basin can be used in projects to stabilize downstream reaches.

Gravel Bar Treatment

The deposition of sediment within the stream channel causes formation of gravel bars and islands. These formations can move the the active channel laterally and direct stream flows into the banks, both of which result in bank erosion and flood threats to farmland and other developed areas. In Waipi'o, these gravel bars include larger sediment sizes like cobbles and boulders. Problem gravel bars are usually formed during significant storm events with the hydraulic power to fully mobilize the streambed. Once formed, however, less intense storm events are unable to move the larger stones that lock the bar in place. In time, the establishment of shrubs and trees on the gravel bar increases the stability of the bar or island. Deposition of fine sediment on the bar in subsequent storms further improves growing conditions for vegetation, improving the permanence of the island or bar.

A method to remove or reduce the durability of gravel bars is to remove the surface vegetation and to remove the sediment above the stream water surface level. This method is described in the State Stream Channel Alteration Permit Application prepared for the WTFA in 2001.

Bank Protection

Erosion of streambanks is the predominant erosion problem in the area. However, it does not appear to be a major problem in the study area. The two most prevalent causes of bank erosion in Waipi'o seem to be 1) the movement of the stream laterally, as in a meander, and 2) streamflow being directed against a bank by obstructions such as fallen trees or piled up coarse sediment. A stream avulsion can be considered a rapid bank erosion event when the failure of a section of bank causes the stream to rush into a new channel. Streambank protection can consist of vegetative plantings, soil bioengineering or structural systems

Two basic categories of bank protection exist. The first type reduces the erosive force of the water against the streambank by reducing localized stream velocities next to the bank, preventing impingement of flow directly into the banks, reducing eddying and/or reducing tractive stresses. The second type of protection increases the resistance of the bank to

erosion by flattening the bank to reduce effect of gravitational forces, improving cohesiveness or matrix of bank soils and/or covering erodible soils with a nonerodable layer.

If stream velocities are generally mild, shaping the bank to flatten it and planting it in appropriate vegetation that will protect the soil surface by reducing flow velocities on the soil surface and have a rooting system that can resist the tractive forces on the exposed plant parts. In deeper channel sections, the tractive stresses on the lower part of the bank can be significantly higher than that near the surface due to the increased weight of the water column. Stabilization of the bank toe is important. Often rock riprap will be placed at the toe to provide stability to an earthen bank.

As stream velocities increase, structural elements, in addition to vegetation, must be considered in the streambank protection system to maintain stability. Some methods to consider include the use of geotextile fabrics to wrap lifts, rock riprap revetment, log or rootwad revetment, and gabions. The modification of the velocity gradient of the stream to reduce high streamflow directed against the bank can be achieved with stream barbs and jetties that protrude into the stream flow. The effect of the streamflow over and around the barbs and jetties is intended to deflect the high velocity currents back to the middle of the stream. A good reference is NRCS, Engineering Field Handbook, Chapter 16 Stream and Shoreline Protection.

Flood levees

Flood levees provide additional flow capacity to the stream by elevating the water level in the stream above the bank. Levees can be set on the bank or setback away from the bank. Setback levees are preferable to bankside levees as the depth of out of bank flow is reduced and some dynamic adjustment of the stream banks is allowed. Levees are designed to be resistant to erosion and overtopping. Engineering standards for Dike Practice Code 356 will apply.

Set back levees will create a floodplain that can be managed. It is important to keep the floodplain a less preferable flow path by keeping roughness higher than the stream channel. Deflections toward the bank should be avoided and flow streams should be directed back toward the channel. Large trees should not be planted on the levees to prevent the uprooting and damage to the levee.

A problem that levees pose is that floodwater trapped behind the levee cannot be easily be brought into the stream. Passage of auwai in and out must be accommodated. In this valley there is enough slope to set up sections of setback levees with openings. Pipes can be used through the levee.

Manowai are rock dams that direct water into the auwai. Manowai are constructed and maintained by hand labor. Manowai are appropriate technology because during high flows the rock dam is usually washed down and limits the amount of water directed to the auwai.

Auwai can function as flood conveyance at flood stage. Many of the Waipi‘o community feel that all channels and conveyance channels need to utilized during high flow in the valley.

River Mouth Maintenance

The maintenance of an open river mouth is a high priority for many in the Waipi‘o community. The blocked river mouth causes many problems that include the following issues:

1) **increased flooding of taro lo'i in the lower part of the valley,**
2) **increased auwai and lo'i water temperature due to slower outflow back into river,**
3) **increased deposition of sediment and loss of stream capacity in the lower part of the valley and**
4) **increased stream depths at the lower locations to cross the river.**

The proposed stream mouth clearing will remove sand, cobbles, and boulders that prevent free-flowing of the stream into the ocean. The intent is to excavate the outlet of the stream in the blocked reach to the elevation of mean high tide. Deeper excavation will not result in any further significant reduction in stream level. A major consideration is prevention of rapid redeposition of boulders and cobbles in the stream mouth. While the store of boulders and cobbles within the bay is virtually inexhaustible, preventing the newly-excavated stony material on the beach from resettling into the river mouth can be prevented by disposing of the cobbles and boulders in areas away from the reach of high waves. In addition, removal of adjacent boulder sources along the beach will also reduce the chance of rapid blockage of the stream mouth.

The river mouth opening through mechanized means will require, at a minimum, the Department of Army permit, the Commission on Water Resources' Stream Channel

Alteration Permit, and the Hawaii County Department of Planning's Special Management Area Permit exemption. Other requirements and permits include a Conservation District Use Application if the work extends beyond the certified shoreline and Solid Waste Disposal permit.

Islands in midstream – Sta 4000 to Sta 6000

Islands have formed in the middle of the stream and have been stabilized by mature vegetation. These islands appear to advance braiding of the stream channel. Mechanized stream maintenance normally removed islands from the stream. These islands may be due to accretion processes that cause stream meander as some of the islands serve to increase the stream thalweg. Streamflow is being deflected toward the streambanks and stream velocities are increased due to the narrowing of the stream flow area. While average stream velocities are relatively slow in this reach due to the flat gradient, during high flow events average velocities in the range of 3 fps can be expected. The strongest stream velocities are often directed to impinge on the banks. The alluvial streambanks are being eroded at their base resulting in undercutting and vertical banks when banks collapse. During high flow events, the vegetation growing on the island also serves to slow flows across the island and to deflect high flow velocities to the stream banks.

Several alternative treatments to remove or alter the islands can be considered. Removal of the island and its vegetation using heavy machinery can be considered if the bank erosion is proceeding at such a rapid rate that immediate relief is necessary. A State Stream Channel Alteration permit will be required for any movement of material within the banks. A federal CWA Section 404 permit and Section 401 Water Quality Certification may not be required if the work does not place any material in the stream. However, written correspondence with the Corps of Engineers Regulatory Branch should be conducted describing the work to be accomplished, including methods, dimensions and timing. The State Department of Health will likely request a pollution control plan be filed as a condition of the Stream Channel Alteration Permit. Notification of the County Planning Department and Public Works Department is recommended.

The removal of vegetation from the island can make the sediments more susceptible to erosion and removal by the stream. Removal of vegetation will also increase stream velocities across the island during high flows and may reduce erosive forces against the streambanks. No permits may be required if the bank or bottom materials are not disturbed and the trimmed vegetation is removed from the stream channel. The use of

herbicides should be thoroughly considered and used only in conformance with labeled uses to avoid liability.

A river training structure known as a stream barb can be used to reduce the stream forces away from the banks and toward the island to intensify erosion of the island (see Figure 10). While the structure will be very similar in form to a manowai, a State Stream Channel Alteration Permit and a federal 404 permit will likely be needed. Once the erosive stream forces that are responsible for the streambank erosion are managed, treatment of the bank to stabilize the steep or undercut bank can be considered. Typically, NRCS recommends shaping the bank to a 2:1 slope and vegetating the graded bank. Stability is improved by protecting the toe of the bank with rock. Permits will likely be required for this work.

Bank erosion above Kawashima

The stream appears highly unstable in this reach, evidenced by abrupt slope changes from the upstream section, a history of bank erosion that has felled large trees on the bank, and recent stream avulsions. The stream appears to be trying to braid. Midstream deposition has created islands, which have deflected flows toward the banks and is creating a wider, braided stream corridor. Avulsion of the stream to the west is feared. The marshland toward the Muliwai Fishpond appears to lower in elevation than the stream and if flows were to breach the western bank the stream could be captured by the marshland to the west. The area to the west includes major cultural sites that might be disturbed if the stream was to flow in that direction.

Figure 16: Example of a Stream Barb

The manowai and auwai for the Kawashima waterhead have been affected by the changes in stream elevation and erosion of the western bank. The apparent drop in the stream elevation has required the intake location to be moved upstream to maintain the hydraulic relationship between the intake and the auwai system. Bank recession has eliminated the land between stream and the auwai. The auwai is now separated from the stream by a stacked ridge of rock and plastic sheeting. Maintenance effort for the current configuration is very high.

Some actions can be taken. Removal of the tall trees that are on the bank. These trees are at risk of being toppled into the river if the bank is eroded. The eroded banks on the western side can be repaired and broadened to reduce the chance of avulsion of the stream to the west. The rebuilt bank should be vegetated and protected against further erosion. Riprap bank protection should be considered here due to the significant effect of bank failure. Stream flow should be directed away from this bank. Upstream stream barbs can be considered to redirect streamflow into the middle of the stream and to dissipate stream energy.

A reconstruction of the manowai and auwai system needs to account for the hydraulic gradient needed by the Kawashima farm for irrigation of their taro lo'i. The flattening of the stream gradient below this reach makes auwai management at this location very difficult. The manowai should be moved to a location that can consistently provide supply. A conveyance solution could be the use of pipe in some of the parts of the auwai. An issue with the use of pipe is sedimentation within the pipe.

Road crossing

The main ford crossing of Wailoa River on the dirt road which extends west from the end of the County Road is used by most farmers and residents on the western side of the River in addition to use by tour operators, both on horseback and vehicles. The major problem is the changing river bottom,

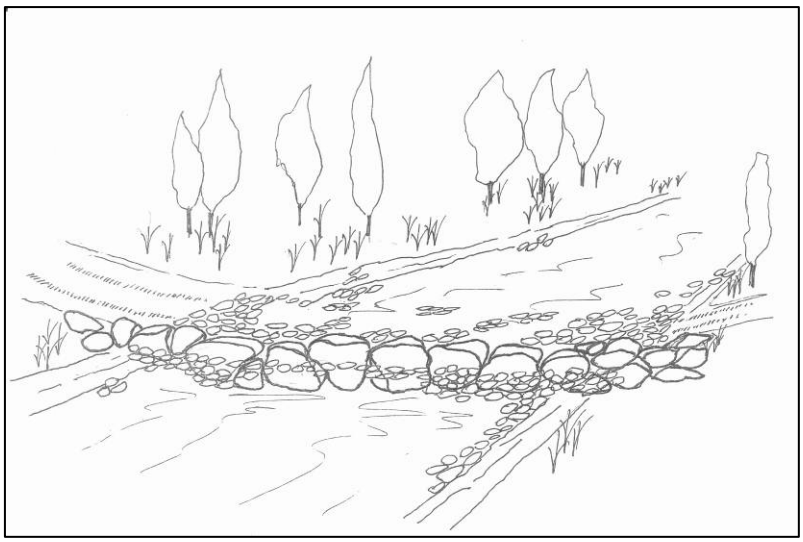


Figure 17: Stream Crossing Sketch

especially after high flows, which sometimes becomes too deep for vehicular crossing. Generally the rocks that form the ford are washed downstream. There appears to be an increased stream gradient downstream of the ford.

The preferred configuration is a broad, flat ford. Stones are often moved around by residents to restore the ford. The stones that hold the ford are generally the locally available sizes. Larger stanes than those normally transported by streamflow to the location will be more stable at the location.

A recommendation will be to imbed several large stones on the lower side to stabilize the general elevation of the streambed. At the downstream cross section, average stream velocities exceed 7 fps with flow depths of 4 feet when flows break out of the streambanks at 1,000 cfs. It is assumed that flood flows can exceed 10 fps at the downstream of the crossing with depths of 6 feet. The large stone sizes should be about 3 feet in diameter and should be inbedded to one-half of its diameter as measured on the downstream side of the rock. Rock that is 16" to 20" should be placed around the large anchor rocks to prevent scour around the large rocks.

Other alternatives may include structural improvements such as a concrete ford. Due to the large amount of bedload passing the location low flow culverts beneath the ford are not recommended.

Kunaka Split

The Kunaka split is an inlet for the auwai system serving the lo'i in the interior of the large bend in the Wailoa River. For some farmers, the Kunaka auwai, also known as the Kunaka River on the WTFA map can also serve as a major waterway during high flow periods to reduce flow and flood problems in the main channel. Other farmers in the Kunaka area resist the idea of having more floodwater due to the threat of increased flood damage. One complaint is that insufficient irrigation water is diverted and transported in the Kunaka auwais for the lo'i in the lower areas.

Continuing discussions and agreement among the Kunaka area farmers with input from other Waipi'o farmers with input from other Waipi'o community members and farmers, regarding the amount of water in the Kunaka Stream are needed. In order to resolve this issue a more intensive survey of the taro irrigation need and flood vulnerability should be conducted. NRCS can help to develop scenarios during low flow and high flow periods.

Two elements that need to be addressed in this agreement are defining the intake to the Kunaka Stream and removing sediment from interior waterways.

Meander Sections

This reach between 10,000 feet to 13,000 feet from the river mouth is a dynamic transport reach. As a result of storm flows in recent years, the stream configuration in this reach has undergone significant alteration in both plan and elevation. The 2002 storm raised or lowered the stream by three to four feet at several of the resurveyed cross sections through erosion or deposition. The March 2004 storm moved the main channel of the river nearly 100 feet laterally in some places.

From the 1960s to 1990s, the stream was apparently bulldozed back into place following a storms with significant levees on both sides of the stream developed in the bulldozing process. The recent storms breached the levees on both sides of the stream, providing an indication of the power of the streamflow at this location. The hydraulic analysis for this reach indicates average channel stream velocities approaching 12 fps for a 1,000 cfs flow.

The maintenance of a wide flood corridor in this area is essential as the valley slope and coarse sediment volume and large size makes this rach the most dynamic with a potential to avulse and rapidly change channel configuration. A well-defined and open stream corridor with vegetated floodplains flanking both sides of the stream is recommended. Large trees, capable of toppling into the stream, should be removed from the stream banks. Any levees along the perimeter of the flood corridor should be designed to resist collapse when overtopped by floodwater. The levees should be short enough to allow floodwaters to overtop the structure during significant floods to redistribute fine sediment and relieve pressure on the flood corridor.

Approaches for Stream Maintenance

There are three basic approaches to implementing the above alternatives: Hand Clearing, Minimal Mechanical Excavation and Heavy Equipment/Mechanical Excavation. A description of some of the positive and negative impacts of these approaches is included below.

<u>Hand Clearing</u>

Hand Clearing seeks to minimize the need for many of the permits and involves manually hand clearing the stream mouth. This requires a concerted effort

involving volunteers or paid laborers drawn from the community. This proposal directly involves the community and in essence brings back to life an old cultural practice; however, it requires a significant number of reliable laborers or volunteers on a reliable basis. Compared to heavy equipment excavation, it is possible that hand clearing may not be sufficiently efficient.

Minimal Mechanical Excavation

A second proposal scales down the amount of material to be excavated. By mechanically excavating to a more shallow depth, the total material could be diminished. The environmental and cultural impacts would probably be halved in proportion to the excavation effort and sitting of the dump pile may be easier to locate. Although this proposal requires heavy equipment and would probably require permits, the preparation of the permit applications may not be as time consuming.

Heavy Equipment/Mechanical Excavation

The use of heavy equipment would enable a massive amount of material to be removed relatively quickly. Few laborers would be needed and the stream banks could be graded to scientific specifications. Best Management Practices could be utilized to lessen environmental damage. However, the permit process may require public hearings, review of documentation, field visits by several agencies and could take time to complete the study and obtain all permits.

Table 5: Hand Labor and Equipment Comparison Chart

Type of Equipment	Photo Description	Grading	Excavating (digging)	Carrying Material	Ability to reach into stream from bank	Ability to manipulate rock
Hand Labor		Very light	Very light	Very light loads, short distances	No impact working in stream	Very good for small rock
Farm Tractor		Light	Light, with backhoe attachment	Small loads in front loader	Yes, short reach with backhoe attachment	Good for small rock
Skid Loader		Moderate	Little	Moderate loads, short distances	No	Moderate for small to medium rock
Backhoe		Moderate	Moderate	Moderate loads, short distances	Yes, short reach	Good for small to medium rock
Excavator		Light	Moderate to Heavy	Small to moderate loads, very short distances	Yes, moderate to long reach	Good for moderate to large rock
Loader		Heavy	Little	Large loads, short distances	No	Moderate for moderate to large rock
Bulldozer		Heavy	Little	None	No	Poor
Dump Truck		None	None	Large loads, long distances	No	Poor

CHAPTER 6: PERMITS AND APPROVALS

The stream system in Waipi‘o has been highly manipulated since the time of Native Hawaiians. Auwai were established and maintained and the muliwai was kept open in a communal manner without government permitting. Enforcement of the permit requirements and federal regulations has affected stream activities heavily since 1972. However, permit regulations and agency attitudes have also undergone change since 1972, and recognition that Waipi‘o is an extraordinary place has brought forth an effort to streamline permitting. The Stream Management Plan will address permit requirements for regular maintenance of the stream with hopes that long-term permitting options for stream maintenance activities will eventually be realized in Waipi‘o. A community meeting was held in February 2005 with a diverse group of agency representatives and community members where regulators discussed the various legal requirements. The table below lists the contacts from that meeting. A discussion and flow chart follow that summarize those presentations, and a reference binder from the meeting is available at the NRCS Waimea Field Office.

Table 6: Quick Reference for Agency Contacts

Name	Agency/Title	Email	Phone Number
Lolly Silva	U.S. Army Corps of Engineers	Laurene.L.Silva@ poh01.usace.army.mil	808-438-9258
Ed Sakoda	DLNR Commission on Water Resource Management	Edwin.T.Sakoda@hawaii.gov	808-587-3868
Denis Lau	Department of Health, Clean Water Branch	dlau@eha.health.state.hi.us	808-586-4309
Roy Takemoto	County of Hawaii, Planning Department	roy_takemoto@co.hawaii.hi.us	808-961-8288
Kelly Gomes	County of Hawaii, Public Works Department	dpweng@co.hawaii.hi.us	808-961-8327
Matthew Wung	District Conservationist, NRCS	Matthew.Wung@hi.usda.gov	808-885-6602x106
Carolyn Wong	Soil Conservationist, Natural Resources Conservation Service	Carolyn.Wong@hi.usda.gov	808-885-6602x105
Katina Henderson	Watershed Planner, Natural Resources Conservation Service	Katina.Henderson@hi.usda.gov	808-541-2600x131
Dudley Kubo	Watershed Planner, Natural Resources Conservation Service	Dudley.Kubo@hi.usda.gov	808-541-2600x124

U.S. Army Corps of Engineers (Corps)

A Department of the Army (DA) permit from the Corps is required for any activity involving the placement of fill material (concrete, rock, dirt, sand, etc.) into a stream, wetland (taro fields), the ocean or other U.S. waters. For those activities relating to farming, ranching and or silviculture, certain activities are exempt and will not require a DA authorization under Section 404 of the Clean Water Act (33 CFR 323.4). To qualify for this exemption, the activities must be part of an established (i.e., on-going farming, silviculture or ranching operation. The federal regulation can be found at the following link: http://www.access.gpo.gov/nara/cfr/waisidx_02/33cfr323_02.html.

Following a storm or flood event, farmers are able to remove any fill material (rocks, debris, etc) which formed during flood flows or other events which if not promptly removed would impair or prevent the plowing, seeding or cultivating of crops on land established for crop production. Removal of sandbars or gravel bars in streams or waterways which are not subject to the influence of the ebb and flow of tide will not require a DA permit. The Corps should be notified prior to conducting any work and best management practices (BMP's) should be used to minimize sediment entering the stream.

State Commission on Water Resources

The Hawaii State government protects, controls, and regulates the use of all water resources for the benefit of its people. Naturally occurring water cannot be "owned" but may only be used by private parties. The State Commission on Water Resources Management carries out the control and management of water resources under a "public trust doctrine." The "public trust doctrine" reaffirms the earlier view of distributed water rights and community ownership exercised by traditional Hawaiian culture. Several kinds of water "rights", which confer a priority to the use of the water, may be in effect in Waipi'o. Appurtenant water right affirms the traditional use of water on a parcel of land for taro cultivation even when distant from streams but connected by an auwai system. Appurtenant rights are sometimes called "kuleana rights" as land awards made during the Mahele also included a water rights provision implying the right to use water for lo'i irrigation. Riparian water right is a western concept conferring the right to use water from a stream on or adjacent to a parcel of land. The riparian principle also implies a reasonable level of water use such as for domestic and agricultural purposes that does not significantly decrease the amount of water in the stream to be utilized by others.

The Water Commission manages water for the benefit of Hawai`i's people. The permits administered by the Water Commission include the Stream Channel Alteration Permit, Stream Diversion Permit, and the Interim Instream Flow Modification Permit. They have regulatory control over streams, springs, and other naturally-occurring water bodies. In regards to diversions, the Commission only regulates diversions that are directly connected to the stream and does not regulate subsequent diversions off existing auwai or ditches. The Water Commission encourages communities to develop local agreements on water use. They also protect "appurtenant rights" which provides water to properties that used irrigation water for crops during the native Hawaiian period.

State Department of Health, Clean Water Branch

The Department of Health (DOH) receives notification and is asked for approval in the form of a 401 Water Quality Certification, whenever a Corps permit is requested. The Water Commission also seeks DOH input for their permit applications. The DOH administers the National Pollutant Discharge Elimination System (NPDES) permits, in some cases referred to as stormwater permits, which is required for any discharges of water from non-natural sources.

Hawaii County Planning Department

Special Management Area permits are required for any building activity in the shoreline area. Most maintenance activities are exempt from the SMA but do need an exemption letter from the planning Department to comply with the law. This letter should be obtained prior to conducting the activity.

County Department of Public Works, Engineering Division

Any earth grading, exceeding 100 cubic yards of material or over an acre of surface area within a parcel, requires a grading permit or can be exempted by having a Soil and Water Conservation District (SWCD)-approved conservation plan. An archaeological clearance is also necessary before the grading permit is approved. For new structures built in the floodplain, the first floor must be above the 100-year flood depth.

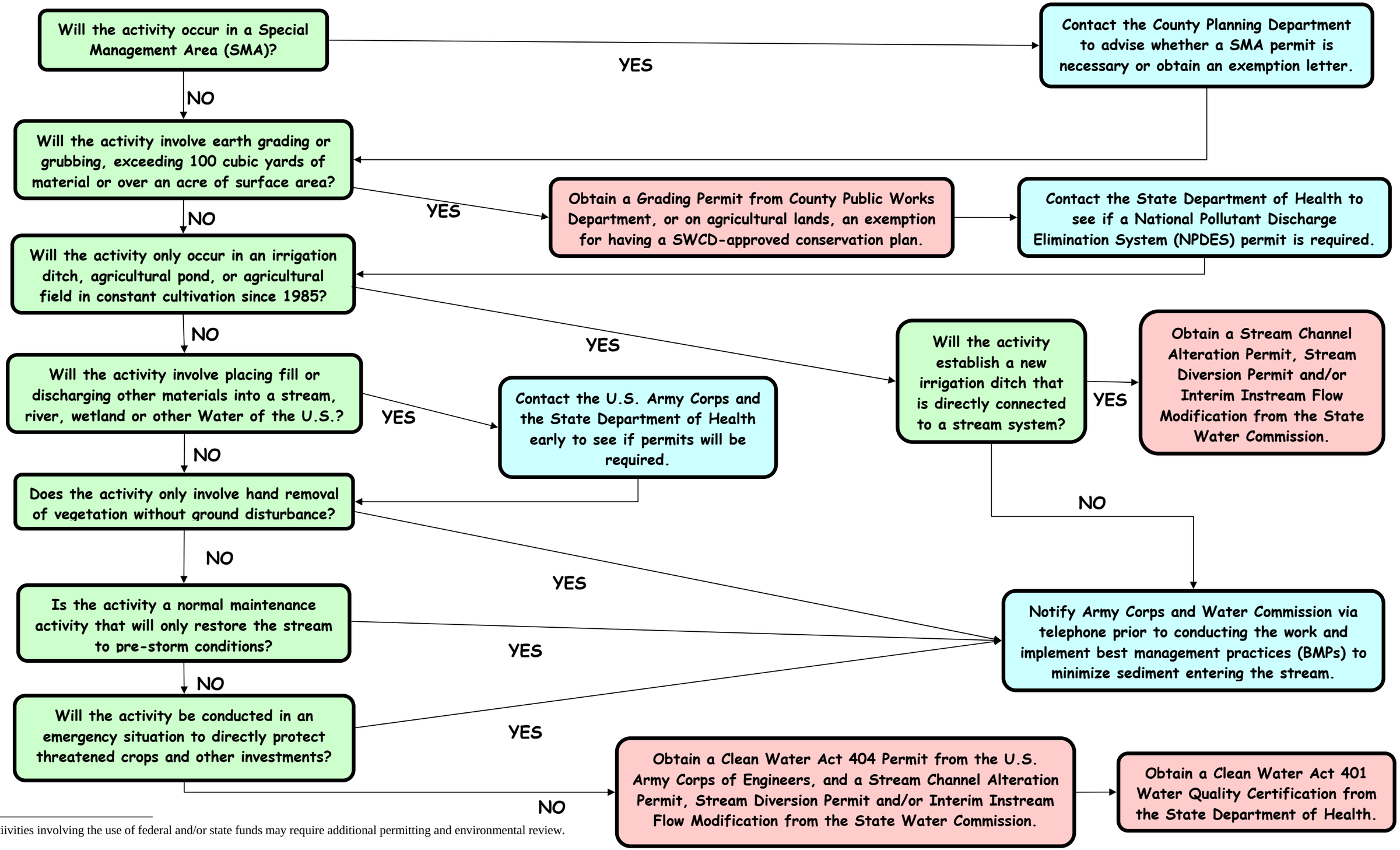
Special Information for Activities Using County, State and/or Federal Resources

When activities are conducted on State or County land or involve State or County resources, the regulatory requirements can become more complex. For state activities, one important element is the development of environmental review document under Chapter

343 of the Hawaii Revised Statutes. When federal resources are utilized for a project, a similar environmental review process is necessary under the National Environmental Policy Act. Other activities related to cultural resources evaluations may also be necessary. The best way to make sure that all regulatory requirements are fulfilled is to work directly with state and federal employees.

Table 7: Permit Chart for Non-Structural Activities in Streams and Wetlands[5]

Examples: Stream Bank Stabilization, Sand-Gravel Bar Removal, Stream Obstruction Removal



[5] Actiivities involving the use of federal and/or state funds may require additional permitting and environmental review.

CHAPTER 7: STRATEGIES FOR IMPLEMENTATION

The Ahupua‘a and Watershed Context

Stream management is a practical task. To succeed it must harmonizes with the broader objectives that keep people together in Waipi‘o Valley. Focusing on stream management alone would not resolve all the standing issues in the valley, yet successful stream maintenance is a good way to resolve "on site" some of those issues.

An ahupua‘a and watershed plan is a modern procedure that includes customary practices that have been perpetuated for generations in the valley. It is part of a process that unites those who care for Waipi‘o so that future generations can experience the valley as a center for traditional taro growing, Hawaiian practices, and educational and spiritual growth. It sets parameters and community values for permitting agencies to consider and signals to funding and financial organizations the steadfast commitment to taro farming, and to the historic, cultural and environmental importance of the valley. It focuses on long-term goals as well as specific actions to be taken short term.

One issue involves harmonizing the different views on river maintenance. Differing views to reconcile may include:

a) **cultural practitioners may see taking care of the river as a spiritual endeavor to be done traditionally by hand;**
b) **taro farmers may consider stream maintenance as their traditional task, done in an efficient way using modern equipment;**
c) **environmentalists may prefer no human intervention, letting nature take its course; and**
d) **regulatory agencies may require aquatic habitat and stream life improvement; erosion control, and retention of water quality and pollution abatement.**

Another issue is addressing government regulations and permits at the federal, state and county level. The complex web of permits may disempower the community members. If community members remain involved in all stream management activities so that the kūpuna, elders, can pass on their knowledge to the youth using

"learn by doing" approaches, the understanding of when and how to obtain permits may be preserved.

To succeed, a planning model in Waipi'o Valley would address the following interrelated dimensions: public trust, stewardship, place-based management, ahupua'a planning and equitable relations among parties.

<u>Public Trust and Government Agencies</u>

The "public trust doctrine" encourages agencies and all stakeholders to move from regulation to cooperative management. Starting from the bioregional and socio-cultural reality of a locality and its people, an interagency-community task force can evolve principles of collaboration that lessen bureaucratic impediments and use more discretion in accomplishing the agreed upon plan, management, and enforcement. Because of the increasing complexity of government regulations, financial resources for a community planner to serve the locality must be provided.

<u>Stewardship</u>

The preamble of the Bishop Museum lease recognizes the Valley as an invaluable living, historical, and cultural treasure, because it perpetuates rural Hawaiian lifestyle and the cultivation of taro (Bishop Museum, 1993). Local communities need to obtain some management responsibility from agency and landowners. They need to maintain an internal system of decision-making so as to evolve in harmony over time. The answer is "place based management" so that community capacity is nurtured.

<u>Place-Based Management</u>

There are two indigenous ideas for "place-based management" that evolved in pre and chiefly times in Hawai'i, that can be re-proposed. They are:

(a) The "konohiki", the traditional caretaker of the ahupua'a who can be revived for a contemporary approach to managing the resources of the valley.

(b) The 'aha council, or the ahupua'a council, a recognized group of experts leaders from the ahupua'a. This council would not only include cultural practitioners, taro farmers, waterhead leaders, tenants and large and small landowners with property in the

valley, but also the large landowners as well as a county representative (because of its regulatory and enforcement powers).

Both the ideas of Konohiki and of ‘aha council imply kuleana, or rights and responsibility. The konohiki would have the authority to invoke the traditional practice of laulima, (many, many hands), or cooperation, so that people would work together towards stream and lo’i maintenance (Handy & Handy & Kupui 1972). These concepts could be loosely applied in modern times. For example, the Waipi‘o Valley Community Circle, or whatever structure the community agrees upon, could serve as the ‘aha council, which, in turn, appoints the konohiki to the management task of the ahupua’a as the executive officer.

Ahupua’a Planning

Ahupua‘a management incorporates a holistic approach to managing natural resources based on a mauka-makai connection between uphill and downhill habitats and also “embodies a unique relationship between the Hawaiian people and the land” (Blane and Chung 1999). Practicing ahupua‘a planning involves the following tasked:

(a) instilling appropriate values.;
(b) community-based efforts involving ahupua‘a tenants, or people with localized knowledge and who have a personal stake in their ahupua‘a;
(c) creation of partnerships of stakeholders to examine western governmental and legal structures to weave the ahupua‘a principles throughout; and
(d) perpetuating this practice from generation to generation” (Blane and Chung 1999).

When analyzing the records on Waipi‘o Valley and of the Waipi‘o Valley Community Circle, strong elements of Hawaiian and local culture ahupua‘a management emerge. They include attention to “protocol”, “precedence” and “sequence” (Minerbi 2001).

<u>Protocol:</u> The style of doing things, the way people enter, exit and behave in the valley, particularly during encounters by individuals and groups, should be consistent with customary island ways. It is essential that newcomers be acculturated to these ways.

<u>Precedence:</u> The perpetuation of Hawaiian culture and the continuation of taro cultivation have precedence over other activities given the vocation of this historic valley.

<u>Sequence:</u> Define which programs and projects should be initiated first and which should follow. Stream and ‘auwai maintenance, selected clearing of the Wailoa River (gravel bars and vegetation), unclogging of the river mouth, and the monitoring system in the river should be completed before major floods occur.

<u>Equitable Relations</u>

Agreed upon norms of behavior can improve in the valley. “New-comers” can be acculturated with the way of life and behaviors of “old-timers” when parties are engaged through facilitated meetings and dialogue to embrace a social contract addressing: agreements on norms and behaviors and protocols and precedence for sake of cultural continuity. Establishing an equitable “social contract” between farmers, small tour operators, other people of the valley for the sake of fairness, ensure that revenues, costs, mitigation of impacts, and maintenance of the valley environmental quality as well as stream management are addressed.

The Waipi‘o Valley Community Action Plan Draft suggests the formation of two committees (Minerbi and Poerbonegoro 2003):

(a) A “Natural Resource Management (NRM) Committee” to initiate and lead participation in natural resource management involving interagency collaboration. Management can be improved by dividing Waipi‘o Valley in natural resource s sub-zones.
(b) “Stream Management Committee” supported by the pertinent permitting agencies leading to plan overall stream monitoring and maintenance.

This supports the idea that the Valley’s community based decision making should address watershed issues for the entire valley and operate by ahupua’a subzones and by stream waterhead subgroups. These areas and locations may coincide. Attention should be paid to: (a) community management; (b) legal stipulations; and (c) zoning rules enforcement. These committees would also: (a) solicit participants; (b) develop scopes of work; (c) design long-term plans; (d) develop funding sources

and receiving mechanism with accounting, administrative and other reporting systems.

The Natural Resource Management Committee would be made up of taro farmers and voluntary members of the Waipiʻo Valley Circle and advisory resource managers. The Committee will research and review behaviors and actions occurring within the valley that could have an effect on native natural resources within Waipiʻo Valley. A part-time or full-time natural resource manager would also be needed.

<u>Participation</u>

The "Stream Management Committee" in charge of overall stream management could be formally recognized by the stakeholders at a Waipiʻo Circle Meeting. This group would form the framework for obtaining stream permits; administer government cost-share funding; administer contracts for stream maintenance services; and form a business or non-profit cooperative.

The permitting process stipulates that neighbors are alerted to proposed activities. A good faith effort should be made to inform all landowners and users downstream of proposed stream maintenance activities and permit applications. This stream management plan strongly suggests that their tenant farmers be active participants in a stream maintenance organization that is dedicated to the comprehensive and integrated management of the valley.

A memorandum of understanding could be drawn up and all the parties could sign on. In this way, minor stream crossing maintenance activities could occur on a more frequent schedule. This may minimize the need for major, costly repair work that may require permits and could alleviate the uncertainty and skepticism permit agency personnel may feel when asked to review maintenance work.

The process for agreeing on stream crossing repair work could be a first step and model for proactive maintenance agreements at other locations along the stream. These locations that require regular maintenance could be identified, such as at mānowai or at confluences of smaller tributary streams. By formulating agreements between farmers, residents, and government agencies prior to maintenance work being performed, future conflicts could be minimized.

For these agreements to be constructed, it requires a willingness of all the stakeholders to dedicate themselves to producing actual plans and drawings, estimates of the level of effort needed, specific methods to be used, and who is going to do the work.

Organization

A formal organization with a concise mission and stated procedures increases accountability, responsibility, clarity and trust. The publication of bylaws, mission statements, elected officers, committees formed, fiscal statements and a schedule of regular meetings can go a long way towards legitimizing a group to potential partners. The Waipiʻo Valley Community Circle may also be able to organize itself as a 501(c)(3) because the membership requirement has been adjusted to be inclusionary. Membership could be based on tax papers or rental agreements and business licenses tour operators.

Waipiʻo as a "Wahi Pana"

Waipiʻo Valley is already identified as an SMA area, as an agricultural zone, a conservation zone and as a flood plain zone. It can be defined as a Wahi Pana (Sacred Place) zone with the support of the stakeholders. Eventually, this designation of Wahi Pana for the Waipiʻo Valley can be adopted in the County of Hawaiʻi General Plan and Local Area Plans.

Leadership Development

Waterhead Leaders

The number of the waterheads have increased in recent times from the originally 6 to 13. Each waterhead has a team leader. There is a need to encourage new comers to joint the pertinent waterhead group so that mutual learning can take place and to ensure each waterhead have enough taro farmers for proper maintenance and repair. Newcomers, , which can be defined as locals and Hawaiians who skipped a generation of working on their family land or those new to taro farming and the Big Island, are not "generation trained." Traditionally, newcomers were to seek out help and guidance of waterhead leaders.

Next Generation of Farmers

Generally, both commercial and subsistence taro farmers are currently forty and older and there is a danger of further declines when the current farmers retire. The

youth have an interest in farming taro, but they have to be gathered as a group. The children and grandchildren should be invited to come to future community and Circle meetings and encouraged to participate. Part of the process of perpetuating the Hawaiian culture is to ensure that the growing of taro and understanding its significance and meaning in Hawaiian culture continues with future generations.

Apprenticeship Programs

The benefits of an apprenticeship program would be enormous for participants and mentors. An apprentice program would increase morale of outsiders interested in maintaining culture through practices such as taro cultivation. The apprentices would provide free or inexpensive labor for the mentors. The increased labor could increase taro production and boost income from taro, providing a more stable income for some taro farmers.

Apprenticeship programs could incorporate traditional aquaculture restoration and expansion programs could be formulated. A possible future taro farmers' waiting list could be compiled to perpetuate this traditional practice in a sustainable and educational manner. Finally, community workdays could be coordinated with apprentices and other students from local schools and Hawaiian cultural programs.

Stream Maintenance Approaches

Wailoa River Mouth Clean Up

An array of ideas exists regarding maintenance at the mouth ranging from doing nothing to mechanized excavation. Performing any of the proposed stream mouth cleanup activities requires a sustained level of cooperation and communication among stakeholders. Landowners have to grant access permission and use of their land to undertake some of the activities on their properties. Discussions about the stream mouth cleanup should be inclusive of those participating in the Community Circle and other individuals with knowledge and experience with the Wailoa Stream, particularly the old timers, including past residents and kūpuna. The NRCS and the Bishop Museum, can provide technical and scientific assistance. Stream mouth clean up activities should be co-designed, communicated and approved also by beach users and surfers so as to gain acceptance and avoid disruptions during permissible stream maintenance activities. A schedule of tasks can be prepared by waterhead or other watershed leaders. For stream cleanup activities, kūpuna and taro farmers have suggested that the river mouth clean out

should precede the Wailoa and Hi‘ilawe Stream channel work so that gravel going downstream does not block the mouth again and back up the river.

<u>‘Auwai and Lo‘i Maintenance</u>

Most stream and lo‘i maintenance decisions are currently made by waterhead leaders who are experienced and respected taro farmers. They reside or tend to farms at key points along the streams and they regulate the water flow. These overseers, who supervise the maintenance of the ‘auwai are responsible for facilitating the equitable flow of water through the lo’i connected to the waterhead and then back into the river so as to serve downstream lo’i. By having in place a structure to resolve issues, complaints can be dealt with in an orderly manner.

Protocols

<u>Evaluation Protocols</u>

Protocols or guidelines for checking stream work can be proactively compiled to ensure that neighbors and agencies can see the long term commitment put forth. Best Management Practices should include monitoring protocols and documentation of past and current routine river maintenance, so as to establish straightforward, community-friendly, affordable standards for watershed monitoring to assist in early detection and prevention of undesirable changes.

<u>Data Collection and Storage Protocol</u>

A protocol for receiving and storing data should be set up so that laws, contracts, permits, technical reports, BMPs, maps, testimony, meeting minutes, oral histories, photographs, video, and artifacts could be recorded, secured, and made easily accessible through user friendly quick reference guides to any interested persons. Possibly data could be collected at Community Circle monthly meetings and deposited in a repository such as the Honoka‘a library.

<u>New Lo’i Water Diversion Protocol</u>

Diversion requires plotting a map of the valley and stream bed showing active and fallow lo‘i. This would show where water is going. Water diverted from the stream to serve a lo’i should go to the next lo‘i down stream and eventually should be returned makai to the stream for other farmers to use.

"Equipment" Protocols

A summary of three basic approaches to conducting stream management activities is included in Chapter 5. The approaches include Hand Clearing, Minimal Mechanical Excavation and Heavy Equipment/Mechanical Excavation. The community will still need to decide when, where, why and how often to use the various approaches.

Conflict Resolution Protocols

By having a structure in place to resolve conflicts, complaints can be dealt with in an orderly manner. Concepts to consider include the konohiki and the 'aha council with the power to call for final decisions, mediation, and binding arbitration.

Conclusions

Overall, the most pressing need, in order to implement the stream management plan successfully, is to organize a mutually agreed upon leadership structure to make decisions. This leadership structure should include ahupua'a zones/waterhead areas so that smaller community groups that have specific common interests come together for project planning and implementation. These groups would need to communicate often and effectively with the rest of the community.

Little by little, project by successful project, the community's capacity will increase and they can work toward becoming a 501(c)3 entity or aligning with an existing non-profit organization to receive and manage funds for full Valley planning. The island's Community Development Plan process is now underway in Kona and Puna; Kohala will begin in mid-2006 and at some point Hamakua will begin. There is some question where Waipio will be included. This is an excellent opportunity for the Waipio community to develop plan for itself and integrate it into both the Waimea and Hamakua regional plans.

A number of other basic actions for stream management plan implementation are suggested:

1) **strengthen organization of community meetings with waterhead leaders in the locality where problems arise,**
2) **establish work days and learning days for regular maintenance work in the stream,**

3) **create a taro farming apprenticeship programs with local high school and college students,**
4) **involve youth in community meetings and**
5) **decide on different types of equipment for different maintenance needs and the levels of permitting necessary.**

Additionally, a few recommendations are listed below that address strategies for overall valley management:

1) **establish a good neighborhood policy,**
2) **meet with Bishop Museum Board,**
3) **raise money to fund cultural programs and education,**
4) **restrict vehicular access to the valley,**
5) **develop funding strategies and**
6) **control tourism and development.**

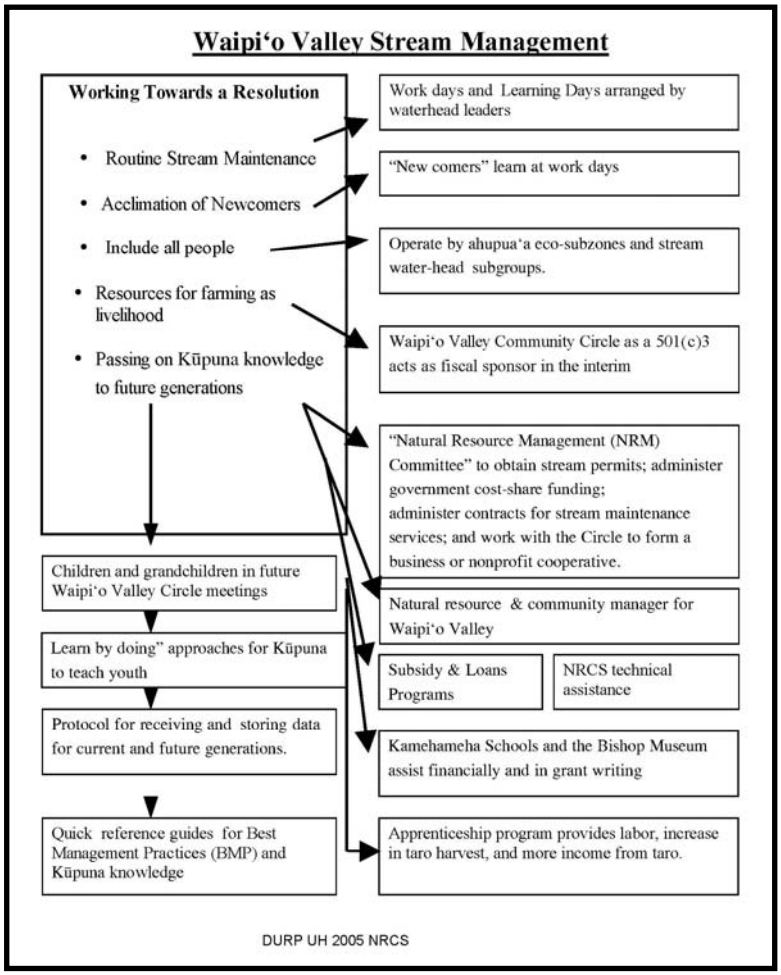


Table 8: Summary of Strategies for Implementation

CHAPTER 8: FUNDING OPPORTUNITIES

To receive grant monies is beneficial; however, receiving monies without a strong foundation could cause problems or disagreements. There first needs to be consensus on a governing structure, which may or may not be a further evolution of the Waipi'o Community Circle process. Whatever structure is created, its decision making process for identifying projects, applying for grants, and financial monitoring system must be transparent and agreed to by the community-at-large.

Available Funding Sources

A variety of funding sources are available for implementation of the alternatives mentioned in this plan. The descriptions below are only a sampling of what is available. The community will need to organize to leverage funds. The NRCS Resource Conservation and Development program or the County Department of Research and Development may be able to assist in requesting grant funds, and the Mauna Kea Soil and Water Conservation District is a potential sponsoring organization. In-kind labor and equipment can be inventoried and valued as matching funds for government grants.

State Civil Defense

Pre-Disaster Mitigation Program program can provide cost-shared funding to implement "stand-alone" construction projects to reduce storm or flood damage. The community would need to have a well-established community organization, like a nonprofit, with sponsorship by a unit of County or State government to apply for most disaster programs.

Department of Health, Clean Water Branch

For projects that involve pollution reduction such as bank stabilization., funds may be available through the Clean Water Act 319 grant program.

Natural Resources Conservation Service

The Natural Resources Conservation Service administers many Farm Bill programs that may be useful in conducting treatment alternatives in the Valley. Particularly appropriate are the Environmental Quality Incentives Program, the Wetlands Reserve Program and the Wildlife Habitat Incentives Program. To learn more about these programs and their applicability, farmers and residents should contact the NRCS Waimea Field Office.

State Dept. of Bus., Econ. Dvlpmt. & Tourism, Coastal Zone Management Program

Their mission is to protect resources in the coastal area, which in Hawai`i, includes all of the land area. The CZM program can serve as a conduit for federal funds.

Private Funding

A variety of private funding sources are available. At the national level, grants are available from organizations such as the National Fish and Wildlife Foundation for Conservation on Private Lands. Locally, individual donations may be sought from wealthy landowners and leaseholders. Kamehameha Schools and the Bishop Museum may also offer strong collaborative assistance to benefit Waipi‘o programs. There may be a number of opportunities to encourage individuals who visit the Valley to contribute to a special fund to provide for long term stream maintenance support.

The future success of a cooperative financial agreement among all segments of the community will hinge on their ability to reconcile. Fortified with experience, these parties have the opportunity to learn from the past to produce an equitable, accountable and sustainable financing strategy.

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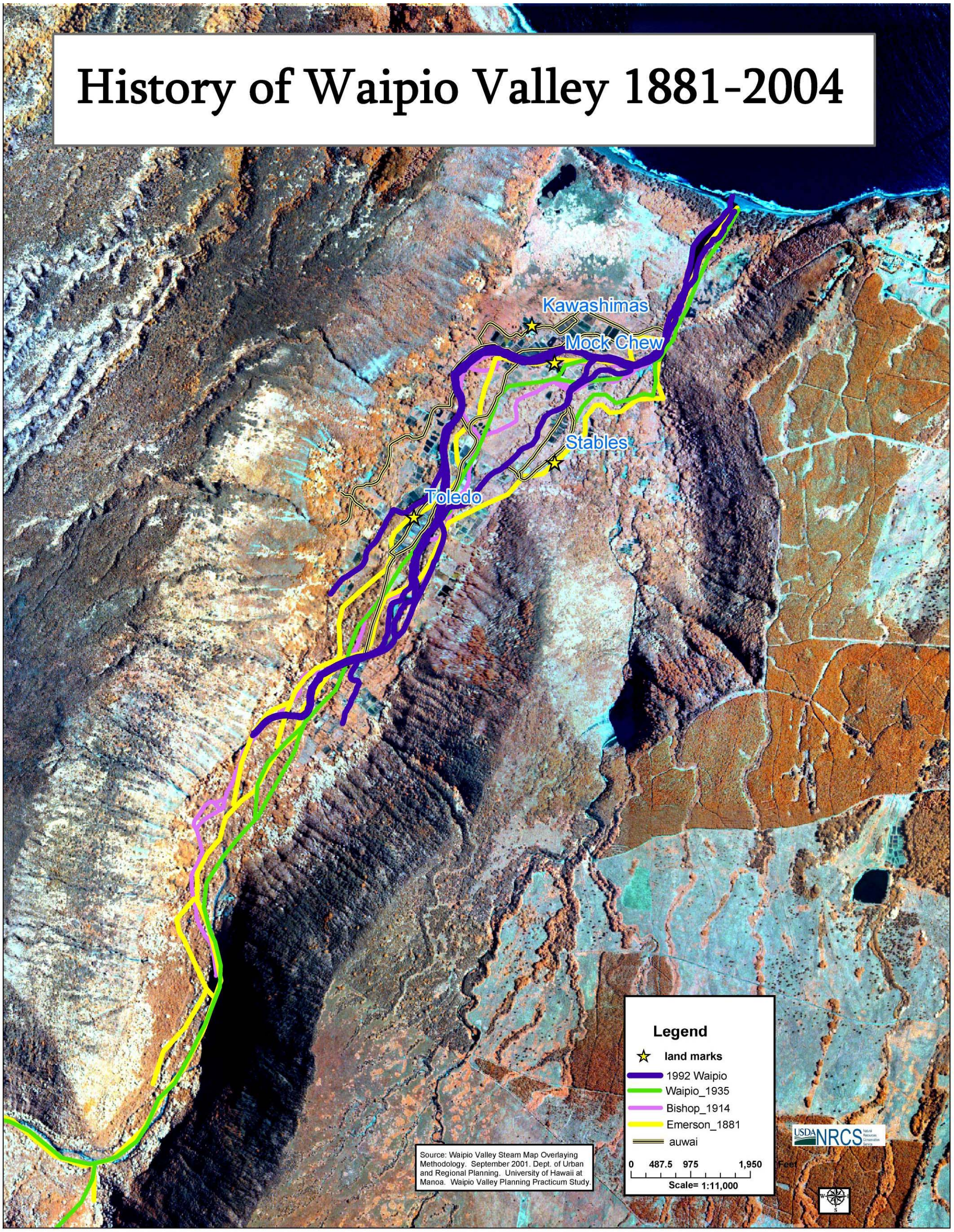
CHAPTER 10: **APPENDICES**

Appendix A:
Historical Map of Waipi‘o Valley Stream Courses
(overlayed on Aerial Imagery)

History of Waipio Valley 1881-2004



Appendix B:
Historical Map of Waipi‘o Valley Stream Courses
(overlayed on 1881 Emerson Map)

WAILOA RIVER

Overlay Map

1881-1994

Hawai'i County Planning Dept. S.Z. Map 1994

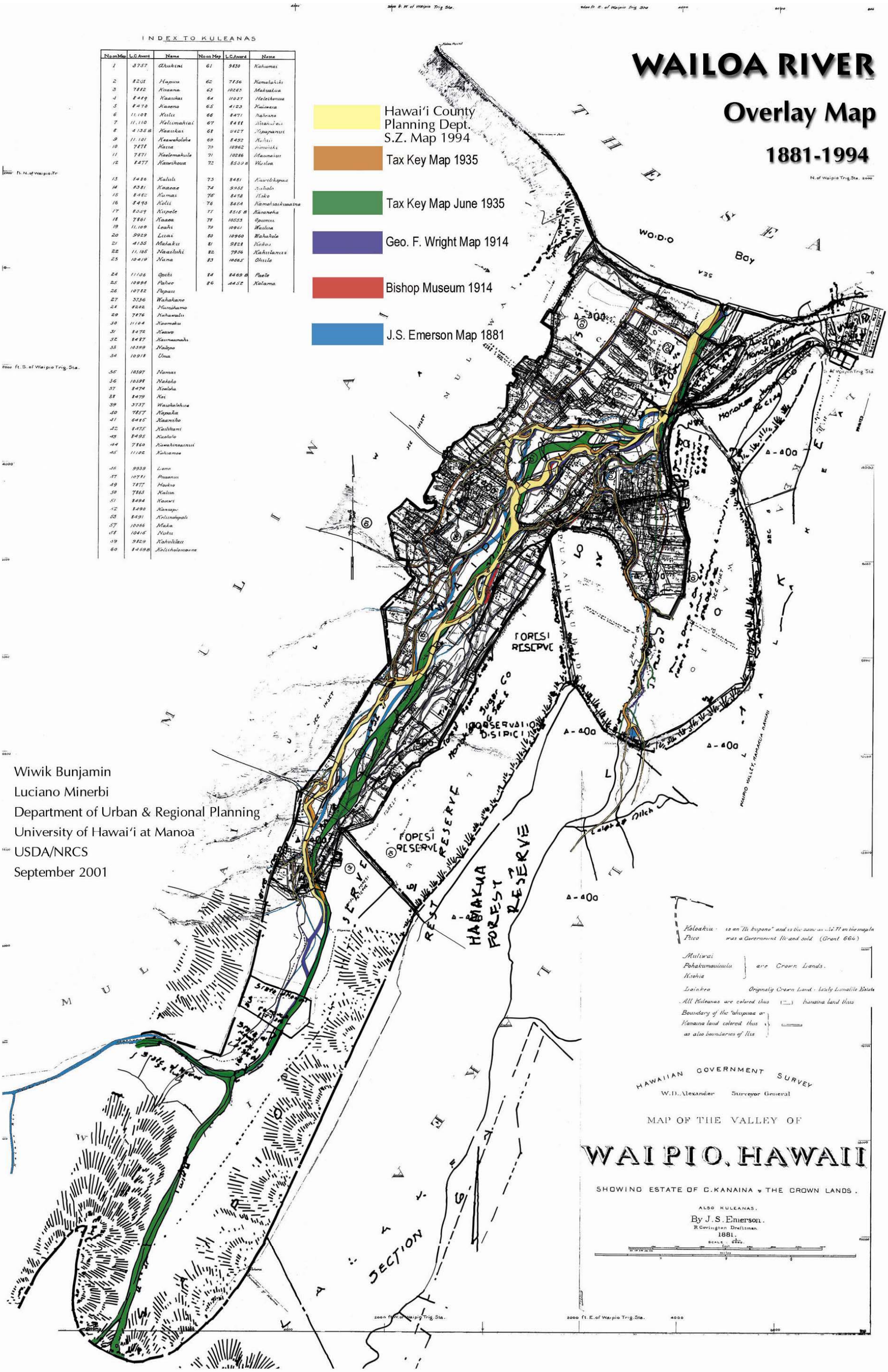
Tax Key Map 1935

Tax Key Map June 1935

Geo. F. Wright Map 1914

Bishop Museum 1914

J.S. Emerson Map 1881



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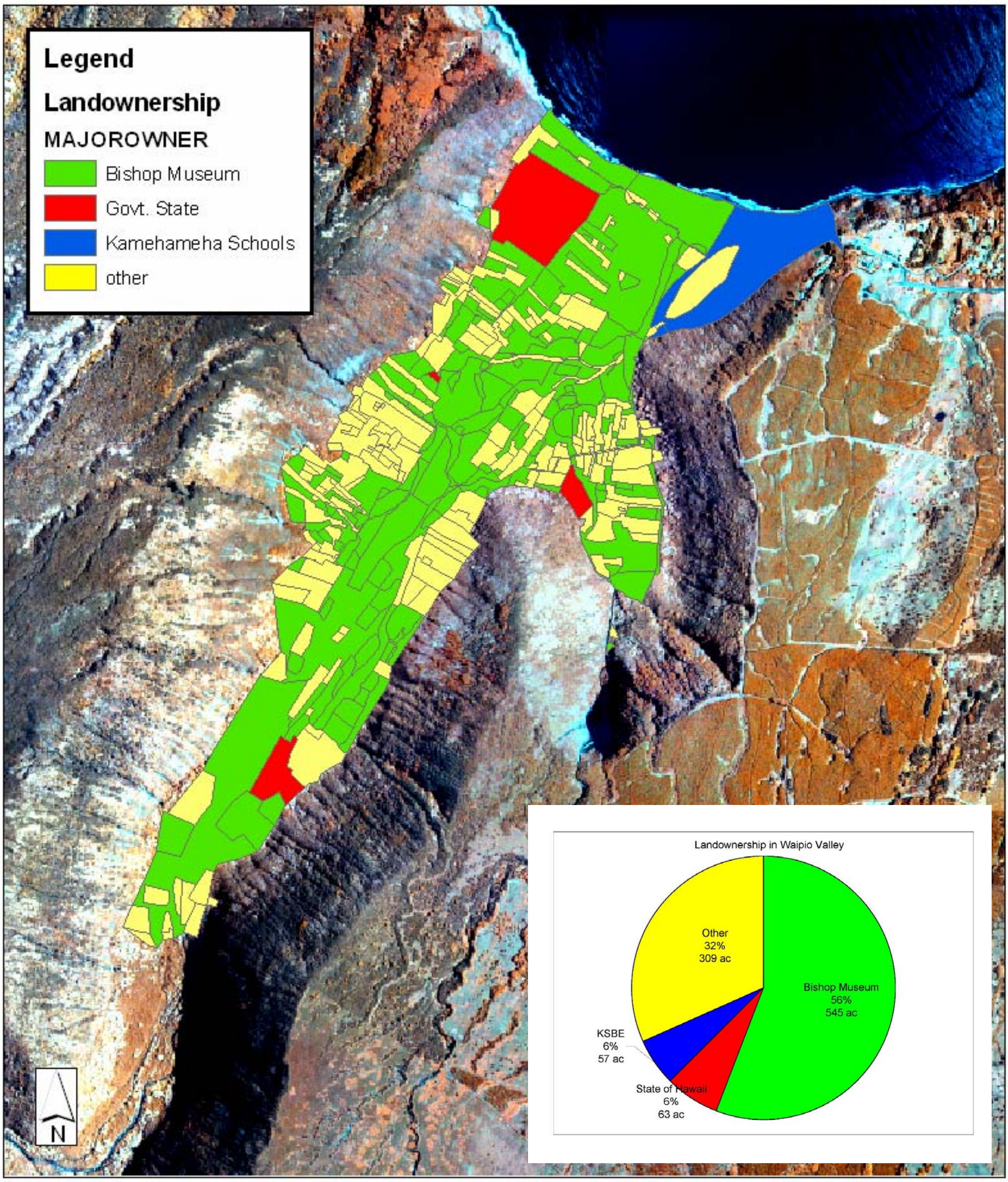
USDA/NRCS
September 2001

Appendix C:
Waipi‘o Valley Land Ownership Map and Chart

Waipio Valley - Landownership Map



Source: County of Hawaii Tax Map Key Data, 2005

Appendix D:
Analysis of 1914 Bishop Estate 570B map reflecting crops in the flood zone

India Clark
UH Manoa - DURP
January 18, 2006
Waipi'o Valley Stream Management Plan

Project: Analysis of 1914 Bishop Estate 570B map reflecting crops in the flood zone

I have divided the 1914 Bishop Estate Map into three sub-zones to analyze the map for the distribution of cropland types in relations to the flood zone in the valley. The three sub-zones are as follows: mauka zone, middle zone, and makai zone. Currently, these sub-zones have been placed based on the characteristics of the valley and stream on the map (i.e. where the tributary streams start). Further study of the valley's topography and slope may lead to relocation of theses sub-zones.

A digitized map has been created (traced and scanned) from the original 1914 Bishop Estate 570B map. This map removes lot ownership to focus on the flood zone and cropland type. The three sub-zones are illustrated on this map.

An examination of the original 1914 Bishop Estate 570B map is recommended as the replicated map's words are often illegible and difficult to decipher. The original map may more legibly note additional cropland types.

Mauka Zone:
This zone contains the least amount of illustrated and labeled croplands (crop field boundaries are illustrated as dashed -----). Some cropland is illustrated but not labeled as such. Other illustrated cropland is labeled as "unplanted" vegetation. One illustrated cropland plot is labeled "old taro land" on the North side of the valley. Cropland is labeled as "taro land" and is planted along the stream corridor on the South side of the valley. In this zone, three areas are noted as: "Rocky covered with guava" (on the North side of the valley). This zone contains the most amount of "rocky islands".

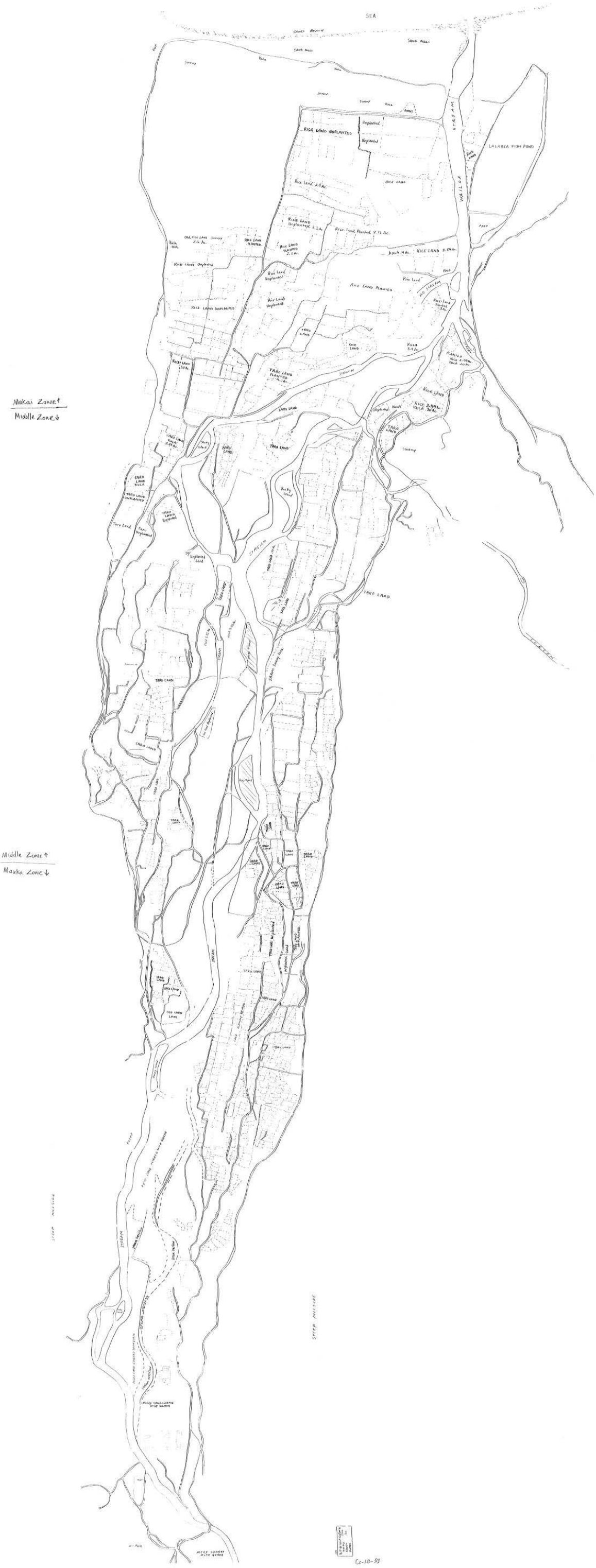
Middle Zone:
The stream starts to spread out and braid in this part of the valley. This zone contains the largest amount of cropland labeled as "taro land" (and is located on both the North and South side of the valley). Although kula and "rice land" appear to be planted closer to the stream bed more often than cropland labeled "taro land", taro lo'i do appear just as close to the stream bed. The middle portion of this zone within the main river braids appear mostly unplanted except in a few places. Kula cropland is often illustrated as combined with taro lo'i.

Makai Zone:
This zone consist mostly of "rice land". Kula is often combined with "rice land" and taro lo'i in this zone. Swampy areas are often noted and seem to coincide with kula. Kula seems to be planted in areas ranging from swampy to more upland areas away from the stream corridor.

A substantial amount of swampy land is noted on the North side and along the south coast of this zone. Sand mills are noted on the coast.

Summary:

The three main types of crops (i.e. kula, rice lands, and taro lo'i) are planted very close to the stream bed. Kula seems to be a very flexible crop. Kula is planted throughout the three sub-zones, while "rice land" is not noted in the Mauka zone. Kula also seems to be the only c intermixed with the other crops. It is often illustrated as a smaller portion of the other cro The most significant difference between the location of the cropland types appear to be between their relation mauka makai, not their distance from the stream.


SEA
SAND BEACH
SAND HILLS
STREAM
WAILUA
LALAREA FISH POND
RICE LAND UNPLANTED
RICE LAND PLANTED
TARO LAND
KULA
STEEP HILLSIDE
Makai Zone ↑
Middle Zone ↓
Middle Zone ↑
Mauka Zone ↓

C-18-93