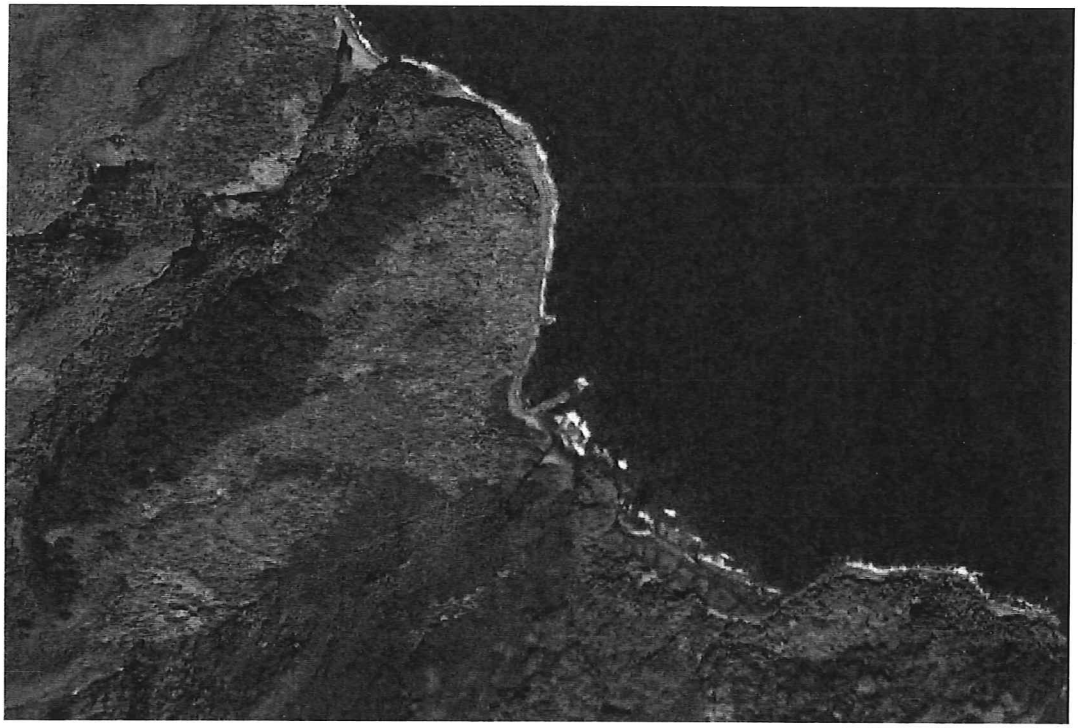
Instream Flow Standard Assessment Report

Island of Maui
Hydrologic Unit 6060
Waiohue

December 2009 **PR-2009-11**



State of Hawaii
Department of Land and Natural Resources
Commission on Water Resource Management

EXHIBIT E-57

TRIAL EXHIBIT AB-157

Figure 3-3. Location of diversions, irrigation systems, USGS gaging stations, and selected ungaged sites in Waiohue hydrologic unit (Source: State of Hawaii, Office of Planning, n.d.; 1996, 2004c; 2005; USGS, 2001b).

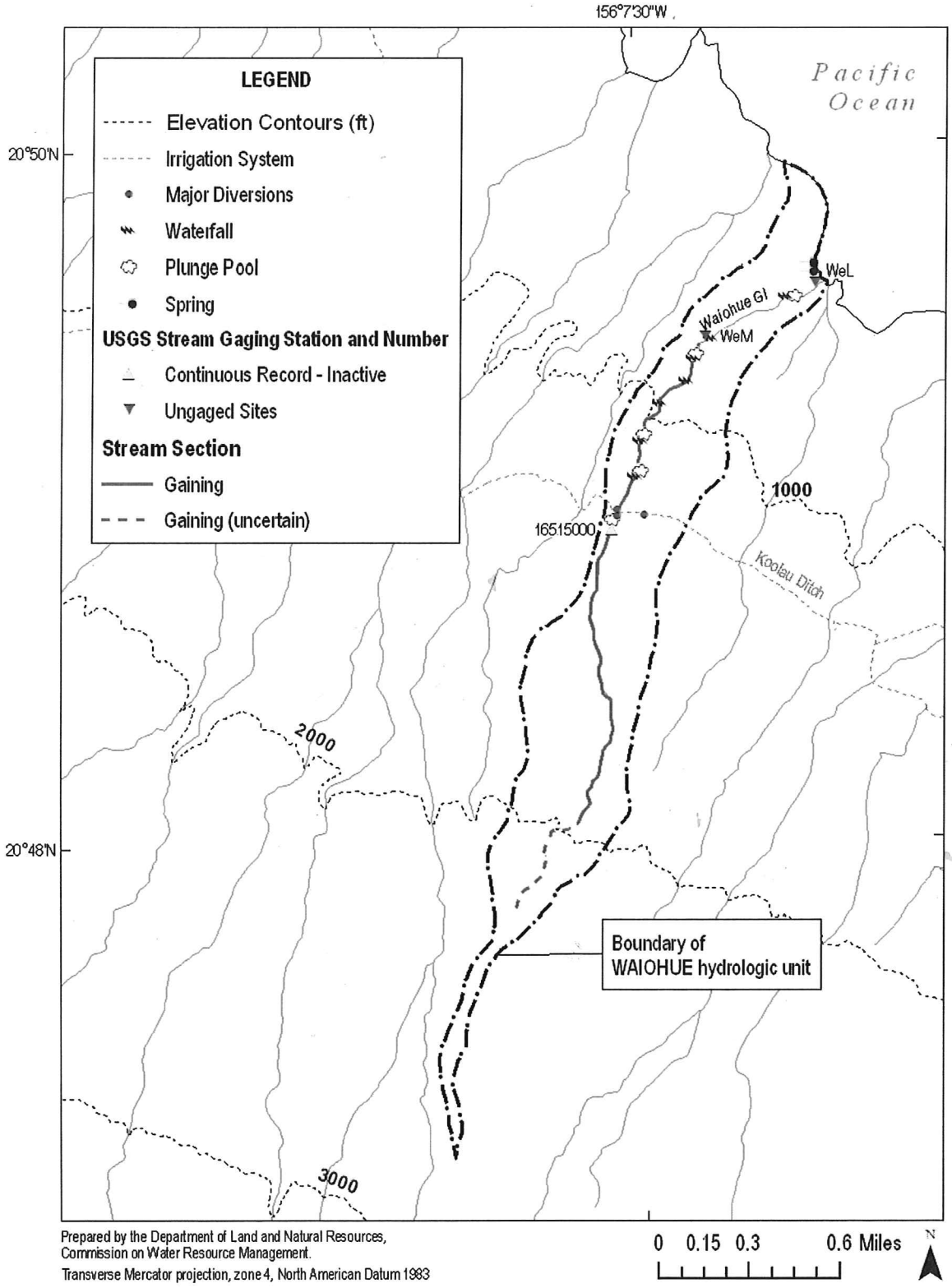


Table 4-2. Hawaii Stream Assessment categorization of aquatic resources in Waiohue Stream.

Category	Value	Rank
Native Species Group 1 (NG1) Four native freshwater species were classified as "indicator species" and comprised the Native Species Group One (NG1). The committee considered these species, 'o'opu alamo'o (*Lentipes concolor*), 'o 'opu nakea (*Awaous stamineus*), 'o'opu nopili (*Sicyopterus stimpsoni),* and hihiwai (Neritina granosa), as representatives of potentially high quality stream ecosystems.	4	Excellent
Native Species Group 1 (NG2) The other seven native species considered more common comprised Native Species Group Two (NG2). These included two 'o'opu akupa (*Eleotris sandwicensis*), 'o'opu naniha (*Stenogobius genivittatus*), aholehole (*Kuhlia sandvicensis*), 'ama'ama (*Mugil cephalus*), 'o'pae kala'ole (*Atyoida bisulcata*), 'o'pae 'oeha'a (*Macrobrachium grandimanus*), and hapawai (*Theodoxus vespertinus*). Presence of these species was considered to be typical of a healthy native stream ecosystem.	7	Excellent
Introduced Species Group One (IG1) This group included noxious, non-native stream animals that may prey upon and/or out-compete with native species. *Macrobrachium lar.* (Tahitian prawn), was not included in this group even though it may pose a threat to native stream animals because it is believed to be present in almost all Hawaiian streams.	1	
Introduced Species Group Two (IG2) This consists of the non-native species considered to be innocuous to Hawaiian streams.	0	

4.3 Analysis of Habitat Availability

In cooperation with the Commission on Water Resource Management and others, the USGS conducted a study to assess the effects of surface water diversion systems on habitat availability for native stream species in northeast Maui. The goal was to determine a relationship between streamflow and habitat availability using a habitat selection model. Five out of 21 streams in the study area were selected for intensive study because they represented a range of hydrologic conditions (i.e., geograhic location, drainage area, terminal waterfall, estuary, human impacts, data availability, and access) present in the study area. By incorporating hydrology, stream morphology, and habitat characteristics, the model simulated habitat and streamflow relations for various species and life stages (Gingerich, 2005) in the 5 representative streams. Results of this habitat model, along with additional data from field reconnaissance surveys, aerial images, and GIS analyses, were extrapolated to estimate habitat availability in the remaining 16 streams. The outcome of the study was ultimately a map (Gingerich and Wolff, 2005, Plate 1) describing the habitat availability for native stream fauna in 21 streams in northeast Maui.

The study focused on certain native fish, snail and shrimp species found in Hawaiian streams. Three fish species of the Gobiidae family, also known as gobies, were considered: 1) alamoo (*Lentipes concolor* (Gill)); 2) nopili (*Sicyopterus stimpsoni* (Gill)); and 3) nakea (*Awaous guamensis* (Valenciennes)). The gobies of interest have a fused pelvic fin, allowing them to climb upstream. One of the fresh water snail species, *Neritina granosa* (Sowerby), commonly referred to as hihiwai, and the mountain shrimp, *Atyoida bisulcata* (Randall), also known as opae kalaole or mountain opae, were also considered in the study. Since opae and alamoo (adult and juvenile) do not typically live in the lower reaches, they were evaluated only in the middle and upper sites. The lower sites were evaluated for adult and juvenile nopili, adult nakea, and hihiwai.

Since Waiohue was not one of the intensely studied streams used to develop the streamflow-habitat relationship, results of the habitat simulation model were extraploted to estimate the stream habitat availability. Estimated natural and diverted median total and base flows were compiled from Gingerich (2005). Since streamflow measured during the habitat surveys was lower than estimated median total and

base flow under diverted conditions, it can be assumed that habitat measurements were made during the driest conditions. Results of the habitat simulation model can be summarized in Figure 4-2. The plot shows the relationship between diverted base flow (x-axis) and habitat availability (y-axis). The colored band indicates the range of values as defined by the 90 percent confidence level. If results from a particular site lie within this colored band, then there is only a 10 percent chance that the results will not be as predicted by the plot. In general, the plot shows that as base flow increases, the area of estimated usable streambed habitat for all interested species also increases. It also shows that "the addition of even a small amount of water to a relatively dry stream can have a significant effect on the amount of habitat available." For instance, when 20 percent of the natural base flow is returned to a dry reach, natural habitat availability increases to 60 percent. Estimates of expected habitat availability are representative for opae and alamoo upstream of large waterfalls.

Of the 70 miles of stream length within the study area, 36 miles have retained 75 to 100 percent of the natural habitat availability, 8 miles with 25 to 50 percent of the natural habitat, and 11 miles with no habitat at all because the stream reaches were dry (Table 4-3). Of the 36 miles with more than 75 percent natural habitat, 20 miles of the stream length were upstream from major diversion ditches. Figure 4-3 describes the habitat availability for Waiohue Stream and specific data are included in Table 4-4. Upstream of Koolau Ditch where there are no diversions, the stream has no reduction in flow and thus, retains 100 percent of the natural habitat. Downstream from the ditch, the stream is dry (no available habitat) until more ground water is gained to provide 45 to 55 percent of the expected natural habitat for all species except opae, and at least 63 percent of natural opae habitat under diverted conditions (17 percent of natural flow conditions). Near the coast, the stream retains enough water to provide at least 67 percent of the expected habitat availability, and over 70 percent of the natural opae habitat under diverted conditions. Overall, less than 50 percent of the natural habitat for all species in Waiohue Stream was maintained below Koolau Ditch under diverted conditions.

Figure 4-2. Relative habitat available for given relative base flow at studied streams. Relative change is the difference between natural and diverted conditions divided by natural conditions (Gingerich and Wolff, 2005).

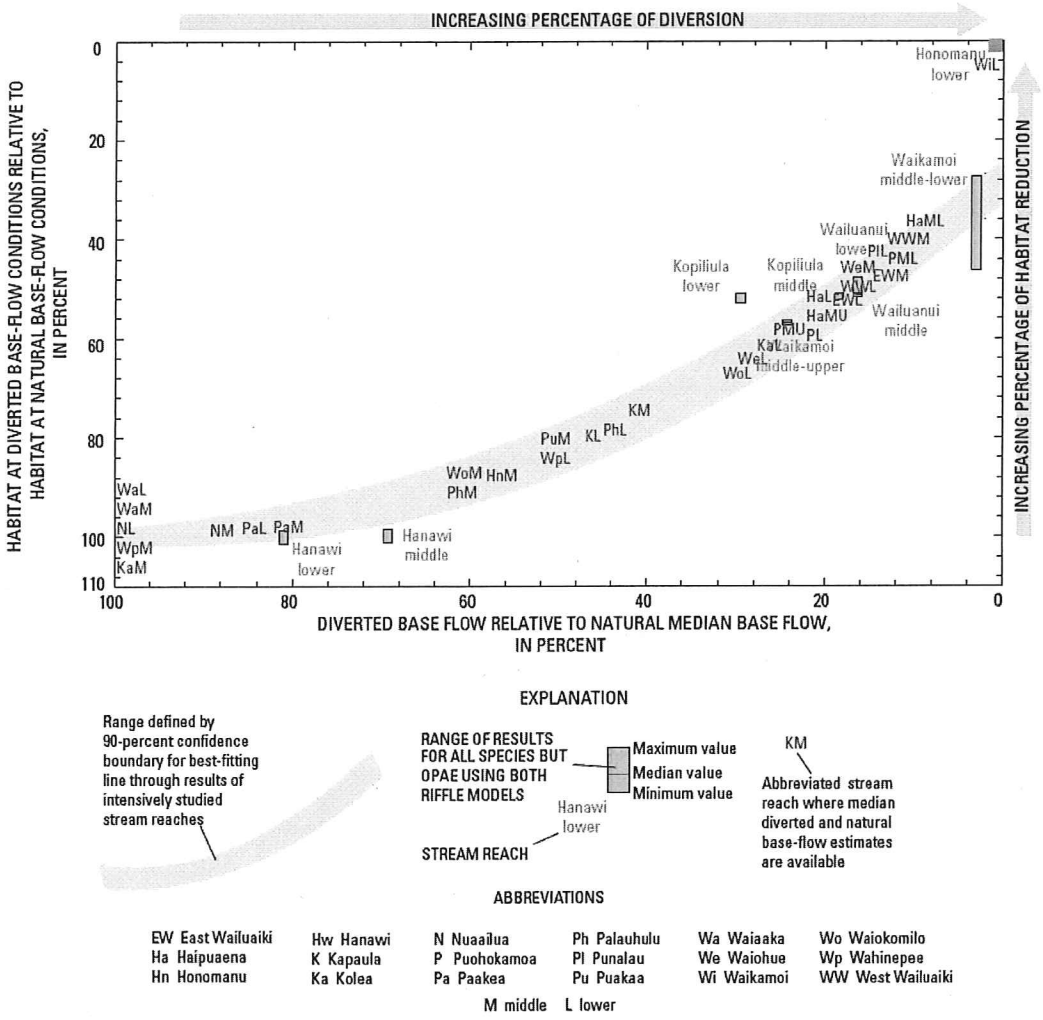


Table 4-3. Summary of estimated aquatic habitat distribution at diverted base flow relative to natural conditions, calculated using GIS from Gingerich and Wolff (2005).

Habitat Availability	Stream Length (miles)
100 percent (no reduction)	26
75 to 100 percent	10
50 to 100 percent	10
25 to 50 percent	8
0 percent (dry)	11
Insufficient Information	5
Total *	70

* The total linear miles of stream length differs from that presented in Ford et al. (2009) probably due to differences in digitization of the stream reaches from Gingerich and Wolff (2005), Plate 1.

Table 4-4. Summary of relative base flow and available habitat in Waiohue Stream (Source: Gingerich and Wolff, 2005, Table 10).

[ft³/s is cubic foot per second; Numbers in ***bold italic*** are considered maximums at sites downstream of unquantified but known losing reaches]

Stream site	Median base flow remaining in stream (ft³/s)		Median base flow at diverted conditions relative to median base flow at natural conditions (% of natural conditions)	Habitat available at diverted conditions (excluding opae) relative to habitat available at natural conditions (% of natural conditions)	Habitat available for opae at diverted conditions relative to habitat available at natural conditions (% of natural conditions)
	Diverted	Natural			
lower (WeL)	2.1	7.5	28	68 – 57	76 – 71
middle (WeM)	1.0	6.0	17	55 – 45	67 - 63

4.4 Distribution of Native Freshwater Species

The HSA inventory was general in nature, resulting in major data gaps, especially those related to the distribution and abundance of aquatic organisms – native and introduced – inhabiting the streams. The State of Hawaii Division of Aquatic Resources (DAR) has since continued to expand the knowledge of aquatic biota in Hawaiian streams. Products from their efforts include the compilation and publication of an *Atlas of Hawaiian Watersheds and Their Aquatic Resources* for each of five major islands in the state (Kauai, Hawaii, Oahu, Molokai, and Maui). Each atlas describes watershed and stream features, distribution and abundance of stream animals and insect species, and stream habitat use and availability. Based on these data, a watershed and biological rating is assigned to each stream to allow comparison with other streams on the same island and across the state. The data presented in the atlases are collected from various sources, and much of the stream biota data are from stream surveys conducted by DAR. Figure 4-4 illustrates the DAR suvey locations on Waiohue Stream. Currently, efforts have been focused on updating the atlases with more recent stream survey data collected statewide, and developing up-to-date reports for Commission use in determining the interim IFS recommendations for east Maui. The following is a brief summary of findings for Waiohue Stream.

- **Point Quadrat Survey.** A number of native stream animals were observed in Waiohue Stream, including oopu nakea (*Awaous guamensis*), oopu nopili (*Sicyopterus stimpsoni*), oopu akupa (*Eleotris sandwicensis*), opae kalaole (*Atyoida bisulcata*), and hihiwai (*Neritina granosa*). During the most recent surveys, oopu nopili was observed near the stream mouth at a water temperature of 20.5 degree Celsius. Oopu nakea and hihiwai were observed in the upper reach near the ditch. The only species recorded in the upper reach above the ditch was opae kalaole. Water temperatures dropped by almost 3 degrees from the lower reach to the upper reach above the ditch. Introduced species such as river prawns (*Macrobrachium lar*) and guppies (*Poecilia reticulata*) were also observed in the stream. The poeciliid fishes dwell in the deep pools created above diversion structures and are known to transmit parasites to native fishes.

- **Estuary Survey.** A recent cast net sampling of the stream mouth and shoreline at Waiohue resulted in catches of aholehole (*Kuhlia xenura*) and Kupipi (*Abudefduf sordidus*). The most dominant catch was aholehole (*Kuhlia xenura*), which were found in areas with varying salinity. The stream had minimal flow entering the ocean during the survey.

- **Insect Survey.** Native damselfly species were observed in the lower and upper reaches of Waiohue Stream; however, the DAR report did not specify which species of damselfly was observed.

- **Watershed and Biological Rating.** Waiohue watershed rates above average (score of 7 out of 10) for Maui and statewide. A combination of forested lands and high rainfall amounts contribute

to the rating of this watershed. The stream also rates fairly well (score of 8 out of 10) on biota due to the high diversity of native species observed in the stream.

Despite the limited available habitat downstream of the ditch, West Wailuaiki Stream had a fairly good diversity of native stream animals. The upper reach above the ditch had moderate streamflow and water temperatures almost 3 degrees cooler than the lower reach, suggesting dewaterment of the stream by the ditch. Based on data collected by DAR, the abundance of aholehole in the estuary could be an indicator for a healthy stream since this species of fish was commonly found in estuaries with flowing streams and open stream mouths to the ocean. Waiohue Stream has the potential to sustain larger populations of native species than currently observed if flow is restored to the downstream reach to increase stream connectivity and available instream habitat. Due to the small size of the estuary, flow restoration would not result in substantial increases in estuarine habitats.

The SWCA Environmental Consultants, at the request of Hawaiian Commercial and Sugar Company, conducted a literature review of the existing data collected by DAR, USGS, and other investigators (Ford et. al., 2009). The objective of this document was to present biological information that may help the Commission in determining reasonable and beneficial instream and offstream uses of the surface water in east Maui. The authors stressed that no data exists to suggest "any of the nine native Hawaiian amphidromous species is at risk of either endangerment and/or extinction in east maui streams or else where in the State", and that dry reaches in diverted streams are periodically wetted by freshets, allowing streamflow continuity and the upstream migration of native species. On the other hand, there is no proof that continued habitat degradation in some of the streams due to dewaterment will not affect species survival (PR-2009-18, 85.0). Other investigators have reported that "hihiwai were limited to about 185 meters and 223 meters in the lower reaches of Waiohue and Waikolu Streams [Maui], respectively...and suggested this was due to the effect of dewaterment on habitat availability" (as cited in Ford et. al., 2009). It was also important to note that frequent changes in stream community structure, such as a change in the streambed composition due to a high flow event, that may result in absence of native stream animals should not be interpreted as a negative indicator of stream health.

The consultant summarized data mainly from the USGS habitat availability study (Gingerich and Wolff, 2005) and DAR's Atlas of Hawaiian Watersheds and Their Aquatic Resources (Tables 4-5 and 4-6). Please note that Commission staff is awaiting updated data from DAR and will supplement the following tables with new data. Compared with the other east Maui streams, a diversity of stream animals were observed in Waiohue Stream. All of the native amphidromous species were observed throughout the stream channel. However, extensive surveys conducted by the USGS revealed no alamoo above the diversions, and results from DAR surveys do no specifically indicate aquatice species observed above the diversions. One alien amphidromous specie, the Tahitian prawn was also present in the stream. According to Table 4-5, the opae was the most conspicuous species that was found in most of the east Maui streams except Punalau and Ohia. Since Waiohue Stream already has a great diversity of native stream animals under diverted conditions, it has the potential to carry a full compliment of native stream fauna if allowed continous mauka to makai flow.

5.0 Outdoor Recreational Activities

Water-related recreation is an integral part of life in Hawaii. Though beaches may attract more users, the value of maintaining streamflow is important to sustaining recreational opportunities for residents and tourists alike. Streams are often utilized for water-based activities, such as boating, fishing, and swimming, while offering added value to land-based activities such as camping, hiking, and hunting. Growing attention to environmental issues worldwide has increased awareness of stream and watershed protection and expanded opportunities for the study of nature; however, this must be weighed in conjunction with the growth of the eco-tourism industry and the burdens that are placed on Hawaii's natural resources.

The State of Hawaii Department of Health (DOH) maintains water quality standards (HAR 11-54) for recreational areas in inland recreational waters based on the geo-mean of *Enterococcus*, a fecal indicator: 33 colony-forming units per 100 mL of water or a single-sample maximum of 89 colonies per 100 mL. This is for full-body contact (swimming, jumping off cliffs, etc.). If *Enterococcus* exceeds those values, the water body is considered to be impaired. DOH also has a standing advisory for *Leptospirosis* in all freshwater streams. The marine recreational zone, which extends from the shoreline seaward to 1,000 feet from shore, requires an *Enterococci* geo-mean of less than 7 colony-forming units per 100 mL of water, to protect human health.

The recreational resources of Waiohue Stream were classified as "outstanding" by the HSA's regional recreation committee. The HSA identified opportunities for camping, hiking, fishing, swimming, parks, and scenic views related to Waiohue. Of these six recreational opportunities, only parks was not considered to be a high-quality experience (National Park Service, Hawaii Cooperative Park Service Unit, 1990) (Table 5-1).

Table 5-1. Hawaii Stream Assessment survey of recreational opportunities by type of experience.

	Urban		Country		Semi-Natural		Natural	
	Norm	High	Norm	High	Norm	High	Norm	High
Camping				■				
Hiking				■	■		■	
Fishing				■		■		■
Hunting								
Swimming				■				
Boating								
Parks			■					
	Trail		Road		Ocean		Air	
Scenic Views		■				■		■
	Educational		Botanical					
Nature Study								

According to public hunting data, Hunting Unit B on the island of Maui consists of portions of the Koolau Forest Reserve and Hunting Unit N1 consists of portions of the Hanawi Natural Area Reserve. Hunting Unit B within Waiohue occupies approximately 52 percent of the hydrologic unit, and Hunting Unit N1 occupies 10 percent of the unit (Figure 5-1). A permit is required for the hunting of wild pigs and goats, using rifles, shotguns, bows and arrows, and dogs. Bag limits are two pigs and two goats of either sex per day, while the hunting season is open year-round on Saturdays, Sundays, and State holidays. Handguns are allowed for the hunting of pigs with or without dogs.

Figure 5-2. Recreational points of interest for Waiohue hydrologic unit (Source: State of Hawaii, Office of Planning, 1999, 2002a; 2002c; 2002d; 2004a; USGS, 2001b).

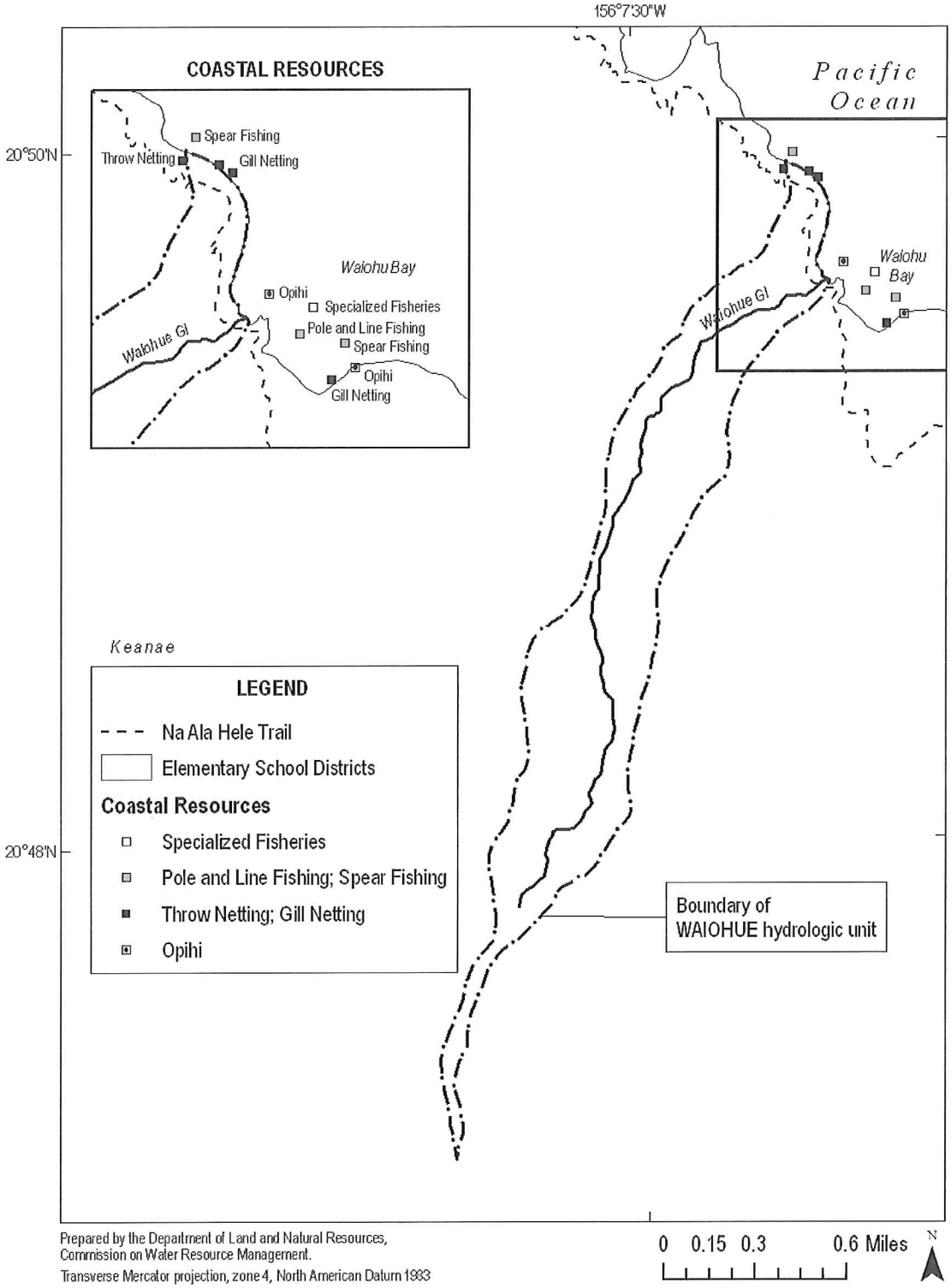
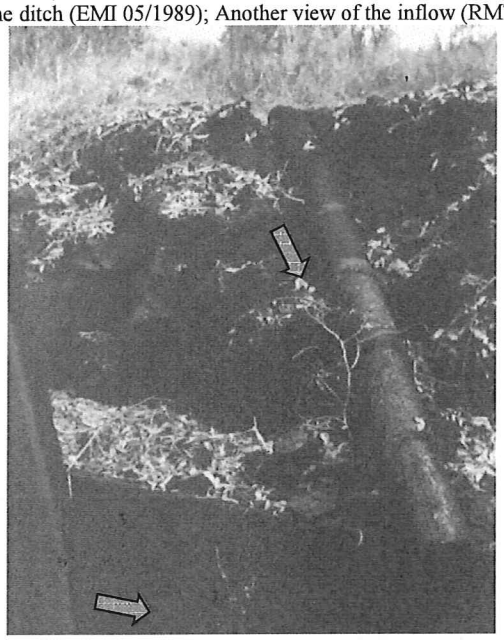


Table 13-2. Minor diversions on the EMI System in the Waiohue hydrologic unit.

Diversion ID	EMI Ditch System	Description
K-11c	Koolau	West Puakea 8-inch concrete pipe run-off intake.

Photos. a) Surface water runoff is captured by an 8-in. concrete pipe that drops water into the Koolau Ditch on the left bank of the ditch (EMI 05/1989); Another view of the inflow (RMT, 09/2007).

a)

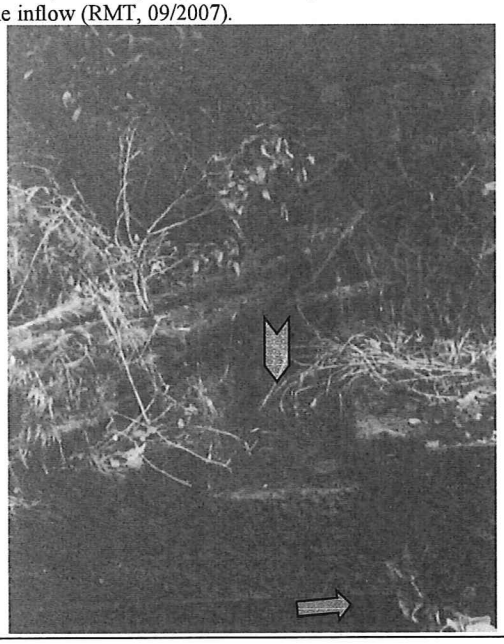


b)

K-12a	Koolau	Waiohue concrete channel intake.

Photos. a) Tributary seeps flow directly into the Koolau Ditch from the left bank of the ditch (EMI 05/1989); Another view of the inflow (RMT, 09/2007).

a)



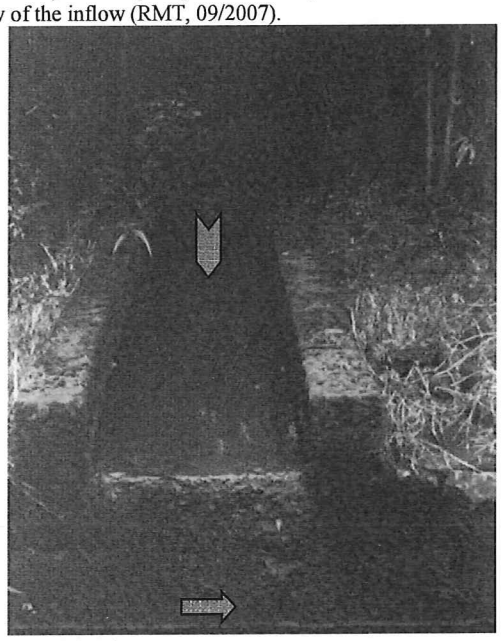
b)

Table 13-2. Continued. Minor diversions on the EMI System in the Waiohue hydrologic unit.

Diversion ID	EMI Ditch System	Description
K-12b	Koolau	East Waiohue concrete channel intake.

Photos. a) Tributary seeps flow directly into the Koolau Ditch from the left bank of the ditch (EMI 05/1989); b) Another view of the inflow (RMT, 09/2007).

a)



b)

K-12c	Koolau	East Waiohue concrete V-channel intake.

Photos. a) Tributary seeps flow directly into the Koolau Ditch from the left bank of the ditch (EMI 05/1989); Another view of the inflow (RMT, 09/2007).

a)

b)

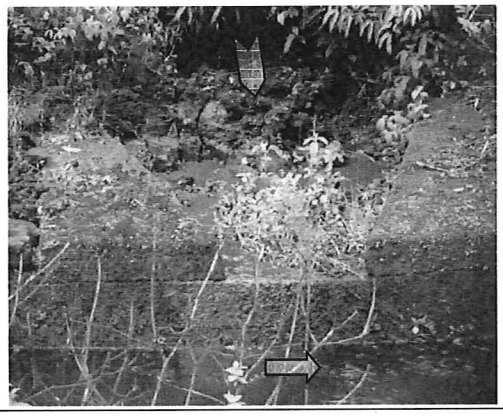


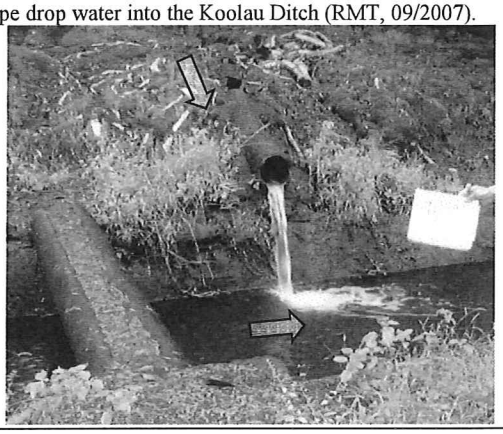
Table 13-2. Continued. Minor diversions on the EMI System in the Waiohue hydrologic unit.

Diversion ID	EMI Ditch System	Description
K-12d	Koolau	East Waiohue 8-inch concrete intake.

Photos. a) Concrete catch basin captures seepage and conveys water to Koolau Ditch via an 8-in. pipe (originally concrete) (RMT, 09/2007); b) Remaining portion of original 8-in. concrete pipe drop water into the Koolau Ditch (RMT, 09/2007).

a)

b)



Civil No. 19-1-0019-01 (JPC)

Defendant A&B/EMI's Exhibit AB-157

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