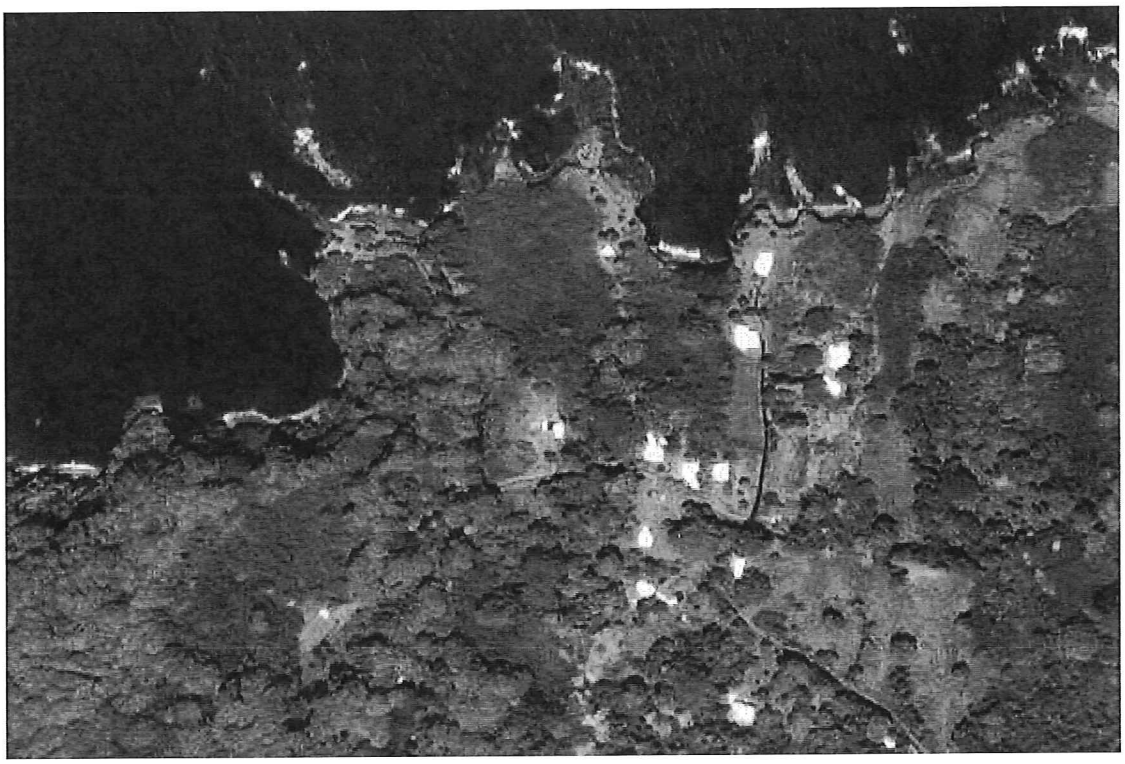
Instream Flow Standard Assessment Report

Island of Maui
Hydrologic Unit 6065
Makapipi

December 2009 **PR-2009-16**



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

EXHIBIT E-68

TRIAL EXHIBIT AB-160

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 Makapipi 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 Makapipi Stream.

- **Point Quadrat Survey.** A number of native stream animals were observed in Makapipi Stream, including oopu naniha (*Stenogobius hawaiiensis*), oopu nakea (*Awaous guamensis*), oopu akupa (*Eleotris sandwicensis*), oopu alamoo (*Lentipes concolor*), opae kalaole (*Atyoida bisulcata*), and aholehole (*Kuhlia xenura*). During the most recent surveys, oopu alamoo was observed in the middle and upper reaches. Opae kalaole was only observed in the upper reach; although it was recorded to inhabit the lower and middle reaches of Makapipi Stream. Introduced species such as river prawns (*Macrobrachium lar*) were also observed in the stream.

- **Estuary Survey.** Makapipi has a small estuary; however, no estuary survey was conducted.

- **Insect Survey.** Native damselfly species were observed in the upper and headwater reaches Makapipi Stream. Of the damselflies observed were blackburn's Hawaiian damselfly (*Megalagrion blackburni*), beautiful Hawaiian damselfly (*Megalagrion calliphya*), Hawaiian upland damselfly (*Megalagrion hawaiiense*), blackline Hawaiian damselfly (*Megalagrion nigrohamatum nigrohamatum*), and pacific Hawaiian damselfly (*Megalagrion pacificum*). The pacific Hawaiian damselfly is currently proposed for listing as Endangered under the Federal Endangered Species Act..

- **Watershed and Biological Rating.** Makapipi watershed rates fairly well (score of 8 out of 10) for Maui and statewide. A combination of forested lands, high rainfall amounts, and moderate reach diversity contribute to the rating of this watershed. The stream rates above average (score of 6 out of 10) on biota due to the high diversity of native species as well as introduced species observed in the stream.

Makapipi Stream provided poor instream habitats due to reduced streamflow and losing sections where water flowed subsurface. Many of the survey sites in the middle and upper reaches were dry, providing no instream habitat. Isolated pools of water had lower water temperatures, which was indicative of spring water input. Only the native shrimp was observed in the upper reach where flow was minimal, but not dry.

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 Makapipi Stream. Akupa, nakea, nopili, alamoo, and opae kalaole 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. 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. One alien amphidromous specie, the Tahitian prawn was also present in Makapipi Stream. Since Makapipi Stream already has a 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.

Based on the two land cover classification systems, the land cover of Makapipi consists mainly of evergreen forests. The headwaters of Makapipi Stream are fed by dense native Ohia forests and native Uluhe shrub lands that lie within the Hanawi Natural Area Reserve. The intermediate slopes are dominated by native Uluhe shrub lands and some alien vegetation that lie within the Koolau Forest Reserve. The lower slopes are mostly alien forests and alien grasslands with scattered native Ohia forests.

The land cover maps (Figures 2-6 and 2-7) provide a general representation of the land cover types in Makapipi. Given that the scale of the maps is relatively large, they may not capture the smaller cultivated lands or other vegetation occupying smaller parcels of land. Land cover types may also have changed slightly since the year when the maps were published.

Table 2-4. C-CAP land cover classes and area distribution in Makapipi (Source: National Oceanographic and Atmospheric Agency, 2000).

Land Cover	Description	Area (mi^2)	Percent of Unit
Evergreen Forest	Areas where more than 67 percent of the trees remain green throughout the year	2.78	84.5
Scrub/Shrub	Areas dominated by woody vegetation less than 6 meters in height	0.27	8.2
Grassland	Natural and managed herbaceous cover	0.20	6.1
Bare Land	Bare soil, gravel, or other earthen material with little or no vegetation	0.03	0.9
Low Intensity Developed	Constructed surface with substantial amounts of vegetated surface	0.01	0.2
Unconsolidated Shoreline	Material such as silt, sand, or gravel that is subject to inundation and redistribution by water	< 0.01	0.1
Water	Areas of open water with less than 30 percent of trees, shrubs, persistent emergent plants, or other land cover	< 0.01	< 0.1

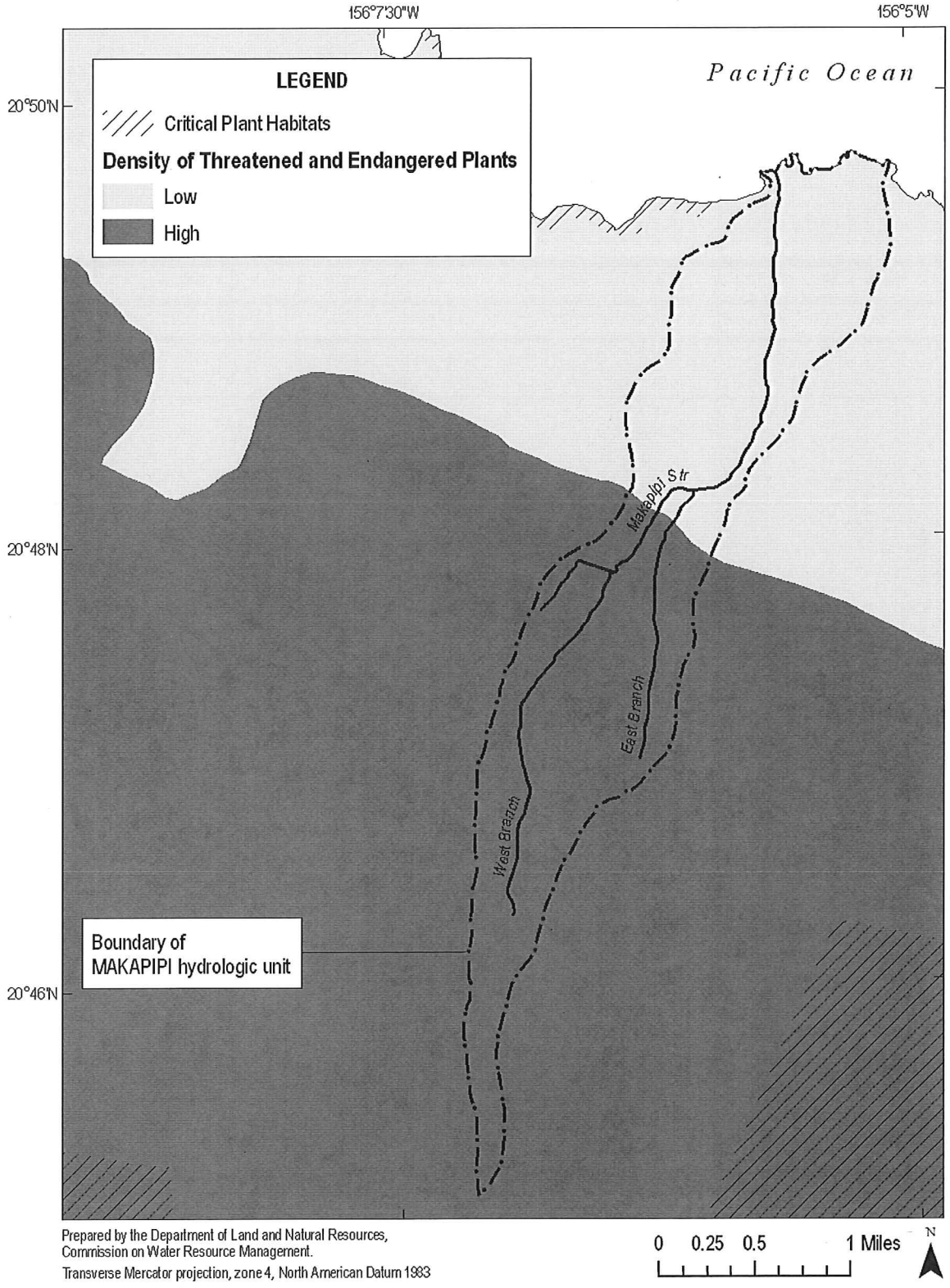
Table 2-5. HI-GAP land cover classes and area distribution in Makapipi (Source: HI-GAP, 2005).

Land Cover	Area (mi^2)	Percent of Unit
Alien Forest	1.55	47.2
Open Ohia Forest (uluhe)	0.83	25.3
Closed Ohia Forest (native shrubs)	0.39	11.9
Closed Ohia Forest (uluhe)	0.31	9.5
Uncharacterized Open-Sparse Vegetation	0.16	4.8
Very Sparse Vegetation to Unvegetated	0.02	0.5
Alien Grassland	0.01	0.3
Uluhe Shrubland	0.01	0.3
Undefined	< 0.01	< 0.1
Uncharacterized Forest	< 0.01	< 0.1

2.8 Flood

Floods usually occur following prolonged or heavy rainfall associated with tropical storms or hurricanes. The magnitude of a flood depends on topography, ground cover, and soil conditions. Rain falling on areas with steep slopes and soil saturated from previous rainfall events tends to produce severe floods in low-lying areas. Four types of floods exist in Hawaii. Stream or river flooding occurs when the water level in a stream rises into the flood plain. A 100-year flood refers to the probability of the flood happening once in a hundred years, or 1 percent chance of happening in a given year. Flash floods occur within a few hours after a rainfall event, or they can be caused by breaching of a flood safety structure such as a dam. Flash flooding is common in Hawaii because the small drainage basins often have a short

Figure 6-4. Critical plant habitats, and density of threatened and endangered plant species for Makapipi hydrologic unit (Source: Jacobi, 1989; Scott et al., 1986; State of Hawaii, Office of Planning, 1992, 2004b; 2004d; USGS, 2001b).



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 Makapipi Stream were classified as "substantial" by the HSA's regional recreation committee. The HSA identified opportunities for hikng, fishing, hunting, swimming, and scenic views related to Makapipi. Of these four recreational opportunies, fishing and scenic views were considered to be high-quality experiences (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 Hanawi occupies approximately 13 percent of the hydrologic unit, whereas Hunting Unit N1 occupies 38 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.

According to Gingerich (1999b), Makapipi Stream is dry in the 0.7 mile reach between the Koolau Ditch to the stream gaging station (station 16507000). Streamflow records show no flow during the period of 1932 to 1945, indicating that the stream is not perennial in that reach of the stream. This is also the same period when there is no ground water flow input from Makapipi Spring. It is unknown whether the stream is gaining or losing in other sections of the stream. Base flow estimates show that the average annual base flow at the station is about 1.96 million gallons per day (Gingerich, 1999b), and part of this flow may be gained from Makapipi Spring.

In cooperation with the Commission on Water Resource Management, the USGS conducted a study (Gingerich, 2005) to assist in determining reasonable and beneficial noninstream and instream uses of surface water in northeast Maui. The purpose of the study was to develop methods of estimating natural (undiverted) median streamflow, total flow statistics (TFQ), and base flow statistics (BFQ) at ungaged sites where observed data are unavailable. The study area lies between the drainage basins of Kolea Stream to the west and Makapipi Stream to the east. Basin characteristics and hydrologic data for the study area were collected and analyzed. One of the products of the study is a set of regression equations that can be used to estimate natural (undiverted) TFQ_{50}, BFQ_{50}, TFQ_{95}, and BFQ_{95} at gaged and ungaged sites. The subscripts indicate the percentage of time the flow, either total or base flow, is equaled or exceeded. Results of the study show that the streams in the eastern side of the study area (i.e., east of Keanae Valley) have the lowest reductions in streamflow due to diversions at the 1,300 feet elevation. Therefore, the stream reaches immediately downstream from the diversions are dry most of the time.

Streamflow statistics at the gaging station was estimated using the regression equations, and then compared to the measured flow to assess the accuracy of the regression method by computing the relative error. Relative error is the percent difference between the measured flow and the estimated statistic. The flow statistics and associated statistical comparisons for station 16507000 in Makapipi Stream are presented in Table 3-6. Note that the measured flows are different from the TFQ_{50} values in Table 3-4. That is because the measured flows in the study were adjusted to a common base period for comparison so that the differences in flow among stations reflect spatial differences in climate and basin characteristics as well as temporal differences in rainfall (Gingerich, 2005). The adjusted flows are listed in Table 3-5.

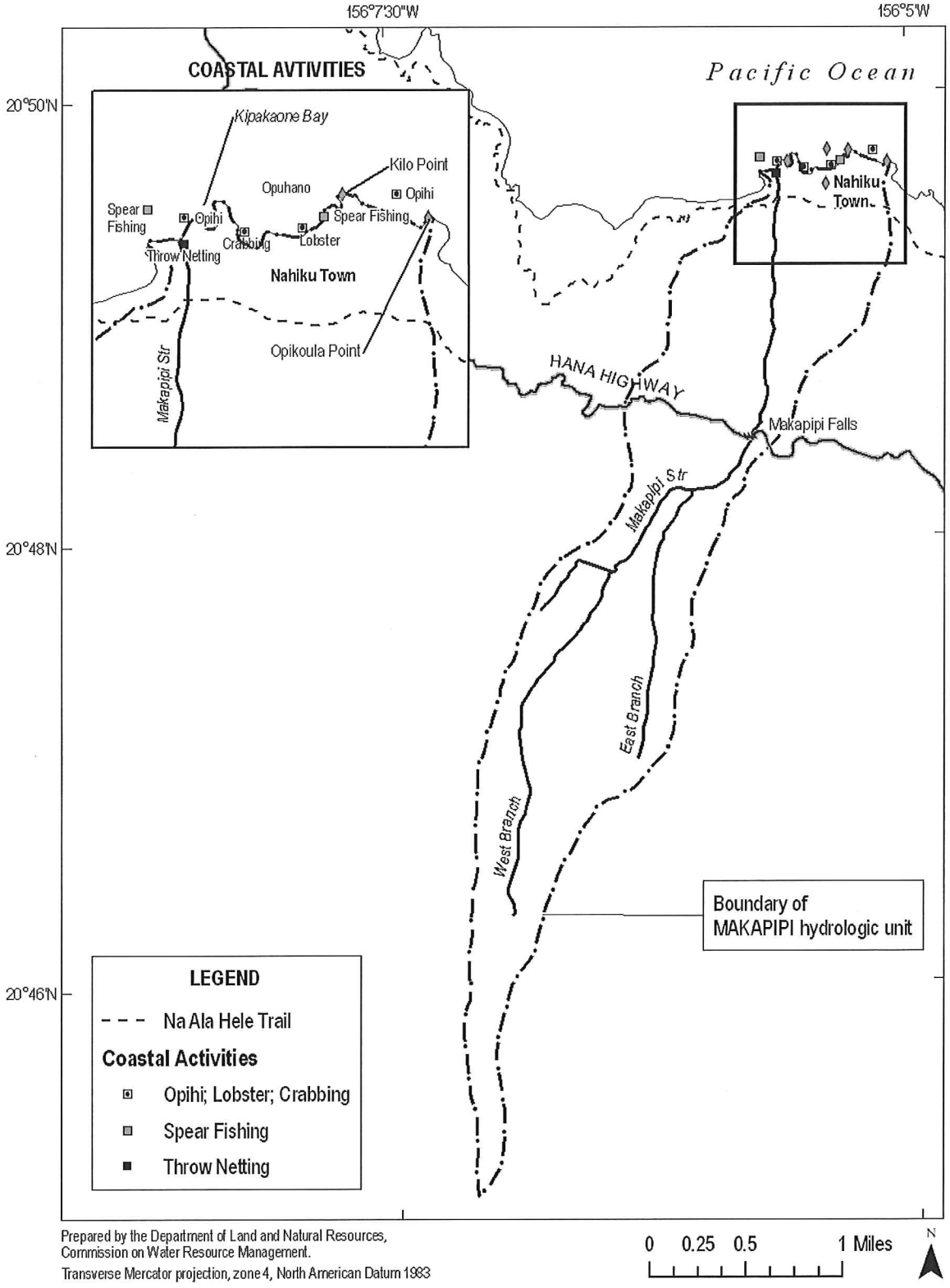
Table 3-5. Selected estimated median and low-flow characteristics for the continuous-record site in the Makapipi hydrologic unit (Gingerich, 2005, Table 2).

[Qxx is the xx percent flow duration of streamflow; ft^3/s, cubic feet per second; base period is 1914-17, 1921-2001; gaging-station number is preceded by 16 and ends in 00; active stations are shown in ***bold italics***; +, combined with record from indicated station; index station is station 5180; --, no adjustment; NA, not applicable]

Gaging-station number	Length of concurrent record (years)	TFQ_{50}		BFQ_{50}		TFQ_{95}		BFQ_{95}	
		during concurrent period (ft3/s)	adjusted to index station (ft3/s)	during concurrent period (ft3/s)	adjusted to index station (ft3/s)	during concurrent period (ft3/s)	adjusted to index station (ft3/s)	during concurrent period (ft3/s)	adjusted to index station (ft3/s)
5070	13	2.9	2.2	1.6	1.3	0	0	0	0

The regression equations performed poorly in predicting the higher flow statistics (TFQ_{50} and BFQ_{50}) and the lower flow statistics (TFQ_{95} and BFQ_{95}) for the stream gaging station in Makapipi Stream. The high flow statistics were largely overestimated because the regression equations did not account for flow losses in the dry reach between the Koolau Ditch and the gaging station, where flow was mainly dependent on spring discharge. Relative errors between measured and estimated flows for the lower flow statistics were not available and not necessarily meaningful since the stream is intermittent and it goes dry during low flow conditions.

Figure 7-1. Aesthetic points of interest for the Makapipi hydrologic unit (Source: USGS, 1996; 2001b).



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