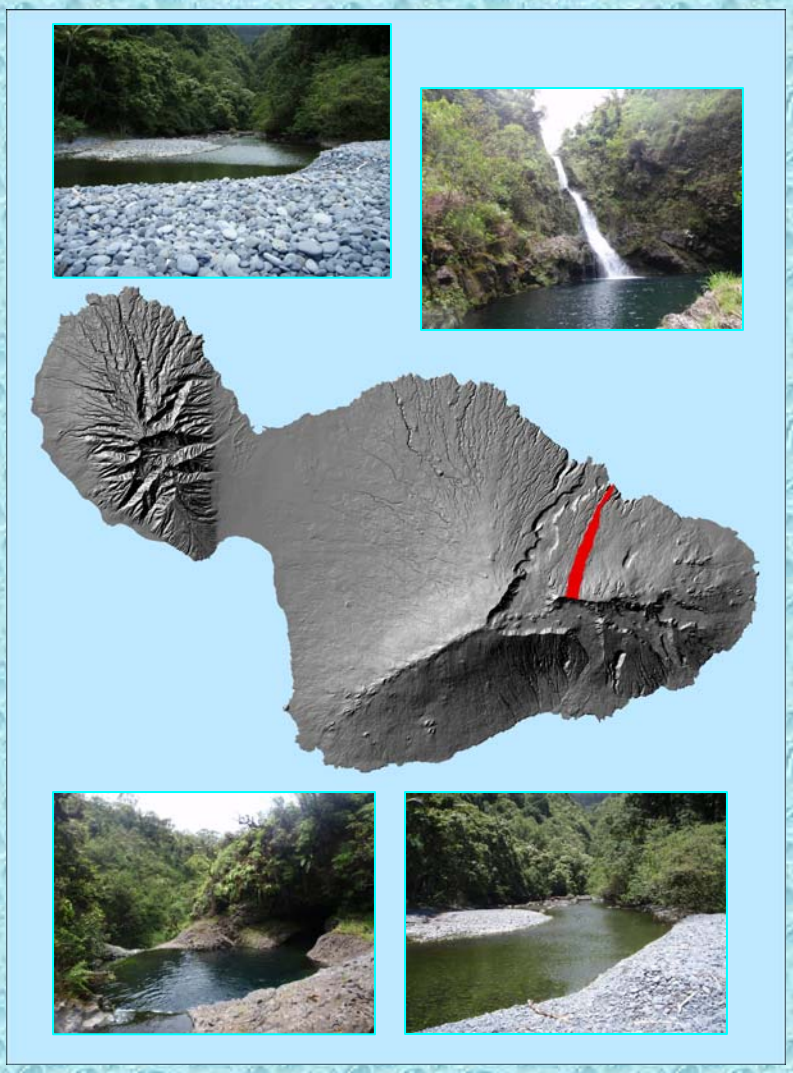
Report on East Wailua Iki Stream
Maui, Hawai‘i



August 2009

State of Hawai‘i
Department of Land and Natural Resources
Division of Aquatic Resources
and
Bishop Museum

Funded in part by the Commission on Water Resource Management, DLNR
and

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Report on Wailua Iki East Stream Maui, Hawai‘i

August 2009

Prepared for
Commission on Water Resource Management
Department of Land and Natural Resources
State of Hawai‘i

Prepared by
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Section 1: Introduction

Overview

On May 24, 2001, the Native Hawaiian Legal Corporation (NHLC) filed a Petition to Amend the Interim Instream Flow Standard (IIFS) for 27 streams in east Maui on behalf of resident taro farmers. Since the acceptance of the petitions in July 2001, the Commission on Water Resource Management (CWRM) has been focused on gathering information for the 27 petitioned streams. Shortly thereafter, NHLC and CWRM staff reached an agreement that efforts would focus on 8 of the 27 petitioned streams: Honopou, Hanehoi, Huelo, Waiokamilo, Kualani, Pi'ina'au, Palauhulu, and Wailua Nui Streams. Currently, the CWRM is collaborating with the State's Division of Aquatic Resources and the U.S. Geological Survey (USGS) for assistance in collecting biological and hydrologic data to determine measurable interim IFS. CWRM has also requested biological data on the remaining 19 petitioned streams which is the main purpose of this report.

This report is an accounting of the aquatic resources that have been observed in Wailua Iki East Stream, Maui from year 2000 to present. The focus of this report is on the animals and insects that live in the stream and the data collected during surveys. The report covers five main sections, including:

- Introduction
- Watershed Atlas Report
- DAR Point Quadrat Survey Report
- DAR Estuary Survey Report
- Photographs of stream taken during stream surveys

The introduction provides the overview for the purpose of this report, a summary of the findings on the stream and its animals, and a discussion of the importance of the findings and how stream conditions influence native species populations. The Watershed Atlas Report provides a description of the watershed and its aquatic resources from Division of Aquatic Resources (DAR) and other published/unpublished surveys, including a rating of the condition of the stream compared to other streams on Maui as well as statewide. The DAR Point Quadrat Survey Report describes the distribution, habitats, and species observed during the standardized DAR stream surveys. The DAR Estuary Survey Report describes the distribution, habitats, and species observed in the estuary during the standardized DAR estuary surveys. Finally, the photographs provide context to the conditions that the stream surveyors encountered in the stream.

This overview reports on the highlights of these findings and provides a discussion of the importance of the information presented. We hope that this format provides the reader with a simplified, general discussion and understanding of the conditions of Wailua Iki East Stream while also providing substantial evidence to support the conclusions presented.

Findings for Wailua Iki East Stream, Maui

Wailua Iki East is a small (3.9 sq miles) watershed with steep upper sections and little embayment. It is fully zoned for conservation (100%) and the land cover is mostly evergreen forest (85%), scrub (11%), grassland (3%) and bare land (1%). Numerous stream surveys of different types have been completed in Wailua Iki East stream beginning in 1962 to the present. This watershed rates high, based on the data contained in the DAR aquatic surveys database, in comparison to other watersheds in Maui and statewide. It has a total watershed rating of 7 out of 10, a total biological rating of 7 out of 10, and a combined overall rating of 8 out of 10.

Native species observed in the stream include the following categories and species:

Fish - *Awaous guamensis, Eleotris sandwicensis, Kuhlia xenura* and *Sicyopterus stimpsoni*

Crustacean - *Atyoida bisulcata*

Insects – *Anax junius* , *Anax* sp, *Anax strenuous*, *Limonia grimshawi*, *Limonia jacobus*, *Megalagrion blackburni*, *Megalagrion calliphya*, *Megalagrion* sp., *Procanacae acuminata*, *Procanace confusa, Saldula exulans, Scatella cilipes, Scatella clavipes, Scatella femoralis, Telmatogeton abnormis, Telmatogen* sp., *Telmatogeton torrenticola*

Mollusks – *Ferrissia sharpi* and *Neritina granosa*

Sponge - *Heteromeyenia baileyi*

Introduced species observed in this stream includes the following categories and species:

Amphibian – *Rana rugosa*

Crustacean - *Macrobrachium lar*

Insects - *Cheumatopsyche analis,* Chironomid sp., *Cricotopus bicinctus, Dolichopus exsul, Limonia advena, Pantala flavescens*

Discussion

Wailua Iki East watershed is small, steep in the upper reach with a small embayment at the stream mouth which it shares with the Wailua Iki West watershed (Figure 5-2.). Aerial photographs show a profile characterized by a series of stair casing waterfalls and pools above and below Hāna Highway. No diversions were observed on Wailua Iki East Stream below Hāna Highway.

A helicopter was used to access the different reaches of Wailua Iki East Stream during estuary surveys and other reaches due to the watersheds steepness and inaccessibility by foot. There are no roads to access stream below and above Hāna Highway. No surveys were conducted in the vicinity of Hāna Highway (Figure 3-1).

During estuary surveys, Wailua Iki East Stream flowed into an unprotected coastal embayment with relatively calm and shallow waters with some areas with large amounts of detritus (Figure 5-7). The stream mouth was closed with moderate subsurface flow entering the bay through the cobble berm with salinity ranging from 11.53 ppt to 27.94 ppt throughout the estuary (Figure 5-2). The shoreline consisted of mainly boulder and

cobble terrain, very similar to that found in Wailua Iki West Estuary, which was on the west end of the bay.

The total of 116 fish and invertebrates were recorded, comprising of three species of fish and one invertebrate species in Wailua Iki East estuary. The most dominant species in our sample was **uouoa***, Neomyxus leuciscus* (N=91), which were recorded at the east end of the estuary in high surge and white water. **ʻIao***, Atherinomorus insularum* was recorded in lower salinity where subsurface freshwater flow was entering the ocean. A single **nehu**, *Encrasicholina purpurea*, was recorded at one site along the shoreline away from the closed stream mouth. One species of shrimp, tiger shrimp*, Palaemon pacificus*, was recorded in thick detritus near the closed stream mouth. A school of **striped mullet**, *Mugil cephalus*, was observed along the shoreline between East and West Wailua Iki, but none were captured during sampling. **Āholehole** (*Kuhlia xenura*), **ʻoʻopu ʻakupa** (*Eleotris sandwicensis*) and **ʻoʻopu nākea** (*Awaous guamensis*) were also observed above the cobble berm in the lower reach of Wailua Iki East stream, near the stream mouth.

Wailua Iki East estuary seemed to have favorable conditions for *N. leuciscus*, which consisted of high surge, white water and boulders with algal cover. Compared to other estuaries that were surveyed in East Maui, Wailua Iki East may provide a more suitable habitat for juvenile and adult estuarine species. This is based on the physical characteristics of the estuary that were described as well as the presence of key estuarine species such as *K. xenura*, *A. insularum*, *M. cephalus*, *E. sandwicensis* and *E. purpurea*. However, an open stream mouth and greater flow from Wailua Iki East Stream may improve the suitability for an estuarine habitat.

Point quadrat surveys were conducted in the lower, middle, and upper reaches. The upper reach by Hāna Highway was not surveyed, but the upper reach above the diversion was. There was moderate stream flow above the diversion. The native species observed in the lower reaches included *E. sandwicensis*, *K. xenura*, *A. guamensis*, and **ʻoʻopu nōpili** *(Sicyopterus stimpsoni)*; in the middle reach included *E. sandwicensis*, *K. xenura*, *A. guamensis*; and in the upper reach above the diversion only **ʻōpae kalaʻole** *(Atyoida bisulcata)* was observed. No waterfalls were in the lower and middle reaches to prevent the upstream movement of *E. sandwicensis* and *K. xenura.*

Overall, Wailua Iki East Stream has good potential stream habitat in the middle and upper reaches, but the majority of habitat was lost to water withdrawal. Restoration of flow downstream would therefore improve animal passage between diversions upstream and downstream and substantially increase the availability of habitat for native stream species. Restoration of flow and improvement of animal passage would have the greatest effect on *S. stimpsoni* and *A. bisulcata*, and would further enhance the overall productivity of Wailua Iki East Stream.

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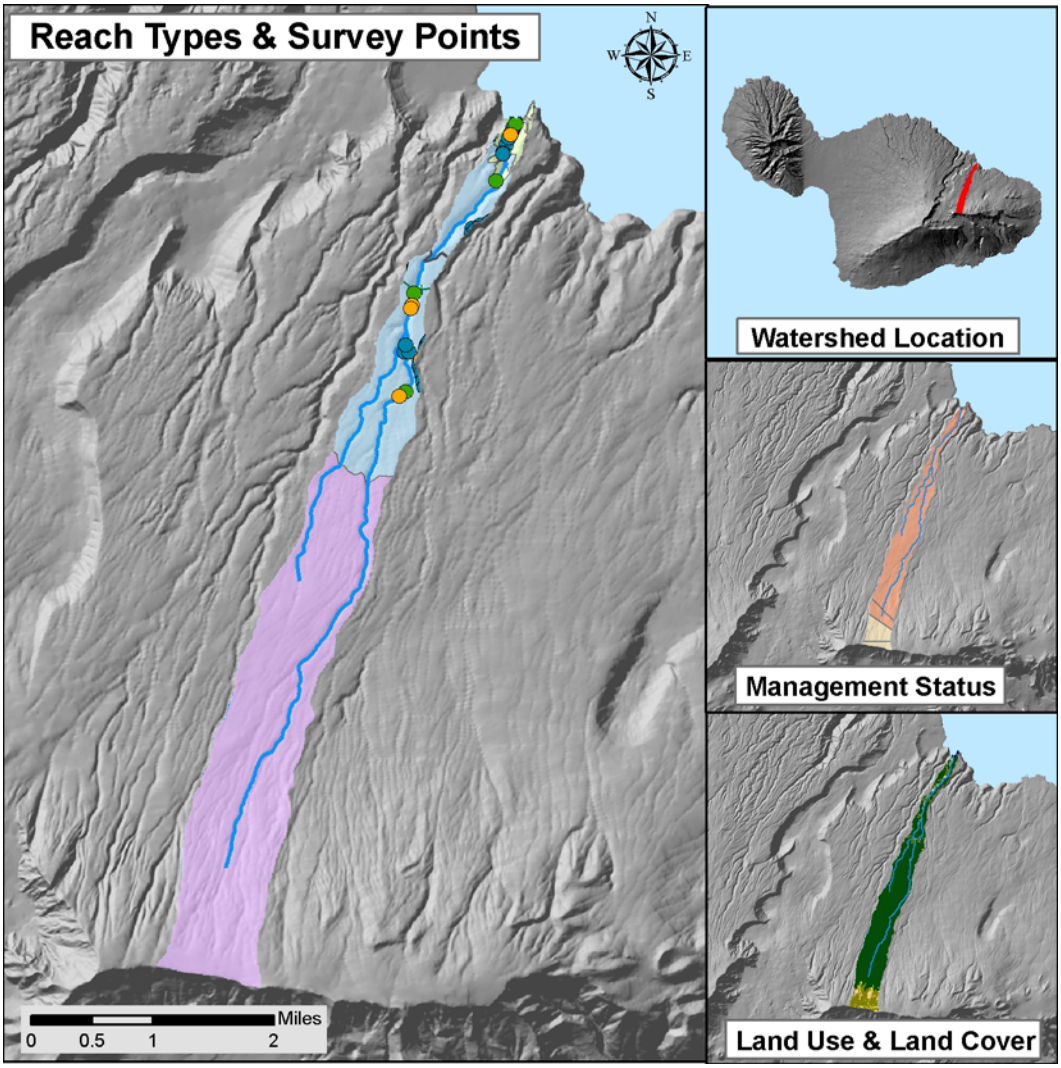
Section 2: Watershed Atlas

DAR Watershed Code: 64016

Wailua Iki East, Maui



Watershed Features

Wailua Iki East watershed occurs on the island of Maui. The area of the watershed is 3.9 square mi (10.2 square km), with maximum elevation of 8497 ft (2590 m). The watershed's DAR cluster code is not yet determined. The percent of the watershed in the different land use districts is as follows: 0% agricultural, 100%conservation, 0% rural and 0% urban.

Land Stewardship: Percentage of the land in the watershed managed or controlled by the corresponding agency or entity. Note that this is not necessarily ownership.

Military	Federal	State	OHA	County	Nature Conservancy	Other Private
0.0	3.3	85.9	0.0	0.0	10.1	0.7

Land Management Status: Percentage of the watershed in the categories of biodiversity protection and management created by the Hawaii GAP program.

Permanent Biodiversity Protection	Managed for Multiple Uses	Protected but Unmanaged	Unprotected
13.4	85.9	0.0	0.7

Land Use: Areas of the various categories of land use. These data are based on NOAA C-CAP remote sensing project.

	Percent	Square mi	Square km
High Intensity Developed	0.0	0.00	0.00
Low Intensity Developed	0.0	0.00	0.00
Cultivated	0.0	0.00	0.00
Grassland	2.7	0.11	0.28
Scrub/Shrub	10.9	0.43	1.11
Evergreen Forest	85.1	3.36	8.70
Palustrine Forested	0.0	0.00	0.00
Palustrine Scrub/Shrub	0.0	0.00	0.00
Palustrine Emergent	0.0	0.00	0.00
Estuarine Forested	0.0	0.00	0.00
Bare Land	1.0	0.04	0.11
Unconsolidated Shoreline	0.0	0.00	0.00
Water	0.2	0.01	0.02
Unclassified	0.0	0.00	0.00

Stream Features

Wailua Iki East is a perennial stream. Total stream length is 9.6 mi (15.4 km). The terminal stream order is 2.

Reach Type Percentages: The percentage of the stream's channel length in each of the reach type categories.

Estuary	Lower	Middle	Upper	Headwaters
0.0	2.5	4.5	44.0	48.9

The following stream(s) occur in the watershed:
Wailua Iki East

Biotic Sampling Effort

Biotic samples were gathered in the following year(s):
1962 2003 2009

Distribution of Biotic Sampling: The number of survey locations that were sampled in the various reach types.

Survey type	Estuary	Lower	Middle	Upper	Headwaters
DAR Point Quadrat	0	6	5	3	0
HDFG	0	1	0	3	0
Published Report	0	1	1	2	0

Biota Information

Species List

Native Species

Crustaceans	*Atyoida bisulcata*
Fish	*Awaous guamensis*
	Eleotris sandwicensis
	Kuhlia xenura
	Sicyopterus stimpsoni
Mollusks	*Ferrissia sharpi*
	Neritina granosa
Sponge	*Heteromeyenia baileyi*

Native Species

Insects	*Anax junius*
	Anax sp.
	Anax strenuus
	Limonia grimshawi
	Limonia jacobus
	Megalagrion blackburni
	Megalagrion calliphya
	Megalagrion sp.
	Procanacae acuminata
	Procanace confusa
	Saldula exulans
	Scatella cilipes
	Scatella clavipes
	Scatella femoralis
	Telmatogeton abnormis
	Telmatogeton sp.
	Telmatogeton torrenticola

Introduced Species

Amphibian	*Rana rugosa*
Crustacean	*Macrobrachium lar*

Introduced Species

Insects	*Cheumatopsyche analis*
	Chironomid sp.
	Cricotopus bicinctus
	Dolichopus exsul
	Limonia advena
	Pantala flavescens

Species Size Data: Species size (inches) observed in DAR Point Quadrat Surveys.

Scientific Name	Status	Minimum Size	Maximum Size	Average Size
Atyoida bisulcata	Endemic	1.25	2	1.6
Eleotris sandwicensis	Endemic	2	6	3.9
Kuhlia xenura	Endemic	1	2	1.5
Sicyopterus stimpsoni	Endemic	1	2.5	1.6
Awaous guamensis	Indigenous	0.75	10	3.0
Neritina granosa	Endemic	1	1.75	1.3

Average Density: The densities (#/square yard) for species observed in DAR Point Quadrat Surveys averaged over all sample dates in each reach type.

Scientific Name	Status	Estuary	Lower	Middle	Upper	Headwaters
Atyoida bisulcata	Endemic				77.7	
Eleotris sandwicensis	Endemic		0.35	2.4		
Kuhlia xenura	Endemic		11.4	3		
Neritina granosa	Endemic		1.38			
Sicyopterus stimpsoni	Endemic		3.11			
Awaous guamensis	Indigenous		0.69	9.6		

Species Distributions: Presence (P) of species in different stream reaches.

Scientific Name	Status	Estuary	Lower	Middle	Upper	Headwaters
Atyoida bisulcata	Endemic		P	P	P	
Eleotris sandwicensis	Endemic		P	P		
Kuhlia xenura	Endemic		P	P		
Sicyopterus stimpsoni	Endemic		P	P		
Anax strenuus	Endemic				P	
Limonia grimshawi	Endemic				P	
Limonia jacobus	Endemic				P	
Megalagrion blackburni	Endemic				P	
Megalagrion calliphya	Endemic				P	
Megalagrion sp.	Endemic				P	P
Procanacae acuminata	Endemic				P	
Procanace confusa	Endemic				P	
Saldula exulans	Endemic				P	
Scatella cilipes	Endemic				P	
Scatella clavipes	Endemic				P	
Scatella femoralis	Endemic				P	
Telmatogeton abnormis	Endemic				P	
Telmatogeton torrenticola	Endemic				P	

Ferrissia sharpi	Endemic			P
Neritina granosa	Endemic	P		
Awaous guamensis	Indigenous	P	P	
Anax junius	Indigenous			P
Anax sp.	Indigenous	P		P
Telmatogeton sp.	Indigenous			P
Heteromeyenia baileyi	Indigenous			P
Rana rugosa	Introduced			P
Macrobrachium lar	Introduced	P	P	
Cheumatopsyche analis	Introduced			P
Chironomid sp.	Introduced	P		P
Cricotopus bicinctus	Introduced			P
Dolichopus exsul	Introduced			P
Limonia advena	Introduced			P
Pantala flavescens	Introduced			P

Historic Rankings

Historic Rankings: These are rankings of streams from historical studies. "Yes" means the stream was considered worthy of protection by that method. Some methods include non-biotic data in their determination. See Atlas Key for details.

Multi-Attribute Prioritization of Streams - Potential Heritage Streams (1998): No

Hawai‘i Stream Assessment Rank (1990): Moderate

U.S. Fish and Wildlife Service High Quality Stream (1988): No

The Nature Conservancy- Priority Aquatic Sites (1985): No

National Park Service - Nationwide Rivers Inventory (1982): No

Current DAR Decision Rule Status: The following criteria are used by DAR to consider the biotic importance of streams. "Yes" means that watershed has that quality.

Native Insect Diversity > 19 spp.	Native Macrofauna Diversity > 5 spp.	Absence of Priority 1 Introduced
No	Yes	No
Abundance of Any Native Species	**Presence of Candidate Endangered Species**	**Endangered Newcomb's Snail Habitat**
No	No	No

CURRENT WATERSHED AND STREAM RATINGS

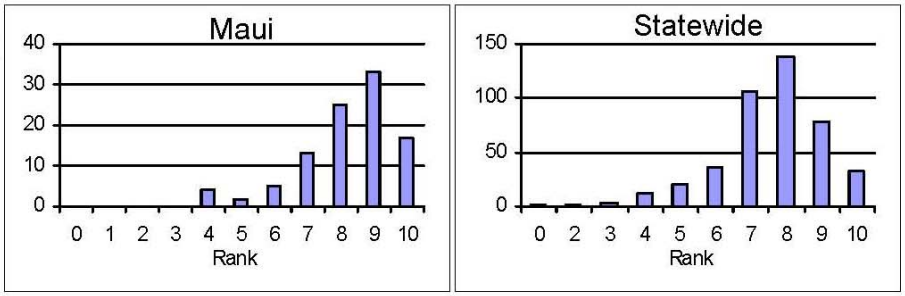
The current watershed and stream ratings are based on the data contained in the DAR Aquatic Surveys Database. The ratings provide the score for the individual watershed or stream, the distribution of ratings for that island, and the distribution of ratings statewide. This allows a better understanding of the meaning of a particular ranking and how it compares to other streams. The ratings are standardized to range from 0 to 10 (0 is lowest and 10 is highest rating) for each variable and the totals are also standardized so that the rating is not the average of each component rating. These ratings are subject to change as more data are entered into the DAR Aquatic Surveys Database and can be automatically recalculated as the data improve. In addition to the ratings, we have also provided an estimate of the confidence level of the ratings. This is called rating strength. The higher the rating strength the more likely the data and rankings represent the actual condition of the watershed, stream, and aquatic biota.

WATERSHED RATING: Wailua Iki East, Maui

Land Cover Rating: Rating is based on a scoring sytem where in general forested lands score positively and developed lands score negatively.

Watershed Rating

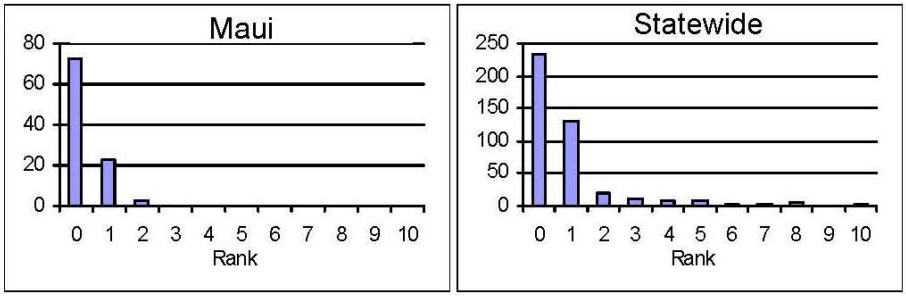
10



Shallow Waters Rating: Rating is based on a combination of the extent of estuarine and shallow marine areas associated with the watershed and stream.

Watershed Rating

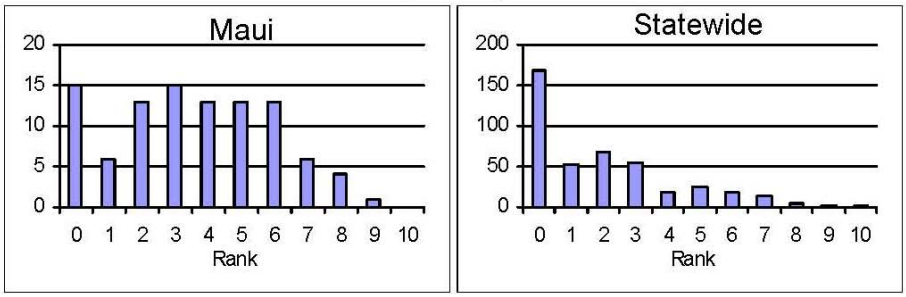
0



Stewardship Rating: Rating is based on a scoring system where higher levels of land and biodiversity protection within the watershed score positively.

Watershed Rating

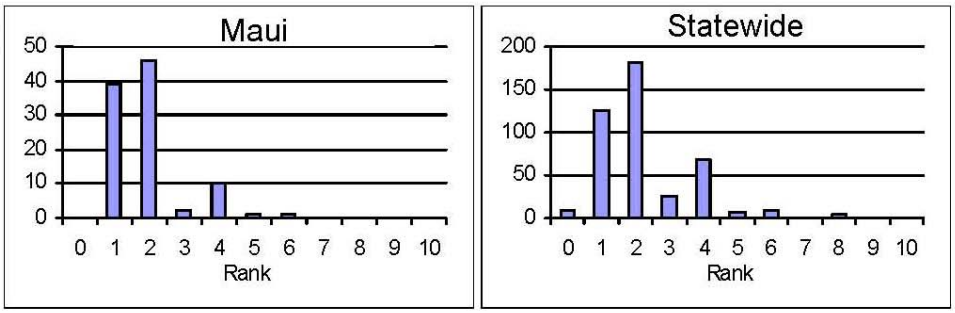
7



WATERSHED RATING (Cont): Wailua Iki East, Maui

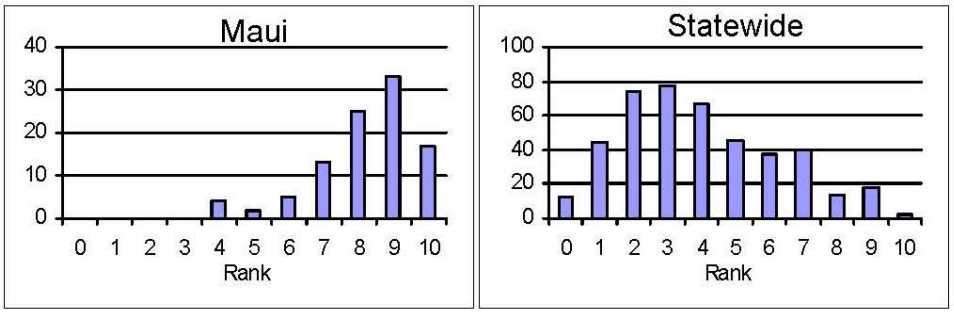
Size Rating: Rating is based on the watershed area and total stream length. Larger watersheds and streams score more positively.

Watershed Rating 2



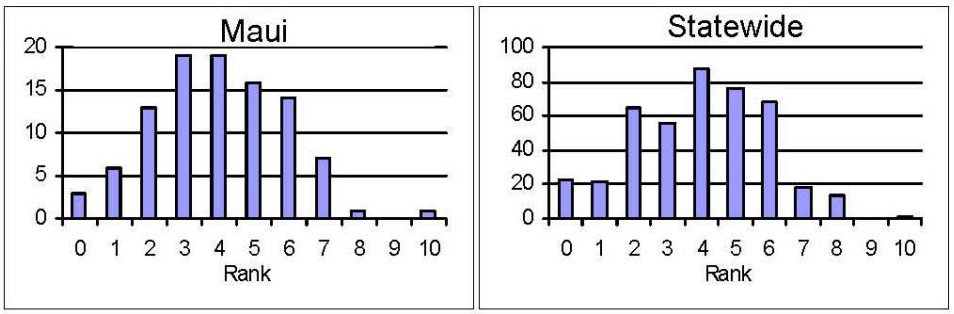
Wetness Rating: Rating is based on the average annual rainfall within the watershed. Higher rainfall totals score more positively.

Watershed Rating 7



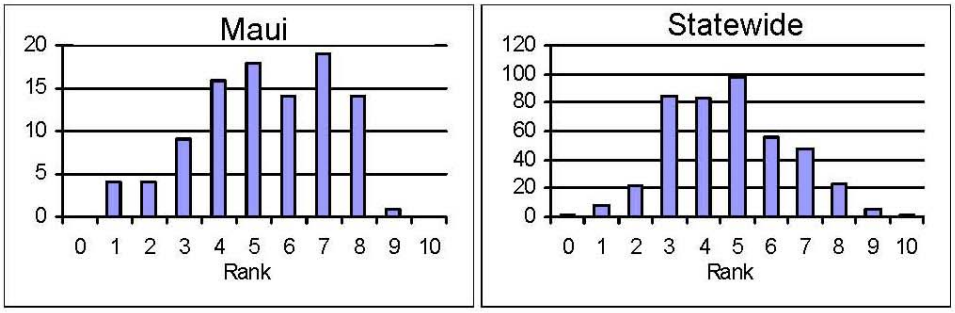
Reach Diversity Rating: Rating is based on the types and amounts of different stream reaches available in the watershed. More area in different reach types score more positively.

Watershed Rating 4



Total Watershed Rating: Rating is based on combination of Land Cover Rating, Shallow Waters Rating, Stewardship Rating, Size Rating, Wetness Rating, and Reach Diversity Rating.

Watershed Rating 7

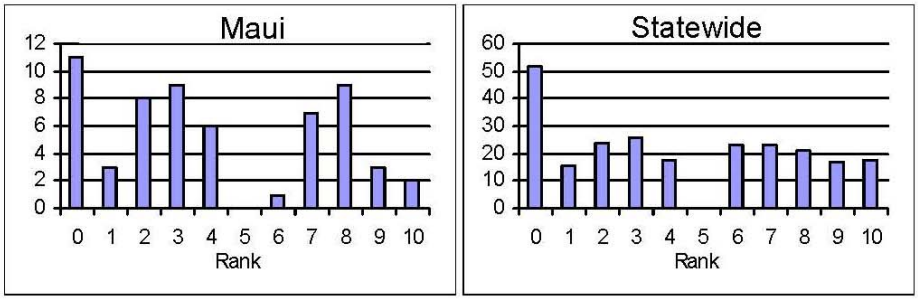


BIOLOGICAL RATING: Wailua Iki East, Maui

Native Species Rating: Rating is based on the number of native species observed in the watershed.

Stream Rating

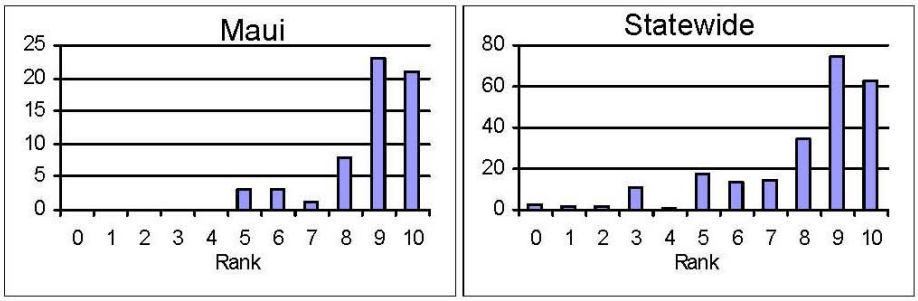
7



Introduced Genera Rating: Rating is based on the number of introduced genera observed in the watershed.

Stream Rating

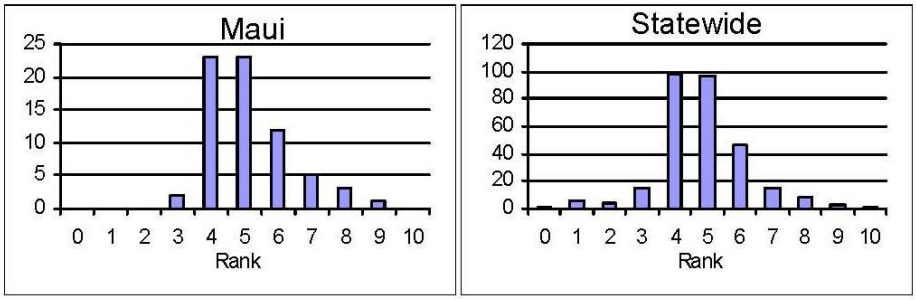
9



All Species' Score Rating: Rating is based on the Hawaii Stream Assessment scoring system where native species score positively and introduced species score negatively.

Stream Rating

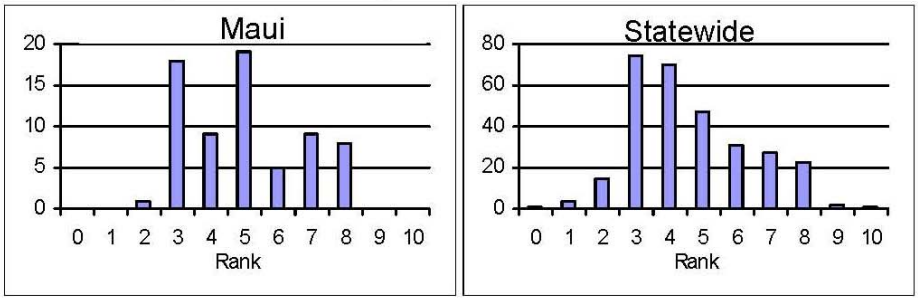
7



Total Biological Rating: Rating is the combination of the Native Species Rating, Introduced Genera Rating, and the All Species' Score Rating.

Stream Rating

7

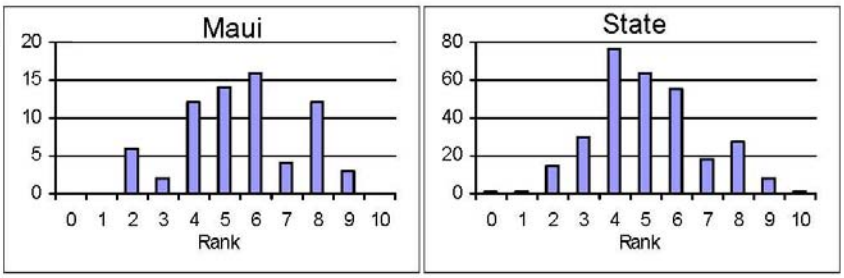


OVERALL RATING: Wailua Iki East, Maui

Overall Rating: Rating is a combination of the Total Watershed Rating and the Total Biological Rating.

Watershed Rating

8

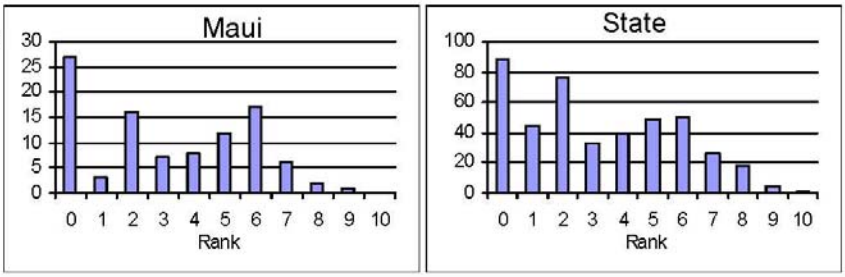


RATING STRENGTH: Wailua Iki East, Maui

Rating Strength: Represents an estimate of the overall study effort in the stream and is a combination of the number of studies, number of different reaches surveyed, and the number of different survey types.

Information Rating

5



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Section 3: DAR Point Quadrat Report for Wailua Iki East, Maui

For Surveys from 5/12/2009 to 5/13/2009

Introduction

This is a report of the Hawai‘i Division of Aquatic Resources stream surveys using the Point Quadrat Methodology. Trained biologists and technicians survey a series of randomly located points in a stream to generate an assessment of the species and habitat in the stream. The Point Quadrat Methodology is one of several techniques that could be chosen for the surveys and is used to develop a statistically comparable stream survey. This methodology is a standardized visual survey technique involving snorkeling, and it is well suited for the physical and ecological characteristics of Hawai‘i streams. The small, steep, dynamic nature of Hawaiian streams with their unique aquatic species is easily observed with this methodology. The in-stream distribution by elevation, behavior, and amphidromous life cycles are easily observed using this technique.

Methods

The point quadrat methodology requires underwater observation. Sampling was conducted using a dive mask, snorkel and two-piece wet suit with hood and glove. Spiked felt-soled wading boots or Japanese spiked **tabis** are also necessary for easy climbing on the wet, algae-covered rocks. After the initial survey site is chosen all the survey sites upstream are selected randomly to prevent any bias in habitat type selection (e.g., pools and runs) and to obtain a representative sample of all habitat types in the stream. At each site, fish and invertebrate observations are recorded and data is collected on the species present, number, size, and sex. Habitat and substrate type, depth and site dimension data are also collected. Other site observations recorded at each station include GPS coordinates and the following water quality parameters using a Hydrolab Quanta™: temperature (° C), salinity (PSS), dissolved oxygen (mg/L), pH, conductivity (mS/cm) and turbidity (NTU). Stream flow measurements are collected using a Marsh McBirney Flo-Mate 2000™ at the beginning and ending of each survey as well as at tributaries and diversions.

The watersheds (and watershed ID), region, and island surveyed in this report are:

Wailua Iki East (ID: 64016), Ke‘anae, Maui

Surveys were conducted by these personnel:

Hau, Skippy
Kuamo‘o, Darrell
Nishiura, Lance
Shimoda, Troy

Results

Table 3-1. The distribution of sites by reach during this survey effort.

Reach	Total number of surveys
Estuary	0
Lower	6
Middle	5
Upper	3
Headwaters	0
Unknown	0

Lower Reach

Table 3-2. Number of Habitat Types surveyed in the lower stream reach.

Reach	Total Habitat Surveyed	Plunge Pool	Cascade	Riffle	Run	Pool	Side Pool	No Water	Dirty Water	Unknown
Lower	6	0	0	1	1	4	0	0	0	0

Table 3-3. Observed Substrates (%) in point quadrat samples in the lower stream reach.

Reach	Detritus	Sediment	Sand	Gravel	Cobble	Boulder	Bedrock
Lower	6	2	18	16	29	22	7

Table 3-4. Observed Water Quality in point quadrat samples in the lower stream reach.

Reach	Temp (º C)	sCond (mS/cm)	DO (mg/L)	pH
Lower	20.573	0.284	8.077	7.54

Table 3-5. Summary of species observed in the lower reach of the watershed.

Category	Status	Scientific Name
Fish	Endemic	*Sicyopterus stimpsoni*
Fish	Endemic	*Kuhlia xenura*
Fish	Endemic	*Eleotris sandwicensis*
Fish	Indigenous	*Awaous guamensis*
Snail	Endemic	*Neritina granosa*

Table 3-6. Average Density and Total number of animals observed in the lower stream reach. Density values are calculated only for random sites, not non-random or outside sites, greater than 6 by 6 inches. Density values are in number of animals per square yard.

Category	Status	Scientific Name	Reach	Avgerage Density	Total # Observed
Fish	Endemic	*Sicyopterus stimpsoni*	Lower	3.34	9
Fish	Endemic	*Kuhlia xenura*	Lower	12.25	33
Fish	Endemic	*Eleotris sandwicensis*	Lower	0.37	1
Fish	Indigenous	*Awaous guamensis*	Lower	0.74	2
Snails	Endemic	*Neritina granosa*	Lower	1.49	4

Middle Reach

Table 3-7. Number of Habitat Types surveyed in the middle stream reach.

Reach	Total Habitats Surveyed	Plunge Pool	Cascade	Riffle	Run	Pool	Side Pool	No Water	Dirty Water	Unknown
Middle	3	1	0	0	0	2	0	0	0	0

Table 3-8. Observed Substrates (%) in point quadrat samples in the middle stream reach

Reach	Detritus	Sediment	Sand	Gravel	Cobble	Boulder	Bedrock
Middle	5	0	8	17	12	38	20

Table 3-9. Observed Water Quality in point quadrat samples in the middle stream reach.

Reach	Temp (º C)	sCond (mS/cm)	DO (mg/L)	pH
Middle	22.38	0.085	8.27	7.788

Table 3-10. Summary of species observed in the middle reach of the watershed.

Category	Status	Scientific Name
Fish	Endemic	*Sicyopterus stimpsoni*
Fish	Endemic	*Kuhlia xenura*
Fish	Endemic	*Eleotris sandwicensis*
Fish	Indigenous	*Awaous guamensis*

Table 3-11. Average Density and Total number of animals observed in the middle stream reach. Density values are calculated only for random sites, not non-random or outside sites, greater than 6 by 6 inches. Density values are in number of animals per square yard.

Category	Status	Scientific Name	Reach	Average Density	Total # observed
Fish	Endemic	*Kuhlia xenura*	Middle	3	5
Fish	Endemic	*Eleotris sandwicensis*	Middle	2.4	4
Fish	Indigenous	*Awaous guamensis*	Middle	9.6	16

Upper Reach

Table 3-12. Number of Habitat Types surveyed in the upper stream reach.

Reach	Total Habitats Surveyed	Plunge Pool	Cascade	Riffle	Run	Pool	Side Pool	No Water	Dirty Water	Unknown
Upper	3	1	0	1	0	1	0	0	0	0

Table 3-13. Observed Substrates (%) in point quadrat samples in the upper stream reach.

Reach	Detritus	Sediment	Sand	Gravel	Cobble	Boulder	Bedrock
Upper	0	0	0	10	3	43	43

Table 3-14. Observed Water Quality in point quadrat samples in the upper stream reach.

Reach	Temp (º C)	sCond (mS/cm)	DO (mg/L)	pH
Upper	18.917	0.073	7.279	7.883

Table 3-15. Summary of species observed in the upper reach of the watershed.

Category	Status	Scientific Name
Crustacean	Endemic	*Atyoida bisulcata*

Table 3-16. Average Density and Total number of animals observed in the upper stream reach. Density values are calculated only for random sites, not non-random or outside sites, greater than 6 by 6 inches. Density values are in number of animals per square yard.

Category	Status	Scientific Name	Reach	Avg. Density	Total # observed
Crustaceans	Endemic	*Atyoida bisulcata*	Upper	12.03	13

Table 3-17. Megalagrion species observed in the upper stream reach.

Insect	Endemic	*Megalagrion blackburni*
Insect	Endemic	*Megalagrion calliphya*
Insect	Endemic	*Megalagrion hawaiiense*
Insect	Endemic	*Megalagrion nesiotes*

Table 3-18. Flow data taken during point quadrat in the lower stream reach.

Reach	Latitude	Longitude	Total CFS	MGD
Lower	20.83353	-156.12517	-0.03	-0.02

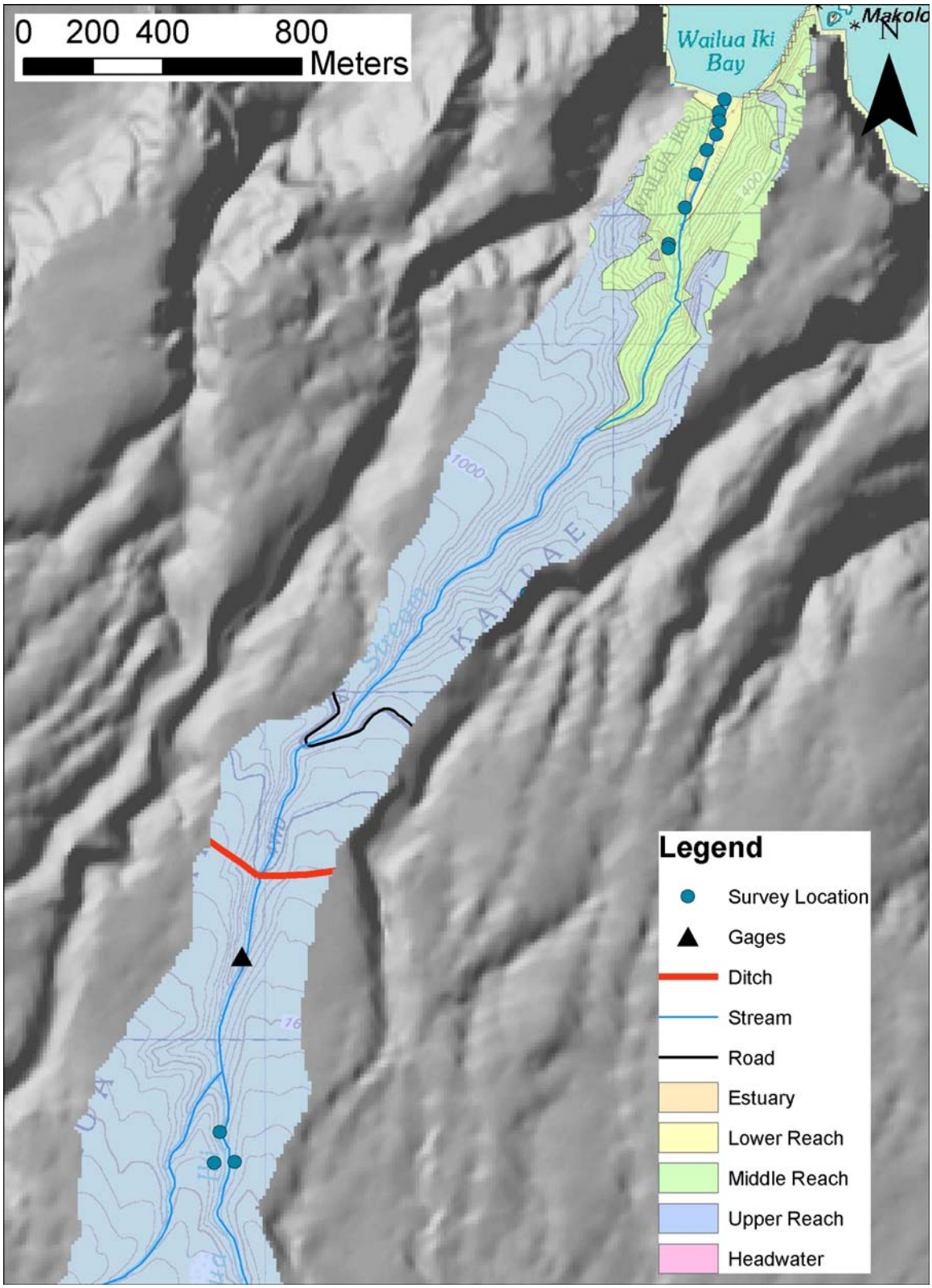

Figure 3-1. Location of point-quadrat surveys conducted in Wailua Iki East Stream.

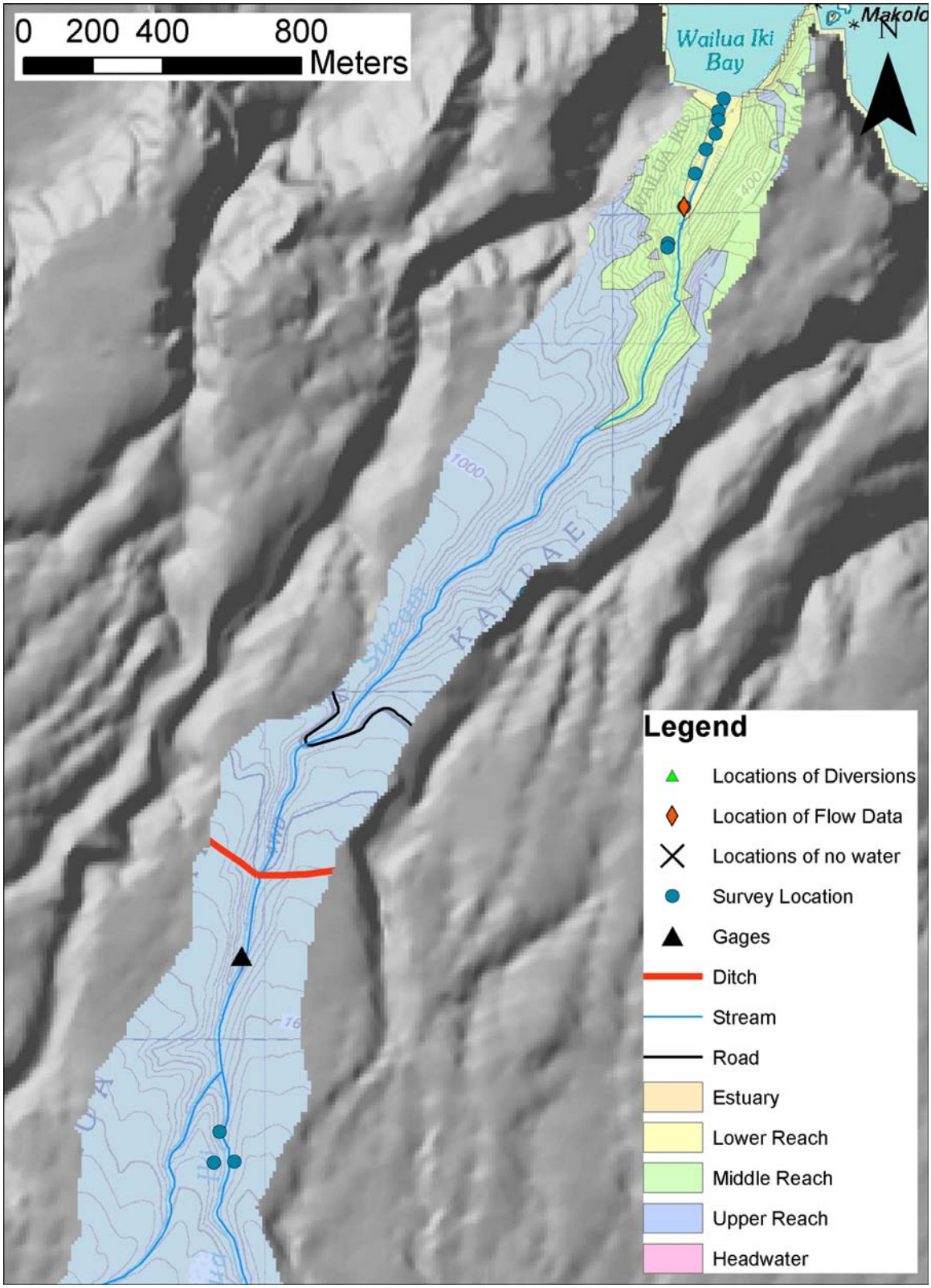

Figure 3-2. Locations of diversions surveys, flow surveys and no flow surveys conducted in Wailua Iki East Stream.

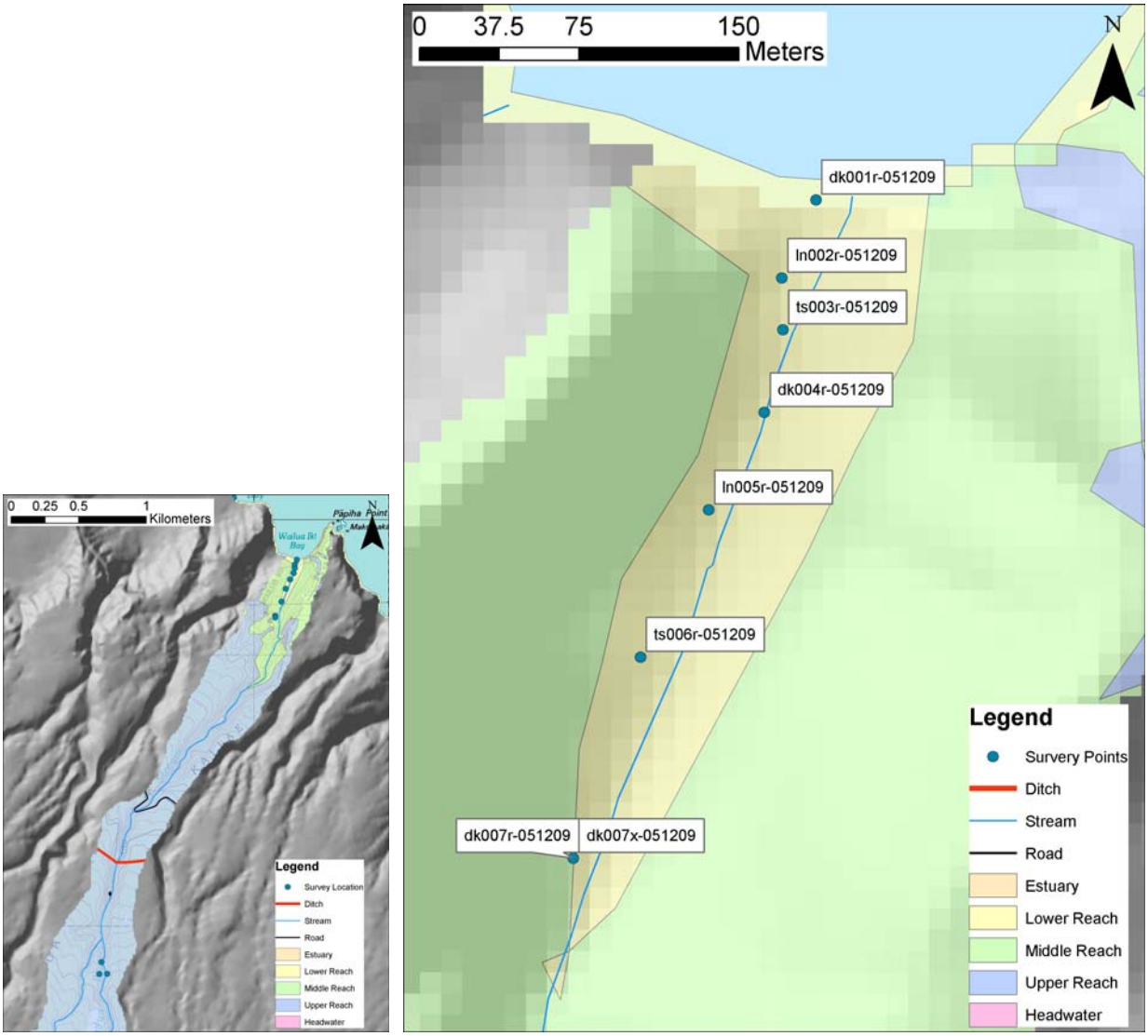

Figure 3-3. Point-quadrat survey locations in the lower reach of Wailua Iki East Stream.

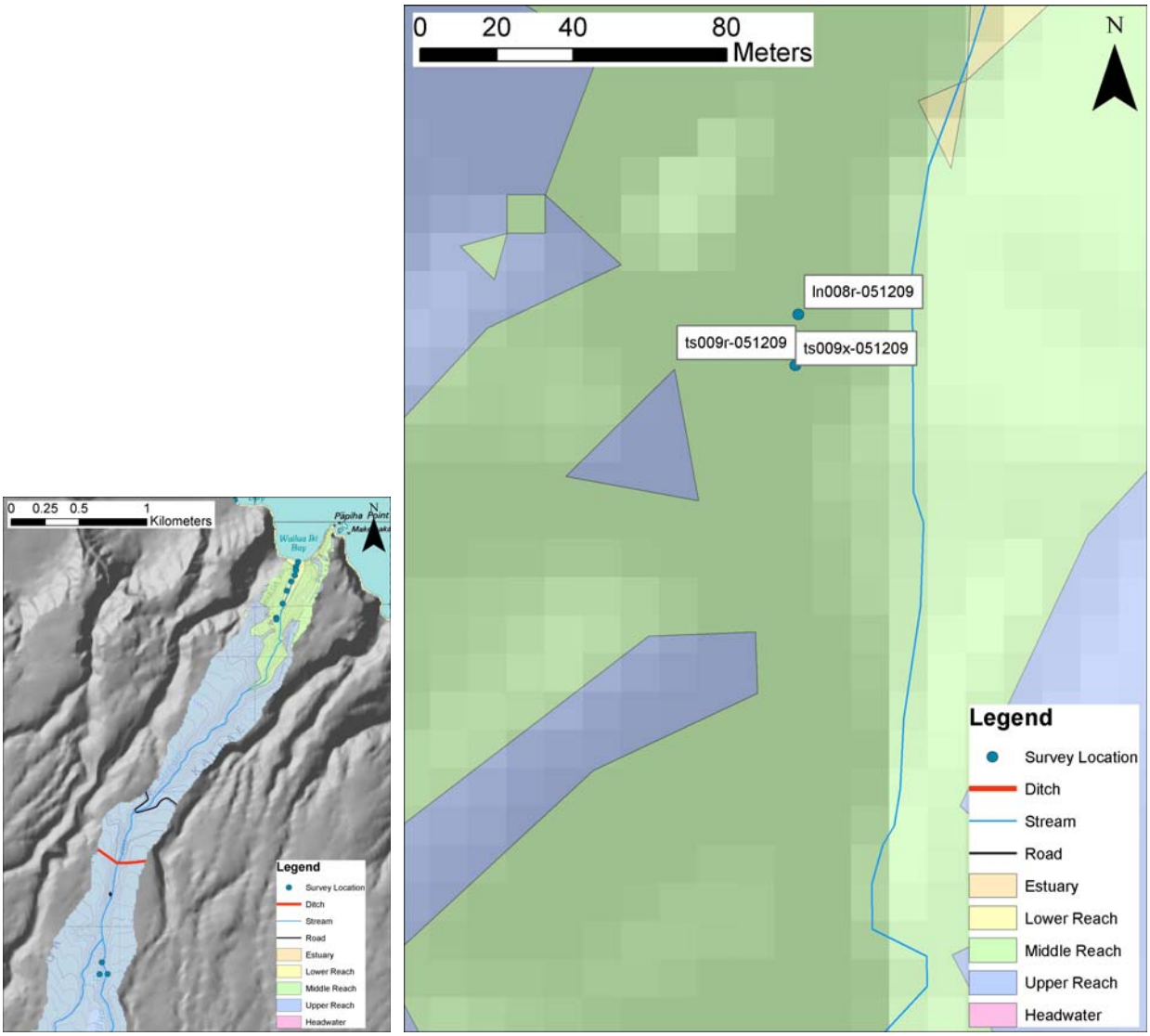

Figure 3-4. Point-quadrat survey locations in the middle reach of Wailua Iki East Stream.

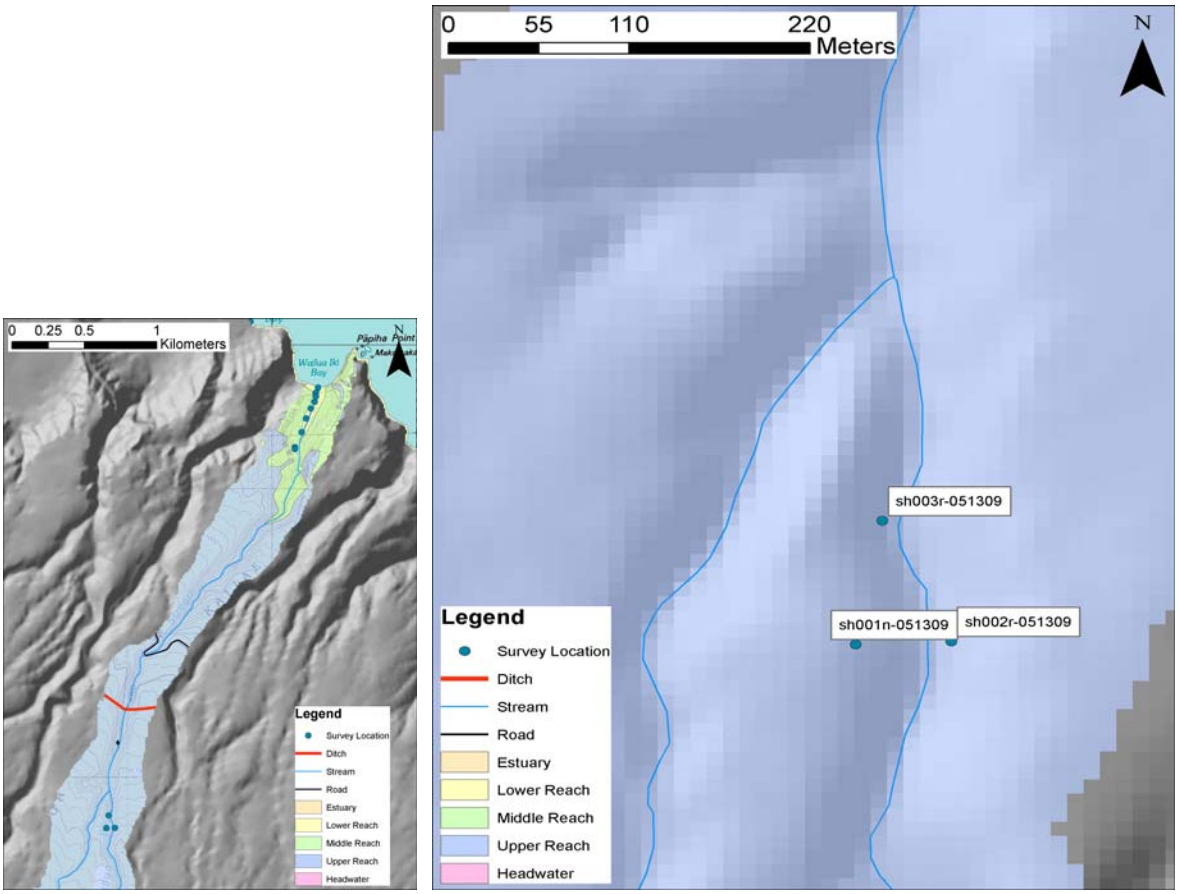

Figure 3-5. Point-quadrat survey locations in the upper reach of Wailua Iki East Stream.

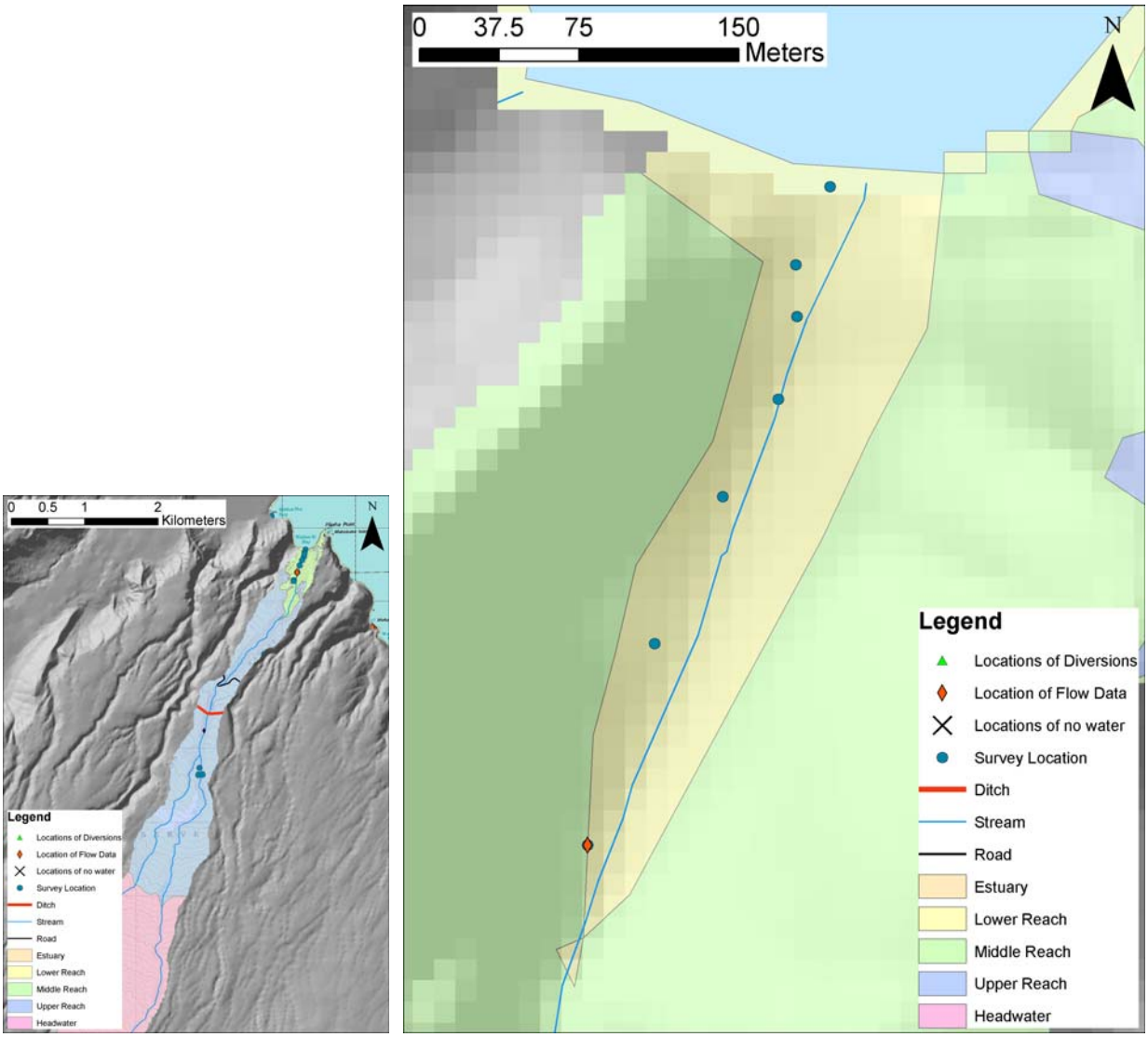

Figure 3-6. Locations of surveys of diversions, flow measurements and no water conditions in the lower reach of Wailua Iki East Stream.

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Section 4: DAR Estuary Survey Report for Wailua Iki East, Maui

For Surveys Conducted on: 5/12/2009

Introduction

This is a report of the Hawai‘i Division of Aquatic Resources estuary survey. Trained biologists and technicians survey a series of randomly located points in a stream to generate an assessment of species and habitat in the stream

Materials and Methods

Sampling was conducted using one cast net, 8 ft in length and ¼ in mesh size. Each random throw was considered a single survey site. The initial survey site was chosen non-randomly at the furthest extent of the estuary along the shoreline, which was determined by salinity level. Any salinity reading below 35‰ was considered estuarine conditions. The locations of random survey sites thereafter were determined by a random number system, which determined the approximate walking distance along the shoreline to the next survey site from the previous survey site. Fish and invertebrates captured in the net were separated, measured and recorded. All species captured were identified, measured and recorded in millimeters. Fish were measured by fork-length while invertebrates were measured by carapace length or total length depending on the classification of the specimen. All fish and invertebrates were measured manually with measuring boards. The following water quality parameters were measured and recorded at each station using a Hydrolab Quanta: temperature (° C), salinity (PSS), dissolved oxygen (mg/L), pH, conductivity (mS/cm) and turbidity (NTU). Other observations recorded were GPS coordinates, method of capture (i.e., random/non-random; cast net/scoop net), estuary status, estuary type, reach, habitat type, substrate composition (%), cloud cover (%), tide stage (ft) and depth (cm). All introduced species and mortally wounded specimens were kept, while all native species were released back to the estuary. Any unidentifiable specimen was kept and preserved in 5% formalin for identification. Any unusual observations were also documented. This process was repeated along the shoreline until the extent of the estuary was surveyed or if physical barriers that restricted continued surveying were reached (i.e., cliffs, hazardous terrain or high surf).

The Estuary Sampling Site, Wailua Iki East, is located in the region of Ke‘anae, Maui. The watershed (and watershed ID), region, and island surveyed in this report

Wailua Iki East (ID: 64016), Ke‘anae, Maui

Surveys were completed by these DAR staff:

Kuamo‘o, Darrell
Nishiura, Lance
Shimoda, Troy

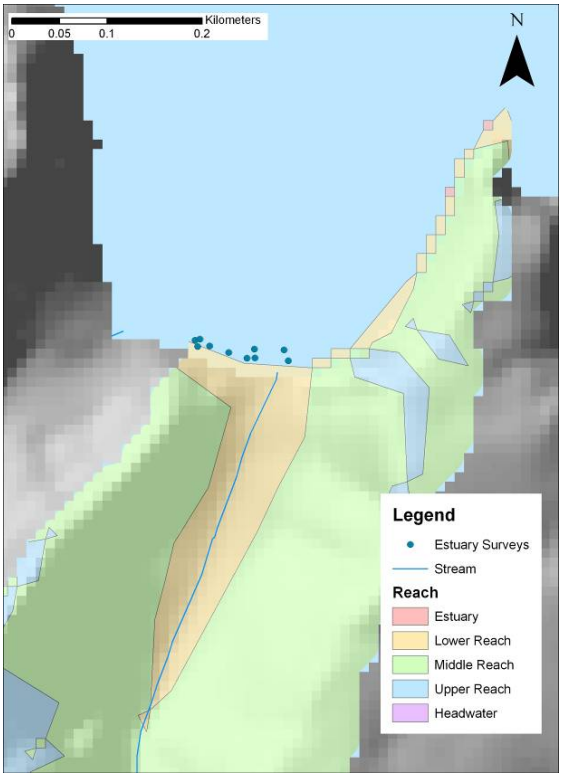

Figure 4-1. Location of estuary surveys conducted in Wailua Iki East.

Results

Table 4-1. Summary of estuary classification and habitat description in Wailua Iki East.

Location	Location ID	Estuary Status	Estuary Type	Reach	Habitat Type(s)
Wailua Iki East	15	Natural	Barrier/Bar Built	Lower	Rock Rubble

Table 4-2. Summary of the observed substrate average(s) (%) in the survey stations in Wailua Iki East.

Avg Detritus	Avg Sediment	Avg Sand	Avg Gravel	Avg Cobble
2	0	0	16	50
Avg Boulder	**Avg Bedrock**	**Avg Emergent Veg**	**Avg Submergent Veg**	**Avg Coral**
32	0	0	0	0

Table 4-3. Summary of the minimum, maximum, average, and the standard deviation of the depth observed in the survey sites in Wailua Iki East.

Location	Location ID	Depth min (cm)	Depth max (cm)	Depth avg (cm)	Depth Std dev. (cm)
Wailua Iki East	15	38	96	42	10.65

Table 4-4. Summary of the minimum, maximum, average, and the standard deviation of the dissolved oxygen observed in the survey stations in Wailua Iki East.

Location	Location ID	DO min (mg/L)	DO max (mg/L)	DO avg. (mg/L)	DO Std. Dev. (mg/L)
Wailua Iki East	15	6.73	7.94	7.23	0.31

Table 4-5. Summary of the minimum, maximum, average, and the standard deviation of the pH observed in the survey stations in Wailua Iki East.

Location	Location ID	pH min	pH max	pH avg.	pH Std. Dev.
Wailua Iki East	15	7.84	8.38	7.94	0.08

Table 4-6. Summary of the minimum, maximum, average, and the standard deviation of the salinity observed in the survey stations in Wailua Iki East.

Location	Location ID	Salinity min (ppt)	Salinity max (ppt)	Salinity avg. (ppt)	Salinity Std. Dev. (ppt)
Wailua Iki East	15	11.53	27.94	22.87	5.13

Table 4-7. Summary of the minimum, maximum, average, and the standard deviation of the temperature observed in the survey stations in Wailua Iki East.

Location	Location ID	Temp min (° C)	Temp max (° C)	Temp avg. (° C)	Temp Std. Dev. (° C)
Wailua Iki East	15	20.91	23.33	22.61	0.77

Table 4-8. Summary of species observed in survey sites.

Location	Location ID	Number of Surveys	Species	Category	Status	# of animals
Wailua Iki East	15	10	*Atherinomorus insularum*	Fish	Indigenous	19
			Encrasicholina purpurea	Fish	Endemic	1
			Neomyxus leuciscus	Fish	Indigenous	91
			Palaemon pacificus	Crustacean	Indigenous	5

Table 4-9. Summary of size. Fish in fork length and crustaceans in total length

Species	Category	# of animals	Max(mm)	Min(mm)	Avg(mm)	Std. Dev.
Atherinomorus insularum	Fish	19	100	75	89	8.11
Encrasicholina purpurea	Fish	1	50	50	50	
Neomyxus leuciscus	Fish	91	146	93	118	11.41
Palaemon pacificus	Crustacean	5	38	19	27	8.76

Summary

Estuary Surveys were conducted in the estuary reach of Wailua Iki East. A total of 114 m of shoreline was surveyed in 1 discrete section. The physical characteristics of Wailua Iki East estuary matched that of West Wailua Iki estuary, consisting of cobble and boulder terrain along the shoreline. The mouth of the stream was closed by a cobble berm created by high surf. Water conditions were relatively calm with slight surge. However, there was a large amount of detritus suspended in the water. The species recorded included three fish and one crustacean. One species (*Neomyxus leuciscus*) is more commonly found in areas of high surge while the other three species are common in estuaries throughout the state.

Species observed in Wailua Iki East Estuary:

Native Species

Fish *Atherinomorus insularum*
Encrasicholina purpurea
Neomyxus leuciscus

Crustacean *Palaemon pacificus*

Section 5: Photographs taken during stream surveys

Estuary and Lower Reach

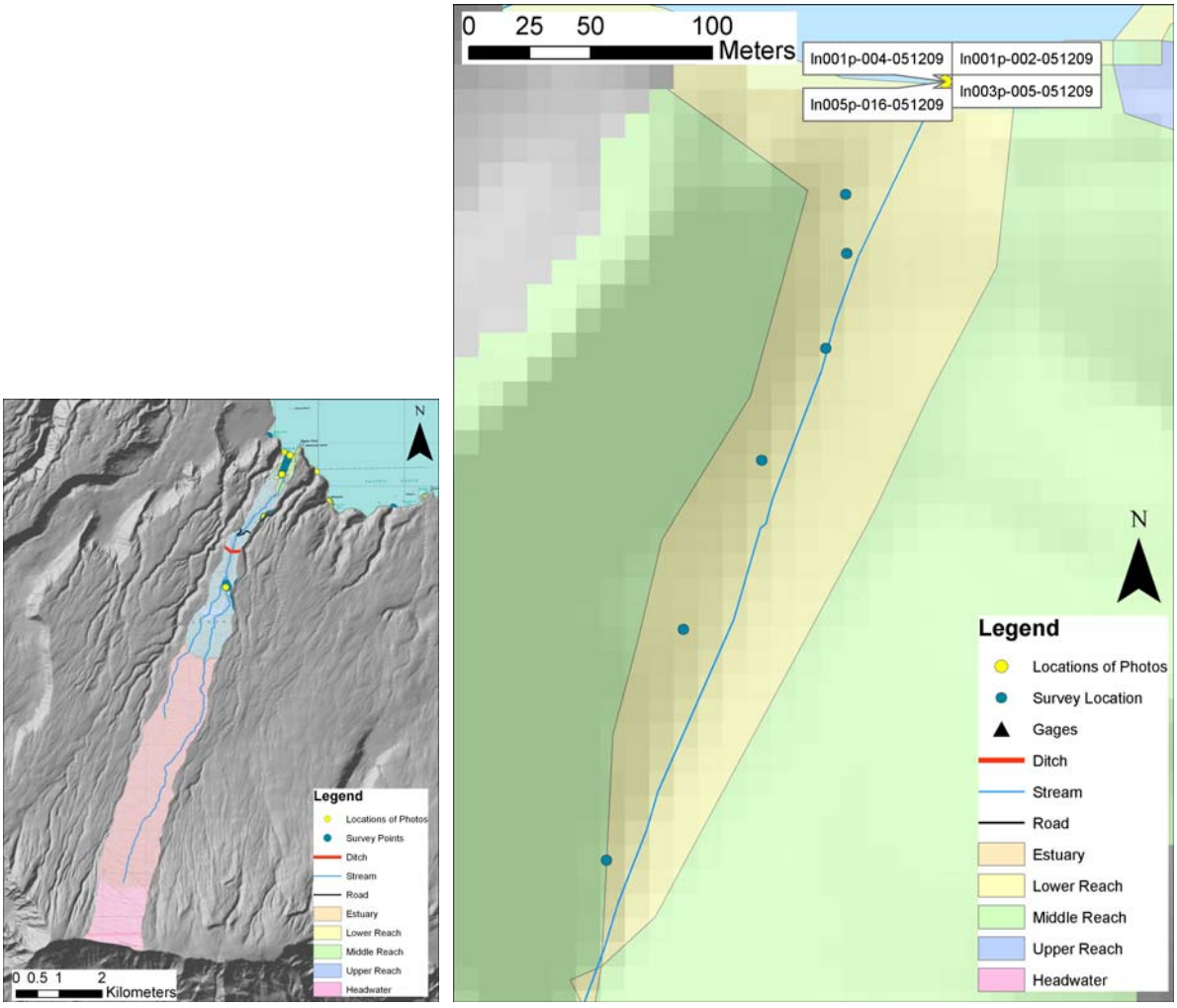

Figure 5-1. Photo locations in the estuary and lower reach of Wailua Iki East Stream.

Figure 5-2. Aerial photo of shoreline for Wailua Iki Bay. Yellow arrow shows Wailua Iki East on the left side with dry waterfall. (4/8/2009; Tributary name: (64016001); PBN: dk64016001p-008-040809; Photo by: Kuamo‘o, D.).

Figure 5-3. Photo showing the natural cobble berm formed at the mouth of the stream at survey site 5. (5/12/2009; Tributary name: East Wailua Iki (64016001); PBN: ln005p-016-051209; Surveyor: Nishiura, L.; SBN: ln005e-051209; Lat. (DD): 20.83639, Long. (DD): -156.12378).

Figure 5-4. Photo of Hawaiian silverside (*Atherinomorus insularum*) on a measuring board, with a fork length of 100mm, collected at site 4. (5/12/2009; Tributary name: East Wailua Iki (64016001); PBN: ln004p-014-051209; Surveyor: Nishiura, L.; SBN: ln004e-051209; Lat. (DD): 20.83639, Long. (DD): -156.12378).

Figure 5-5. Photo of a Uouoa (*Neomyxus leuciscus*) collected at site 4, with an approx FL=140mm. (5/12/2009; Tributary name: East Wailua Iki (64016001); PBN: ln004p-017-051209; Surveyor: Nishiura, L.; SBN: ln004e-051209; Lat. (DD): 20.83639, Long. (DD): -156.12378).

Figure 5-6. Photo showing upstream view of Wailua Iki East Stream at the mouth, from survey site 4. (5/12/2009; Tributary name: East Wailua Iki (64016001); PBN: ln004p-010-051209; Surveyor: Nishiura, L.; Habitat type: Pool; SBN: ln004e-051209; Lat. (DD): 20.83639, Long. (DD): -156.12378).

Figure 5-7. Photo of DAR surveyors collecting a sample at survey site 3. Note the amount of detritus in the cast net. The current pushes detritus to this location of estuary; it contained shrimp and amphipods. (5/12/2009; Tributary name: East Wailua Iki (64016001); PBN: ln003p-005-051209; Surveyor: Nishiura, L.; SBN: ln003e-051209; Lat. (DD): 20.83639, Long. (DD): -156.12378).

Figure 5-8. Photo of amphipods found in detritus in collected sample from survey site 1. (5/12/2009; Tributary name: East Wailua Iki (64016001); PBN: ln001p-004-051209; Surveyor: Nishiura, L.; SBN: ln001e-051209; Lat. (DD): 20.83639, Long. (DD): -156.12378).

Figure 5-9. Survey site 1. Shoreline at the closed stream mouth of Wailua Iki East Stream. (5/12/2009; Tributary name: East Wailua Iki (64016001); PBN: ln001p-002-051209; Surveyor: Nishiura, L.; SBN: ln001e-051209; Lat. (DD): 20.83639, Long. (DD): -156.12378).

Middle Reach

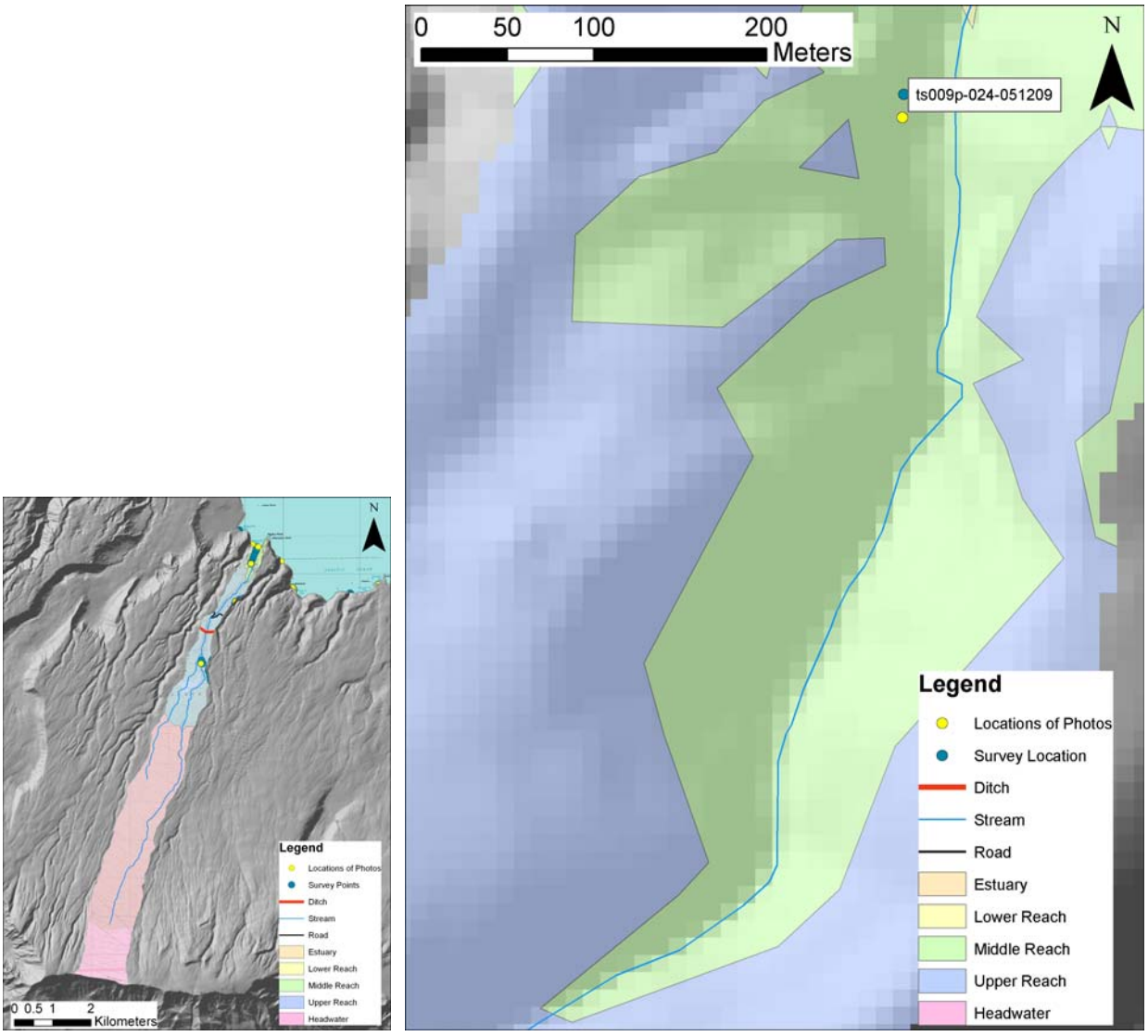

Figure 5-10. Photo locations in the middle reach of Wailua Iki East Stream.

Figure 5-11. Photo shows survey site 9 (red oval) and an upstream waterfall. (5/12/2009; Tributary name: East Wailua Iki (64016001); PBN: ts009p-024-051209; Surveyor: Shimoda, T.; Habitat type: Plunge Pool; SBN: ts009r-051209; Lat. (DD): 20.83247, Long. (DD): -156.12564).

Upper Reach

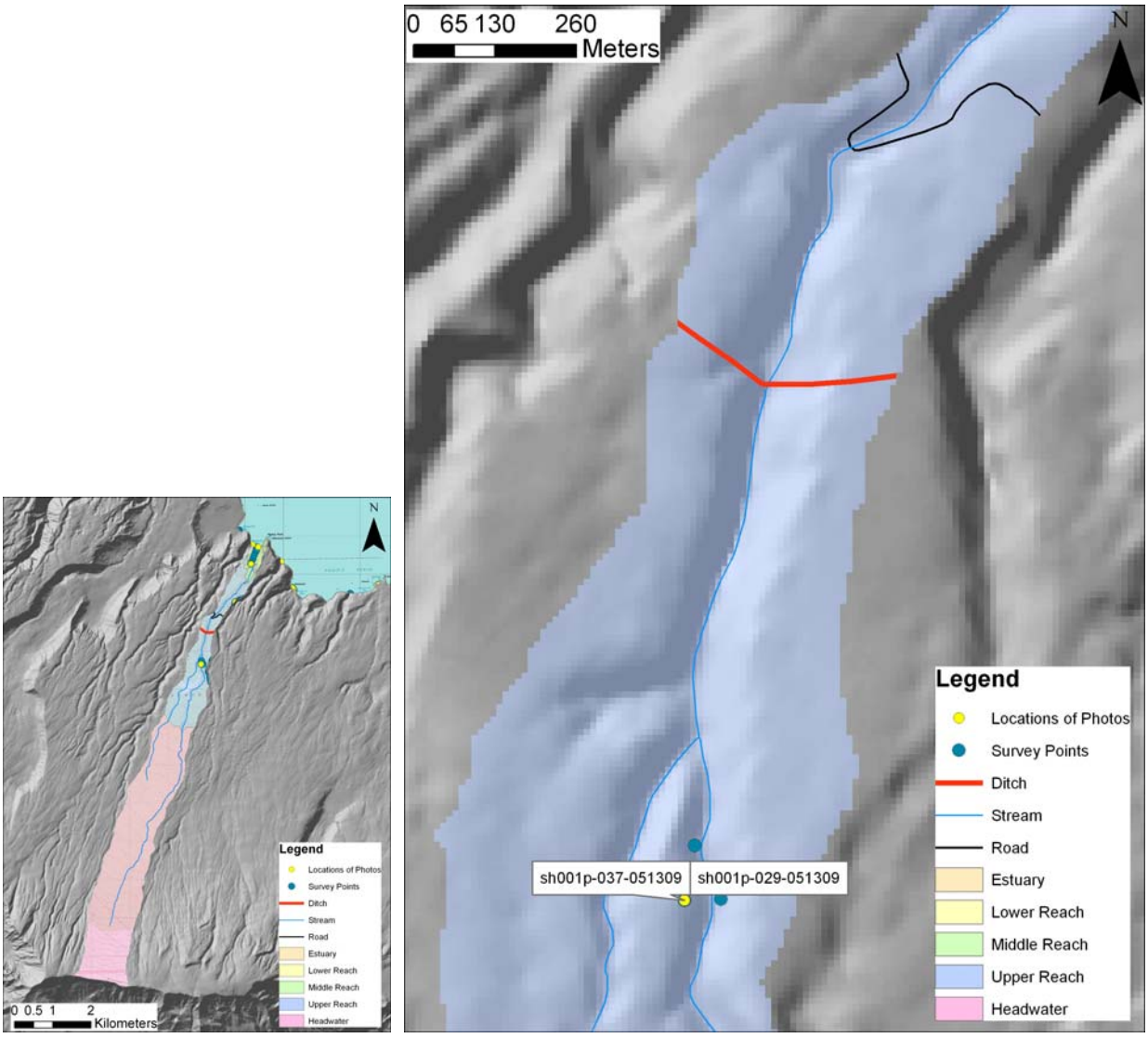

Figure 5-12. Locations of photos and photo book numbers (PBN) in the upper reach of Wailua Iki East.

Figure 5-13. Diversion structure on the upper reach of Wailua Iki East Stream above Hāna Highway. (CWRM diversion photo 288.1).

Figure 5-14. Diversion impoundment structure on the upper reach of Wailua Iki East Stream above Hāna Highway. (CWRM diversion photo 288.2).

Figure 5-15. Photo of a ditch and stream below the diversion on the upper reach of Wailua Iki East Stream above Hāna Highway. (CWRM diversion photo 288.3).

Figure 5-16. Photo was taken downstream from survey site 1 above Hāna Highway and the diversion. (5/13/2009; Tributary name: East Wailua Iki (64016003); PBN: sh001p-037-051309; Surveyor: Hau, S.; Habitat type: Plunge Pool; SBN: sh001n-051309; Lat. (DD): 20.80895, Long. (DD): -156.13861).

Figure 5-17. Photo shows cascading waterfall and plunge pool in upper reach of Wailua Iki East Stream above survey site 1. (5/13/2009; Tributary name: East Wailua Iki (64016003); PBN: sh001p-029-051309; Surveyor: Hau, S.; Habitat type: Plunge Pool; SBN: sh001n-051309; Lat. (DD): 20.80895, Long. (DD): -156.13861).

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Pukui, M. K. and S.H. Elbert. 1971. Hawaiian Dictionary. University of Hawaii

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Appendix: Survey Sites Latitude and Longitude

Tributary	Stream	Survey Book #	Site	Surveyor	Date	Latitude	Longitude
64016001	Wailua Iki East	ts009x-051209		Shimoda, Troy	5/12/2009	20.83247	-156.12564
64016001	Wailua Iki East	dk007x-051209		Kuamo‘o, Darrell	5/12/2009	20.83353	-156.12517
64016001	Wailua Iki East	dk001r-051209	1	Kuamo‘o, Darrell	5/12/2009	20.83631	-156.12402
64016001	Wailua Iki East	ln002r-051209	2	Nishiura, Lance	5/12/2009	20.83598	-156.12418
64016001	Wailua Iki East	ts003r-051209	3	Shimoda, Troy	5/12/2009	20.83576	-156.12418
64016001	Wailua Iki East	dk004r-051209	4	Kuamo‘o, Darrell	5/12/2009	20.83541	-156.12427
64016001	Wailua Iki East	ln005r-051209	5	Nishiura, Lance	5/12/2009	20.83500	-156.12453
64016001	Wailua Iki East	ts006r-051209	6	Shimoda, Troy	5/12/2009	20.83438	-156.12485
64016001	Wailua Iki East	dk007r-051209	7	Kuamo‘o, Darrell	5/12/2009	20.83353	-156.12517
64016001	Wailua Iki East	ln008r-051209	8	Nishiura, Lance	5/12/2009	20.83259	-156.12563
64016001	Wailua Iki East	ts009r-051209	9	Shimoda, Troy	5/12/2009	20.83247	-156.12564
64016003	Wailua Iki East	sh001n-051309	1	Hau, Skippy	5/13/2009	20.80895	-156.13861
64016003	Wailua Iki East	sh002r-051309	2	Hau, Skippy	5/13/2009	20.80896	-156.13805
64016003	Wailua Iki East	sh003r-051309	3	Hau, Skippy	5/13/2009	20.80974	-156.13844

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