Biological reconnaissance and water quality survey of Māʻili Stream for a bridge replacement project on the leeward coast of Oʻahu[1]

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Introduction

The Hawaiʻi Department of Transportation (HDOT) is proposing to replace the existing Maipalaoa Bridge over Māʻili Stream (Fig. 1) with a four-lane bridge to include widened shoulders and sidewalks. To implement the bridge replacement project, HDOT will prepare a Federal and State Environmental Assessment (EA); apply for a Clean Water Act Water Quality Certification (WQC); and submit applications for a Stream Channel Alteration Permit (SCAP), National Pollution Discharge Elimination System (NPDES) permit, and Department of Army (DA) permit. To provide information for the EA and the permit applications, *AECOS* biologists conducted a reconnaissance-level survey of Māʻili Stream on March 23, 2009. The purpose of the survey was to ascertain biological resources and collect water quality samples. This report presents the findings of that survey.

Site Description

Māʻili Stream and its watershed is sometimes considered a sub-watershed of the larger Māʻiliʻili Stream (State Watershed Code No. 35004), which originates in the Waianae Mountains (DLNR-DAR, 2009). Māʻili Stream, however, is a short, highly modified second order perennial stream that originates in the coastal plain of leeward Oʻahu, and discharges into the Pacific Ocean at Ulehawa Beach

[1] This report was prepared for SSFM for use associated with environmental permitting for the Maipalaoa Bridge project, Oʻahu.

Park in Māʻili (Fig. 1). This stream is not tributary to Māʻiliʻili Stream located a little over 2 km (1.3 mi) to the north; Māʻili Stream and has a drainage basin of only 8.0 km^2 (3.1 mi^2) entirely within the coastal plain (Belt Collins, 2001), extending only about three km (~2 mi) inland.

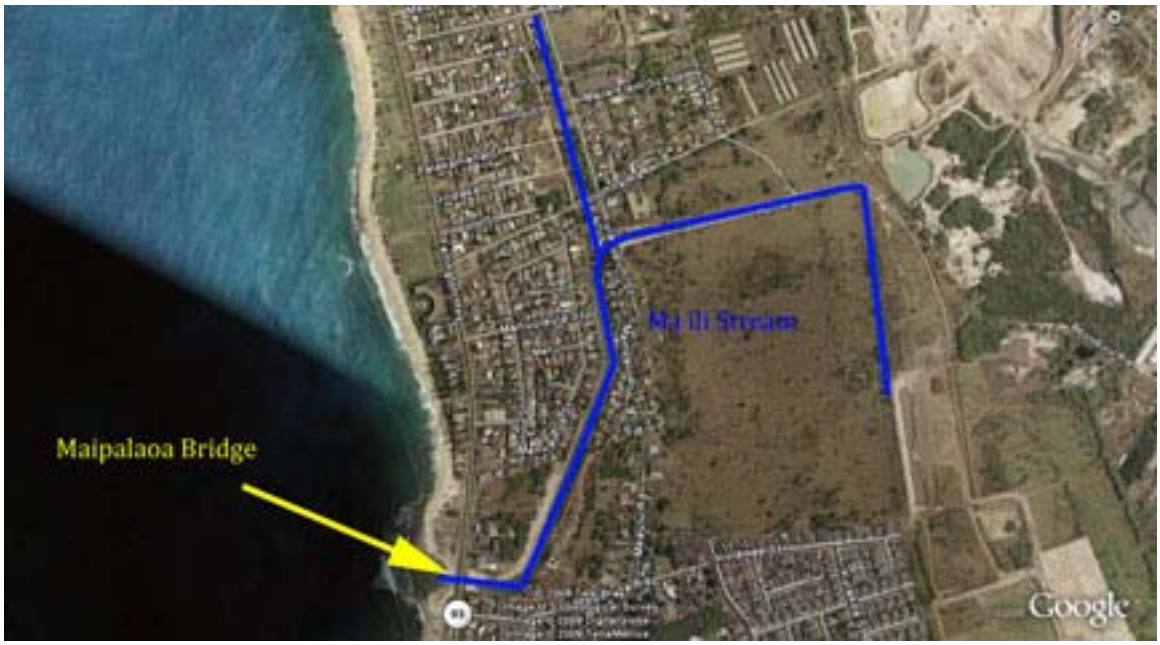

Figure 1. Māʻili Stream (marked in blue), leeward Oʻahu.

Most of Māʻili Stream was channelized in a concrete-lined drainageway in the 1960s and 1970s (Belt Collins, 2001). In 1996, heavy rains resulted in extensive flooding in the Māʻili drainage basin. Flood mitigation improvements have been recommended to minimize future flooding and include construction of new culverts, drain lines, and catch basins within the watershed (Belt Collins, 2001).

Māʻili Stream converges with the drainage channel that flows through Lualualei Homestead and downstream of this convergence the stream/channel becomes estuarine. Māʻili Estuary flows through the homesteads in a man-made flood control channel until it reaches Maipalaoa Bridge at Farrington Highway (Fig. 2). Maipalaoa Bridge (project area) crosses Māʻili Stream within 65 m (213 ft) of the shore.

The channel in the project area is around 30 m (98 ft) across and, at low tide, the water is about 0.5 m (1.5 ft) deep; the stream here is clearly tidal. *Makai* (seaward) of the bridge, the stream cuts through the beach and limestone reef

flat. Reef rubble and sand are found in the channel just *makai* of the bridge. Significant erosion is apparent at the upper shore south of the stream mouth.

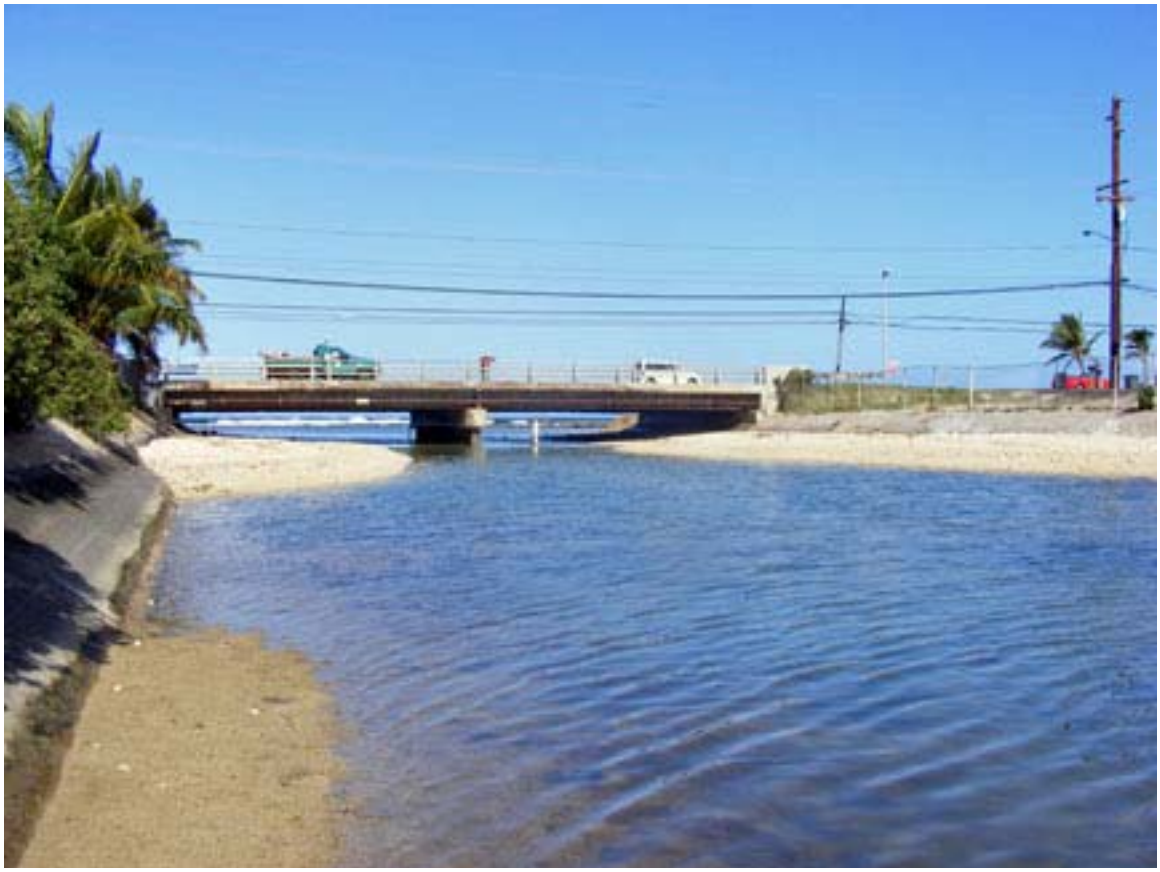

Figure 2. Māʻili Stream as it flows through the concrete drainageway, under Maipalaoa Bridge, and into the Pacific Ocean.

Water Quality

Three water quality sampling stations in Māʻili Stream, "Upstream," "Bridge," and "Reef," (Fig. 3) were sampled on March 23, 2009 and the data used to assess water quality of the estuary. Specific criteria listed in the Hawaiʻi Water Quality Standards (HDOH, 2004) applicable to estuaries were measured at the three stations. Additionally, the "Bridge" station was sampled to collect data for a source water quality assessment (SWQA) that may be used for a National Pollutant Discharge Elimination System (NPDES) permit application for the discharge of construction dewatering discharges.

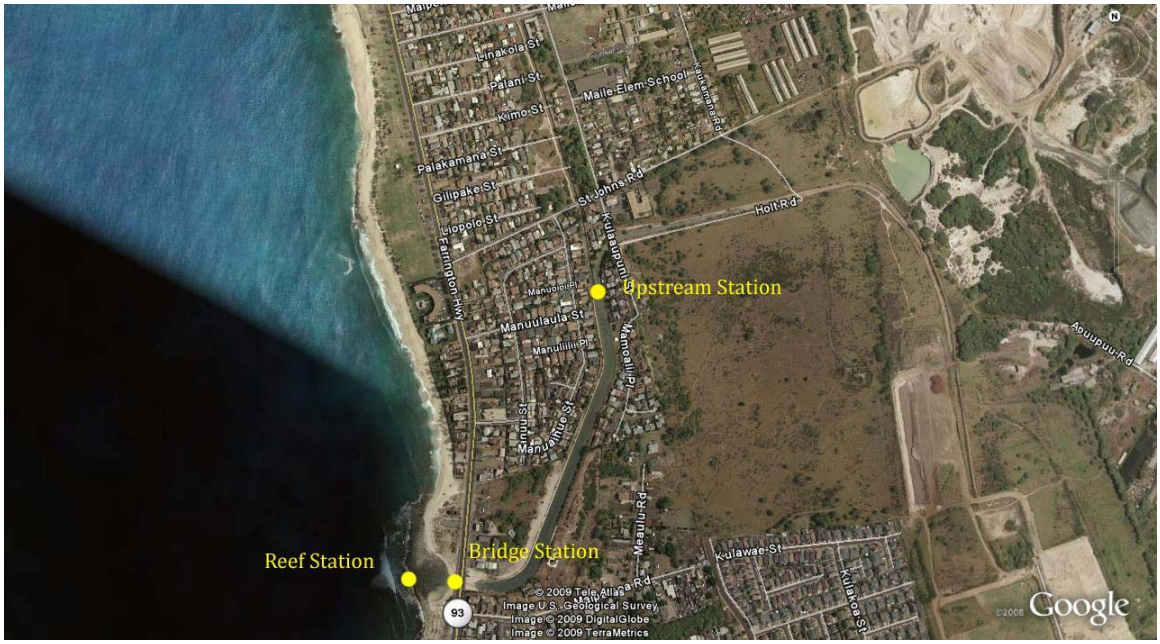

Figure 3. Location of March 23, 2009 water quality sampling stations.

At the time of the survey, the tidal stage was low and rising. Some parameters were measured by field meter and others in samples collected in appropriate containers and taken to the *AECOS*, Inc. laboratory. The 'Upstream' sample was collected in the center of the channel just downstream from the convergence with the lateral tributary through the Lualualei Homesteads. The 'Bridge' sample was collected in the center of the channel underneath the Maipalaoa Bridge. The 'Reef' sample was collected on the seaward edge of the limestone bench.

Dissolved oxygen (DO), pH, salinity, and temperature were measured *in situ* at each of the three stations. The samples collected at each of the three stations to characterize the quality of the water in the estuary were collected in one 1-L, one 250-mL, and two 125-mL plastic bottles that were pre-rinsed with the stream water prior to sampling. The sample that was collected at the 'Bridge' Station for the source water quality evaluation for the NPDES permit application was collected in three 1-L glass bottles that contained H_2SO_2 as a preservative, two 1-L glass bottles without a preservative, and four 40-mL glass bottles with HCl as a preservative. All samples were collected about 0.3 m (1 ft) below the water surface. The samples were placed in a cooler and delivered to

the *AECOS* laboratory (*AECOS* Log No. 25112) the same day. Table 1 lists the analytical methods and instrumentation used for each water quality parameter measured.

Table 1. Analytical methods and instruments used for March 23, 2009 water quality sampling of Māʻili Estuary.

Analysis	Method	Reference	Instrument
Ammonia Nitrogen	SM4500-NH3 B/C (SWQA)	Grasshoff (1986)	Technicon AutoAnalyzer II
Chlorophyll α	10200 H	SM (1998)	Turner Model 112 fluorometer
Dissolved Oxygen	EPA 360.1	USEPA (1979)	YSI Model 550A DO meter
Nitrate + Nitrite Nitrogen	EPA 353.2 SM 4500-NO3 E (SWQA)	USEPA (1993)	Technicon AutoAnalyzer II
Oil and Grease	EPA 1664A	USEPA (1993)	
Organochlorine Pesticides	EPA 3510C/608 (SWQA)	USEPA (1993)	
pH	EPA 150.1	USEPA (1979)	Hannah pocket pH meter
Salinity	bench salinometer	Grasshoff (1986)	AGE Model 2100 salinometer
Temperature	thermister calibrated to NBS cert. thermometer (EPA 170.1)	USEPA (1979)	YSI Model 550A DO meter
Total Kjeldahl Nitrogen	SM 4500 N Org B (SWQA)	SM (1998)	
Total Nitrogen	4500 N org B + SM 4500-NO3 E (SWQA)	Grasshoff (1986)	Technicon AutoAnalyzer II
Total Phosphorus	EP 365.1, rev. 2.0 SM 4500 P B/E (SWQA)	USEPA (1993)	Technicon AutoAnalyzer II
Total Suspended Solids	SM 2540D	SM (1998)	Mettler H31 balance
Turbidity	EPA 180.1, rev. 2.0	USEPA (1993)	2100N Hach Turbidimeter
Volatile Organic Compounds (VOCs)	EPA 624 (SWQA)	USEPA (1993)	

The results of the water quality analyses are given in Tables 2 and 3.

Table 2. Water quality measured on March 23, 2009 at three stations during a flooding tide in Māʻili Estuary, Māʻili.

	Time	Temp. (°C)	DO (mg/l)	DO sat. (%)	pH	Salinity (psu)	
Upstream	1015	27.0	7.40	104	7.73	20	
Bridge	1045	24.9	7.97	113	8.05	28	
Reef	1105	24.7	8.23	119	8.30	32	
	TSS (mg/l)	Turbidity (ntu)	Chl α (µg /l)	Ammonia (µg N/l)	$N0_3 + N0_2$ (µg N/l)	Total N (µg N/l)	Total P (µg P/l)
Upstream	20.8	11.0	11.8	56	3630	4610	138
Bridge	10.0	2.96	1.24	18	1750	2150	27
Reef	5.6	1.04	1.25	10	632	837	23

Table 3. Water quality measured at 'Bridge' Station in Māʻili Estuary on March 23, 2009 during a flooding tide for the Source Water Quality Assessment (SWQA).

Parameter	**Results**
Ammonia Nitrogen	Non detected at reporting limit
Chlorophyll α	1.24 µg/L
Dissolved Oxygen	7.97 mg/L, 113%
Nitrate + Nitrite Nitrogen	2.2 mg/L
Oil and Grease	2.1 mg/L
Organochlorine Pesticides	Non detected at reporting limit
pH	8.05
Salinity	28 psu
Temperature	24.9 ℃
Total Kjeldahl Nitrogen	2.5 mg/L
Total Nitrogen	4.7 mg/L
Total Phosphorus	Non detected at reporting limit
Total Suspended Solids	10.0 mg/L
Turbidity	2.96 ntu
Volatile Organic Compounds (VOCs)	Non detected at reporting limit

Flora and Fauna

The vegetation surrounding the *muliwai* (estuary) *makai* of Farrington Highway is typical strand vegetation of dry, coastal areas on Oʻahu (Table 4). No listed threatened or endangered plants occur near the estuary in the project area. *Mauka* of the bridge, the estuary is channelized with hardened banks and has essentially no riparian zone. Some ruderal (weedy) species and ornamental plants are growing at the top of the banks.

Table 4. Checklist of plants and relative abundances near the Maipalaoa Bridge, Māʻili, Oʻahu.

Species listed by family	Common name	Status	Abundance *Makai*	Abundance *Mauka*
FLOWERING PLANTS				
DICOTYLEDONS				
AIZOACEAE				
Sesuvium portulacastrum (L.) L.	*ʻakulikuli*	**ind**		R
AMARANTHACEAE				
Amaranthus spinosus L.	spiny amaranth	nat	U	
ASTERACEAE (COMPOSITAE)				
Bidens alba (L.) DC. var. *radiata* (Sch. Bip.) Ballard ex T.E. Melchert	beggartick	nat	U	
Emilia fosbergii Nicolson	Flora's paintbrush	nat		R
Pluchea carolinensis (Jacq.) G. Don	sourbush	nat	U	
Pluchea indica (L.) Less.	Indian fleabane	nat	U	U
Tridax procumbens L.	coat buttons	nat	U	
Verbesina encelioides (Cav.) Benth. & Hook. f. ex A. Gray	golden crownbeard	nat	U	O
BATACEAE				
Batis maritima L.	pickleweed	nat		O
BORAGINACEAE				
Cordia subcordata Lam.	*kou*	nat		R
Heliotropium curassavicum L.	salt heliotrope	**ind**		O
BRASSICACEAE				
Lepidium sp.	pepperweed	---	U	
CHENOPODIACEAE				
Atriplex semibaccata R. Br.	Australian saltbush	nat		U
Chenopodium murale L.	*ʻaheahea*	nat	U	
CONVOLVULACEAE				
Ipomoea pes-caprae (L.) R. Br. ssp. *brasiliensis* (L.) van Ooststr.	beach morning glory	**ind**	O	

Table 4 (continued).

Species listed by family	Common name	Status	Abundance *Makai*	Abundance *Mauka*
CUSCUTACEAE				
Cuscuta sp.	dodder	---	O	
EUPHORBIACEA				
Chamaesyce hirta (L.) Millsp.	garden spurge	nat	U	U
Chamaesyce hypericifolia (L.) Millsp.	graceful spurge	nat	U	
FABACEAE				
Desmanthus virgatus (L.) Willd.	virgata mimosa	nat	U	
Leucaena leucocephala (Lam.) de Wit	*koa haole*	nat		U
Prosopis pallida (Humb. & Bonpl.) Ex Willd.) Knuth	*kiawe*	nat	O	U
GOODENIACEAE				
Scaevola sericea Vahl	*naupaka kahakai*	**ind**	O	O
MALVACEAE				
Gossypium hirsutum L.	cotton	nat		R
Sida rhombifolia L.	Cuba jute	nat	U	
NYCTAGINACEAE				
Boerhavia coccinea Mill.	false alena	nat	U	
RUBIACEAE				
Morinda citrifolia L.	*noni*, Indian mulberry	nat		U
STERCULIACEAE				
Waltheria indica L.	*ʻuhaloa*	**ind**	U	
	MONOCOTYLEDONS			
ARECACEAE				
Cocos nucifera L.	*niu*, coconut palm	**pol**	O	
POACEAE (GRAMINEAE)				
Cenchrus ciliaris L.	buffelgrass	nat	C	
Cenchrus echinatus L.	sandbur	nat	U	
Chloris barbata Sw.	swollen fingergrass	nat		O
Sporobolus virginicus (L.) Kunth	*ʻaki ʻaki* seashore dropseed	**ind**	O	
Urochloa maxima (Jacq.) Webster	Guinea grass	nat		U

Legend to Table 4

STATUS = distributional status for the Hawaiian Islands:

end = endemic; native to Hawaii and found naturally nowhere else.

ind = indigenous; native to Hawaii, but not unique to the Hawaiian Islands.

nat = naturalized, exotic, plant introduced to the Hawaiian Islands since the arrival of Cook Expedition in 1778, and well-established outside of cultivation.

orn = exotic, ornamental or cultivated; plant not naturalized (not well-established outside of cultivation).

pol = Polynesian introduction before 1778.

Table 4 (continued).

ABUNDANCE = occurrence ratings for plants by area:

R – Rare	seen in only one or perhaps two locations.
U - Uncommon	seen at most in several locations
O - Occasional	seen with some regularity
C - Common	observed numerous times during the survey
A - Abundant	found in large numbers; may be locally dominant.

A listing of the organisms observed in the estuary of Māʻili Stream is given in Table 5. The introduced cichlid (blackchin tilapia or *Sarotherodon melanotheron*), is the dominant fish in the estuary *mauka* of the bridge. Schools of juvenile Kuhliidae (the endemic *aholehole* nor *Kuhlia xenura*) and schools of various size classes of mullet (the indigenous *ʻamaʻama* or *Mugil cephalus*) are present in the estuary, making these fishes abundant. Small Mexican mollies (*Poecilia mexicana*), an introduced species, are common in the shallow waters along the edges of the estuary. Three native *ʻoʻopu*: *Eleotris sandwicensis*, *Awaous guamensis,* and *Stenogobius hawaiiensis* (*ʻoʻopu akupa*, *ʻoʻopu nakea*, and *ʻoʻopu naniha*, respectively) are rare or uncommon in the estuary with only one or several individuals of each species seen during the survey. Some marine reef fishes, such as *manini* (*Acanthurus triostegus*) and the Moorish idol (*Zanclus cornutus*), were also observed in the estuary several hundred meters upstream from Maipalaoa Bridge.

Under the bridge, the most conspicuous non-native organisms are the bushy bryozoans (*Amathia distans*) and various sponges and barnacles adhering to the bridge pilings. Blackchin tilapia are common in the *muliwai makai* of the bridge. From the bridge out onto the limestone reef bench, the community composition is one that is largely native. A few individual *ʻoʻopu* (*Eleotris sandwicensis* and *Awaous guamensis*) were seen on the sand bottom of the channel and *aholehole* and *ʻawaʻawa* were seen schooling in the murky waters. A diverse assemblage of algae and macroinvertebrates live on and in the reef platform. Juvenile reef fishes live in the small tide pools on the bench. Brighteye damselfish (*Plectroglyphidodon imparipennis*) are common in the shallow waters of the nearshore reef flat.

In 1998, the Hawaiʻi Biological Survey (HBS) determined the biodiversity of the freshwater, estuarine, and marine communities in Māʻili Stream as part of a larger study of introduced species along the south and west shores of Oʻahu (Englund, et al., 2000). The results of this survey are included in Table 5. Many insects and smaller crustaceans that were not noted in our survey were identified and recorded in the HBS survey.

Table 5. Checklist of aquatic biota reported from Maʻili Stream.

Phylum **Class** Order Family Taxon	Common name	Status	Rel. Abundance	Location	Notes
	ALGAE				
CYANOPHYTA	cyanobacteria				
Unidentified cyanophyta		---	C	Estuary	<1>
CHLOROPHYTA	green algae				
CLADOPHORALES					
Cladophoraceae					
Chaetomorpha sp.		**Ind**	U	Marine	<1>
Ulva fasciata	*limu pālahalaha*, sea lettuce	**Ind**	C	Marine	<1>
PHAEOPHYTA	brown algae				
FUCALES					
Sargassaceae					
Sargassum echinocarpum	*limu kala*	**End**	O	Marine	<1>
RHODOPHYTA	red algae				
Unidentified rhodophyta		---	A	Estuary	<1>
GIGARTINALES					
Hypneaceae					
Hypnea musciformis	hookweed	Nat	O	Marine	<1>
Phyllophoraceae					
Ahnfeltiopsis flabelliformis	*ʻopihi limu*	**Ind**	C	Marine	<1>
CORALLINALES					
Corallinaceae					
Hydrolithon gardineri		**Ind**	O	Marine	<1>
Hydrolithon onkodes		**Ind**	O	Marine	<1>
GELIDIALES					
Gelidiaceae					
Pterocladiella caerulescens		**Ind**	O	Marine	<1>
GRACILARIALES					
Gracilariaceae					
Gracilaria salicornia	gorilla ogo	Nat	C	Marine	<1>
CERAMIALES					
Rhodomelaceae					
Acanthophora spicifera		Nat	C	Marine	<1>
Tolypiocladia glomerulata		**Ind**	O	Marine	<1>
	INVERTEBRATES				
PORIFERA					
DEMOSPONGIAE					
Undetermined demospongiae	yellow sponge	---	O	Marine	<1>
ANNELIDA					
POLYCHAETA					
Canalipalpata					
Serpulidae					
Undetermined serpulidae	tube worm	---	C	Marine	<1>

Table 5 (continued).

Phylum **Class** Order Family Taxon	Common name	Status	Rel. Abundance	Location	Notes
ECTOPROCTA					
GYMNOLAEMATA					
Ctenostomata					
Vesiculariidae					
Amathia distans	white bushy bryozoan	Nat	O	Marine	<1>
MOLLUSCA					
GASTROPODA					
Siphonariidae					
Siphonaria normalis	*ʻopihi ʻawa*, false *opihi*	**Ind**	R	Marine	<1>
Archaeogastropoda					
Neritidae					
Nerita picea	common nerite, *pipipi*	**End**	C	Marine	<1>
Littorinidae					
Littoraria pintado	dotted periwinkle	**Ind**	C	Marine	<1>
Neotaenioglossa					
Ranellidae					
Cymatium muricinum	knobbed triton	**---**	R	Marine	<1>
Neogastropoda					
Buccinidae					
Undetermined buccinidae			R	Marine	<1>
Opisthobranchia					
Undetermined opisthobranchia	eggs	---	R	Marine	<1>
Columbellidae					
Anachis sp. cf. *miser*		**Ind**	p	E, M	<2>
Muricidae					
Morula granulata	granulated drupe	**Ind**	O	Marine	<2>
BIVALVIA					
Mytilidae					
Brachidontes crebristriatus	Hawaiian mussel	**End**	O	Marine	<1>
ARTHROPODA					
INSECTA					
Diptera					
Canacidae					
Canaceoides angulatus		Nat	p	E, F, M	<2>
Canaceoides hawaiiensis		**End**	p	E, M	<2>
Chironomidae					
Thalassomya setosipennis		**End**	p	E, F, M	<2>
Dolichopodidae	long-legged flies				
Thambemyia acrosticalis		**End**	p	E, M	<2>
Ephydridae	brine flies				
Undetermined ephydridae		---	C	Estuary	<1>
Tethinidae					
Dasyrhicnoessa vockerothi		**Ind?**	p	E, M	<2>

Table 5 (continued).

Phylum **Class** Order Family Taxon	Common name	Status	Rel. Abundance	Location	Notes
Odonata					
Aeshnidae					
Anax junius	green darner	**Ind**	R	Estuary	<1>
Libellulidae					
Pantala flavescens	globe skimmer	Nat	p	E, F, M	<2>
			O	Marine	<1>
			U	Estuary	<1>
Tramea lacerata	black saddlebags	Nat	R	Estuary	<1>
ARTHROPODA					
CRUSTACEA					
Caligoida					
Caligidae					
Caligus rapax		**Ind**	p	E, F, M	<2>
Tanaidacea					
Leptocheliidae					
Leptochelia dubia		---	p	E, M	<2>
Cirripedia					
Chthamalidae					
Neochthamalus intertextus	purple rock barnacle	**End**	C	Marine	<1>
Amphipoda					
Undetermined amphipoda	amphipod	---	p	E, M	<2>
Caprellidae					
Caprella scaura		---	p	E, M	<2>
Corophiidae					
Undetermined corophiidae		---	p	M	<2>
Talitridae					
Orchestia sp.		---	p	M	<2>
Decapoda					
Calappidae					
Calappa hepatica		**Ind**	R	Marine	<1>
Diogenidae					
Calcinus laevimanus	left-handed hermit crab	**---**	O	Marine	<1>
Grapsidae					
Grapsus tenuicrustatus	*ʻaʻama*, thin-shelled rock crab	**Ind**	O	Marine	<1>
			O	Estuary	<1>
Metopograpsus thukuhar	*kukuau*	**Ind**	O	Marine	<1>
Plagusiidae					
Percnon planissimum	*papa*, flat rock crab	**Ind**	U	Marine	<1>
Portunidae	swimming crabs				
Portunus cf. *granulatus*		**Ind**	p	E, M	<2>
Portunus oahuensis		**End**	p	E, M	<2>
Scylla serrata	Samoan crab	Nat	U	Marine	<1>
Thalamita edwardsi	Edward's swimming crab	**Ind**	O	Marine	<1>
Thalamita integra		**Ind**	p	E, M	<2>

Table 5 (continued).

Phylum **Class** Order Family Taxon	Common name	Status	Rel. Abundance	Location	Notes
Xanthidae					
Undetermined meglopa		?	p	E, M	<2>
Platypodia eydouxii	red-eyed xanthid crab	Ind	U	Marine	<1>
ECHINODERMATA					
Ophiuroidea					
Ophiurida					
Ophiocomidae					
Undetermined ophiocomidae	brittle star	?	C	Marine	<1>
Echinoidea					
Echinoida					
Echinometridae					
Echinometra mathaei	pale rock boring urchin	**Ind**	A	Marine	<1>
Echinometra oblonga	black rock boring urchin	**Ind**	C	Marine	<1>
Holothuroidea					
Aspidochirotidae					
Holothuriidae					
Actinoypyga mauritiana	white-spotted sea cucumber	**Ind**	U	Marine	<1>
Holothuria atra	black sea cucumber	**Ind**	O	Marine	<1>
CHORDATA					
OSTEICHTHYES					
Actinopterygii					
Clupeformes					
Engraulidae					
Encrasicholina purpurea	*nehu*, Hawaiian anchovy	**Ind**	C	Marine	<1>
Aulopiformes					
Synodontidae					
Synodus dermatogenys	*sand lizardfish*	**Ind**	p	E, M	<2>
Beliformes					
Belonidae					
Platybelone argalus	keeltail needlefish	**Ind**	O	Marine	<1>
				Estuary	<1>
Cyprinodontiformes					
Poeciliidae					
Poecilia mexicana	molly	Nat	O	Estuary	<1>
Tetradontiformes					
Ostraciidae					
Ostracion meleagris	*moa*, spotted boxfish	**Ind**	O	Marine	<1>
Pleuronectiformes					
Bothidae					
Undetermined bothidae	lefteyed flounder		R	Marine	<1>
Dactyloptena orientalis	purple flying gurnard	**Ind**	R	Marine	<1>

Table 5 (continued).

Phylum **Class** Order Family Taxon	Common name	Status	Rel. Abundance	Location	Notes
Perciformes					
Kuhliidae					
Kuhlia xenura	*aholehole*, Hawaiian flagtail	**End**	p	E, F, M	<2>
			A	Marine	<1>
			A	Estuary	<1>
Mugilidae					
Moolgarda engeli	*kanda*, Marquesan mullet	Nat	p	E, M	<2>
Mugil cephalus	*ʻamaʻama*, striped mullet	**Ind**	p	E, F, M	<2>
			C	Marine	<1>
			A	Estuary	<1>
Carangidae					
Unidentified carangidae	juvenile jack	?	O	Estuary	<1>
Scomberoides lysan	doublespotted queenfish	**Ind**	R	Estuary	<1>
Lutjanidae					
Lutjanus kasmira	*taʻape*, bluestriped snapper (dead)	Nat	†	Marine	<1>
Mulilidae					
Mulloidichthys flavolineatus	*wekeʻaʻa*, yellowstripe goatfish	**Ind**	O	Marine	<1>
Mulloidichthys vanicolensis	*wekeʻula*, yellowfin goatfish	**Ind**	U	Marine	<1>
Parupeneus porphyreus	*kumu*, whitesaddle goatfish	**End**	U	Marine	<1>
Pomacentridae					
Abudefduf abdominalis	*mamo*, Hawaiian seargent	**End**	C	Marine	<1>
Abudefduf sordidus	*kupipi*, blackspot seargent	**Ind**	U	Marine	<1>
Plectroglyphidodon imparipennis	brighteye damselfish	**Ind**	C	Marine	<1>
Labridae					
Stethojulis balteata	*ʻomaka*, belted wrasse	**End**	U	Marine	<1>
Thalassoma duperrey	*hinalea lauwili*, saddle wrasse	**End**	U	Marine	<1>
Blenniidae					
Entomacrodus marmoratus	marbled blenny	**End**	U	Marine	<1>
Zanclidae					
Zanclus cornutus	*kihkihi*, Moorish idol	**Ind**	U	Estuary	<1>
Acanthuridae					
Acanthurus triostegus	*manini*, convict tang	**Ind**	C	Marine	<1>
			C	Estuary	<1>
Zebrasoma veliferum	*maneʻoneʻo*, sailfin tang (juv)	**Ind**	U	Marine	<1>
Tetradontidae					
Canthigaster jactator	Hawaiian spotted toby	**End**	U	Marine	<1>
Cichlidae					
Amatitlania nigrofasciata	convict cichlid	Nat	O	Estuary	<1>
Sarotherodon melanotheron	black chin tilapia	Nat	p	E, F, M	<2>
			A	Estuary	<1>
			C	Marine	<1>
Creediidae					
Crystallodytes cookei	South Pacific sandburrorer	**Ind**	p	E, M	<2>

Table 5 (continued).

Phylum **Class** Order Family Taxon	Common name	Status	Rel. Abundance	Location	Notes
Eleotridae					
Eleotris sandwicensis	*ʻoʻopu akupa*, Hawaiian sleeper	**End**	R R	Estuary, Marine	<1>, <2>
Gobiidae					
Awaous guamensis	*ʻoʻopu nakea*	**Ind**	R R	Estuary Marine	<1>, <2>
Bathygobius cocosensis	*ʻoʻopu ōhuna*, Cocos frill goby	**Ind**	p	E, M	<2>
Stenogobius hawaiiensis	*ʻoʻopu naniha*	**Ind**	U	Estuary	<1>

KEY TO SYMBOLS USED:

Status:

nat - naturalized. An introduced or exotic species.
ind - indigenous. A native species also found elsewhere in the Pacific.
end - endemic - A native species found only in the Hawaiian Islands.

Location:

F – Freshwater (identified by Englund, et al. 2000, limits not defined).
E – Estuary (identified by Englund, et al. 2000, limits not defined).
M – Marine (identified by Englund, et al. 2000, limits not defined).
Marine – From the reef edge, upstream to Farrington Hwy Bridge.
Estuary – Upstream from Farrington Hwy Bridge to confluence with Lualualei drainage.

Abundance at survey location:

P - present; not common, but abundance not determined.
R - rare; only one or two individuals seen.
U - uncommon; several individuals seen, in some habitat places visited.
O – occasional; observed irregularly in small numbers
C - common; numerous individuals seen, or seen in most habitat places visited.
A - abundant; numerous in most habitat places visited
† - not seen alive.

Notes:

<1> observed on March 23, 2009.
<2> recorded in Englund, et al. 2000.

Fishing activity is light to moderate along most of the leeward coast (*AECOS*, 1981). Spearfishing and net fishing are infrequent in these waters. Certain offshore areas are noted for their fishing, trapping for lobsters, diving for octopus, and collecting shells. A local resident reported that sardines are sometimes caught in Māʻili Stream and sold in the fish markets in Chinatown.

Assessment

Water quality criteria for estuaries have been promulgated by the State of Hawaiʻi Department of Health or HDOH (Table 6). Note that state water quality criteria for turbidity, chlorophyll α, and nutrients (NH_3, NO_3 + NO_2, Total N, and Total P) require comparisons to geometric mean values. Geometric means are

to be based upon samples collected over time; therefore, the results of this sampling effort cannot be compared with the criteria in Table 6 to establish compliance with the water quality standards.

Table 6. Selected State of Hawaii water quality criteria for estuaries (HAR §11-54-05.2; HDOH, 2004)

Parameter	Geometric Mean value not to exceed this value	Value not to be exceeded more than 10% of the time	Value not to be exceeded more than 2% of the time
Total Nitrogen (µg N/l)	200.00	350.00	500.00
Ammonia Nitrogen (µg N/l)	6.00	10.00	20.00
Nitrate + Nitrite (µg N/l)	8.00	25.00	35.00
Total Phosphorus (µg P/l)	25.00	50.00	75.00
Chlorophyll α (µg/l)	2.00	5.00	10.00
Turbidity (NTU)	1.5	3.00	5.00

Other "standards":
- pH units shall not deviate more than 0.5 units from ambient conditions and shall not be lower than 7.0 nor higher than 8.6.
- Dissolved oxygen shall not decrease below 75% of saturation.
- Temperature shall not vary more than 1 C° from ambient conditions.
- Salinity shall not vary more than 10% from ambient conditions.

The water quality characteristics of the 'Upstream' Station demonstrated a greater freshwater influence than the 'Bridge' and 'Reef' stations, whose characteristics were more typical of marine water. At the 'Upstream' Station, temperature was higher and pH and salinity were lower than at the downstream stations. The water at all three locations was supersaturated with respect to dissolved oxygen.

Chlorophyll α levels were greater than the downstream stations by a factor of ten. Turbidity and TSS levels were two to ten times higher than the downstream stations, and nutrients levels were about six times higher than measured at the 'Reef' Station and two to five times higher than measured at the 'Bridge' Station.

The concentrations of all nutrients (all nitrogen moieties and total phosphorus) were very high at the 'Upstream' Station. Chlorophyll α, turbidity and suspended sediments, and nutrient levels were elevated at all three stations. Though nutrient levels would appear to decrease significantly as the water discharges into the ocean, the concentrations still may exceed those which would be appropriate for discharge into a coral reef ecosystem.

The flora of the project area is comprised of flowering plants and dominated by alien (non-native species). A total of 33 species of plants were recorded during the survey on March 23, 2009. Six (18%) of these species are known from the Hawaiian Islands before the arrival of James Cook in 1778, although all are indigenous species—meaning native to Hawaii and other places. The indigenous natives are common lowland plants from dry leeward and coastal sites throughout the Pacific Islands.

The biologists did not observe any state or federally listed endangered or threatened plants or aquatic animals (DLNR, 1998; Federal Register, 2005; USFWS, 2005, 2009) in the project area during the survey.

Conclusions

Construction of a new bridge over Māʻili Stream will not have a significant adverse impact on any rare, threatened, or endangered species. No federally and state listed as endangered or threatened plants or animals (DLNR, 1998; Federal Register, 2005; USFWS, 2005, 2009) were observed during our survey. Endemic amphidromous *ʻoʻopu* (*Eleotris sandwicensis*, *Awaous guamensis*, and *Stenogobius hawaiiensis*) reside in Māʻili Stream. Hawaii Administrative Rules (HAR) 13-100 and 188-43.5 regulate the taking of all *ʻoʻopu* in Hawaiʻi waters (DLNR, 2007). So long as the flow is never completely diverted nor access blocked during or after dredging, the lifecycle of these species will not be altered. No structures should be built within the stream bed that would impede the migration of native aquatic fauna.

Water quality characteristics of Māʻili Stream as determined on March 23, 2009 are fairly poor. While Māʻili Stream is not listed on the Hawaiʻi Department of Health (HDOH) 2006 list of impaired waters in Hawaiʻi, prepared under Clean Water Act §303(d), Ulehawa Beach is listed as impaired (HDOH, 2006). This impaired listing is based upon water quality data collected by HDOH in the nearshore waters of Ulehawa Beach at station no. HI784010. This listing indicates that the open coastal waters within 1000 ft and 100 fathoms of the sampling station may not meet the Hawaiʻi Water Quality Standards for certain parameters.

Ulehawa Beach is listed as impaired for the dry season, although the basis for listing the waterbody (decision code) is unknown for all of the listed parameters (enterococci, Total N, NO_3+NO_2, Total P, and turbidity). Ulehawa Beach is listed as a "Category 3" waterbody, meaning that "there is [sic] insufficient availablea data and/or information to make a use support determinations [sic]." Ulehawa Beach has not been assigned a Total Maximum Daily Load (TMDL) priority code. Until a TMDL is prepared and approved, certain parameters as determined by HDOH may need to be included in a water quality monitoring program designed to monitoring impacts on water quality of Ulehawa Beach during construction of the bridge. A Best Management Practices (BMP) plan should be developed and implemented to minimize environmental impacts to water quality and aquatic biota in the vicinity of and adjacent to the project site.

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