ALAN M. ARAKAWA
Mayor

KYLE K. GINOZA, P.E.
Director

MICHAEL M. MIYAMOTO
Deputy Director

TRACY TAKAMINE, P.E.
Solid Waste Division

ERIC NAKAGAWA, P.E.
Wastewater Reclamation Division

AUG 23 2012

FILE COPY

'12 AUG -6 P1:26

RECEIVED

COUNTY OF MAUI
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
2200 MAIN STREET, SUITE 100
WAILUKU, MAUI, HAWAII 96793

July 25, 2012

Mr. Gary Hooser, Director
Office of Environmental Quality Control
235 South Beretania Street, Suite 702
Honolulu, Hawaii 96813

Dear Director Hooser:

SUBJECT: WAILUKU-KAHULUI WASTEWATER RECLAMATION FACILITY SHORELINE PROTECTION EXTENSION, KAHULUI, (TMK NO. (2) 3-8-001:188)

With this letter, the County of Maui, Department of Environmental Management (DEM) hereby transmits the documents package for the Draft Environmental Impact Statement (EIS) for the Proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension situated at TMK (2)3-8-001:188, in the Wailuku District on the island of Maui for publication of a notice of availability for public comment for 45-days in the next available edition of the Environmental Notice. The Draft EIS has included copies of all written comments received during the early consultation period and during the 30-day statutory public consultation period for the FEA-EISPN.

Also enclosed is a distribution list for the verification of OEQC under Section 11-200-20, Hawaii Administrative Rules. Upon receiving verification from OEQC (along with the bulletin proof of the notice containing the pertinent details for commenters), we will make the Draft EIS and the bulletin proof available to those so indicated on the distribution list so that they will have the full 45-day statutory period to review and comment on the Draft EIS.

Finally, enclosed is a completed OEQC Publication Form, two (2) copies of the Draft EIS, an Adobe Acrobat PDF file of the same, and an electronic copy of the publication form in MS Word. Simultaneous with this letter, we have submitted the summary of the action in a text file by electronic mail to your office.

Notary Certification Attached

If there are any questions, please contact the consultant Mr. Mich Hirano, AICP, Senior Vice President, with Munekiyo & Hiraga, Inc. at (808) 244-2015 or the County Project Manager, Mr. Juan A. Rivera, P.E. at 270-7268.

Kyle K. Ginoza
Director
Department of Environmental Management

KG
Encl.
cc: Juan Rivera, Department of Environmental Management (w/out enclosures)
Rob Sloop, Moffat Nichol (w/out enclosures)
Mich Hirano, Munekiyo & Hiraga, Inc. (w/enclosures)

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
PRESIDENT
KARLYNN FUKUDA
EXECUTIVE VICE PRESIDENT
GWEN OHASHI HIRAGA
SENIOR VICE PRESIDENT
MITSURU "MICH" HIRANO
SENIOR VICE PRESIDENT
MARK ALEXANDER ROY
VICE PRESIDENT

TO: Gary Hooser, Director
Office of Environmental Quality Control
State of Hawaii
235 South Beretania Street, Suite 702
Honolulu, Hawaii 96813

DATE: August 3, 2012

SUBJECT: Proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension

---

Enclosed is/are:

Copies	Date	Description
Orig.	7/25/12	Transmittal Letter from Department of Environmental Management
2 + 1 (CD)	August 2012	Draft Environmental Impact Statement (EIS)
1	----	OEQC Publication Form with Project Summary

	For your information	**For your use**
X	**For necessary action**	**As requested**
	For your review	**For your signature**
	For your files	**Returning**

REMARKS: The attached documents are provided for publication in the next OEQC Bulletin on August 23, 2012.

Should you have any questions, please do not hesitate to call me at (808) 244-2015.

Signed: [signature]
Colleen Suyama
Senior Associate

CS:yp
Copy to: Juan Rivera, Department of Environmental Management (w/out enclosures)
Rob Sloop, Moffatt and Nichol (w/out enclosures)
K:\DATA\MoffattNichol\WK WWRF\Aug 2012 Draft EIS\DraftEIS OEQC trans.doc

Agency Action EIS
Chapter 343, HRS
Publication Form

Project Name Proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension DEIS

Island: Maui
District: Wailuku
TMK: (2)3-8-001:188
Permits: Department of Army Permit, Conservation District Use Permit, Section 401 Water Quality Certification, National Pollutant Discharge Elimination System Permit, Coastal Zone Management Consistency Approval, Special Management Area Use Permit, Shoreline Setback Variance, Flood Hazard Area Development Permit
Proposing Agency: County of Maui, Department of Environmental Management, 2200 Main Street, Suite 200, Wailuku, Hawaii 96793, Kyle Ginoza, Director , (808) 270-8230
Accepting Authority: County of Maui, Department of Environmental Management, 2200 Main Street, Suite 200, Wailuku, Hawaii 96793, Kyle Ginoza, Director, (808) 270-8230
Consultant: Munekiyo & Hiraga, Inc., 305 High Street, Suite 104, Wailuku, Hawaii 96793, Mich Hirano, AICP, Senior Vice President, (808) 244-2015

Status: (To be completed by OEQC)

Summary (Provide proposed action and purpose/need in less than 200 words. Please keep the summary brief and on this one page):

The County of Maui Department of Environmental Management proposes to extend the existing shoreline protection at the Wailuku-Kahului Wastewater Reclamation Facility (WKWWRF). In accordance with recommendations for a 1,500 foot revetment from the Army Corps of Engineers to protect the facility, a 450-foot portion of the rock revetment was constructed in 1979. The proposed project entails completing the revetment with an extension of 1,200 feet of new revetment to the west of the existing revetment. A short section of the revetment extension where it connects to the existing revetment will be aligned seaward of the certified shoreline, then it follows an inland alignment to minimize impacts on the shoreline. Additional landward extensions will be required at each end of the revetment to prevent flanking. The crest of the new revetment will be between elevations of +10 to +13 feet Mean Lower Low Water (MLLW) and the toe of the revetment will be set at -3 feet MLLW. The crest elevation of the existing revetment will be raised to match the new revetment crest height to provide additional sea-level rise capacity. At the base of the revetment will be a layer of geotextile filter fabric, then a layer of bedding stones and two (2) layers of armor stone. Any required fill will be of beach-quality sand, and any additional sand will be used to cover the revetment.

Office of Environmental Quality Control
EA / EIS DISTRIBUTION LIST

Distribution	Draft EA	Final EA	EISPN	Draft EIS	Final EIS
Accepting Authority	M (HC)	M (HC)	M (HC)	M (3 HC + CD)	M (HC)
OEQC	M (HC+CD)	M (HC+CD)	M (HC+CD)	M (2 HC +CD)	M (HC+CD)
State Agencies					
Dept of Agriculture	R	O	O	M	O
Dept of Accounting and General Serv	R	O	O	M	O
Dept of Bus, Econ. Dev. and Tourism	R	O	O	M (HC)	O
DBEDT – Energy Division	R	O	O	M	O
DBEDT – Office of Planning	R	O	O	M (HC+CD)	O
Dept of Defense	R	O	O	M	O
Dept of Education	R	O	O	M	O
Dept of Hawaiian Home Lands	R	O	O	M	O
Dept of Health	R-3	O	R-3	M-3	O
Dept of Human Services	R	O	O	M	O
Dept of Labor and Industrial Relations	R	O	O	M	O
Dept of Land and Natural Resources	R-5	O	R-5	M-5	O
DLNR – Historic Preservation Div	R (HC)	O	R	M (HC)	O
Dept of Transportation	R	O	R	M	O
Hawaii Housing Fin. and Dev. Corp.	R	O	O	M	O
Office of Hawaiian Affairs	R	O	R	M	O
UH Environmental Center	R	O	O	M (2HC+2CD)	M (HC)
Federal Agencies					
US Army Engineer Division	O	O	O	O **CD**	O
US Geological Survey	O	O	O	O	O
US Fish and Wildlife Service	M (HC)	O	O	M (HC)	O
US National Marine Fisheries Service	O	O	O	O **CD**	O
US National Park Service	O	O	O	O	O
US Natural Resources Cons Serv	O	O	O	O	O
US Naval Base, Pearl Harbor	O	O	O	O	O
US Federal Aviation Administration	O	O	O	O **CD**	O
US Federal Highway Administration	O	O	O	O	O
US Coast Guard	O	O	O	O	O
US EPA – Pacific Islands Office	O	O	O	O	O

All documents should be sent for review on CD in pdf format, unless a hardopy is noted

CD = pdf format on a CD
HC = Hard Copy
M = Mandatory
O = Optional
R = Recommended

Office of Environmental Quality Control
EA / EIS DISTRIBUTION LIST

***City and County of Honolulu**	**Draft EA**	**Final EA**	**EISPN**	**Draft EIS**	**Final EIS**
Board of Water Supply	R	O	R	M	O
Dept of Community Services	R	O	O	R	O
Dept of Design and Construction	R	O	O	M	O
Dept of Environmental Services	R	O	R	M	O
Dept of Facility Maintenance	R	O	R	M	O
Dept of Planning and Permitting	M-5	O	R-5	M-5	O
Dept of Parks and Recreation	R	O	R	M (HC)	O
Dept of Transportation Services	R	O	R	M	O
Fire Dept	O	O	O	O	O
Police Dept	O	O	O	O	O
***County of Hawaii**					
Dept of Environmental Management	R	O	R	M	O
Dept of Parks and Recreation	R	O	O	M	O
Dept of Public Works	R	O	R	M	O
Dept of Research and Dev	O	O	O	O	O
Dept of Water Supply	R	O	R	M	O
Fire Dept	O	O	O	O	O
Office of Housing and Community Dev	R	O	O	M	O
Planning Dept	M (HC)	O	R (HC)	M (HC)	CD
Police Dept	O	O	O	O	O
***County of Kauai**					
Dept of Parks and Recreation	M	O	R	M	O
Dept of Planning	M	O	R	M	O
Dept of Public Works	R	O	R	M	O
Dept of Transportation	R	O	O	M	O
Dept of Water	R	O	R	M	O
Fire Dept	O	O	O	O	O
Police Dept	O	O	O	O	O
***County of Maui**					
Dept of Environmental Management	R	O	R	M	O
Dept of Fire and Public Safety	O	O	O	O **CD**	O
Dept of Housing and Human Concerns	R	O	R	M	O
Dept of Parks and Recreation	R	O	R	M	O
Dept of Planning	M	O	R	M	O
Dept of Transportation	R	O	R	M	O
Dept of Water Supply	R	O	R	M	O
Police Dept	O	O	O	O **CD**	O

*For actions in the respective county

Department of Public Works — **CD (5)**

Mayor — **HC**

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Office of Environmental Quality Control
EA / EIS DISTRIBUTION LIST

Libraries	**Draft EA**	**Final EA**	**EISPN**	**Draft EIS**	**Final EIS**
*Kauai Community College Library	O	O	O	~~M (HC)~~	M (HC)
*Maui Community College Library	O	O	O	M (HC)	M (HC)
*Nearest State Library	M (HC)	O	R	M (HC)	O
*UH Hilo	O	O	O	~~M (HC)~~	M (HC)
*Municipal Library, Honolulu	O	O	O	~~M (HC)~~	M (HC)
Legislative Reference Bureau	O	O	O	M (HC)	M (HC)
State Main Library	O	O	O	M (HC)	M (HC)
UH Hamilton	O	O	O	M (HC)	M (HC)
News Media					
Honolulu Star Advertiser	O	O	R	M	M
*Hawaii Tribune Herald	O	O	R	~~M~~	M
*Garden Island	O	O	R	~~M~~	M
*Maui News	O	O	R	M	M
*Molokai Dispatch	O	O	R	~~M~~	M
Elected Officials					
US Senator	O	O	O	~~O~~	O
US Representative	O	O	O	~~O~~	O
State Senator	O	O	O	~~O~~	O
State Representative	O	O	O	~~O~~	O
County Council member	O	O	R	R **HC+CD**	O
Neighborhood Board Chair	O	O	R	~~R~~	O
Utility Companies					
Electric	O	O	O	O **CD**	O
Telephone	O	O	O	O **CD**	O
Gas	O	O	O	~~O~~	O
Citizen Groups, Individuals, and Consulted Parties	Maui Tomorrow			**CD**	

*For actions in the respective county

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R = Recommended

NEIL ABERCROMBIE
GOVERNOR OF HAWAI'I

GARY HOOSER
DIRECTOR

STATE OF HAWAI'I
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
235 SOUTH BERETANIA STREET
LEIOPAPA A KAMEHAMEHA, SUITE 702
HONOLULU, HAWAI'I 96813
Telephone (808) 586-4185
Facsimile (808) 586-4186
Electronic Mail: OEQC@doh.hawaii.gov

August 14, 2012

Mr. Kyle Ginoza, Director
County of Maui, Department of Environmental Management
2200 Main Street, Suite 100
Wailuku, Hawai'i 96793

Mr. Mich Hirano, AICP
Munekiyo & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawai'i 96793

Dear Messrs. Ginoza and Hirano:

This is in response to the County of Maui, Department of Environmental Management's July 25, 2012, letter, filing the Draft Environmental Impact Statement and ancillary documents with the Office of Environmental Quality Control for the Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension, Kahului, situated in the district of Wailuku, at TMK (2) 3-8-001: 188. The Office of Environmental Quality Control has reviewed the distribution list and finds that the following agencies/regional libraries need to be included on the distribution list (please see Exhibit 4-1 in the Guide to the Implementation and Practice of the Hawai'i Environmental Policy Act, 2012).

1. U. S. Department of the Interior, Geological Survey, 677 Ala Moana Boulevard, Suite 415, Honolulu, HI 96813
2. U. S. Department of Commerce, National Marine Fisheries Service, Pacific Islands Regional Office, 1611 Kapi'olani Boulevard, Suite 1110, Honolulu, HI 96814
3. U. S. Department of the Interior, National Parks Service, Pacific Islands Support Office, 300 Ala Moana Boulevard, Room 6-226, Honolulu, HI 96850
4. U. S. Department of Agriculture, National Resources Conservation Service, Pacific Islands Area Office, P.O. Box 50004, Honolulu, HI 96850
5. U. S. Department of Homeland Security, U. S. Coast Guard, Commander, 14th Coast Guard District, 300 Ala Moana Boulevard, Room 9-204, Honolulu, HI 96850-4982
6. State of Hawaii, Kaimuki Regional Library, 1041 Koko Head Avenue, Honolulu, HI 96813
7. State of Hawaii, Kane'ohe Regional Library, 45-829 Kamehameha Highway, Kaneohe, HI 96744
8. State of Hawaii, Pearl City Regional Library, 1138 Waimano Home Road, Pearl City, HI 96782
9. State of Hawaii, Hawai'i Kai Regional Library, 249 Lunalilo Home Road, Honolulu, HI 96825
10. State of Hawaii, Hilo Regional Library, 300 Waianuenue Avenue, Hilo, HI 96720
11. State of Hawaii, Kahului Regional Library, 90 School Street, Kahului, HI 96732
12. State of Hawaii, Lihu'e Regional Library, 4344 Hardy Street, Lihu'e, HI 96766

With the addition of the twelve agencies/regional libraries above, the Office of Environmental Qualitry Control verifies the accuracy of the distribution list pursuant to Section 11-200-21, Hawai'i Administrative Rules. If there are any questions or concerns, please call me at (808) 586-4185.

Most respectfully,

Leslie Segundo
Environmental Health Specialist III

ALAN M. ARAKAWA
Mayor

KYLE K. GINOZA, P.E.
Director

MICHAEL M. MIYAMOTO
Deputy Director

TRACY TAKAMINE, P.E.
Solid Waste Division

ERIC NAKAGAWA, P.E.
Wastewater Reclamation Division

COUNTY OF MAUI
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
2200 MAIN STREET, SUITE 100
WAILUKU, MAUI, HAWAII 96793

July 25, 2012

Mr. Gary Hooser, Director
Office of Environmental Quality Control
235 South Beretania Street, Suite 702
Honolulu, Hawaii 96813

Dear Director Hooser:

SUBJECT: WAILUKU-KAHULUI WASTEWATER RECLAMATION FACILITY SHORELINE PROTECTION EXTENSION, KAHULUI, (TMK NO. (2) 3-8-001:188)

With this letter, the County of Maui, Department of Environmental Management (DEM) hereby transmits the documents package for the Draft Environmental Impact Statement (EIS) for the Proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension situated at TMK (2)3-8-001:188, in the Wailuku District on the island of Maui for publication of a notice of availability for public comment for 45-days in the next available edition of the Environmental Notice. The Draft EIS has included copies of all written comments received during the early consultation period and during the 30-day statutory public consultation period for the FEA-EISPN.

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Notary Certification Attached

If there are any questions, please contact the consultant Mr. Mich Hirano, AICP, Senior Vice President, with Munekiyo & Hiraga, Inc. at (808) 244-2015 or the County Project Manager, Mr. Juan A. Rivera, P.E. at 270-7268.

Kyle K. Ginoza
Director
Department of Environmental Management

KG
Encl.
cc: Juan Rivera, Department of Environmental Management (w/out enclosures)
Rob Sloop, Moffat Nichol (w/out enclosures)
Mich Hirano, Munekiyo & Hiraga, Inc. (w/enclosures)

Draft Environmental Impact Statement

PROPOSED SHORELINE PROTECTION EXTENSION AT WAILUKU-KAHULUI WASTEWATER RECLAMATION FACILITY

Prepared for:

County of Maui,
Department of Environmental Management

Accepting Authority:

County of Maui,
Department of Environmental Management

August 2012

MUNEKIYO HIRAGA, INC.

CONTENTS

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LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

Project Summary

Project Name:	Proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension
Type of Document:	Draft Environmental Impact Statement
Legal Authority:	Chapter 343, Hawaii Revised Statutes Chapter 200, Title 11, Department of Health Administrative Rules, Enviromental Impact Statement Rules
Agency Determination:	Environmental Impact Statement
Applicable Environmental Assessment review "Trigger":	Use of County and State Lands and County Funds Work within the State Land Use Conservation District Action within the Shoreline and Shoreline Setback Area
Location:	TMK: (2) 3-8-001:188 Kahului Island of Maui
Applicant:	Department of Environmental Management, County of Maui 2200 Main Street, Suite 200 Wailuku, Hawaii 96793 Contact: Juan A. Rivera, P.E., Engineer Phone: (808) 270-7268
Accepting Authority:	Department of Environmental Management County of Maui 2200 Main Street, Suite 200 Wailuku, Hawaii 96793 Contact: Juan A. Rivera, P.E., Engineer Phone: (808) 270-7268
Consultant:	Munekiyo & Hiraga, Inc. 305 High Street, Suite 104 Wailuku, Hawaii 96793 Contact: Mich Hirano, AICP, Senior Vice President Phone: (808) 244-2015

Project Summary:

The applicant, the County of Maui, Department of Environmental Management, proposes to extend the existing shoreline protection structure at the Wailuku-Kahului Wastewater Reclamation Facility (WKWWRF). The WKWWRF is located on a shore-fronting parcel to the east of Kahului Harbor.

The shoreline seaward of the WKWWRF is experiencing significant rates of erosion, Annual Erosion Hazard Rate (AEHR), from the Hawaii Shoreline Study, ranges from 1.0 to 2.5 feet per year according to the County of Maui Shoreline Erosion maps. However, from 2007 to 2011, during which time the facility was hit by the tsunami caused by the March 2011 earthquake off the Pacific Coast of Japan, the average annual erosion for the site is 3.7 feet per year, with a maximum annual erosion rate of 6.7 feet per year. Erosion threatens several structures at the WKWWRF, including structures which cannot be moved.

Correspondence between the County of Maui and the U.S. Army Corps of Engineers (USACE) indicates that in 1978, the County of Maui requested that the USACE complete a feasibility study for providing emergency shoreline protection at the WKWWRF under Section 103A of the River and Harbor Act of 1962. The study cited erosion rates as high as 10 feet per year and concluded that the erosion had reached a critical state. It further recommended that a 1,500 foot long rock revetment be constructed along the entire seaward side of the WKWWRF. In 1979, USACE authorized the design and construction of the revetment under Section 14 of the Flood Control Act of 1946. At that time, Federal funding participation was limited to $250,000.00, and only a 450 feet section of the revetment was completed seaward of the holding pond. The Board of Land and Natural Resources (BLNR) approved the County's Conservation District Use Application (CDUA) for the 450-foot rock revetment in 1979.

The preferred alternative proposed in the Environmental Assessment and Environmental Impact Statement Preparation Notice (EA/EISPN) published on January 23, 2011, involved completing the revetment with a 1,200-foot extension along the beach scarp to the west and landward extensions on both sides. Since the publication of the EA/EISPN, the development plans have been modified to minimize impacts to the beach and a new alignment, further inland and closer to the edge of the WKWWRF, has been adopted. The revised project entails completing the revetment along the seaward side of the facility with an extension of approximately 1,100 feet of new rock mound revetment to the west. Additional landward extensions will also be put in place at each end of the revetment to prevent flanking. The revetment will be constructed just seaward of the WKWWRF. The crest of the new revetment will be at an elevation of +13 feet Mean Lower Low Water (MLLW) with an earthen cap to +15 feet MLLW and the toe of the revetment will be set at -3 feet MLLW. The crest elevation of the existing revetment will be raised to match the new revetment crest height at +13 feet MLLW to provide additional sea-level rise capacity. At the base of the revetment will be a layer of geotextile filter fabric, then a layer of bedding stone and six (6) feet of 2-ton armor stone. There will be both excavation and fill required to prepare the slope for the new revetment. Any required fill will be of beach-quality sand, and any surplus sand will be used to cover a portion of the revetment. To ensure public access to the beach, a stairway will be incorporated into the exposed portion of the revetment.

The construction baseyard, storage and staging areas will be onsite.

Construction will begin upon receipt of applicable permits and approvals, which is anticipated to be in 2013. Anticipated cost of the initial construction is estimated to be approximately $4.5 million (2012 dollars). The project will be carried out in one (1) phase and is anticipated to take twelve (12) months to complete.

ACRONYMS

AEHR	Annual Erosion Hazard Rate
ALISH	Agricultural Lands of Importance to the State of Hawaii
AOA	Apartment Owners Association
BLNR	Board of Land and Natural Resources
BMP	Best Management Practice
BS	Beach Soils
BWS	Board of Water Supply
CDUA	Conservation District Use Application
CDUP	Conservation District Use Permit
CFS	Cubic Feet Per Second
CIA	Cultural Impact Assessment
Cm	Centimeter
CZM	Coastal Zone Management
DA	U. S. Department of the Army
DEM	Department of Environmental Management
DLNR	Department of Land and Natural Resources
DO	Dissolved Oxygen
DOFAW	Hawaii Division of Forestry and Wildlife
DOH	Department of Health
DWS	Department of Water Supply
EA/EISPN	Environmental Assessment and Environmental Impact Statement Preparation Notice

EIS	Environmental Impact Statement
ESA	Endangered Species Act
FAA	Federal Aviation Administration
Fd	Fill Lands
FIRM	Flood Insurance Rate Map
GPD	Gallons Per Day
HAR	Hawaii Administrative Rules
HC&S	Hawaiian Commercial & Sugar Company
HCZMP	Hawaii Coastal Zone Management Program
HDOT	Hawaii Department of Transportation
HRS	Hawaii Revised Statutes
JcC	Jaucus Sand
KPWS	Kanaha Pond Wildlife Sanctuary
MCC	Maui County Code
MGD	Million Gallons Per Day
MLLW	Mean Lower Low Water
MPD	Maui Police Department
MPH	Miles Per Hour
MSL	Mean Sea Level
NASKA	Naval Air Station Kahului
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration

NPV	Net Present Value
OCCL	Office of Conservation and Coastal Lands
OEQC	Office of Environmental Quality Control
PER	Preliminary Engineering Report
pH	Phosphorus
PSU	Practical Salinity Units
SHPD	State Historic Preservation Division
SLUC	State Land Use Commission
SMA	Special Management Area
SSV	Shoreline Setback Variance
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
UH-Maui	University of Hawaii – Maui College
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WKWWRF	Wailuku-Kahului Wastewater Reclamation Facility
WWII	World War II
WWRD	Wastewater Reclamation Division
WWRF	Wastewater Reclamation Facility

I. PROJECT OVERVIEW

I. PROJECT OVERVIEW

A. PROJECT LOCATION, EXISTING USE, AND OWNERSHIP

The Wailuku-Kahului Wastewater Reclamation Facility (WKWWRF) is located on the northern coastline of the island of Maui at 281 Amala Place in Kahului. See **Figure 1**. The WKWWRF site covers an area of 18.755 acres. The subject property is identified by Tax Map Key (2) 3-8-001:188. See **Figure 2**. The subject property is a shore fronting parcel and is surrounded by Kanaha Beach Park to the east, Amala Place to the south, the Kanaha Pond Wildlife Sanctuary (KPWS) further south, and Kahului Harbor to the west. Access to the WKWWRF is provided by Amala Place.

The subject property is located in the State Land Use Conservation District. Lands within the Conservation District fall within the purview of the Department of Land and Natural Resources (DLNR), Office of Conservation and Coastal Lands (OCCL). The subject property is designated for Public/Quasi-Public use in the Wailuku-Kahului Community Plan map. Although the subject property was zoned "AP-Airport" district by Maui County Zoning, as it is part of the State Conservation District, there is no County zoning jurisdiction attached to the property.

The WKWWRF provides secondary treatment of sewage and features an activated sludge biological treatment process, secondary clarification, and filtration. The principle solids treatment and handling processes are aerobic digestion and centrifuge dewatering. The final R-2 effluent is disposed of primarily via eight (8) gravity injection wells. The balance of the effluent (approximately 182,000 gallons per day (gpd) in FY 2009) is recycled for plant use, irrigation, and dust control.

The subject property is owned by the State of Hawaii. On April 19, 1980, the Governor of the State of Hawaii, through Executive Order No. 3006, set aside the subject property for sewage treatment purposes and vested control and management of the property with the County of Maui. Further, a portion of the proposed revetment extension connecting to the existing revetment will be located seaward of the certified shoreline on lands under the jurisdiction of the State of Hawaii. Approval from the Board of Land and Natural Resources (BLNR) will be required for the use of State lands.

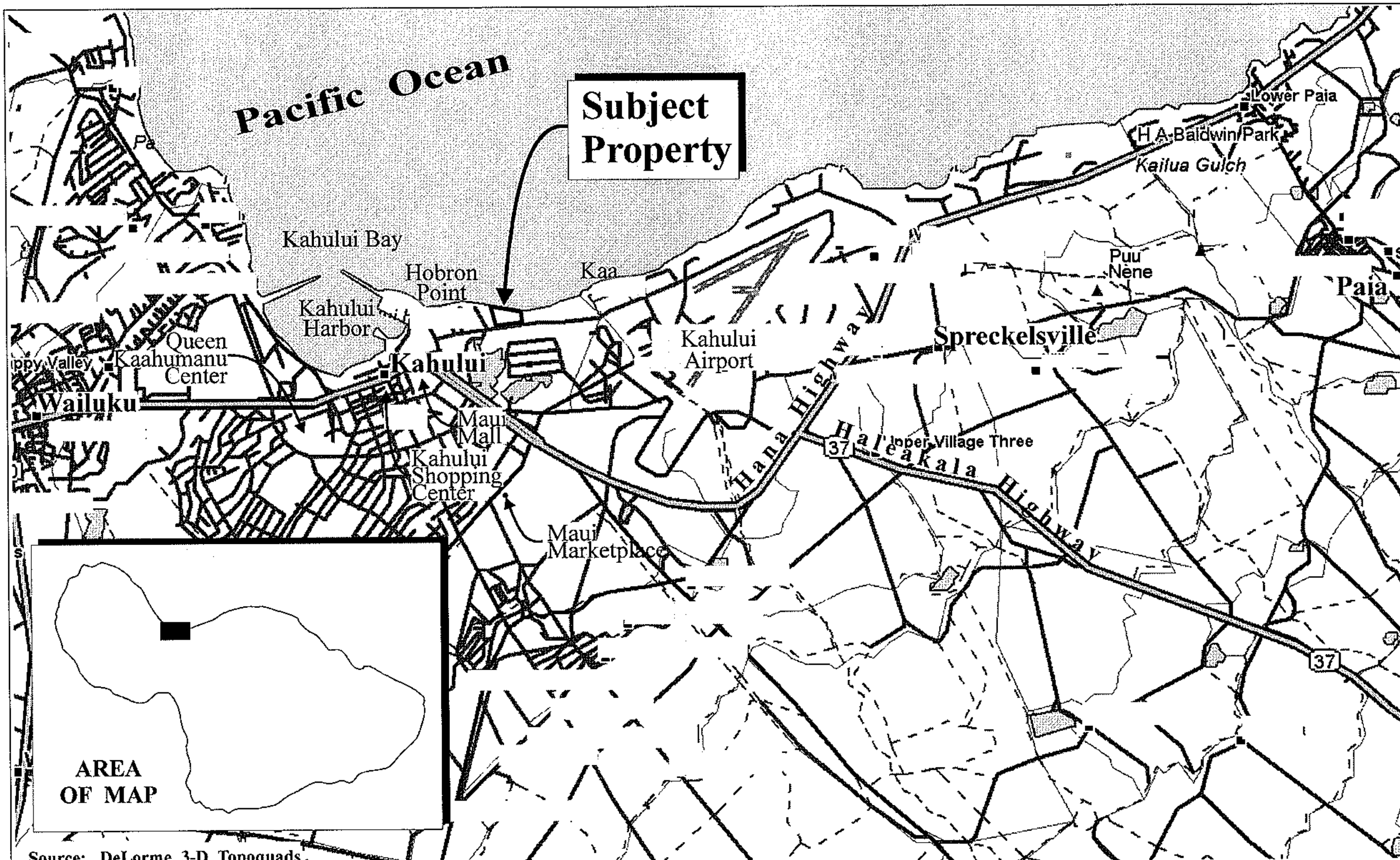


Figure 1

Proposed Shoreline Protection Extension at Wailuku-Kahului Wastewater Reclamation Facility

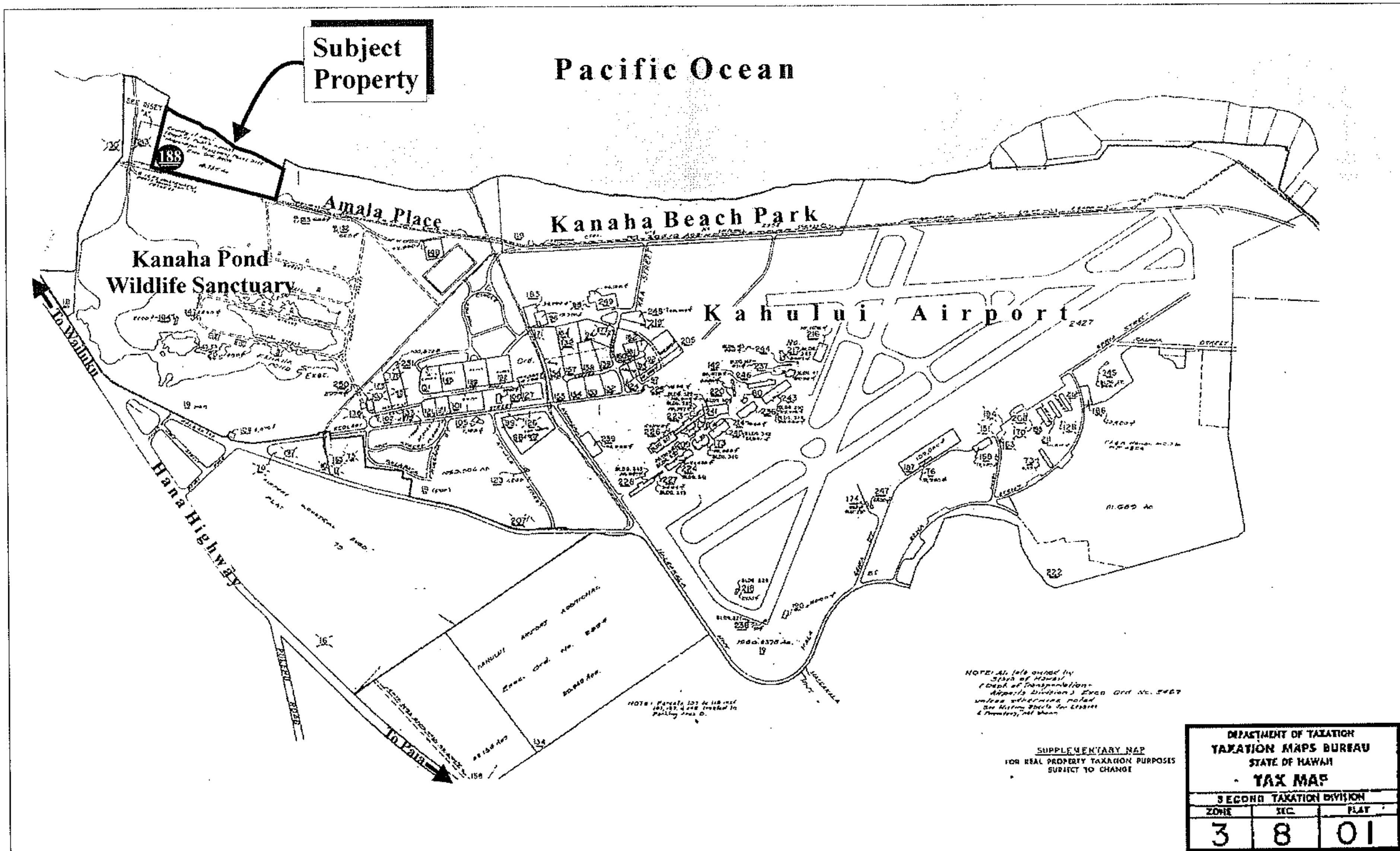
Regional Location Map

NOT TO SCALE

Prepared for: County of Maui, Department of Environmental Management

MUNEKIYO & HIRAGA, INC.

MoffattNichol\WK WWRF\DraftEIS\regionallocation



Source: Realty Atlas

Figure 2 Proposed Shoreline Protection Extension at Wailuku-Kahului Wastewater Reclamation Facility

Property Location Map

NOT TO SCALE

Prepared for: County of Maui, Department of Environmental Management

MUNEKIYO & HIRAGA, INC.

MoffattNichol\WK WWRF\DraftEIS\propertyloca

B. HISTORICAL CONTEXT

1. History of the Facility

The WKWWRF was constructed in 1973 to serve the Central Maui region, including the areas defined by the developed areas of Waiehu, Wailuku, Kahului, Spreckelsville, and Paia. The plant has an existing treatment capacity of 7.9 million gallons per day (mgd) average dry-weather flow. According to projections, the facility will reach capacity around 2029 and will need plant upgrades and the currently proposed shoreline erosion protection measures to accommodate more growth of residents and businesses in the Central Maui service area.

Since its original construction, the plant has been upgraded to provide increased capacity as well as structural measures to protect the facility from tsunami and shoreline erosion hazards. In 1979, the U. S. Army Corps of Engineers (USACE) constructed 450 feet of a planned 1,500 foot-long revetment to provide emergency shoreline erosion protection. See **Figure 3** and **Figure 4**. The Conservation District Use Application (CDUA), File No. MA-7/28/78-1074, was approved prior to construction. See **Appendix "A"**. With the plant upgrades the existing retention pond is now used for emergency overflow and the processing of sewage is handled in the sludge holding tanks which are located above ground.

Improvements were completed at the WKWWRF for tsunami protection. The tsunami protection measures included below grade structural reinforcement of the concrete slab foundation to prevent underscouring and wave action erosion of the shoreward side of the Operations Building. The Centrifuge Control Room was relocated above the 100-year tsunami wave height. Refer to **Figure 3**. Improvements at the Tanks and Headworks Building included thickening of the slab below grade, addition of walls and flood doors at grade level, and reinforcing footings below the scourline to protect against wave action erosion. These projects were separate and distinct from the scope of this shoreline protection project. On January 13, 2009, based on the County of Maui's exemption list approved on January 10, 2007, an exemption from Chapter 343, Hawaii Revised Statutes (HRS), was issued for the upgrades by the Department of Environmental Management (DEM). See **Appendix "B"**.

Source: Moffatt and Nichol

Figure 3

Proposed Shoreline Protection Extension at Wailuku-Kahului Wastewater Reclamation Facility
Aerial Photograph of Project Site and Surrounding Area

NOT TO SCALE

Prepared for: County of Maui, Department of Environmental Management

MUNEKIYO & HIRAGA, INC.

MoffattNichol\WK WWRF\DraftEIS\aerial photo

East Flank of Existing Revetment

West Flank of Existing Revetment

Source: Moffatt & Nichol

Figure 4

Proposed Shoreline Protection Extension at Wailuku-Kahului Wastewater Reclamation Facility

Photographs of Existing Revetment

Prepared for: County of Maui, Department of Environmental Management

MUNEKIYO & HIRAGA, INC.

Moffatt\Nichol\WK WWRF\DraftEIS\ExistingRevetmentPhotos

2. Central Maui Wastewater Reclamation Facility Study

In 2005, the County of Maui, DEM ("Applicant") completed the Central Maui Wastewater Reclamation Facility (WWRF) Study (Study) to identify alternatives to meet the long-term wastewater infrastructure requirements of the region (Austin, Tsutsumi & Associates, 2006). The three (3) main issues at the WKWWRF are available treatment capacity, shoreline erosion, and potential tsunami impacts. The Study included the following elements to address these issues and to develop alternative solutions:

- Community Participation through assembly of a Core Working Group (CWG), consisting of stakeholders and community members
- Existing Wastewater Infrastructure and Capacity
- Options for Effluent and Biosolids Disposal
- Shoreline Issues
- Wastewater Reclamation Facility Structural Issues
- Alternatives for Future Wastewater Infrastructure Needs
- Public Outreach
- Financial Plan

Twenty-one new capacity treatment alternatives were generated, considering multiple effluent disposal options for new capacity. Three (3) system wide demand-side management alternatives were also considered, which included the following:

1. Initiate a water conservation program;
2. Replace existing high-use water fixtures (e.g., toilets and showerheads); and
3. Expand the existing Infiltration and Inflow reduction program.

The County team ranked these options in order to identify the top ten (10) ranked alternatives for further evaluation. The evaluation criteria included cost, environmental impacts, reclamation potential, and other items. The No Build alternative was ranked last of the 21 alternatives. The three (3) demand-side management alternatives have all been implemented by the County.

After a thorough evaluation analysis, the highest ranked wastewater treatment concept alternative (Alternative 1) was to: *Expand the existing Wailuku/Kahului WWRF for future capacity, strengthen the WWRF for tsunami/erosion concerns, and utilize injection wells for effluent disposal.* The Study recommended implementation of the following plan:

- Implement Alternative 1 to protect the County's major financial investment in the existing facility by mitigating the tsunami impact risk and armoring the shoreline fronting the facility.
- Continue the Wastewater Reclamation Division's (WWRD) program to reduce Infiltration/Inflow into the wastewater collection system.
- Implement a comprehensive water conservation program through a partnership between the WWRD and the County Board of Water Supply (BWS).
- Reconsider water reuse opportunities for Central Maui.

The Study notes in its recommendations that Alternative 1 has the least financial impact on the community and wastewater rate payers at a capital cost of $30 million (in 2005 dollars) or a $8.68 per billing cycle increase in sewer users' fees. The alternative of building a new Central Maui wastewater reclamation facility was estimated to cost in the range of $350 million to $475 million (in 2005 dollars).

The Central Maui WWRF Study included a Shoreline Evaluation Report, which reviewed potential alternatives for shoreline protection of the facility. See **Appendix "C"**. The Report considered multiple alternatives for shoreline protection. These included beach nourishment, beach nourishment augmented with sand retention structures, armor rock revetment, and other alternatives. The beach nourishment options included placing additional sand on the beach over two (2) different lengths. The beach nourishment augmented with sand retention structures would entail placing additional sand on the beach as well as construction of T-groin structures. The revetment options included an extension of the existing revetment, with or without the placement of additional sand over the structure. The other alternatives included coral rubble fill and a vertical seawall/revetment hybrid structure. A detailed description of these alternatives is provided in Chapter V of this EIS document.

These alternatives were evaluated based on the following nine (9) criteria.

- Construction Cost
- Maintenance Cost
- Public Access and Usage
- Design Life
- Regulatory Compliance
- Aesthetics
- Impacts to Kahului Harbor
- Environmental Impacts – Biology
- Environmental Impacts – Adjacent Shorelines

The criteria were weighted for importance and each alternative was assessed on the value assigned to each criteria. Net present value costs were estimated over a 50-year project lifetime. Based on this evaluation, the first preferred alternative was the buried revetment, with an estimated total cost of $5.4 million (in 2005 dollars). This was followed by an extension of the existing revetment, with an estimated total cost of $1.6 million (in 2005 dollars).

In 2008, a more detailed analysis and revised costs were presented in the Preliminary Engineering Report (PER) for Shoreline Erosion Control. See **Appendix "D"**. The total cost for the revetment extension was revised and estimated at $4.2 million (in 2008 dollars).

3. <u>Maui County Council Action on the Study</u>

The Maui County Council Public Works Committee met on January 9, 2006 to consider Resolution No. 06-12, "ACCEPTING THE CENTRAL MAUI WASTEWATER RECLAMATION FACILITY STUDY AND CONCURRING RECOMMENDATIONS AND LONG TERM PLAN". See **Appendix "E"**. The Committee met with the Director of Finance; the Deputy Director of Public Works and Environmental Management[1]; the Wastewater Reclamation Division Chief, Department of Public Works and Environmental Management; Deputy Corporation Counsel; and Study consultants. The Committee also accepted public testimony.

The Director of Finance responded to Committee questions about the County's ability to finance the various options considered by the Study. The Finance Director stated that the original facility had been constructed with the assistance of State and Federal funds, but the current assessment concluded that no significant portion of future expenses would be available external to the County. The Committee discussed the process used to involve the community in the Study, the Study's recommendation, and its adequacy. The Committee also reviewed the arguments in support of maintaining the facility in its current location, rather than relocating the facility. The Committee expressed a concern about determining whether the facility should be maintained at its current site or moved without full Council discussion. After discussing whether to refer the resolution to the Committee of the Whole, defer it to hold Council public hearings, or recommend adoption of the resolution, the Committee voted to recommend adoption of the resolution.

On February 17, 2008, the Maui County Council voted to adopt Resolution No. 06-12. The resolution states that shoreline erosion is one (1) of three (3) primary concerns regarding the future of the WKWWRF and that the "County of Maui must decide how it will meet its wastewater treatment and disposal needs for the Central Maui Region for the next 20 to 30 years". The resolution further states that the Council "accepts the Study" and concurs with the Department of Public Works and Environmental Management recommendations. This includes the recommendation to "mitigate shoreline erosion through the construction of shoreline erosion structures or beach nourishment". Refer to **Appendix "E"**.

In January 2011, the project's EA/EISPN was submitted for publication in the January 23, 2011 Environmental Notice, published twice monthly by the Office of Environmental Quality Control (OEQC). The EA/EISPN presented an alternative that called for an "exposed" rock mound revetment extension west of the existing shoreline protection structure along the beach scarp. In response to agency comments, the rock mound revetment alternative in the EA/EISPN document has

[1] In 2006, the functional responsibilities of the Department of Public Works and Environmental Management were split into two (2) departments: Department of Public Works and Department of Environmental Management. The Wastewater Reclamation Division is now within the Department of Environmental Management.

since been revised with a new alignment further inland. An addendum to the PER that provides a detailed analysis of the proposal facility improvements and revised costs was prepared in April 2012 by Moffat & Nichol. See **Appendix "D"**. This new inland revetment alignment has been determined to be the preferred alternative. The environmental effects of this new alternative are further studied and presented herein.

C. PROJECT NEED

The need for shoreline erosion protection has been identified and documented by the County of Maui since the completion of the WKWWRF in 1976. From 1976 to 1978, the County of Maui and USACE worked together and evaluated the erosion at the site, performed a Feasibility Study, and designed a protective revetment. This resulted in the CDUA approval and construction of the existing revetment in 1979. The original intention was to protect the whole facility, but funding limitations reduced the actual constructed length to the most critical area at the time, a 450-feet section seaward of and partially flanking the east side of the facility's retention pond.

The Shoreline Evaluation Report included in the Central Maui WWRF Study delineated the shoreline erosion issues at the facility and potential causes of the erosion. Refer to **Appendix "C"**. The north shore of Maui has historically experienced erosion and resultant shoreline recession, including the stretch fronting the WKWWRF. The report discussed long-term shoreline changes over the 13,000-ft long beach extending east from Kahului Harbor towards Spreckelsville. This stretch of beach is broken into a series of pocket beaches by manmade groins, natural lava points, and beachrock points. The report also discussed changes in the shoreline from Kahului Harbor to Kaa Point, which is a subsection of the 13,000-ft beach, over shorter periods of time.

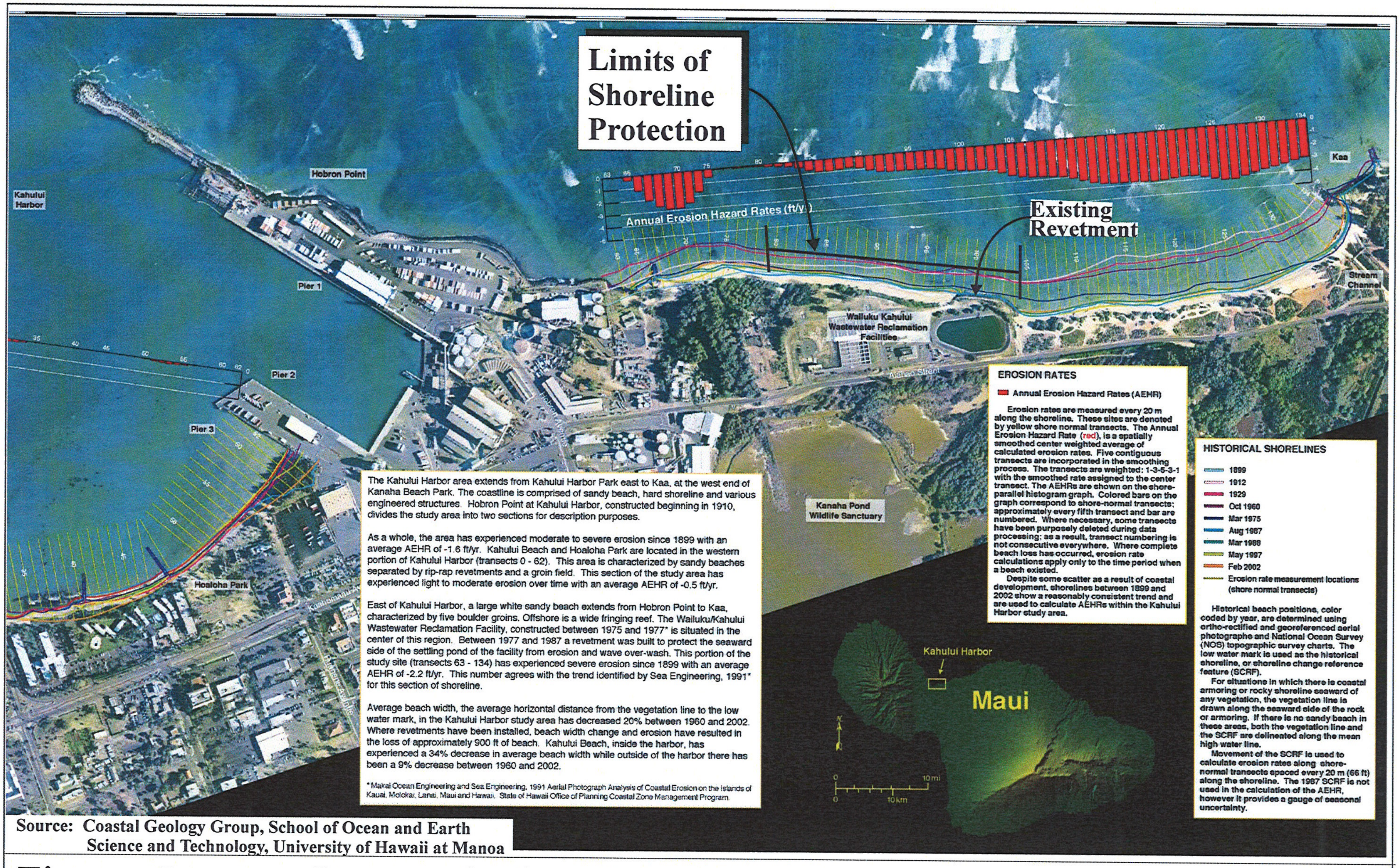
Much of the change in beach configuration is attributed to sand mining operations in the area from the early 1900s through the 1970s. Sand was mined for use as cement aggregate for construction and in the production of lime for sugar cane processing. Other natural potential contributors to shoreline erosion include relative sea level rise, elevated sea levels during storms, and changes in reef production of coralline sand. Man-induced influences other than sand mining include the structures and dredging practices of Kahului Harbor, World War II (WWII) training exercises along the beach, and dune destruction. Refer to **Appendix "C"**.

Shoreline erosion in the area of the WKWWRF has been documented for over 100 years.

The County of Maui Shoreline Erosion Maps were compiled using aerial photography and historic T-sheets. The erosion map including the WKWWRF shoreline indicates the extent of erosion for over 100 years. See **Figure 5**. The map indicates that the Annual Erosion Hazard Rate (AEHR), which is calculated by the Coastal Geology Group at the School of Coastal and Earth Science and Technology, University of Hawaii at Manoa, ranges from -1.0 to -2.5 feet per year (ft./yr.) directly in front of the WKWWRF. However, the existing revetment built in 1979 has halted further shoreline erosion for that particular section, which results in the average AEHR being under-reported along the WKWWRF property. The average AEHR is -2.4 ft./yr.

Independent studies of the shoreline have been conducted over the past decade and include multiple Certified Shoreline Surveys. Review of past shoreline surveys indicates that the shoreline west of the existing revetment is eroding at a rate of up to -6.0 ft./yr. (Brown and Caldwell, 2002). In addition to on-going erosion, there are seasonal shifts in the shoreline position that range from 25 to 55 feet. These shifts increase the likelihood of erosion and property loss when the beach is narrow, typically in the winter months.

The 2007 certified shoreline and a 2002 site map of the WKWWRF from Brown and Caldwell were analyzed to determine when the first structures at the WKWWRF could be threatened if no additional protection is put in place based on the seasonal shoreline position shifts and annual erosion rates. The existing injection wells located makai of the access road could be threatened without additional shoreline protection in less than three (3) years. See **Figure 6**. Although the County is studying options to reuse the treated wastewater, the existing injection wells continue to be necessary, therefore, protecting the shoreline will be necessary for the continued protection of the injection wells. The existing injection Well No. 2 is already at risk of damage based on the worst-case seasonal recession and erosion rates. The access road could be threatened in only one (1) year and the existing sludge holding tanks in as few as four (4) years. These structures could possibly be relocated within the WKWWRF property. However, the northeast corner of the chlorine contact tank and effluent meter structure is located approximately 120 feet from the existing fence line. The size of this structure and its position in the wastewater treatment cycle would prohibit it from being relocated elsewhere on the property. See **Figure 7**. As calculated in 2008 assuming the worst case scenario of maximum seasonal recession and annual erosion, the chlorine contact tank and effluent meter could be threatened by 2022. Refer to **Appendix "D"**.



Source: Coastal Geology Group, School of Ocean and Earth Science and Technology, University of Hawaii at Manoa

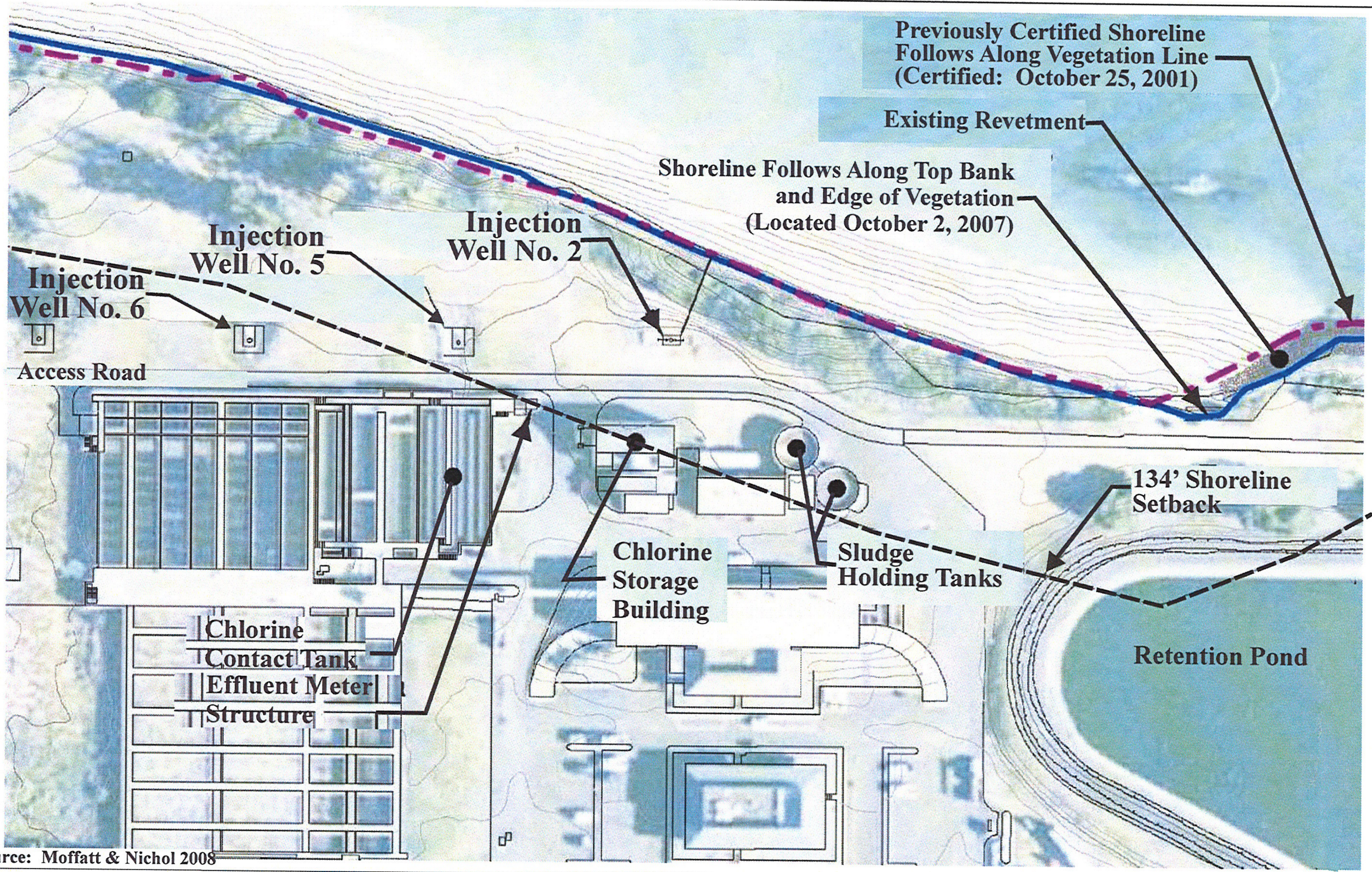
Figure 5 Proposed Shoreline Protection Extension at Wailuku-Kahului Wastewater Reclamation Facility
Annual Erosion Hazard Rate Map

NOT TO SCALE

Prepared for: County of Maui, Department of Environmental Management

MUNEKIYO & HIRAGA, INC.

MoffattNichol/WK WWRF/DraftEIS/annualerosion



Source: Moffatt & Nichol 2008

Figure 6 Proposed Shoreline Protection Extension at Wailuku-Kahului Wastewater Reclamation Facility

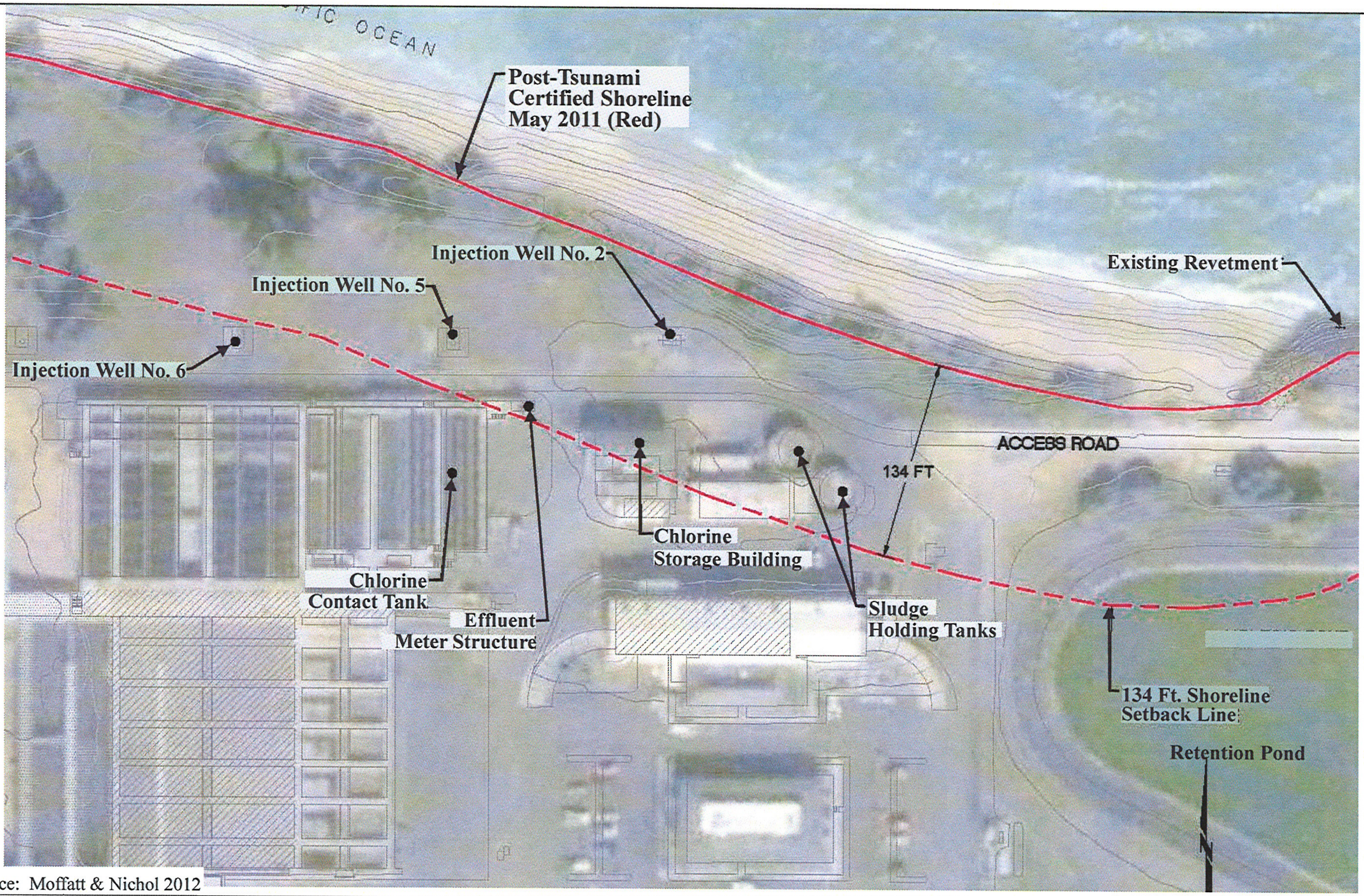
Threatened Infrastructure Based on 2007 Certified Shoreline Map

NOT TO SCALE

Prepared for: County of Maui, Department of Environmental Management

MUNEKIYO & HIRAGA, INC.

MoffattNichol/WK WWRF/DraftEIS/ThreatenedInfrastructure



Source: Moffatt & Nichol 2012

Figure 7 Proposed Shoreline Protection Extension at Wailuku-Kahului Wastewater Reclamation Facility

Threatened Infrastructure Based on 2011 Certified Shoreline Map

NOT TO SCALE

Prepared for: County of Maui, Department of Environmental Management

MUNEKIYO & HIRAGA, INC.

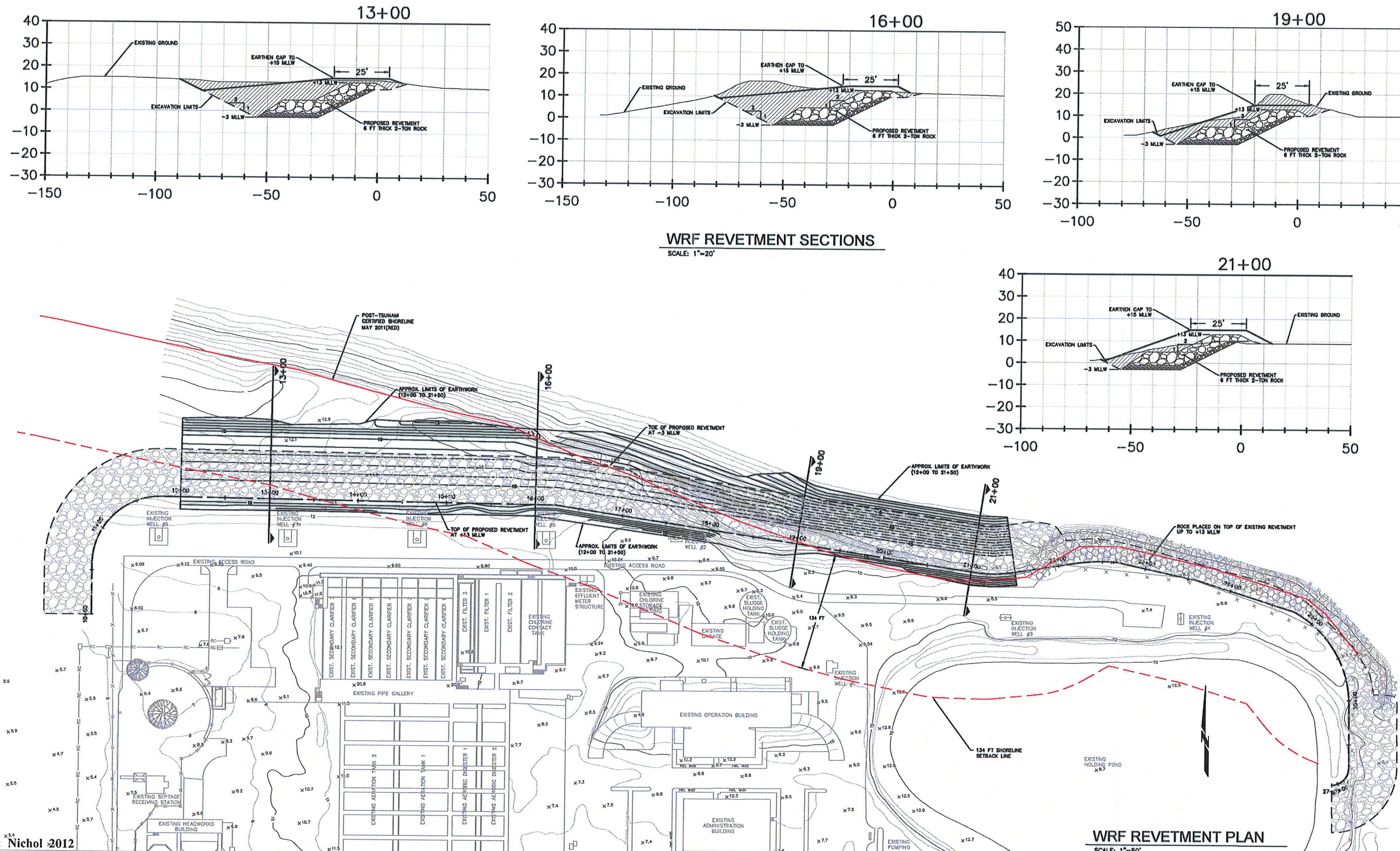
MoffattNichol/WK WWRF/DraftEIS/ThreatenedInfrastructureMay2011

As part of ongoing shoreline studies, further shoreline surveys have been conducted. These included two (2) surveys before the tsunami of March 2011, which resulted from the earthquake off the Pacific Coast of Japan: one (1) in February 2008 and one (1) in January 2011. In May 2011, following the tsunami, a shoreline certification survey was conducted. A comparison of the pre-tsunami (January 2011) and post-tsunami (May 2011) shorelines indicates an average retreat of 9.8 feet along the WKWWRF shoreline, with a maximum retreat of 14.4 feet. The average recession rate from October 2007 to May 2011 is 3.7 ft./yr. However, because of the short averaging period and the magnifying effects of the March 2011 tsunami, the values, which are slightly higher than the long-term erosion rates recommended for facility planning, are not considered to be more accurate than previous averages. Refer to **Appendix "D-1"**.

As demonstrated by the tsunami of March 2011, catastrophic events, also including large hurricanes, or an increase in the rate of sea level rise could significantly reduce the foregoing time estimates. Given the unpredictability of future storms and tsunamis, as well as the typical time required to design, permit, and construct a shoreline protection project (three (3) to five (5) years), it was recommended that a shoreline protection alternative be selected and implemented as soon as possible. The no build alternative puts the facility at a high risk of damage due to erosion, which would threaten the facility's ability to meet the wastewater treatment needs of Central Maui, and presents a significant potential environmental hazard.

D. PROPOSED ACTION

The County of Maui, DEM, WWRD proposes to extend the existing shoreline protection at the WKWWRF, located in Kahului, Maui, Hawaii. The proposed project consists of the construction of an approximately 1,100-ft. rock mound revetment extension to the west of the existing revetment with short landward returns to prevent flanking erosion which will be partially covered with the excess excavated beach sand. See **Figure 8**. It is noted that the proposed action has been modified from the preferred alternative presented in the January 2011 EA/EISPN, which involved a 1,200-foot "exposed" rock mound revetment extension along the beach scarp to the west of the existing revetment. The proposed action follows a revised alignment more inland of the previously proposed alternative. The revised alternative will minimize the impacts to biological resources, recreational beach area, and adjacent beaches by locating the revetment as far landward as possible. Over 800 linear feet of the revetment will be installed landward of the shoreline. Material excavated during the



Source: Moffatt & Nichol 2012

Figure 8

Proposed Shoreline Protection Extension at Wailuku-Kahului Wastewater Reclamation Facility

Proposed Revetment Preliminary Site Plan

NOT TO SCALE

MUNEKIYO & HIRAGA, INC.

Prepared for: County of Maui, Department of Environmental Management

MoffattNichol\WK WWRF\DraftEIS\ProposedRevetmentPreSitePlan(Revised) construction of the revetment will be replaced on top of the revetment, resulting in a reduction of "exposed" armored shoreline by almost 70 percent. To ensure public access to the beach, a stairway will be incorporated into the exposed portion of the revetment.

The revetment would require approximately 29,000 tons of armor and under layer rock. The extension would be constructed as far inland as practicable. The crest of the new revetment will be at elevation of +13 feet Mean Lower Low Water (MLLW) and the toe of the revetment set at -3 feet MLLW. See **Figure 9**. At the base of the revetment will be a layer of geotextile filter fabric, then a layer of bedding stone and six (6) feet of 2-ton armor stone. There will be excavation required to prepare the slope for the new revetment. Any required fill will be of beach-quality sand with the excess excavated sand used to partially cover the revetment. Refer to **Figure 9**. This structure would be located within the County of Maui Shoreline Setback Area.

The crest elevation of the existing revetment will be raised to match the new revetment crest height to provide additional sea-level rise capacity. See **Figure 10**.

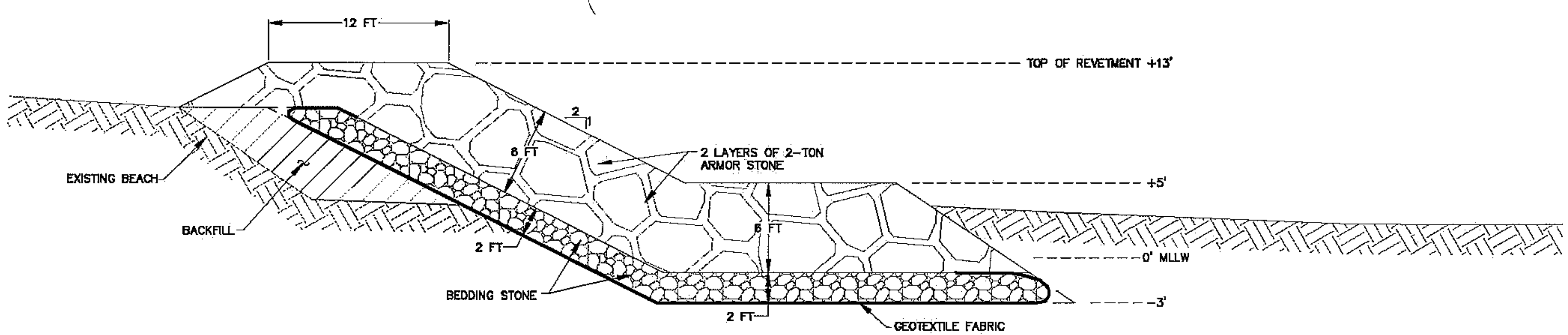
E. CONSTRUCTION METHODOLOGY

An onsite construction baseyard, storage, and staging areas will be established within open areas available on the WKWWRF site. See **Figure 11**.

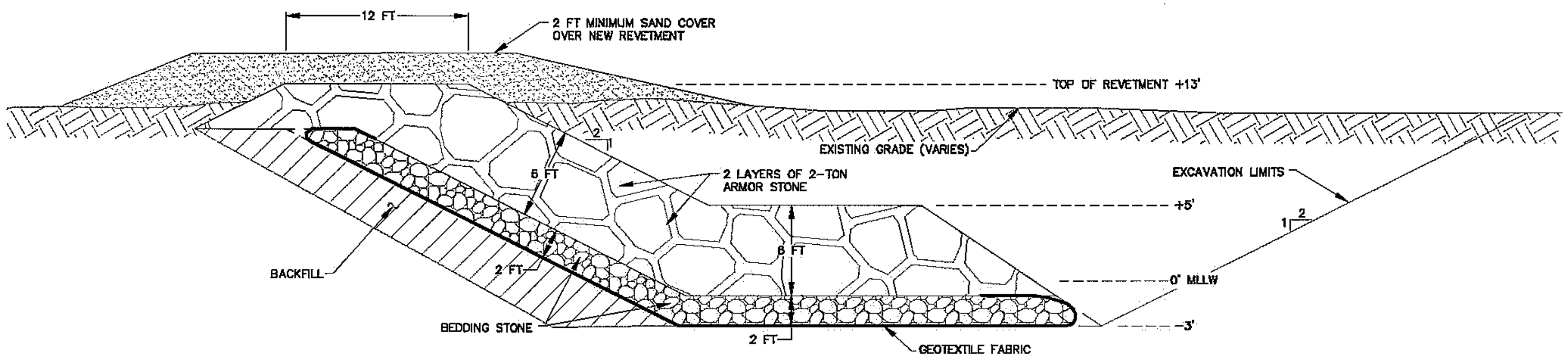
The construction of the revetment will be performed using typical land-based equipment for rock/excavation work. It is anticipated that the contractor will mobilize, stage and access the project site from the WKWWRF property.

The existing vegetation will be cleared and grubbed to the extent that is required for access and working space. All removed vegetation debris will be hauled off site and disposed of at an appropriate landfill or recycling location.

The slope of the embankment will be prepared with excavators and filter fabric will be placed by hand. The bedding stone, underlayer stone, and armor stone will be delivered to the site by rock hauling trucks, transported onsite by a front-end loader and placed with a backhoe excavator. Modifications to the existing revetment will be made from the top of the slope using an excavator.



East Section



West Section

Source: Moffatt & Nichol

Figure 9

Proposed Shoreline Protection Extension at Wailuku-Kahului Wastewater Reclamation Facility

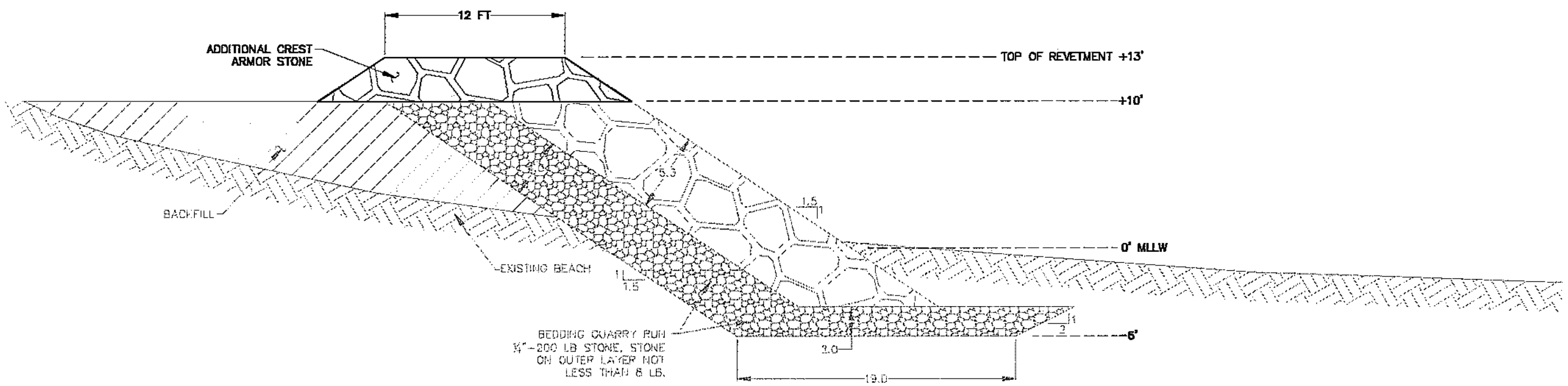
Typical New Revetment Sections

0 2.5 5 10 Feet

Prepared for: County of Maui, Department of Environmental Management

MUNEKIYO & HIRAGA, INC.

MoffattNichol\WK WWRF\DraftEIS\Typical New Revetment Sections



Existing Revetment Improvements

Source: Moffatt & Nichol

Figure 10

Proposed Shoreline Protection Extension at Wailuku-Kahului Wastewater Reclamation Facility

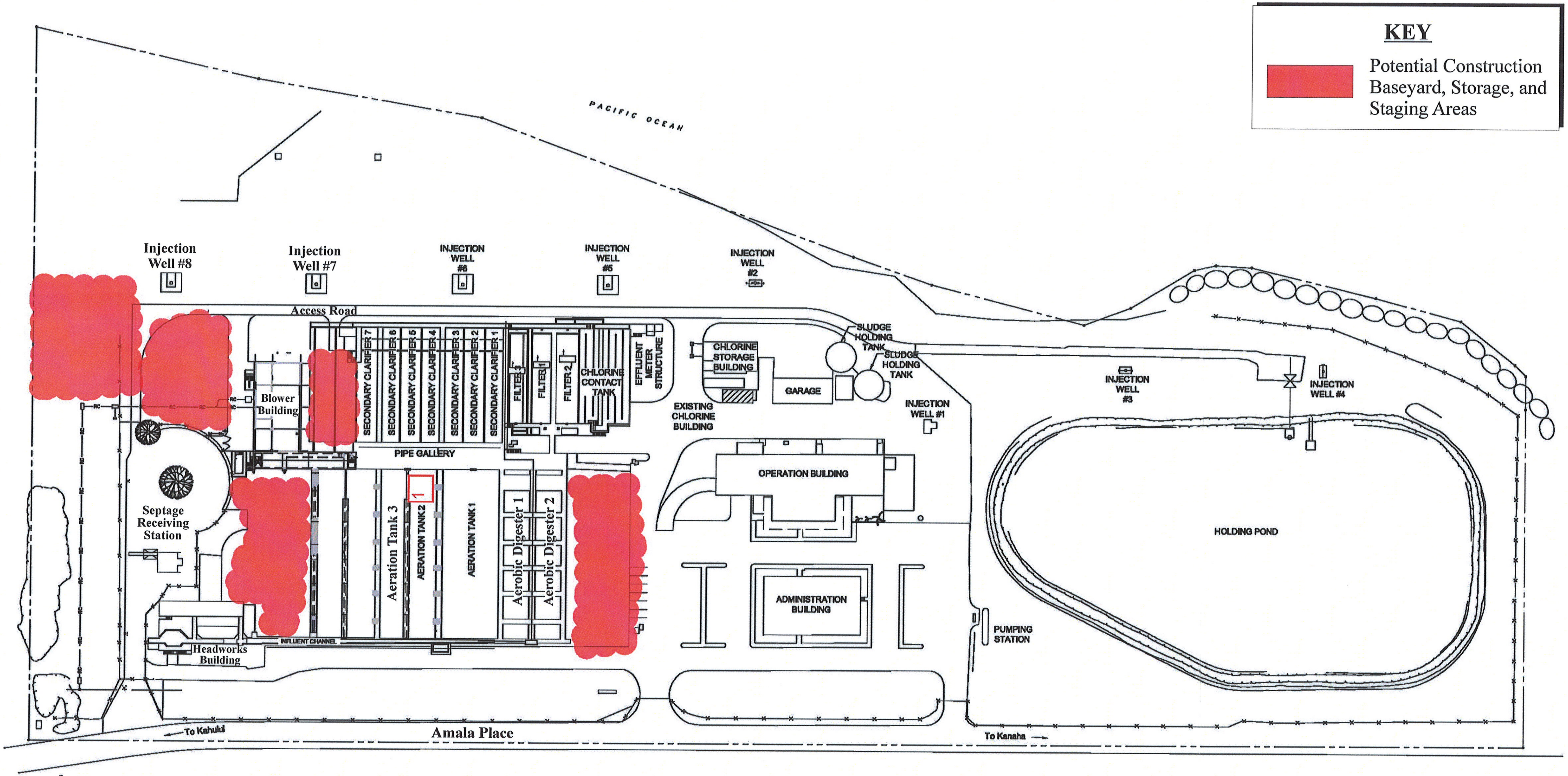
Existing Revetment Improvement Section

0 2.5 5 10 Feet

MUNEKIYO & HIRAGA, INC.

Prepared for: County of Maui, Department of Environmental Management

MoffattNichol\WK WWRF\DraftEIS\ExistingRevetmentImprovementSection



Source: County of Maui, Department of Environmental Management

Figure 11

Proposed Shoreline Protection Extension at Wailuku-Kahului Wastewater Reclamation Facility
Potential Construction Baseyard, Storage, and Staging Area

NOT TO SCALE

Prepared for: County of Maui, Department of Environmental Management

MUNEKIYO & HIRAGA, INC.

MoffattNichol\WK WWRF\DraftEIS\PotentialConstructionBaseyardStorageandStagingAreas

The majority of the work will be performed from the top of the slope, but the contractor will be required to place excavators and similar machinery on the beach during favorable tide, wind, and wave conditions. Sand may need to be moved around to provide a level working pad for the equipment. When working on the beach, the contractor will provide appropriate signage and public safety measures. Disturbed areas in the vicinity of the project will be restored to its natural condition with the excess excavated sand covering a portion of the rock mound revetment. The maximum onsite construction period is estimated to be 12 months, however, the actual construction period is anticipated to be shorter.

F. CHAPTER 343, HAWAII REVISED STATUTES COMPLIANCE

The proposed project involves three (3) actions which trigger the environmental review process. They are the use of County and State lands and County funds, work within the State Conservation District, and action within the Shoreline and Shoreline Setback Area. In accordance with Chapter 343, Hawaii Revised Statutes (HRS), this Environmental Impact Statement (EIS) is being prepared to assess the project's impact. This EIS is prepared in accordance with Chapter 200 of Title 11, Department of Health Administrative Rules, Environmental Impact Statement Rules.

Due to the multiple jurisdictions involved in the project, potential accepting authorities include the DEM; the Maui County Planning Commission; or the DLNR, OCCL. By letter dated March 10, 2010, DEM requested the opinion of Office of Environmental Quality Control (OEQC) as to whether the DEM could be the Accepting Authority based on the fact that the DEM has control and management of the property. The DEM also requested, by letter dated March 10, 2010, the Department of Land and Natural Resources (DLNR) concurrence with DEM being the Accepting Authority. By letter dated April 1, 2010, the DLNR concurred with DEM being the Accepting Authority. See **Appendix "F"**. By letter dated April 7, 2010, OEQC opined that since DEM has control of the property through an Executive Order, DEM can be the Accepting Authority. OEQC further stated that according to Section 11-200-4(a)(2), Hawaii Administrative Rules (HAR), whenever an agency proposes an action, the final authority to accept a statement is the mayor, or an authorized representative, of the respective county. See **Appendix "G"**. By letter dated April 21, 2010, Mayor, Charmaine Tavares designated the DEM as the mayor's authorized representative to process and accept the EIS for the project. See **Appendix "H"**.

Chapter 343, HRS, ensures that environmental concerns are given appropriate consideration in decision making along with economic and technical considerations. This EIS is a disclosure document which identifies the potential environmental effects and mitigative measures necessary to minimize these effects. The EIS will serve as the primary technical supporting document for the regulatory permitting applications.

The EA/EISPN was filed with the OEQC and published in the Environmental Notice on January 23, 2011. Publication of the EA/EISPN initiated the thirty (30) day period in which agencies, groups, or individuals may request to become a consulted party and to make written comments regarding the environmental effects of the proposed action. Substantive comments received have been responded to in writing and are included in this Draft EIS.

On February 16, 2011, during the 30-day public comment period, the DEM held a public informational meeting at Maui Waena Intermediate School in Kahului, Maui to review the EISPN. Comments received at the meeting are included in Chapter IX of this document.

This Draft EIS is being filed with the OEQC for publication in the Environmental Notice, notifying agencies, groups, and individuals of the availability of this document for review and comment. The period for public review and for submitting written comments commences from the date notice of availability of the Draft EIS is published in the Environmental Notice and shall continue for a period of 45 days.

Substantive comments received will be responded to in writing and included in the Final EIS. Pursuant to the EIS Rules, a statement shall be deemed to be an acceptable document by the Accepting Authority only if all of the following criteria are satisfied:

1. The procedures for assessment, consultation process, review, and the preparation and submission of the statement, have all been completed satisfactorily as specified in Chapter 343, HRS;

2. The content requirements described in Chapter 343, HRS, have been satisfied; and

3. Comments submitted during the review process have received responses satisfactory to the accepting authority, or approving agency, and have been incorporated in the statement.

Upon decision to accept the Final EIS, the DEM will file the Final EIS with the OEQC to complete the environmental review process. The Final EIS may be appealed through judicial review in the courts upon filing of an appeal within sixty (60) days of its notice in the Environmental Notice.

G. PERMITTING REQUIREMENTS

The following regulatory compliance and approvals will be required for project implementation:

1. Chapter 343, HRS, Environmental Impact Statement (EIS)

As discussed above, Chapter 343, HRS is invoked due to three (3) triggers: the use of County and State lands and County funds, work with the State Conservation District, and action within the Shoreline and Shoreline Setback Area.

Due to the sensitive marine environment and anticipated environmental impacts associated with the proposed action, an EIS is being prepared to assess the proposed action. As such, an EA/EISPN has been issued by the Accepting Authority, DEM.

2. Special Management Area (SMA) Use Permit and Shoreline Setback Variance (SSV)

The project is located within the County of Maui, Special Management Area (SMA) and the Shoreline Setback Area. As such, the SMA Use Permit and Shoreline Setback Variance (SSV) approvals are required from the Maui Planning Commission.

3. Conservation District Use Permit (CDUP)

The project is located within the State Conservation District. As such, a Conservation District Use Permit (CDUP) is required from the BLNR. A portion of the improvements will be located in the shoreline area and on State lands, which will require an easement from the BLNR.

4. U.S. Department of the Army Permit

The project area affects the navigable waters of the U.S. which are under the jurisdiction of the U.S. Department of the Army (DA). In accordance with Section 10 of the Rivers and Harbors Act of 1899 and Section 401 and Section 404 of the Clean Water Act, a DA Permit will be required for the proposed action.

5. Water Quality Certification

A portion of the project construction occurs within range of waters protected by Section 401 of the Clean Water Act. In accordance with the Act, a Section 401 Water Quality Certification will be required from the State of Hawaii, Department of Health (DOH).

6. Coastal Zone Management (CZM) Consistency Approval

As previously noted, the project is located within the County SMA and involves federal permitting approval by the DA. As such, a Coastal Zone Management (CZM) Consistency Approval must be obtained from the State Department of Business, Economic Development, and Tourism, Office of Planning.

H. PROJECT COST AND IMPLEMENTATION SCHEDULE

Construction will begin upon receipt of applicable permits and approvals, which is anticipated to be in early 2013. The estimated cost for the revetment is approximately $4.5 million (in 2012 dollars). The Net Present Value (NPV) cost, which includes the anticipated maintenance costs adjusted for inflation for an expected lifetime of 50 years, is estimated to be $4.9 million (in 2012 dollars). Refer to **Appendix "D-1"**. The project will be carried out in one (1) phase and is anticipated to take a maximum of 12 months to complete.

II. EXISTING ENVIRONMENT, POTENTIAL IMPACTS, AND MITIGATION MEASURES

II. EXISTING ENVIRONMENT, POTENTIAL IMPACTS, AND MITIGATION MEASURES

A. PHYSICAL ENVIRONMENT

1. Surrounding Land Use

a. Existing Conditions

The project site is located in Kahului, the island of Maui's center of commerce. Kahului is home to Kahului Harbor, the island's only deep water port, and to the Kahului Airport, the second busiest airport in the State. With its proximity to the harbor and airport, the Kahului region has emerged as the focal point for heavy industrial, light industrial, and commercial activities and services, such as warehousing, baseyard operations, automotive sales and maintenance, and retailing for equipment and materials suppliers. The region is considered Central Maui's commercial retailing center with Queen Kaahumanu Center, Maui Mall, Kahului Shopping Center, and Maui Marketplace located within proximity of the project site. Refer to **Figure 1**.

Surrounding this commercial core is an expansive residential area comprised principally of single-family residential units. Residential uses encompass the area extending from Maui Memorial Medical Center to Puunene Avenue located to the west of the project site. The nearest residential areas to the project site are east of Puunene Avenue, located just over one (1) mile away and Spreckelsville to the east, located approximately 1.8 miles away.

The area immediately west of the WKWWRF is considered to be a heavy industrial area and includes oil tank farms, auto storage yards, warehouses, and a power plant. The port facilities at Kahului Harbor are located approximately 0.5 mile to the west of the WKWWRF. The Kahului Airport is located approximately one (1) mile east of the WKWWRF and Kanaha Beach Park is located to the east of the WKWWRF. The Kanaha Pond Wildlife Sanctuary (KPWS) is located to the south across Amala Place road. The WKWWRF site is bounded on the north by Kahului Bay.

b. Potential Impacts and Mitigation Measures

The project site is located in an area of heavy industrial uses related to Kahului Harbor and in proximity to the Kahului Airport as well as recreational uses related to beach activities and the KPWS. The WKWWRF has been in use since 1973 and is complementary to other public/quasi-public uses at the Kahului Harbor and Airport. The proposed project will provide protection for the WKWWRF from damage due to shoreline erosion and mitigate potential adverse impacts to surrounding land uses from erosion damage to the wastewater facility. It is anticipated that the shoreline protection will not adversely impact the character of the surrounding land uses.

2. Climate, Topography, and Soils

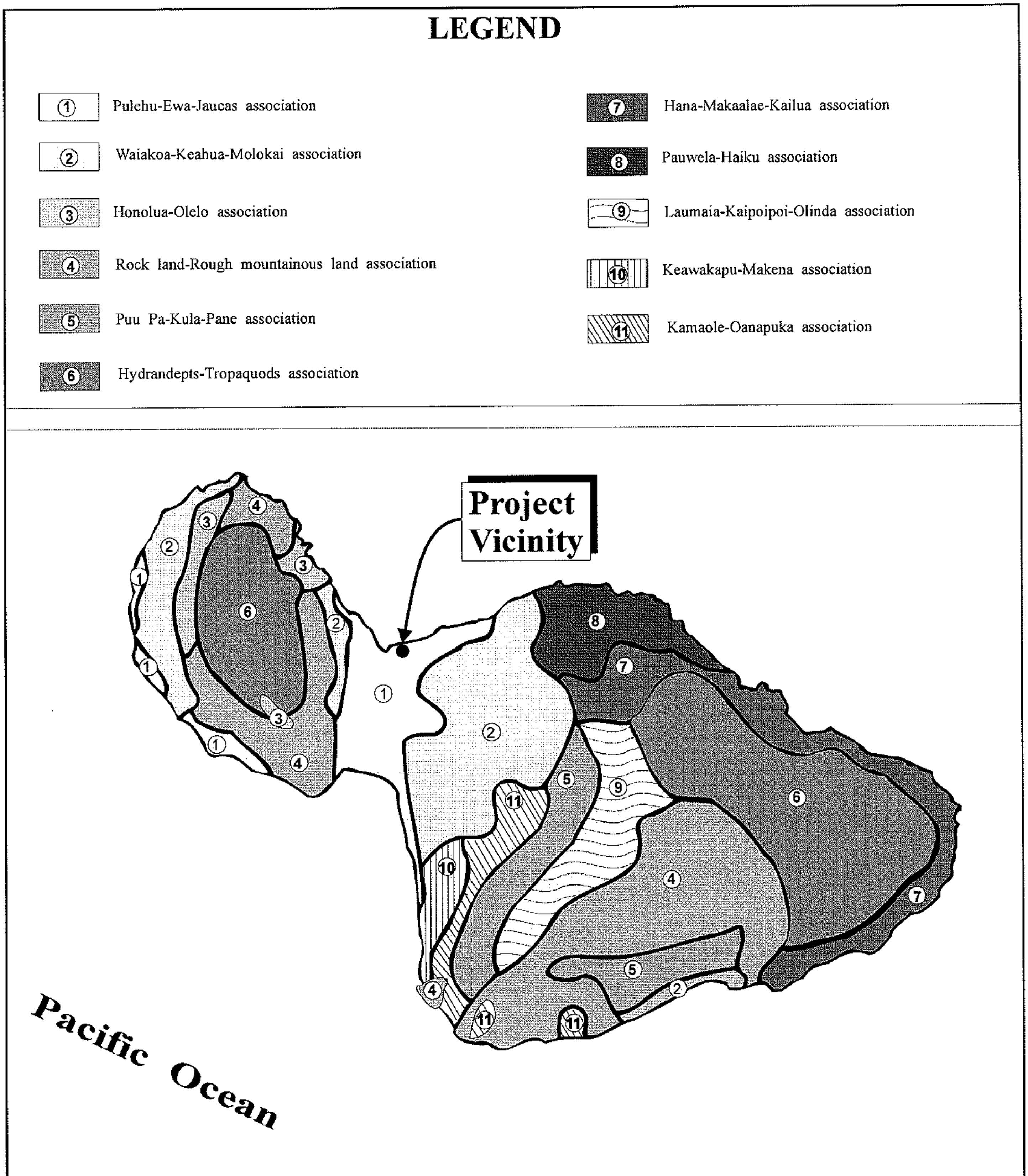
a. Existing Conditions

Like most areas of Hawaii, Maui's climate is relatively uniform year-round. Characteristic of Hawaii's climate, the project site experiences mild and uniform temperatures year round, moderate humidity, and a relatively consistent northeasterly tradewind. Variation in climate on the island is largely left to local terrain.

Average temperatures recorded at the neighboring Kahului Airport range from lows in the 70's to highs in the 80's. September is historically the warmest month, while February is the coolest. Rainfall in the area averaged approximately 19 inches in 2008 (Maui County Data Book, 2010). Winds in the Kahului region are predominantly out of the north-northeast and northeast.

The existing site is relatively flat and ranges in elevation from six (6) to ten (10) feet above mean sea level (msl) (Austin, Tsutsumi & Associates, Inc., 2006).

Underlying the project site is soil of the Pulehu-Ewa-Jaucas soil association. See **Figure 12**. This association occurs in basins and on alluvial fans and



Map Source: USDA Soil Conservation Service

Figure 12 Proposed Shoreline Protection Extension at Wailuku-Kahului Wastewater Reclamation Facility

Soil Association Map

NOT TO SCALE

MUNEKIYO & HIRAGA, INC.

Prepared for: County of Maui, Department of Environmental Management

MoffattNichol\WK WWRF\DraftEIS\soils

is characterized by well-drained and excessively drained soils that have a moderately-fine to coarse-textured subsoil or underlying material.

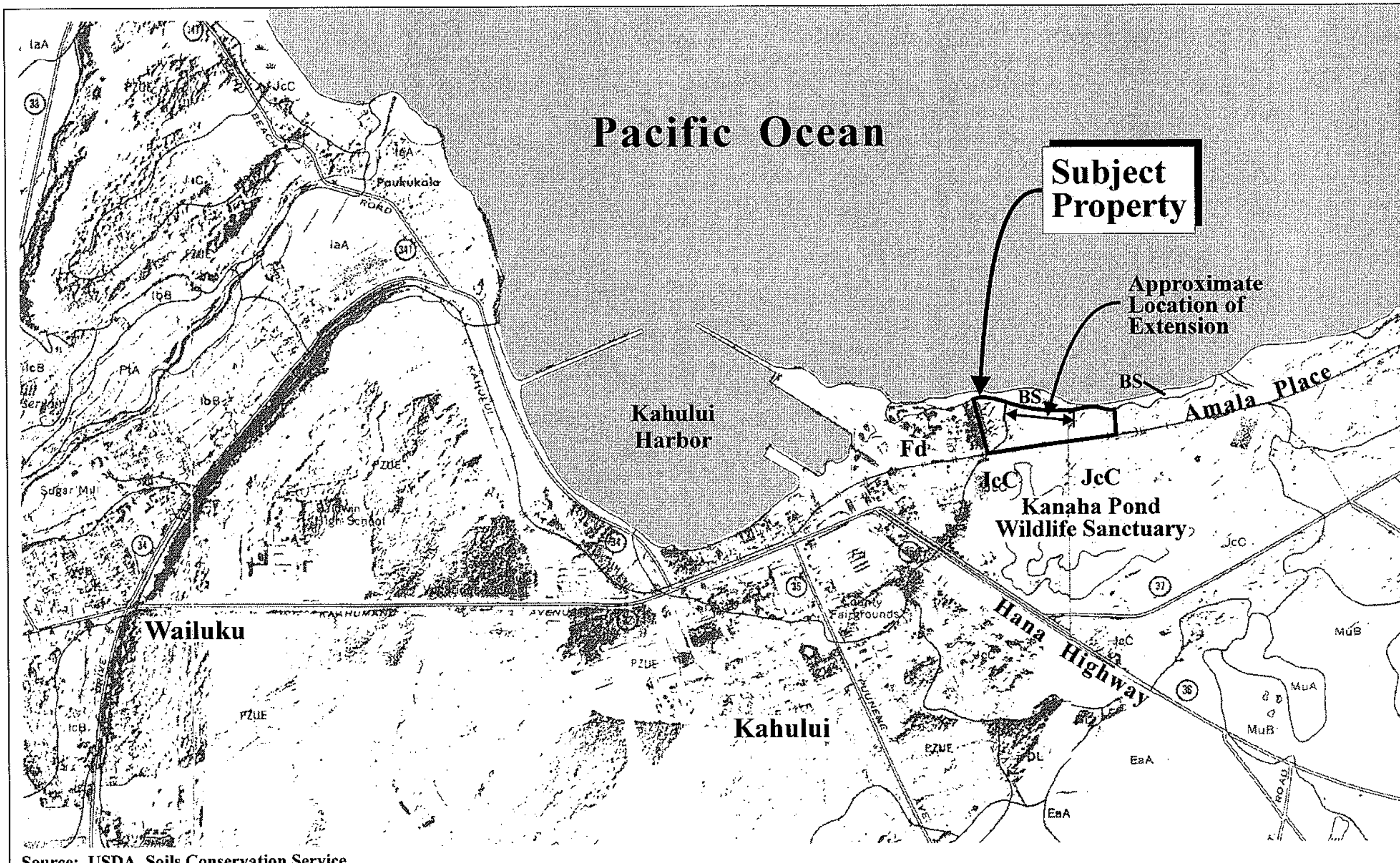
Specifically, the project site contains Jaucus sand, saline (JcC), 0 to 12 percent slope soils, Fill lands (Fd), and Beach soils (BS). See **Figure 13**. JcC soils occur near the ocean in areas where the water table is near the surface and salts have accumulated. This soil is used for pastures, wildlife habitat, and urban development. It is poorly drained in depressions but excessively drained on knolls. Fill Land (Fd) are located in the western portion of the parcel. Beach soils (BS) front the subject property.

The Detailed Land Classification-Island of Maui establishes a soil productivity rating ranging from "A" to "E", with "A" representing the highest level of productivity and "E" being very poor for agricultural production. This rating system is based on factors including machine tillability, stoniness, texture, clay properties, drainage, rainfall, elevation, and slope. The land underlying the project site is unclassified, as it is situated within an existing urbanized area.

In 1977, the State Department of Agriculture established a classification system for identifying Agricultural Lands of Importance to the State of Hawaii (ALISH), primarily, but not exclusively, on the basis of soil characteristics. The three (3) classes of ALISH lands are: "prime", "unique", and "other important" agricultural land with the remaining non-classified lands designated as "unclassified". The subject property is "unclassified" by the ALISH system, with no agricultural uses.

b. <u>**Potential Impacts and Mitigation Measures**</u>

The site is developed and the WKWWRF has been established on the site since 1973. The proposed revetment could have potential impacts on the sand soils. The revetment will change the topography of the site in the area between the beach and WKWWRF structures where it will be constructed. The elevation of the existing grade at the backbeach line is approximately +10 feet MLLW, while landward of the beach berm the ground elevation varies, but is generally higher in elevation. The elevation of the top of the revetment will be at +13 feet MLLW and alignment of the



Source: USDA, Soils Conservation Service

Figure 13

Proposed Shoreline Protection Extension at Wailuku-Kahului Wastewater Reclamation Facility

Soil Classification Map

NOT TO SCALE

Prepared for: County of Maui, Department of Environmental Management

MUNEKIYO & HIRAGA, INC.

MoffattNichol\WK WWRF\DraftEIS\soilclass major portion (800 feet) of the revetment will be landward of the beach berm. This landward section of the revetment will be covered by an approximately 2-foot earthern cap. This cap will not adversely impact topography or public view planes in and around the project site.

3. Flood and Tsunami Hazard

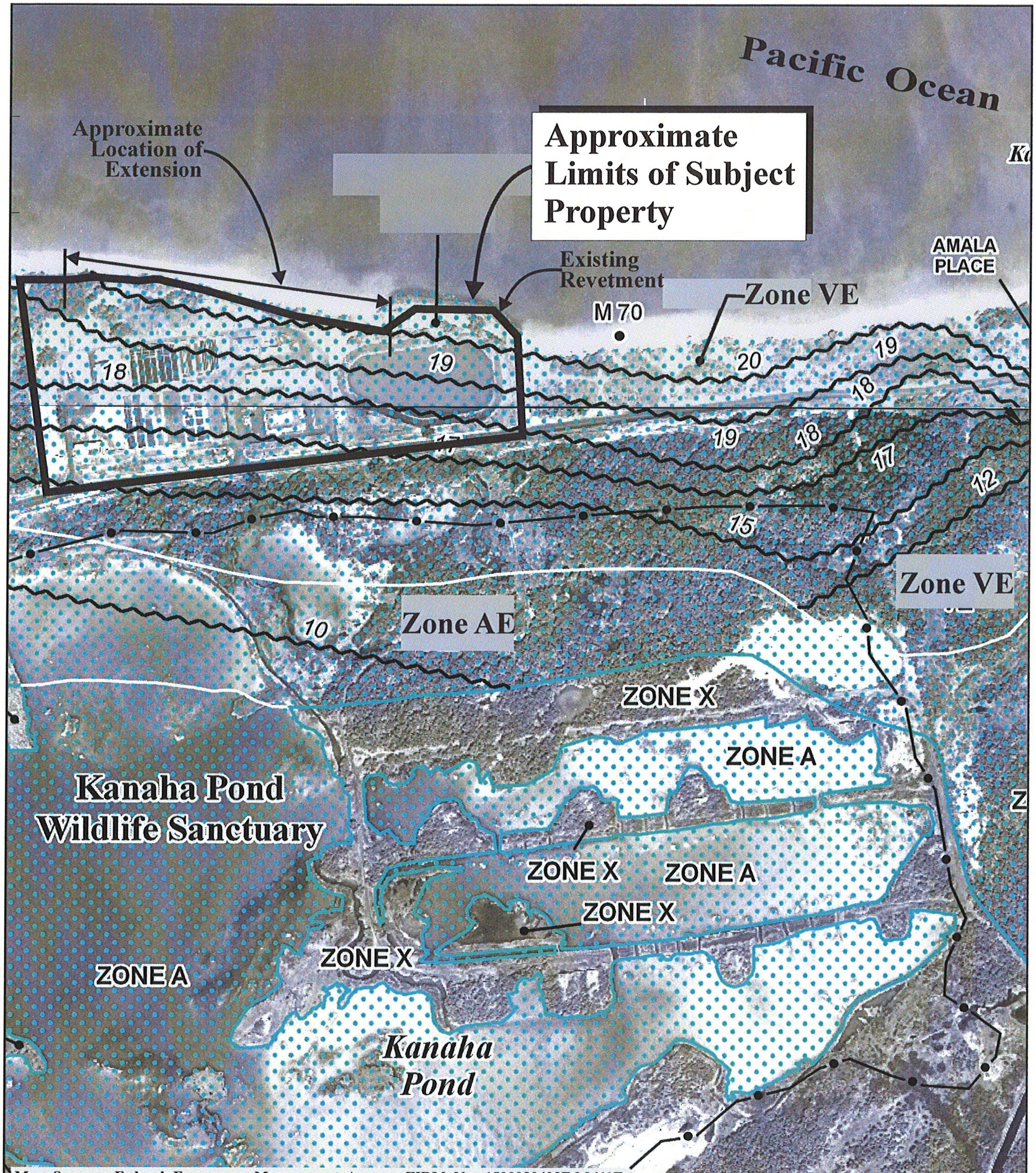
a. Existing Conditions

The project site is located within Flood Zone VE, with base flood elevations of 15 to 20 feet above mean sea level (msl), as established by the applicable Flood Insurance Rate Map (FIRM) for Maui County. See **Figure 14**. Flood Zone VE is a coastal flood zone with velocity hazard from wave action and determined base flood elevations. Regarding tsunami hazard, the tsunami evacuation map for the region produced by the State Civil Defense Agency indicates the tsunami evacuation area extends from the shoreline up to Keolani Place and Haleakala Highway. The project site is, therefore, situated within the tsunami evacuation area.

When a tsunami strikes, the maximum vertical height of the water in relation to sea level is referred to as run-up and the maximum horizontal distance is referred to as inundation. The 2010 Maui Multi-Hazard Mitigation Plan lists the greatest run-up experienced in Kahului as 12 feet. The most destructive tsunami occurred in May 1960 when "*the waves washed inland for a distance of about 3,000 feet to ground elevations of about six (6) feet*". Refer to **Appendix "D"**.

The March 11, 2011 magnitude 8.9 earthquake off the coast of Japan and subsequent tsunami resulted in high wave activity off the north shore of Maui which overtopped the existing rock revetment. The tsunami wave passed through the WKWWRF site across Alamaha Place into the KPWS. Causing moderate loss of beach and soils and minor damage to the facility. See **Figure 15** and refer to **Exhibit "D-1"**. The possibility will always exist that future tsunamis of greater destructive power than those previously recorded may reach the island.

Structural tsunami protection improvements were completed as a



Map Source: Federal Emergency Management Agency, FIRM No. 1500030403E&0411E

Figure 14 Proposed Shoreline Protection Extension at Wailuku-Kahului Wastewater Reclamation Facility Flood Insurance Rate Map

NOT TO SCALE

Prepared for: County of Maui, Department of Environmental Management

MUNEKIYO & HIRAGA, INC.

MoffattNichol\WK WWRF\DraftEIS\FIRM

Photo No. 1: Scouring at West End of Revetment (pictured on the right)

Photo No. 2: Erosion from Behind the East Flank, Which Undermined the Chain Link Fence Footings

Map Source: USDA Soil Conservation Service

Figure 15 Proposed Shoreline Protection Extension at Wailuku-Kahului

Photographs of Tsunami Damage

NOT TO SCALE

Prepared for: County of Maui, Department of Environmental Management

MUNEKIYO & HIRAGA, INC.

MoffattNichol\WK WWRF\DraftEIS\PhotographsofTsunamiDamage separate project at the WKWWRF. The tsunami protection measures were reviewed by the Department of Planning and a SMA Exemption (SM5 2008/00347)was issued in 2008. The tsunami protection measures included below grade structural reinforcement of the concrete slab foundation to prevent underscouring and wave action erosion of the shoreward side of the Operations Building. Refer to **Figure 3**. The Centrifuge Control Room in the Operations Building was relocated above the 100-year tsunami wave height. Improvements at the Tanks and Headworks Building included thickening of the slab below grade, addition of walls and flood doors at grade level, and reinforcing footings below the scourline to protect against wave action erosion.

b. Potential Impacts and Mitigation Measures

The proposed revetment is specifically intended to provide additional protection against severe storms and tsunamis, helping to mitigate their impact. Without the shoreline protection measures, the beach would continue to erode and threaten the upland area, creating a greater potential flood and tsunami hazard at the site as well as loss of land. All vertical construction will be implemented in accordance with Maui County Code, Chapter 19.62 relating to Flood Hazard Areas, as applicable. Where required, standards of development set forth in Chapter 19.62 will be incorporated in the shoreline protection design.

4. Coastal Processes

a. Existing Conditions

The project site is fronted on the north by approximately 1,350 linear feet of shoreline. There is an existing 450-foot rock revetment on the east side of the property. The beach fronting the project site is part of the 13,000-foot long beach that extends east from Kahului Harbor towards Spreckelsville Beach. This beach is broken into a series of pocket beaches separated by manmade groins, natural beachrock, and lava points. Sand ranges in size from medium-sized grains to cobbles. The beaches in this area are primarily used by locals and visitors for world-class windsurfing, kitesurfing, as well as fishing and regular beach recreation.

There is a large fringe reef just offshore that extends for several miles along this beach. The reef is characterized by a wide crest (one-half (0.5) mile to one (1) mile in width) that extends from a shallow nearshore toe to depths ranging from 10 to 30 feet. Closer to Kahului Harbor, the reef is narrow or absent. Refer to **Appendix "C"** and **Appendix "D"**.

The coastal processes influencing shoreline conditions fronting the WKWWRF site involves long-term changes in the beach caused by long-term fluctuations in sediment supply and littoral transport which are augmented by seasonal fluctuations in beach conditions. Other factors which influence the coastal processes fronting the project site include wind transport, the coastal dune system, coral reef system and rising sea levels in and around the project area. A summary of the coastal processes along the shoreline fronting the project site is provided below.

The primary source of sediment which enters the coastal system in and around the project site is from biological production with foraminifers and other small marine organisms transported in from the reef edge. Sand is also transported by winds and waves, and additional sand enters the littoral system as the beaches retreat and the underlying substrate erodes. The littoral system refers to the deposition and erosion of sediments such as sand along the coastline. Human intervention that has affected the littoral system along the shoreline in the vicinity of the project site include the construction of Kahului Harbor and its east breakwater, past sand mining which supported the sugar industry and later concrete manufacturing; subsequent beach replenishment east of the project site at Sugar Cove; damage to the coastal dune system; construction of revetments and groins along the shoreline; and a possible decrease in reef productivity resulting from ocean warming and/or increased turbidity in nearshore waters.

Historical Context

The shoreline changes in the vicinity of the WKWWRF have been documented for over 100 years. Refer to Moffatt & Nichol Report, **Appendix "C"** and **Appendix "D"**. In 1954, Doak Cox, a preeminent geophysicist in Hawaii during the middle of the 20^{th} Century affirmed that the shoreline between Kahului and Paia had been in the process of eroding for at least 50 years, since shortly after the turn of the last century. Cox stated the only portion of the shoreline that was not eroding was the area east of the Kahului Harbor East breakwater where the beach had been accreting over the length of a 2,400-foot segment. This was a result of the construction of the Kahului Harbor breakwaters and the longshore transport of sediment flow from east to west. Other reports which outline early erosional trends along the project area include a report by geologist Ralph Moberly in 1963, which states that, "the lines of beachrock awash at the waterline as much as 800 feet offshore show the historical record of erosion is merely latest stage in a process operating over the last few hundred years" (Moberley, etal, 1963). Another report by the USACE and the State of Hawaii describes the beach as having "moderate to minor erosion in recent years" (U.S. Army Engineer District, 1964).

The east breakwater of Kahului Harbor was originally constructed in 1900 and the first breakwater improvements were constructed by the USACE in 1913. Based on review of historical T-sheets and aerial photographs it is clear that the breakwater and groin to the east caused accretion to the adjacent WKWWRF beach in the early years of the twentieth century.

Sand mining for lime production in support of the sugar industry and later mining by others for cement manufacturing and aggregate had a significant effect on the beaches between Kahului Harbor and the mining site at the lime kilns near Baldwin Beach. Mining began around 1900 and ended sometime between 1960 and 1975. In 1954, it was estimated that approximately 12,000 cubic yards per year of sand had been mined from the beach area to the east of the project site (Cox, 1954). It was also reported by Moffatt & Nichol, that dredging during sand mining efforts offshore of the lime kilns changed the bathymetry of the nearshore area, creating "new deep water areas", as stated by Levin (1970). It may have also caused turbidity which can also affect the adjacent reef system. Since the cessation of the sand mining, the erosion rate in the area has substantially lessened.

Recently, Sugar Cove Apartment Owners Association (AOA) replenished the beach at Sugar Cove which is located 3 to 3.5 miles to the east of the WKWWRF site. Between 1996 to 2002, approximately 17,000 cubic yards of sand were placed at Sugar Cove to replenish the beach. This replenishment project significantly added to the local beach width and introduced a new source of sand into the coastal system.

Apart from the beach nourishment project, according to Moberly (1963), biological production is responsible for all new natural sediment entering the littoral system east of Kahului Harbor. The chief constituent of the biological sediment is foraminifers which are small marine organisms that are transported in from the reef edge. It has been speculated by Sea Engineering (1991) and Guild (1999) that the reefs located offshore of the Spreckelsville Beach area may not be as productive as they have been in the past. If this assessment is accurate, then there would be a decrease in the coralline sand washed onshore from the fringing reef offshore fronting the WKWWRF site.

Shoreline Erosion

The County of Maui Shoreline Erosion Maps, compiled by the University of Hawaii, Coastal Geology Group, also provide a historical record of the coastal profile fronting the project site over several year intervals from as early as 1899 to 2002. Based on the tracking of the shoreline over this period, the AEHR for the section of coast from Hobron Point (to the west) to Kaa (in the east) has been established. Directly fronting the project site, the historic long-term AEHR is shown to range between -1.0 and -2.5 ft. per year (ft./yr.). The AEHR increases gradually from the western edge of the subject property from -0.5 ft./yr. to almost -4.0 ft./yr. at the eastern portion of the subject property. Refer to **Figure 5**. Based on existing data and review of the coastal processes in and around the project site, Moffatt & Nichol recommend use of a typical long-term erosion rate of -2.4 ft./yr. and a maximum long-term erosion rate of -6 ft./yr. for planning purposes.

The March 2011 tsunami, caused by the earthquake off of the Pacific shore of Japan, hit Maui's north and western shores during Moffat & Nichol's ongoing shoreline study. As part of the continued study, two (2) surveys had been conducted before the tsunami of March 2011, the earlier survey in February 2008 and another in January 2011. In May 2011, following the tsunami, a shoreline certification survey was conducted. A comparison of the pre-tsunami (January 2011) and post-tsunami (May 2011) shorelines indicates an average retreat of 9.8 feet along the WKWWRF shoreline, with a maximum retreat of 14.4 feet. The average recession rate from October 2007 to May 2011 is 3.7 ft./yr. However, because of the short averaging period and the magnifying effects of the March 2011 tsunami, the values, which are slightly higher than the long-term erosion rates recommended for facility planning, are not considered to be more accurate than previous averages. The ongoing value of -2.4 ft./yr. is slightly larger than the County's AEHR at the WKWWRF site and slightly smaller than the AEHR immediately east of the revetment, in the areas at risk of outflanking.

Longshore Sediment Transport

Longshore sediment transport is defined as the transport of nearshore sediments by waves and currents parallel to or along the shoreline. Moffatt & Nichol reviewed the historical and more recent trends in longshore sediment transportation along the shoreline between the rocky headlands immediately east of Sugar Cove (about 3.5 miles east of the WKWWRF site) to the Kahului Harbor breakwater (to the west of the WKWWRF site) to arrive at a sediment budget for the shoreline. Refer to **Appendix "D"**. The sediment budget calculates the annual average input of sediment to and loss of sediment from this shoreline zone. The long-term sediment transport rates at the WKWWRF beach were calculated for two (2) periods: "before" and "after" the beach retreat associated with sand mining. In addition, two (2) cases were developed for the sediment budget: the first case assumed the sand mining operations were carried out between 1912 and1975; and the second case assumed that the sand mining operations were carried out between 1912 and 1960. The results of the sediment budget analysis for the two (2) periods and for the two (2) cases are summarized in **Table 1**, below.

Table 1. Long-Term Sediment Transport Rates at the WKWWRF

Interval	Transport Rate (Cubic Yards Per Year)
Case 1	
1912 - 1975	7,100
1975 - 2002	5,400
Case 2	
1912 - 1960	8,500
1960 - 2002	6,000

The long-term sediment transport analysis indicates that for Case 1, before beach retreat (during the period of sand mining from 1912-1975), the average volume of sediment transported along the shoreline was calculated to be approximately 7,100 cubic yards per year. After beach retreat (1975-2002), the average volume of sediment was approximately 5,400 cubic yards per year. In Case 2, before beach retreat (during the period of sand mining from 1912-1960), the average volume of sediment transported along the shoreline was calculated to be approximately 8,500 cubic yards per year and after beach retreat the average volume of sediment was approximately 6,000 cubic yards per year. Moffatt & Nichol further noted that the shoreline did not stabilize until about 1987, and the transport rate probably decreased compared to the long-term average shown in **Table 1**, above. Taking into account recent trends and stabilization of the beach, Moffatt & Nichol concluded the transport rate has probably decreased compared to the long-term average shown in **Table 1**, above. The net rate of sediment transport at the shoreline adjacent to the WKWWRF site is estimated currently between 1,300 to 4,000 cubic yards per year and is likely to continue in the future.

<u>Beach Dimensions</u>

The Sugar Cove AOA compiled one of the most comprehensive data sets for modern beach dimensions on the stretch of beach fronting their property (approximately 3 to 3.5 miles to the east of the WKWWRF site) for their beach nourishment project. Sand has been added to the beach at Sugar Cove since 1996. Based on the set of beach profiles at Sugar Cove the following typical estimates have been developed for the beaches along the north coast of Maui.

- The elevation of the backbeach line (the upper limit of the active beach) relative to the local sea level datum is +10 to +12 feet.

- Elevation of the shorebase (approximate depth of closure, beyond which no seasonal or short-term changes in the sea bed are observed) relative to the local sea level datum is -8 to -10 feet.

- Horizontal distance from the shoreline (at local sea level datum) to the shorebase is 250 to 400 feet.

From this set of data, Moffatt & Nichol has concluded that the vertical extent of the active littoral zone ranges from 20 to 22 feet. The backbeach at the WKWWRF is slightly lower than elsewhere, and therefore it is assumed that the vertical extent of the active littoral zone in front of the WKWWRF is at the lower end of the range (20 feet).

The coastline stretching from Kahului Harbor towards Spreckelsville Beach in the east experiences net longshore sediment transport in the east to west direction. It appears very unlikely that the direction of net sediment transport would reverse to be east-directed. Refer to **Appendix "C"**. Historical sand mining in the area created a sediment deficit, and the significant effects of this are seen through the lack of sediment input from the upcoast beaches to the east. As mentioned previously, the net rate of longshore sediment transportation in the WKWWRF littoral cell is currently estimated to be between 1,300 and 4,000 cubic yards per year from east to west. This rate is likely to continue into the future. Refer to **Appendix "C"**.

Erosion has occurred along a majority of the north shore, and is not a result of the existing revetment at the WKWWRF retention pond. The highest erosion rates along the WKWWRF occurred before the existing revetment was constructed in the 1970s. The largest contribution to the long term erosion of the north shore beaches has been the past removal of sand for lime production as well as cement manufacturing and aggregate. This permanent removal of sand from the littoral system resulted in a deficit in the sediment budget and erosion over the length of beach from Kahului Harbor (in the west) to Baldwin Beach (in the east). Refer to **Appendix "C"**.

The area in the vicinity of the project site has experienced moderate to severe erosion over the years. Along the WKWWRF property, the average AEHR is -2.4 ft./yr. Review of past shoreline surveys indicates that the shoreline west of the existing revetment is eroding at a rate of up to -6.0 ft./yr. In addition to ongoing erosion, there are seasonal shifts in the shoreline position ranging from 25 to 55 feet in width. Refer to **Figure 5**.

b. Potential Impacts and Mitigation Measures

The proposed project is intended to protect the shoreline fronting the WKWWRF from further erosion. It would protect the WKWWRF from threats posed by erosion, allowing the facility to continue serving Central Maui's wastewater needs into the future.

In order to minimize the potential impacts on coastal processes, the alignment of the proposed revetment has been revised, moving the revetment inland and off the beach as much as possible. The portion of the revetment on the beach has the potential to limit longshore transport if the adjacent beaches recede to the point that sand can no longer pass around the revetment. However, there are indications that this is already occurring due to the existing revetment. The proposed increased revetment length should have minimal impact. Furthermore, on shorelines that experience net long term erosion or are subject to relative sea level rise, the shorelines adjacent to hard structures can migrate landward, resulting in "passive erosion", which can limit lateral access to adjacent beaches (Griggs, 2005).

5. Flora and Fauna

a. Existing Conditions

A biological survey was carried out for the project by AECOS, Inc. and the findings are summarized as follows. See **Appendix "I"**. The vegetation on the beach and dunes within the project site includes beach naupaka (*Scawvola sericea*) which grows along the entire length of the property along the upper bank of the beach; tree heliotrope (*Tournefortia argentea*) and akiaki (*Sporobolus viginicus*) also commonly occurs on the project site. Sourbush (*Pluchea carolinensis*), Indian fleabane (*Puchea indica*), and sea purslane or akulikuli (*Sesuvium portulacastrum*) are also present on the project site.

Ironwood (*Casuarina equisetifolia*) and koa haole (*Leucaena leucocephala*) are present landward of the beach. Beach morning glory (*Ipomoea violacea*) cover the sand dunes in a few areas devoid of larger vegetation. The seaward edge of the strip of land from the existing rock revetment is dominated by sea purslane (*Sesuvium portulacastrum*). A few grasses (*S. virginicus, Chloris barbata, Cynodon dactylon*) and dicot herbs like alena (*Boerhavia repens*) and seaside heliotrope (*Helitropium curassavicum*) grow in the fill area as well. Indian fleabane also occurs in the area around the existing revetment. Goosefoot (*Chenopodium murale*) is common landward of the revetment's western end. Pigweed (*Portulaca oleracea*), tree tobacco (*Nicotiana glauca*), beach morning glory, white morning glory, and golden crown-beard (*Veresina enceliodes*) are also present on the project site. A single nehe (*Lipochaeta succulenta*) plant was the only endemic species identified during the field survey.

The green sea turtle was not encountered during the field survey, but are known to frequent the waters fronting the WKWWRF site. Refer to **Appendix "I"**. The green sea turtle is listed as a "threatened" species under the Endangered Species Act (ESA). Additionally the green sea turtle is protected under Hawaii Revised Statutes (HRS), Chapter 195 D and Hawaii Administrative Rules (HAR), 13-24. No other protected, endangered or threatened species are anticipated to utilize the project site nor the nearshore waters fronting the WKWWRF.

Further description of the marine biota is covered in Section 7, below.

Terrestrial fauna in the vicinity of the project site include introduced species, such as rats, feral cats, mongoose, and dogs. Avifauna typically found in this area include the mynah, spotted dove, zebra dove, barred dove, Japanese white-eye, cardinal and red-crested cardinal, gray francolin, house finch, chickens, nutmeg mannikin, African silverbill, chestnut mannikin, sparrow, and the kolea.

It is noted that the adjacent KPWS is home to the Hawaiian stilt and Hawaiian coot, which are both endangered endemic birds. The pond is also a critical habitat for the endangered Blackburn's sphinx moth.

b. **Potential Impacts and Mitigation Measures**

The flora in the area of the proposed revetment extension consists of a mix of coastal and ruderal species common to the beaches in the Hawaiian Islands. Only one (1) endemic plant specimen, a small nehe, was identified in the project site. This species is not a federally listed threatened or endangered species. A tree tobacco plant was found growing near the fence line above the existing revetment. The tree tobacco plant is reported to host Blackburn's sphinx moth (*Manduca blackburni*), an endangered species native to Hawaii with a known population in the area and sometimes observed around the KPWS (USFWS, 2010). Examination of the single tree tobacco plant on the project site revealed no Blackburn's sphinx moth larvae feeding on the leaves at the time of the survey (AECOS 2010). This plant will require removal prior to construction of the seawall extension. Therefore, before removal, the plant will be observed for eggs and caterpillars (larvae). If Blackburn's sphinx moth eggs or larvae are present, arrangements will be made with U.S. Fish and Wildlife Service (USFWS) to protect these eggs or larvae from adverse impacts from project implementation. Protection may involve moving the larvae, under the supervision of USFWS and a professional entomologist, to another tree tobacco plant out of harms way.

The principal potential threats to the green sea turtle, identified above as likely to frequent the project area, are those associated with construction activity. The potential threats to the threatened and protected green sea turtle include the following construction activities:

- Noise
- Pollutants entering the ocean
- Lighting associated with nighttime construction activities
- Impact to nesting habitats
- Unintentional harassment or harm to turtles by construction equipment or personnel

The following Best Management Practices (BMPs) will be followed to avoid and minimize adverse impacts to threatened and endangered species of sea turtle that may be observed during construction. The following list of BMPs are based on recommended practices by the USFWS and the National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS), Pacific Islands Regional Office:

1. Trained biological monitors will inspect the beach each morning during the green sea turtle nesting period, between the months of May to November. If nests of the green sea turtle are found, the USFWS shall be contacted and as may be necessary appropriate measures shall be implemented to protect the nests.

2. Prior to the initiation of construction, a marine conservation-training program will be developed, and all construction and onsite managers will be required to attend training.

3. To minimize collateral damage to areas outside of the construction area, the special Contract Requirements will mandate that all construction activity be restricted to within the clearly delineated disturbance area.

4. Filling in the marine/aquatic environment will be minimized and the loss of special aquatic site habitat (wetlands etc.)and the unavoidable loss of such habitat will be compensated for;

5. All project-related materials and equipment (backhoes etc.) to be placed near the water will be cleaned and free of pollutants;

6. Project-related materials (fill, revetment rock, etc.) will not be stockpiled near the water (intertidal zones, reef flats, stream channels, wetlands etc.);

7. All debris removed from the marine/aquatic environment shall be disposed of at an approved upland dumping site;

8. No contamination (trash or debris disposal, alien species introductions etc.) of adjacent marine/aquatic environments (reef flats, channels, open ocean, stream channels, wetlands, etc.) will result from project-related activities;

9. Fueling of project-related vehicles and equipment will take place away from the water and a contingency plan to control petroleum products accidentally spilled during the project will be developed. Absorbent pads and containment booms will be stored on-site, if appropriate, to facilitate the clean-up of accidental petroleum

releases;

10. Any under-layer fills used in the project will be protected from loss with armor stones or concrete armor units as soon after placement as practicable;

11. Any soil exposed near water as part of the project will be protected from erosion (with plastic sheeting, filter fabric, etc.) after exposure and stabilized as soon as practicable;

12. Any construction-related debris that may pose an entanglement hazard to marine protected species must be removed from the project site if not actively being used and/or at the conclusion of the construction work;

13. Return flow of or run-off from excavated material stored at inland dewatering or storage sites will be prevented; and

14. Avoid drift of project-related materials to waterways and non-targeted sites.

Also, during the construction period, industry-standard BMPs will be employed to further avoid or minimize adverse effects on marine resources. The selected contractor will ensure employees maintain constant vigilance for the presence of ESA-listed marine species during all aspects of construction, particularly activities in or near the shoreline such as excavation, subgrade preparation, and placement of rock. The contractor will implement the following additional BMPS for the protection of ESA-listed marine species:

1. The project manager will designate an appropriate number of competent observers to survey the areas adjacent to the proposed action for ESA-listed marine species.

2. Surveys will be made prior to the start of work each day, and prior to resumption of work following any break of more than one half hour.

3. All work will be postponed or halted when ESA-listed marine species are within 50 yards of the proposed work, and will only begin/resume after the animals have voluntarily departed the area. If ESA-listed marine species are noticed within 50 yards after work has already begun, that work may continue if, in the best judgment of the project supervisor, that there is no way for the activity to adversely affect the animal(s). For example; workers performing surveys, or conducting

over-water work would likely be permissible, whereas operation of heavy equipment for rock placement is not.

4. Rock placement sites will be devoid of live corals, sea grass beds, or other significant resources.

5. Prior to construction employees during orientation will be informed not to attempt to feed, touch, ride, or otherwise intentionally interact with any ESA-listed marine species.

The incorporation of these BMP measures during construction will greatly avoid or minimize the potential for project related adverse impacts to marine resources.

6. Streams and Wetlands

a. Existing Conditions

There are no streams or wetlands located within the project site, however, the KPWS lies across Amala Place to the south of the WKWWRF. The pond was historically a natural pond which was used by early Hawaiians. However, due to drainage alterations in the area, water in the pond is now supplemented by an underground source pumped into KPWS. Since the early 1900s, it has served as a waterfowl refuge, however, parts of the sanctuary were used as a disposal site for dredged material during construction of the Kahului Harbor. In 1952, the site was designated as a wildlife sanctuary. In 1971, it was placed on the National Registry of Historical Natural Landmarks by the U.S. Department of the Interior, National Park Service (U.S. Army Corps of Engineers, 2003).

The KPWS is home to two (2) endangered endemic birds, the Hawaiian Stilt (Aeo) and the Hawaiian coot, along with a number of other migratory species. The sanctuary is also designated as a critical habitat for the endangered Blackburn's sphinx moth (U. S. Army Corps of Engineers, 2003).

b. Potential Impacts and Mitigation Measures

The construction of the proposed revetment extension would increase the level of protection along the shoreline of the project site and would further protect a portion of Kanaha Pond fronting the WKWWRF from wave overtopping. The March 11, 2011 magnitude 8.9 earthquake off the Pacific coast of Japan and subsequent tsunami resulted in waves overtopping the existing rock revetment and passing through the WKWWRF and into the KPWS. The proposed revetment expansion is intended to provide additional protection against high wave activity and tsunamis.

Potential impacts to the Hawaiian Stilt and Hawaiian Coot frequenting the Kanaha Pond from the proposed project are those associated with construction activity.

In order to minimize impacts to listed seabirds, all existing and additional lighting will be down-shielded. The development and implementation of a Seabird Response Plan will be prepared and followed during construction. The following information and protocols will be included in the plan as recommended by USFWS:

- Site preparation and construction of facilities will be assessed with respect to their risk of creating collision hazards for flying birds.
- Response plan for circling/downed birds: lights may be turned off temporarily *if it is safe* for workers and if birds are circling lights.
- Seabird awareness training for construction staff.
- Provision of an on-site list of qualified bird rescue contact(s) such as a local veterinarian or rehabilitation center and Hawaii Division of Forestry and Wildlife (DOFAW) representative.
- Procedures for active searching for downed birds around the project site.
- Maintenance of a pet carrier on site at all times with instructions on how and where to keep covered birds.
- Maintenance of a log of seabird incidences that will be submitted to the USFWS and DOFAW at regular intervals.

The Seabird Response Plan will be submitted to the USFWS for review and approval prior to commencement of construction.

7. Nearshore Marine Environment

a. Existing Conditions

There is a large fringe reef just offshore of the project site that extends for several miles along this beach. The reef is characterized by a wide crest (one-half (0.5) mile to one (1) mile in width) that extends from a shallow nearshore toe to depths ranging from 10 to 30 feet. Refer to **Appendix "C"**. Closer to Kahului Harbor, the reef is narrow or absent. The NOAA (2007) recently completed a characterization of the geomorphology and biology of the nearshore regions around Maui. The biological coverage maps indicate that the area fronting the WKWWRF contains pavement, scattered coral and rock, and sand. In this sense, the pavement is flat, solid carbonate rock that is often covered by a thin sand veneer.

The marine biota of the nearshore environment likely to be affected by the proposed project was surveyed by AECOS, Inc. in December 2009. Refer to **Appendix "I"**. Three (3) transects, with a total of 89 quadrat counts, were used to calculate bethnic community composition. Results of the point-intercept quadrat surveys show that zoanthids, sand, and algae (turf and foliose), make up the majority of the bottom (roughly 25 percent coverage for each within the survey area). The invasive red Algae (*Rhodopyta*), *Acanthophora spicifera*, and green alga (*Chlorophyta*), *Byropsis pennata*, are commonly observed growing on the hard substrata. Also common is the encrusting coralline red alga, *Hydrolithon reinboldii*. Present in low abundance are the red algal species *Amansia glomerata*, *Hydrolithon reinboldii*, *Martensia fragilis*, *Pterocladiella capillacea*, *Wranglia elegantisssima*, and the brown algae, *Dictyota friablis*, and *Sphacelaria rigidula*. Two endemic species (*Dotyella hawaiiensis* and *Wranglia elegantissima*) are present but rare. Smaller amounts of rubble (15 percent), crustose coralline algae (3 percent) and bare limestone (6 percent) are present. Only two (2) of the 89 quadrats surveyed contained live coral heads, both occurring on the eastern transect. Two (2) species of coral were identified: lace coral (*Pocillopora damicornis*) and cauliflower coral *(P. meandrina*). Coral cover accounts for less than one (1) percent of the area sampled by the transects, as calculated from the quadrat surveys. Refer to **Appendix "I"**.

Zoanthids *(Palythoa caesia* and *Zoanthus spp.*) are common in the surveyed area, found growing on exposed hard surfaces and partially buried in sand. Other invertebrates surveyed were surveyed in small numbers accounting for only about 0.2 percent of bottom cover. Glass anemone (*Aiptasia pulchella*), the most common, is found in crevices and growing alongside zoanthids. Turf tubeworms (*Mesochaetopterus sagittarius*), false opihi (Siphonaria normalis), and nerite snail (*Nerita picea*) is sighted occasionally. Other invertebrates seen rarely throughout the survey include the whitespotted cucumber (*Actinopyga mauritiana*), cone snails (*Conus sp.)*, brown purse shells (Isognomon perna), spiny brittle star (*Ophiocoma erinaceus*), pebble crab (*Liomera sp.*), and thin shelled rock crab (*Grapsus tenuicrustatus*). The black foot opihi (*Cellana exarta)* is the only endemic invertebrate species observed during the marine survey. Fishes are uncommon in the project area. The rock-mover wrasse (*Novaculichthys taeniourus*), striped mullet (*Mugi cephalus*), racoon butterflyfish (*Chaetodon lunula*), bright-eye damselfish (*Plecctorgylphidodon imparipennis*), and the black tail snapper (*Lutjanus fulvus*) are among the few fishes sighted during the survey. The Hawaiian green lionfish (*Dendrochirus barberi*) and the ornate wrasse *(Halichoeres ornatissimus*), both endemic to Hawaii, occur hiding in rubble. Refer to **Appendix "I"**. No green sea turtles were observed during the marine surveys but are known to frequent the waters fronting the WKWWRF.

b. <u>Potential Impacts and Mitigation Measures</u>

The marine life occurring in the project area likely to be impacted by the project is largely made up of algae, zoanthids, other invertebrates, and a few species of fish. Two (2) corals colonies were located in the area of potential effect. Both colonies were small and located approximately 50 feet offshore. Maintaining water quality through construction BMPs and avoiding directly impacting coral colonies by construction activities will avoid loss, damage and adversely impacting the coral colonies. Refer to BMP plan for construction in Section 5 (Flora and Fauna).

Short-term impacts from construction include the potential for increased turbidity of the coastal waters and excavation of sand to construct the revetment. Sand excavated during the construction of the revetment will be placed on top of the revetment upon its completion. As previously stated in Section 5 of Chapter II BMPs during construction will be implemented to minimize turbidity and to protect ESA-listed marine species.

8. Relative Sea Level Rise

a. Existing Conditions

Relative sea level changes in the Hawaiian Islands are caused by rising sea levels, as a result of global warming and land subduction. Land subduction is caused by the plate movements of the islands. Globally, the mean sea level (msl) has risen by 4 to 12 inches over the last century. Sea level is projected to rise twice this amount (2 feet) over the 21st Century (Fletcher, et al. 2002).

In the Hawaiian Islands, the long-term trend of sea level rise caused by land subduction decreases from the island of Hawaii to the northwest (D. Jeon, 1995). Therefore, the island of Maui subsides faster than Oahu and Kauai, since it is located closer to Hawaii. Tide gauge data from Kahului, Maui shows a relative sea level rise of 0.97 inches (±0.09) per decade.

Several studies indicate that future sea level rise may increase considerably (Fletcher, 1992 and Fletcher *et al.*, 2002). The median sea level increase on Maui is predicted to be 9.1 inches over the next 50 years and over 19 inches over the next century.

More recent work by Fletcher indicates that a sea level rise of 40 inches by 2100 is "highly likely" (Fletcher, 2008). The risk of sea level rise to Maui's critical infrastructure is highlighted in Norcross-Nu`u, Charles Fletcher, et al. 2008, *Bringing Sea-Level Rise Into Long-Range Planning Considerations on Maui, Hawaii*, where the WKWWRF is explicitly identified.

At the Kahului Beach area, the U. S. Geological Survey (USGS) profile data indicate the shoreline slope is approximately 10 feet horizontal to one foot vertical (Brown & Caldwell, 2002). With this slope, a one-inch change in sea level relates to a 9.7- inch change in the relative shoreline position per decade (approximately 0.081 feet per year, or 0.97 inch per year). Over time, the erosive effects of storms could be enhanced because of the rising sea levels.

b. **Potential Impacts and Mitigation Measures**

The proposed project itself will not affect the sea level. However, rising sea level could potentially impact the shoreline fronting the facility and pose a further risk to the WKWWRF itself. The latest research from the University of Hawaii Coastal Geology Group on sea level rise and coastal erosion has been reviewed as well as other reference material on this subject. The findings indicate a net addition of 0.002 inch per year or 0.072 inch per year over the next 50 years (design life of the WKWWRF shoreline protection project) to present sea level rise rate can be expected. As such the revetment height will need to be raised by approximately 36 inches to accommodate for sea level rise. The design height of the revetment structure has been increased from +10 feet msl to +13 feet MLLW to accommodate for anticipated future sea level rise.

9. Historical and Archaeological Resources

a. **Existing Conditions**

An archaeological field inspection was conducted on portions of the WKWWRF property in 2007 by Xamanek Researches, LLC for the tsunami protection project. See **Appendix "J"**. A wave cut bank was inspected near the boundary of the parcel closest to the shoreline. The inspection revealed previously disturbed sand; no cultural materials were noted in the cut bank.

Sand dune deposits were noted in all the non-built areas of the subject property, as well as along Amala Place. Of note was adjacent Kanaha Pond which has traditional cultural value and is identified by the State Historic Preservation Inventory Site No. 50-50-05-1783.

An Archaeological Assessment Survey (AAS) was conducted by Xamanek Researches LLC on the approximate one (1) acre project area of the proposed WKWWRF shoreline revetment extension. See **Appendix "J-1"**. The project area consisted of sand, sand dunes and vegetation. No historic sites or cultural resources were identified along the project alignment during the AAS.

Historical Context

Kanaha Pond and Mauoni Pond

Kanaha Pond and Mauoni Pond were directly across Amala Place and the WKWWRF and is designated State Inventory of Historic Properties (SIHP) No. 50-50-05-1783. Both Kanaha Pond and Mauoni Pond are shown on a 1881 Alexander map. However, between 1881 and 1922, Mauoni Pond was apparently filled. These ponds were built in a natural wetland that was located in this area. According to Samuel Kamakau, Maui high chief Kiha-a-Piilani was involved in the initial construction of a rock wall that originally divided these two (2) ponds, which is shown on the 1881 map. The two (2) ponds are also associated with an early 18th century Oahu high chief, Ka-pii-oho-o-kalani who ordered construction at the ponds, naming them for his son, Kanaha-o-ka-lani, and his daughter, Kahama-lui-hii-ke-ao-ihi-lani.

A narrow extension of the pond on its northwestern corner was said to have connected to the ocean near an old landing to the west of the present Pier 1 in Kahului Harbor. The pond area was again impacted by human activity around 1910 when Kahului Harbor was first dredged.

In the late 1970s, the USACE approved a flood control project which created a network of drainage canals that served to channel groundwater out of the developing Kahului Industrial Area to the ocean. One (1) of these drainage canals exits to the ocean west of the WKWWRF.

Kahului Railroad

The Kahului Railroad originated from the harbor to Wailuku Sugar Mill parallel to Lower Main Street and was one of the first commercial projects to impact the dune on the south side of Iao Stream. The remnants of this old railroad bed can still be noted in a few places along Lower Main Street and along Kahului Beach Road.

The most striking architectural remnants of the railway system is located along Kahului Beach Road near its intersection with Kanaloa Avenue on the mauka side of the roadway. There are five (5) concrete pillars and arches of the former Makaweli Rock Crusher Mill, the most visible one impressed with the date "1921".

The railroad also connected Kahului Harbor to the Spreckelsville and Haiku areas. The 1881 map identifies the route of the railroad running parallel to the ocean following the alignment of Amala Place near the WKWWRF and Kanaha Pond.

b. <u>Potential Impacts and Mitigation Measures</u>

Due to the presence of sand deposits and the location of the project near the shoreline, construction of the proposed action would include precautionary archaeological monitoring. A general Archaeological Monitoring Plan was prepared and submitted to the State Historic Preservation Division (SHPD) for review and approval prior to ground disturbing activity for the proposed tsunami protection project. See **Appendix "J-2"**. The SHPD approved the Archaeological Monitoring Plan. See **Appendix "J-3"**. In their approval the SHPD noted that any future onsite improvements planned for the WKWWRF will be covered by this approved Monitoring Plan but will require the submittal of phased monitoring reports. As such, the current Monitoring Plan will be used to cover the shoreline protection project at the WKWWRF and a phased monitoring report will be submitted to SHPD as set out in SHPD approval letter.

Due to the realignment of the revetment further inland, an AAS was prepared in 2012. Refer to **Appendix "J-1"**. The AAS indicated the project area has been impacted by previous and current earth moving activities associated with the WKWWRF as well as natural occurring activities such as the tides and the March 2011 tsunami.

The significance evaluation for the WKWWRF is based on the Rules Governing Procedures for Historic Preservation Review (DLNR 1996; Chapter 275) which includes the following criterion:

> ***Criterion "a":*** *Be associated with events that have made an important contribution to the broad patterns of our history;*
>
> ***Criterion "b":*** *Be associated with the lives of persons*

important in our past;

Criterion "c": *Embody the distinctive characteristics of a type, period, or method of construction; represent the work of a master; or possess high artistic value;*

Criterion "d": *Have yielded, or is likely to yield, important information for research on prehistory or history;*

Criterion "e": *Have an important traditional cultural value to the native Hawaiian people or to another ethnic group of the state due to associations with traditional cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts.*

The AAS did not locate any above ground surface remains or significant subsurface material remains. As previously stated, precautionary monitoring is recommended, due to the presence of intact marine sand deposits in portions of all test trenches excavated on the project area.

Further, should any archaeological remains be encountered during construction, work in the vicinity of the find will be stopped and the SHPD will be contacted to establish appropriate mitigation measures in accordance with Chapter 6E, Hawaii Revised Statutes.

10. Cultural Assessment

a. Settlement Patterns and Existing Conditions

The WKWWRF site is a developed property that has been heavily altered since it was constructed in 1973. The project site falls within the limits of what was once called Kaa Lands, or Wailuku Commons, a region which covered about 24,000 acres between Wailuku and Paia (Monsarratt, 1882). In 1882, Claus Spreckels acquired fee simple title to all of Wailuku ahupuaa, including the Commons (Kennedy et al., 1993). Later that year, Spreckels founded Hawaiian Commercial and Sugar Company (HC&S), and within a short time, developed a state-of-the-art sugar mill, as well as a support system of railways and irrigation ditches (Kennedy et al, 1993).

A 1882 map of Kahului Harbor (Monsarratt, 1882) shows the Commons as vacant land south of Kahului town, which was then a mixture of about 20 buildings and a wharf (Jackson, 1881). Around the same time, the area was described as *"a complete desert, a great, barren stretch of sand and dust spread from Wailuku to Paia, except for a little cattle grazing around the present location of Spreckelsville"* (Burns, 1991). A 1881 map by Jackson of the surrounding area shows "undulating sand hills" crossed only by dirt roads and the railroad line to Paia, while a 1910 map by Shoemaker shows the seaward half of the area as "pasture".

In 1942, the U.S. Government annexed 3,800 acres at Puunene and Kahului for the construction of naval air stations. At Kahului, 1,350 acres were leased from HC&S for Naval Air Station Kahului (NASKA). Remnants of an old WWII pill box from Navy use of the area remain offshore in front of the treatment plant. In the early 1950's, NASKA was taken over by civilian authorities for public airport purposes (present-day Kahului Airport). In recent decades, the Kahului Airport has been expanded into today's configuration.

Traditional and customary native Hawaiian rights exercised in the area relate to access to beach and marine resources and access to the adjacent Kanaha Pond, a significant cultural resource. The proposed project will not limit, alter, or interfere with access to Kanaha Pond.

b. Potential Impacts and Mitigation Measures

The Cultural Impact Assessment (CIA) was conducted in accordance with the State of Hawaii Office of Environmental Quality Control (OEQC) Guidelines for Assessing Cultural Impacts (1997) and includes oral interviews with knowledgeable native Hawaiian practitioners familiar with the surrounding area. See **Appendix "K"**.

The following are summaries of the cultural interviews conducted between June and September, 2010.

1. Clifford Naeole

Clifford Naeole is the Cultural Advisor to the Ritz-Carlton Kapalua Resort and was born and raised on Maui. Mr. Naeole's paternal grandfather was of Hawaiian descent and lived in Waihee as a taro farmer. Mr. Naeole recalled that it was common for his paternal grandfather to go diving the length of Kanaha beach to Paukūkalo, often in the span of a single afternoon. Mr. Naeole's maternal grandfather, Henry Ching, was of Chinese descent and an avid fisherman. Mr. Naeole recalled that his maternal grandfather once claimed a catch that numbered a total of one-hundred and twenty-eight fish. It was from his maternal grandfather, Henry Ching, that Mr. Naeole ultimately learned how to fish—how to spot fish in the water and where the best places to fish were.

As a youth, Mr. Naeole frequently played amongst the beaches of Kahului, from the harbor all the way up to NASKA. In those days, Mr. Naeole recalled the town of Kahului being a small town with limited development. He lived in a house on Temple Street which serviced a total of only 5 homes. Across the street from his house was a sausage making company and a few commercial office buildings lay scattered throughout the area. The Kahului Railroad, which his grandfather worked for, ran right through town, passing right next to their house. The few families that lived there were fishing families, including the Aikaus (of Eddie Aikau fame) and the Melamai's.

According to Mr. Naeole, fishing was a widespread practice in this area. It was the favorite place of ulua fishermen and Mr. Naeole himself would often fish from a pier in the harbor. He remembers that there were plenty of fish in the area, including Halalu, Manini, Aholehole, Kawakawa, and even Barracuda. Besides fishing, other activities such as crabbing, opihi picking, and limu gathering were commonly performed. According to Mr. Naeole, in those days there were many different varieties of limu. However, since dredging of the harbor began, the production of limu began to change. Since around the early 80's, Mr. Naeole observed a strange increase in the growth of foreign limu, with Vaivaiole as the predominant species. He believes that the influx of limu dampened fishing practices in the area.

Mr. Naeole cites the dredging of Kahului harbor as having a major impact on Kahului waters. Before the dredging occurred, he explained that waters at Kanaha and Kahului were clear and clean. After the dredging however, water inside the harbor became milky-colored and dirty, and the water quality outside the harbor changed too. The dredging of the harbor also seemed to affect changes in wave breaks of the area.

Now, Mr. Naeole says the fishing and limu gathering in the Kahului area are not as plentiful as they were before. However, Mr. Naeole knows that people still use the area for fishing, diving, surfing, canoe paddling, and shoreline gathering. He isn't aware of any other cultural activities in the vicinity of the project site.

The only concerns that Mr. Naeole has in regards to the project is whether or not the Wailuku-Kahului Wastewater Treatment Plant's facilities are up to date. He recalled an incident that happened about six years ago when run-off from the treatment plant spilled over onto the road. He hopes that appropriate measures will be taken to ensure that something like that will not happen again.

2. **<u>Hokulani Holt</u>**

Hokulani Holt, the Director of Cultural Programs at the Maui Arts and Cultural Center, was raised in Waiehu. Ms. Holt's familial roots in the area go back six generations and, as a result, she is very familiar with historical and current cultural practices that occur in the area.

As a youth, Ms. Holt recalled that her grandparents would often take her to the various beaches from Waihee to Kaa, or Kanaha, for shoreline gathering. Her family would also frequent the Kanaha area and would often partake in limu gathering, fishing, and collecting kiawe. Ms. Holt explained that historically, land in the vicinity of the WKWWRF was actively used by many fishing families for net-laying, diving and throw-netting. There were also many families in the area, primarily of Hawaiian, Japanese, and Portuguese descent, that lived in Quonset huts built for the Naval Air Station.

Ms. Holt acknowledged that in recent years limu growth in the area has subsided, most likely due to the construction of a drainage ditch, located to the west of the WKWWRF, which empties out into the waters off Kanaha. She believes that the drainage ditch altered the quality of the ocean waters and affected limu growth in the area. However, Ms. Holt explained that there are still people who continue to utilize the area today. Kaunaoa, a native Hawaiian plant which is bright orange and stringy in appearance, is often gathered along Kanaha beach for hula and lei-making. Other cultural practices such as diving, shoreline fishing, and kiawe cutting for imu preparation are still performed in the area.

Ms. Holt does not believe that the proposed project will impact coastal waters, however, she is concerned that implementing a revetment would lead to increased erosion of the beach. Ms. Holt also wants to ensure that public access to the beach area will be maintained, to allow the continuation of cultural practices within the area, as well as to ensure that future cultural practices will be allowed to flourish. Finally, Ms. Holt voiced her concerns for fishing koa, or fishing houses, that may be located offshore of the project site. She explained that the fishing koa are used as fishing sites for local fisherman familiar within the area. She expressed concern that wave action and underscouring at the toe of the revetment will affect off-shore currents and impact marine habitats and the fishing koa sites.

3. **<u>Ki`ope Raymond</u>**

Ki`ope Raymond was born in Lahaina, Maui, sharing the same birthplace as his mother. His father was from Kauai. As Mr. Raymond grew older, he moved from island to island. After attending college on the mainland at Oregon State, he developed a renewed passion for Hawaii and the Hawaiian culture. As a native Hawaiian himself, Mr. Raymond pursued a growing interest in Hawaiian studies, collecting knowledge from family members and taking classes at Maui Community College (now the University of

Hawaii-Maui College) and the University of Hawaii at Manoa. He continues to share his knowledge with others, having taught in the Hawaiian Studies program at University of Hawaii - Maui College (UH-Maui), as well as participating in a variety of community organizations, such as the Lahaina Restoration Foundation, the Friends of Haleakala, and Surfrider Foundation. In addition, Mr. Raymond serves as the President of the Kilakila O Haleakala Organization.

Historically, the land in the vicinity of the WKWWRF was used by the Hawaiian people for providing sustenance. Few people lived in the immediate area, but the area was frequently visited by the people of Wailuku. Kanaha Pond and the neighboring Mauoni Pond were used for aquaculture to raise fish for the alii and the populace. Mr. Raymond explained that the Hawaiian word *naha* literally means "to burst out". During periods of heavy rain, the waters would flow out of Kanaha Pond towards the ocean.

Nowadays, there is no formalized aquaculture in the ponds. However, the coastal area from Spreckelsville to Waihee is still recognized for its resources. In the area by the WKWWRF, Mr. Raymond noted that people perform a variety of cultural practices, such as gathering limu (seaweed), fishing by shore-casting and net-laying, and catching tako (octopus). The nearby area is also a popular site for surfing and kite surfing, as Mr. Raymond and many others often visit the adjacent Kanaha Beach Park to take part in these activities.

Mr. Raymond does not believe that the proposed project will have impacts related to the historical uses of Kanaha Pond, since the WKWWRF is already there. However, his main concern is the possible impacts to cultural use from beach loss. Impacts to Kanaha Beach Park would affect him personally, since he surfs and spends time there. He doesn't believe the project would change the surf break, but the project could disrupt fishing and gathering practices if it leads to a loss of sand. He also requested that careful attention be given to any significant archaeological finds discovered during the construction of the project.

Based on the information provided the proposed project is not anticipated to adversely impact native Hawaiian cultural practices. The exposed crest of the revetment structure would allow lateral shoreline access fronting the WKWWRF site should beach loss occur and a stairway incorporated in the exposed portion of the revetment structure will provide access to the beach.

In accordance with Section 6E-43.6, Hawaii Revised Statutes, and Chapter 13-300, Hawaii Administrative Rules, if any significant cultural deposits or human skeletal remains are encountered during construction, work will stop in the immediate vicinity and the SHPD will be contacted. Specific protocols will be incorporated into the Archaeological Monitoring Plan.

11. Air Quality

a. Existing Conditions

Air quality in the Wailuku-Kahului region is considered good, as point sources (e.g., Maui Electric Power Plant, HC&S Mill) and non-point sources (e.g., automobiles) of emissions do not generate problematic high concentrations of pollutants. The relatively high quality of air can also be attributed to the region's constant exposure to the northeast trade winds ranging from 10 to 25 mph which quickly disperse emissions.

b. Potential Impacts and Mitigation Measures

Short-term impacts on air quality may result from construction-related activities. BMPs will be implemented such as dust fences and watering to control wind-blown dust, to minimize such impacts. The revetment extension will not generate additional emissions and in the long term, adverse impacts to air quality associated with the proposed project are not anticipated.

12. Noise Characteristics

a. Existing Conditions

Traffic noise generated by vehicles traveling along Hana Highway and Kaahumanu Avenue is a source of background noise in the vicinity of the plant. The predominant factor in noise quality is aircraft traffic utilizing the Kahului Airport. Ambient noise in the vicinity is also generated by wind and surf from the adjacent marine environment.

b. Potential Impacts and Mitigation Measures

Ambient noise conditions may be temporarily affected by construction activities in the short term. Potential noise impacts from equipment will be mitigated by maintenance of mufflers or noise attenuated equipment and on equipment engines. In the long term, adverse noise impacts associated with the proposed project are not anticipated.

13. Water Quality

a. Existing Conditions

The coastal nearshore waters fronting the project site are classified "Class A" waters according to the State Department of Health Water Quality Standards Map of the Island of Maui (October 1987). Pursuant to Hawaii Administrative Rules (HAR) Chapter 11-54, it is the objective of Class A waters that their use for recreational purposes and aesthetic enjoyment be protected. Any other use shall be permitted as long as it is compatible with the protection and propagation of fish, shellfish, and wildlife, and with recreation in and on these waters.

An assessment of the inshore and offshore water quality in the project was carried out for the EIS. Refer to **Appendix "I"**. Water samples were collected in and around the project site and analyzed for temperature, salinity, dissolved oxygen (DO), phosphorus (pH) values, as well as for turbidity and total suspended solids (TSS), and concentrations of ammonia nitrate-nitrite, total nitrogen (TN), total phosphorus (TP) and chlorophyll.

Water samples were collected and field parameters measured at three (3) water quality stations off the shore fronting the proposed project area on three (3) sampling events in December (11, 17 and 22), 2009. One station was located near the western end of the project area, a mid station was located approximately in the middle of the project area, and an eastern station was located off of the eastern portion of the existing rock revetment.

A summary of the water quality results (means) for temperature, salinity, pH and dissolved oxygen are presented in **Table 2**.

Table 2. Summary (Means) of Marine Water Quality Characteristics of WKWWRF Shoreline*

Station	Temp. (°C)	Salinity (PSU)	pH	DO (mg/l)	DO Sat.** (%)
West	25.1	33.43	8.05	6.88	101
Mid	25.0	33.40	7.97	6.88	101
East	25.4	33.15	8.12	6.85	101

* From three (3) Sample Events
** Saturation
Source: AECOS, Inc. 2010

For complete results, refer to Appendix "A" of AECOS, Inc 2010 report in **Appendix "I"** of this report.

The stations had very similar water temperature, dissolved oxygen (DO), pH and salinity. The pH was normal for seawater and similar at all three (3) stations. Mean salinities were 33 PSU (practical salinity units), typical for seawater.

Geometric means were calculated for particulates (turbidity and TSS) and for nutrients. The results are presented in **Table 3**.

Table 3. Summary (Geometric Means) of Nutrients, and Chlorophyll α in Marine Waters Off of the WKWWRF Site*

STA.	TSS (mg/L)	Turbidity (NTU)	Ammonia (μg N/L)	Nitrate + Nitrate (μg N/L)	Total Nitrogen (μg N/L)	Total Phosphorus (μg P/L)	Chl. α (μg/L)
West	10.14	6.32	4.48	59.42	253.87	25.41	0.90
Mid	11.11	5.36	4.90	61.94	248.90	21.86	0.97
East	11.39	7.00	7.36	144.45	378.24	30.72	0.80

* From three (3) Sample Events
Source: AECOS, Inc. 2010

For comparison purposes, the State of Hawaii water quality criteria for Class A, marine open coastal waters are presented in **Table 4**.

Table 4. State of Hawaii Water Quality Criteria for Class A, Marine Open Coastal Waters

Parameter units		Turbidity (NTU)	Ammonia (μg N/L)	Nitrate + Nitrite (μg N/L)	Total Nitrogen (μg N/L)	Total Phosphorus (μg P/L)	Chl. α (μg/L)
Geometric mean not to exceed given value	Wet*	0.50	3.50	5.00	150.00	20.00	0.30
	Dry**	0.20	2.00	3.50	110.00	16.00	0.15
Value not to be exceeded more than 10% of the time	Wet*	1.25	8.50	14.00	250.00	40.00	0.90
	Dry**	0.50	5.00	10.00	180.00	30.00	0.50
Value not to be exceeded more than 2% of the time	Wet*	2.00	15.00	25.00	350.00	60.00	1.75
	Dry**						

* Wet criteria apply when the average fresh water inflow from the land equals or exceeds one percent of the embayment volume per day.

** Dry criteria apply when the average fresh water inflow from the land is less than one percent of the embayment volume per day.

The following non-specific criteria are applicable to both "wet" and "dry" conditions.

- pH shall not deviate more than 0.5 units from 8.1, except at coastal locations where and when freshwater may depress the pH to a minimum of 7.0.
- Dissolved oxygen shall not be less than 75% saturation.
- Temperature shall not vary more than 1 °C from ambient.
- Salinity shall not vary more than 10 percent from natural or seasonal changes.

Source: Hawaii Administrative Rules, &11-54-6(b)(3). Department of Health, 2004

In comparison to the State standards, TSS, turbidity, and concentrations of ammonia, nitrate+nitrite, total nitrogen and total phosphorus were elevated at all three stations. The eastern station means for nitrate+nitrite and total nitrogen were especially elevated. The Chlorophyll ∝ in the water column gives an indication of the phytoplankton biomass present and was high at all three stations, ranging from 0.80 to 0.97 ug/L.

b. <u>Potential Impacts and Mitigation Measures</u>

Water quality (measured on three sampling events) in front of the WKWWRF project site showed temperatures, DO, pH and salinity values within the normal ranges. The salinity values (in the range of 33.4 PSU) indicate that fresh or brackish water inputs were evident along the surveyed shoreline. TSS, turbidity and concentrations of TN, TP, nitrate + nitrite and chlorophyll were clearly elevated with respect to State Water Quality criteria at all three stations. The proximity of the sampling stations to the shore where the heavy wave and surge activity may explain the elevated TSS and turbidity by suspending bottom sediments. The concentrations of ammonia, nitrate+nitrite, TN and TP values at the Eastern Station were especially high. The AECOS, Inc report indicated the elevated nutrient levels may reflect groundwater inputs at the shore. Refer to **Appendix "I"**. Sources of groundwater could include the injection well, and the asphalt pond upland from the revetment, at the WKWWRF and Kanaha Pond, mauka of the project site. Rainwater and irrigation water applied to fertilized agricultural lands in central Maui drain into Kahului Bay and surrounding waters through the aquifer and surface waterways like Kalialinui Gulch located 2,100 feet to the east of the project site can also elevate nutrient levels and influence salinities (Brown and Caldwell, 2004). The proposed extension of the revetment is not connected or related to the sources of the elevated nutrient levels found off shore to the WKWWRF site. Therefore, the proposed project is not anticipated to have an adverse effect on the nutrient levels in the nearshore environment.

Construction of a revetment structure and construction activities involving mechanical equipment in the vicinity of the shoreline can lead to turbidity during the construction period. Typically, this type of turbidity is short term, limited in spatial extent, and similar to the turbidity experienced in a high-wind event.

A water quality monitoring program will be implemented for the project. The program will include collection of baseline water quality data prior to the initiation of construction in order to measure any degradation of water quality that may be attributable to the construction activity. BMPs will also be followed during construction to mitigate adverse impacts to water quality and to minimize sediment and storm water runoff from entering the nearshore marine environment. The BMPs will include but not be limited to the following practices: silt containment devices around the area of construction, no construction material will be stock piled near the shoreline, fueling of project related vehicles and equipment will take place away from the shoreline, underlayer fills will be protected from erosion with filter fabric as soon after placement is practical, return flow or runoff from excavated material will be stored at inland dewatering or storage sites, all debris removed from the shoreline environment will be disposed of at an upland dumping site, and any soil exposed near the water will be protected from erosion after exposure and stabilized as soon as practicable.

Temporary increases in turbidity as a result of construction activities will cease once the project is completed. Further, the proposed rock mound revetment is anticipated to reduce the amount of sand sediment input into the marine environment currently resulting from beach erosion. More importantly, the revetment is designed to prevent erosion and damage that could lead to a large-scale release of sewage and/or treatment byproducts into the marine environment. Coordination with the State Department of Health, Clean Water Branch, will be undertaken to address applicable permitting requirements for the proposed action.

14. Scenic and Open Space Resources

a. Existing Conditions

Scenic and open space resources to the south of the project site include the KPWS, and beyond, the West Maui Mountains. Toward the east is Kanaha Beach Park, while the Pacific Ocean and a stretch of sandy beach lie to the north. The majority of undeveloped lands in the Central Maui isthmus is utilized for sugar cane cultivation. This agricultural use creates a vast expanse of sugar cane fields that establishes and dominates the open space character of the region. The stretch of sandy beach fronting and to the north and east of the project site also establishes the open space character along the coastline. There is a public beach access to the east of the subject property.

The site currently has a 450-ft rock revetment in front of the WKWWRF Retention Pond. This existing revetment has been in place for over 30 years.

b. Potential Impacts and Mitigation Measures

The site is located in an area that is both industrial and natural. Public use of the shoreline in front of the WKWWRF is, however, limited relative to neighboring beaches. The public beach access to the east of the subject property will not be adversely impacted by the proposed project. Due to the existing revetment, a portion of the shoreline already has a rock structure. The extension of the revetment would not adversely impact the visual and open space resources in the area. The beach along this section of coastline is experiencing annual erosion rates ranging from nil to over five (5) feet per year. The AEHR fronting the project site is -2.4 feet per year. The revetment structure will protect the property from erosion. However, the revetment was moved inland to reduce potential impacts to the sandy beach fronting the WKWWRF.

B. SOCIO-ECONOMIC ENVIRONMENT

1. Population and Demographic

a. Existing Conditions

Maui County has experienced strong growth in recent years. From 2000 to 2010 the population in Maui County increased 20.9 percent from 128,094 to 154,834 residents (U. S. Census, 2010). Growth in the County is expected to continue with the resident population projected to increase to 174,450 residents by 2020 and 199,550 residents by 2030 (County of Maui, June 2006). In order to accommodate this growth, the County of Maui has established the parameters for future growth in the Draft Maui Island Plan to the target year of 2030. The County of Maui has determined the shoreline protection, as well as capacity upgrades at the WKWWRF will be necessary to ensure the facility will be able to meet the anticipated increases in wastewater flow in the Central Maui region.

b. Potential Impacts and Mitigation Measures

The proposed project is not a direct generator of population, nor will it alter the demographic characteristics of the area. With the proposed shoreline protection in place, the WKWWRF will be better equipped to serve the long-term wastewater needs of Central Maui residents. The WKWWRF will also be able to provide its services without vulnerability to interruption or damage to the facility caused by erosion.

2. Economy

a. Existing Conditions

The Kahului region is the island's center of commerce. Combined with neighboring Wailuku, the region's economic character encompasses a broad range of commercial, service, and governmental activities. In addition, the region is surrounded by significant agricultural acreages, which include sugar cane fields. The vast expanse of agricultural land, managed by HC&S, is considered a key component of the local economy.

Visitor arrivals on the island of Maui were at 2,692,068 in 2010, with the vast majority arriving by air (Maui County Data Book, 2011).

The unemployment rate for Maui County and Maui Island were 6.5 and 6.3 percent respectively, in April 2012 (Hawaii Workforce Informer, June 2012). The unemployment rate for the same period in 2011 for Maui County and Maui Island were 7.5 and 7.4 percent, a decrease of 1.0 and 1.1 percent, respectively.

b. Potential Impacts and Mitigation Measures

Short-term economic benefits are expected as a result of project construction. Beyond the short-term effects, the proposed project will also have indirect positive impacts on the economy by protecting long-term wastewater handling capacity in the Central Maui Region. An anticipated additional positive impact resulting from project implementation is increased safety for the public due to the reduction of risk of damage to the WKWWRF from shoreline erosion. The proposed revetment would also provide a last line of defense against a tsunami. The proposed action has been identified as the most cost-effective solution for the facility and it does not place an undue burden on taxpayers, especially in comparison to other alternatives considered, including relocating the facility inland.

C. PUBLIC SERVICES

1. Recreational Facilities

a. Existing Conditions

County recreational facilities are administered and maintained by the Department of Parks and Recreation. The Wailuku-Kahului region contains a network of recreational facilities comprised of mini-parks, as well as neighborhood and district parks. The region's seven (7) mini-parks are distributed uniformly throughout the area, while the region's eleven (11) neighborhood and three (3) district parks provide a wide range of facilities to meet the recreational needs of the community.

In the vicinity of the project site, a wide range of shoreline and ocean recreation activities such as boating, fishing, diving, surfing, canoeing, kayaking, picnicking, kitesurfing, and windsurfing are available at the Kahului Harbor and nearby beach parks. County parks in the vicinity include Kanaha Beach Park, Baldwin Beach Park, Hoaloha Park, Kahului Community Center, Keopuolani Park, and the War Memorial Sports Complex. The site is also within proximity of the State's Iao Valley Park.

b. Potential Impacts and Mitigation Measures

The shoreline fronting the facility sees only limited use by the public. The proposed project has potential impacts on the stretch of shoreline fronting the facility as well as the adjacent shoreline. These include possible beach loss and loss of lateral access due to passive erosion. Although there may be loss of beach and access, the proposed improvements will protect a critical public facility and ensure the public's health and safety over the long term. The exposed crest of the revetment structure would allow lateral access by the public should beach loss occur and a stairway incorporated in the exposed portion of the revetment structure will provide access to the beach.

2. Police and Fire Protection

a. Existing Conditions

Police protection for the Wailuku-Kahului region is provided from the Maui

Police Department (MPD) headquarters in Wailuku, approximately 2.5 miles from the project site. The region is served by the Department's Central Maui patrol.

Fire prevention, suppression, and protection services for the Wailuku-Kahului region are provided by the Department of Fire and Public Safety's Wailuku Station, located in Wailuku Town about three (3) miles from the project site, and the Department's Kahului Station, which is located on Dairy Road less than one (1) mile to the south of the subject property.

b. **Potential Impacts and Mitigation Measures**

The proposed project is limited in scope to provide shoreline erosion protection at the existing WKWWRF. It is not anticipated to have an adverse impact on police and fire services. The proposed structure will not extend existing service limits for emergency services.

3. **Solid Waste**

a. **Existing Conditions**

Single-family residential solid waste collection service is provided by the County of Maui on a regular basis. Residential solid waste collected by County crews is disposed of at the County's Central Maui Landfill, located four (4) miles southeast of the Kahului Airport. In addition to County-collected refuse, the Central Maui Landfill accepts commercial waste from private collection companies. Refuse collection for the WKWWRF is provided by County refuse collection service.

b. **Potential Impacts and Mitigation Measures**

The proposed project is limited in scope to provide shoreline erosion protection at the existing WKWWRF. It is not anticipated to have an adverse impact on solid waste services. Construction waste will be minimal. Other excavated material will either be stockpiled onsite or trucked to the Maui Disposal construction waste site for disposal, as necessary.

4. Medical Services

a. Existing Conditions

Maui Memorial Medical Center, the only major medical facility on the island, services the Wailuku-Kahului region. Acute, general, and emergency care services are provided by the 231-bed facility. In addition, numerous privately operated medical/dental clinics and offices are located in the area to serve the region's residents.

b. Potential Impacts and Mitigation Measures

The proposed project is limited in scope to provide shoreline erosion protection at the WKWWRF. The proposed project is not anticipated to adversely impact medical services.

5. Schools

a. Existing Conditions

The Wailuku-Kahului region is served by the State Department of Education's public school system, as well as several privately operated schools accommodating elementary, intermediate, and high school students. Department of Education facilities in the Kahului area include Lihikai, Pomaikai, and Kahului Elementary Schools (Grades K to 5), Maui Waena Intermediate School (Grades 6 to 8), and Maui High School (Grades 9 to 12). Existing facilities in the Wailuku area include Wailuku Elementary School (Grades K to 5), Iao Intermediate School (Grades 6 to 8), and Baldwin High School (Grades 9 to 12).

b. Potential Impacts and Mitigation Measures

The proposed project is not a generator of population. As such, no impacts to existing schools and educational services are anticipated from the proposed action.

D. INFRASTRUCTURE

1. Roadways

a. Existing Conditions

The Wailuku-Kahului region is served by a roadway network which includes arterial, collector, and local roads. Major roadways in the vicinity of the project site include Hana Highway, Dairy Road, Keolani Place, and Hobron Avenue.

Access to the project site is provided by Amala Place via Hana Highway and Hobron Avenue through the Kahului Harbor industrial area.

In proximity of the project site, Hana Highway has an east-west orientation and functions as a four-lane, major divided State arterial highway which links East Maui and Central Maui. The posted speed limit on Hana Highway is 45 miles per hour (mph) at the approaches to the Dairy Road and Hobron Avenue intersections.

Amala Place is a two-lane, east-west County road that provides access to the KPWS and Kanaha Beach Park. The posted speed limit on Amala Place is 30 mph. The project site is located to the north of Amala Place.

b. Potential Impacts and Mitigation Measures

Traffic to and from the WKWWRF will, for the most part, be limited to vehicles of operations personnel and employees. Traffic resulting from these sources will be intermittent and is not anticipated to significantly impact existing traffic conditions along Hobron Avenue, Amala Place, or other area roadways. A construction traffic management plan will be prepared and submitted to the Department of Public Works and Police Department for review and approval during the permitting process to address the increased construction traffic and transport of boulders to the site. Increased construction traffic will be temporary and intermittent duration and will be mitigated by the construction management plan. The proposed shoreline protection measures are not anticipated to increase traffic at the WKWWRF in the long term. The proposed project would provide a benefit to Amala

Place by preventing further shoreline erosion along this section of roadway in to the future.

2. Wastewater

a. Existing Conditions

Domestic wastewater generated in the Wailuku-Kahului and Paia regions are conveyed to the WKWWRF. As previously mentioned, the design capacity of the facility is 7.9 million gallons per day (MGD). Cumulative wastewater flow currently allocated is approximately 6.6 MGD.

b. Potential Impacts and Mitigation Measures

The proposed improvements will not involve any increase in wastewater flows. The proposed project will protect the WKWWRF site from shoreline erosion and result in the long-term viability of the facility to meet the wastewater processing requirements for Central Maui in an efficient and cost-effective manner. Taking action to protect the facility from shoreline erosion is critical, and the no action alternative is highly undesirable because it places the facility and the nearshore environment at a high risk of damage.

Based on the DEM's Central Maui Wastewater Reclamation Facility Study (Austin, Tsutsumi & Associates, 2006), the demand for additional wastewater treatment capacity would be triggered in 2029, when the existing WKWWRF is projected to reach its design capacity of 7.9 MGD.

3. Water

a. Existing Conditions

Domestic water for the Wailuku-Kahului region is provided by the Department of Water Supply's (DWS) Central Maui Water System.

The project area is served by the DWS system. The source for this water is the Waihee wells that were developed by the Central Maui Source Joint Venture. The three (3) developed wells currently have a total capacity of 13.5 MGD. The water storage tanks that serve the system for this area are located in Wailuku.

b. Potential Impacts and Mitigation Measures

The proposed shoreline protection structure is not anticipated to increase water demand at the project site. It is not located near the water source and would not have an impact on source water quality.

4. Drainage

a. Existing Conditions

Currently there are no drainage improvements at the WKWWRF project site. The existing site is generally flat and the total surface runoff generated from the site is approximately 39.03 cubic feet per second (cfs). The subject property can generally be broken into four (4) drainage areas. Runoff from a small portion of the subject property (approximately 1.23 cfs) currently sheetflows off the site in a northerly direction towards the shoreline. The runoff from the other drainage areas sheetflows over the property towards the existing roadway, Amala Place, and to the adjacent properties (SSFM, 2008).

b. Potential Impacts and Mitigation Measures

The revetment structure could affect the drainage from the portion of the project site that currently sheet flows towards the shoreline by creating a barrier to the existing drainage flow. However, the runoff towards the shoreline is small compared to the total runoff from the property and is not anticipated to adversely impact drainage on the site.

During construction appropriate BMPs will be implemented to protect water quality and the marine environment from construction activity and stormwater runoff. The following recommended BMPs will be implemented:

BMPS to prevent contamination of the marine environment from project-related activities:

1. A contingency plan to control toxic materials will be developed and implemented.

2. Appropriate materials to contain and clean potential spills will be stored at the work site and be readily available.

3. No project-related materials (fill, sediment stockpile, rock, etc.) will be stockpiled near the water (intertidal zones, reef flats, stream channels, wetlands etc.). A material staging and storage area will be designated within the WKWWRF and equipped with sediment control BMP's to prevent loss of material due to erosion or leaks.

4. All project-related materials and equipment placed in the water will be free of pollutants.

5. Any materials or equipment to be used to carry out the authorized work must be cleaned of pollutants before use in or over the water.

6. The project manager and heavy equipment operators will perform daily pre-work equipment inspections for cleanliness and leaks. All heavy equipment operations will be postponed or halted should a leak be detected, and will not proceed until the leak is repaired and equipment cleaned.

7. Fueling of land-based vehicles and equipment will take place at least 50 feet away from the water, preferably over an impervious surface.

8. Turbidity and siltation from project-related work will be minimized and contained through the appropriate use of erosion control practices, effective silt containment devices, and the curtailment of work during adverse weather and tidal/flow conditions.

9. The Contractor will conduct daily visual observations to ensure that control measures are in place and functioning properly. If an activity-related plume is observed outside of the silt curtain, the Contractor will stop that activity and take immediate corrective action. Activity will resume only after the problem is corrected.

10. In addition to daily visual observations, the Contractor will conduct periodic water quality monitoring during periods of in-water construction to validate the effectiveness of the containment device.

11. The contractor will employ construction debris control devices such as booms, tarpaulins, floats, or other devices as necessary to prevent construction debris from entering the water and airborne materials from leaving the immediate vicinity of the site.

12. All debris removed from the marine/aquatic environment will be disposed of at an approved upland dumping site.

BMPS to prevent contamination from stormwater runoff:

1. The construction entrance and roadways will be stabilized to prevent tracking of materials from the project site.

2. Specific and contained areas will be designated for vehicle and equipment cleaning and fueling to prevent discharges of polluted wash water, fuel spills or leaks.

3. Prevent, reduce, or eliminate the discharge of pollutants from material delivery and storage to the stormwater system or marine environment by minimizing the storage of hazardous materials onsite, storing materials in watertight containers and/or a completely enclosed designated area, installing secondary containment, conducting regular inspections, and training employees and subcontractors.

4. Stockpiles will be located away from the marine environment or any stormwater facility and equipped with erosion prevention BMPs such as plastic coverings to protect against wind or rainfall, and containment BMPs such as berms, silt fences, or dikes to protect stockpiled material from run-on.

5. Existing vegetation will be preserved to the extent practible outside of the project footprint to avoid any unnecessary disturbance to native materials.

6. During earthwork activities, sediment control BMP's such as silt fences, straw wattles, and sandbags will be used to prevent discharge of sediment laden discharge.

7. At the completion of work, hydraulic mulch or hydroseed will be applied to disturbed areas to encourage re-establishment of vegetation.

The implementation of appropriate water quality and stormwater runoff mitigation, including BMPs required in accordance with County drainage regulations, is anticipated to minimize the impacts of contaminants and runoff into the ocean.

5. Electricity, Telephone, and Cable Television Systems

a. Existing Conditions

Electrical, telephone, and cable television services to the project site are available though Maui Electric Company, Hawaiian Telcom, and Oceanic Time Warner Cable, respectively.

b. Potential Impacts and Mitigation Measures

No impacts to the electrical, telephone, and cable television systems are anticipated from the proposed project.

E. CUMULATIVE AND SECONDARY IMPACTS

1. Context for Cumulative Impact Analysis

Pursuant to Section 11-200-2 of the HAR, Chapter 200, entitled Environmental Impact Statement Rules, a cumulative impact means:

> *The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.*

A key element in understanding the requirement for assessing cumulative impacts, therefore, is the need to recognize what constitutes "reasonably foreseeable actions".

2. Cumulative Impact Evaluation Parameters

To ensure that cumulative impacts are analyzed in a structured and systematic manner, parameters described in **Table 5** have been used to address cumulative effects.

Table 5. Criteria for Evaluating Cumulative Impacts

Assessment Criteria	**Basis for Impact Evaluation**
Time Crowding	Effects of frequent and repetitive actions on the environment
Time Lags	Delayed effects of a proposed action
Space Crowding	Effects of spatial density on the environment
Cross Boundary	Effects of an action occurring away from the source
Fragmentation	Effects or changes in landscape pattern
Compounding Effects	Effects arising our of multiple pathways
Indirect Effects	Secondary effects
Triggers and Thresholds	Effects defined by agency laws, policies or regulations

3. Methodology for Addressing Cumulative Impacts

A list of potential cumulative impact issues and concerns were identified through full review of comment letters received on the EA/EISPN. While the issues and concerns addressed a broad range of impact considerations, screening of these issues and concerns was required to ensure that the scope of the cumulative impact assessment fell within the scope of a "cumulative impact" analysis, as set forth in Section 11-200-2 of the HAR, Chapter 200. Pre-screened issues and concerns relating to cumulative impacts, as well as secondary impacts are listed below:

1. Impacts on natural resources, particularly given the location of the proposed improvements.

2. Impacts of the proposed action on neighboring land uses, in particular Kahului Harbor, KPWS and Kanaha Beach Park.

3. Infrastructure impacts associated with the proposed improvement.

4. Impacts of the proposed action on shoreline access and recreational use of the shoreline.

5. Impacts to the County's long range land use plans.

6. Impacts to the County's water resources.

The next step in the analysis involved the identification of applicable evaluative criteria to each of the issues and concerns raised. This step resulted in the formulation of an evaluative criteria matrix, as presented in **Table 6**.

Table 6. Evaluation Criteria Matrix

Assessment Criteria	Basis for Impact Evaluation
Time Crowding	a. Impacts to natural resources b. Impacts to archaeological and cultural resources c. Impacts to shoreline access and recreation
Time Lags	a. Impacts on State land use plan b. Impacts on County land use plans
Space Crowding	a. Impacts to neighboring land uses b. Impacts on natural resources
Cross Boundary	a. Effects on County land use plans
Fragmentation	a. Impacts upon neighboring land uses
Compounding Effects	a. Impacts to land use b. Impacts to infrastructure systems
Indirect Effects	a. Impacts to Central Maui region
Triggers and Thresholds	a. Effects on State land use plan b. Effects on County land use plans

4. Cumulative Impact Assessment

Based on the methodology described in the previous sections, an analysis of each assessment criteria was undertaken for each applicable issue/concern. The analysis is presented below.

a. Time Crowding Effects on Natural, Archaeological and Cultural Resources and on Shoreline Access and Recreation

Time crowding refers to the repetitive and frequent effects from an action upon a particular component of the environment. For example, from a natural resource perspective, time crowding effects may be possible depletion of a resource or opportunity based on recurring impacts on that resource or opportunity.

<u>Natural Resources</u>: Natural resources having a potential time crowding relationship to the proposed improvements include marine waters, marine biota, flora, and fauna. The time crowding effect associated with marine waters, for example, includes potential water quality degradation, with repetitive contributions of stormwater runoff from the project site and erosion of the shoreline area. The time crowding effect on flora and fauna relates to displacement of onsite flora and fauna and their habitat on an incremental basis over the construction period.

With respect to marine waters, appropriate contaminant and stormwater runoff mitigation measures, including BMPs noted in Section 4 will be implemented during construction. Also, BMPS will be required in accordance with County drainage regulations to minimize the impacts of sediment and runoff into the ocean.

With regard to the marine biota, appropriate mitigation measures are proposed in order to minimize impacts on the green sea turtle and other endangered marine species that frequent the near shore area. Also, flora, fauna and their habitat were limited to one (1) endemic plant, the nehe, and a tree tobacco plant found on the project site. The nehe plant is not a federally listed threatened or endangered species, while the tree tobacco plant is a habitat for the endangered Blackburn's sphinx moth. Examination of the plant revealed no evidence of the Blackburn's sphinx moth. Refer to **Appendix "I"**.

<u>Archaeological and Cultural Resources</u>: Archaeological work in 2007 and 2012 revealed no historic sites or cultural resources. However, due to the sand deposits and project location, a general Archaeological Monitoring Plan was approved by SHPD and will be implemented during any ground disturbing activity with a monitoring report submitted to SHPD. Based on information provided, the project will not adversely impact native Hawaiian cultural practices. However, if any historic or cultural resources are discovered, all construction activity will stop and coordination will be carried out with the appropriate agencies to mitigate potential adverse impacts.

Shoreline Access and Recreation: There may be cumulative impacts of the proposed action which may lead to beach loss and a reduced supply of sand for beaches downdrift from the project site. On shorelines that experience net long-term erosion or are subject to relative sea level rise, such as that fronting the WKWWRF, the shoreline will eventually migrate landward beyond the stable hardened structure, resulting in the loss of the beach due to "passive erosion". This can limit lateral access to the adjacent beaches (Griggs, 2005). Lateral public shoreline access will be maintained during project completion along the earthen cap covering a portion of the revetment and by the crest of the exposed portion of the revetment and proposed stairway to the beach.

b. **Time Lag Effects on State and County Land Use Plans**

Time lag effects refer to changes to the environment which may occur over a longer duration. Such effects, for example, may include changes in microclimates resulting from changes in land cover characteristics. Such changes may not be immediately identified, but may, over a period of time, become apparent. The applicability of time lag effects to cumulative impact issues has been evaluated with regard to the State's and County's land use plans.

The WKWWRF is located in the State Conservation District and the proposed improvements will require a Conservation District Use Permit from the Board of Land and Natural Resources. However, the use of the property will not change and will continue as the WKWWRF.

The extension of the shoreline revetment will protect an existing major infrastructure facility to ensure the continued operation of waste-disposal services for the Central Maui region. The project site is identified for "Public/Quasi-Public" use in the Wailuku-Kahului Community Plan and the proposed revetment extension is ancillary to the WKWWRF.

As such, the proposed improvements will not affect the land use plans of the State and County.

c. **Space Crowding Effects on Neighboring Land Uses**

Space crowding effects on the neighboring land uses may include the need for additional infrastructure and public services resulting from increased population in the project area that may result in the degradation of existing public infrastructure and services. The proposed improvement is limited to the protection of the WKWWRF and is not considered a generating component for the population nor will it place additional burden upon infrastructure or public services.

d. Cross Boundary Effects on the County's Land Use Plan

Cross boundary refers to effect the proposed action will have on areas outside the limits of the affected action. For example, the withdrawal of water in one aquifer may affect the water level in an adjacent aquifer or over pumping of a well in close proximity to another well can result in less pumpage from the adjacent well.

The evaluative criteria for cross boundary effect are whether the proposed action will affect future land uses in the Central Maui region. Future land uses are guided by the County's general plans including the community plans. The project site is identified for "Public/Quasi-Public" use and has been utilized as the WKWWRF since 1973. The Maui County Council (Council) by Resolution declared the WKWWRF would remain in its current location and that shoreline protection for the facility should be pursued as an immediate priority.

The proposed shoreline revetment is in keeping with the use of the property as the WKWWRF and is implementation of the Council's directive. Failure to protect the facility may result in loss of critical infrastructure components of the WKWWRF and future degradation of the environment. The WKWWRF is the primary wastewater treatment and disposal system for the Central Maui region and failure to provide a reliable facility in this regard will adversely impact public health and safety for existing and future users.

e. Fragmentation Effects on Neighboring Land Uses

Fragmentation refers to changes to landscape patterns as a result of a proposed action. For example, fragmentation of a historic district may occur if development approvals for a project having non-historic architectural design elements are approved and developed adjacent to such district.

Fragmentation may also result with the construction of a new highway through a habitat area, where the functional continuity of the habitat may be disrupted by the highway.

The evaluative criteria for fragmentation are whether the proposed shoreline revetment will adversely affect the regional landscape pattern of the Central Maui region in a significant way. The proposed revetment is an extension of an existing revetment and is not expected to adversely affect the neighboring industrial and recreational land uses.

f. **Compounding Effects on Land Use and Infrastructure Systems**

Compounding effects relate to the additive and synergistic effects of impacts arising out of multiple pathways. For example, the implementation of new infrastructure which will ultimately serve new residential communities must be analyzed not only in terms of the project itself, but also the reasonable foreseeable future developments which may develop as a result of the new development.

With regard to the shoreline revetment, compounding effects were assessed in connection with anticipated growth within the Central Maui region. As stated previously, failure to protect the facility may result in loss of the WKWWRF and future degradation of the environment. The WKWWRF is the primary wastewater treatment and disposal system for the Central Maui region and failure to provide a reliable facility in this regard will adversely impact public health and safety for existing and future users.

g. **Indirect Effects to Central Maui Region**

Indirect effects are also referred to as secondary impacts. According to Section 11-200-2 of the Hawaii Administrative Rules, Chapter 200, entitled Environmental Impact Statement Rules, a secondary impact or indirect effect means:

> *Effects which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and*

related effects on air and water and other natural systems, including ecosystems.

The indirect effect associated with the shoreline revetment pertains to its implications for future growth in the Central Maui region. As stated previously, failure to protect the facility may result in loss of the WKWWRF and future degradation of the environment. The WKWWRF is the primary wastewater treatment facility for the Central Maui region and failure to provide a reliable facility in this regard will adversely impact public health and safety for not only existing users but future users. Lack of a reliable facility will indirectly result in the failure to accommodate future population growth in Central Maui.

h. <u>Triggers and Thresholds on Water Quality</u>

Triggers and thresholds refer to impacts which may be tied to indicators established through laws, policies, regulations, or standards. Triggers and thresholds may include standards which identify key indicators which, when exceeded, would require special study or mitigation efforts. In traffic analyses, for example, the Level of Service (LOS) "F" reflects a worst case condition in terms of traffic operations. Such a level of service would require that traffic mitigation be implemented to bring conditions back within the acceptable range of operations, generally considered to be LOS "A" to LOS "C".

Regarding the proposed shoreline revetment, the parameter identified as requiring evaluation with respect to triggers and thresholds is the effect of the project on ocean water quality. To minimize impact on the ocean the proposed shoreline revetment extension has been sited further inland of the certified shoreline. Also, the excess excavated sand will be used to cover the revetment so the finished work will resemble as much as possible the original site conditions.

Sand placement and construction activities may lead to temporary increased turbidity. The revetment is anticipated to require a Section 401 water quality permit and DA permit that will evaluate the effects in greater detail which may result in the imposition of conditions to mitigate such effects.

Summary

The evaluation of cumulative and secondary impacts addressed key issues raised through the EIS process. Each issue has been analyzed with respect to applicable cumulative impact evaluative criteria. In general, appropriate mitigation measures and/or regulatory oversight processes have been identified to ensure that cumulative impacts for each key issue are managed to the extent practicable, such that adverse conditions affecting the natural and man-made environments are minimized.

III. RELATIONSHIP TO GOVERNMENTAL PLANS, POLICIES, AND CONTROLS

III. RELATIONSHIP TO GOVERNMENTAL PLANS, POLICIES, AND CONTROLS

A. STATE LAND USE DISTRICTS

Pursuant to Chapter 205, Hawaii Revised Statutes (HRS), all lands in the State have been divided and placed into one (1) of four (4) land use districts by the State Land Use Commission. These land use districts have been designated "Urban", "Rural", "Agricultural", and "Conservation". The project site is located within the State "Conservation" district. See **Figure 16**. The existing wastewater reclamation facilities are covered under Conservation District Use Permit (CDUP) MA-3047. A CDUP, approved by the Board of Land and Natural Resources (BLNR), will be required for the proposed extension of the revetment. Based on the Department of Land and Natural Resources (DLNR) Conservation Subzone map, the subject property falls within the "Limited" subzone. Pursuant HRS to Chapter 13-5-22 (P-6), permitted uses within the "Limited" subzone include:

> *Land uses undertaken by the State of Hawaii or the counties to fulfill a mandated government function, activity, or service for public benefit and in accordance with public policy and the purpose of the conservation district.*

The proposed project meets the permitted uses definition in the "Limited" subzone.

A portion of the shoreline revetment extension connecting to the existing revetment will be located seaward of the certified shoreline on lands under the jurisdiction of the State of Hawaii. Approval from the BLNR will be required for the use of State lands.

B. CONSERVATION DISTRICT USE ANALYSIS

A Conservation District Use Application (CDUA) File No. MA-7/28/78-1074, was approved for the original revetment in 1979. Refer to **Appendix "A"**.

The subject project, which is an identified permitted use within the "Limited" subzone of the Conservation District, requires a Conservation District Use Permit from the BLNR. Accordingly, a CDUA for the project will be prepared in accordance with HAR, Title 13.

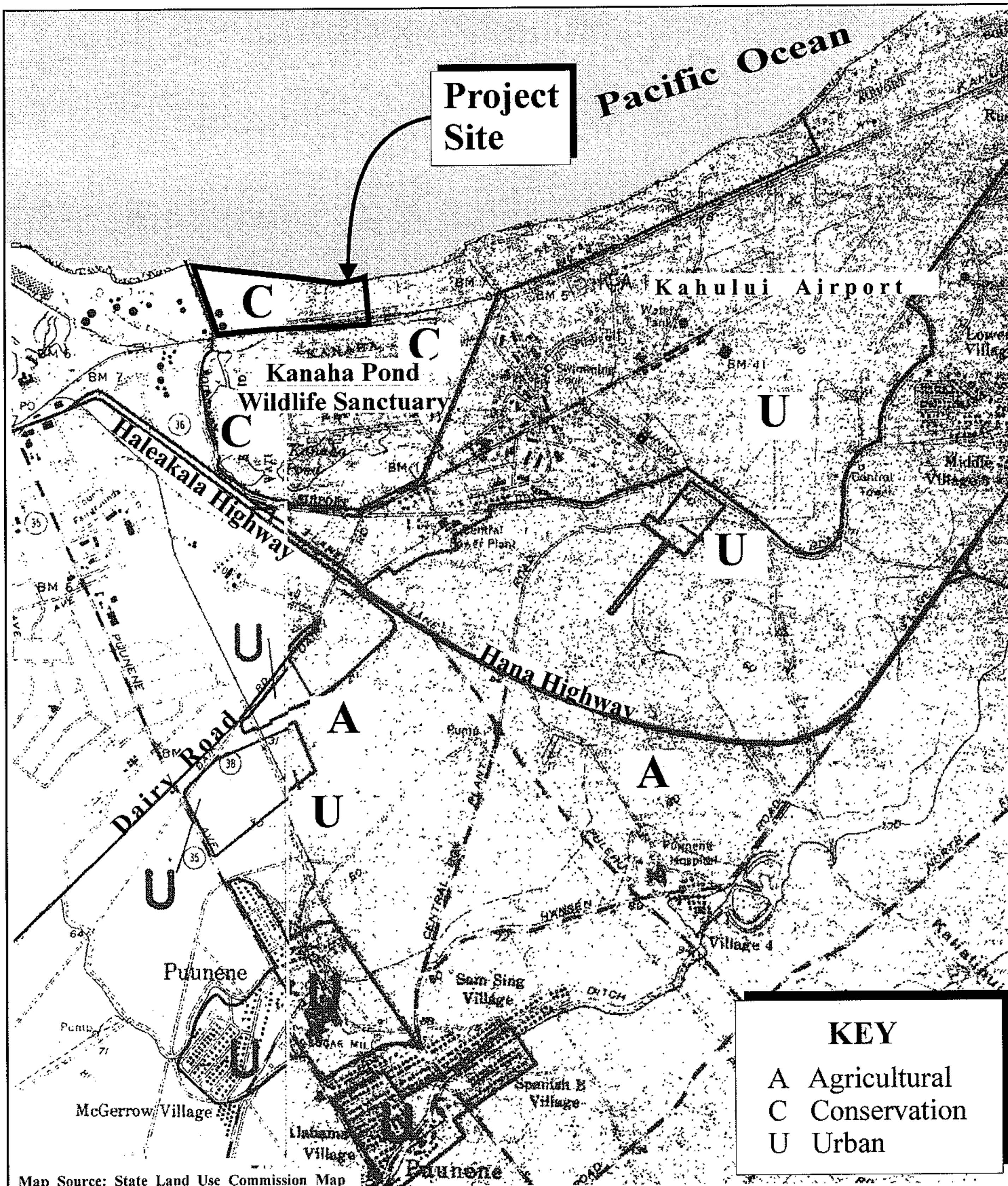


Figure 16 Proposed Shoreline Protection Extension at Wailuku-Kahului Wastewater Reclamation Facility
State Land Use Designation

NOT TO SCALE

Prepared for: County of Maui, Department of Environmental Management

MUNEKIYO & HIRAGA, INC.

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Thus, with regard to the subject property's consistency with the purposes of the Conservation District, the following criteria are addressed below.

1. **<u>The proposed land use is consistent with the purpose of the Conservation District:</u>**

The proposed project is consistent with the purposes of the Conservation District. The subject property is not located near a watershed area and will not, therefore, impact watersheds or water sources. The proposed project has been part of an established land use since 1973 and is located adjacent to industrial and recreational areas. There is an existing revetment that was built in 1979. The extension of this revetment is consistent with the character of this area. Scenic resources and viewplanes will not be significantly affected by the construction of the revetment.

Existing coastal access to the east of the subject property will be maintained. However, the shoreline may see passive erosion due to continuing shoreline erosion of the beach limiting lateral access. Appropriate lateral public access over the revetment will be provided to maintain access along the shoreline. The beach fronting the WKWWRF is not heavily used by the public.

The proposed action will provide erosion control to protect the land on which the WKWWRF is located. Shoreline protection is critical to the continued operation of the facility, the ability to provide for Central Maui's wastewater needs, and the prevention of a potential large-scale environmental issue.

2. **<u>The proposed land use is consistent with the objectives of the subzone of the land on which the use will occur:</u>**

The proposed project is the continuation of an armor rock revetment as a shoreline protection measure within the "Limited" subzone of the Conservation District. Erosion control and other hazard prevention devices are permissible uses within the "Limited" subzone of the Conservation District. Erosion control is critical to the safety and integrity of the facility and its ability to meet Central Maui's wastewater treatment needs.

3. **<u>The proposed land use complies with provisions and guidelines contained in Chapter 205A, HRS, entitled "Coastal Zone Management", where applicable:</u>**

The subject project complies with provisions and guidelines in Chapter 205A, HRS.

An application for a Special Management Area (SMA) Use Permit for the subject project will be prepared and submitted to the County of Maui, Department of Planning for processing. Issuance of SMA approval for the project is anticipated to occur prior to the 180-day processing deadline on the CDUA.

4. **The proposed land use will not cause substantial adverse impacts to existing natural resources within the surrounding area:**

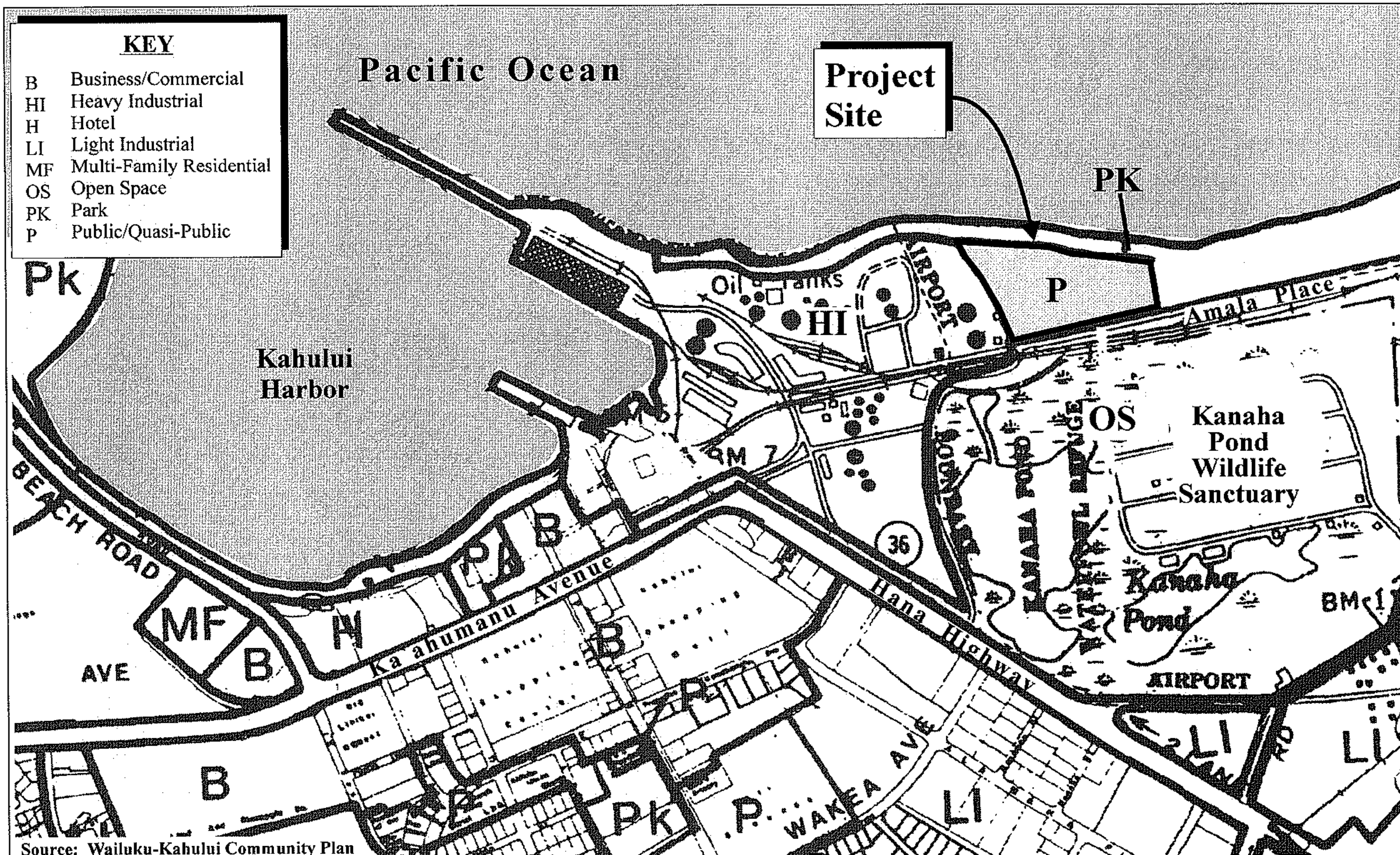
The strip of land designated for "Park" use on the Wailuku-Kahului Community Plan in front of the facility, where the existing beach is located, is currently threatened by erosion and relative sea level rise. See **Figure 17**. The proposed action is designed to prevent additional shoreline erosion in front of the WKWWRF. Beach loss, passive erosion, and a decreased supply of sediment material for beaches downdrift is an existing problem which will continue after the revetment is constructed. Best Management Practices (BMPs) relating to endangered marine species, drainage and erosion control measures will be implemented to ensure that potential adverse impacts to existing natural resources in the area are appropriately mitigated during construction. Consequently, the proposed action is not anticipated to cause substantial adverse impact to local natural resources within the surrounding area, community, or region.

5. **The proposed land use, including buildings, structures, and facilities shall be compatible with the locality and surrounding areas, appropriate to physical conditions and capabilities of the specific parcel or parcels:**

The WKWWRF has been an established land use since 1973. The proposed action is limited in scope and scale, consisting of a previously identified extension to an existing revetment at the site. The proposed action is deemed a viable and cost-effective alternative in protecting the WKWWRF and its ability to provide for Central Maui's wastewater treatment needs. As the WKWWRF shoreline protection project extends an existing revetment located adjacent to an industrial use, and the beach fronting the facility has limited use by the public, the proposed improvements are considered compatible with the surrounding area.

6. **The existing physical and environmental aspects of the land, such as natural beauty and open space characteristics, will be preserved or improved upon, whichever is applicable:**

The proposed action includes the extension of an armor rock revetment between the



Source: Wailuku-Kahului Community Plan

Figure 17 Proposed Shoreline Protection Extension at Wailuku-Kahului Wastewater Reclamation Facility
Community Plan Designation

NOT TO SCALE

Prepared for: County of Maui, Department of Environmental Management

MUNEKIYO & HIRAGA, INC.

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existing revetment on the east side of the WKWWRF property and the industrial area to the west of the WKWWRF property. As such, it is aesthetically compatible with the existing improvements present in the area. The proposed action will not obstruct any viewplanes or impede upon open space characteristics. As a result, physical, open space, and environmental aspects of the land will not be adversely impacted.

7. **Subdivision of land will not be utilized to increase the intensity of land uses in the Conservation District:**

The subject project does not involve the subdivision of land nor does the applicant intend on subdividing the parcel in the future.

8. **The proposed land use will not be materially detrimental to public health, safety, and welfare:**

The proposed action is intended to maintain the functional integrity of the WKWWRF. No adverse impacts to public health, safety, and welfare are anticipated to result from the proposed project. The proposed shoreline protection will create a public benefit in protecting the capability of the WKWWRF to meet Central Maui's wastewater needs and safely contain wastewater before it is treated and disposed of. BMPs will be utilized to avoid or minimize potential impacts to neighboring properties.

C. HAWAII STATE PLAN

Chapter 226, HRS, also known as the Hawaii State Plan, is a long-range comprehensive plan which serves as a guide for the future long-term development of the State by identifying goals, objectives, policies, and priorities, as well as implementation mechanisms. The proposed action is in keeping with the following Hawaii State Plan objectives and policies:

SECTION 226-11 OBJECTIVES AND POLICIES FOR THE PHYSICAL ENVIRONMENT - LAND-BASED, SHORELINE, AND MARINE RESOURCES

Objectives

- *Prudent use of Hawaii's land-based, shoreline, and marine resources.*

- *Effective protection of Hawaii's unique and fragile environmental resources.*

Policies

- *Take into account the physical attributes of areas when planning and designing activities and facilities.*

- *Manage natural resources and environs to encourage their beneficial and multiple use without generating costly or irreparable environmental damage.*

- *Promote increased accessibility and prudent use of inland and shoreline areas for public recreational, educational, and scientific purposes.*

The decision to pursue the proposed new alignment of a partially covered rock mound revetment alternative further inland in lieu of the exposed rock mound revetment alternative proposed in the EA/EISPN provides additional protection of shoreline and marine resources. Aligning the revetment in the WKWWRF site will preserve beach resources and lateral shoreline access.

SECTION 226-13 PHYSICAL ENVIRONMENT – LAND, AIR, AND WATER QUALITY

Objective

1. *Maintenance and pursuit of improved quality in Hawaii's land, air, and water resources.*

Policy

- *Reduce the threat to life and property from erosion, flooding, tsunamis, hurricanes, earthquakes, volcanic eruptions, and other natural or man-induced hazards and disasters.*

The proposed project will protect the WKWWRF from coastal erosion and the accompanying threat to the facility's ability to provide wastewater treatment services for Central Maui. It improves the reliability and safety of the facility, especially in the event of strong storm events or relative sea level rise which would increase the rate of erosion.

D. MAUI COUNTY GENERAL PLAN

As stated in the Maui County Charter the purpose of the general plan shall be to:

> *...indicate desired population and physical development patterns for each island within the county; shall address the unique problems and needs of each island and region within the county; shall explain the opportunities and the social, economic, and environmental consequences related to potential developments; and shall set forth the desired sequence, patterns, and characteristics of future developments. The general plan shall identify objectives to be achieved, and priorities, policies and implementing actions to be pursued with respect to population density, land use maps, land use regulations, transportation systems, public and community facility locations, water and sewage systems, visitor destinations, urban design and other matters related to development.*

Ordinance No. 3732 adopting the General Plan's Countywide Policy Plan 2030 took effect on March 24, 2010. The following analysis of the project is provided in relationship to the Countywide Policy Plan 2030:

With regard to the Countywide Policy Plan, Section 2.80B.030 of the Maui County Code states the following:

> *The countywide policy plan shall provide broad policies and objectives which portray the desired direction of the County's future. The countywide policy plan shall include:*
>
> 1. *A vision for the County;*
> 2. *A Statement of core themes or principles for the county; and*
> 3. *A list of countywide objectives and policies for population, land use, the environment, the economy, and housing.*

Core principles set forth in the Countywide Policy Plan are listed as follows:

1. *Excellence in the stewardship of the natural environment and cultural resources;*
2. *Compassion for and understanding of others;*
3. *Respect for diversity;*

4. *Engagement and empowerment of Maui County residents;*

5. *Honor for all cultural traditions and histories;*

6. *Consideration of the contributions of past generations as well as the needs of future generations;*

7. *Commitment to self-sufficiency;*

8. *Wisdom and balance in decision making;*

9. *Thoughtful, island-appropriate innovation; and*

10. *Nurturance of the health and well-being of our families and our communities.*

Congruent with these core principles, the Countywide Policy Plan identifies goals, objectives, policies and implementing actions for pertinent functional planning categories, which are identified as follows:

1. *Natural environment*

2. *Local cultures and traditions*

3. *Education*

4. *Social and healthcare services*

5. *Housing opportunities for residents*

6. *Local economy*

7. *Parks and public facilities*

8. *Transportation options*

9. *Physical infrastructure*

10. *Sustainable land use and growth management*

11. *Good governance*

With respect to the Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension Project, the following goals, objectives, policies and implementing actions are illustrative of the project's compliance with the Countywide Policy Plan:

PROTECT THE NATURAL ENVIRONMENT

Goal:

Maui County's natural environment and distinctive open spaces will be preserved, managed, and cared for in perpetuity.

Objective:

Improve the stewardship of the natural environment.

Policies:

Preserve and protect natural resources with significant scenic, economic, cultural, environmental, or recreational value.

Evaluate development to assess potential short-term and long-term impacts on land, air, aquatic, and marine environments.

Improve efforts to mitigate and plan for the impact of natural disasters, human-influenced emergencies, and global warming.

Provide public access to beaches and shorelines for recreational and cultural purposes where appropriate.

While public use of the shoreline fronting the WKWWRF is limited, the beach system is still interconnected with the neighboring natural areas. The implementation of the new alignment of the rock mound revetment alternative for the WKWWRF will provide protection to a major infrastructure facility while also preserving the beach in front of the treatment facility and maintaining lateral access for the public along the beach and the proposed stairway will provide access to the beach.

PRESERVE LOCAL CULTURES AND TRADITIONS

Goal:

Maui County will foster a spirit of pono and protect, perpetuate, and reinvigorate its residents' multi-cultural values and traditions to ensure that current and future generations will enjoy the benefits of their rich island heritage.

Objective:

Protect and preserve access to mountain, ocean, and island resources for traditional Hawaiian cultural practices.

Policy:

Protect and preserve access to mountain, ocean, and island resources for traditional Hawaiian cultural practices.

The new alignment of the partially covered rock mound revetment alternative further inland will preserve access to ocean resources for traditional Hawaiian cultural practices while still protecting the WKWWRF.

IMPROVE PHYSICAL INFRASTRUCTURE

Goal:

Maui County's physical infrastructure will be maintained in optimum condition and will provide for and effectively serve the needs of the County through clean and sustainable technologies.

Objective:

Improve waste-disposal practices and systems to be efficient, safe, and as environmentally sound as possible.

Policy:

Pursue improvements and upgrades to existing wastewater and solid-waste systems consistent with current and future plans and the County's Capital Improvement Program.

Objective:

Improve the planning and management of infrastructure systems.

Policies:

Ensure that basic infrastructure needs can be met during a disaster.

The extension of the shoreline revetment will protect an existing major infrastructure facility from shoreline erosion and potential wave-generated hazards from storms and tsunamis to ensure the continued operation of waste-disposal services for the Central Maui region.

In summary, the Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension Project is consistent with the theme and principles of the Countywide Policy Plan.

E. WAILUKU-KAHULUI COMMUNITY PLAN

The project site is located in the Wailuku-Kahului Community Plan region which is one (1) of nine (9) Community Plan regions established in the County of Maui. Planning for each region is guided by the respective Community Plans, which are designed to implement the Maui County General Plan. Each Community Plan contains recommendations and standards which guide the sequencing, patterns, and characteristics of future development in the region.

Land use guidelines are set forth by the existing Wailuku-Kahului Community Plan Land Use Map. The WKWWRF site is designated for "Public/Quasi-Public" use by the Community Plan Land Use Map. The strip of land fronting the project site along the shoreline is designated for "Park" use. Refer to **Figure 17**. The proposed revetment would be constructed on the WKWWRF property, except where the extension will connect to the existing revetment, and will be similar to the existing revetment.

The proposed action is in keeping with the following Wailuku-Kahului Community Plan (2002) objectives and policies:

INFRASTRUCTURE

Goal

Timely and environmentally sound planning, development, and maintenance of infrastructure systems which serve to protect and preserve the safety and health of the region's residents, commuters, and visitors through the provision of clean water, effective waste disposal and drainage systems, and efficient transportation systems which meet the needs of the community.

LIQUID AND SOLID WASTE

Objective and Policy

1. *Coordinate sewer system improvement plans with future growth requirements, as defined in the Community Plan.*

Implementing Action

3. *Investigate the feasibility of constructing a wastewater treatment*

facility for the Central Maui area to service the future needs of population growth. Locations to be investigated include the airport area, the Puunene sugar mill area, and other areas east of Kuihelani Highway. Site conditions to be evaluated shall include, but not be limited to, potential odor problems with surrounding neighborhoods, corrosive environments, effluent disposal, groundwater contamination and project costs.

The Central Maui Wastewater Reclamation Facility Study recommended the use of the existing facility, taking measures to protect it from tsunamis and erosion after extensive review and investigation of the feasibility to relocate the facility. The proposed action is in keeping with this implementing action based on Maui County Council Resolution No. 06-12, "ACCEPTING THE CENTRAL MAUI WASTEWATER RECLAMATION FACILITY STUDY AND CONCURRING RECOMMENDATIONS AND LONG TERM PLAN". Refer to **Appendix "E"**.

F. COUNTY ZONING

As previously mentioned, the subject property is zoned "AP, Airport" district. However, the subject property also falls within the State Land Use Conservation District. Lands within the Conservation District fall within the purview of the DLNR. In this context, County zoning is not considered an active land use designation at the property. As previously mentioned, the proposed improvements will require a CDUP approval by the BLNR.

G. COASTAL ZONE MANAGEMENT CONSIDERATIONS

The subject property is located within the County of Maui's Special Management Area (SMA). Pursuant to Chapter 205A, HRS, and the Rules and Regulations of the Maui Planning Commission, actions proposed within the SMA are evaluated with respect to SMA objectives, policies, and guidelines. This section addresses the project's relationship to applicable coastal zone management considerations, as set forth in Chapter 205A, HRS and the Rules and Regulations of the Maui Planning Commission.

Chapter 205A, HRS

1. Recreational Resources

Objective

Provide coastal recreational opportunities accessible to the public.

Policies

(A) *Improve coordination and funding of coastal recreational planning and management; and*

(B) *Provide adequate, accessible, and diverse recreational opportunities in the coastal zone management area by:*

(i) *Protecting coastal resources uniquely suited for recreational activities that cannot be provided in other areas;*

(ii) *Requiring replacement of coastal resources having significant recreational value, including but not limited to surfing sites, fishponds, and sand beaches, when such resources will be unavoidably damaged by development; or requiring reasonable monetary compensation to the state for recreation when replacement is not feasible or desirable;*

(iii) *Providing and managing adequate public access, consistent with conservation of natural resources, to and along shorelines with recreational value;*

(iv) *Providing an adequate supply of shoreline parks and other recreational facilities suitable for public recreation;*

(v) *Ensuring public recreational use of county, state, and federally owned or controlled shoreline lands and waters having recreational value consistent with public safety standards and conservation of natural resources;*

(vi) *Adopting water quality standards and regulating point and non-point sources of pollution to protect, and where feasible, restore the recreational value of coastal waters;*

(vii) *Developing new shoreline recreational opportunities, where appropriate, such as artificial lagoons, artificial beaches, and artificial reefs for surfing and fishing; and*

(viii) *Encouraging reasonable dedication of shoreline areas with recreational value for public use as part of discretionary approvals or permits by the land use commission, board of*

land and natural resources, and county authorities; and crediting such dedication against the requirements of Section 46-6, HRS.

Response: There is public shoreline access to the east of the subject property, but the beach directly seaward of the facility is not heavily used. The existing revetment itself is used for fishing. In order to preserve the beach fronting the WKWWRF, the new alignment of the partially covered rock mound revetment alternative, located further inland, has been adopted. The access to the beach and to the revetment for fishing will not be impacted by the proposed project. Beach loss between the structure and the ocean is expected to continue due to ongoing shoreline erosion at the rate of -2.4 feet per year. On shorelines that experience net long-term erosion or are subject to relative sea level rise, the shorelines adjacent to hard structures can migrate landward, resulting in "passive erosion", which can limit lateral access to adjacent beaches (Griggs, 2005). However, the earthen cap covering a portion of the revetment and the crest above the exposed portion of the revetment will allow for continued lateral access fronting the WKWWRF and the proposed stairway will provide access to the beach.

2. Historical/Cultural Resources

Objective

Protect, preserve, and, where desirable, restore those natural and manmade historic and prehistoric resources in the coastal zone management area that are significant in Hawaiian and American history and culture.

Policies

(A) Identify and analyze significant archaeological resources;

(B) Maximize information retention through preservation of remains and artifacts or salvage operations; and

(C) Support state goals for protection, restoration, interpretation, and display of historic resources.

Response: Archaeological surveys and a cultural impact assessment were carried out to assess the potential impacts of the proposed action on cultural and historic properties and practices in the vicinity. No significant historic remains were identified, however, precautionary monitoring is recommended due to the presence of intact marine sand deposits in portions of all test trenches excavated on the project site. Further, should any archaeological remains be encountered during construction, work in the vicinity of the find will be stopped and the SHPD contacted to establish appropriate mitigation.

In order to mitigate potential impacts from passive erosion, the new alignment of the partially covered rock mound revetment alternative further inland, in lieu of the exposed rock mound revetment alternative presented in the EA/EISPN has been selected in order to stave off the effects of passive erosion. A portion of the revetment will be covered with the excess excavated sand and lateral public access will be provided along the top of the earthen cap and on top of the exposed portion of the revetment to maintain access along the coastline. The proposed revetment would provide new opportunities for fishing in the area which would be a positive cultural benefit for fishers.

No significant adverse impacts on historic and cultural resources are anticipated.

3. Scenic and Open Space Resources

Objective

Protect, preserve, and, where desirable, restore or improve the quality of coastal scenic and open space resources.

Policies

(A) *Identify valued scenic resources in the coastal zone management area;*

(B) *Ensure that new developments are compatible with their visual environment by designing and locating such developments to minimize the alteration of natural landforms and existing public views to and along the shoreline;*

(C) *Preserve, maintain, and, where desirable, improve and restore shoreline open space and scenic resources; and*

(D) *Encourage those developments which are not coastal dependent to locate in inland areas.*

Response: The extension of the existing revetment is anticipated to have minimal adverse impacts to scenic and open space resources in the area. The proposed project site is bounded to the west by an industrial area and to the east by the existing revetment which will be extended landward, not laterally along the shoreline. Extension of the existing revetment is not anticipated to visually impair viewscapes and open space resources.

The beach area, currently designated as "Park" land on the Wailuku-Kahului Community Plan seaward of the project site, is experiencing long-term net erosion. The proposed revetment would halt further erosion of land inland of the revetment structure. The new alignment, located further inland of the exposed rock mound revetment alternative will help to reduce impacts on the beach and will provide lateral access along the shoreline and a proposed stairway will provide access to the beach. A portion of the revetment will be covered with the excess excavated sand, maintaining a natural appearance along the shoreline.

4. Coastal Ecosystem

Objective

Protect valuable coastal ecosystems, including reefs, from disruption and minimize adverse impacts on all coastal ecosystems.

Policies

(A) *Exercise an overall conservation ethic, and practice stewardship in the protection, use, and development of marine and coastal resources;*

(B) *Improve the technical basis for natural resource management;*

(C) *Preserve valuable coastal ecosystems, including reefs, of significant biological or economic importance;*

(D) *Minimize disruption or degradation of coastal water ecosystems by effective regulation of stream diversions, channelization, and similar land and water uses, recognizing competing water needs; and*

(E) *Promote water quantity and quality planning and management practices that reflect the tolerance of fresh water and marine ecosystems and maintain and enhance water quality through the development and implementation of point and nonpoint source water pollution control measures.*

Response: The revetment is designed to protect the WKWWRF from erosion and storm damage, reducing the risk of point source sewage discharges to the marine ecosystem. During construction, there is the potential for limited, temporary increases in turbidity in the nearshore waters, similar to that seen on windy days or during small storms. The area fronting the WKWWRF contains some scattered coral and rock formations, as well as carbonate rock pavement and sand. A BMP plan will be developed to avoid or minimize adverse impacts to coastal resources. Additionally, the revetment can provide valuable nearshore hard-bottom habitat and has the potential to encourage juvenile fish recruitment offshore.

5. Economic Use

Objective

Provide public or private facilities and improvements important to the State's economy in suitable locations.

Policies

(A) *Concentrate coastal dependent development in appropriate areas;*

(B) *Ensure that coastal dependent development such as harbors and ports, and coastal related development such as visitor facilities and energy generating facilities, are located, designed, and constructed to minimize adverse social, visual, and environmental impacts in the coastal zone management area; and*

(C) *Direct the location and expansion of coastal dependent developments to areas presently designated and used for such developments and permit reasonable long-term growth at such areas, and permit coastal dependent development outside of presently designated areas when:*

(i) *Use of presently designated locations is not feasible;*

(ii) *Adverse environmental effects are minimized; and*

(iii) *The development is important to the State's economy.*

Response: The proposed action to protect the shoreline fronting the WKWWRF enables the continuing use of the site for wastewater treatment purposes. Plant relocation costs have been estimated to range between $350 million and $475 million (in 2005 dollars). Shoreline protection measures at the existing facility, in contrast, have been estimated to range between $4.2 million and $13.1 million (in 2008 dollars). Investing in measures to protect the existing facility from tsunamis and shoreline erosion threats is much more cost-effective and places significantly less burden on taxpayers and rate payers than relocating the plant.

6. Coastal Hazards

Objective

Reduce hazard to life and property from tsunami, storm waves, stream flooding, erosion, subsidence, and pollution.

Policies

(A) *Develop and communicate adequate information about storm wave, tsunami, flood, erosion, subsidence, and point and nonpoint source pollution hazards;*

(B) *Control development in areas subject to storm wave, tsunami, flood, erosion, hurricane, wind, subsidence, and point and nonpoint pollution hazards;*

(C) *Ensure that developments comply with requirements of the Federal Flood Insurance Program; and*

(D) *Prevent coastal flooding from inland projects.*

Response: The purpose of the proposed action is to protect the WKWWRF from shoreline erosion and storm damage. The project site is located within Zone VE, an area of flooding due to wave velocity. It is also located in an area where severe erosion has been occurring over at least the past 100 years. Along the project site, the AEHR is -2.4 ft./yr. Review of historic shoreline surveys indicates that the shoreline west of the existing revetment is eroding at a rate of up to -6.0 ft./yr. Refer to **Appendix "C"**. The revetment would also provide a degree of protection against tsunamis and designed to accommodate sea level rise. New construction shall comply with applicable provisions of Chapter 19.62, Flood Hazard Areas, of the Maui County Code.

7. Managing Development

Objective

Improve the development review process, communication, and public participation in the management of coastal resources and hazards.

Policies

(A) *Use, implement, and enforce existing law effectively to the maximum extent possible in managing present and future coastal zone development;*

(B) *Facilitate timely processing of applications for development permits and resolve overlapping of conflicting permit requirements; and*

(C) *Communicate the potential short and long-term impacts of proposed significant coastal developments early in their life cycle and in terms understandable to the public to facilitate public participation in the planning and review process.*

Response: The proposed project involves the development of a new alignment for a partially covered rock mound revetment structure, located further inland of the alignment originally proposed in the EA/EISPN, in order to protect an existing land use and major infrastructure facility from shoreline encroachment. As to provide a balance between costs and potential impacts, the new alignment inland is proposed with a portion of the revetment to be covered with the excess excavated sand. This alternative will provide additional protection of the beach resources and will allow for the continued use of an existing facility as opposed to the development of a new facility at a cost of between $350 and $475 million (in 2005 dollars).

Through the EA/EISPN and EIS review processes, the proposed project is under public review and comment pursuant to Chapter 343, HRS. A public meeting was held on February 16, 2011 to review and receive comments on the EA/EISPN. Comments received have been incorporated into this Draft EIS. See Chapter IX. The project is also subject to a public hearing at the Maui County Planning Commission in connection with the project's SMA Use Permit and Shoreline Setback Variance (SSV) applications review and approval process, as well as a public notified review of the CDUP before the BLNR.

8. **Public Participation**

Objective

Stimulate public awareness, education, and participation in coastal management.

Policies

(A) *Promote public involvement in coastal zone management processes;*

(B) *Disseminate information on coastal management issues by means of educational materials, published reports, staff contact, and public workshops for persons and organizations concerned with coastal issues, developments, and government activities; and*

(C) *Organize workshops, policy dialogues, and site-specific mediations to respond to coastal issues and conflicts.*

Response: As discussed above, public awareness and participation for the project are facilitated through the Chapter 343, HRS, SMA Use Permit, SSV, and CDUP approval processes. In addition, there was an extensive public involvement element in the original Central Maui Wastewater Reclamation Facility Study in 2005 and a public informational meeting held on February 16, 2011 to review and receive comments on the EA/EISPN.

9. **Beach Protection**

Objective

Protect beaches for public use and recreation.

Policies

(A) *Locate new structures inland from the shoreline setback to conserve open space, minimize interference with natural shoreline processes, and minimize loss of improvements due to erosion;*

(B) *Prohibit construction of private erosion-protection structures seaward of the shoreline, except when they result in improved aesthetic and engineering solutions to erosion at the sites and do not interfere with existing recreational and waterline activities; and*

(C) *Minimize the construction of public erosion-protection structures seaward of the shoreline.*

Response: The beach fronting the project site is designated as "Park" land on the Wailuku-Kahului Community Plan. The shoreline in this area is characterized by long-term net loss and the land seaward of the WKWWRF will disappear due to erosion without any additional measures. The shoreline protection project is proposed so that no damage occurs to the WKWWRF and there is no loss of the "Public/Quasi-Public" land on which it is built. Beach loss and loss of lateral access will occur with or without the project. In order to stave off the effects of passive erosion and prolong the life of the beach fronting the WKWWRF, the revetment alternative, which consists of a partially covered rock mound revetment further inland similar to the preferred alternative presented in the EA/EISPN is proposed. The revetment will be partially covered with excess excavated sand.

10. Marine Resources

Objective

Promote the protection, use, and development of marine and coastal resources to assure their sustainability.

Policies

(A) *Ensure that the use and development of marine and coastal resources are ecologically and environmentally sound and economically beneficial;*

(B) *Coordinate the management of marine and coastal resources and activities to improve effectiveness and efficiency;*

(C) *Assert and articulate the interests of the State as a partner with federal agencies in the sound management of ocean resources within the United States exclusive economic zone;*

(D) *Promote research, study, and understanding of ocean processes, marine life, and other ocean resources in order to acquire and inventory information necessary to understand how ocean development activities relate to and impact upon ocean and coastal resources; and*

(E) *Encourage research and development of new, innovative technologies for exploring, using, or protecting marine and coastal resources.*

Response: The revetment is designed to protect the WKWWRF from erosion and future storm damage, which reduces the risk of point source sewage discharges that would have a negative impact on marine resources. During construction, there is the potential for limited, temporary increases in turbidity in the nearshore waters, similar to that seen on windy days or during small storms. A BMP plan will be developed as a part of the design plans and specifications to mitigate potential adverse impacts to coastal and marine resources during construction.

In addition to the foregoing objectives and policies, HRS, Section 205A-30.5 Prohibitions, provides specifications for the limitation of lighting in coastal shoreline areas in relation to granting of SMA permits.

No special management area use permit or special management area minor permit shall be granted for structures that allow artificial light from floodlights, uplights, or spotlights used for decorative or aesthetic purposes when the light:

(1) *Directly illuminates the shoreline and ocean waters; or*

(2) *Is directed to travel across property boundaries toward the shoreline and ocean waters.*

(b) *Subsection (a) shall not apply to special management area use permit for structures with:*

(3) *Artificial lighting provided by a government agency or its authorized users for government operations, security, public safety, or navigational needs; provided that a government agency or its authorized users shall make reasonable efforts to properly position or shield lights to minimize adverse impacts.*

Response: The proposed shoreline protection improvements will not involve or result in direct illumination of the shoreline or ocean waters, nor direct light across property boundaries toward the shoreline.

RULES AND REGULATIONS OF THE MAUI PLANNING COMMISSION, SPECIAL MANAGEMENT AREA RULES

The Rules and Regulations of the Maui Planning Commission, Chapter 202 were established in order to implement Hawaii Revised Statues, Chapter 205A relating to Coastal Zone Management and Special Management Areas. In addition to establishing procedures for processing of Special Management Area applications and procurement of related permits, the rules assist the Commission in giving consideration to state policy regarding coastal zones.

This section addresses the project's relationship to applicable coastal zone management considerations as set forth in the Maui Planning Commission Rules and Regulations, Chapter 202, "Special Management Area Permit Procedures," which are provided for considering the significance of potential environmental and ecological effects of a proposed action. The criteria have been reviewed and analyzed with respect to the proposed shoreline protection extension at the WKWWRF project as follows.

1. **Involves an irrevocable commitment to loss or destruction of any natural or cultural resources.**

   As mentioned in Chapter II, appropriate archaeological surveys and a cultural impact assessment were conducted to address natural and cultural resources. No significant historic remains were identified, however, precautionary monitoring is recommended due to the presence of intact marine sand deposits in portions of the project site. Further, should any archaeological remains be encountered during construction, work in the vicinity of the find will be stopped and the SHPD contacted to establish appropriate mitigation.

   A portion of the shoreline revetment extension will be covered with the excess excavated sand. Lateral public access will be provided along the top of the earthen cap and on top of the exposed portion of the revetment and a proposed stairway will provide access to the beach. The proposed shoreline revetment extension would provide new opportunities for fishing in the area which would be a possible cultural benefit for fishers.

2. **<u>Significantly curtails the range of beneficial uses of the environment.</u>**

The proposed project will not curtail the range of beneficial uses of the environment. Development of detailed engineering plans will allow for the identification of applicable BMPs to minimize any construction-related impacts. The proposed project will protect a significant County of Maui infrastructure and ensure continued reliable wastewater services to Central Maui residents.

3. **<u>Conflicts with the county's or the state's long-term environmental policies or goals.</u>**

The proposed project does not conflict with the State's Environmental Policy and Guidelines such as those established in Chapter 344, HRS. The proposed project is consistent with the property's underlying land use designations, which were established to guide development patterns, limiting the land uses considered to be compatible with the regional context and suitable for the regional environment.

4. **<u>Substantially affects the economic or social welfare and activities of the community, county, or state.</u>**

On a short-term basis, the project will support construction and construction-related industries, thereby increasing employment opportunities to result in a beneficial impact on the local economy during the period of construction. The proposed development is located within the Wailuku-Kahului Community Plan region and designated for "Public/Quasi-Public" use. The proposed shoreline revetment extension will protect a significant public infrastructure and ensure continued reliable wastewater services to Central Maui residents.

5. **<u>Involves substantial secondary impacts, such as population changes and increased effects on public facilities, streets, drainage, sewage, and water systems, and pedestrian walkways.</u>**

The population in the Wailuku-Kahului region has seen steady growth over the last 20 years and the population is projected to increase through 2030. The proposed shoreline revetment extension will protect a significant public infrastructure for existing and future Central Maui residents and ensure continued reliable wastewater services. The proposed project is not a population generator and will not cause a significant change in the population. As such, secondary impacts, on other public facilities, streets, drainage, and water is not anticipated.

6. **In itself has no significant adverse effects but cumulatively has considerable effect upon the environment or involves a commitment for larger actions.**

The development of the proposed project is not anticipated to create or contribute to any significant adverse long-term environmental effects. As noted above, the proposed shoreline revetment extension will protect a significant public infrastructure.

7. **Substantially affects a rare, threatened, or endangered species of animal or plant, or its habitat.**

A biological survey was conducted to insure that any sensitive biological resources within the project site and surrounding areas would be identified and provided adequate protection. Refer to **Appendix "I"**. The assessment determined that the proposed project would not significantly impact native botanical resources. Although not observed during the marine surveys, green sea turtles are known to frequent the waters fronting the WKWWRF. The BMPs recommended in Chapter II, Section 5 include monitoring of the beach during the nesting period of the green sea turtles and if necessary implementation of appropriate measures to protect their nests, as well as measures to prevent degradation of the near shore waters.

8. **Is contrary to the state plan, county's general plan, appropriate community plans, zoning and subdivision ordinances.**

Although in the State Conservation District, the WKWWRF has been in existence since the early 1970's and by Council Resolution No. 06-12 will continue at the project site. The resolution also directs the DEM to fortify and protect the WKWWRF. Further, the Wailuku-Kahului Community Plan designates the subject property for "Public/Quasi-Public" use recognizing the WKWWRF. The proposed revetment extension is consistent with the State Plan and County land use plans.

9. **Detrimentally affects air or water quality or ambient noise levels.**

Construction activities will result in short-term air quality and noise impacts. Dust control measures, such as regular watering and sprinkling and the installation of dust screens, will be implemented to minimize wind-blown emissions. In the short term, noise impacts will occur primarily from construction equipment. Equipment mufflers or other noise attenuating equipment as well as proper vehicle maintenance will be used during construction activities. Construction noise impacts will be mitigated through compliance with the provisions of the State of Hawaii, Department of Health Administrative Rules Title 11, Chapter 46, "Community Noise Control." These rules require a noise permit if the noise levels from construction activities are expected to exceed the allowable levels set forth in Chapter 46. In the long term, the shoreline revetment extension is not anticipated to significantly impact ambient air or noise levels.

A water quality report was prepared for the project. Refer to **Appendix "I"**. Temporary increases in turbidity due to construction activities will cease once the project is completed and will be mitigated through proposed BMPs. It is further recommended that a water quality monitoring program be implemented for the project to monitor any long term degradation of water quality. The revetment is being designed to prevent erosion and damage to the facility to prevent a larger scale release of sewage and/or treatment by products into the marine environment.

10. Affects an environmentally sensitive area, such as flood plains, shoreline, tsunami zone, erosion-prone area, geologically hazardous land, estuary, fresh waters, or coastal waters.

As a shoreline protection measure, it will be located within the shoreline setback area and tsunami inundation zone. However, the shoreline revetment extension is being designed to prevent shoreline erosion and damage to the WKWWRF to prevent a larger scale release of sewage and/or treatment by products into the marine environment.

11. Substantially alters natural land forms and existing public views to and along the shoreline.

A portion of the shoreline revetment extension will be covered with the excess excavated sand, which will match the existing topography and appearance. The exposed portion of the revetment will essentially match the existing grade. As such, the revetment will not impact public views to and along the shoreline.

12. Is contrary to the objectives and policies of chapter 205A, HRS.

A review of the objectives and policies of chapter 205A, HRS, is provided in its entirety in the previous part of this section. Therein, it addresses the project's relationship to the Coastal Zone Management considerations. Based on the foregoing analysis, the project will appropriately and adequately mitigate impacts to SMA-relevant areas of interest. Accordingly, there are no anticipated significant environmental and ecological effects attributed to the proposed action.

H. SHORELINE SETBACK VARIANCE

A Shoreline Setback Variance (SSV) from the County of Maui will also be required as part of project implementation, as portions of the proposed revetment structure will be located within the Shoreline Setback Area. See **Figure 18**. A separate SSV application will be prepared and filed with the County of Maui, Department of Planning for review and approval by the Maui Planning Commission.

The following improvements are proposed within the shoreline setback:

1. Minor grading to prepare an even surface for the placement of the shoreline protection base material.

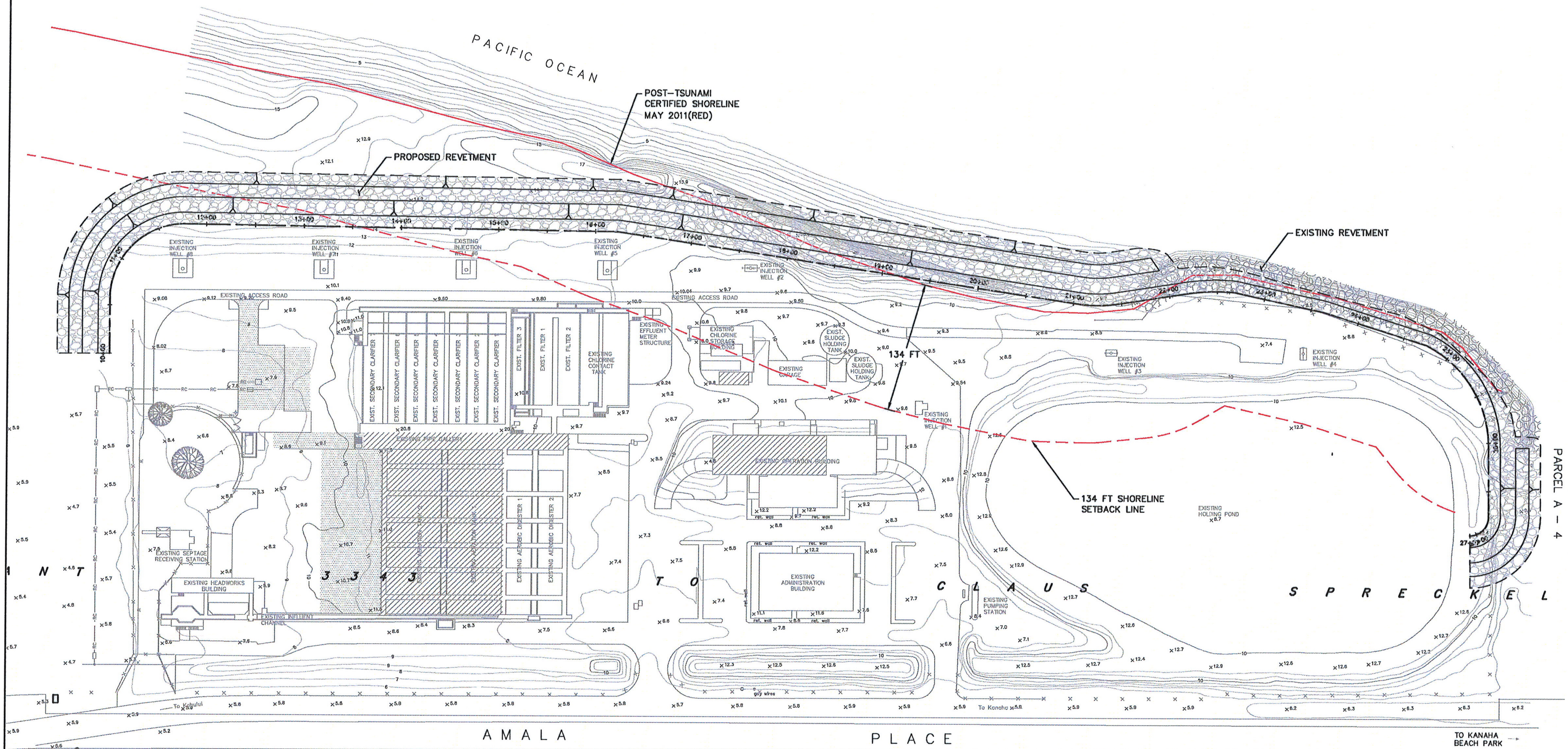
2. Placement of smaller rocks and geotextile fabric to prevent leaching of the backfill through the voids between the large boulders.

3. Placement of armor stone to stabilize the shoreline slope.

Application and approval criteria required for a SSV are set forth in the "Shoreline Rules for the Maui Planning Commission", Chapter 203, Sections 14 and 15. The most recent certified shoreline survey (August 2011) is included in **Appendix "L"**. The proposed actions within the shoreline setback have been analyzed with respect to these criteria, as discussed below.

1. A shoreline area variance may be granted for a structure or activity, if the commission finds that the proposed structure or activity is necessary for or ancillary to certain uses.

<u>**Response:**</u> The placement of the revetment along the shoreline to protect the functional integrity of the WKWWRF is deemed to be in the interest of the public. The proposed revetment and related improvements will stabilize shoreline conditions to ensure the continued long-term functional integrity of the WKWWRF. The proposed action has been chosen after extensive study of the feasibility of different



Source: Moffatt & Nichol 2012

Figure 18

Proposed Shoreline Protection Extension at Wailuku-Kahului Wastewater Reclamation Facility

Site and Revetment with Shoreline and Shoreline Setback

NOT TO SCALE

MUNEKIYO & HIRAGA, INC.

Prepared for: County of Maui, Department of Environmental Management options to meet Central Maui's long-term wastewater needs. Refer to **Appendix "C"**. The proposed shoreline protection is essential for maintaining public health and safety, and is the most cost-effective option.

2. **A structure or activity may be granted to a variance upon grounds of hardship if:**

   a. **The applicant would be deprived of reasonable use of land if required to fully comply with the shoreline setback rules.**

   Response: The proposed action within the shoreline setback area is needed to protect the functional operations of the existing WKWWRF. The shoreline fronting the WKWWRF site is eroding at an annual average rate of -2.4 ft./yr. Leaving the shoreline unprotected would deprive the County of the long-term use of the property. The proposed action will provide protection to the shoreline and the WKWWRF from erosion, as well as an additional degree of protection from tsunamis. The Central Maui Wastewater Reclamation Facility Study concluded after much analysis that the best option to meet Central Maui's wastewater needs is to strengthen the existing facility to protect against tsunamis and shoreline erosion, and to expand it in the future for additional capacity. Given the existing critical infrastructure system being impacted and the threat to the shoreline within the shoreline setback, the applicant would be deprived of reasonable use of the land if these actions could not be implemented. Refer to **Appendix "C"**.

   b. **The applicant's proposal is due to unique circumstances and does not draw into question the reasonableness of the shoreline setback rules.**

   Response: The existing conditions of the property pose a unique circumstance which warrants the need for the proposed action. The original erosion control revetment for the facility in 1979 was not fully completed due to financial constraints. The proposed revetment is necessary to maintain the functional viability of the WKWWRF. The existing land use is aesthetically compatible with the nearby industrial area and the proposed structure will be functionally compatible with the existing revetment on the east side of the WKWWRF property. The proposed development plans have been altered since the EA/EISPN and the proposed revetment will be aligned further inland with a portion of the revetment covered with the excess excavated sand, resulting at time of project completion in similar aesthetic characteristics to that of pre-development conditions. In summary, the unique circumstances of rapid shoreline erosion affecting the subject property do not draw into question the reasonableness of the shoreline setback rules.

c. **The proposal is the practical alternative which best conforms to the purpose of the shoreline setback rules.**

Response: The existing portion of the revetment has demonstrated favorable performance over its 30 year life and the rock mound revetment alternative further inland proves to be a conservative yet economical alternative to meet required standards. Therefore, the proposed action represents a practical alternative which best conforms to the purpose of the shoreline setback rules. In particular, the proposed work will stabilize the location of the shoreline to enable continued functional operations of the WKWWRF; the proposed action will ensure public health and welfare; and the proposed action will maintain the quality of scenic and open space resources fronting the subject property. The rock mound revetment alternative, located further inland and partially covered with the excess excavated sand will help preserve the existing characteristics of the shoreline area and will allow for continued public lateral access along the shoreline.

3. **Before granting a hardship variance, the commission must determine that the applicant's proposal is a reasonable use of the land.**

Response: The proposed actions are an extension of an existing erosion control revetment designed to stabilize conditions along the shoreline at the WKWWRF. The actions do not intensify the use of the shoreline with respect to the current conditions, nor do they pose a risk to individuals or to the public health and safety. The proposed actions are essential elements in allowing the WKWWRF to be functionally viable, while maintaining a context of reasonableness, as prescribed by the shoreline rules.

4. **For purposes of the shoreline rules, hardship shall not include economic hardship to the applicant; county zoning changes, planned development permits, cluster permits or subdivision approvals after June 16, 1989; any other permit or approval which may have been issued by the commission.**

Response: The proposed action is not being sought as relief to economic hardship to the applicant but is proposed to ensure public health and safety to the residents of

Central Maui. The action is intended to stabilize conditions along the shoreline while ensuring the continued functional integrity of the WKWWRF.

5. **No variance shall be granted unless appropriate conditions are imposed.**

<u>**Response:**</u> The proposed actions comply with conditions relating to the provision of safe lateral access; minimization of risk to beach processes; minimization of risk relating to structural failure and loose rock and rubble; and minimization of impacts on public views to, from, and along the shoreline. The need for lateral access over the revetment structure and to the beach will be provided for in the design of the improvement. The revetment will be designed by a professional engineer licensed in the State of Hawaii to ensure its structural integrity and structural soundness. The top of the revetment will be set at +13 ft. MLLW and is not anticipated to adversely impact views and scenic resources.

In summary, the proposed actions within the shoreline setback are considered necessary for the viable operation of the WKWWRF and the protection of the adjacent shoreline. The actions are in keeping with the purpose and criteria set forth in the shoreline rules.

I. <u>OTHER REGULATORY REQUIREMENTS</u>

As described in Chapter I, the proposed action will require a Department of the Army Permit, a Section 401 Water Quality Certification, and a Coastal Zone Management Consistency Approval. Coordination will be undertaken with the Department of the Army, Department of Health, and Office of Planning, respectively, to prepare and submit the required application submittals.

Additionally, the Office of Environmental Quality Control (OEQC) has published a Shoreline Hardening Policy and Environmental Assessment Guidelines. The Guidelines list thirteen (13) items that should be included with "any Environmental Assessment prepared in conjunction with an application to construct a seawall, revetment, or similar structure, or an activity that will alter in any way littoral processes affecting the shoreline" (OEQC, 1998). These items are listed below with a description of how they are addressed in this Draft EIS.

1. <u>Historical Shoreline Analysis of Coastal Erosion and Accretion Rates</u>

A historical shoreline analysis is included in the Shoreline Evaluation Report, found in **Appendix "C"**. This analysis includes long-term changes over the past 100 years as well as an analysis of changes over shorter periods of time.

2. Shoreline Type

A description of the nature of the affected shoreline, types of sand located on the shoreline, relationship between the shoreline and the reef, and historical information about the area are included in the WKWWRF Preliminary Engineering Report, Shoreline Erosion Control. Refer to **Appendix "D"**.

3. Site Maps

Aerial photographs of the project site and surrounding land uses, as well as erosion rate maps, property location maps, and site plans can be found in Chapter I of this Draft EIS report.

4. Beach Profiles

USGS beach profile data is included in the WKWWRF Preliminary Engineering Report, Shoreline Erosion Control. Refer to **Appendix "D"**. The profile location closest to the project site is called "VKHL" and it is located near the western property line of the WKWWRF, close to Station 72 in the County Erosion Maps.

5. Existing Walls

There is an existing 450-ft revetment on the eastern side of the WKWWRF property, protecting the WKWWRF holding pond. This revetment was built by the USACE in 1979 under the authority of Section 14, Emergency Flood Control Act of 1946, as amended.

6. Description of Improvements

The description of the proposed improvement is found in Chapter I of this document and in **Appendix "D"**, the Preliminary Engineering Report. It discusses the structures on the WKWWRF property, including their location, an estimation of time until they are threatened by erosion, and the feasibility of relocating them.

7. **Coastal Hazard History**

A description of coastal hazards in the vicinity of the WKWWRF is contained in Chapter II of this document, as well as the Preliminary Engineering Report, found in **Appendix "D"**.

8. **Waves and Currents**

A summary of the wave climate that affects the WKWWRF is contained in the Shoreline Evaluation Report found in **Appendix "C"**.

9. **Sediment Movement**

A Sediment Budget Analysis is included in the WKWWRF Preliminary Engineering Report, Shoreline Erosion Control. Refer to **Appendix "D"**.

10. **Thirty-year Erosion Hazard**

The Maui Shoreline Erosion Maps used aerial photography and historic T-sheets to assess the extent of erosion over 100 years in and around the project site. Refer to **Figure 5**. The determination of the annual rate of erosion was based on this data.

11. **Photographs**

Photographs of the existing revetment and the site of the proposed revetment, an aerial map of erosion in the area, and an aerial rendering of the proposed revetment are included in Chapter I of this document. Photographs of the shoreline and historic aerial photographs are provided in the WKWWRF Preliminary Engineering Report Shoreline Erosion Control and Addendum No. 1 Report. Refer to **Appendix "D"** and **Appendix "D-1"**, respectively.

12. **Alternatives**

The alternatives to both the relocation of the wastewater treatment facility and shoreline protection measures at the existing facility are detailed in Chapter V of this document. They are further detailed in the Preliminary Engineering Report found in **Appendix "D"**.

13. <u>Professional Engineer Seal</u>

The coastal engineering firm Moffatt & Nichol will prepare the project design drawings with the required Professional Engineer (P.E.) seal.

IV. SUMMARY OF UNAVOIDABLE ENVIRONMENTAL IMPACTS

IV. SUMMARY OF UNAVOIDABLE ENVIRONMENTAL IMPACTS

The proposed project will result in certain unavoidable construction-related environmental impacts as outlined in Chapter II.

In the short-term, construction associated with the project will generate noise impacts. These impacts will be limited to the immediate vicinity of the project construction areas. Sound attenuating devices will be used on construction equipment where practicable to mitigate noise impacts caused by construction.

Unavoidable temporary air and water quality impacts will also arise as a result of construction activities, such as the generation of dust and other airborne pollutants. Appropriate Best Management Practices (BMPs) will be incorporated in the construction process to mitigate adverse construction-related impacts.

In the long term, the proposed project will protect the Wailuku-Kahului Wastewater Reclamation Facility (WKWWRF), but it will not prevent the existing beach loss and the related effect of passive erosion on lateral access along the shoreline. Should the revetment extension limit the transfer of sand from the kite beach area to the beach west of the WKWWRF, there is the potential for a reduced supply of sand for beaches downdrift from the project site. It is estimated that approximately 1,300 to 4,000 cubic yards of sand per year is lost each year and is likely to continue in the future. Measures to mitigate potential impacts to lateral access along the shoreline are provided for on the exposed crest of the proposed shoreline revetment extension and through the incorporation of a stairway to the beach.

V. ALTERNATIVES TO THE PROPOSED ACTION

V. ALTERNATIVES TO THE PROPOSED ACTION

A. ALTERNATIVES FOR CENTRAL MAUI'S WASTEWATER NEEDS

The County of Maui, Department of Environmental Management (DEM) has looked at a variety of options in providing for the wastewater needs of Central Maui for the next 20 to 30 years (Austin, Tsutsumi and Associates, 2006).

1. Preferred Alternative

The proposed development plan, as outlined in Chapter I, Project Overview, represents the Preferred Alternative. It should be noted that the preferred alternative has been revised from the preferred alternative presented in the EA/EISPN in response to agency comments. This new preferred alternative involves a new alignment for the revetment further inland. This alternative, was ranked Number 1 in the alternatives considered and entails shoreline protection to the existing Wailuku-Kahului Wastewater Reclamation Facility (WKWWRF), presents a viable alternative since the capital infrastructure is already existent onsite. Even though various components of the WKWWRF will require upgrading as they approach the design capacity of 7.9 MGD by the year 2029, the proposed shoreline revetment extension plan was deemed to be the most cost-effective at a cost of approximately $4.2 million (in 2008 dollars).

2. Alternatives Considered

The Central Maui Wastewater Reclamation Facility Study (May 2006) identified five (5) core wastewater treatment facility concepts as a basis for project alternatives with multiple effluent disposal options resulting in 11 alternatives for initial consideration. The five (5) core wastewater treatment facility concepts studied included the following.

a. Expand the existing WKWWRF and fortify facility to protect against tsunamis and shoreline erosion.

b. Maintain the existing WKWWRF at its current capacity; fortify facility to protect against tsunamis and shoreline erosion and construct satellite WWRF(s) to meet future wastewater capacity demands.

c. Maintain the existing WKWWRF at its current capacity, fortify facility to protect against tsunamis and shoreline erosion and require new development to install individual wastewater systems.

d. Construct a new Central Maui WWRF to treat existing and future wastewater flows. Phase out existing WKWWRF.

e. Construct a new Central Maui WWRF to meet future wastewater treatment demands and relocate the existing WKWWRF away from tsunami and shoreline erosion impacts.

The direct and indirect effluent disposal options selected for consideration included the following.

1. Injection wells

2. Deep ocean outfalls

3. Brackish groundwater recharge

4. Water recycling

The resulting evaluation ranking of the 11 alternatives studied are summarized in **Table 7**, below.

Table 7. Wastewater Treatment Concept Alternatives

Rank	Alternative	Effluent Disposal Method
1	Expand the existing WKWWRF and fortify facility to protect against tsunamis and shoreline erosion.	Injection wells
2	Construct a new Central Maui WWRF to treat existing and future wastewater flows. Phase out existing WKWWRF.	Brackish groundwater recharge
3	Construct a new Central Maui WWRF to treat existing and future wastewater flows. Phase out existingWKWWRF.	Water recycling
4	Construct a new Central Maui WWRF to treat existing and future wastewater flows. Phase out existing WKWWRF.	Injection wells
5	Construct a new Central Maui WWRF to meet future wastewater treatment demands and relocate the existing WKWWRF away from tsunami and shoreline erosion zones.	Brackish groundwater recharge
6	Construct a new Central Maui WWRF to meet future wastewater treatment demands and relocate the existing WKWWRF away from tsunami and shoreline erosion zones.	Water recycling
7	Expand the existing WKWWRF and fortify facility to protect against tsunamis and shoreline erosion.	Brackish groundwater recharge
8	Construct a new Central Maui WWRF to treat existing and future wastewater flows. Phase out existing WKWWRF.	Ocean outfall
9	Expand the existing WKWWRF and fortify facility to protect against tsunamis and shoreline erosion.	Ocean outfall
10	Construct a new Central Maui WWRF to meet future wastewater treatment needs and relocate the existing WKWWRF away from tsunami and shoreline erosion zones.	Injection wells
11	Expand the existing WKWWRF and fortify facility to protect against tsunamis and shoreline erosion.	Water recycling

Source: Austin, Tsutsumi & Associates, Inc. 2006.

3. **Site Location Options**

Potential new site options considered in the study for a new Central Maui WWRF included the following:

a. Keopuolani County Park

b. South of Kuihelani Highway, in the vicinity of Kuihelani Highway and Maui Lani Parkway in existing agricultural lands

c. Puunene Sugar Mill site

d. South of Kahului Airport, in the vicinity south of Old Haleakala Highway and Hana Highway approximately 0.5 mile from the WKWWRF.

e. Old Puunene Airport Site

The sites were selected based on proximity to developed lands, adjacent land uses, and potential for water recycling and/or brackish groundwater recharge. The costs of developing a new facility at these alternative site locations ranged from $350 million to $475 million (in 2005 dollars).

4. Non-Structural Alternative

In addition to the new capacity alternatives, three (3) water and wastewater demand management alternatives were considered as a means to provide additional wastewater system capacity through managing potable water usage or reducing Infiltration/Inflow (I/I) into the wastewater system. The three (3) non-structural alternatives included:

- Initiate a water conservation program
- Replace existing high-use water fixtures (toilets, showerheads)
- Expand the existing I/I reduction program

These alternatives have all been implemented by the County to some extent. However, they do not eliminate the long-term need to increase wastewater treatment capacity in the Central Maui region.

B. ALTERNATIVES FOR SHORELINE PROTECTION AT THE EXISTING FACILITY

The following discussion provides an evaluation of alternatives considered for shoreline protection at the WKWWRF.

1. Preferred Alternative

The proposed alternative, outlined in Chapter I, entails developing an approximate

1,200-ft. rock mound revetment extending west from the existing 450-ft. revetment with improvements to the existing revetment to bring its cap to the same +13 feet MLLW and a 150-foot extension of the east flank to provide long-term protection to the facility in the case of continued erosion. This alternative represents a modification from the preferred alternative as presented in the EA/EISPN, which is presented immediately below. In response to comments during the EA/EISPN comment period, the proposed rock mound revetment has been realigned inland from the beachface and will be partially buried with the excess excavated sand. This alternative minimizes impacts to the beach fronting the WKWWRF. The partially covered rock mound revetment alternative provides a viable solution that makes use of the capital infrastructure already in existence, minimizing the burden placed on taxpayers, balancing costs and environmental impacts.

2. **Rock Mound Revetment Alternative**

Approximately 1,200 feet of exposed rock mound revetment extending from the existing revetment west along the beach scarp was identified as the preferred alternative in the EA/EISPN. While the financial costs associated with an exposed rock mound revetment are less than the preferred alternative above, the previously proposed development plans with a seaward alignment would result in a larger footprint on the beach.

3. **Beach Nourishment Alternatives**

Two (2) alternatives utilizing beach nourishment were considered: a longer section covering 4,000 feet, and a shorter section covering 2,650 feet (Based on approximate measurements). The 4,000-ft. alternative would require an initial 215,000 cubic yards of sand fill to create an 80-ft. wide berm, followed by an additional 85,000 cubic yards every ten years. This longer alternative is estimated to cost between $8.1 and $13.1 million (in 2005 dollars). The 2,650-ft. alternative would require an initial 145,000 cubic yards of sand fill to create an 80-ft. wide berm, followed by an additional 55,000 cubic yards every eight years. This shorter alternative is estimated to cost between $5.5 and $10.4 million (in 2005 dollars). Both projects would require replenishment of the sand over the entire life of the project. Smaller beach nourishment projects typically have less success with retaining beach area over time. Both projects presented a higher cost and a continued financial obligation in the sand replacement for the foreseeable life of the plant. In addition, the availability of a viable source of beach quality sand on Maui is presently very limited, and looks to be even more limited in the future as demand increases.

4. **Rock Mound Revetment with Beach Nourishment**

An alternative that combined the rock mound revetment and the shorter, 2,400-foot beach nourishment alternative was considered. As with the other beach nourishment alternatives, this alternative would require replenishment of the sand over the entire life of the project. With total costs ranging from $7.2 million to $11.2 million, this alternative provided an alternative that would be more economically feasible than the long beach nourishment alternative, however, as with the nourishment alternatives, this project has higher costs of initial construction and continued financial obligations for the foreseeable life of the plant as a result of the sand replacement.

5. **Onsite Strategic Retreat of Facilities Alternative**

Relocating the facilities at risk to other areas of the WKWWRF site was also considered as an alternative. Due to the land requirements and costs of relocation, this alternative was deemed to be not feasible. Structures currently at the highest risk due to shoreline erosion, such as the existing injection Well No. 2, access road, and existing sludge holding tanks, could possibly be relocated. However, it is not feasible to relocate the chlorine contact tank and effluent meter, due to the size of the structure and its position in the wastewater treatment process. The cost of relocating the operations building is also prohibitive. Even if the most threatened structures were to be relocated, other parts of the facility would soon become threatened by erosion. Thus, relocation is not a cost-effective or a reasonable long-term solution.

6. **Other Alternatives**

The use of coral rubble fill as beach nourishment was considered. It was deemed impractical and undesirable due to the lack of a sufficient source for the material locally. This method is also discouraged because coral rubble is a littoral material and should remain in the littoral zone.

The use of rock or geotextile groins was also considered. These devices were deemed ineffective due to the high cost and low net longshore transport rates in the WKWWRF littoral cell. Shore-perpendicular structures such as groins are best used in locations with high rates of net longshore transport.

A vertical seawall and hybrid structure was considered as another option. It was not pursued by DEM, however, because this type of structure is significantly more expensive. There is limited public use of the beach fronting the facility, and this type of structure is more beneficial where the public benefits of retaining beach space outweigh the costs of construction and maintenance.

7. <u>No Action Alternative</u>

The "no action" alternative would maintain the facility's exposure to shoreline erosion, which poses a threat to the integrity of the facility and its ability to keep operating. In addition, this alternative presents the highest environmental and financial risk to the County. This alternative would not address the purpose and need for this project. Out of twenty-one (21) alternatives for meeting Central Maui's wastewater needs for the next 20 to 30 years, this option was ranked last and rejected by DEM.

8. <u>Deferred Action Alternative</u>

The "deferred action" alternative would have similar consequences to the "no action" alternative in terms of the near-term safety of the facility and its ability to provide for Central Maui's wastewater needs. As a result, this option was also rejected by DEM.

VI. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

VI. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The development of the proposed project would involve the commitment of County lands and funds to protect the Wailuku-Kahului Wastewater Reclamation Facility (WKWWRF). In addition, labor and material resources would be expended as part of the project's construction phase. Commitments of these resources are considered irreversible and irretrievable. These commitments, however, are also considered appropriate in the context of providing sufficient protection for the WKWWRF to satisfy the current and future wastewater treatment demands of the Central Maui Region. Beach loss without beach nourishment would result in an irretrievable commitment of recreational resources. In order to address this potential loss, the Department of Environmental Management (DEM) has modified the project alignment inland from the beach scarp to retain existing beach areas for use by the public. Lateral shoreline access over the proposed shoreline revetment extension structure and a proposed stairway to the beach will also be provided as part of the design of the project.

VII. RELATIONSHIP BETWEEN THE SHORT-TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

VII. RELATIONSHIP BETWEEN THE SHORT-TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The functional integrity of the Wailuku-Kahului Wastewater Reclamation Facility (WKWWRF) is currently threatened by erosion of the shoreline fronting the facility. The alternatives to build a new Central Maui wastewater reclamation facility further inland were estimated to cost in the range of $350 million to $475 million (in 2005 dollars). With an estimated cost of approximately $4.5 million (in 2012 dollars), the proposed shoreline protection extension places less burden on the taxpayers. The proposed shoreline protection is considered a more balanced solution to provide reliable wastewater treatment capacity for the Central Maui service area into the future.

VIII. UNRESOLVED ISSUES

VIII. UNRESOLVED ISSUES

The evaluation of the proposed action has provided a thorough analysis of the potential environmental impacts. The following section summaries the issues that remain unresolved at the time of writing the Draft EIS for the proposed shoreline revetment extension at the WKWWRF:

A. WATER QUALITY AND MARINE RESOURCES

Permits from the U.S. Department of the Army (DA) and the State of Hawaii, Department of Health (DOH) will be required prior to project implementation. Technical review during the DA permit and DOH Section 401 Water Quality Certification (WQC) process may identify additional impacts as well as proposed mitigation measures to protect water quality and marine resources. However, as previously stated, a water quality monitoring program will be implemented for the project in order to measure any degradation of water quality.

B. BEACH EROSION

Construction of the shoreline revetment extension will protect the WKWWRF but it will not prevent ongoing beach erosion along the shoreline fronting the facility. Beach erosion is expected to continue at the typical average rate of approximately -2.4 ft./yr. until such time the erosion reaches the proposed revetment extension and landward flanking of the facility will further continue.

IX. PUBLIC INFORMATIONAL MEETING

IX. PUBLIC INFORMATIONAL MEETING

A. <u>PUBLIC INFORMATIONAL MEETING TO REVIEW ENVIRONMENTAL ASSESSMENT/ENVIRONMENTAL IMPACT PREPARATION NOTICE</u>

The County of Maui Department of Environment Management (DEM) held a public informational meeting on February 16, 2011 at the Maui Waena Intermediate School in Kahului to review the EA/EISPN. The EA/EISPN was published in the Environmental Notice on January 23, 2011. The public meeting was held during the 30 day comment period to solicit comments from the public on the project as part of the EIS process. The project environmental consultant and coastal engineering consultant gave a powerpoint presentation which provided information on the project need, the proposed action and scope of the environmental review that will be carried out in the Draft EIS and to invite comments from members of the public attending the meeting. A summary of the comments and questions received during the public informational meeting and the responses given are summarized as follows.

1. A comment was made that the beach fronting the Wailuku-Kahului Wastewater Reclamation Facility (WKWWRF) is a place of safe refuge for kite surfers and it is important that the beach remains available for kite surfers into the future.

2. It was noted that the beach has been used in the past by local families for fishing and limu gathering and continues to be regarded as a local beach. The existing beach should be valued in the historical context as important for local families. Beach nourishment should not be carried out at another beach or put into a beach nourishment bank, but should take place at the beach fronting the WKWWRF. The beach nourishment mitigation should be kept local.

3. A question was asked if the revetment would accelerate erosion down stream of the WKWWRF?

<u>Response:</u> The coastal engineer responded that the revetment will not accelerate erosion downstream. The erosion of the shoreline is happening already. The Kahului Harbor lies downstream to the northwest of the WKWWRF site and there is a breakwater extending from the harbor which protects the area from erosion.

4. If the beach nourishment is implemented, how far out will the beach sand be extended?

Response: The coastal engineer responded that the beach nourishment will extend approximately 40 to 50 feet into the water from the shoreline.

5. A question was asked how much beach would be lost without the revetment?

Response: The coastal engineer responded that the erosion will cause approximately 40 feet of the beach to be lost and this loss would extend along the entire 1200 feet length of the beach fronting the WKWWRF property.

X. LIST OF PERMITS AND APPROVALS

X. LIST OF PERMITS AND APPROVALS

The following permits and approvals are anticipated to be needed for project implementation:

<u>Federal Government</u>

1. Section 404 of the Clean Water Act, U.S. Department of the Army Permit

<u>State of Hawaii</u>

1. Hawaii Revised Statutes, Chapter 343 Environmental Impact Statement
2. Conservation District Use Permit (BLNR Permit)
3. Section 401 of the Clean Water Act, Water Quality Certification
4. National Pollutant Discharge Elimination System Permit
5. Coastal Zone Management Consistency Approval
6. Easement from Board of Land and Natural Resources

<u>County of Maui</u>

1. Special Management Area Use Permit
2. Shoreline Setback Variance
3. Flood Hazard Area Development Permit
4. Construction Permits

XI. AGENCIES AND ORGANIZATIONS CONSULTED IN THE PREPARATION OF THE DRAFT EIS

XI. AGENCIES AND ORGANIZATIONS CONSULTED IN THE PREPARATION OF THE DRAFT EIS

1. Larry Yamamoto, State Conservationist
   U.S. Department of Agriculture
   Natural Resources Conservation Service
   P.O. Box 50004
   Honolulu, Hawaii 96850-0001

2. Ranae Ganske-Cerizo, Soil Conservationist
   Natural Resources Conservation Service
   U.S. Department of Agriculture
   77 Hookele Street, Suite 202
   Kahului, Hawaii 96732

3. Lt. Doug Jannusch, Commander
   U. S. Coast Guard
   Fourteenth Coast Guard District
   300 Ala Moana Boulevard
   Honolulu, Hawaii 96850-4982

4. George Young
   Chief, Regulatory Branch
   U.S. Department of the Army
   U.S. Army Engineer District, Honolulu
   Regulatory Branch
   Building 230
   Fort Shafter, Hawaii 96858-5440

   cc: Dan Meyers

5. Wayne Nastri, Regional Administrator
   U. S. Environmental Protection Agency
   Region 9
   75 Hawthorne Street
   San Francisco, California 94105

6. Loyal Mehrhoff
   Field Supervisor
   U. S. Fish and Wildlife Service
   300 Ala Moana Blvd., Rm. 3-122
   Box 50088
   Honolulu, Hawaii 96813

7. State Comptroller
   Department of Accounting and General Services
   1151 Punchbowl Street, #426
   Honolulu, Hawaii 96813

8. Karen Seddon
   Executive Director
   Hawaii Housing Finance and Development Corporation
   677 Queen Street
   Honolulu, Hawaii 96813

9. Director
   State of Hawaii
   Department of Business, Economic Development & Tourism
   P.O. Box 2359
   Honolulu, Hawaii 96804

10. Superintendent
    State of Hawaii
    Department of Education
    P.O. Box 2360
    Honolulu, Hawaii 96804

11. Chairman
    Department of Hawaiian Home Lands
    P. O. Box 1879
    Honolulu, Hawaii 96805

12. Director
    State of Hawaii
    Department of Health
    919 Ala Moana Blvd., Room 300
    Honolulu, Hawaii 96814

13. Alec Wong, P.E., Chief
    Clean Water Branch
    State of Hawaii
    Department of Health
    919 Ala Moana Blvd., Room 300
    Honolulu, Hawaii 96814

14. Patti Kitkowski
Acting District Environmental Health Program Chief
State of Hawaii
Department of Health
54 High Street
Wailuku, Hawaii 96793

15. Chairperson
State of Hawaii
Department of Land and Natural Resources
P. O. Box 621
Honolulu, Hawaii 96809

16. Administrator
State of Hawaii
Department of Land and Natural Resources
State Historic Preservation Division
601 Kamokila Blvd., Room 555
Kapolei, Hawaii 96707

17. Hinano Rodrigues
Department of Land and Natural Resources
State Historic Preservation Division
130 Mahalani Street
Wailuku, Hawaii 96793

18. Director
State of Hawaii
Department of Transportation
869 Punchbowl Street
Honolulu, Hawaii 96813

cc: Fred Cajigal

19. Major General Robert G.S. Lee, Director
Hawaii State Civil Defense
3949 Diamond Head Road
Honolulu, Hawaii 96816-4495

20. Director
Office Of Environmental Quality Control
235 S. Beretania Street, Suite 702
Honolulu, Hawaii 96813

21. Administrator
Office of Hawaiian Affairs
711 Kapiolani Boulevard, Suite 500
Honolulu, Hawaii 96813

22. Director
State of Hawaii
Office of Planning
P.O. Box 2359
Honolulu, Hawaii 96804

23. Dan Davidson, Executive Officer
State of Hawaii
State Land Use Commission
P.O. Box 2359
Honolulu, Hawaii 96804

24. Mayor
County of Maui
200 South High Street
Wailuku, Hawaii 96793

25. Director
County of Maui
Office of Economic Development
2200 Main Street, Suite 305
Wailuku, Hawaii 96793

26. Administrator
Maui Civil Defense Agency
200 South High Street
Wailuku, Hawaii 96793

27. Jeffrey A. Murray, Fire Chief
County of Maui
Department of Fire and Public Safety
200 Dairy Road
Kahului, Hawaii 96732

28. Director
County of Maui
Department of Housing and Human Concerns
One Main Plaza
2200 Main Street, Suite 546
Wailuku, Hawaii 96793

29. Director
County of Maui
Department of Parks and Recreation
700 Halia Nakoa Street, Unit 2
Wailuku, Hawaii 96793

30. Director
County of Maui
Department of Planning
250 South High Street
Wailuku, Hawaii 96793

31. Chairperson, **Maui Planning Commission**
c/o Department of Planning
County of Maui
250 South High Street
Wailuku, Hawaii 96793

32. Gary Yabuta, Chief
County of Maui
Police Department
55 Mahalani Street
Wailuku, Hawaii 96793

33. Director
County of Maui
Department of Public Works
200 South High Street
Wailuku, Hawaii 96793

34. Director
County of Maui
Department of Transportation
200 South High Street
Wailuku, Hawaii 96793

35. Director
County of Maui
Department of Water Supply
200 South High Street
Wailuku, Hawaii 96793

36. Danny Mateo, Council Chair
Maui County Council
200 South High Street
Wailuku, Hawaii 96793

37. Councilmember Joseph Pontanilla
Maui County Council
200 South High Street
Wailuku, Hawaii 96793

38. Councilmember Mike Victorino
Maui County Council
200 South High Street
Wailuku, Hawaii 96793

39. **Hawaiian Telcom**
60 South Church Street
Wailuku, Hawaii 96793

40. Greg Kauhi, Manager, Customer Operations
Maui Electric Company, Ltd.
P.O. Box 398
Kahului, Hawaii 96733

41. **Kahului Regional Library**
90 School Street
Kahului, Hawaii 96732

42. **Wailuku Regional Library**
251 High Street
Wailuku, Hawaii 96793

43. **The Maui News**
100 Mahalani Street
Wailuku, Hawaii 96793

44. **UH Environmental Center**
Krauss Annex 19
2500 Dole Street
Honolulu, Hawaii 96822

FEB 22 2011

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, HONOLULU
FORT SHAFTER, HAWAII 96858-5440

REPLY TO
ATTENTION OF:

February 16, 2011

Regulatory Branch

File Number POH-2011-00035

County of Maui-Department of Environmental Management
Attention: Kyle Ginoza
One Main Plaza
2200 Main Street, Suite 100
Wailuku, Hawaii 96793

APPROVED JURISDICTIONAL DETERMINATION
PERMIT REQUIRED

Dear Mr. Ginoza:

This is in response to your letter dated January 21, 2011 requesting a Department of the Army (DA) review and comment on the Environmental Impact Statement Preparation Notice (EISPN) for the proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension at TMK (2) 3-8-001:188, Kahului, Island of Maui, Hawaii. We have assigned the project the reference number **POH-2011-00035.** Please cite the reference number in any future correspondence concerning this project.

We completed our review of the submitted documents pursuant to Section 10 of the Rivers and Harbors Act of 1899 (Section 10) and Section 404 of the Clean Water Act (Section 404) and have determined that the submitted documents, accurately identify waters under the regulatory jurisdiction of U.S. Army Corps of Engineers (the Corps).

Section 10 requires that a DA permit be obtained from the Corps prior to undertaking any construction, dredging, or other activity occurring **in, over, or under or affecting navigable waters of the U.S.** For tidal waters, the shoreward limit of the **Corps' jurisdiction extends to the Mean High Water Mark.** Section 404 requires that a DA permit be obtained for the **discharge (placement) of dredged and/or fill material into waters of the U.S.**, including wetlands. For tidally influenced waters, in the absence of adjacent wetlands, the shoreward limit of the **Corps' jurisdiction extends to the High Tide Line**, which in Hawai'i may be approximated by reference to the Mean Higher High Water Mark. For non-tidal waters, the lateral limits of the Corps' jurisdiction extend to the Ordinary High Water Mark or the approved delineated boundary of any adjacent wetlands.

The **Pacific Ocean** is a **navigable water of the U.S.**, subject to Corps jurisdiction. The submitted documents indicated that the shoreline protection extension including site clearing, grubbing, excavating and grading along the shoreline of the Pacific Ocean. Therefore, in accordance with Section 10, a **DA permit will be required** prior to commencement of work activity **in, over or under or affecting** a navigable water of the U.S.

The information you have submitted indicates that the proposed construction of the 1,200-foot long rock mound revetment will require placement of approximately 15,000 tons of filter fabric, bedding stone, underlayer stone and armor stone between the elevations of +10 to +13 Mean Lower Low Water (MLLW) at its crest and -3 MLLW at its toe. Therefore, in accordance with Section 404, **a DA permit will be required** prior to commencement of work activity resulting in the **discharge of fill material waterward of the High Tide Line of this water of the U.S.**

We advise your client to submit a DA Permit application and associated drawings that meet our drawing recommendations found at *http://www.poh.usace.army.mil/EC-R/EC-R.htm* to the Corps. We advise that your client conduct and include a thorough aquatic resource survey of the review area, describing any adjacent wetlands and/or estuarine wetlands and/or additional streams, etc., on-site, especially those that may be impacted by any of the proposed project components. In addition, supporting information submitted with the permit application should include sufficient information concerning the scope of work, including the use of Best Management Practices, i.e. silt fences and sandbag berms within the vicinity and in close proximity to potentially regulated bodies of water. The Corps will at that time review the application to ensure it complies with all necessary federal laws and regulations. Be advised, if the fill results in either temporary or permanent loss of waters of the U.S. and/or associated function, your client may be required to provide compensatory mitigation for any unavoidable impacts to the aquatic environment.

This letter contains an approved JD for the property in question and is valid for a period of five (5) years unless new information warrants revision of the determination before the expiration date. If you object to this determination, you may request an Administrative Appeal under Corps regulations at 33 Code of Federal Regulations (CFR) Part 331. We have enclosed a Notification of Appeal Process and Request For Appeal (NAP/RFA) form. If you request to appeal this determination you must submit a completed RFA form, according to instructions in the RFA, to the Corps' Pacific Ocean Division office at the following address:

Thom Lichte, Appeals Review Officer
U.S. Army Corps of Engineers
Pacific Ocean Division, ATTN: CEPOD-PDC
Building 525
Fort Shafter, HI 96858-5440

We noted that the proposed shoreline protection will require placement of additional armor stone on top of the existing 450-foot long revetment, increasing the crest elevation by 3 feet to match the proposed revetment, accounting for sea level rise. The existing revetment was constructed by the Corps in 1979 and as such, will require approval from the Corps Chief of Engineers in accordance with 33 USC 408 prior to commencement of a work activity resulting in the significant modification or alteration to a locally or federally maintained Corps project. Please contact Mr. Derek Chow, Chief of the Honolulu District Corps Civil and Public Works Branch at *808.438.7009* or via email at *Derek.J.Chow@usace.army.mil* requesting review of the proposed shoreline protection extension. Required documents for your submittal are enclosed.

Thank you for contacting us regarding this project and providing us with the opportunity to comment. Should you have any questions, please contact Ms. Jessie Pa'ahana at *808.438.0391* or via email at *Jessie.K.Paahana@usace.army.mil*. You are encouraged to provide comments on your experience with the Honolulu District Regulatory Branch by accessing our web-based customer survey form at ***http://www.per2.nwp.usace.army.mil/survey.html.***

Sincerely,

George P. Young, P.E.
Chief, Regulatory Branch

Enclosures

Copy furnished (w/out enclosures):
Munekiyo & Hiraga, Inc., Colleen Suyama, 305 High St., Suite 104, Wailuku, HI 96793
US Army Engineer District, Honolulu, Derek Chow, Chief, Civil & Public Works Branch, Bldg. 230, Ft. Shafter, HI 96858-5440
US Army Engineer District, Honolulu, Michael F. Wong, Chief, Civil Works Technical Branch, Bldg. 223, Ft. Shafter, HI 96858-5440

APPROVED JURISDICTIONAL DETERMINATION FORM
U.S. Army Corps of Engineers

This form should be completed by following the instructions provided in Section IV of the JD Form Instructional Guidebook.

SECTION I: BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR APPROVED JURISDICTIONAL DETERMINATION (JD): 15 Feb 11

B. DISTRICT OFFICE, FILE NAME, AND NUMBER: CEPOH-EC-R Wailuku-Kahului WWRF Shoreline Protection Extension POH-2011-00035

C. PROJECT LOCATION AND BACKGROUND INFORMATION:

State:Hawaii County/parish/borough: Maui County City: Kahului
Center coordinates of site (lat/long in degree decimal format): Lat. 20.89686° N, Long. -156.45535° W.
Universal Transverse Mercator: UTM Zone 4 North NAD 83
Name of nearest waterbody: Pacific Ocean
Name of nearest Traditional Navigable Water (TNW) into which the aquatic resource flows: Pacific Ocean
Name of watershed or Hydrologic Unit Code (HUC):

☒ Check if map/diagram of review area and/or potential jurisdictional areas is/are available upon request.
☐ Check if other sites (e.g., offsite mitigation sites, disposal sites, etc…) are associated with this action and are recorded on a different JD form.

D. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):

☒ Office (Desk) Determination. Date: 15 Feb 11
☐ Field Determination. Date(s):

SECTION II: SUMMARY OF FINDINGS

A. RHA SECTION 10 DETERMINATION OF JURISDICTION.

There **Are** "*navigable waters of the U.S.*" within Rivers and Harbors Act (RHA) jurisdiction (as defined by 33 CFR part 329) in the review area. [*Required*]

☒ Waters subject to the ebb and flow of the tide.
☐ Waters are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. Explain: .

B. CWA SECTION 404 DETERMINATION OF JURISDICTION.

There **Are** "*waters of the U.S.*" within Clean Water Act (CWA) jurisdiction (as defined by 33 CFR part 328) in the review area. [*Required*]

1. Waters of the U.S.

a. Indicate presence of waters of U.S. in review area (check all that apply): [1]

☒ TNWs, including territorial seas
☐ Wetlands adjacent to TNWs
☐ Relatively permanent waters[2] (RPWs) that flow directly or indirectly into TNWs
☐ Non-RPWs that flow directly or indirectly into TNWs
☐ Wetlands directly abutting RPWs that flow directly or indirectly into TNWs
☐ Wetlands adjacent to but not directly abutting RPWs that flow directly or indirectly into TNWs
☐ Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs
☐ Impoundments of jurisdictional waters
☐ Isolated (interstate or intrastate) waters, including isolated wetlands

b. Identify (estimate) size of waters of the U.S. in the review area:

Non-wetland waters: linear feet: width (ft) and/or 0.33 acres.
Wetlands: acres.

c. Limits (boundaries) of jurisdiction based on: **within 3-mile baseline**
Elevation of established OHWM (if known): .

2. Non-regulated waters/wetlands (check if applicable):[3]

☐ Potentially jurisdictional waters and/or wetlands were assessed within the review area and determined to be not jurisdictional. Explain: .

---

[1] Boxes checked below shall be supported by completing the appropriate sections in Section III below.
[2] For purposes of this form, an RPW is defined as a tributary that is not a TNW and that typically flows year-round or has continuous flow at least "seasonally" (e.g., typically 3 months).
[3] Supporting documentation is presented in Section III.F.

SECTION III: CWA ANALYSIS

A. TNWs AND WETLANDS ADJACENT TO TNWs

The agencies will assert jurisdiction over TNWs and wetlands adjacent to TNWs. If the aquatic resource is a TNW, complete Section III.A.1 and Section III.D.1. only; if the aquatic resource is a wetland adjacent to a TNW, complete Sections III.A.1 and 2 and Section III.D.1.; otherwise, see Section III.B below.

1. **TNW**
   Identify TNW: **Pacific Ocean.**

   Summarize rationale supporting determination: Navigable water subject to ebb and flow of tide.

2. **Wetland adjacent to TNW**
   Summarize rationale supporting conclusion that wetland is "adjacent": .

B. CHARACTERISTICS OF TRIBUTARY (THAT IS NOT A TNW) AND ITS ADJACENT WETLANDS (IF ANY):

This section summarizes information regarding characteristics of the tributary and its adjacent wetlands, if any, and it helps determine whether or not the standards for jurisdiction established under *Rapanos* have been met.

The agencies will assert jurisdiction over non-navigable tributaries of TNWs where the tributaries are "relatively permanent waters" (RPWs), i.e. tributaries that typically flow year-round or have continuous flow at least seasonally (e.g., typically 3 months). A wetland that directly abuts an RPW is also jurisdictional. If the aquatic resource is not a TNW, but has year-round (perennial) flow, skip to Section III.D.2. If the aquatic resource is a wetland directly abutting a tributary with perennial flow, skip to Section III.D.4.

A wetland that is adjacent to but that does not directly abut an RPW requires a significant nexus evaluation. Corps districts and EPA regions will include in the record any available information that documents the existence of a significant nexus between a relatively permanent tributary that is not perennial (and its adjacent wetlands if any) and a traditional navigable water, even though a significant nexus finding is not required as a matter of law.

If the waterbody[4] is not an RPW, or a wetland directly abutting an RPW, a JD will require additional data to determine if the waterbody has a significant nexus with a TNW. If the tributary has adjacent wetlands, the significant nexus evaluation must consider the tributary in combination with all of its adjacent wetlands. This significant nexus evaluation that combines, for analytical purposes, the tributary and all of its adjacent wetlands is used whether the review area identified in the JD request is the tributary, or its adjacent wetlands, or both. If the JD covers a tributary with adjacent wetlands, complete Section III.B.1 for the tributary, Section III.B.2 for any onsite wetlands, and Section III.B.3 for all wetlands adjacent to that tributary, both onsite and offsite. The determination whether a significant nexus exists is determined in Section III.C below.

1. **Characteristics of non-TNWs that flow directly or indirectly into TNW**

   (i) **General Area Conditions:**
   Watershed size: **Pick List**
   Drainage area: **Pick List**
   Average annual rainfall: inches
   Average annual snowfall: inches

   (ii) **Physical Characteristics:**
   (a) Relationship with TNW:
   ☐ Tributary flows directly into TNW.
   ☐ Tributary flows through **Pick List** tributaries before entering TNW.

   Project waters are **Pick List** river miles from TNW.
   Project waters are **Pick List** river miles from RPW.
   Project waters are **Pick List** aerial (straight) miles from TNW.
   Project waters are **Pick List** aerial (straight) miles from RPW.
   Project waters cross or serve as state boundaries. Explain: .

   Identify flow route to TNW[5]: .
   Tributary stream order, if known: .

[4] Note that the Instructional Guidebook contains additional information regarding swales, ditches, washes, and erosional features generally and in the arid West.
[5] Flow route can be described by identifying, e.g., tributary a, which flows through the review area, to flow into tributary b, which then flows into TNW.

(b) General Tributary Characteristics (check all that apply):

Tributary is: ☐ Natural
☐ Artificial (man-made). Explain: .
☐ Manipulated (man-altered). Explain: .

Tributary properties with respect to top of bank (estimate):
Average width: feet
Average depth: feet
Average side slopes: **Pick List.**

Primary tributary substrate composition (check all that apply):

☐ Silts ☐ Sands ☐ Concrete
☐ Cobbles ☐ Gravel ☐ Muck
☐ Bedrock ☐ Vegetation. Type/% cover:
☐ Other. Explain: .

Tributary condition/stability [e.g., highly eroding, sloughing banks]. Explain: .
Presence of run/riffle/pool complexes. Explain: .
Tributary geometry: **Pick List**
Tributary gradient (approximate average slope): %

(c) Flow:

Tributary provides for: **Pick List**
Estimate average number of flow events in review area/year: **Pick List**
Describe flow regime: .
Other information on duration and volume: .

Surface flow is: **Pick List.** Characteristics: .

Subsurface flow: **Pick List.** Explain findings: .
☐ Dye (or other) test performed: .

Tributary has (check all that apply):
☐ Bed and banks
☐ OHWM[6] (check all indicators that apply):

☐ clear, natural line impressed on the bank ☐ the presence of litter and debris
☐ changes in the character of soil ☐ destruction of terrestrial vegetation
☐ shelving ☐ the presence of wrack line
☐ vegetation matted down, bent, or absent ☐ sediment sorting
☐ leaf litter disturbed or washed away ☐ scour
☐ sediment deposition ☐ multiple observed or predicted flow events
☐ water staining ☐ abrupt change in plant community
☐ other (list):

☐ Discontinuous OHWM.[7] Explain: .

If factors other than the OHWM were used to determine lateral extent of CWA jurisdiction (check all that apply):

☐ High Tide Line indicated by: ☐ Mean High Water Mark indicated by:
☐ oil or scum line along shore objects ☐ survey to available datum;
☐ fine shell or debris deposits (foreshore) ☐ physical markings;
☐ physical markings/characteristics ☐ vegetation lines/changes in vegetation types.
☐ tidal gauges
☐ other (list):

(iii) Chemical Characteristics:

Characterize tributary (e.g., water color is clear, discolored, oily film; water quality; general watershed characteristics, etc.).
Explain: .
Identify specific pollutants, if known: .

---

[6]A natural or man-made discontinuity in the OHWM does not necessarily sever jurisdiction (e.g., where the stream temporarily flows underground, or where the OHWM has been removed by development or agricultural practices). Where there is a break in the OHWM that is unrelated to the waterbody's flow regime (e.g., flow over a rock outcrop or through a culvert), the agencies will look for indicators of flow above and below the break.
[7]Ibid.

(iv) **Biological Characteristics. Channel supports (check all that apply):**
- ☐ Riparian corridor. Characteristics (type, average width): .
- ☐ Wetland fringe. Characteristics: .
- ☐ Habitat for:
  - ☐ Federally Listed species. Explain findings: .
  - ☐ Fish/spawn areas. Explain findings: .
  - ☐ Other environmentally-sensitive species. Explain findings: .
  - ☐ Aquatic/wildlife diversity. Explain findings: .

2. Characteristics of wetlands adjacent to non-TNW that flow directly or indirectly into TNW

(i) **Physical Characteristics:**

(a) General Wetland Characteristics:

Properties:

Wetland size: acres

Wetland type. Explain: .

Wetland quality. Explain: .

Project wetlands cross or serve as state boundaries. Explain: .

(b) General Flow Relationship with Non-TNW:

Flow is: **Pick List**. Explain: .

Surface flow is: **Pick List**

Characteristics: .

Subsurface flow: **Pick List**. Explain findings: .

☐ Dye (or other) test performed: .

(c) Wetland Adjacency Determination with Non-TNW:
- ☐ Directly abutting
- ☐ Not directly abutting
  - ☐ Discrete wetland hydrologic connection. Explain: .
  - ☐ Ecological connection. Explain: .
  - ☐ Separated by berm/barrier. Explain: .

(d) Proximity (Relationship) to TNW

Project wetlands are **Pick List** river miles from TNW.

Project waters are **Pick List** aerial (straight) miles from TNW.

Flow is from: **Pick List.**

Estimate approximate location of wetland as within the **Pick List** floodplain.

(ii) **Chemical Characteristics:**

Characterize wetland system (e.g., water color is clear, brown, oil film on surface; water quality; general watershed characteristics; etc.). Explain: .

Identify specific pollutants, if known: .

(iii) **Biological Characteristics. Wetland supports (check all that apply):**
- ☐ Riparian buffer. Characteristics (type, average width): .
- ☐ Vegetation type/percent cover. Explain: .
- ☐ Habitat for:
  - ☐ Federally Listed species. Explain findings: .
  - ☐ Fish/spawn areas. Explain findings: .
  - ☐ Other environmentally-sensitive species. Explain findings: .
  - ☐ Aquatic/wildlife diversity. Explain findings: .

3. Characteristics of all wetlands adjacent to the tributary (if any)

All wetland(s) being considered in the cumulative analysis: **Pick List**

Approximately ( ) acres in total are being considered in the cumulative analysis.

For each wetland, specify the following:

Directly abuts? (Y/N)	Size (in acres)	Directly abuts? (Y/N)	Size (in acres)

Summarize overall biological, chemical and physical functions being performed: .

C. SIGNIFICANT NEXUS DETERMINATION

A significant nexus analysis will assess the flow characteristics and functions of the tributary itself and the functions performed by any wetlands adjacent to the tributary to determine if they significantly affect the chemical, physical, and biological integrity of a TNW. For each of the following situations, a significant nexus exists if the tributary, in combination with all of its adjacent wetlands, has more than a speculative or insubstantial effect on the chemical, physical and/or biological integrity of a TNW. Considerations when evaluating significant nexus include, but are not limited to the volume, duration, and frequency of the flow of water in the tributary and its proximity to a TNW, and the functions performed by the tributary and all its adjacent wetlands. It is not appropriate to determine significant nexus based solely on any specific threshold of distance (e.g. between a tributary and its adjacent wetland or between a tributary and the TNW). Similarly, the fact an adjacent wetland lies within or outside of a floodplain is not solely determinative of significant nexus.

Draw connections between the features documented and the effects on the TNW, as identified in the *Rapanos* Guidance and discussed in the Instructional Guidebook. Factors to consider include, for example:

- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to carry pollutants or flood waters to TNWs, or to reduce the amount of pollutants or flood waters reaching a TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), provide habitat and lifecycle support functions for fish and other species, such as feeding, nesting, spawning, or rearing young for species that are present in the TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to transfer nutrients and organic carbon that support downstream foodwebs?
- Does the tributary, in combination with its adjacent wetlands (if any), have other relationships to the physical, chemical, or biological integrity of the TNW?

Note: the above list of considerations is not inclusive and other functions observed or known to occur should be documented below:

1. **Significant nexus findings for non-RPW that has no adjacent wetlands and flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary itself, then go to Section III.D: .

2. **Significant nexus findings for non-RPW and its adjacent wetlands, where the non-RPW flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

3. **Significant nexus findings for wetlands adjacent to an RPW but that do not directly abut the RPW.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

D. DETERMINATIONS OF JURISDICTIONAL FINDINGS. THE SUBJECT WATERS/WETLANDS ARE (CHECK ALL THAT APPLY):

1. **TNWs and Adjacent Wetlands.** Check all that apply and provide size estimates in review area:
   - ☒ TNWs: linear feet width (ft), Or, acres.
   - ☐ Wetlands adjacent to TNWs: acres.

2. **RPWs that flow directly or indirectly into TNWs.**
   - ☐ Tributaries of TNWs where tributaries typically flow year-round are jurisdictional. Provide data and rationale indicating that tributary is perennial: .
   - ☐ Tributaries of TNW where tributaries have continuous flow "seasonally" (e.g., typically three months each year) are jurisdictional. Data supporting this conclusion is provided at Section III.B. Provide rationale indicating that tributary flows seasonally: .

Provide estimates for jurisdictional waters in the review area (check all that apply):
☐ Tributary waters: linear feet width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: .

3. **Non-RPWs[8] that flow directly or indirectly into TNWs.**
☐ Waterbody that is not a TNW or an RPW, but flows directly or indirectly into a TNW, and it has a significant nexus with a TNW is jurisdictional. Data supporting this conclusion is provided at Section III.C.

Provide estimates for jurisdictional waters within the review area (check all that apply):
☐ Tributary waters: linear feet width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: .

4. **Wetlands directly abutting an RPW that flow directly or indirectly into TNWs.**
☐ Wetlands directly abut RPW and thus are jurisdictional as adjacent wetlands.
☐ Wetlands directly abutting an RPW where tributaries typically flow year-round. Provide data and rationale indicating that tributary is perennial in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

☐ Wetlands directly abutting an RPW where tributaries typically flow "seasonally." Provide data indicating that tributary is seasonal in Section III.B and rationale in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

Provide acreage estimates for jurisdictional wetlands in the review area: acres.

5. **Wetlands adjacent to but not directly abutting an RPW that flow directly or indirectly into TNWs.**
☐ Wetlands that do not directly abut an RPW, but when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisidictional. Data supporting this conclusion is provided at Section III.C.

Provide acreage estimates for jurisdictional wetlands in the review area: acres.

6. **Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs.**
☐ Wetlands adjacent to such waters, and have when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisdictional. Data supporting this conclusion is provided at Section III.C.

Provide estimates for jurisdictional wetlands in the review area: acres.

7. **Impoundments of jurisdictional waters.[9]**
As a general rule, the impoundment of a jurisdictional tributary remains jurisdictional.
☐ Demonstrate that impoundment was created from "waters of the U.S.," or
☐ Demonstrate that water meets the criteria for one of the categories presented above (1-6), or
☐ Demonstrate that water is isolated with a nexus to commerce (see E below).

E. **ISOLATED [INTERSTATE OR INTRA-STATE] WATERS, INCLUDING ISOLATED WETLANDS, THE USE, DEGRADATION OR DESTRUCTION OF WHICH COULD AFFECT INTERSTATE COMMERCE, INCLUDING ANY SUCH WATERS (CHECK ALL THAT APPLY):[10]**
☐ which are or could be used by interstate or foreign travelers for recreational or other purposes.
☐ from which fish or shellfish are or could be taken and sold in interstate or foreign commerce.
☐ which are or could be used for industrial purposes by industries in interstate commerce.
☐ Interstate isolated waters. Explain: .
☐ Other factors. Explain: .

Identify water body and summarize rationale supporting determination: .

[8]See Footnote # 3.
[9] To complete the analysis refer to the key in Section III.D.6 of the Instructional Guidebook.
[10] **Prior to asserting or declining CWA jurisdiction based solely on this category, Corps Districts will elevate the action to Corps and EPA HQ for review consistent with the process described in the Corps/EPA** ***Memorandum Regarding CWA Act Jurisdiction Following Rapanos.***

Provide estimates for jurisdictional waters in the review area (check all that apply):
☐ Tributary waters: linear feet width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: .
☐ Wetlands: acres.

F. NON-JURISDICTIONAL WATERS, INCLUDING WETLANDS (CHECK ALL THAT APPLY):
☐ If potential wetlands were assessed within the review area, these areas did not meet the criteria in the 1987 Corps of Engineers Wetland Delineation Manual and/or appropriate Regional Supplements.
☐ Review area included isolated waters with no substantial nexus to interstate (or foreign) commerce.
☐ Prior to the Jan 2001 Supreme Court decision in "*SWANCC*," the review area would have been regulated based solely on the "Migratory Bird Rule" (MBR).
☐ Waters do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction. Explain: .
☐ Other: (explain, if not covered above): .

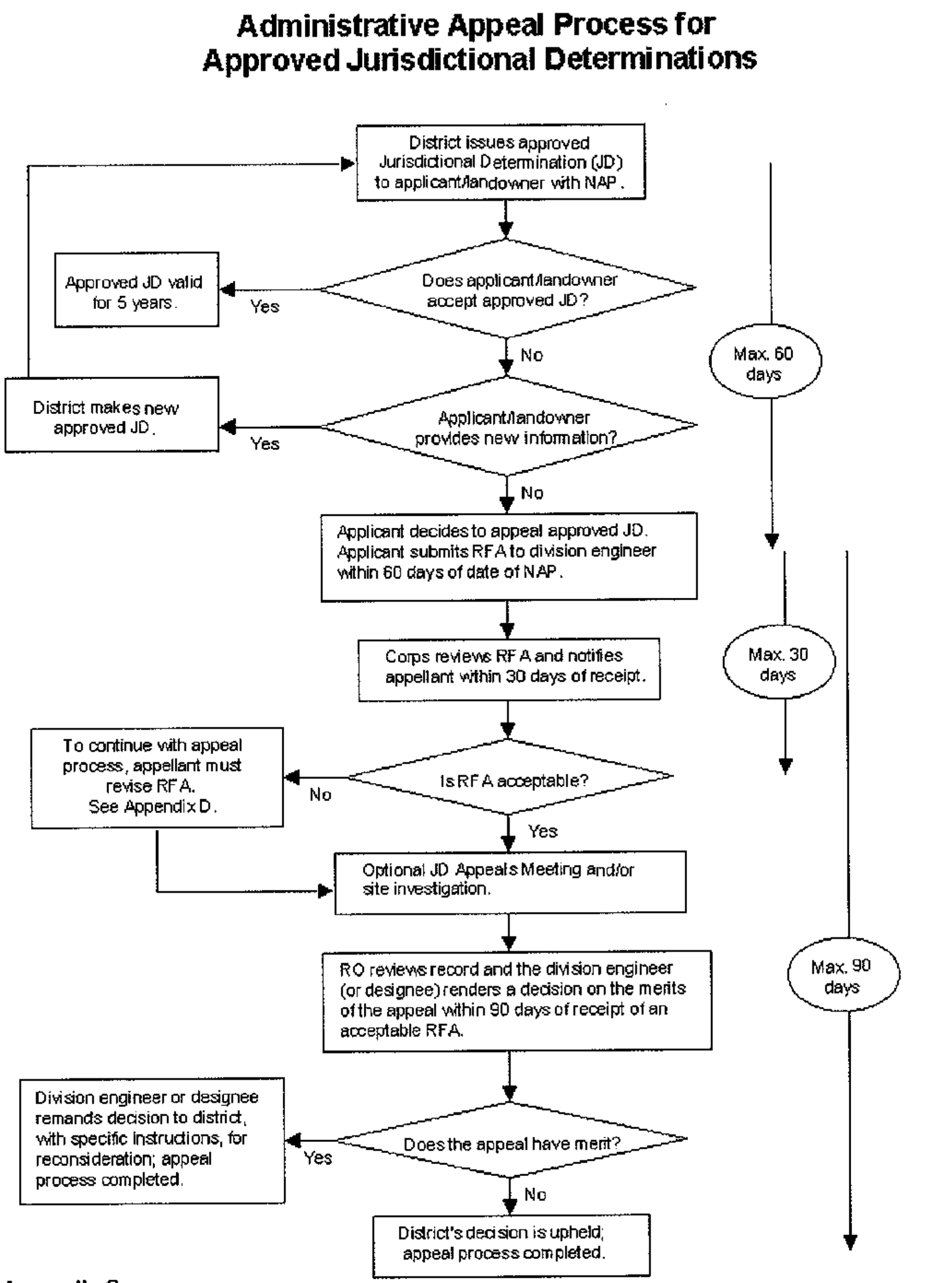
Provide acreage estimates for non-jurisdictional waters in the review area, where the sole potential basis of jurisdiction is the MBR factors (i.e., presence of migratory birds, presence of endangered species, use of water for irrigated agriculture), using best professional judgment (check all that apply):
☐ Non-wetland waters (i.e., rivers, streams): linear feet width (ft).
☐ Lakes/ponds: acres.
☐ Other non-wetland waters: acres. List type of aquatic resource: .
☐ Wetlands: acres.

Provide acreage estimates for non-jurisdictional waters in the review area that do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction (check all that apply):
☐ Non-wetland waters (i.e., rivers, streams): linear feet, width (ft).
☐ Lakes/ponds: acres.
☐ Other non-wetland waters: acres. List type of aquatic resource: .
☐ Wetlands: acres.

SECTION IV: DATA SOURCES.

A. SUPPORTING DATA. Data reviewed for JD (check all that apply - checked items shall be included in case file and, where checked and requested, appropriately reference sources below):
☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant:EISPN rcv'd 21 Jan 11.
☐ Data sheets prepared/submitted by or on behalf of the applicant/consultant.
☐ Office concurs with data sheets/delineation report.
☐ Office does not concur with data sheets/delineation report.
☐ Data sheets prepared by the Corps: .
☐ Corps navigable waters' study: .
☐ U.S. Geological Survey Hydrologic Atlas: .
☐ USGS NHD data.
☐ USGS 8 and 12 digit HUC maps.
☒ U.S. Geological Survey map(s). Cite scale & quad name:1:24000 (ORM website, retv'd 15 Feb 11).
☒ USDA Natural Resources Conservation Service Soil Survey. Citation:NRCS Web Soil Survey conducted 31 Dec 2006.
☒ National wetlands inventory map(s). Cite name:ORM website per USFWS-NWI overlay, retv'd 15 Feb 11.
☐ State/Local wetland inventory map(s): .
☐ FEMA/FIRM maps: .
☐ 100-year Floodplain Elevation is: (National Geodectic Vertical Datum of 1929)
☒ Photographs: ☒ Aerial (Name & Date):Aerial Satellite Image (ORM website, retv'd 15 Feb 11).
or ☐ Other (Name & Date): .
☐ Previous determination(s). File no. and date of response letter: .
☐ Applicable/supporting case law: .
☐ Applicable/supporting scientific literature: .
☐ Other information (please specify): .

B. ADDITIONAL COMMENTS TO SUPPORT JD: Shoreline protection abutting Pacific Ocean (TNW). Sect 10 for work, Sect 404 for fill. Extension of existing Corps project thus Section408-404 integration req'd. Reference data located in physical file POH-2011-00035.



Appendix C

11

NOTIFICATION OF ADMINISTRATIVE APPEAL OPTIONS AND PROCESS AND REQUEST FOR APPEAL		
Applicant: County of Maui, Dept of Environmental Management	File Number: POH-2011-00035	Date: February 16, 2011
Attached is:		See Section below
	INITIAL PROFFERED PERMIT (Standard Permit or Letter of permission)	A
	PROFFERED PERMIT (Standard Permit or Letter of permission)	B
	PERMIT DENIAL	C
XX	APPROVED JURISDICTIONAL DETERMINATION	D
	PRELIMINARY JURISDICTIONAL DETERMINATION	E

SECTION I - The following identifies your rights and options regarding an administrative appeal of the above decision. Additional information may be found at http://www.usace.army.mil/inet/functions/cw/cecwo/reg or Corps regulations at 33 CFR Part 331.

A: INITIAL PROFFERED PERMIT: You may accept or object to the permit.

- ACCEPT: If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- OBJECT: If you object to the permit (Standard or LOP) because of certain terms and conditions therein, you may request that the permit be modified accordingly. You must complete Section II of this form and return the form to the district engineer. Your objections must be received by the district engineer within 60 days of the date of this notice, or you will forfeit your right to appeal the permit in the future. Upon receipt of your letter, the district engineer will evaluate your objections and may: (a) modify the permit to address all of your concerns, (b) modify the permit to address some of your objections, or (c) not modify the permit having determined that the permit should be issued as previously written. After evaluating your objections, the district engineer will send you a proffered permit for your reconsideration, as indicated in Section B below.

B: PROFFERED PERMIT: You may accept or appeal the permit.

- ACCEPT: If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- APPEAL: If you choose to decline the proffered permit (Standard or LOP) because of certain terms and conditions therein, you may appeal the declined permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

C: PERMIT DENIAL: You may appeal the denial of a permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

D: APPROVED JURISDICTIONAL DETERMINATION: You may accept or appeal the approved JD or provide new information.

- ACCEPT: You do not need to notify the Corps to accept an approved JD. Failure to notify the Corps within 60 days of the date of this notice, means that you accept the approved JD in its entirety, and waive all rights to appeal the approved JD.
- APPEAL: If you disagree with the approved JD, you may appeal the approved JD under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

E: PRELIMINARY JURISDICTIONAL DETERMINATION: You do not need to respond to the Corps regarding the preliminary JD. The Preliminary JD is not appealable. If you wish, you may request an approved JD (which may be appealed), by contacting the Corps district for further instruction. Also you may provide new information for further consideration by the Corps to reevaluate the JD.

SECTION II - REQUEST FOR APPEAL or OBJECTIONS TO AN INITIAL PROFFERED PERMIT

REASONS FOR APPEAL OR OBJECTIONS: (Describe your reasons for appealing the decision or your objections to an initial proffered permit in clear concise statements. You may attach additional information to this form to clarify where your reasons or objections are addressed in the administrative record.)

ADDITIONAL INFORMATION: The appeal is limited to a review of the administrative record, the Corps memorandum for the record of the appeal conference or meeting, and any supplemental information that the review officer has determined is needed to clarify the administrative record. Neither the appellant nor the Corps may add new information or analyses to the record. However, you may provide additional information to clarify the location of information that is already in the administrative record.

POINT OF CONTACT FOR QUESTIONS OR INFORMATION:

If you have questions regarding this decision and/or the appeal process you may contact:	If you only have questions regarding the appeal process you may also contact:
Jessie K. Paahana, Project Manager US Army Corps of Engineers, Honolulu District ATTN: CEPOH-EC-R Building 214 Fort Shafter, HI 96858-5440 Ph: (808) 438-0391	Thom Lichte, Appeal Review Officer US Army Corps of Engineers, Pacific Ocean Division ATTN: CEPOD-PDC Building 525 Fort Shafter, HI 96858-5440 Tel. (808) 438-0397

RIGHT OF ENTRY: Your signature below grants the right of entry to Corps of Engineers personnel, and any government consultants, to conduct investigations of the project site during the course of the appeal process. You will be provided a 15 day notice of any site investigation, and will have the opportunity to participate in all site investigations.

	Date:	Telephone number:
Signature of appellant or agent.		

CECW-P

Final
11/12/08

Section 408 Submittal Package Guide

This guide is intended to ensure a complete submittal, aid the review process and serve as a guide for sponsors/applicants requesting approval of significant modifications or alterations to a locally or federally maintained Corps project requiring Chief of Engineers approval under 33 USC 408. Incomplete submittals will delay processing of applicant requests. This information will be submitted to the MSC for quality assurance review prior to making any recommendations to HQUSACE.

Applicant (Normally the Non-Federal Sponsor) Prepared Documents

1. Written request for approval of the project modification

- A detailed description of the proposed modification
- The purpose/need for the modification
- An appropriate map or drawing

2. Technical Analysis and Adequacy of Design. All necessary technical analysis should be provided. The list below is only a guide for typical items that would routinely be expected and is not intended to list every item that could be needed to make this determination.

- Geotechnical Evaluation.
  - Stability
  - Under seepage
  - Erosion Control
  - Vegetation
  - Material usage/borrow/waste/transport/hauling
- Structural
  - Bridges and related abutments
  - Pier penetrations of levee embankments
  - Diaphragm walls
  - Other structural components integral to the project
  - Gates or other operable features
- Hydraulic and Hydrology
  - Changes in inflow
  - Changes in water surface profiles and flow distribution
  - Assessment of local and system wide resultant impacts
  - Upstream and downstream impacts of the proposed alterations, including Sediment transport analysis as needed
  - Impacts to existing floodplain management

Enclosure

14

- Operation and Maintenance Requirements
  - Applicant facilities
    - Pre flood preparation
    - Post flood clean up
    - Sediment removal
  - Water control management plan
    - Impacts to other Federal projects within the basin
    - Corps facilities

3. Real Estate Analysis

- Reference ER 405-1-12, Chapter 12, Sections I and II.
  - Include:
    - Description of all Lands, Easements and Rights of Way required for the modification, including proposed estates
    - Description of all Lands, Easements and Rights of Way owned as a part of the authorized project
    - Maps clearly depicting both required real estate and existing real estate limits
    - Navigational servitude, facility relocations, relocation housing assistance and any other relevant factors

4. Discussion of Residual Risk. Discuss the changes to the existing level of risk to life, property as a result of the modification. Will the project incur damages more frequently as a result of flooding that will require Federal assistance under PL 84-99? Risk analysis will be used as the method for communicating residual risk.

5. Administrative record for key decisions for related actions for applicants proposed modification such as environmental reports, judges' decisions, permits, etc.

6. Discussion of Executive Order 11988 Considerations
   - Justification to construct in the floodplain
   - No practicable alternative determination, if Federal agency, Agency determination. Public Notice Notifications

7. Environmental Protection Compliance. All 408 actions must be in full compliance with all applicable Public laws, executive orders, rules and regulations, treaties, and other policy statements of the Federal government and all plans and constitutions, laws, directives, resolutions, gubernatorial directives, and other policy statements of States with jurisdiction in the planning area. Examples are State water and air quality regulations; State historic preservation plans; State lists of rare, threatened, or endangered species; and State comprehensive fish and wildlife management plans. The District must maintain full documentation of compliance as part of the administrative record. The submittal package provided to HQUSACE will document considerations with significant bearing on decisions regarding the 408 request. Typically the minimum submission will include the following:

- National Environmental Policy Act. The appropriate NEPA process will be determined by the district in consultation with agencies that regulate resources that may be affected by the proposed action. All resources listed in Section 122 of the Rivers and Harbors Act 1970 must be considered. The evaluation will include a description and analysis of project alternatives, the significance of the effects of each alternative on significant resources. Direct, indirect, and cumulative effects of all reasonably foreseeable actions including the actions of others and natural succession must be considered and documented. A risk analysis must be completed to determine the significance of risks to human life & safety, and property. Mitigation plans must be well described. If Federal funds are or may be involved the mitigation plan must be incrementally justified. NEPA documents will be consistent with 33 CFR 230.

- Endangered Species Act. Coordination/consultation with the US Fish and Wildlife Service and/or NOAA Marine Fisheries Service must be complete. Each agency with jurisdiction over a species that may be affected by the proposed action must provide a letter/memo indicating completion of ESA coordination. This documentation may range from a memo saying no ESA protected species or habitats are in the project impact area through a Biological Opinion.

- Fish and Wildlife Coordination Act. Either a Final FWCA Report or a letter from the USFWS stating that a FWCA Report is not required must be included.

- Marine Protection, Research and Sanctuaries Act For projects involving ocean disposal, or dredged material disposal within the territorial seas, the discharge will be evaluated under Section 103 of the MPRSA. The disposal must meet the criteria established by the EPA (40 C.F.R. 227 and 228). The submittal will document that that materials to be discharged are consistent with the current criteria and the disposal site is suitable.

- Wild and Scenic Rivers Act. The submittal will document efforts to identify designated rivers or river reaches (including potential rivers) in the vicinity of the project, and describe follow-up coordination with the agency having management responsibility for the particular river. If a designated river reach is affected, a letter indicating completed coordination is required from the managing agency.

- Coastal Zone Management Act. If the proposed action is in a coastal zone documentation of a "determination of consistency" with the state coastal zone management program the appropriate State agency (16 U.S.C 1456) must be included.

- Clean Air Act. This is a two-part compliance process. First, the submittal must include a determination that the proposed action is consistent with the Implementation Plan of the affected jurisdiction(s), and concurrence of the appropriate regulatory agency, or a conditional permit. Second, the submittal must include a letter from the USEPA that they have reviewed and commented on the environmental impact evaluations including the NEPA documents.

- HTRW. HTRW includes but is not limited to the Comprehensive Environmental Response, Compensation and Liability Act, the Resource Conservation and Recovery Act, and the Toxic Substances Control Act. The submittal package must include documentation that the USEPA and appropriate State and Tribal agencies with jurisdiction or expertise have been given reasonable opportunity to comment on the proposed action and that their input has been fully considered. The Corps will not incur additional liability related to HTRW.

- National Historic Preservation Act. This includes all other applicable historic and cultural protection statutes. The submittal package will include documentation that the Advisory Council on Historic Preservation, and appropriate State and Tribal agencies with jurisdiction or expertise has been given a reasonable opportunity to comment on the proposed action and that their input has been fully considered. It is not expected that actual mitigation will be completed but appropriate letters indicating completed Consultation determination of significance must be provided.

- Noise Control Act. Documentation of the significance of noise likely to be generated during construction of the proposed project and the noise that may result due to implementation must be provided. If significant noise may result, a noise mitigation plan must be provided.

District Prepared Documents and Analysis of Applicants Request to be submitted to MSC

1. Transmittal letter to MSC Commander with district's determination of technical soundness and environmental acceptability.

a. A physical and functional description of the existing project
   1. Name of authorized project
   2. authorizing document
   3. Law/Section/Date of project authorization
   4. Law Sections/Dates of any post-authorization modifications
   5. Non-Federal sponsor
   6. Congressional Interests (Senator(s), Representative(s) and District(s))

b. Project Documents:
   1. Type of Decision Document:
   2. Agency Technical Review (ATR) approval Date
   3. Independent External Peer Review (IEPR) approval date

c. Policy, Legal and Technical Analysis:
   1. Is the original project authority adequate to complete the project as proposed?
   2. Has the District Counsel reviewed and approved the decision document for legal sufficiency?
   3. Have all aspects of ATR been completed with no unresolved issues remaining?
   4. Have the District Commander documented policy/legal/technical compliance of the decision document?

d. Written request for approval of the project modification (applicant prepared)

   1. A detailed description of the proposed modification
   2. The purpose/need/rationale for the modification

e. A description of any related, ongoing Corps studies and studies by others within the watershed

f. A description and listing of other Corps projects, ongoing and completed, in the watershed

g. A description of any projected/anticipated credit (section 215/104, etc.) for project modification work and date credit agreement(s) signed

h. Sponsor letter of understanding of their responsibility to perform all required OMRR&R for project modifications. For approved alterations/modifications, the non-Federal sponsor shall revise/update the

MUNEKIYO & HIRAGA, INC.

Gwen Ohashi Hiraga
Mitsuru "Michi" Hirano
Karlynn Fukuda

Mark Alexander Roy

April 6, 2011

George P. Young, Chief
Regulatory Branch
Department of the Army
Army Engineer District, Honolulu
Fort Shafter, Hawaii 96858-5440

SUBJECT: Response to Environmental Impact Statement Preparation Notice (EISPN) Comment Letter Regarding Proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension at TMK (2) 3-8-001, Kahului, Maui, Hawaii (POH-2011-00035)

Dear Mr. Young:

Thank you for your letter of February 16, 2011, providing comments on the proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension. We offer the following information, which addresses your comments in the order listed in your letter.

1. We acknowledge a Department of Army (DA) permit is required prior to the commencement of work within the waters of the U.S. A DA permit will be filed with your agency.

2. We acknowledge receipt of the Jurisdictional Determination (JD) for the property which is valid for a period of five (5) years.

3. As advised, prior to work on the existing revetment approval from Mr. Derek Chow, Chief of the Honolulu District Corps Civil and Public Works Branch will be obtained.

305 High Street, Suite 104 · Wailuku, Hawaii 96793 · ph: (808)244-2015 · fax: (808)244-8729 · planning@mhplanning.com · www.mhplanning.com

Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes review process. A copy of your letter will be included in the Draft Environmental Impact Statement. In the meantime, if there are any questions or if additional information is needed, please feel free to contact me at (808) 244-2015.

Very truly yours,

Colleen Suyama
Senior Associate

CS:yp
Cc: Derek Chow, Chief, Civil & Public Works Branch
Kyle Ginoza, Director, Department of Environmental Management
Russ Boudreau, Moffat Nichol
Rob Sloop, Moffat Nichol

K:\DATA\MoffattNichol\WK WWRF\EISPN Response\DOA EISPNres.doc

FEB 10 2011

NEIL ABERCROMBIE
GOVERNOR

BRUCE A. COPPA
COMPTROLLER

RYAN T. OKAHARA
DEPUTY COMPTROLLER

(P)1020.1

STATE OF HAWAII
DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES
P.O. BOX 119, HONOLULU, HAWAII 96810-0119

FEB 9 2011

Ms. Colleen Suyama, Senior Associate
Munekiyo & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Maui, Hawai'i 96793

Dear Ms. Suyama:

Subject: Environmental Impact Statement Preparation Notice for
Proposed Wailuku-Kahului Wastewater Reclamation Facility
Shoreline Protection Extension
Kahului, Maui
TMK: (2) 3-8-001: 188

Thank you for the opportunity to provide comments for the subject document. The subject documents do not impact any of the Department of Accounting and General Services' projects or existing facilities, and we have no comments to offer at this time.

If you have any questions, please call me at 586-0400 or have your staff call Ms. Gayle Takasaki of the Planning Branch at 586-0584.

Sincerely,

ERNEST Y. W. LAU
Public Works Administrator

GT:mo

MUNEKIYO & HIRAGA, INC.

Michael T. Munekiyo
Gwen Ohashi Hiraga
Mitsuru "Mich" Hirano
Karlynn Fukuda

Mark Alexander Roy

April 6, 2011

Ernest Y. W. Lau, Public Works
Administrator
Department of Accounting and
General Services
P. O. Box 119
Honolulu, Hawaii 96810-0119

SUBJECT: Response to Environmental Impact Statement Preparation Notice (EISPN) Comment Letter Regarding Proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension at TMK (2) 3-8-001, Kahului, Maui, Hawaii

Dear Mr Lau:

Thank you for your letter of February 9, 2011, responding to our request for comments on the Environmental Impact Statement Preparation Notice (EISPN) on the proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension project. We appreciate your review of the document and your confirmation that the Department has no comment at this time.

Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes review process. A copy of your letter will be included in the Draft Environmental Impact Statement. In the meantime, if there are any questions or if additional information is needed, please feel free to con tact me at (808) 244-2015.

Very truly yours,

Colleen Suyama
Senior Associate

CS:yp
cc: Kyle Ginoza, Director, Department of Environmental Management
Russ Boudreau, Moffat Nichol
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FEB 1 1 2011

NEIL ABERCROMBIE
GOVERNOR

KATHRYN S. MATAYOSHI
SUPERINTENDENT

STATE OF HAWAI'I

DEPARTMENT OF EDUCATION

P.O. BOX 2360

HONOLULU, HAWAI'I 96804

OFFICE OF THE SUPERINTENDENT

February 9, 2011

Ms. Colleen Suyama, Senior Associate
Munekiyo & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Ms. Suyama:

Subject: Environmental Impact Statement Preparation Notice (EISPN)
Proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline
Protection Extension, TMK (2) 3-8-001:188, Kahului, Maui, Hawaii

The Department of Education (DOE) has reviewed the EISPN for the proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension.

The DOE has no comment regarding this project.

Thank you for the opportunity to provide comments. If you have any questions, please call Jeremy Kwock of the Facilities Development Branch at (808) 377-8301.

Very truly yours,

Kathryn S. Matayoshi
Superintendent

KSM:jmb

c: Randolph Moore, Asst. Supt., OSFSS
Bruce Anderson, CAS, Baldwin/Kekaulike/Maui Complex Areas
Kyle Ginoza, Director, Department of Environmental Management

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

April 6, 2011

Kathryn S. Matayoshi, Superintendent
Department of Education
P. O. Box 2360
Honolulu, Hawaii 96804

SUBJECT: Response to Environmental Impact Statement Preparation Notice (EISPN) Comment Letter Regarding Proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension at TMK (2) 3-8-001, Kahului, Maui, Hawaii

Dear Ms. Matayoshi:

Thank you for your letter of February 9, 2011, responding to our request for comments on the Environmental Impact Statement Preparation Notice (EISPN) on the proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension project. We appreciate your review of the document and conveying the Department has no comment at this time.

Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes review process. A copy of your letter will be included in the Draft Environmental Impact Statement. In the meantime, if there are any questions or if additional information is needed, please feel free to contact me at (808) 244-2015.

Very truly yours,

Colleen Suyama
Senior Associate

CS:yp
cc: Kyle Ginoza, Director, Department of Environmental Management
Russ Boudreau, Moffat Nichol
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NEIL ABERCROMBIE
GOVERNOR OF HAWAII

FEB 17 2011

LORETTA J. FUDDY, A.C.S.W., M.P.H.
ACTING DIRECTOR OF HEALTH

LORRIN W. PANG, M.D., M.P.H.
DISTRICT HEALTH OFFICER

In reply, please refer to:
File:

STATE OF HAWAII
DEPARTMENT OF HEALTH
54 HIGH STREET
WAILUKU, MAUI, HAWAII 96793-2102

February 16, 2011

Mr. Kyle Ginoza
Director
Department of Environmental Management
County of Maui
One Main Plaza
2200 Main Street, Suite 100
Wailuku, Hawai`i 96793

Dear Mr. Ginoza:

Subject: Environmental Impact Statement Preparation Notice for Proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension, Kahului, Hawai`i TMK: (2) 3-8-001:188

Thank you for the opportunity to review this project. We have the following comments to offer:

1. National Pollutant Discharge Elimination System (NPDES) permit coverage maybe required for this project. The Clean Water Branch should be contacted at 808 586-4309.

2. The U.S. Army Corp of Engineers should be consulted.

3. A Section 401 Water Qualification Certification (WQC) maybe required. The Clean Water Branch should be contacted at 808 586-4309.

4. The noise created during the construction phase of the project may exceed the maximum allowable levels as set forth in Hawaii Administrative Rules (HAR), Chapter 11-46, "Community Noise Control." A noise permit may be required and should be obtained before the commencement of work.

It is strongly recommended that the Standard Comments found at the Department's website: http://hawaii.gov/health/environmental/env-planning/landuse/landuse.html be reviewed, and any comments specifically applicable to this project should be adhered to.

Should you have any questions, please call me at 808 984-8230 or E-mail me at patricia.kitkowski@doh.hawaii.gov.

Sincerely,

Patti Kitkowski

Patti Kitkowski
District Environmental Health Program Chief

c Colleen Suyama
EPO

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

April 6, 2011

Patti Kitkowski
District Environmental Health Program Chief
Department of Health
Maui District
54 South High Street
Wailuku, Hawaii 96793

SUBJECT: Response to Environmental Impact Statement Preparation Notice (EISPN) Comment Letter Regarding Proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension at TMK (2) 3-8-001, Kahului, Maui, Hawaii

Dear Ms. Kitkowski:

Thank you for your letter of February 16, 2011, providing comments on the proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension. We offer the following information, which addresses your comments in the order listed in your letter.

1. As required, a National Pollutant Discharge Elimination System (NPDES) permit coverage will be obtained prior to initiation of construction.

2. The U.S. Army Corp of Engineers has been consulted regarding the project.

3. As required, a Section 401 Water Qualification Certification (WQC) will be obtained prior to initiation of construction.

4. Noise from construction activity will comply with Hawaii Administrative Rules (HAR), Chapter 11-46, "Community Noise Control". As may be required, a noise permit will be obtained prior to the initiation of construction.

Further, the design consultants have been advised to review the standard comments found on the Department of Health website.

305 High Street, Suite 104 · Wailuku, Hawaii 96793 · ph: (808)244-2015 · fax: (808)244-8729 · planning@mhplanning.com · www.mhplanning.com

Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes review process. A copy of your letter will be included in the Draft Environmental Impact Statement. In the meantime, if there are any questions or if additional information is needed, please feel free to contact me at 244-2015.

Very truly yours,

Colleen Suyama
Senior Associate

CS:yp
cc: Kyle Ginoza, Director, Department of Environmental Management
Russ Boudreau, Moffat Nichol
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MAR 0 7 2011

NEIL ABERCROMBIE
GOVERNOR

GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
Ford N. Fuchigami
Jan S. Gouveia
Randy Grune
Jadine Urasaki

IN REPLY REFER TO:

STP 8.0365

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

February 28, 2011

Ms. Colleen Suyama
Senior Associate
Munekiyo & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Ms. Suyama:

Subject: Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension Environmental Impact Statement Preparation Notice (EISPN)

Thank you for requesting the Department of Transportation's (DOT) review of the subject Maui County project. DOT's comments are as follows:

1. The project will not significantly impact any State highway facilities.

2. If cranes are planned to be used for the construction of the revetment, the County may be required to submit a completed Federal Aviation Administration (FAA) Form 7460-1 (Notice of Proposed Construction or Alternation) to the FAA Hawaii Airport District Office in Honolulu with copies to the DOT Airports Division Planning Section and Maui District Manager. The DOT recommends that the County consult with the FAA on the matter due to the proximity of the project site to Kahului Airport. FAA will determine whether any construction work, materials or improvements will create interference (e.g. light reflection emissions, etc.) with aircraft flights.

DOT appreciates the opportunity to provide comments.

Very truly yours,

GLENN M. OKIMOTO, Ph.D.
Director of Transportation

c: Kyle Ginoza, Department of Environmental Management

MUNEKIYO & HIRAGA, INC.

Michael T. Munekiyo
Gwen Ohashi Hiraga
Mitsuru "Mich" Hirano
Karlynn Fukuda

Mark Alexander Roy

April 6, 2011

Glenn M. Okimoto, Director
Department of Transportation
869 Punchbowl Street
Honolulu, Hawaii 96813-5097

SUBJECT: Response to Environmental Impact Statement Preparation Notice (EISPN) Comment Letter Regarding Proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension at TMK (2) 3-8-001, Kahului, Maui, Hawaii (STP 8.0365)

Dear Mr. Okimoto:

Thank you for your letter of February 28, 2011, providing comments on the proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension. We offer the following information, which addresses your comments in the order listed in your letter.

1. We appreciate your conveying confirmation that the project will not significantly impact State highway facilities.

2. As advised, if cranes are used for construction of the revetment, the Federal Aviation Administration (FAA), Department of Transportation Airports Division Planning Section and Maui District Manager will be contacted to determine whether a FAA Form 7460-1 is required for the project. If required, Form 7460-1 will be filed with the appropriate agencies.

305 High Street, Suite 104 · Wailuku, Hawaii 96793 · ph: (808)244-2015 · fax: (808)244-8729 · planning@mhplanning.com · www.mhplanning.com

Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes review process. A copy of your letter will be included in the Draft Environmental Impact Statement. In the meantime, if there are any questions or if additional information is needed, please feel free to contact me at (808) 244-2015.

Very truly yours,

Colleen Suyama
Senior Associate

CS:yp
cc: Kyle Ginoza, Director, Department of Environmental Management
Russ Boudreau, Moffat Nichol
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FEB 18 2011

NEIL ABERCROMBIE
GOVERNOR

MAJOR GENERAL DARRYLL D. M. WONG
DIRECTOR OF CIVIL DEFENSE

EDWARD T. TEIXEIRA
VICE DIRECTOR OF CIVIL DEFENSE

PHONE (808) 733-4300
FAX (808) 733-4287

STATE OF HAWAII
DEPARTMENT OF DEFENSE
OFFICE OF THE DIRECTOR OF CIVIL DEFENSE
3949 DIAMOND HEAD ROAD
HONOLULU, HAWAII 96816-4495

February 16, 2011

Ms. Colleen Suyama, Senior Associate
Munekiyo & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Ms. Suyama:

Environmental Impact Statement Preparation Notice for Proposed Wailuku-Kahului Wastewater Reclamation Facility (WKWWRF) Shoreline Protection Extension at TMK (2)3-8-001:188, Kahului, Maui, Hawaii

Thank you for the opportunity to comment on this Environmental Impact Statement Preparation Notice.

We concur that mitigation measures must be taken to protect this critical facility. As the WKWWRF is located within Flood Zone VE, we strongly recommend that dry and/or wet floodproofing mitigation measures be taken as appropriate. Additionally, Maui County is recognized as a TsunamiReady community and therefore, we recommend tsunami evacuation zone signage.

We will anticipate reviewing the Environmental Impact Statement when it is completed and will submit appropriate comments at that time.

If you have any questions, please call Ms. Havinne Okamura, Hazard Mitigation Planner, at (808) 733-4300, extension 556.

Sincerely,

EDWARD T. TEIXEIRA
Vice Director of Civil Defense

c: Kyle Ginoza, Director, Department of Environmental Management

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

April 6, 2011

Edward T. Teixeira, Vice Director of Civil Defense
Department of Defense
Office of the Director of Civil Defense
3949 Diamond Head Road
Honolulu, Hawaii 96816-4495

SUBJECT: Response to Environmental Impact Statement Preparation Notice (EISPN) Comment Letter Regarding Proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension at TMK (2) 3-8-001, Kahului, Maui, Hawaii

Dear Vice Director Teixeira:

Thank you for your letter of February 16, 2011, responding to our request for comments on the Environmental Impact Statement Preparation Notice (EISPN) on the proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension project. We appreciate your review of the document and your concurrence that the mitigation measures must be taken to protect this critical facility. Further, your recommendation that dry and/or wet floodproofing mitigation measures be taken as appropriate has been forwarded to the Department of Environmental Management for consideration.

305 High Street, Suite 104 · Wailuku, Hawaii 96793 · ph: (808)244-2015 · fax: (808)244-8729 · planning@mhplanning.com · www.mhplanning.com

Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes review process. A copy of your letter will be included in the Draft Environmental Impact Statement. In the meantime, if there are any questions or if additional information is needed, please feel free to contact me at (808) 244-2015.

Very truly yours,

Colleen Suyama
Senior Associate

CS:yp
cc: Kyle Ginoza, Director, Department of Environmental Management
Russ Boudreau, Moffat Nichol
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FEB 25 2011

PHONE (808) 594-1888

FAX (808) 594-1865

STATE OF HAWAI'I
OFFICE OF HAWAIIAN AFFAIRS
711 KAPI'OLANI BOULEVARD, SUITE 500
HONOLULU, HAWAI'I 96813

HRD11/0063E

February 17, 2011

Colleen Suyama, Senior Associate
Munekiyo & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawai'i 96793

Re: Environmental Impact Statement Preparation Notice
Wailuku-Kahului Wastewater Reclamation Facility Project
Kahului, Island of Maui

Aloha e Colleen Suyama,

The Office of Hawaiian Affairs (OHA) is in receipt of your January 21, 2011 letter seeking comments on an environmental impact statement preparation notice (EISPN) for the proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension Project (project) proposed by the County of Maui-Department of Environmental Management (County). The need for shoreline protection was initially identified upon the completion of the Wailuku-Kahului Wastewater Reclamation Facility (facility) in 1976. The U.S. Army Corps of Engineers completed 450 feet of a planned 1,500 foot revetment fronting the facility in 1979. Funding limitations prevented the completion of the remainder of the revetment.

The project proposes the construction of an additional 1,200 foot extension of a rock mound revetment (extension) to the west of the existing revetment (EISPN, figure 7). Approximately 15,000 tons of armor and under rock will be required. Excavations and import of fill material along the extension alignment will also be required. Upon completion of the project, the sand beach fronting the facility will be "armored" and protected from erosion. A draft environmental assessment (DEIS) will be prepared to support the use of County lands and funds and certain County and State of Hawai'i permits and approvals. In accordance with the Rivers and Harbors Act and the Clean Water Act, a U.S. Army Corps of Engineers Permit will also be required for the project, which is expected to begin in 2012 and take twelve months to complete.

The facility is located on the shoreline east of Kahului Harbor. Because of this location, the facility is threatened by beach erosion which is believed to be caused by both man-made and natural events. Large scale sand mining circa 1900-1970 along the north coast of Maui (where the facility is located) for cement aggregate and lime production changed beach configurations significantly. The construction of Kahului Harbor and other man-made structures along the shoreline and the destruction of sand dunes combined with natural events such as sea level rise are also believed to be contributing to beach erosion.

The facility serves the growing population of Central Maui and is expected to reach capacity in 2029 (EISPN, page 4). This project intends to protect the existing facility and planned upgrades to increase capacity in order to meet the infrastructure needs of the Central Maui Community. OHA understands that the County has assessed options for the long-term wastewater treatment requirements for Central Maui and we recognize that protecting and upgrading the existing facility as opposed to building a new facility might be the most realistic and economically feasible option at this time. Tsunami protection improvements are already occurring at the facility to protect operations and structures in the event of a major natural disaster.

OHA looks forward to seeing the potential impacts of this project on natural and cultural resources carefully assessed in the DEIS and if necessary, appropriate mitigation measures implemented. We note that Kanaha Pond State Wildlife Sanctuary is located immediately south of the facility and project are and we recommend consultation with the Department of Land and Natural Resources- Division of Forestry and Wildlife and the U.S. Fish and Wildlife Service.

The secondary and cumulative impacts of "armoring" the shoreline should also be comprehensively studied with the results detailed in the DEIS. OHA recognizes that projects to protect essential facilities and infrastructure from shoreline erosion are becoming a necessary reality throughout the State of Hawai'i. We hope that the information and possible mitigation which will be explored in the DEIS will contribute to larger efforts to address beach loss, sand accretion and the overall adverse impacts to the near-shore marine ecosystem caused by these types of projects. OHA also anticipates this issue as being one which is carefully assessed by the Department of Land and natural Resources-Office of Conservation and Coastal Lands (OCCL) in their review of the Conservation District Use Application (CDUA) which the project requires.

This project will require excavations within sand dunes and beach sand along the shoreline. OHA is concerned that there is a possibility for encountering Native Hawaiian burials. Appendix H of the EISPN is a "letter report" of what is defined as an "archaeological field inspection" (inspection). It is noted in this report that the project area is situated within a general "*area which is known to contain both isolated and clusters of Native Hawaiian burials and/or habitation sites*". Based on the information available to us at this time, OHA believes that this inspection seems to have only consisted of a "walk-over" of the project area which resulted in observations of beach erosion and a "wave cut-bank" with "previously disturbed sand" which resulted in the conclusion that "*no significant material cultural remains noted*". OHA is concerned that the scope of this inspection may not have been adequate to determine the extent of disturbed sand in the project area and the absence of burials. We would like to see additional discussion of this issue in the DEIS.

An archaeological monitoring plan (plan) has been prepared for the project (EISPN, Appendix H-1) and reviewed and approved by the Department of Land and Natural Resources-State Historic Preservation Division (SHPD). There seems to be some confusion within the plan over the process required by Chapter §6E-43.6, Hawaii Revised Statutes (HRS). In the event human skeletal remains are inadvertently discovered, any activity in the immediate area must immediately cease pursuant to §6E-43.6(a) and the appropriate agencies notified pursuant to §6E-43.6 (b and c). The plan suggests (page 4) that the SHPD will make "recommendations" on appropriate mitigation for inadvertently discovered human remains. To be clear, the SHPD has the statutory authority to render determinations of preservation in place or relocation of inadvertently discovered human skeletal remains and shall subsequently approve required mitigation plans.

Thank you for initiating consultation. We look forward to reviewing the DEIS and providing additional comments at that time. Should you have any questions or concerns, please contact Keola Lindsey at 594-0244 or keolal@oha.org.

ʻO wau iho nō me ka ʻoiaʻiʻo,

Clyde W. Nāmuʻo
Chief Executive Officer

C: OHA- Maui Community Outreach Coordinator

MUNEKIYO HIRAGA, INC.

MICHAEL T. MUNEKIYO
PRESIDENT

KARLYNN FUKUDA
EXECUTIVE VICE PRESIDENT

GWEN OHASHI HIRAGA
SENIOR VICE PRESIDENT

MITSURU "MICH" HIRANO
SENIOR VICE PRESIDENT

MARK ALEXANDER ROY
VICE PRESIDENT

July 2, 2012

Clyde W. Namu'o, Chief Executive Officer
Office of Hawaiian Affairs
711 Kapiolani Boulevard, Stuite 500
Honolulu, Hawaii 96813

SUBJECT: Response to Environmental Impact Statement Preparation Notice (EISPN) Comment Letter Regarding Proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension at TMK (2) 3-8-001, Kahului, Maui, Hawaii (HRD11/0063E)

Dear Mr. Namu'o:

Thank you for your letter of February 17, 2011, providing comments on the proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension. Our response letter sent on April 6, 2011 had a numbering discrepancy which we would like to correct. We, therefore, offer the following information, which addresses your comments in the order listed in your letter.

1. We confirm that the Draft Environmental Impact Statement (DEIS) will include the potential impacts of the project on natural and cultural resources and appropriate mitigation measures.

2. The DEIS will include several alternatives, as well as an assessment of the secondary and cumulative impacts of "armoring" the shoreline.

3. In response to your concern regarding cultural remains, an archaeological inventory survey will be prepared and included in the DEIS.

4. A new archaeological monitoring plan will be prepared for the project that reflect that the State Historic Preservation Division has the statutory authority to render determinations of preservation in place or relocate on inadvertently discovered human skeletal remains and shall subsequently approve required mitigation plans.

305 High Street, Suite 104 · Wailuku, Hawaii 96793 · ph: (808)244-2015 · fax: (808)244-8729 · planning@mhplanning.com · www.mhplanning.com

Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes review process. A copy of your letter will be included in the Draft Environmental Impact Statement. In the meantime, if there are any questions or if additional information is needed, please feel free to contact me at (808) 244-2015.

Very truly yours,

Colleen Suyama
Senior Associate

CS:yp
cc: Kyle Ginoza, Director, Department of Environmental Management
Russ Boudreau, Moffat Nichol
K:\DATA\MoffattNichol\WK WWRF\EISPN Response\OHA EISPNres.doc

FEB 01 2011

ALAN M. ARAKAWA
MAYOR

JEFFREY A. MURRAY
CHIEF

ROBERT M. SHIMADA
DEPUTY CHIEF

COUNTY OF MAUI
DEPARTMENT OF FIRE AND PUBLIC SAFETY
FIRE PREVENTION BUREAU

313 MANEA PLACE • WAILUKU, HAWAII 96793
(808) 244-9161 • FAX (808) 244-1363

January 25, 2011

Colleen Suyama, Project Manager
Munekiyo & Hiraga, Inc.
305 High St.
Wailuku, HI 96793

Re : **EISPN for proposed Wailuku - Kahului Wastewater Reclamation Facility Shoreline Protection Extention**
(2) 3-8-001:188
Kahului, Maui, HI

Dear Ms. Suyama,

Thank you for the opportunity to comment on EISPN for the proposed project. At this time our office does not have any comment and reserve the right to comment during the building permit process.

If there are any questions or comments, please feel free to contact me by phone at 244-9161 ext. 25.

Sincerely,

Kono Davis

Kono Davis
Lieutenant, Fire Prevention Bureau
313 Manea Place
Wailuku, HI 96793

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

April 6, 2011

Lieutenant Kono Davis
Fire Prevention Bureau
313 Manea Place
Wailuku, Hawaii 96793

SUBJECT: Response to Environmental Impact Statement Preparation Notice (EISPN) Comment Letter Regarding Proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension at TMK (2) 3-8-001, Kahului, Maui, Hawaii

Dear Lieutenant Davis:

Thank you for your letter of January 25, 2011, responding to our request for comments on the Environmental Impact Statement Preparation Notice (EISPN) on the proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension project. We appreciate your review of the document and conveying the Department has no comment at this time.

Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes review process. A copy of your letter will be included in the Draft Environmental Impact Statement. In the meantime, if there are any questions or if additional information is needed, please feel free to contact me at 244-2015.

Very truly yours,

Colleen Suyama
Senior Associate

CS:yp
cc: Kyle Ginoza, Director, Department of Environmental Management
Russ Boudreau, Moffat Nichol
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7154

DEPARTMENT OF
HOUSING AND HUMAN CONCERNS
HOUSING DIVISION
COUNTY OF MAUI

ALAN M. ARAKAWA
Mayor
JO-ANN T. RIDAO
Director
JAN SHISHIDO
Deputy Director

35 LUNALILO STREET, SUITE 102 • WAILUKU, HAWAII 96793 • PHONE (808) 270-7351 • FAX (808) 270-...

RUSH

February 18, 2011

DEPT. OF ENVIRONMENTAL MANAGEMENT

	INFO	ACTION	SEE ME	COMMENTS	COPY	FILE
DIRECTOR	☑	☐	☐	☐	☐	☐
DEPUTY DIR.	☑	☐	☐	☐	☐	☐
PERS.	☐	☐	☐	☐	☐	☐
WWR	☑	☐	☐	☐	☐	☐
SW	☐	☐	☐	☐	☐	☐
SECTY.	☐	☐	☐	☐	☐	☐

Return to ________ Due ____
By: ________

Ms. Colleen Suyama
Senior Associate
Munekiyo & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Ms. Suyama:

Subject: Environmental Impact Statement Preparation Notice For Proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension located at Kahului, Maui, HI. TMK (2) 3-8-001:188

The Department has reviewed the Environmental Impact Statement Preparation Notice for the above subject project. Based on our review, we have determined that the subject project is not subject to chapter 2.96, Maui County Code. At the present time, the Department has no additional comments to offer.

Please call Mr. Buddy Almeida of our Housing Division at 270-7356 if you have any questions.

RECEIVED
2011 FEB 23 AM 10: 3
COUNTY OF MAUI
ENVIRONMENTAL MANAGEMENT

Sincerely,

Wayde T. Oshiro

WAYDE T. OSHIRO
Housing Administrator

cc: Director of Housing and Human Concerns
Kyle Ginoza, Department of Environmental Management

☐ RUSH

WWRD	INFO	ACTION	DRAFT RESP	SEE ME	COMMENTS	FILE	COPY
CHIEF			☐	☐	☐	☐	☐
PLA			☐	☐	☐	☐	☐
DES	✓			☐	☐	☑	☐
ACC				☐	☐	☐	☐
SEC					☐	☐	☐
OPER							☐

By ___ Return to: ___

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

April 6, 2011

Wayde T. Oshiro, Housing Administrator
Department of Housing and
Human Concerns
35 Lunalilo Street, Suite 102
Wailuku, Hawaii 96793

SUBJECT: Response to Environmental Impact Statement Preparation Notice (EISPN) Comment Letter Regarding Proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension at TMK (2) 3-8-001, Kahului, Maui, Hawaii

Dear Mr. Young:

Thank you for your letter of February 18, 2011, responding to our request for comments on the Environmental Impact Statement Preparation Notice (EISPN) on the proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension project. We appreciate your review of the document and acknowledge that the project is not subject to Chapter 2.96, Maui County Code.

Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes review process. A copy of your letter will be included in the Draft Environmental Impact Statement. In the meantime, if there are any questions or if additional information is needed, please feel free to contact me at 244-2015.

Very truly yours,

Colleen Suyama
Senior Associate

CS:yp
cc: Kyle Ginoza, Director, Department of Environmental Management
Russ Boudreau, Moffat Nichol
K:\DATA\MoffattNichol\WK WWRF\EISPN Response\DHHC EISPNres.doc

FEB 25 2011

ALAN M. ARAKAWA
Mayor

GLENN T. CORREA
Director

PATRICK T. MATSUI
Deputy Director

(808) 270-7230
FAX (808) 270-7934

DEPARTMENT OF PARKS & RECREATION

700 Hali'a Nakoa Street, Unit 2, Wailuku, Hawaii 96793

February 18, 2011

Ms. Colleen Suyama, Senior Associate
Munekiyo & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Ms. Suyama:

SUBJECT: WAILUKU-KAHULUI WASTEWATER RECLAMATION FACILITY SHORELINE PROTECTION EXTENSION, TMK: (2) 3-8-001:188, KAHULUI, MAUI, HAWAII
Environmental Impact Statement Preparation Notice

Thank you for the opportunity to review and comment on the subject project. We are in support of the proposed action and would like to be kept informed as the project plans are finalized.

Please feel free to contact me or Karla Peters, Parks Project Manager, at (808) 270-7981, if there are any questions.

Sincerely,

GLENN T. CORREA
Director

GTC:RH:kp

c: Kyle Ginoza, Department of Environmental Management
Robert Halvorson, Acting Chief of Parks Planning and Development

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

April 6, 2011

Glenn T. Correa, Director
Department of Parks & Recreation
700 Hali'a Nakoa Street, Unit 2
Wailuku, Hawaii 96793

SUBJECT: Response to Environmental Impact Statement Preparation Notice (EISPN) Comment Letter Regarding Proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension at TMK (2) 3-8-001, Kahului, Maui, Hawaii

Dear Mr. Correa:

Thank you for your letter of February 18, 2011, responding to our request for comments on the Environmental Impact Statement Preparation Notice (EISPN) on the proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension project. We appreciate your review of the document and conveying the Department has no comment at this time.

Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes review process. A copy of your letter will be included in the Draft Environmental Impact Statement. In the meantime, if there are any questions or if additional information is needed, please feel free to contact me at 244-2015.

Very truly yours,

Colleen Suyama
Senior Associate

CS:yp
cc: Kyle Ginoza, Director, Department of Environmental Management
Russ Boudreau, Moffat Nichol
K:\DATA\MoffattNichol\WK WWRF\EISPN Response\DPR EISPNres.doc

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7288

ALAN M. ARAKAWA
Mayor

WILLIAM R. SPENCE
Director

MICHELE CHOUTEAU McLEAN
Deputy Director

RECEIVED
2011 MAR 29 AM 10: 04
COUNTY OF ENVIRONMENTAL MANAGEMENT

RECEIVED
2011 MAR 29 PM 1: 36
WASTEWATER RECLAMATION DIVISION
COUNTY OF MAUI

RUSH

DEPT. OF ENVIRONMENTAL MANAGEMENT

	INFO	ACTION	SEE ME	COMMENTS	COPY	FILE
DIRECTOR	✓	✓				
DEPUTY DIR.						
PERS.						
WWR	✓	✓				
SW						
SECTY.						

Return to______ Due______
By:______ Date______

COUNTY OF MAUI

DEPARTMENT OF PLANNING

February 21, 2011

Mr. Kyle Ginoza, Director
Department of Environmental Management
One Main Plaza
2200 Main Street, Suite 100
Wailuku, Hawaii 96793

Dear Mr. Ginoza:

SUBJECT: COMMENTS REGARDING ENVIRONMENTAL IMPACT STATEMENT (EIS) PREPARATION NOTICE FOR PROPOSED WAILUKU-KAHULUI WASTEWATER RECLAMATION FACILITY SHORELINE PROTECTION EXTENSION, AT MAUI, HAWAII; TMK: (2) 3-8-001:188 (RFC 2011/0013)

The Department of Planning (Department) has the following comments regarding the subject EIS Preparation Notice received on January 21, 2011. In addition, the Department's Coastal Resources Planner James Buika attended a presentation on the project on February 15, 2011, with the consultants and members of your staff. The Department understands that the project will harden the shoreline to protect the County of Maui critical facility from continued chronic erosion. The Department will contribute additional comments during review of the Draft EIS.

From the information provided and from the presentation on February 15, 2011, the Department offers the following comments:

1. The County agrees that the Department of Environmental Management is the accepting authority for this EIS;

2. Please ensure that the Maui Planning Commission (Commission), as a body, is allowed to comment on the Draft EIS;

3. Please ensure that the University of Hawaii, Sea Grant Agency, is allowed to comment on the Draft EIS;

4. The property affected is within the Special Management Area (SMA) and Shoreline Setback Area and is subjected to the *Special Management Area Rules for the Maui Planning Commission* and the *Shoreline Rules for the Maui Planning Commission*;

5. The project will require a SMA Major Use Permit and a Shoreline Setback Variance Permit from the Commission;

6. The property is within the Tsunami Hazard area and is within the Flood Hazard Zone. Thus, a flood hazard development permit is required;

250 SOUTH HIGH STREET, WAILUKU, MAUI, HAWAII 96793
MAIN LINE (808) 270-7735; FACSIMILE (808) 270-7634
CURRENT DIVISION (808) 270-8205; LONG RANGE DIVISION (808) 270-7214; ZONING DIVISION (808) 270-7253

7. Erosion maps for the shoreline along the property indicate that the shoreline is subject to annual erosion, varying along the parcel, ranging from 0.0 feet per year to 2.9 feet per year, as shown on the Maui Shoreline Atlas;

8. Clearly define the known environmental impacts from the project which appear to include the loss of the beach park fronting the facility and proposed revetment;

9. As shown in Figure 1, Aerial Photograph, and as explained in the presentation, coastal processes generally move sand laterally from east to west along this shoreline system. Just beyond the western boundary of the property is the Kahului Harbor breakwater that prevents any further lateral transport of the beach sand. At this location, most of the sand appears to be lost to the beach system by moving off shore to deeper waters. As a mitigation option, to mitigate against the loss of the beach park, consider understanding where this lost sand goes offshore and consider methods to capture the beach sand, as it reaches the subject parcel, before the beach sand is lost off shore, and consider methods to move the captured sand back into the system, along a shoreline location farther east within the littoral system;

10. Understand and document use by the public of the beach park fronting the parcel;

11. In the revetment design, incorporate lateral access into the revetment design, through a walkway across the top of the revetment; and

12. Consider input from local fisherman.

Thank you for your cooperation. If you require further clarification, please contact Coastal Resources Planner James Buika at james.buika@mauicounty.gov or at (808) 270-6271.

Sincerely,

[signature]

WILLIAM SPENCE
Planning Director

xc: Clayton I. Yoshida, AICP, Planning Program Administrator
James A. Buika, Coastal Resources Planner
Tara Owens, University of Hawaii Sea Grant Agency
DLNR-OCCL
RFC File
General File

WRS:JAB:sa
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MUNEKIYO HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

April 9, 2012

Mr. William Spence, Director
Department of Planning
250 South High Street
Wailuku, Hawaii 96793

SUBJECT: Response to Environmental Impact Statement Preparation Notice (EISPN) Comment Letter Regarding Proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension at TMK (2) 3-8-001, Kahului, Maui, Hawaii

Dear Mr. Spence:

Thank you for your letter of February 21, 2011, providing comments on the proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension. We offer the following information, which addresses your comments in the order listed in your letter.

1. We acknowledge that the Department of Environmental Management is the accepting authority for the Environmental Impact Statement (EIS).

2. The Draft EIS will be forwarded to the Maui Planning Department (Department) for distribution to the Maui Planning Commission (Commission) for review and comment.

3. The Draft EIS will be forwarded to the University of Hawaii, Sea Grant agency for review and comment.

4. Special Management Area (SMA) and Shoreline Setback Variance applications will be filed with the Department for action by the Commission.

5. As required, a Flood Hazard Development Permit will be filed with the Department.

6. We acknowledge the erosion maps indicate the annual erosion rate for the shoreline varies from 0.0 feet per year to 2.9 feet per year.

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305 High Street, Suite 104 · Wailuku, Hawaii 96793 · ph: (808)244-2015 · fax: (808)244-8729 · planning@mhplanning.com · www.mhplanning.com

7. The Draft EIS will include a discussion of the environmental impacts on the adjacent beach fronting the facility and proposed revetment.

8. Your comments on sand transport and possible measures to capture sand before it is lost to deeper waters will be included in the Draft EIS.

9. The Draft EIS will identify the public use of the beach fronting the parcel.

10. Depending on the alternative selected for the project, consideration will be given to lateral access across the top of the revetment.

11. We will investigate the use of the area by local fishermen.

Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes review process. A copy of your letter will be included in the Draft Environmental Impact Statement.

In the meantime, if there are any questions or if additional information is needed, please feel free to con tact me at 244-2015.

Very truly yours,

Colleen Suyama
Senior Associate

CS:yp
cc: Kyle Ginoza, Director, Department of Environmental Management
Russ Boudreau, Moffat Nichol

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MAR 04 2011

POLICE DEPARTMENT

COUNTY OF MAUI

ALAN M. ARAKAWA
MAYOR

OUR REFERENCE

YOUR REFERENCE

55 MAHALANI STREET
WAILUKU, HAWAII 96793
(808) 244-6400
FAX (808) 244-6411

GARY A. YABUTA
CHIEF OF POLICE

CLAYTON N.Y.W. TOM
DEPUTY CHIEF OF POLICE

February 16, 2011

Ms. Colleen Suyama
Senior Associate
Munekiyo & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, HI 96793

Dear Ms. Suyama:

SUBJECT: EIS Preparation Notice for Proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension
TMK (2) 3-8-001

This is in response to the request for comments on the above subject.

We have reviewed the information submitted for this project and have submitted our comments and/or recommendations. Thank you for giving us the opportunity to comment on this project.

Very truly yours,

AC D. Matsu

Assistant Chief Danny Matsuura
for: Gary A. Yabuta
Chief of Police

c: William Spence, Planning Department

TO	:	GARY YABUTA, CHIEF OF POLICE, COUNTY OF MAUI
VIA	:	CHANNELS
FROM	:	LAWRENCE PAGADUAN, SERGEANT, PATROL DIVISION-WAILUKU DISTRICT
SUBJECT	:	RESPONSE FOR COMMENTS REGARDING THE ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN) FOR PROPOSED WAILUKU-KAHULUI WASTEWATER RECLAMATION FACILITY SHORELINE PROTECTION EXTENSION PROJECT

ACD·Ma[illegible] 2/15/11

This communication is submitted as a response to a request for comments by Munekiyo & Hiraga, Inc., Senior Associate, Colleen SUYAMA, regarding the Environmental Impact Statement Preparation Notice for the following project;

PROJECT	:	WAILUKU-KAHULUI WASTEWATER FACILITY SHORELINE PROTECTION EXTENSION PROJECT
TMK #	:	(2) 2-3-001: 188
APPLICANT	:	MUNEKIYO & HIRAGA, INC.
LOCATION	:	Kahului, Hawaii
PROJECT AREA	:	APROXIMATELY 1,200-ft. AREA AT TMK (2) 2-3-001: 188

RESPONSE:

In review of the submitted documents, concerns from the police perspective are upon the safety of pedestrian and vehicular movement.

This proposed project consists of the construction of an approximately 1,200-ft. rock mound revetment extension to the west of the existing revetment with short landward returns to prevent flanking erosion This is a preventative measure against erosion to the shoreline at the Wailuku-Kahului Wastewater Reclamation Facility (WKWWRF)

EXISTING ROADWAY CONDITION:

The Wailuku-Kahului region is served by a roadway network which includes arterial, collector, and local roads. Major roadways in the vicinity of the project site include Hana Highway, Dairy Road, Keolani Place, and Hobron Avenue.

Access to the project site is provided by Amala Place via Hana Highway and Hobron Avenue through the Kahului Harbor industrial area.

In proximity of the project site, Hana Highway has an east-west orientation and functions as a four-lane, major divided State arterial highway which links East Maui to Central

Maui. The posted speed limit on Hana Highway is 45 miles per hour (MPH) at the approaches to Dairy Road and Hobron Avenue intersections.

Amala Place is a two-lane, east-west County road that provides access to the Kanaha Pons State Wildlife Sanctuary and Kanaha Beach Park. The posted speed limit on Amala Place is 30 mph. The project site is located to the north of Amala Place.

POTENTIAL IMPACTS AND MITIGATION MEASURES:

Traffic to and from the WKWWRF will, for the most part, be limited to vehicles of operations personnel and employees. Traffic resulting from these sources will be intermittent and is not anticipated to significantly impact existing traffic conditions along Hobron Avenue, Amala Place, or other area roadways. A construction traffic management plan will be prepared and submitted to the Department of Public Works for review and approval during the permitting process, as applicable. Increased construction traffic will be short term and mitigated by the construction management plan. The proposed shoreline protection measures are not anticipated to increase traffic at the WKWWRF in the long term. The proposed project would provide a benefit in protecting Amala Place from wave overtopping.

CONCLUSION:

There are no immediate concerns or objections to the progression of this project at this time, from the police standpoint, in regards to pedestrian and vehicular movement. The location of the project is located within the WKWWRF on the shoreline. The construction itself is not anticipated to affect vehicular or pedestrian traffic on Amala Place.

No comments

Respectfully submitted,

Sgt Lawrence PAGADUAN E#10218
Patrol Division, District I
February 11, 2011 at 1030 hrs.

MUNEKIYO & HIRAGA, INC.

Michael T. Munekiyo
Gwen Ohashi Hiraga
Mitsuru "Mich" Hirano
Karlynn Fukuda

Mark Alexander Roy

April 6, 2011

Chief Gary A. Yabuta
Police Department
55 Mahalani Street
Wailuku, Hawaii 96793

SUBJECT: Response to Environmental Impact Statement Preparation Notice (EISPN) Comment Letter Regarding Proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension at TMK (2) 3-8-001, Kahului, Maui, Hawaii

Dear Chief Yabuta:

Thank you for your letter of February 16, 2011, responding to our request for comments on the Environmental Impact Statement Preparation Notice (EISPN) on the proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension project. We appreciate your review of the document and conveying the Department has no immediate concerns or objections to the project with regards to pedestrian and vehicular movement.

Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes review process. A copy of your letter will be included in the Draft Environmental Impact Statement. In the meantime, if there are any questions or if additional information is needed, please feel free to contact me at 244-2015.

Very truly yours,

Colleen Suyama
Senior Associate

CS:yp
cc: Kyle Ginoza, Director, Department of Environmental Management
Russ Boudreau, Moffat Nichol
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305 High Street, Suite 104 · Wailuku, Hawaii 96793 · ph: (808)244-2015 · fax: (808)244-8729 · planning@mhplanning.com · www.mhplanning.com

FEB 09 2011

ALAN M. ARAKAWA
Mayor

DAVID C. GOODE
Director

ROWENA M. DAGDAG-ANDAYA
Deputy Director

Telephone: (808) 270-7845
Fax: (808) 270-7955

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
200 SOUTH HIGH STREET, ROOM NO. 434
WAILUKU, MAUI, HAWAII 96793

RALPH NAGAMINE, L.S., P.E.
Development Services Administration

CARY YAMASHITA, P.E.
Engineering Division

BRIAN HASHIRO, P.E.
Highways Division

February 7, 2011

Ms. Colleen Suyama
MUNEKIYO & HIRAGA, INC.
305 High Street, Suite 104
Wailuku, Maui, Hawaii 96793

Dear Ms. Suyama:

SUBJECT: ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE FOR PROPOSED WAILUKU-KAHULUI WASTEWATER RECLAMATION FACILITY SHORELINE PROTECTION EXTENSION; TMK: (2) 3-8-001:188

We reviewed the subject application and have the following comment:

1. Building Permit Nos. B 2008/1072 and B2008/1073 are open and have not had any inspections. Please call Ernie Takitani at 270-7375 regarding inspections for these expired permits.

Please call Rowena M. Dagdag-Andaya at 270-7845 if you have any questions regarding this letter.

Sincerely,

for DAVID C. GOODE
Director of Public Works

DCG:RMDA:jso
xc: Highways Division
Engineering Division
Kyle Ginoza, Director of Environmental Management
S:\LUCA\CZM\prop_wailuku_kahului_wwr_facility_eis_38001188_ls.wpd

MUNEKIYO & HIRAGA, INC.

April 6, 2011

David Goode, Director
Department of Public Works
200 South High Street, Room 434
Wailuku, Hawaii 96793

SUBJECT: Response to Environmental Impact Statement Preparation Notice (EISPN) Comment Letter Regarding Proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension at TMK (2) 3-8-001, Kahului, Maui, Hawaii

Dear Mr. Goode:

Thank you for your letter of February 7, 2011, responding to our request for comments on the Environmental Impact Statement Preparation Notice (EISPN) on the proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension project. We appreciate your review of the document. As requested, the Department of Environmental Management is working with Deputy Director Rowena Dagdag-Andaya regarding the inspections related to Building Permit Nos. B 2008/1072 and B 2008/1073.

Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes review process. A copy of your letter will be included in the Draft Environmental Impact Statement. In the meantime, if there are any questions or if additional information is needed, please feel free to contact me at 244-2015.

Very truly yours,

Colleen Suyama
Senior Associate

CS:yp
cc: Rowena Dagdag-Andaya, Deputy Director, Department of Public Works
Kyle Ginoza, Director, Department of Environmental Management
Russ Boudreau, Moffat Nichol

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FEB 09 2011

ALAN M. ARAKAWA
MAYOR

JO ANNE JOHNSON
Director
MARC I. TAKAMORI
Deputy Director
Telephone (808) 270-7511

DEPARTMENT OF TRANSPORTATION

COUNTY OF MAUI
200 South High Street
Wailuku, Hawaii, USA 96793-2155

February 1, 2011

Ms. Colleen Suyama
Munekiyo & Hiraga Inc.
305 High Street, Suite 104
Wailuku, Maui, Hawaii 96793

Subject: EIS for Proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection

Dear Ms. Suyama,

Thank you for the opportunity to comment on this project. We have no comments to make at this time.

Please feel free to contact me if you have any questions.

Sincerely,

Jo Anne Johnson
Director

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

April 6, 2011

Jo Anne Johnson, Director
Department of Transportation
County of Maui
200 South High Street
Wailuku, Hawaii 96804

SUBJECT: Response to Environmental Impact Statement Preparation Notice (EISPN) Comment Letter Regarding Proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension at TMK (2) 3-8-001, Kahului, Maui, Hawaii

Dear Ms. Johnson:

Thank you for your letter of February 1, 2011, responding to our request for comments on the Environmental Impact Statement Preparation Notice (EISPN) on the proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension project. We appreciate your review of the document and conveying the Department has no comment at this time.

Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes review process. A copy of your letter will be included in the Draft Environmental Impact Statement. In the meantime, if there are any questions or if additional information is needed, please feel free to contact me at 244-2015.

Very truly yours,

Colleen Suyama
Senior Associate

CS:yp
cc: Kyle Ginoza, Director, Department of Environmental Management
Russ Boudreau, Moffat Nichol
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MAR 15 2011

ALAN M. ARAKAWA
Mayor

DAVID TAYLOR, P.E.
Director

PAUL J. MEYER
Deputy Director

DEPARTMENT OF WATER SUPPLY
COUNTY OF MAUI
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793-2155
www.mauiwater.org

March 8, 2011

Mr. Kyle Ginoza
Department of Environmental Management
235 South Beretania Street, 702
Honolulu, Hawaii 96813

Re: Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension Environmental Impact Statement Preparation Notice (EISPN)
TMK: (2) 3-8-001:188

Dear Mr. Ginoza:

Thank you for the opportunity to comment on this EISPN. We offer the following comments.

Infrastructure
An 8" water line runs along Amala Street fronting the Wastewater Treatment Plant. Hydrant #742 is located along Amala Street approximately 100 feet from the southwest corner of the Wailuku-Kahului Wastewater Reclamation Facility. The DWS requires that construction plans be reviewed by the Engineering Division (270-7835).

Conservation
The EISPN should discuss the project's landscaping and irrigation plans, if any are anticipated. To alleviate demand on the Central Maui system, we recommend that the applicant implement the following conservation measures:

1. Dust Control: Reclaimed water for dust control is available from the Kihei and Kahului sewage treatment plants; this should be considered as an alternative source of water for dust control during construction.

2. Use climate-adapted native plants if applicable: Native plants adapted to the natural rainfall of the area conserve water and protect the watershed from degradation due to the spread of invasive alien species. Please consider the use of native Hawaiian plants adapted to the natural rainfall of the area for decorative borders and other landscaping features, if applicable. The subject project is located in Plant Zone 5. We have attached a native plant brochure to assist with appropriate plant selection.

3. Prevent Over Watering:
   In the event the project will be landscaped, we recommend:
   a. Equip all irrigated areas with smart controllers capable of self-adjusting to account for moisture conditions.
   b. Arrange irrigation valves and circuits such that plants with different water requirements are watered separately and appropriately (hydrozones).
   c. Provide rain sensors and shut-offs on all automated irrigation controllers.
   d. If weather or moisture sensing controllers are not used, at the very minimum check and reset controllers at least once a month to reflect the monthly changes in evapo transpiration rates at the site.

Should you have any questions, please contact our Water Resources and Planning Division at 808-244-8550.

Sincerely,

David Taylor, P.E.
Director
bab

cc: engineering division

Attachments:
1. A Checklist of Water Conservation Ideas for Industrial and Large Landscapes
2. Plant Brochure: "Saving Water in the Yard"

A Checklist of Water Conservation Ideas For

This checklist provides water conservation tips successfully implemented by industrial and commercial users. This list has been revised from the original copy first published and distributed by the Los Angeles Department of Water and Power and the Water Efficiency Manual by the North Carolina Department of Environment and Natural Resources.

START A WATER CONSERVATION PROGRAM

- Increase employee awareness of water conservation.
- Install signs encouraging water conservation in employee and customer restrooms.
- When cleaning with water is necessary, use budgeted amounts.
- Read water meter weekly to monitor success of water conservation efforts.
- Assign an employee to monitor water use and waste.
- Seek employee suggestions on water conservation; put suggestion boxes in prominent areas.
- Determine the quantity and purpose of water being used.
- Determine other methods of water conservation.
- Conduct contests for employees (e.g., posters, slogans, or conservation ideas).

PLANNING AND DESIGN

- Consider the following:
  - Physical conditions (drainage, soil type, sun/shade, etc.) and the use of the site (foot traffic, recreation, viewing, etc.)
  - Creating shade areas, which can be 20 degrees cooler than non-shaded areas, decreasing evaporation.
  - Grass areas only where needed; avoid small areas under 10 feet wide.
  - Permeable materials such as porous concrete or permeable paving methods.

  - Grading and directing surface run-off and rainfall gutters to landscaped areas as opposed to drainageways that exit the property.
- Incorporate high water demanding plants at the bottom of slopes, and maintain the use of existing trees, plants, and wildlife in the area during planning.
- Minimize the use of impermeable surfaces to lessen runoff and resulting stormwater pollution.
- Identify water source points.
- Develop a schematic of all water entry points (know where your faucets, time clocks, solenoids, booster pumps, sprinklers and bubblers are located).

- Identify capacity of each water-carrying unit and frequency of use.
- Determine specific use for each entry source.

ANALYZE AND IMPROVE SOIL CONDITIONS

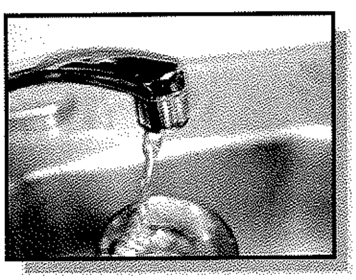
- Test the soil quality, nutrients and absorptive capacity, and then select plants based on findings. Adjust the pH level if necessary.
- Use organic matter (compost, mulch or manure) to increase the soil's water holding capacity. This helps improve water distribution and lowers levels of evaporation.
- When improving the soil of a given area, remember to treat a larger area around the planting to allow ample space for root systems.
- Prevent heavy construction equipment from compacting soil in areas around trees or other sensitive habitats.

PLANT SELECTION

- Choose native, climate-appropriate species.
- Consider plants' water demand, pest tolerance, soil nutrient and drainage requirements.

INTERIOR AREAS

- Discontinue continuous flow.
- Use ponded water where available.
- Adjust flows to reduce discharge of water.
- Install water-saving devices to decrease water consumption – restrooms (toilet dams and flappers), faucets (aerators), cooling systems.



  - Retrofit toilets with high efficiency models that use 1.28 gallons per flush or less.
  - Retrofit urinals with high efficiency models that use 0.5 gallons per flush.
  - Install showerheads with a flow rate of 1.5 gpm at 60 psi or less in all units.
  - Retrofit bathroom sink faucets with fixtures that do not exceed 1 gpm at 60 psi.
- Use recycling systems for chillers and cooling towers.
- Consider installing energy-and-water-efficient air conditioning equipment.

MAINTENANCE PROCEDURES

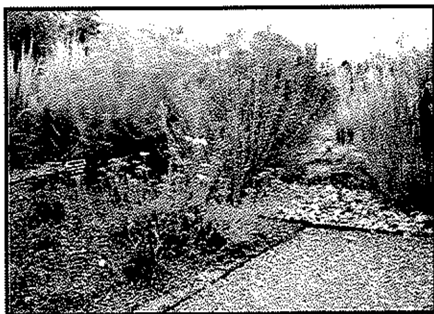
- Sweep materials from floor instead of washing down whenever possible.
- Instruct clean-up crews to use less water where appropriate.
- Check water supply system for leaks.
- Repair dripping faucets and continuously-running or leaking toilets.

DESIGN CRITERIA FOR TURF AND LANDSCAPE AREAS

- Contact the Department of Water Resources or your local water supplier about possible landscape water auditor classes for managers.
- Hire a landscape architect with water conservation and xeriscape experience.
- Use turf only where actually necessary: Immediate picnic areas/outside lunch areas and gold course target areas (greens, tees, landing areas).
- Turfgrass should be cut to the maximum recommended height for its type (generally a minimum of two inches to a maximum of four inches) for most efficient water use.
- Use only low-water use plant material in non-turf areas.

- Drip irrigation and microsprays place water at the base of the plant. This reduces evaporation and saves water by not soaking the entire ground surface. This works for trees, shrubs, and groundcovers.

- Use automatic irrigation systems monitored by moisture probes (i.e. tensiometers), and rain shut-off devices to cut power off during rain.



- Design dual watering systems with sprinklers for turf and low-volume irrigation for plants, trees, and shrubs. Operate sprinkler system before sunrise and after sunset. Amount of irrigation can be determined by the evapotranspiration rate, which DWR can help you determine.

- Use properly-treated waste water for irrigation where available.

EXTERIOR AREAS

- Regular aeration of clay soils will improve water holding capabilities and prevent runoff.

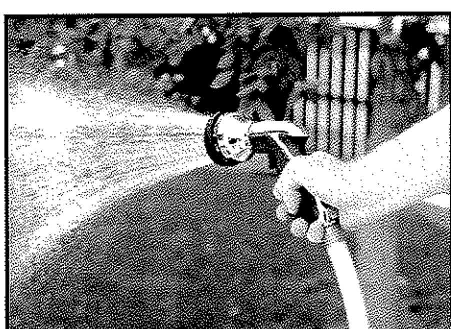
- Discontinue using water to clean sidewalks, tennis courts, pool decks, driveways, and parking lots.

- Make sure irrigation water does not run onto streets or into alleys. Adjust sprinklers to water only plants and not sidewalks or roads.

- Use the same size nozzle when replacement is needed. Sprinklers should be replaced with the same brand of sprinklers. Spray heads are aligned with grade.

- Replace worn spray nozzles.

- Regulate pressure properly for system demands.



- Make sure rotors or spray heads are mounted correctly. Replace with proper unit for the job.

- Post a current controller schedule inside the door of the controller.

- Check for leaking valves.

- Adjust the operating time (runtimes) of the sprinklers to meet appropriate seasonal or monthly requirements.

- Check plant leaves and take soil samples to confirm proper system functioning.

- Look into alternative sources for irrigation water (i.e. the use of wells as opposed to city water, water reuse operations from air conditioning condensate, storm water retention ponds, or cisterns, non-contact cooling water).

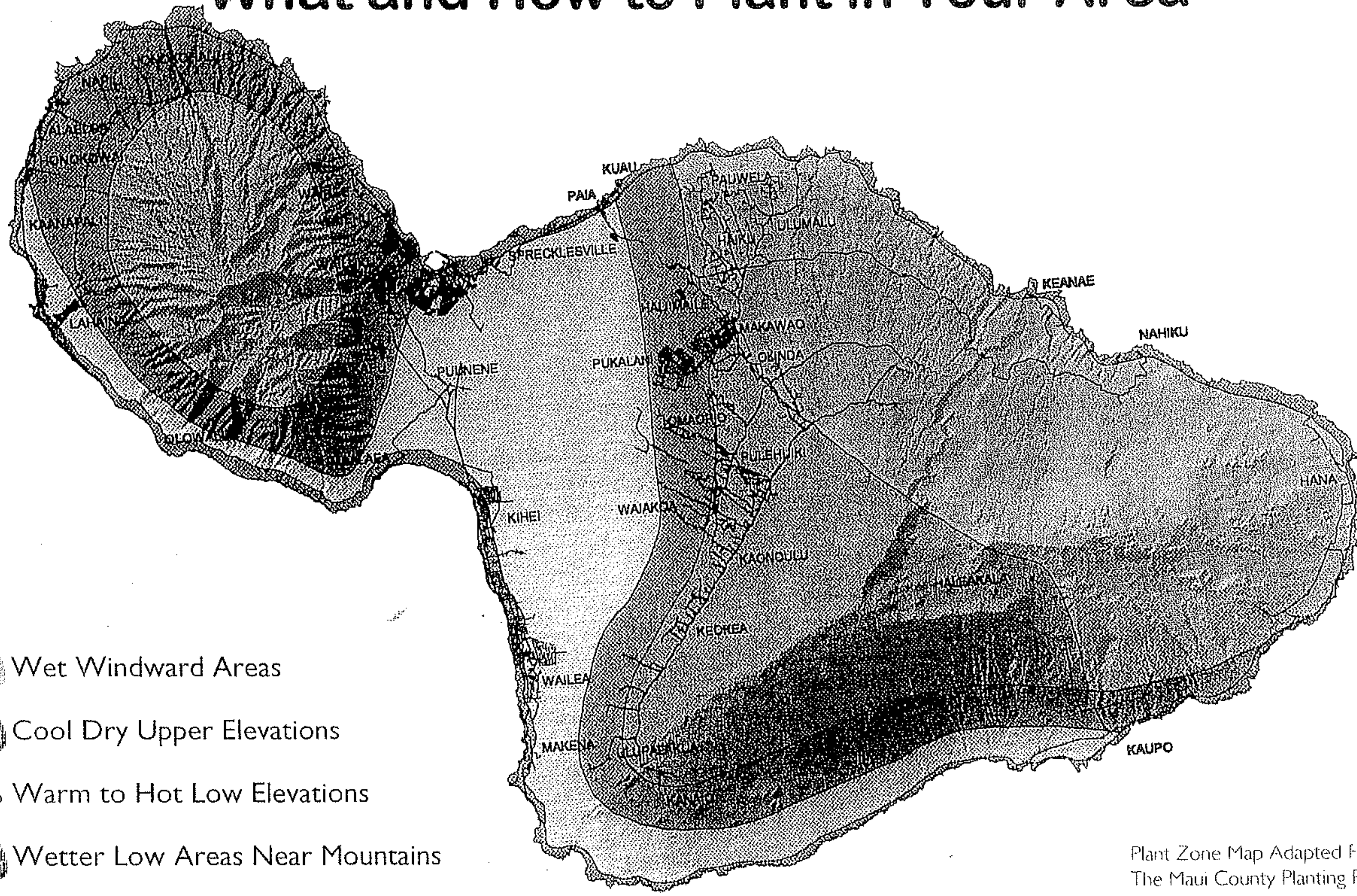
- Use dedicated water meters to monitor landscaping water use.

- Have a catchment/distribution uniformity test performed on-site to determine how evenly water is applied when sprinklers are in use.

For more information, contact:
Maui County Department of Water Supply
Water Resources and Planning Division
59 Kanoa Street Wailuku, HI 96793
Telephone: (808) 244-8550
FAX: (808) 244-6701

Saving Water in The Yard

What and How to Plant in Your Area



1 Wet Windward Areas

2 Cool Dry Upper Elevations

3 Warm to Hot Low Elevations

4 Wetter Low Areas Near Mountains

5 Windward Coastal Salt Spray Zones

Plant Zone Map Adapted From
The Maui County Planting Plan

Tips From The Maui County Department of Water Supply
By Water All Things Find Life

Zone-specific Native and Polynesian plants for Maui County

Zone 1

TYPE: **F** Fern **G** Grass **Gr** Ground Cover **Sh** Shrub **P** Palm **S** Sedge **Tr** Tree **V** Vine

Type	Scientific Name	Common Name	Height	Spread	Elevation	Water req.
F	Psilotum nudum	moa, moa kula	1'	1'	sea to 3,000'	Dry to Wet
F	Sadleria cyatheoides	'ama'u, ama'uma'u				
Gr - Sh	Lipochaeta succulenta	nehe	2'	5'	sea to 1,000'	Dry to Wet
P	Cocos nucifera	coconut, niu	100'	30'	sea to 1,000'	Dry to Wet
P	Pritchardia arecina	lo'ulu, hawane	40'	10'	1,000' to 3,000'	Dry to Wet
P	Pritchardia forbesiana	lo'ulu	15'			
P	Pritchardia hillebrandii	lo'ulu, fan palm	25'	15'	sea to 1,000'	Dry to Wet
S	Mariscus javanicus	marsh cypress, 'ahu'awa	0.5'	0.5'	sea to 1,000'	Dry to Medium
Sh	Bidens hillebrandiana ssp. hillebrandiana	ko'oko'olau	1'	2'	sea to 1,000'	Dry to Wet
Sh	Cordyline fruticosa	ti, ki	6			
Sh	Hedyotis spp.	au, pilo	3'	2'	1,000' to 3,000'	Dry to Wet
Sh - Tr	Broussonetia papyrifera	wauke, paper mulberry	8'	6'	sea to 1,000'	Dry to Medium
Tr	Acacia koa	koa	50' - 100'	40' - 80'	1,500' to 4,000'	Dry to Medium
Tr	Aleurites moluccana	candlenut, kukui	50'	50'	sea to 3,000'	Medium to Wet
Tr	Calophyllum inophyllum	kamani, alexandrian laurel	60'	40'	sea to 3,000'	Medium to Wet
Tr	Charpentiera obovata		15'			
Tr	Cordia subcordata	kou	30'	25'	sea to 1,000'	Dry to Wet
Tr	Hibiscus furcellatus	'akiohala, hau-hele	8'			
Tr	Metrosideros polymorpha var. macrophylla	ohi'a lehua	25'	25'	sea to 1,000'	Dry to Wet
Tr	Morinda citrifolia	indian mulberry, noni	20'	15'	sea to 1,000'	Dry to Wet
Tr	Pandanus tectorius	hala, puhala (HALELIST)	35'	25'	sea to 1,000'	Dry to Wet
V	Alyxia oliviformis	maile	Vine		sea to 6,000'	Medium to Wet

Zone-specific Native and Polynesian plants for Maui County

Zone 2

TYPE: **F** Fern **G** Grass **Gr** Ground Cover **Sh** Shrub **P** Palm **S** Sedge **Tr** Tree **V** Vine

Type	Scientific Name	Common Name	Height	Spread	Elevation	Water req.
F	Psilotum nudum	moa, moa kula	1'	1'	sea to 3,000'	Dry to Wet
F	Sadleria cyatheoides	'ama'u, ama'uma'u				
G	Eragrostis monticola	kalamalo	1'	2'	sea to 3,000'	Dry to Medium
Gr	Ipomoea tuboides	Hawaiian moon flower, 'uala	1'	10'	sea to 3,000'	Dry to Medium
Gr	Peperomia leptostachya	'ala'ala-wai-nui	1'	1'	sea to 3,000'	Dry to Medium
Gr	Plumbago zeylanica	'ilie'e	1'			
Gr - Sh	Hibiscus calyphyllus	ma'o hau hele, Rock's hibiscus	3'	2'	sea to 3,000'	Dry to Medium
Gr - Sh	Lipochaeta rockii	nehe	2'	2'	sea to 3,000'	Dry to Medium
Sh	Argemone glauca var. decipiens	pua kala	3'	2'	sea to 3,000'	Dry to Medium
Sh	Artemisia mauiensis var. diffusa	Maui wormwood, 'ahinahina	2'	3'	1,000' to higher	Dry to Medium
Sh	Chenopodium oahuense	'aheahea, 'aweoweo	6'		sea to higher	Dry to Medium
Sh	Dianella sandwicensis	'uki	2'	2'	1,000' to higher	Dry to Medium
Sh	Lipochaeta lavarum	nehe	3'	3'	sea to 3,000'	Dry to Medium
Sh	Osteomeles anthyllidifolia	'ulei, eluehe	4'	6'	sea to 3,000'	Dry to Medium
Sh	Senna gaudichaudii	kolomana	5'	5'	sea to 3,000'	Dry to Medium
Sh	Styphelia tameiameiae	pukiawe	6'	6'	1,000' to higher	Dry to Medium
Sh	Vitex rotundifolia	pohinahina	3'	4'	sea to 1,000'	Dry to Medium
Sh - Tr	Myoporum sandwicense	naio, false sandalwood	10'	10'	sea to higher	Dry to Medium
Sh - Tr	Nototrichium sandwicense	kulu'i	8'	8'	sea to 3,000'	Dry to Medium
Sh-Tr	Dodonaea viscosa	'a'ali'i	6'	8'	sea to higher	Dry to Medium
Tr	Acacia koa	koa	50' - 100'	40' - 80'	1,500' to 4,000'	Dry to Medium
Tr	Charpentiera obovata		15'			
Tr	Erythrina sandwicensis	wiliwili	20'	20'	sea to 1,000'	Dry
Tr	Metrosideros polymorpha var. macrophylla	ohi'a lehua	25'	25'	sea to 1,000'	Dry to Wet

Zone 2

Zone-specific Native and Polynesian plants for Maui County

Type	Scientific Name	Common Name	Height	Spread	Elevation	Water req.
Tr	Nestegis sandwicensis	olopua	15'	15'	1,000' to 3,000'	Dry to Medium
Tr	Pleomele auwahiensis	halapepe	20'			
Tr	Rauvolfia sandwicensis	hao	20'	15'	sea to 3,000'	Dry to Medium
Tr	Santalum ellipticum	coastal sandalwood, 'ili-ahi	8'	8'	sea to 3,000'	Dry to Medium
Tr	Sophora chrysophylla	mamane	15'	15'	1,000' to 3,000'	Medium
V	Alyxia oliviformis	maile	Vine		sea to 6,000'	Medium to Wet

Zone-specific Native and Polynesian plants for Maui County

Zone 3

TYPE: **F** Fern **G** Grass **Gr** Ground Cover **Sh** Shrub **P** Palm **S** Sedge **Tr** Tree **V** Vine

Type	Scientific Name	Common Name	Height	Spread	Elevation	Water req.
F	Psilotum nudum	moa, moa kula	1'	1'	sea to 3,000'	Dry to Wet
G	Colubrina asiatica	'anapanapa	3'	10'	sea to 1,000'	Dry to Wet
G	Eragrostis monticola	kalamalo	1'	2'	sea to 3,000'	Dry to Medium
G	Eragrostis variabilis	'emo-loa	1'	2'	sea to 3,000'	Dry to Medium
G	Fimbristylis cymosa ssp. spathacea	mau'u'aki'aki fimbristylis	0.5'	1'	sea to 1,000'	Dry to Medium
Gr	Boerhavia repens	alena	0.5'	4'	sea to 1,000'	Dry to Medium
Gr	Chamaesyce celastroides var. laehiensis	'akoko	2'	3'	sea to 1,000'	Dry to Medium
Gr	Cressa truxillensis	cressa	0.5'	1'	sea to 1,000'	Dry to Medium
Gr	Heliotropium anomalum var. argenteum	hinahina ku kahakai	1'	2'	sea to 1,000'	Dry to Medium
Gr	Ipomoea tuboides	Hawaiian moon flower, uala	1'	10'	sea to 3,000'	Dry to Medium
Gr	Jacquemontia ovalifolia ssp. sandwicensis	pa'u o hi'iaka	0.5'	6'	sea to 1,000'	Dry to Medium
Gr	Lipochaeta integrifolia	nehe	1'	5'	sea to 1,00'	Dry to Medium
Gr	Peperomia leptostachya	'ala'ala-wai-nui	1'	1'	sea to 3,000'	Dry to Medium
Gr	Plumbago zeylanica	'ilie'e	1'			
Gr	Sesuvium portulacastrum	'akulikuli, sea-purslane	0.5'	2'	sea to 1,000'	Dry to Wet
Gr	Sida fallax	'ilima	0.5'	3'	sea to 1,000'	Dry to Medium
Gr	Tephrosia purpurea var. purpurea	'auhuhu	2'	2'	sea to 1,000'	Dry to Medium
Gr - Sh	Hibiscus calyphyllus	ma'o hau hele, Rock's hibiscus	3'	2'	sea to 3,000'	Dry to Medium
Gr - Sh	Lipochaeta rockii	nehe	2'	2'	sea to 3,000'	Dry to Medium
Gr - Sh	Lipochaeta succulenta	nehe	2'	5'	sea to 1,000'	Dry to Wet
Gr - Sh	Lycium sandwicense	'ohelo-kai, 'ae'ae	2'	2'	sea to 1,000'	Dry to Medium
P	Cocos nucifera	coconut, niu	100'	30'	sea to 1,000'	Dry to Wet
P	Pritchardia hillebrandii	lo'ulu, fan palm	25'	15'	sea to 1,000'	Dry to Wet
S	Mariscus javanicus	marsh cypress, 'ahu'awa	0.5'	0.5'	sea to 1,000'	Dry to Medium

Zone-specific Native and Polynesian plants for Maui County

Zone 3

Type	Scientific Name	Common Name	Height	Spread	Elevation	Water req.
Sh	Argemone glauca var. decipiens	pua kala	3'	2'	sea to 3,000'	Dry to Medium
Sh	Bidens mauiensis	ko'oko'olau	1'	3'	sea to 1,000'	Dry to Medium
Sh	Bidens menziesii ssp. menziesii	ko'oko'olau	1'	3'		
Sh	Bidens micrantha ssp. micrantha	ko'oko'olau	1'	3'		
Sh	Chenopodium oahuense	'aheahea, 'aweoweo	6'		sea to higher	Dry to Medium
Sh	Dianella sandwicensis	'uki	2'	2'	1,000' to higher	Dry to Medium
Sh	Gossypium tomentosum	mao, Hawaiian cotton	5'	8'	sea to 1,000'	Dry to Medium
Sh	Hedyotis spp.	au, pilo	3'	2'	1,000' to 3,000'	Dry to Wet
Sh	Lipochaeta lavarum	nehe	3'	3'	sea to 3,000'	Dry to Medium
Sh	Osteomeles anthyllidifolia	'ulei, eluehe	4'	6'	sea to 3,000'	Dry to Medium
Sh	Scaevola sericea	naupaka, naupaka-kahakai	6'	8'	sea to 1,000'	Dry to Medium
Sh	Senna gaudichaudii	kolomana	5'	5'	sea to 3,000'	Dry to Medium
Sh	Solanum nelsonii	'akia, beach solanum	3'	3'	sea to 1,00'	Dry to Medium
Sh	Styphelia tameiameiae	pukiawe	6'	6'	1,000' to higher	Dry to Medium
Sh	Vitex rotundifolia	pohinahina	3'	4'	sea to 1,000'	Dry to Medium
Sh	Wikstroemia uva-ursi kauaiensis kauaiensis	'akia, Molokai osmanthus				
Sh - Tr	Broussonetia papyrifera	wauke, paper mulberry	8'	6'	sea to 1,000'	Dry to Medium
Sh - Tr	Myoporum sandwicense	naio, false sandalwood	10'	10'	sea to higher	Dry to Medium
Sh - Tr	Nototrichium sandwicense	kulu'i	8'	8'	sea to 3,000'	Dry to Medium
Sh-Tr	Dodonaea viscosa	'a'ali'i	6'	8'	sea to higher	Dry to Medium
Tr	Aleurites moluccana	candlenut, kukui	50'	50'	sea to 3,000'	Medium to Wet
Tr	Calophyllum inophyllum	kamani, alexandrian laurel	60'	40'	sea to 3,000'	Medium to Wet
Tr	Canthium odoratum	Alahe'e, 'ohe'e, walahe'e	12'	8'	sea to 3,000'	Dry to Medium
Tr	Cordia subcordata	kou	30'	25'	sea to 1,000'	Dry to Wet
Tr	Diospyros sandwicensis	lama	12'	15'	sea to 3,000'	Dry to Medium
Tr	Erythrina sandwicensis	wiliwili	20'	20'	sea to 1,000'	Dry
Tr	Metrosideros polymorpha var. macrophylla	ohi'a lehua	25'	25'	sea to 1,000'	Dry to Wet

Zone-specific Native and Polynesian plants for Maui County

Zone 3

Type	Scientific Name	Common Name	Height	Spread	Elevation	Water req.
Tr	Morinda citrifolia	indian mulberry, noni	20'	15'	sea to 1,000'	Dry to Wet
Tr	Nesoluma polynesicum	keahi	15'	15'	sea to 3,00'	Dry
Tr	Nestegis sandwicensis	olopua	15'	15'	1,000' to 3,000'	Dry to Medium
Tr	Pandanus tectorius	hala, puhala (HALELIST)	35'	25'	sea to 1,000'	Dry to Wet
Tr	Pleomele auwahiensis	halapepe	20'			
Tr	Rauvolfia sandwicensis	hao	20'	15'	sea to 3,000'	Dry to Medium
Tr	Reynoldsia sandwicensis	'ohe makai	20'	20'	1,000' to 3,000'	Dry
Tr	Santalum ellipticum	coastal sandalwood, 'ili-ahi	8'	8'	sea to 3,000'	Dry to Medium
Tr	Thespesia populnea	milo	30'	30'	sea to 3,000'	Dry to Wet

Zone-specific Native and Polynesian plants for Maui County

Zone 4

TYPE: **F** Fern **G** Grass **Gr** Ground Cover **Sh** Shrub **P** Palm **S** Sedge **Tr** Tree **V** Vine

Type	Scientific Name	Common Name	Height	Spread	Elevation	Water req.
F	Psilotum nudum	moa, moa kula	1'	1'	sea to 3,000'	Dry to Wet
F	Sadleria cyatheoides	'ama'u, ama'uma'u				
G	Colubrina asiatica	'anapanapa	3'	10'	sea to 1,000'	Dry to Wet
G	Eragrostis monticola	kalamalo	1'	2'	sea to 3,000'	Dry to Medium
G	Eragrostis variabilis	'emo-loa	1'	2'	sea to 3,000'	Dry to Medium
G	Fimbristylis cymosa ssp. spathacea	mau'u'aki'aki fimbristylis	0.5'	1'	sea to 1,000'	Dry to Medium
Gr	Chamaesyce celastroides var. laehiensis	'akoko	2'	3'	sea to 1,000'	Dry to Medium
Gr	Ipomoea tuboides	Hawaiian moon flower, 'uala	1'	10'	sea to 3,000'	Dry to Medium
Gr	Jacquemontia ovalifolia ssp. sandwicensis	pa'u o hi'iaka	0.5'	6'	sea to 1,000'	Dry to Medium
Gr	Lipochaeta integrifolia	nehe	1'	5'	sea to 1,00'	Dry to Medium
Gr	Peperomia leptostachya	'ala'ala-wai-nui	1'	1'	sea to 3,000'	Dry to Medium
Gr	Plumbago zeylanica	'ilie'e	1'			
Gr	Sida fallax	'ilima	0.5'	3'	sea to 1,000'	Dry to Medium
Gr	Tephrosia purpurea var. purpurea	'auhuhu	2'	2'	sea to 1,000'	Dry to Medium
Gr - Sh	Hibiscus calyphyllus	ma'o hau hele, Rock's hibiscus	3'	2'	sea to 3,000'	Dry to Medium
Gr - Sh	Lipochaeta rockii	nehe	2'	2'	sea to 3,000'	Dry to Medium
Gr - Sh	Lipochaeta succulenta	nehe	2'	5'	sea to 1,000'	Dry to Wet
P	Cocos nucifera	coconut, niu	100'	30'	sea to 1,000'	Dry to Wet
P	Pritchardia arecina	lo'ulu, hawane	40'	10'	1,000' to 3,000'	Dry to Wet
P	Pritchardia forbesiana	lo'ulu	15'			
P	Pritchardia hillebrandii	lo'ulu, fan palm	25'	15'	sea to 1,000'	Dry to Wet
S	Mariscus javanicus	marsh cypress, 'ahu'awa	0.5'	0.5'	sea to 1,000'	Dry to Medium
Sh	Argemone glauca var. decipiens	pua kala	3'	2'	sea to 3,000'	Dry to Medium
Sh	Artemisia australis	'ahinahina	2'	3'	sea to 3,000'	Dry to Medium

Zone-specific Native and Polynesian plants for Maui County

Zone 4

Type	Scientific Name	Common Name	Height	Spread	Elevation	Water req.
Sh	Artemisia mauiensis var. diffusa	Maui wormwood, 'ahinahina	2'	3'	1,000' to higher	Dry to Medium
Sh	Bidens hillebrandiana ssp. hillebrandiana	ko'oko'olau	1'	2'	sea to 1,000'	Dry to Wet
Sh	Bidens menziesii ssp. menziesii	ko'oko'olau	1'	3'		
Sh	Bidens micrantha ssp. micrantha	ko'oko'olau	1'	3'		
Sh	Cordyline fruticosa	ti, ki	6			
Sh	Dianella sandwicensis	'uki	2'	2'	1,000' to higher	Dry to Medium
Sh	Lipochaeta lavarum	nehe	3'	3'	sea to 3,000'	Dry to Medium
Sh	Osteomeles anthyllidifolia	'ulei, eluehe	4'	6'	sea to 3,000'	Dry to Medium
Sh	Scaevola sericea	naupaka, naupaka-kahakai	6'	8'	sea to 1,000'	Dry to Medium
Sh	Solanum nelsonii	'akia, beach solanum	3'	3'	sea to 1,00'	Dry to Medium
Sh	Styphelia tameiameiae	pukiawe	6'	6'	1,000' to higher	Dry to Medium
Sh	Vitex rotundifolia	pohinahina	3'	4'	sea to 1,000'	Dry to Medium
Sh	Wikstroemia uva-ursi kauaiensis kauaiensis	'akia, Molokai osmanthus				
Sh - Tr	Broussonetia papyrifera	wauke, paper mulberry	8'	6'	sea to 1,000'	Dry to Medium
Sh - Tr	Myoporum sandwicense	naio, false sandalwood	10'	10'	sea to higher	Dry to Medium
Sh - Tr	Nototrichium sandwicense	kulu'i	8'	8'	sea to 3,000'	Dry to Medium
Sh-Tr	Dodonaea viscosa	'a'ali'i	6'	8'	sea to higher	Dry to Medium
Tr	Acacia koa	koa	50' - 100'	40' - 80'	1,500' to 4,000'	Dry to Medium
Tr	Aleurites moluccana	candlenut, kukui	50'	50'	sea to 3,000'	Medium to Wet
Tr	Calophyllum inophyllum	kamani, alexandrian laurel	60'	40'	sea to 3,000'	Medium to Wet
Tr	Canthium odoratum	Alahe'e, 'ohe'e, walahe'e	12'	8'	sea to 3,000'	Dry to Medium
Tr	Charpentiera obovata		15'			
Tr	Cordia subcordata	kou	30'	25'	sea to 1,000'	Dry to Wet
Tr	Diospyros sandwicensis	lama	12'	15'	sea to 3,000'	Dry to Medium
Tr	Hibiscus furcellatus	'akiohala, hau-hele	8'			
Tr	Metrosideros polymorpha var. macrophylla	ohi'a lehua	25'	25'	sea to 1,000'	Dry to Wet
Tr	Morinda citrifolia	indian mulberry, noni	20'	15'	sea to 1,000'	Dry to Wet

Zone-specific Native and Polynesian plants for Maui County

Zone 4

Type	Scientific Name	Common Name	Height	Spread	Elevation	Water req.
Tr	Nestegis sandwicensis	olopua	15'	15'	1,000' to 3,000'	Dry to Medium
Tr	Pandanus tectorius	hala, puhala (HALELIST)	35'	25'	sea to 1,000'	Dry to Wet
Tr	Pleomele auwahiensis	halapepe	20'			
Tr	Rauvolfia sandwicensis	hao	20'	15'	sea to 3,000'	Dry to Medium
Tr	Santalum ellipticum	coastal sandalwood, 'ili-ahi	8'	8'	sea to 3,000'	Dry to Medium
Tr	Sophora chrysophylla	mamane	15'	15'	1,000' to 3,000'	Medium
Tr	Thespesia populnea	milo	30'	30'	sea to 3,000'	Dry to Wet
V	Alyxia oliviformis	maile	Vine		sea to 6,000'	Medium to Wet

Zone-specific Native and Polynesian plants for Maui County

Zone 5

TYPE: **F** Fern **G** Grass **Gr** Ground Cover **Sh** Shrub **P** Palm **S** Sedge **Tr** Tree **V** Vine

Type	Scientific Name	Common Name	Height	Spread	Elevation	Water req.
G	Colubrina asiatica	'anapanapa	3'	10'	sea to 1,000'	Dry to Wet
G	Eragrostis variabilis	'emo-loa	1'	2'	sea to 3,000'	Dry to Medium
G	Fimbristylis cymosa ssp. spathacea	mau'u'aki'aki fimbristylis	0.5'	1'	sea to 1,000'	Dry to Medium
Gr	Boerhavia repens	alena	0.5'	4'	sea to 1,000'	Dry to Medium
Gr	Chamaesyce celastroides var. laehiensis	'akoko	2'	3'	sea to 1,000'	Dry to Medium
Gr	Cressa truxillensis	cressa	0.5'	1'	sea to 1,000'	Dry to Medium
Gr	Heliotropium anomalum var. argenteum	hinahina ku kahakai	1'	2'	sea to 1,000'	Dry to Medium
Gr	Jacquemontia ovalifolia ssp. sandwicensis	pa'u o hi'iaka	0.5'	6'	sea to 1,000'	Dry to Medium
Gr	Lipochaeta integrifolia	nehe	1'	5'	sea to 1,00'	Dry to Medium
Gr	Sesuvium portulacastrum	'akulikuli, sea-purslane	0.5'	2'	sea to 1,000'	Dry to Wet
Gr	Sida fallax	'ilima	0.5'	3'	sea to 1,000'	Dry to Medium
Gr	Tephrosia purpurea var. purpurea	'auhuhu	2'	2'	sea to 1,000'	Dry to Medium
Gr - Sh	Hibiscus calyphyllus	ma'o hau hele, Rock's hibiscus	3'	2'	sea to 3,000'	Dry to Medium
Gr - Sh	Lycium sandwicense	'ohelo-kai, 'ae'ae	2'	2'	sea to 1,000'	Dry to Medium
P	Cocos nucifera	coconut, niu	100'	30'	sea to 1,000'	Dry to Wet
P	Pritchardia hillebrandii	lo'ulu, fan palm	25'	15'	sea to 1,000'	Dry to Wet
S	Mariscus javanicus	marsh cypress, 'ahu'awa	0.5'	0.5'	sea to 1,000'	Dry to Medium
Sh	Argemone glauca var. decipiens	pua kala	3'	2'	sea to 3,000'	Dry to Medium
Sh	Artemisia australis	'ahinahina	2'	3'	sea to 3,000'	Dry to Medium
Sh	Bidens hillebrandiana ssp. hillebrandiana	ko'oko'olau	1'	2'	sea to 1,000'	Dry to Wet
Sh	Bidens mauiensis	ko'oko'olau	1'	3'	sea to 1,000'	Dry to Medium
Sh	Chenopodium oahuense	'aheahea, 'aweoweo	6'		sea to higher	Dry to Medium
Sh	Dianella sandwicensis	'uki	2'	2'	1,000' to higher	Dry to Medium
Sh	Gossypium tomentosum	mao, Hawaiian cotton	5'	8'	sea to 1,000'	Dry to Medium

Zone-specific Native and Polynesian plants for Maui County

Zone 5

Type	Scientific Name	Common Name	Height	Spread	Elevation	Water req.
Sh	Hedyotis spp.	au, pilo	3'	2'	1,000' to 3,000'	Dry to Wet
Sh	Lipochaeta lavarum	nehe	3'	3'	sea to 3,000'	Dry to Medium
Sh	Osteomeles anthyllidifolia	'ulei, eluehe	4'	6'	sea to 3,000'	Dry to Medium
Sh	Scaevola sericea	naupaka, naupaka-kahakai	6'	8'	sea to 1,000'	Dry to Medium
Sh	Senna gaudichaudii	kolomana	5'	5'	sea to 3,000'	Dry to Medium
Sh	Solanum nelsonii	'akia, beach solanum	3'	3'	sea to 1,00'	Dry to Medium
Sh	Vitex rotundifolia	pohinahina	3'	4'	sea to 1,000'	Dry to Medium
Sh	Wikstroemia uva-ursi kauaiensis kauaiensis	'akia, Molokai osmanthus				
Sh - Tr	Myoporum sandwicense	naio, false sandalwood	10'	10'	sea to higher	Dry to Medium
Sh-Tr	Dodonaea viscosa	'a'ali'i	6'	8'	sea to higher	Dry to Medium
Tr	Aleurites moluccana	candlenut, kukui	50'	50'	sea to 3,000'	Medium to Wet
Tr	Calophyllum inophyllum	kamani, alexandrian laurel	60'	40'	sea to 3,000'	Medium to Wet
Tr	Cordia subcordata	kou	30'	25'	sea to 1,000'	Dry to Wet
Tr	Hibiscus furcellatus	'akiohala, hau-hele	8'			
Tr	Morinda citrifolia	indian mulberry, noni	20'	15'	sea to 1,000'	Dry to Wet
Tr	Pandanus tectorius	hala, puhala (HALELIST)	35'	25'	sea to 1,000'	Dry to Wet
Tr	Thespesia populnea	milo	30'	30'	sea to 3,000'	Dry to Wet
V	Ipomoea pes-caprae	beach morning glory, pohuehue	1'			

DO NOT PLANT THESE PLANTS !!!

Common name	Scientific name	Plant family
black wattle	Acacia mearnsii	Mimosaceae
blackberry	Rubus argutus	Rosaceae
blue gum	Eucalyptus globulus	Myrtaceae
bocconia	Bocconia frutescens	Papaveraceae
broad-leaved cordia	Cordia glabra	Boraginaceae
broomsedge, yellow bluestem	Andropogon virginicus	Poaceae
buffelgrass	Cenchrus ciliaris	Poaceae
butterfly bush, smoke bush	Buddleja madagascariensis	Buddlejaceae
cats claw, Mysore thorn, wait-a-bit	Caesalpinia decapetala	Caesalpiniaceae
common ironwood	Casuarina equisetifolia	Casuarinaceae
common velvet grass, Yorkshire fog	Holcus lanatus	Poaceae
fiddlewood	Citharexylum spinosum	Verbenaceae
fire tree, faya tree	Myrica faya	Myricaceae
glorybower	Clerodendrum laponicum	Verbenaceae
hairy cat's ear, gosmore	Hypochoeris radicata	Asteraceae
haole koa	Leucaena leucocephala	Fabaceae
ivy gourd, scarlet-fruited gourd	Coccinia grandis	Cucurbitaceae
juniper berry	Citharexylum caudatum	Verbenaceae
kahili flower	Grevillea banksii	Proteaceae
klu, popinac	Acacia farnesiana	Mimosaceae
logwood, bloodwood tree	Haematoxylon campechianum	Caesalpiniaceae
loquat	Eriobotrya japonica	Rosaceae
meadow ricegrass	Ehrharta stipoides	Poaceae
melaleuca	Melaleuca quinquenervia	Myrtaceae
miconia, velvet leaf	Miconia calvescens	Melastomataceae
narrow-leaved carpetgrass	Axonopus fissifolius	Poaceae
oleaster	Elaeagnus umbellata	Elaeagnaceae
oriental mangrove	Bruguiera gymnorrhiza	Rhizophoraceae
padang cassia	Cinnamomum burmanii	Lauraceae
palmgrass	Setaria palmifolia	Poaceae
pearl flower	Heterocentron subtriplinervium	Melastomataceae
quinine tree	Cinchona pubesens	Rubiaceae
satin leaf, caimitillo	Chrysophyllum oliviforme	Sapotaceae
silkwood, Queensland maple	Flindersia brayleyana	Rutaceae
silky oak, silver oak	Grevillea robusta	Proteaceae
strawberry guava	Psidium cattleianum	Myrtaceae
swamp oak, saltmarsh, longleaf ironwood	Casuarina glauca	Casuarinaceae
sweet vernalgrass	Anthoxanthum odoratum	Poaceae
tree of heaven	Ailanthus altissima	Simaroubaceae
trumpet tree, guarumo	Cecropia obtusifolia	Cecropiaceae
white ginger	Hedychium coronarium	Zingiberaceae
white moho	Heliocarpus popayanensis	Tiliaceae
yellow ginger	Hedychium flavescens	Zingiberaceae

DO NOT PLANT THESE PLANTS !!!

Common name	Scientific name	Plant family
	Jasminum fluminense	Oleaceae
	Arthrostema ciliatum	Melastomataceae
	Dissotis rotundifolia	Melastomataceae
	Erigeron karvinskianus	Asteraceae
	Eucalyptus robusta	Myrtaceae
	Hedychium gardnerianum	Zingiberaceae
	Juncus planifolius	Juncaceae
	Lophostemon confertus	Myrtaceae
	Medinilla cumingii	Melastomataceae
	Medinilla magnifica	Melastomataceae
	Medinilla venosa	Melastomataceae
	Melastoma candidum	Melastomataceae
	Melinis minutiflora	Poaceae
	Olea europaea	
	Oxyspora paniculata	Melastomataceae
	Panicum maximum	Poaceae
	Paspalum urvillei	Poaceae
	Passiflora edulis	Passifloraceae
	Phormium tenax	Agavaceae
	Pinus taeda	Pinaceae
	Prosopis pallida	Fabaceae
	Pterolepis glomerata	Melastomataceae
	Rhodomyrtus tomentosa	Myrtaceae
	Schefflera actinophylla	Araliaceae
	Syzygium jambos	Myrtaceae
Australian blackwood	Acacia melanoxylon	Mimosaceae
Australian tree fern	Cyathea cooperi	Cyatheaceae
Australian tree fern	Sphaeropteris cooperi	Cyatheaceae
Beggar's tick, Spanish needle	Bidens pilosa	Asteraceae
California grass	Brachiaria mutica	Poaceae
Chinese banyon, Maylayan banyon	Ficus mirocarpa	Moraceae
Chinese violet	Asystasia gangetica	Acanthaceae
Christmasberry, Brazilian pepper	Schinus terebinthifolius	Anacardiaceae
Formosan koa	Acacia confusa	Mimosaceae
German ivy	Senecio mikanioides	Asteraceae
Japanese honeysuckle	Lonicera japonica	Caprifoliaceae
Koster's curse	Clidemia hirta	Melastomataceae
Lantana	Lantana camara	Verbenaceae
Mauritius hemp	Furcraea foetida	Agavaceae
Mexican ash, tropical ash	Fraxinus uhdei	Oleaceae
Mexican tulip poppy	Hunnemannia fumariifolia	Papaveraceae
Mules foot, Madagascar tree fern	Angiopteris evecta	Marattiaceae
New Zealand laurel, karakaranut	Corynocarpus laevigatus	Corynocarpaceae
New Zealand tea	Leptospermum scoparium	Myrtaceae
Pampas grass	Cortaderia jubata	Poaceae
Panama rubber tree, Mexican rubber tree	Castilloa elastica	Moraceae
Shoebutton ardisia	Ardisia elliptica	Myrsinaceae
banana poka	Passiflora mollissima	Passifloraceae

Selection

As a general rule, it is best to select the largest and healthiest specimens. However, be sure to note that they are not pot-bound. Smaller, younger plants may result in a low rate of plant survival.[1] When selecting native species, consider the site they are to be planted in, and the space that you have to plant. For example: Mountain species such as koa and maile will not grow well in hot coastal areas exposed to strong ocean breezes. Lowland and coastal species such as wiliwili and Kou require abundant sunshine and porus soil. They will not grow well with frequent cloud cover, high rainfall and heavy soil.

Consider too, the size that the species will grow to be. It is not wise to plant trees that will grow too large.[2] Overplanting tends to be a big problem in the landscape due to the underestimation of a species' height, width or spread.

A large, dense canopied tree such as the kukui is a good shade tree for a lawn. However, it's canopy size and density of shade will limit what can be planted in the surrounding area. Shade cast by a koa and ohia lehua is relatively light and will not inhibit growth beneath it.

Keep seasons in mind when you are selecting your plants. Not all plants look good year round, some plants such as ilima will look scraggly after they have flowered and formed seeds. Avoid planting large areas with only one native plant. Mixing plants which naturally grow together will ensure the garden will look good all year round.[3] Looking at natural habitats helps to show how plants grow naturally in the landscape.

When planting an area with a mixed-ecosystem, keep in mind the size and ecological requirements of each plant. Start with the hardiest and most easily grown species, but allow space for fragile ones in subsequent plantings.

Acquiring natives

Plants in their wild habitat must be protected and maintained. It is best and easiest to get your plants from nurseries (see list), or friend's gardens. Obtain proper permits from landowners and make sure you follow a few common sense rules:

- collect sparingly from each plant or area.
- some plants are on the state or Federal Endangered Species list. Make sure you get permits (see app. A,B)

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[1] K. Nagata, P.6

[2] K. Nagata, P.9

[3] Nagata, P.9

Soil

Once you have selected your site and the plants you wish to establish there, you must look at the soil conditions on the site. Proper soil is necessary for the successful growth of most native plants, which preform poorly in hard pan, clay or adobe soils. If natives are to be planted in these types of soil, it would be wise to dig planting holes several times the size of the rootball and backfill with 50-75% compost.[4] A large planting hole ensures the development of a strong root system. The plant will have a headstart before the roots penetrate the surrounding poor soil.[5]

It is recommended that native plants not be planted in ground that is more dense than potting soil. If there is no alternative, dig a hole in a mound of soil mixed with volcanic cinder which encourages maximum root development. Fill the hole with water, if the water tends to puddle or drain too slowly, dig a deeper hole until the water does not puddle longer than 1 or 2 minutes.[6] Well-drained soil is one of the most important things when planting natives as you will see in the next section.

Irrigation

Most natives do very poorly in waterlogged conditions. Do not water if the soil is damp. Water when the soil is dry and the plants are wilting. Once established, a good soaking twice a week should suffice. Deep soaking encourages the development of stronger, and deeper root systems. This is better than frequent and shallow watering which encourage weaker, more shallow root systems.

The following is a watering schedule from Kenneth Nagata's Booklet, *How To Plant A Native Hawaiian Garden*:

WATER REQUIREMENT	WATERING FREQUENCY
Heavy	3x / week
Moderate	2x / week
Light	1x / week

Red clay soils hold more water for a longer period of time than sandy soils do. If your area is very sunny or near a beach, things will dry out faster. Even in the area of one garden, there are parts that will need more or less water. Soils can vary and amount of shade and wind differ. After plants are established (a month or two for most plants, up to a year for some trees), you can back off watering.

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[4] Nagata, p. 6

[5] Nagata, p. 8

[6] Nagata, p. 8

Automatic sprinkler systems are expensive to install and must be checked and adjusted regularly. Above-ground systems allow you to monitor how much water is being put out, but you lose a lot due to malfunctioning of sprinkler heads and wind. The most efficient way to save water and make sure your plants get enough water, is to hand-water. This way you are getting our precious water to the right places in the right amounts.[7]

Fertilizer

An all-purpose fertilizer 10-10-10 is adequate for most species. They should be applied at planting time, 3 months later, and 6 months thereafter. Use half the dosage recommended for ornamentals and pay special attention to native ferns which are sensitive to strong fertilizers. Use of organic composts and aged animal manures is suggested instead of chemical fertilizers. In addition, use of cinders for providing trace minerals is strongly recommended.[8]

Natives are plants which were here hundreds of years before the polynesians inhabited the Hawaiian Islands. They were brought here by birds, or survived the harsh ocean conditions to float here. They are well-adapted to Hawaii's varying soil and environmental conditions. This is why they make prime specimens for a xeriscape garden. However, natives will not thrive on their own, especially under harsh conditions. On the other hand, like any other plant, if you over-water and over-fertilize them, they will die. Follow the instructions given to you by the nursery you buy the plant from, or from this booklet. Better yet, buy a book (suggested readings can be found in the bibliography in the back of this pamphlet), read it, and learn more about native plants. I guarantee that you will be pleased with the results.

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[7] Bornhorst, p. 19-20

[8] Nagata, p. 6

Propagation

There are many ways to propagate and plant-out native Hawaiian species. One of the most thourough and helpful book is Heidi Bornhorst's book, *Growing Native Hawaiian Plants.* The easiest, and best way to obtain natives for the novice gardener is to get them from a reputable nursery (see appendix c). That way all you will have to do is know how to transplant (if necessary) and plant-out when you are ready. These are the two methods I have listed here.

Transplanting

1. Use pots that are one size bigger than the potted plant is in
2. Get your potting medium ready

Good potting medium is a ½, ½ mixture of peat moss and perlite. If the plant is from a dry or coastal area, add chunks of cinder or extra perlite. If it is a wet forest species, add more peat moss or compost. Be aware that peat moss is very acidic and certain plants react severely to acidity.

If the plant is to eventually be planted into the ground, make a mix of equal parts peat moss, perlite, and soil from the area in which the plant is to be planted. Slow-release fertilizer can be mixed into the potting medium.

3. Once pots, potting medium, fertilizer and water are ready, you can begin re-potting. Keep the plant stem at the same depth it was in the original pot. Avoid putting the plant in too large a pot, as the plant may not be able to soak up all the water in the soil and the roots may drown and rot.

Mix potting medium and add slow-release fertilizer at this time. Pre-wet the medium to keep dust down and lessen shock to the plant. Put medium in bottom of pot. Measure for the correct depth in the new pot. Make sure there is from ½ to 2 inches from the top of the pot so the plant can get adequate water. Try to stand the plant upright and center the stem in the middle of the pot.

Water the plant thoroughly after transplanting. A vitamin B-1 transplanting solution can help to lessen the transplant shock. Keep the plant in the same type of environment as it was before, sun or shade. If roots were broken, trimm off some of the leaves to compensate for the loss.[9]

Planting out

1. Plant most native Hawaiian plants in a sunny location in soil that is well-drained.
2. Make the planting hole twice as wide as the root ball or present pot, and just as deep. If the soil is clay-like, and drains slowly, mix in some coarse red or bland cinder, coarse perlite or

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[9] Bornhorst, p.20-21

coarse compost. Place some slow-release fertilizer at the bottom of the hole.

3. Carefully remove the plant from the container and place it in the hole. The top of the soil should be at the same level as the top of the hole, if it is too high or too low, adjust the soil level so that the plant is at the right depth.

4. Water thoroughly after you transplant.

Mulch

Most natives cannot compete with weeds, and therefore must be weeded around constantly in order to thrive. Mulch is a practical alternative, which discourages and prevents weeds from growing.

Hawaii's hot, humid climate leads to the breaking down of organic mulches. Thick organic mulches such as wood chips and leaves, may also be hiding places for pests.

Stone mulches are attractive, permanent and can help to improve soil quality. Red or black cinder, blue rock chips, smooth river rocks and coral chips are some natural choices.[10] Macadamia nut hulls are also easy to find and can make a nice mulch.[11]

Never pile up mulch right next to the stem or trunk of a plant, keep it a few inches away.

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[10] Bornhorst, p. 24

[11] Nagata, p. 7

ZONES

The Maui County Planting Plan has compiled a system of 5 zones of plant growth for Maui County. The descriptions of zones and maps for these zones are as follows:

Zone 1:

Wet areas on the windward side of the island. More than 40 inches of rain per year. Higher than 3,000 feet.

Zone 2:

Cool, dry areas in higher elevations (above 1,000 feet). 20 to 40 inches of rain per year.

Zone 3:

Low, drier areas, warm to hot. Less than 20 inches of rain per year. Sea level to 1,000 feet.

Zone 4:

Lower elevations which are wetter due to proximity of mountains. 1,000 to 3,000 feet.

Zone 5:

Salt spray zones in coastal areas on the windward side.

These zones are to be used as a general guide to planting for Maui County. In addition to looking at the maps, read the descriptions of the zones and decide which zone best fits your area. Plants can be listed in more than one zone and can be planted in a variety of conditions. For best results, take notes on the rainfall, wind, sun and salt conditions of your site. Use the zones as a general guide for selection and read about the plants to decide which best fits your needs as far as care and or function.

PLACES TO SEE NATIVES ON MAUI:

The following places propagate native Hawaiian plants from seeds and/or cuttings. Their purpose is to protect and preserve these native plants. Please contact them before going to view the sites, they can provide valuable information and referral to other sources.

1. Hoolawa Farms — 575-5099
   P O Box 731
   Haiku HI 96708

2. The Hawaiian Collection — 878-1701
   1127 Manu Street
   Kula HI 96790

3. Kula Botanical Gardens — 878-1715
   RR4, Box 228
   Kula HI 96790

4. Maui Botanical Gardens — 249-2798
   Kanaloa Avenue, Kahului
   across from stadium

5. Kula Forest Reserve
   access road at the end of Waipoli Rd
   Call the Maui District Office — 984-8100

6. Wailea Point, Private Condominium residence — 875-9557
   4000 Wailea Alanui, Kihei
   public access points at Four Seasons Resort or
   Polo Beach

7. Kahanu Gardens, National Tropical Botanical Garden — 248-8912
   Alau Place, Hana HI 96713

8. Kahului Library Courtyard — 873-3097
   20 School Street
   Kahului HI 96732

PLACES TO BUY NATIVE PLANTS ON MAUI

1. Ho'olawa Farms
   Anna Palomino
   P O Box 731
   Haiku HI 96708
   575-5099

   * The largest and best collection of natives in the state. They will deliver, but worth the drive to go and see! Will propagate upon request

2. Kahanu Gardens
   National Tropical Botanical Garden
   Alau Place, Hana
   248-8912

3. Kihana Nursery
   1708 South Kihei Road
   Kihei HI 96753
   879-1165

4. Kihei Garden and Landscape
   Waiko Road, Wailuku
   P O Box 1058
   Puunene HI 96784
   244-3804

5. Kula Ace Hardware and Nursery
   3600 Lower Kula Road
   Kula HI 96790
   876-0734
   * many natives in stock
   * get most of their plants from Ho'olawa Farms
   * they take special requests

6. Kulamanu Farms - Ann Carter
   Kula HI 96790
   878-1801

7. Maui Nui Botanical Gardens
   Kanaloa Avenue
   (Across from stadium)
   Kahului HI 96732
   249-2798

8. Native Gardenscapes
   Robin McMillan
   1330 Lower Kimo Drive
   Kula HI 96790
   870-1421

   * grows native plants and installs landscapes including irrigation.

9. Native Hawaiian Tree Source
   1630 Piiholo Road
   Makawao HI 96768
   572-6180

10. Native Nursery, LLC
    Jonathan Keyser
    250-3341

11. New Moon Enterprises - Pat Bily
    47 Kahoea Place
    Kula HI 96790
    878-2441

12. Waiakoa Tree Farm - Kua Rogoff
    Pukalani HI 96768
    Cell - 264-4166

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200 S. High Street
Wailuku, Hawaii 96793-2155

SUBJECT: Response to Environmental Impact Statement Preparation Notice (EISPN) Comment Letter Regarding Proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension at TMK (2) 3-8-001, Kahului, Maui, Hawaii (HRD11/0063E)

Dear Mr. Taylor:

Thank you for your letter of March 8, 2011, responding to our request for comments on the Environmental Impact Statement Preparation Notice (EISPN) on the proposed Wailuku-Kahului Wastewater Reclamation Facility (WK WWRF) Shoreline Protection Extension project. We offer the following information, which addresses your comments in the order listed in your letter.

Infrastructure:

1. The information provided on the existing water system along Amala Street will be included in the Draft EIS. We also acknowledge that, if required, the construction plans for the project will be submitted to the Department of Water Supply's (DWS) Engineering Division for review.

Conservation:

2. **Dust Control**: The Department of Environmental Management (DEM) will use reclaimed water from the WK WWRF for dust control during construction.

3. **Use climate-adapted native plants, if applicable**: Landscaping is limited to planting of grass to stabilize the soil once construction has been completed. As recommended, the DEM will consider a native grass species such as ‘aki ‘aki.

4. **Prevent Over Watering**: The WK WWRF is irrigated with reclaimed water from the facility which conserves the County's potable water resources.

Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes review process. A copy of your letter will be included in the Draft Environmental Impact Statement. In the meantime, if there are any questions or if additional information is needed, please feel free to contact me at 244-2015.

Very truly yours,

Colleen Suyama
Senior Associate

CS:yp
cc: Kyle Ginoza, Director, Department of Environmental Management
Russ Boudreau, Moffat Nichol
K:\DATA\MoffatlNichol\WK WWRF\EISPN Response\DWS EISPNres.doc

FEB 03 2011

COUNTY COUNCIL
COUNTY OF MAUI
200 S. HIGH STREET
WAILUKU, MAUI, HAWAII 96793
www.mauicounty.gov/council

February 1, 2011

Department of Environmental Management
Attn: Kyle Ginoza, Director
2200 Main Street, Suite 100
Wailuku, HI 96793

Munekiyo and Hiraga, Inc.
Attn: Colleen Suyama, Senior Associate
305 High Street, Suite 104
Wailuku, HI 96793

Dear Mr. Ginoza and Ms.Suyama:

SUBJECT: Environmental Impact Statement Preparation Notice For Proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension At TMK (2)3-8-001:188, Kahului, Maui,Hawaii

Thank you for the opportunity to provide review and comments for the proposed action.

After review of the information presented, I have no comments at the present time.

Sincerely,

JOSEPH PONTANILLA,
COUNCIL MEMBER

86

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

April 6, 2011

Joseph Pontanilla, Council Vice Chair
Maui County Council
County of Maui
200 South High Street
Wailuku, Hawaii 96793

SUBJECT: Response to Environmental Impact Statement Preparation Notice (EISPN) Comment Letter Regarding Proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension at TMK (2) 3-8-001, Kahului, Maui, Hawaii

Dear Council Vice Chair Pontanilla:

Thank you for your letter of February 1, 2011, responding to our request for comments on the Environmental Impact Statement Preparation Notice (EISPN) on the proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension project. We appreciate your review of the document and conveying you have no comment at this time.

Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes review process. A copy of your letter will be included in the Draft Environmental Impact Statement. In the meantime, if there are any questions or if additional information is needed, please feel free to contact me at 244-2015.

Very truly yours,

Colleen Suyama
Senior Associate

CS:yp
cc: Kyle Ginoza, Director, Department of Environmental Management
Russ Boudreau, Moffat Nichol

K:\DATA\MoffattNichol\WK WWRF\EISPN Response\Pontanilla EISPNres.doc

JAN 27 2011

Maui Electric Company, Ltd. • 210 West Kamehameha Avenue • PO Box 398 • Kahului, Maui, HI 96733-6898 • (808) 871-8461

January 26, 2011

Ms. Colleen Suyama, Senior Associate
Munekiyo & Hiraga, Inc.
305 South High Street, Suite 104
Wailuku, Maui, Hawaii, 96793

Subject: Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension – Environmental Impact Statement Preparation Notice
Kahului, Maui, Hawaii
Tax Map Key: (2) 3-8-001:188

Dear Ms. Suyama,

Thank you for allowing us to comment on the Environmental Impact Statement Preparation Notice for the subject project.

In reviewing our records and the information received, Maui Electric Company has no objection to the subject project at this time.

Should you have any questions or concerns, please call me at 871-2341.

Sincerely,

Kyle Tamori
Staff Engineer

c: Department of Environmental Management – Mr. Kyle Ginoza

MUNEKIYO & HIRAGA, INC.

Michael T. Munekiyo
Gwen Ohashi Hiraga
Mitsuru "Mich" Hirano
Karlynn Fukuda

Mark Alexander Roy

April 6, 2011

Kyle Tamori, Staff Engineer
Maui Electric Company, Ltd.
P. O. Box 398
Kahului, Hawaii 96733-6898

SUBJECT: Response to Environmental Impact Statement Preparation Notice (EISPN) Comment Letter Regarding Proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension at TMK (2) 3-8-001, Kahului, Maui, Hawaii

Dear Mr. Tamori:

Thank you for your letter of January 26, 2011, responding to our request for comments on the Environmental Impact Statement Preparation Notice (EISPN) on the proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension project. We appreciate your review of the document and your confirmation that Maui Electric Company, Ltd. has no objections to the project.

Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes review process. A copy of your letter will be included in the Draft Environmental Impact Statement. In the meantime, if there are any questions or if additional information is needed, please feel free to contact me at 244-2015.

Very truly yours,

Colleen Suyama
Senior Associate

CS:yp
cc: Kyle Ginoza, Director, Department of Environmental Management
Russ Boudreau, Moffat Nichol

K:\DATA\MoffattNichol\WK WWRF\EISPN Response\MECO EISPNres.doc

JAN 31 2011

Hawaiian Telcom

January 27, 2011

County of Maui
Department of Environmental Management
One Main Plaza
2200 Main Street, Suite 100
Wailuku, HI 96793

Attention: Kyle Ginoza, Director

Subject: EISPN for the Proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension Project

Dear Sir,

Thank you for allowing us to review and comment on the subject project. Your plans have been received and put on file.

Hawaiian Telcom, Inc. has no comment, nor do we require any additional information at this time.

Should you require further assistance, please call me at 242-5107.

Sincerely,

Tom Hutchison
OSP Engineer

cc: Colleen Suyama, Munekiyo & Hiraga
Lynette Yoshida, Network Engineering Senior Manager

BICS File # 0803-026 (3030)

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

April 6, 2011

Tom Hutchison, OSP Engineer
Hawaiian Telcom
P. O. Box 2200
Honolulu, Hawaii 96841

SUBJECT: Response to Environmental Impact Statement Preparation Notice (EISPN) Comment Letter Regarding Proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension at TMK (2) 3-8-001, Kahului, Maui, Hawaii

Dear Ms. Hutchison:

Thank you for your letter of January 27, 2011, responding to our request for comments on the Environmental Impact Statement Preparation Notice (EISPN) on the proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension project. We appreciate your review of the document and conveying Hawaiian Telcom has no comment at this time.

Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes review process. A copy of your letter will be included in the Draft Environmental Impact Statement. In the meantime, if there are any questions or if additional information is needed, please feel free to contact me at (808) 244-2015.

Very truly yours,

Colleen Suyama
Senior Associate

CS:yp
cc: Kyle Ginoza, Director, Department of Environmental Management
Russ Boudreau, Moffat Nichol
K:\DATA\MoffattNichol\WK WWRF\EISPN Response\HawaiianTelcom EISPNres.doc

FEB 28 2011

MAUI TOMORROW

Protecting Maui's Future

Feb. 25, 2011

Munekiyo & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawaii 96793
Email: planning@mhplanning.com

RE: Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension (EA/EISPN)

Aloha, I am writing today to offer comments from Maui Tomorrow Foundation on the EA/EISPN for the planned shoreline extension of the Wailuku-Kahului Wastewater Reclamation Facility.

Maui Tomorrow has many concerns regarding the Wailuku-Kahului Wastewater Reclamation Facility. By placing an extension of the revetment at the plant the life of the facility will be extended. With the growing population in Central Maui an extension of the facility's life expands the amount of effluent going through the plant's eight injection wells. Maui Tomorrow feels it is imperative that water recycling by way of an R1 waterline be developed congruent with this action in order to lessen the amount of wastewater entering into Kahului Bay. The cost of this accompanying action, especially if using the two existing 14" lines at the old Maui Land & Pine facility in Kahului, would still make this option more economically viable than the cost of moving the entire plant to a new inland location.

Further comments for consideration:

Page 25 Potential Impacts and Mitigation Measures
If sand is lost the EISPN states that it could be replaced with other sand, most likely dredged from a 200 acre site off of Kahului Harbor. In the preliminary Engineering Report (pg. 47) it states that *"Additionally, beach replenishment at another site could be considered as mitigation for any potential environmental effects associated with Alternative 3A, the revetment extension."* At the public scoping meeting it was mentioned that a more "popular" beach might be the site for such replenishment. Please state clearly in the DEIS the process to be followed in order to determine how a more "popular" beach would be chosen.

Page 31 Flora and Fauna, A. Existing Conditions
The document states that *"no known rare, threatened, or endangered species"* are found in the area surrounding the Wailuku-Kahului WWRF yet endangered green sea turtles live year round in the waters surrounding this area and frequently come onshore. Other

turtle species occasionally seen in nearby waters include the highly endangered hawksbill turtle. Please address in the DEIS how these species will be effected by the proposed action.

Page 45, Public Services, 1. Recreational Facilities, a. Existing Conditions.
"in the vicinity of the project site, a wide range of shoreline and ocean recreation activities such as boating, fishing, diving, surfing, canoeing, kayaking, picnicking, kitesurfing, and windsurfing are available at the Kahului Harbor and nearby beach parks." Please expand in the DEIS on current water quality findings that may affect the health of ocean recreation users in the area as these findings will also reflect ocean users' future health issues as this action will extend the life of plant and Central Maui's growing population will increase the amount of effluent going through the plant's injection wells.

Mahalo for considering these comments and please add Maui Tomorrow Foundation, Inc. as a consulted party,

Irene Bowie

Irene Bowie
Executive Director

55 N. Church St. Ste. A5, Wailuku, HI 96793 808.244.7570 director@maui-tomorrow.org

MUNEKIYO & HIRAGA, INC.

Michael T. Munekiyo
Gwen Ohashi Hiraga
Mitsuru "Mich" Hirano
Karlynn Fukuda

Mark Alexander Roy

April 6, 2011

Irene Bowie, Executive Director
Maui Tomorrow
55 North Church Street, Suite A5
Wailuku, Hawaii 96793

SUBJECT: Response to Environmental Impact Statement Preparation Notice (EISPN) Comment Letter Regarding Proposed Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension at TMK (2) 3-8-001, Kahului, Maui, Hawaii

Dear Ms Bowie:

Thank you for your letter of February 25, 2011, providing comments on the proposed Wailuku-Kahului Wastewater Reclamation Facility (WK WWRF) Shoreline Protection Extension. We offer the following information in response to your comments. The response are in the same order listed in your letter.

INJECTION WELLS:

1. The County of Maui County Council through Resolution No. 06-12 accepted the Central Maui Wastewater Reclamation Facility Study and concurred with the recommendations and long term plan. The long term plan is to leave the existing WK WWRF at the current site. It also recommended mitigating shoreline erosion through construction of shoreline erosion structures or beach nourishment. The proposed shoreline protection extension project is implementation of this recommendation.

   The shoreline protection measure is primarily designed to protect the facility from erosion which currently threatens injection Well No. 2 and will threaten the structural integrity of the existing sludge holding tanks in as few as four (4) years. As noted the shoreline protection will extend the plant life of the facility. The phasing out of injection wells at the facility is part of a county-wide review by the Wastewater Working Group in 2010. Development of alternatives to the injection wells at the facility well need to be addressed through implementation of an R-1 irrigation system for Central Maui. This effort is beyond the scope of the proposed shoreline protection project and will require a policy decision by the Maui County Council.

305 High Street, Suite 104 · Wailuku, Hawaii 96793 · ph: (808)244-2015 · fax: (808)244-8729 · planning@mhplanning.com · www.mhplanning.com

PAGE 25, POTENTIAL IMPACTS AND MITIGATION MEASURES:

2. The Draft Environmental Impact Statement (EIS) will include discussion on beach replenishment at another "popular" recreational beach site as an alternative to the beach replenishment fronting the subject property.

PAGE 31, FLORA AND FAUNA, A. EXISTING CONDITIONS:

3. The Draft EIS will include a Biological and Water Quality Report prepared by AECOS, Inc. The report includes a discussion of the endangered green sea turtles that are occasionally seen in nearby waters and proposed mitigation will be addressed in the Draft EIS.

PAGE 45, PUBLIC SERVICES, 1. RECREATIONAL FACILITIES, A. EXISTING CONDITIONS:

4. As noted in Item 3, above, a Biological and Water Quality Report has been prepared by AECOS, Inc., water quality sampling will be carried out and the results will be included in the Draft EIS.

Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes review process. A copy of your letter will be included in the Draft Environmental Impact Statement. In the meantime, if there are any questions or if additional information is needed, please feel free to con tact me at 244-2015.

Very truly yours,

Colleen Suyama
Senior Associate

CS:yp
cc: Kyle Ginoza, Director, Department of Environmental Management
Russ Boudreau, Moffat Nichol
Snookie Mello, AECOS, Inc.

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XII. LIST OF ENIRONMENTAL IMPACTS STATEMENT PREPARERS

XII. LIST OF ENVIRONMENTAL IMPACTS STATEMENT PREPARERS

	Name of Firm	Area of Responsibility
1.	Moffat Nichol 3780 Kilroy Airport Way, Suite 600 Long Beach, California 90806	Russell Boudraux, P.E. - Coastal Engineering Rob Sloop, P.E. - Coastal Engineering
2.	SSFM International, Inc. 1351 Lower Main Street, Suite 3 Wailuku, Hawaii 96793	Preliminary Engineering Report
3.	Munekiyo & Hiraga, Inc. 305 High Street, Suite 104 Wailuku, Hawaii 96793	Mich Hirano, AICP, Colleen Suyama, and Neal Dixon - Environmental Impact Statement and Cultural Impact Assessment
4.	AECOS, Inc. 45-939 Kamehameha Highway, Room 104 Kaneohe, Hawaii 96744	Eric Guinther and Katie Laing - Marine Biology and Water Quality Survey
5.	Xamanek Researches, LLC P.O. Box 880131 Pukalani, Hawaii 96788	Erik Fredericksen, Archaeological Inventory Survey
6.	R.T. Tanaka Engineers, Inc. 871 Kolu Street #201 Wailuku, Hawaii 96793	Kirk Tanaka, P.E., L.P.L.S. - Certified Shoreline Survey

XIII. REFERENCES

XIII. REFERENCES

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APPENDIX A.

Conservation District Use Application Approval Letter for Existing Revetment

GEORGE R. ARIYOSHI
GOVERNOR OF HAWAII

DIVISIONS:
CONVEYANCES
FISH AND GAME
FORESTRY
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF LAND MANAGEMENT
P. O. BOX 621
HONOLULU, HAWAII 96809

January 12, 1979

Board of Land and
Natural Resources
State of Hawaii
Honolulu, HI

Gentlemen:

MAUI

County of Maui Department of Public Works
Request for Right of Entry to Construct
Rock Revetment at Kahului, Maui, Hawaii

At its meeting of October 13, 1978 under agenda Item H-7, the Board approved a County of Maui Department of Public Works Conservation District Use Application for the construction of a 450 feet rock revetment on the beach area fronting the Kahului Wastewater Treatment Plant at Kahului, Maui, Hawaii, Tax Map Key 3-8-01:por. 19 and storage of construction equipment on portions of the adjoining proposed Kanaha Beach Park area in connection with this erosion control project subject to the following terms and conditions:

1. The applicant shall comply with applicable provisions of Section 6 of Departmental Regulation No. 4;

2. Inclusion of hold-harmless condition for all work to be awarded by contract;

3. That the applicant obtain appropriate authorization through the Division of Land Management, DLNR, for the use of State lands, since this approval is for the use of conservation lands only;

4. In the event that unanticipated historical or archaeological remains are encountered by the effectuation of the proposed use, the applicant shall immediately contact the Historic Preservation Office at 548-6408;

5. Precautionary measures shall be taken to prevent pollution of coastal waters by accidental spillage of petroleum products, debris, or other construction related products during construction;

6. No materials shall be placed on or taken from conservation districts outside the project area;

APPROVED BY THE BOARD OF
LAND AND NATURAL RESOURCES
AT ITS MEETING HELD ON

1/12/79

ITEM F-7

7. All areas disturbed by work and work related activities shall be restored to acceptable conditions;

8. Appropriate measures shall be taken to minimize inconveniences and hazards to neighboring residences and the public in general; and

9. That the studies made for the project be forwarded to the Division of Water and Land Development for review.

RECOMMENDATION:

That the Board authorize a right of entry to the subject areas to the County of Maui for construction of rock revetment and storage of equipment purposes, respectively, subject to the foregoing and such other terms and conditions as may be prescribed by the Chairman.

Respectfully submitted,

JAMES J. DETOR
Land Management Administrator

APPROVED FOR SUBMITTAL:

SUSUMU ONO, Chairman

APPENDIX B.

Declaration of Exemption, January 13, 2009

CHARMAINE TAVARES
Mayor

CHERYL K. OKUMA, Esq.
Director

GREGG KRESGE
Deputy Director

TRACY TAKAMINE, P.E.
Solid Waste Division

DAVID TAYLOR, P.E.
Wastewater Reclamation Division

COUNTY OF MAUI
DEPARTMENT OF
ENVIRONMENTAL MANAGEMENT
2200 MAIN STREET, SUITE 610
WAILUKU, MAUI, HAWAII 96793

DECLARATION OF EXEMPTION

from the preparation of an environmental assessment,
under the authority of Chapter 343, Hawaii Revised Statutes (HRS),
and Chapter 11-200, Hawaii Administrative Rules (HAR)

Project Name: Wailuku-Kahului Wastewater Reclamation Facility Tsunami Protection Project, County Job 07-32, TMK (2) 3-8-01:188

Project Description: Thickening and reinforcement of existing walls and foundations at the Headworks Building, Secondary Clarifier Structure, Chlorine Contact Chamber and Effluent Meter Structures.

Exemption List: County of Maui, Issued January 10, 2007

APPLICABLE EXEMPTIONS:

CLASS 1: Operations, repairs and maintenance of existing structures, facilities, equipment or topographical features, involving negligible or no expansion or change of use beyond that previously existing.

Item 2: Overhauling, repairing, repainting, cleaning, polishing, greasing, oiling, and servicing of the following agency facilities, structures and equipment:

a. Existing Buildings,
b. Structures, including water and sewage handling and treatment systems and drainage systems.

CLASS 4: Minor alteration in the conditions of land, water, or vegetation

Item 1: Minor cut, fill, and grading of County property which does not exceed one hundred cubic yards of material on any one site and does not exceed four feet in vertical height at its highest point for work outside the Special Management Area; and minor cut, fill, and grading of County property which does not exceed fifty cubic yards of material on any one site and does not exceed two feet in vertical height at its highest point within the Special Management Area.

CLASS 6: Construction or placement of minor structures accessory to existing facilities.

Item 12: Installation of Best Management Practices (BMPs) in accordance with Chapter 20.08, Maui County Code.

CLASS 7: Interior alterations involving such things as partitions, plumbing and electrical conveyances.

Item 1: Interior alterations to building or structures that do not increase the floor area or change the occupancy.

I have considered the potential effects of the above listed projects as provided by Chapter 343, HRS and Chapter 11-200, HAR. I declare that this project will have minimal or no significant effect on the environment, and is therefore exempt from the preparation of an environmental assessment.

Signed: Cheryl K. Okuma — 1-13-09

Cheryl K. Okuma, Esq.
Director of Environmental Management

Date

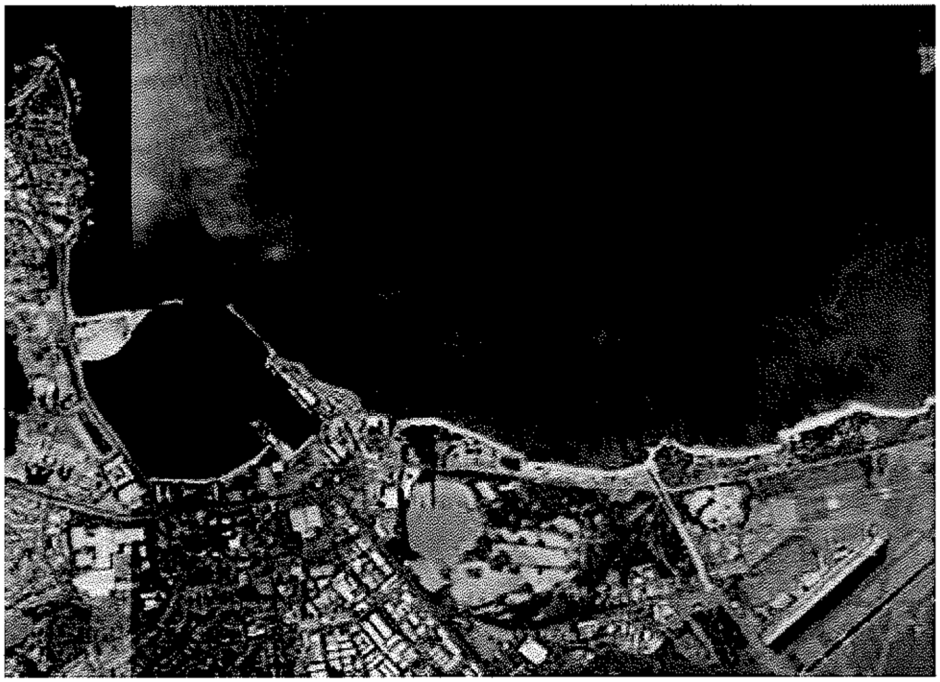
cc: Katherine Puana Kealoha, Interim Director, Office of Environmental Quality Control
Jeffrey S. Hunt, Director, Department of Planning

APPENDIX C.

Central Maui Wastewater Reclamation Facility Shoreline Evaluation Report

Central Maui Wastewater Reclamation Facility

Shoreline Evaluation Report



Prepared for:

Austin, Tsutsumi & Associates, Inc.
501 Sumner Street, Suite 521
Honolulu, HI 96817

Prepared by:

Moffatt & Nichol
250 W. Wardlow Road
Long Beach, CA 90807

April 2005

M&N File: 5454

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CENTRAL MAUI WASTEWATER RECLAMATION FACILITY
DRAFT
SHORELINE EVALUATION REPORT

I. INTRODUCTION

A. Background

The County of Maui owns and operates the Wailuku-Kahului Wastewater Reclamation Facility (WWRF). The facility has a design capacity of 7.9 million gallons per day (MGD) and it is estimated the facility will reach this capacity sometime in the future. The County will soon be making decisions on how the wastewater treatment needs can be met for the next 20 to 30 years. Alternatives need to be discussed which will provide for the future wastewater treatment needs of the County. Alternatives under consideration include relocating the facility, increasing the capacity of the current facility, or directing some of the future flows to another facility or facilities.

A critical constraint associated with the alternatives analysis is that many of the County's beaches are eroding, including the shoreline fronting the Kahului WWRF. There are concerns regarding the current erosional trends on the existing and any future plant expansions.

The Wailuku Wastewater Pump Station (WWPS) is also part of the County's wastewater collection system. This pump station is also located close to the shoreline, on the west side of Kahului Harbor. This shoreline has experienced historical shoreline recession and needs to be included in the shoreline evaluation.

B. Purpose and Scope

The purpose of this study is to quantify shoreline erosion trends, assess potential causes for erosion, and develop preliminary shoreline protection alternatives for the Kahului WWRF site and also at the WWPS. The study is based on existing and available data and studies relating to shoreline erosion, causes of erosion, and potential solutions.

The shoreline evaluation comprises the following tasks:

1. Quantify shoreline erosion;
2. Assess potential causes of erosion;
3. Develop solution alternatives; and
4. Concept development.

II. RELEVANT COASTAL PROCESSES AND CONDITIONS

Understanding the relevant coastal processes and conditions is important in assessing causes for erosion and shoreline change and also for assessing potential solutions for shoreline protection. This section outlines water levels, wave conditions, and climate conditions (wind and precipitation).

A. Water Levels

Tides in the Hawaiian Islands are semi-diurnal, with two high waters and two low waters each tidal day. The tidal range varies from tide to tide, thus the tides are considered to have a diurnal inequality. The mean tide range is approximately two feet, and the maximum annual tide range is approximately four feet. Tide data for Kahului Harbor is presented in Table 1 [1].

Table 1. Kahului Harbor Tidal Datums

Highest Observed Water Level (1/9/74)	3.70 feet
Mean Higher High Water (MHHW)	2.35 feet
Mean High Water (MHW)	1.97 feet
Mean Sea Level (MSL)	1.17 feet
Mean Tide Level (MTL)	1.16 feet
Hawaiian Geodetic Vertical Datum (HGVD)	0.90 feet
Mean Low Water (MLW)	0.35 feet
Mean Lower Low Water (MLLW)	0.00 feet
Lowest Observed Water Level (6/20/55)	-1.40 feet

In addition to normal short-term periodic fluctuations of the sea surface, there is also a progressive change in sea level. Various projections of future sea level rise resulting from global warming, given past and projected increases in atmospheric carbon dioxide and other "greenhouse" gases have been developed. There can also be a relative sea level rise that results from combinations of rising sea level and sinking land. This can be of particular importance in the Hawaiian Islands due to ongoing geologic and tectonic processes. Relative sea level rise measured at Kahului Harbor is approximately 1.2 inches per decade (University of Hawaii 1998).

B. Waves

Ocean waves are the critical driving force in the movement of beach sand along a shoreline. This section provides a brief summary of the wave climate along Maui's North coast.

[1] Obtained from <<http://co-ops.nos.noaa.gov/benchmarks/1615680.html>>

1. Wave Sources

Waves approaching the Hawaiian Islands may be represented by the following general types:

1. ***Northeast Trade Waves*** – These waves are generated by the northeasterly trade winds that prevail approximately 75 percent of the year. Northeast trade waves are characterized in deep water by wave heights of up to 20 feet and periods ranging from 5 to 12 seconds. They occur most frequently and are the largest during the months from April through November.

2. ***Kona Storm Waves*** – During the winter season, Kona winds generate waves from the southwest with characteristics similar to those of trade waves. Kona conditions occur most frequently from November through April. Infrequently, a Kona storm associated with a large low-pressure system generates large storm waves from the southwest.

3. ***North Pacific Swell*** – The North Pacific swell, for which the large surf on the north and northwest coasts of Hawaii has become famous, is due to the waves generated from North Pacific extra-tropical cyclones. These large waves have heights in excess of 20 feet and periods ranging from 10 to 15 seconds. The North Pacific cyclones travel eastward and generate waves that approach the northwestern exposed shores of the islands. These waves are most likely to occur from October through April.

4. ***Southern Hemisphere Swell*** – Southern hemisphere swell that can reach the Hawaiian Islands is generated in the South Pacific Ocean. Large, extra-tropical storms generate waves and swell that travel 5,000 miles with breaking wave heights ranging up to 10 to 15 feet annually. The wave heights in deep water are 3 to 6 feet, with 14 to 18 second periods. These waves are generally characterized by rather long wave lengths, distinct wave groups, and are independent of the local wind system.

5. ***Local Storms and Hurricanes*** – Local storms and hurricanes are infrequent. Tropical storms generated off the coast of Mexico move westward through the equatorial region and occasionally deflect northward toward the Hawaiian Islands. Hurricane Iniki in September 1992, Hurricane Iwa in November 1982, Hurricane Dot in August 1959, and Hurricane Nina in December 1957 are the major hurricanes that have caused damage to the Hawaiian shoreline in the past 40 years.

2. Wave Exposure at Maui's North Coast

The Wailuku-Kahului Wastewater Reclamation Facility and Wailuku Wastewater Pump Station are located on Maui's North Central Coast, adjacent to Kahului Harbor. The North Central Coast is exposed to Northeast trade waves and North Pacific swell. The Northeast trade waves approach the Kahului area from the Northeast and the North Pacific swell approach from the North to Northwest.

C. Wind

The predominant winds in the vicinity of the Hawaiian Islands are the northeast trade winds, which are present approximately 70% to 75% of the year. The other 25% to 30% of the year produces Kona Winds predominantly from the south to southwest. Trade winds generally range from 10 to 25 mph, although can reach 40 to 50 mph during extreme events (Fletcher et al. 2002). On Maui, the trade winds are strongly influenced by topographic conditions. For example, at Maalaea and Kihei the wind speeds may be higher than the north shore due to the trade winds accelerating across the island's isthmus. At the Kahului site, the Northeast trade wind direction is unaffected by the island topography, and is clearly from the unobstructed prevailing northeast direction.

Winter is characterized by a weakening of the northeast trade winds (Moberly and Chamberlain 1964) and the appearance of southwesterly winds, known as Kona winds. The Kona winds are characterized by light and variable winds that persist for a few days to a few weeks at a time. Although Kona storms are capable of generating wind speeds exceeding 30 knots, the frequency of occurrence is low.

D. Precipitation

The average monthly precipitation at Kahului is presented in the table below. The average annual total is estimated to be approximately 19 inches per year (Western Regional Climate Center website at <<http://www.wrcc. dri.edu/cgi-bin/cliMAIN.pl?hikahu>>).

Table 2. Average Monthly Rainfall at Kahului

Average Rainfall at Kahului, Maui from 4/1/1954 to 3/31/2004 (in inches)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
3.73	2.59	2.55	1.44	0.67	0.24	0.48	0.48	0.36	1.05	2.37	3.13	19.08

E. Typical Hawaiian Beach Characteristics

The following provides a general description of Hawaiian beaches including their formation and composition. Most of the information was derived from the study *Hawaiian Beach Systems* by Moberly and Chamberlain (1964), unless otherwise noted.

Each of the Hawaiian Islands was formed by volcanoes that built up basaltic lava in intermittent layers from the seafloor. The general succession of island formation has been from northwest down the island chain to the southeast, with Maui being one of the more recent geologic formations. Maui was formed by the two adjacent volcanoes of Haleakala and West Maui, with an isthmus connecting the two. Kahului is located on the north side of Maui.

Coral reefs are found along much of the Hawaiian Island shorelines. These wave-resistant structures are formed by shallow water organisms in warm water environments. The most common type of reefs found in Hawaiian waters is fringing reefs. Fringing reefs along the sheltered leeward coasts in Hawaii are some of the wider and flatter reefs in the islands. Commonly, they have detrital (originating from the land after weathering and erosion) grains mixed with the predominantly calcareous sands covering them and their adjacent beaches. These reefs were the ones most utilized by the ancient Hawaiians for their fish ponds.

Hawaiian beaches mainly consist of medium grain-size sand, although their sediments actually range from gravel to sandy mud. Many beaches have coarse sand; most Maui beaches have fine sand. Hawaiian beach sand is composed of two general types of grains mixed together in proportions that vary from one locality to another. Light-colored calcareous grains of biochemical origin, the fragments of skeletal parts of certain marine invertebrate animals and algae, contrast with dark-colored silicate grains of detrital origin.

III. SITE DESCRIPTION

A site visit was conducted on July 16, 2004, to the WWRF and the WWPS. Appendix A contains photographs from the site visit. This section describes each site and existing conditions, uses, and features.

A. Kahului-Wailuku WWRF

The Kahului-Wailuku WWRF is located on the north shore of the island of Maui, and approximately one mile east of the Kahului Harbor. Figure 1 is an aerial photograph of the site. The area immediately west of the WWRF is considered to be a heavy industrial area and includes oil tank farms, auto storage yards, warehouses, and a power plant (Brown and Caldwell 1990). The port facilities at Kahului Harbor are located approximately ½ mile to the west of the WWRF. The Kahului Airport is located approximately one mile east of the

WWRF and Kanaha Beach Park is located approximately ¾ mile to the east of the WWRF.

The WWRF site is bounded on the north by approximately 1350 linear feet of shoreline in Kahului Bay. There is a 520-foot existing rock revetment along this shoreline that was constructed between 1977 and 1978 fronting the WWRF retention pond (Makai Ocean Engineering and Sea Engineering 1991). Observations during the site visit on July 16, 2004, indicated that the east flank of the revetment is being outflanked from recent erosion trends in the area (see Figure 2 and Figure 3).

The shoreline along this reach has experienced severe erosion as can be seen by the remnants of an old WWII pill box offshore of the beach (Figure 4). Also, there are a series of old groins east of the plant that were constructed during WWII to retard the erosion process (USEPA 1974).

The 13,000-foot long beach that extends east from Kahului Harbor is also known as Sprecklesville Beach. This reach is broken into a series of pocket beaches separated by manmade groins and natural beachrock and lava points (Moberly 1963 and USACE 1971). The beach sand is poorly sorted calcareous sand, ranging in size from medium-sized grains to cobbles. The beaches along this reach are backed by large sand dunes. The Sprecklesville Beach area is primarily used by locals and visitors for world-class kite surfing and windsurfing, as well as fishing and regular beach recreation.

There is a large fringe reef just offshore that extends for several miles along this reach. The reef is characterized by a wide crest (one-half to one mile in width) that extends from a shallow nearshore toe to depths ranging from 10 to 30 feet (Cox 1954). Closer to the Kahului Harbor, the reef is narrow or absent (Cox 1954).

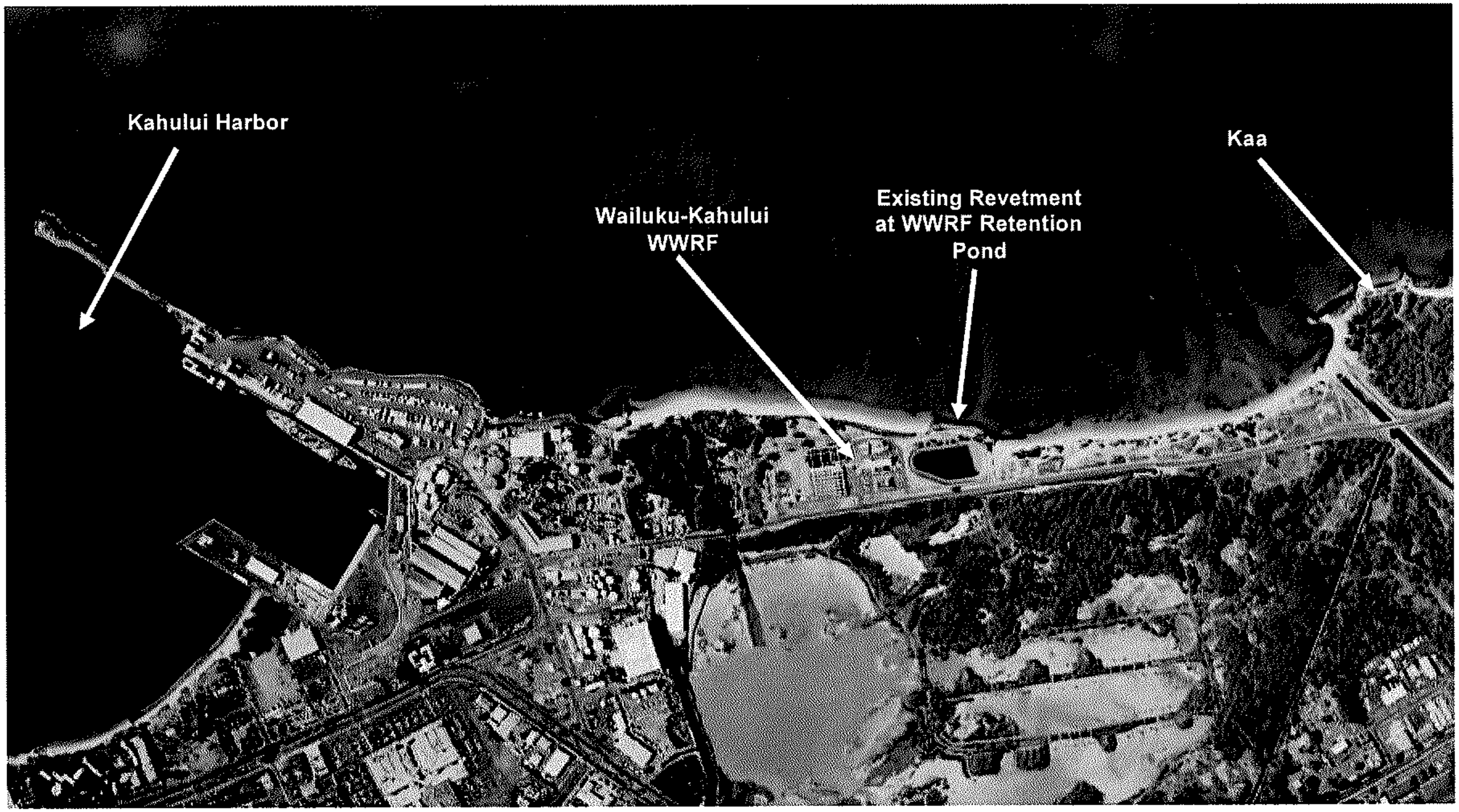


Figure 1. Aerial photograph of the coast from Kahului Harbor to Kaa
[obtained from <<http://www. soest.hawaii.edu/coasts/Islandimagery.html>>]

Figure 2. East flank of the revetment fronting the Wailuku-Kahului WWRF.

Figure 3. Looking West towards the Wailuku-Kahului WWRF revetment.

Figure 4. Looking East from the revetment at the Wailuku-Kahului WWRF. (Notice the old "pill box" offshore.)

B. Wailuku Wastewater Pump Station

The shoreline along the coast west of the Kahului Harbor is characterized as a narrow beach of poorly sorted sand and gravel (USACE 1971). Figure 5 is an aerial photograph of the Wailuku WWPS site. The Waihee Reef extends from Waihee Point to Kahului Harbor. The width of this reef near the harbor is about 500 feet wide.

The Wailuku Wastewater Pump Station is located west of the Kahului Harbor. Observations during the site visit on July 16, 2004, indicated a rocky shoreline, which consisted of natural cobbles and boulders, and also concrete rubble and armor stone. The rocky slope did not appear to be unstable or erodible. However, there is upland erosion on the site appearing to be from high water levels and storm waves reaching higher elevations on the beach slope, causing the upland soil to erode, leaving a high vertical escarpment. This escarpment can be seen in Figure 6 and Figure 7. Verbal communication with County staff (Dave Taylor, July 16, 2004) indicated that a large storm in 1993 caused over 10 feet of horizontal upper bank loss in one day. In early February 1993, 25 to 30-foot waves were recorded on the North Shore of Maui (Fletcher et al. 2002)

Also, the shoreline along this reach does not appear to be generally used by the public for beach access and/or recreation. North of the site, it appears the residential area is highly armored with vertical seawalls (Figure 7).

Figure 5. Aerial photograph of the coast at the Wailuku Wastewater Pump Station.
[obtained from <<http://www. soest.hawaii.edu/coasts/Isla ndimagery.html>>]

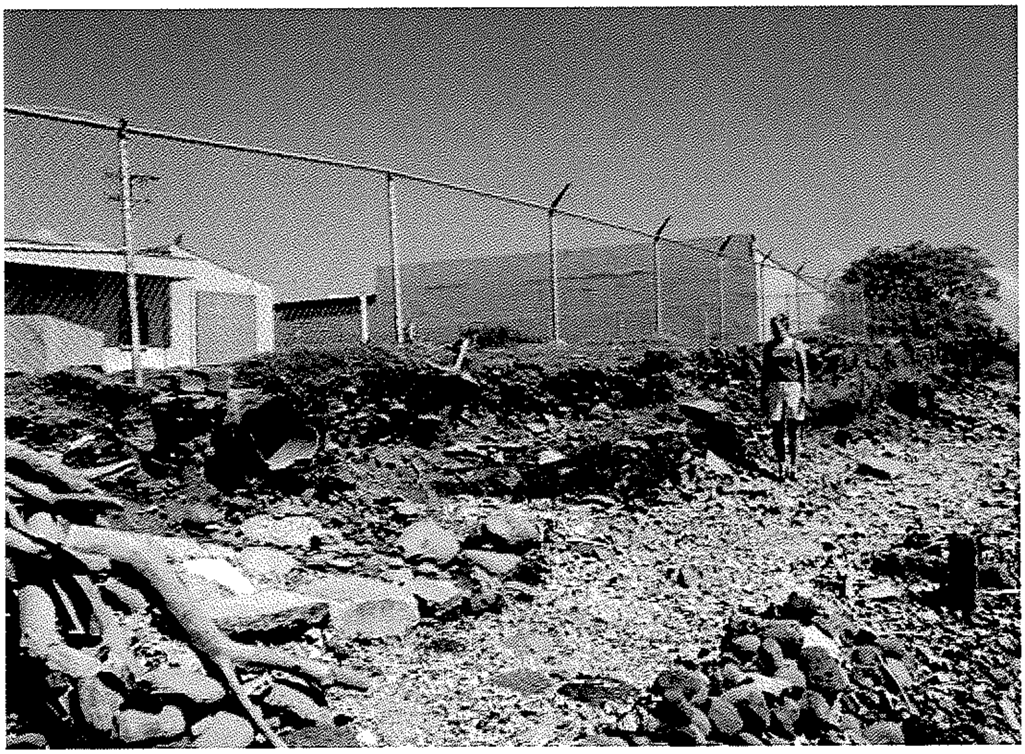


Figure 6. Large escarpment fronting the WWPS property (fence).

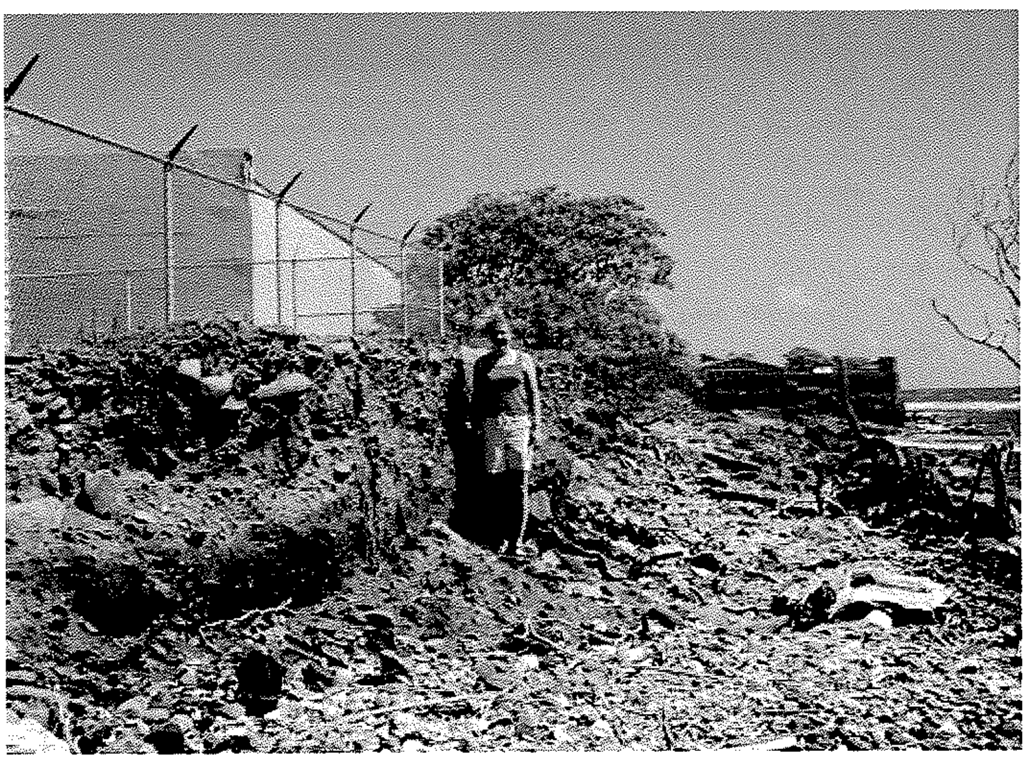


Figure 7. Escarpment and shoreline looking northwest from WWPS.
(notice large seawall fronting property to the north)

IV. WAILUKU-KAHULUI WWRF SHORELINE CHANGES

A. Long-Term Changes

This section discusses long-term shoreline changes over the last 50 to 100 years. The shoreline reach that is discussed is a 13,000-foot long reach extending from Kahului Harbor. It is broken into a series of pocket beaches by manmade groins and natural lava and beachrock points.

Shoreline erosion in the vicinity of the Kahului WWRF has been documented for over 100 years. Doak Cox (1954) stated the shoreline between Kahului and Paia had been eroding for at least 50 years, since soon after the turn of the last century. Cox stated the only portion of the shoreline that was not eroding was the area east of the Kahului East breakwater where the beach had been accreting over a length of 2,400 feet. This accretion resulted from the construction of the Kahului Harbor breakwaters and the longshore transport of sediment flow from east to west. Cox's 1954 report does indicate this area adjacent to the east breakwater was recently receding.

Other reports which outline early erosional trends along the project area include a report by Moberly (1963), which states that "lines of beachrock awash at the waterline as much as 800 feet offshore show the historical record of erosion is merely the latest stage in a process operating over the last few hundred years." In the report, Moberly indicates sand mining was being conducted along the western end of the 5-mile long section of beach that extends east from the Kahului Harbor. He states this causes changes in the beach configuration because of the mining and stockpiling operations. Another report by the US Army Corp of Engineers and the State of Hawaii (1964) describes the beach as having "moderate to minor erosion in recent years."

These studies are also complimented by the County of Maui Shoreline Erosion Maps. These maps were compiled using aerial photography and historic T-sheets to determine long-term historic trends in shoreline position. The earliest shoreline position on the County Maps is the 1899 shoreline, followed by 1912, 1929, 1960, 1975, 1987, 1988, 1997, and 2002. The long-term shoreline erosion rate for the section of coast from Hobron Point to Kaa is indicated in Figure 8. The red bars indicate the Annual Erosion Hazard Rate (AEHR) in feet per year (ft/yr). At the western end of the map, the AEHR ranges from -0.5 ft/yr to almost -3.0 ft/yr. From the western edge of the WWRF property line, the AEHR increases gradually from near 0.0 ft/yr to slightly over -4.0 ft/yr at the eastern terminus of the map. Directly fronting the WWRF, the historic long-term AEHR is shown to be between -1.0 and -2.5 ft/yr. It is noted however, that once a section of coast is armored, the long-term shoreline erosion rate only consists of the pre-armored time frame. This may represent a skewed view of the erosion rate fronting the WWRF revetment, because the structure itself halts further shoreline retreat and therefore decreases the erosion rate over time.

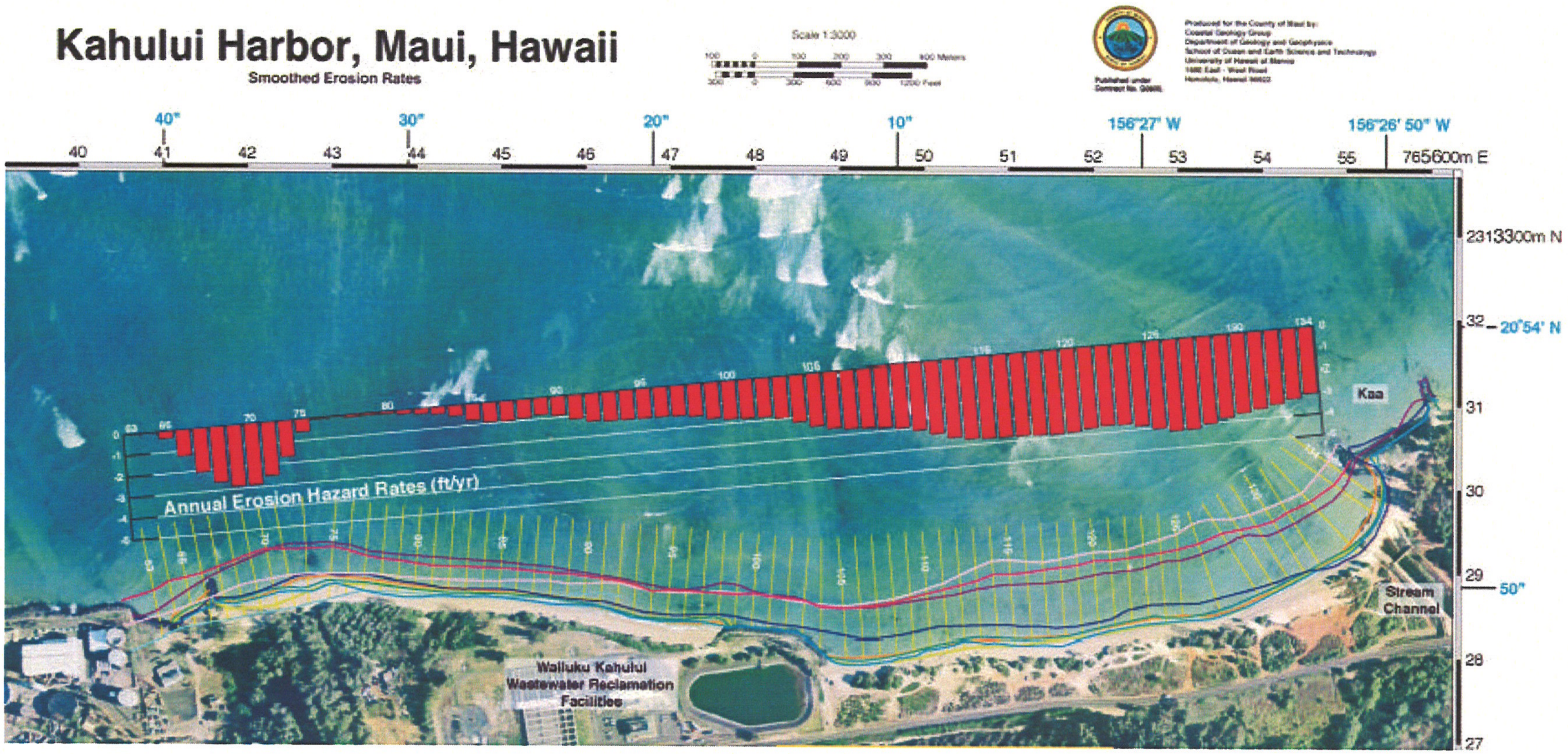


Figure 8. County of Maui Shoreline Erosion Map at the Wailuku-Kahului Wastewater Reclamation Facility.

B. Shorter-Term and Current Shoreline Changes

This section includes analysis of the historic data and summarizes the changes in shorter (decadal) intervals. This will provide a better understanding of how the shoreline erosion has changed over time. The data used in the County of Maui Shoreline Erosion Maps was obtained to determine short-term erosion rates. Shorter-term erosion rates will provide information as to whether the erosion is increasing, decreasing, or constant through time and may aide in assessing potential causes for erosion based on historical events. Also, the data presented in Sea Engineering (1991) report will be compared to the County of Maui shoreline data.

Figure 9 through Figure 11 illustrate shorter-term erosion trends between the various surveys available for this coast. The shoreline position at each transect was subtracted from the previous shoreline position and then divided by the number of years between shoreline surveys. This produces a shoreline change rate in feet per year (ft/yr). Each Figure shows the shoreline change rate along each of the transects indicated on the County Shoreline Erosion Maps. For reference, station 70 of the County Shoreline Erosion Map is located west of the WWRF property, and Station 134 is located at Kaa, east of the Stream Channel.

1. 1912-1929 and 1929-1960

Figure 9 shows that from 1912 to 1929 (dashed red line), there is a trend of shoreline advance west of the WWRF and slight erosion occurring east of the facility. The accretion west of the site is typical for a westward longshore transport where the littoral sediments move from the east to the west and are trapped at the East Jetty at Kahului Harbor (East Jetty construction began in 1906). The rate of accretion decreases to approximately 0.0 ft/yr along the shoreline just fronting where the revetment and retention pond is now located. From the location of the revetment to approximately 400 feet east, the shoreline has a slight erosional trend on the order of -0.5 ft/yr. From approximately 400 feet east of the pond and revetment to the end of the reach, this rate of shoreline change increases to approximately –4.0 ft/yr.

The next time step shown in Figure 9 represents the shoreline change rate from 1929 to 1960 (blue solid line). This graph shows the beach west of the WWRF is advancing at a much lower rate than the previous time interval (approximately 1.0 ft/yr). East of the facility, the rate of shoreline recession is slightly less than the 1912-1929 time interval (approximately 1.0 to 2.0 ft/yr). The shoreline immediately fronting the location of the WWRF revetment is similar between the two time intervals (e.g., 0.0 ft/yr).

The reason for change in the rate of shoreline advance is not known, but it could be speculated that the impoundment area could have reached its maximum capacity, and thus no further shoreline advance would occur. Another possible scenario is that the sand mining operations were started in the early part of the century (Guild 1999), which may have contributed to the erosional trend to the east. In fact, Moberly (1964) states sand mining was being conducted along the eastern end of reach. This would cause less sediment available to the longshore transport, and may contribute to the lower shoreline advance rate west of the WWRF.

Makai Ocean Engineering and Sea Engineering (1991) analyzed shoreline positions from 1950 and 1964 and determined that the shoreline change rate ranged from -2.9 ft/yr west of the WWRF, to almost -5 ft/yr near Kaa. These data are also shown on the Figure (blue triangles). These erosion rates are slightly higher than the 1929-1960 data. This increase in erosion may be because of the increased rate of sand mining during the latter part of this time interval.

2. 1960-1975 and 1975-1987

Figure 10 shows the shoreline change rate trends from 1960 to 1975 (red dashed line) and from 1975 to 1987 (solid blue line) from the County of Maui Shoreline Erosion Map data. Over the entire reach, the rate of shoreline erosion from 1960 to 1975 increased substantially, from about -8.0 ft/yr to the west of the WWRF, to over -16.0 ft/yr at the eastern bounds of the reach. This correlates to a 120-foot shoreline recession west of the WWRF to over 240 feet of recession adjacent to Kaa over the 15-year time interval. Data from Makai Ocean Engineering and Sea Engineering comparing 1964 and 1975 shoreline data are also plotted on the Figure (red diamonds). These data show close correlation between the time series with the County's data.

This dramatic increase in the erosion rate over these 15 years is most probably due to the sand mining efforts conducted during this time. Potential causes for shoreline erosion are presented in Section VI of this report.

The period from 1975 to 1987 (blue solid line) shows the rate of shoreline erosion is lessening over this time, but it is still significant. For this 12-year interval, the shoreline west of the WWRF has a change rate of approximately -2.0 to -4.0 ft/yr (25 to 50 feet of shoreline retreat). Immediately east of the WWRF revetment, the shoreline change dips to approximately -9.0 ft/yr (approximately 100 feet of shoreline retreat over 12 years). Along the remainder of the east reach, the shoreline change rate decreases from this -9.0 ft/yr to a slightly advancing beach (+2.0 ft/yr) at Kaa. The Makai Ocean Engineering and Sea Engineering data comparing the 1975 and 1988 shorelines are also plotted below (blue triangles). These data are very consistent with the County's data and show the same trends.

The decrease in the rate of shoreline recession could largely be due to the cessation of the sand mining efforts along this coast in the 1970s. Large-scale sand mining was prohibited in 1986 (University of Hawaii Sea Grant Extension Service and County of Maui Planning Department 1997).

3. 1987-1997 and 1997-2002

Figure 11 shows the shoreline change rate trends from 1987 to 1997 (red dashed line) and from 1997 to 2002 (solid blue line) from the County of Maui Shoreline Erosion Map data. For both data sets, the rate of shoreline erosion is substantially less than the previous time series, and in some locations the shoreline is accreting.

From 1987 to 1997, the shoreline west of the WWRF revetment has a change rate of approximately +2.0 ft/yr. This equates to a shoreline advance of approximately 20 feet. At the revetment, the shoreline change rate is 0.0 ft/yr. This is because the revetment is a fixed structure and does not change in time. East of the revetment, the shoreline shows a slightly erosional trend, on the order of 0.0 to -2.0 ft/yr.

The next time series compares the 1997 shoreline to the 2002 shoreline. This is shown on the Figure (blue solid line) and appears to have an opposite trend as the earlier time series. From 1997 to 2002, the shoreline west of the revetment has been eroding at a rate of -4.0 to -6.0 ft/yr (approximately 30 feet of recession). East of the revetment, the shoreline change rate is approximately +6.0 ft/yr and decreases to 0.0 ft/yr towards the eastern end of the reach. This change in trends from 1987-1997 to 1997-2002 suggests that the revetment at the WWRF is acting like a groin and causing accretion on the updrift side (east) and erosion on the downdrift side (west).

Both of these data sets represent more current trends in the shoreline. It appears that the beach is more stable now than it was in the 1960 to 1987 time intervals in that the rate of erosion is much less (maximum of -6 ft/yr compared to over -14 ft/yr) and is showing signs of accretion along some sections that has not been noted in the previous time intervals.

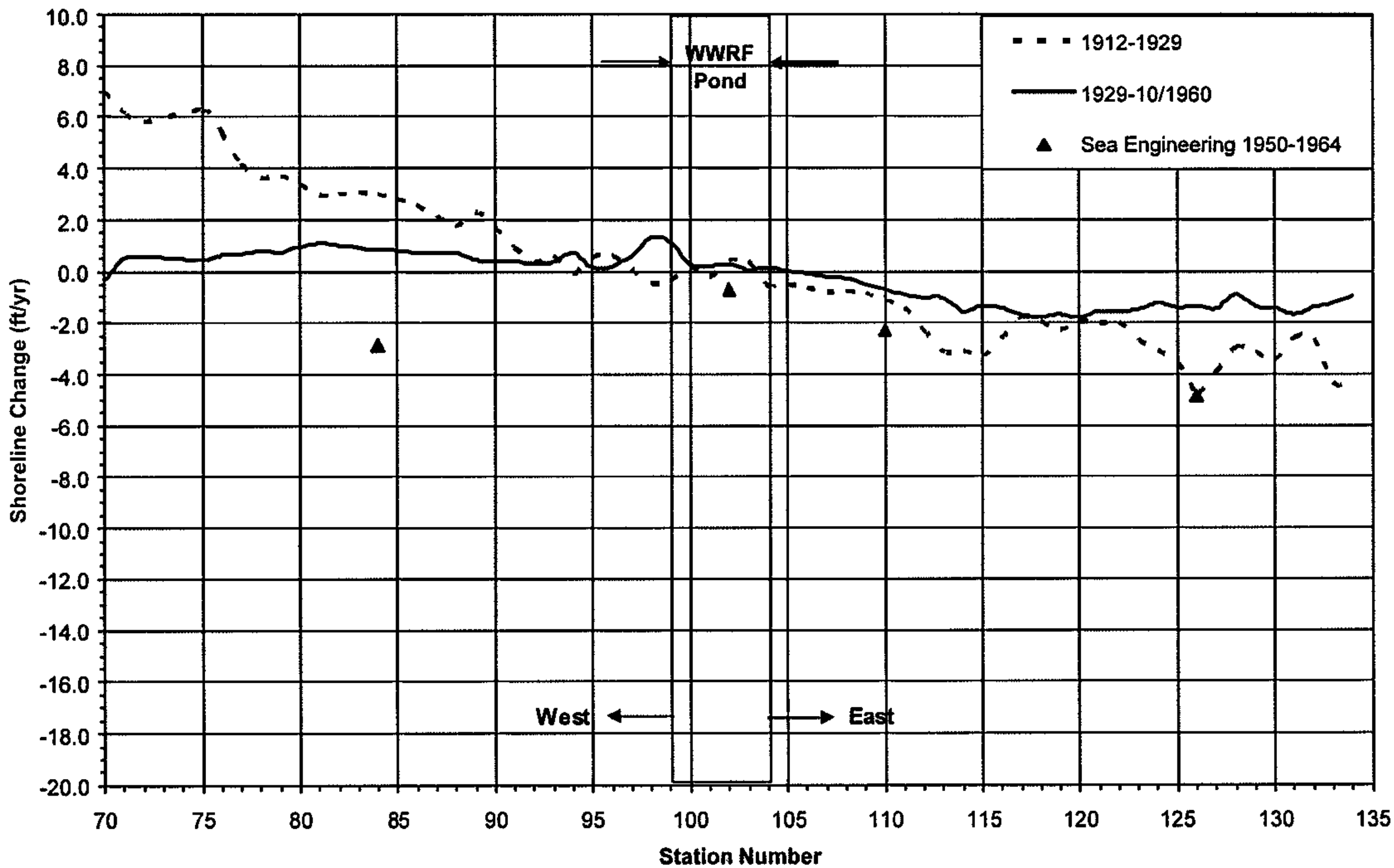


Figure 9. Shoreline Change Rate from 1912-1929 and 1929-1960 at the WWRF.
[from UH and County of Maui Shoreline Erosion Map data and Makai Ocean Engineering & Sea Engineering (1991)]

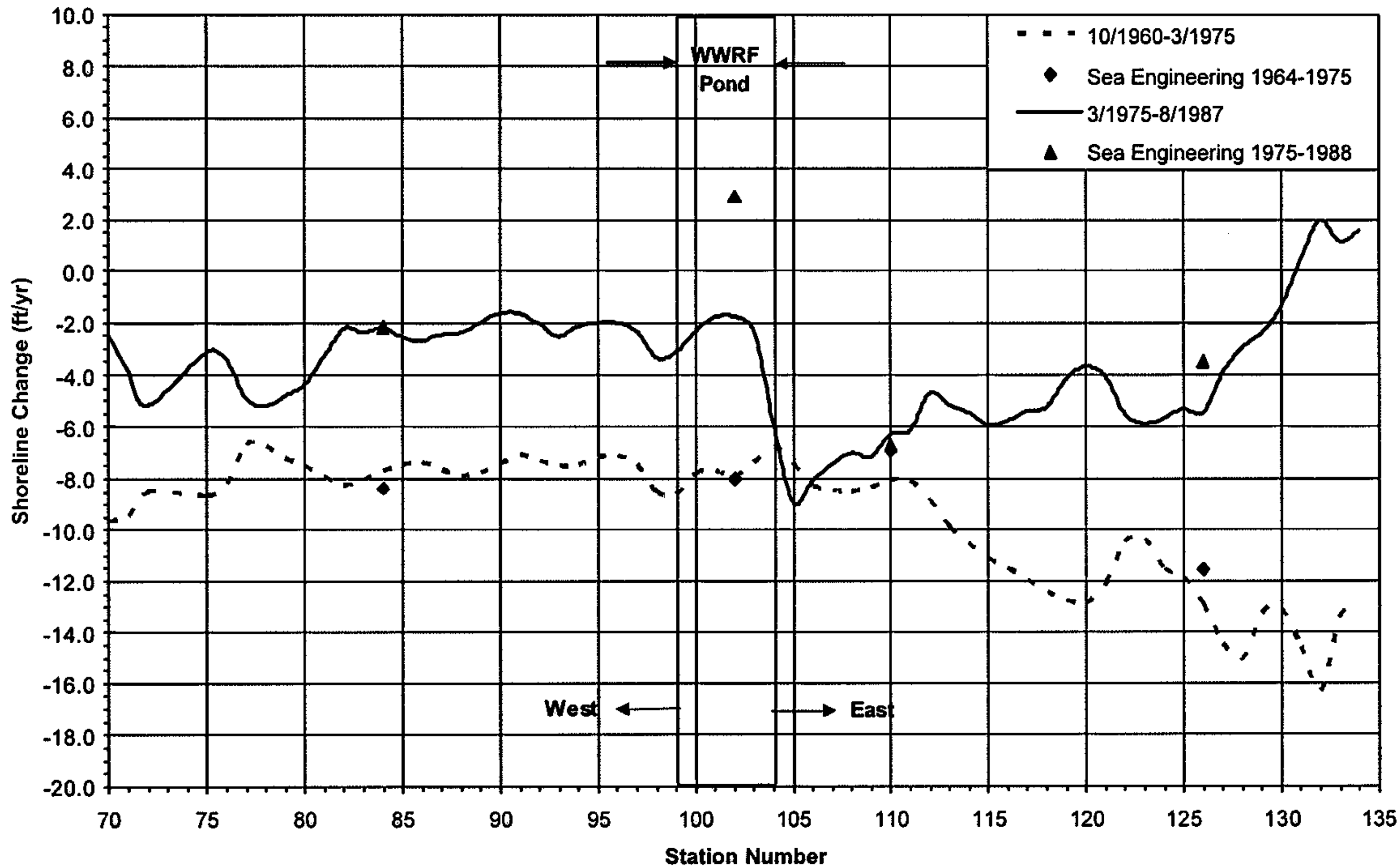


Figure 10. Shoreline Change Rate from 1960-1975 and 1975-1987 at the WWRF.
[from UH and County of Maui Shoreline Erosion Map data and Makai Ocean Engineering & Sea Engineering (1991)]

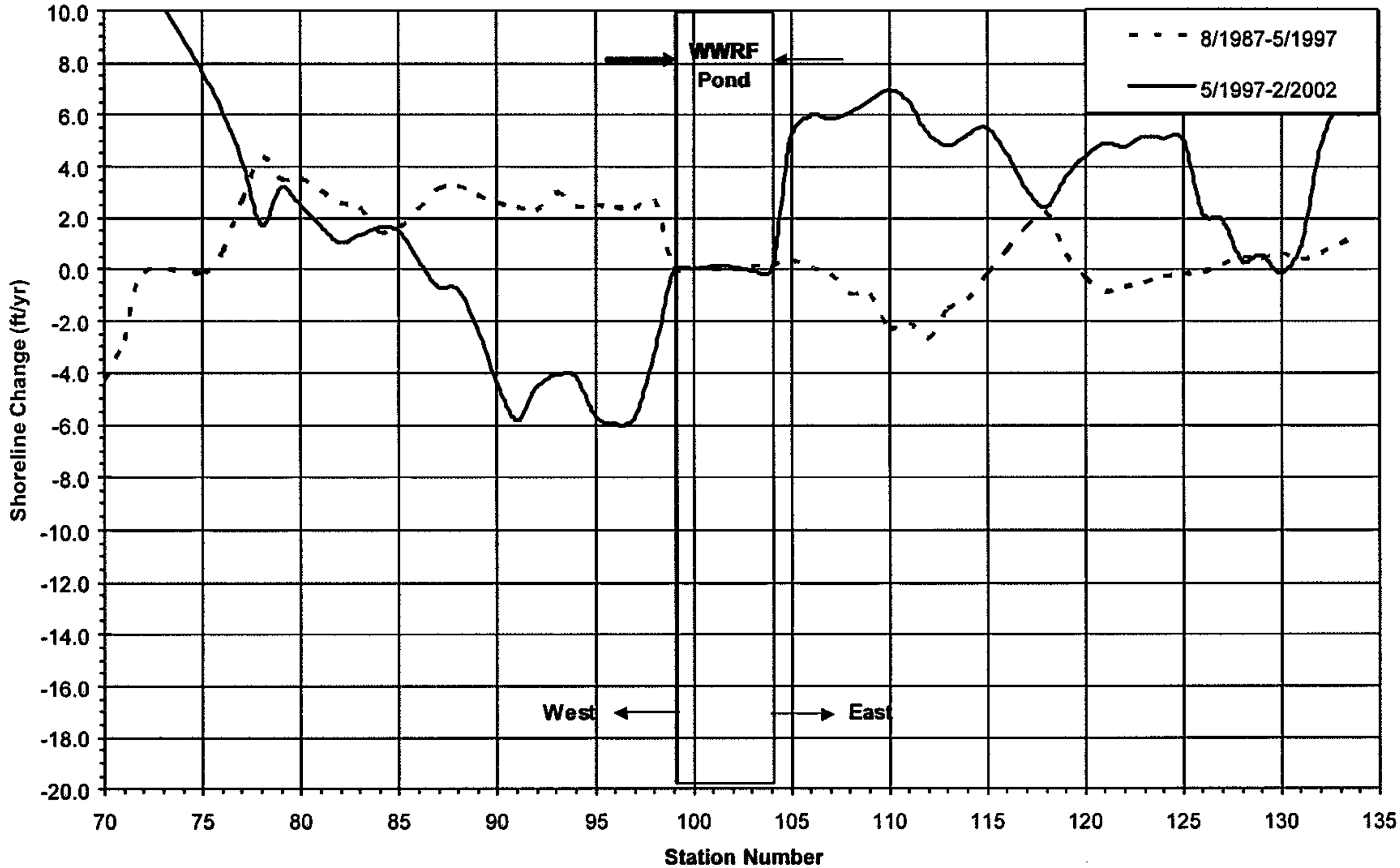


Figure 11. Shoreline Change Rate from 1987-1997 and 1997-2002 at the WWRF.
[from UH and County of Maui Shoreline Erosion Map data]

4. Recent Profile and Shoreline Survey Data

USGS profile data: Profile data from 1995 to 1999 were obtained from the USGS website (<<http://geopubs. wr.usgs.gov/open-file/of01-308/HTML1/Mnorth.html>>). A copy of the map indicating the locations of the profile stations is shown in Figure 12. For this study, the profile data at VKHL were reviewed to determine any current short-term trends in shoreline position near the WWRF. It is important to compare data from the same seasons (winter to winter) to obtain an accurate picture of the shoreline trends without the seasonal fluctuations.

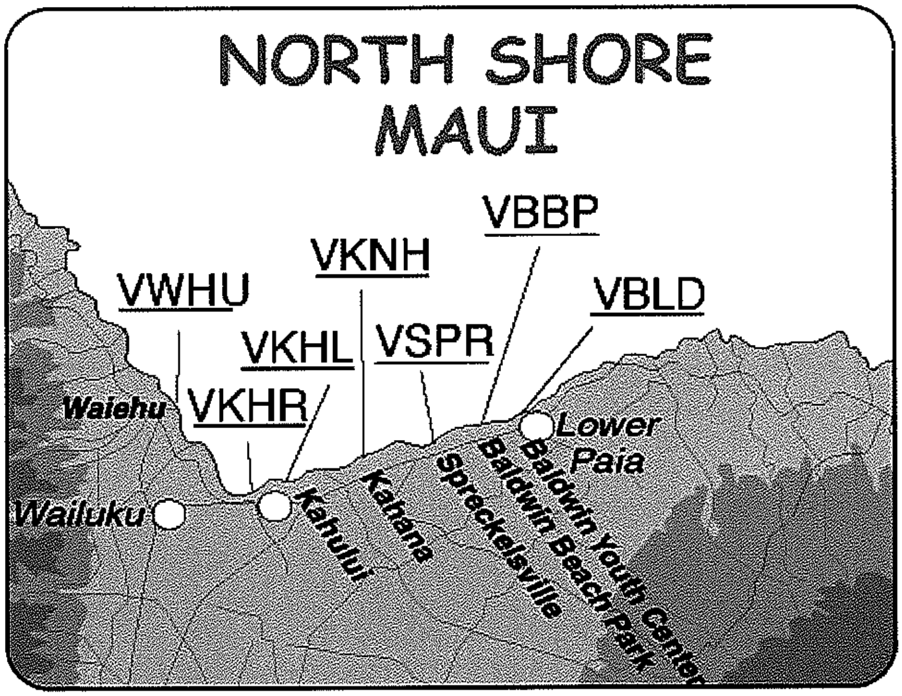


Figure 12. Location of the USGS profile transects on Maui's North Shore.

At VKHL, the winter profile data (Figure 13) show that from January 1995 (purple) to February 1996 (blue), the 0-meter depth contour receded approximately 12 meters. The shoreline position remained constant at this position through January 1998 (yellow). The January 1999 (black) data indicate that the shoreline had recovered (advanced) approximately 10 feet.

The summer profiles show a similar trend (Figure 14). The shoreline recedes approximately 10 feet between September 1995 (yellow) and August 1996 (red). By June 1997 (blue), the shoreline receded an additional 7 to 8 feet. The following two years, the shoreline advances, such that by July 1999 (black) the shoreline position is almost at the same position as the 1995 shoreline. These data indicate that the shoreline erosion trends along this reach are similar to those discussed in the previous section; the shoreline is fairly stable with trends of recession and accretion. Just comparing the 1995 and 1999 profile data at this location, it is seen there is a slight erosional trend, at least for this short time interval.

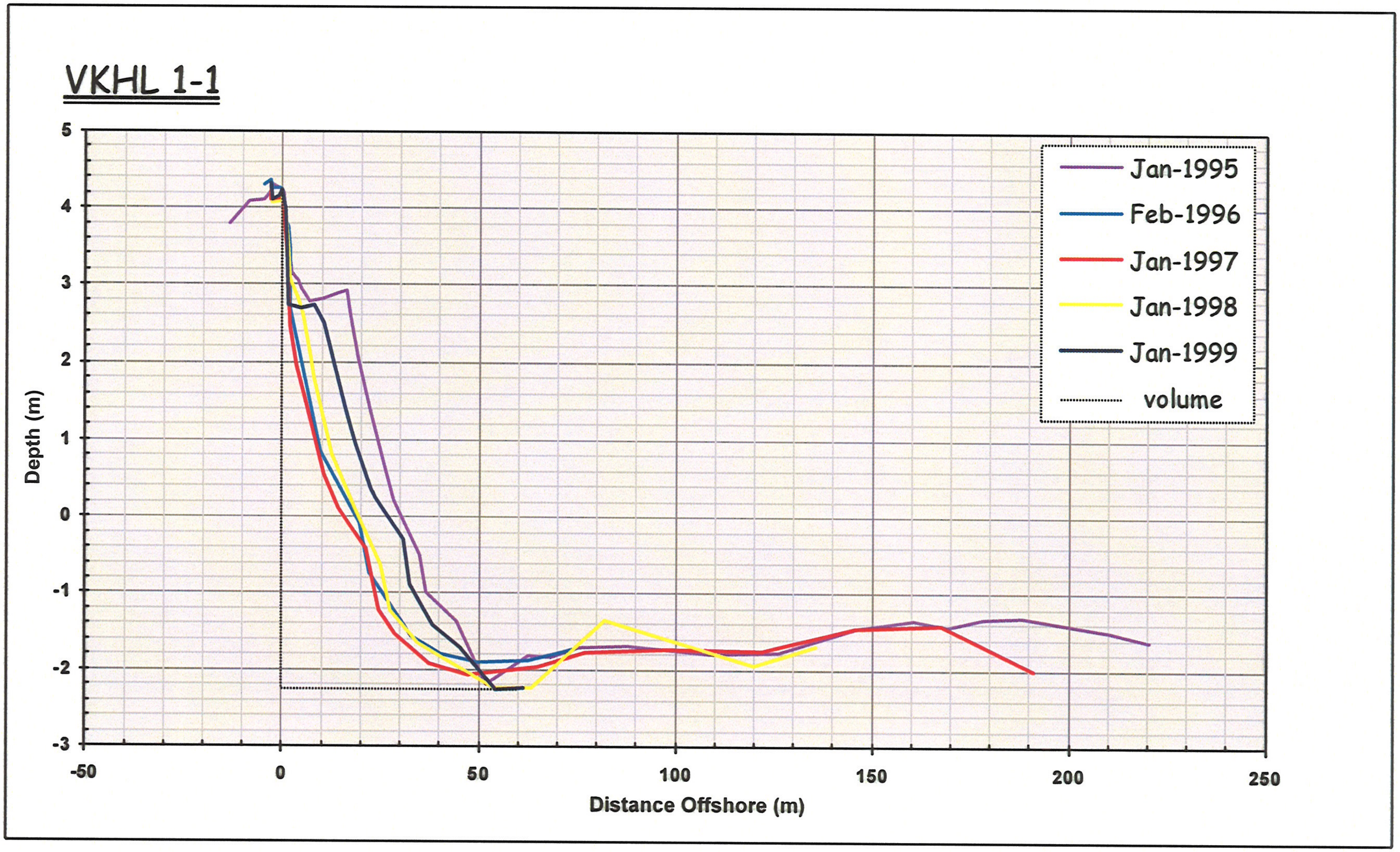


Figure 13. Winter profile data at VKHL from 1995 to 1999.

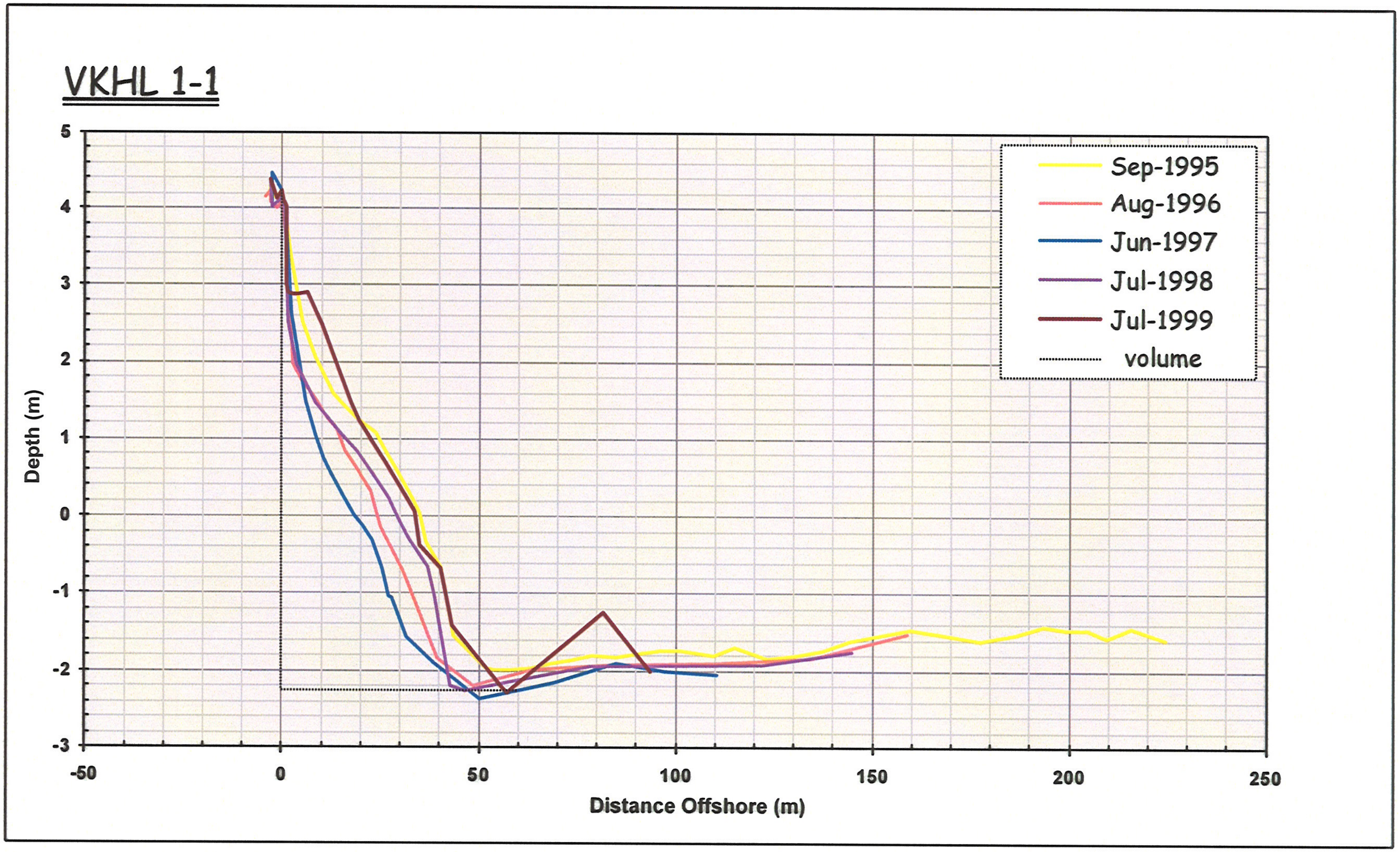


Figure 14. Summer profile data at VKHL from 1995 to 1999.

V. WAILUKU WWPS SHORELINE CHANGES

A. Long-Term Changes

This section discusses long-term shoreline changes over the last 50 to 100 years at the WWPS. The section of coast from one-half mile northwest of Waihee, south to Kahului Harbor is generally characterized as a depositional coast (Moberly 1963) due to the Waihee Reef and Iao Stream. The delta of the Iao Stream is located at Nehe Point, about one-half mile north of the WWPS. The Waihee Reef extends along the coast, with its width narrowing towards the Kahului Harbor. The south section of this reach, including the location of the WWPS, is characterized as a "low, eroding sandy coast" (Moberly 1963).

The County of Maui Shoreline Erosion Maps were obtained for the Waiehu reach, which includes the location of the WWPS (see Figure 15). The earliest shoreline position on the County Maps is the 1899 shoreline, followed by 1912, 1929, 1960, 1975, 1987, 1988, 1997, and 2002. The long-term shoreline erosion rate for the section of coast from Nehe Point to the Kahului Harbor west jetty is indicated on the below figure. The red bars indicate the Annual Erosion Hazard Rate (AEHR) in feet per year (ft/yr). Along the entire reach, the AEHR ranges from 0.0 ft/yr to -1.0 ft/yr. Directly fronting the WWPS, the historic long-term AEHR is approximately -0.3 ft/yr.

B. Historic and Current Decadal Shoreline Changes

Similarly to Section IV.B, this section will look at the historic data and summarize the changes in shorter (decadal) intervals. This will provide a better understanding of how the shoreline erosion has changed over time. The data used in the County of Maui Shoreline Erosion Maps was obtained to determine short-term erosion rates. Shorter-term erosion rates will provide information as to whether the erosion is increasing, decreasing, or constant through time and may aide in assessing potential causes for erosion based on historical events.

Figure 16 through Figure 18 illustrate shorter-term erosion trends between the various surveys available for this coast. The shoreline position at each transect was subtracted from the previous shoreline position and then divided by the number of years between shoreline surveys. This produces a shoreline change rate in feet per year (ft/yr). Each Figure shows the shoreline change rate along each of transect indicated on the County Shoreline Erosion Maps. For reference, station 135 of the County Shoreline Erosion Map is located south of Nehe Point and Station 197 is located adjacent to the west jetty at Kahului Harbor.

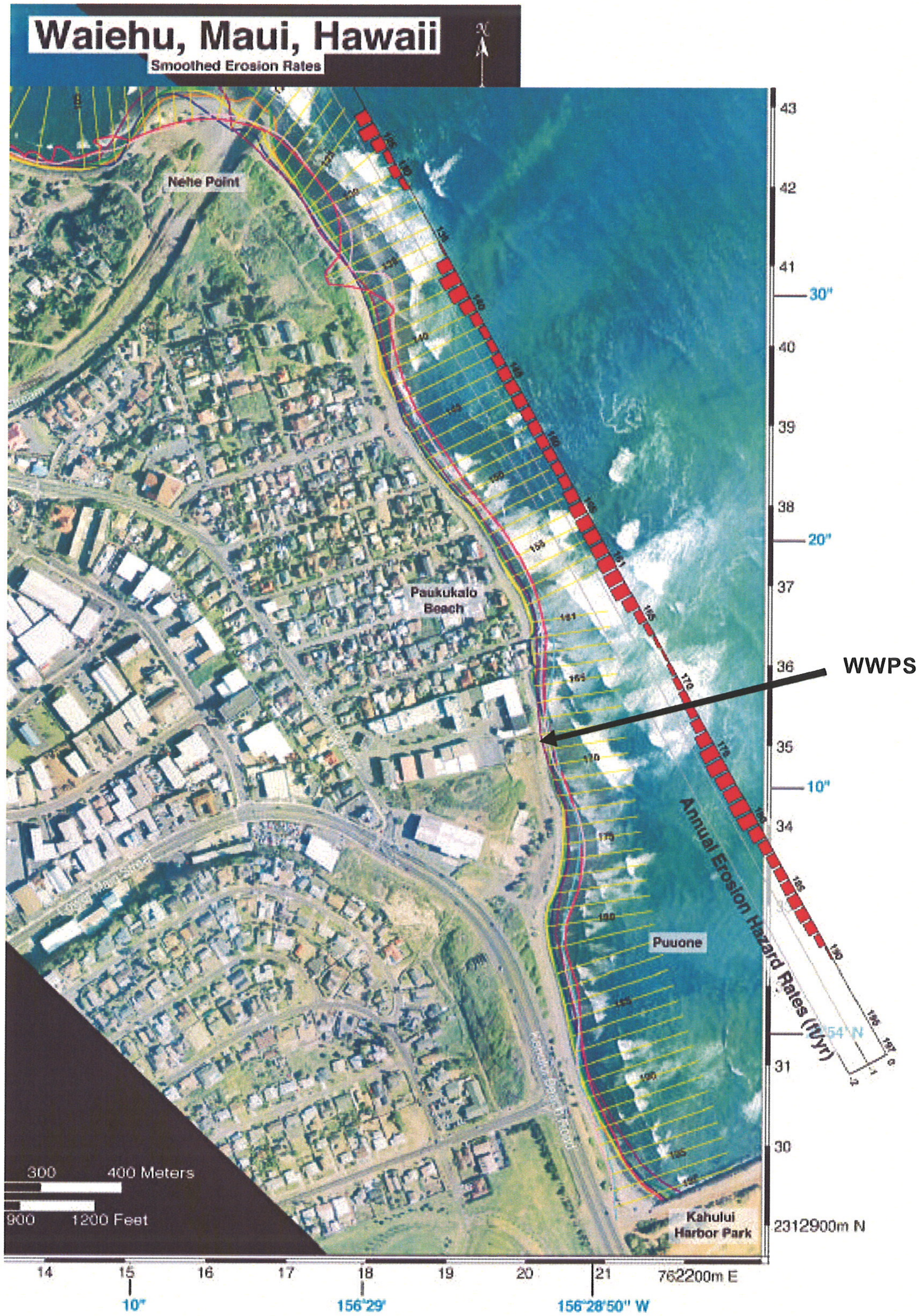


Figure 15. County of Maui Shoreline Erosion Map at the Wailuku Wastewater Pump Station.

1. 1912-1929 and 1929-1960

Figure 16 shows that from 1912 to 1929 (dashed red line), there is a trend of shoreline advance along most of the shoreline reach. The rate of change varies from 0.0 ft/yr to +2.0 ft/yr. Directly fronting the WWPS, the rate of change is approximately +1.0 ft/yr.

The next time step shown on Figure 16 represents the shoreline change rate from 1929 to 1960 (blue solid line). During this time interval, the shoreline trend reverses to slightly erosional over the entire reach. The Figure indicates that there is a -1.0 to -2.0 ft/yr erosion rate.

2. 1960-1975 and 1975-1988

Figure 17 illustrates the data from 1960 to 1975 and from 1975 to 1988. From 1960 to 1975, the shoreline along this reach remained slightly erosional, with trends ranging from 0.0 ft/yr to -2.0 ft/yr. Directly fronting the WWPS, the shoreline exhibits a positive shoreline change of over +2.0 ft/yr.

The following time interval from 1975 to 1988, the shoreline exhibits a slightly more erosional trend, ranging from 0.0 ft/yr to -2.0 ft/yr. The shoreline fronting the WWPS has a slight erosion rate of -1.0 ft/yr over these 12 years.

3. 1988-1997 and 1997-2002

Figure 18 presents the shoreline change rates between 1988 and 1997 and between 1997 and 2002. From 1988 to 1997, there was a slight erosional trend along most of the reach on the order of 0.0 ft/yr up to -2.0 ft/yr. Immediately fronting the WWPS, the shoreline was stable, with slight accretion (0.0 to +1.0 ft/yr).

From 1997 to 2002, the shoreline had a reversed to a slight accretional trend along the reach. Along most of the reach, the shoreline changed from 0.0 ft/yr to +2.0 ft/yr. At the WWPS, the shoreline appears to have an erosion-accretion wave with change rates from -2.0 ft/yr to +2.0 ft/yr. South of the site, towards the harbor, the shoreline position advanced from +2.0 to +4.0 ft/yr, which equates to a shoreline advance of 10 to 20 feet.

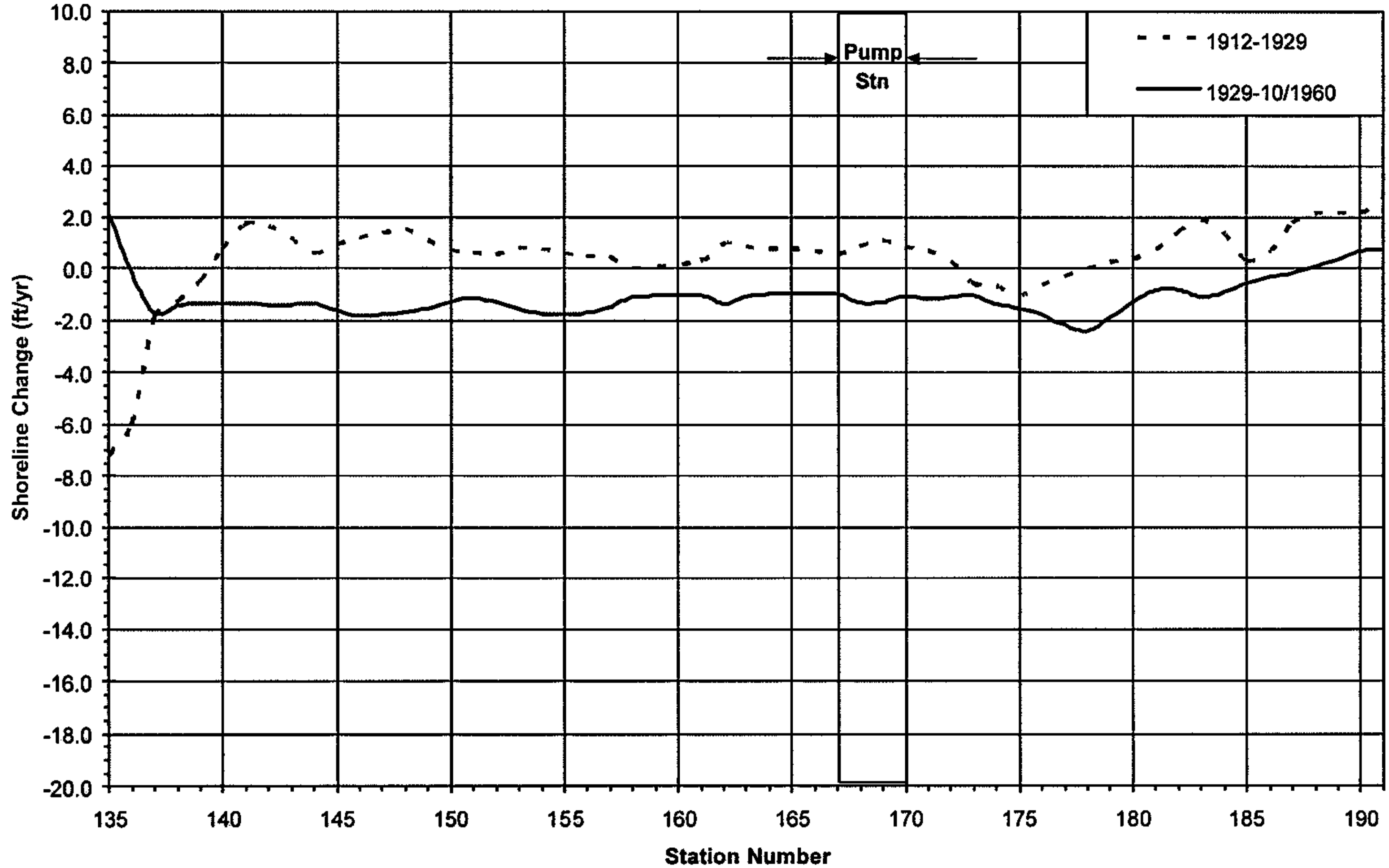


Figure 16. Shoreline Change Rate from 1912-1929 and 1929-1960 at the WWPS.

[from UH and County of Maui Shoreline Erosion Map data]

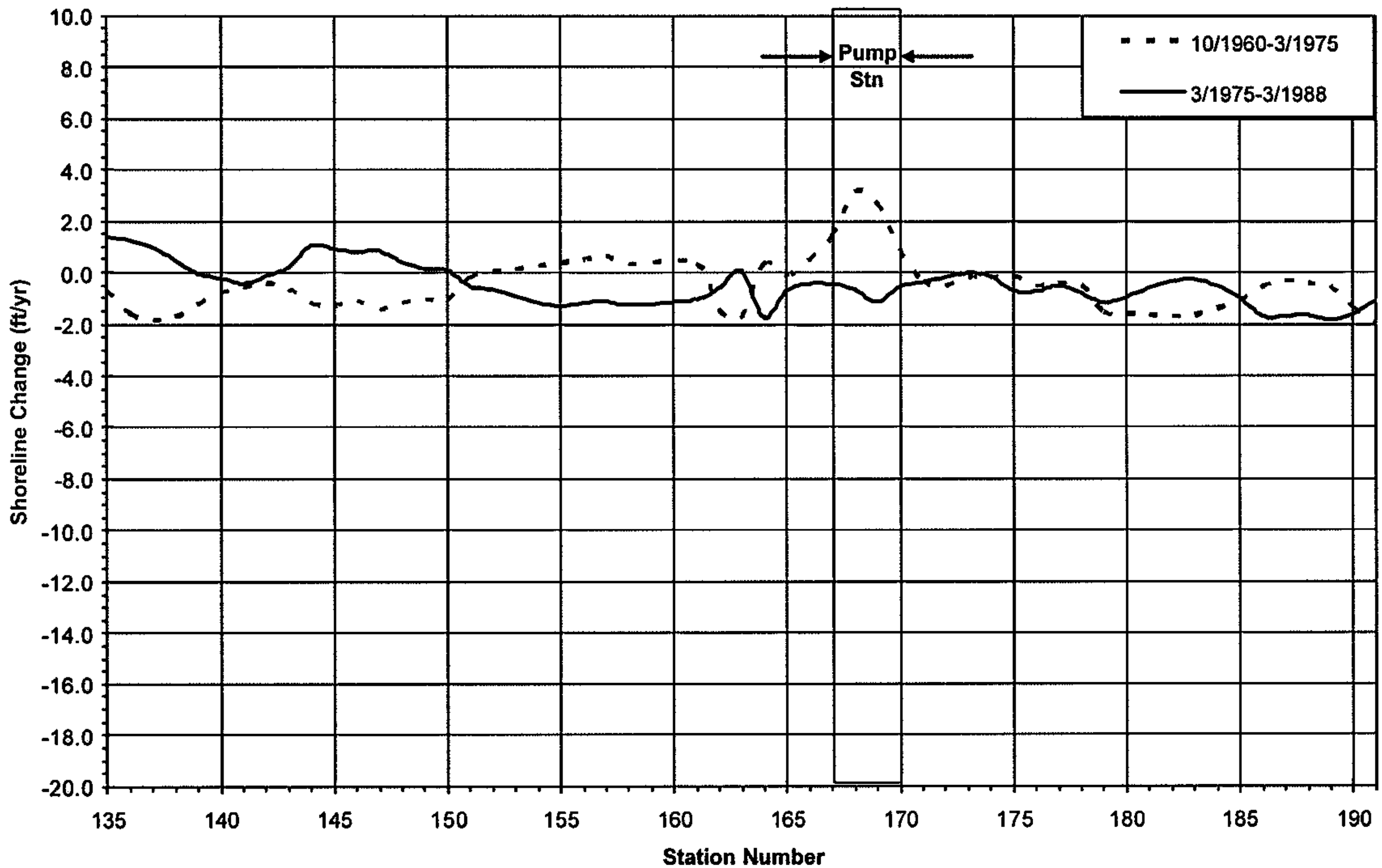


Figure 17. Shoreline Change Rate from 1960-1975 and 1975-1988 at the WWPS.
[from UH and County of Maui Shoreline Erosion Map data]

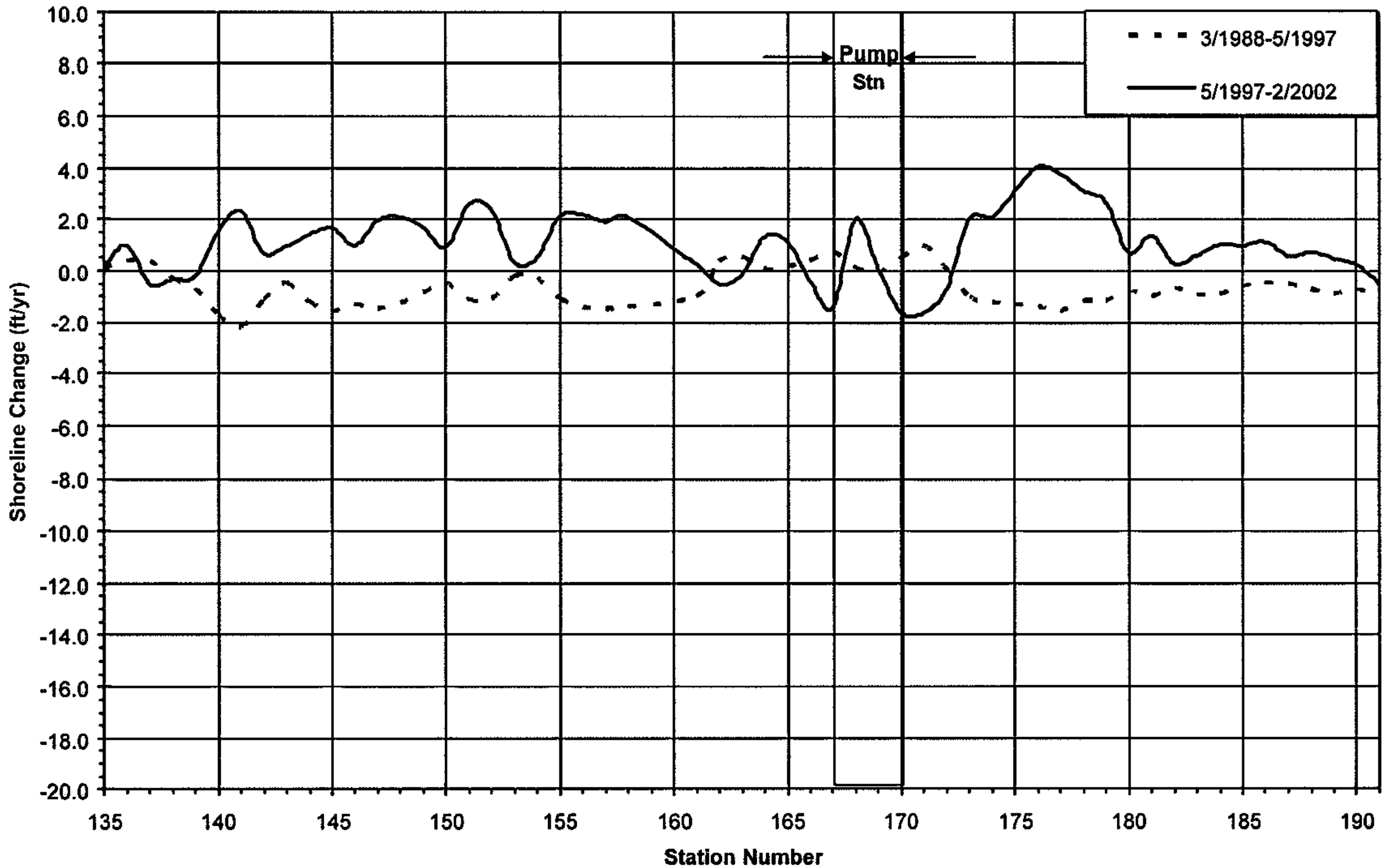


Figure 18. Shoreline Change Rate from 1988-1997 and 1997-2002 at the WWPS.
[from UH and County of Maui Shoreline Erosion Map data]

VI. POTENTIAL CAUSES OF EROSION

There are both natural and man-made influences that can contribute to shoreline erosion. The naturally occurring influences may include sea level rise, storm impacts, tsunamis, and reef changes. Man-made influences include, but may not be limited to harbor construction, shore protection structures, sand mining, damage to dune system, and reef destruction. This section presents some of the potential causes for erosion at the project area.

A. Natural Influences

1. Sea Level Rise

Relative sea level changes on the Hawaiian Islands are caused by rising sea levels, caused by global warming, and land subduction, caused by the plate movements of the islands. Globally, the mean sea level has risen by 10 to 30 cm (4 to 12 inches) over the last century. Sea level is projected to rise twice this amount (2 feet) over the 21st Century (Fletcher, et al. 2002).

In the Hawaiian Islands, the long-term trend of sea level rise caused by land subduction decreases from the island of Hawaii to the northwest (D. Jeon 1995). Therefore, the island of Maui subsides faster than Oahu and Kauai, since it is located closer to Hawaii. Tide gauge data from Kahului, Maui shows a relative sea level rise of 2.46±0.23 cm per decade (0.97±0.09 inches per decade). Approximately 1.3 cm per decade of this amount is caused by global sea level change.

Several studies indicate that future sea level rise may increase considerably (Fletcher 1992 and Fletcher *et al.* 2002). The median sea level increase on Maui is predicted to be 9.1 inches over the next 50 years and over 19 inches over the next century. With the average slopes in Hawaii varying from 1:15 to 1:6, this equates to a shoreline recession of 6 to 15 inches for every inch of sea level rise (Oceanit Laboratories, Inc. 1997).

At the Kahului Beach area, the USGS profile data indicate the shoreline slope is approximately 10 feet horizontal to one foot vertical (Brown & Caldwell 2002). With this slope a one-inch change in sea level relates to a 9.7-inch change in the relative shoreline position per decade (approximately 0.081 feet per year, or 0.97 inches per year). Overtime, the erosive effects of storms could be enhanced because of the rising sea levels.

2. Storms (Wave-induced flooding)

Elevated water levels (storm surge and wave setup) during storm events provide an elevated platform for the large storm waves to react with the shoreline. The waves can then reach higher on the beach profile and cause upper beach and dune erosion. This is evident at the WWPS site, where storm waves were elevated and reached the upper reaches of the back beach, causing sever erosion and escarpments.

3. Reefs

It has been speculated (Sea Engineering 1991 and Guild 1999) that the reefs located offshore of the Sprecklesville Beach area may not be as productive as they have been in the past. If the reef is less productive, then there would be a decrease in the coralline sand washed onshore from the reef system. The most important function of the reefs is the protection they offer against erosion (Levin 1970).

Stream flooding can cause significant flows from Maui's rivers. The discharge can cause high levels of turbidity in coastal waters. The increased turbidity, if prolonged, may have an adverse impact on the local reefs.

B. Man-Induced Influences

1. Kahului Harbor

Limited study has apparently been done assessing the effects of Kahului Harbor and its jetties on the adjacent shoreline. The long-term effects of the structures and dredging practices are not known at this time.

2. Sand Mining

In 1954, it was estimated (Cox) that approximately 12,000 cy/yr of sand had been mined from the beach area to the east of the WWRF. The sand mining continued into 1970s. The effects of this practice is evidenced in Figure 10, which shows the rate of shoreline erosion was -8 to over -16 ft/yr along the beach reach fronting the WWRF.

Also, Levin (1970) states the dredging during the sand mining efforts change the bathymetry of the nearshore area, creating "new deep water areas" and may also cause turbidity which can affect the adjacent reef systems. As stated in the previous section, reefs are needed to provide protection against erosion. Since the cessation of the sand mining, the erosion rate in this area has substantially lessened. Current shoreline change rates are around -6.0 to +6.0 ft/yr.

3. WWII Training Exercises

WWII training exercises destroyed portions of Maui's reefs during the early to mid-1940s. This is evidenced on South Maui, at south Kalama Park in 1943-1945. The Navy underwater demolition team blew up reef as practice for beach landings for the war in the Pacific. Also, there is evidence that other reefs in south Maui were destroyed by the Navy in

1945 at the request of the County of Maui in an attempt to improve the quality of the swimming beach (Halama Beach Homeowners Association 1999).

Evidence supporting these types of activities on Maui's north shore have not been found, but it has been speculated that some of the WWII training exercises did take place along Sprecklesville Beach area.

4. Dune Destruction

Dunes are important components to the coastal processes. Dunes serve to trap wind-blown sand, store excess beach sand, and serve as natural erosion protection. Increased public access over the natural dune system can destroy the natural stabilizing dune vegetation. Also, flood control channels that cross the natural dune system can contribute to the dune destruction. Both of these cases cause direct sand loss, as well as allowing wind-blown sand to migrate inland of the shoreline and out of the littoral system. A region-wide dune restoration project could have a significant impact on reduction of shoreline erosion. This type of program is recommended by the Beach Management Plan for Maui (1997).

VII. NO-PROJECT ALTERNATIVE

A. WWRF

The most recent shoreline surveys indicate the shoreline west of the WWRF revetment is eroding at a rate of up to six feet per year. The average shoreline change rate along the WWRF property is approximately -2.4 feet per year. The County of Maui shoreline Erosion maps indicate the long-term Annual Erosion Hazard Rate (AEHR) is -2.2 feet per year along the coast from Hobron Point to Kaa.

For the no-project alternative, it is assumed that current shoreline change trends will continue in the future and no further shoreline protection will be constructed at the site. A 2001 shoreline survey and site map of the WWRF (Brown and Caldwell 2002) were analyzed to determine when the first structures at the WWRF site could be threatened. This site map is illustrated in Figure 19. The equation below was developed to calculate the years until a structure is threatened.

$$Y = \frac{D - W}{SL + LTE}$$

Where D is the distance between the structure and the back of the beach (approximately the +10-ft contour), W is the winter recession, SL is the shoreline recession due to sea level rise, and LTE is the current longer term erosion rate.

Maximum and Average values were used for the winter recession and the current erosion rate to calculate a range of years until the structures are threatened.

For this analysis, it is assumed the revetment will remain and be maintained in place and will provide protection to the holding pond and other upland structures behind the revetment. It is assumed the revetment has ceased further erosion to the area immediately behind it.

Table 3 below outline the approximate number of years until WWRF structures could be threatened using both, the maximum current erosion rate (-6.0 feet per year) and the average current erosion rate (-2.4 feet per year) (See Section IV for further details on these rates) . The seasonal recession was determined from analyzing the USGS profile data from 1995 to 1999. For this time period, the minimum recession is 0 ft (no change between summer and winter) and the maximum is 53.5 ft between summer and winter. It is noted that these data are very limited and no extreme storms or large hurricanes occurred during the 1995 to 1999 time period (Gibbs, Richmond, and Fletcher 2000). Section VI.A discusses the effects of sea level rise and states that a change of approximately 0.081 feet of horizontal recession occurs every year at the project area as a result of relative sea level rise.

Subtracting the winter recession (W) from the distance of the structure to the back of the beach (D), and then dividing by the combined erosion rate (SL + LTE), gives the time before the structure is considered threatened.

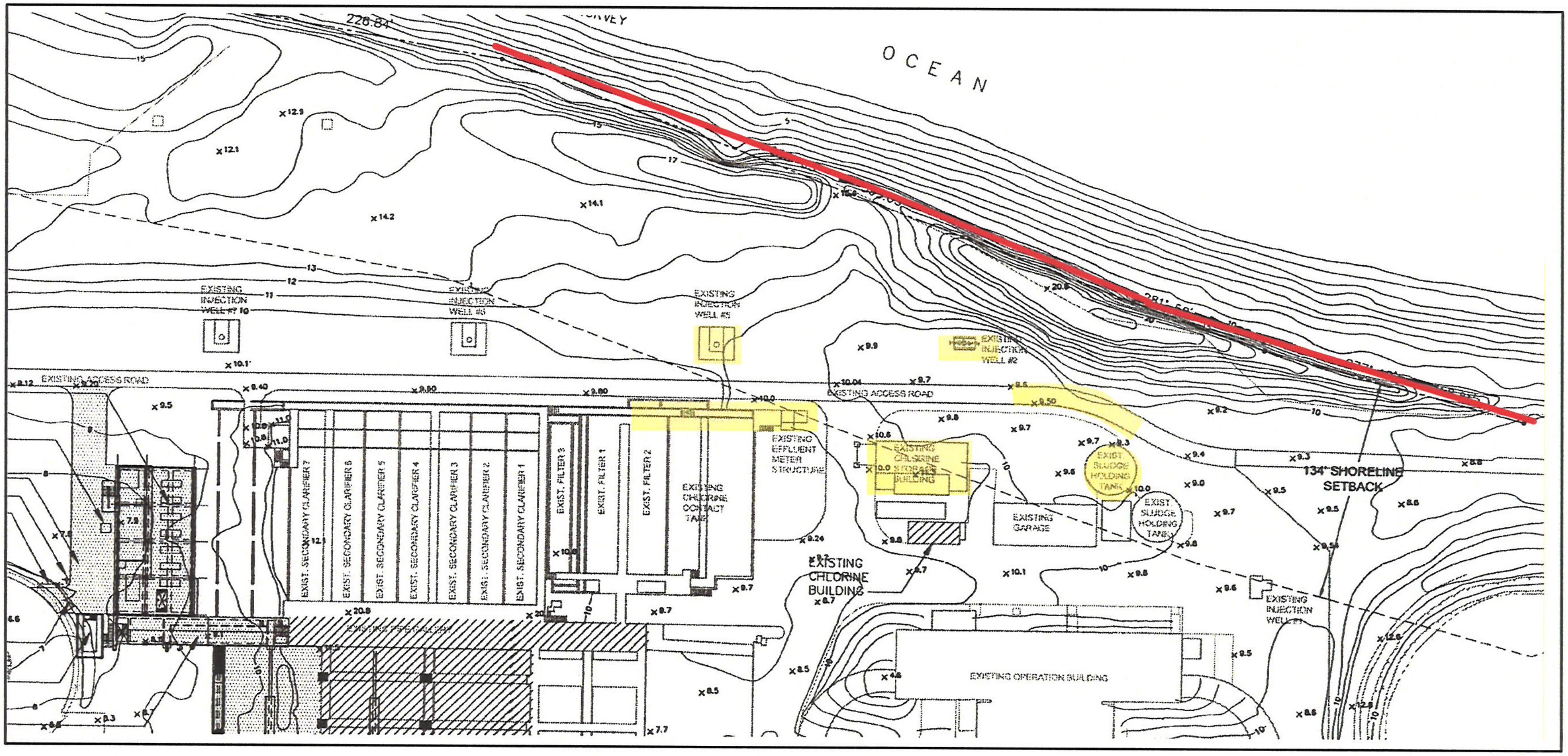


Figure 1. Wailuku-Kahului Wastewater Reclamation Facility
[from Brown and Caldwell 2002]

Table 3. Calculation of Years until WWRF Structures are Threatened.

		MINIMUM/AVERAGE CONDITIONS				MAXIMUM CONDITIONS			
Structure	Distance between top of berm and structure (ft)	Minimum Winter Recession (ft)	Average Recent Erosion Rate (ft/yr)	Sea Level Rise Recession Rate (ft/yr)	Approx. Yrs until Threatened	Maximum Winter Recession (ft)	Maximum Recent Erosion Rate (ft/yr)	Sea Level Rise Recession Rate (ft/yr)	Approx. Yrs until Threatened
Existing Access Road	65	0.0	2.4	0.0807	26	53.5	6.0	0.0807	2
Sludge Holding Tank	90				36				6
Chlorine Storage Bldg	120				48				11
Effluent Meter Structure	140				56				14
Existing Injection Well #2	72				29				3
Existing Injection Well #5	110				44				9

Table 3. Calculation of Years until WWRF Structures are Threatened. (Continued)

		MIN-MAX CONDITIONS				MAX-AVG CONDITIONS			
Structure	Distance between top of berm and structure (ft)	Minimum Winter Recession (ft)	Maximum Recent Erosion Rate (ft/yr)	Sea Level Rise Recession Rate (ft/yr)	Approx. Yrs until Threatened	Maximum Winter Recession (ft)	Average Recent Erosion Rate (ft/yr)	Sea Level Rise Recession Rate (ft/yr)	Approx. Yrs until Threatened
Existing Access Road	65	0.0	6.0	0.0807	11	53.5	2.4	0.0807	5
Sludge Holding Tank	90				15				15
Chlorine Storage Bldg	120				20				27
Effluent Meter Structure	140				23				35
Existing Injection Well #2	72				12				7
Existing Injection Well #5	110				18				23

The previous tables illustrate that in as few as 3 years, the existing injection well #2 could be threatened using the maximum current erosion rate and maximum winter recession rate that was observed from 1995 to 1999. The access road could be threatened in as few as 2 years and the existing sludge holding tanks in as few as 6 years. The chlorine storage building is located approximately 120 feet from the fence line, which relates to a minimum of 11 years before the structure is threatened using the maximum erosion rate and seasonal change. Table 4 below outlines the structures evaluated on the WWRF site and the minimum, maximum, and average time until each structure is considered threatened. These values are also supported by the recent exposure of an effluent line east of the revetment resulting from the erosional trends and winter storm response at the beach.

Table 4. Summary of WWRF Structures that may be Threatened.

Structure	Approx. Minimum Time (yrs)	Approx. Maximum Time (yrs)	Approx. Average Time (yrs)
Existing Access Road	2	26	11
Sludge Holding Tank	6	36	18
Chlorine Storage Bldg	11	48	26
Effluent Meter Structure	14	56	32
Existing Injection Well #2	3	29	13
Existing Injection Well #5	9	44	24

It is possible that most of these structures identified above could be relocated elsewhere on the WWRF property. However, the northeast corner of the Chlorine contact tank and effluent meter structure is located approximately 140 feet from the existing fence line. The size of this structure and its position in the wastewater treatment cycle would prohibit it from being relocated elsewhere on the property. With this distance, the chlorine contact tank and effluent meter could be threatened in as little as 14 years.

Also, observations during the site visit on July 16, 2004, indicated signs of flanking around the ends of the revetment. If this flanking continues, the revetment could become unstable and the shoreline in its immediate shadow may take on erosion hot-spots. It is imperative that the revetment be maintained for the life of the WWRF to provide protection to the upland structures.

B. WWPS

The shoreline at the WWPS is naturally protected by rubble beach from further short-term erosion. However, the upland property and structures are not protected from erosion caused by storms (elevated water levels and subsequent wave attack). Therefore, the upland property will continue to fail and erode during large storms unless protection is offered. Estimating the amount of time before structures at the WWPS are threatened is difficult to assess since the majority of erosion at this site is caused by large storms and waves, which occur at irregular intervals.

VIII. POTENTIAL PROJECT ALTERNATIVES AT THE WWRF

This section reviews potential alternatives for protection of the WWRF property. The alternatives that are presented include beach nourishment, groins with beach nourishment, revetment, revetment with beach nourishment, and coral rubble revetment.

A. Alternative 1 - Beach Nourishment

Beach nourishment is a proven method to stabilize a shoreline against erosion and protect threatened upland areas. However, there is very limited beach nourishment experience in Hawaii, especially using offshore sand sources. This limited experience makes it difficult to predict performance as well as assess construction and maintenance costs of a larger-scale beach nourishment project. Historically, most small-scale beach nourishment projects on Maui have used sand from inland sources. These inland sediments are typically finer grained than the natural beach sand, and may not be the most compatible sediments available for large-scale projects, such as the WWRF beach site.

Recent smaller-scale beach nourishment projects have occurred on Maui at Sugar Cove, located approximately 4 miles east of Kahului Harbor. These projects include trucking sand from the inland quarries and placing the material in a small (600-ft long) pocket beach. The initial nourishment costs were approximately $100,000 and approximately $20,000 per year for ongoing maintenance. From 1995 to 2000, Sugar Cove has placed approximately 18,000 cy of sand on their beach. The larger projects during this time included approximately 5,800 cy in 1996 and approximately 6,300 cy in 1998. Research indicates the Sugar Cove project has purchased and placed the sand for about $12/cubic yard from the local inland source. All of the project costs have been covered by the Sugar Cove residents and approvals for the projects have been readily obtained (<http://www.hawaii.gov/dbedt/czm/ce111997.htm>).

Another recent beach nourishment project is a pilot project at Waikiki, scheduled to begin in late February/early March 2005. This project is a small-scale pilot project that involves pumping 10,000 cy of sand from an offshore sand source to Kuhio Beach. Total project costs are approximately $450,000, which includes $320,000 for the direct cost of pumping the sand ($32 per cubic yard) (Eversole, e-mail communication, 2005).

The U.S. Army Corps of Engineers (USACE), Honolulu District, is conducting an erosion study in the Kihei area. The study will look at the restoration of approximately seven miles of shoreline. The study reach is on Maui's southeast coast and extends from Kihei park in the north to Keawekapu point in the south (USACE 2003). Potential sand sources should be identified in the study.

It is well established that beach nourishment projects constructed with larger volumes and coarser materials tend to remain on the upper portion of the beach for longer time periods. Smaller and finer-grained projects tend to disperse more rapidly and remain on the upper beach for a shorter time period. Therefore, it is important to use the best-suitable sand source for any beach nourishment project.

The two alternatives presented in this section propose to acquire sandy material from either upland and/or offshore sand sources and placed along the shore fronting the WWRF.

1. Alternative 1A – 4,000-ft Long Beach Nourishment

The project reach for this alternative extends from Kaa to the WWRF western property boundary; a distance of approximately 4,000 feet. The purpose of nourishing the entire reach is to allow for the upcoast (east) beach area to act as a feeder beach to the downcoast (west) beach area. Since the net sediment transport is from east to west, the material placed near Kaa would migrate west over time, offsetting some of the maintenance required for the downdrift area fronting the WWRF.

This alternative requires approximately 215,000 cy of initial fill placement to create an 80-foot wide berm to provide a sand buffer between the property and the ongoing erosion. The nourished beach would continue to erode as it would under natural conditions and periodic maintenance nourishments would be required for the life of the project. The USGS profile data indicate that the maximum seasonal variation along the shore at the WWRF is approximately 50 feet. Therefore, the project would require renourishment when the nourished beach width has receded approximately 30 feet, preserving the 50-foot seasonal change. It is estimated that approximately 85,000 cy would be required for this renourishment every 10 years to maintain the project design width. However, the frequency may be longer than this estimate if the updrift beach acts effectively as a feeder beach providing more material to the beach fronting the WWRF. Figure 20 provides a cross-section illustration of the beach fill at the site and Figure 21 provides a plan view of the project reach.

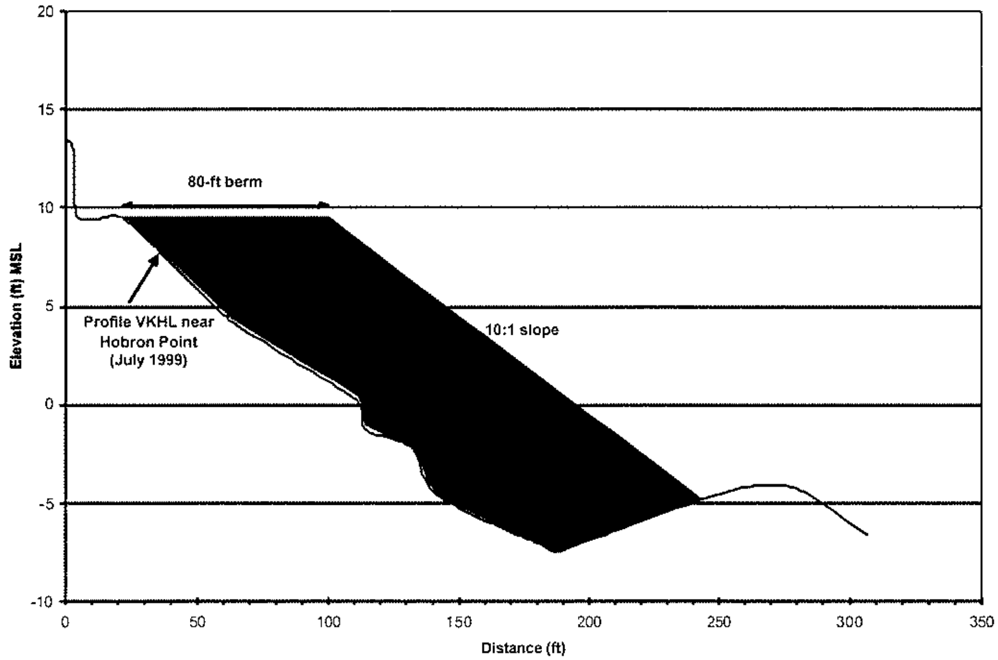


Figure 20. Alt. 1A and 1B - Cross-section of beach nourishment at the WWRF site.

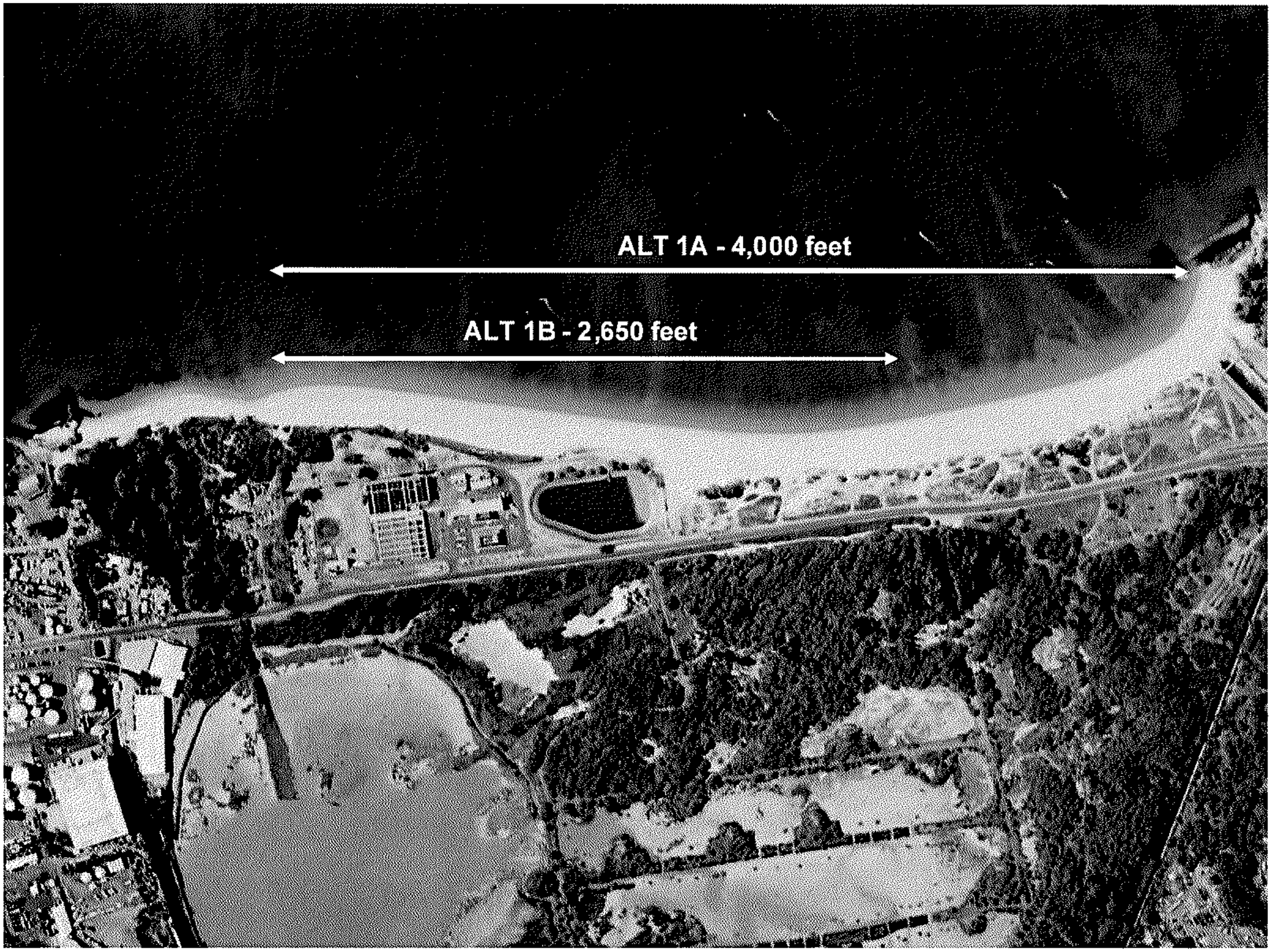


Figure 21. Plan view of the beach nourishment alternatives at the WWRF site.

2. Alternative 1B – 2,650-ft Long Beach Nourishment

This alternative is similar to Alternative 1A, above; however, the beach fill length is reduced to approximately 2,650 feet. The nourishment extends along the WWRF property to about 1,000 feet east of the existing revetment. Similar to above, the nourishment area would continue to erode as it would under natural conditions. However, smaller beach nourishment projects typically have less success with retaining beach area over the long term. Therefore, careful consideration should be exercised in analyzing a reduced beach nourishment length.

Since the project reach is shortened, the upcoast (east) fill area will not provide as much feeder material to the downcoast (west) beach area fronting the WWRF. Therefore, the frequency of renourishment may need to be increased. This alternative requires approximately 145,000 cy of initial beach fill to create an 80-foot beach berm. Approximately 55,000 cy would be required every 8 years to renourishment and maintain the project design width. Figure 20 provides a cross-section illustration of the beach fill at the site and Figure 21 provides a plan view of the project reach for both beach nourishment alternatives.

3. Sand Sources

Moberly and Chamberlain (1964) conducted sand samples analyses on various Hawaiian beaches. The sands from the Kahului to Sprecklesville area were almost entirely carbonate. Mechanical analyses were made of sand samples taken from the berm and approximate sea level. At the beach adjacent to the east breakwater at Kahului Harbor, the grain size was found to be 0.2-0.5 mm at the berm and 0.3-1.0 mm at sea level. The median diameter of Maui's Windward beaches had a median diameter of 0.18 mm. They concluded that finer-grained sediments were found on the windward coasts of all of the islands analyzed; however, the authors found that Maui's beach sands were typically finer than sands found on the other Hawaiian Islands.

There are several known inland sources of sand for construction of a beach nourishment project. Maui dune sand is relatively fine sand that is found in the upland areas and is used for dune and minor beach fills. Typically, fine-grained sediments are not ideal for high-energy beaches, such as the Kahului Beach area. Bodge (1999) stated the Honokowai Beach Park site, the upland dune material exhibited a 45% overfill requirement. There is an inland dune quarry that has been used for source material located in Happy Valley, approximately 10 miles from Sugar Cove (Guild 1999). The inland sand mines on Maui have historically charged between $10 and $18 per cubic yard. However, on other islands, the cost has ranged from $25 to $60 per cubic yard (Honolulu Advertiser, September 9, 2004).

For this analysis, a cost of $25 per cubic yard was assumed for the sand material, but whether inland, offshore, or a combination of sources is not defined. It is noted, however, that the costs for inland sources may increase substantially due to the large volume required to construct Alternatives 1A or 1B. These large volumes will likely make the use of inland source material cost-prohibitive. Ultimately, offshore borrow areas may be less costly for a beach nourishment project requiring large volumes.

Using offshore borrow areas involves dredging the sandy material and pumping it to the shore. The Waikiki demonstration project will be the first major pumping operation of its kind in the Islands, and could be a prime example for slowing beach erosion across the state (Honolulu Advertiser, September 9, 2004). Maui's Beach Management Plan (University of Hawaii Sea Grant Extension Service and County of Maui Planning Department 1997) recommends that a pilot project for beach nourishment is "very much needed." This plan also states that in order to ensure a successful pilot beach nourishment project, a site-specific, coastal engineering study would be needed.

B. Alternative 2 - Beach Nourishment Augmented with Sand Retention Structures (T-Groins)

This alternative includes constructing seven sand retention structures (groins) along the 2,640-foot project reach and filling the area with sandy material. The groins replicate natural sand barriers, such as headlands and smaller rock outcroppings, blocking the longshore transport and "trap" the sand in the pockets between the structures. Therefore, the initial fill volume and renourishment volume and frequency are decreased compared to conventional beach nourishment.

Approximately 40,000 tons of quarried rock is required to construct the groin system and approximately 130,000 cy of sand is required for the initial beach fill. Renourishment is proposed every 10 years with approximately 40,000 cy of sand to maintain the design profile within the project area. This alternative provides added longevity to the beach fill and provides better public access than a revetment alone. Figure 22 and Figure 23 illustrate the groins and beach fill.

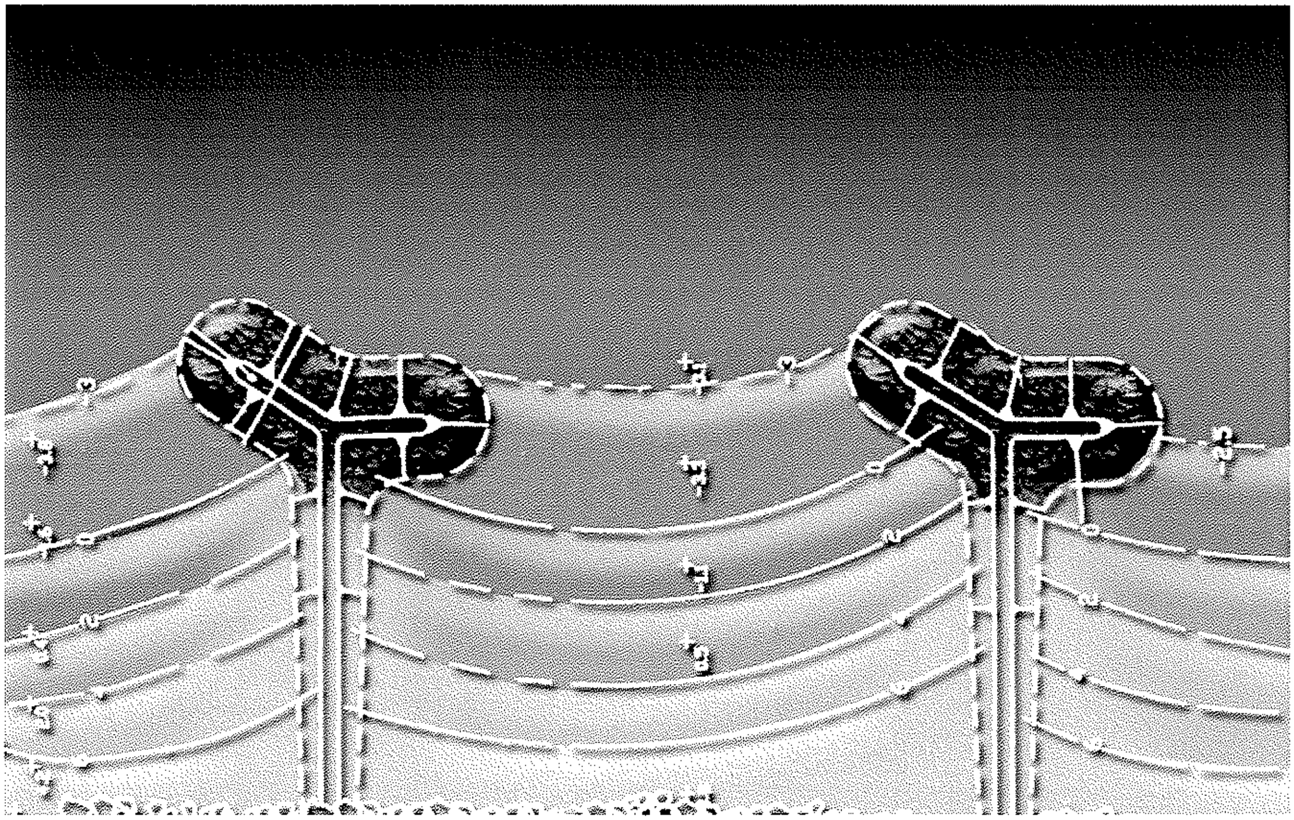


Figure 22. Details of the T-Groin Structure

1. Sources of Armor and Nourishment Material

Both inland quarries and inland boulder fields are typically used for acquiring armor stone for beach protection structures. The inland boulders are typically located in the sugar cane fields and are found from the preparation of the soil for planting and/or harvesting.

The beach nourishment material may be acquired from inland and/or offshore sand sources, as described in Section VIII A.3. For this study, we estimate a cost of $75 per ton for the large armor stone, $65 per ton for the under layer rock, and $25 per cubic yard for the nourishment material.

Figure 23. Plan view of site with T-Groins and Beach Nourishment.

C. Alternative 3 - Armor Rock Revetment

Hard structures, such as revetments and seawalls, can provide shoreline protection as a last line of defense from coastal erosion resulting from storm wave attack, storm- and tsunami-induced erosion, and long-term shoreline retreat. Without the structures, the beach would continue to erode and threaten the upland area. Typically, hard structures are not as acceptable to the public or regulatory agencies as soft structures, such as beach nourishment. At the WWRF site, the existing revetment could be extended along the property to provide upland protection from severe erosion and storm events. The east flank of the existing revetment may need to be extended or revised to minimize further flanking.

1. Alternative 3A – Revetment Extension

The USACE constructed the original 450-foot revetment in 1979 for a total cost of approximately $300,000 with federal and non-federal funds. For this alternative, the revetment would be extended to the west along the WWRF property length, a distance of approximately 1,200 feet, and would require approximately 14,000 tons of armor and under layer rock. The revetment would be constructed along the back portion of the beach, close to the existing fence line, and would be a similar design to the existing revetment. The existing beach material that was removed to construct the revetment would be replaced over the structure, but no further sand would be added to the system. Figure 24 and Figure 25 illustrate the plan view and cross-section of the revetment alternative.

2. Alternative 3B – Buried Revetment

This alternative includes adding beach nourishment with the revetment to provide a recreational beach area and to minimize impacts to littoral transport and adjacent beaches. The revetment would remain buried and would retain a last line of defense for protection of the WWRF in the event of severe erosion caused by storms or tsunami. A decreased beach width is proposed, since it is not necessary to provide protection from the seasonal fluctuations as the revetment will protect the property in the absence of any sand. Normal seasonal accretion in front of the revetment will be encouraged such that the revetment remains covered the bulk of the time. With proper planning of the revetment location and periodic beach nourishment maintenance, the seasonal erosion and accretion will occur naturally in front of the revetment.

This alternative includes approximately 75,000 cy of initial beach fill, creating a 50-foot beach berm. The beach nourishment extends along the entire length of the proposed and existing revetment and to the east for an additional 500 feet. The total project length is approximately 2,150 feet. Approximately 30,000 cy of renourishment is required every eight years to maintain the project design width. The profile would be similar to Figure 25, but would be buried by the nourishment material. Sources for the armor and nourishment material are discussed in Sections VIII A.3 and VIII B.1, above.

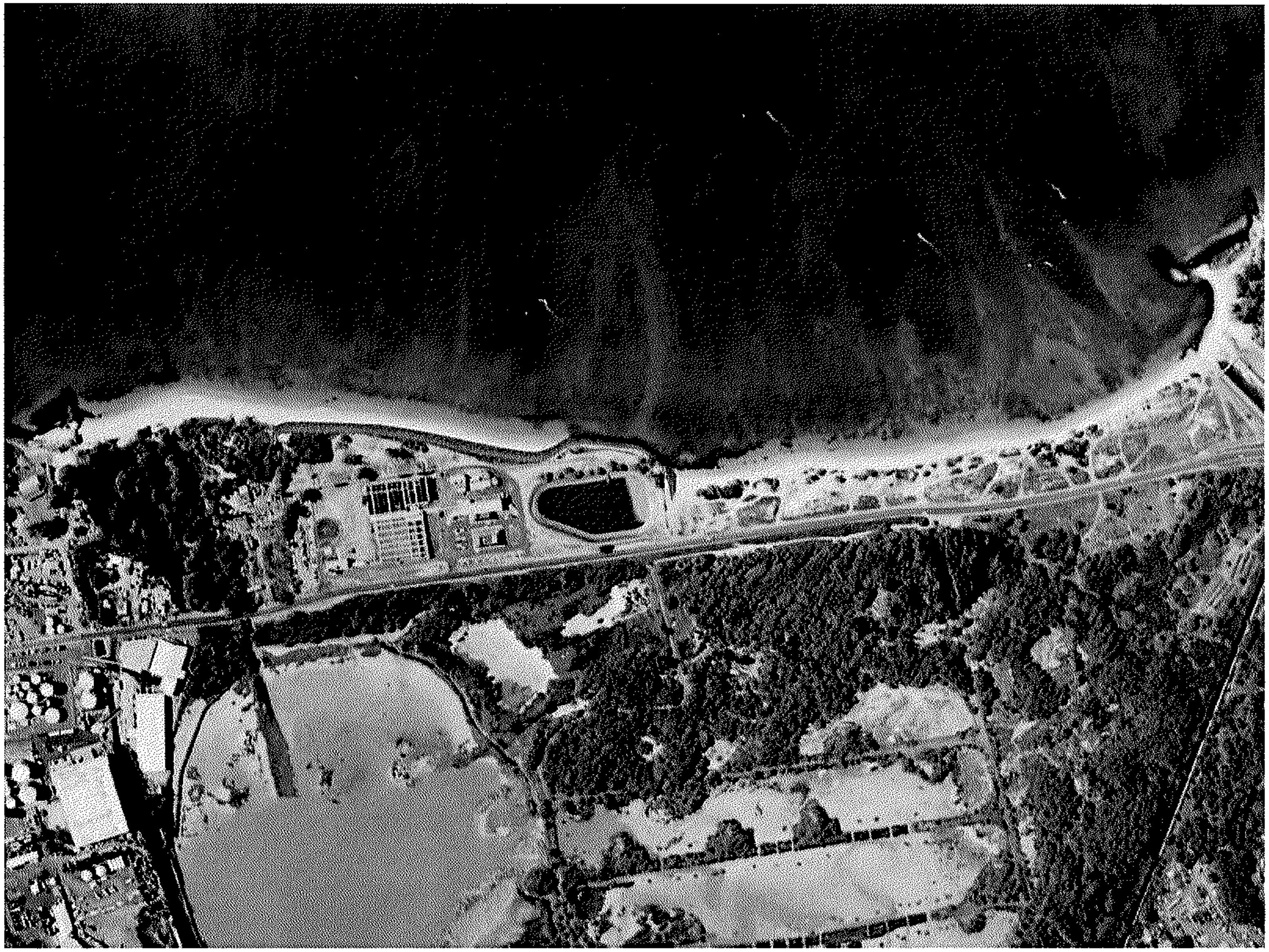


Figure 24. Plan view of Revetment Alternative

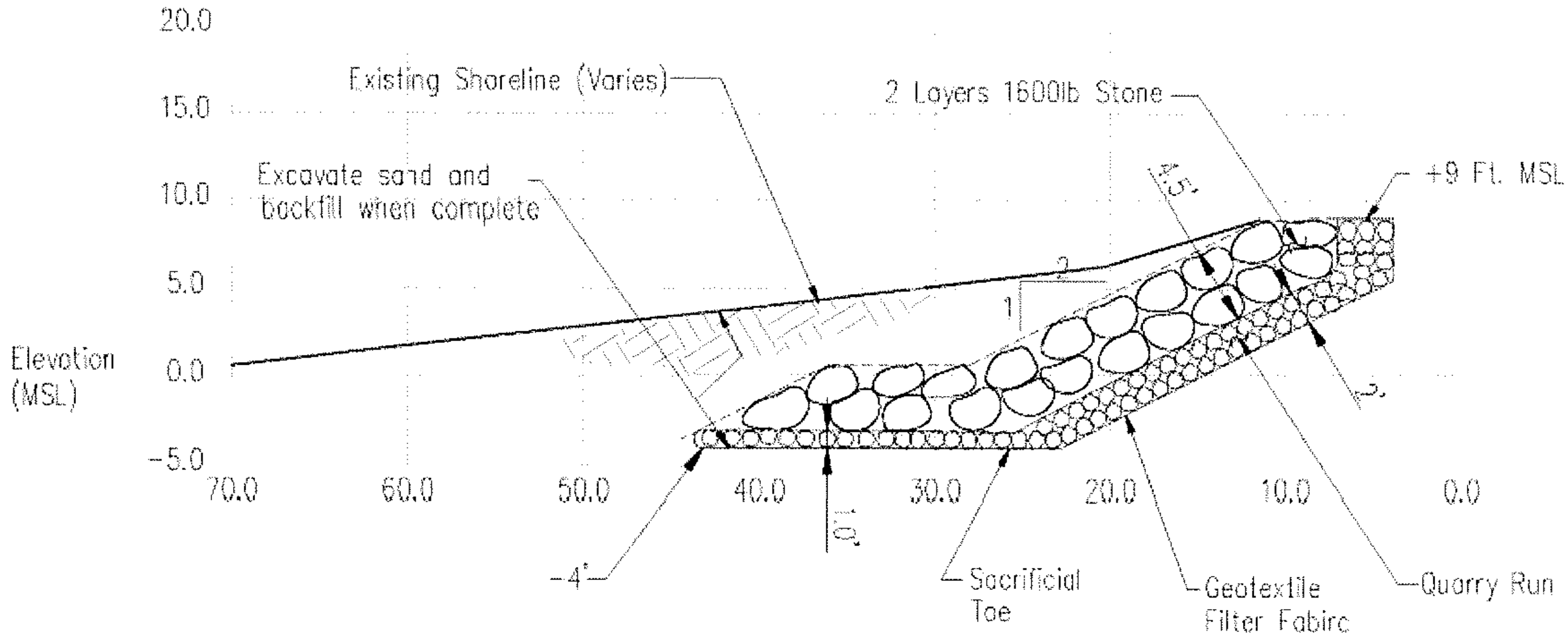


Figure 25. Typical Revetment Cross-Section

D. Other Alternatives

1. Coral Rubble Fill

Use of cobble as beach nourishment is not typical along most areas of the U.S. The practice has achieved wider acceptance in Europe. There have been some small-scale projects constructed in Southern California along reaches where the beach is naturally composed of cobble. A photograph of a cobble beach nourishment project in Southern California is provided in Figure 26. Applying a similar project to the WWRF property would include using coral rubble as the fill material. This would potentially provide a more stable beach than using sand, since the coral rubble is heavier and less subject to longshore transport. Overtime, the coral would break apart by the wave action and create a sandy surface.

The County had historically used coral rubble as road base material until this practice was discouraged since the rubble is littoral material and should remain in the littoral zone. Sources for such a coral rubble fill are not extensively known, although accumulations of this material can be observed along many of Maui's shorelines.

Due to the severity of the erosion at the WWRF and the high importance of the recreational beach use and reclamation facility to Maui residents, this type of project may not be practical and conventional methods are probably preferred.

2. Vertical Seawall and Hybrid Structure

Because the site is already protected by an armor stone revetment and because of the relatively limited public use of the beach fronting the property, a vertical seawall is not considered further. It is our experience this type of structure is significantly more expensive and is more beneficial in areas where the public benefits of retaining beach space far outweighs the costs of construction and maintenance.

Figure 26. Picture of a cobble nourishment project, City of Ventura in Southern California.

E. Potential Environmental Impacts

Potential impacts from construction of any of the alternatives may include temporary and permanent impacts. Temporary impacts include traffic congestion from trucking sand or armor to the beach; air quality impacts from the trucking, construction equipment, and dredge equipment; and turbidity impacts during placement of sand.

Permanent impacts from construction of a shore protection project include increased sedimentation at Kahului Harbor, impacts to adjacent shorelines, biological impacts (reefs), and impacts to public access. Precautions would be taken to prevent eroded soils, construction debris, and other contaminants from entering the coastal waters. Increased sedimentation at Kahului Harbor may occur from the placement of large quantities of beach fill along the reach east of the harbor. This may require more frequent maintenance dredging to maintain the design depth in the harbor.

Surrounding beaches may benefit from the placement of sand as the sand disperses and longshore transport carries the sand up- and downcoast. However, careful design and modeling may be necessary prior to implementation of any beach fill alternative to ensure the fill material does not migrate significantly offshore, burying the reefs along the project coast.

Impacts to adjacent beaches from the construction of a revetment or shore-parallel structures, such as seawalls, are the subject of much controversy. Most science indicates such structures do not negatively impact adjacent shorelines, unless they prevent erosion of an upland source of sand for a beach downdrift or are so situated that they act as a groin. Revetments and seawalls are usually constructed on eroding beaches to protect the upland property. They are also constructed in some cases on stable beaches, providing as needed protection against short-term storm-induced erosion. The former is the case for this project. Maui's north coast is actively eroding and will continue to erode under natural conditions.

Beach nourishment provides better public access than hard structures, such as the groin system and revetment. However, the groin system does provide more sand retention, requiring less volume of initial sand and less frequent renourishment. The revetment will provide a last-line of defense to the facility if a major storm or tsunami occurs. Beach nourishment alone will probably not provide the same protection to the facility.

Monitoring will be required for any alternative constructed at the site and may include beach profiling, grain size analysis, project performance, and any observable adverse water quality impacts.

F. Regulatory Requirements

The State of Hawaii and County of Maui are the local regulatory agencies for permitting shore protection structures. The main regulations pertaining to shore protection include the Hawaii Revised Statutes Chapter 205-A, Coastal Zone Management, and the Shoreline Rules for the Maui Planning Commission.

In general, the State and County will not approve any shore protection (except sand placement) unless a structure is imminently threatened. An imminent threat means the structure is within the shoreline setback area. At the WWRF facility, the shoreline setback line is approximately 134 feet from the chain link fence on the northern boundary of the property. Some of the WWRF structures are located within this setback area.

If a structure is within the shoreline setback area and is not under an emergency situation, then the County proceeds in its regular process of building a new structure in the Special Management Area (SMA). The first item the County considers is if the structures can be relocated. In the case of the WWRF, some structures may be relocated, but most of the large process areas cannot be relocated because of limited area at the site. Since many of the structures at the WWRF cannot be relocated, County regulators may require a long-term commitment to beach replenishment program be implemented and also provide safe lateral public access along the shoreline. This can either be a walkway on or near the revetment or beach area for the public.

In general, the State will not allow hard structures to be placed within its jurisdiction, so most applications for hard structures will be permitted under the County SMA, and will need to be placed entirely within the boundaries of the property owner (landward of the shoreline). In order to acquire a variance from the County to construct a hard structure, an Environmental Assessment, public notice, and a public hearing will need to be conducted. A variance can be approved for improvements proposed by public agencies or public utilities regulated under Hawaii Revised Statutes (HRS) Chapter 269. The Wailuku-Kahului Wastewater Reclamation Facility is a County-owned pubic utility regulated under this statute

G. Cost Estimates

Costs for each of the alternatives were estimated based on both, Present Value and Annualized costs for both the construction and maintenance cycle. Each alternative has a 50-year design life. A more detailed cost estimate for each alternative is provided in Appendix B.

Present Value Costs calculate the initial construction and future maintenance costs based on current value dollars. The maintenance costs were inflated for each maintenance cycle to address inflation, future labor rates, future construction costs, etc. It is assumed that this inflation is a simple interest of 2.3% based on the Engineering News Record Construction Cost Index since 1977. For each maintenance cycle, the maintenance costs were then translated to present-value dollars assuming a 7.13% rate of return

Table 5 outlines the Present Value total cost for construction and future maintenance for each alternative for the WWRF. Alternative 1A, 4,000-foot long beach nourishment, has the highest cost at approximately $10 million, because of the large volume of sand needed to construct the project. The decreased length beach nourishment alternative (1B) is less expensive ($7.4 million), however, does require more frequent renourishment to maintain the design beach width. The nourishment with groin system is the third most expensive alternative ($9.8 million), mainly due to the large amount of armor stone that would be required to construct the groins. Both of the revetment alternatives are the least expensive ($1.6 million and $4.4 million). However, it is noted the buried revetment does provide additional recreational and aesthetic benefits over the revetment alone.

Table 5. Approximate Present-Value Cost Estimates for the WWRF Alternatives

Alternative		***Total Cost***
1A	Beach Nourishment (4,000 ft project length)	$10,200,000
1B	Beach Nourishment (2,650 ft project length)	$7,400,000
2	Beach Nourishment with Groin System (2,640 ft project length)	$9,800,000
3A	Revetment (1,200 ft project length)	$1,600,000
3B	Revetment with Beach Nourishment (1,200 ft revetment, 2,150 ft nourishment)	$5,400,000

Annualized Costs calculate the annual cost of each alternative over the life cycle of the project (50-years). Annualized Construction Costs indicate the annual value of the initial construction costs over a 50-year life cycle. Whereas, the Annualized Maintenance Costs indicate the annual cost needed to conduct the future maintenance over the 50-year life cycle. The rate of return used in the Annualized Costs is 7.13%. The table below outlines the construction, maintenance, and total annualized cost for each alternative.

As shown in Table 6, Alternative 1A has the highest annualized total cost of approximately $724,000 per year for 50-years. Alternatives 1B and 2 have the next highest annualized total costs ($553,000 and $609,000 per year, respectively). The revetment and buried revetment have the two lowest annualized costs ($87,400 and $118,000 per year, respectively). However, it is again noted that the buried revetment does provide additional benefits over the revetment alone.

Table 6. Approximate Annualized Cost Estimates for the WWRF Alternatives

	Alternative	*Annualized Construction Cost **	*Annualized Maintenance Cost **	*Total Annualized Cost **
1A	Beach Nourishment (4,000 ft project length)	$400,000	$324,000	$724,000
1B	Beach Nourishment (2,650 ft project length)	$271,000	$282,000	$553,000
2	Beach Nourishment with Groin System (2,640 ft project length)	$459,000	$150,000	$609,000
3A	Revetment (1,200 ft project length)	$82,000	$5,400	$87,400
3B	Revetment with Beach Nourishment (1,200 ft revetment, 2,150 ft nourishment)	$82,000	$36,000	$118,000
**Costs represent dollars per year ($/yr) for a 50-year life cycle.*				

IX. POTENTIAL PROJECT ALTERNATIVES AT THE WWPS

The WWPS site is a small lot located to the west of Kahului Harbor with a beach front width of approximately 150 feet. This section describes alternatives that could be constructed at the WWPS site to minimize future scour and erosion from severe storms. Each of these alternatives only provides protection for the 150-foot property width. However, further scour erosion would occur up- and down-coast of the property unless they are also protected. If only the WWPS property is protected, then careful design of the flanking areas needs to be considered to minimize impacts from erosion occurring around the ends of the protective structure. Since this site is not generally accessed by the public, hard structures may be more amenable by the public and regulatory agencies.

A. Alternative 1 - New Revetment

This alternative includes removing the rubble fronting the site and replacing it with a new engineered revetment. Initial estimates assume the same cross-section as the revetment fronting the WWRF, as shown in Figure 25. The site would be graded and a layer of filter fabric placed under the proposed revetment. Approximately 1,800 tons of armor and under layer rock are required for construction of the 150-foot long revetment. The filter fabric and engineered design provide adequate protection from future storm surge and requires minimal maintenance over the project life.

B. Alternative 2 - Repair Rubble Revetment

It does not appear the existing rubble at the site was placed in any engineered configuration, but rather just randomly dumped. This alternative includes repairing and replacing the existing rubble at the site to provide better protection from severe storms. Placement of filter fabric is not proposed for this alternative, but the general cross-section would be similar to the revetment shown in Figure 25. Some grading is proposed and it is estimated a portion of the existing rubble may be reused at the site, but at least half of the volume needed would be brought in from outside sources. It is estimated that approximately 1,700 tons of rubble would be required in addition to the material available at the site. Future storms may cause the rubble to move and resettle and would require more frequent maintenance after storm events.

C. Other Alternatives

1. Seawall

A seawall is another alternative that could be constructed for shore protection. Typically, seawalls are constructed to minimize encroachment onto the beach system and minimize impacts to recreational beach users. However, since this site is fronted by a rubble mound, public access is currently restricted. Also, the cost for seawall construction compared to a revetment is much greater and at this site the benefits are minimal. Therefore, a seawall at the WWPS site is not considered further.

2. Beach Nourishment

A beach nourishment project could also be constructed at the WWPS. However, this shoreline currently consists of a cobble, rock, and rubble foreshore and a large volume of sand could be required along the entire reach and not just fronting the WWPS property. The entire reach from the Kahului west jetty to the adjacent armoring structure to the north would need to be filled to provide adequate protection. If a sandy beach were constructed just on the shore immediately fronting the WWPS, the fill material would disperse up- and downcoast, and offshore and the WWPS would be threatened again. It is also noted the major threat at this site appears to be from sever storm events and not recent erosion trends.

D. Cost Estimates

Costs for each alternative at the WWPS were estimated based on both, Present Value and Annualized costs for both the construction and maintenance cycle. Each alternative has a 50-year design life. A more detailed cost estimate for each alternative is provided in Appendix B.

Present Value Costs calculate the initial construction and future maintenance costs based on current value dollars as discussed in Section VIII.G. Table 7 outlines the total cost for construction and future maintenance for each alternative for the WWPS. Alternative 1 is the newly engineered revetment and has a slightly higher cost than Alternative 2, repair of existing rubble revetment ($260,000 vs. $205,000, respectively). Although the initial construction cost for Alternative 1 is higher, the maintenance cost for Alternative 2 is much higher than Alternative 1. It is noted the new engineered revetment provides better protection from severe storm surges. A more detailed cost estimate for each alternative is provided in Appendix B.

Table 7. Approximate Present-Value Cost estimates for the WWPS Alternatives

Alternative		*Total Cost*
1	Revetment (150 ft project length)	$260,000
2	Repair Rubble Revetment (150 ft project length)	$205,000

Annualized Costs calculate the annual cost of each alternative over the life cycle of the project (50-years) as discussed in Section VIII.G. Table 8 shows that Alternative 1 has a slightly higher annualized cost than Alternative 2 ($14,400 and $11,800 per year for 50 years, respectively). As stated above, the new engineered revetment (Alternative 1) does provide better storm protection compared to the rubble repair (Alternative 2).

Table 8. Approximate Annualized Cost Estimates for the WWRF Alternatives

Alternative		*Annualized Construction Cost **	*Annualized Maintenance Cost **	*Total Annualized Cost **
1	Revetment (150 ft project length)	$13,400	$1,000	$14,400
2	Repair Rubble Revetment (150 ft project length)	$9,300	$2,500	$11,800

**Costs represent dollars per year ($/yr) for a 50-year life cycle.*

X. RANKING CRITERIA

This section discusses the various ranking criteria used to evaluate each of the alternatives described in Sections VIII and IX. The evaluation criteria include:

- Construction Cost – Initial costs for construction of the alternative
- Maintenance Cost – Life-cycle costs for maintenance of the alternative
- Public Access and Usage – Affects to public beach access and recreational use
- Design Life – Offers best protection over design life
- Regulatory Compliance – Best meets regulatory regulations
- Aesthetics – Effects to the aesthetics of the existing area
- Impacts to Kahului Harbor – Increased frequency of dredging at Kahului Harbor or other adverse impacts
- Environmental Impacts to Biology – Impacts to biological resources in the area
- Environmental Impacts to Adjacent Shoreline – Impacts to adjacent shoreline areas

These alternatives were evaluated to determine a weighted value for each. Some criteria are more important than others in evaluating the alternatives and should be weighted more than other less-important criteria. Table 9 shows the criteria and the weighted value assigned to each.

Environmental impacts to both biology and adjacent shorelines received the highest rank. This is because it is extremely difficult and costly to mitigate for biological impacts if any were caused by the shore protection alternative. Impacts to Kahului Harbor are slightly less important than the environmental impacts, because the main cause of any impact is sedimentation at the harbor, which would increase the maintenance dredging cycle, but not cause any long-term negative impact. Design life is slightly more important than construction and maintenance cost to ensure that the quality of the alternative in providing protection is cost effective.

Regulatory compliance received a lower score than the previous criteria, not because it is not important to comply with the regulations, but because these sites are part of a public utility and variances are generally more permissible than at private locations and many existing structures at the sites are already located within the shoreline setback line. Public access and usage and aesthetics received the lowest score mainly because these sites are not a heavily used site by the public. The beaches to the east of the WWRF are used by the locals and wind surfing or kite surfing community.

Table 9. Weighted Value of Evaluation Criteria

Criteria	Weighted Value
Construction Cost	21
Maintenance Cost	21
Public Access and Usage	16
Design Life	24
Regulatory Compliance	19
Aesthetics	17
Impacts to Kahului Harbor	28
Environmental Impacts - Biology	35
Environmental Impacts - Adj shorelines	35

Each alternative was evaluated based on the criteria listed above. A value of 1 through 5 was assigned to each criteria evaluation for each alternative. A 5 represents the best value for the criteria and a 1 is the poorest value. Then a weighted score is calculated by multiplying the value assigned to the criteria and the weighted value of each criteria. For each alternative, the total scores are summed to determine a ranking of alternatives. The alternative with the highest score is the preferred alternative based on the evaluating criteria.

The following tables show the weight value of each criteria in *italics* under each criteria heading. For each alternative, the value assigned to each criteria is shown in the gray box, and the score calculated for each criteria is in bold.

The total score column of the tables indicates the preferred alternative at the WWRF and WWPS are the Buried Revetment and New Engineered Revetment, respectively.

Table 10. WWRF Alternative Evaluation

	Construction Cost		Maintenance Cost		Public Access & Usage		Design Life		Regulatory Compliance		Aesthetics		Impacts to Kahului Harbor		Environmental Impacts to Biology		Environmental Impacts to Adjacent Shorelines		TOTAL SCORE	RANK
Criteria Weighted Value	*21*		*21*		*16*		*24*		*19*		*17*		*28*		*35*		*35*			
	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score		
ALT 1A- 4000-FT BEACH FILL	2	**42**	1	**21**	5	**80**	2	**48**	5	**95**	5	**85**	2	**56**	2	**70**	5	**175**	**672**	3
ALT 1B- 2500-FT BEACH FILL	3	**63**	2	**42**	4	**64**	1	**24**	5	**95**	4	**68**	2	**56**	2	**70**	4	**140**	**622**	5
ALT 2- BEACH FILL W/ GROINS	1	**21**	3	**63**	3	**48**	3	**72**	3	**57**	3	**51**	4	**112**	3	**105**	3	**105**	**634**	4
ALT 3A- REVETMENT	5	**105**	5	**105**	1	**16**	5	**120**	1	**19**	2	**34**	5	**140**	4	**140**	2	**70**	**749**	2
ALT 3B- BURIED REVETMENT	4	**84**	3	**63**	4	**64**	4	**96**	4	**76**	4	**68**	3	**84**	3	**105**	4	**140**	**780**	1

Table 11. WWPS Alternative Evaluation

	Construction Cost		Maintenance Cost		Public Access & Usage		Design Life		Regulatory Compliance		Aesthetics		Impacts to Kahului Harbor		Environmental Impacts to Biology		Environmental Impacts to Adjacent Shorelines		TOTAL SCORE	RANK
Criteria Weighted Value	*21*		*21*		*16*		*24*		*19*		*17*		*28*		*35*		*35*			
	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score		
ALT 1- NEW REVETMENT	3	**63**	4	**84**	2	**32**	4	**96**	2	**38**	3	**51**	3	**84**	3	**105**	3	**105**	**658**	1
ALT 2- RUBBLE REPAIR	4	**84**	2	**42**	2	**32**	2	**48**	2	**38**	2	**34**	3	**84**	3	**105**	3	**105**	**572**	2

XI. SUMMARY AND CONCLUSIONS

A. Wailuku-Kahului WWRF

Evaluation of the available shoreline data indicates the rate of recession was highest from 1960 to 1975 and from 1975 to 1987. The rate of shoreline recession has since decreased and shoreline advance has occurred in some areas along the study reach. However, immediately west of the revetment at the WWRF, the rate of shoreline recession from 1997 to 2002 indicates a strong (up to 6 feet per year) rate of shoreline recession.

Using this maximum shoreline recession rate, it is estimated that some structures at the facility may be threatened in as little as two to three years. However, some of these early-threatened structures can be relocated to other areas on the WWRF property. The first major structure that would be threatened is the Effluent Meter at the end of the Chlorine Contact Tank. This structure may be threatened in as little as 14 years. For average recession conditions, this structure may be threatened in approximately 26 years. It is noted, this erosion rate is an average of recent conditions, and significant storms can accelerate and localize the erosion in the area.

Methods to provide protection to the WWRF site include beach nourishment and construction of revetment. Preliminary alternatives described in this study include beach nourishment with compatible sand material, beach nourishment with retention structures, continuing the revetment along the property, and a combination of a revetment extension and beach nourishment.

Evaluation of the alternatives indicates the preferred alternative is the buried revetment. This alternative provides a last line of defense against severe storms and tsunamis and also provides a recreational beach area which is more amenable to the general public and regulatory agencies. A long-term commitment must be made to ensure future funding for maintenance of the beach fill.

B. Wailuku WWPS

Analysis of the available shoreline data indicates that this area has exhibited slight recession. The most recent trends from 1997 to 2002 indicate that the shoreline has been fairly stable. This is most probably due to the fact that properties have been armored or the beach face area is rocky, halting further shoreline recession.

The WWPS shoreline is naturally protected by a rubble beach from further short-term erosion. Any further damage to the upland areas will be caused by severe storms (elevated water levels and subsequent wave attack) and tsunami. The upland property will continue to fail and erode during large storms unless it is protected.

This site appears to be fairly easy and acceptable to construct a revetment within the existing rubble footprint, because of the large amounts of rubble and boulders already existing along the reach and limited public use. Evaluation of the alternatives indicates that the preferred alternative is a new engineered revetment. This alternative provides a last line of defense against severe storms and tsunamis without degrading the rubble beach further.

C. Recommended Future Studies

Future recommended studies include a sediment budget analysis of the Kahului region and investigation study of potential offshore sand sources.

1. Sediment Budget Analysis

A more-detailed study is required to better understand the physical processes of the shoreline, as well as determine the efficacy of the alternatives presented in this report. A sediment budget analysis should be considered as the next step for Maui's north coast to better identify and quantify specific causes of the erosion problem. A sediment budget analysis is a continuity exercise to quantify fluxes of sediment into and out of a specific control volume. The budget is developed to (1) estimate the incoming and outgoing volumes of sediment to the extent possible with the existing information; (2) sum all losses and gains; (3) compare the results with measured changes in volume within the control volume; and (4) use judgment and perhaps additional data to adjust the fluxes until they best balance. The goal for a sediment budget analysis at the Kahului beach areas is to estimate the amount of sand available in the system, identify and quantify the major fluxes of sediment that can affect the shoreline, estimate changes in them before and after various natural and man-induced impacts occurred, and identify those changes that are considered reversible due to shore protection.

Specific elements of the sediment budget analysis should include:

- An assessment of the amount of sand within the littoral system based on field observations including jet probing
- Wind transport analysis using improved predictive models that can be calibrated with field measurements
- Estimate past, present and potential future rates of sand production from the fringing reef system
- More information on the shoreline evolution after construction of Kahului Harbor
- Sand transport through the reef system and around Kahului Harbor
- Sand transport/sedimentation within Kahului Harbor

2. Investigation of Offshore Sand Sources

A study investigating the potential of offshore sand sources should be conducted. The use of inland sand sources is viable for small-scale projects; however, it may be economically unfeasible for large-scale nourishment projects.

This study has been recommended by other interested parties in the Hawaiian Islands. University of Hawaii Sea Grant Extension Service and County of Maui Planning Department prepared a Beach Management Plan for Maui (1997). The plan recommends potential offshore borrow sites be identified, mapped, and sampled. The plan also recommends funding for the offshore sand resource studies could be shared by Maui County, DLNR, the University of Hawaii, and the U.S. Army Corps of Engineers.

Further, this Beach Management Plan recommends conducting a pilot project for beach nourishment on Maui to illustrate the engineering requirements, permitting requirements, problems and concerns.

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APPENDIX A

SITE PHOTOGRAPHS OF THE SHORELINE FRONTING THE WAILUKU-KAHULUI WASTEWATER RECLAMATION FACILITY AND THE WAILUKU WASTEWATER PUMP STATION

JULY 16, 2004

Photo 1. East flank of the revetment fronting the Wailuku-Kahului WWRF.

Photo 2. Looking East from the revetment at the W-K WWRF.
(Notice the old "pill box" offshore.)

Photo 3. Looking West towards the W-K WWRF revetment.

Photo 4. Looking West from the crest of the revetment towards Kahului Harbor.


Photo 5. Looking East from the Revetment. (Notice the old "pill box" offshore.)


Photo 6. Looking West from the crest of the revetment towards Kahului Harbor.

Photo 7. Looking West from the revetment towards Kahului Harbor.

Photo 8. Looking East towards the revetment.


Photo 9. West of the WWRF property, looking West at remnants of an old groin. Kahului Harbor is seen in the background.


Photo 10. Remnants of an old groin (same location as above).

Photo 11. Shoreline looking northwest towards the WWPS.

Photo 12. Shoreline looking southeast towards Kahului Harbor.


Photo 13. Large escarpment fronting the WWPS property (fence).


Photo 14. Looking Southeast along WWPS property line towards Kahului Harbor.


Photo 15. Wailuku WWPS facilities.


Photo 16. Shoreline fronting the WWPS, looking southeast.

Photo 17. Exposed drainage pipe at the WWPS.

Photo 18. Escarpment and shoreline looking northwest from WWPS.
(notice large seawall fronting property to the north.)

APPENDIX B – COST ESTIMATE DETAILS

WWRF ALTERNATIVES

Alternative 1A - Beach Nourishment (4,000 ft project length)

			Unit Cost	Cost
Item Description	**Quantity**	**Unit**		
Mob/Demob	1	LS	$50,000	$50,000
Fill material	215,000	CY	$25	$5,375,000
			Initial Construction Subtotal	$5,425,000
Present Construction Rate Maintenance Costs	86,000	CY	$25	$2,150,000
- 40% of original volume every 10 years				
Project Year			Future Inflated Cost	Present Worth
10			$2,644,500	$1,328,105
20			$3,139,000	$791,716
30			$3,633,500	$460,248
40			$4,128,000	$262,600
			Subtotal	$8,267,670
			Supervision and Administration (6%)	$325,500
			Engineering & Design (10%)	$542,500
			Contingency (20%)	$1,085,000
			TOTAL	**$10,220,670**

Alternative 1B - Beach Nourishment (2,650 ft project length)

			Unit Cost	Cost
Item Description	**Quantity**	**Unit**		
Mob/Demob	1	LS	$50,000	$50,000
Fill material	145,000	CY	$25	$3,625,000
			Initial Construction Subtotal	$3,675,000
Present Construction Rate Maintenance Costs	55,000	CY	$25	$1,375,000
- 40% of original volume every 10 years				
Project Year			Future Inflated Cost	Present Worth
8			$1,628,000	$938,352
16			$1,881,000	$624,901
24			$2,134,000	$408,628
32			$2,387,000	$263,449
40			$2,640,000	$167,942
			Subtotal	$6,078,272
			Supervision and Administration (6%)	$220,500
			Engineering & Design (10%)	$367,500
			Contingency (20%)	$735,000
			TOTAL	**$7,401,272**

Alternative 2 - Beach Nourishment with Groin System (2,640 ft project length)

			Unit Cost	Cost
Item Description	**Quantity**	**Unit**		
Mob/Demob	1	LS	$100,000	$100,000
Armor Rock	25,050	TN	$75	$1,878,750
Underlayer Rock	14,620	TN	$65	$950,300
Fill Material	132,000	CY	$25	$3,300,000
			Initial Construction Subtotal	$6,229,050
Present Construction Rate Maintenance Costs	40,000	CY	$25	$1,000,000
- 30% of original volume every 10 years				
Project Year			Future Inflated Cost	Present Worth
10			$1,230,000	$617,723
20			$1,460,000	$368,240
30			$1,690,000	$214,069
40			$1,920,000	$122,140
			Subtotal	$7,551,222
			Supervision and Administration (6%)	$373,743
			Engineering & Design (10%)	$622,905
			Contingency (20%)	$1,245,810
			TOTAL	**$9,793,680**

Alternative 3A - Revetment (1,200 ft project length)

			Unit Cost	Cost
Item Description	**Quantity**	**Unit**		
Mob/Demob	1	LS	$50,000	$50,000
2000-lb Armor Rock	9,000	TN	$75	$675,000
Quarry Rock	5,000	TN	$65	$325,000
Filter Fabric	12,000	SY	$5	$60,000
			Initial Construction Subtotal	$1,110,000
Present Construction Rate Maintenance Costs	1	LS	$55,500	$55,500
- 5% of original cost every 10 years				
Project Year			Future Inflated Cost	Present Worth
10			$68,265	$34,284
20			$81,030	$20,437
30			$93,795	$11,881
40			$106,560	$6,779
			Subtotal	$1,183,381
			Supervision and Administration (6%)	$66,600
			Engineering & Design (10%)	$111,000
			Contingency (20%)	$222,000
			TOTAL	**$1,582,981**

Alternative 3B - Revetment with Beach Nourishment (1,200 ft revetment, 2,150 ft nourishment)

			Unit Cost	Cost
Item Description	**Quantity**	**Unit**		
Mob/Demob	1	LS	$50,000	$50,000
2000-lb Armor Rock	9,000	TN	$75	$675,000
Quarry Rock	5,000	TN	$65	$325,000
Filter Fabric	12,000	SY	$5	$60,000
Fill Material	75,000	CY	$25	$1,875,000
			Initial Construction Subtotal	$2,985,000
Present Construction Rate Maintenance Costs				
Fill Material	30,000	CY	$25	$750,000
- 40% of original volume every 8 years				
Revetment	1	LS	$55,500	$55,500
- 5% of original cost every 20 years				
Project Year			Future Inflated Cost	Present Worth
8			$888,000	$511,828
16			$1,026,000	$340,855
20			$81,030	$20,437
24			$1,164,000	$222,888
32			$1,302,000	$143,700
40			$1,546,560	$98,384
			Subtotal	$4,323,091
			Supervision and Administration (6%)	$179,100
			Engineering & Design (10%)	$298,500
			Contingency (20%)	$597,000
			TOTAL	**$5,397,691**

WWPS ALTERNATIVES

Alternative 1 - Revetment (150 ft project length)

			Unit Cost	Cost
Item Description	**Quantity**	**Unit**		
Mob/Demob	1	LS	$50,000	$50,000
2000-lb Armor Rock	1,125	TN	$75	$84,375
Quarry Rock	625	TN	$65	$40,625
Filter Fabric	1,500	SY	$5	$7,500
			Initial Construction Subtotal	$182,500
Present Construction Rate Maintenance Costs	1	LS	$10,000	$10,000
- 5% of original cost every 10 years				
Project Year			Future Inflated Cost	Present Worth
10			$12,300	$6,177
20			$14,600	$3,682
30			$16,900	$2,141
40			$19,200	$1,221
			Subtotal	$195,722
			Supervision and Administration (6%)	$10,950
			Engineering & Design (10%)	$18,250
			Contingency (20%)	$36,500
			TOTAL	**$261,422**

Notes:

1) Armor rock was calculated based on the tons per linear foot for WWRF alternative and applying this to the 150-ft project length at the WWRF

2) Maintenance frequency and amount is est engineers estimate

Alternative 2 - Repair Rubble Revetment (150 ft project length)

			Unit Cost	Cost
Item Description	**Quantity**	**Unit**		
Mob/Demob	1	LS	$50,000	$50,000
Rubble	1,700	TN	$45	$76,500
			Initial Construction Subtotal	$126,500
Present Construction Rate Maintenance Costs	1	LS	$25,300	$25,300
- 15% of original cost every 10 years				
Project Year			Future Inflated Cost	Present Worth
10			$31,119	$15,628
20			$36,938	$9,316
30			$42,757	$5,416
40			$48,576	$3,090
			Subtotal	$159,951
			Supervision and Administration (6%)	$7,590
			Engineering & Design (10%)	$12,650
			Contingency (20%)	$25,300
			TOTAL	**$205,491**

Notes:

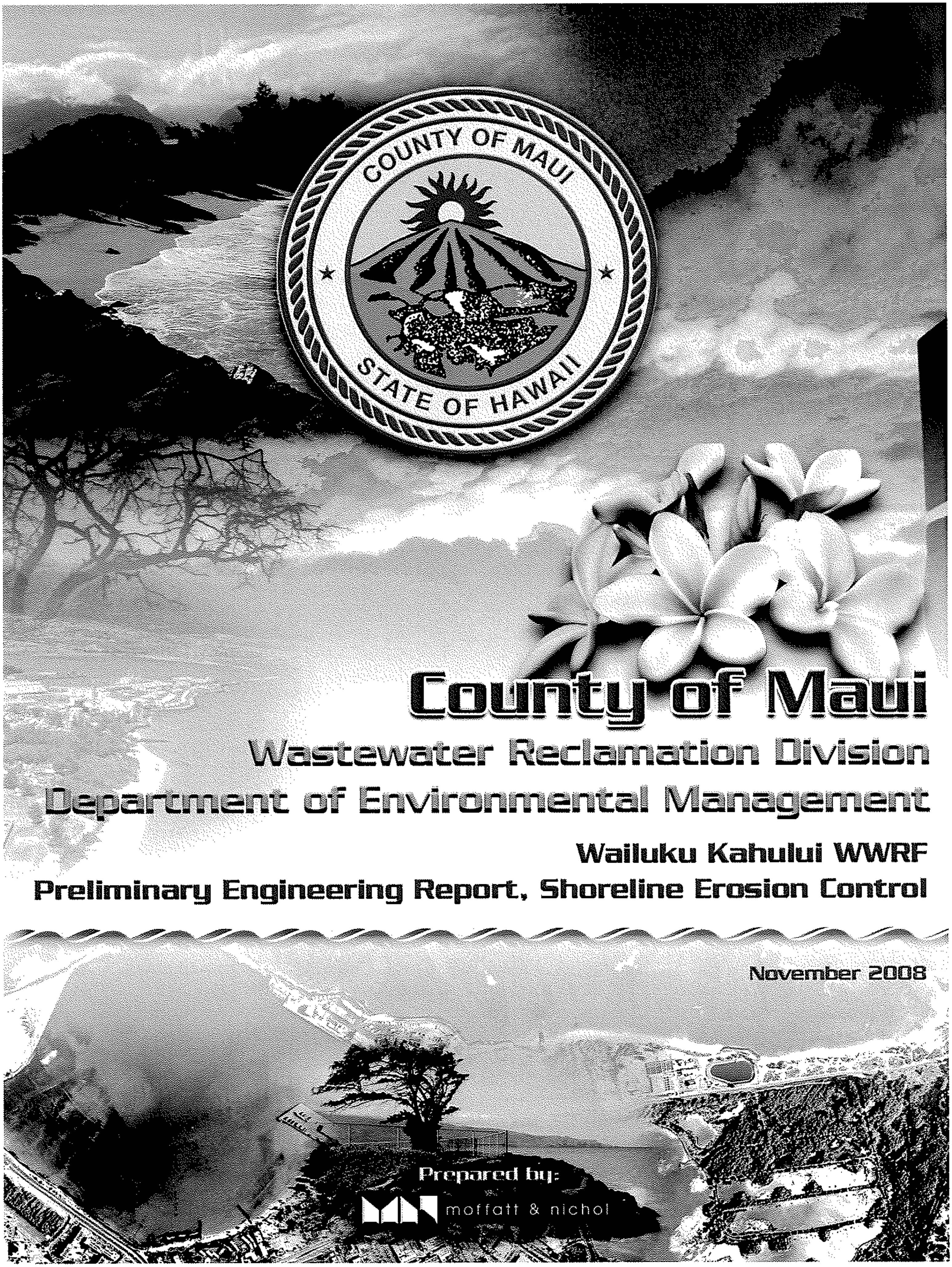
1) Assume the same amount of rubble (tons) is needed to repair the rubble revetment as was required for the design of the new revetment

2) Assume a cost of $45/ton for rubble. Some existing rubble can be reused and other rubble may have to be imported. The cost is an estimate based on engineering judgment

3) Maintenance assumes that more maintenance will be required of the rubble structure since it is not engineered. Storms will shift the rubble more frequently and require more frequent maintenance to ensure upland protection

APPENDIX D.

Wailuku-Kahului WWRF Preliminary Engineering Report, Shoreline Erosion Control



County of Maui

Wastewater Reclamation Division

Department of Environmental Management

Wailuku Kahului WWRF

Preliminary Engineering Report, Shoreline Erosion Control

November 2008

Prepared by:
moffatt & nichol

Wailuku Kahului WWRF
Preliminary Engineering Report for
Shoreline Erosion Control

Prepared for:
County of Maui
Wastewater Reclamation Division, Department of Environmental Management

Prepared by:
Moffatt & Nichol

In Association with:
SSFM International, Inc.

November 2008

M&N File: 6395

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Wailuku Kahului WWRF
Preliminary Engineering Report - Shoreline Erosion Control

1. EXECUTIVE SUMMARY

The County of Maui owns and operates the Wailuku-Kahului Wastewater Reclamation Facility (WWRF) on the North Shore of Maui adjacent to the Kahului Harbor. The facility is reaching its design capacity and the County has decided to expand the plant in its present location. As a part of the decision process, Moffatt & Nichol (M&N) was retained to quantify shoreline erosion trends, assess potential causes for erosion, and develop preliminary shoreline protection alternatives for site. (M&N, "Central Maui Wastewater Reclamation Facility, Shoreline Evaluation Report" 2005.) This Preliminary Engineering Report is an update and continuation of the 2005 study and is intended to provide additional detail for the alternatives analysis and allow the County Council to select an option and begin the design and regulatory process.

1.1 Problem Summary

- The major cause of the long-term erosion of the north shore beaches is historic the removal of sand from the beaches for lime production by the sugar company and additional sand mining by others for cement manufacturing and aggregate. This permanent removal of sand from the littoral system has resulted in a deficit in the sediment budget and erosion over the length of the study area from Baldwin Beach to Kahului Harbor.
- The rate of shoreline erosion at the WWRF has slowed since the cessation of sand mining; however, it is still a significant consideration for the long-term safety of the facility.
- Based several different shoreline analysis techniques and data sets, we recommend that a typical seasonal variation of 20 to 30 feet and a maximum seasonal variation of 50 to 60 feet be used for planning. Similarly, we recommend using typical long-term erosion rate of 2.4 feet per year and a maximum long-term erosion rate of 6 feet per year for use in planning, engineering design and estimating the time until facilities are impacted.
- The shoreline at the WWRF facility has demonstrated long-term erosion that threatens several minor structures from a single large seasonal recession event within a year or less. The first major structures to be impacted by this shoreline recession may be threatened in as little as 13 years. If the estimates of acceleration in sea level rise are realized, then the time until the structures are threatened would be reduced. Given the small data set, unpredictability of future storms, unknowns concerning the acceleration of sea level rise, and the typical time required to design, permit, and construct a shoreline protection project (3 to 5 years), **it is recommended that a shoreline protection alternative be selected and implemented as soon as possible.**
- The results of a sediment budget analysis indicate that that the net rate of sediment transport at the shoreline adjacent to the Kahului Wastewater Reclamation Facility is currently between 1,300 and 4,000 cubic yards per year.

- Recent observations and photographs suggest that the shoreline has receded to the point that the existing WWRF revetment may be acting as a groin and may be limiting the transport of sand from Kite Beach towards the Kahului Harbor. This could result in increased erosion to the west of the revetment.

1.2 Alternative Solutions

- There were there basic shoreline stabilization alternatives considered:
  1. Beach Nourishment (two length variations),
  2. Revetment
  3. Buried Revetment.
- It should be assumed that there will be no upland sand sources available to provide suitable sand for a beach nourishment solution for erosion control due to quantity and quality requirements. However, a sand search seaward of the Kahului Harbor breakwater indicated a very large potential source of beach-quality sand that could be dredged for the project.
- A review of the permitting process indicates that the project may be subject to special legislation at the county level due to over-lapping jurisdictions and criteria at the certified shoreline.
- Two erosion control alternatives from the initial study were removed from further consideration. "T-Groins", and any other shore-perpendicular structures were removed due to the low longshore sand transport rates, and "Geotextile Tubes for Revetment" were removed due to durability and stability concerns.
- Four of the original concepts from the initial study were retained for comparative evaluation. Two different beach nourishment scenarios and two revetment scenarios. For planning of beach nourishment project, the estimates of renourishment volumes are 2,000-3,000 cubic yards per year at 8 year intervals. These higher rates provide a larger margin of safety and result in a more practical and economical renourishment plan that minimizes contractor mobilizations and takes advantage of economies of scale.
- A summary of the evaluation is tabulated as follows.

	Alternative 1A 3,800-ft Beach Replenishment	**Alternative 1B 2,400-ft Beach Replenishment**	**Alternative 3A 1,200-ft Revetment**	**Alternative 3B Revetment with Replenishment**
Economic Criteria				
Facility Protection Effectiveness	Basic shoreline erosion protection with sand reserve if properly maintained.	Basic shoreline erosion protection if properly maintained.	The revetment may provide some measure of tsunami protection to the upland facility in addition to protecting the facility from shoreline erosion.	The revetment may provide some measure of tsunami protection to the upland facility in addition to protecting the facility from shoreline erosion.
Initial Construction Cost*	$4 M to $6 M	$3 M to $4.5 M	$3.5 M to $4 M	$5 M to $6 M
Maintenance Cost (NPV)*	$4 M to $7 M	$3 M to $6 M	$0.5 M	$3 M to $6 M
Environmental Criteria				
Regulatory Compliance	Compliant	Compliant	Compliant. May be an unpopular solution (due to aesthetics and access) which may delay permitting. More likely to require mitigation.	Compliant
Effects to Adjacent Shoreline	Significantly increases the width of the beach east of the Kahului WWRF – by an average 40 feet Over time, will increase the width of the beach west of the Kahului WWRF to a lesser extent	Over time, will increase the width of the beach east of the Kahului WWRF through diffusion, and west of the WWRF through diffusion and net longshore transport This increase will be less than for Alternative 1A, and will likely be concentrated in the area close to the WWRF property	If the revetment acts as a groin, this alternative may limit the transfer of sand from the kite beach area to the beach west of the WWRF. Without adding additional sand, the revetment has the potential for causing passive erosion of the adjacent beaches and limiting lateral access.	Similar to Alternative 1B unless the seaward beach erodes, then the effects would be similar to Alternative 3B.

	Alternative 1A 3,800-ft Beach Replenishment	**Alternative 1B 2,400-ft Beach Replenishment**	**Alternative 3A 1,200-ft Revetment**	**Alternative 3B Revetment with Replenishment**
Biology	Short-term turbidity impacts may occur during construction. Additional sediment fate modeling is needed to ensure the reef will not be negatively impacted by sand transported offshore in the short- or long-term Provided appropriate work windows are maintained, the effects on species dependent on the beach are expected to be positive for this alternative	As Alternative 1A, except that both potential positive and negative effects are likely to be less.	Minor effects compared to existing conditions.	Similar to Alternative 1B
Environmental Criteria – Human				
Aesthetics	Positive effect if beach sand is selected with acceptable coloration	Similar to Alternative 1A, except that the effect is observed over a shorter stretch of beach.	The longer revetment may be considered unsightly	Similar to Alternative 1B
Public Access and Usage	Positive effect: approximately 6 acres of additional beach area directly adjacent to heavily-used beaches with good public access	Smaller but still positive effect: approximately 4 acres of additional beach area, approximately one-quarter mile from the most heavily-used beaches	Potential for passive erosion of shoreline and limitations to public access at the site a lateral access to adjacent beaches.	Similar to Alternative 1B if the beach fronting the revetment is maintained.

	Alternative 1A 3,800-ft Beach Replenishment	**Alternative 1B 2,400-ft Beach Replenishment**	**Alternative 3A 1,200-ft Revetment**	**Alternative 3B Revetment with Replenishment**
Effects to Kahului Harbor	Little or no effects anticipated. The proposed replenished beach is well within the historical range of beach widths, and dramatic changes in required maintenance dredging at Kahului Harbor have not been observed over time	Little or no effects anticipated	Little or no effect	Little or no effects anticipated

* Note: Costs are very dependent on the availability of suitable sand for replenishment, and may vary outside this range

2. INTRODUCTION

2.1 Background

The County of Maui owns and operates the Wailuku-Kahului Wastewater Reclamation Facility (WWRF) and has recently completed a study (Austin, Tsutsumi & Associates, "Central Maui Wastewater Reclamation Facility Study," 2005) that addresses the future wastewater treatment for the next 20 to 30 years. The WWRF is nearing its design capacity and is located on an actively eroding shoreline, so the report presented alternatives including relocating the facility, increasing the capacity of the current facility, or directing some of the future flows to another facility or facilities. Based on the report findings, the County concluded the WWRF should remain in its present location and erosion control measures should be implemented to provide long-term protection for the facility.

As a part of the initial study, Moffatt & Nichol (M&N) was retained to quantify the shoreline erosion trends, assess potential causes for erosion, and develop preliminary shoreline protection alternatives for the Kahului WWRF site. (M&N, "Central Maui Wastewater Reclamation Facility, Shoreline Evaluation Report," 2005.) This report is a continuation of the 2005 study and is intended to provide additional detail for the alternatives analysis and allow the County Council to select an option and begin the design and regulatory process.

2.2 Scope

The specific scope for this phase of the project included:

- Site Visits – Attend kick-off meeting, site investigation, meetings with regulatory agencies in Honolulu.
- Data Review – Review updated data, drawings, surveys, and reports. Identify additional data requirements.
- Develop General Evaluation Criteria – Update the criteria from the Shoreline Evaluation Report with input from the County. At present, these criteria are presented in a qualitative form for discussion. If the County wishes, they will be quantified for use in a pairwise ranking analysis as defined in the scope.
- Sediment Budget Analysis – Conduct a preliminary sediment budget analysis to evaluate the past and present littoral transport of the system, identify short- and long-term variations in the transport rates, and evaluate seasonal changes in transport to help determine potential beach replenishment and maintenance volumes.
- Investigate Sand Sources – Investigate existing studies and data, and meet with local sand suppliers to gather information on material quality, available quantities, and cost.
- Develop Mitigation Alternatives – Identify mitigation alternatives for the observed shoreline erosion, including beach replenishment, beach replenishment with retention structures, geotextile solutions, and shore protective devices such as revetment or seawalls. The evaluation of these alternatives will result in the identification of one preferred approach, however, it is anticipated that all of the measures will be carried to the permitting phase to satisfy the regulatory agencies' alternatives analysis requirements.

- Investigate Permit Requirements – Coordinate with the local planner on the team to identify permits required for project implementation and meet with the Corps of Engineers, County of Maui Planning Department, and the DLNR to help determine an acceptable alternative.
- Develop Construction and Maintenance Costs – Develop opinions of probable construction and maintenance costs for each mitigation alternative. Costs are presented both as present value and annualized costs to assist in overall comparison of life-cycle costs.
- Prepare Matrix Analysis of Alternatives – Preparation of a matrix showing each of the alternatives, summarizing advantages, disadvantages, cost information and permit issues, as well as rankings under the various evaluation criteria to assist in formulating a basis for selection of a recommended alternative.

3. SITE DESCRIPTION

The Kahului-Wailuku WWRF is located on the north shore of the island of Maui, approximately one mile east of the Kahului Harbor. Figure 1 is an aerial photograph of the site. The area immediately west of the WWRF is considered a heavy industrial area and includes oil tank farms, auto storage yards, warehouses, and a power plant (Brown and Caldwell 1990). The port facilities at Kahului Harbor are located approximately ½ mile to the west of the WWRF. The Kahului Airport is located approximately one mile east of the WWRF and Kanaha Beach Park is located approximately ¾ mile to the east of the WWRF.

The 13,000-foot long beach extending east from Kahului Harbor is also known as Spreckelsville Beach (and Kite Beach). This reach is broken into a series of pocket beaches separated by manmade groins and by natural beachrock and lava points (Moberly 1963 and USACE 1971). The beach sand is poorly sorted calcareous sand, ranging in size from medium-sized grains to cobbles. The beaches along this reach are backed by large sand dunes. The Spreckelsville Beach area is heavily used by locals and visitors for world-class kite surfing and windsurfing, as well as fishing and regular beach recreation.

The WWRF site is bounded on the north by approximately 1,350 linear feet of shoreline in Kahului Bay. A 520-foot existing rock revetment along this shoreline constructed between 1977 and 1978 fronts the WWRF retention pond (Makai Ocean Engineering and Sea Engineering 1991). For much or all of the time since its construction, there has been essentially no beach in front of the revetment.

A large fringe reef located just offshore extends for several miles along this reach. The reef is characterized by a wide crest (one-half to one mile in width) extending from a shallow nearshore toe to depths ranging from 10 to 30 feet (Cox 1954). Closer to the Kahului Harbor, the reef is narrow or absent (Cox 1954).

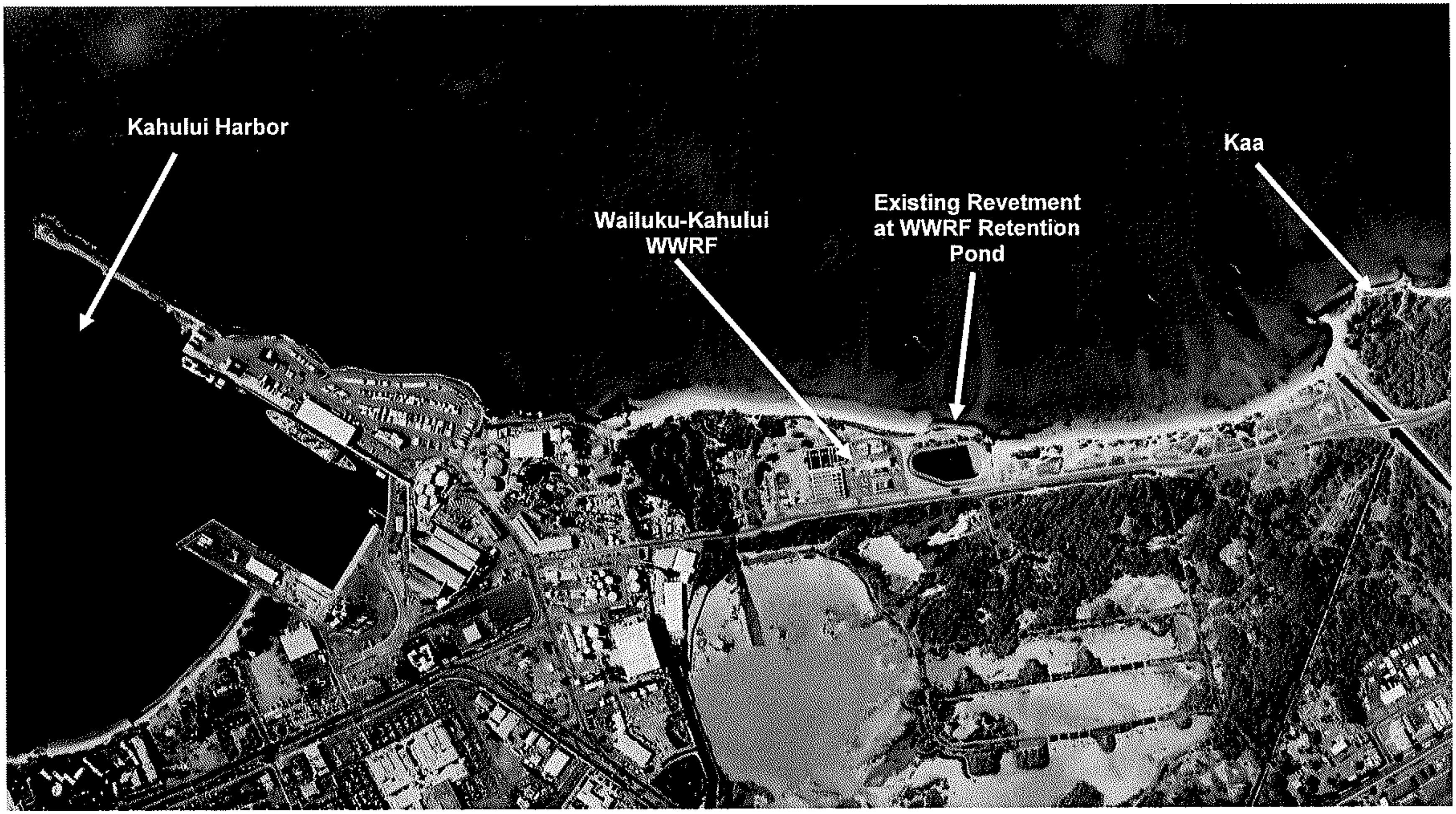


Figure 1. Aerial photograph of the coast from Kahului Harbor to Kaa

4. COASTAL PROCESSES AND CONDITIONS

This section presents a summary of the water levels, wave conditions, and climate conditions (wind and precipitation) for the site as determined in the Shoreline Evaluation Report (M&N 2005) and as background to the Sediment Budget Analysis (see Appendix A).

4.1 Water Levels

Tides in the Hawaiian Islands are semi-diurnal, with two high waters and two low waters each tidal day. The tidal range varies from tide to tide, thus the tides are considered to have a diurnal inequality. The mean tide range is approximately two feet, and the maximum annual tide range is approximately four feet. Tide data for Kahului Harbor are presented in Table 1 [1].

Table 1. Kahului Harbor Tidal Datums

Highest Observed Water Level (1/9/74)	3.70 feet
Mean Higher High Water (MHHW)	2.35 feet
Mean High Water (MHW)	1.97 feet
Mean Sea Level (MSL)	1.17 feet
Mean Tide Level (MTL)	1.16 feet
Hawaiian Geodetic Vertical Datum (HGVD)	0.90 feet
Mean Low Water (MLW)	0.35 feet
Mean Lower Low Water (MLLW)	0.00 feet
Lowest Observed Water Level (6/20/55)	-1.40 feet

In addition to normal short-term periodic fluctuations of the sea surface, there is also a progressive change in sea level. Relative sea level changes on the Hawaiian Islands are caused by rising sea levels, which may be accelerated by global warming, and land subduction, which are caused by the plate movements of the islands.

Globally, the mean sea level has risen by 10 to 30 cm (4 to 12 inches) over the last century. In the Hawaiian Islands, land subduction increases the rate of relative sea level rise. The rate of land subduction decreases from the island of Hawaii to the northwest (D. Jeon 1995). Therefore, the island of Maui subsides faster than Oahu and Kauai, since it is located closer to Hawaii. Tide gauge data from Kahului, Maui presented by NOAA[2] show a relative sea level rise of 2.09±0.43 mm per year (8.2±1.7 inches per century).

Several studies indicate future sea level rise may increase considerably (Fletcher 1992 and Fletcher *et al.* 2002). The median sea level increase on Maui is predicted to be 9.1 inches over the next 50 years and over 19 inches over the next century. More recent (date) work by Fletcher (http://www.soest.hawaii.edu/coasts/sealevel/) indicates that a value of 40 inches by 2100 is "highly likely." The risk of seal level rise to Maui's critical infrastructure is highlighted in Norcross-Nu'u, Charles Fletcher, et al. 2008, *Bringing Sea-Level Rise Into Long-Range Planning Considerations on Maui, Hawaii*, where the WWRF facility is explicitly identified. In addition, the paper cites the potential for rates that range as high as 1.6m (63 inches) per century. The large variations in these potential predictions warrants serious consideration for shore protection systems at critical infrastructure locations with a design life of 50 – 100 years.

[1] Obtained from <<http://co-ops.nos.noaa.gov/benchmarks/1615680.html>>
[2] Obtained from << http://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?stnid=1615680>>

4.2 Wind

The predominant winds in the vicinity of the Hawaiian Islands are the northeast trade winds, which are present approximately 70 to 75 percent of the time – primarily between April and November. The other 25 to 30 percent of the year produces Kona winds predominantly from the south to southwest.

Trade winds generally range from 10 to 25 mph, although they can reach 40 to 50 mph during extreme events (Fletcher et al. 2002). On Maui, the trade winds are strongly influenced by topographic conditions. For example, at Maalaea and Kihei the wind speeds can be higher than at the north shore due to the trade winds accelerating across the island's isthmus. At the Kahului site, however, the northeast trade wind direction is unaffected by the island topography, and is from the unobstructed prevailing northeast direction.

Winter is characterized by a weakening of the northeast trade winds (Moberly and Chamberlain 1964) and the appearance of the southwesterly Kona winds. The Kona winds are characterized by light and variable winds that persist for a few days to a few weeks at a time. Although Kona storms are capable of generating wind speeds exceeding 30 knots, the frequency of occurrence is low.

4.3 Waves

Ocean waves are the critical driving force in the movement of beach sand along a shoreline. This section provides a brief summary of the wave climate that affects the WWRF site on the north shore of central Maui.

Northeast Trade Waves – These waves are generated by the northeast trade winds that prevail approximately 75 percent of the year. Northeast trade waves are characterized in deep water by wave heights which are typically 4 to 12 feet but up to 20 feet, and periods ranging from 5 to 12 seconds. They occur most frequently and are the largest during the months from April through November. Information from north Maui residents and a lifeguard indicate the season with the most sand loss on the beach occurs during the period of the northeast trade waves and the sand losses increase towards the end of the season.

North Pacific Swell – The North Pacific swell, for which the large surf on the north and northwest coasts of Hawaii has become famous, is due to the waves generated from North Pacific extra-tropical cyclones. These large waves have heights in excess of 20 feet and periods ranging from 10 to 15 seconds. The North Pacific cyclones travel eastward and generate waves that approach the northwestern exposed shores of the islands. These waves are most likely to occur from October through April.

Local Storms and Hurricanes – Local storms and hurricanes are infrequent. Tropical storms generated off the coast of Mexico move westward through the equatorial region and occasionally deflect northward toward the Hawaiian Islands. Hurricane Iniki in September 1992, Hurricane Iwa in November 1982, Hurricane Dot in August 1959, and Hurricane Nina in December 1957 are the major hurricanes that have caused damage to the Hawaiian shoreline in the past 40 years.

Tsunami – Tsunamis are "the mostly deadly natural affecting Hawai'i" (Curtis 2008), although they are relatively infrequent. The WWRF is located well within the Tsunami Hazard Zone established by University of Hawai'i under direction of State Civil Defense. (Figure 2) The 1946 Tsunami destroyed the waterfront at Hilo, Hawaii and caused widespread flooding as far as 1.6 km (1 mile) inland. (Keating, 2008) Walker (1994) found that since 1937 there have been

11 tsunamis with a wave runup of 1 meter (3.3 feet) or more, with certain areas of Oahu experiencing runups of 7.2 meters (24 feet.). Modifications to the WWRF for tsunami protection area subject of a larger study presently being performed by the County.

Figure 2. Tsunami Hazard Map

4.4 Precipitation

The average monthly precipitation at Kahului is presented in the table below. The average annual total is estimated to be approximately 19 inches per year (Western Regional Climate Center website at <<http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?hikahu>>).

Table 2 Average Monthly Rainfall at Kahului (4/1/1954 to 12/31/2005, inches)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
3.70	2.55	2.64	1.44	0.69	0.23	0.48	0.48	0.35	1.03	2.31	3.04	18.93

4.5 Typical Hawaiian Beach Characteristics

The following provides a general description of Hawaiian beaches including their formation and composition. Most of the information is derived from the study *Hawaiian Beach Systems* by Moberly and Chamberlain (1964).

Each of the Hawaiian Islands was formed by volcanoes that built up basaltic lava in intermittent layers from the seafloor. The general succession of island formation has been from northwest down the island chain to the southeast, with Maui being one of the more recent geologic formations. Maui was formed by the two adjacent volcanoes of Haleakala and West Maui, with an isthmus connecting the two. Kahului is located on the north side of Maui.

Coral reefs are found along much of the Hawaiian Island shorelines. These wave-resistant structures are formed by shallow-water organisms in warm-water environments. The most common type of reefs found in Hawaiian waters is fringing reefs. Fringing reefs along the sheltered leeward coasts in Hawaii are some of the wider and flatter reefs in the islands. Commonly, they have detrital (originating from the land after weathering and erosion) grains mixed with the predominantly calcareous sands covering them and their adjacent beaches. These reefs were the ones most utilized by the ancient Hawaiians for their fish ponds.

Hawaiian beaches mainly consist of medium grain-size sand, although their sediments actually range from gravel to sandy mud. Many beaches have coarse sand; most Maui beaches have fine sand. Hawaiian beach sand is composed of two general types of grains mixed together in proportions that vary from one locality to another. Light-colored calcareous grains of biochemical origin, the fragments of skeletal parts of certain marine invertebrate animals and algae, contrast with dark-colored silicate grains of detrital origin.

5. WAILUKU-KAHULUI WWRF SHORELINE CHANGES

5.1 Introduction

This section discusses long-term shoreline changes over periods during the last 100 years. The shoreline reach considered here is approximately 5-miles long and extends east from Kahului Harbor to Paia Bay. It is broken into a series of pocket beaches by manmade groins and natural lava and beachrock points. Most of the attention is applied to the 4,400-feet stretch of beach from the Kahului Harbor breakwater to Kaa Point, and in particularly the 2,100 feet of beach west of the WWRF revetment and fronting the WWRF. This section refers to the shoreline west of the WWRF revetment as the WWRF beach, and the shoreline east of the WWRF revetment as Kite Beach.

Natural and anthropogenic processes affecting this shoreline are unusually varied and complex. Seasonal fluctuations are overlaid on long-term changes in the beach caused by long-term changes in sediment supply and littoral transport.

The primary sediment source is from biological production, with foraminifers and other small marine organisms transported in from the reef edge. Sand is transported by winds and waves, and additional sand enters the littoral system as the beaches retreat and the underlying substrate erodes. Anthropogenic processes affecting the system have included construction of Kahului Harbor and its east breakwater, sand mining and later beach replenishment east of the WWRF, damage to the coastal dune system, construction of revetments and groins along the shoreline, and (possibly) a decrease in reef productivity resulting from ocean warming and/or increased turbidity in nearshore waters. Some of these influences are described in more detail in Sections 5.2.2 to 5.2.5.

This section reviews the different sources of data used to describe and understand past shoreline behavior, and so to predict its future behavior. The main data sources are: early, generally qualitative literature (lime kiln removal of sand, etc.); erosion maps from the County of Maui (based upon aerial photography over the past century); site visits performed by Moffatt & Nichol in 2004 and 2007; and beach profiles measured by the USGS between 1995 and 1999.

5.2 Historical Changes and Anthropogenic Influences on the Shoreline

5.2.1 Early Observations

Shoreline erosion in the vicinity of the Kahului WWRF has been documented for over 100 years. Doak Cox (1954) stated the shoreline between Kahului and Paia had been eroding for at least 50 years, since soon after the turn of the last century. Cox stated the only portion of the shoreline that was not eroding was the area east of the Kahului Harbor breakwater, where the beach had been accreting over a length of 2,400 feet. This accretion resulted from the construction of the Kahului Harbor breakwaters and the longshore transport of sediment flow from east to west. Cox's 1954 report does indicate this area adjacent to the east breakwater had recently started to recede.

Other reports which outline early erosional trends along the project area include a report by Moberly (1963), which states "lines of beachrock awash at the waterline as much as 800 feet offshore show the historical record of erosion is merely the latest stage in a process operating over the last few hundred years." In the report, Moberly indicates sand mining was being conducted along the eastern end of the 5-mile long section of beach that extends east from the Kahului Harbor. He identified changes in the beach configuration caused by the mining and stockpiling operations. Another report by the US Army Corps of Engineers and the State of Hawaii (1964) describes the beach as having “moderate to minor erosion in recent years.”

5.2.2 Kahului Harbor Breakwater

The east breakwater of Kahului Harbor was originally constructed in 1900, and the first breakwater improvements constructed by the Corps of Engineers were completed in 1913 (USACE 1988). While the long-term effects of the breakwater structure and dredging practices are not known in detail, it is clear that the breakwater (and adjacent groin to the east) caused significant accretion to the adjacent WWRF beach in the early years of the twentieth century.

5.2.3 Sand Mining

Sand mining for lime production by the sugar company and later mining by others for cement manufacturing and aggregate has had a profound effect on the beaches between Kahului Harbor and the mining site at the lime kilns near Baldwin Beach, nearly 5 miles east of the Kahului Harbor breakwater. Mining apparently began around 1900 and ended sometime between 1960 and 1975. Large-scale sand mining was prohibited in 1986 (University of Hawaii Sea Grant Extension Service and County of Maui Planning Department 1997).

In 1954, it was estimated (Cox) that approximately 12,000 cubic yards per year (cy/yr) of sand had been mined from the beach area to the east of the WWRF. Also, Levin (1970) states the dredging during sand mining efforts offshore of the lime kilns changed the bathymetry of the nearshore area, creating “new deep water areas”; it may also have caused turbidity which can affect the adjacent reef systems. Since the cessation of the sand mining, the erosion rate in the area has substantially lessened.

5.2.4 Beach Replenishment

Sugar Cove is located approximately 3 to 3.5 miles east of the Kahului WWRF. Sand has been added to the beach at Sugar Cove by the Sugar Cove Apartment Owners Association resulting in significant increases in the local beach width. 17,000 cubic yards of sand were placed at Sugar Cove between 1996 and 2002, according to data supplied by Ms. Barbara Guild of the Association. More details of the beach replenishment are given in Appendix A.

5.2.5 Reefs

Biological production is responsible for all the new sediment entering the littoral system east of Kahului Harbor according to Moberly (1963). The chief constituent is foraminifers. These small marine organisms are transported in from the reef edge. Living mollusks and echinoids are found there too, but they, as well as living coral, are rare or absent on the reef flat. Algae are the only common inhabitants there. From high to low in scale of supply, the sources of beach sediment are: foraminifer skeletons, mollusks, red algae, echinoids, corals, and green algae.

It has been speculated (Sea Engineering 1991 and Guild 1999) that the reefs located offshore of the Spreckelsville Beach area may not be as productive as they have been in the past. If the reef is less productive, then there would be a decrease in the coralline sand washed onshore from the reef system. This may be a result of ocean warming. In addition, stream flooding can cause significant flows from Maui’s rivers. The discharge can cause high levels of turbidity in coastal waters. The increased turbidity, if prolonged, may have an adverse impact on the local reefs.

WWII training exercises destroyed portions of Maui's reefs during the early to mid-1940s. This is evidenced on South Maui, at south Kalama Park in 1943-1945. The Navy underwater demolition team blew up reefs as practice for beach landings for the war in the Pacific. Also, there is evidence that other reefs in south Maui were destroyed by the Navy in 1945 at the request of the County of Maui in an attempt to improve the quality of the swimming beach (Halama Beach Homeowners Association 1999). Evidence supporting these types of activities on Maui's north shore has not been found, but it has been speculated that some of the WWII training exercises did take place along the Spreckelsville Beach area.

5.3 County of Maui Shoreline Erosion Maps

5.3.1 General Description

The County of Maui Shoreline Erosion Maps were compiled using aerial photography and historic T-sheets to determine long-term historic trends in shoreline position. The earliest shoreline position on the County Maps is the 1899 shoreline (which does not include the WWRF revetment); this is followed by 1912, 1929, 1960, 1975, 1987, 1988, 1997, and 2002. More recent (2007) aerial photography, used here to update the erosion estimates, was obtained from the University of Hawaii.

Using the digitized shorelines, the County calculates the Annual Erosion Hazard Rate (AEHR) in feet per year (ft/yr). The shorelines and associated AEHR (red bars) for the section of coast from Hobron Point to Kaa are shown in Figure 3. At the western end of the map, the AEHR ranges from -0.5 ft/yr to almost -3.0 ft/yr. From the western edge of the WWRF property line, the AEHR increases gradually from near 0.0 ft/yr to slightly over -4.0 ft/yr at the eastern terminus of the map. Directly fronting the WWRF, the historic long-term AEHR is shown to be between -1.0 and -2.5 ft/yr. Once a section of coast is armored, the long-term shoreline erosion rate only consists of the pre-armored time frame. The current erosion rate at the WWRF revetment is likely less than shown here, because the structure has halted further shoreline retreat.

5.3.2 Further Analysis

More detailed analysis of the information contained in the aerial photography has been performed by M&N and is described in this section. The analysis includes seasonal, short-term (a few decades), and long-term (up to a century) effects.

The basic analysis performed by M&N included the digitization of the shoreline from the June 2007 aerial photography, measurement of beach widths and beach plan areas from those photographs, and measurement of changes in those beach widths and beach plan areas between the earlier dates (listed above) and June 2007. The following discussion, and the sediment budget in Appendix A, is based on these measurements.

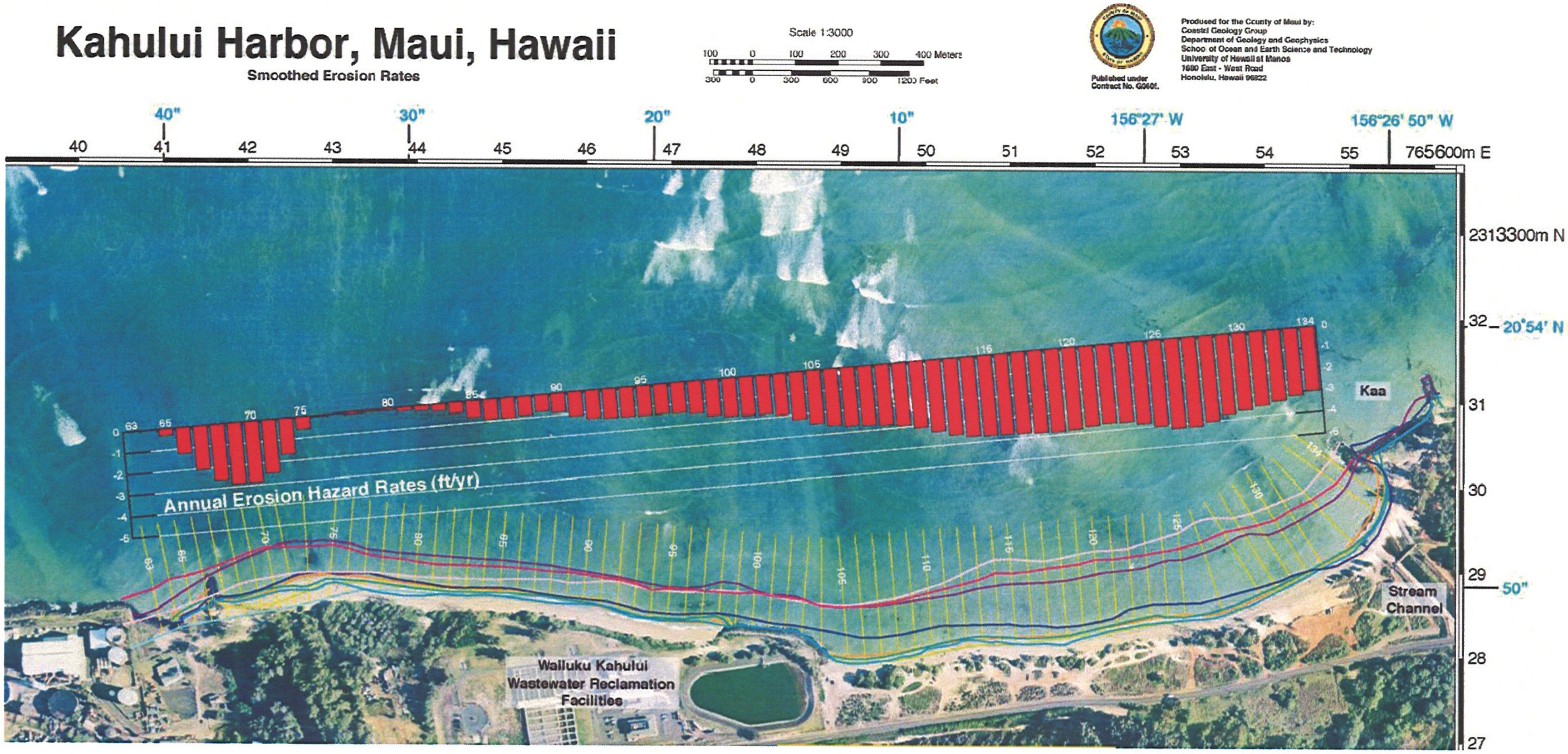


Figure 3. County of Maui Shoreline Erosion Map at the Wailuku-Kahului Wastewater Reclamation Facility.

5.3.3 Long-Term Changes

Figure 4 illustrates the long-term fluctuations in the plan area of the WWRF beach (west of the revetment fronting the WWRF pond) and Kite Beach (east of the revetment) relative to the 2007 beach area. The behavior of the two beaches was very different in the early part of the century. It appears that the WWRF beach accreted rapidly in response to the construction of the Kahului Harbor breakwater in the early 1900s, but the effects of the breakwater did not extend to Kite Beach. Dramatic erosion at both beaches between 1960 and 1987 has been followed by a relatively stable period from 1987 to 2007.

As will be described in Section 6, the decrease in erosion rate is believed to be associated with the cessation of large-scale sand mining east (upcoast) of this stretch of shoreline, and with the general decrease in the rate of sediment transport that comes with shoreline retreat.

A more detailed spatial analysis of the long-term shoreline accretion and erosion trends, from 1912 to present, and a comparison with data presented by Sea Engineering (1991), are given in M&N's "Central Maui Wastewater Reclamation Facility, Shoreline Evaluation Report" (2005). Shorter-term (seasonal and decadal) fluctuations are discussed in more detail below.

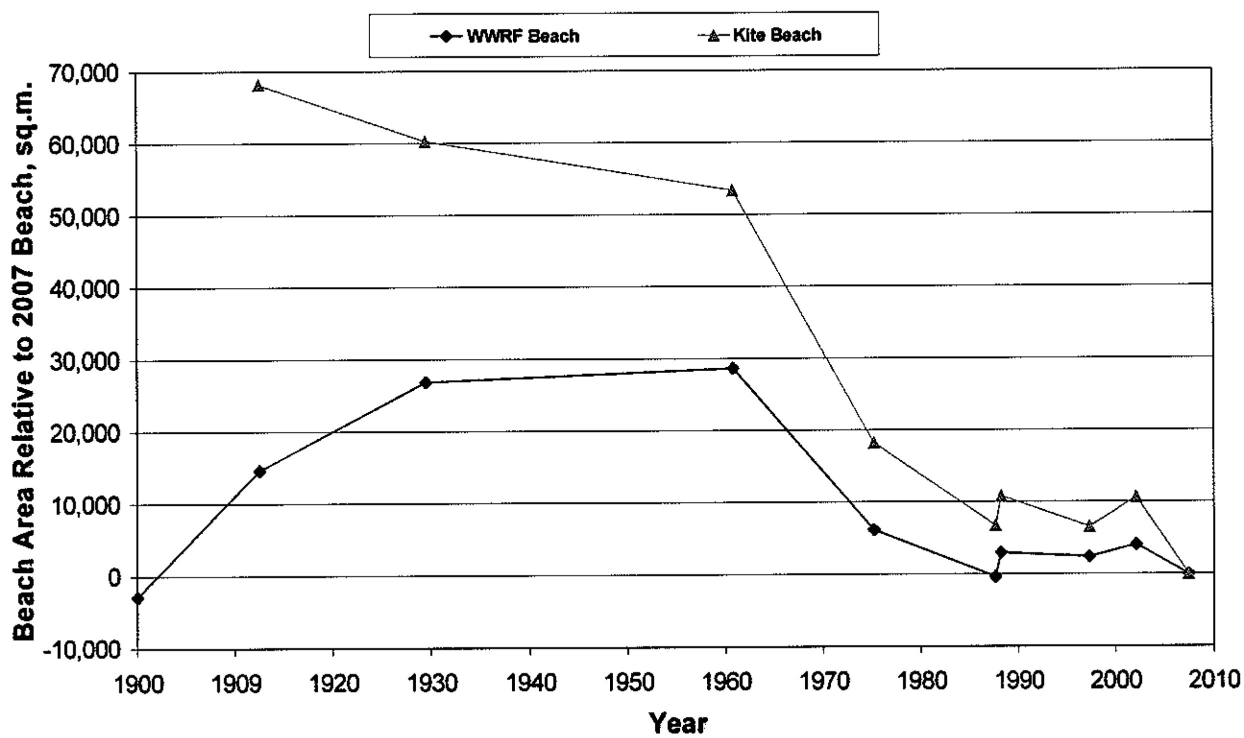


Figure 4. Long-Term Fluctuations in Beach Plan Area at the WWRF Beach, 1889-2007.

5.3.4 Seasonal Fluctuations

As shown in Figure 4, the WWRF beach has been relatively stable since 1987. An estimate of average seasonal fluctuations in the beach can be obtained by plotting the beach plan area over this period against the month of observation. The results, shown in Figure 5, strongly suggest the beach area decreases during the summer months. This figure gives the plan area relative to the widest, February 2007, data set.

The seasonal change in plan area measured in this way is approximately 50,000 square feet of beach for the 2,160 shoreline feet of the WWRF beach. The change in beach area corresponds to a seasonal beach width fluctuation of 23 feet. The results for Kite Beach are more variable but are generally consistent with this value.

This is a typical change in beach area, and does not account for inter-annual variability or for additional losses that may occur at the end of the northeast trade season – between August and October. As such, it appears to provide a lower limit on the seasonal fluctuations that should be incorporated in the design of a beach replenishment or other infrastructure protection program.

To highlight the importance of the seasonal fluctuations, Figure 6 shows the plan area of the WWRF beach, with and without correction for these average seasonal fluctuations, for the period 1987 to 2007. The majority of the fluctuations appear to be seasonal rather than inter-annual.

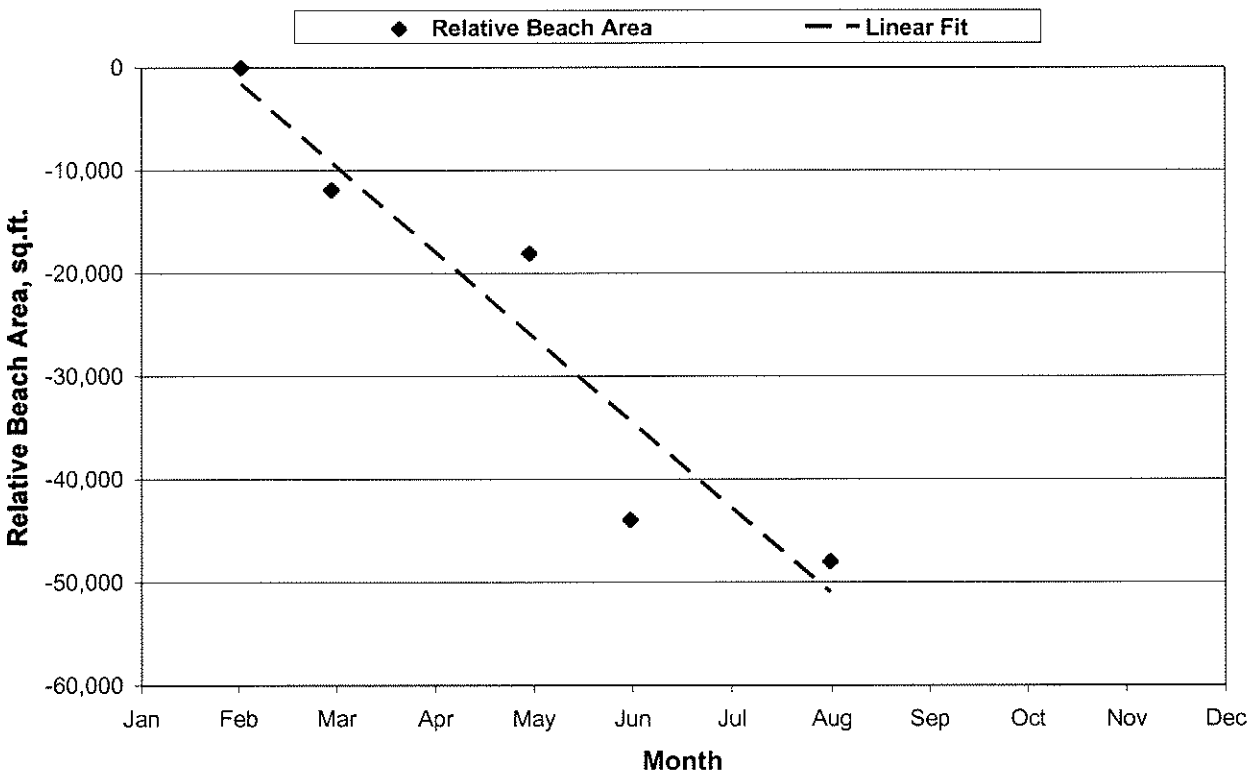


Figure 5. Monthly Variation in Plan Area at the WWRF Beach, 1987-2007.

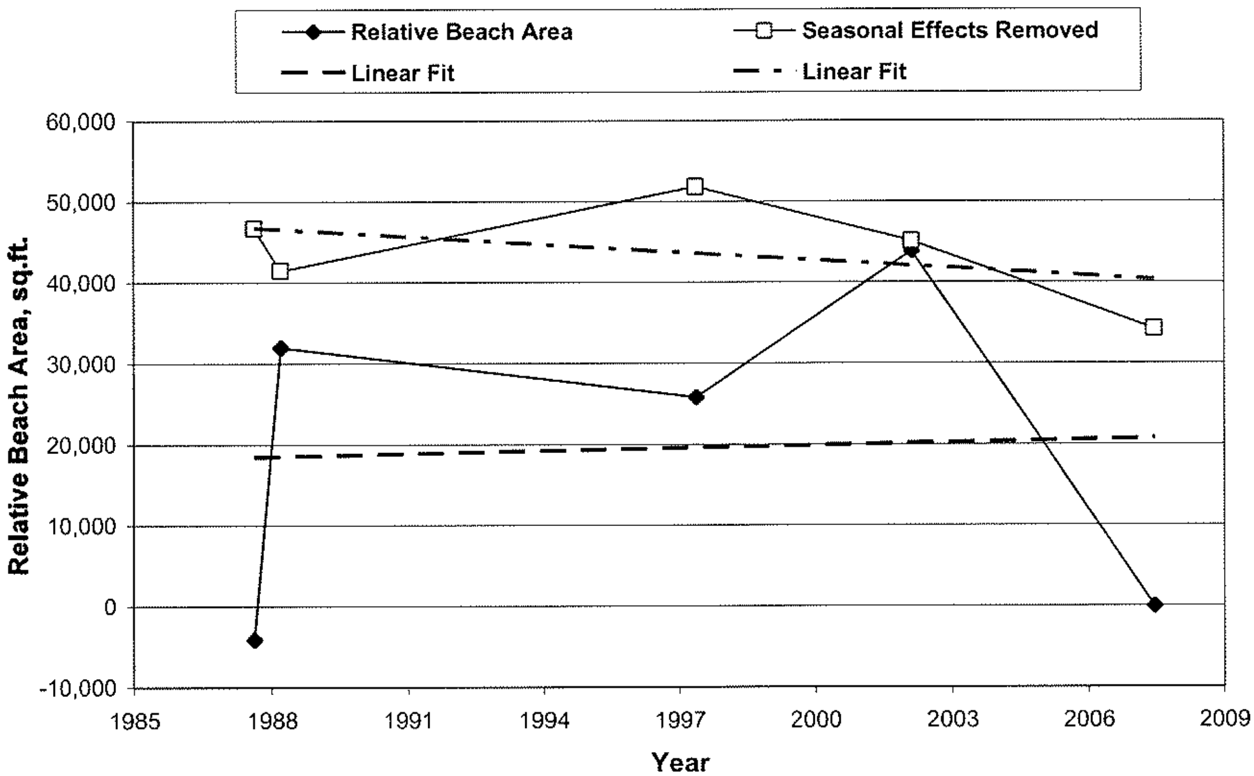


Figure 6. Trends in Plan Area, WWRF Beach, 1987-2007, With and Without Seasonal Fluctuations

5.3.5 Alongshore Patterns of Shoreline Change

The shorter-term (decadal) patterns of shoreline change west and east of the WWRF pond and revetment can be investigated by plotting the change in beach area or shoreline position between measurements. This section focuses on the recent decades 1987 to 2007. Earlier shoreline accretion and erosion trends, from 1912 to present, and a comparison with data presented by Sea Engineering (1991), are given in M&N's "Central Maui Wastewater Reclamation Facility, Shoreline Evaluation Report" (2005).

Figure 7 illustrates the erosion (negative) and accretion (positive) rates between recent surveys at ten-year intervals for the WWRF beach and Kite Beach. The shoreline change rate is shown for each transect on the County Shoreline Erosion Maps. The transect spacing is approximately 20 meters (66 feet): Station 70 is located west of the WWRF property, and Station 134 is located at Kaa, east of the Stream Channel.

The intervals shown are from 1987 to 1997 (dashed pink line) and from 1997 to 2007 (solid blue line). The shoreline position at each transect was subtracted from the previous shoreline position and then divided by the number of years between shoreline surveys. This produces a shoreline change rate in feet per year (ft/yr).

From 1987 to 1997 (dashed pink line), the WWRF beach west of the WWRF revetment accreted at a rate of approximately +2.0 ft/yr over most of its length. This equates to a shoreline advance of approximately 20 feet. At the revetment, the shoreline change rate is 0.0 ft/yr. As shown in Figure 1 and Figure 3, there is essentially no beach in front of this revetment, which is acting as a fixed point. At Kite Beach east of the revetment, the shoreline showed a slightly erosional trend, on the order of 0.0 to -2.0 ft/yr, between 1987 and 1997.

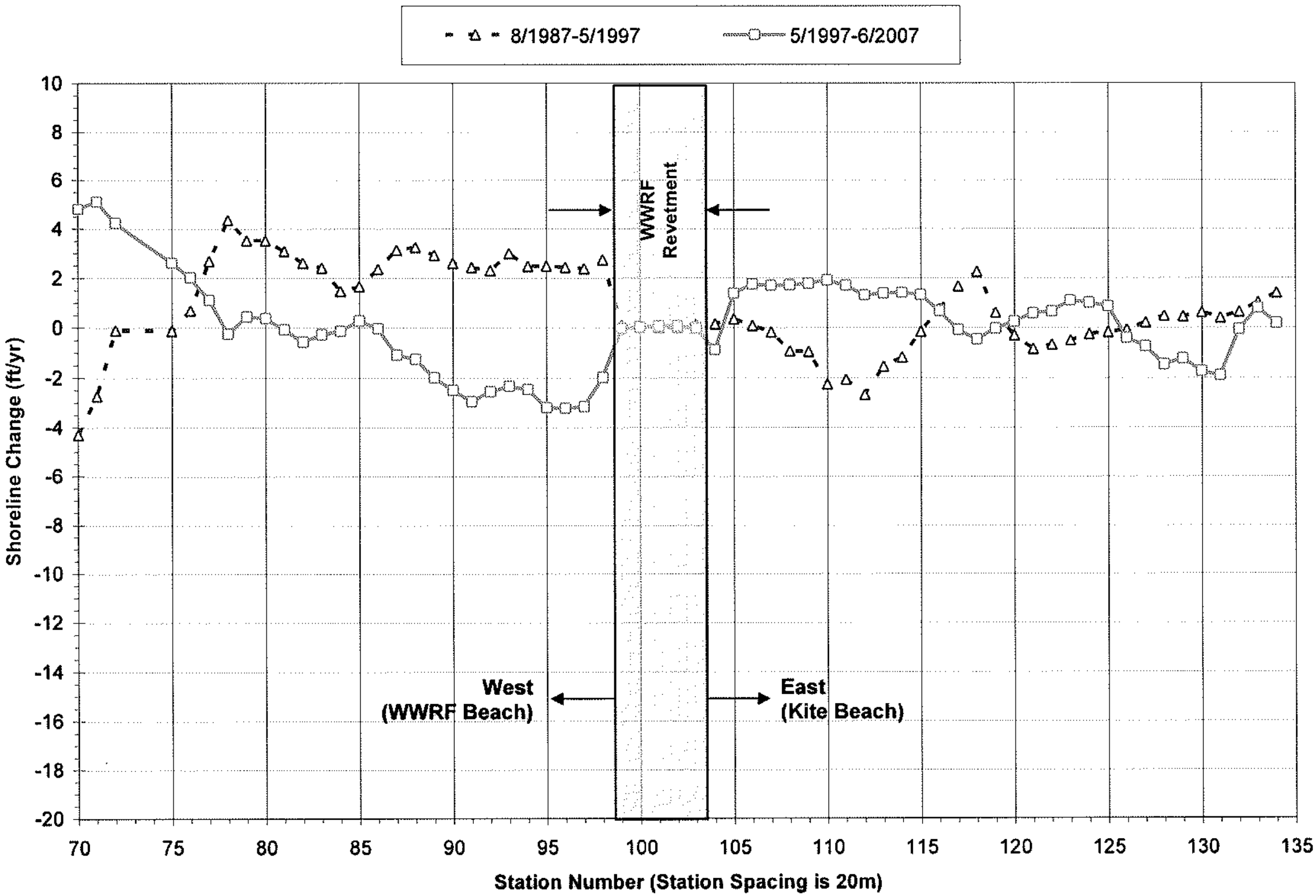


Figure 7. Shoreline Change Rate from 1987-1997 and 1997-2007 at the WWRF and Kite Beach. [From UH and County of Maui Shoreline Erosion Map data]

These trends are essentially reversed between 1997 and 2007 (blue solid line). The WWRF beach west of the revetment has been eroding at a rate of up to -3.0 ft/yr (approximately 30 feet of recession). East of the revetment, the shoreline change rate is approximately +2.0 ft/yr, decreasing to 0.0 ft/yr towards the eastern end of the reach. These recent trends suggest the WWRF revetment is now extending far enough into the surf zone to have some of the characteristics of a groin and the revetment has the tendency to cause accretion on the upcoast side (east) and erosion on the downcoast side (west).

5.4 Recent Observations

M&N visited the site in July 2004, November 2007, and March 2008; Figure 9 through Figure 16 illustrate the condition of the shoreline in the vicinity of the WWRF revetment on these dates.

In 2004, there were signs that the eastern end of the revetment was in danger of being flanked. Between July 2004 and November 2007, this area of the beach accreted (compare Figure 9 and Figure 10). This is consistent with the conclusion that the WWRF revetment may be acting as a partially blocking groin, with the direction of sediment transport from east to west. The beach behavior immediately west of the revetment was also consistent with this conclusion: this area of beach eroded between July 2004 and November 2007 (compare Figure 11 and Figure 12). Still further west, the beach accreted in this period (compare Figure 15 and Figure 16).

The period between November 2007 and March 2008 was outside the season of the northeast trade winds. The strength of sediment transport in from east to west is expected to be much less during this period; the transport could even reverse in response to southwesterly Kona winds and associated wave activity. Relatively little change was observed east of the revetment during this period (compare Figure 10 and Figure 11), while the beach west of the revetment actually accreted (compare Figure 13 and Figure 14).

These observations do not constitute a formal field investigation: the dates and available time for the site visits were determined by the scheduling of meetings associated with project milestones, rather than by the seasons, tide levels, etc. As such, detailed and firm conclusions cannot be drawn from these observations alone. However, the observations are entirely consistent with the general conclusions gained from M&N's analysis from shoreline surveys: the WWRF revetment is acting as a partially blocking groin, and the sediment transport between the beaches east and west of the revetment is limited by the revetment.

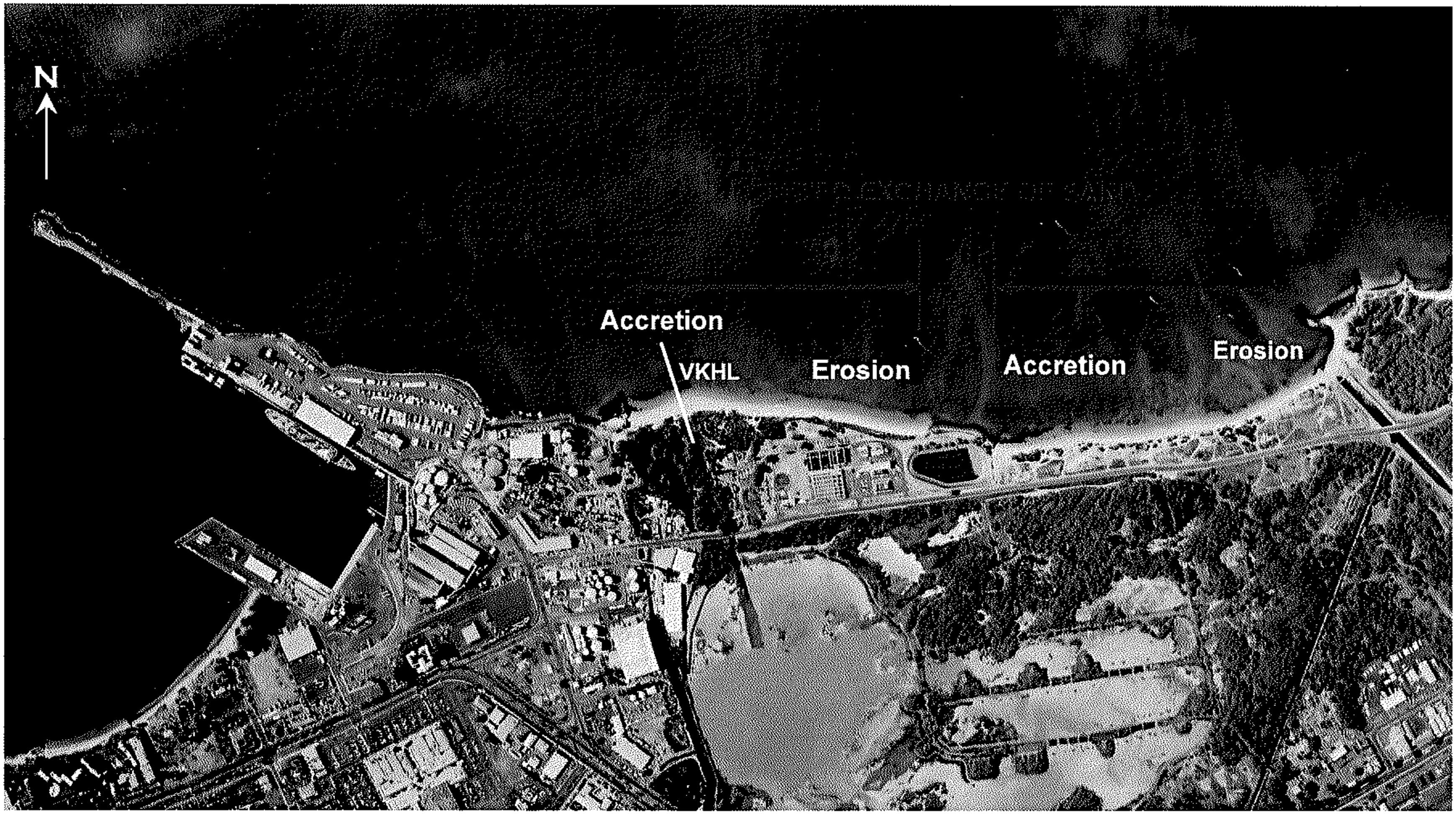


Figure 8. Accretion and Erosion at the Coast between Kahului Harbor and Kaa, July 2004 – November 2007

Figure 9. Looking East from the Revetment: July 2004 (Note Concrete "Pill Box")

Figure 10. Looking East from the Revetment: November 2007 (Note Accretion of Sand)

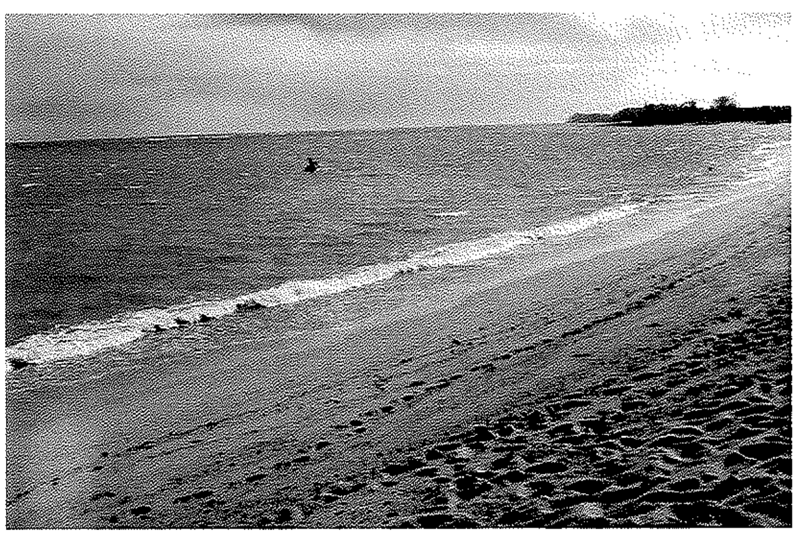


Figure 11. Looking East from the Revetment: March 2008. (Little Change)

Figure 12. Looking West from the Revetment: July 2004 (Note High Back Beach)

Figure 13. Looking West from the Revetment: November 2007 (No Large Berm)

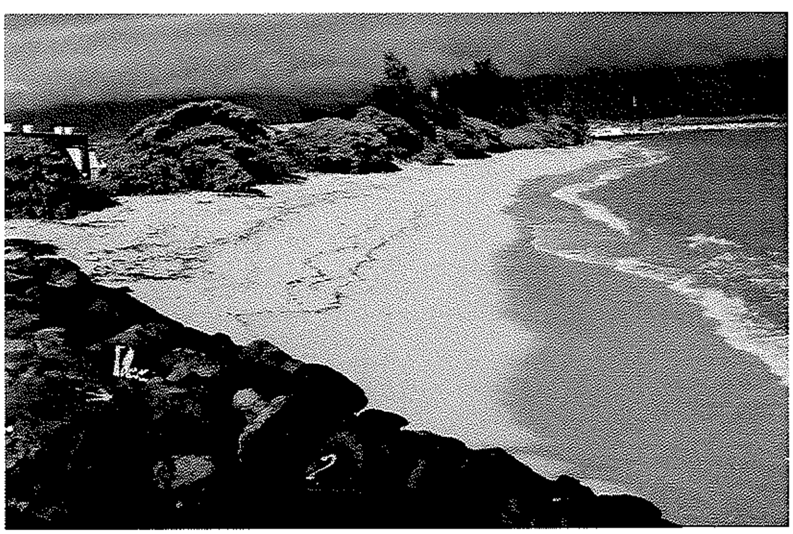


Figure 14. Looking West from the Revetment: March 2008 (Partial Recovery)

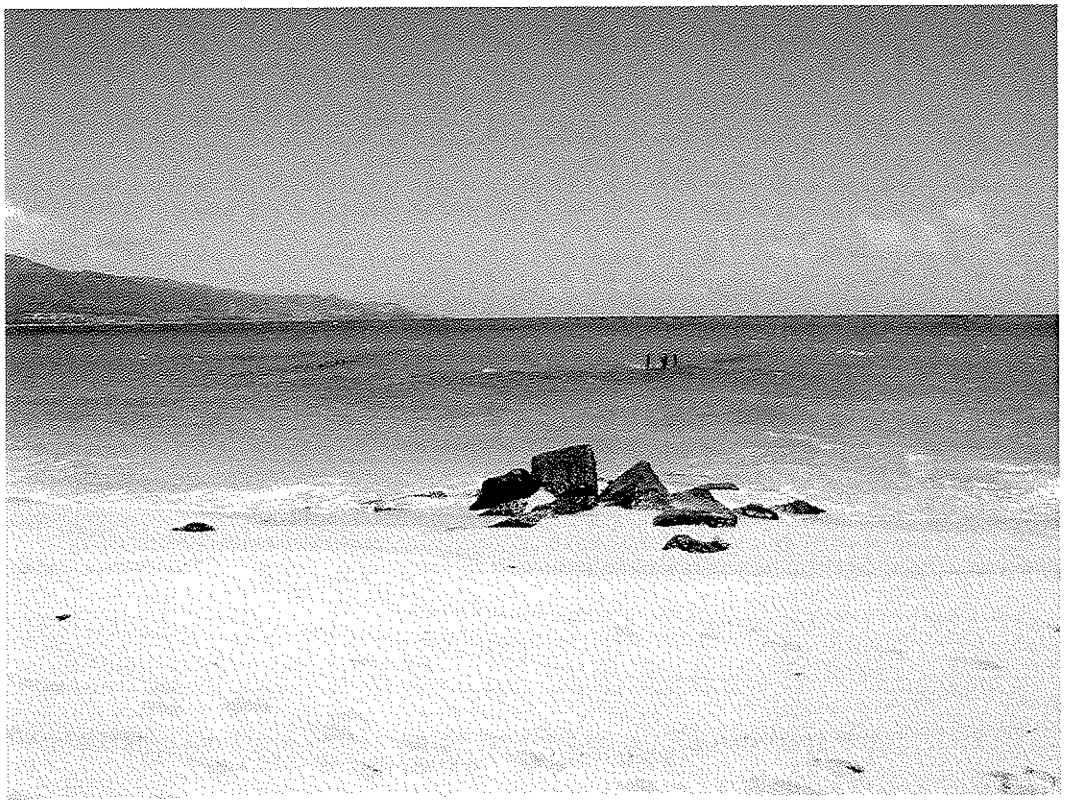


Figure 15. Outfall West of Revetment - 2004 (Note Rocks and Distance Offshore)

Figure 16. Outfall West of Revetment – 2007 (Rocks Buried and Beach Accretion)

5.5 USGS Profile Data

Profile data measured by the USGS from 1995 to 1999 measured by were obtained from the USGS website (<http://geopubs.wr.usgs.gov/open-file/of01-308/HTML1/Mnorth.html>). The nearest profile location to the project site is called VKHL and it is located near the western property line of the WWRF, close to Station 72 in the County Erosion Maps. The data from these profiles were reviewed to evaluate short-term – annual and seasonal – changes in trends in shoreline position west of the WWRF.

5.5.1 Annual Changes

For the annual shoreline change rates, it is important to compare data from the same seasons to obtain an accurate picture of the shoreline trends without the seasonal fluctuations.

At VKHL, the winter profile data (Figure 17) show that from January 1995 (black line with crosses) to February 1996 (dark blue/squares), the MLLW contour receded approximately 42 feet. The shoreline position remained similar at the January 1997 measurement, but recovered somewhat by 1998 (light blue/triangles). The January 1999 (gray/ circles) data indicate the shoreline had advanced again and had almost reached the original January 1995 position.

The summer profiles show a similar trend (Figure 18). The shoreline receded approximately 30 feet between September 1995 (dark red/squares) and August 1996 (light red/diamonds). By June 1997 (yellow/triangle), the shoreline receded an additional 12 feet. The shoreline advanced over the following two years, such that by July 1999 (mauve/crosses) the shoreline position was almost at the same position as the 1995 shoreline.

These data indicate the shoreline at this location has varied in recent years around a mean rather than displaying a consistent erosional or accretional trend. The maximum variation from year to year is 40 to 45 feet.

5.5.2 Seasonal Changes

The shoreline also moves between summer and winter profiles every year. The direction of movement is the opposite of that suggested by the analysis of plan view changes (Section 5.3.4) and general observations regarding the generally erosional effects of waves generated by northeast trade winds (Section 4.3). As is shown below, the winter profiles, measured before the northeast trade season (January/February), are consistently landward of the summer profiles, measured in the middle and end of the season (June through September) – the opposite trend to Figure 5. The likely reasons for this are discussed below, after the data have been presented.

Figure 19 and Figure 20 present the seasonal changes for each year of the shoreline profile data. The winter profiles are consistently landward of the previous summer profiles. From Figure 19, the largest recession is on the order of 42 feet, observed between September 1995 and February 1996. The 1997-1998 and 1998-1999 profiles show little or no erosion (a maximum of 6 feet) between the summer and subsequent winter locations.

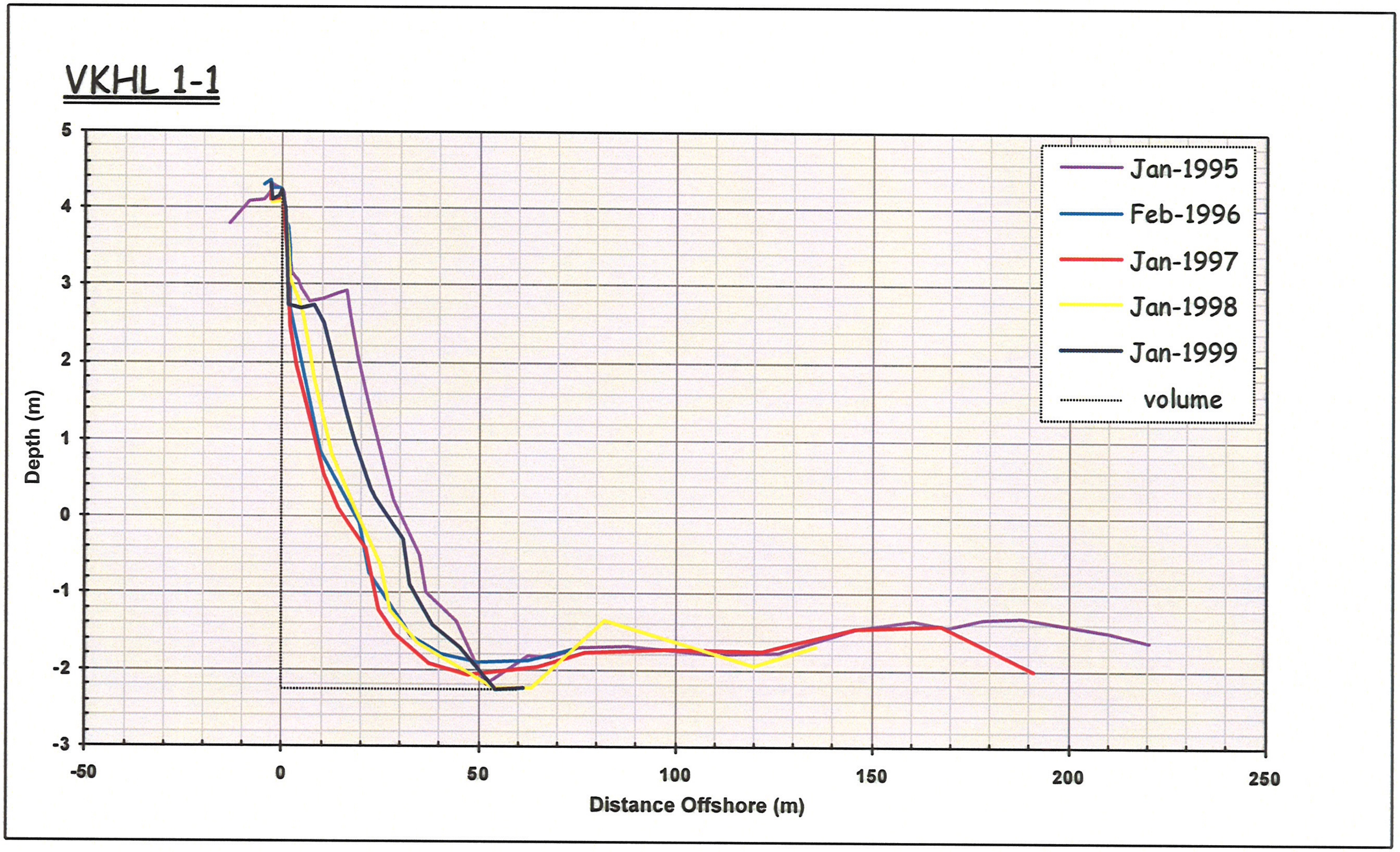


Figure 13. Winter profile data at VKHL from 1995 to 1999.

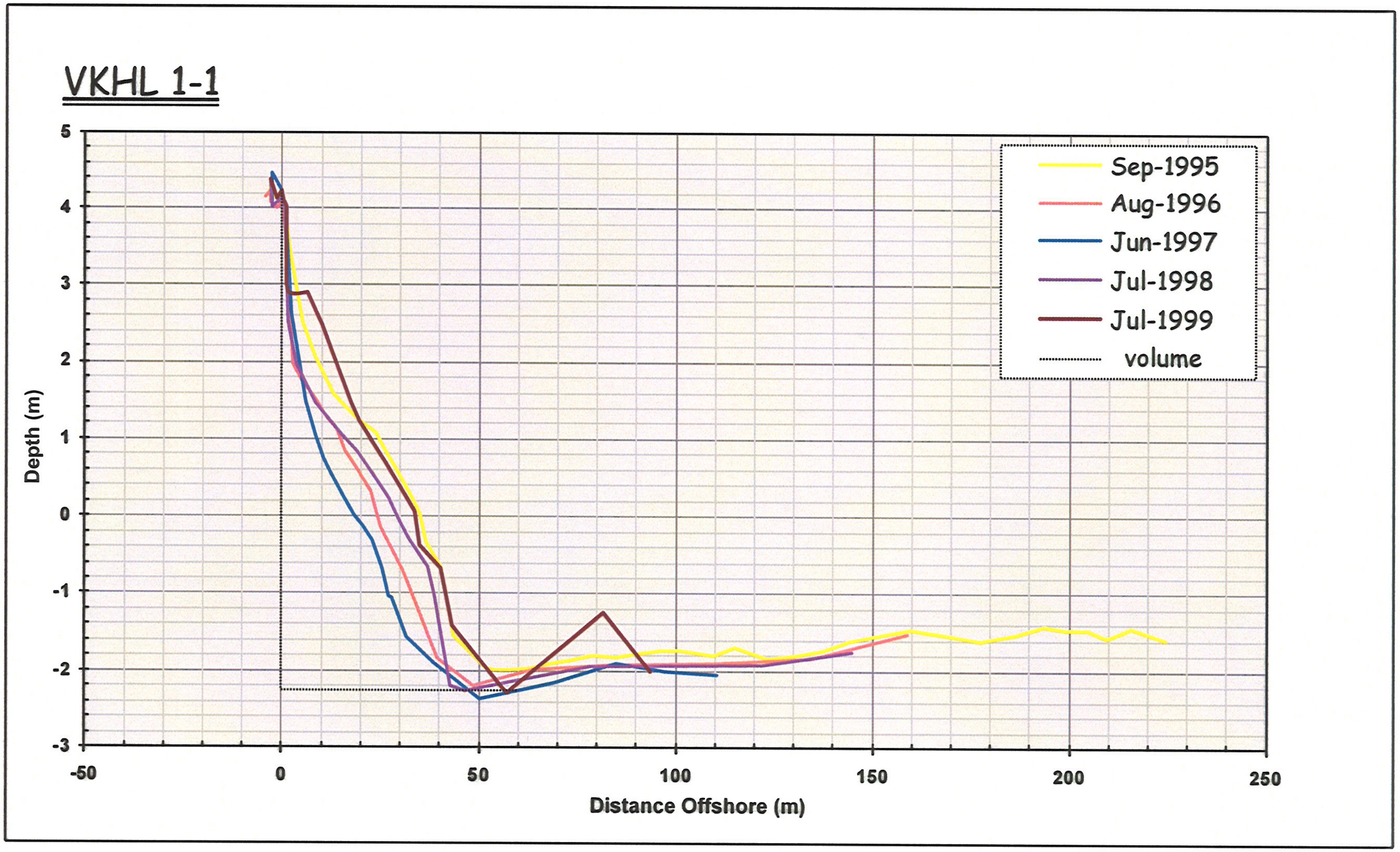


Figure 14. Summer profile data at VKHL from 1995 to 1999.

The reason for this contrary behavior of the shoreline at VHKL – with the shoreline accreting rather than receding during the northeast trade season – is that the profile is located close to the western limit of the WWRF beach (see Figure 8). During the northeast trade season, the WWRF beach and Kite Beach both generally experience erosion. However, since the waves generated by the northeast trade winds are directed towards the southwest, there is also a tendency for the sediment within the two, largely isolated, beaches to move towards the west. The movement of sediment towards VHKL near the western limit of the WWRF beach apparently outweighs the general narrowing of the WWRF beach during this season.

Figure 7 shows recent decadal changes in the beach at VHKL, at approximately Station 72, are directed contrary to the decadal changes in the WWRF beach as a whole. Repeating the analysis of Figure 5 for the western, middle, and eastern thirds of the WWRF beach, show the expected seasonal changes (narrowing during the northeast trade season) are by far the most consistent in the middle of this littoral subcell. The typical seasonal variation in this middle portion of the beach is about 30 feet.

5.5.3 SBEACH Analysis

The USGS measurements at VKHL did not include a significant storm season. M&N developed an SBEACH model of the site to investigate whether a dramatically greater level of erosion would be expected from a major storm event. The results presented here do not rise to the level of a detailed modeling study: the model is uncalibrated, and only a single event is considered. However, the results give a general indication of the degree of erosion that may be caused from a major storm.

The initial (pre-storm) shoreline was based on the January 1999 VHKL profile, extended offshore based on the nautical chart and extended inshore based on the available topographic information (Figure 23). Storm conditions included two-feet of storm surge superimposed on a relatively high tide, for a peak water surface elevation of 4.8 feet MLLW; and waves with a deepwater significant wave height of 25 feet and an 18-second period approaching the shoreline for 12 hours total. The 25-foot, 18-second wave is the design offshore wave used for the Kahului Harbor breakwater and is considered an extreme event.

Figure 21 shows the initial (pre-storm) and final shoreline resulting from this event. The final shoreline is shown two days after the event (the offshore bar is still migrating offshore at this time: however, the dry beach is no longer evolving).

About 60 feet of upland erosion is shown to be caused by the storm. This is similar to the maximum erosion distance observed during a single, not particularly stormy, winter season at VKHL. The wide offshore reef provides a significant level of protection to the shoreline. Thus, the risk to the WWRF caused by erosion from major storm events does not appear to be dramatically greater than the risk during a more normal season.

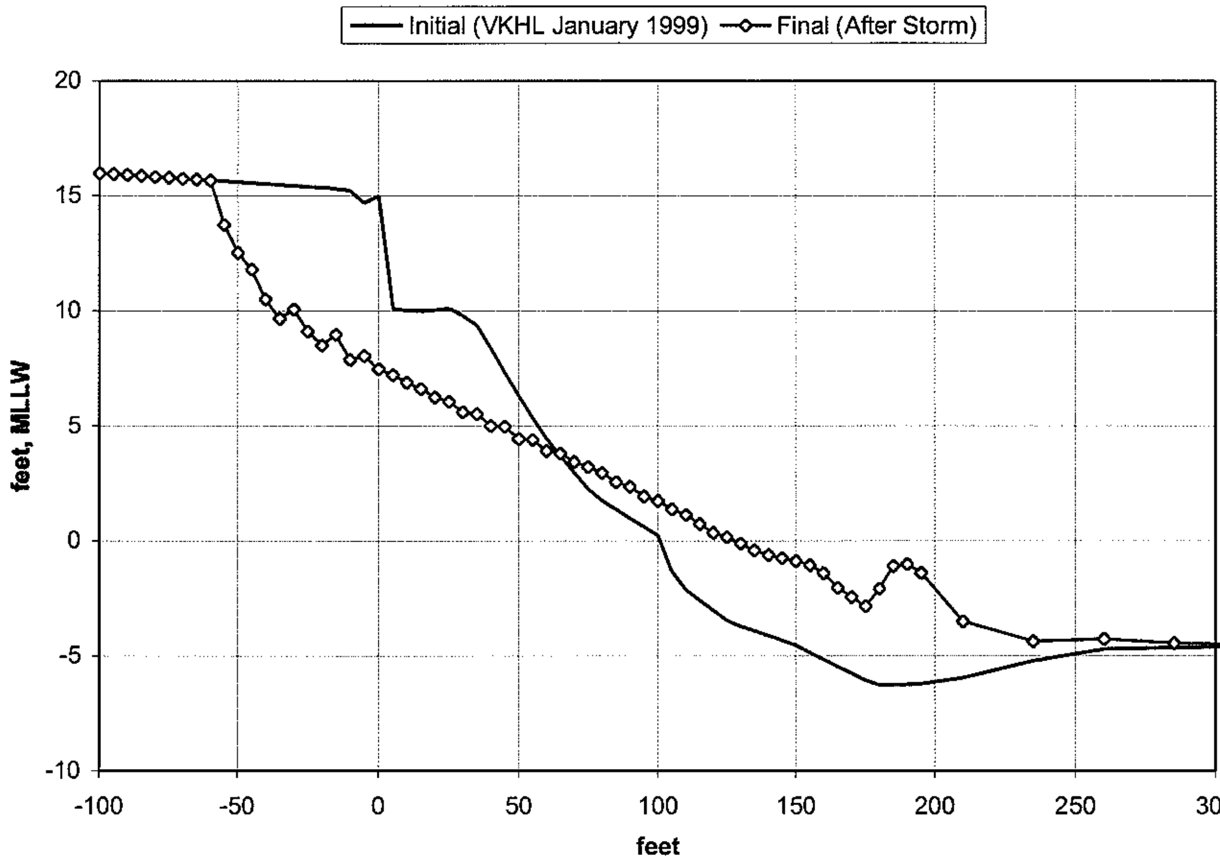


Figure 21. Initial and Final Profiles at VKHL predicted by an SBEACH Model Run for an Extreme Wave Event

5.6 Certified Shorelines

Several surveys have been performed to establish the "Certified Shoreline" position for the WRRF facility.

Figure 22 presents a comparison of the November 1977 and October 2007 "Certified Shorelines" at the WWRF facility and Table 3 presents a summary of the recession at the site.

Table 3. Recession from "Certified Shoreline" Data

Shoreline Recession 1997-2007	Total Recession (Feet)	Recession Rate (Feet/Year)
Maximum	38	1.3
Average	14	0.5
Minimum	4	0.1

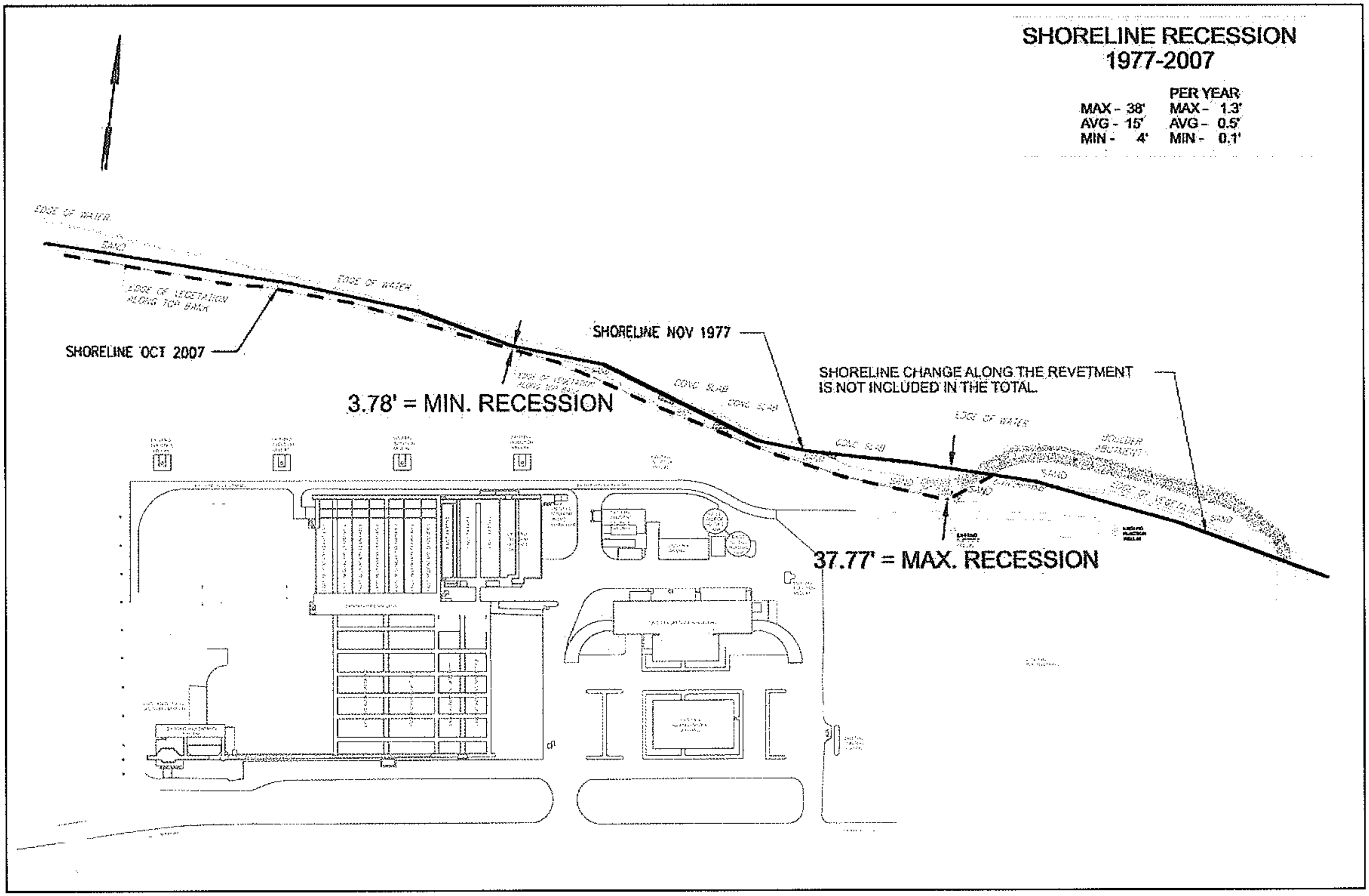


Figure 22. Certified shorelines at the WWRF, 1997 and 2007

5.7 Discussion

The aim of this review of historical shoreline behavior is to address the following questions:

1. What is the maximum likely seasonal and interannual shoreline retreat at the site?
2. What is the average or typical long-term shoreline retreat rate?

The first of these questions sheds light on the current vulnerability of the WWRF infrastructure to worst-case erosional events, and allows the buffer width appropriate to a beach replenishment protection scheme to be determined. The second question is relevant to the vulnerability of the WWRF infrastructure to the more likely (typical case) future shoreline recession, and provides input to the planning of future beach renourishment frequencies and quantities.

Fluctuations observed in the data set described here include the following:

- Analysis of variations in the beach plan area at the WWRF beach (Section 5.3.4) gives a typical seasonal fluctuation of 23 feet between February and August. Restricting the analysis to the middle portion of the WWRF beach increases the typical seasonal variation to about 30 feet.
- The largest annual recession observed at the USGS profile VHKL was 42 feet; see Section 5.5. This included a seasonal recession of 52 feet followed by recovery. While the seasonal behavior at this location differed from that observed for the beach at a whole, the general range of seasonal fluctuations is similar.
- Based on these observations, we recommend a typical seasonal variation of 20 to 30 feet and a maximum seasonal variation of 50 to 60 feet be used for planning. Given the typical pattern of seasonal shoreline erosion followed by recovery, it is not necessary to consider the worst-case interannual shoreline retreat in addition to the maximum seasonal shoreline retreat – the interannual shoreline retreat is typically smaller than the seasonal retreat as the beach recovers after an erosional season. For comparison, the setbacks required by the County of Maui include a buffer of 25 feet to allow for acute erosion events (County of Maui 2008).
- Long-term shoreline retreat at the WWRF site has slowed in recent years. Given that the general timescales associated with beach replenishment is a few years, the decade 1997-2007 is used to assess current retreat rates. Observations of the shoreline retreat in this period, discussed in Section 5.3.5, are as follows.
- The average retreat rate over the decade for the portion of the WWRF beach exhibiting significant decadal erosion is 2.4 feet per year. Stations 87 to 98 in Figure 7 were used in this average: these stations eroded 10 feet or more over the decade. The area used in the average is a little over one-third of the total length of the WWRF beach.
- The maximum retreat rate observed at the WWRF over the decade 1997-2007 beach is 3.2 feet per year: this was observed at Stations 95 and 96. However, much of the retreat occurred between 1997 and 2002. Within this period, Station 96 retreated at an annual rate of 6 feet per year.

- Based on these observations, we recommend a typical long-term erosion rate of 2.4 feet per year and a maximum long-term erosion rate of 6 feet per year for use in planning. The value of 2.4 feet is slightly larger than the County's Average Erosion Hazard Rate (AEHR) at the WWRF (Figure 3), but slightly smaller than the AEHR immediately east of the revetment, in the areas at risk of outflanking.

6. SEDIMENT BUDGET ANALYSIS

6.1 Overview

Everts Coastal[3] (2007 – Appendix A) prepared a detailed analysis of the sediment inputs, losses, and historical and likely future volume changes along much of the north Maui coast, with a focus on the shoreline fronting the Kahului WWRF. The two main outputs of the analysis are an estimate of the longshore sediment transport rate at the WWRF beach, and an estimate of the likely future beach changes and associated volumes.

The longshore sediment transport rate depends on the wave conditions, sediment characteristics, and – critically – on the nature of the shoreline. A shoreline with abundant sand tends to have wide, straight beaches that are not broken up by natural headlands, groins, or other blocking features. The wave energy that reaches such a shoreline is able to transport sediment very effectively. Consequently, the longshore sediment transport rate tends to increase with increasing beach widths. It is important to estimate the sediment budget, including the longshore sediment transport rate, at the WWRF beach in order to address the following technical questions:

Is the longshore sediment transport rate sufficiently large that sand retention structures such as groins will be needed in order for a beach replenishment project to perform acceptably? With no sand retention structures, if the transport rate at the nourished beach is large compared to the planned renourishment rate then the sand that is placed at the site will immediately be swept downcoast (west) or offshore at the Kahului Harbor breakwater.

Does the sediment budget analysis suggest that the future behavior of the beach will be similar to the recent past behavior, or are further changes to be expected and planned for?

6.2 Beach Dimensions

One of the most comprehensive data sets for modern beach dimensions have been compiled by the Sugar Cove Association of Apartment Owners as a result of their efforts to nourish and maintain their beach. Sugar Cove is located approximately 3 to 3.5 miles east of the Kahului WWRF. Sand has been added to the beach at Sugar Cove by the Association since 1996, as described in Section 5.2.4.

- An extensive set of beach profiles at Sugar Cove was made available, allowing the response of the beach to the recent replenishment efforts to be analyzed in some detail. Based on these profiles, the following are considered to be typical estimates the for the north Maui coast:
- Elevation of the backbeach line (the upper limit of the active beach) relative to the local sea level datum is +12 feet;
- Elevation of the shorebase (approximate depth of closure, beyond which no seasonal or short-term changes in the sea bed are observed) relative to the local sea level datum is -8 to -10 feet;

3 Note: Dr Craig Everts is a former Moffatt & Nichol employee who formed Everts Coastal as a specialist coastal geomorphology firm. M&N retained Everts Coastal for their particular expertise on shoreline evolution and their familiarity with the Hawaiian Islands.

- Horizontal distance from the shoreline (at local sea level datum) to the shorebase is 250 to 400 feet.

Thus, the vertical extent of the active littoral zone is taken to be 20 to 22 feet. The backbeach at the WWRF is slightly lower than elsewhere, and it is assumed that the vertical extent of the active littoral cell in that region is at the lower end of the range (20 feet).

6.3 Current Erosion Volume Rates

As described in Section 5.3.3 and Figure 6, the WWRF beach is relatively stable at present. The average change in beach plan area from 1987 to 2007 was used to estimate the shoreline change rate at between -6 inches per year and +2 inches per year. Using this average shoreline change rate, a shoreline length of 2,160 feet (which excludes the beach immediately in front of the WWRF revetment), and a moderate acceleration in the rate of sea level rise, an average beach replenishment quantity of between 650 cubic yards per year and 1,300 cubic yards per year (500 to 1,000 cubic meters per year) was estimated.

These estimates are scientific in nature and are not conservative in an engineering sense. This analysis is based the average shoreline change rate on a relatively stable historical period, 1987 to 2007. In addition, the volume estimates are based on the average shoreline rate over the entire beach – including portions that are not currently erosional. As described further in Section 7.2, a more conservative engineering approach that includes a safety factor and takes advantage of cost savings due to economies of scale may be more appropriate for project planning purposes.

6.4 Sediment Inputs and Losses

In order to estimate the longshore sediment transport rate at the Kahului WWRF, the sediment budget analysis first estimates the sediment inputs to, and losses from, each identified cell between the rocky headland immediately east of Sugar Cove and the Kahului Harbor breakwater. The following inputs are considered:

Biological flux of calcareous sediments - As noted in Section 5.2.4, the rate of production of beach sediments from reefs in the area may have dropped over the past century. The reefs may have suffered a loss of productivity as ocean waters have become warmer and as human influences may have affected it. The reef input was estimated to be 3,700 cubic yards per year for each mile of shoreline until 1975, dropping to 2,100 cubic yards per year per mile thereafter (1,750 dropping to 2,100 cubic meters per year per kilometer).

- Substrate sediment flux – that is, the input of sediment that is scoured from the previously inactive shoreline and contributed to the active beach. A major unknown associated with the substrate sediment flux is the fraction of substrate that is of sand size; this was estimated to be between 50 percent at the Kahului WWRF, dropping to 10 percent in the vicinity of Sugar Cove.
- Beach replenishment – 17,000 cubic yards (13,000 cubic meters) of sand were placed at Sugar Cove between 1996 and 2002.

The following losses of sediment are considered:

- Aeolian flux – that is, losses due to wind transport, generally to the coastal dune system.

- Overwash flux – in this case, loss of sand upland of the back beach line resulting from tsunamis.
- Grain abrasion – which may be an important loss of sand in calcareous beaches, reef type sediment can lose mass up to 2,000 times as rapidly as quartz sediments of similar size and roundness.

The loss rates due to aeolian and overwash flux vary along the north Maui coast, depending on the relative wind and tsunami wave exposure.

Sand mining in the area is not explicitly included in the sediment budget, as the majority of the extraction lies outside (east of) the area analyzed. Rather, the (significant) effects of sand mining are observed through the lack of sediment input from the beaches east of Sugar Cove. The rocky headland that forms the eastern boundary to Sugar Cove can currently be considered a blocking structure, such that no sediment enters the littoral system from the east.

6.5 Longshore Sediment Transport

The sediment budget analysis calculates the annual average input of sediment to, and loss of sediment from, each of 13 littoral cells along the north Maui coast, between the Kahului Harbor breakwater and Sugar Cove. The two cells at the far western end are the WWRF beach and Kite Beach, immediately west and east of the revetment at the Kahului WWRF. The residual sediment – that is, the difference between the identified sediment inputs and losses – is assumed to arrive at these two cells, and eventually to be lost offshore at the Kahului Harbor breakwater.

A summary of the calculated long-term sediment transport rates at the WWRF beach is given in Table 4. The transport rates are calculated for two periods: before and after the beach retreat associated with sand mining. For comparison, two cases are considered: one in which the earlier (pre-retreat) interval is taken to end in 1975, and a second in which that interval is taken to end in 1960.

Table 4. Long-Term Sediment Transport Rates at the Kahului WWRF

Interval	**Transport rate cubic yards per year (cubic meters per year)**	
Case 1		
1912-1975	7,100	(5,400)
1975-2002	5,400	(4,100)
Case 2		
1912-1960	8,500	(6,500)
1960-2002	6,000	(4,600)

It is noted that since the shoreline did not stabilize until about 1987, the transport rate has probably decreased compared to the long-term average shown here. The conclusion drawn is that ***the net rate of sediment transport at the shoreline adjacent to the Kahului Wastewater Reclamation Facility is currently between 1,300 and 4,000 cubic yards per year (1,000 to 3,000 cubic meters per year).*** This rate is likely to continue in the future.

Two conclusions can be drawn from this estimate. First, the sediment transport rate is relatively small in comparison to the quantities of sediment that are estimated to be required for beach replenishment and (more important) for periodic renourishment at the site; see Section 7.2 for a discussion of the beach replenishment alternatives. Shore-normal beach retention structures such as groins are typically used to stabilize beach replenishment in situations with high rates of littoral transport. Consequently, the benefits of a shore-normal retention structure at this site would be low.

The earlier shoreline evaluation report by Moffatt & Nichol (2005) proposed the use of T-Groins in one of the project alternatives, although even at the time this alternative was not considered preferred. Based on this relatively low estimate of longshore sediment transport, this earlier conclusion is confirmed. The rock that would be needed for the T-Groins would be more effectively used in a revetment, as the major threat for the facility appears to be storms and the potential for cross-shore loss of sand. Therefore, the alternative including T-Groins (or other shore-normal retention structures) is not taken further.

The second use of the longshore transport rate is as a guide to potential future changes to the degree of erosion and/or accretion at the Kahului WWRF. This is of particular importance for project alternatives based around beach replenishment, with or without a backing seawall or revetment. In the worst case, longshore sediment transport to the shoreline at the Kahului WWRF could potentially drop to zero (it appears very unlikely that the direction of net sediment transport would reverse to be east-directed). In this case, the quantity of beach renourishment would increase by up to 4,000 cubic yards per year (3,000 cubic meters per year). This increase would be in addition to the increase associated with other potential factors that directly affect the shoreline at the WWRF (e.g., accelerated local sea level rise).

7. PROJECT ALTERNATIVES

The project alternatives described in the Shoreline Evaluation Report have been reviewed, updated, and (in some cases) eliminated from further consideration based on newly available sand source information (see Section 8) and the sediment budget. This section describes the remaining alternatives, together with the No Project alternative. It should be understood that the No Project alternative is not a practical solution given the decision to keep the WWRF in its present location and the erosion rates at the site; it is presented as a baseline for comparison and planning purposes only.

7.1 No Project Alternative

For the no-project alternative, it is assumed that current shoreline change trends will continue in the future and no further shoreline protection will be constructed at the site. The 2007 certified shoreline and a site map of the WWRF (Brown and Caldwell 2002) were analyzed to determine when the first structures at the WWRF site could be threatened. This site map is illustrated in Figure 23. For this analysis it is assumed the revetment will remain and be maintained in place and will provide protection to the holding pond and other upland structures behind the revetment: these structures are not considered threatened.

The equation below was used to calculate the years until a structure is threatened:

$$Y = \frac{D - SR}{LTE}$$

where D is the distance between the structure and the back of the beach (approximately the +10-ft contour), SR is the seasonal recession, and LTE is the current longer-term erosion rate. Maximum and minimum values were used for the seasonal recession and the current longer-term erosion rate to calculate a range of years until the structures are threatened. As summarized in Section 5.7, the maximum and typical values of the seasonal recession are 50 to 60 feet and 20 to 30 feet respectively: the minimum seasonal recession is taken as zero. The maximum and typical longer-term erosion rates are 6.0 feet per year and 2.4 feet per year, respectively. These erosion rates implicitly include the effects of present-day sea level rise. Since the time until the structures are threatened is relatively short compared to the decades over which sea level rise is likely to accelerate, the effects of sea level rise are not explicitly included in the present estimate. If the rate of sea level rise accelerates, these times would be significantly reduced.

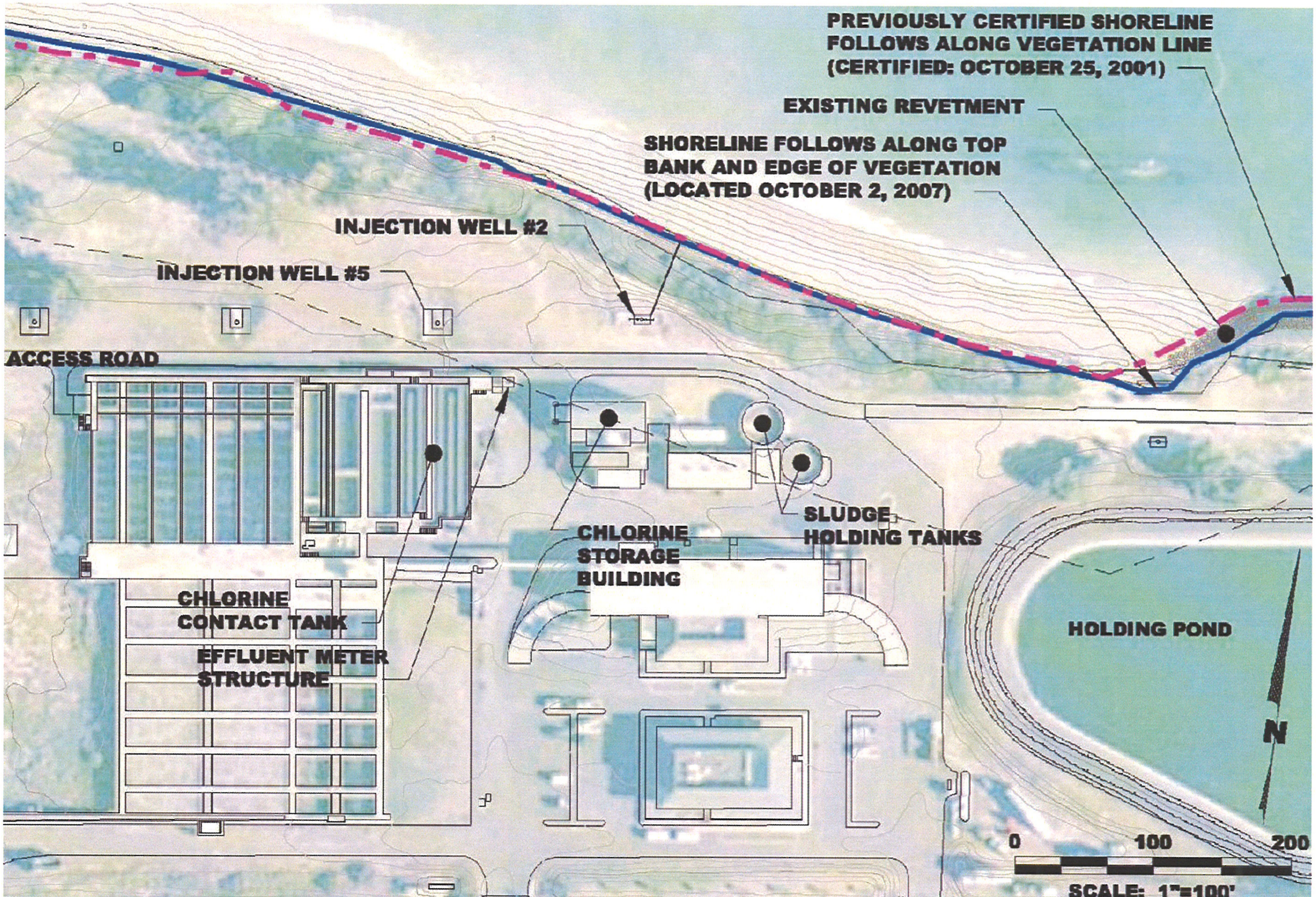


Figure 23. Threatened Infrastructure at Wailuku-Kahului Wastewater Reclamation Facility

Table 5. Calculation of Years until WWRF Structures are Threatened, Based on October 2007 Certified Shoreline

Structure	Distance from Top of Berm to Structure (ft)	Minimum Winter Recession (ft)	Average Recent Erosion Rate (ft/yr)	Approx. Yrs until Threatened
Minimum Seasonal Recession / Typical Long-Term Erosion				
Existing Access Road	63	0.0	2.4	26
Sludge Holding Tank	85			35
Chlorine Storage Bldg	118			49
Effluent Meter Structure	141			58
Existing Injection Well #2	59			24
Existing Injection Well #5	113			47
Minimum Seasonal Recession / Maximum Long-Term Erosion				
Existing Access Road	63	0.0	6.0	10
Sludge Holding Tank	85			14
Chlorine Storage Bldg	118			19
Effluent Meter Structure	141			23
Existing Injection Well #2	59			9
Existing Injection Well #5	113			18
Maximum Seasonal Recession / Typical Long-Term Erosion				
Existing Access Road	63	60.0	2.4	**1**
Sludge Holding Tank	85			10
Chlorine Storage Bldg	118			24
Effluent Meter Structure	141			33
Existing Injection Well #2	59			**< 1**
Existing Injection Well #5	113			22
Maximum Seasonal Recession / Maximum Long-Term Erosion				
Existing Access Road	63	60.0	6.0	**< 1**
Sludge Holding Tank	85			4
Chlorine Storage Bldg	118			9
Effluent Meter Structure	141			13
Existing Injection Well #2	59			**< 1**
Existing Injection Well #5	113			8

The data used to develop the maximum seasonal recession are very limited. In particular, no extreme storms or large hurricanes occurred during the period 1995 to 1999 when the USGS was measuring nearshore profiles (Gibbs, Richmond, and Fletcher 2000; see Section 5.5).

The previous table illustrates that the existing injection well #2 is already at threat of damage based on the worst-case seasonal recession. The access road could be threatened in only one year and the existing sludge holding tanks in as few as 4 years. The Chlorine storage building is located approximately 120 feet from the fence line, which relates to a minimum of 11 years before the structure is threatened using the maximum erosion rate and seasonal change. Table 6 summarizes the minimum, maximum, and average time until each structure is considered threatened. These values are supported by the recent exposure of an effluent line east of the revetment resulting from the erosional trends and winter storm response at the beach.

Table 6. Summary of WWRF Structures that may be threatened.

Structure	Approx. Minimum Time (yrs)	Approx. Maximum Time (yrs)	Approx. Average Time* (yrs)
Existing Access Road	< 1	26	5
Sludge Holding Tank	4	35	12
Chlorine Storage Bldg	9	49	21
Effluent Meter Structure	13	58	28
Existing Injection Well #2	< 1	24	4
Existing Injection Well #5	8	47	20

* Median value

It is possible that most of these structures identified above could be relocated elsewhere on the WWRF property. However, the northeast corner of the Chlorine contact tank and effluent meter structure is located approximately 120 feet from the existing fence line. The size of this structure and its position in the wastewater treatment cycle would prohibit it from being relocated elsewhere on the property. With this distance, the chlorine contact tank and effluent meter could be threatened in as little as 14 years.

Given the variability in these projections, the unpredictability of future storms, and the typical time required to design, permit, and construct a shoreline protection project (3 – 5 years), it is recommended a shoreline protection alternative be selected and implemented as soon as possible.

7.2 Alternative 1 - Beach Replenishment

Beach replenishment is a proven method to stabilize a shoreline against erosion, protect threatened upland areas, and advance a shoreline seaward. Recent smaller-scale beach replenishment projects have occurred on Maui at Sugar Cove, located approximately 4 miles east of Kahului Harbor. These projects included trucking sand from the inland quarries and placing the material in a small (600-ft long) pocket beach. The initial replenishment costs were approximately $100,000 and approximately $20,000 per year for ongoing maintenance. From 1995 to 2000, Sugar Cove has placed approximately 18,000 cubic yards of sand on their beach. The larger projects during this time included approximately 5,800 cubic yards in 1996 and approximately 6,300 cubic yards in 1998.

Beach replenishment projects constructed with larger volumes and coarser materials tend to remain longer on the upper portion of the beach for longer periods. Smaller and finer-grained projects tend to disperse more rapidly and remain on the upper beach for a shorter length of time. Therefore, it is important to use the best-suitable sand source for any beach replenishment project.

The alternatives presented in this section would build out the beach berm at an elevation of +10 feet MLLW by a distance of 40 feet. Assuming the existing beach width fluctuates seasonally between zero and 30 feet in width, this would give a nourished beach width expected to fluctuate seasonally between 40 and 70 feet in width. The 70 feet of width at the start of the erosional season would protect the upland area against (worst-case) long-term erosion rates of up to 6 feet per year for 3 years or more, followed by a (nearly worst case) seasonal retreat of 50 feet in a single season. The more likely long-term erosion rate, used in the estimate of renourishment frequencies and quantities, is 2.4 feet per year.

The beach face would be constructed at a slope of 1V:10H, as illustrated in Figure 24. This profile is selected to match the existing beach slope (measured at the USGS site VKHL). The natural profile meets the nourished profile at a depth of approximately -6 feet MLLW. The replenishment sand is proposed to be dredged from offshore sand sources (see Section 0).

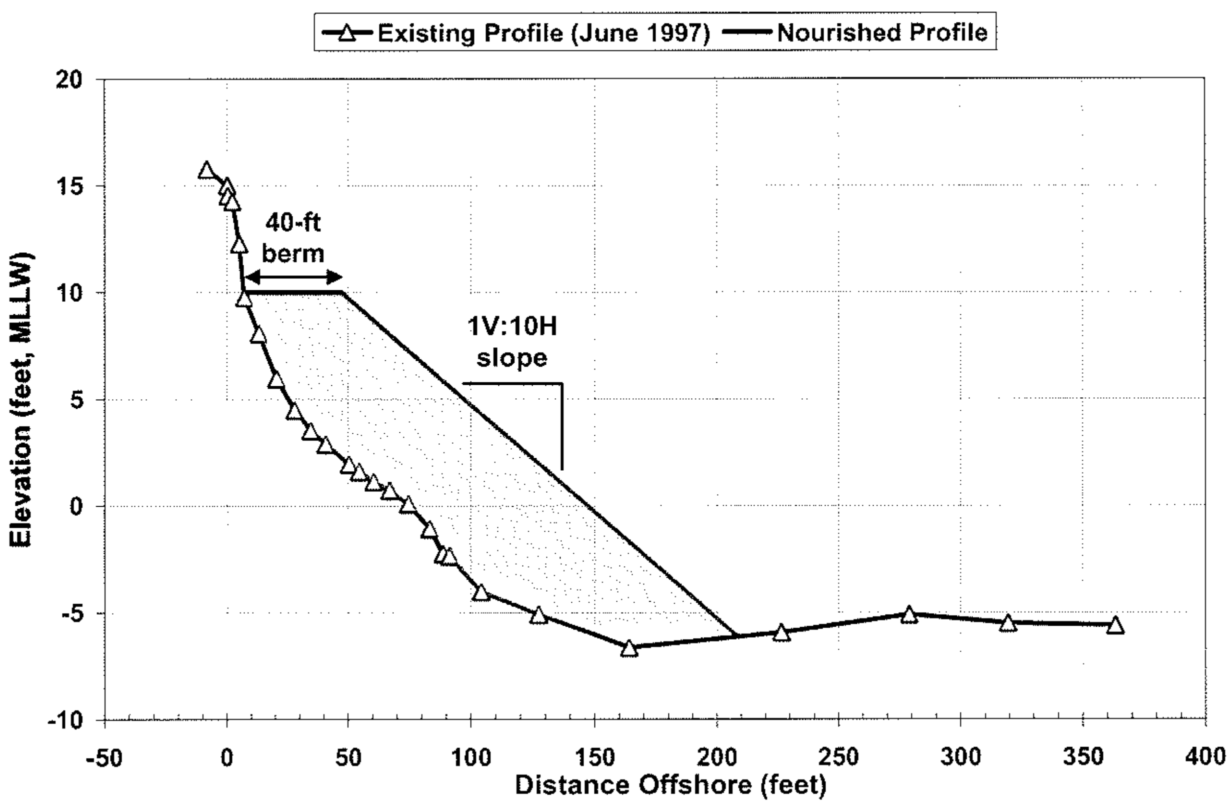


Figure 24. Alt. 1A and 1B - Cross-section of beach replenishment at the WWRF site.

The renourishment volumes presented for the beach replenishment alternatives are much greater than the basic sediment budget estimates presented in Section 6.3. The main reason for this is that these estimates are conservative in an engineering sense, while the sediment budget estimates are more scientific in nature and do not include a "safety factor". The engineering analysis estimates use the erosion rate over the relatively recent, and erosional, period 1997 to 2007, and focus on the most erosional 700 feet of the WWRF beach. In contrast, the Sediment Budget Analysis (Section 6.3) uses the longer and relatively less erosional period 1987 to 2007, and uses the average retreat rate over the entire beach – including portions that are not currently erosional. The project planning must account for the possibility that shoreline stretches which are not currently erosional, particularly areas retained by the short groin east of the Kahului Harbor breakwater, may become erosional once the replenishment project has made the beach wider and straighter.

7.2.1 Alternative 1A – 3,800-ft Long Beach Replenishment

The project reach for this alternative extends from approximately the WWRF western property boundary to approximately 100 feet east of the stream channel adjacent to Kaa, a distance of approximately 3,800 feet. The purpose of nourishing the entire reach is to develop a relatively natural beach plan form (the plan is similar to the beach observed in October 1960, and illustrated in the County erosion maps). The net sediment transport is from east to west, so that over the long term the material placed near Kaa would migrate west and could decrease the amount of maintenance replenishment required for the downdrift area fronting the WWRF. In the shorter term (a few years), the initial placement of a natural beach plan would decrease loss of sand from the area fronting the WWRF to adjacent areas through diffusion. Figure 25 provides a plan view of this replenishment alternative.

Alternative 1A requires approximately 105,000 cubic yards of initial sand placement to create an additional 40-foot wide berm along the full 3,800-feet length of the project (this would create a beach fluctuating seasonally between 40 and 70 feet in width). The nourished beach would continue to erode as it would under natural conditions and periodic maintenance nourishments would be required for the life of the project. Based on the average erosion rate of 2.4 feet per year, the beach would retreat by 20 feet in approximately 8 years. Once the beach width has retreated by 20 feet, it is possible for the entire beach to be lost in a single season, based on the worst-case seasonal fluctuations developed in Section 5.7: the beach should therefore be renourished at this stage. Taking into account that approximately 1,600 feet of the beach have been erosional over the past decade (Figure 7), it is estimated that approximately 21,000 cubic yards of sand would be required every 8 years to maintain the project design width – about 2,600 cubic yards per year.

7.2.2 Alternative 1B – 2,400-ft Long Beach Replenishment

This alternative is similar to Alternative 1A, above, except that the project length is reduced to approximately 2,400 feet. The replenishment extends along the WWRF property to about 500 feet east of the existing revetment; Figure 25 (dotted lines) illustrates the initial plan view of this beach replenishment alternative. The initial sand quantity is approximately 65,000 cubic yards.

Similar to Alternative 1A, the replenished area would continue to erode as it would under natural conditions. Approximately 1,200 feet of this stretch of the beach have been erosional over the past decade (Figure 7). Assuming a slightly greater renourishment density to account for the fact that smaller beach replenishment projects typically have less success with retaining beach area over the long term, it is estimated that approximately 16,000 cubic yards of sand would be required every 8 years to maintain the project design width – about 2,000 cubic yards per year.

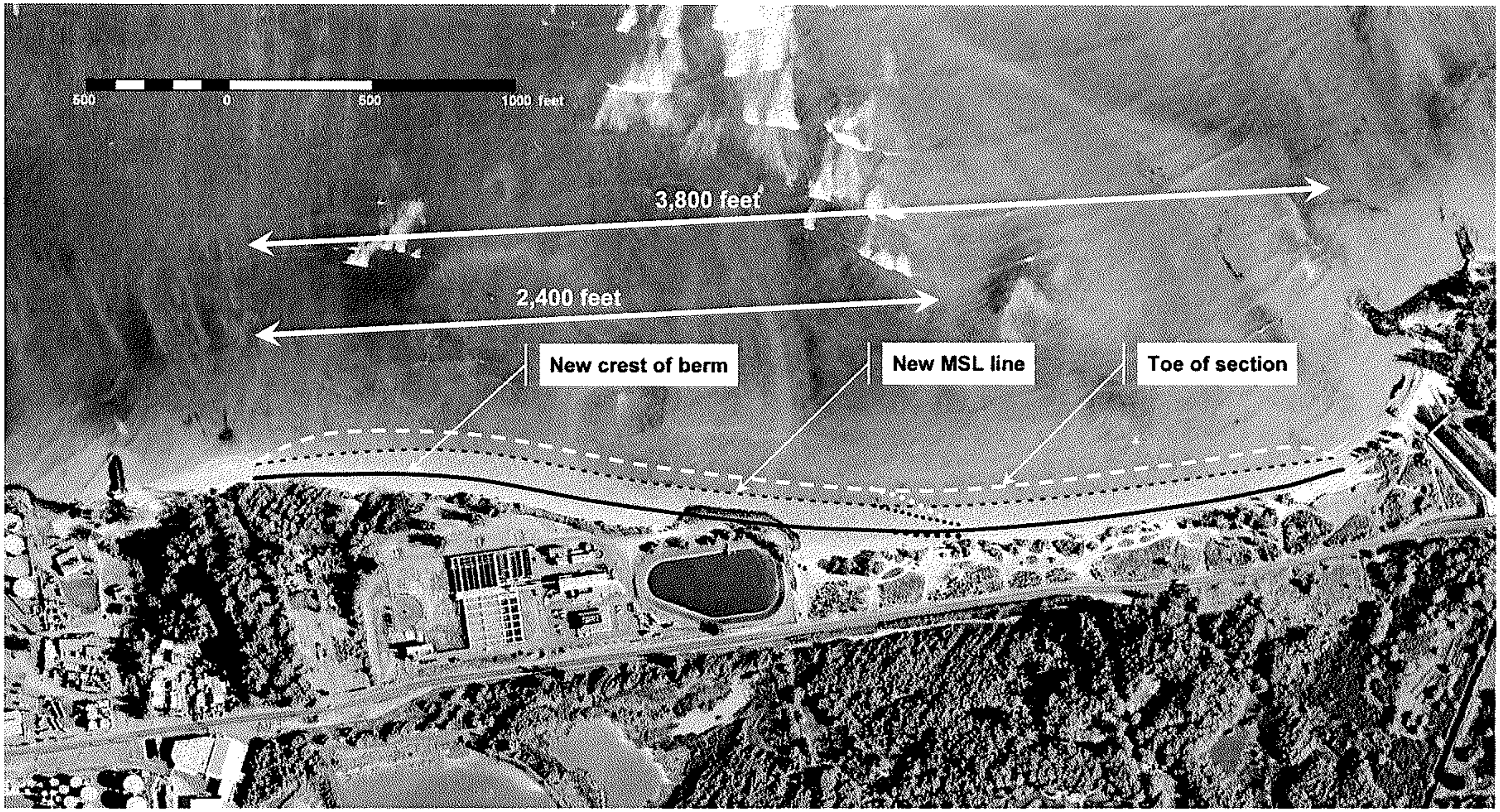


Figure 25. Plan view of the beach replenishment alternatives at the WWRF site.

7.2.3 Additional Beach Replenishment Alternatives

If beach replenishment is selected as the preferred alternative, additional sub-alternatives could be considered as the engineering design progresses. These additional sub-alternatives would be considered as part of the design optimization – they are not considered further in this document, and would only be constructed if they were more cost-effective and at least as environmentally benign as Alternatives 1A and 1B considered here. Examples are as follows.

Carry out the initial beach replenishment according to Alternative 1A, but place renourishment preferentially along the shoreline fronting the WWRF site. This could provide a wider beach for infrastructure protection, at a similar cost to Alternative 1A and while providing a similar beach area for recreational purposes.

Replenish only the relatively short reach of beach fronting the WWRF site and west of the revetment. Construct a low groin in the vicinity of the WWRF revetment to decrease the rate of diffusion of sand to the east. This low groin could be constructed of sand-filled geotubes or other readily removable construction material if it is desired to test this alternative before finally committing to a groin.

Additionally, beach replenishment at another site could be considered as mitigation for any potential environmental effects associated with Alternative 3A, the revetment extension. This would be considered and suitable sites identified as part of the environmental and regulatory process.

7.3 Alternative 3 – Armor Rock Revetment

Hard structures, such as revetments and seawalls, can provide a last line of defense against coastal erosion – limiting the distance to which erosion can proceed and preventing the erosion from threatening the upland area. Observations from the Boxing Day Tsunami on 2004 indicate that structures located behind seawalls as small as 1 m (3.3 ft) high were more protected than adjacent structures of similar construction without seawalls. (Dalrymple, et al 2005)

Hard structures do not protect the seaward beach, which can continue to erode until it is narrow or nonexistent. On shorelines that experience a net long term erosion or are subject to relative sea level rise, the shorelines adjacent to hard structures can migrate landward, resulting in "passive erosion", which can limit lateral access to the adjacent beaches. (Griggs 2005)

The USACE constructed the original 450-foot revetment in 1979 for a total cost of approximately $300,000 with federal and non-federal funds. The revetment protects the seaward edge of the holding pond. The revetment designs presented in this section extend the revetment to provide protection to the remainder of the facility and are based on the following assumptions regarding waves and water levels.

The design tide level is taken to be the maximum observed water level at Kahului Harbor, 3.5 feet above MLLW.

Based on NOAA Nautical Chart number 19342, Kahului Harbor and Approaches, the bottom elevation for a significant distance (several hundred yards) offshore of the WWRF beach, on the reef flat, is taken to be in the range 3 to 6 feet (½ to 1 fathom), with a value of 4.5 feet or ¾ fathom used for the design.

Offshore waves are taken to have a significant wave height of 25 feet and a period of 18 seconds, which is the design condition used for the Kahului Harbor breakwater (USACE 1988).

The offshore waves are depth-limited when they reach the WWRF beach. Based on the design tide level and assumed sea bed elevation, the water depth is 8 feet and a typical depth-limited wave height would be 6 feet. To account for loss of energy over the reef flat, additional water depths associated with wave setup are not included in the calculation.

To summarize, the design waves at the WWRF shoreline are taken to be 6 feet significant wave height with a period of 18 seconds. Based on these wave conditions and the Hudson equation, the rock size is calculated at approximately 2 tons – that is, a rock diameter of about 3 feet. This is only slightly larger than the rock size at the existing WWRF revetment.

7.3.1 Alternative 3A – Revetment Extension

For this alternative, the revetment would be extended to the west along the WWRF property length, a distance of approximately 1,200 feet. The east flank of the existing revetment may also need to be revised or extended landward to minimize the potential for flanking by the beach as erosion proceeds. The revetment would be constructed along the back portion of the beach, close to the existing fence line, and would be a similar design to the existing revetment. Figure 26 and Figure 27 illustrate the plan view and cross-section of this revetment alternative.

Alternative 3A would require approximately 13,000 tons of 2-ton armor stone and 6,000 tons of bedding stone. The existing beach material that was removed to construct the revetment would be replaced over the structure, but no further sand would be added to the system. Thus, Alternative 3A would not encroach on the existing beach, but it would not protect the beach or provide additional beach area.

Alternative 3A would not protect the upland area from runup and overwash associated with a major storm or tsunami event. Flooding and minor damage to the upland area can be expected in the event of a significant storm.

7.3.2 Alternative 3B – Buried Revetment

This alternative includes adding beach replenishment to the revetment solution to provide a recreational beach area and to minimize impacts to littoral transport and adjacent beaches. The revetment would be identical to that in Alternative 3A, except in that it would be buried. The revetment would remain buried for the most part, and would act as a last line of defense for the WWRF in the event of severe erosion caused by storms or tsunami. The revetment and beach replenishment plan is shown in Figure 28; the revetment section is the same as in Alternative 3A, see Figure 27.

The proposed beach is narrower than that proposed in Alternative 1B, Beach Replenishment. The beach is narrower – a 20-foot increase in beach crest – because it need not be wide enough to provide protection from seasonal fluctuations. The revetment will protect the property in the event of a large seasonal fluctuation that temporarily removes sand from the shoreline fronting the WWRF property. It is anticipated, however, that normal seasonal accretion would occur and that the revetment would remain covered the bulk of the time. With proper planning of the revetment location and periodic beach replenishment maintenance, the seasonal erosion and accretion will occur naturally in front of the revetment.

In addition to the rock quantities listed in Alternative 3A, this alternative includes approximately 30,000 cubic yards of initial beach fill for the 20-foot increase in beach width. The renourishment quantity would be similar to that in Alternative 1B: approximately 16,000 cubic yards of replenishment sand would be required every 8 years to maintain the project design width.

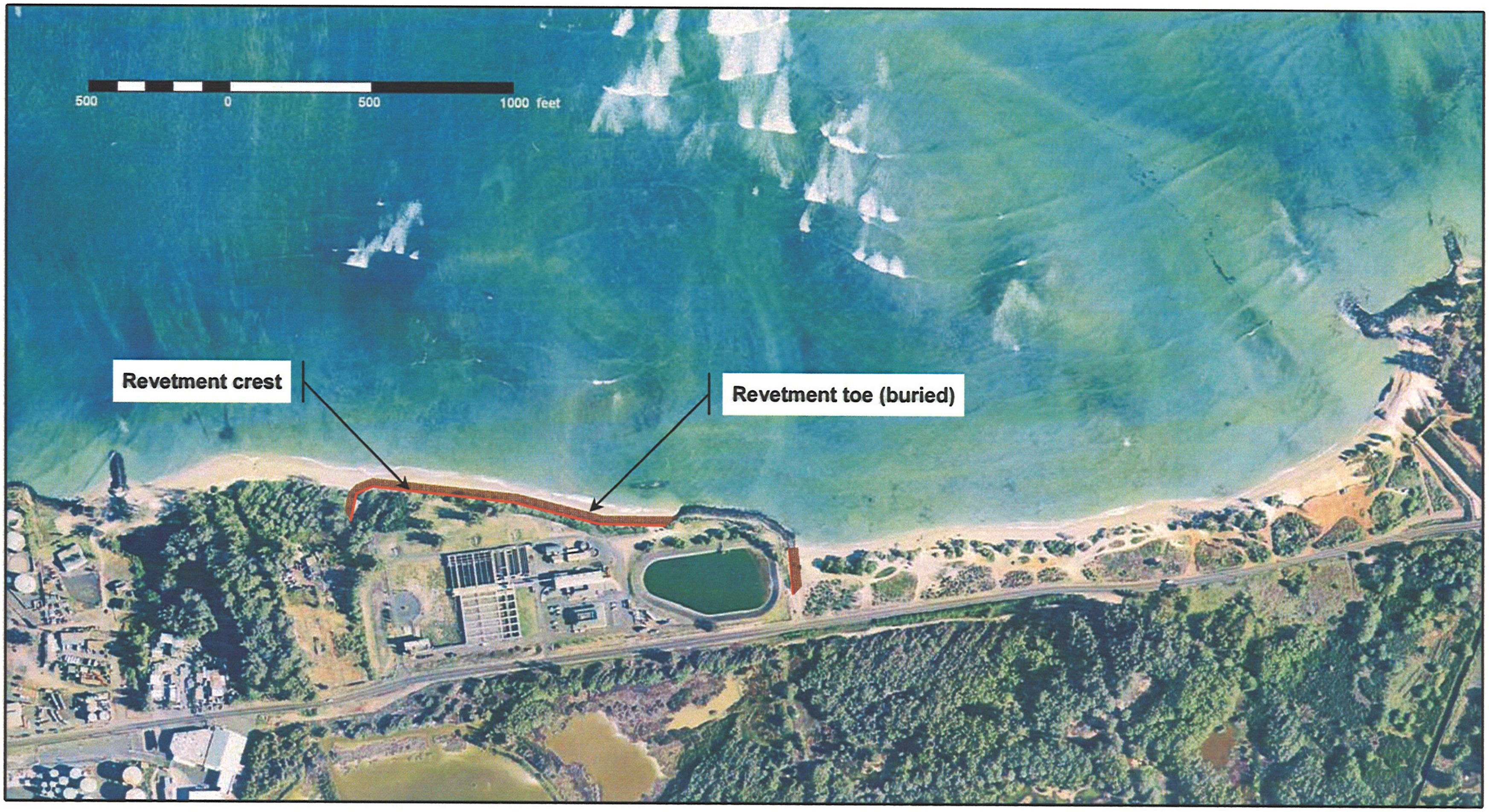


Figure 26. Plan view of Revetment Alternative 3A

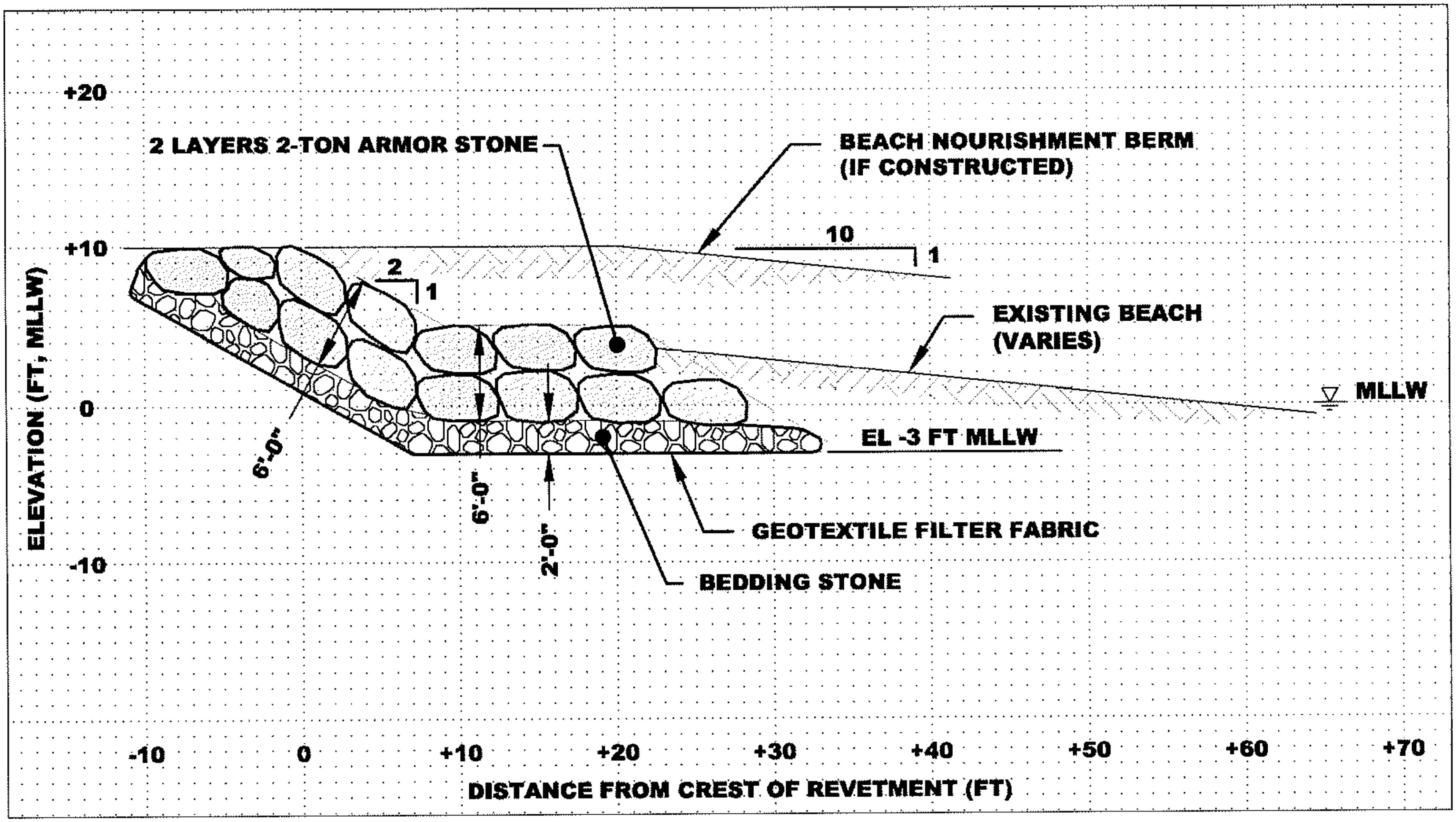


Figure 27. Typical Revetment Cross-Section

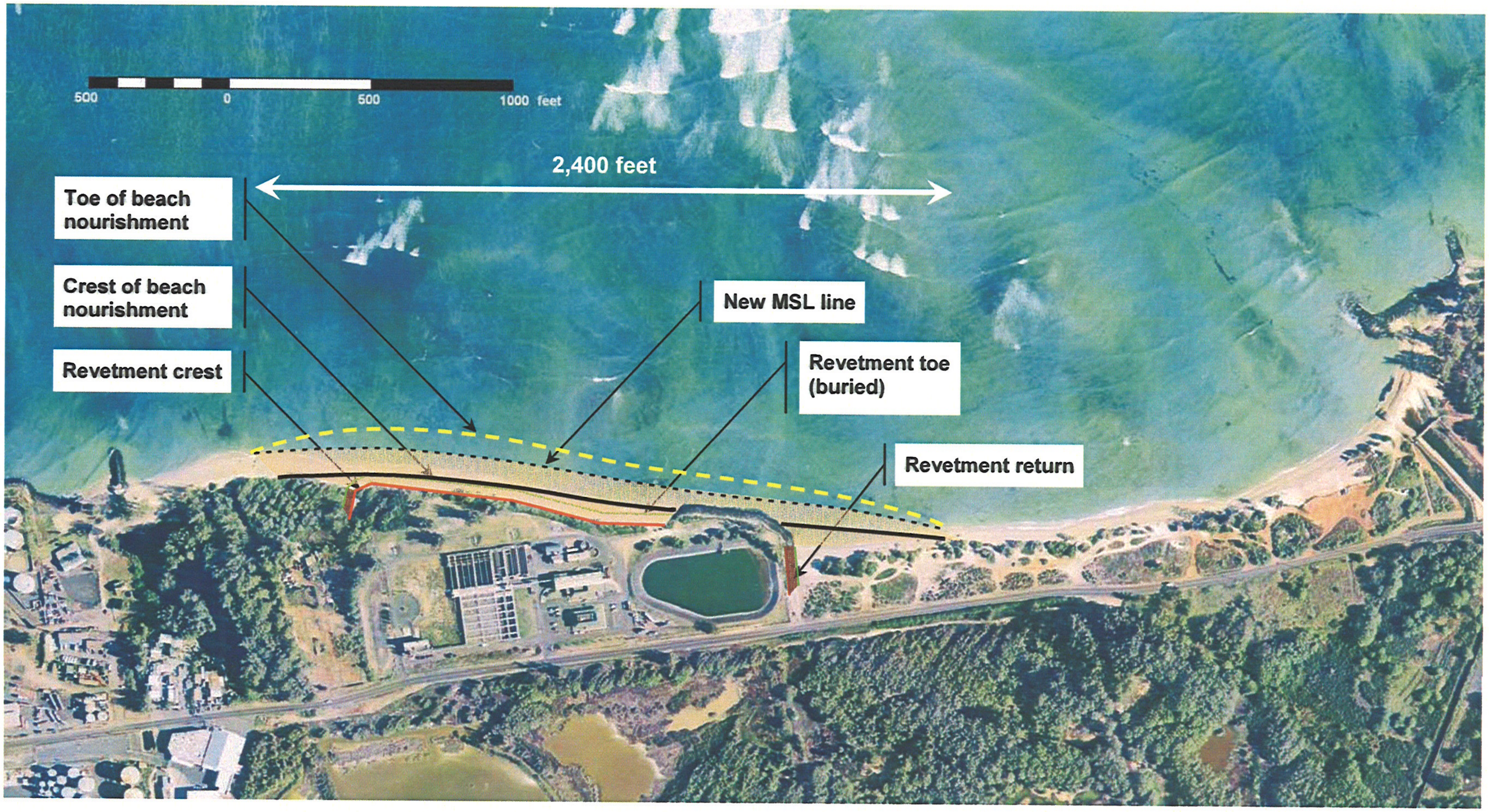


Figure 28. Plan view of Revetment Alternative 3B (With Beach Replenishment)

7.4 Alternatives Not Carried Further

Two alternatives previously suggested for the WWRF shore protection are eliminated from further consideration: beach replenishment with multiple T-groins, and the use of sand-filled geotubes as a revetment alternative.

As mentioned in Section 7.2.3, one possible beach replenishment alternative would include a single groin in the vicinity of the existing WWRF revetment, to retain beach sand along the shoreline fronting the WWRF and to avoid its moving east (updrift) through diffusion effects. This sub-alternative would involve a single, much less intrusive, groin than the full groin field previously suggested. The groin could potentially be constructed of a single sand-filled geotube as a pilot or test project: if successful, it would likely need to be replaced with a rock groin in the long-term. Because of the limited extent of the groin in this sub-alternative, it is not explored in detail in this report.

7.4.1 Beach Replenishment with T-Groins

This alternative was proposed as Alternative 2 in the initial Shoreline Evaluation Report (M&N 2005). At the time, the relative magnitude of the longshore sediment transport rate and the volume erosion rate were unknown. In cases where the longshore sediment transport is large compared to the volume erosion rate, beach replenishment without sand retention structures such as a groin field is unlikely to be cost-effective – the placed sand will immediately be swept downcoast.

This does not appear to be the case at the Maui WWRF. The most likely average rate of longshore sediment transport to the WWRF beach is estimated at approximately 2,600 cubic yards annually (Section 6.5), which is similar to the quantity of sand that will be placed annually. Thus, the rate of longshore transport does not dominate the system and a dense groin field is not required. The main threat to the WWRF appears to be cross-shore loss of sand during seasonal fluctuations, rather than alongshore loss of sand to the Kahului Harbor breakwater and offshore. This alternative is not taken further.

7.4.2 Geotubes as Revetment Alternatives

Geotubes are simply large geotextile bags that are hydraulically pumped full of sand and used as elements of a revetment or groin system, typically in place of stone. Given the high cost and limited availability of sand on Maui, using rock is a more effective solution. In addition, the durability and long-term stability of geotubes in an open-ocean application is questionable, therefore this alternative was eliminated as a revetment alternative.

8. SAND SOURCES

Almost all of the recommendations for erosion control include beach replenishment. One of the critical unknowns is the availability of sand and the estimated costs for placement. This section reviews the findings from M&N's 2005 *Shoreline Evaluation Report* and presents updated information from the quarries and a preliminary search for potential offshore sand deposits.

8.1 Native Sand Characteristics

One of the critical parameters for the success of beach replenishment projects is the ability to match the native (existing) and source sands. Although this phase of the work did not include a sampling program, the following information provides a baseline for developing the native sand parameters to guide the search for suitable beach-compatible sand.

Moberly and Chamberlain (1964) analyzed sand samples on various Hawaiian beaches. The sands from the Kahului to Spreckelsville area were almost entirely carbonate. Mechanical analyses were made of sand samples taken from the berm and at approximately mean sea level. At the beach adjacent to the east breakwater at Kahului Harbor, the grain size was found to be 0.2-0.5 mm at the berm and 0.3-1.0 mm at sea level. The median diameter of Maui's windward beaches was 0.18 mm. Moberly and Chamberlain concluded that finer-grained sediments were found on the windward coasts of all of the islands analyzed; however, they found that Maui's beach sands were typically finer than sands found on the other Hawaiian Islands.

8.2 Upland Sand Sources

Maui dune sand is relatively fine sand that is found in the upland areas; this sand has been used for dune and minor beach fills. One upland dune quarry that has been used for source material is located in Happy Valley, approximately 10 miles from Sugar Cove (Guild 1999). However, these relatively fine-grained sediments are not ideal for high-energy beaches such as the Kahului area. For example, Bodge (1999) stated the Honokowai Beach Park site, the upland dune material exhibited a 45% overfill requirement. (Overfill is the additional sand that must be placed on the beach due to the source sand being finer than the native sand. The higher this ratio, the more material must be placed, and the higher the project costs.)

The inland sand mines on Maui have historically charged between $10 and $18 per cubic yard. On other islands, the cost has ranged from $25 to $60 per cubic yard (Honolulu Advertiser, September 9, 2004).

In 2006, SSFM completed the *Maui Inland Sand Resource Quantification Study* (SSFM International 2006) to help the County of Maui mange its limited sand resources. The most significant finding from this report was that the upland sand resources for both concrete and larger-scale beach replenishment will be exhausted within 5 to 6 years. Some estimates predict the available beach quality sand will run out in as little as 2 years (Honolulu Advisor 2007). While there may still be some smaller sites available for small-scale beach replenishment projects this likely will be at a higher cost that the existing "production" site.

Due to the probable sand quantity and quality requirements for the WWRF project, it should be assumed that there will be no upland sand sources available to provide suitable beach sand for the Kahului WWRF erosion control project.

8.3 Imported Sand

Sand is regularly imported from Canada for use in concrete production, and sand from China and Australia has been used for beach replenishment on Waikiki in the past (Tim Folks, Hawaiian Cement, telephone communication, 2007).

Three Canadian sources of sand for concrete production are at Sechelt, BC, which is about 60 miles north of Vancouver; Earle Creek, about 20 miles further north; and Orcas Sand and Gravel on Vancouver Island. The sand from Canada is generally silicate rather than the carbonate sand typical of Hawaiian beach sand: for example, the sand from Orca Sand and Gravel is granite with a little basalt, and is salt and pepper or dark gray in color. The cost to import sand to Oahu is slightly more than the cost of Hawaiian sand, although the costs increase further if the sand is to be moved to another island.

8.4 In-Water Sand Sources

There is very limited beach replenishment experience in Hawaii, especially using offshore sand sources. This makes it difficult to predict performance as well as to assess construction and maintenance costs of a larger-scale beach replenishment project.

Historically, most small-scale beach replenishment projects on Maui have used sand from upland sources. As described in the Section 8.2, sand from these sources is not likely to be available in sufficient quantities and of a suitable quality for use at the Kahului WWRF. Imported sand sources are unlikely to be economically viable. Consequently, a primary recommendation of the M&N's 2005 "Shoreline Evaluation Report" was to conduct a study to investigate the potential of offshore sand sources. This study has also been recommended by other interested parties in the Hawaiian Islands. For example, the University of Hawaii Sea Grant Extension Service and County of Maui Planning Department prepared a *Beach Management Plan for Maui (1997).* The plan recommended potential offshore borrow sites be identified, mapped, and sampled. NOAA (2007) recently completed a characterization of the geomorphology and biology of the nearshore regions around Maui. Figure 29 presents the area near the WWRF and indicates that there are two potential borrow locations within one mile of the site. The larger of the two is well over 200 acres, and may be more than adequate to provide all of the present and future replenishment needs at the site. The biological coverage maps indicate that these sites have very limited coral cover, so they may be good candidates as borrow areas from a biological impact aspect.

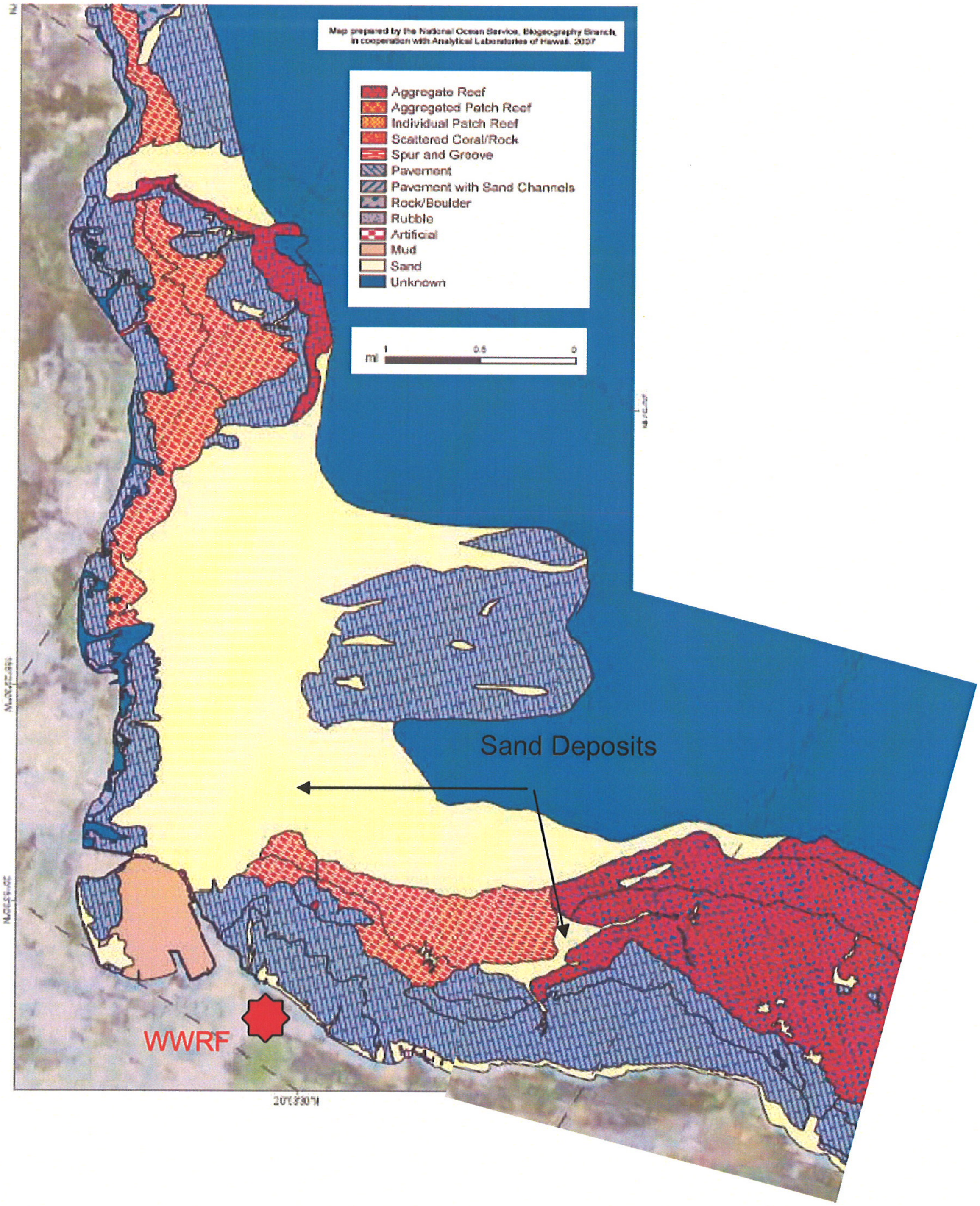


Figure 29. Nearshore Geomorphology near WWRF

To investigate this potential source for sand, M&N subcontracted Sea Engineering, Inc. to perform a sub-bottom geophysical survey with grab samples offshore of the Kahului Harbor. The survey was performed in May 2008, covering an area of approximately 5.5 square miles and collecting 8 grab samples over the course of two days. The results confirmed that there is a large deposit of sand, 10-20 feet deep over much of the sampled area. Figure 30 presents the sampling area, the depths of the sand deposits, and the locations of the grab samples.

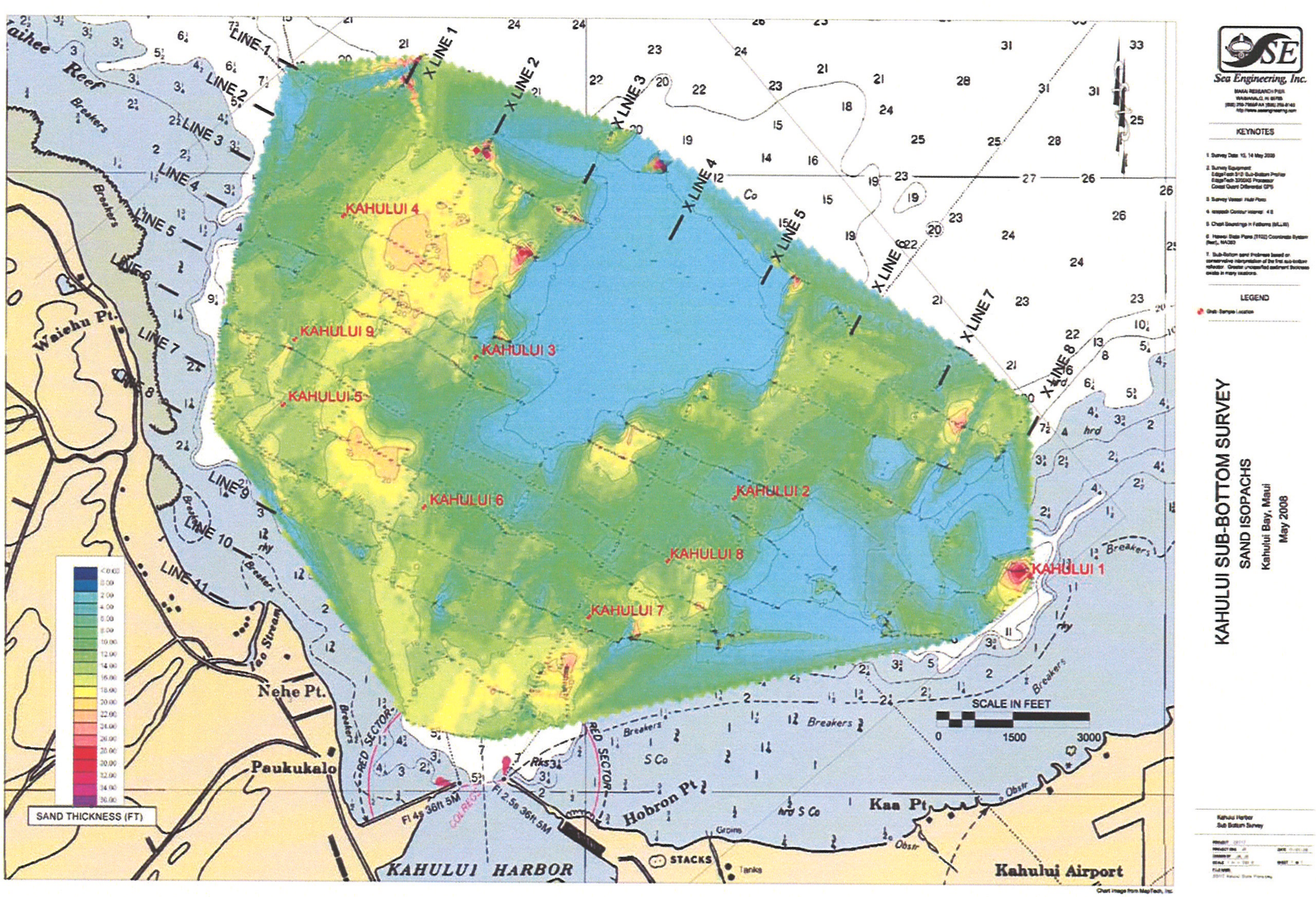


Figure 30. Sand Thicknesses and Grab Sample Locations (Sea Engineering 2008)

Of the nine samples collected, 2 two (Samples 5 and 8) had booth good color and grain size for use as beach-quality sand. Figure 41 presents a photo of the sample from location 8 (D50 ~ 0.50mm), and the entire Sea Engineering Report is presented as Appendix C.

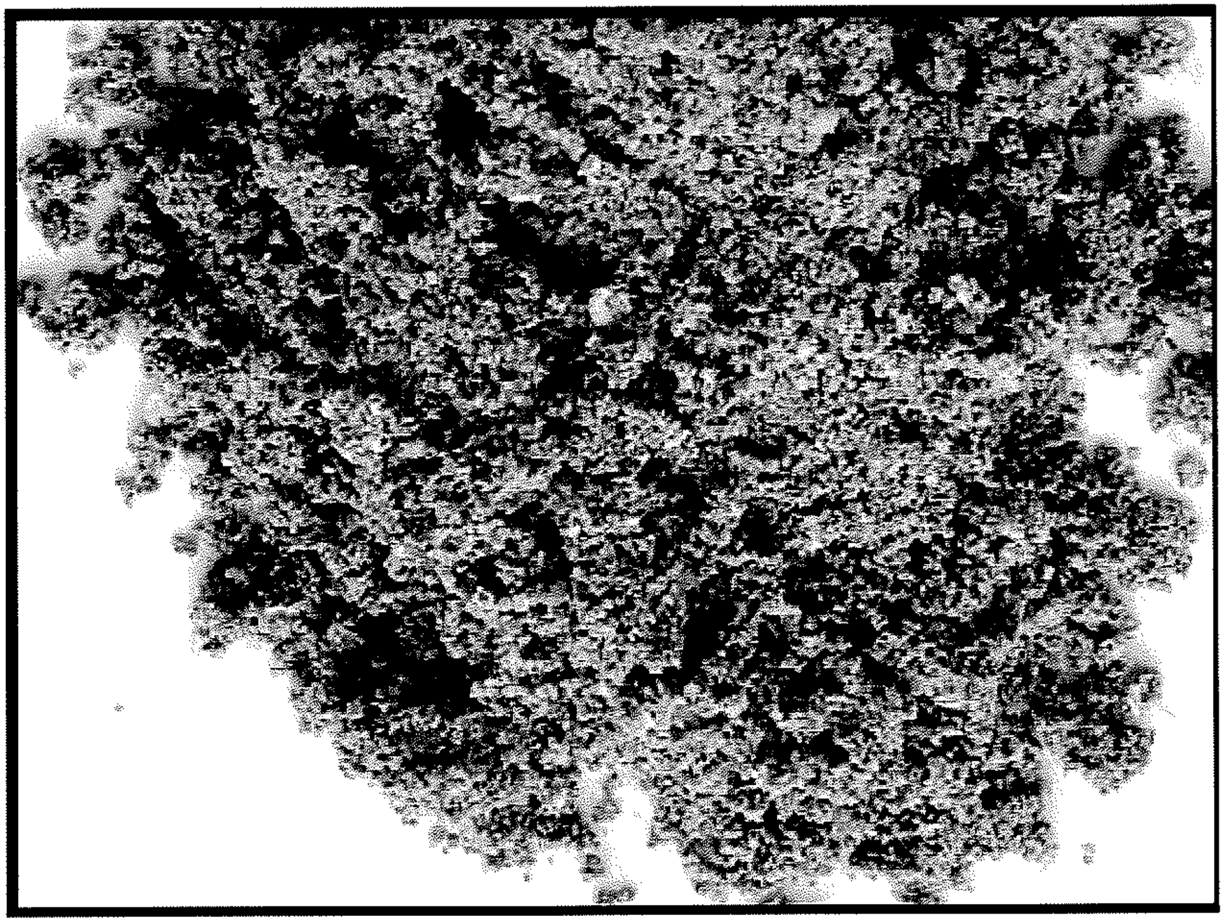


Figure 31. Grab Sample 8 Sand

Unit costs for beach replenishment using dredged material can vary widely depending on the characteristics and proximity of the borrow site. In the 2005 "Shoreline Evaluation Report", M&N used a cost basis of $25 per cubic yard, based on mainland dredging projects. Discussions with local contractors indicate that the costs at the potential borrow site offshore of Kahului may be more than $70 per cubic yard due to the dredging depths, wave exposure, and potential environmental restrictions that could reduce production rates. A recent small-scale pilot project at Waikiki, constructed in late February/early March 2005, involved pumping 10,000 CY of sand from an offshore sand source to Kuhio Beach. The total project costs were approximately $450,000, including $320,000 for the direct cost of pumping the sand and $75,000 for mobilization. Based on the sand placement costs alone, this gives a unit cost (in 2005) of $39.50 per cubic yard (Eversole, e-mail communication, 2005).

A recent 100,000 cubic yard confidential analysis for a project in Maui was quoted with a total unit cost of $40-$50 per cubic yard, constructed as follows:

Mobilization and Demobilization: $1.1 million. Equipment included the following:

- 1 – crane barge w off shore mooring equipment mobilized from Oahu
- 1 – 2,000 hp tugboat for crane barge utilized because of 24 hr/day operations
- 1 – 500 hp workboat
- 1 – 10" submersible pump. Toyo DP150 or equal
- 1 – 100 KW generator
- 1 – D8 Dozer
- 1 – Cat 322 excavator
- 1 – Cat 980 loader
- 6 – light plants for beach work

Production rate 1,600 cubic yards per day
Work 7 days per week
15% downtime due to weather
The offshore sand source was approximately 0.5 km to 1 km offshore of the beach.

The present cost analysis is based on these values for mobilization/demobilization and production rate. An additional outcome of this analysis is that, given the relatively high costs of mobilization for dredging, it is recommended that additional sand be dredged and stockpiled for future beach renourishment and/or emergency use.

9. ENVIRONMENTAL AND REGULATORY CONSIDERATIONS

9.1 Potential Environmental Impacts and Benefits

Potential impacts from construction of any of the alternatives may include temporary and permanent impacts. Temporary impacts include traffic congestion from trucking sand or armor to the beach; air quality impacts from the trucking, construction equipment, and dredge equipment; and turbidity impacts during placement of sand.

Permanent impacts from construction of a shore protection project include the potential for impacts to adjacent shorelines, reef health, and public access. Precautions should be taken to prevent eroded soils, construction debris, and other contaminants from entering the coastal waters. There is also a small chance of increased sedimentation at Kahului Harbor if large quantities of beach fill are placed along the reach east of the harbor. This may require more frequent maintenance dredging to maintain the design depth in the harbor; however, the present lack of beach quality sand at the mouth of the harbor indicates that beach sand is not being transported there.

Surrounding beaches may benefit from the placement of sand as the sand disperses and longshore transport carries the sand up- and downcoast. However, careful design and modeling may be necessary prior to implementation of any beach fill alternative to ensure the fill material does not migrate significantly offshore, burying the reefs along the project coast.

Impacts to adjacent beaches from the construction of a revetment or shore-parallel structures, such as seawalls, are the subject of much controversy. Most science indicates such structures do not negatively impact adjacent shorelines unless they prevent erosion of an upland source of sand for a beach downdrift or are situated to act as a groin. On shorelines that experience a net long term erosion or are subject to relative sea level rise, the shorelines adjacent to hard structures can migrate landward, resulting in "passive erosion", which can limit lateral access to the adjacent beaches. (Griggs 2005) Revetments and seawalls are usually constructed on eroding beaches to protect the upland property. They are also constructed in some cases on stable beaches, providing as needed protection against short-term, storm-induced erosion. The former is the case for this project.

Maui's north coast is actively eroding and will continue to erode under natural conditions. If a revetment alternative is selected, it may be beneficial to propose beach replenishment at a different location – for example, at a beach that is more heavily used for public access and recreation – in mitigation for potential impacts. This may provide more valuable benefits than on-site beach replenishment as assumed in the buried revetment alternative.

Monitoring will be required for any alternative constructed at the site and may include beach profiling, grain size analysis, project performance, and observable water quality impacts.

9.2 Regulatory Requirements

The State of Hawaii and County of Maui are the local regulatory agencies for permitting shore protection structures. The main local regulations pertaining to shore protection include the *Hawaii Revised Statutes Chapter 205-A,* Coastal Zone Management, and the *Shoreline Rules* for the Maui Planning Commission. Other agencies involved with the permitting of a shore-protection project will be the State of Hawaii Conservation and Coastal Lands Department, the

Hawaii Health Department Clean Water Branch, and the US Army Corps of Engineers (USACE).

The first step will be for an Environmental Impact Statement (EIS) to be prepared for the project. This document will describe the proposed project; any impacts associated with the project, and proposed mitigation. It is highly recommended that a pre-consultation with the regulatory agencies be conducted during the preparation of the Draft EIS to better understand agency positions and resolve any issues prior to the Draft EIS being released for public comment.

The Draft EIS is circulated for public review and comments and will go to a public hearing. After all comments have been received and addressed, the EIS can be finalized. The Final EIS also will have a public hearing process for approval.

After the EIS is approved and certified, pre-application meeting with the local, state, and federal agencies can commence. The County will process their application first, followed by the State Conservation Use Permit application, and finally the USACE Section 404/Section 10 and the Water Quality 401 Certification.

The County of Maui permits include a Shoreline Setback Variance and a Special Management Area (SMA) permit. All proposed activities and/or structures within the SMAs will undergo an assessment to determine what special conditions or controls on development, if any, are required before the activity or structure is permitted. Most coastal projects fall within the jurisdiction of the County's Coastal Zone Management program. The Maui County Planning Department also works closely with the State of Hawaii Coastal and Conservation Lands Office in helping find the best long-term solutions to coastal erosion problems. These two agencies also consult with the University of Hawaii's Sea Grant Program for their technical assistance on the proposed coastal activity.

If a structure is within the shoreline setback area and is not under an emergency situation, then the County proceeds in its regular process of building a new structure in the Special Management Area (SMA). The WWRF alternatives will all fall under the Major SMA permit, which includes projects that cost more than $125,000 or may have coastal or other environmental impacts. Major SMA permits are required to go through a public hearing process and approval is by the Maui Planning Commission. The first item the County considers is if the structures can be relocated. In the case of the WWRF, some structures may be relocated, but most of the large process areas cannot be relocated because of limited area at the site. Since many of the structures at the WWRF cannot be relocated, County regulators may require a long-term commitment to beach replenishment program be implemented and also provide safe lateral public access along the shoreline. This can either be a walkway on or near the revetment or beach area for the public.

The State generally does not allow hard structures to be placed within its jurisdiction, so most applications for hard structures need to be placed entirely within the boundaries of the property owner (landward of the shoreline), if possible, and as such are permitted under the County SMA,. In order to acquire a variance from the County to construct a hard structure, an Environmental Impact Statement, Environmental Assessment, public notice, and a public hearing will need to be conducted as described above. A variance can be approved for improvements proposed by public agencies or public utilities regulated under *Hawaii Revised Statutes (HRS) Chapter 269*. The Kahului-Wailuku Wastewater Reclamation Facility is a County-owned pubic utility regulated under this statute. To facilitate permitting, the County could create a special zoning designation for the project.

The USACE permits fall under the *Rivers & Harbors Act 1899 § 10 and/or the Clean Water Act § 404*. Section 10 of the Rivers and Harbors Act of 1899 requires approval by the USACE prior to any work in navigable waters of the United States, or which affects the course, location, condition or capacity of such waters. For the WWRF project, any dredging offshore would require a Section 10 permit. Section 404 of the Clean Water Act requires approval by the USACE prior to discharging dredged or fill material into the waters of the United States. This would include beach fill material as well as riprap for revetment construction. The USACE may also initiate a Section 7 consultation with the United States Fish and Wildlife Service (USFWS) if any aspect of the project may impact any endangered or threatened species or adversely impact any critical habitat of these species. The USACE will likely process any project at the WWRF as an individual permit, which undergoes through a public notice period. Processing of Individual permits can take up to 180 days for complex and highly controversial projects.

The State of Hawaii Department of Health, Clean Water Branch is the agency charged with issuing 401 Water Quality Certifications under the *Clean Water Act - § 401*. Section 401 of the Clean Water Act requires that any project requiring a Section 404 Federal Permit shall also require approval to ensure that the discharge will comply with the applicable provisions of the Clean Water Act.

In Hawaii, there is a special permit process for small-scale beach replenishment projects. Projects that propose placement of less than 10,000 CY of carbonate sand in waters and land of the State of Hawaii can be permitted through the State of Hawaii Department of Land and Natural Resources under a streamlined permit application process. This small-scale beach replenishment permit consolidates the permits required under Local County, State, and federal agencies. These permits include the statewide DLNR, Conservation District Use Permit (CDUP), the US Army Corps of Engineers (USACE), State Programmatic General Permit (SPGP), the State of Hawaii Department of Health Section 401 Water Quality Certification and the Hawaii Coastal Zone Management Federal Consistency Review. Although this permit would probably not apply to the base project, it may be applicable for future renourishment and/or emergency sand placement.

10. COST ESTIMATES

Costs for each of the alternatives were estimated based on a 50-year design life and include estimates for engineering and construction support. Due to the unknowns regarding the permitting requirements and level of community resistance to various schemes, the costs for permitting have not been included. (For budgeting purposes, the permitting costs are anticipated to be on the order of $300,000 - $400,000.) A more detailed cost estimate for each alternative is provided in Appendix B.

Present Value Costs calculate the initial construction and future maintenance costs based on current-value dollars. The maintenance costs were inflated for each maintenance cycle to address inflation, future labor rates, future construction costs, etc. The inflation rate is taken at 3.5%, based on the Engineering News Record Construction Cost Index between 1990 and 2005. Recent construction inflation has been higher than this: the Construction Cost Index increased by 9% in 2004, and increases were even higher for heavy construction such as the shore protection considered here. However, given the beach replenishment alternatives require renourishment over a period of 50 years; the relatively long-term construction inflation rate is more relevant than the recent dramatic increases.

The inflated costs for maintenance were reduced to a Present Value cost using the present (2008) interest rate for USACE projects, 4.875%.

Annualized Costs calculate the annual cost of each alternative over the life cycle of the project (50-years). This section provides Annualized Maintenance Costs, indicating the annual cost needed to conduct the future maintenance over the 50-year life cycle. The rate of return used in the Annualized Costs is 4.875%.

Table 7 outlines the Net Present Value (NPV) total cost for construction and future maintenance for each alternative for the WWRF. The annualized maintenance cost is also shown. Note the annualized maintenance cost is shown for convenience – it is not in addition to the NPV maintenance cost.

Table 7. Approximate Costs for the WWRF Alternatives

Item	Initial Construction	NPV of Maintenance	NPV of Total Cost	Annualized Maintenance*
Alternative 1A: 3,800-foot Beach Replenishment				
Dredged Sand	$6,000,000	$7,100,000	$13,100,000	$380,000
Purchased Sand	$4,300,000	$3,700,000	$8,100,000	$200,000
Alternative 1B: 2,400-foot Beach Replenishment				
Dredged Sand	$4,400,000	$5,900,000	$10,400,000	$320,000
Purchased Sand	$2,800,000	$2,700,000	$5,500,000	$150,000
Alternative 3A: 1,200-foot Revetment Extension				
Initial Construction	$3,700,000	$500,000	$4,200,000	$50,000
Alternative 3B: Revetment with 2,400-foot Beach Replenishment				
Dredged Sand	$5,800,000	$5,900,000	$11,700,000	$320,000
Purchased Sand	$5,000,000	$2,700,000	$7,700,000	$170,000

* The annualized maintenance cost is *not* in addition to the NPV maintenance cost: this column is provided for convenience

Two alternative costs are provided for the alternatives that include beach nourishment: these account for the fact that mobilization costs are likely to be significantly higher if the replenishment sand must be dredged specifically for this project. More generally, the costs for the beach replenishment alternatives depend critically on the availability of suitable beach sand. While general nearshore geomorphology (see Figure 29 and 30) suggests the presence of suitable sand sources, the costs and viability of dredging this material have not been confirmed. The results of a targeted sand search and dredging feasibility analysis could dramatically change the costs given here.

The initial construction costs for the different alternatives are relatively similar – potentially varying between $2.8 million and $5.8 million. As a result of the need for ongoing renourishment, the alternatives with a beach replenishment component have larger total costs. However, these alternatives also provide recreational and habitat benefits in addition to the benefits association with protection of the WWRF.

11. ALTERNATIVES EVALUATION

A number of evaluation criteria are available to determine the most appropriate shoreline erosion solution for the Kahului WWRF. No single solution is best in all possible circumstances. This truism results not only from physical differences – for example, the availability of sufficient beach sand – but also from the different weight applied to the evaluation criteria by different organizations or individuals.

- Three main categories of evaluation criteria can be identified:
- Economic: initial construction cost, life-cycle costs, design life.
- Environmental / Biological: effects on biological resources in the area including sea turtles and the reef.
- Environmental / Human: effects on direct human interests in the area, including aesthetics, the potential for impacts to Kahului Harbor such as increase dredging frequency, effects on recreation.

One criterion that ties in all three areas is the potential for effects on adjacent shoreline areas. These can be economic (e.g., erosion or accretion caused by the project could change the potential for storm damage at an adjacent property); biological (e.g., changes to turtle nesting areas); or recreational (changes in the available beach area). Because of the importance of this criterion, it is called out separately in the present analysis.

Regulatory compliance is a critical criterion: if an alternative is not consistent with current regulations then it must be rejected. However, it is unlikely to distinguish between acceptable alternatives – this is a pass/fail criterion.

Table 8. WWRF Alternative Evaluation Criteria

	Alternative 1A 3,800-ft Beach Replenishment	Alternative 1B 2,400-ft Beach Replenishment	Alternative 3A 1,200-ft Revetment	Alternative 3B Revetment with Replenishment
Economic Criteria				
Facility Protection Effectiveness	Basic shoreline erosion protection with sand reserve if properly maintained.	Basic shoreline erosion protection if properly maintained.	The revetment may provide some measure of tsunami protection to the upland facility in addition to protecting the facility from shoreline erosion.	The revetment may provide some measure of tsunami protection to the upland facility in addition to protecting the facility from shoreline erosion.
Initial Construction Cost*	$4 M to $6 M	$3 M to $4.5 M	$3.5 M to $4 M	$5 M to $6 M
Maintenance Cost (NPV)*	$4 M to $7 M	$3 M to $6 M	$0.5 M	$3 M to $6 M
Environmental Criteria				
Regulatory Compliance	Compliant	Compliant	Compliant. May be an unpopular solution (due to aesthetics and access) which may delay permitting. More likely to require mitigation.	Compliant
Effects to Adjacent Shoreline	Significantly increases the width of the beach east of the Kahului WWRF – by an average 40 feet Over time, will increase the width of the beach west of the Kahului WWRF to a lesser extent	Over time, will increase the width of the beach east of the Kahului WWRF through diffusion, and west of the WWRF through diffusion and net longshore transport This increase will be less than for Alternative 1A, and will likely be concentrated in the area close to the WWRF property	If the revetment acts as a groin, this alternative may limit the transfer of sand from the kite beach area to the beach west of the WWRF. Without adding additional sand, the revetment has the potential for causing passive erosion of the adjacent beaches and limiting lateral access.	Similar to Alternative 1B unless the seaward beach erodes, then the effects would be similar to Alternative 3B.

	Alternative 1A 3,800-ft Beach Replenishment	**Alternative 1B 2,400-ft Beach Replenishment**	**Alternative 3A 1,200-ft Revetment**	**Alternative 3B Revetment with Replenishment**
Biology	Short-term turbidity impacts may occur during construction. Additional sediment fate modeling is needed to ensure the reef will not be negatively impacted by sand transported offshore in the short- or long-term Provided appropriate work windows are maintained, the effects on species dependent on the beach are expected to be positive for this alternative	As Alternative 1A, except that both potential positive and negative effects are likely to be less.	Minor effects compared to existing conditions.	Similar to Alternative 1B
Environmental Criteria – Human				
Aesthetics	Positive effect if beach sand is selected with acceptable coloration	Similar to Alternative 1A, except that the effect is observed over a shorter stretch of beach.	The longer revetment may be considered unsightly	Similar to Alternative 1B
Public Access and Usage	Positive effect: approximately 6 acres of additional beach area directly adjacent to heavily-used beaches with good public access	Smaller but still positive effect: approximately 4 acres of additional beach area, approximately one-quarter mile from the most heavily-used beaches	Potential for passive erosion of shoreline and limitations to public access at the site a lateral access to adjacent beaches.	Similar to Alternative 1B if the beach fronting the revetment is maintained.

	Alternative 1A 3,800-ft Beach Replenishment	**Alternative 1B 2,400-ft Beach Replenishment**	**Alternative 3A 1,200-ft Revetment**	**Alternative 3B Revetment with Replenishment**
Effects to Kahului Harbor	Little or no effects anticipated. The proposed replenished beach is well within the historical range of beach widths, and dramatic changes in required maintenance dredging at Kahului Harbor have not been observed over time	Little or no effects anticipated	Little or no effect	Little or no effects anticipated

* Note: Costs are very dependent on the availability of suitable sand for replenishment, and may vary outside this range

12. SUMMARY AND CONCLUSIONS

12.1 Erosion Rates and Infrastructure Risk

The analysis of recession rates at the Kahului WWRF has been updated to include the most recent (2007) aerial photography. The analysis shows the rate of recession was generally less during the period 2002 to 2007 than it was during the previous 5 years. This may result from normal interannual fluctuations, or it may represent a real slowing of shoreline erosion resulting from the decrease in longshore sediment transport with a narrowing beach.

The lower rate of recession has not been in place for long enough to rely on it for predictions of future behavior. Some structures, notably the access road and Injection Well No. 2, are within about 60 feet of the shoreline and will be at threat from a single large seasonal recession event within a year or less. The first major structure to be threatened by shoreline recession is the Effluent Meter adjacent to the Chlorine Contact Tank. This structure may be threatened in as little as 13 years, with an average anticipated period of 28 years until the structure is threatened. (For comparison, M&N estimated the minimum time for this structure to be threatened at 14 years in 2005).

In summary, the revised estimate of erosion rates and infrastructure risk has not significantly affected M&N's earlier (2005) conclusions, however, given the variability in these projections, the unpredictability of future storms, and the typical time required to design, permit, and construct a shoreline protection project (3 – 5 years), it is recommended a shoreline protection alternative be selected and implemented as soon as possible.

Key Points

- The largest contribution to the long-term erosion of the north shore beaches is the removal of sand from the beaches for lime production by the Sugar Company and additional sand mining by others for cement manufacturing and aggregate. This permanent removal of sand from the littoral system has resulted in a deficit in the sediment budget and erosion over the length of the study area from Baldwin Beach to Kahului Harbor.
- The rate of shoreline erosion at the WWRF has slowed since the cessation of sand mining; however, it is still a significant consideration for the log-term safety of the facility.
- Based several different shoreline analysis techniques and data sets, we recommend using that a typical seasonal variation of 20 to 30 feet and a maximum seasonal variation of 50 to 60 feet be used for planning. Similarly, we recommend using typical long-term erosion rate of 2.4 feet per year and a maximum long-term erosion rate of 6 feet per year for use in planning, engineering design and estimating the time until facilities are impacted.
- The shoreline at the WWRF facility has demonstrated long-term erosion that threatens several minor structures from a single large seasonal recession event within a year or less. The first major structures to be impacted by this shoreline recession may be threatened in as little as 13 years. If the estimates of acceleration in sea level rise are realized, then the time until the structures are threatened would be reduced. Given the small data set, unpredictability of future storms, unknowns concerning the acceleration of sea level rise,

and the typical time required to design, permit, and construct a shoreline protection project (3 – 5 years), **it is recommended a shoreline protection alternative be selected and implemented as soon as possible.** .

12.2 Sediment Budget

A major recommendation of M&N's 2005 *Shoreline Evaluation Report* was that a sediment budget analysis of the Kahului region should be performed. This report summarizes the results of this analysis, which is included in its entirety in Appendix A.

The major conclusion from the sediment budget analysis is the rate of longshore littoral transport is relatively small compared to the anticipated renourishment quantities required by the different beach replenishment alternatives. This means one of the previously proposed alternatives – beach replenishment retained by multiple T-groins – has been eliminated from consideration.

Secondary conclusions from the sediment budget include an independent estimate of the seasonal recession rate, which is consistent with the values developed by M&N; and estimates of the likely quantities of sand needed for future beach replenishment, which are generally smaller than the values developed by M&N. It is reasonable that the estimates of sand are different, in that the values provided here are conservative in an engineering sense and account for the importance of not underestimating future budgetary needs – while the values provided by the sediment budget analysis have the nature of a scientific "most likely" estimate. The engineering estimates provide a larger margin of safety and result in a more practical and economical renourishment plan that minimizes contractor mobilizations and takes advantage of economies of scale.

Key Points

- The results of a sediment budget study indicate that that the net rate of sediment transport at the shoreline adjacent to the Kahului Wastewater Reclamation Facility is currently between 1,300 and 4,000 cubic yards per year.

12.3 Alternatives Analysis

The previous *Shoreline Evaluation Report* considered three main alternatives: beach replenishment alone, beach replenishment with multiple T-groins, and a revetment. As mentioned above, the beach replenishment with multiple T-groins has been eliminated as an alternative. The two remaining alternatives, with two sub-alternatives for each, are analyzed further in this report:

- Alternative 1A: 3,800-foot long, 40-foot wide beach replenishment project;
- Alternative 1B: 2,400-foot long, 40-foot wide beach replenishment project;
- Alternative 3A: 1,200-foot long revetment extension;
- Alternative 3B: 1,200-foot long revetment extension, buried under a 2,400-foot long, 20-foot wide beach replenishment project.

Costs to construct and maintain these alternatives have been updated based on more recent construction information and updated designs. Results of the recent geophysical investigations (Barry 2008) offshore of Kahului identified large areas of potential beach-quality sand that has the potential to be dredged for the project. The costs could vary dramatically depending on the suitability of this material, the quantities required, and on any environmental conditions that may apply.

Key Points

- It should be assumed that there will be no upland sand sources available to provide suitable sand for a beach nourishment solution for erosion control due to quantity and quality requirements. However, a sand search seaward of the Kahului Harbor breakwater indicated a very large potential source of beach-quality sand that could be dredged for the project.
- A review of the permitting process indicates that the project may be subject to special legislation at the county level due to over-lapping jurisdictions and criteria at the certified shoreline.
- Two erosion control alternatives from the initial study were removed from further consideration. "T-Groins", and any other shore-perpendicular structures were removed due to the low longshore sand transport rates, and "Geotextile Tubes for Revetment" were removed due to durability and cost concerns.
- Four of the original concepts from the initial study were retained for comparative evaluation. Two different beach nourishment scenarios and two revetment scenarios. For planning of beach nourishment project, the estimates of renourishment volumes are 2,000-3,000 cubic yards per year at 8 year intervals. These higher rates provide a larger margin of safety and result in a more practical and economical renourishment plan that minimizes contractor mobilizations and takes advantage of economies of scale.

12.4 Initial Environmental Review

Initial discussions with regulatory agencies should be performed at an early stage to verify their concerns, mitigation needs, etc. Permits will be required on the Local, State, and Federal levels. It is anticipated that an EIS will be required for the project and that there will considerable community interest and involvement in the process.

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APPENDIX A –ESTIMATE OF FUTURE BEACH BEHAVIOR

ESTIMATE OF FUTURE BEACH BEHAVIOR AT THE KAHULUI WASTEWATER RECLAMATION FACILITY, NORTH MAUI

Report prepared for Moffatt and Nichol Engineers
Report prepared by Everts Coastal
13 December 2007

Abstract

An estimated 1000 to 3000 cubic meters of sand per year is transported to the west along the beach in front of the Kalului Water Reclamation Facility. This net longshore sand transport rate is likely to continue into the future in the absence of any further upcoast human interventions and a continuation of the current sediment fluxes. A net addition of 0.002 meters/year to the present sea level rise rate (a distinct possibility) over the next 50 years could reduce this rate by 500 to 1000 cm/y. Our certainty in the estimates, on a scale of one (low) to 10 (high) is 5, an indication the analysis is a work in progress.

With conditions as they now exist, the shoreline movement rate at KWRF beach for the next 50 years will probably be somewhere in the range -0.15 to 0.05 m/y. This estimate is the rate at which the mean width of the beach will change since its back boundary will likely be fixed by a seawall. The volume change to shoreline change ratio is between 3000 and 6000 cubic meters per meter of shoreline retreat or advance.

To maintain the KWRF shoreline at its present mean position will require an estimated 400 to 900 cm/y of artificially-placed beachfill. If the sea level rise rate accelerates by 0.002 m/y, this estimate will increase by 80 to 200 cm/y and possibly slightly more due to a reduced input from upcoast. On a scale of 1 to 10, our certainty that the beachfill requirement will average between 500 and 1000 cm/y is a 6. Less beachfill will be required at the beginning of a 50-year project; more will be needed leading up to its conclusion.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0 INTRODUCTION

This report was completed under a contractual agreement with Moffatt and Nichol, Engineers. Its primary objective is to estimate future beach behavior at the Kahului Wastewater Reclamation Facility, North Maui. As a part of a plan to protect the facility from wave attack, the goal is to quantify the requirement for artificial beachfill to retain the shoreline in a dynamically fixed position for the next 50 years, and to estimate the annual amount of sand that will be supplied from upcoast.

This report describes how the results were obtained using existing information and observations made during a three-day field trip. To increase confidence we used two methods to estimate the past behavior of the study beach in order to predict future performance.

An extrapolation of historic changes is a useful beginning. This approach suffers, though, because the causes of future beach behavior are not likely to be the same as those that affected it in the past.

An historic sediment budget analysis - a continuity of sediment volume approach - was used to sort out recurring and non-recurring effects. Non-recurring effects are sand mining in the last century, recent beach restoration at Sugar Cove, and the construction of groins, a revetment, and the Kahului Harbor breakwater. Isolating the non-recurring effects in a sediment budget provides a means to estimate the future contribution of sand to KWRF beach from the east and to estimate its performance.

2.0 BEACH PERFORMANCE DATA SET

University of Hawaii shoreline positions as defined on a set of 2002 aerial photograph underlays, and augmented with shorelines from a set of 2007 aerial photographs, were used by Moffatt and Nichol to calculate the plan area of coast change for the reach between Blue Tile House beach and Kalului Harbor. These data are the foundation upon which our results are predicated. Resources did not allow time to check the UH shoreline selections or the Moffatt and Nichol area change data. We took them at face value.

The study reach was segmented into the 21 cells listed in Table 1. Each cell contains a sandy beach. UH shorelines are defined for these cells from the following times: 1912, 1960, 1975, 1987, 1997 and 2002. All areas calculated by Moffatt and Nichol are referenced to the UH 2002 shoreline. The shoreline year and month are provided by UH for all shorelines from 1960 onward. Only year is available for the 1912 shoreline. UH shorelines are the "beach step", located at the base of the foreshore. Three other cells from Blue Tile House beach to Hookipa point at the east end of the sandy northeast Maui littoral system have fewer shorelines than the 21 cells to the west. These small easternmost cells are not included in the shoreline analysis. Sand collected from almost all 24 beaches indicated these three beaches are not supplying much material to beaches west of them. In addition, they are separated from the more westerly beaches by a dominant headland around which sand may not pass in quantity to the west. The main reason for excluding them, however, was to retain a consistent data set.

Seasonal fluctuations were removed from the data set with the use of five shorelines from KWRF beach in the period 1987-2007 as shown in Figure 1. This beach was relatively stable then (in comparison to others like adjacent Kite Beach, also included in the figure). Fluctuations correspond well with the seasonality of waves on the north coast of Maui. Moberly (1963), Moberly and Cox (1964, 1968 revision) and Gibbs, Richmond and Fletcher (2000) describe two main wave seasons: (1) April through October of strong NE trade winds with deep water heights of 4 to 12 feet and spectral periods of 5 to 8 seconds, and (2) December to March of north Pacific swell with deep water heights averaging 8 to 12 feet with a spectral period of 10 to 15 seconds. Information from north Maui residents and a lifeguard indicates the season of most sand loss above mean sea level (MSL) occurs during the period of NE trades and losses increase toward the end of the NE trade season.

Table 1. Cells with sandy beaches included in this analysis.

Cell	Location	Hawaii easting	Hawaii northing	Distance east and north of FWRC beach, meters	Beach length, meters	East boundary	West boundary
1	FWRF	764500	2312900	0	658	Revetment at FWRF	Structures at breakwater
2	Kite beach	765100	2312780	612	694	Pre-1960 groin at Kaa Point	Revetment at FWRF
3	Kanaha Beach Park (west)	766000	2313100	1513	670	Groin probably constructed in phases beginning around 1929	Five large groins constructed before 1960
4	Kanaha Beach Park (central)	766400	2313450	1978	444	Groin constructed before 1960	Groin probably constructed in phases beginning around 1929
5	Kanaha Beach Park (east)	766850	2313600	2452	385	Groin constructed before 1960	Groin constructed before 1960
6	East of Kanaha beach	767150	2313750	2783	179	Groin constructed before 1960	Groin constructed before 1960
7	?	767400	2314050	3120	475	Shoreline bulge; sandy beach not evident revetment or beachrock outcrop today	Groin constructed before 1960
8	Spreckelsville beach on UH map	767700	2314200	3454	271	Beachrock exposures	Shoreline bulge; sandy beach not evident
9	/Coral Beach on UH map	768000	2314350	3788	309	Papaula Point, large beachrock exposures	Beachrock exposures
10	Stables Beach on UH map	768300	2314200	4016	321	Natural boulder point incl.submerged section	Papaula Point, large beachrock exposures
11	Spreckelsville (west) on UH map	768750	2314200	4444	402	Large sandy point retained by offshore beachrock bench	Natural boulder point incl.submerged section
12	Spreckelsville (east) on UH map	769100	2314150	4767	360	Natural boulder point incl.submerged section	Large sandy point retained by offshore beachrock bench
13	Sugar Cove	769500	2314300	5192	260	Natural boulder point incl.submerged section	Natural boulder point incl.submerged section
14	Baby Beach	770200	2314700	5977	241	Large sandy point retained by offshore beachrock bench	Natural boulder point incl.submerged section
15	Baldwin Beach	770700	2314700	6456	939	Large sandy point retained by offshore beachrock bench	Large sandy point retained by offshore beachrock bench
16	Sm beach west of lime kiln revetment	771300	2314900	7088	135	Lime kiln revetment constructed before 1960	Large sandy point retained by offshore beachrock bench
17	Lime kiln revetment	771450	2315000	7260	180	Lime kiln revetment constructed before 1960	Lime kiln revetment constructed before 1960
18	Paia Bay (west end) from UH map	771700	2315000	7500	241	Natural boulder point incl.submerged section	Lime kiln revetment constructed before 1960
19	Paia Bay (east end) from UH map	772100	2315100	7912	619	Large protruding basalt point incl.submerged section	Natural boulder point incl.submerged section
20	Mantokuji Bay	772600	2315550	8522	221	Paia Bay (west end) from UH map	Large protruding basalt point incl.submerged section

21	Kuau Bay	773100	2315850	9092	267	Paia Bay (west end) from UH map	Paia Bay (west end) from UH map

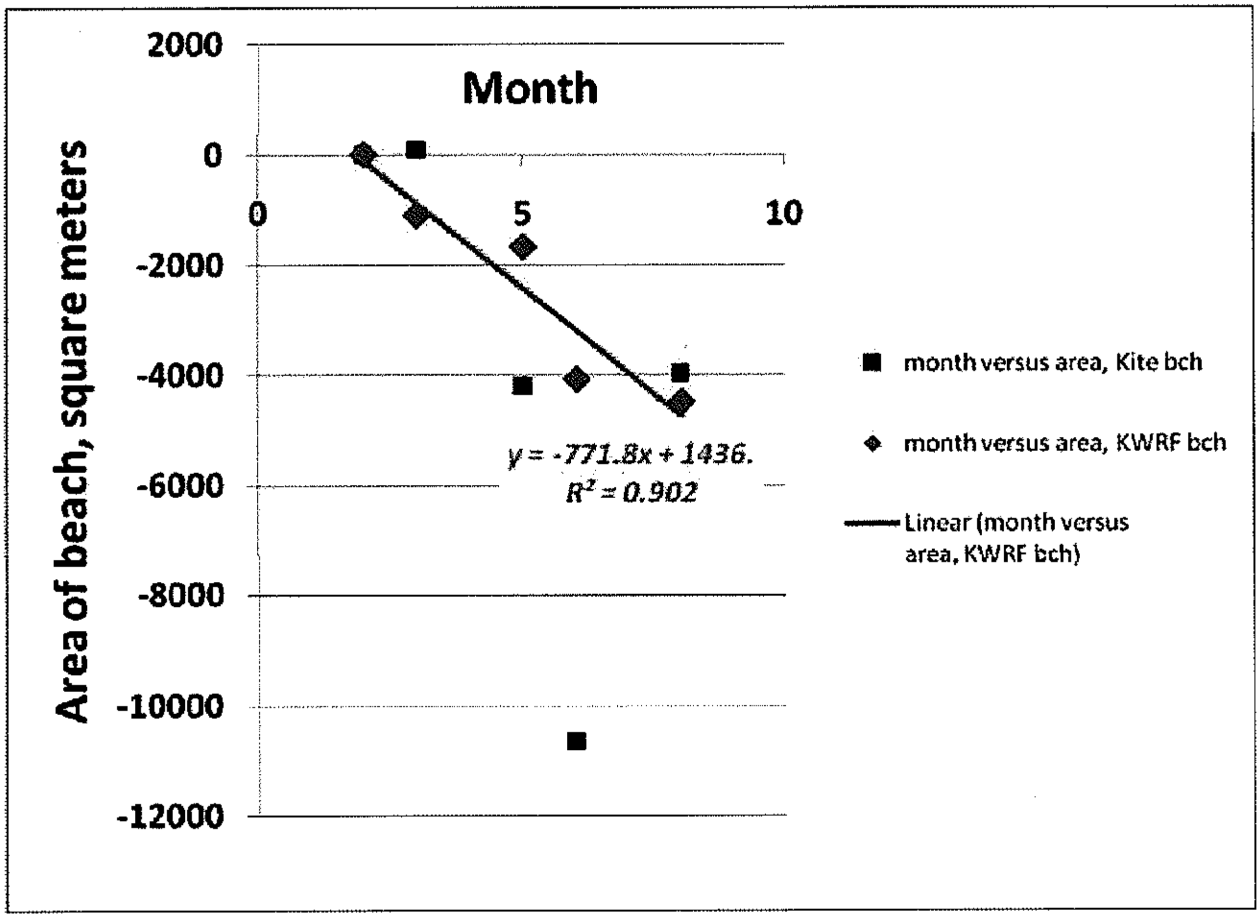

Figure 1. Beach area as a function of survey month for KWRF beach and Kite beach (1987-2007)

Gibbs, Richmond and Fletcher (2000) found the 5-yr maximum change in beach volume from summer to winter conditions to be 18 cubic meters per shoreline meter (cm/m) on KWRF beach, which translates to a similar change as that shown in Figure 1. They found no net volume change during their 5-yr monitoring period.

Figure 2 shows the consequences of removing seasonal reversible effects. For the period 1987 to June 2007, the removal of seasonal effects resulted in a least squares fit annual loss of 29 square meters of plan area landward of the shoreline. Without the removal of seasonal effects, the 20-yr trend of plan area increase was 12 sm/y. These values are well within the margin of error in selecting the shorelines and in estimating seasonal effects.

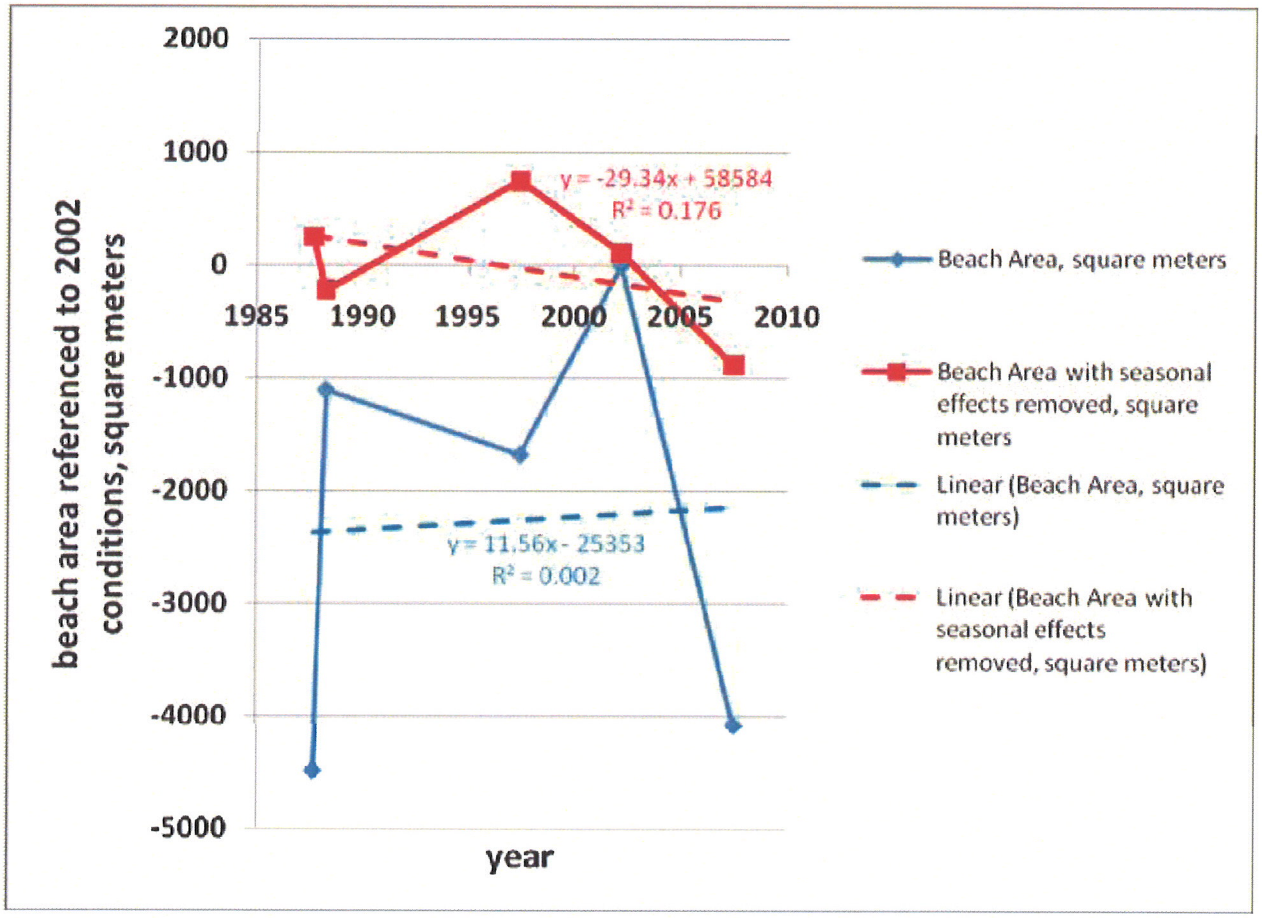

Figure 2. KWRF beach area change with and without seasonal effects removed.

3.0 HISTORIC BEACH BEHAVIOR

Both of the curves in Figure 2 indicate a near stable KWRF shoreline in the past 20 years. Figure 3, however, with the long-term behavior of KWRF and Kite beaches with seasonal adjustments filtered out using the formula in Figure 1, clearly shows the KWRF shoreline advanced between 1912 and 1960 and retreated a great deal between 1960 and 1988. The question is: What caused these changes and why did Kite beach behave differently? Did non-recurring factors have a substantial effect on the earlier large retreat of the shoreline? What is responsible for the more recent apparent stability? How will the answers affect our ability to forecast 50 years into the future and how do we identify and exclude non-recurring effects from our projections?

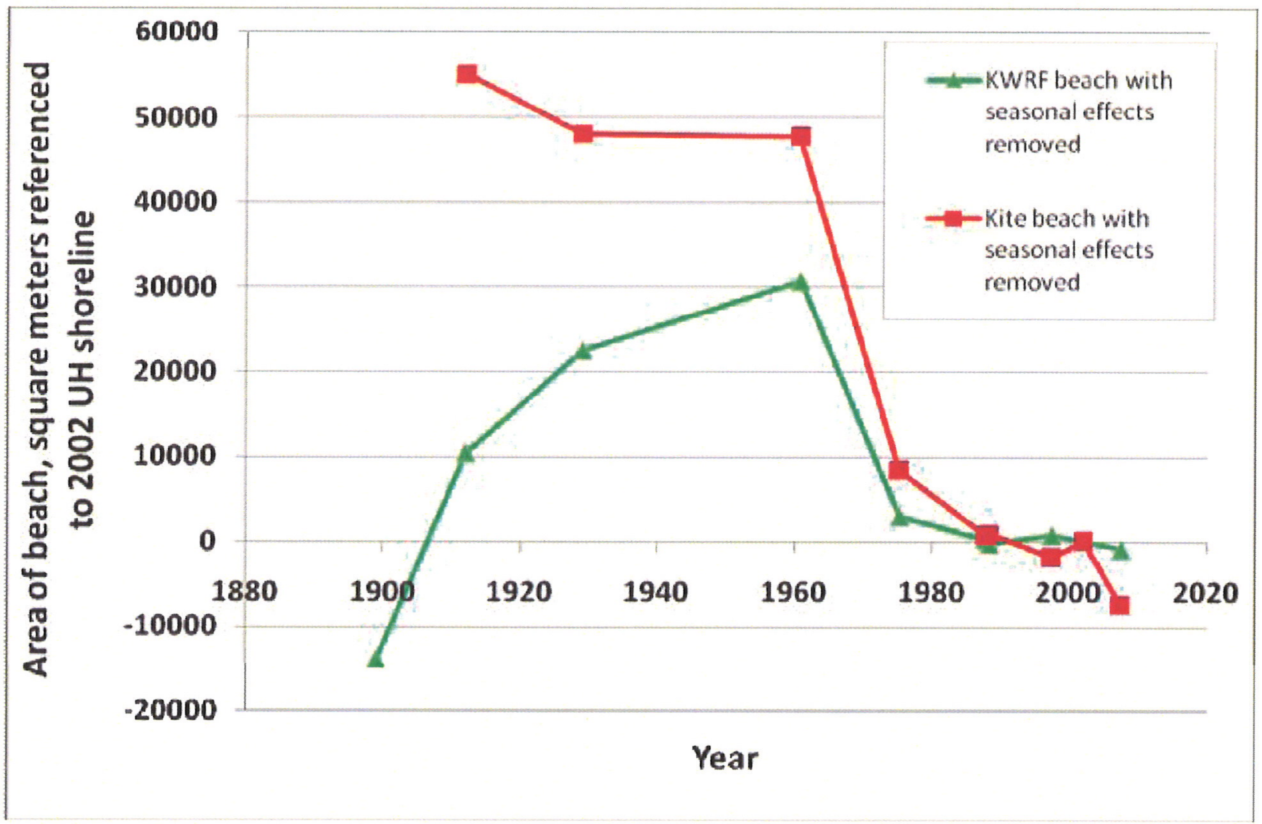

Figure 3. Beach area as a function of shoreline date adjusted for seasonal fluctuations, KWRF and Kite beaches.

An important objective of a sediment budget focused on predicting future beach behavior is that of separating natural conditions that are likely to be nearly the same in the future, such as the wave climate, from non-recurring effects. Most non-recurring effects are human interventions that will likely not be repeated or will be repeated, but to a different level, in the next 50 years. Sea level rise affects beaches and its rate of change is an example of a natural effect that will likely accelerate in the next 50 years. In order of construction, non-recurring projects that have affected the beach from Kahului Harbor to Blue Tile House Beach are: (1) construction of the east breakwater at Kahului Harbor, (2) sand mining, (3) groins east of the KWRF beach, the groin at the west end of KWRF beach, (4) the revetment at the east end of KWRF beach, and (5) beach restoration at Sugar Cove. The latter effort may or may not continue over the life of the project and other beach nourishment projects may come on line.

The 19 cells east of KWRF and Kite beaches (Table 1) may have affected KWRF beach between 1912 and 2002. Figure 4 is an overview of changes that occurred in the position of the shoreline between KWRF beach and Blue Tile House beach in that time period. The cells can be located by counting from left to right. Figure 4 indicates a greater retreat of the shoreline in the east part of the reach than the west, but the correlation is poor. It also suggests a need to pin down the changes to more limited time intervals in order to sort out and quantify causes.

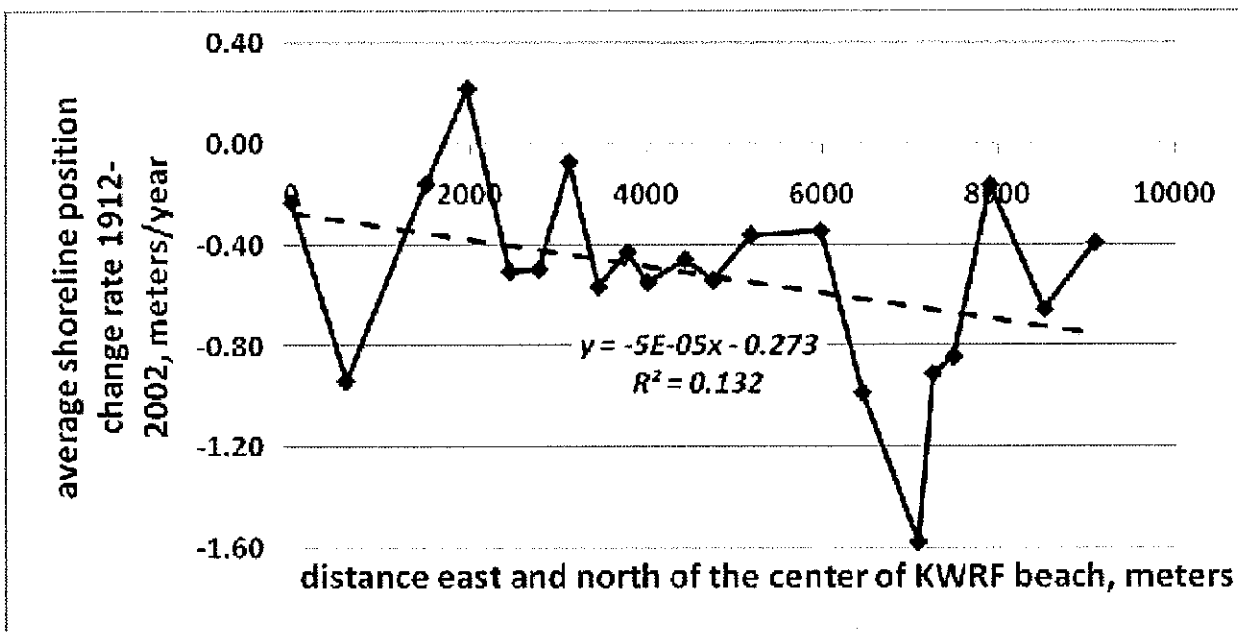

Figure 4. Annual shoreline position change between 1912 and 2002.

Figure 5 illustrates the average change in shoreline position by lumping the 21 beach cells by time interval from 1912 to 2002 as defined in the UH shoreline maps. Note shoreline retreat in the 1912-1960 period was at an annual rate at least 3 times as great as any other e period. It also suggests a more recent overall stability or even a slight advance on beaches. A 2002-2007 advance (not included) is indicative of shoreline behavior only along the westerly 4 km of this coast. But Figure 5 still does not pinpoint the locations of below and above average beach performance, either in time or location.

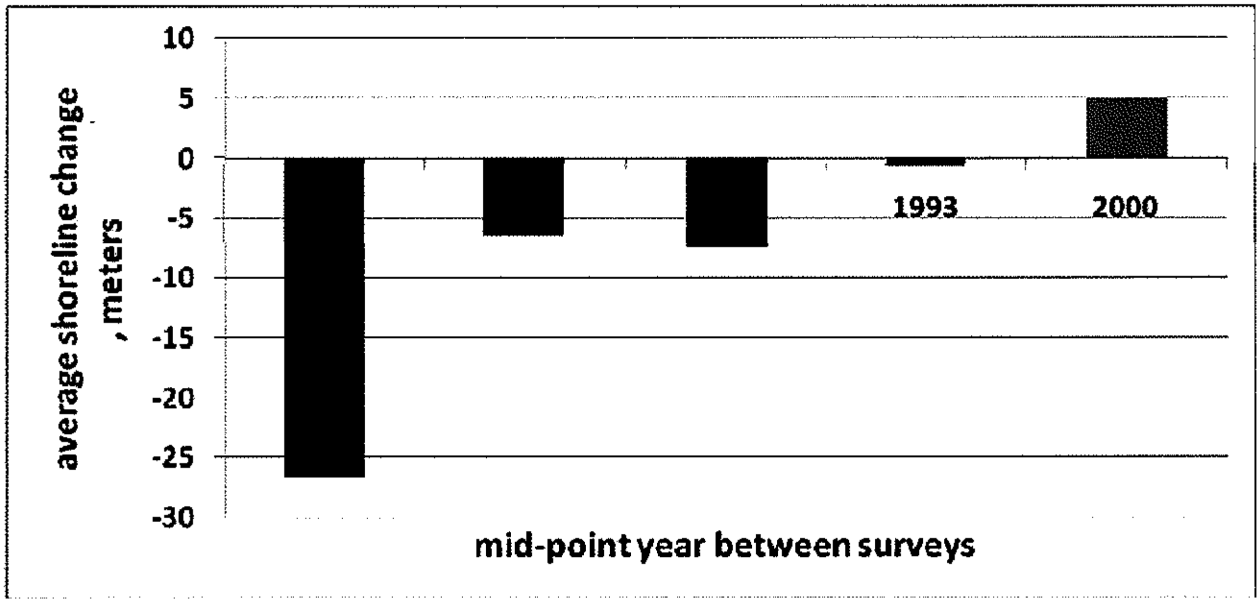

Figure 5. Net shoreline change rates shown for the mid-points of time intervals between 1912 and 2007 averaged for the reach between KWRF beach and Blue Tile House beach, with the latest estimate limited to the reach from KWRF beach to the east end of Kanaha Park (data are not adjusted for reversible seasonal effects).

Figures 6 through 10 illustrate alongshore variations in the change in beach plan area that occurred in time intervals between 1912 and 2002 between KWRF beach (Cell 1) and Blue Tile House beach (Cell 21). These changes are referenced to a zero change for the entire reach. , i.e., the sum of beach area change by time period is zero when the area changes for all 21 sandy beaches in this reach are totaled by length. Gains and losses balance. By highlighting alongshore differences in this way it is easier to isolate and quantify non-recurring effects for the respective time periods and to follow them from one time period to another. Based solely on these measured beach area changes, however, it was not possible to isolate the effects of the groin at the west end of KWRF beach, the revetment between KWRF and Kite beaches, and recent artificial beach restoration at Sugar Cove. In contrast, the effects of the Kahului Harbor breakwater, sand mining, and groins between Kaa Point and Papaula Point are quite evident. Comments included in the figure captions are expanded in later sections of this report.

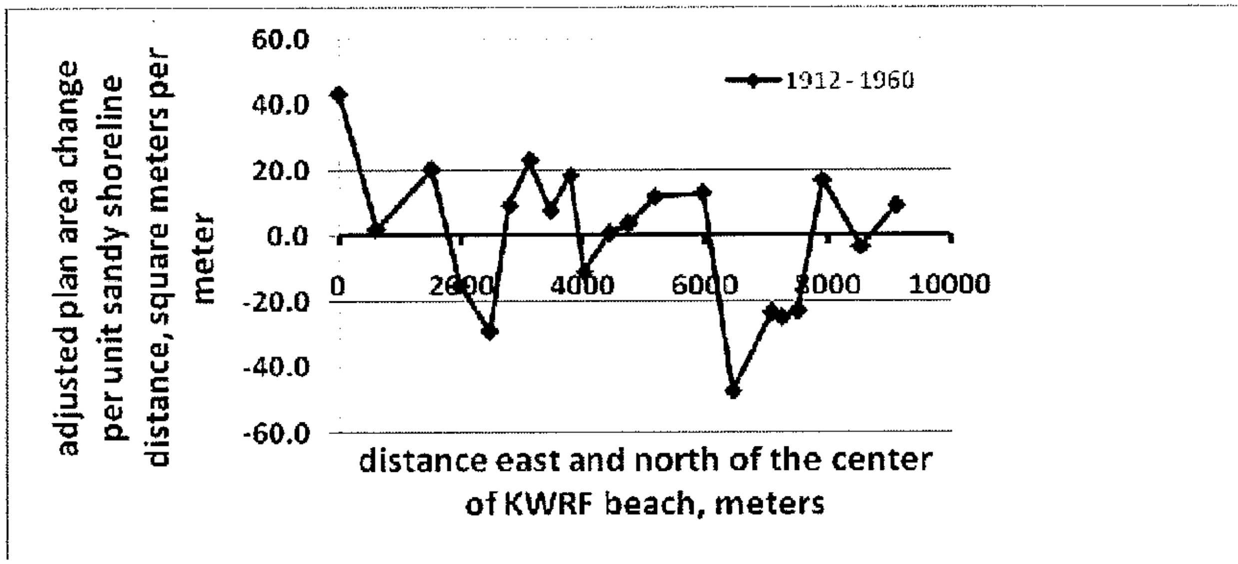

Figure 6. Beach plan area changes by coastal cell relative to a zero change for the entire 1912-1960 time period; large losses in cells 15-18 are due to sand mining, in cells 4 and 5 to the formation of hook-shaped bays by shore retreat just downcoast of large boulder groins, and the large gain in cell 1 to the formation of a fillet on the east side of the Kahului Harbor breakwater.

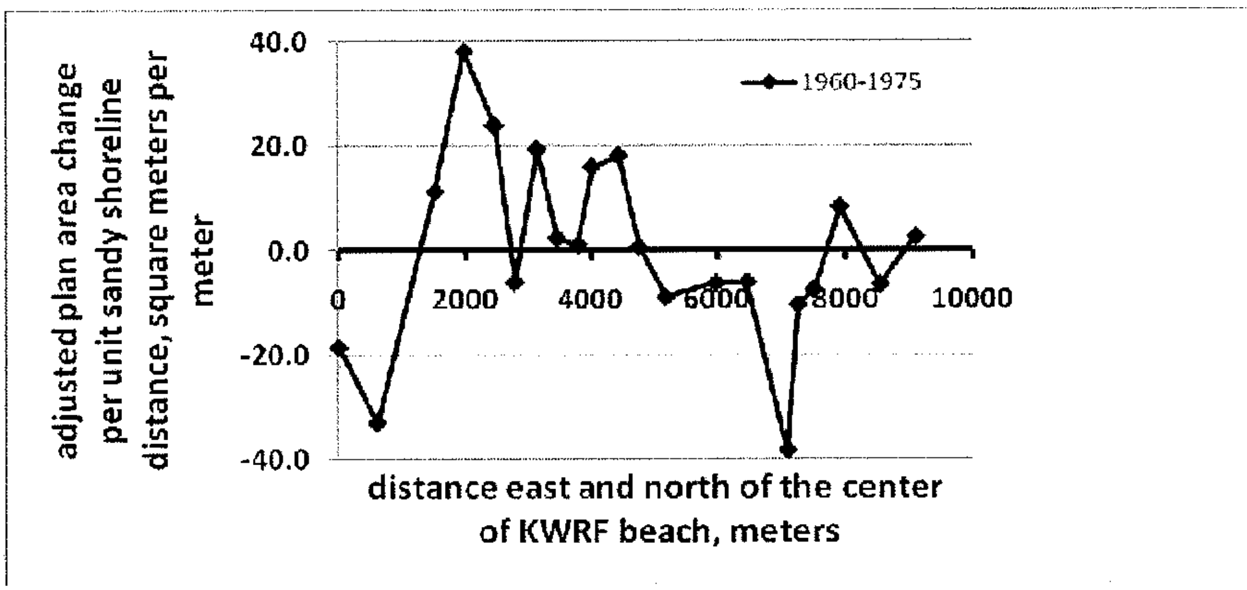

Figure 7. Beach plan area changes by coastal cell relative to a zero change for the entire 1960-1975 time period; the large loss on KWRF and Kite beaches (cells 1 and 2) is due to the formation of a hook-shaped bay to the west of a large groin at Kaa Point (between cells 2 and 3), the losses in cells 13-18 are in response to a continuation of beach sand mining, and the comparatively large gain in cell 4 probably reflects an extension of the groin between cells 3 and 4.

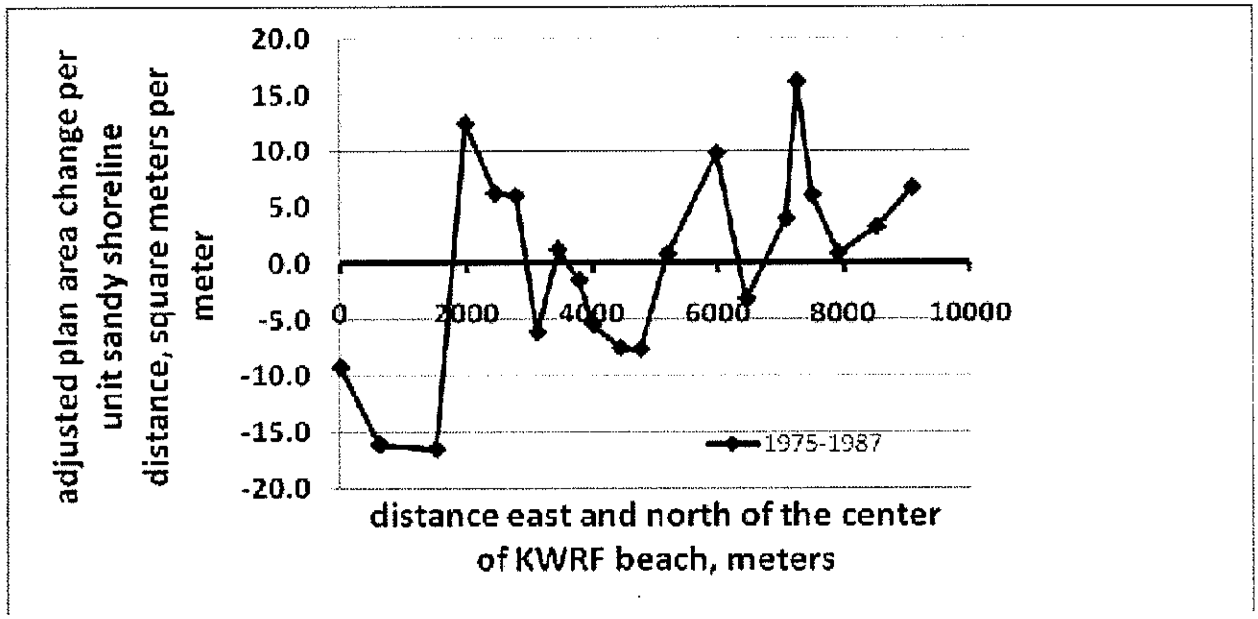

Figure 8. Beach plan area changes by coastal cell relative to a zero change for the entire 1975 and 1987 time period; large losses in cells 1 through 3 are due to a continuation of the evolution of hook-shaped bays in those cells.

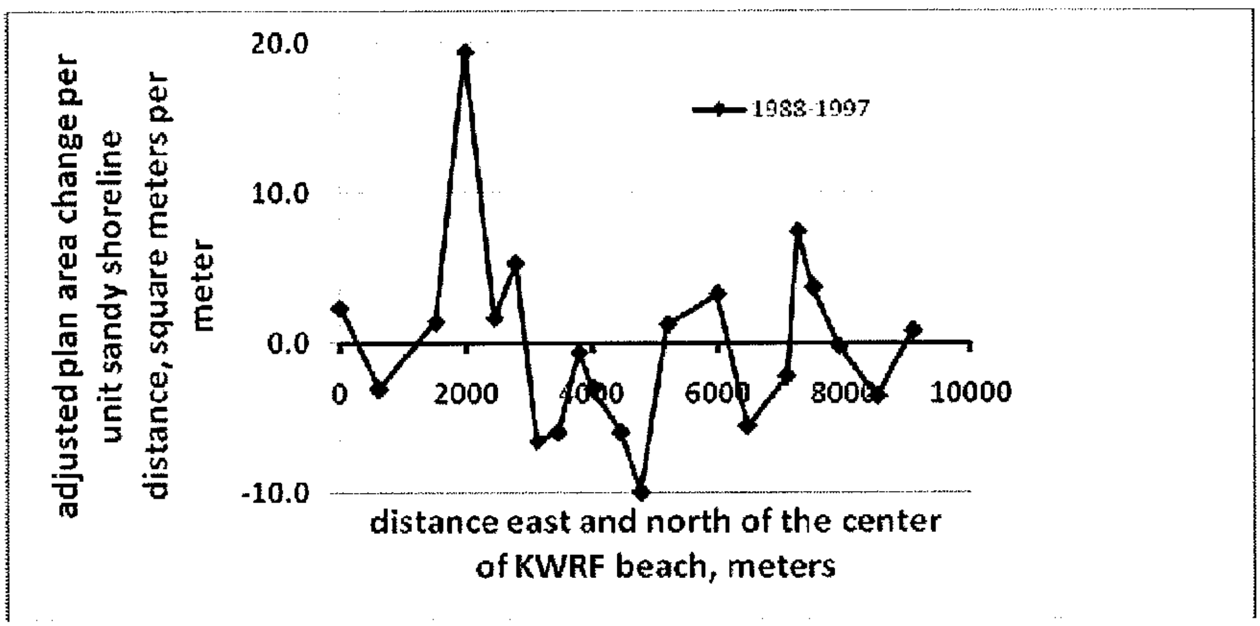

Figure 9. Beach plan area changes by coastal cell relative to a zero change for the entire 1988-1997 time period; the large gain in cell 4 is apparently due to another extension of the groin between cells 3 and 4 and a continuation of the accretionary cycle of fillet formation.

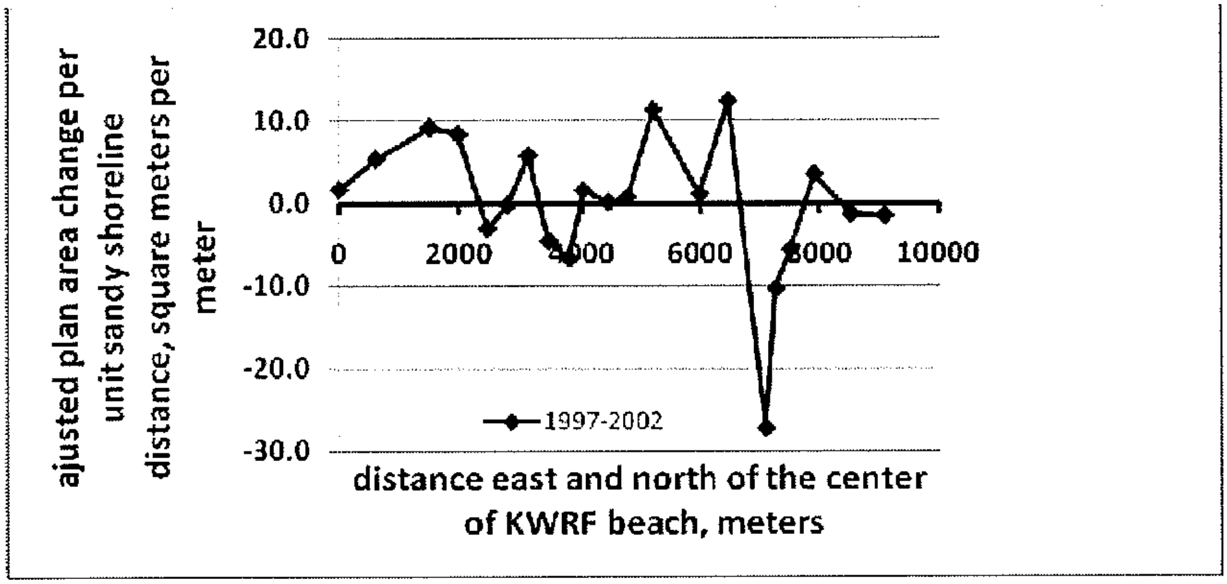

Figure 10. Beach plan area changes by coastal cell relative to a zero change for the entire 1997-2002 time period; the large loss at cell 16 is due to the incipient formation of a hook-shaped bay immediately downcoast of the lime kiln revetment at cell 17.

4.0 SEDIMENT BUDGET INPUT PARAMETERS

Reaching an understanding on what reasonably can and cannot be done to manage the coastal sand resource is greatly aided by an awareness of the condition of the beach and what might affect it in the future, especially if conditions change. Sediment budgets are a fundamental element of coastal sediment processes studies encompassing applications such as this. They serve as a useful framework to understand the sources, sinks, transport pathways and magnitudes for a selected region of coast within a defined period of time. By altering fluxes in a calibrated historic budget it is usually possible to answer "what if" planning and design questions. For instance, how will the mean width and rate of beach retreat be altered if the rate of sea level rise doubles? A third application is to alter the historic budget to forecast future beach behavior, but it involves timing future event forcings, a statistical task, so it is probably the least accurate application.

Sediment budgets are summations of sediment gains and losses within a designated coastal control volume over a given time interval. The continuity equality is

$$\sum_{i=1}^{n} q_i + \frac{\Delta V_l}{\Delta t} = residual \qquad (1)$$

in which $\sum q_i$ = the sum of all fluxes, both import (gain) and export (loss), including those occurring within the control volume, such as biological production, chemical precipitation, chemical solution, and mechanical abrasion, artificial beach enhancement, restoration, and nourishment, and sand mining from the beach; $\Delta V_l / \Delta t$ = average rate of sediment volume change in the control volume; and *residual* = amount by which the sediment budget is not in balance.

As a basis for "what if" and future predictions, a continuity of sediment volume analysis in completed in two parts. An historic littoral sediment budget is first adjusted until it is in balance. Then one or more fluxes in that calibrated budget are altered, for instance, the removal of the historic effects of sand mining, to predict future beach change. The calibration task follows a sequence: (1) define the alongshore and cross-shore bounds of the control volume, (2) identify the entire suite of relevant sediment fluxes across those boundaries as well as in-situ gains and losses within them, (3) determine a meaningful historic averaging time period for the fluxes, in our case 1912-1960 or -1975, and 1960- or 1975-2002 for the reach between Kahului Harbor and Blue Tile House beach, (4) estimate a mean value for each historic flux based on available information, (5) establish a hierarchy of perceived uncertainty in the mean flux values and control volume boundary parameters for the specified averaging period, and (6) sum all fluxes and balance the budget in steps with adjustments generally proportional to uncertainty in the preliminary fluxes and the mean control volume change using a trial and error approach. The last step is akin to getting the residual in Equation 1 to zero or using the residual as a proxy for an unknown flux as we do for the net longshore sand transport rate along KWRF beach (which fortunately is at the downcoast end of the north Maui study reach). The volume change in that equation, and the substrate sediment flux, which are both based on UH shoreline positions, is considered the most reliable parameter.

A long view is inherent in this approach. Confidence in a measured or estimated historical average is usually proportional to the length of time over which it is made. The requirement for averaging over at least scale of decades is evident in all facets of a sediment budget analysis. While not steady, some fluxes like the net longshore sand transport rate into and out of the control volume, or aeolian transport out of it, usually vary less than a few hundred percent from year to year. But episodic flux-producing events may be many years apart, such as sediment contributions from hinterland erosion during infrequent extreme storms or tsunami-caused overwash. Sometimes decades pass between these events with no flux at all.

In the predictive budget the dependent variable is either the shoreline position change rate, mean beach width and width change rate, or beach retreat or advance rate, or several of those. It is simply a rerun of the historical budget, but with one or more changed fluxes. Since it is impossible, with certainty, to predict future forcings, the flux change is always a bit of a guess. Accordingly, the forecast is only as good as the prediction of future forcings so this is an important constraint since we are forecasting 50-years ahead at KWRF beach. We really don't know what nature is going to bring us so we go on past behavior and instinct.

4.1 Control Volume Boundaries and Dimensions.

We refer to the control volume, or mobile part of the coastal zone, as the <u>*littoral sediment lens*</u>. Five key assumptions concerning the LSL are: (1) mean beach width is proportional to its volume, (2) a net change in LSL volume occurs when there is an imbalance between the cumulative magnitudes of import and export sediment fluxes across its boundaries and/or a net change in the rate of sediment loss or gain within it, (3) reversible seasonal and most storm-related sediment movements occur within it and have no affect on its volume, (4) as the beach retreats or advances at the rate, $\Delta\bar{S}_b/\Delta t$, and/or moves vertically with a net change in sea surface elevation at the rate, $\Delta\bar{a}/\Delta t$, it moves in its entirety at the same horizontal and vertical rate and in the same direction, and (5) if it retreats it is into the substrate behind and below it and if it advances a new substrate is created with littoral sediment from it. Littoral sediment is any material small enough to be moved by waves and currents, but large enough that it contributes to the volume of the LSL.

Coastal features that are affected when the LSL moves are: (1) the <u>*hinterland*</u>, (2) the <u>*substrate*</u> beneath the LSL, and (3) the <u>*ramp*</u> or inner portion of the Continental Shelf seaward of the LSL. As the LSL moves landward it encroaches on the hinterland while leaving behind a new segment of ramp at its seaward edge. If it advances seaward it covers a portion of ramp, and at its landward edge a wide beach leaves behind a new segment of hinterland up to the elevation of the berm. The *beach* is the landward portion of the LSL. It is vertically separated from the *shoreface* at a designated sea level datum. The landward limit of the beach is the *backbeach line*. The seaward bound of the shoreface is the *shorebase*. The *shoreline* separates the beach from the shoreface. The supporting substrate surface is composed of two segments, the typically steeply sloping *backbeach substrate surface* and the comparatively less steep *basal substrate surface* that come together at the *notch*. The notch is commonly located near mean sea level where the most wave energy per unit vertical distance is expended when the hinterland is scoured during severe erosional events. Unless there is a change in the characteristics of the sediment within the LSL or a change in the wave climate, we assume an unchanging dynamic equilibrium beachface (foreshore) and shoreface profile. A profile in shape dynamic equilibrium, the distance between the mean positions of the shoreline and the shorebase is a constant even as the beach advances or retreats. The only LSL surface parameter dependent upon the volume of the LSL is the mean width of the beach. Without evidence to the contrary, we also assume the movement of the combined backbeach and basal substrate surface occurs without a change in it its dynamic equilibrium shape. Thus, although the upper and lower profiles of the LSL vary on all scales of time and are almost never in complete equilibrium with the waves that shape them, over decade long intervals we assume they fluctuate about mean shapes.

The locations of the shorebase, backbeach line, and substrate surface are prescribed by (1) nature, (2) the constraints imposed by the sediment continuity approach, and (3) the time averaging period of the sediment budget. The shorebase is the seaward most location of *reversible* shore-normal sediment transport. Onshore- and offshore-directed shore-normal transport that affects the volume of the LSL passes across the shorebase. One way to define it is as the depth (or offshore distance) at which the shoreface profile is morphodynamically inactive. This "pinchout depth" or "depth of closure" are usually defined as the location where bottom fluctuations decrease to less than the resolution of profile measurements, and by implication the seaward limit of "significant cross-shore transport". Reversible offshore and onshore transport is primarily a seasonal phenomenon, nearly canceling annually. However, in any year more sediment may be moved farther from shore during storms than is returned to the beach during episodes of long-period swell. But over many years these fluctuations average out except for the residual amount that passes across it. We refer to that residual as the shorebase flux and in our sediment budgets we assume it is zero.

Two lines of evidence provide a rough indication of the shorebase location in the study areas: (1) a small scale bathymetric chart (C-Map, 1:5000, WGS1984), and (2) Sugar Cove survey data. The chart indicates a shallow reef flat with an irregular surface. Given the paucity of soundings it is only possible to identify the depth of the inner flat surface in the range 2 to 5 m below MSL.

The base of the envelope of repetitive surveys is a more definitive way to define the bounds of the LSL and the only place we know of to do that is at Sugar Cove. Sand has been artificially added there since 1996 as shown in Figure 11. This figure is based on data supplied by the Sugar Cove Apartment Owners Assn through Mrs. Barbara Guild.

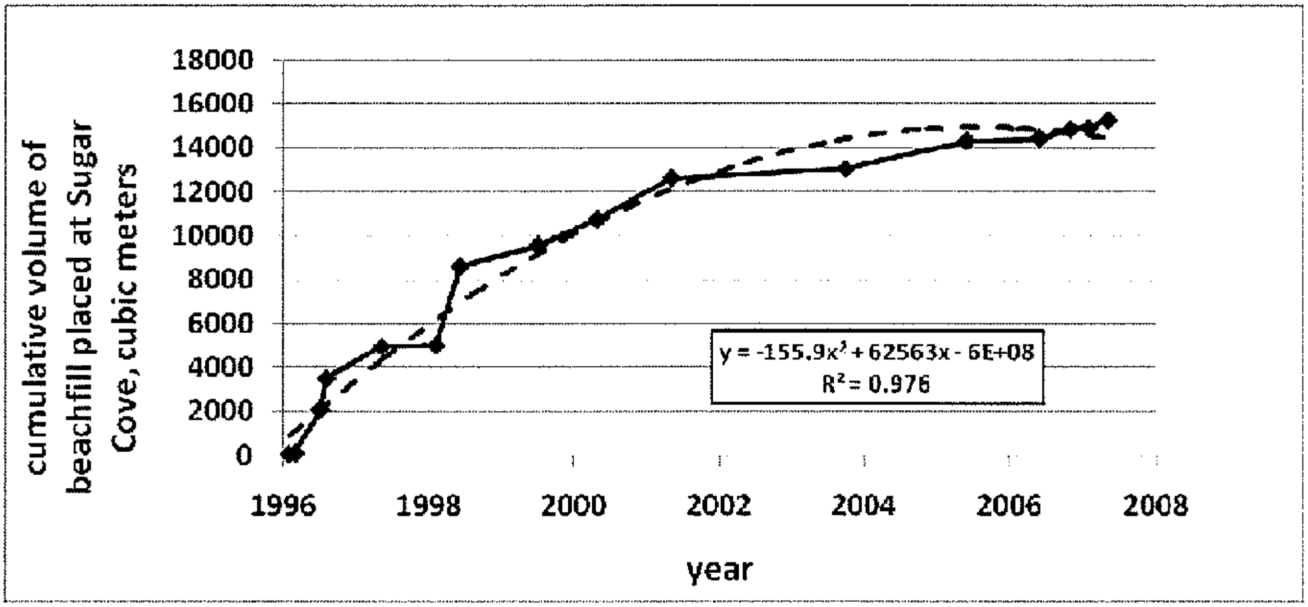

Figure 11. Cumulative quantity of sand placed in Sugar Cove, cubic meters.

We assume the beach was almost absent before any beachfill was placed. Then, as shown in Figure 12, which is based on surveys made by the apartment owners association, the beach gained sand until about 2000 and from then on it remained quite stable in cross-sectional area for the next 6-plus years. As shown in Figure 13, about 3500 cm/y were placed in the first four years of this ongoing project and only about 1000 cm/y in the last 7 years. The widest beach was in 2005.

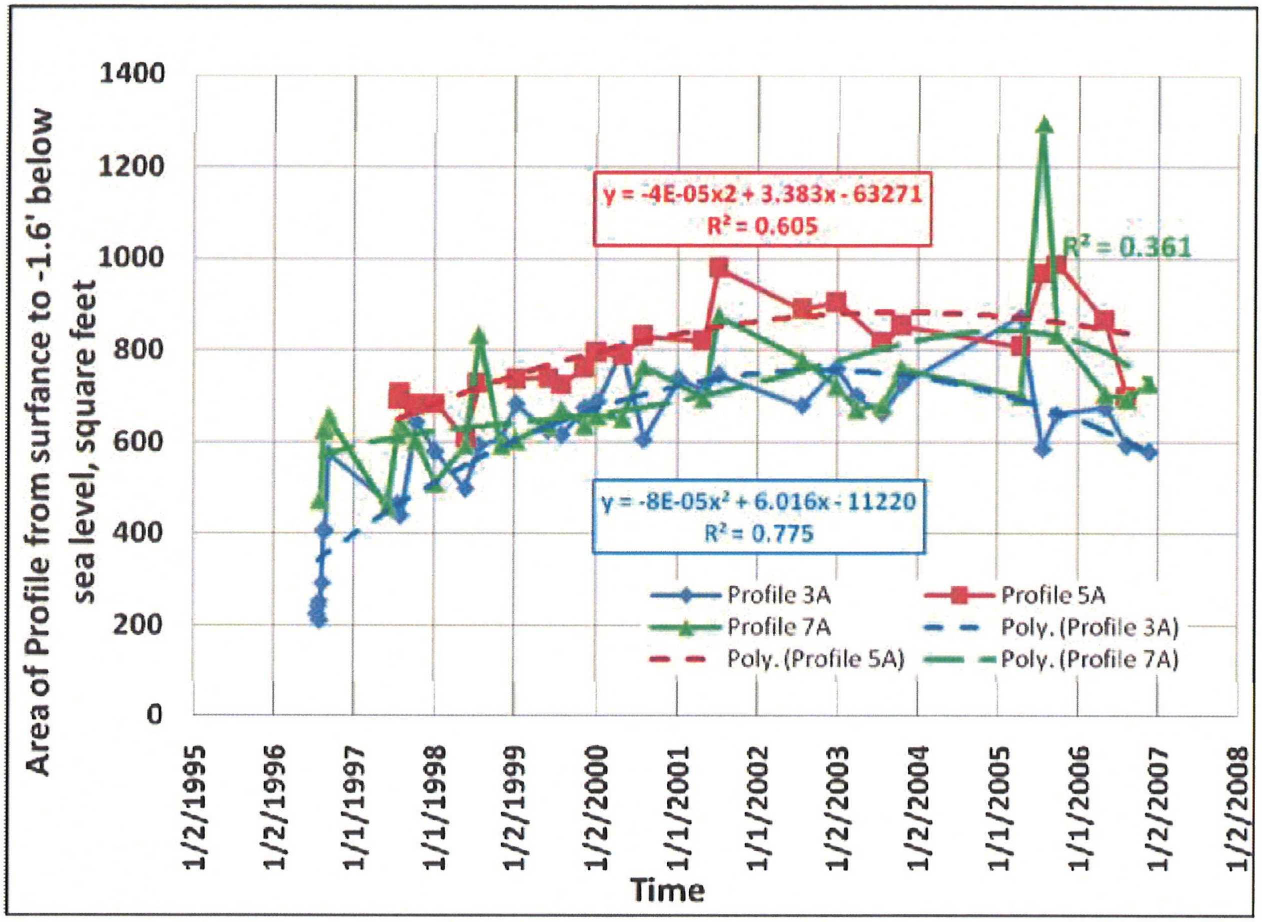

Figure 12. Beach areas above -1.6 ft (local sea level datum) at Sugar Cove during a period of artificial beach nourishment, in square feet as compiled by the apartment owners association; Profile (range) 3A is at the east end of the beach, 5A in the middle, and 7A at the west end.

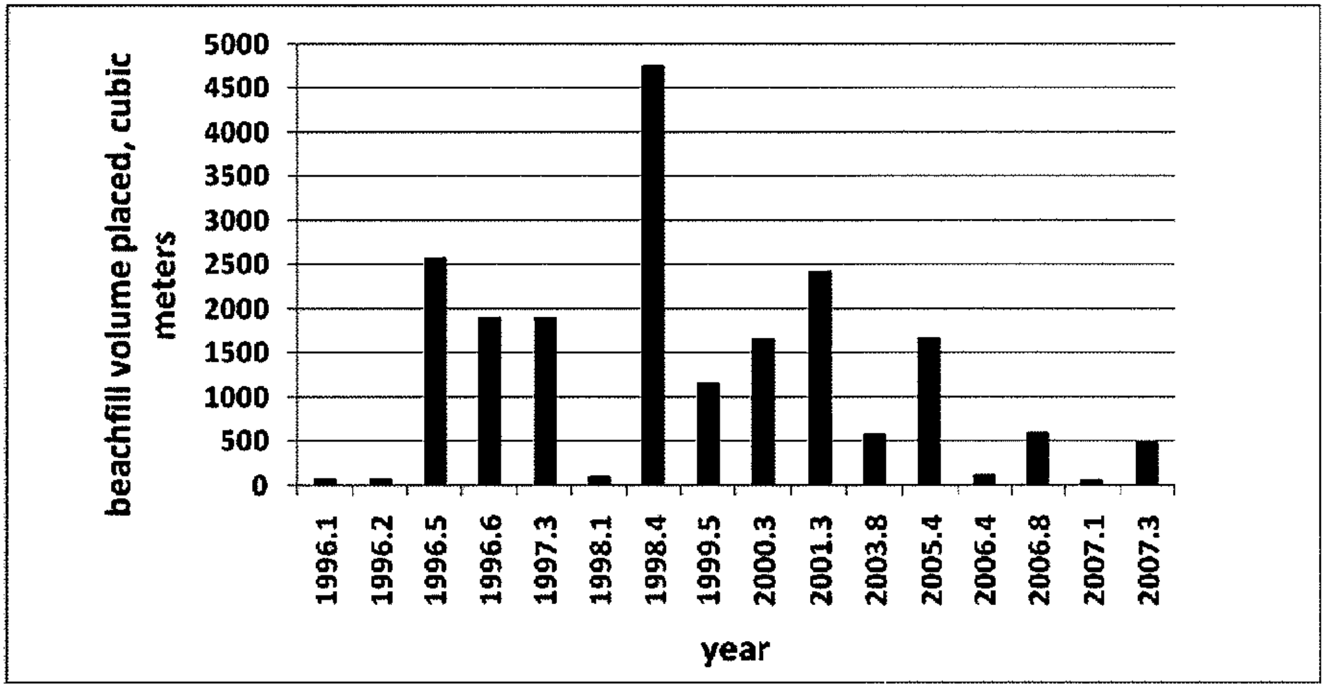

Figure 13. Volume of sand artificially placed in Sugar Cove, cubic meters per placement episode.

Figure 14 shows the beachfill did not extend out to the pinchout depth. However, it is still possible to estimate the relationship between mean beach width and the cross-sectional area of the littoral sediment lens by extrapolating the position of the shorebase seaward with consideration of the chart bathymetry. As shown in this figure, the mean width of the beach at local sea level elevation is 60-80 ft (about 20 m) and the height of the beach is about 12 ft (4 m) referenced to that datum (Sugar Cove measurements were archived in English units). A berm is rarely present in the restored beach. By extrapolation the depth to the shorebase is probably in the range -8 to -10 ft and its distance from the mean position of the shoreline seems to be between 250 and 400-ft. Given we have no better data available concerning the north Maui shorebase, and no reason to believe substantial changes occur between cells, we assume the LSL parameters listed in Table 2 are appropriate for all 21 cells.

Table 2. Dimensions of the littoral sediment lens.

Lens component	Estimated value	Range
Mean beach width, $\bar{W}$, meters	Approx 20 in 2002	18 to 24
Elevation of backbeach line above sea level, h_b, meters	4	3 to 4.5
Shoreface depth, z_s meters	3	2.5 to 5
Horizontal distance, shoreline to shorebase, y_s, meters	100	75 to 125

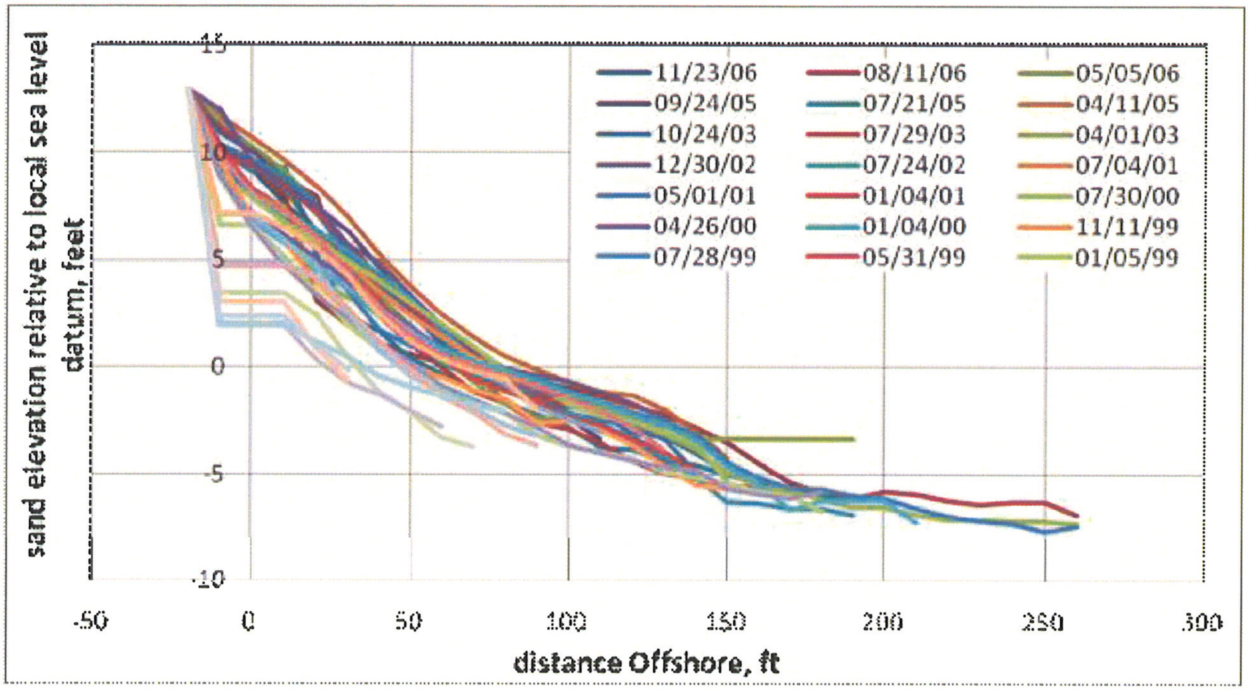

Figure 14. Envelope of all profiles on Range 3A at Sugar Cove, Maui, 1996-2006; Range 3A is on the east side of the beach and near the middle of the cove.

With the estimated LSL dimensions, the volume of the Sugar Cove littoral sediment lens appears to be 600 to 900 cubic feet per foot of sandy shoreline (55 to 85 cm/m). Thus, the ratio of mean beach width to LSL volume per unit sandy shoreline distance at Sugar Cove is about 1:10. The total volume of sand in the Sugar Cove littoral sediment lens is perhaps 6000 to 9000 cm.

Alongshore boundaries of the 21 cells between KWRF and Blue Tile House beaches are provided in Table 1. All are fixed between physiographic features like large rocky or boulder headlands, boulder groins, or sandy projections of the shoreline in the lee of natural offshore bathymetric highs.

4.2 Mean Beach Widths and Retreat Rates.

Mean beach width is an important parameter since it partially controls the rate of beach retreat. It also affects the sea level rise impact on the size of the LSL. According to UH map text and a 1950 aerial photo supplied by Moffatt and Nichol, while most beaches have retreated, mean beach widths have not changed much since 1950 and especially 1960, except perhaps at KWRF beach where they declined. This suggests a dynamic equilibrium LSL. It also suggests, with less certainty, there was no substantial permanent change in a major flux in the last almost 50 years. "Island of Maui" (1962 plus) states the mean width of Spreckelsville Beach in 1962 was 62 ft, the beach from Papaula Pt to Maliko Bay was 75 ft wide and the beach at Lower Paia was 80 ft wide and arcuate in shape.

We have little idea of the mean widths of the 1912 beaches, but we (I think realistically) assume they were larger than today's since the shoreline was less convoluted. Consequently the net longshore sand transport rate was also larger then. Alongshore sand transport along the north Maui coast is energy constrained, not limited by availability. In turn, the alongshore component of wave energy at the breakpoint is controlled in part by the orientation of the shore. For the purposes of our sediment budget, we assume the 2002 mean beach width was near 20 m in most cells. Further we assume the mean width at any year in the period 1912 - 2002 can be defined as

$$\bar{w}(t) = \left[\frac{S(t)}{S_{max}}\right]20 \qquad (2)$$

in which S_{max} = maximum distance the mean position of the shoreline retreated in any cell by 2002, and S = position of the shoreline on any date it was identified. This approach assures no 1912 mean beach width is greater than 40 m, probably a reasonable assumption given no other information on beach widths 100 years ago. The relationship between a change in mean beach width (from Eq. 2), a change in shoreline position (known values), and the rate of beach (backbeach line) advance or retreat, $\Delta\overline{S_b}/\Delta t$ is

$$\frac{\Delta\overline{S_b}}{\Delta t} = \frac{\Delta\bar{S}}{\Delta t} - \frac{\Delta\bar{w}}{\Delta t}. \qquad (3)$$

A change in the LSL volume is reflected by a change in the mean width of the beach; a change in the mean width of the beach affects a change in the beach movement rate.

4.3 Substrate Sediment Flux.

The substrate sediment flux is important almost everywhere beaches are retreating and all of the beaches in the study area are in this category. At KWRF, the substrate flux is that quantity of littoral-type sediment that is scoured and contributed to the LSL as it retreats minus the amount that is added as the LSL moves upward in response to sea level rise. The amount of material released as the substrate and hinterland retreat is dependent upon the compatibility of the released material with material in the LSL. Eroded silt and mud will not long remain there.

A change in the cross-sectional area of the substrate surface as it retreats and ascends defines the substrate sediment flux, $\bar{q}_s$, when the portion of littoral-type sediment is considered, is

$$\bar{q}_s = -x\left[\left[\rho_h(h_h - h_b) + \rho_b h_b + \rho_s z_s\right]\frac{\Delta \bar{S}_b}{\Delta t} + \left(\bar{w} + y_s\right)\frac{\Delta \bar{a}}{\Delta t}\right] \quad (4)$$

in which x = alongshore length of the control volume (LSL), ρ_h, ρ_b, ρ_s = portions of the material that will be compatible with sediment in the LSL as it is contributed, respectively, as the hinterland, backbeach substrate surface, and basal substrate surfaces are eroded, h_h, h_b, z_s = respectively, the vertical distances to the crest of the hinterland substrate surface above the elevation of the backbeach line, to the crest of the backbeach substrate surface, and to the shorebase referenced to sea level datum, y_s= horizontal dimension of the shoreface, assumed constant unless there is an alteration in the long-term wave climate. The rate of beach movement is positive for an advance and negative when it retreats.

For Maui, sea level rise has been estimated at 2.46 plus or minus 0.23 mm/yr by Jeon (?), and in another case (citation not given) at 2.67 mm/yr, both in recent years. In the study area the composition of the basal and backbeach substrate is mostly unknown. This is a major impediment in quantifying the substrate sediment flux. The portion of littoral-type material that is released could vary from 0 to 1.0, which translates to an order of magnitude variation in the flux as indicated in Equation 4. Beach retreat has been an important factor and as a consequence, the substrate sediment flux is the most substantial natural component of the sediment budget in the earlier periods. We have little knowledge of the portion of sediment in the backbeach substrate, but anecdotal evidence is that it is mostly volcanic, such as the red clay that outcrops in many places behind the beach, but that the portion of sand increases to the west of Cell 11. We have no knowledge of the portion of littoral-type material in the basal substrate although it may be hard coral rock or basalt boulders in a volcanic fines matrix as at Red Hill Point. As a consequence for sediment budget purposes we consider the composite portion of littoral-type material in the basal and backbeach line substrate to be 0.5 in Cells 1 and 2, 0.2 in Cells 3 through 11, and 0.1 further to the east. Materials above beach elevation were in most cases deposited by wind or possibly overwash. Its portion of sand is near 1.0.

4.4 Net Longshore Sand Transport Fluxes.

The second important unknown in our sediment budget analysis is the quantity of sediment that is transported to KWRF beach from the east. The first advantage we have is that KWRF beach seems to be at the downcoast end of the littoral system. A second advantage is that shoreline positions are available from near the time construction apparently began on the breakwater at Kahului Harbor (in 1910?) through the present. Figure 6 shows the addition to the beach plan area in the form of a fillet that evolved between 1912 and 1960. Today the breakwater continues to retain a part or all of KWRF beach. It also reflects waves and is apparently responsible for the bulge in the shoreline just east of the groin at the west end of KWRF beach. The plan area changes, as obtained from the UH shoreline map at Kuhului Harbor are shown in Table 3 and our interpretation is as follows:

1. The 1899-1912 value is surprising if the breakwater was completed in 1910. An examination of the data suggests an accumulation rate of 10 to 45 thousand cubic meters per year just after construction. The lower value is predicated on the deposit not extending out to the present shorebase depth and the berm elevation being lower than it is today due to the rapid buildup. This rate would have been near the total amount of sand that reached KWRF beach in that time period, but the large magnitude is still is hard to reconcile with other results.

2. In the 1912-1929 interval the accumulation rate averaged between 3000 and 5000 cm/y. The net transport rate at Kaa Point may have been larger with some of it carried through the KWRF system thence offshore near the breakwater (or east of there). This value correlates well with Cox (1954) who concluded about 240,000 cy of sand accumulated at the east breakwater between 1910 and 1950 or an average 4600 cm/y.

3. The fillet accumulation rate between 1929 and 1960 was much lower, averaging only a few hundred cm/y. The hooked bay that evolved in KWRF and Kite beaches between 1912 and 1987 was only beginning between 1912 and 1929 due to a huge amount of sand that was passing Kaa Point as other hooked bays formed further east in the lee of other newly-constructed groins.

4. After 1960, the huge loss of sand from KWRF beach occurred as a hook-shaped bay formed west of Kaa Point (and including KWRF beach). The result of this loss of coastal area was sand either carried directly offshore (unlikely) or moved further west to the breakwater where it was then carried offshore. Depending on the portion of littoral-type material that was liberated, the net longshore sand transport rate to the west averaged between near zero and perhaps as much as 10,000 cm/y.

Table 3. Beach changes upcoast of Kahului Harbor breakwater, 1899-1987.

Time interval	Change in beach plan area, square meters	Estimated change in coastal sand volume, cubic meters	Remarks
1899-1912	+13,000	Gain: 20,000 to 90,000	Fillet formation at breakwater with modest beginning of hook-shaped bay formation west of Kaa Point
1912-1929	+12,000	Gain: 55,000 to 85,000	Fillet formation with continuing modest beginning of hook-shaped bay formation west of Kaa Point
1929-1960	1000	4500 to 6000	Very small addition to fillet
1960-1975	-27,800	Loss: <125,000 to 170,000	Change throughout KWRF beach due to rapid formation of a hook-shaped bay west of Kaa Point
1975-1987	-2700	Loss: <12,000	Change throughout KWRF beach due to

		to17,000	completion of formation of a hook-shaped bay west of Kaa Point

Groins constructed before 1960 have affected all beaches in Cells 1 through 7 (Table 1). The coast on their east or upcoast sides generally performed with less loss of property than elsewhere and in some cases they were outstandingly effective in this regard. However, beaches to the west or downcoast, generally lost more land than elsewhere and in three cases they lost dramatically more due to the formation, by erosion, of hook-shaped bays. As previously noted, our interest in the effects of these structures comes in the quantity of sand that was released to downcoast (west) beaches. KWRF and Kite beaches were both affected by the five groins constructed at Kaa Point (actually the one at the west end) in the period 1912-1987. After the revetment was constructed to protect the KWRF pond, only Kite beach was directly affected by the evolution of this bay. However, it appears that by 1987 it had formed to near its dynamic equilibrium shape. The loss centroid in Cells 2, 3, 5 and 6 tended to move from east to west with time, indicative of the east to west net longshore sand transport regime.

Table 4. Groin location and effects, north Maui.

Groin location between cells:	Downcoast effect	Time period of maximum change	Year of maximum landward excursion of hooked shoreline	Remarks
2 and 3	Large hook-shaped bay ***First very nice smooth hook in Cell 2***	1960-1975	1987 & 1997	Hook formed in Cells 1 and 2 between 1912 and 1975 with cell 2 being the only reach that was directly affected after 1987 (?) when construction of the KWRF revetment separated cells 1 and 2
3 and 4	Large hook-shaped bay ***Second very nice smooth hook in Cell 3*** between eastern groin and most eastern groin in the Kaa Point group of five	1912-1960	1987 & 1997	Hook formed east of the most easternmost of the 5 groins constructed east of Kaa Point
4 and 5	Very small hook-shaped bay formed	?	1960	The shoreline is approximately straight in Cell 4 and 2 groins within it are now only functioning minimally; cell was accretional between 1960 and 2002
5 and 6	Large hook-shaped bay ***Third very nice smooth hook in Cell 5***	1912-1960	1960	Well defined hooked shoreline
6 and 7	Medium-sized (compared to others) hook-shaped bay formed	1912-1960	1987 & 1997	Five or more small groins in the Cell 7 reach maintain a nearly straight shoreline

These downcoast effects are in contrast to the effects of a reduction in the net longshore sand transport rate downcoast of a beach sand mining site. Sand mining effectively lengthens the downcoast sediment blocking structure and the amount that passes it declines as mining progresses. The formation of a hook-shaped bay produces sand that is carried downcoast as the bay evolves. This quantity is greater than the pre-hook-formation amount, but as the bay evolves the amount produced and carried downcoast declines until the littoral zone returns to a state of dynamic equilibrium. At that time net longshore sand transport through the bay, all other factors being equal, returns to its pre-hook rate.

An important question is therefore: Why did the net longshore sand transport rate apparently decline with time at Kaa Point? The answer lies in the impact of the substrate on the net longshore sand flux on a coast broken by headlands and other obstructions. Overall this rate is controlled by the: (1) transporting capacity of incident waves, (2) tidal history of the region and its consequent effect on the foreshore and surf zone transport conduit, (3) beach and shoreface profile, (4) characteristics of the sediments, (5) sediment supply, and importantly in the case of north Maui, (6) three-dimensional shape of the LSL-substrate surface. With respect to the last factor, mean beach width seems to be a reasonable proxy for how efficiently sediment is moved along a coast when there are impediments to its movement. Substrate impediments to alongshore transport reduce the amount moved for three reasons.

First, if the substrate surface is exposed so that wave energy is expended on it rather than on moving sand along the coast, the energy used in moving sediment will be inversely proportional to the (1) area of substrate that outcrops through the beach and shoreface LSL, (2) portion of time the outcrop is exposed, and (3) roughness of the surface and its effect on friction and turbulence losses. It will also be affected by the cross-shore location of the exposure with respect to the cross-shore gradient in the longshore component of wave energy flux. Added beach width increases the coverage of substrate outcrops. This factor – wide beaches that extended further out along the rocky points - is why there was a greater net transport in the early part of the last century than today after the impact of sand mining at and near Baldwin Beach worked its way to KWRF beach.

Second, a longshore transport impediment exists if beach contours and shoreface isobaths are non-parallel and/or not straight. With a larger sand supply, beaches in bays tend to widen and straighten creating an increase in the downcoast component of wave energy flux and a reduction in the upcoast component. The result is an increase in the net longshore sediment transport rate. This factor also affected the north Maui coast and is responsible for a lower net longshore sand transport rate today than existed in 1912.

Third, all manner of irregular structures, including rocky headlands, reefs, and groins, function to force sediment around, through and over them, thereby slowing its downcoast progress. When these structures are partially or wholly exposed or their effective lengths increased as a beach narrows or retreats, the amount of sediment that passes them is reduced, another factor at north Maui. A question then is: If the net longshore sand transport rate declined between 1912 and today why was there a greater amount of material available for movement in earlier times? The most obvious answer is that the reef was more productive then than it is today.

Of interest then is the relationship between the net longshore sand transport rate and the mean width of the beach on north Maui. To a minor extent it can be extracted from the previously discussed Sugar Cove data. About 1000 cm/y was the net amount of sand added and lost from Sugar Cove while the beach was maintained at a near-constant beach width of 20 m after 2000 as shown in Figures 12-14. The total amount that moved out of the cove was equal to this 1000 cm/y plus the amount that entered from offshore (or minus the amount lost offshore) and especially the quantity that entered from upcoast. If we assume the only substantial flux into the Sugar Cove LSL was the amount that entered from the east, both before and after beach replenishment began, then the ratio of the added net longshore sand transport as a function of beach width is 1000 cm/y for a 20 m advance in mean width or 40 to 60 cm/y of additional net longshore sand transport per meter of added mean beach width (at least in the 0 to 20-m range).

Table 5 is a summary list of net longshore sand transport rate estimates by location and time period. This is a guide; we treat the net longshore sand transport rate as an unknown in our historic sediment budget calculations.

Table 5. Summary of net longshore sand transport estimates in and near KWRF beach.

Time period	Location of estimate	Net longshore sand transport rate, cubic meters per year	Evidence	Remarks
1910-1912	**West end of KWRF beach**	**10,000 – 45,000**	**UH shoreline position maps**	**Short time interval; and all that reached the bkwtr was trapped**
1912-1929	**West end of KWRF beach**	**3000 - 5000**	**UH shoreline position maps**	**Average for a time that formation of upcoast hooked bays increased the net rate; value is minimum**
1910-1950	**West end of KWRF beach**	**4600**	**Cox (1953)**	**Average for a time that formation of upcoast hooked bays increased the net rate; value is minimum**
1929-1960	**West end of KWRF beach**	**Few hundred**	**UH shoreline position maps**	**Fillet formation complete by 1929; most sand reaching the west end of KWRF beach is carried offshore**
1960 – 1975	**West end of KWRF beach**	**0 – 10,000 plus**	**UH shoreline position maps**	**Rate of evolution of hooked bay west of Kaa Point is at a maximum**
1975-1987	**West end of KWRF beach**	**0 – 1500 plus**	**UH shoreline position maps**	**Source is hooked bay forming west of Kaa Point**
1997-2002	**Sugar Cove**	**1000 plus**	**Sugar Cove Assn survey data**	**Increase in net longshore sand transport rate as mean beach width increased from near zero to 20 meters**

4.5 Aeolian Sediment Flux.

Moberly (1963) hypothesizes aeolian transport at 2000 cyy per mile of coast, locally (about 1 cm/my). He reports the beach from Kahului Harbor to Hookpia Park was low and mostly backed by sand dunes on the low gradient slopes of Hiealakala around 1960. Lineations in vegetated dunes on the UH (aerial) shoreline maps show the predominant wind direction is from the NNE (30 to 35 degrees, true north). Today aeolian transport from the beach to the hinterland behind it seems to be most prevalent on NE-facing portions of the coastal cells and near their western ends. A detailed determination of the aeolian transport flux or even all of its locations has not been made. One location, however, where there is a clue to the transport rate is at Baby Beach just east of Red Hill Point (Cell 14). Perhaps 1000 cm/y has moved inland there in the past 75 years along a 100-m long portion of coast (10 cm/my). This, to our brief observation, is a maximum for north Maui. Accordingly, from field observation and what we can glean from 2002 and 2007 aerial photos, for sediment budget purposes we use this as basis and Moberly's approximation to apportion aeolian losses as shown in Figure 15.

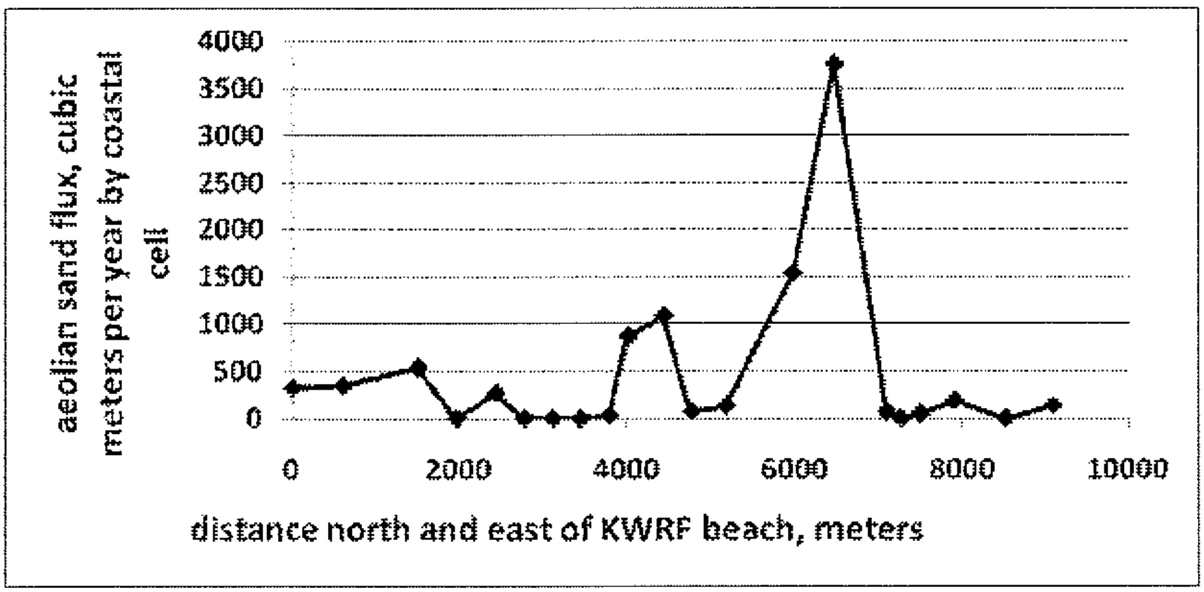

Figure 15. Estimated aeolian sediment transport flux for north Maui.

4.6 Beachrock (Formation) Flux.

Beachrock is present in many cells, often as offshore benches. Moberly (1963) reckons its formation is an important sink for beach sand in the study area. He hypothesizes it is created at a rate of 100 cyy per mile of beach (about 0.5 cm/my of beach). For our purposes, however, we conclude that when it forms it is buried in the beach, not exposed. Further, if it is forming today, it is occupying a portion of the LSL volume and as a consequence, it does not seem realistic to subtract it from the budget so we assume the beachrock-formation flux is zero.

4.7 Sand Mining and Beach Restoration.

Sand mining for lime production by the sugar company and later mining by others for cement manufacture and aggregate has had a profound effect on the east end of the north Maui reach. Mining apparently began around 1900 and ended sometime after 1960 and before 1975. Shoreline retreat data indicate it was concentrated in Cells 15 through 18 along 1500-m of sandy beaches. The region offshore the revetment constructed to protect the sugar company lime kilns in Cell 17 was also mined as Figures 6 and 7 illustrate. Clearly most of the loss was at and to the west of the lime kilns and the most affected location was 940-m long Baldwin Beach. In the 1912-1960 period the average loss of coastal land area in Cells 15-18 was -1200 sm/y and in the 1960-1975 period it was only slightly less at -970 sm/y. These translate to volume losses of -5400 to -7200 cm/y in the earlier period, and -4300 to -5800 cm/y in the latter period, or total of a bit over 500,000 cm. These values outlined in Table 6 are of lost coastal material. They exceed the volume mined and consequently provide a check on an estimate of the quantity mined.

Table 6. Beach behavior in the vicinity of the lime kilns during and immediately after the sand mining period.

Cell number	Cell Length, meters	1912-1960 average shoreline retreat, meters (sq.m)	1960-1975 average shoreline retreat, meters (sq.m)	1975-1987 average shoreline retreat, meters
15	939	-47.4 (44500)	-6.1 (5700)	-3.2
16	135	-23.4 (3200)	-38.3 (5200)	+4.0
17	180 (lime kilns)	-24.9 (4500)	-10.3 (1900)	+16.2
18	241	-23.1 (5600)	-7.6 (1800)	+6.1

Cox (1954) estimated about 3500 cyy was removed for lime production in the 40 years prior to about 1953 and in the later part of that interval about 170 cy per week was removed for other purposes, mostly from Baldwin Beach. An extrapolation of these quantities to about 1900 when mining presumably began, and to about 1970 when mining apparently ended, yields a total of 200 to 400 thousand cm of sand removed from beaches in Cells 15-18. We see no evidence that sand - in quantity - was mined in other areas. Thus the ratio of sand volume mined to coastal volume lost is 0.4 to 0.8. This is the value of $\rho_b + \rho_s$ for those cells in Equation 4.

The lime kilns are no longer there. But the revetment constructed to protect them still exists and it is responsible for the 1997-2002 loss of shoreline position in Cell 16 (as shown in Figure 10) just to the east of the revetment. The revetment is responsible for the beginning formation of a hook-shaped bay. In this 135-m long cell in that 5-yr period the shoreline retreated about 27 m on average and the hooked shoreline will likely evolve and affect the east end of Baldwin Beach in the near future.

With the exception of this evolving hook-shaped bay the previously mined beaches in Cells 15-18 have been slowly recovering. Figure 16 compares these "sand mined" beaches with those east and west of them except those in Cells 1-7 that have been substantially affected by the construction of groins. Although there are times when beaches in and adjacent to the sand mining reach are eroded during the NE trades season, as occurred on Baldwin Beach (Cell 15) in 2005, this portion of coast performed in a superior manner in comparison to its downcoast neighbors that lost plan area in the 1975-2002 period. Net changes are: (1) an average loss of 115 sm/y outside the sand mining zone (Cells 9-14 and 19-21), and (2) a net gain of 215 sm/y within it (Cells 15-18). Without the hooked bay forming in Cell 16, the gain would be +334 sm/y in the former sand mining reach for the 1975-2002 period. This result is not unexpected. As previously noted, natural boundaries separating cells function to contain sand proportional to the distance between the shoreline and the projecting headland (or groin). When the shoreline retreats with respect to that fixed boundary, there is a reduction in the amount of sand carried past it, so over time and with distance downcoast beaches are adversely affected. Therefore, with the mined beaches now apparently recovering, that recovery is to some extent at the expense of downcoast beaches.

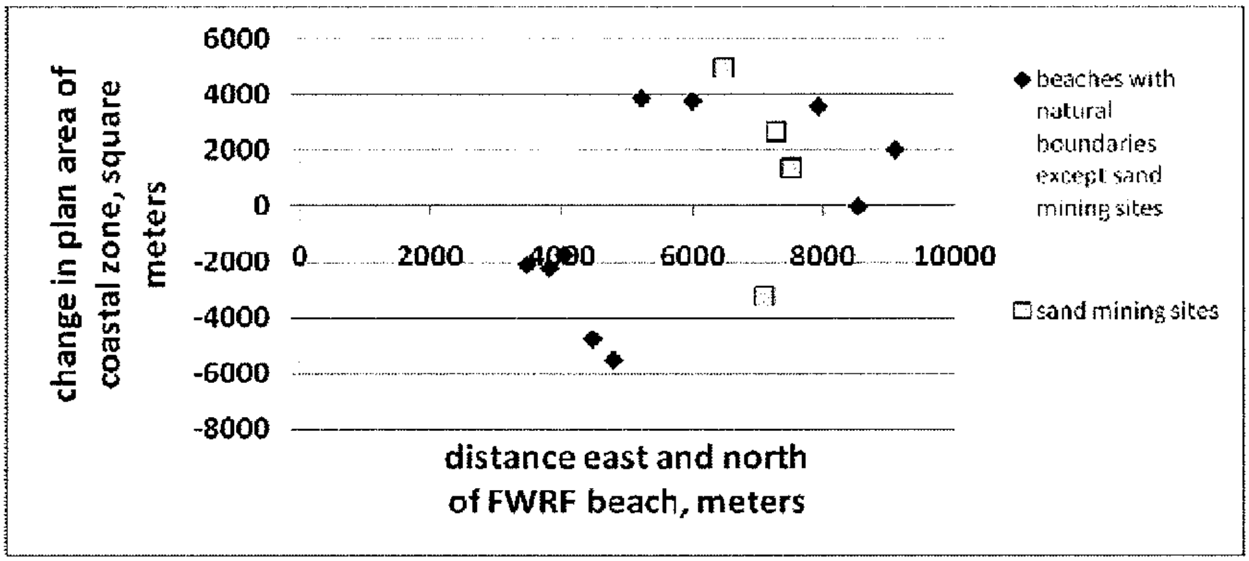

Figure 16. Changes in coastal plan areas between 1975 and 2002 except in Cells 1 through 7 (cells with groins that have affected the coast since before 1960).

Sugar Cove placed about 12,500 cm/y of sandy beachfill in the littoral zone there in the 1996-2002 period. This is the only beach building that has ever been done in the study area to our knowledge. Its effect cannot be detected away from Sugar Cove on the UH shoreline position maps. The 1997-2002 beach plan area for that cell (No.13), however, indicates a gain of 2250 sm or about 750 cm/y between 1997 and 2000 at which time the beach reached state of dynamic equilibrium with the nourishment flux. The 2250 sm translates to an advance of the shoreline of about 15 m or close to the advance shown in Figure 14.

Sand mining losses and beach restoration gains as treated in the sediment budget are summarized in Table 7.

Table 7. Summary: sand mining and beachfill fluxes.

Cell number	Cell Length, meters	1912-1960 average sand volume removed by mining, in cubic meters	1960-1975 average sand volume removed by mining , in cubic meters
15	939	315000	39900
16	135	22400	36400
17	180 (lime kilns)	31500	13300
18	241	39200	12600
13	260	Sugar Cove added beachfill: 1988-1997 = 5000 cm, 1997-2002 = 8000 cm	

4.8 Offshore Sediment Source.

Beach sediments from Kahului Harbor to Blue Tile House beach are calcareous. Biological production is responsible for all the new sediment entering this reach according to Moberly (1963). The chief constituent is foraminifers. These small marine organisms are transported in from the reef edge. Living mollusks and echinoids are found there too, but they as well as living coral are rare or absent on the reef flat. Algae are the only common inhabitants there. Also according to Moberly (1963), from high to low in scale of supply, the sources of beach sediment are: foraminifer skeletons, mollusks, red algae, echinoids, corals, and green algae He hypothesizes the average sand contribution per kilometer of reef to be 1 to nearly 2.5 thousand cm/y in Hawaii with biologic activity contributing 0.5 to 2 thousand cm/y per km of well developed reef (the rest is presumably broken coral debris). Moberly also states the mean grain size of Maui beach sand is 0.18 mm, of which 30-40% is oblate, 40% is bladed, and 10% or less is equant. Most of the Maui sand is semi-rounded.

We assume a reef flux of 1750 cm/y per km for the period 1912-1975 and 1000 cm/y per km for years thereafter. This reflects the possibility the reef has suffered a loss of productivity as ocean waters have become warmer and as human influences may have affected it.

4.9 Seaward-Directed Flux Past the Shorebase.

The shorebase between Kalului Harbor and Blue Tile House beach is not as deep as it would be if it were not supported on the reef flat. This situation favors onshore rather than offshore transport under “normal” wave conditions. Offshore directed transport probably only occurs during severe events. Examples might be tsunamis and severe winter swell from the NW. Trades may be responsible for offshore directed sand movement at deflection points, but with the exception of the clear break in the reef with a sand filling between Cells 4 and 5, the location of these sites is not known to us (note: we have not had an opportunity to examine aerial photos that show the reef edge off KWRF beach taken when the water was clear). Moberly and Cox (1964) conclude in some places there is up to four times as much sand in reef channels (some more than 15-ft thick) as on the beach. They consider them to be temporary reservoirs for sand storage. At Kahului they state 59,000 cy is held, at Papaula 79,000 cy is held, and at Paia 97,000 cy is held in these channels. We did not attempt to verify these values.

For our sediment budget analysis we began with the assumption that the seaward-directed sand flux across the shorebase is negligible except at KWRF beach (the west end).

4.10 In-Situ Gains and Losses.

Grain abrasion may be an important factor in the loss of sand on the study beaches. This is to be expected since (1) the source is the reef edge and it is composed of skeletal carbonate clasts that are less dense than quartz or solid carbonate, (2) it is elongate, and (3 especially) it is not as durable as other beach components. Tests in wet tumblers indicate this sort of reef type sediment loses mass 100 to 1000 or even 2000 times as fast as quartz of the same size and roundness. Moberly (1963) notes abrasion declines with size and echinoids abrade the fastest. We assume abrasion destroys 300 cm/y per km of LSL sand.

4.11 Overwash Flux.

Tsunamis that affect the north shore of Maui are probably the only events that create conditions where overwash carries sand inland past the backbeach line. The extent of that transport is unknown, but it is possible to make a guess based on the water surface super-elevation and number of waves that moved inland during some past tsunamis. The most extreme tsunami during the 1912-2002 period occurred on 1 April 1946. It originated with an earth displacement in the east Aleutian Islands and caused a surge reported to be 8.5 m above MSL on north Maui. Several waves came ashore, houses near the beach were lost in some places, including Spreckelsville beach, and flooding was reported almost a kilometer inland. Severe tsunamis also affected the north shore and pushed beachfront homes off their foundations in 1952, 1957 and as a result of the Alaskan Earthquake of 1964. The surge in these events was apparently 5 or 6 m above MSL with the 1964 event being the least severe.

We assume each of the 21 cells (that are not backed by a high seacliff) was thus affected by all four tsunamis. Due to the different severity of the events, we assign them a different flux. We assume the 1946 event pushed 3cm of sand past the backbeach line per meter of sandy shoreline, the 1952 and 1957 events pushed 1cm/m ashore, and the 1964 event carried 0.5 cm/m landward off the beach. Thus, for the 1912-1960 period a total of 5cm/m (or 0.1 cm/my) were lost to the littoral system and 0.5 cm/m (or 0.03 cm/my) were lost inland between 1960 and 1975.

5.0 SEDIMENT BUDGETS AND NET LONGSHORE SAND TRANSPORT ALONG KWRF BEACH

Our sediment budget effort has a singular purpose. It is to estimate the present net longshore sand transport rate at the west end of KWRF beach and the range of uncertainty in that estimate. We employ two sets of historic budgets in our attempt to accomplish that. The first part of the first set is for the period 1912-1975. This is when the most change occurred in the position of the shoreline on north Maui. Sand mining and the emplacement of groins (structures that impounded sand on their east sides and caused the formation of hook-shaped bays on their west sides) had an enormous impact almost all of the beaches east of Kahului Harbor. The second part of this set is for the period 1975-2002, after sand mining and most groin construction ended. The first part is for a 63-year period and the second for a 27-year period. The second set of sediment budgets is for the periods 1912-1960 and 1960-2002, respectively 48 and 42 year long intervals. This budget was selected to include near equal decades-long averaging intervals. Both sets of budgets are for the reach between Kahului Harbor and Blue Tile House beach. Separate budgets for each of the five time periods (six shorelines) in the UH data set were of little use because year-to-year fluctuations in shoreline movement were much greater than the longer-term net change.

The sediment budget used for the north shore of Maui to estimate the net longshore sand transport rate at KWRF beach is

$$Q_{in}(\Delta T) = q_s(\Delta T) + q_a(\Delta T) + q_o(\Delta T) + q_{SM}(\Delta T) + q_{SP}(\Delta T) + q_{re}(\Delta T) + q_{ia}(\Delta T) + \Delta V_l(\Delta T) + residual(\Delta T) \quad (5)$$

in which Q_{in} = the longshore sand transport flux to KWRF beach from the east during the averaging period, ΔT, q_s = substrate sediment flux, mostly positive, but in some cases it is slightly negative when the sea level rise effect is greater than the beach retreat effect (this flux is only considered when the beach movement rate is negative), q_a = aeolian sediment flux, a negative quantity, q_o = overwash sediment flux during severe tsunamis, a negative quantity, q_{SM} = sand mining flux, a negative quantity, q_{SP} = beachfill placement flux, a positive quantity, q_{re} = reef edge source flux, a positive quantity, q_{ia} = insitu abrasion flux, a negative quantity, ΔV_l = flux to or from the littoral sediment lens as it expands or contracts, may be either positive or negative, and $residual$ = amount of sediment unaccounted for in the sediment budget, may be either positive or negative. The two sets of sediment budgets were run simultaneously (excel) using common parameters in the sediment fluxes.

Figure 17 shows the seasonally adjusted shoreline change rates for the unequal averaging periods when displayed as a function of location. These are the values used in our first set of sediment budgets. The average shoreline change rate for the 1912-1975 period is -0.41 meters per year; for the 1975-2002 period it is -0.02 m/y. The earlier value is a reflection of the era of sand mining (Cells 15-18) and the main period of groin construction (mostly Cells 1-7). The later value reflects more "natural" conditions. The large shoreline advance in Cell 4 is apparently due to the expansion of a fillet after a groin was extended between Cells 3 and 4 in the period 1975-1997. The large shoreline retreat in Cell 16 is due to the rapid degradation of the previously-mentioned sandy salient in the lee of a beachrock bench between Cells 15 and 16.

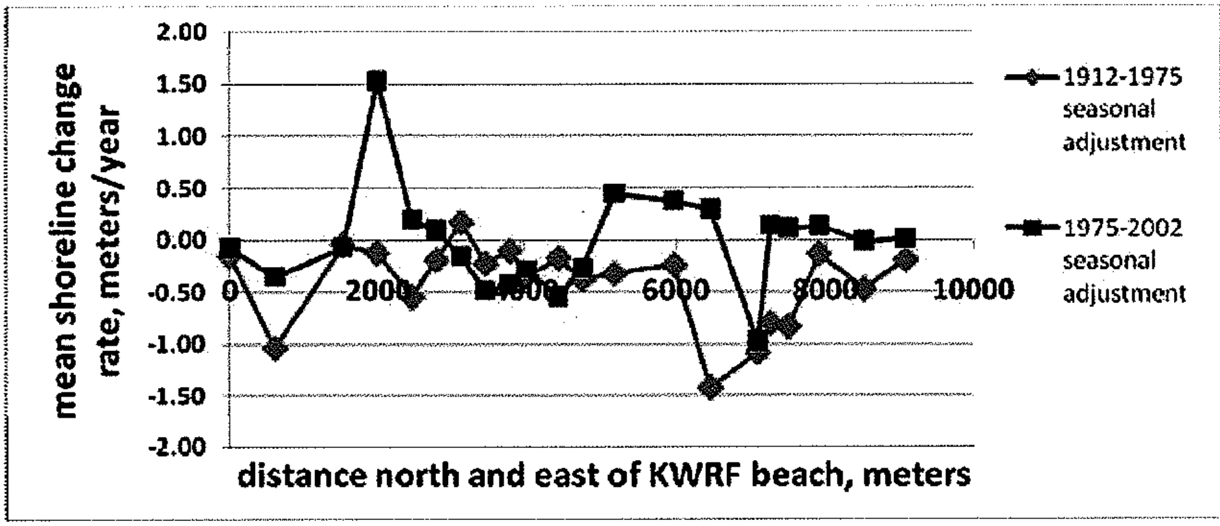

Figure 17. Shoreline changes on north Maui for 1912-1975 and 1975-2002, adjusted for seasonal reversible fluctuations; cell numbers begin at the origin and go to 21 about 9000 meters from KWRF beach.

The second set of budgets is for the near-equal averaging periods, 1912-1960 and 1960-2002. Shoreline changes are similar in pattern, but not magnitude in the two sets of data as shown in a comparison of Figures 17 and 18.

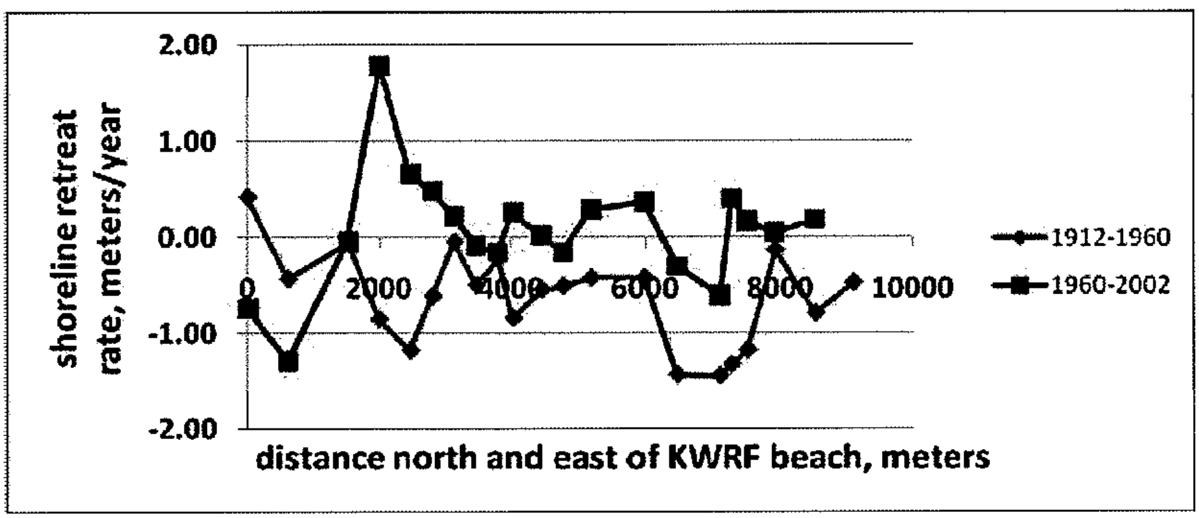

Figure 18. Shoreline changes on north Maui by time interval, 1912-1960 and 1960-2002, adjusted for seasonal reversible fluctuations; cell numbers begin at the origin and go to 21 at about 9000 meters from KWRF beach.

5.1 Sediment Budget Results

We present the results of the two sets of sediment budgets in Table 8 and employ Table 9 to assist in explaining them. Table 8 shows the budget-derived estimate of the net longshore sand transport is somewhat larger in the earliest time interval in both sets. In 1912 the shoreline was well seaward of its later positions and in an alongshore sense it was smoother and less indented at the upcoast headlands. Our analysis of the recent Sugar Cove data suggests the net longshore sand transport rate increased there by about 50cm/y for each meter of added mean beach width (or mean shoreline advance). Early more seaward beaches surely resulted in a larger net longshore sand discharge to KWRF beach. This finding is not surprising since, as shown in Table 9, the period to 1960 was one of the most overall shoreline retreat. From 1960 trough 1975 Kite beach contributed the most sand to KWRF beach as the former evolved as a hook-shaped bay. It wasn't until 1988 that that hooked bay equilibrated in planform and the revetment separating Kite and KWRF beaches became an effective boundary between them. Most likely the average 4000 plus cm/y contributions from upcoast after 1975 (set 1) and 1960 (set 2) declined, especially after 1975.

Table 8. Estimated net longshore sand transport rates at KWRF beach; based on sediment budget residuals.

sediment budget set	**ONE**		**TWO**	
time interval	**1912-1975**	**1975-2002**	**1912-1960**	**1960-2002**
rate, in cm/y	5400	4100	6500	4600

Table 9. Mean shoreline position change rates, west end of north Maui littoral system.

Time interval	**1912-1960**	**1960-1975**	**1975-1987**	**1988-1997**	**1997-2002**
Kite beach	**-19**	**-51**	**-17**	**-6**	**9**
KWRF beach	**21**	**-35**	**-10**	**-1**	**3**
Average of remaining upcoast cells	**-30**	**-3**	**-7**	**-6**	**5**

5.2 Uncertainty

Sediment budgets rarely get more complicated. The north Maui littoral system is complex in comparison to most others because of the irregular planform of the shore, the many natural and artificial beach retention structures (headlands, shore-parallel beachrock reefs, and groins), and the effect of the irregular bathymetry of the reef edge and reef flat on incident waves. Sediment fluxes are poorly known and some are uncommon. Reef-edge source and abrasion of complex carbonate grains are examples. Estimates of these and some of the other fluxes are at best order of magnitude guesses.

Other aspects of this littoral system remain unanswered as well. For example: Why did the three small beaches to the east of Blue Tile House beach lose more coastal land or beach between 1912 and 1975 than in more recent times, even when they were probably not subject to sand mining and are upcoast of the sand mining region? It was either a period of great loss everywhere, the no-sand-mining assumption is wrong, or the USC&GS shoreline is incorrectly located. Cell 19 had little change in this period, but Cell 20 had a lot: Why? Cells 22-24 show quite a bit of change 1912-1975, but little after that. Could sand have been mined there and in Cell 20, but not Cell 19? Alternatively, Cells 22-24 are seacliff backed and they might have suffered more than elsewhere during the 1946 tsunami by offshore losses, since there was no release of the long-period wave by overwash.

Thus, due to the lack of good input to define some of the fluxes, and questions such as these, the sediment budget results are somewhat questionable. It would be possible to tighten up the most important ones and possibly answer those questions. One task would involve a detailed beach-retention-structures and hook-shaped bay analysis. Another would require a field investigation. The alternative is to go with the results of this investigation with periodic and scheduled nourishment to maintain the mean width of the KWRF beach in front of a newly-constructed seawall. An important caveat is that an alteration in the project might be required in future. With a good monitoring program and further investigation this might be the more cost effective approach without a major technical downside.

5.3 Net Longshore Sand Transport Estimate for KWRF Beach

The net longshore sand transport rate at KWRF beach is of interest mainly (1) in whether it would be cost effective or technically feasible to capture all of part of it (as a sand source) before it is lost offshore, and (2) how KWRF beach might be stabilized with a beach retention structure whose function is partly controlled by Q_{in} . Magnitudes and trends shown in Tables 3, 5 and 8, indicate the net longshore sand transport rate at KWRF beach was high in the early 1900's due to the more seaward position of the shoreline. It remained high after groins were constructed along the western portion of the study reach as hook-shaped bays evolved with substantial erosion downcoast of the structures. It stayed high through 1987 as the last hooked bay evolved downcoast of Kaa Point. After 1987 beach retreat rates declined everywhere and they remain low or some shorelines even exhibit an advance to the present. **This indicates the net rate at present, and the rate likely to continue into the future, will be between 1000 and 3000 cm/y, perhaps averaging 2000 cm/y.** The assumption is that human interventions will be no more invasive (in a good way) than the 1000 cm/y that is artificially placed on Sugar Cove beach or in any adverse ways. That said, any other upcoast artificial beachfills are not likely to increase the amount reaching KWRF beach by much since they will not advance the beaches at Kanaha Beach Park by much. **A net addition of 0.002 m/y to the present sea level rise rate in the next 50-years could reduce the net longshore sand transport rate by 500 to 1000 cm/y at KWRF beach.**

Uncertainty in each of the sediment-budget-related estimates of the net longshore sand transport rate at KWRF beach is substantial (Table 8). However, given the redundancy in the two budget-related estimates and the correlation with other estimates, and a fairly good idea of what caused changes; confidence is improved in the range of the estimate. The estimate, however, should be considered a work in progress. **Our subjective take on the accuracy of the future net longshore sand transport rate estimate, on a scale of one (low) to10 (high), is 5.**

6.0 ESTIMATE OF FUTURE PERFORMANCE OF KWRF BEACH

Figure 19 shows the most recent shoreline behavior at KWRF beach with data adjusted for seasonal effects. The slight recession depicted, -0.044 m/y, shows poor correlation, and indeed if the seasonal adjustment is eliminated (see Figure 2, which illustrates the unadjusted coastal plan area as a function of time) there would be a slight net advance between 1987 and 2007. The shoreline at Kite beach also receeded between 2002 and 2007 (Fig. 3), but beaches at Kanaha Beach Park advanced and in total the western portion of the study area advanced in this latest period.

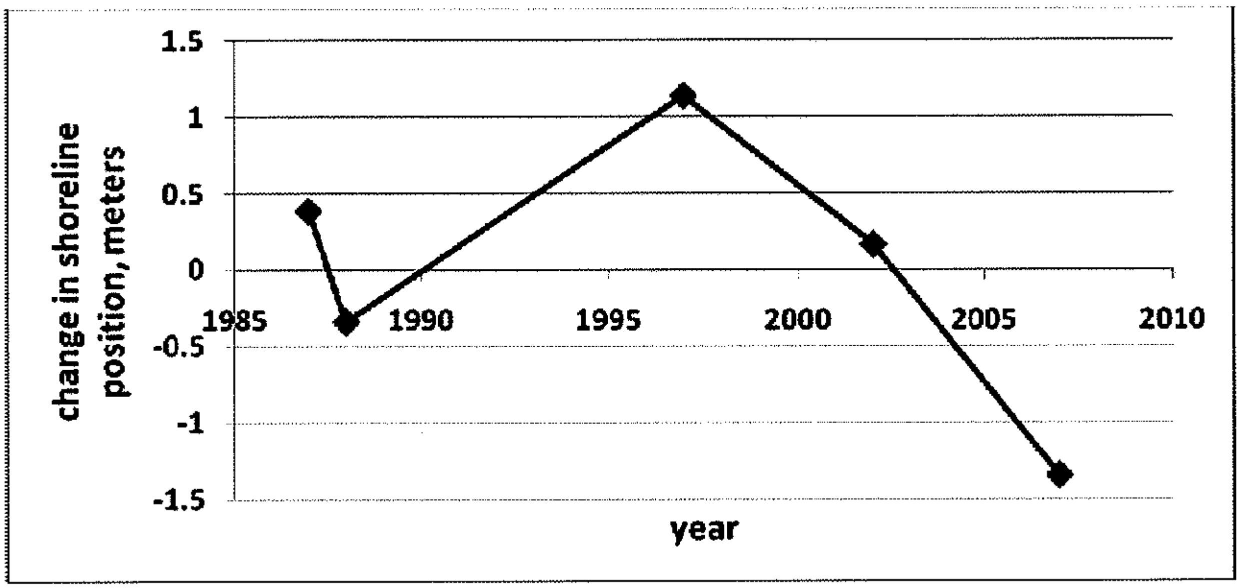

Figure 19. Recent (1987-2002) shoreline behavior, KWRF beach.

6.1 Net Future Beach Volume Change Estimate

Of most interest is the beachfill requirement to artificially nourish FWRF beach in the future if a seawall is constructed at its landward edge. The two most definitive aspects of beach behavior are changes in its size, i.e., mean beach width, $\Delta\bar{w}$ and changes in its position, i.e., of the backbeach line, $\Delta\bar{S}_b$. Figure 19 is an historical glimpse of the behavior of its shoreline, i.e., changes in its position, $\Delta\bar{S}$. The seawall, if successful, will arrest any movement of its backbeach line and hold it in a fixed position so

$$\Delta\bar{S}(\Delta T) = \Delta\bar{w}(\Delta T), \qquad (6)$$

since any change in the position of the shoreline will be reflected as a change in beach width and LSL volume. At KWRF beach, the shoreline change to volume change ratio is between 3000 and

6000 cubic meters of sand per 1 meter of shoreline retreat or advance. A realistic value is probably 4000 cm/m. Thus, given the results in Figure 19 and the near stability of the position of the shorelines in the western part of the study area in the past 40 or so years (Figs. 17 and 18), we conclude the shoreline change rate at KWRF beach without a change in the position of the beach (no retreat) will probably be somewhere in the range -0.15 m/y to +0.05 m/y. Without a change in the recent past sea level rise rate, this translates to a beachfill requirement to maintain it at its present mean position of 400 to 900 cm/y. If the sea level rise rate accelerates by 0.002 m/y, the requirement will increase by 80 to 200 cm/y, averaged over the next 50 years, with an increasing need over time. ***Conservatively, in the next 50 years, the average annual beachfill need will likely be between 500 and 1000 cm.***

6.2 Uncertainty

Sediment input to KWRF beach will likely remain near its present upcoast supply rate of 1000 to 3000 cm/y from Kite beach if the sea level rise rate remains constant. If it increases that amount may decline by 500 to 1000 cm/y. This coupled with the uncertainty in the shoreline change forecast and uncertainty in the shoreline change to volume change ratio, implies the requirement for beachfill to maintain the 2007 mean beach width could be as much as 1000 cm/y. Interestingly, this is the amount of beachfill the Sugar Cove folks have placed, on average, since 2000 to maintain a mean width of 20-m, but for a beach that is only 40% as long. ***On a scale of 1 to 10, our subjective take is an uncertainty of 6 that the beachfill requirement will average between 500 and 1000 cm/y.*** Less than the average will be required at the beginning and more will be required leading up to 2057.

7.0 CONCLUSIONS

Future net longshore sand transport at KWRF beach is of interest mainly (1) in determining whether it would be cost effective to capture all of part of it (as a sand source) before it is lost, presumably offshore, and (2) how KWRF beach might be stabilized with a beach retention structure whose function is partly controlled by the characteristics of the longshore sand transport regime. The net longshore sand transport rate at present, and one that is likely to continue into the future in the absence of upcoast human interventions and changed natural sediment fluxes, will be between 1000 and 3000 cm/y, perhaps averaging 2000 cm/y. A net addition of 0.002 m/y to the present sea level rise rate over the next 50-years could reduce the net longshore sand transport rate by 500 to 1000 cm/y. Our subjective take on the accuracy of these estimates, on a scale of one (low) to 10 (high), is 5.

Of most interest if a seawall is constructed at the landward edge of KWRF beach is the beachfill requirement to maintain the 2007 mean width for the next 50 years. We conclude the shoreline change rate at KWRF beach without a change in its position (due to it being fixed by the seawall), and with conditions as they now exist, will probably be somewhere in the range -0.15 m/y to +0.05 m/y. Without a change in the recent past sea level rise rate, this translates to a beachfill requirement to maintain it at its present mean position of 400 to 900 cm/y. If the sea level rise rate accelerates by 0.002 m/y, the requirement will increase by 80 to 200 cm/y, averaged over the next 50 years. On a scale of 1 to 10, we believe the certainty that the beachfill requirement will average between 500 and 1000 cm/y is 6 on a scale of 1 to 10. Less than this range will be required at the beginning and more required leading up to the end of a 50-year project.

8.0 ACKNOWLEDGEMENTS

Barbara Guild graciously provided beach replenishment data for Sugar Cove. Patti Cadiz led a number of trips to sites along the north Maui coast and explained its history. Rob Sloop and Russ Boudreau accompanied the author on a three-day visit to the study area and Anne-Lise Lindquist provided much needed background information.

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APPENDIX B – COST ESTIMATE DETAILS

ALTERNATIVE 1A: 3,800 FEET BEACH REPLENISHMENT

DREDGED SAND

Item	Quantity	Unit	Unit Cost	Total Cost
Initial Construction (2008 Dollars)				
Dredge Mob/Demob	1	LS	$1,500,000	$1,500,000
Dredged Sand	105,000	CY	$30	$3,150,000
Initial Construction Subtotal (Rounded)				**$4,650,000**
Maintenance (2008 Dollars)				
Dredge Mob/Demob	1	LS	$500,000	$500,000
Dredged Sand	21,000	CY	$40	$840,000
Maintenance Subtotal (Rounded)				**$1,300,000**
Maintenance (Future Dollars and Net Present Value)				
Maintenance Cycle			**Inflated Cost**	**Present Value**
Year 8			$1,711,852	$1,169,743
Year 16			$2,254,182	$1,052,537
Year 24			$2,968,327	$947,075
Year 32			$3,908,720	$852,180
Year 40			$5,147,038	$766,793
Year 48			$6,777,666	$689,962
Maintenance Subtotal (Rounded)				**$5,500,000**
Construction Subtotal				**$10,150,000**
Eng., Const. Support (12%)				$1,218,000
Contingency (15%)				$1,705,200
TOTAL PROJECT COST				**$13,100,000**

PURCHASED SAND

Item	Quantity	Unit	Unit Cost	Total Cost
Initial Construction (2008 Dollars)				
Mob/Demob	1	LS	$200,000	$200,000
Purchased Sand	105,000	CY	$30	$3,150,000
Initial Construction Subtotal (Rounded)				**$3,350,000**
Maintenance (2008 Dollars)				
Mob/Demob	1	LS	$50,000	$50,000
Purchased Sand	21,000	CY	$30	$630,000
Maintenance Subtotal (Rounded)				**$700,000**
Maintenance (Future Dollars and Net Present Value)				
Maintenance Cycle			**Inflated Cost**	**Present Value**
Year 8			$921,766	$629,861
Year 16			$1,213,790	$566,751
Year 24			$1,598,330	$509,963
Year 32			$2,104,695	$458,866
Year 40			$2,771,482	$412,889
Year 48			$3,649,512	$371,518
Maintenance Subtotal (Rounded)				**$2,900,000**
Construction Subtotal				**$6,250,000**
Eng., Const. Support (12%)				$750,000
Contingency (15%)				$1,050,000
TOTAL PROJECT COST				**$8,100,000**

ALTERNATIVE 1B: 2,400 FEET BEACH REPLENISHMENT

DREDGED SAND

Item	Quantity	Unit	Unit Cost	Total Cost
Initial Construction (2008 Dollars)				
Dredge Mob/Demob	1	LS	$1,500,000	$1,500,000
Dredged Sand	65,000	CY	$30	$1,950,000
Initial Construction Subtotal (Rounded)				**$3,450,000**
Maintenance (2008 Dollars)				
Dredge Mob/Demob	1	LS	$500,000	$500,000
Dredged Sand	16,000	CY	$40	$640,000
Maintenance Subtotal (Rounded)				**$1,100,000**
Maintenance (Future Dollars and Net Present Value)				
Maintenance Cycle			**Inflated Cost**	**Present Value**
Year 8			$1,448,490	$989,782
Year 16			$1,907,385	$890,608
Year 24			$2,511,661	$801,371
Year 32			$3,307,378	$721,075
Year 40			$4,355,186	$648,825
Year 48			$5,734,948	$583,814
Maintenance Subtotal (Rounded)				**$4,600,000**
Construction Subtotal				**$8,050,000**
Eng., Const. Support (12%)				$966,000
Contingency (15%)				$1,352,400
TOTAL PROJECT COST				**$10,400,000**

PURCHASED SAND

Item	Quantity	Unit	Unit Cost	Total Cost
Initial Construction (2008 Dollars)				
Mob/Demob	1	LS	$200,000	$200,000
Purchased Sand	65,000	CY	$30	$1,950,000
Initial Construction Subtotal (Rounded)				**$2,150,000**
Maintenance (2008 Dollars)				
Mob/Demob	1	LS	$50,000	$50,000
Purchased Sand	16,000	CY	$30	$480,000
Maintenance Subtotal (Rounded)				**$500,000**
Maintenance (Future Dollars and Net Present Value)				
Maintenance Cycle			**Inflated Cost**	**Present Value**
Year 8			$658,405	$449,901
Year 16			$866,993	$404,822
Year 24			$1,141,664	$364,260
Year 32			$1,503,354	$327,762
Year 40			$1,979,630	$294,921
Year 48			$2,606,794	$265,370
Maintenance Subtotal (Rounded)				**$2,100,000**
Construction Subtotal				**$4,250,000**
Eng., Const. Support (12%)				$510,000
Contingency (15%)				$714,000
TOTAL PROJECT COST				**$5,500,000**

ALTERNATIVE 3A: 1,200 FEET REVETMENT

Item	Quantity	Unit	Unit Cost	Total Cost
Initial Construction (2008 Dollars)				
Mob/Demob	1	LS	$500,000	$500,000
2 ton Armor Stone	13,200	TON	$70	$924,000
Bedding Stone	6,000	TON	$30	$180,000
Geotextile	80,000	SF	$7	$560,000
Excavation & Backfill	16,000	CY	$40	$640,000
Initial Construction Subtotal (Rounded)				**$2,800,000**
Maintenance (2008 Dollars)				
5% of Initial Construction Cost every 10 years				$140,000
Maintenance Cycle			**Inflated Cost**	**Present Value**
Year 10			$197,484	$122,691
Year 20			$278,570	$107,522
Year 30			$392,951	$94,228
Year 40			$554,296	$82,578
Maintenance Subtotal (Rounded)				**$400,000**
Construction Subtotal				**$3,200,000**
Eng., Const. Support (15%)				$480,000
Contingency (15%)				$552,000
TOTAL PROJECT COST				**$4,200,000**

ALTERNATIVE 3B: 1,200 FEET REVETMENT WITH BEACH REPLENISHMENT

DREDGED SAND

Item	Quantity	Unit	Unit Cost	Total Cost
Initial Construction (2008 Dollars)				
Revetment (As 3A)	1	LS	$2,800,000	$2,800,000
Dredge Mob/Demob	1	LS	$500,000	$500,000
Dredged Sand	30,000	CY	$40	$1,200,000
Initial Construction Subtotal (Rounded)				**$4,500,000**
Maintenance (2008 Dollars)				
Dredge Mob/Demob	1	LS	$500,000	$500,000
Dredged Sand	16,000	CY	$40	$640,000
Maintenance Subtotal (Rounded)				**$1,100,000**
Maintenance (Future Dollars and Net Present Value)				
Maintenance Cycle			**Inflated Cost**	**Present Value**
Year 8			$1,448,490	$989,782
Year 16			$1,907,385	$890,608
Year 24			$2,511,661	$801,371
Year 32			$3,307,378	$721,075
Year 40			$4,355,186	$648,825
Year 48			$5,734,948	$583,814
Maintenance Subtotal (Rounded)				**$4,600,000**
Construction Subtotal				**$9,100,000**
Eng., Const. Support (12%)				$1,092,000
Contingency (15%)				$1,528,800
TOTAL PROJECT COST				**$11,700,000**

PURCHASED SAND

Item	Quantity	Unit	Unit Cost	Total Cost
Initial Construction (2008 Dollars)				
Revetment (As 3A)	1	LS	$2,800,000	$2,800,000
Mob/Demob	1	LS	$200,000	$200,000
Purchased Sand	30,000	CY	$30	$900,000
Initial Construction Subtotal (Rounded)				**$3,900,000**
Maintenance (2008 Dollars)				
Mob/Demob	1	LS	$50,000	$50,000
Purchased Sand	16,000	CY	$30	$480,000
Maintenance Subtotal (Rounded)				**$500,000**
Maintenance (Future Dollars and Net Present Value)				
Maintenance Cycle			**Inflated Cost**	**Present Value**
Year 8			$658,405	$449,901
Year 16			$866,993	$404,822
Year 24			$1,141,664	$364,260
Year 32			$1,503,354	$327,762
Year 40			$1,979,630	$294,921
Year 48			$2,606,794	$265,370
Maintenance Subtotal (Rounded)				**$2,100,000**
Construction Subtotal				**$6,000,000**
Eng., Const. Support (12%)				$720,000
Contingency (15%)				$1,008,000
TOTAL PROJECT COST				**$7,700,000**

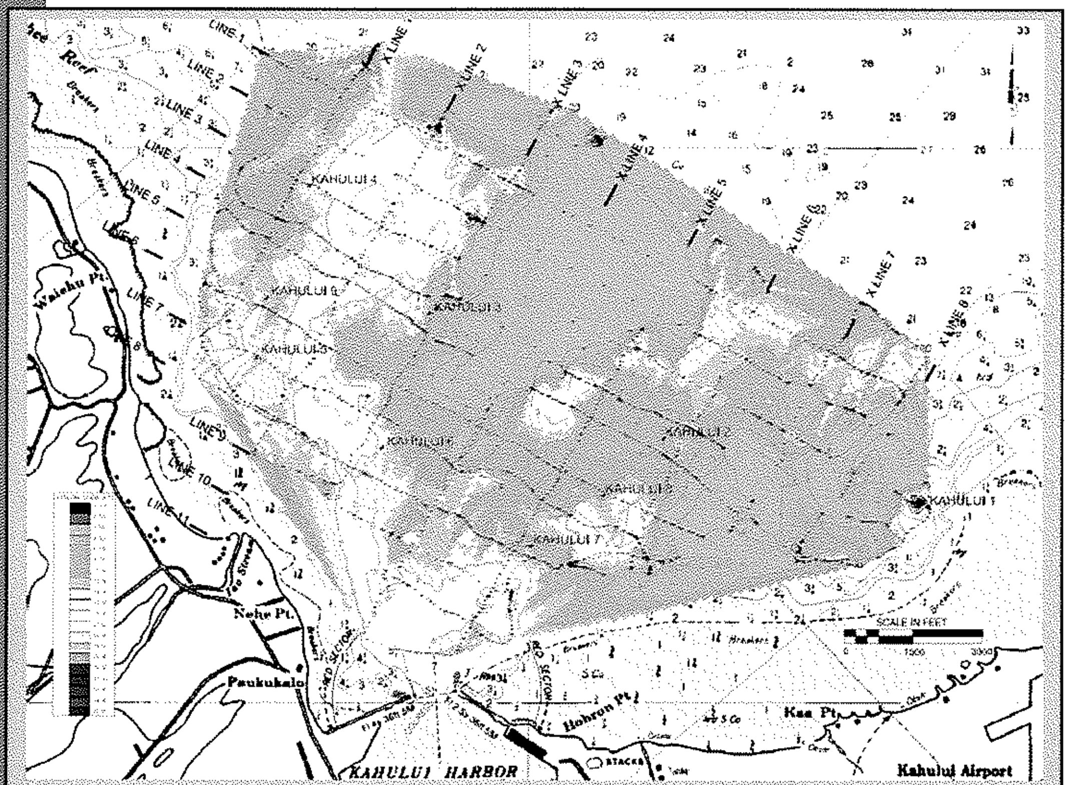
COST SUMMARY
INCLUDES ALL MARKUPS AND CONTINGENCY

Item	Initial Construction	NPV of Maintenance	NPV of Total Cost	Annualized Maintenance
Alternative 1A: 3,800-foot Beach Replenishment				
Dredged Sand	$6,000,000	$7,100,000	$13,100,000	$380,000
Purchased Sand	$4,300,000	$3,700,000	$8,100,000	$200,000
Alternative 1B: 2,400-foot Beach Replenishment				
Dredged Sand	$4,400,000	$5,900,000	$10,400,000	$320,000
Purchased Sand	$2,800,000	$2,700,000	$5,500,000	$150,000
Alternative 3A: 1,200-foot Revetment Extension				
Initial Construction	$3,700,000	$500,000	$4,200,000	$30,000
Alternative 3B: Revetment with 2,400-foot Beach Replenishment				
Dredged Sand	$5,800,000	$5,900,000	$11,700,000	$320,000
Purchased Sand	$5,000,000	$2,700,000	$7,700,000	$150,000

APPENDIX C – SAND SEARCH RESULTS

KAHULUI BAY SUB-BOTTOM SURVEY

November 2008



Prepared for:

Moffatt & Nichol
3789 Kilroy Airport Way, Suite 600
Long Beach, CA 98060

Prepared by:

Sea Engineering, Inc.
Makai Research Pier
Waimanalo, Hawaii 96795

SEI Job No.25117

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

In May, 2008, Sea Engineering, Inc. (SEI) was retained by Moffatt & Nichol to conduct a sub-bottom survey using geophysical methods of Kahului Bay on the north shore of the island of Maui. The survey was designed to investigate the nature of sand deposits in the bay. Previous benthic surficial mapping by NOAA (National Oceanographic and Atmospheric Administration) had indicated the broad presence of sand deposits within the bay, however there were no data available to determine the thickness of the sand deposits.

The survey covered an area of approximately 5.5 square miles. Primary survey lines were run at 1,000-ft intervals, and survey cross-lines were run at 2,000-ft intervals. The project location and survey line plan is shown in Figure 1-1.

The geophysical work was conducted over the course of two days, May 13 and 14, 2008. In addition, a series of nine surficial sediment samples were collected using a Ponar grab sampler.

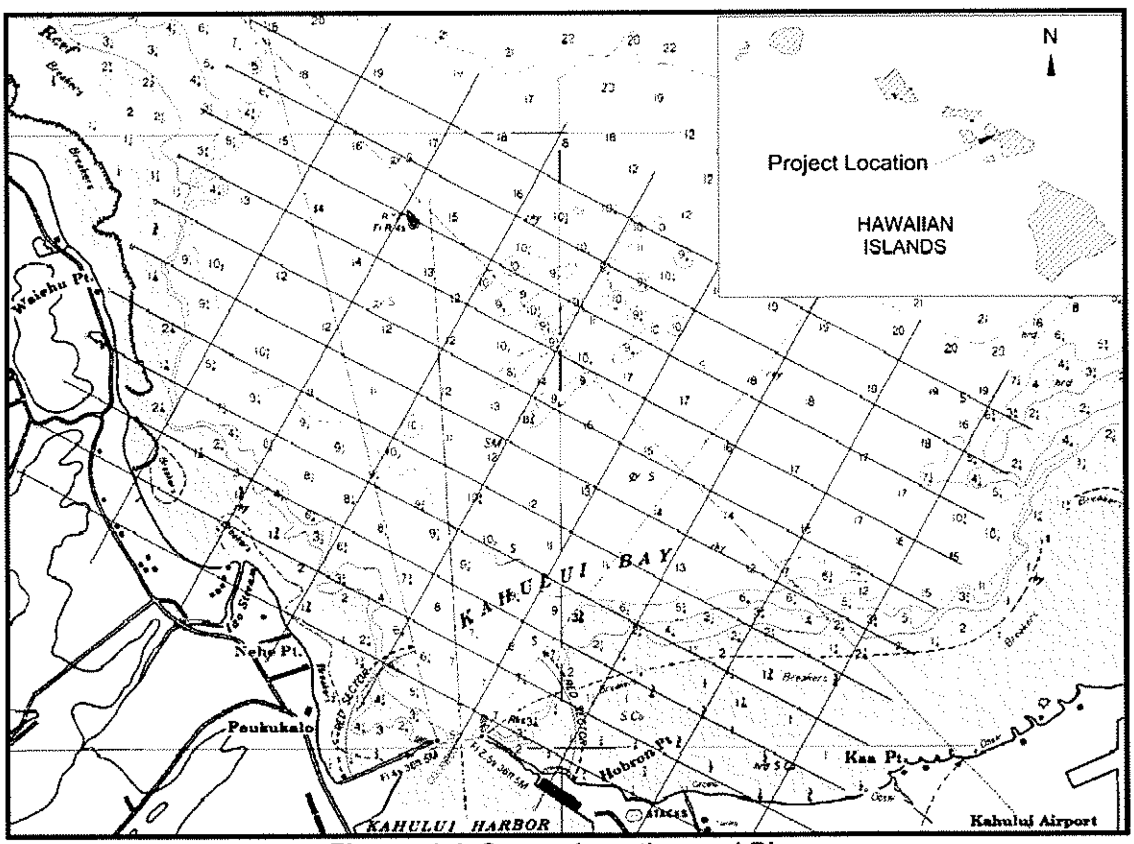


Figure 1-1 Survey Location and Plan

2. METHODOLOGY

2.1 Sub-Bottom Profiling Methods

Geophysical sub-bottom profiling systems are essentially echo-sounders that use lower acoustic frequencies to penetrate into the substrate. Where common echo-sounders may use an acoustic frequency in the vicinity of 200 kHz, sub-bottom system frequencies are typically between 500 Hz and 20 kHz. The term sub-bottom refers to a generally hard layer of sediment or rock that underlies recent soft sediment deposition. The lower the acoustic frequency, the deeper into the bottom the system can penetrate

For this survey, an EdgeTech 0512i "chirp" sub-bottom profiler was used with an EdgeTech 3200XS processing system. The chirp processors use signal processing to shape the acoustic wavelets used to image the substrate. They provide significantly greater image resolution than traditional impulsive systems such as boomers and sparkers. Different wavelets are available with the system for use in different terrains. After on-site system deployment, trial survey lines were conducted using various pulse configurations. The optimal pulse for the substrate in Kahului Bay was found to be a 20 ms pulse with a frequency range of 500 Hz to 7kHz. This is a relatively low frequency range, but necessary for penetration into the coralline limestone sands and gravels found in Hawaii. The EdgeTech 0512i system is in fact a specialty system for use in coarse sand environments.

2.2 Sub-Bottom Data Processing and Interpretation

The sub-bottom data were reviewed with EdgeTech software and sub-bottom horizons were digitized for processing. Sand thickness data were contoured using Digital Terrain Model (DTM) software, and final charts created using AutoCAD.

The offshore substrate around the Hawaiian Islands is complex, and can consist of different combinations of carbonate sand, coral gravels and cobbles, lithified or indurated sediment horizons, hard coralline limestone and some areas with volcanic rock features and terrigenous sediment. The sub-bottom horizons are therefore often difficult to interpret. As a generalized model, Kahului Bay appears to have a hard reef layer that is overlain by sediment layers 20 to 60 feet in thickness, and sometimes greater. The reef emerges from the bottom and outcrops in bathymetric high areas scattered throughout the survey area. However, the thick sediment overlying the reef has numerous acoustic reflectors that are indicative of hard layers. A conservative approach was taken for this study, and sand thickness was mapped to the first indication of a hard layer. Sand thickness in mapped areas is typically 10 to 20 feet. Sand deposits less than about 6 feet in thickness were difficult to map.

Figure 2-1 is a typical sub-bottom image showing the basal reef layer (acoustic basement – the limit of acoustic imaging) and overlying sediments, including about 15 to 20 ft of sand. The basal layer is approximately 40 to 60 feet below the seafloor. The intermediate sediments are likely to be an assortment of indurated sand, gravel, cobble and possibly even thin layers of coralline reef limestone. Figure 2-2 is a section showing the emergence of reef limestone into a bathymetric high.

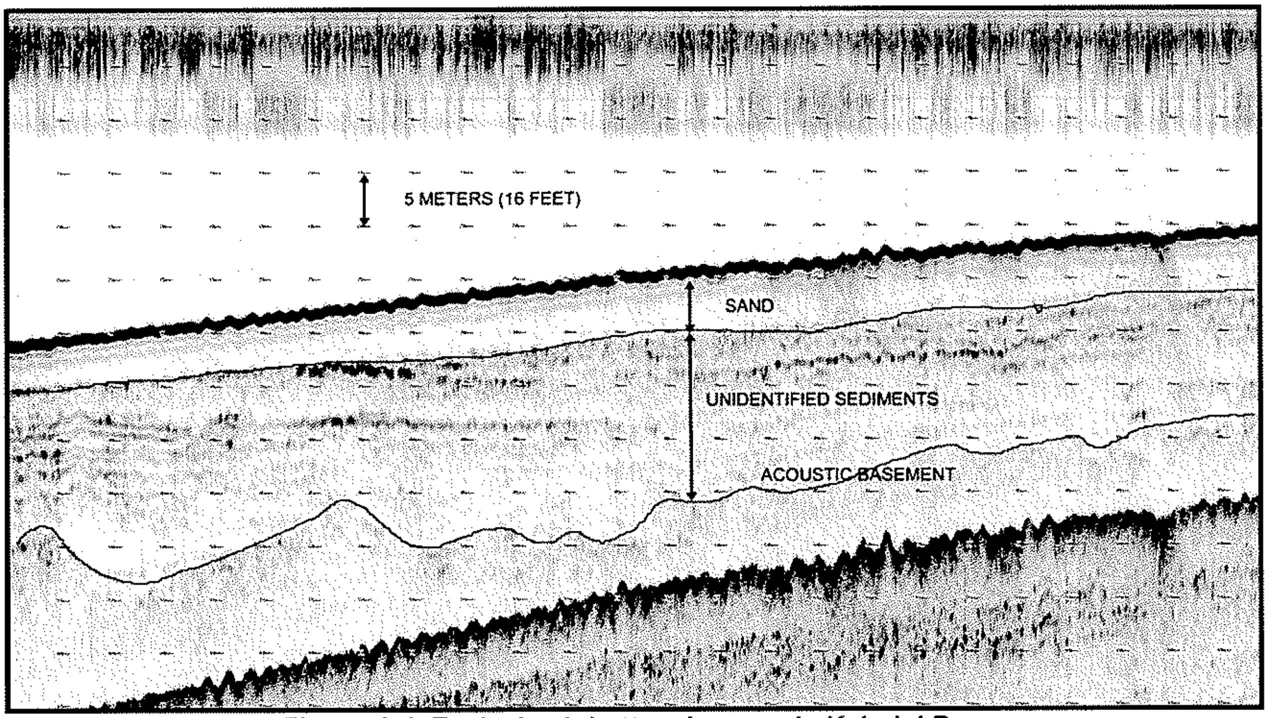


Figure 2-1 Typical sub-bottom imagery in Kahului Bay

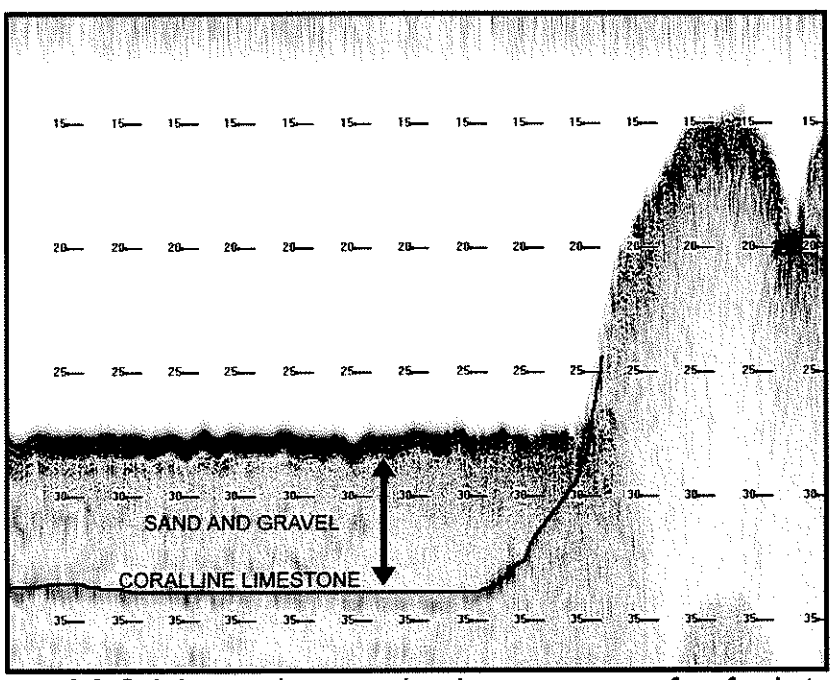


Figure 2-2 Sub-bottom imagery showing emergence of reef substrate

2.3 Bottom Sediment Samples

A total of nine bottom surface samples were retrieved using a Ponar sampler. Eight of the samples were analyzed for grain size by AECOS, Inc (note: sample Kahului 1 was not analyzed as it consisted of coral gravel and cobbles). Sediment descriptions and photographs are included as an appendix; size distribution results are shown in Table 2-1 and Figure 2-3.

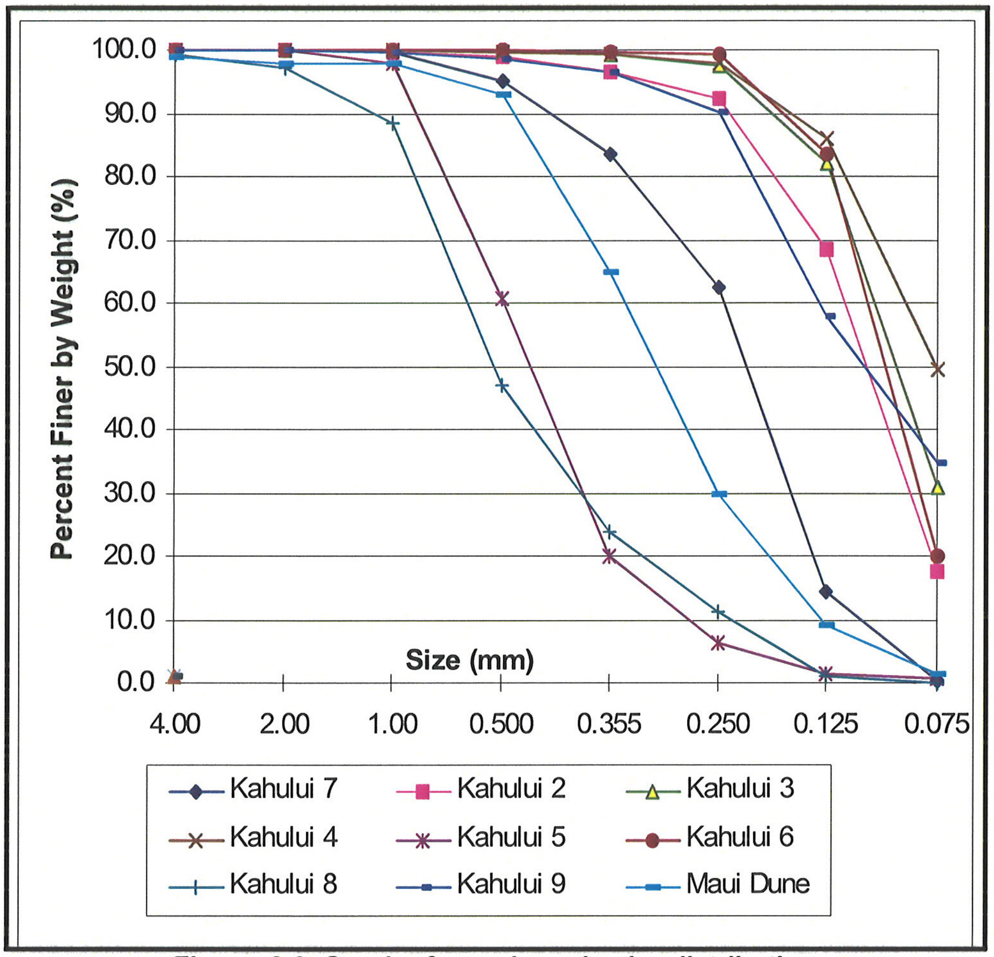


Figure 2-3 Graph of sample grain size distribution

Table 2-1 Sample grain size distribution

Percent Finer by Weight (%)								
size (mm)	**4.00**	**2.00**	**1.00**	**0.500**	**0.355**	**0.250**	**0.125**	**0.075**
Kahului 2	100.0	100.0	99.8	99.1	96.7	92.2	68.4	17.5
Kahului 3	100.0	100.0	100.0	100.0	99.2	97.4	82.1	30.8
Kahului 4	100.0	100.0	100.0	99.8	99.4	98.0	86.1	49.4
Kahului 5	100.0	99.8	97.8	60.6	19.8	6.4	1.6	0.8
Kahului 6	100.0	100.0	100.0	100.0	99.8	99.1	83.4	19.9
Kahului 7	100.0	100.0	99.8	95.0	83.7	62.4	14.3	0.4
Kahului 8	99.4	97.4	88.3	47.2	23.9	11.1	1.0	0.0
Kahului 9	100.0	100.0	99.6	98.4	96.5	90.2	58.1	34.7

3. RESULTS

3.1 Sub-bottom survey results

The presence of sand deposits 10 to 20 feet in thickness over much of Kahului Bay was confirmed by the sub-bottom survey. Figure 3-1 shows the results of the survey, with thickness contours highlighted in color. The bottom morphology of the bay is dominated by a broad central area with bathymetrically high reef areas (see Figure 2-2). With the exception of these emergent reef areas, it appears that most of the bay has at least 6 feet of sand substrate. As a conservative approach was taken during the interpretation process, it is possible that some areas have thicker sand deposits. As a general observation, the western portion of the bay appears to have somewhat thicker sand deposits. Differentiation between sand and gravel is difficult in sub-bottom images, and gravel areas were not mapped for that reason. However, what appear to be gravel deposits were more prevalent in the eastern portion of the bay.

The surface sand layers are commonly underlain by unknown sediment deposits that are stratified by acoustically reflective horizons. These sediments are likely to be inter-bedded layers of sand, gravel, indurated sand – in fact, any kind of coralline limestone reef derived deposits. It is also possible that viable sand deposits could be found underneath some of the hard reflectors that have been mapped as the base of the surficial deposits.

3.2 Sand sample results

Sand sample locations and photographs are contained in Appendix 1. Locations are also shown on the survey drawing, Figure 3-1 labeled as Kahului 1 through Kahului 9. Grain size distributions are shown in Figure 2-3 and Table 2-1. For comparison, Figure 2-3 also shows the distribution for Maui Dune Sand. The dune sand has been one of the major sources of sand for small-scale beach nourishment projects and sand bag protection projects on Maui. It is fine sand and barely meets grain size criteria for most beach projects, and is not really suitable for beach nourishment in energetic wave conditions.

Offshore sand deposits in Hawaii typically have two major limitations with respect to use for beach nourishment:

- Deposits are typically too fine-grained and,
- Deposits are often stained gray in color and therefore aesthetically un-pleasing.

Of the nine samples collected, two (Samples 5 and 8) had both good color and grain size characteristics. Sample 8 was coarse sand with a buff color that is attractive for beach sand. Sample 5 is exceptional in both color and grain size characteristics. It has a "salt and pepper" appearance due to a high percentage of terrigenous basalt fragments so it may not be suitable for all applications. Most of the samples (Samples 2, 3, 4, 6, 9) were both too fine and poorly colored. Sample 7 was too fine, although nicely colored, and Sample 1 consisted of large coral pieces.

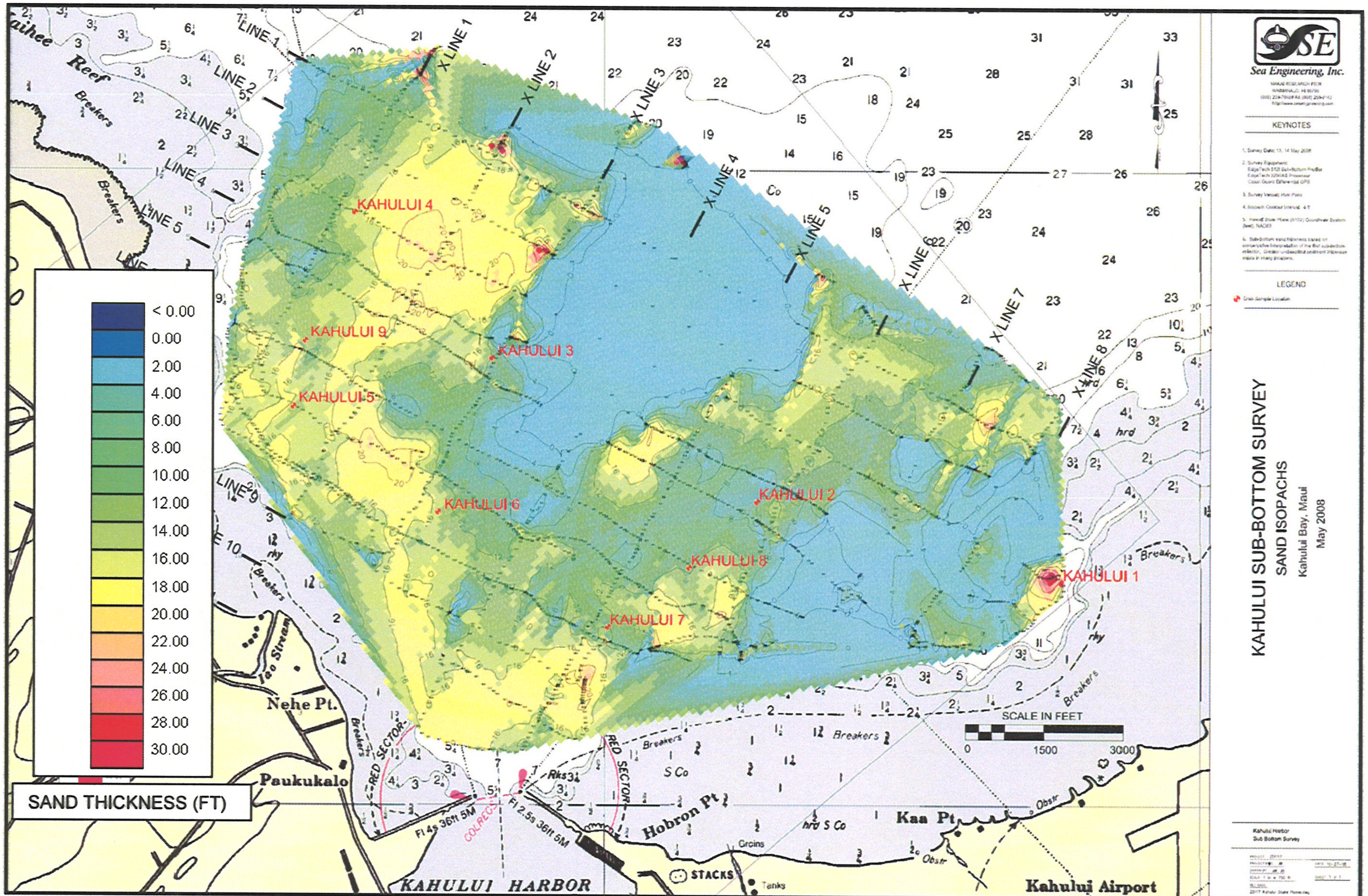


Figure 3-1 Kahului Bay sand thickness and sample locations

4. DISCUSSION

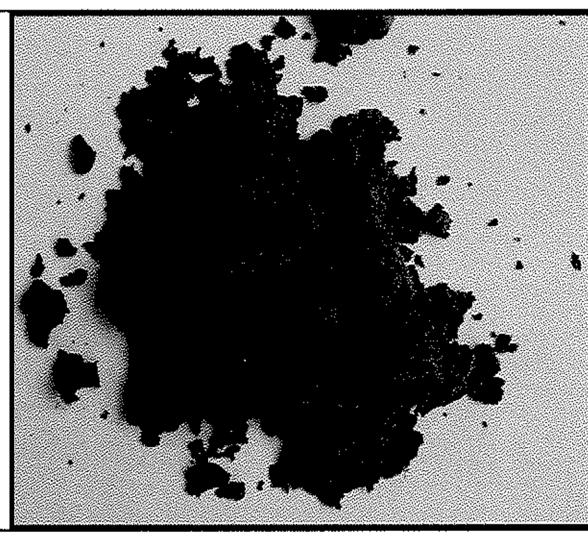
The survey results show the presence of widespread sand deposits in Kahului Bay. Most of the sand in the bay is probably too fine and poor in color for beach projects. However, two out of nine bottom samples indicated sand that would be suitable for beach nourishment, and in fact have excellent color and grain size characteristics. The extent of the suitable sand is not known and will require follow up investigations in order to characterize the areal extent of the deposits, and grain size and color characteristics below the surface.

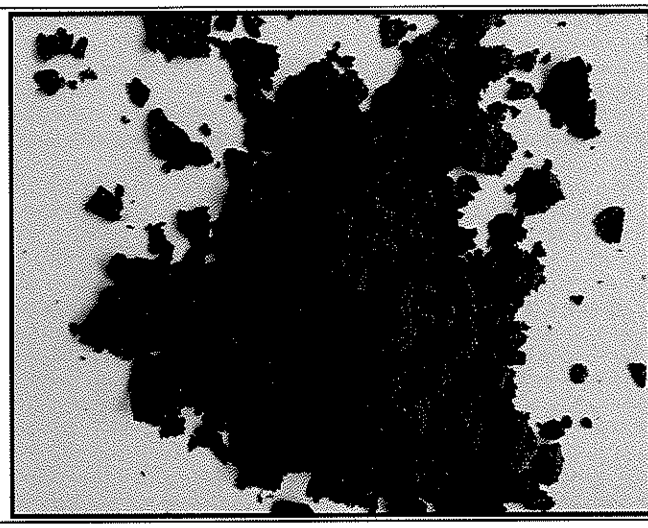
Follow on work may include survey work in the form of side scan sonar and drop camera surveys for acoustic and visual imaging of the bottom surface, a more intensive bottom sampling effort, and vibracore sampling to collect deposits below the bottom surface. SEI recently completed a comprehensive study of this type off West Maui for the Kaanapali Operators Association.

Kahului Bay is on the exposed windward side of the island, and conditions are generally poor for ocean work. Much of the fieldwork mentioned above will require calm weather windows, such as light and variable or Kona wind conditions, in order to produce good quality field data.

APPENDIX 1. SAMPLE PHOTOGRAPHS AND DESCRIPTIONS

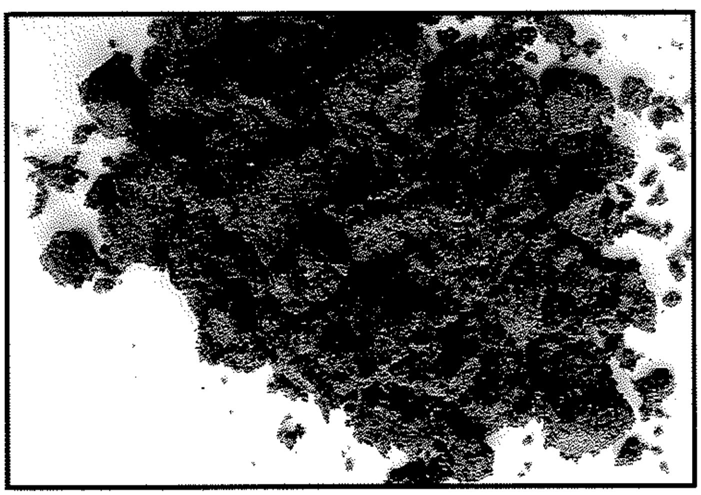
Ponar Surface Sample **Vessel: Huki Pono**	**Kahului Bay, Maui** **Date: 14 May, 2008**
Sample: Kahului 1	
Position **(NAD83 State Plane, ft)**	**Description**
1,717,194 E / 210,174 N	Coral gravel and cobble, 0.5 to 3 inch fragments

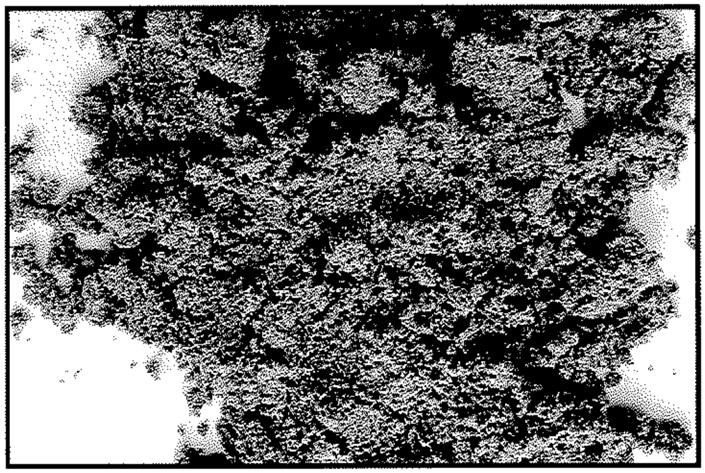
Ponar Surface Sample **Vessel: Huki Pono**	**Kahului Bay, Maui** **Date: 14 May, 2008**
Sample: Kahului 2	
Position **(NAD83 State Plane, ft)**	**Description**
1,7115,79 E / 211,654 N	Well sorted light gray fine sand

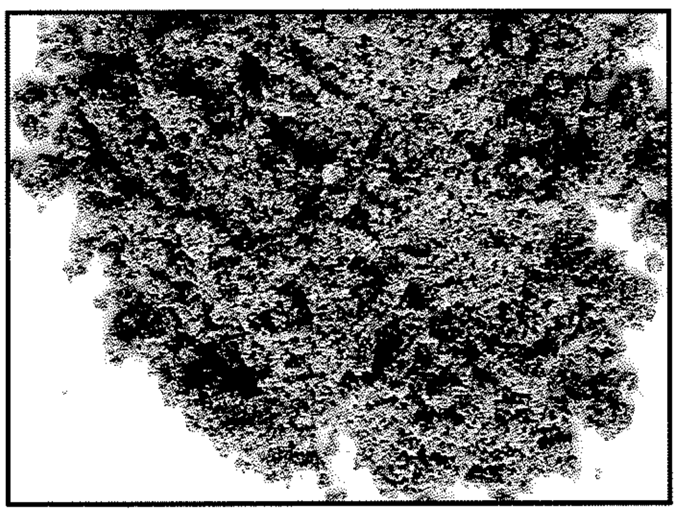
Ponar Surface Sample **Vessel: Huki Pono**		**Kahului Bay, Maui** **Date: 14 May, 2008**
Sample: Kahului 3		
Position **(NAD83 State Plane, ft)**		**Description**
1,706,510 E / 214,379 N		Well sorted gray fine sand

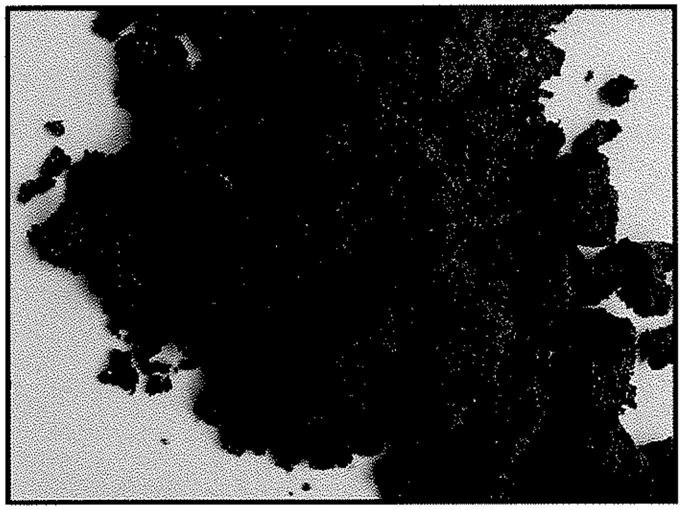
Ponar Surface Sample **Vessel: Huki Pono**		**Kahului Bay, Maui** **Date: 14 May, 2008**
Sample: Kahului 4		
Position **(NAD83 State Plane, ft)**		**Description**
1,703,902 E / 217,150 N		Well sorted gray fine sand

Ponar Surface Sample **Vessel: Huki Pono**		**Kahului Bay, Maui** **Date: 14 May, 2008**
Sample: Kahului 5		
Position (NAD83 State Plane, ft)		**Description**
1,702,734 E / 213,427 N		Well sorted coarse sand, "salt and pepper" mix of coralline components and approx. 30% basalt components.

Ponar Surface Sample **Vessel: Huki Pono**		**Kahului Bay, Maui** **Date: 14 May, 2008**
Sample: Kahului 6		
Position (NAD83 State Plane, ft)		**Description**
1,705,498 E / 211,443 N		Well sorted light gray fine sand.

Ponar Surface Sample **Vessel: Huki Pono**		**Kahului Bay, Maui** **Date: 14 May, 2008**
Sample: Kahului 7		
Position **(NAD83 State Plane, ft)**		**Description**
1,708,736 E / 209,290 N		Moderately sorted fine-grained buff colored coralline sand.

Ponar Surface Sample **Vessel: Huki Pono**		**Kahului Bay, Maui** **Date: 14 May, 2008**
Sample: Kahului 8		
Position **(NAD83 State Plane, ft)**		**Description**
1,710,287 E / 210,415 N		Moderately sorted coarse-grained buff colored coralline sand.

Ponar Surface Sample **Vessel: Huki Pono**		**Kahului Bay, Maui** **Date: 14 May, 2008**
Sample: Kahului 9		
Position **(NAD83 State Plane, ft)**		**Description**
1,702,960 E / 214,707 N		Well sorted gray fine sand.

APPENDIX D-1.

Preliminary Engineering Report; Addendum No. 1

Wailuku Kahului WWRF
Preliminary Engineering Report
Addendum No. 1

Prepared for:
County of Maui
Wastewater Reclamation Division, Department of Environmental Management

Prepared by:
Moffatt & Nichol

April 2012

M&N File: 6832

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

The purpose of this addendum is to present updated information on recent shoreline changes and further refinement of the proposed shoreline protection alternative. This addendum serves as a follow-up to the *Preliminary Engineering Report* (PER) prepared by Moffatt & Nichol in November, 2008 (M&N, 2008). Since publication of that report there have been several certified shorelines published for the site which capture the effects of the March 2011 tsunami, generated by the earthquake off the coast of Japan. The proposed shoreline protection alternative alignment has also been refined to minimize the environmental and aesthetic impacts associated with the preferred alternative.

1.1 Background

The County of Maui owns and operates the Wailuku-Kahului Wastewater Reclamation Facility (WWRF) on the North Shore of Maui adjacent to the Kahului Harbor (Figure 1). The County has decided to expand the plant in its present location as opposed to relocating it to another upland site. Plant relocation costs have been estimated to range between $350 million and $475 million. A critical constraint associated with decisions regarding public infrastructure along the County shoreline is that many of its beaches are eroding. As a part of the initial WWRF study completed in 2005, it was determined that site is subject to long term erosion and requires shoreline stabilization and protection for the plant to remain in its present location. Approximately one-third of the 1,350 foot length of shoreline fronting the WWRF has already required stabilization by a rock revetment constructed by the US Army Corps of Engineers in the late 1970s.

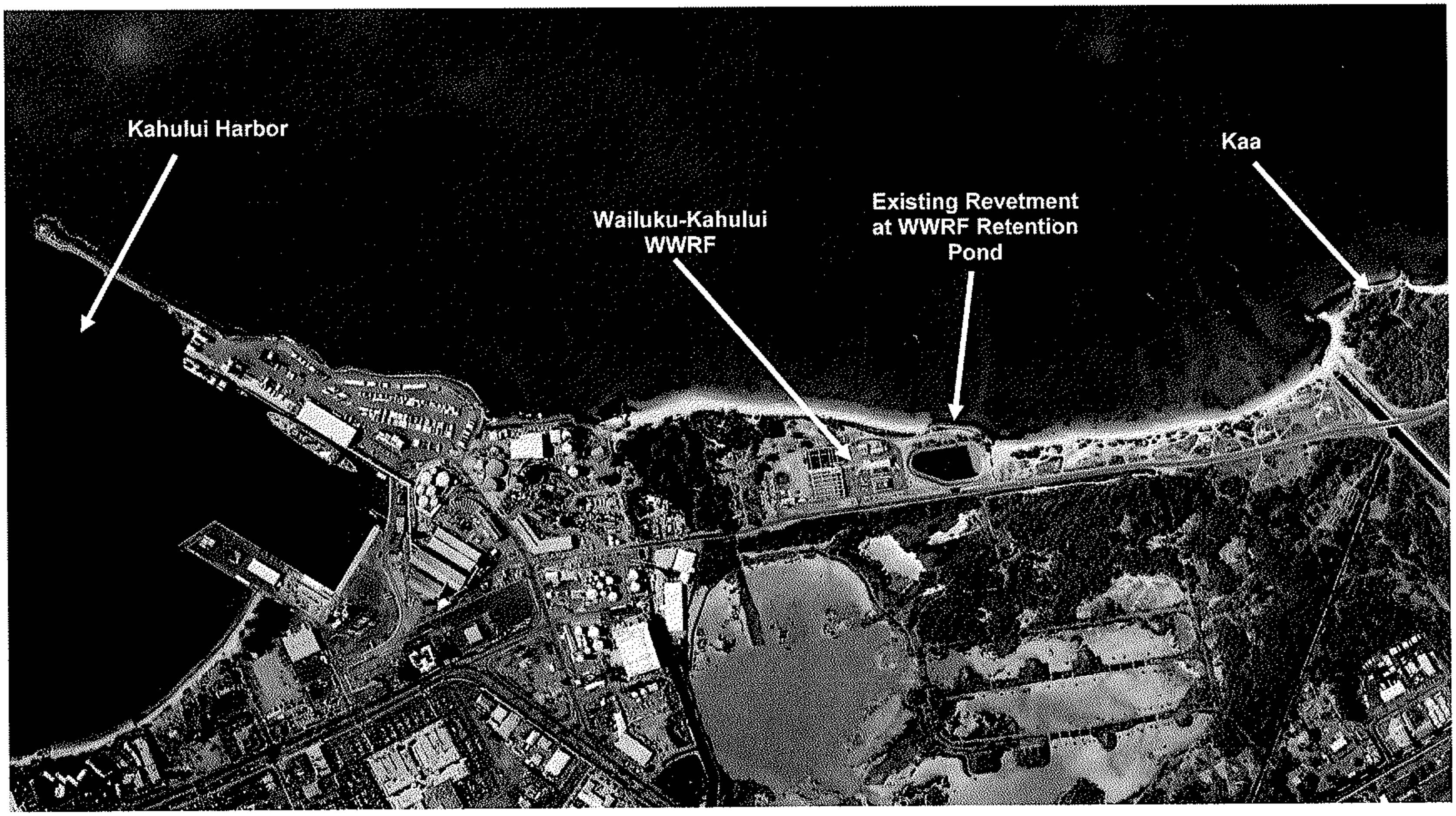


Figure 1. Aerial photograph of the coast from Kahului Harbor to Kaa

1.2 Findings of the Preliminary Engineering Report

The PER (M&N, 2008) concluded that the fundamental cause of shoreline erosion is the deficit of sand in the system due primarily to the historic removal for lime production by the sugar industry and additional sand mining by others for cement manufacturing and aggregate. Other contributors to erosion include losses due to wind, reduced coral reef productivity, sand grain abrasion, and relative sea level rise. It should be noted that erosion has occurred along a majority of the north shore, and is not a result of the existing revetment at the WWRF treatment pond. In fact, the highest erosion rates along the WWRF occurred prior to the existing revetment construction. Currently, the long-term shoreline erosion rate of the beach fronting the WWRF is 2.4 feet per year. Historically it has been as high as 6 feet per year.

The focus of the PER was to quantify shoreline erosion trends, assess potential causes for erosion, and develop preliminary shoreline protection alternatives. The range of alternatives considered included:

- No Project (i.e. no shoreline erosion mitigation)
- Beach Nourishment
- Sand Retention Structures (structures such as groins that retain beach sand by blocking its alongshore movement)
- Shoreline Protection Structures (seawalls and revetment)
- Combinations of the above.

After preliminary screening, the PER investigated the Beach Nourishment, Rock Revetment, and Buried Revetment (Rock Revetment combined with Beach Nourishment) as viable alternatives. The PER alternative analysis included engineering, economic, and environmental (biological and human impacts) considerations. ***Based upon the findings of the alternative analysis, the Rock Revetment Alternative (3A) was selected for the following reasons***:

- The revetment extension provides the required protection of the plant at the lowest cost with the minimal long-term maintenance commitment (present value cost approximately \$4-\$6 million as opposed to \$8-\$12 million for the buried revetment and \$8-\$13 million for beach nourishment). (Note: present value costs presented are for construction and maintenance for an assumed 50-year life).
- Rock revetment has a long history of effective shoreline protection throughout the US and internationally.
- Damage to a rock revetment typically occurs slowly, is easily observed, and can be repaired prior to failure.
- The existing rock revetment on a portion of the site has performed well for 30+ years without major incident and with minimal maintenance costs.

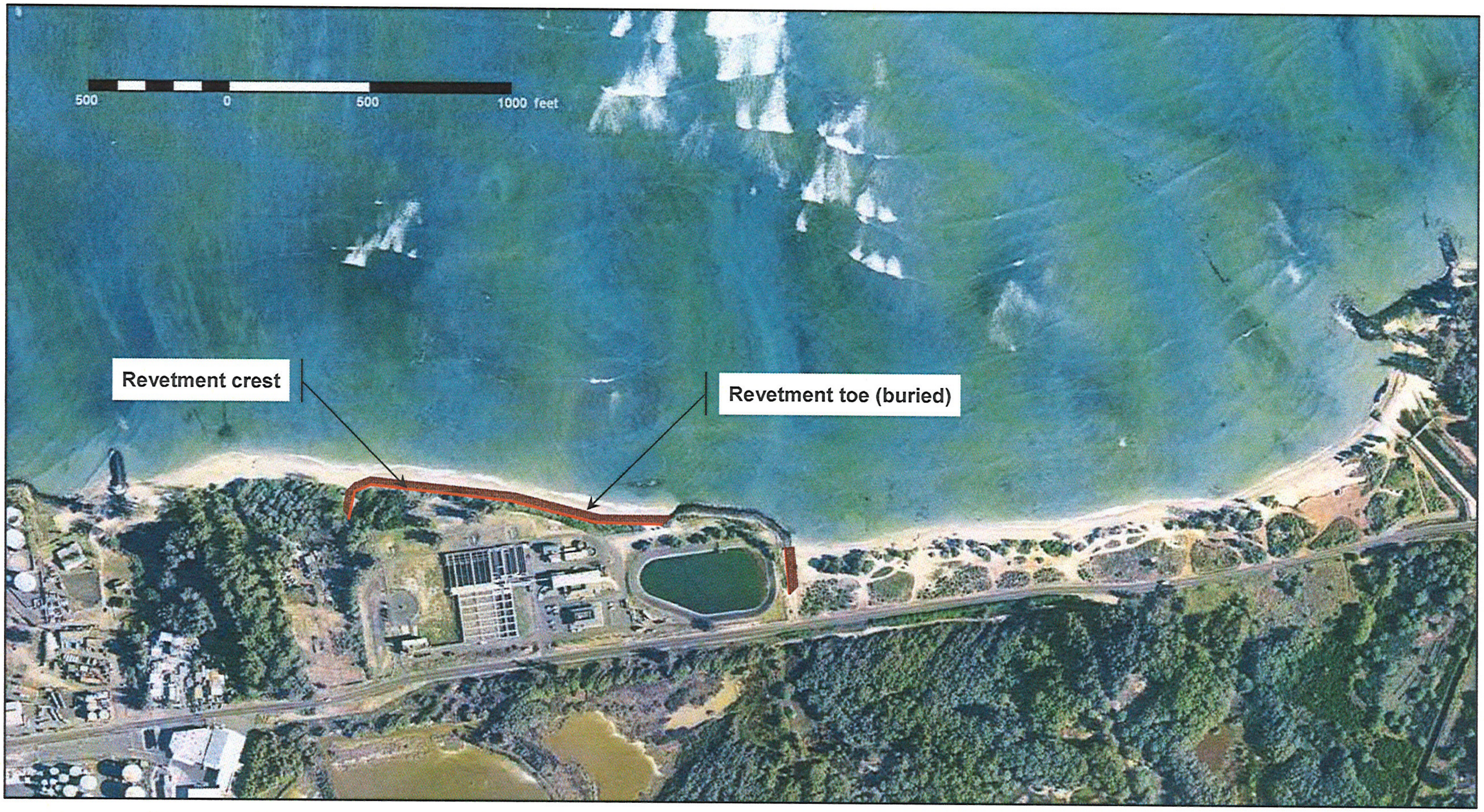


Figure 2. Plan View of Original Alternative 3A Revetment

2. RECENT OBSERVATIONS OF WAILUKU-KAHULUI WWRF SHORELINE CHANGES

Estimates for short term, long term and seasonal shoreline changes along the Wailuku-Kahului WWRF coastline were documented in the PER (M&N, 2008) and the *Central Maui WWRF Shoreline Evaluation Report* (M&N, 2005). A long-term erosion rate of 2.4 feet per year and a maximum long-term erosion rate of 6 feet per year were recommended for planning purposes and risk assessment. These studies based their conclusions on analysis of historic aerial photography (1912 – 2007) to estimate seasonal, short-term, and long-term trends in shoreline change and sediment budget; erosion maps from the County of Maui (based upon aerial photography over the past century); site visits performed by Moffatt & Nichol in 2004 and 2007; and beach profiles measured by the USGS between 1995 and 1999. The data available since publication of the PER is not sufficient to re-analyze the long-term rates of erosion but they do provide an opportunity to evaluate shoreline behavior in recent years for validation of the recommended rates.

2.1 Certified Shorelines (2007 to 2011)

Shoreline certification surveys were performed in February 2008, January 2011, and May 2011 and are shown in Figure 3. These shorelines were compared to the October 2007 certified shoreline to evaluate shoreline changes along the WWRF coastline over the last 3.5 years.

Comparison of these shorelines suggests the trend of shoreline retreat has continued in recent years, even prior to the 2011 tsunami. Between October 2007 and January 2011 (pre-tsunami) the shoreline retreated at an average rate of 1.1 feet/year with a maximum shoreline change of -11 feet. Although the majority of shoreline receded during this period some localized accretion occurred immediately west of the existing revetment.

A comparison of the pre-tsunami (January 2011) and post-tsunami (May 2011) shorelines indicates an average retreat of -9.8 feet along the WWRF shoreline with a maximum retreat of -14.4 feet. Most of this shoreline change is likely due to the March 2011 tsunami generated by the earthquake off the coast of Japan. The shoreline retreat resulting from this single event is about 4 times greater than the long-term average erosion rate. This event demonstrates how the time frame until WWRF infrastructure is threatened can be significantly reduced by a large cyclone, increase in the rate of sea level rise, or in this case a tsunami.

Table 1 provides a list of the shoreline change rates between October 2007 and May 2011. The average rate of retreat of the WWRF shoreline, including the effects of the tsunami was 3.7 feet/year between October 2007 and May 2011. The maximum rate of shoreline retreat was 6.6 feet/year over this period. Although these are slightly higher than the long-term erosion rates recommended for planning, they are not considered more accurate due the short averaging period (3.5 years) and magnified effects of the 2011 tsunami.

Table 1. Shoreline Recession from "Certified Shoreline" Data

Time Period	Maximum Total Recession (ft)	Average Recession Rate (ft/yr)	Maximum Recession Rate (ft/yr)
Oct 2007 to Jan 2011 (pre-tsunami)	-11	1.1	3.4
Oct 2007 to May 2011	-23.7	-3.7	-6.6

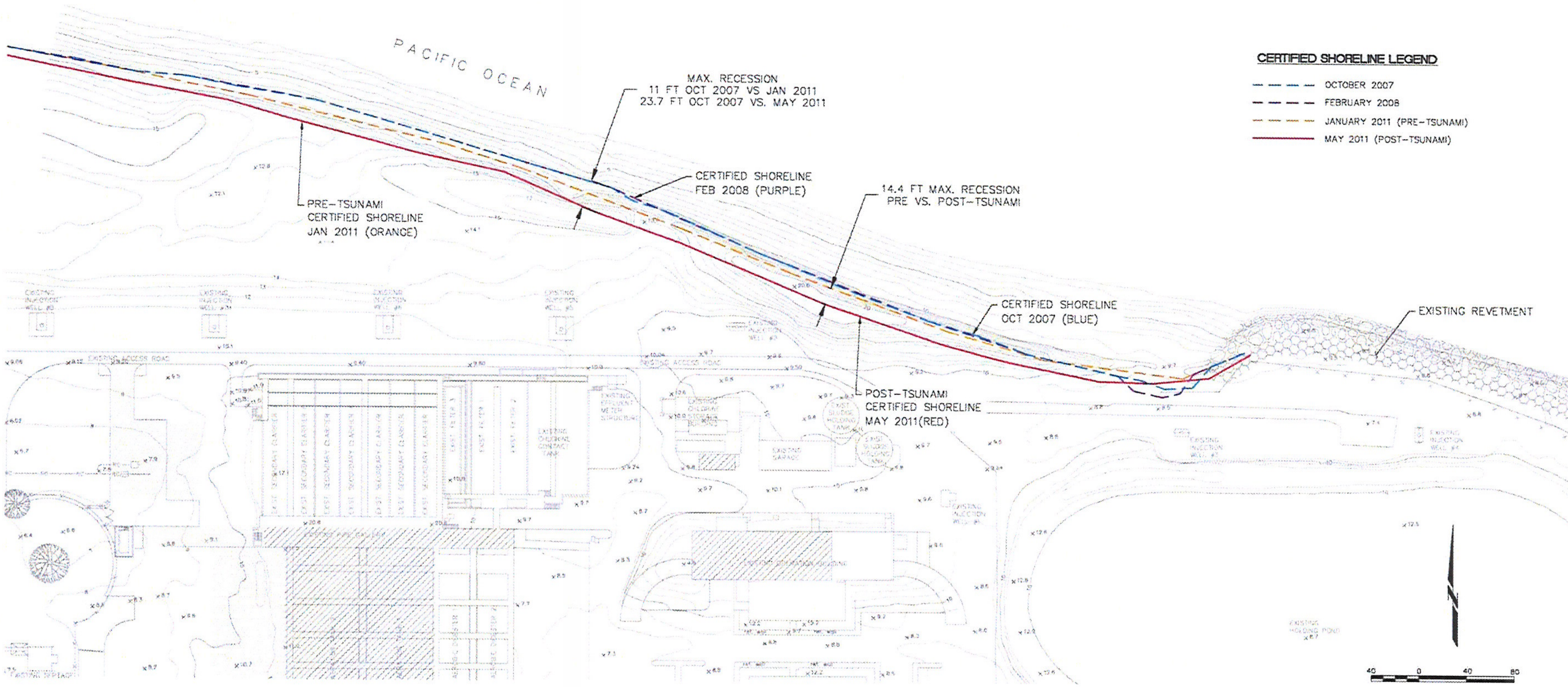


Figure 3. Certified shorelines at the WWRF, October 2007 to May 2011

2.2 Post Tsunami Site Observations

The March 2011 tsunami caused significant overtopping along the WWRF shoreline. Overtopping of the existing WWRF revetment displaced a significant volume of underlayer stone and destroyed the chain link fence as shown in Figure 4. Some of the underlayer stone was washed into the WWRF pond. Considerable erosion also occurred at each end of the revetment due to overtopping and flanking as shown in post-tsunami photos in Figure 5 and Figure 6.

Along the beach locations with berm elevations below about +12 MLLW experienced overtopping that washed sand and debris into the WWRF site. Figure 7 is a photograph of sand and debris deposited near the WWRF sludge holding tanks. At locations with higher berm elevations overtopping did not occur but a significant volume of sand was lost from the upper portion of the beach profile leaving a scarp several feet high in some areas. An example of this is shown in Figure 8.

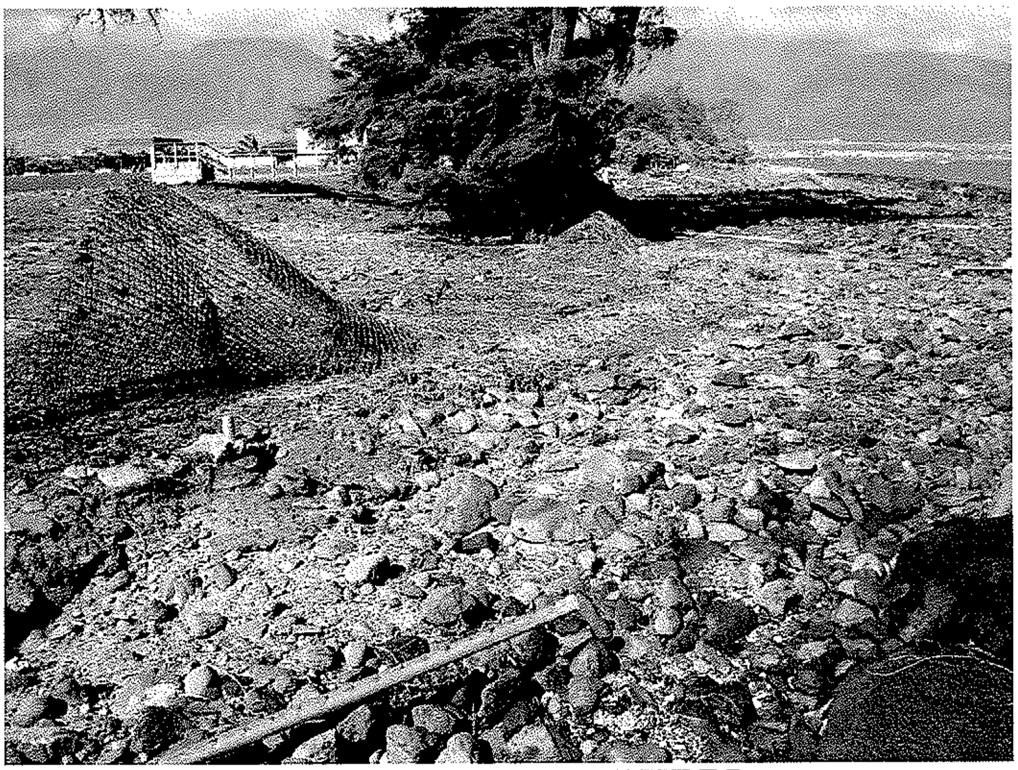


Figure 4. Looking West Along the WWRF Revetment

Figure 5. Damage at East End of the WWRF Revetment

Figure 6. Damage at West End of the WWRF Revetment

Figure 7. Sand and Debris Near WWRF Sludge Holding Tanks

Figure 8. Erosion of Upper Beach in Front of the WWRF

3. UPDATED PROJECT ALTERNATIVE

Based on a thorough evaluation of several potential shore protection alternatives in the PER, an extension of the existing rock revetment (Alternative 3A) was selected as the preferred option to provide long-term protection of the WWRF shoreline. This option provided the required protection of the plant at the lowest cost with a minimal long-term maintenance commitment.

The alternative proposed to extend the existing WWRF revetment to the west for a distance of about 1,200 ft. The east flank of the existing revetment would also be extended landward to minimize the potential for flanking as beach erosion proceeds. The revetment would be constructed along the back portion of the beach, close to the existing fence line, and would be a similar design to the existing revetment. Any excess beach material that was removed to construct the revetment would be replaced over the structure, but no further sand would be added to the system. Thus, Alternative 3A would not encroach on the existing beach, but it would not protect the beach or provide additional beach area. One of the drawbacks of this alternative was the potential for impacts to littoral transport and reduction of beach area as the shoreline continues to recede.

3.1 Updated Alternative 3A – Rock Revetment

Alternative 3A was refined to improve the effectiveness and reduce the impacts associated with extending the existing rock revetment. The updated rock revetment alternative includes the following design modifications:

1. Landward Re-alignment of the Revetment

The proposed rock revetment extension was shifted landward as far possible to minimize the potential for impacts to biological resources, recreational beach area and adjacent beaches. The landward re-alignment of the revetment achieves many of the same benefits as the beach nourishment alternatives. The re-aligned revetment will reduce the length of armored shoreline by almost 70%. In other words, over 800 feet of the proposed revetment will be buried landward of the active beach profile. A footprint comparison, shown in Figure 9, illustrates the significant reduction in area seaward of the May 2011 certified shoreline. A large scale plan and cross sections of the proposed revetment is provided in Appendix A.

2. Design Crest Elevation of +13 Mean Lower Low Water (MLLW)

The crest elevation of the proposed revetment will be +13 MLLW. An increased crest elevation will reduce the risk of runup and overwash from extreme events and provide added protection against the effects of sea level rise. The eastern 400 feet of the revetment will be constructed over the existing beach berm similar to the original design concept. The western 800 feet will be constructed landward of the existing beach berm. Most of the revetment will be placed below existing grade except for a few locations. In locations where the crest of the revetment is higher than adjacent grade a 2 foot sand cover will be placed over the revetment using excavated material. Typical cross sections for these two design concepts are presented in Figure 10. This alternative alignment is considerd to be the Least Environmentally Damaging Practicable Alternative (LEDPA).

Armor stone will also be added over the existing revetment to increase the crest elevation from +10 to +13 MLLW and add protection to the filter layer which suffered some damage during overwash from the March 2011 tsunami. A typical cross section of the modified existing revetment is presented in Figure 11.

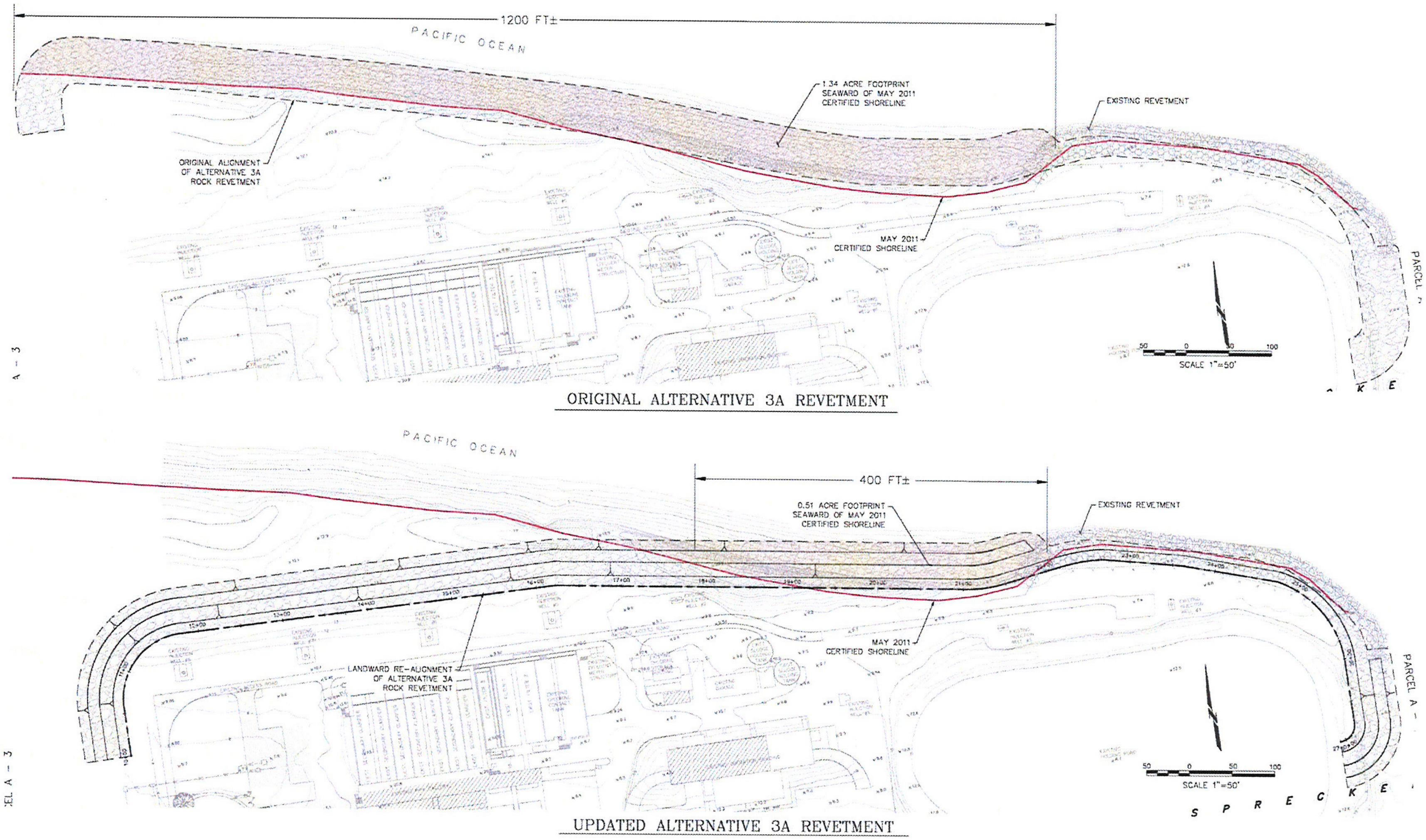
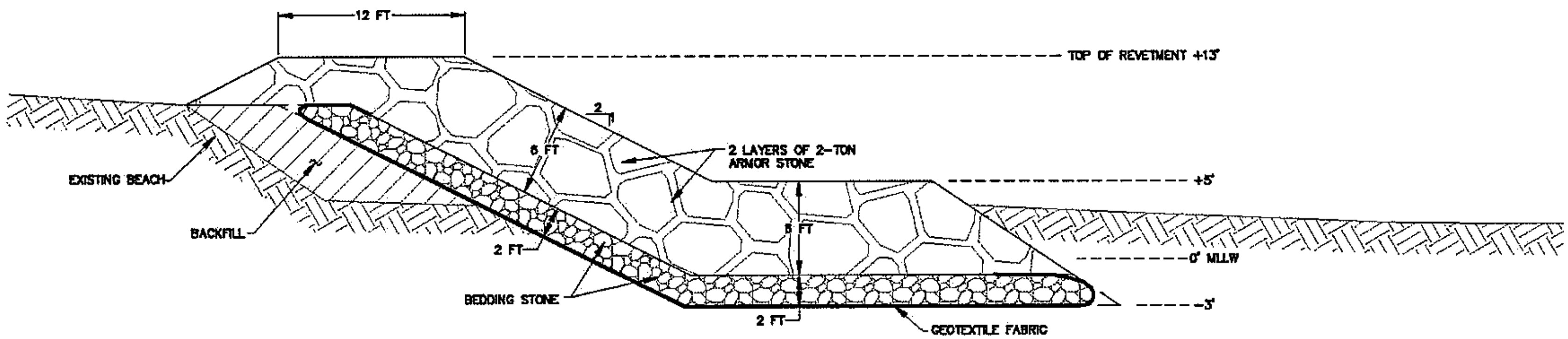
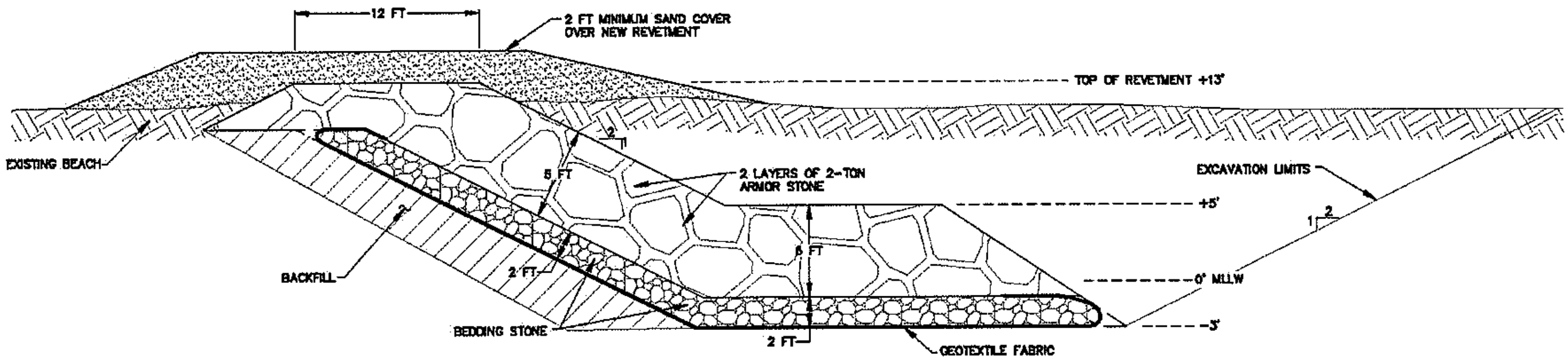


Figure 9. Alternative 3A Revetment Footprint Comparison



NEW REVETMENT EXTENSION - EAST SECTION



NEW REVETMENT EXTENSION - WEST SECTION

Figure 10. Proposed Revetment Cross-Sections

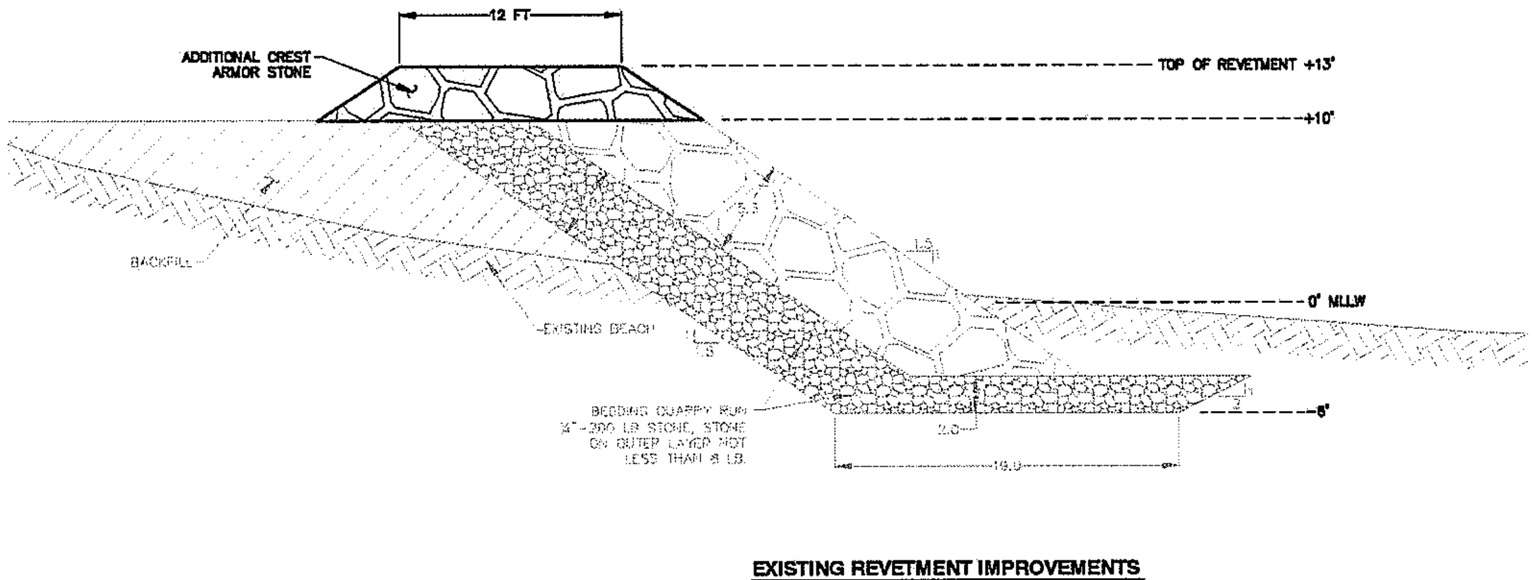


Figure 11. Modified Existing Revetment Cross-Sections

4. COST ESTIMATES

The cost estimate provided in the PER was updated with the new Alternative 3A design improvements. Costs for each of the alternatives were estimated based on a 50-year design life and include estimates for engineering and construction support. The cost estimate included a present value analysis of the initial construction cost and the future maintenance costs. A more detailed description of the assumptions involved in the cost estimates can be found in the PER.

The updated Alternative 3A cost estimate accounts for the major design modifications such as an increased revetment height to +13 MLLW, a layer of armor stone over the existing revetment to maintain a crest of +13 along the entire structure, and a 120 ft landward extension from the east end of the existing revetment. These design improvements increase the quantities for armor stone, bedding material, and geotextile by about 55%. The updated alternative also involves additional earthwork associated with the landward re-alignment of the revetment.

Table 2 outlines the Net Present Value (NPV) total cost for construction and future maintenance for the updated Alternative 3A and each alternative previously considered for the WWRF. Note the annualized maintenance cost is shown for convenience – it is not in addition to the NPV maintenance cost.

The initial construction cost for the updated Alternative 3A is about $4.5 million compared to an estimate of $3.2 million for the original design concept. Note that the original cost estimate assumed a revetment crest of +10 MLLW and no modifications to the existing revetment. Therefore, this is not necessarily a comparison of equivalent shore protection structures. The updated alternative provides a more substantial and improved shoreline protection structure with an elevated crest at +13 MLLW and significantly reduced environmental and recreational impacts due to the modified alignment. A breakdown of the original and updated Alternative 3A cost estimates are provided in Appendix B.

Table 2. Approximate Costs for the WWRF Alternatives

Item	Initial Construction	NPV of Maintenance	NPV of Total Cost	Annualized Maintenance*
Alternative 1A: 3,800-foot Beach Replenishment				
Dredged Sand	$6,000,000	$7,100,000	$13,100,000	$380,000
Purchased Sand	$4,300,000	$3,700,000	$8,100,000	$200,000
Alternative 1B: 2,400-foot Beach Replenishment				
Dredged Sand	$4,400,000	$5,900,000	$10,400,000	$320,000
Purchased Sand	$2,800,000	$2,700,000	$5,500,000	$150,000
Alternative 3A: 1,200-foot Revetment Extension				
Initial Construction	$3,200,000	$400,000	$3,600,000	$20,000
Updated Alternative 3A: 1,200 foot West Revetment Extension, 120 foot East Revetment Extension, Crest at +13 MLLW				
Initial Construction	$4,500,000	$400,000	$4,900,000	$20,000
Alternative 3B: Revetment with 2,400-foot Beach Replenishment				
Dredged Sand	$5,300,000	$5,900,000	$11,200,000	$320,000
Purchased Sand	$4,500,000	$2,700,000	$7,200,000	$150,000

* The annualized maintenance cost is *not* in addition to the NPV maintenance cost: this column is provided for convenience

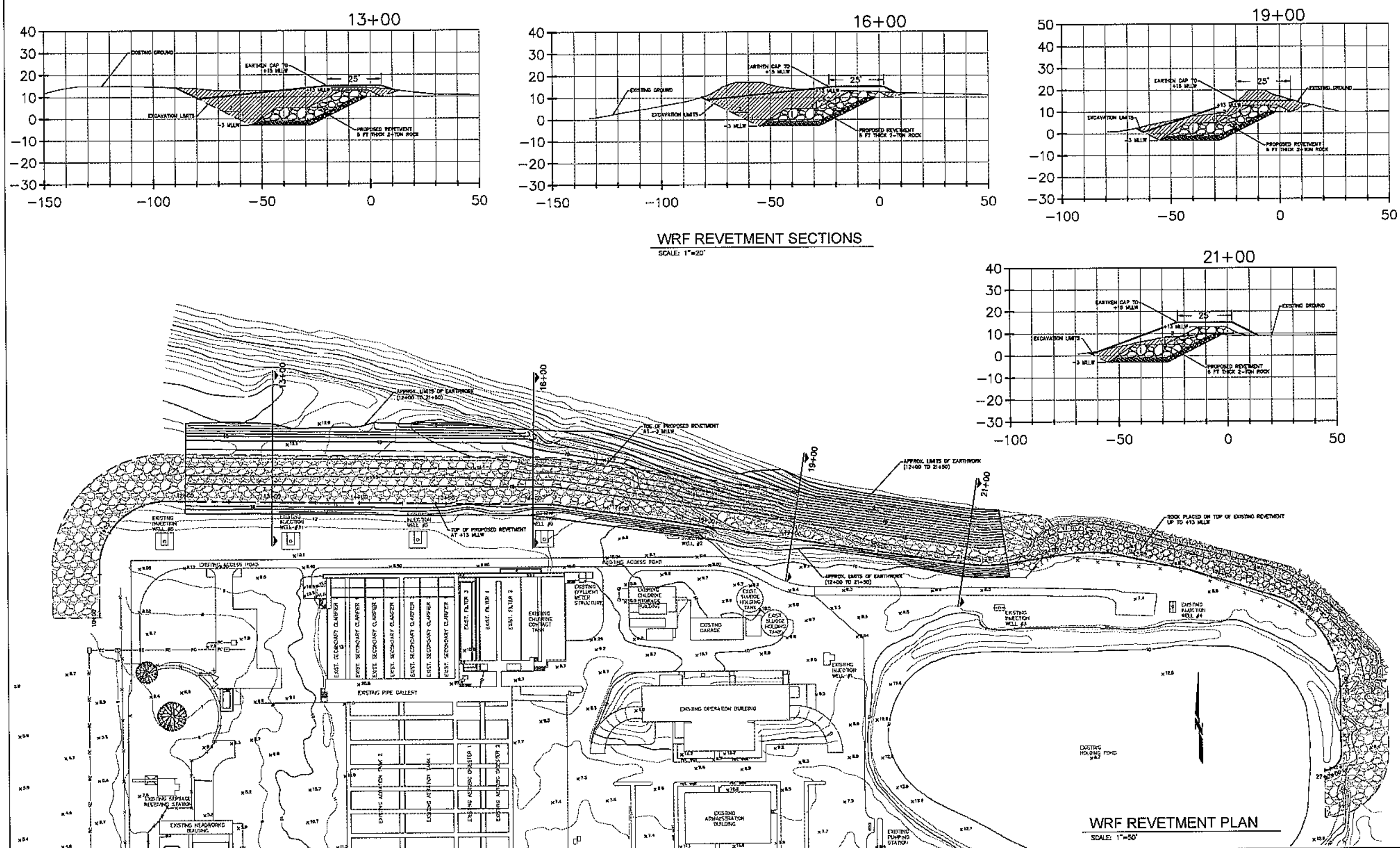
5. REFERENCES

Moffatt & Nichol, 2008. Wailuku Kahului WWRF Preliminary Engineering Report for Shoreline Erosion Control. Prepared for County of Maui, Wastewater Reclamation Division, Department of Environmental Management. November 2008.

Moffatt & Nichol, 2005. Central Maui Wastewater Reclamation Facility Shoreline Evaluation Report. Prepared for Austin, Tsutsumi & Associates, Inc. April 2005.

APPENDIX A

PLAN & SECTIONS
UPDATED ALTERNATIVE 3A
REVETMENT



moffatt & nichol

WAILUKU–KAHULUI WRF REVETMENT PLAN & SECTIONS

1

APPENDIX B

UPDATED ALTERNATIVE 3A
COST ESTIMATE

UPDATED ALTERNATIVE 3A: 1,200 FOOT REVETMENT
Landward re-alignment and crest elevation raised to +13 MLLW

Item	Quantity	Unit	Unit Cost	Total Cost
Initial Construction (2008 Dollars)				
Mob/Demob	1	LS	$500,000	$500,000
2 ton Armor Stone	20,350	TON	$70	$1,424,500
Bedding Stone	8,300	TON	$30	$249,000
Geotextile	90,000	SF	$7	$630,000
Excavation & Backfill	40,000	CY	$15	$600,000
Initial Construction Subtotal (Rounded)				**$3,400,000**
Maintenance (2008 Dollars)				
3% of Initial Construction Cost every 10 years				$102,000
Maintenance Cycle			**Inflated Cost**	**Present Value**
Year 10			$143,881	$89,389
Year 20			$202,958	$78,337
Year 30			$286,293	$68,652
Year 40			$403,844	$60,164
Maintenance Subtotal (Rounded)				**$300,000**
Construction Subtotal				**$3,700,000**
Eng., Const. Support (15%)				$555,000
Contingency (15%)				$638,250
TOTAL PROJECT COST				**$4,900,000**

ALTERNATIVE 3A: 1,200 FOOT REVETMENT

Original alignment follows existing beach, crest elevation at +10 MLLW

Item	Quantity	Unit	Unit Cost	Total Cost
Initial Construction (2008 Dollars)				
Mob/Demob	1	LS	$500,000	$500,000
2 ton Armor Stone	13,200	TON	$70	$924,000
Bedding Stone	6,000	TON	$30	$180,000
Geotextile	80,000	SF	$7	$560,000
Excavation & Backfill	16,000	CY	$15	$240,000
Initial Construction Subtotal (Rounded)				**$2,400,000**
Maintenance (2008 Dollars)				
5% of Initial Construction Cost every 10 years				$120,000
Maintenance Cycle			**Inflated Cost**	**Present Value**
Year 10			$169,272	$105,163
Year 20			$238,775	$92,161
Year 30			$336,815	$80,767
Year 40			$475,111	$70,781
Maintenance Subtotal (Rounded)				**$300,000**
Construction Subtotal				**$2,700,000**
Eng., Const. Support (15%)				$405,000
Contingency (15%)				$465,750
TOTAL PROJECT COST				**$3,600,000**

APPENDIX E.

Maui County Council Resolution No. 06-12, "Accepting the Central Maui Wastewater Reclamation Facility Study and Concurring Recommendations and Long Term Plan"

Resolution

No. 06-12

ACCEPTING THE CENTRAL MAUI WASTEWATER
RECLAMATION FACILITY STUDY AND
CONCURRING RECOMMENDATIONS AND LONG TERM PLAN

WHEREAS, the County of Maui must decide how it will meet its wastewater treatment and disposal needs for the Central Maui Region for the next 20 to 30 years; and

WHEREAS, in order to decide the future needs of the Central Maui Region the County of Maui must also decide the future of the Wailuku/Kahului Wastewater Reclamation Facility ("WWRF"); and

WHEREAS, the three primary concerns regarding the future of the Wailuku/Kahului WWRF are the: (1) Remaining capacity; (2) Shoreline erosion; and (3) Potential impact of a tsunami; and

WHEREAS, in order to address these concerns the County of Maui completed a study of the Wailuku/Kahului WWRF to identify and develop a comprehensive list of conceptual treatment and disposal alternatives to meet the future wastewater infrastructure requirements for the Central Maui Region ("Study"); and

WHEREAS, the major sections of the Study included: (1) Community Participation; (2) Existing Central Maui Wastewater Infrastructure and Alternative Wastewater Capacity Demand Alternatives; (3) Regulatory Assessment; (4) Financial Planning; (5) Shoreline Evaluation; and (6) Existing Central Maui Wastewater Reclamation Facility Structural Evaluation; and

WHEREAS, to ensure meaningful and broad-based community participation a project Core Working Group ("CWG"), comprised of a diverse group of community members who collectively reflected a broad cross section of community values, was convened; and

WHEREAS, based on the Study and after meeting with the CWG for 13 months the Department of Public Works and Environmental Management ("DPWEM") recommends the following: (1) Leave the existing Wailuku/Kahului WWRF at the current site and expand in the future; (2) Strengthen the existing Wailuku/Kahului WWRF to withstand a 100 year (20 foot high) tsunami event; (3) Mitigate shoreline erosion through the construction of shoreline erosion structures or beach nourishment; and (4) Implement the long term plan of action to service the Central Maui Service Area; now, therefore, BE IT RESOLVED by the Council of the County of Maui:

1. That it hereby accepts the Study; and

2. That it concurs with the DPWEM recommendations to: (1) Leave the existing Wailuku/Kahului WWRF at the current site and expand in the future; (2) Strengthen the existing Wailuku/Kahului WWRF to withstand a 100 year (20 foot high) tsunami event; (3) Mitigate shoreline erosion through the construction of shoreline erosion structures or beach nourishment; and (4) Implement the long term plan of action to service the Central Maui Service Area; and

3. That certified copies of this resolution be transmitted to the Mayor of the County of Maui and the Director of Public Works and Environmental Management.

APPROVED AS TO FORM
AND LEGALITY:

TRACI FUJITA VILLAROSA
First Deputy Corporation Counsel
County of Maui
S:\ALL\TFV\Resolutions\centralwwrfstudy.wpd

COUNCIL OF THE COUNTY OF MAUI

WAILUKU, HAWAII 96793

CERTIFICATION OF ADOPTION

It is HEREBY CERTIFIED that RESOLUTION NO. 06-12 was adopted by the Council of the County of Maui, State of Hawaii, on the 17th day of February, 2006, by the following vote:

MEMBERS	G. Riki HOKAMA Chair	Robert CARROLL Vice-Chair	Michelle ANDERSON	Jo Anne JOHNSON	Dain P. KANE	Dennis A. MATEO	Michael J. MOLINA	Joseph PONTANILLA	Charmaine TAVARES
ROLL CALL	No	Aye	No	Aye	No	Aye	Aye	Aye	Aye

COUNTY CLERK

APPENDIX F.

April 1, 2010 Letter from Department of Land and Natural Resources

LINDA LINGLE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
OFFICE OF CONSERVATION AND COASTAL LANDS
POST OFFICE BOX 621
HONOLULU, HAWAII 96809

LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

RUSSELL Y. TSUJI
FIRST DEPUTY

KEN C. KAWAHARA
DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

REF:OCCL:AB

Correspondence MA-10-189

APR - 1 2010

Cheryl Okuma, Director
County of Maui
Department of Environmental Management
2200 Main Street, Suite 100
Wailuku, Hawai'i 96793

SUBJECT: Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension, Located at Kahului, Maui, TMK: (2) 3-8-001:188

Dear Ms. Okuma:

The Department of Land and Natural Resources (DLNR) Office of Conservation and Coastal Lands (OCCL) has reviewed your letter regarding the Wailuku-Kahului Wastewater Reclamation Facility (WWRF) Shoreline Protection Extension, Located at Kahului, Maui, TMK: (2) 3-8-001:188.

According to the information provided, Executive Order No. 3006 grants the County of Maui management and control of the subject property for the purpose of operating the WWRF. An existing rock revetment was built in the 1970s to protect portions of the WWRF from shoreline erosion. The Maui Department of Environmental Management proposes to extend the shoreline revetment structure from approximately 5,350 feet to approximately 20,520 feet along the seaward boundary of the WWRF.

In your letter, you request clarification that the proposed shoreline rock revetment structure extension is ancillary to the WWRF, and within the scope of Executive Order No. 3006. You also request our concurrence that the Department of Environmental Management is the Accepting/Approving Authority pursuant to Chapter 343, Hawai'i Revised Statutes (HRS) and Chapter 200 of Title 11, Department of Health Hawai'i Administrative Rules (HAR).

ANALYSIS:

According to OCCL records, the subject property is located within the State Land Use Conservation District, Limited subzone. There is an existing Conservation District Use Permit (CDUP) for the subject WWRF, CDUP MA-349, which was approved by the Board of Land and Natural Resources on July 28, 1972. Subsequently, CDUP MA-3047 was approved on January

11, 2002 for modifications to the WWRF. The OCCL notes that no CDUP was obtained for the subject shoreline revetment structure.

The extension of the shoreline revetment structure is an identified land use in the Conservation District pursuant to HAR §13-5-23 *Identified Land Uses in the Limited Subzone* L-5 SEAWALLS AND SHORELINE PROTECTION (D-1) *Seawalls, shoreline protection devices, and shoreline structures.* **This proposed action requires the filing of a Conservation District Use Application (CDUA) for a Board permit.**

Because the proposed extension of the shoreline revetment structure may cause a significant impact in a particularly sensitive environment, the OCCL determines that **this proposed action would not be exempt from HRS Chapter 343 and HAR §11-200-8.**

The OCCL concurs that the revetment structure and proposed extension would be within the scope of Executive Order No. 3006, and the Department of Environmental Management may be the Accepting/Approving Authority pursuant to HRS Chapter 343 and HAR Chapter 200 of Title 11, Environmental Impact Statement.

Should you have any questions regarding this correspondence, please contact Audrey Barker of our office at (808) 587-0316 or audrey.t.barker@hawaii.gov.

Sincerely,

Samuel J. Lemmo, Administrator
Office of Conservation and Coastal Lands

C: Chairperson
MDLO/DOFAW
Maui Planning Department

APPENDIX G.

April 7, 2010 Letter from Office of Environmental Quality Control

LINDA LINGLE
GOVERNOR OF HAWAI'I

KATHERINE PUANA KEALOHA
DIRECTOR

STATE OF HAWAI'I
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
235 S BERETANIA ST. SUITE 702
HONOLULU, HAWAI'I 96813
Tel. (808) 586-4185
Fax. (808) 586-4186
Email: oeqc@doh.hawaii.gov

April 7, 2010

Cheryl K. Okuma, Esq.
Department of Environmental Management
County of Maui
2200 Main Street, Suite 100
Wailuku, Maui, Hawaii 96793

Subject: Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension

Thank you for your letter dated March 10, 2010, requesting the Office of Environmental Quality Control's (OEQC) opinion on whether the Department of Environmental Management can be the Accepting Authority for a proposed Environmental Impact Statement Preparation Notice for the subject proposed action. According to your letter, the property is under control of the County of Maui per Executive Order No. 3006.

According to Section 11-200-4(a)(2), Hawaii Administrative Rules, whenever an agency proposes an action, the final authority to accept a statement shall rest with the mayor, or an authorized representative, of the respective county. An Executive Order is sufficient to determine that the county has control over the land and is therefore the accepting authority.

The OEQC respectfully defers to the Department of Land and Natural Resources questions regarding the shoreline rock revetment extension that may be ancillary to the subject project since structures in the conservation district are under their jurisdiction.

If you have any questions, please call Rebecca Alakai at 586-4185.

Sincerely,

Rebecca Alakai

for Katherine Puana Kealoha, Esq.
Director

APPENDIX H.

April 21, 2010 Letter from the Office of Mayor

CHARMAINE TAVARES
MAYOR

200 South High Street
Wailuku, Hawaii 96793-2155
Telephone (808) 270-7855
Fax (808) 270-7870
e-mail: mayors.office@mauicounty.gov

OFFICE OF THE MAYOR
County of Maui

April 21, 2010

Ms. Cheryl K. Okuma, Esq., Director
Department of Environmental Management
2200 Main St. Suite 100
Wailuku, Hawaii 96793

Dear Ms. Okuma,

SUBJECT: DESIGNATION OF EIS ACCEPTING AUTHORITY FOR THE WAILUKU-KAHULUI WWRF SHORELINE EROSION CONTROL PROJECT ("ROCK REVETMENT EXTENSION") IN KAHULUI, HAWAII. COUNTY JOB WW08-08,

I have reviewed the April 1, 2010 letter from the State Department of Land and Natural Resources, Ocean Conservation and Coastal Lands (DLNR/OCCL) which confirms the proposed shoreline rock revetment extension is included under Executive Order No. 3006 and that the Department of Environmental Management (DEM) may be the accepting authority for the project's Environmental Impact Statement (EIS). Further, the State Office of Environmental Quality Control (OEQC), in a letter dated April 7, 2010, agreed that through Executive Order, the County of Maui had control of the land and is therefore the accepting authority.

Pursuant to Title 200, §11-200-4, Hawaii Administrative Rules, Environmental Impact Statement Rules, the mayor or an authorized representative possesses the final authority to accept the EIS. On April 15, 2010, the DEM and the Planning Department held a coordination meeting to discuss which agency should be the authorized representative for the County of Maui for this EIS. It was agreed that as the agency controlling the land, the DEM would be the mayor's authorized representative.

I hereby designate the Department of Environmental Management as the authorized representative for processing and accepting the EIS for the subject project.

Sincerely,

Charmaine Tavares
Mayor, County of Maui.

Attachments: Letter from DLNR/OCCL, Letter from OEQC
Copy: Jeff Hunt, Director of Planning
Juan Rivera, DEM/WWRD
Mich Hirano, Munekiyo & Hiraga, Inc.

APPENDIX I.

Biological and Water Quality Survey for the Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection, Maui, Hawaii

AECOS No. 1224

Biological and water quality survey for the Wailuku-Kahului Wastewater Reclamation Facility shoreline protection, Maui, Hawai'i

Prepared by:

AECOS, Inc.
45-939 Kamehameha Hwy, Suite 104
Kāne'ohe, Hawai'i 96744-3221

May 22, 2012

Biological and water quality survey for the Wailuku–Kahului Wastewater Reclamation Facility shoreline protection, Maui, Hawai'i[1]

May 22, 2012 | **DRAFT** | *AECOS* No. 1224

Stacey Kilarski and Chad Linebaugh
AECOS, Inc.
45-939 Kamehameha Hwy, Suite 104
Kāne'ohe , Hawai'i 96744
Phone: (808) 234-7770 Fax: (808) 234-7775 Email: aecos@aecos.com

Introduction

In December 2009, *AECOS* Inc. biologists conducted water quality and aquatic biota surveys along the shore fronting the Wailuku–Kahului Wastewater Reclamation Facility (WKWWRF), located on the northern coastline of the Island of Maui, Hawai'i (Fig. 1). The WKWWRF provides secondary treatment of sewage, utilizing an activated sludge biological treatment process, secondary clarification, and filtration. The property is located in the State Land Use Conservation District and falls within the purview of the Department of Land and Natural Resources (DLNR). Erosion threatens several structures at the WKWWRF, including structures which cannot be moved elsewhere. The County of Maui, Department of Environmental Management, Wastewater Reclamation Division proposes to provide shoreline protection at the existing WKWWRF. The purpose of this report is to identify any sensitive biological resources present along the shore or in the nearshore waters that may be impacted by the proposed shoreline protection activities. This report includes results from a marine biological survey and water quality sampling in the potential project impact area.

[1] Report prepared for Munekiyo & Miraga, Inc. for use in the preparation of an environmental documents and various environmental permits and will become part of the public record.

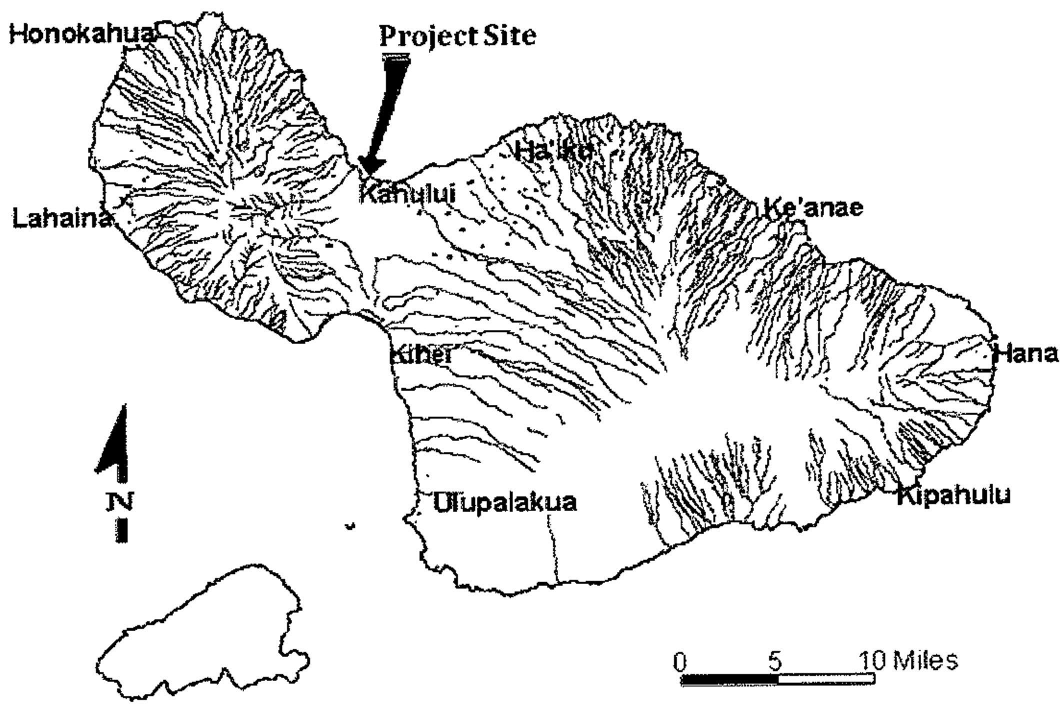


Figure 1. The project location in Kahului on the Island of Maui.

Project Area Description

The WKWWRF is located on the Pacific Ocean shore to the east of Kahului Harbor, on the northern coast of the Island of Maui. The site covers an area of 18.75 ac, and is surrounded by Kanahā Beach Park to the east, ʻĀmala Place to the south with Kanahā Pond State Wildlife Sanctuary to the south across ʻĀmala Place, and light industrial properties to the west (Fig 2). According to the County of Maui Shoreline Erosion maps (County of Maui, 2008), the shoreline in front of the WKWWRF is experiencing erosion at an annual erosion rate of -1.0 to -2.5 ft per year. The existing boulder revetment at the site is 450 ft in length and the revetment is proposed to be extended out to 400 ft to the west (Fig. 3). A smaller extension of the revetment to the east may also be necessary to prevent flanking. The project property is owned by the State of Hawaiʻi and managed by the County of Maui.

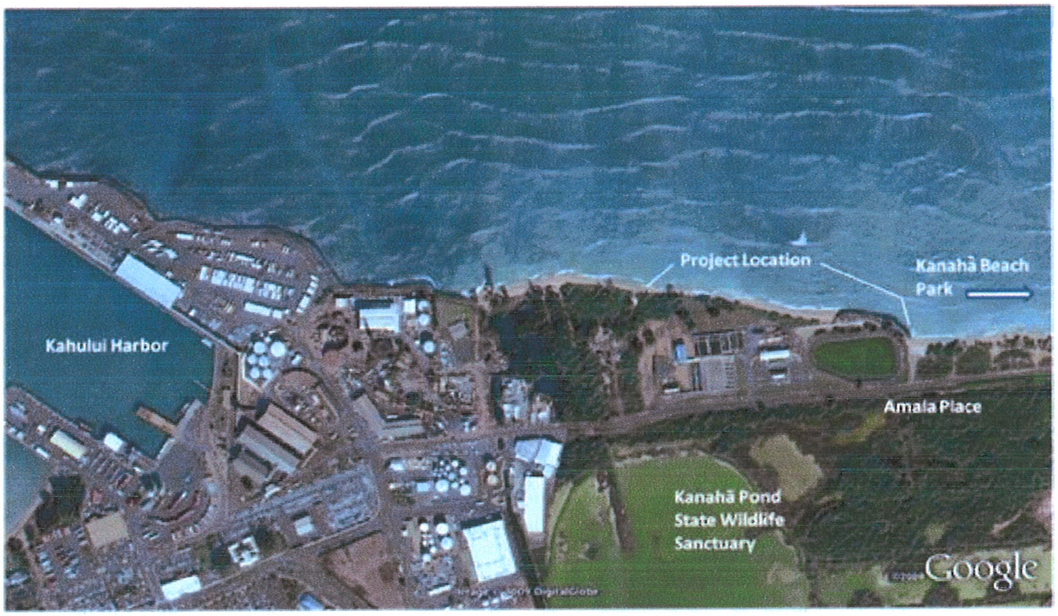


Figure 2. Satellite image of the proposed project location.

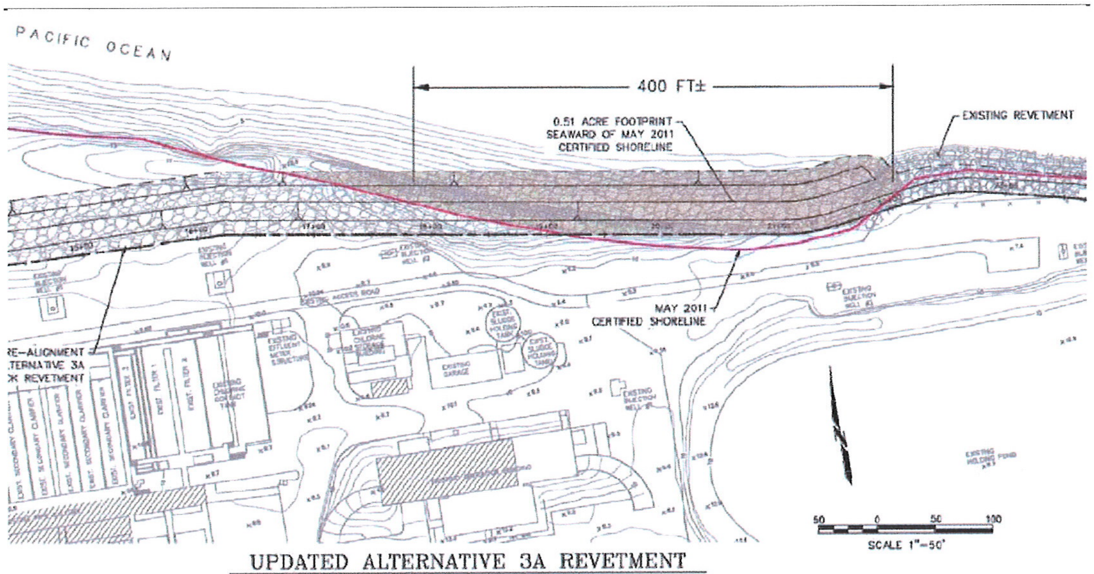


Figure 3. Location the proposed WKWWRF shoreline revetment extension.

Survey Methods

Water Quality

Water samples were collected and field parameters measured at three water quality stations off the shore in the proposed project area on three sampling events: December 11, 17, and 22, 2009. Figure 4 illustrates the station locations. Station "West" was located nearly to the western end of the project area; Station "Mid" was located roughly in the middle of the project area; and Station "East" was located off the rock mound revetment at the eastern side of the project area. Samples collected at each of the three stations were collected in appropriate containers, placed on ice, and taken to the *AECOS*, Inc. laboratory. The following parameters were measured in the laboratory on collected water samples: turbidity, total suspended solids, ammonia, nitrate+nitrite, total nitrogen, total phosphorus, and chlorophyll α. Dissolved oxygen (DO), pH, salinity, and temperature were measured with field instruments at the time of sample collection. Table 1 lists the instrumentation and analytical methods used for field and laboratory water analyses.

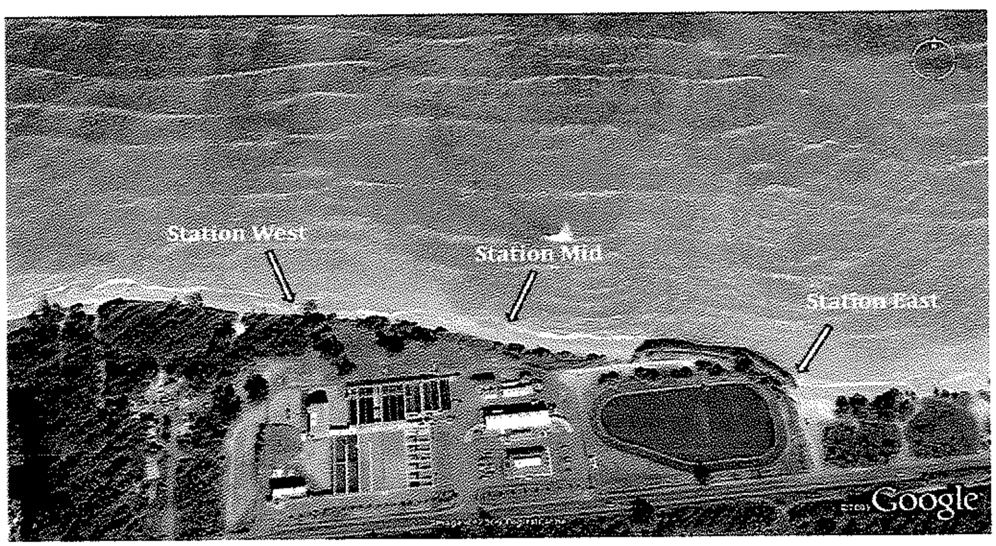


Figure 4. Location of December 2009 water quality sample stations.

Table 1. Analytical methods used in water quality analysis of samples collected for the WKWWRF shoreline protection project.

Analysis	Method	Reference	Instrument
Ammonia	EPA 350.1	EPA (1993)	Technicon AutoAnalyzer II
Dissolved Oxygen	SM 4500-O G	Standard Methods 20th Edition (1998)	YSI Model 550A DO meter
Nitrate + Nitrite	EPA 353.2 Rev 2.0	EPA (1993)	Technicon AutoAnalyzer II
pH	SM 4500 H+	Standard Methods 20th Edition (1998)	Hannah pocket pH meter
Salinity	Method 2520 B	Standard Methods 20th Edition (1998)	Age Model 2100 bench salinometer
Temperature	thermister calibrated to NBS cert. thermometer SM 2550 B	Standard Methods 20th Edition (1998)	YSI Model 550A DO meter
Total Nitrogen	persulfate digestion/EPA 353.2	Grasshoff et al (1986)/ EPA (1993)	Technicon AutoAnalyzer II
Total Phosphorus	persulfate digestion/EPA 365.1 Rev 2.0	Grasshoff et al. (1986)/EPA (1993)	Technicon AutoAnalyzer II
Total Suspended Solids	Method 2540D	Standard Methods 20th Edition (1998)	Mettler H31 balance
Turbidity	EPA 180.1 Rev 2.0	EPA (1993)	Hach 2100N Turbidimeter

EPA. 1993. Methods for the Determination of Inorganic Substances in Environmental Samples. EPA 600/R-93/100. U.S.
Grasshoff, K., M. Ehrhardt, & K. Kremling (eds). 1986. Methods of Seawater Analysis (2nd ed). Verlag Chemie, GmbH, Weinheim.
Standard Methods. 1998. Standard Methods for the Examination of Water and Wastewater. 20th Edition. 1998. (Greenberg, Clesceri, and Eaton, eds.). APHA, AWWA, & WEF. 1220 pp.

Flora

AECOS, Inc. biologists walked the length of the project site identifying plants and noting their relative abundance within the area. Sample specimens for species not identified in the field were collected for laboratory examination and identification.

Marine Biota

AECOS biologists surveyed the marine community in the nearshore waters fronting WKWWRF using SCUBA. Three transect lines were laid in a northern direction, starting approximately 3 m (9.8 ft) from the shoreline (Fig. 5): two 20-m (65.6-ft) transects off the western (Transect West) and eastern (Transect East) ends of the project area; and a 49-m (160.8 ft) transect off the middle of the project area (Transect Mid). Benthic composition along each transect was determined as percent cover using a point-intercept quadrat method. A 0.5 x 0.5 m (0.25 m^2), polyvinyl chloride (PVC), quadrat frame was placed at every meter mark along each transect line, resulting in a total of 89 quadrat counts. The frame was strung with heavy nylon thread forming a 10 cm grid of five rows and five columns, and producing 25 point-intercepts. Due to high surf and heavy wave surge conditions, it was necessary for both biologists to secure and hold down the frame. Once laid and held in place, the item under each of the 25 cross points was recorded. From these counts, percent cover was determined by category.

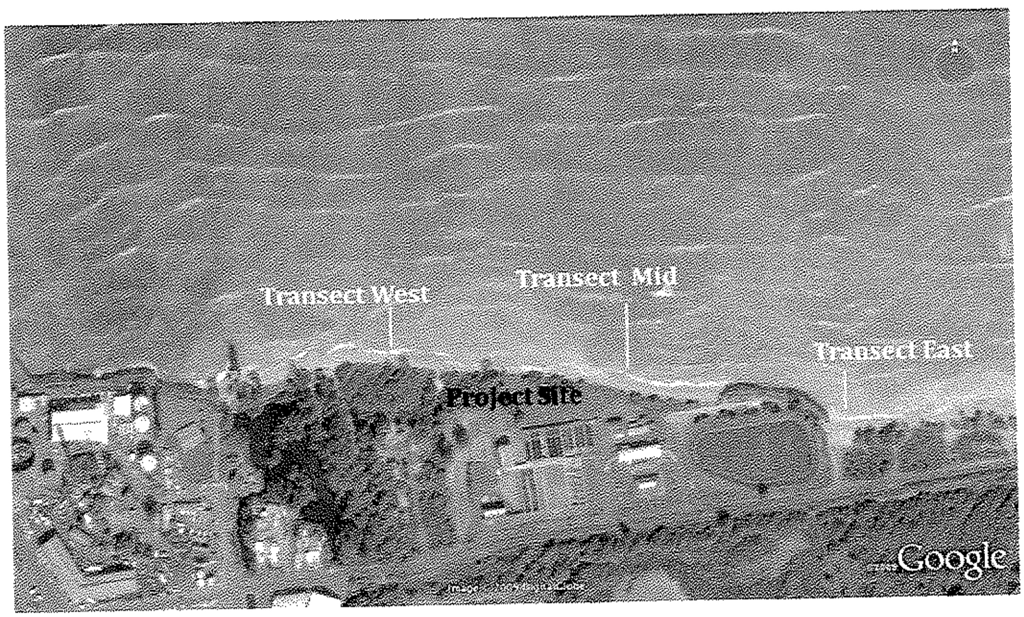


Figure 5. Location of the December 17, 2009 survey transects along the project shoreline.

A separate, quantitative fish survey, with a biologist swimming slowly along each transect and recording all fishes and their approximate lengths was planned. However, due to the extreme surge conditions, it was necessary for both biologists to conduct the quadrat survey. Fishes that were encountered along transects during the quadrat survey were identified and recorded.

Survey Results

Water Quality

A summary of the water quality results are presented in Tables 2 and 3. Complete water quality data for each sampling event are given in Appendix A. As might be expected, given their proximity to each other, the stations had very similar water temperature, dissolved oxygen (DO), pH, and salinity. Mean water temperatures were exactly or nearly the same across the three stations (25.1 to 25.4° C. Mean DO was also nearly the same across the stations (6.85 to 6.88 mg/l, representing saturations of 101%); mean pH was normal for seawater and similar at all three stations; mean salinities were 33 PSU (practical salinity units), typical for seawater.

Table 2. Summary (means) of marine water quality characteristics off WKWWRF shoreline, December 2009 (n = 3)

STATION	Temp. (°C)	Salinity (PSU)	pH	DO (mg/l)	DO Sat. (%)
West	25.1	33.43	8.05	6.88	101
Mid	25.0	33.40	7.97	6.88	101
East	25.4	33.15	8.12	6.85	101

Geometric means were calculated for particulates (turbidity and total suspended solids [TSS]), and for nutrients (Table 3). These means can be used for comparison with state water quality criteria (see below). TSS, turbidity, and concentrations of ammonia, nitrate-nitrite, total nitrogen (TN), total phosphorus (TP) were elevated at all three stations, but especially so at Sta. East. Chlorophyll α in the water column gives an indication of the phytoplankton biomass present and was high at all three stations, ranging from 0.80 to 0.97 µg/L.

Table 3. Summary (geometric means) of nutrients and chlorophyll α in marine waters off WKWWRF shoreline (*n* = 3).

STA.	TSS (mg/L)	Turbidity (NTU)	Ammonia (µg N/L)	NO_2+NO_3 (µg N/L)	Total N (µg N/L)	Total P (µg P/L)	Chl. α (µg/L)
West	10.14	6.32	4.48	59.42	253.87	25.41	0.90
Mid	11.11	5.36	4.90	61.94	248.90	21.86	0.97
East	11.39	7.00	7.36	144.45	378.24	30.72	0.80

Flora

A listing of plant species identified along the project shoreline and existing seawall is provided in Table 4. The vegetation on the beach and dunes within project site are typical of coastal sites in Hawaiʻi. Beach *naupaka* (*Scaevola sericea*) is dominant, growing the entire length of the survey area. Tree heliotrope (*Tournefortia argentea*) and *ʻakiʻaki* (*Sporobolus virginicus*) are common. Sourbush (*Pluchea carolinensis*), Indian fleabane (*Pluchea indica*), and sea purslane or *ʻakulikuli* (*Sesuvium portulacastrum*) are occasional behind the beach. Ironwood (*Casuarina equisetifolia*) and *koa haole* (*Leucaena leucocephala*) are also present, typically growing several meters landward of the beach. Beach morning glory (*Ipomoea pes-caprae* ssp. *brasiliensis*) and white morning glory (*Ipomoea violacea*) cover sand dunes in a few areas devoid of larger vegetation.

The soil inland from the existing seawall consists of fill material with a large amount of gravel that is only sparsely vegetated. The seaward edge of this strip of land is dominated by sea purslane. A few grasses (*S. virginicus*, *Chloris barbata*, *Cynodon dactylon*) and dicot herbs like *alena* (*Boerhavia repens*) and seaside heliotrope (*Heliotropium curassavicum*) grow in the fill area as well. Indian fleabane is occasional. Goosefoot (*Chenopodium murale*) is common landward of the seawall's western end. Pigweed (*Portulaca oleracea*), tree tobacco (*Nicotiana glauca*), beach morning glory, white morning glory, and golden crown-beard (*Verbesina enceliodes*) are all present. A single *nehe* (*Lipochaeta succulenta*) plant is the only endemic species identified in the project area.

Table 4. List of plant species identified from the project area on December 11, 2009.

FAMILY *Genus species*	Common name	Status	Abundance Sea-wall	 Beach/ Dune
	Fungi			
AGARICACEAE				
Agaricus subrufescens Peck	almond mushrooom	**Ind**	R	--
	Flowering Plants – Dicotyledons			
AIZOACEAE				
Sesuvium portulacastrum (L.) L.	sea purslane; *'ākulikuli*	**Ind**	C	O
ASTERACEAE				
Lipochaeta succulenta (Hook. & Arnott) DC	*nehe*	**End**	R	--
Pluchea carolinensis (Jacq.) G.Don	sourbush	Ind	--	O
Pluchea indica (L.) Less.	Indian fleabane	Nat	O	O
Verbesina enceliodes L.	golden crown-beard	Nat	R	--
BORAGINACEAE				
Heliotropium curassavicum L.	seaside heliotrope *kīpūkai*	**Ind**	R	--
Tournefortia argentea L. Filius.	tree heliotrope	Nat	--	C
CASUARINACEAE				
Casuarina equisetifolia L.	ironwood	Nat	R	O
CHENOPODIACEAE				
Chenopodium cf. *murale* L.	goosefoot	Nat	C	--
CONVULVULACEAE				
Ipomoea pes-caprae (L.) R.Br. ssp. *brasiliensis* (L.) Ooststr.	beach morning glory; *pōhuehue*	**Ind**	R	U
Ipomoea violacea L.	white morning glory	Nat	--	U
EUPHORBACEAE				
Chamaesyce hypericifolia (L.) Mills.	graceful spurge	Nat	R	--
FABACEAE				
Leucaena leucocephala (Lam.) deWit	*koa haole*	Nat	--	O
GOODENIACEAE				
Scaevola sericea Vahl.	*naupaka kahakai*	**Ind**	--	A

Table 4 (continued).

FAMILY *Genus species*	Common name	Status	Abundance Sea-wall	Abundance Beach/ Dune
MALVACEAE				
Thespesia populnea (L.) Sol. ex Correa	*milo*	**Ind**	--	U
NYCTAGINACEAE				
Boerhavia repens L.	*alena*	**Ind**	--	U
PORTULACACEAE				
Portulaca oleracea L.	pigweed; *'ākuilkuli kula*	Nat	R	--
SOLANACEAE				
Nicotiana glauca R.C. Graham	tree tobacco; *mākahāla*	Nat	R	--
Flowering Plants - Monocotyledons				
ARECACEAE				
Cocos nucifera L.	coconut palm; *niu*	**Pol**	--	R
POACEAE				
Chloris barbata (L.) Sw.	swollen fingergrass	Nat	O	--
Cynodon dactylon (L.) Pers.	Bermuda grass	Nat	U	--
Sporobolus virginicus (L.) Kunth	*'aki'aki*	**Ind**	R	C
indet.	foxtail	Nat	R	--

Legend:

Status = distributional status

End – Native and unique to the Hawaiian Islands;

Ind - indigenous; native to Hawai'i, 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;

Pol - Polynesian introduction before 1778.

Abundance = occurrence ratings for plants

R - rare - only one or two plants seen;

U - uncommon - several to five plants observed;

O - occasional - found between five and ten times; not abundant anywhere;

C - common - considered an important part of the vegetation and observed numerous times;

A - abundant - found in large numbers; may be locally dominant.

Marine Biota Survey

The environment off the project site consists of a remnant reef in water ranging in depth from 0 to 3.7 m (0 to 12 ft), with a substratum of sand and minimal habitat complexity or vertical structure. High surf and heavy surge at the time of the survey resulted in resuspension of sand and cloudy water conditions during the survey. A listing of marine algae and animals—including fishes identified and their relative abundances— encountered during the survey is presented as Appendix B. Of the species identified in the project area, none is listed as threatened or endangered (USFWS, 2009).

Three transects, with a total of 89 quadrat counts, were used to calculate benthic community composition in the area likely to be effected by the proposed project (Table 5). Benthic community composition for each transect is listed in Appendix C. Results from the point-intercept quadrat surveys show that zoanthids, sand, and algae (turf and foliose), make up the majority of the bottom (roughly 25% coverage for each; see Fig. 5). Smaller amounts of rubble (15%), crustose coralline algae (3%), and bare limestone (6%) are present. Coral cover accounts for less than one percent of the area sampled by the transects.

Table 5. Summary statistics of percent benthic cover in nearshore waters of WKWWRF.

	Sand	Rubble	Coralline	Turf	Foliose	Limestone	Zoanthid	Coral	Invert
Mean	25.2	15.2	2.9	10.3	14.2	5.8	26.0	0.1	0.2
Median	20.0	0.0	0.0	8.0	12.0	0.0	12.0	0.0	0.0
Range	0 - 100	0 - 76	0 - 28	0 - 48	0 – 68	0 - 52	0 - 88	0 - 8	0 – 4
Std. dev	±23.6	±21.2	±5.7	±12.1	±14.1	±10.5	±29.5	±0.9	±0.9

Foliose and turf-forming algae comprise approximately 25% of bottom cover in the surveyed area (Fig. 5). The invasive red alga (Rhodophyta), *Acanthophora spicifera*, and green alga (Chlorophyta), *Bryopsis pennata*, are commonly observed growing on hard substrata. Also common is the encrusting coralline red alga, *Hydrolithon reinboldii*. Present in low abundance are the red algal species *Amansia glomerata*, *Hydrolithon reinboldii*, *Martensia fragilis*, *Pterocladiella capillacea*, *Wranglia elegantissima*, and the brown algae, *Dictyota* *friablis*, and *Sphacelaria rigidula*. Two endemic species (*Dotyella hawaiiensis* and *Wranglia elegantissima*) are present but rare.

Only 2 of the 89 quadrats surveyed within the project area contained live coral heads, both occurring on Transect East. As calculated from the quadrat surveys, coral coverage accounts for less than one percent of the area sampled (Fig. 6). Two species of coral were identified in the area: lace coral (*Pocillopora damicornis*) and cauliflower coral (*P. meandrina*).

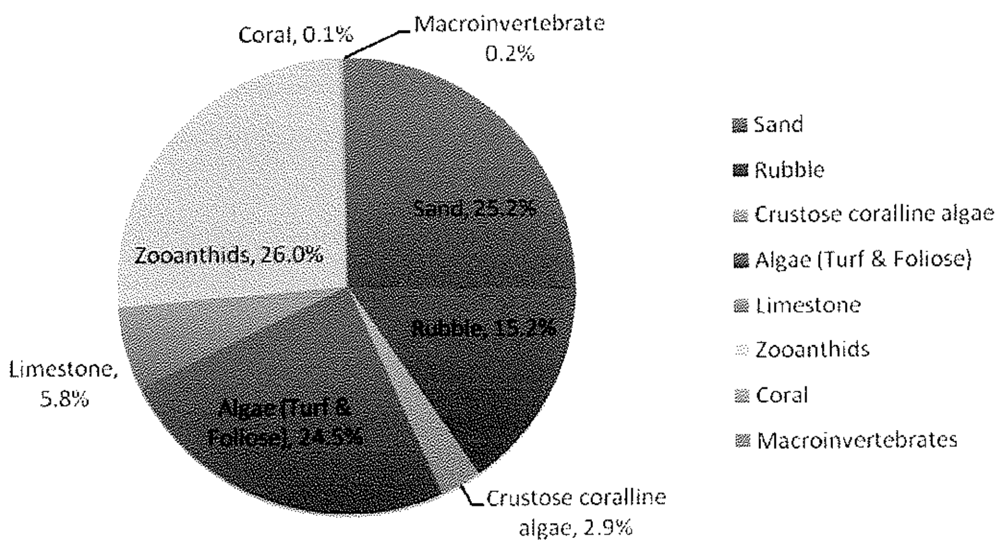


Figure 6. Percent benthic cover in nearshore waters of WKWWRF.

Zoanthids (*Palythoa caesia* and *Zoanthus* spp.) are common in the project area, found growing on exposed hard surfaces and partially buried in sand. Other invertebrates are seen in small numbers in the project area, accounting for only about 0.2% of bottom cover. Of the few invertebrates seen, the glass anemone (*Aiptasia pulchella*) is most common, found in crevices and growing alongside zoanthids. Turf tubeworms (*Mesochaetopterus sagittarius*), false 'opihi (*Siphonaria normalis*), and nerite snail (*Nerita picea*) are sighted occasionally. Other invertebrates seen rarely throughout the survey include the whitespotted cucumber (*Actinopyga mauritiana*), dotted periwinkle (*Littorina pintado*), hooked wenteltrap (*Epitonium replicatum*), cone snails (*Conus* sp.), brown purse shells (*Isognomon perna*), spiny brittle star (*Ophiocoma erinaceus*), pebble crab (*Liomera* sp.), and thin shelled rock crab (*Grapsus tenuicrustatus*). The black foot *'opihi* (*Cellana exarta*) is the only endemic invertebrate species observed during the marine survey.

Fishes are uncommon in the project area. The rock-mover wrasse (*Novaculichthys taeniourus*), striped mullet (*Mugi cephalus*), raccoon butterflyfish (*Chaetodon lunula*), bright-eye damselfish (*Plectroglyphidodon imparipennis*), and the black tail snapper *(Lutjanus fulvus*) are among the few fishes sighted. The Hawaiian green lionfish (*Dendrochirus barberi*) and the ornate wrasse (*Halichoeres ornatissimus*), both endemic to Hawai'i, occur hiding in rubble.

Discussion

Water Quality

State of Hawai'i, Water Quality Standards classify the marine waters fronting WKWWRF as Class A, open coastal waters (HDOH, 2004). The objective of Class-A waters is that their use for recreational purposes and aesthetic enjoyment be protected. Other use shall be permitted, as long as compatible with the protection and propagation of fish, shellfish, and wildlife, and with recreation in and on these waters.

The primary purpose of the water quality measurements made in December 2009 was to characterize the existing aquatic environment. The criteria for all nutrient measurements, turbidity, and chlorophyll α require developing geometric means to compare with the state standards (HDOH, 2004). These water quality means can be used to establish whether the nearshore waters in the project area meet the standards as promulgated for marine open coastal waters (Table 6). However, the fact that the samples were collected over a relatively short time period of less than two weeks does call to question their representativeness, and this fact should be considered in interpreting the results.

Water quality at the proposed project site, as measured on three occasions in December 2009, showed temperatures, DO, pH, and salinity values within normal ranges. Salinity values indicate that fresh or brackish water inputs were evident along the surveyed shoreline, particularly at Sta. East. TSS, turbidity and concentrations of TN, TP, nitrate + nitrite, and chlorophyll were clearly elevated with respect to state criteria at all three stations. Our samples were located close to shore where heavy wave and surge activity may explain the elevated TSS and turbidity by suspending bottom sediments. Concentrations of ammonia, nitrate-nitrite, TN, and TP values at Sta. East were especially high. Sta. East was located adjacent to the basalt boulder revetment and elevated nutrient levels may reflect groundwater inputs at the shore. Sources of groundwater could include the pond west of the WKWWRF, Kanaha Pond mauka of the project, or the asphalt lined pond on the WKWWRF facility. Rainwater and irrigation water applied to fertilized agricultural lands in central Maui drain into Kahului Bay and surrounding waters through the aquifer and surface waterways like Kalialinui Gulch located 2100 ft (640 m) east of the project site and can elevate nutrient levels and influence salinities (Brown and Caldwell, 1990).

Table 6. State of Hawai'i water quality criteria for Class A, marine open coastal waters from HAR §11-54-6 (b)(3) (HDOH, 2004).

Parameter units	**Turbidity** (NTU)	**Total Nitrogen** (µg N/l)	**Nitrate + Nitrite** (µg N/l)	**Ammonia** (µg N/l)	**Total Phosphorus** (µg P/l)	**Chl. α** (µg/l)
Geometric mean not to exceed given value	0.50*	150.00*	5.00*	3.50*	20.00*	0.30*
	0.20**	110.00**	3.50**	2.00**	16.00**	0.15**
Value not to be exceeded more than 10% of the time	1.25*	250.00*	14.00*	8.50*	40.00*	0.90*
	0.50**	180.00**	10.00**	5.00**	30.00**	0.50**
Value not to be exceeded more than 2% of the time	2.00*	350.00*	25.00*	15.00*	60.00*	1.75*
	1.00**	250.00**	20.00**	9.00**	45.00**	1.00**

* Wet criteria apply when the average fresh water inflow from the land equals or exceeds one percent of the embayment volume per day.

** Dry criteria apply when the average fresh water inflow from the land is less than one percent of the embayment volume per day.

The following non-specific criteria are applicable to both "wet" and "dry" conditions.

- pH shall not deviate more than 0.5 units from 8.1, except at coastal locations where and when freshwater may depress the pH to a minimum of 7.0.
- Dissolved oxygen shall not be less than 75% saturation.
- Temperature shall not vary more than 1 °C from ambient.
- Salinity shall not vary more than 10 percent from natural or seasonal changes.

Flora

The flora in the area of the proposed seawall extension consists of coastal strand vegetation typical of beaches in the Hawaiian Islands. The area where a seawall already exists is a mix of coastal and ruderal species common in Hawai'i. Only one endemic plant specimen, a small *nehe* (*Lipochaeta succulenta*) was identified in the survey area. A tree tobacco (*Nicotiana glauca*) plant was also identified growing near the fence-line above the existing seawall. Tree tobacco and other Solonaceae are reported to host Blackburn's sphinx moth (*Manduca blackburni*), an endangered species native to Hawai'i with a known population in the area and sometimes observed around Kanahā Pond (USFWS, 2010). Casual examination of the single tree tobacco plant in the project area revealed no Blackburns's sphinx moth larvae feeding on the leaves at the time of the biological survey or during any of the three dates on which water quality samples were collected. If it is necessary to remove this plant for the seawall extensions, observations for eggs and caterpillars (larvae) must be made just prior to its removal. If Blackburn's sphinx moth eggs or larvae are present, arrangements will need to be made with USFWS to protect these, possibly by moving the larvae—under supervision of an entomologist—to another tree tobacco plant out of harms way.

Marine Biota

Marine life occurring in the proposed project area is largely limited to algae, zoanthids, other invertebrates, and few fishes. Our survey found two species of scleractinian (stony) corals colonies located within the project area. Both small colonies were found approximately 15 m (49.2) offshore. Maintaining water quality and avoiding directly impacting coral colonies during construction will be necessary to prevent loss, damage, or other adverse effects to the coral colonies near the project site. Relatively few fishes are present on this part of the reef and fishes will not be adversely affected by the project.

The green sea turtle was not encountered during the survey but likely frequents the marine waters fronting WKWWRF. Green sea turtle congregations are a daily occurrence at the Kahului Power Plant's seawater discharge located just 1300 ft (400 m) west of the project site (Maui News, 2010). The green sea turtle is listed as a "threatened" species (NOAA, 2009) under the Endangered Species Act (ESA). Additionally, green sea turtle is protected under Hawai'i Revised Statutes, Chapter 195D and Hawai'i Administrative Rules, 13-124. The proposed methods of construction will avoid impacts to sea turtles that may be in the area, although work should stop if a turtle enters the immediate area of construction, to resume only after the turtle departs the project area. No other endangered or threatened species (USFWS, 2009) are anticipated to utilize the nearshore waters fronting the WKWWRF.

Both direct and indirect impacts to the biological community and water quality off the shore from WKWWRF are likely to be fairly minimal, but construction best management practices (BMPs) must be implemented.

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Appendix A. Water Quality Data of nearshore waters of WKWWRF, from three sampling events.

STATION Date	Time Sampled	Temp. (°C)	Salinity (PSU)	pH --	DO (mg/l)	DO Sat. (%)	TSS (mg/L)
West							
12-11-2009	1219	25.3	33.5	8.22	6.88	102	11.8
12-17-2009	0915	24.9	34.0	7.91	6.79	100	9.7
12-22-2009	1639	25.2	32.8	8.02	6.97	102	9.1
Mid							
12-11-2009	1205	25.6	33.5	8.21	6.72	100	15.4
12-17-2009	0933	24.4	33.7	7.94	6.70	98	9.0
12-22-2009	1649	24.9	32.4	8.04	7.31	107	9.9
East							
12-11-2009	1237	25.1	32.9	8.27	7.17	104	22
12-17-2009	0941	24.4	33.5	8.01	6.20	91	8.2
12-22-2009	1700	24.8	31.3	8.04	7.47	108	8.2

STATION Date	Turbidity (NTU)	Ammonia (µg N/L)	Nitrate-Nitrite (µg N/L)	Total N (µg N/L)	Total P (µg P/L)	Chl α (µg/L)
West						
12-11-2009	8.52	6	72	197	19	1.24
12-17-2009	6.00	5	47	317	54	0.76
12-22-2009	4.94	<3	62	262	16	0.78
Mid						
12-11-2009	7.15	<4	75	201	22	1.45
12-17-2009	4.20	8	48	281	19	0.71
12-22-2009	5.12	<3	66	273	25	0.89
East						
12-11-2009	12.2	19	186	308	35	0.89
12-17-2009	4.36	7	74	316	23	0.99
12-22-2009	6.46	<3	219	556	36	0.59

Appendix B. Listing of marine biota observed in waters off WKWWRF on December 17, 2009.

PHYLUM, CLASS, ORDER FAMILY *Genus species*	Common name	Abundance	Status
	ALGAE		
RHODOPHYTA			
Acanthophora spicifera		C	Ind.
Ahnfeltiopsis coincinna	*limu 'aki'aki*	U	Ind.
Amansia glomerata		O	Ind.
Dotyella hawaiiensis		U	End.
Hydrolithon onkodes		R	Ind.
Hydrolithon reinboldii		C	Ind.
Hypnea musciformis	hookweed	U	Ind.
Martensia fragilis		O	Ind.
Peyssonnelia rubra		U	Ind.
Pterocladiella capillacea		O	Ind.
Wranglia elegantissima		O	End.
CHLOROPHYTA			
Bryopsis pennata		C	Ind.
Caulerpa macrophysa		U	Ind.
Caulerpa serrulata		R	Ind.
Dictyospaeria cavernosa			
Ulva fasciata	*limu pālahalaha*	U	Ind.
PHAEOPHTYA			
Dictyota friablis		O	Ind.
Ralfsia expansa		R	Ind.
Sphacelaria rigidula		O	Ind.
	INVERTEBRATES		
PORIFERA			
unid.	purple sponge	R	--
CNIDARIA, ANTHOZOA, ACTINARIA			
AIPTISIIDAE			
Aiptasia pulchella	glass anemone	A	Ind.
CNIDARIA, ANTHOZOA, ZOOANTHINARIA			
ZOANTHIDAEAE			
Palythoa caesia	blue-gray zoanthid	A	Ind.
Zooanthus sp.	unid. zoanthid	A	--

PHYLUM, CLASS, ORDER FAMILY *Genus species*	Common name	Abundance	Status
CNIDARIA, ANTHOZOA, SCLERACTINIA			
POCILLOPORIDAE			
Pocillopora damicornis	lace coral	R	Ind.
Pocillopora meandrina	cauliflower coral	R	Ind.
ANNELIDA, POLYCHAETA			
CHAETOPTERIDAE			
Mesochaetopterus sagittarius	turf tube worms	O	Ind.
MOLLUSCA, GASTROPODA, PROSOBRANCHIA			
PATELLIDAE			
Cellana exarta	black foot *'opihi*	R	End.
SIPHONARIDAE			
Siphonaria normalis	false 'opihi	O	Ind.
NERITIDAE			
Nerita picea	nerite snail; *pipipi*	O	Ind.
LITTORINIDAE			
Littorina pintado	dotted periwinkle; *pipipi kōlea*	R	Ind.
VERMETIDAE			
Serpulorbis variabilis	variable worm snail; *kauna'oa*	R	Ind.
MOLLUSCA, GASTROPODA			
EPITONIIDAE			
Epitonium replicatum	hooked wenteltrap; *pūpū alapa'i*	R	Ind.
CONIDAE			
Conus lividus	spiteful cone; *pūpū'alā*	R	Ind.
Conus sp.	unid. cone snail	R	–
MOLLUSCA, BIVALVIA			
ISOGNOMIDAE			
Isognomon perna	brown purse shells; *nahawele*	R	Ind.
ARTHROPODA, CRUSTACEA, DECAPODA			
PORTUNIDAE			
unid.	indet. swimming crab	R	--
XANTHIDAE			
Liomera sp.	pebble crab	R	–
GRAPSIDAE			
Grapsus tenuicrustatus	thin shelled rock crab; *'a'ama*	R	Ind.

PHYLUM, CLASS, ORDER FAMILY *Genus species*	Common name	Abundance	Status
OCYPODIDAE			
Ocypode pallidula†	pallid ghost crab; *'ohiki*	U	Ind.
ECHINODERMATA, OPHIUROIDEA			
OPHIOCOMIDAE			
Ophiocoma erinaceus	spiny brittle star	R	Ind.
ECHINODERMATA, HOLOTHUROIDEA			
HOLOTHURIIDAE			
Actinopyga mauritiana	white spotted cucumber; *loli*	R	Ind.
	FISHES		
SCORPAENIDAE			
Dendrochirus barberi	green lionfish	R	End.
LUTJANIDAE			
Lutjanus fulvus	black tail snapper; *to'au*	R	Nat.
MUGILIDAE			
Mugil cephalus	striped mullet; *'ama'ama*	R	Ind.
CHAETODONTIDAE			
Chaetodon lunula	raccoon butterflyfish; *kikākapu*	R	Ind.
POMACENTRIDAE			
Plectroglyphidodon impairipennis	brighteye damselfish	R	Ind.
LABRIDAE			
Halichoeres ornatissimus	ornate wrasse; *la'o*	R	End.
Novaculichthys taeniourus	rockmover wrasse	R	Ind.
unid.	juvenile wrasse	R	–

Appendix C. Summary statistics of percent benthic cover for transect surveyed offshore WKWWRF, December 17, 2009.

Transect West

	Sand	Rubble	Coralline	Turf	Foliose	Limestone	Zoanthid	Coral	Invert.
Mean	45.4	8.4	2.0	16.4	9.8	14.0	3.8	0.0	0.2
Median	40.0	4.0	0.0	12.0	8.0	12.0	0.0	0.0	0.1
Std. dev	±21.8	±11.0	±4.8	±15.6	±9.3	±15.2	±6.2	±0.0	±0.9

Transect Mid

	Sand	Rubble	Coralline	Turf	Foliose	Limestone	Zoanthid	Coral	Invert.
Mean	15.9	22.9	2.0	8.8	14.4	3.4	32.2	0.0	0.2
Median	12.0	8.0	0.0	4.0	12.0	0.0	16.0	0.0	0.0
Std. dev	±18.0	±25.0	±4.2	±11.4	±15.8	±6.1	±33.0	±0.0	±1.0

Transect East

	Sand	Rubble	Coralline	Turf	Foliose	Limestone	Zoanthid	Coral	Invert.
Mean	27.8	3.2	5.8	7.8	18.0	3.6	33.0	0.6	0.2
Median	22.0	0.0	0.0	8.0	16.0	0.0	26.0	0.0	0.0
Std. dev	±25.1	±6.2	±8.5	±7.2	±12.7	±9.6	±24.2	±1.9	±0.9

APPENDIX J.

Letter Report on an Archaeological Field Inspection of Portions of the Central Maui Wastewater Reclamation Facility

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State Historic Preservation Division Maui Office
Department of Land and Natural Resources Annex
Wailuku, Maui
Fax: 243-5838

Attn.: Ms. Jenny Pickett, SHPD Maui Office **30 November 2007**

Subject: Letter report on an archaeological field inspection of portions of the Central Maui Wastewater Reclamation Facility, Wailuku *ahupua`a*, Wailuku District, Maui (TMK (2) 3-8-1: 188). Note: this study has been undertaken for the Tsunami Improvements project at the County of Maui Waste Water Treatment Plant at Kanaha, Maui.

Per our previous conversation, I am providing you with a letter report on a field inspection that I conducted on a portion of the County of Maui Waste Water Treatment Plant at Kanaha, Maui (Figures 1 and 2). The County is currently reviewing improvements that will be needed to "harden" the wastewater treatment facility, and protect it from tsunami inundation. My inspection of a portion of the 18.755 acre parcel was carried out on 29 November of this year.

The project area lies on the windward side of the isthmus of Maui on the coastline. The project area is located in Jaucus and beach sand deposit. This area is known to contain both isolated and clusters of Native Hawaiian burials and/or habitation sites. Much of the project area has been altered by the construction of this wastewater treatment facility, existing infrastructure, and roads. Observed vegetation on the project area consisted of alien weeds and grasses, *koa haole* (Leucaena leucocephela) shrubs, along with *kiawe* (Prosopis pallida) trees. *Naupaka kahakai* (Scaevola sericea) was noted along the makai portion of the parcel. It is estimated that this part of Maui receives between 20 and 30 inches of annual rainfall.

Results of the Field Inspection

I walked over non-built portions of the County parcel; noting portions of the facility that may be "hardened" to resist possible tsunami inundation (see Figure 3 and project photographs). During the course of my walk-over, I noted an area of shoreline erosion (Photograph). Inspection of a wave cut bank revealed what is interpreted as previously disturbed sand. No cultural materials were noted in the cut bank, which is near the *makai* boundary of the parcel. Sand dune deposits were noted in all non built areas. In addition, sand deposits were noted along Amala Place, which provides access to the County facility and Kanaha Park.

It is noteworthy that a portion of Kanaha Pond (Site 50-50-05-1783) is located to the south of the facility, across Amala Place. The pond qualifies for significance under all four National Register Criteria as well as HRHP Criterion "e" for its traditional cultural value. However, the pond will not be impacted by this County project.

Summary and Recommendation

There were no significant material culture remains noted during my inspection. However, based on the presence of sand deposits and the proximity of the shoreline, precautionary monitoring is recommended during the construction of tsunami protection measures. We will prepare and submit a monitoring plan for the Tsunami Improvements project at the County of Maui Waste Water Treatment Plant at Kanaha, in the near future.

Please feel free to contact me @ 572-8900 should you have any questions or need additional information regarding this field inspection for the Tsunami Improvements project at the County of Maui Waste Water Treatment Plant at Kanaha.

Sincerely,

Erik M. Fredericksen

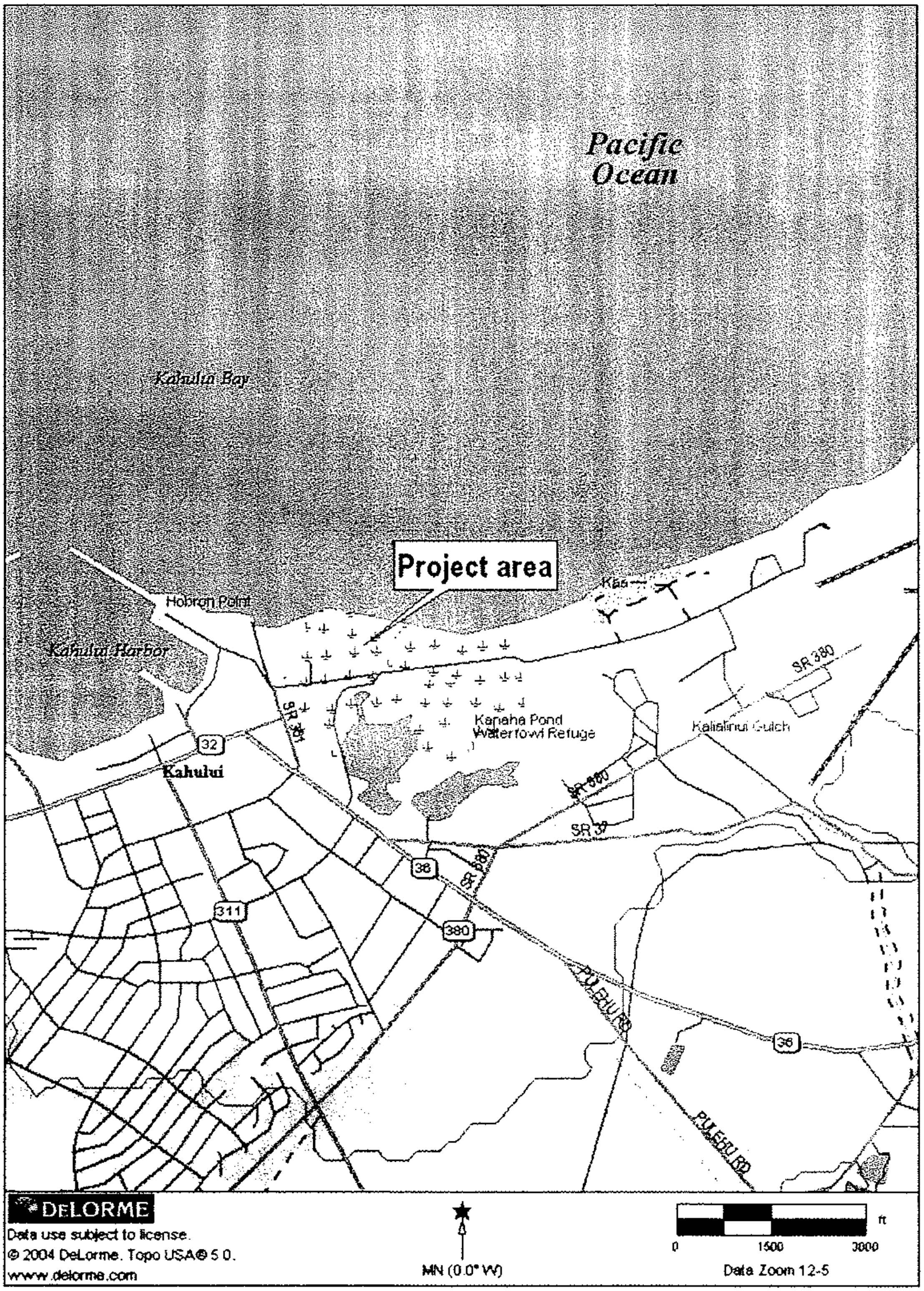


Figure 1: Topographic map with location of the project area, County of Maui Waste Water Treatment Plant at Kanaha, Maui.

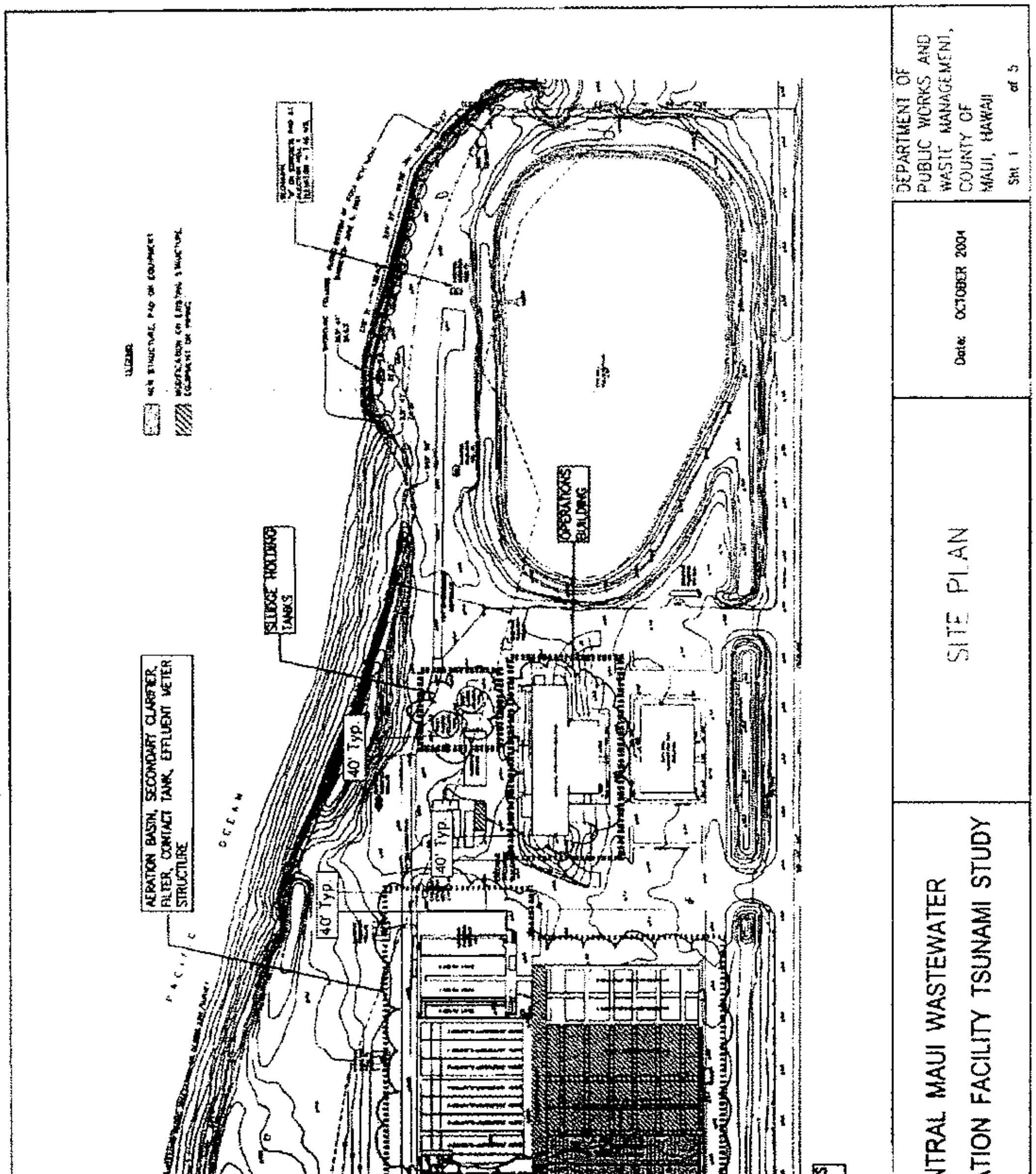
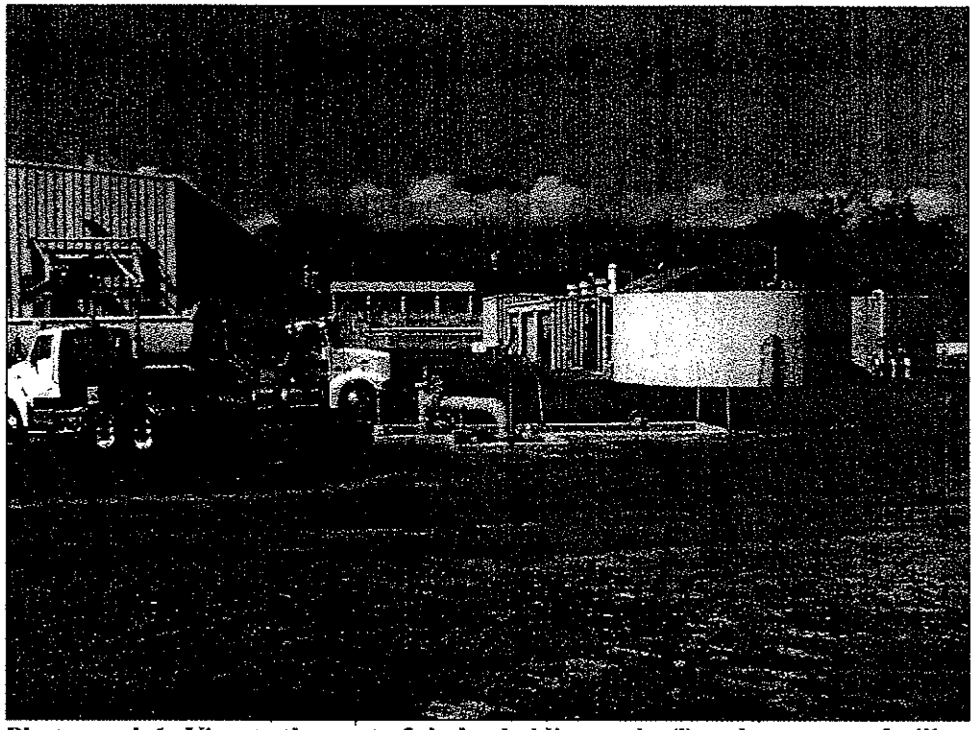


Figure 2: Plan view of the wastewater treatment facility; red areas to be "hardened".

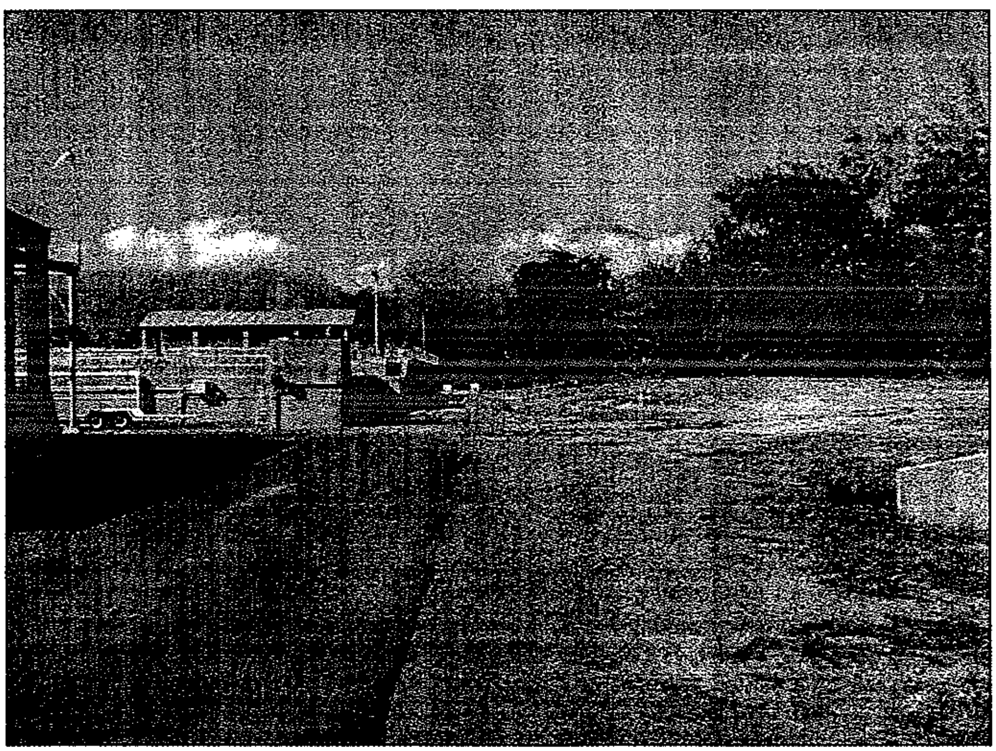
Project Photographs



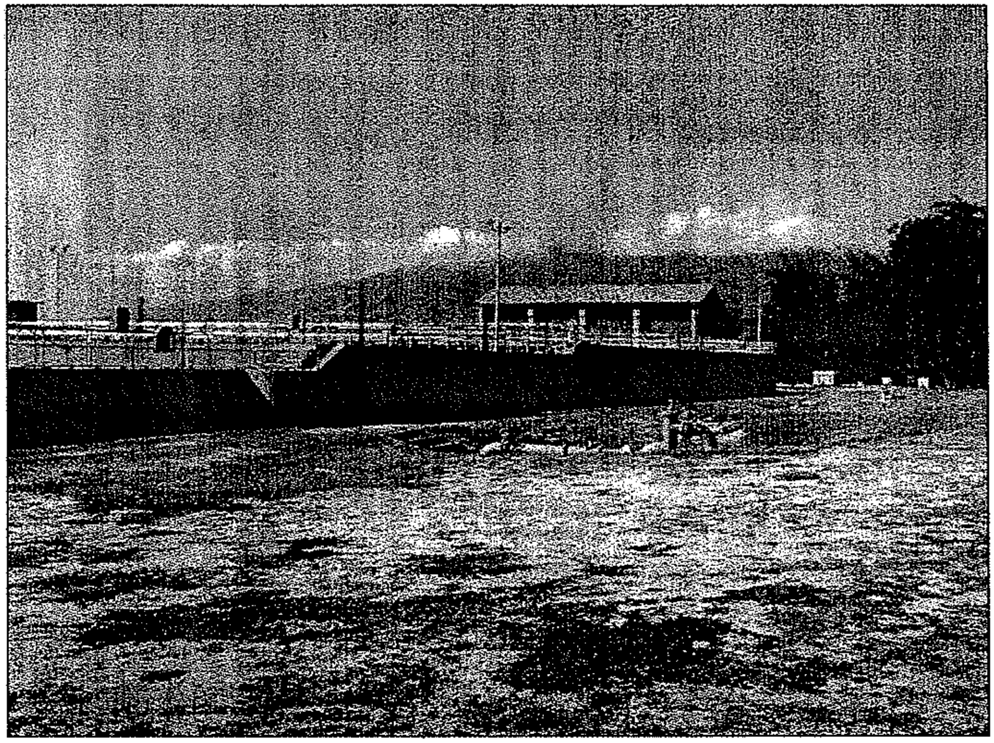
Photograph 1: View to the west of sludge holding tanks (l) and treatment facility.

Photograph 2: View to the west of sludge holding tanks.

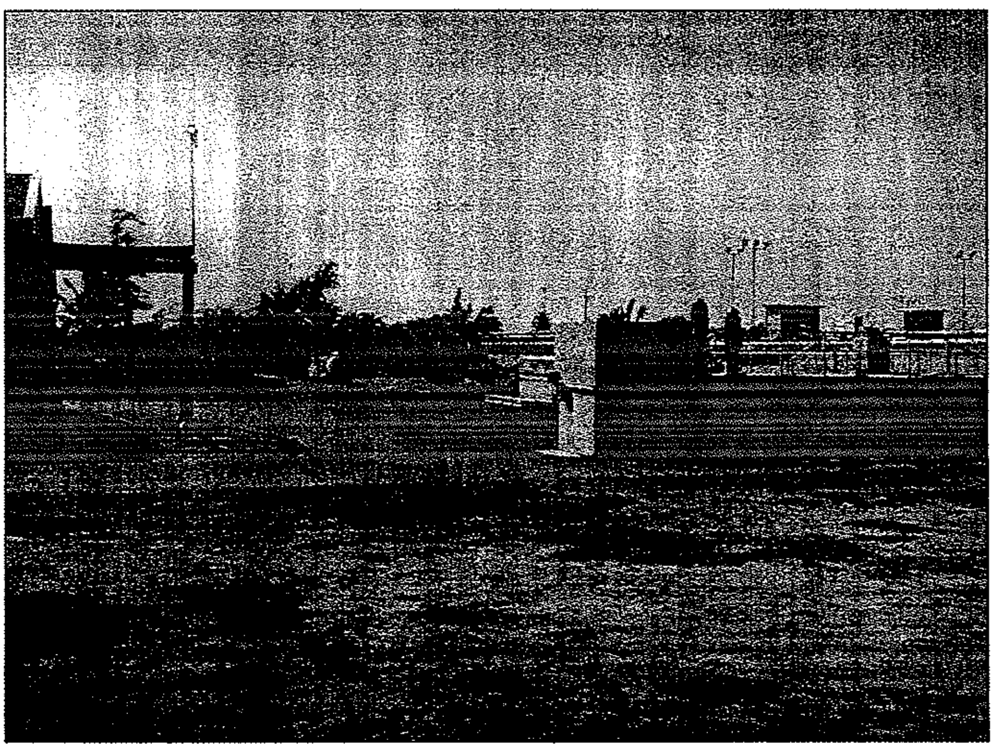
Photograph 3: View to the ENE of wave cut bank that was inspected.



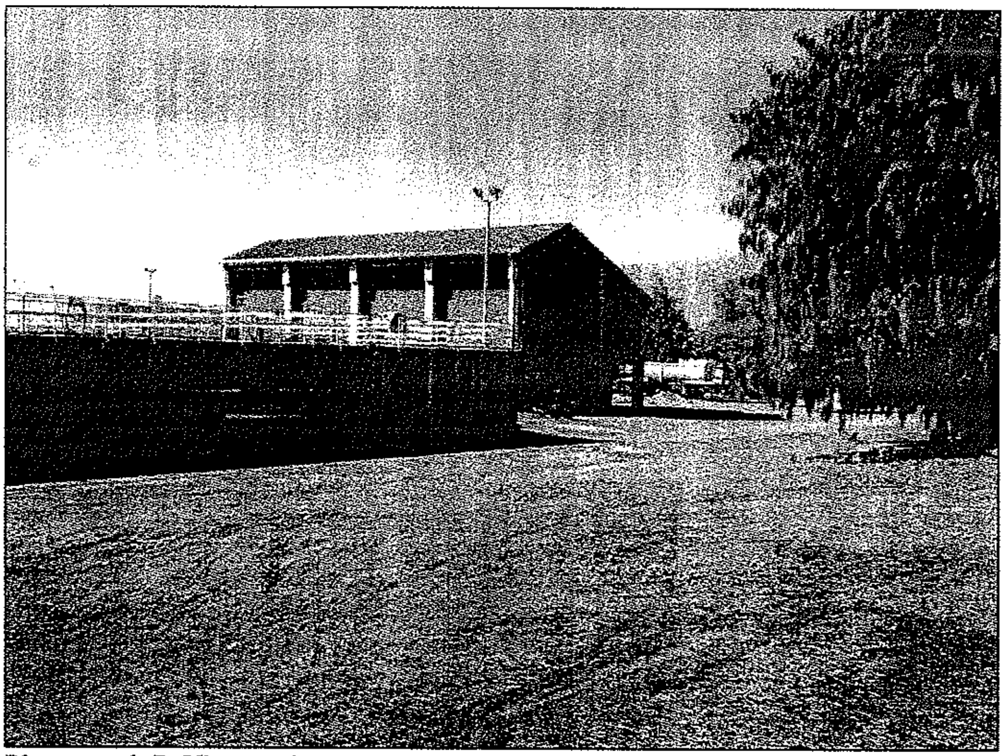
Photograph 4: View to the west towards aeration basin area.



Photograph 5: View to the west towards aeration basin area, pump in foreground.

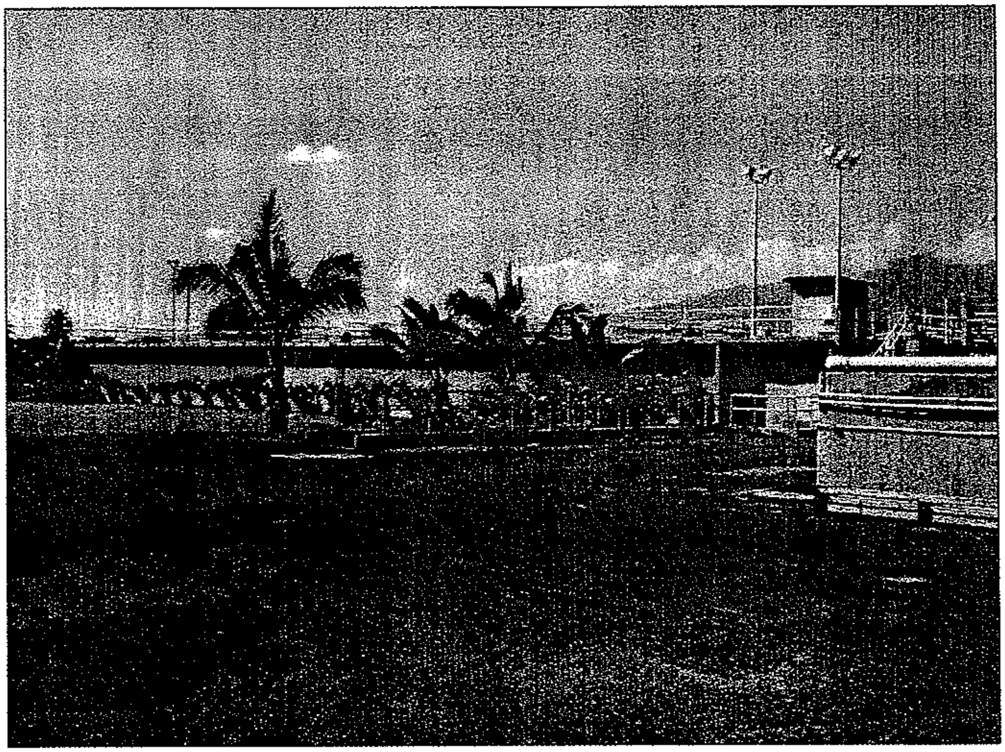


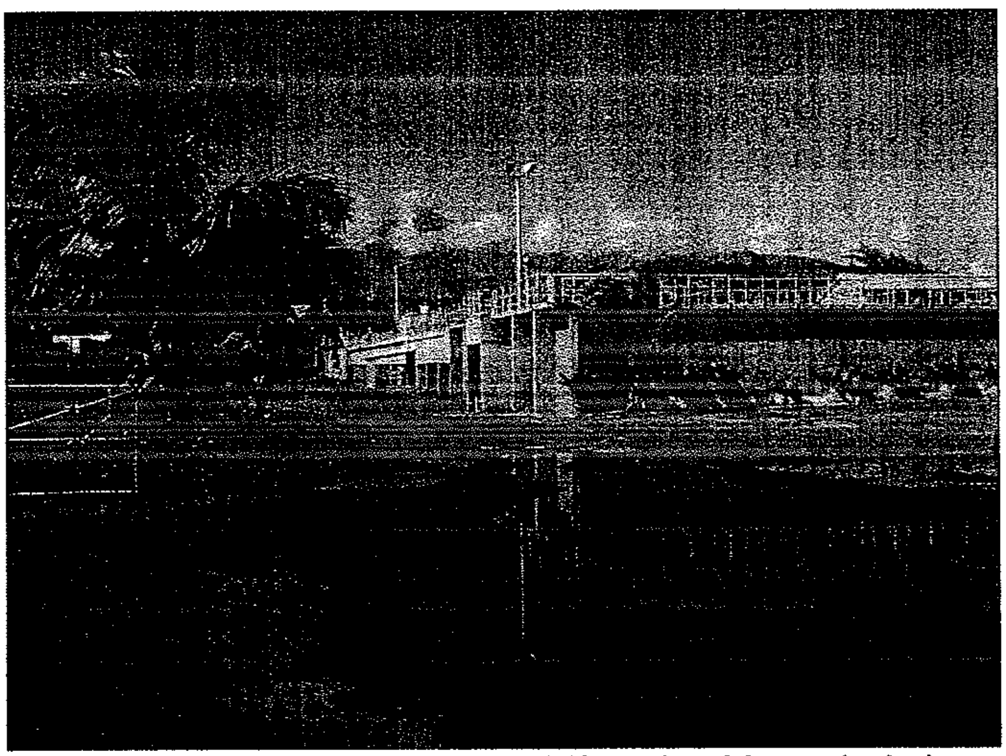
Photograph 6: View to the south of the area between the aeration basin area and the treatment facility.



Photograph 7: View to the west towards western side of the aeration basin area.

Photograph 8: View to the south along the western side of the aeration basin area.


Photograph 9: View to the southwest along the eastern side of the aeration basin area.


Photograph 10: View to the WNW of the roadside portion of the aeration basin area.

APPENDIX J-1.

Archaeological Assessment Survey

AN ARCHAEOLOGICAL ASSESSMENT SURVEY OF AN APPROXIMATELY 1-ACRE PORTION OF LAND EOR THE WAILUKU-KAHULUI WASTEWATER RECLAMATION FACILITY SHORELINE PROTECTION EXTENSION, WAILUKU AHUPUA`A, WAILUKU DISTRICT ISLAND OF MAUI

TMK: (2) 3-8-001: Portion of 188

Prepared on behalf of:

Prepared by:

Xamanek Researches, LLC
Pukalani, Maui

Jennifer J. Frey
Erik M. Fredericksen

7 February 2012

ABSTRACT

Xamanek Researches LLC was first contacted about this tsunami remediation project in the fall of 2010. At the time, there was general concern about the Kahului Waste Water Treatment facility's proximity to the coast. Following the March 2011 Japan tsunami, this concern magnified. Given the location of the project area, it was determined that an inventory/assessment survey was necessary for the proposed c. 1-acre area of impact on the coastal side of the existing waste water treatment facility. Current project plans for the Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension project call for the construction of a new rock revetment and the expansion of an existing revetment on the seaward side of the subject parcel (TMK: (2) 3-8-001: Portion of 188). The project area is located in Wailuku *Ahupua`a*, Wailuku District, Maui.

Fieldwork consisting of a surface walkover and subsurface mechanical testing was carried out in November 2011. No significant material culture remains were located during the archaeological assessment survey. A total of 12 backhoe trenches were utilized to sample the project area. While no significant cultural materials were located, intact sand (marine and dune) deposits were encountered in all test instances. Given the presence of intact sand deposits in the proposed project area, precautionary archaeological monitoring is recommended for all future earthmoving activities within the coastal project area.

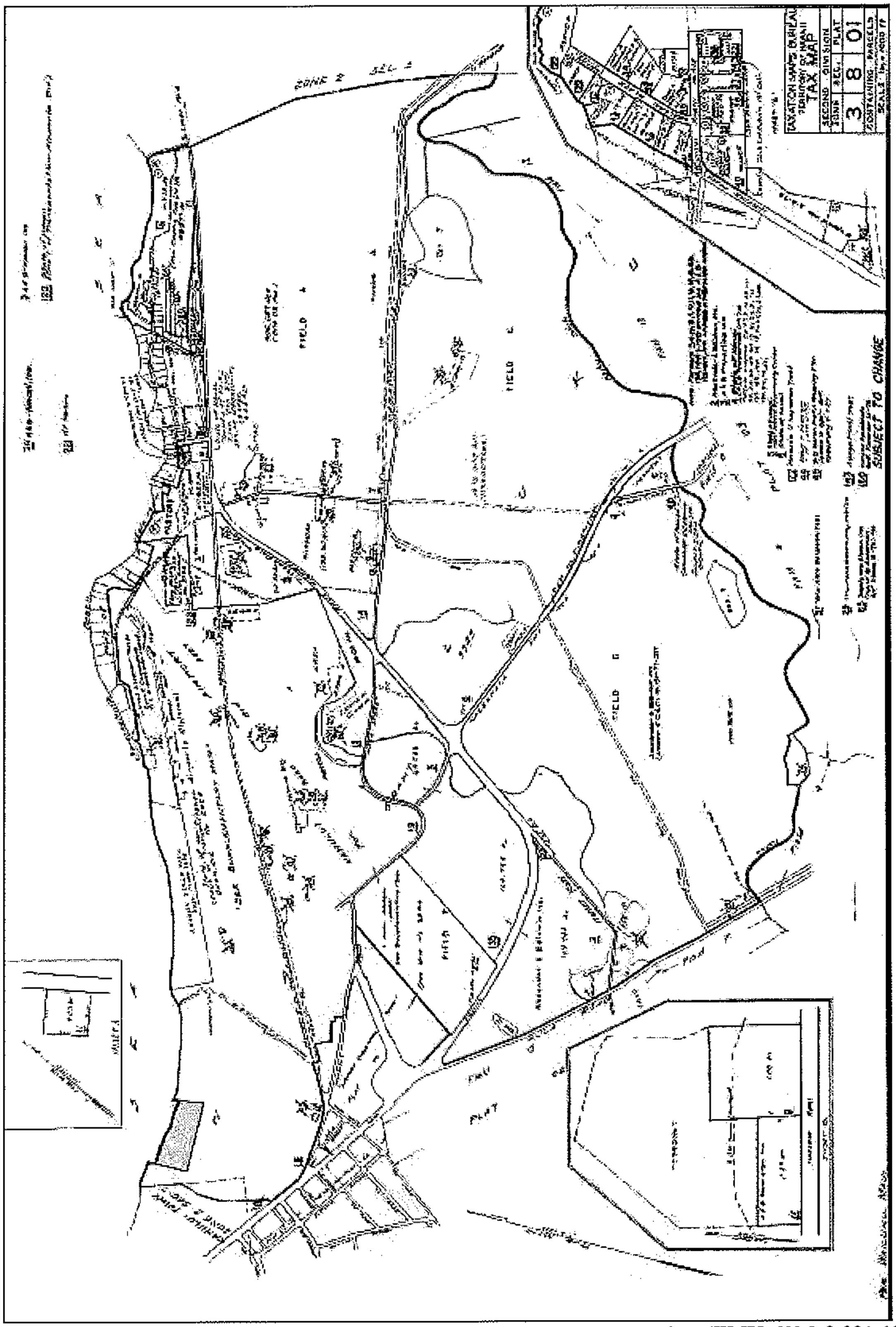


Figure 1: Approximate area of the Kahului Wastewater Treatment Plant project (TMK: [2] 3-8-001:188).

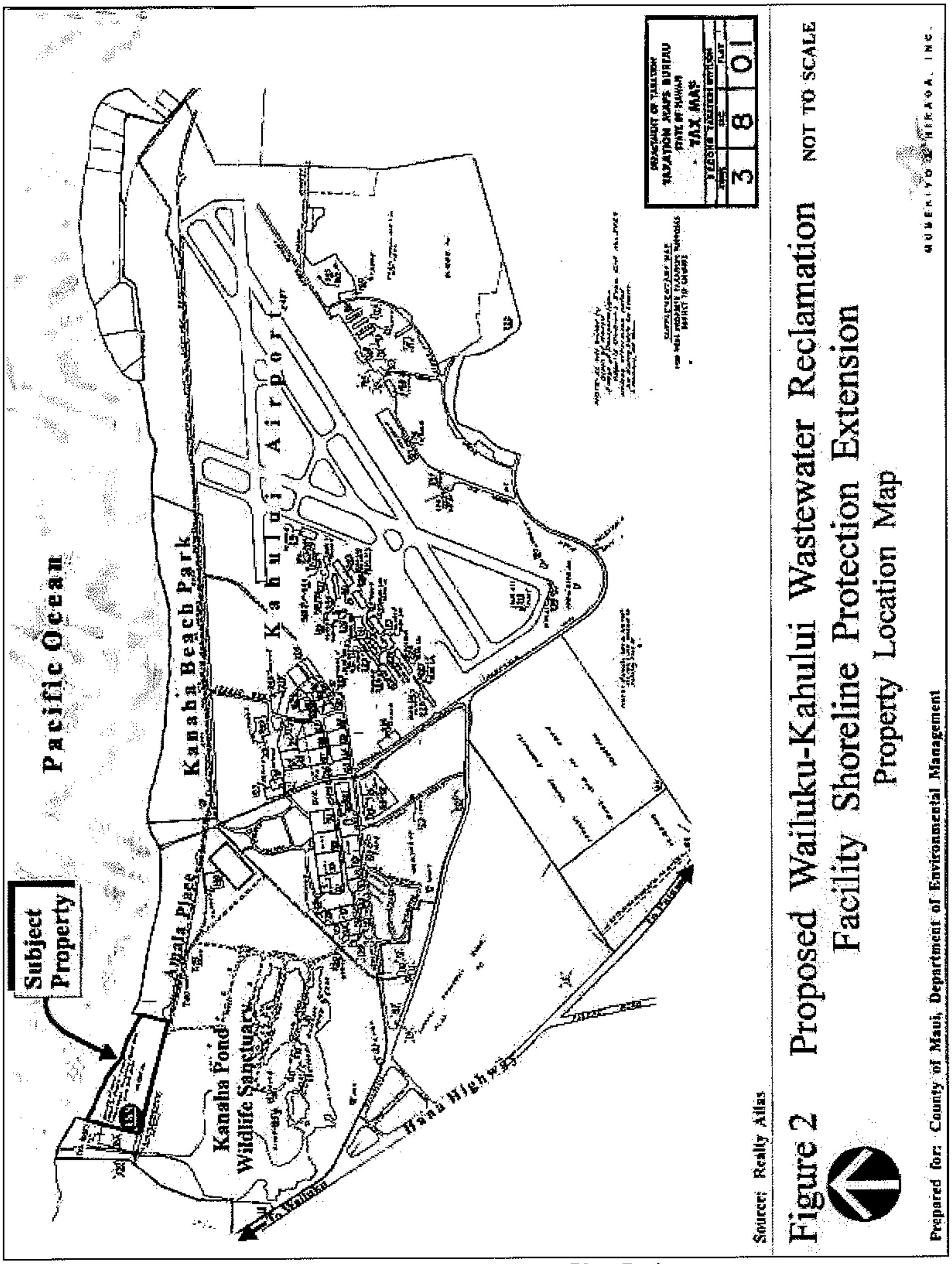


Figure 2: Kahului Wastewater Treatment Plant Project area map.

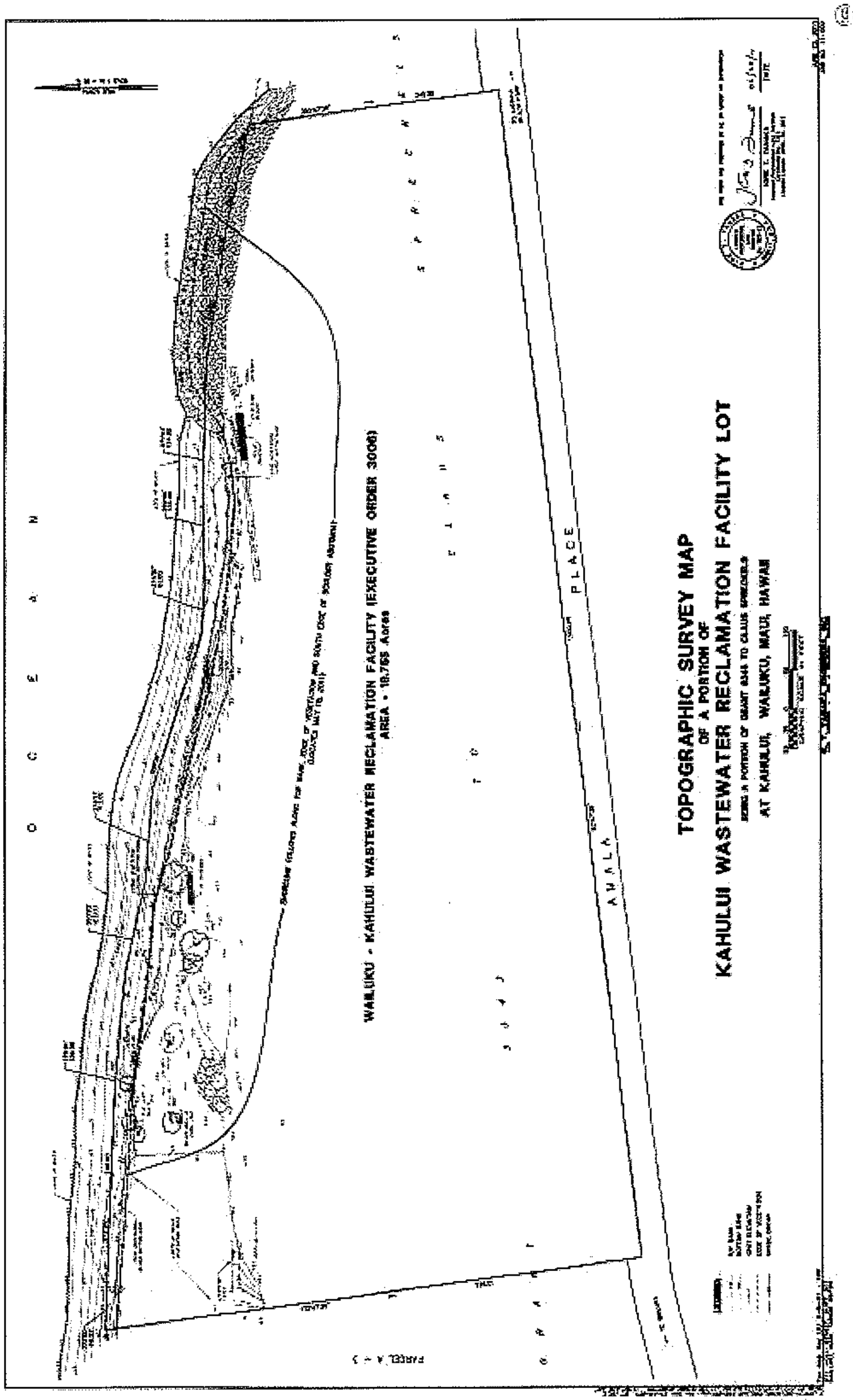


Figure 3: Kahului Wastewater Treatment Plant topographic map of the project area.

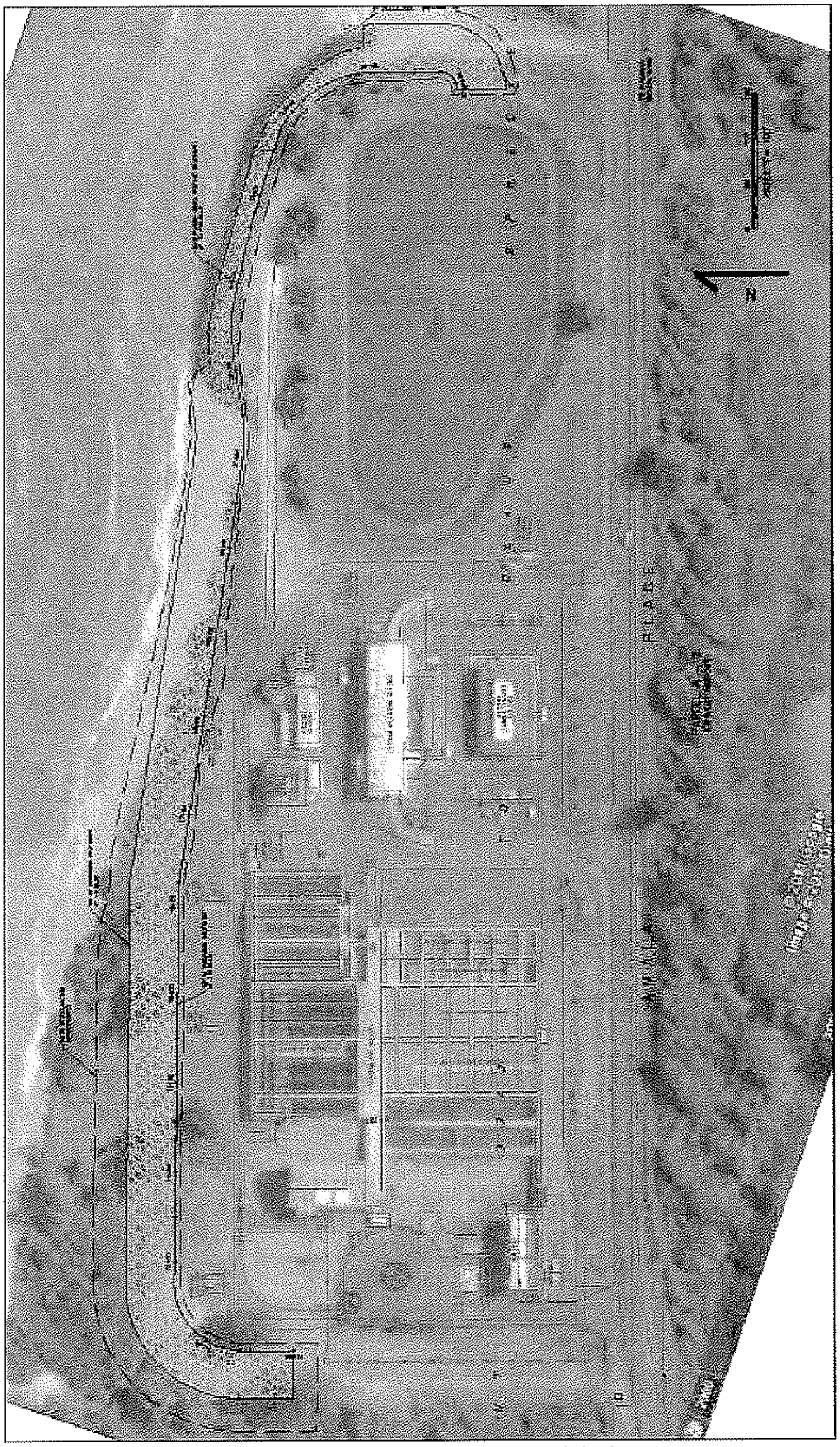


Figure 4: Project area location, aerial view.

TABLE OF CONTENTS

List of Figures

List of Photos

List of Tables

INTRODUCTION

Xamanek Researches LLC was first contacted about this tsunami remediation project in the fall of 2010. At the time, there was a concern about the Kahului Waste Water Treatment facility's proximity to the coast (Figures 1-4). Following the March 2011 Japan tsunami, this concern magnified. Given the location of the project area, Ms. Morgan Davis, State Historic Preservation Division (SHPD) Maui Lead Archaeologist was contacted. Following this consultation, it was determined that an inventory/assessment survey was necessary for the proposed c. 1-acre area of impact on the coastal side of the existing waste water treatment facility (refer to Figure 3). Current project plans call for the construction of a new rock revetment and the expansion of an existing revetment on the seaward side of the subject parcel (TMK: (2) 3-8-001: Portion of 188). This planned undertaking is known as the Wailuku-Kahului Wastewater Reclamation Facility Shoreline Protection Extension project. The project area is located in Wailuku *Ahupua`a*, Wailuku District, Maui.

STUDY AREA

The project area is located at the west end of Kanaha Beach located along the north shore of Maui just east of downtown Kahului on the *makai* (ocean) side of Amala Pl. (AKA Beach Road). Testing included the area along the newly constructed fence bordering the north side of the Kahului Wastewater Treatment facility, along the beachfront coastline. This chain link fence was installed following the March 2011 tsunami, which damaged the previous chain link fence. The project area consisted of sand, sand dunes and beach vegetation. This included *hau* (Hibiscus tiliaceus), *naupaka* (Scaevola sericea), *pohuehue* (Ipomoea pes-caprae), Bermuda grass (Cynodon dactylon), Ironwood (Casuarina equisetifolia), tree heliotrope (Tournefortia argentea) and seagrass. The tested area was contained along and near the fence line. All the backhoe trenches contained sand of various colors.

The project area is at c. 3-6 ft. AMSL high along the shoreline setback. The study area lies in a sand dune area zone. This zone continues east to Kanaha Beach Park.

Results from our subsurface testing of the project area indicate that intact sand dune and marine beach sand deposits are present. Annual rainfall in this windward area ranges from c. 20-30 inches, with the majority of precipitation occurring between November and March (Juvic and Juvic, 1998).

BACKGROUND INFORMATION

Precontact Period

The *ahupua`a* of Wailuku is a large land unit stretching around Kahului Bay from Paukukalo to Kapukaulua. It includes Iao Valley and the northern half of the Kahului Isthmus. This single land division comprises nearly half of the District of Wailuku, and is noted as a place where chiefs were buried and wars were fought. The word itself can be translated as "water of destruction" (Pukui, et. al., 1974, p. 225), and this name is in reference to the battles that took place in the area.

Iao Valley and the two associated dune formations on the north and south sides of the river, constituted the core area of Wailuku. This was the religious and political center of Maui, which culminated during the time of Pi`ilani (c. 1600 AD). In the late precontact period, warfare increased as the chiefs from Maui, Oahu and Hawaii struggled for political and military dominance. High Chief Pi`ilani succeeded in unifying the districts of Maui by warfare, but after his death, his sons fought with one another--each hoping to succeed their father as high chief. Eventually Kiha-a-Pi`ilani became victorious, but each following generation of chiefs had to struggle through warfare to secure their positions of political domination (Speakman, 1978, pp. 9-13).

During the reign of the last powerful paramount chief or king, Kahekili (who ruled from 1765 to 1790), Wailuku again became the site of intense warfare. Wailuku was considered to be the capital of Maui, as Kahekili's royal residence, Kalanihale, was located in there, surrounded by his retinue.[1] In the mid-1770s, Kalanihale was marched upon by a Big Island chief named Kalani`opu`u and his *alapa* (the name given to his warriors). News of his coming preceded him, and Kahekili hid his warriors in the sand dunes above Haleki`i *heiau* to surprise the invading troops. A fierce battle ensued, and Kalani`opu`u's army was pushed to the sea and slaughtered (Speakman, pp. 16-17).

By 1786, Kahekili controlled Maui, Molokai, Lanai, and Oahu. This undisputed political control lasted for only 4 years, however. In 1790, Kamehameha the First invaded Kahekili's territory—an action that ended in the battle of Kepaniwai[2] and the defeat of the Maui ruler. The word Kahului can be translated as "the winning", and the Bay takes this name because

[1]The location is said to be located just north of the intersection of High Street and Main Street leading into Iao Valley in Wailuku town.

[2]Kepaniwai means literally "water dam" in reference to Iao Stream, because the stream was choked with human bodies after the slaughter there (Pukui, et. al., 1974, p. 109).

Kamehameha gathered his warriors there prior to fighting the battle in Iao Valley (Pukui, et. al., 1974).

Kanaha Pond and Mau`oni Pond

These two ponds are directly across Amala Place road from the WWTP which contains the current project area, and have been previously been designated SIHP No. 50-50-05-1783. While Mau`oni Pond is shown on the 1881 Alexander map in this report, a later 1922 USGS map does not show this pond, suggesting that it was apparently filled at some point during the c. 40 year period between the issuance of these two maps. Modern maps only depict the c. 37 acre Kanaha Pond. To date, there have not been any archaeological investigations conducted on either of these ponds. These ponds were built in a natural wetland that was located in this area.

Kanaha Pond and Mau`oni Pond have been mentioned by Samuel Kamakau (1991). He related that Maui high chief Kiha-a-Pi`ilani was involved in the initial construction of a rock wall that divided these two ponds. Fornander (in Walker, 1931) has suggested that Kiha-a-Pi`ilani lived in the mid-1500s, which potentially dates modification to this area to the mid-16$^{th}$ century. The two ponds are also associated with an early 18$^{th}$ century Oahu high chief, Ka-pi`i-oho-o-ka-lani who ordered construction at the ponds, naming them for his son, Kanaha-o-ka-lani, and his daughter, Kahama-lui-hi`i-ke-ao-ihi-lani[3] (from notes by Catherine Summers, **quoted in Kikuchi, 1973)**.

The 1881 Alexander map contained in this report depicts a wall that divided these two ponds. A narrow extension of the pond on its northwestern corner was said to have connected to the ocean near an old landing to the west of the present Pier 1 in Kahului Harbor. The pond area was again impacted by human activity in c. 1910 when Kahului Harbor was first dredged.

The dredging of the harbor generated substantial amounts of coral and sand. Much of this material was spread out along the shoreline from near the intersection of Ka`ahumanu Avenue and Kahului Beach Road and eastward toward Hobron Point. In addition, fill associated with this time period was located near Maui Community College, the hospital, under sections of various roads, including Mahalani Street, Lower Main Street, and even in some unpaved access roads in the Central Maui area. The deposition of this fill in some near shore areas added several feet to the former ground surface (Foote et al., 1972).

The next era of impact to the general coastal portion of the Kahului area occurred in the late 1970s when the U.S. Army Corps of Engineers approved a flood control project.[4] This project created a network of drainage canals that served to channel groundwater out of the developing Kahului Industrial Area and to the ocean.

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[3]Kahama-lui-hi`i-ke-ao-ihi-lani was also known by the name Mau`oni.

[4] Another Army Corps of Engineers flood control project also impacted Iao Stream and its flood plain in the late 1970s.

Early Post-Contact Period

The reign of Kamehameha was intertwined with the increasing presence of foreigners (*haoles*) in the Hawaiian Islands. The arrival of Captain Cook offshore at Kahului Bay in 1778 began the steady flow of outside influences that would forever alter the indigenous population and environment. One of the first of these influences came with missionaries, whose charge it was to save heathen souls. The first missionaries arrived in Wailuku in 1832, and the traditional religion began to wane under their influence. Rev. Jonathan Green established a girls' seminary (Central Female Boarding School) in 1836, where young Hawaiian women were taught the language, customs and religion of the foreigners.

Another influence to bring change to the Hawaiians was foreign commercialism, and it came initially in the form of sugar production. The first sugarcane crops grown in the *ahupua`a* were harvested and processed in 1828. Kamehameha III, with the help of two Chinese technicians, established a water-powered mill in Wailuku. This was known as Hungtai Sugar Works, and its location was fairly close to the later location of the Wailuku Sugar Mill, which was established in 1862. Hungtai Sugar Works continued to operate until the opening of the new mill.

The population of the *ahupua'a* of Wailuku was listed in the 1831-32 census as 2,256, with most of it being in the northern portion, presumably in Iao Valley (Cordy, 1978, p. 59)

In Central Maui, on the southern and eastern side of the Iao Valley dunes (Pu`uone Dunes), an early commercial activity took the form of cattle ranching. This sizable area was used for pasturage. By as early as 1845, large herds of cattle were roaming the Kahului Isthmus (cattle had been introduced on the Big Island by Vancouver in 1793). The Maui cattle were under royal *kapu,* so were not to be molested. They were so destructive to the environment that Native Hawaiian landowners protested, but to no avail **(Barrere, 1975, p. 52)**. In addition to the commercial raising of cattle, there were also other commercial efforts, one being a brief attempt at the production of cotton in the 1830s. This endeavor met with little commercial success however[5], and further adversely impacted the landscape.

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[5]The Anglican Church felt that "the Hawaiian people, freed from their service to and dependence on the chiefs should be self-supporting and thought that the encouragement of the manufacture of cloth from the superior cotton which grew luxuriantly in the islands would be a means to that end. They therefore suggested that a manufacturer be sent with sufficient machinery to get the project started. They felt that the people would continue to work with the encouragement and cooperation of the chiefs." **(Lemmon et. al., 1973, p. 2.B.3).** To this end they sent Miss Lydia Brown in 1835 with " 'a quantity of domestic spinning apparatus' (presumably spinning wheels and a loom)" (Ibid.), and "charged with the responsibility of teaching the Hawaiian girls the arts of carding, spinning, weaving and knitting locally grown cotton and wool." (Ibid.) As each class grew proficient enough to teach others, a new class was formed (Ibid., 2.B.4).

Post-1850s Period

After the Mahele in 1848, much of the *ahupua`a* of Wailuku was designated as Crown Land, to be used in support of the royal "state and dignity". In 1872, Kamehameha V died, and his sister Princess Ruth Ke`elikolani inherited the land. She was designated as the owner of the *Ka`a* lands of Wailuku, the southern portion of the *ahupua`a*. The *ili* of *Owa* comprised of 743.40 acres, (LCA 420) was granted to Kuihelani, a steward to Kamehameha I. The much smaller northern section (the *ili* of *Kalua*-LCA 7713, Apana 23 [391 acres]) was awarded to Princess Ruth's half-sister, Victoria Kamamalu. In 1882, Princess Ruth sold one-half of the Crown Lands of Hawaii to sugar producer, Claus Spreckels, in order to settle her debts with him. Spreckels already held a lease for 16,000 acres of Wailuku *ahupua`a*, dating from 1878. Worried about what Spreckels might do with half of the Crown Lands, King Kalakaua gave him Land Grant 3343, a 24,000 acre portion of the southeastern section of Wailuku *ahupua`a,* in return for the surrender of his claim (Adler, 1966, pp. 262-263). The Kanaha Wastewater Treatment Plant is within this Grant 3343.

The Reciprocity Treaty of 1876 with the United States gave a boost to the sugar industry by increasing the prices of sugar. The dry eastern part of the *ahupua`a* became attractive as potential sugar land—if only water could be brought to it. In 1880, Spreckels began construction of what was called "Spreckels' Ditch", located *makai* of the Hamakua Ditch, which had been built earlier by Alexander and Baldwin to water their Maui Agricultural Company's fields in and around Pa`ia. The "Spreckels' Ditch" brought Haleakala water farther west onto the arid Kahului isthmus. The ditch was 30 miles long, delivered about 60 million gallons of water a day, and cost $500,000 to construct.

Spreckels also built another ditch, the Waihe`e ditch in 1882, which tapped the water resources from the West Maui Mountains, thus bringing water to both sides of the Wailuku Commons isthmus area (Adler, 1966, pp. 48-49). These endeavors enabled him, in 1882, to found Hawaiian Commercial and Sugar Company. He continued to be involved in the company until 1898, when control was wrested from his hands. The parent company still bears the name of Alexander and Baldwin, the principal participants in the transfer of corporate control. The production of sugarcane continues to be an activity in the isthmus area to this day, although some portions operated by C. Brewer and Company were shifted to pineapple production for several years.[6]

The environmental conditions during precontact times in lower Iao Valley, which lies well to the WNW of the project area, were ideal for agricultural production necessary to support a large population. The wide valley floor, rich alluvial soils, and a constant water supply from Iao Stream in combination provided Native Hawaiians with an abundance of food. These combined with the access to the Kahului Harbor area, rich in marine resources, made this general area the prime precontact location on West Maui for a political and religious center. The lower

[6] Pineapple production is in decline, and much of the lands that were in pineapple production have been converted into new housing developments.

portion of Iao Valley contained some of the most productive taro land on the island, and the abundance of Land Commission Awards in the lower valley attest to this. There are 66 LCA's, primarily taro patch *kuleana*, and 39 *po`alima* located between the old Wailuku Mill site and Paukukalo, on the southern side of Iao stream. In addition, Kamehameha IV granted 13 awards directly to individual chiefs.

The above land use pattern is in contrast to the area south and east of Lower Iao Valley, in which the study parcel is located. Here there were only two LCAs awarded—one to Victoria Kamamalu (7713), and one to Kuihelani (420). The largest land partition of Central Maui area is Grant 3343 to Claus Spreckels. The current project area is within the Grant 3343 to Claus Spreckels.

Lower Main Street was built along the route of an old government road, which very likely followed the course of traditional transportation routes from the ocean to the inland portions of Iao Valley. Many of the LCAs in this area have borders aligned with the road, indicating it was an important transportation corridor at the time the *kuleana* were granted. This corridor follows the natural boundary between the sand dune and the alluvial deposits of the valley. The Kahului Railroad paralleled Lower Main Street, and was one of the earliest known commercial projects that impacted the dune itself.

The route of the railroad ran from Kahului Harbor to Wailuku Sugar Mill. The remnants of this old railroad bed can still be noted in a few places along Lower Main, and along Kahului Beach Road. The most striking architectural remnants of the railway system located along Kahului Beach Road are the 5 concrete pillars and arches, the most visible *makai* one impressed with the date "1921". In the past, a large wooden frame building rested on these pillars, serving as the housing for the Makaweli Rock Crusher apparatus. It was constructed so the train carrying rock from the quarry could off-load from the track-bed into the crusher. The concrete pilings elevated the crusher adequately above ground so trucks could be driven in and filled with crushed rock. This series of pillars (that comprised the footings for the Makaweli Rock Crusher Mill) still stands near the intersection of Kanaloa Avenue and Kahului Beach Road.

Railroad construction began in the late 1870s[7] and continued for nearly 20 years, as new routes were added and service expanded. **The Maui News** contains articles dealing with activities in the general vicinity of the project area. One dated February 8, 1902, describes a problem and potential solution resulting from the railroad:

> *"Superintendent R.W. Fuller of the Kahului Railroad Company is preparing to make some important changes in the line of railroad track between Kahului and Wailuku.*
>
> *At present the sharp turn and the railroad crossing at the beach is extremely dangerous on account of the sand dunes that shut out the approaching trains from the view of those approaching the crossing with teams, especially the wind is blowing a gale.*

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[7] This painting by Rev. Bailey shows several structures, which may be houses associated with two LCAs near the intersection of Kanaloa Avenue and Kahului Beach Road to the northwest of the project area.

The track will be moved some hundreds of feet south of its present location, so that the point where it crosses the road as well as the approaching trains themselves can be seen for quite a distance. On crossing the road, the track will skirt the pasture at greater distance from the public road."

On June 8, 1907, another reference describes plans improving the land for further residential use in the future:

"The Kahului Railroad Company is filling in the lowlands, in and about Kahului and will in time raise the level of the entire town site, when the work is completed and proper drains provided, the town should be free of mosquitoes and the place a most desirable locality in which to live."

The Kahului Railroad continued operations until after World War II. Then demands slowly began to change, and segments of the system were phased out over the next two decades. An article contained in an article of **The Maui News** on 15 October 1957 bore the headline "Iron Horses Bow Out As Wailuku Sugar Company Discontinues Use of Railroad". The railroad continued to serve other areas until 1966, when it ceased operation.

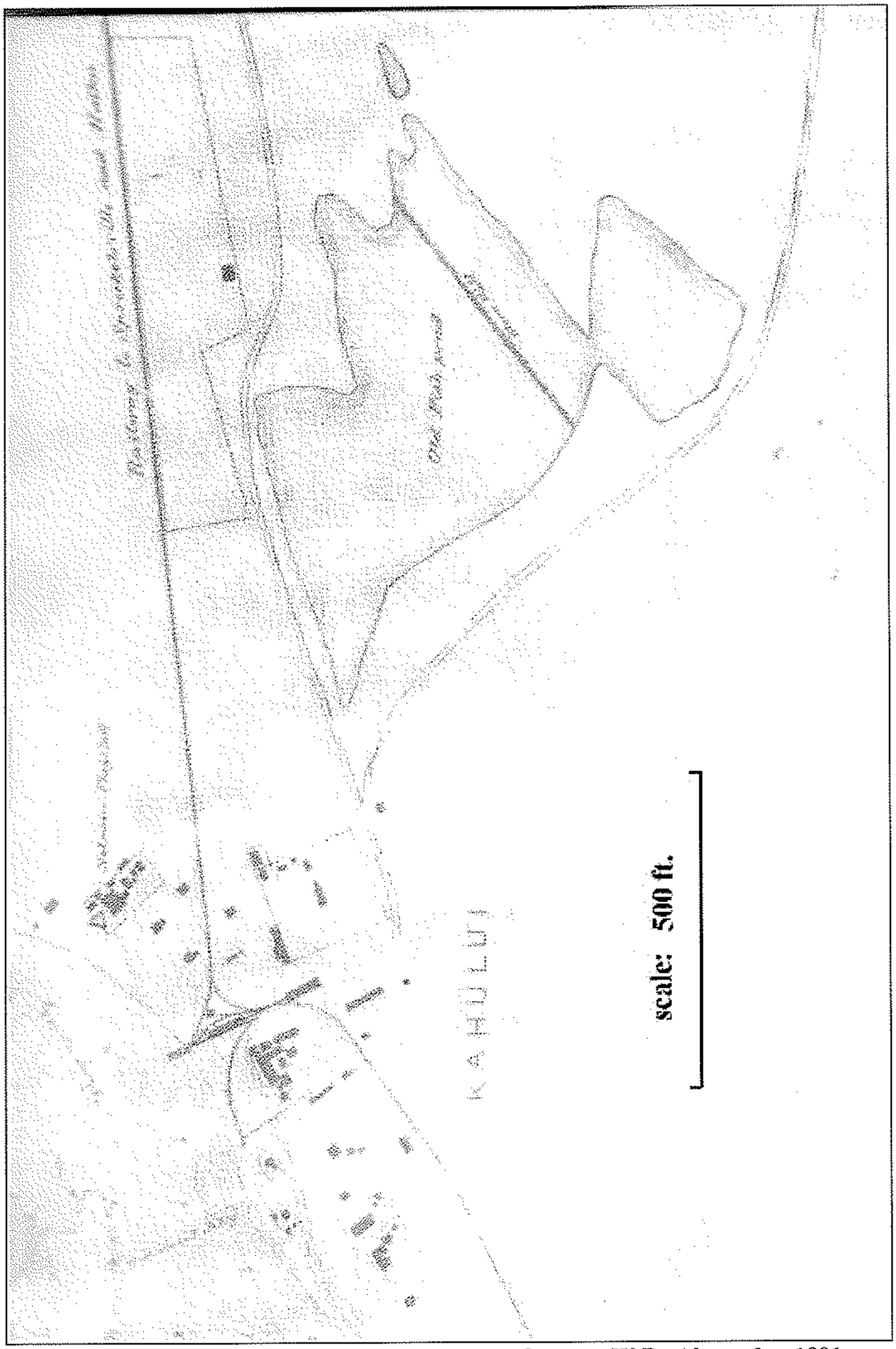

Figure 5: Portion of the Hawaiian Government Survey, W.D. Alexander 1881 map showing Kanaha Pond, and a small section of Kahului shoreline prior to expansion of Kahului Harbor (map provided by Mr. Les Kuloloio).

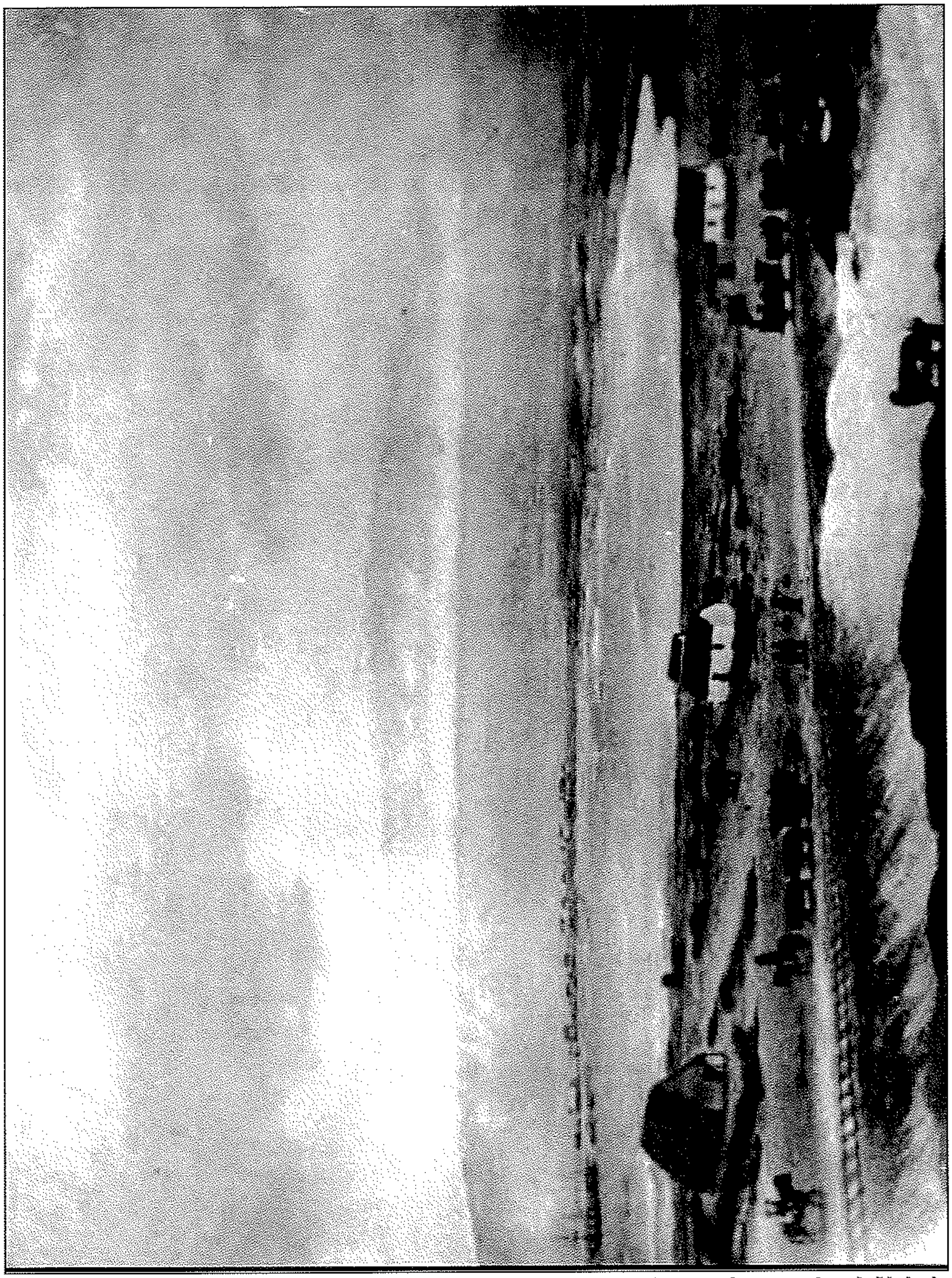

Figure 6: A painting of the Kahului Harbor area showing the newly completed Kahului Railroad as well as old houses possibly associated with Land Commission Awards in the general area.

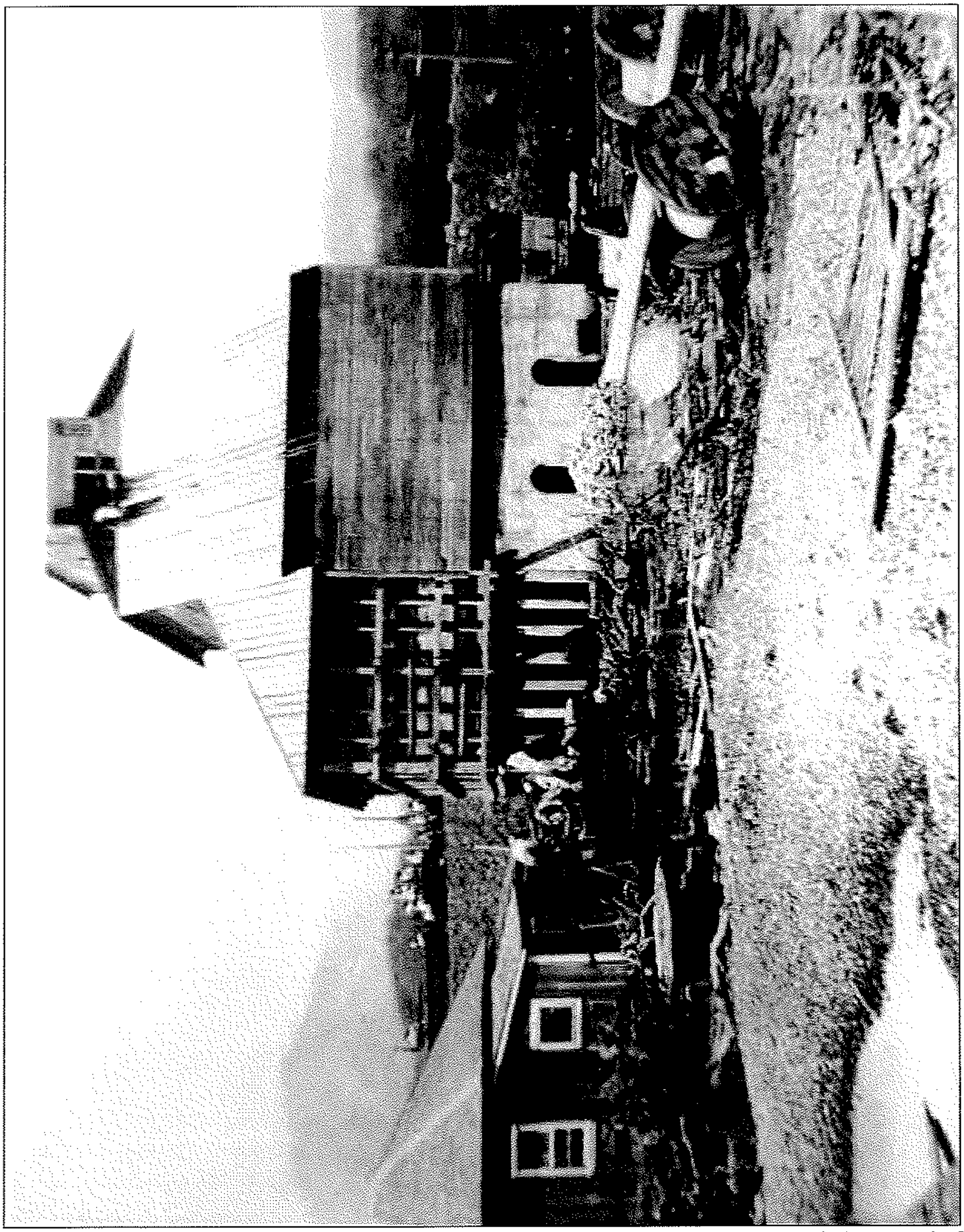

Figure 7: The Makaweli Rock Crusher building - shown in 1941, following the April 1 tsunami of that year.

PREVIOUS ARCHAEOLOGICAL STUDIES

Maui Palms Hotel area archaeological work

Donham (1990) carried out the original inventory survey for the Maui Palms Hotel property. This earlier survey took place prior to the demolition of the hotel facility in 2002. Testing utilized a series of 40 manual auger cores that were spaced across the former Maui Palms Hotel facility. The presence of Buildings A-K as well as former facility infrastructure limited potential areas for sampling. There were two historic era artifact concentrations that were located during the survey. Site 852-1 was noted on the surface near the existing U.S. Coast Guard channel marker and light tower. At the time of the survey, a newly excavated hole (c. 20 ft square by 9 ft deep) was present on the Coast Guard property, which is adjacent to the current project area. A concentration of historic refuse, consisting of mid- to late 1900s bottles, as well as metal and sawn beef and/or pork bones were noted in the backdirt of the excavation. This concentration of historic period refuse was designated Site 852-1. This site was determined to have resulted from secondary deposition. The subsurface component of this site was designated Site 852-2. While it remains somewhat unclear, this secondary deposition may possibly be associated with earlier fill activities that have taken place in this general area.

Xamanek Researches conducted a monitoring program for the Kahului Barge Terminal Improvements Project (Job No. H.C. 3281) during 1999 (Fredericksen and Fredericksen, 1999). This project site lies an estimated 500 m to the east of the Maui Palms Hotel Redevelopment Project area. Ground disturbance was relatively shallow in most instances, but several fence post holes were bored. In addition, landscaping palms were planted along the border of the property with Pu`unene Avenue. One previously unidentified subsurface site was located during the monitoring program, and further investigated with two manual test units. This site, which consisted of a waterworn pavement and indigenous food remains, was designated SIHP NO: 50-50-05-4753. It is interpreted as a possible precontact habitation area.

An archaeological assessment survey was undertaken on a 6.926 acre property across Ka`ahumanu Avenue to the SSW of the Maui Palms Redevelopment project area in 2004. This recent survey produced no findings, but precautionary monitoring was nevertheless recommended, given the presence of sand deposits (Monahan, 2004).

Airport Area archaeological work

While a comprehensive inventory survey of the Kahului Airport to the southeast of the project area has not been undertaken to date, previous archaeological work in this area has uncovered significant sites. The earliest work was associated with the construction monitoring carried out in conjunction with the installation of the sewer line for the Paia Sewerage System from Spreckelsville to Ku`au. Clark and Toenjes (1987) of the B.P. Bishop Museum recorded a total of six sites that were encountered between 30 and 160 cmbs. Subsurface features included various pits and charcoal concentrations. In addition, indigenous food midden and artifacts were recovered. Charcoal recovered from Site 50-50-04-1777, part of which was identified *makai* of Kahului Airport, yielded a radiocarbon date range of A.D. 1380-1700.

Two sites have been identified on the airport property that will require additional work. These cultural resources include Site 50-50-05-1798, which is composed of an unknown number of human burials, a reburial area[8], and a subsurface terrace wall with associated pond field deposits. There is a Programmatic Agreement, signed in 1997, that covers this area, which lies to the north of the runway. To date, it remains unclear what work has been carried out in this area. The second site, Site 1799 is located to the north of Site 1798 and consists of a c. 4 m long rock alignment and a possible coral pavement of unknown function. The SHPD has previously indicated that this site has not been adequately assessed.

Site 50-50-05-2849 is made up of an extensive subsurface cultural deposit that was identified during archaeological testing carried out by IARII in c. 1990-1991 **(Welch, 1991).** This site qualifies for significance under Criterion "d" because of its information content. The SHPD has recommended that data recovery work be undertaken on this cultural deposit.

Site 50-50-05-4197 consists of related features of the former WWII Naval Air Station (NASKA). The SHPD has indicated that additional work at the inventory level is needed for this complex before additional evaluations/recommendations can be made.

Settlement Patterns and Expected Findings

The lower Iao Valley portion of Wailuku *ahupua'a* was a central political and religious area of West Maui, because of its fertile taro lands and close proximity to the sea. Given these conditions, a large population could be supported, and wherever large population clusters are found, the social framework of chiefly importance and religious expression is also present. This is attested to by the existence of the two *heiau* (Haleki'i and Pihana) atop the northern dune system, and others reported by Walker (1931) and Keau (1992, oral communication) within the Iao Stream corridor. The middle and upper reaches of Iao Valley were also rich in *lo'i* and *'auwai* which produced additional food stuffs to support political and religious activities. The Upper Iao Valley had been traditionally known as a very significant sacred place in the history of Maui (Donham, MCCRC minutes, June 1, 1995). Coastal sites, such as Site 3120 at the Nisei Veterans Memorial Center, have been occupied since the 1200s (and possibly much earlier), and no doubt provided the area's population with marine resources. There seems to be a pattern in Iao Valley, whereby sites closer to the ocean have earlier dates than the ones farther inland, suggesting that settlement occurred first along the sea shore and gradually moved inland as the population numbers increased.

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[8] Mr. Charles Kauluwehi Maxwell Sr., current Chair, Maui/Lana`i Islands Burial Council (MLIBC), assisted in the reburial of human remains that were disturbed by airport construction activities c. 20+ years ago (personal communication with Mr. Maxwell, 2005).

An intensification of usage appears to have occurred during the 16th century, and seems to have peaked around the time of Pi`ilani, ca. 1600 AD (Donham, MCCRC minutes, June 1, 1995). All radiocarbon dates, which have been recovered from the sites along this corridor fall into this temporal framework.

A large Marine base existed in the area that is now Keopuolani Park. In addition, the remains of several military related buildings as well as remnants of the NASKA facility are located to the WNW of the current area. Finally, it is important to note that portions of Kahului coastline, Kanaha Pond, and the Kanaha Beach Park area have been altered by WWII activities. The general area was formerly used for pasturage prior to WWII. As a consequence of the considerable amount of land alteration associated with these events, most surface traces of precontact activity, if it existed, has been most likely destroyed. Remnants of habitation sites—some with associated burials—have been found in the near shore area, and there is a possibility that similar subsurface features could be present beneath the surface of the project area.

ARCHAEOLOGICAL FIELD METHODS

Fieldwork consisted of an initial pedestrian inspection of the parcel and subsurface testing through backhoe testing. The survey indicated that the entire project area had been impacted by current use a sewer wastewater treatment plant as well as recent weather activities, the tsunami of March 2011. The pedestrian inspection utilized surface sweeps that were spaced c. 5 meters apart where accessible. This surface inspection was carried out on 9 November 2011.

Archaeological survey members consisted of Jennifer J. Frey, B.A. and Marco P. Molina, B.A. Erik Fredericksen (SHPD Permit #11-07; #12-06) was the project director and principal investigator for this assessment survey.

The subsurface evaluation phase was undertaken on 15 and 16 November 2011. Testing utilized 12 backhoe trenches that were c. 5 meters in length by up to c. 2.0 m in depth. These trenches were excavated in portions of the overall project area that were accessible, and not covered with existing woody beach strand vegetation. Back dirt was visually inspected and spot-checked with 1/8th inch screen. Standard recordation methods were followed in the field and all mapping was done with metric survey tapes and hand held compasses. Photographs were taken in a digital format. Project field notes and photographs are on file at the Xamanek Researches LLC facility in Pukalani, Maui.

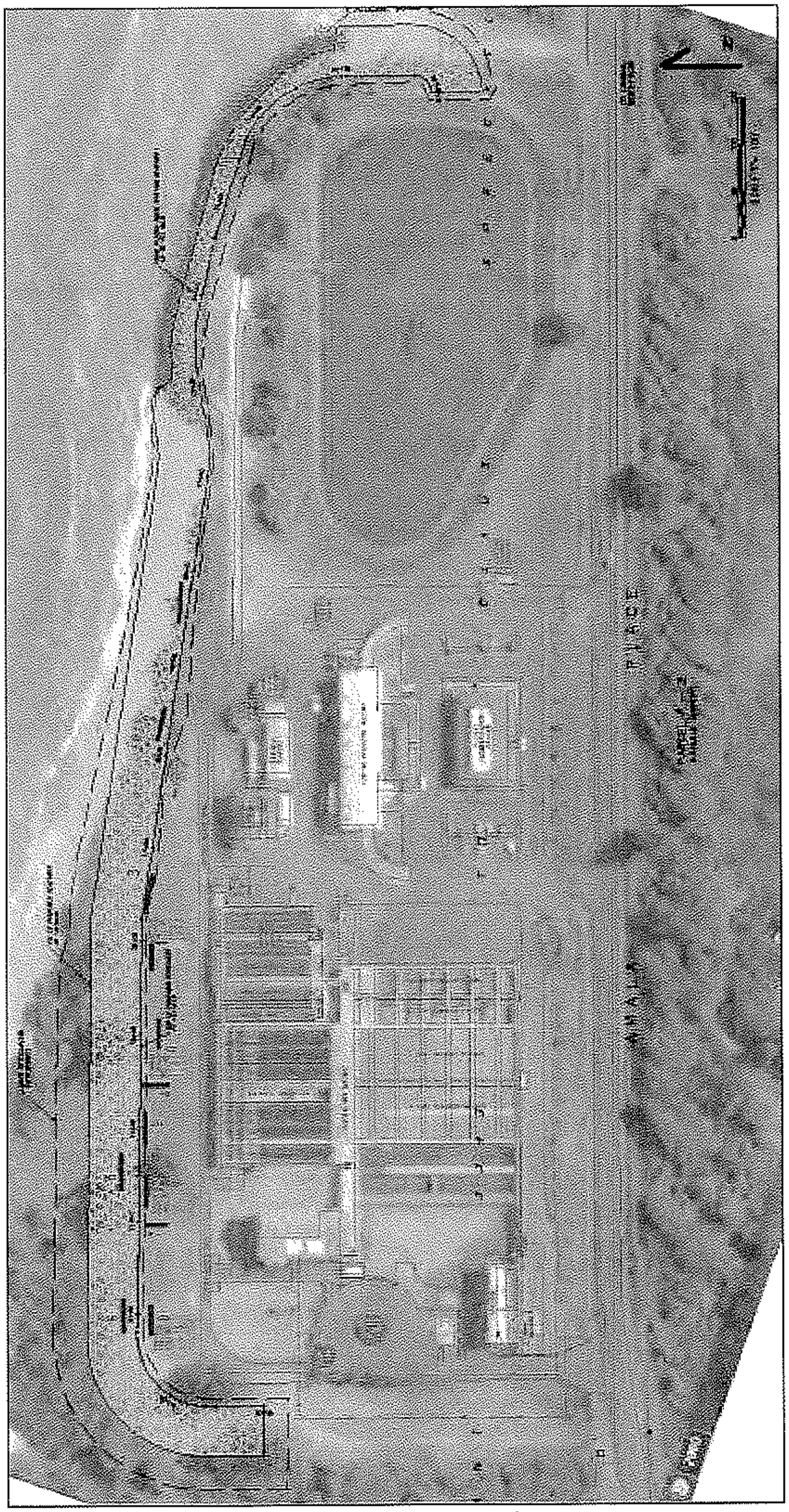

Figure 8: Backhoe trench location map.

ARCHAEOLOGICAL RESULTS

As previously noted, a total of 12 backhoe trenches were used to sample the study area. Subsurface results are discussed below. Refer to Table 1 for backhoe test results and Figure 8 for backhoe trench locations.

Discussion of Subsurface Results

Twelve backhoe trenches were utilized to assess subsurface conditions of the project area. The majority of these backhoe trenches were c. 1.1-2.0 meters in depth. Most of the trenches were terminated due to collapse. All the trenches consisted of undisturbed sand with a topsoil layer of vegetation and sea grass rootlets. There was no evidence of a subsurface cultural deposit located during testing in the study area. The project area appears to have been impacted by previous and current activities associated with the running of the wastewater treatment plant. There were up to two common strata layers with a top layer of disturbed sandy loam throughout. These strata included yellowish brown (10YR 3/4, and 5/4) and a very pale brown (10YR 7/4) loose sand. All the trenches were terminated when the safety of project personnel was compromised, because of the collapse of the loose sand sidewalls.

Backhoe Trench #1

BT-1 was situated at the east most end of the property. BT – 1 measured 5 meters long, x c. 1.3 m wide x 1.6 m deep. BT-1 had one distinct stratigraphic layer with a disturbed layer of mixed strata on the surface. This backhoe trench is just outside the existing chain link fence along the inside of the sand berm. There is an asphalt roadway inside the property line.

Layer III 10YR 7/4, very pale brown, sand, loose and collapsing, contains no cultural material

Photo 1: Representative north profile of BT #1.

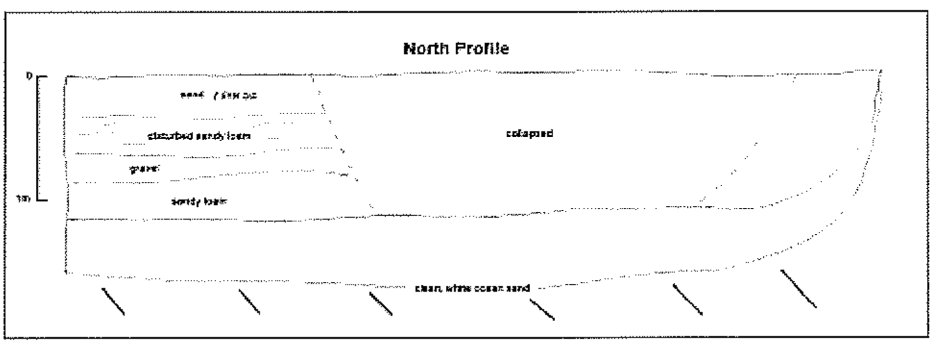

Figure 9: North profile of BT #1.

Backhoe Trench #2

BT-2 was also situated on the outside of the chain link fence along the inside of the sand berm. BT-2 measured 5 m long, x c. 1.3 m wide x 1.6 m deep. BT-2 contained two distinct stratigraphic layers and the same disturbed top layer of mixed strata.

Layer Ia	10YR 2/1, black, sandy loam, transition layer between the disturbed top layer and the sand below it.
Layer II	10YR 5/4, yellowish brown, sand, loose, sterile

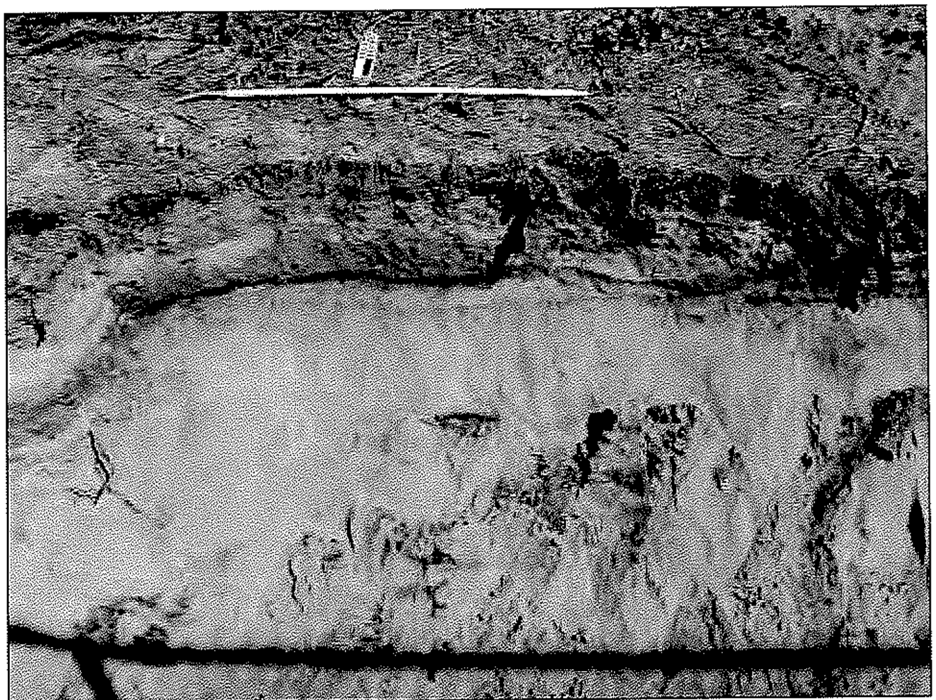

Photo 2: Representative north profile of BT #2.

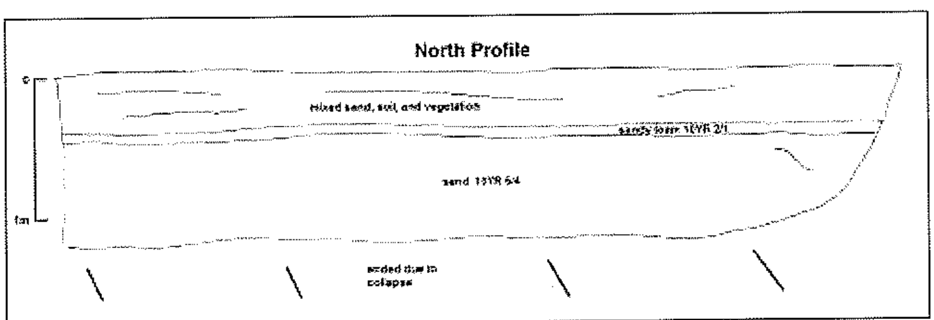

Figure 10: North profile of BT #2.

Backhoe Trench #3

BT-3 was situated just inside of the chain link fence line. BT-3 measured 5 meters long, x c. 1.6 m wide x 1.1 m deep. BT-3 included one distinct stratigraphic layer with the disturbed layer of disturbed mixed strata on the surface.

Layer III 10YR 7/4, very pale brown, loose sand, collapsing, contains no cultural material.

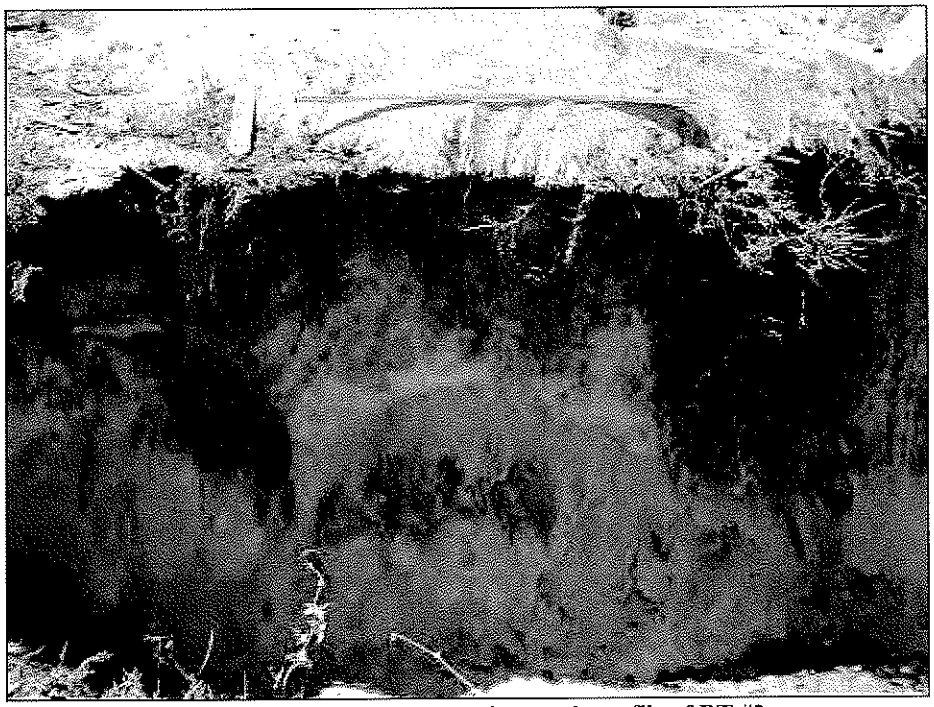

Photo 3: Representative south profile of BT #3.

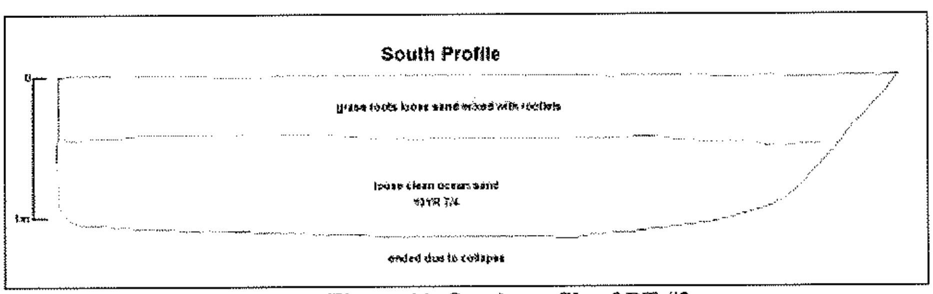

Figure 11: South profile of BT #3.

Backhoe Trench #4

BT-4 was situated near the fence line of the edge of the project property. BT-4 measured 5 meters long, x c. 2.1 m wide x 2.0 m deep. BT-4 included two distinct stratigraphic layers, with the disturbed layer of mixed strata on the surface.

Layer II	10YR 5/4, yellowish brown; sandy loam, transition layer between the disturbed mixed strata and the undisturbed sand below
Layer III	10YR 7/4, very pale brown, sand, undisturbed, contains no cultural material.

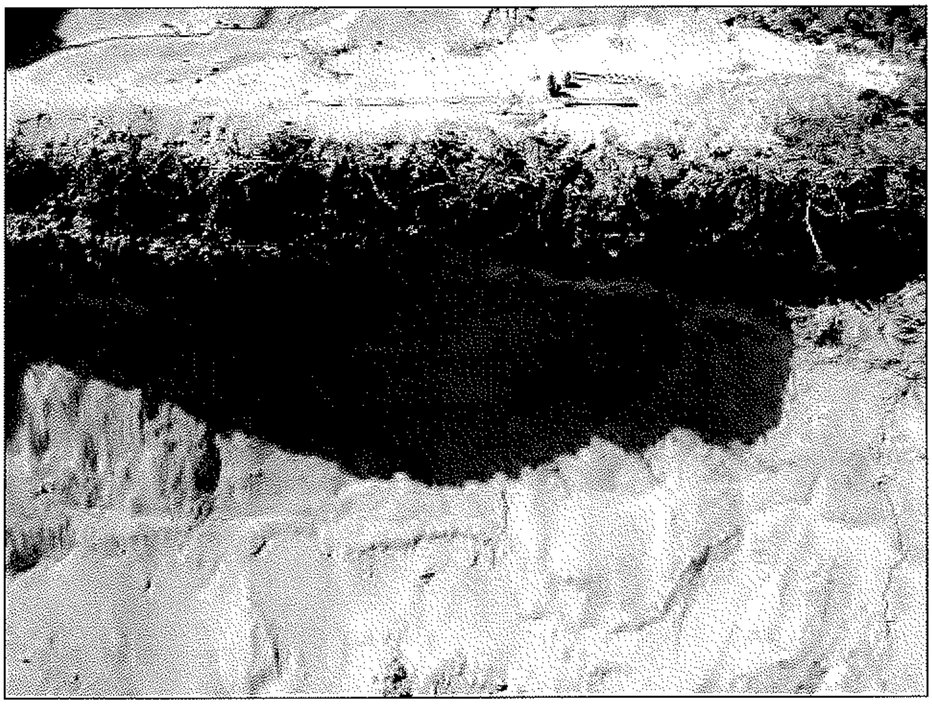

Photo 4: Representative west profile of BT #4.

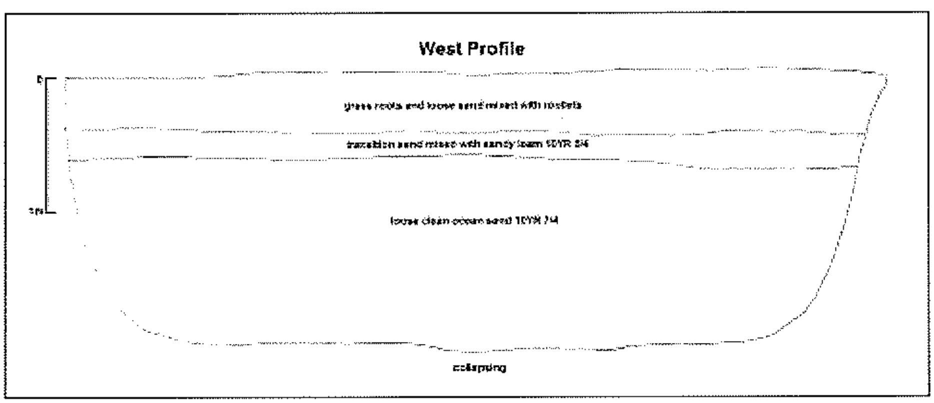

Figure 12: West profile of BT #4.

Backhoe Trench #5

BT-5 was outside the property chain link fence in the sand dune. BT-5 measured 5 meters long, x c. 1.7 m wide x 1.3 m deep. BT-5 included two distinct stratigraphic layers.

Layer I 10YR 3/4, dark yellowish brown, loose, sandy loam with few rocks, sea grass and vegetation, disturbed

Layer III 10YR 7/4, very pale brown, sand, loose, sterile

Photo 5: Representative south profile of BT #5.

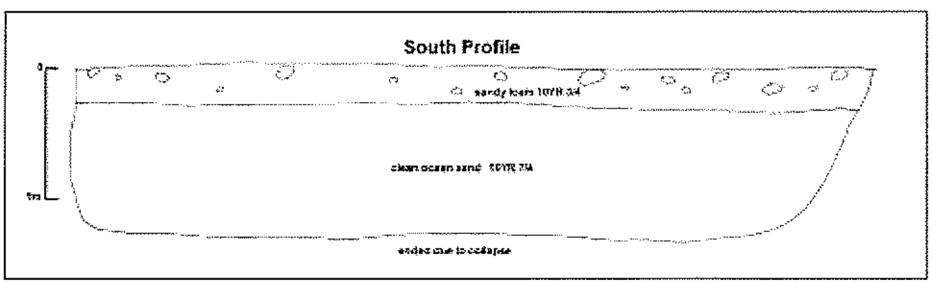

Figure 13: South profile of BT #5.

Backhoe Trench #6

BT-6 was also situated outside the chain link fence near the west end of the project property. There is a large *naupaka* hedge bordering this side of the property. BT-6 measured 5 meters long, x 1.5 m wide x 1.3 m deep. BT-6 included two distinct stratigraphic layers.

Layer I 10YR 3/4, dark yellowish brown, loose, sandy loam with few rocks, sea grass and vegetation, disturbed

Layer III 10YR 7/4, very pale brown, sand, loose, sterile

Photo 6: Representative north profile of BT #6.

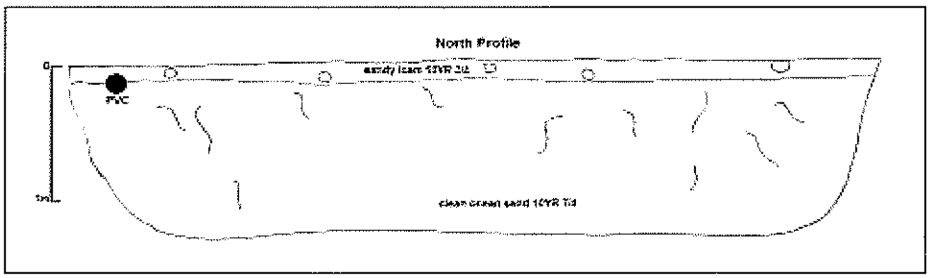

Figure 14: North profile of BT #6.

Backhoe Trench #7

BT-7 was situated inside the fence line near the west end of the project property. BT-7 measured 5 meters long, x c. 1.6 m wide x 1.45 m deep. BT-7 contained one distinct stratigraphic layer with the disturbed mixed strata layer on the surface.

Layer III 10YR 7/4, very pale brown, sand, contains intrusions of darker sand, disturbed, contains no cultural material.

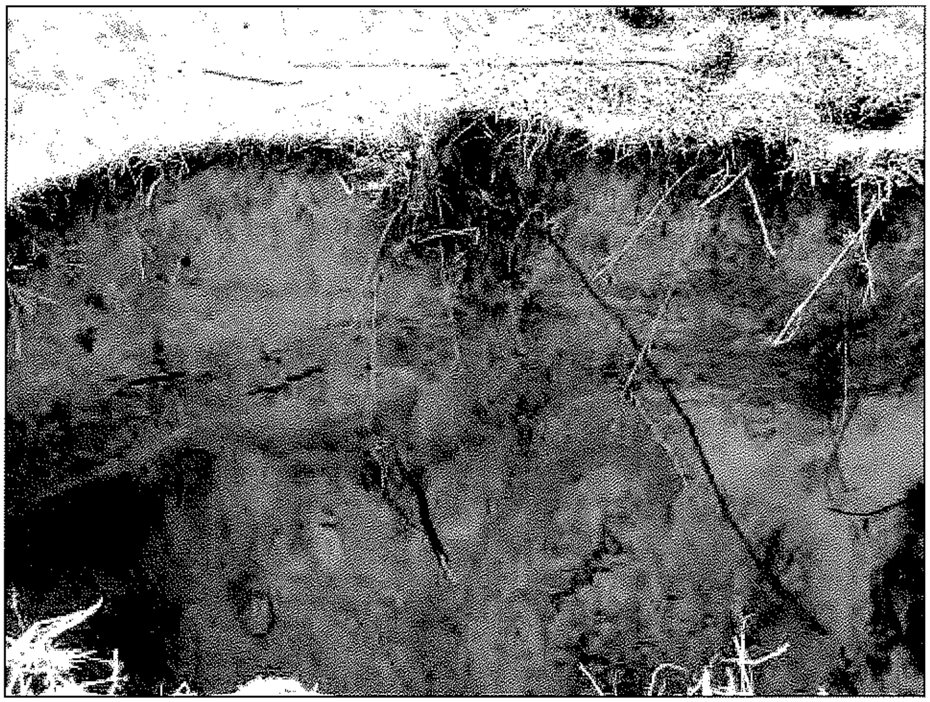

Photo 7: Representative west profile of BT #7.

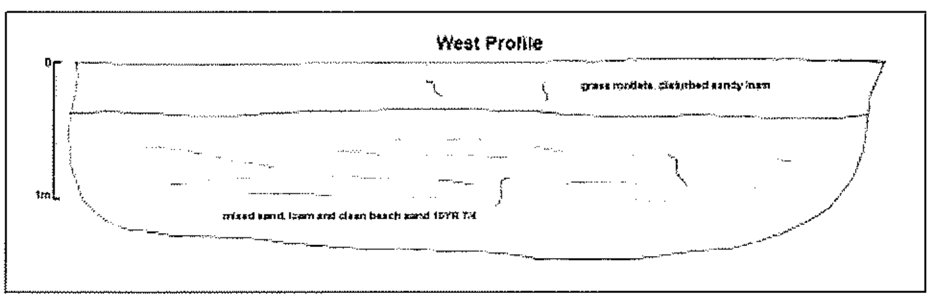

Figure 15: West profile of BT #7.

Backhoe Trench #8

BT-8 was near the west end of the project property inside the fence line. BT-8 measured 5 meters long, x c. 0.80 m wide x 1.3 m deep. BT-8 included one distinct stratigraphic layer, with the disturbed mixed strata layer on the surface.

Layer III 10YR 7/4, very pale brown, loose sand, undisturbed, contains no cultural material.

Photo 8: Representative south profile of BT #8.

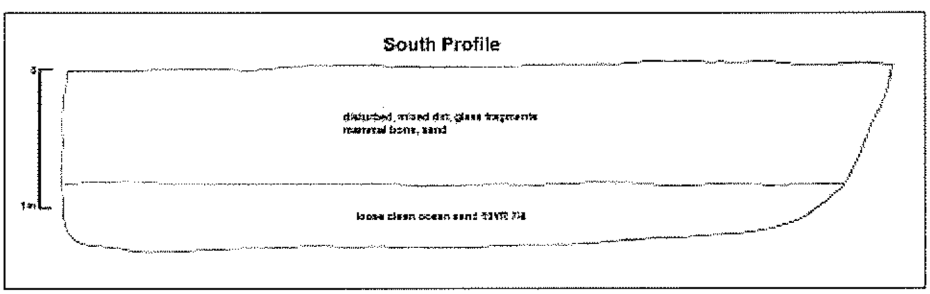

Figure 16: South profile of BT #8.

Backhoe Trench #9

BT-9 was situated just inside the chain link fence near the west end of the project property. BT-9 measured 5 meters long, x c. 1.0 m wide x 1.2 m deep. BT-9 included one distinct stratigraphic layer with the disturbed mixed strata layer on the surface.

Layer III 10YR 7/4, very pale brown, loose, collapsing, sand, undisturbed, contains no cultural material.

Photo 9: Representative south profile of BT #9.

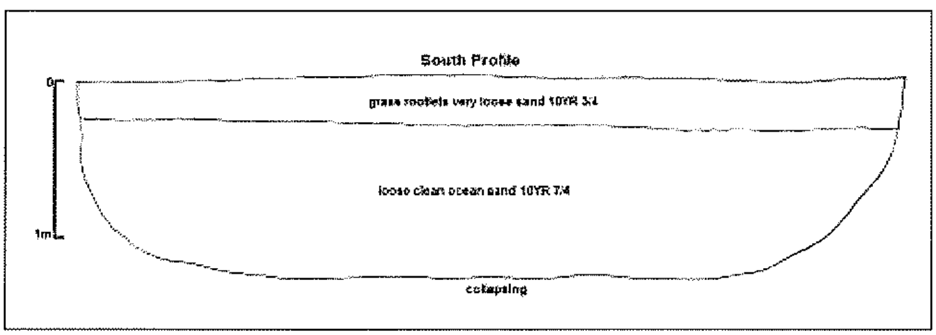

Figure 17: South profile of BT #9.

Backhoe Trench #10

BT-10 was situated on the west end of the project property inside the chain link fence. BT-10 measured 5 meters long, x c. 1.2 m wide x 1.2 m deep. BT-10 included two distinct stratigraphic layers.

Layer I 10YR 3/4, dark yellowish brown, sandy loam, few rocks, vegetation, disturbed, contains no cultural material.

Layer III 10YR 7/4, very pale brown, loose sand, undisturbed, contains no cultural material.

Photo 10: Representative south profile of BT #10.

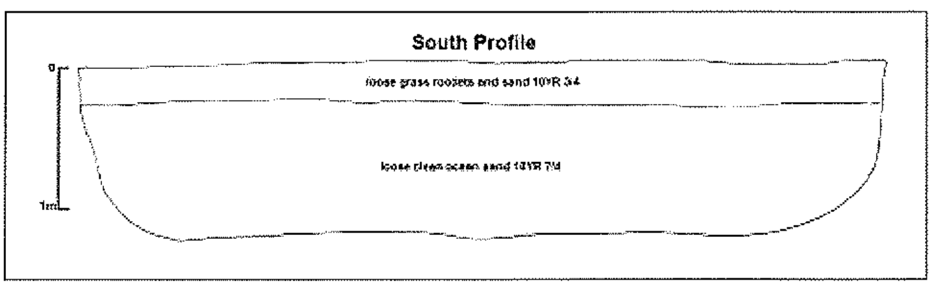

Figure 18: South profile of BT #10.

Backhoe Trench #11

BT-11 was the inside the chain link fence, in the middle of the tested area. BT-11 measures 5 meter long, x c. 1.2 m wide x 1.2 m deep. BT-11 included the disturbed mixed strata layer and one distinct stratigraphic layer.

Layer III: 10YR 7/4, very pale brown, loose sand, undisturbed, contains no cultural material.

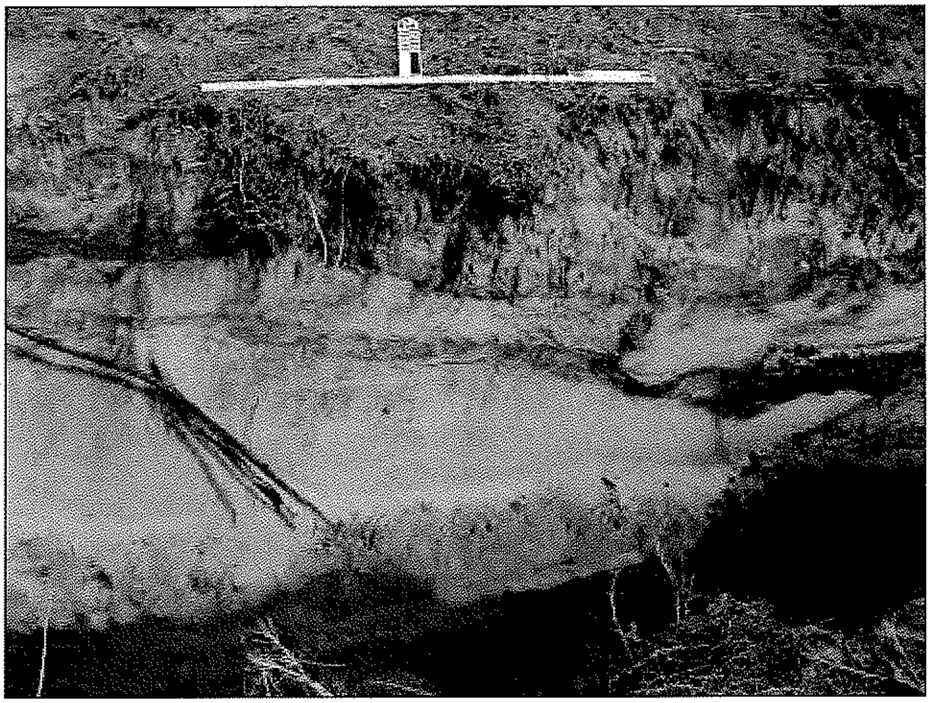

Photo 11: Representative north profile of BT #11.

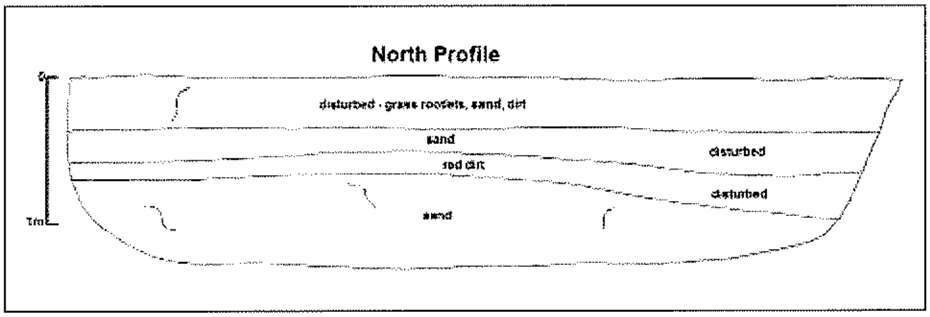

Figure 19: North profile of BT #11.

Backhoe Trench #12

BT-12 was situated just inside the chain link fence line. BT-12 measured 5 meters long, x c. 1.2 m wide x 1.2 m deep. BT-12 included one distinct stratigraphic layer and the disturbed mixed strata layer on the surface.

Layer III	10YR 7/4, very pale brown, loose sand, undisturbed, contains no cultural material

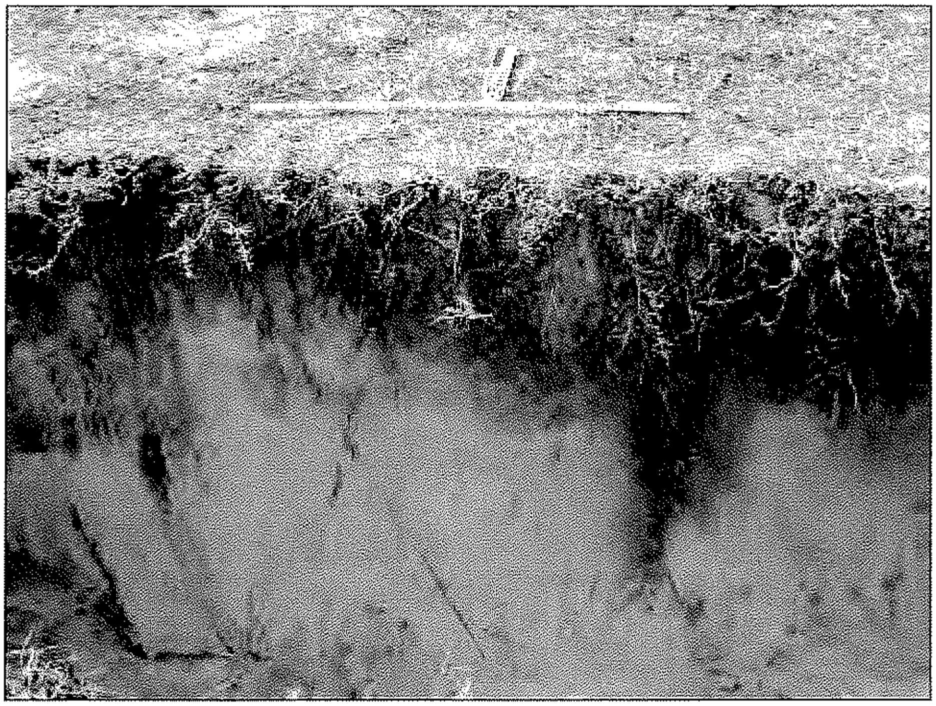

Photo 12: Representative south profile of BT #12.

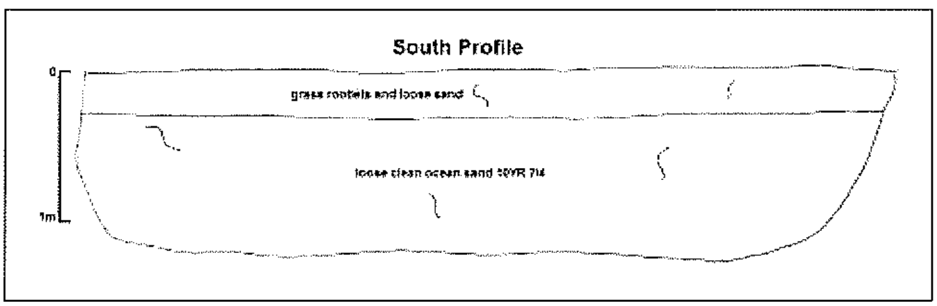

Figure 20: South profile of BT #12.

Table 1: Backhoe Trench Results

BT#	Length X width[9]	Stratigraphy	cmbs[10]	Remarks
1	5.0 x 1.3	Disturbed and mixed strata (7.5YR 3/4) Layer III: 10YR 7/4, very pale brown, sand	0-110 110-160	Disturbed – gravel, sandy loam, sand, modern glass, shell, mammal bone Layer III: Clean, undisturbed sand, sterile
2	5.0m x 1.7	Disturbed and mixed strata (7.5YR 3/4) Layer Ia: 10YR 2/1, black, sandy loam Layer II: 10YR 5/4, yellowish brown, sand	0-40 40-50 50-120	Disturbed and mixed sandy loam, sand and vegetation Layer Ia: sandy loam, transition layer, sterile Layer II: clean, undisturbed sand, sterile
3	5.0m. x 1.6	Disturbed and mixed strata Layer III: 10YR 7/4, very pale brown, loose sand	0-45 40-110	Disturbed and mixed sandy loam, sand, and vegetation, grass rootlets Layer III: clean, undisturbed sand, sterile
4	5.0m. x 2.1	Disturbed and mixed strata Layer II: 10YR 5/4, yellowish brown, sandy loam Layer III: 10YR 7/4, very pale brown, sand	0-40 40-70 60-200	Disturbed and mixed sandy loam, sand and vegetation, grass rootlets Layer II: transition sand mixed with sandy loam, sterile Layer III: clean, undisturbed sand, sterile
5	5.0 x 1.7	Layer I: 10YR 3/4, dark yellowish brown, sandy loam Layer III:10YR 7/4, very pale brown, sand	0-20 20-130	Layer I: sandy loam, few stones, topsoil, vegetation, disturbed Layer III: clean, undisturbed sand, sterile
6	5.0 x 1.5	Layer I: 10YR 3/4, dark yellowish brown, sandy loam Layer III: 10YR 7/4, very pale brown, sand	0-10 10-130	Layer I: sandy loam, few stones, topsoil, vegetation, grass rootlets Layer III: clean, undisturbed sand, sterile
7	5.0 x 1.60	Disturbed and mixed strata Layer III: 10YR 7/4, very pale brown, sand	0-40 40-145	Disturbed and mixed sandy loam Layer III: clean sand with some mottling with sandy loam
8	5.0 x .80	Disturbed and mixed strata Layer III: 10YR 7/4, very pale brown, loose sand	0-90 90-130	Disturbed and mixed sandy loam, modern glass fragments, mammal bone Layer III: clean, undisturbed sand, sterile
9	5.0 x 1.0	Disturbed and mixed strata Layer III: 10YR 7/4, very pale brown, loose sand	0-30 30-120	Disturbed and mixed sandy loam, grass roots Layer III: clean, undisturbed sand, sterile
10	5.0 x 1.2	Layer I: 10YR 3/4, dark yellowish brown, sandy loam Layer III: 10YR 7/4 very pale brown, loose sand	0-30 20-120	Layer I: sandy loam, few stones, topsoil, vegetation, disturbed Layer III: clean, undisturbed, sterile
11	5.0 x 1.2	Disturbed and mixed strata Layer III: 10YR 7/4, very pale brown, loose sand	0-90 90-120	Disturbed, sand and dirt, grass roots Layer III: clean, undisturbed, sterile
12	5.0 x 1.2	Disturbed and mixed strata Layer III: 10YR 7/4, very pale brown, loose sand	0-30 30-120	Disturbed sand, grass roots Layer III: clean, undisturbed, sterile

[9] In meters
[10] cmbs = Centimeters below surface

SUMMARY AND CONCLUSIONS

As previously discussed, a total of 12 backhoe trenches were used to sample subsurface conditions on the study area. Test results suggest the bulk of the project area has been impacted by previous and current earth moving activities associated with the operations of the wastewater treatment plant. As mentioned above, there was no evidence of an intact cultural deposit located during this assessment survey. Eleven of twelve of the trenches contained the intact clean sterile sand of the natural beach. Additionally, the area has been affected by naturally occurring activities, such as the tides and the March 2011 tsunami.

SITE SIGNIFICANCE EVALUATIONS

The following significance evaluations are based on the Rules Governing Procedures for Historic Preservation Review (DLNR 1996; Chapter 275). According to these rules, a site must possess integrity of location, design, setting, materials, workmanship, feeling and association and shall meet one or more of the following criteria:

Criterion "a"—Be associated with events that have made an important contribution to the broad patterns of our history;

Criterion "b"—Be associated with the lives of persons important in our past;

Criterion "c"—Embody the distinctive characteristics of a type, period, or method of construction; represent the work of a master; or possess high artistic value;

Criterion "d"—Have yielded, or is likely to yield, important information for research on prehistory or history;

Criterion "e"—Have an important traditional cultural value to the native Hawaiian people or to another ethnic group of the state due to associations with traditional cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts.

As mentioned earlier in this report, we did not locate any above ground surface remains or significant subsurface material remains during our assessment survey. Given the lack of significant finds, there are no site significance assessments that can be made at this time for this archaeological assessment survey. However, precautionary monitoring is recommended, due to the presence of intact marine sand deposits in portions of all test trenches excavated on the project area.

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APPENDIX J-2.

A General Archaeological Monitoring Plan for Scheduled Tsunami Improvements Project at the County of Maui Wastewater Treatment Plant at Kanaha, Wailuku Ahupuaa, Wailuku District, Maui Island

A GENERAL ARCHAEOLOGICAL MONITORING PLAN FOR THE SCHEDULED TSUNAMI IMPROVEMENTS PROJECT AT THE COUNTY OF MAUI WASTE WATER TREATMENT PLANT AT KANAHA, WAILUKU *AHUPUA`A*, WAILUKU DISTRICT, MAUI ISLAND (TMK: (2) 3-8-01: 188)

Prepared on behalf of:

County of Maui
Department of Environmental Management

Prepared by:

Xamanek Researches, LLC
Pukalani, Maui
Erik Fredericksen

4 December 2007

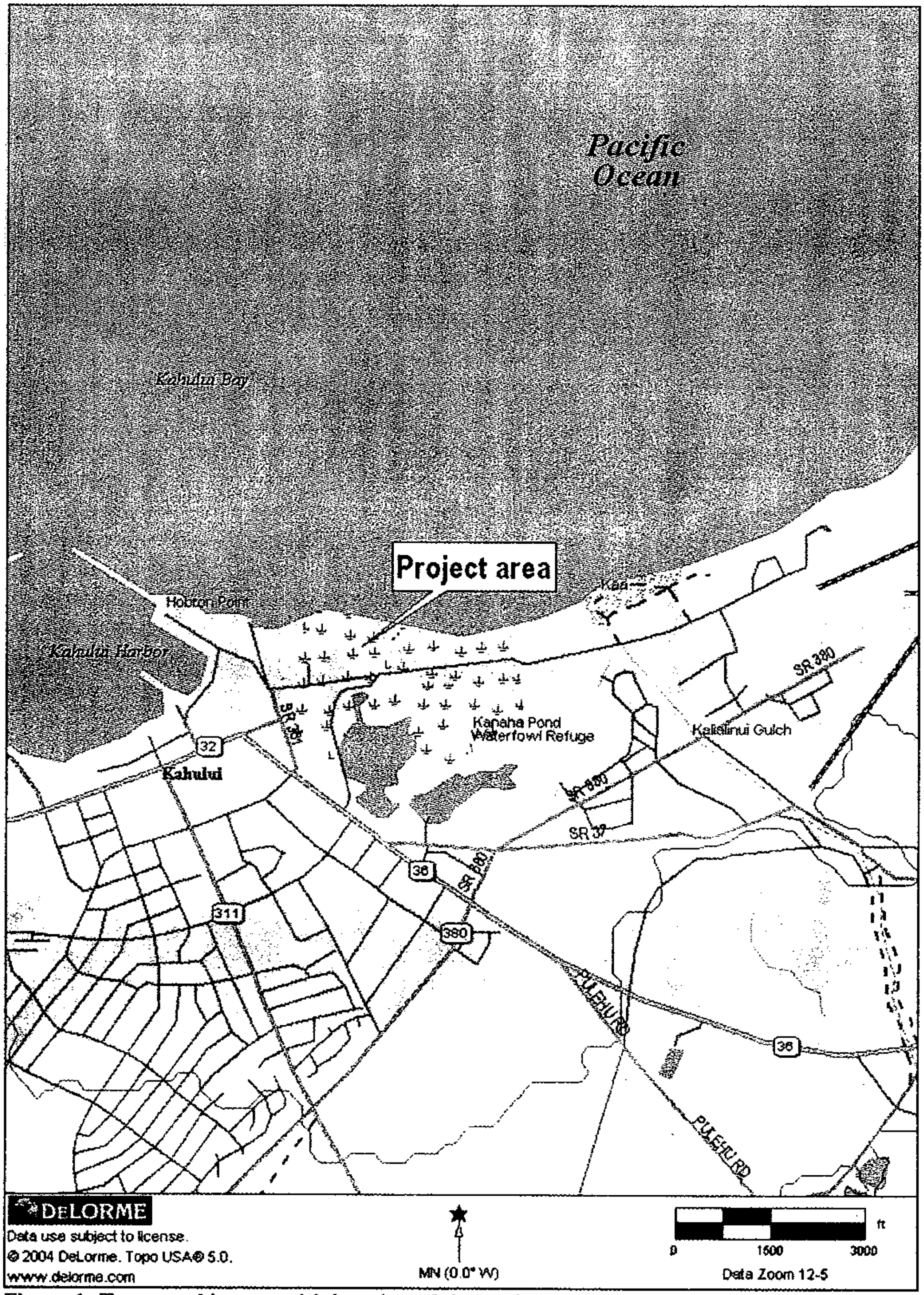

Figure 1: Topographic map with location of the project area, County of Maui Waste Water Treatment Plant at Kanaha, Maui.

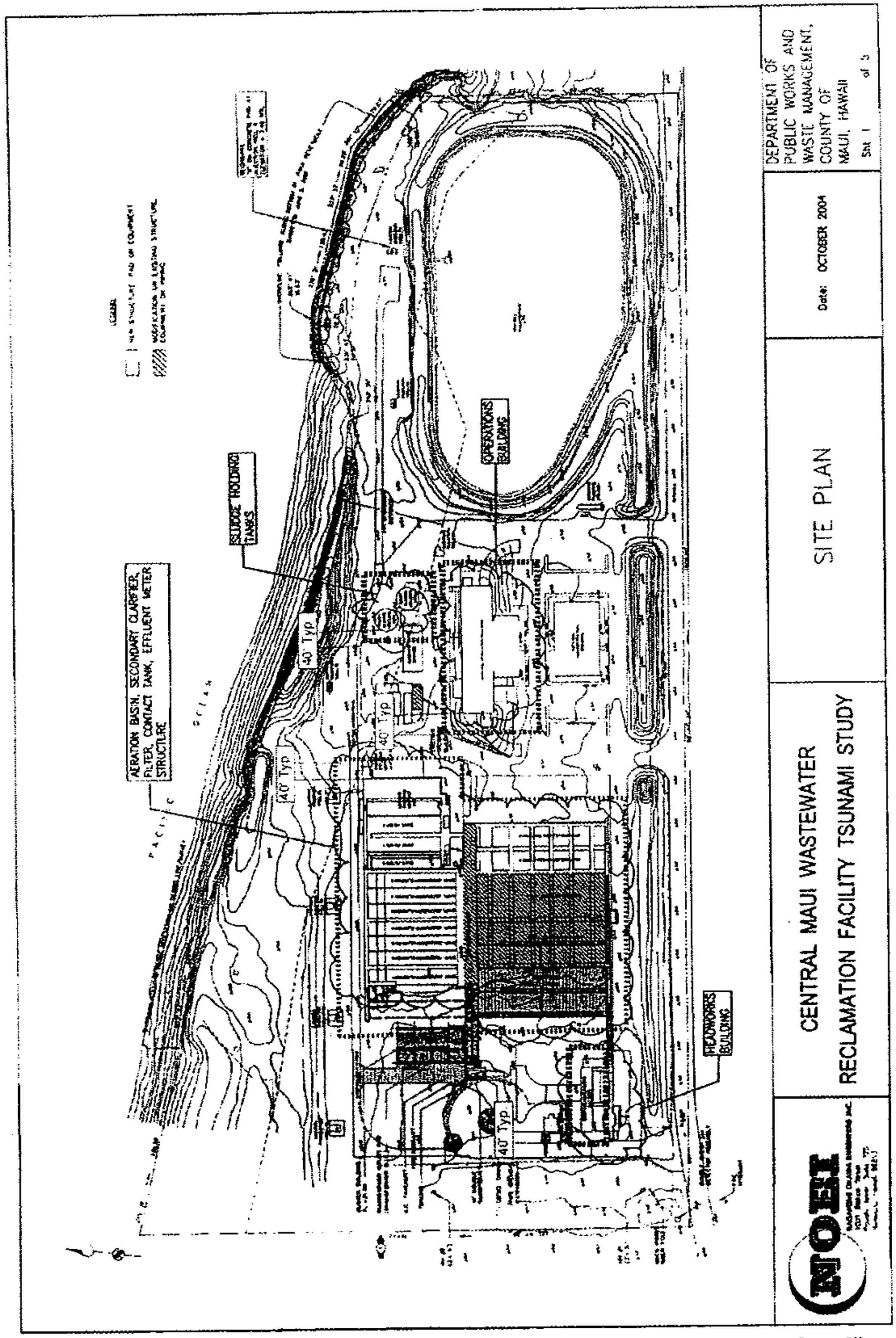

Figure 2: Plan view of the wastewater treatment facility; red areas to be "hardened".

INTRODUCTION

Mr. Michael Munekiyo of Munekiyo & Hiraga, Inc., contacted Xamanek Researches, LLC on behalf the County of Maui Department of Environmental Management in April 2007 about a proposed tsunami improvements project at the County of Maui Waste Water Treatment facility in Kanaha, Maui (Figures 1 and 2). This project would consist of earthmoving activities associated with the construction of various tsunami "hardening" measures at the treatment plant.

Given the coastal location of the project area, the State Historic Preservation Division (SHPD) was contacted. Per discussions with Dr. Melissa Kirkendall[1] of the SHPD Maui office, it was determined that a field inspection of the area would first be undertaken. In the event that significant cultural resources were noted during this field inspection, a reassessment of necessary work would then be made. We were given the notice to proceed with the field inspection in the fall of 2007.

Erik Fredericksen conducted the field inspection of the proposed impact areas at the waste water treatment facility on 29 November 2007 (see Figure 2). The non-built portions of the County parcel, near portions of the facility that may be "hardened" to resist possible tsunami inundation were inspected at this time. During the course of the walk-over, an area of shoreline erosion was noted. Inspection of a wave cut bank revealed what is interpreted as previously disturbed sand. No cultural materials were noted in the cut bank, which is near the *makai* boundary of the parcel. Sand dune deposits were noted in all non-built areas. In addition, sand deposits were noted along Amala Place, which provides access to the County facility and as well as Kanaha Park.

It is noteworthy that a portion of Kanaha Pond (Site 50-50-05-1783) is located to the south of the facility, across Amala Place. The pond qualifies for significance under all four National Register Criteria as well as HRHP Criterion "e" for its traditional cultural value. The pond will not be impacted by actions of this County project.

Based on the results of the field inspection, it was determined that precautionary archaeological monitoring would need to be carried out during earthmoving activities at the facility. This action was recommended because of the presence of sand deposits on the parcel.

[1] Dr. Kirkendall resigned from the SHPD at the end of June 2007.

The following archaeological monitoring plan has been prepared on behalf of the County of Maui Department of Environmental Management. This monitoring plan covers the proposed tsunami improvements project and any future on-site improvements at the facility (TMK (2) 3-8-1: 188).

BACKGROUND INFORMATION

The project area is located in Kanaha near Kahului Harbor on the windward side of the isthmus of the island of Maui. Marine sand and dune sand deposits are present in this region, which is part of the large Pu`uone dune system. The first phase of the Central Maui Waste Water Treatment facility was developed over 30 years ago. The project area is located in Jaucus and beach sand deposit. This general area is known to contain both isolated and clusters of Native Hawaiian burials and/or habitation site remnants. Much of the project area has been altered by the construction of this wastewater treatment facility, existing infrastructure, and roads. Observed vegetation on the project area consisted of alien weeds and grasses, *koa haole* (Leucaena leucocephela) shrubs, along with *kiawe* (Prosopis pallida) trees. *Naupaka kahakai* (Scaevola sericea) was noted along the *makai* portion of the parcel. It is estimated that this part of Maui receives between 20 and 30 inches of annual precipitation. The County parcel ranges from a low of c. 3 ft AMSL to a high of about 8 ft AMSL.

Previous archaeological work

Previously identified cultural resources in the vicinity of the waste water treatment facility include Sites 50-50-05-1777, 1798, 1799, 2849, 4197, and 1783. The bulk of these sites have been identified during work associated with the Kahului Airport. These previously identified sites are briefly summarized below.

Site 50-50-05-1777 consists of a subsurface cultural deposit that contains associated features, midden deposits, as well as numbers of artifacts. This habitation deposit was encountered during monitoring that was carried out for the installation of a sewer line in the 1980s. Radiocarbon analysis dated this site to c. AD 1380-1700. A 1996 SHPD review letter for an airport project indicates that inventory level work was needed on this site, in order to more fully evaluate Site 1777. In addition, the review letter also states that data recovery work would also be necessary. There does not appear to have been any inventory level work or data recovery work that has been carried out on this site since the 1996 SHPD letter.

Site 50-50-05-1798 is composed of an unknown number of human burials, a reburial area[2], and a subsurface terrace wall with associated pond field deposits. There is a Programmatic Agreement, signed in 1997, that covers this area, which lies to the north of the runway. To date, it remains unclear what work has been carried out in this area. We will be working on bringing preservation commitments into place. The 1996 SHPD review letter notes that it remains unknown whether Site 1798 extends beneath runways 5/23 and/or 5/20. The letter also indicates that data recovery work is recommended for the pond field and wall feature that are contained within Site 1798. In addition, SHPD also recommended that additional testing be conducted in order to better assess the extent of burials and human remains in this portion of the airport property. This testing has not, to the author's knowledge, been carried out at the writing of this memorandum. Finally, it was noted that some of the fill that the military used in this portion of the airport may have contained human skeletal remains. Should this indeed be the case, a precautionary treatment plan will need to be incorporated into a general monitoring plan for the overall airport project.

Site 50-50-05-1799 is located to the north of Site 1798 and consists of a c. 4 m long rock alignment and a possible coral pavement of unknown function. The 1996 SHPD comment letter notes that this site has not been adequately assessed. In addition, the review letter also indicates that further work is needed at this site.

Site 50-50-05-2849 is made up of an extensive subsurface cultural deposit that was identified during archaeological testing in c. 1990-1991. This site qualifies for significance under Criterion "d" because of its information content. The SHPD has recommended that data recovery work be undertaken on this cultural deposit.

Site 50-50-05-4197 consists of related features of the former WWII Naval Air Station (NASKA). An SHPD review letter indicates that additional work is needed for this complex. The letter goes on to note that an inventory survey of the area is needed before additional evaluations/recommendations can be made.

Site 50-50-05-1783 [Kanaha Pond]: as previously noted, a portion of Kanaha Pond is located to the south of the waste water treatment facility. This site qualifies for significance under all four National Register Criteria as well as HRHP Criterion "e" for its traditional cultural value.

---

[2] Mr. Charles Kauluwehi Maxwell Sr., current Chair, Maui/Lana`i Islands Burial Council (MLIBC), assisted in the reburial of human remains that were disturbed by airport construction activities over 20 years ago.

ARCHAEOLOGICAL MONITORING PLAN

Scope of monitoring

The scope of this monitoring plan includes having an archaeological monitor present during all subsurface earthmoving activities scheduled for the proposed tsunami improvements project at the County of Maui Waste Water Treatment facility in Kanaha, Maui. Actual on-site time and specific actions to be followed in the event of inadvertent discoveries will be discussed and agreed upon by the general contractor and the archaeological consultant at a pre-construction meeting held for this purpose. Additional meetings may be called, if either the monitoring archaeologist or contractor believes that other relevant information should be disseminated. As previously mentioned, this plan covers this current project as well as any future on-site improvements for the waste water treatment facility (TMK (2) 3-8-1: 188).

Monitoring methodology

Given the coastal location of the water treatment facility, there is a possibility that significant material culture remains may be inadvertently disturbed during earthmoving activities in this portion of coastal Maui. Possible cultural materials could include subsurface habitation deposits, human burials and/or human skeletal remains.

Close cooperation between the monitoring archaeologist and construction personnel is important to a successful monitoring program. The monitoring program will follow the 12 conditions listed below:

1) The contractor shall be responsible for ensuring that the archaeological consultant is aware of all pertinent construction schedules and that the monitor is present for <u>all</u> subsurface excavation activities on this coastal parcel.

2) Both the archaeological consultant and the contractor are responsible for ensuring that on-site work is halted in an area of significant findings and to protect any such find from any further damage (i.e., construction fencing, protective covering, etc.). The State Historic Preservation Division will recommend appropriate mitigation actions. The SHPD Burial Sites Program, the SHPD Maui office, and the Maui/Lana`i Islands Burial Council (MLIBC) will be consulted in the event that human remains are found (Change work order).

3) In the event of the discovery of human remains, work shall cease in the immediate find area. The monitoring archaeologist will be responsible for notifying the SHPD Maui office and the Historic Preservation Division Burial Sites Program (HPDBSP), which, in consultation with the Maui/Lana'i Islands Burial Council, will determine the appropriate mitigation measures. This notification will include accurate information regarding the context and composition of the find (Change work order).

4) The archaeological consultant will work in compliance with Hawai'i Revised Statutes Chapter 6E (procedures Relating to Inadvertent Discoveries).

5) The monitoring archaeologist will have the authority to closedown construction activities in areas where potentially significant discoveries have been made until they have been properly evaluated. Normally, construction activities may continue in unaffected portions of the project area (Change work order).

6) Field procedures to be followed for documentation of discovered cultural features or human skeletal remains: a) standard field methods including recordation of profiles showing stratigraphy, cultural layers, etc.; b) mapping and photographing of finds other than human remains; c) and excavation of cultural materials and/or exposed features.

7) The SHPD Maui archaeologist shall be notified and consulted with regarding treatment of identified features such as cultural layers, artifact or midden concentrations, structural remains, etc., considered to be of significance under S13-279-2 (definitions).

8) The contractor should take into account the necessity for machine excavation at a speed slow enough to allow for reasonable visual inspection of the work. The monitoring archaeologist must make a "best effort" to search for significant material culture remains (i.e. artifacts, features, midden, skeletal remains, etc.). Machine excavation speed will need to be slowed in an area where significant material culture remains have been identified (Change work order).

9) Significant archaeological discoveries, if they occur, shall be protected and identified by construction "caution" tape, fencing, or other reasonable means, until the SHPD Maui office and the archaeological consultant decide appropriate mitigation actions. All recovered material culture remains—with the possible exception of charcoal samples for radiometric analysis—will remain on Maui. Standard laboratory methods shall be utilized by the archaeological consultant in the event that cultural materials are recovered during monitoring and/or mitigation work. Cultural materials will be curated by the archaeological consultant (change work order)

10) One monitor in most instances will carry out the necessary fieldwork. Tasks will include observation of grubbing and earth-moving activities. However, the SHPD and the MLIBC require that one archaeological monitor be assigned to each piece of major earth-moving equipment in sand dune areas or other culturally sensitive locations (Change work order if more than one piece of machinery is to be utilized).

11) In the event of night work, the general contractor shall supply adequate lighting for the onsite monitor.

12) Chapter 6E-11 (a) specifies the following "It shall be unlawful for any person or corporate, to take, appropriate, excavate, injure, destroy, or alter any historic property or aviation artifact located on the private lands of any owner thereof without the owner's written permission being first obtained. It shall be unlawful for any person, natural or corporate, to take, appropriate, excavate, injure, destroy, or alter any historic property located upon lands owned or controlled by the State or any of its political subdivisions, except as permitted by the department."

Field methods utilized shall include photographic recordation (where appropriate), artifact excavation (recovery and recordation), profile documentation of cultural layers and stratigraphy, excavation and recordation of exposed features, and mapping of all pertinent features on an appropriate site map. A daily log (field notes) of activities and findings will also be kept. Gathered information shall be utilized in the preparation of the monitoring report to be submitted to the SHPD.

In the event human skeletal remains are inadvertently disturbed, the SHPD Maui office, the Burial Sites Program, and the Maui/Lana`i Islands Burial Council shall be notified, and appropriate mitigation actions determined (photographs of human skeletal remains will not be taken).

A supervisory archaeologist may periodically visit the monitoring site as often as is necessitated by the nature of the construction activities and archaeological findings. If significant discoveries are made, appropriate mitigation measures will be discussed with the SHPD Maui office.

The archaeological consultant shall curate all cultural materials recovered from this monitoring project on Maui, with the possible exception of human remains.[3] When analysis is completed, recovered material culture remains will be turned over to the appropriate parties. Long-term curation arrangements of such materials will be approved by the SHPD.

A draft monitoring report detailing the results of the monitoring program will be prepared. This draft report shall be submitted to the State Historic Preservation Division

[3] In the event that the SHPD Maui office has insufficient space for recovered human remains, then the consultant shall curate the human remains on Maui.

within 180 days of the completion of fieldwork, for comment and approval. Approved changes and corrections will result in the final monitoring report for this construction project for the Waste water treatment facility at Kanaha, Maui. Any future on-site improvements for this County of Maui facility located on TMK: (2) 3-8-1: 188 will be covered by this monitoring plan, but will require separate monitoring reports.

APPENDIX J-3.

State Historic Preservation Division Approval Letter of Monitoring Plan

LINDA LINGLE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
STATE HISTORIC PRESEERVATION DIVISION
601 KAMOKILA BOULEVARD, ROOM 555
KAPOLEI, HAWAII 96707

LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

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FIRST DEPUTY

KEN C. KAWAHARA
DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
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BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

January 31, 2008

Mr. Erik Fredericksen
Xamanek Researches, LLC
P.O. Box 880131
Pukalani, Hawai'i 96788

LOG NO: 2007.4180
DOC NO: 0801JP06
Archaeology

Dear Mr. Fredericksen:

SUBJECT: Chapter 6E-8 Historic Preservation Review
Archaeological Monitoring Plan for the Scheduled Tsunami Improvements Project at the County of Maui Waste Water Treatment Plant at Kanaha
Wailuku Ahupua'a, Wailuku District, Maui Island
TMK: (2) POR of 3-8-001:188

Thank you for the opportunity to review the archaeological monitoring plan, which was received by our staff in December 2007 (Fredericksen 2007, *An Archaeological Monitoring Plan for the Scheduled Tsunami Improvements Project at the County of Maui Waste Water Treatment Plant at Kanaha, Wailuku Ahupua'a, Wailuku District, Maui Island [TMK: (2) 3-8-001:188]*)...Xamanek Researches, LLC, ms.

Archaeological field inspection occurred on the subject parcel and archaeological monitoring was the accepted mitigation. Statewide Inventory of Historic Places (SIHP) 50-50-05-1777, -1783, -1798, -1799, -2849, and -4197 have been documented in the vicinity of the current project area. The sites consist of World War II Naval Air Station remnants, significant subsurface cultural deposits, a rock alignment with coral, and several human burials. A portion of Kanaha Pond is located south of the facility, across Amala Place. Additional archaeological inventory survey and data recovery work has been recommended for the majority of the sites. None of the previously documented sites will be impacted by the proposed construction activities. Archaeological monitoring is necessary during all construction activities because of the possibility of the discovery of subsurface cultural deposits during the course of the project (including human burials).

This plan conforms to Hawaii Administrative Rules Chapter 13-279 which governs the standards for archaeological monitoring. The subject plan includes the following provisions: an archaeologist will be on site on a full-time basis and will have the authority to halt excavation in the event that cultural materials are identified. Consultation with the Maui State Historic Preservation Division (SHPD) will occur in this event, to determine an acceptable course of action. If human burials are identified, work will cease, the SHPD Burial Sites Program, Maui SHPD, O'ahu SHPD and the Maui/Lana'i Islands Burial Council will be notified, and compliance with procedures outlined in HRS 6.E-43 will be followed. Coordination meetings with the construction crew will be held prior to project initiation.

The plan further indicates that an acceptable report will be submitted to this office within 180 days of project completion. We understand that any future on-site improvements planned for this County of Maui facility on TMK (2) 3-8-001:188 will be covered by this monitoring plan but will require the submittal of phased monitoring reports.

The plan is acceptable. Please notify our Maui and O'ahu offices, via facsimile, at the onset and completion of the project and monitoring program. We believe it is unlikely that any historic properties will be affected with the implementation of this accepted monitoring plan. If you have any questions, please contact the Maui SHPD at (808) 243-4641.

Aloha,

Nancy McMahon, Archaeologist and Acting Archaeology Branch Chief
State Historic Preservation Division

c: Director, Dept. of Planning, 250 S. High Street, Wailuku, HI 96793
Maui Cultural Resources Commission, Dept. of Planning, 250 S. High Street, Wailuku, HI 96793
* DPWEM County of Maui

APPENDIX K.

Cultural Interview Summaries

PROPOSED SHORELINE PROTECTION EXTENSION
CULTURAL INTERVIEW SUMMARY

Interview with: Clifford Naeole

Interviewed by: Justin Tanaka, Planner
Mich Hirano, Principal
Munekiyo & Hiraga, Inc.

Clifford Naeole is the Cultural Advisor to the Ritz-Carlton Kapalua Resort and was born and raised on Maui. Mr. Naeole's paternal grandfather was of Hawaiian descent and lived in Waihe'e as a taro farmer. Mr. Naeole recalled that it was common for his paternal grandfather to go diving the length of Kanaha beach to Paukukalo, often in the span of a single afternoon. Mr. Naeole's maternal grandfather, Henry Ching, was of Chinese descent and an avid fisherman. Mr. Naeole recalled that his maternal grandfather once claimed a catch that numbered a total of one-hundred and twenty-eight fish. It was from his maternal grandfather, Henry Ching, that Mr. Naeole ultimately learned how to fish—how to spot fish in the water and where the best places to fish were.

As a youth, Mr. Naeole frequently played amongst the beaches of Kahului, from the harbor all the way up to Naskas (now known as Kanaha). In those days, Mr. Naeole recalled the town of Kahului being a small town with limited development. He lived in a house on Temple Street which serviced a total of only 5 homes. Across the street from his house was a sausage making company, and a few commercial office buildings lay scattered throughout the area. The Kahului Railroad, which his grandfather worked for, ran right through town, passing right next to their house. The few families that lived here were fishing families, including the Aikaus (of Eddie Aikau fame) and the Melamai's.

According to Mr. Naeole, fishing was a widespread practice in this area. It was the favorite place of ulua fishermen, and Mr. Naeole himself would often fish from a pier in the harbor. He remembers that there were plenty of fish in the area, including Halalu, Manini, Aholehole, Kawakawa, and even Barracuda. Besides fishing, other activities such as crabbing, opihi picking, and limu gathering were commonly performed. According to Mr. Naeole, in those days there were many different varieties of limu. However, since dredging of the harbor began, the production of limu began to change. Since about the early 80's, Mr. Naeole observed a strange increase in the growth of foreign limu, with Vaivaiole as the predominant species. He believes that the influx of limu dampened fishing practices in the area.

Mr. Naeole cites the dredging of Kahului harbor as a major impact to Kahului waters. Before the dredging occurred, he explained that waters at Kanaha and Kahului were clear and clean. After the dredging however, water inside the harbor became milky-colored and dirty, and the water quality outside the harbor changed too. The dredging of the harbor also seemed to affect changes in wave breaks of the area.

Now, Mr. Naeole says the fishing and limu gathering in the Kahului area are not as plentiful as they were before. However, Mr. Naeole knows that people still use the area for fishing, and canoe paddling, diving, surfing, and shoreline gathering. He isn't aware of any other cultural activities in the vicinity of the project site.

The only concerns that Mr. Naeole has in regards to the project is whether or not the Wailuku-Kahului Wastewater Treatment Plant's facilities are up to date. He recalled an incident that happened about six years ago when run-off from the treatment plant spilled over onto the road. He hopes that appropriate measures will be taken to ensure that something like that will not happen again.

K:\DATA\MoffattNichol\WK WWRF\CliffordNaole.interview.wpd

PROPOSED SHORELINE PROTECTION EXTENSION CULTURAL INTERVIEW SUMMARY

Interview with: Hokulani Holt

Interviewed by: Mich Hirano, Principal
Justin Tanaka, Planner
Munekiyo & Hiraga, Inc.

Hokulani Holt is the Director of Cultural Programs at the Maui Arts and Cultural Center and was raised in Waiehu. Ms. Holt's familial roots in the area go back six generations and as a result, she is very familiar with historical and current cultural practices that occur in the area.

As a youth, Ms. Holt recalled that her grandparents would often take her to the various beaches from Waihee to Ka'a, or Kanaha, for shoreline gathering. Her family would also frequent the Kanaha area and would often partake in limu gathering, fishing, and collecting kiawe. Ms. Holt explained that historically, land in the vicinity of the Wailuku-Kahului Wastewater Reclamation Facility was actively used by many fishing families for net-laying, diving and throw-netting. There were also many families in the area, primarily of Hawaiian, Japanese, and Portuguese descent, that lived in Quonset huts built for a Naval Air Station complex.

Ms. Holt acknowledged that in recent years limu growth in the area has subsided, most likely due to the construction of a drainage ditch, located to the west of the WKWWRF, which empties out into the waters off Kanaha. She believes that the drainage ditch altered the quality of the ocean waters and affected limu growth in the area. However, Ms. Holt explained that there are still people who continue to utilize the area today. Kaunaoa, a native Hawaiian plant which is bright orange and stringy in appearance, is often gathered along Kanaha beach for hula and lei-making. Other cultural practices such as diving, shoreline fishing, and kiawe cutting for imu preparation are still performed in the area.

Ms. Holt does not believe that the proposed project will impact coastal waters, however, she is concerned that implementing a revetment would lead to increased erosion of the beach. Ms. Holt also wants to ensure that public access to the beach area will be maintained, to allow the continuation of cultural practices within the area, as well as to ensure that future cultural practices will be allowed to flourish. Finally, Ms. Holt voiced her concerns for fishing koa, or fishing houses, that may be located offshore of the project site. She explained that the fishing koa are used as fishing sites for local fisherman familiar with the area. She expressed concern that wave action and underscouring at the toe of the revetment will not affect off-shore currents and impact marine habitats and the fishing koa sites.

K:\DATA\MoffattNichol\WK WWRF\HHolt.interview.wpd

PROPOSED SHORELINE PROTECTION EXTENSION CULTURAL INTERVIEW SUMMARY

Interview with: Ki`ope Raymond

Interviewed by: Carol Matasci and Justin Tanaka, Planners
Munekiyo & Hiraga, Inc.

Ki`ope Raymond was born in Lahaina, Maui, sharing the same birthplace as his mother. His father was from Kauai. As Mr. Raymond grew older, he moved from island to island. After attending college at Oregon State on the mainland, he developed a renewed passion for Hawaii and the Hawaiian culture. As a native Hawaiian himself, Mr. Raymond pursued a growing interest in Hawaiian studies, collecting knowledge from family members and taking classes at Maui Community College (MCC) and the University of Hawaii at Manoa. He continues to share his knowledge with others, having taught in the Hawaiian Studies program at MCC, as well as participating in a variety of community organizations, such as the Lahaina Restoration Foundation, the Friends of Haleakala, and Surfrider Foundation. In addition, Mr. Raymond serves as the President of the Kilakila O Haleakala Organization.

Historically, the land in the vicinity of the Wailuku-Kahului Wastewater Reclamation Facility (WKWWRF) was used by the Hawaiian people for providing sustenance. Few people lived in the immediate area, but the area was frequently visited by the people of Wailuku. Kanaha Pond and the neighboring Mauoni Pond were used for aquaculture to raise fish for the ali`i and the populace. Mr. Raymond explained that the Hawaiian word *naha* literally means "to burst out". During periods of heavy rain, the waters would flow out of Kanaha Pond towards the ocean.

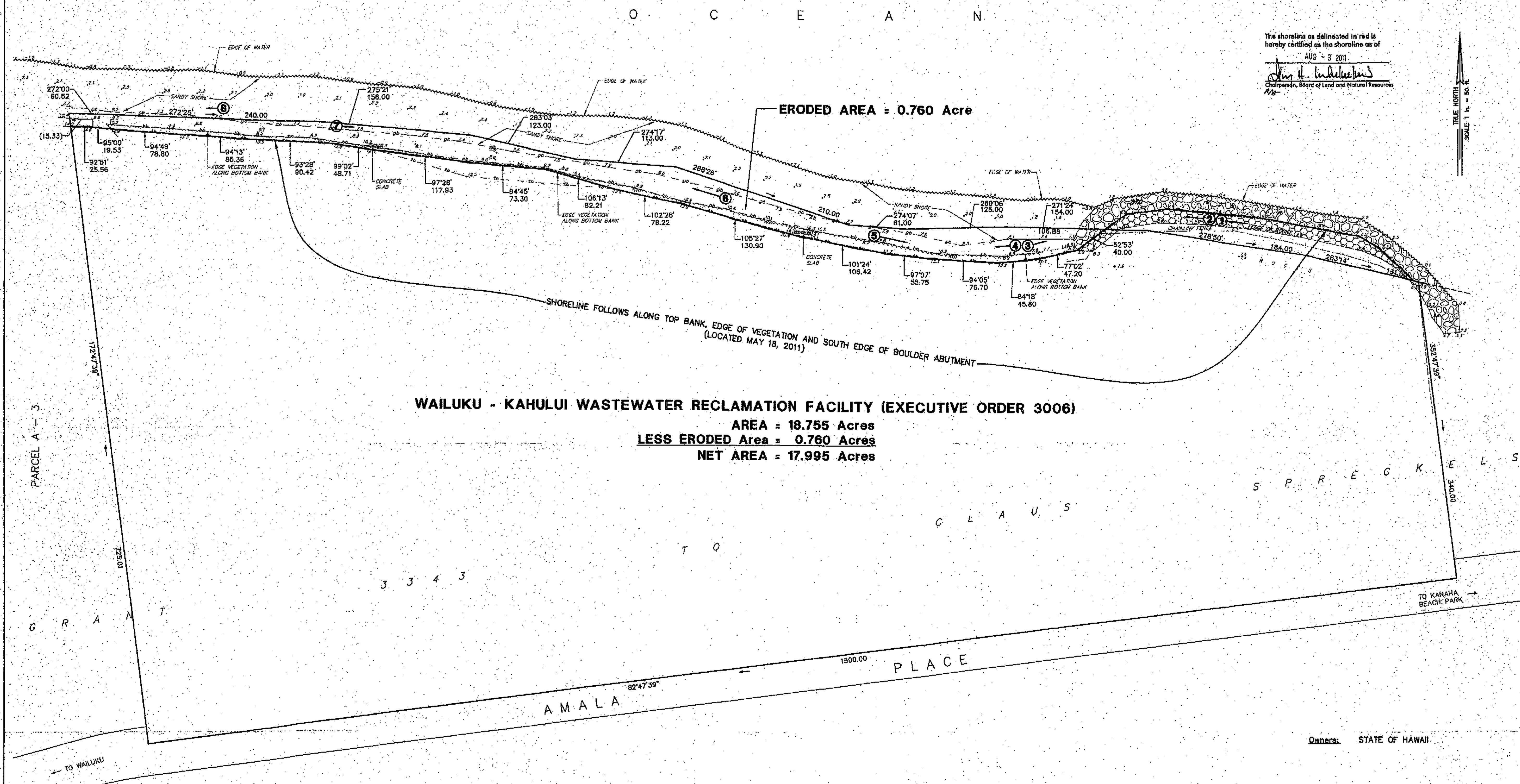
Nowadays, there is no formalized aquaculture in the ponds. However, the coastal area from Spreckelsville out to Waihee is still recognized for its resources. In the area by the WKWWRF, Mr. Raymond noted that people perform a variety of cultural practices, such as gathering limu (seaweed), fishing by shore-casting and net-laying, and catching tako (octopus). The nearby area is also a popular site for surfing and kite surfing, as Mr. Raymond and many others often visit the adjacent Kanaha Beach Park to take part in these activities.

Mr. Raymond does not believe that the proposed project will have impacts related to the historical uses of Kanaha Pond, since the WKWWRF is already there. However, his main concern is the possible impacts to cultural use from beach loss. Impacts to Kanaha Beach Park would affect him personally, since he surfs and spends time there. He doesn't believe the project would change the surf break, but the project could disrupt fishing and gathering practices if it leads to a loss of sand. He also requested that careful attention be given to any significant archaeological finds discovered during the construction of the project.

F:\DATA\MoffattNichol\WK WWRF\KRaymond.interview.wpd

APPENDIX L.

Certified Shoreline Survey



SHORELINE SURVEY MAP
OF
KAHULUI WASTEWATER RECLAMATION FACILITY LOT

BEING A PORTION OF GRANT 3343 TO CLAUS SPRECKELS

AT KAHULUI, WAILUKU, MAUI, HAWAII

50 25 0 50 100
GRAPHIC SCALE IN FEET

LEGEND:

- TOP BANK
- BOTTOM BANK
- SPOT ELEVATION
- EDGE OF VEGETATION
- GRADE BREAK
- ① LOCATION AND DIRECTION OF PHOTOGRAPHS TAKEN ON MAY 18, 2011 AT 1:30 PM.

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION

KIRK T. TANAKA, LICENSED PROFESSIONAL LAND SURVEYOR No. 7223-LS, HAWAII, U.S.A.

KIRK T. TANAKA
Licensed Professional Land Surveyor
Certificate No. 7223
License Expires: APRIL 30, 2012

06/22/11
DATE

Tax Map Key (2) 3-8-01 : 188

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LAND SURVEYORS - CIVIL & STRUCTURAL ENGINEERS

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