DEPARTMENT OF WATER SUPPLY • COUNTY OF HAWAIʻI
345 KEKŪANAŌʻA STREET, SUITE 20 • HILO, HAWAIʻI 96720
TELEPHONE (808) 961-8050 • FAX (808) 961-8657

December 4, 2014

FILE COPY
JAN 8 2015

RECEIVED
'14 DEC 12 A10:39
OFC. OF ENVIRONMENTAL QUALITY CONTROL

Ms. Jessica Wooley, Director
Office of Environmental Quality Control
235 South Beretania Street, Suite 702
Honolulu, HI 96813

KEŌPŪ WELL #4 PUMP AND TRANSMISSION LINES PROJECT
DRAFT ENVIRONMENTAL ASSESSMENT

The enclosed Draft Environmental Assessment (DEA) for the proposed Keōpū Well #4 Pump and Transmission Lines project assesses the potential effects of constructing, testing, and operating the proposed facilities. Based on the information contained in the DEA, the County of Hawaiʻi Department of Water Supply anticipates a Finding of No Significant Impact (FONSI) determination. Please publish notice of availability for this project in the December 23, 2014 OEQC *Environmental Notice*.

We have enclosed a completed OEQC Publication Form, two printed copies of the DEA, and a CD containing the project summary (in Word format) and a pdf version of the DEA. Please call the project consultant Dr. Charles Morgan of Planning Solutions, Inc., at 808-550-4539, if you have any questions.

Sincerely yours,

Quirino Antonio, Jr., P.E.
Manager-Chief Engineer

RECEIVED
'14 DEC 12 A10:36
OFC. OF ENVIRONMENTAL QUALITY CONTROL

KKU:dfg

copy – County of Hawaiʻi, Department of Water Supply

Encs.:
(1) Draft EA, 2 printed & 1 electronic copy
(2) OEQC Publication Form
(3) Electronic version of Project Summary on disk

APPLICANT ACTIONS
SECTION 343-5(C), HRS
PUBLICATION FORM (JANUARY 2013 REVISION)

Project Name: KEŌPŪ WELL #4 PUMP AND TRANSMISSION LINES PROJECT
Island: **Hawaiʻi**
District: **North Kona**
TMKs: **7-5-001:115, 7-5-001:159, 7-5-013:022, 7-5-024:999, 7-5-002:999, and 7-4-002:999**
Permits: **Conservation District Use Permit Extension, National Pollutant Discharge Elimination System – Notice of Intent [Construction] (NPDES-NOI[C]), Noise Permit and/or Noise Variance, Grubbing, Grading, and Stockpiling Permit, and Building Permits, Construction within State Road right of way**

Approving Agency:
Department of Water Supply, County of Hawaiʻi
45 Kekuanaoa Street, Suite 20, Hilo, HI 96720
Mr. Quirino Antonio, Manager
(808) 961-8050

Applicant:
Forest City Hawaiʻi
5173 Nimitz Road, Honolulu, HI 96818
Ann Bouslog, (808) 839-8769

Consultant:
Planning Solutions, Inc.
210 Ward Avenue, Suite 330, Honolulu, Hawaii 96814
Perry White, (808) 550-4483

Status (check one only):

_✓_DEA-AFNSI	Submit the approving agency notice of determination/transmittal on agency letterhead, a hard copy of DEA, a completed OEQC publication form, along with an electronic word processing summary and a PDF copy (you may send both summary and PDF to oeqchawaii@doh.hawaii.gov; a 30-day comment period ensues upon publication in the periodic bulletin.
__FEA-FONSI	Submit the approving agency notice of determination/transmittal on agency letterhead, a hard copy of the FEA, an OEQC publication form, along with an electronic word processing summary and a PDF copy (send both summary and PDF to oeqchawaii@doh.hawaii.gov; no comment period ensues upon publication in the periodic bulletin.
__FEA-EISPN	Submit the approving agency notice of determination/transmittal on agency letterhead, a hard copy of the FEA, an OEQC publication form, along with an electronic word processing summary and PDF copy (you may send both summary and PDF to oeqchawaii@doh.hawaii.gov; a 30-day consultation period ensues upon publication in the periodic bulletin.
__Act 172-12 EISPN	Submit the approving agency notice of determination on agency letterhead, an OEQC publication form, and an electronic word processing summary (you may send the summary to oeqchawaii@doh.hawaii.gov. NO environmental assessment is required and a 30-day consultation period upon publication in the periodic bulletin.
__DEIS	The applicant simultaneously transmits to both the OEQC and the approving agency, a hard copy of the DEIS, a completed OEQC publication form, a distribution list, along with an electronic word processing summary and PDF copy of the DEIS (you may send both the summary and PDF to oeqc@doh.hawaii.gov); a 45-day comment period ensues upon publication in the periodic bulletin.
__FEIS	The applicant simultaneously transmits to both the OEQC and the approving agency, a hard copy of the FEIS, a completed OEQC publication form, a distribution list, along with an electronic word processing summary and PDF copy of the FEIS (you may send both the summary and PDF to oeqc@doh.hawaii.gov); no comment period ensues upon publication in the periodic bulletin.
__ Section 11-200-23 Determination	The approving agency simultaneous transmits its determination of acceptance or nonacceptance (pursuant to Section 11-200-23, HAR) of the FEIS to both OEQC and the applicant. No comment period ensues upon publication in the periodic bulletin.
__Statutory hammer Acceptance	The approving agency simultaneously transmits its notice to both the applicant and the OEQC that it failed to timely make a determination on the acceptance or nonacceptance of the applicant's FEIS under Section 343-5(c), HRS, and that the applicant's FEIS is deemed accepted as a matter of law.
__Section 11-200-27	

Determination — The approving agency simultaneously transmits its notice to both the applicant and the OEQC that it has reviewed (pursuant to Section 11-200-27, HAR) the previously accepted FEIS and determines that a supplemental EIS is not required. No EA is required and no comment period ensues upon publication in the periodic bulletin.

__Withdrawal (explain)

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

Forest City Hawaiʻi is proposing to convert an existing exploratory well (Keōpū Well #4,State Well No. 3957-05) in North Kona, Island of Hawaiʻi, to a production well to serve as an additional water source for the Hawaiʻi County Department of Water Supply's (DWS) system. When completed, the new production well and associated control building, booster pump, and transmission lines will be turned over to the County DWS for full operation.

Improvements that will be required consist of the following:

- Installation of a 1,050 gallons per minute (GPM) pump in the Keōpū Well #4
- Construction at the Keōpū #4 well site of a control building to house the motor control center for the pump and a chlorination water treatment system.
- Grading and paving of the existing 900-foot-long access road between the Keōpū #4 well site and Māmalahoa Highway.
- Installation of a 12-inch, 890-foot-long pipeline from the Keōpū #4 well site to the existing County of Hawaiʻi Department of Water Supply (DWS) 1.0 million gallon (MG) Keōpū storage reservoir.
- Construction at the Keōpū reservoir site of a booster pump station,
- Installation of a 16-inch, 3,600-foot-long pipeline in the Māmalahoa Highway roadway.

Draft Environmental Assessment
KEŌPŪ WELL #4 PUMP AND TRANSMISSION LINES PROJECT

HAWAI‘I ISLAND, NORTH KONA, HAWAI‘I

PREPARED FOR:
Forest City Hawai‘i

PREPARED BY:
PLANNING SOLUTIONS

DECEMBER 2014

PROJECT SUMMARY

Project:	**Keōpū Well #4 Pump and Transmission Lines**
Proposing Applicant:	Forest City Hawaiʻi
Approving Agency:	County of Hawaiʻi Department of Water Supply
Location:	The Keōpū #4 Well Site is located along Māmalahoa Highway approximately 3.3 miles south of the Māmalahoa Highway- Palani Road Junction. The well's associated water transmission pipelines will be located within the Māmalahoa Highway roadway and within a new access road between Keōpū Well #4 and the existing Keōpū production well and 1.0 MG reservoir.
Project Description:	Forest City Hawaiʻi is proposing to convert an existing exploratory well (Keōpū Well #4,State Well No. 3957-05) in North Kona to a production well to serve as an additional source to the Hawaiʻi County Department of Water Supply's (DWS) system currently serving the North Kona District of the island of Hawaiʻi. When completed, the new production well and associated control building, booster pump, and transmission lines will be turned over to the County DWS for full operation.
Associated Actions Requiring Environmental Assessment:	Use of County of Hawaiʻi Property
Tax Map Keys: All portions	7-4-002:999, 7-5-001:115, 7-5-001:159, 7-5-002:999, 7-5-013:022, and 7-5-024:999
Judicial District:	North Kona
State Land Use Districts:	Agriculture and Conservation
County Zoning:	A-1a, A-5a, and roadway
Potential Required Permits & Approvals:	• Chapter 343 Environmental Assessment • Conservation District Use Permit Extension • National Pollutant Discharge Elimination System – Notice of Intent [Construction] (NPDES-NOI[C]) • Noise Permit and/or Noise Variance • Grubbing, Grading, and Stockpiling Permits • Building Permits • Construction within State Road right of way
Anticipated Determination:	Finding of No Significant Impact
Parties Consulted:	Hawaiʻi Housing Finance and Development Corporation (HHFDC), DWS
Consultant:	Planning Solutions, Inc. 210 Ward Avenue, Suite 330 Honolulu, HI 96814 Contact: Perry White (808-550-4483)

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

THIS PAGE WAS INTENTIONALLY LEFT BLANK

1. DESCRIPTION OF PROPOSED ACTION

1.1 PROJECT OBJECTIVES AND OVERVIEW

The objectives of the proposed project are listed in Table 1.1.

Table 1.1 Project Objectives

Objective	Definition
1	To develop a supplemental source of potable water (capacity at least 1.0 million gallons per day, MGD) for the North Kona Water System
2	To supply the Kamakana affordable housing development (referred to herein as the "Kamakana Project") planned by the Hawaiʻi Housing Finance Development Corporation (HHFDC) in cooperation with Forest City Hawaiʻi
3	To minimize disruptions to public and private properties
4	To avoid or minimize adverse environmental impacts
Source: Tom Nance Water Resource Engineering	

Improvements that will be required to develop the new source of drinking water will consist of the following (see Figure 1.1 and Figure 1.2):

- Installation of a 1,050 gallons per minute (GPM) pump in the Keōpū Well #4 (State Well No. 3957-05). The 18-inch cased well was drilled and pump tested in 2003.
- Construction at the Keōpū #4 well site of a control building to house the motor control center for the pump and a chlorination water treatment system. Water for the chlorination system will come directly from the well.
- Grading and paving of the existing 900-foot-long access road between the Keōpū #4 well site and Māmalahoa Highway.
- Installation of a 12-inch, 890-foot-long pipeline and access road from the Keōpū #4 well site to the existing County of Hawaiʻi Department of Water Supply (DWS) 1.0 million gallon (MG) Keōpū storage reservoir. The section of road that crosses the intermittent drainage way will be reinforced with concrete and riprap to prevent potential washouts within the flood zone. Easements with the private property owner (TMK: 7-5-001:159) are currently being negotiated.
- Construction at the Keōpū reservoir site of a booster pump station, consisting of three 875 GPM pumps (two operating, one standby). These pumps each will be only 20 HP, and no upgrading of the existing electrical supply will be necessary.
- Installation of a 16-inch, 3,600-foot-long pipeline in the Māmalahoa Highway roadway, starting at the intersection of Keōpū Mauka Drive and going northward to the present end of the existing 16-inch main pipeline within the Māmalahoa Highway roadway.

HHFDC completed a Final Environmental Assessment/Finding of No Significant Impact (FEA/ FONSI) in 2010 (HHFDC, 2010) for a plan to utilize the exploratory Keōpū Well #4 for the Kamakana Project, called at that time the Keahuolū Project. The plan at that time was to construct a higher-capacity pump (1,400 GPM) in the Keōpū Well #4, build a new storage reservoir (2.0 MG) above the well site, install a pipeline from the reservoir to Māmalahoa Highway, and install a much longer length of pipeline (~7,000 ft.) in the Māmalahoa Highway roadway. The present plan involves substantially less construction and, with the booster pump at the existing production Keōpū Well and reservoir site, enables full use of both the exploratory Keōpū Well #4 and DWS's existing Keōpū Well (State Well No. 3957-01).

In order to avoid unnecessary duplication of effort, this report draws on information and analysis in the 2010 FEA/FONSI for those elements of the project that are unchanged. The revised plan achieves the same objectives as the original project, but will require substantially less construction and cost than the original plan.

1.2 HHFDC'S KAMAKANA VILLAGES PROJECT

In 2007, HHFDC prepared a master plan for a residential community of up to 2,330 residential units, a commercial/retail district, a civic square, school site, neighborhood parks, an archaeological preserve, and landscaped buffers and open space. The project was originally called the Keahuolū Project and is now called the Kamakana Villages Project. An Environmental Impact Statement (EIS) was prepared in late 2007 for the project, and on October 8, 2008, a notice of the acceptance of the Final EIS was published in the Office of Environmental Quality Control's (OEQC) bi-monthly Bulletin, *The Environmental Notice*.

1.3 PROPOSED ACTION

The exploratory Keōpū Well #4 is located *mauka* of Māmalahoa Highway at the 1,601-foot elevation of the Hienaloli 1-6 land tract in North Kona (see Figure 1.1 and Figure 1.2). The 1,781 foot-deep well extends 180 feet below mean sea level (msl). The upper 1,641 feet of the well hole is lined with 1,561 feet of steel casing above 80 feet of perforated casing; the bottom 140-foot length is uncased. The pump used for initial pump tests at the time the well was drilled has been removed, and the well is presently capped.

Forest City Hawaiʻi is proposing to install the well and dedicate it to DWS for use as a production well capable of producing up to 1.5 MGD. Outfitting the well for production will require installation of a submersible pump (see Figure 1.3). The pump will be operated by electricity that will be brought to the site from the existing Hawaiʻi Electric Light Company (HELCO) power line along Māmalahoa Highway via a new overhead power line following the well access road. A control building (Figure 1.4 and Figure 1.5) will be constructed to provide control and monitoring of well operations; it will also include a chlorination unit and backup generator. A chain link fence will be erected around the well and control building and the reservoir for security purposes. Installations at the wellhead of Keōpū Well #4 will include a concrete well pad and various pipes, valves and other controls (see Figure 1.6). The project will also include a booster pump station (Figure 1.7) and electrical control building (Figure 1.8), to be installed at the existing Keōpū production well and reservoir site. This pump will provide sufficient pressure to ensure transmission of water into the DWS North Kona distribution system. Though detailed design of these structures has not been completed, they are expected to have the following dimensions:

- Keōpū Well #4 Control Building: 20'-8" x 31'-4"
- Keōpū Well Booster Pump: 14' x 19'
- Keōpū Well Electrical Control Building 10'-8" x 26'
- Keōpū Well #4 Well Head Installations 26'-6" x 10'

As shown in Figure 1.2, an existing 900-foot long dirt jeep road from Māmalahoa Highway to the Keōpū Well #4 site will be graded and paved to provide improved access for facility monitoring and maintenance purposes. Another approximately 800-foot long, paved access road and water transmission line will be installed from the new production well facility to the existing Keōpū 1.0 MG reservoir. A section of the access road will require crossing an existing natural drainageway; a concrete ford crossing is proposed for that location. Power and telecommunication lines will be

Figure 1.1 Location Map

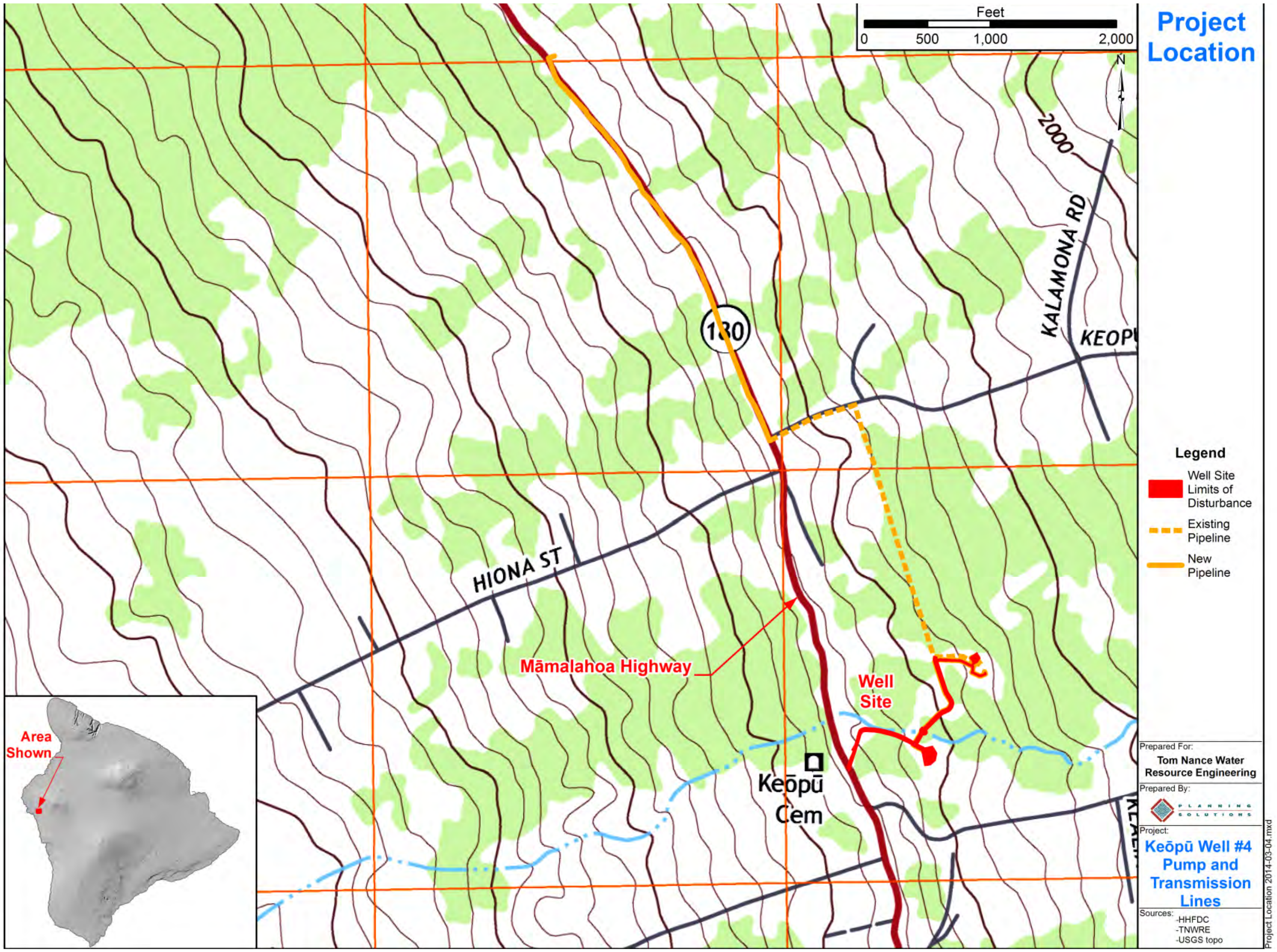


Figure 1.2 Keōpū Well Sites

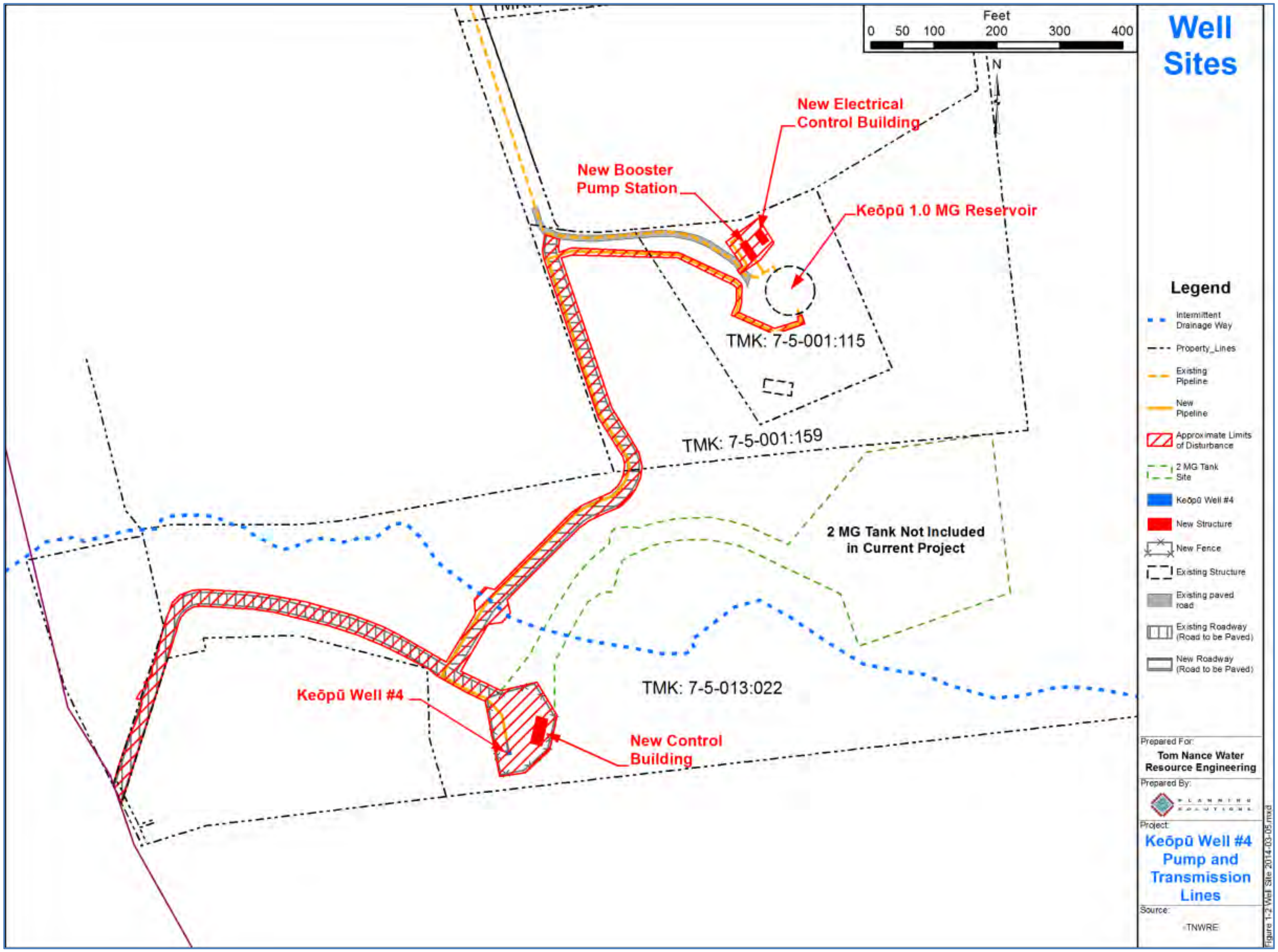
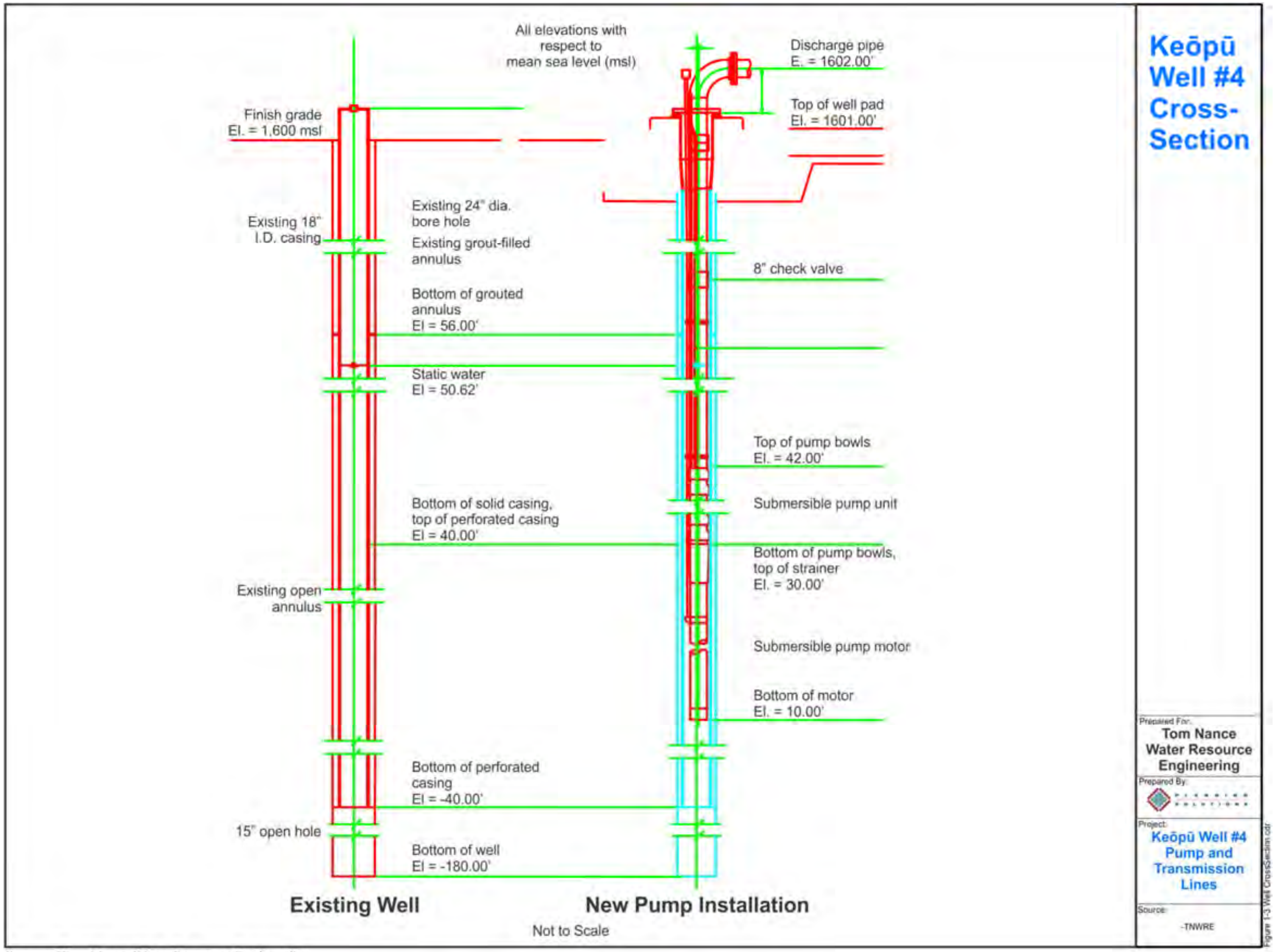
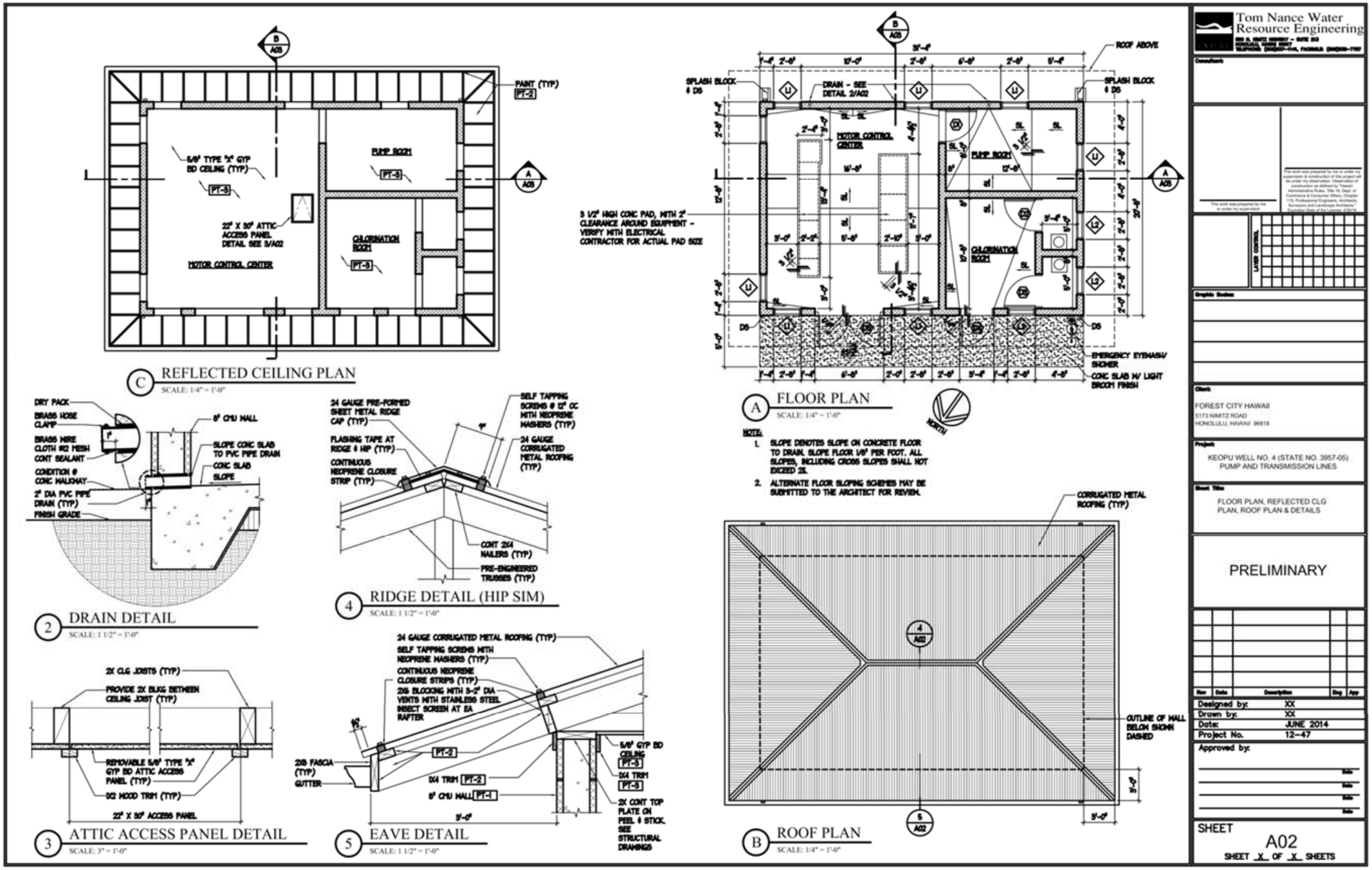


Figure 1.3 Cross-Sections of Keōpū Well #4



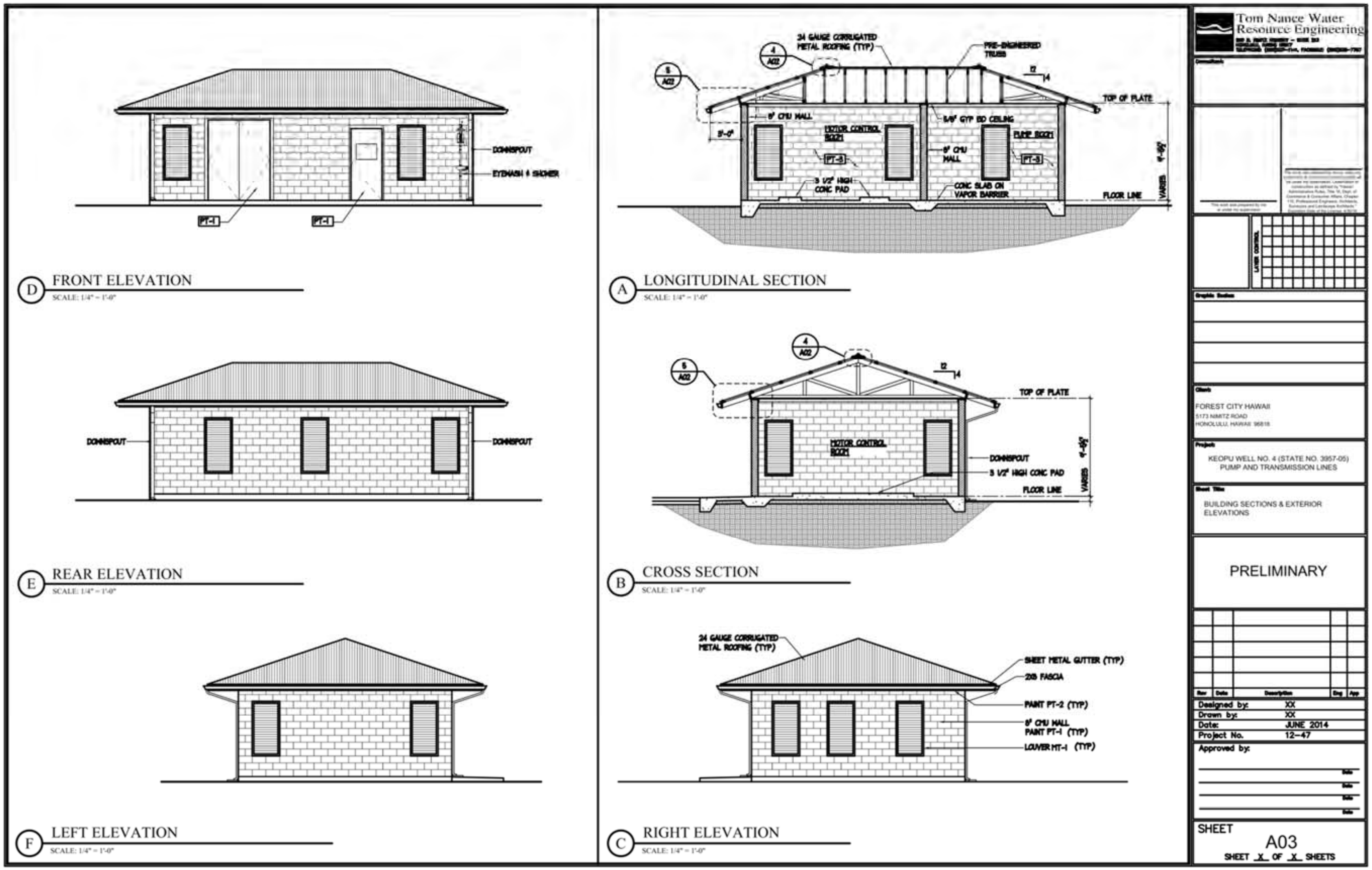
Source: Tom Nance Water Resource Engineering

Figure 1.4 Keōpū Well #4 Control Building (Plan Views)



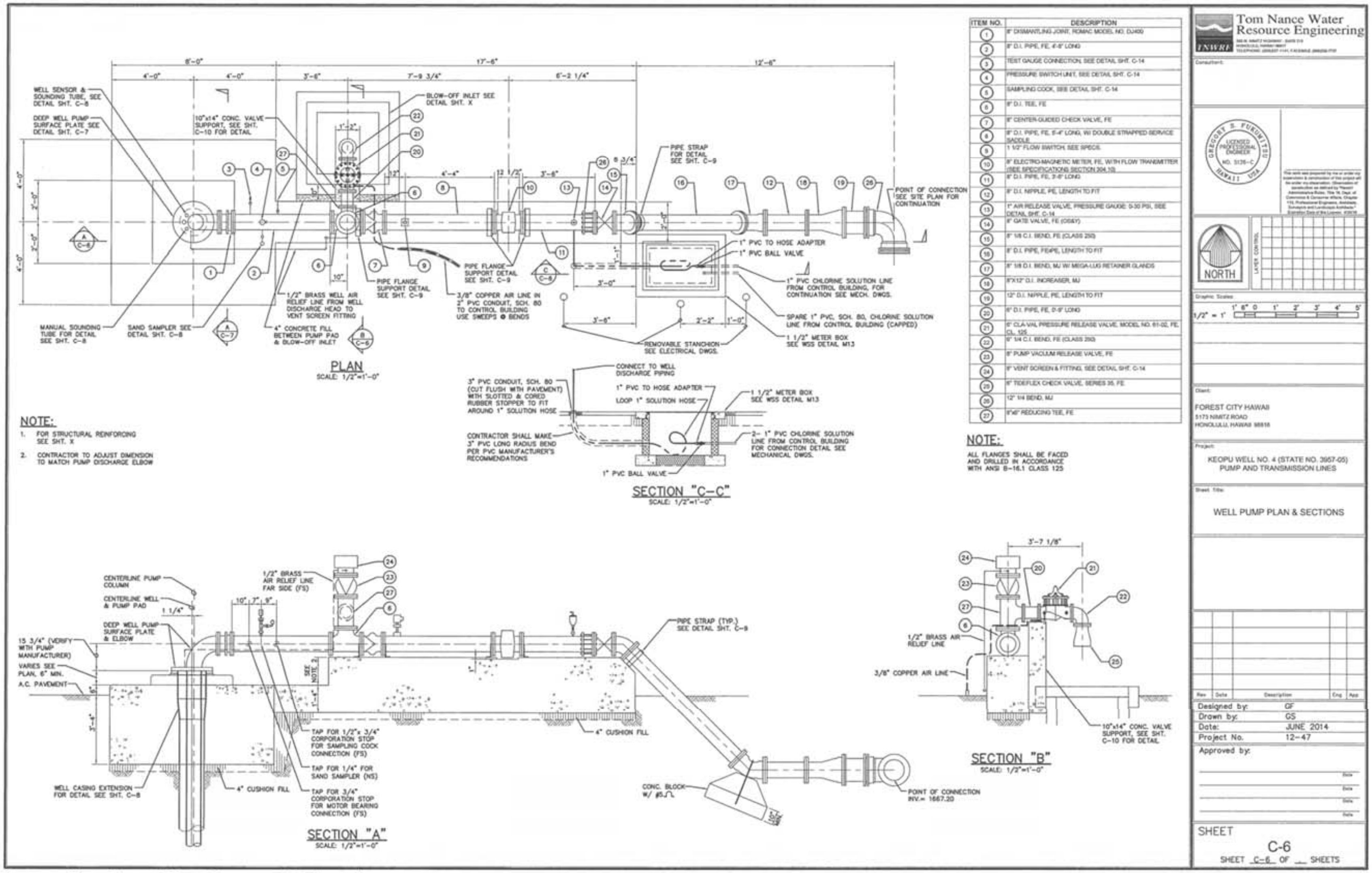
Source: Tom Nance Water Resource Engineering

Figure 1.5 Keōpū Well #4 Control Building (Building Sections and Exterior Elevations)



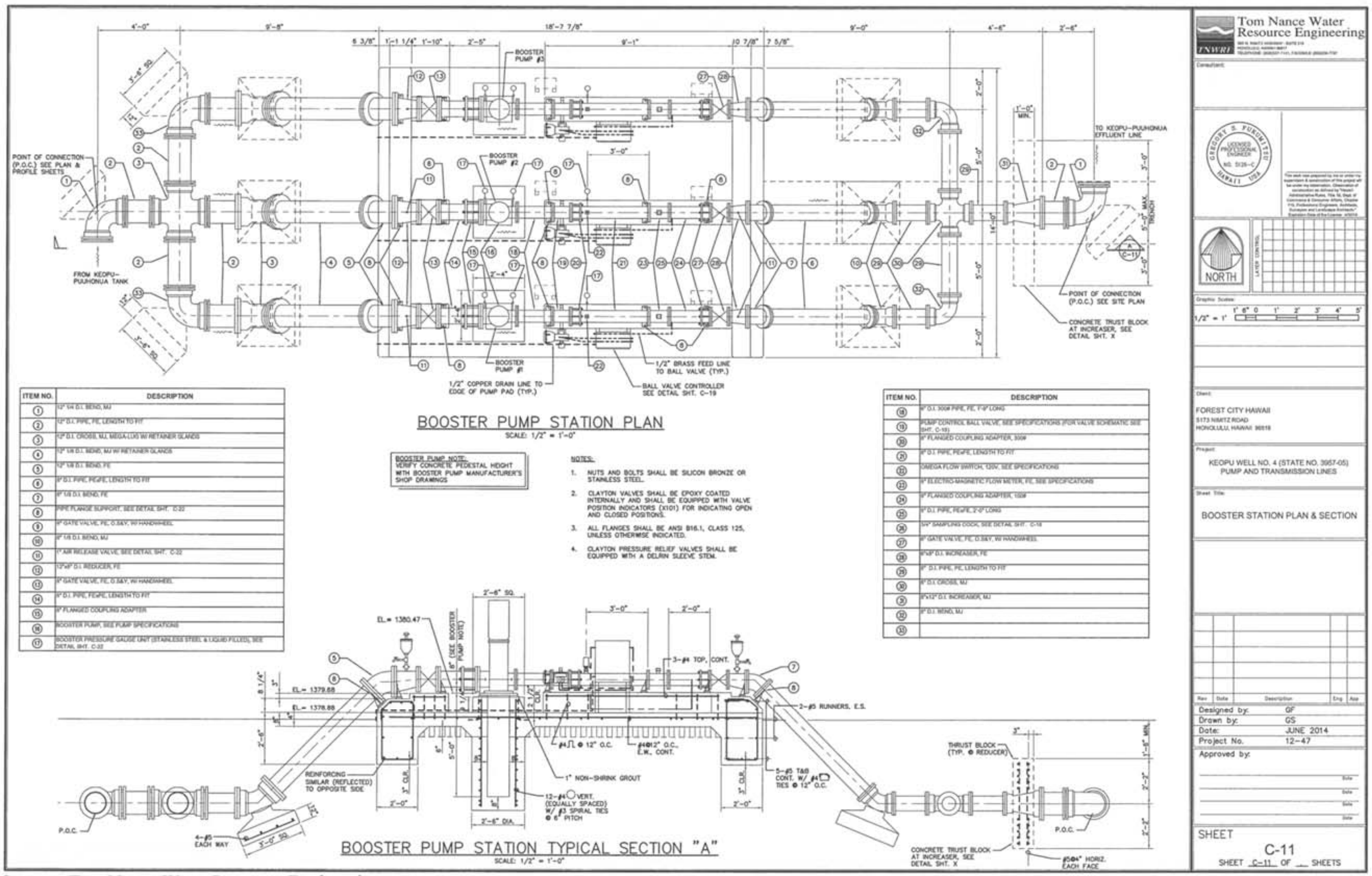
Source: Tom Nance Water Resource Engineering

Figure 1.6 Keōpū Well #4 Well Head Installations



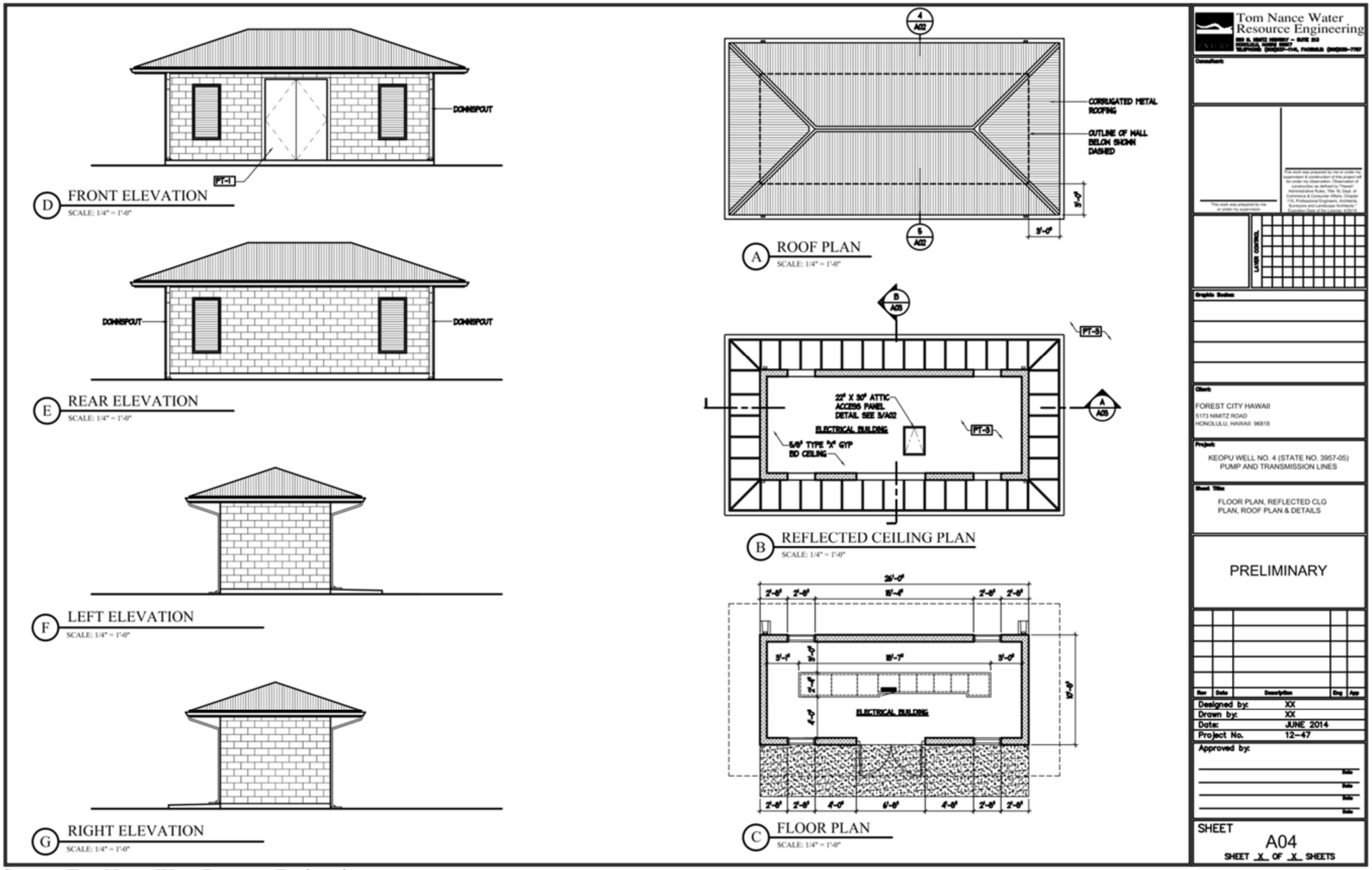
Source: Tom Nance Water Resource Engineering

Figure 1.7 Booster Pump Installation at Existing Keōpū Well and Reservoir Facility



Source: Tom Nance Water Resource Engineering

Figure 1.8 Electrical Building at Existing Keōpū Well and Reservoir Facility



Source: Tom Nance Water Resource Engineering

installed on utility poles following the new driveway from Māmalahoa Highway to the Keōpū Well #4 site.

As shown in Figure 1.1, the project includes installation of a 16-inch diameter line along Māmalahoa Highway from an existing 12-inch line at the intersection of Keōpū Mauka Drive and Māmalahoa Highway to an existing 16-inch County line in North Kona's Kamakana land tract, a distance of approximately 3,600 feet. The new line will be located entirely within the existing County road right of way. For comparison, the original project involved the installation of 3,400 feet of additional pipeline along Māmalahoa Highway from Keōpū Mauka Drive and then along the access road to the new well installation, a total distance of about 7,000 feet.

1.4 ESTIMATED COST AND SCHEDULE

The order-of-magnitude cost for construction of the production well, control building, reservoir, and associated facilities, in addition to the water line along Māmalahoa Highway, is approximately $8 million in 2014 dollars. In contrast, the original project, that included installation of significantly more pipeline and a 2.0 MG reservoir, was estimated to cost over $13 million in 2009 dollars (HHFDC, 2010).

Forest City Hawaiʻi anticipates that work on the well and water lines discussed in this report will commence within one year of the date it receives its last infrastructure approval and will be completed within approximately two years from that time.

1.5 OWNERSHIP AND REQUIRED LAND USE APPROVALS

The Keōpū #4 well site and its access road are located on State Conservation land (TMK: 7-5-13: 22; see Figure 1.2). It is owned by the State of Hawaiʻi (encumbered by Executive Order No. 4166 to the State Division of Forestry and Wildlife of the Department of Land and Natural Resources-hereinafter "DOFAW"). Forest City Hawaiʻi, through HHFDC has obtained a Conservation District Use Permit (CDUP) from the Board of Land and Natural Resources (BLNR) to enter the site and develop the well. Because of the schedule delays experienced for this project, Forest City Hawaiʻi obtained approval from BLNR on October 10, 2014 to extend this CDUP to complete the project. Forest City Hawaiʻi is obtaining approval from the owner of the adjacent parcel (TMK: 7-5-001:159) to install the new access road and pipeline to connect the exploratory Keōpū Well #4 to the existing production Keōpū Well. It also has the approval of DWS to install the new booster pump, control building, and associated equipment at the existing production Keōpū Well and reservoir site (TMK: 7-5-001:115), subject to the issuance of a Finding of No Significant Impact (FONSI) for this project.

Once conversion of the well is completed, Forest City Hawaiʻi plans to turn over the facility to DWS for ownership and operation. The transfer of ownership would first require a description of the site for the well and reservoir facilities and a possible easement for the access road. Once a Finding of No Significant Impact for the project is obtained, a modified water agreement with DWS has been finalized, and any other required discretionary permits are acquired, Forest City Hawaiʻi will then request withdrawal of the site from DOFAW's forest reserve and EO No. 4166, create a parcel for the site through the subdivision process, and set aside the site or parcel to DWS by a new Executive Order.

The other proposed pipeline will be located within Māmalahoa Highway roadway, an existing County road right of way, and installation of the waterline will require approval from the County of Hawaiʻi Department of Public Works (DPW). When completed, the new lines also will be turned over to the County DWS for ownership and maintenance.

THIS PAGE WAS INTENTIONALLY LEFT BLANK

2. ALTERNATIVES CONSIDERED

Title 11, Chapter 200 of the Hawai‘i Administrative Rules (HAR §11-200) contains the Department of Health's environmental impact rules. Section §11-200-9 defines the assessment process for "applicant actions" such as the project discussed in this report. Among other things, it requires alternatives to the proposed action to be addressed in the environmental assessment.

In accordance with those requirements, Forest City Hawai‘i and the DWS considered various alternatives before choosing the proposed project as the appropriate course of action. This process consisted of defining the objectives of the project as described in Section 1.1, identifying possible alternatives, and evaluating each alternative with respect to the project's objectives. This Chapter briefly describes the process that was followed and the alternatives that were determined to be appropriate to address in the environmental assessment.

2.1 NO ACTION ALTERNATIVE

At the Keōpū #4 well site, the No Action Alternative would result in the exploratory well hole remaining unused even though it has been pump-tested and proven to be capable of serving as a production well. The well site would remain undeveloped in a largely natural state heavily covered with vegetation typical of the area. No further alteration of the land will occur and no construction impacts will result. The well site would remain unproductive and idle, HHFDC would not have a readily available source of water for its Kamakana Project, and DWS would not have a supplemental source for its North Kona Water System. The No Action Alternative would not achieve the project objectives as outlined in Section 1.1. It is included here solely to satisfy the requirements of HAR §11-200.

2.2 ALTERNATIVE LOCATIONS

2.2.1 ALTERNATIVE WELL SITE

The proposed project involves converting an existing exploratory well into a production well. An alternative location for the production well would require an existing well that has been tested and proven successful or an entirely new exploratory well to be drilled and tested. The alternate would need to be located in an appropriate location and elevation to fit into the DWS distribution network of the North Kona Water System. No suitable alternate existing exploratory well exists and drilling and testing a new well would require time and additional investment that it is not a practical alternative to the proposed action.

2.2.2 ALTERNATIVE WATER TRANSMISSION LINE ALIGNMENT

The proposed new water mains will be located within the new access road proposed for the project between Keōpū Well #4 and the Keōpū 1.0 MG reservoir, and within the Māmalahoa Highway roadway. Other alignments are technically feasible, but they would require traversing State lands and numerous private properties, which entail high land acquisition costs. Because this would entail additional time, cost, and uncertainty, substantially different pipeline alignments are not a feasible alternative.

2.3 ALTERNATIVE USES

The well site is located in the State-designated Conservation District. In addition to public facilities such as the proposed project, other activities and land uses that protect or conserve the natural resources of the land are allowed. However, no proposal for alternate uses is known to exist. Moreover, none of the permitted alternatives would achieve the objectives of the proposed project. Use of the Māmalahoa Highway right of way would not prevent or interfere with the other uses for which the roadways are intended. Hence, the water main installation will be compatible and consistent with the intended function of this County right of way.

2.4 ALTERNATIVE DESIGN

2.4.1 ALTERNATE FACILITY SIZE

Alternative sizes for the proposed facility are generally dictated by the potential yield that the well can draw from the site, and standard practices would indicate that the facility be designed to accommodate the potential maximum sustainable production. Pump test results (see Section 3.3.1.3) show that Keōpū Well #4 is capable of pumping at a sustainable rate of 2.34 MGD. The original recommended maximum capacity of a permanent pump for the well was 2.0 MGD (HHFDC, 2010), and sizing for this was considered during the design process. However, DWS determined that a capacity of 1.5 MGD would be sufficient for this well and that the associated smaller down-hole motor size would be expected to have a longer operational life than a motor capable of pumping 2.0 MGD. To decrease this capacity further would not permit achievement of the project objectives. Installing pumps with the 2.0 MGD capacity would unnecessarily increase the construction and operating cost of the facility and has, therefore, been eliminated from further consideration.

2.4.2 ALTERNATE CONSTRUCTION MATERIALS

Since the well, control building, pump station, transmission lines, and appurtenant equipment will be turned over to the County once construction is completed, they are required to meet DWS design specifications. Hence, alternate construction materials are not a feasible alternative. Design of this equipment will be reviewed and approved by the DWS before construction proceeds.

3. AFFECTED ENVIRONMENT AND POTENTIAL IMPACTS

3.1 LAND USE

3.1.1 AFFECTED ENVIRONMENT

The Keōpū #4 well site occupies the *makai* portion of the 78.4-acre vacant State parcel (TMK (1) 7-5-13:22). The elongated rectangular parcel measures approximately 500 feet by 6,600 feet and extends east and upland from Māmalahoa Highway. Much of the project, including the Keōpū #4 well site, is located in the State Conservation District (see Figure 3.1). DWS' existing Keōpū Well and reservoir site is located in the State Agricultural District. Both well sites and the access roads are in parcels that the County of Hawaiʻi has zoned for agriculture (Figure 3.2). However, the parcel hosting the Keōpū #4 well site, except for the existing access road and graded area where the well was drilled, is undeveloped, consistent with its designation in the State Conservation District, Resource Subzone.

A dirt jeep road presently provides access from the highway into the Keōpū #4 well site. The well itself is presently capped, and all equipment used to drill the facility has been removed. The new production-well facility, including a control building, access road, appurtenant facilities, and the portion of the planned access road to the Keōpū reservoir within the Conservation District will occupy approximately 1.5 acres. By comparison, the original project required about 3.7 acres within the Conservation District, due to the installation of the 2.0 MG reservoir.

3.1.2 POTENTIAL IMPACTS AND MITIGATION

Upon receipt of appropriate agency approvals, Forest City will seek to obtain for DWS from the State of Hawaiʻi control over the Keōpū #4 well site through subdivision or lease. Forest City Hawaiʻi must obtain access easements from the State in favor of DWS for the roadways located in the Conservation District (TMK 7-5-013:022) and from the property owner for the portion of the access road connecting the two well sites in the parcel hosting the existing Keōpū Well and reservoir site (TMK 7-7-001:159). Forest City Hawaiʻi has obtained a Conservation Use Permit (CDUP HA-3549) for the project, based on a Finding of No Significant Impact issued in 2010 by HHFDC and will seek an extension of this permit to complete the project. Installation of the well, connecting pipelines, and access roads are permitted uses in the agricultural and roadway parcels (County Zoning Regulations, §25-4-11-9b) affected by the project. Thus, the project will have no significant impacts on land use.

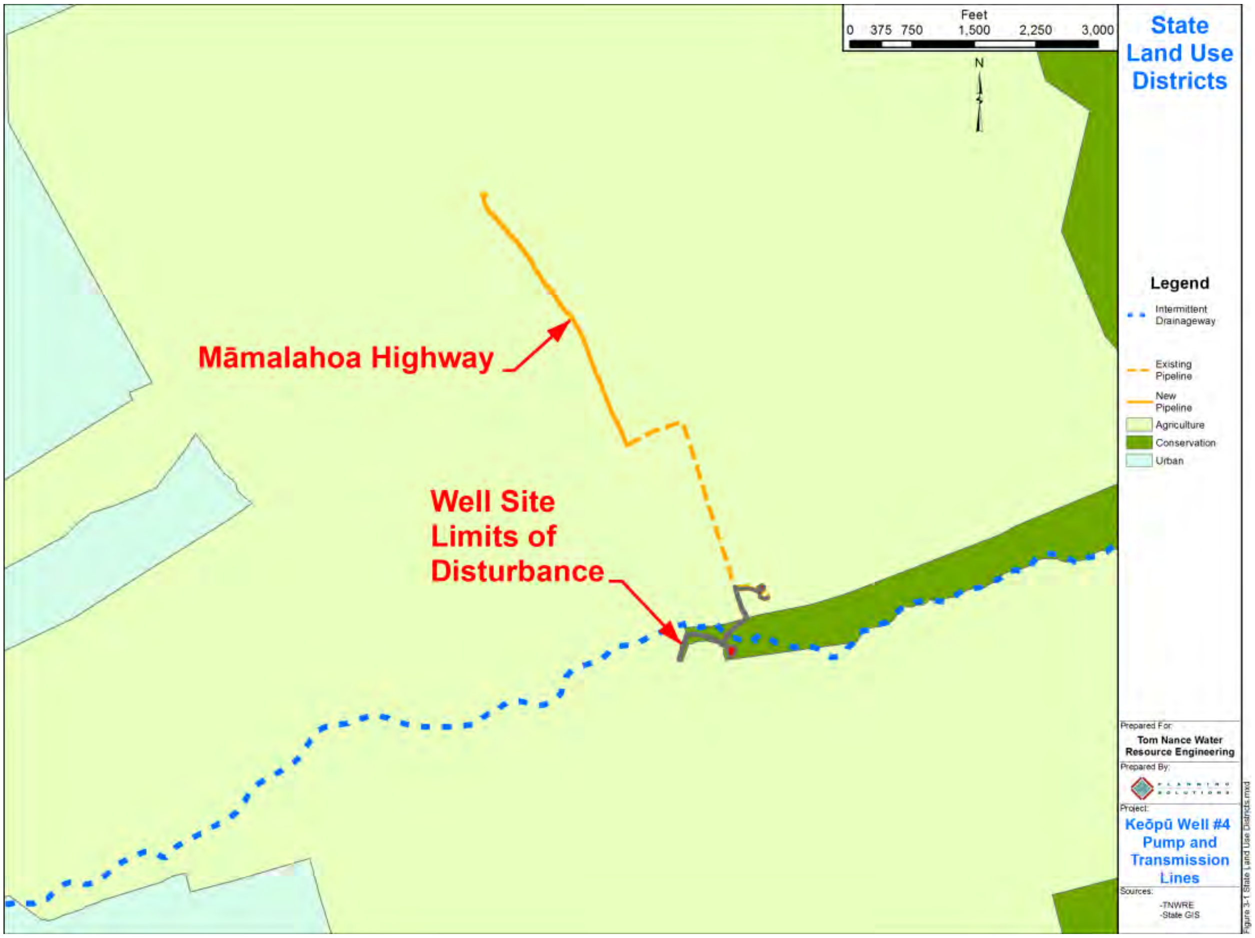
3.2 GEOLOGY, TOPOGRAPHY AND DRAINAGE

3.2.1 AFFECTED ENVIRONMENT

The well sites are located on the southwestern slopes of Hualālai, a dormant volcano that rises to an elevation of 8,271 feet above sea level. The slopes of Hualālai consist of a veneer of geologically young (1,000 to 13,000 year old) lava flows of primarily alkali olivine basalts characteristic of the late stages of its eruptive activity (Macdonald, Abbott and Peterson, 1983). The alkalic veneer is largely undissected by erosion, although some local gullying has occurred on older flows. The oldest surfaces on Hualālai are found in the Kailua-Kona vicinity and also in the vicinity of Puʻu Waʻawaʻa, to the northeast. Hualālai's youngest rocks are the 1800-1801 lava flows which erupted north of the project site from the Northwest Rift Zone. The project site is located on lava flows older than 10,000 years, and the risk of lava flow inundation is considered to be low.

Elevations in the project site range from 1,480 feet at Māmalahoa Highway to approximately 1,700 feet at the top of the existing Keōpū Well and reservoir site (see Figure 3.3). The existing access road to Keōpū Well #4 is relatively steep, with an average slope of 20 percent. The average slope of the planned new access road to Keōpū Well # 4 will only be about 5 percent, but portions of this road,

Figure 3.1 State Land Use Districts



particularly just south of the property boundary between the existing and new well sites, will also be quite steep, up to about 35 percent. The proposed access roads will be paved.

A natural drainageway diagonally crosses the lower section of the State parcel between the well sites. The depth of the drainageway varies from 2 to 4 feet and its width varies from 20 to 80 feet. The access road between the well sites will require crossing of the drainageway. Current plans call for a concrete pavement ford crossing at grade within the flood zone and riprap reinforcement to prevent possible washouts during flood events.

3.2.2 POTENTIAL IMPACTS AND MITIGATION

Forest City Hawai‘i will comply with all applicable building codes for the project access roads and equipment installations and will obtain the required approval from the State Department of Health (NOI-C) for minimization of sediment entrainment in rainwater runoff during and after construction. These measures will ensure that the work will not lead to significant erosion or degradation of the existing drainage at the site. No significant impacts to the site geology, topography, or drainage will be caused.

Figure 3.2 County Zoning

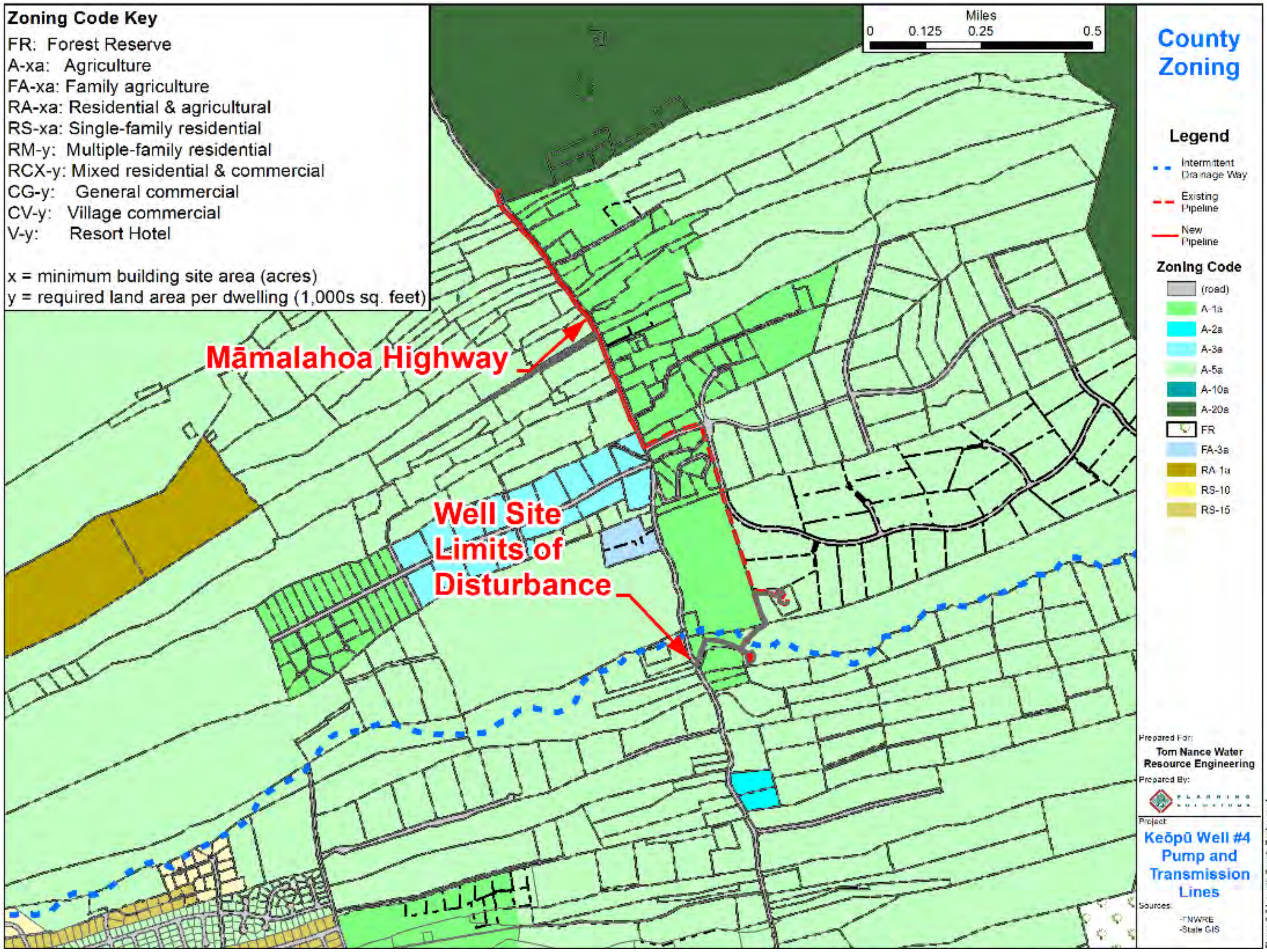
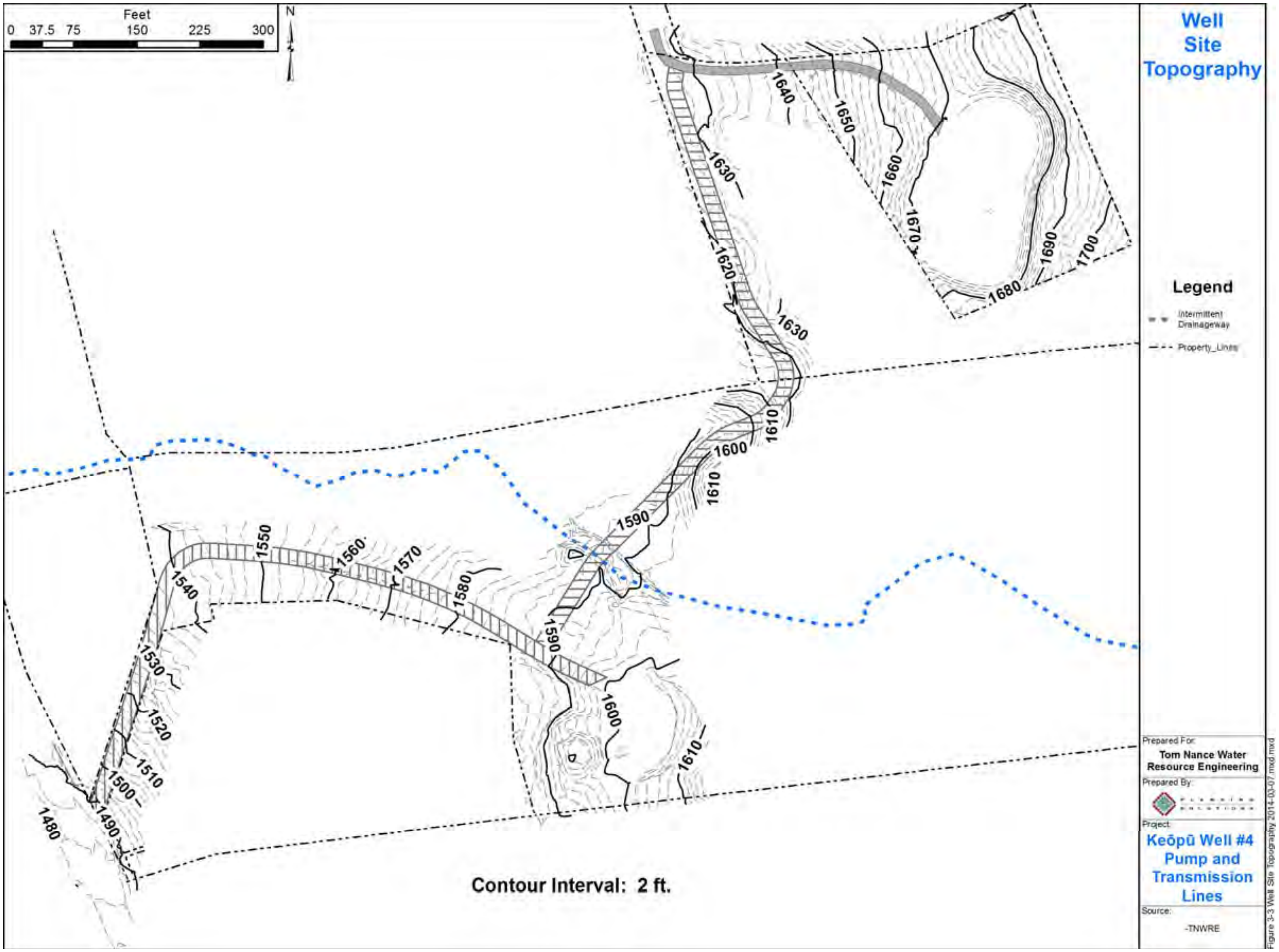


Figure 3.3 Site Topography



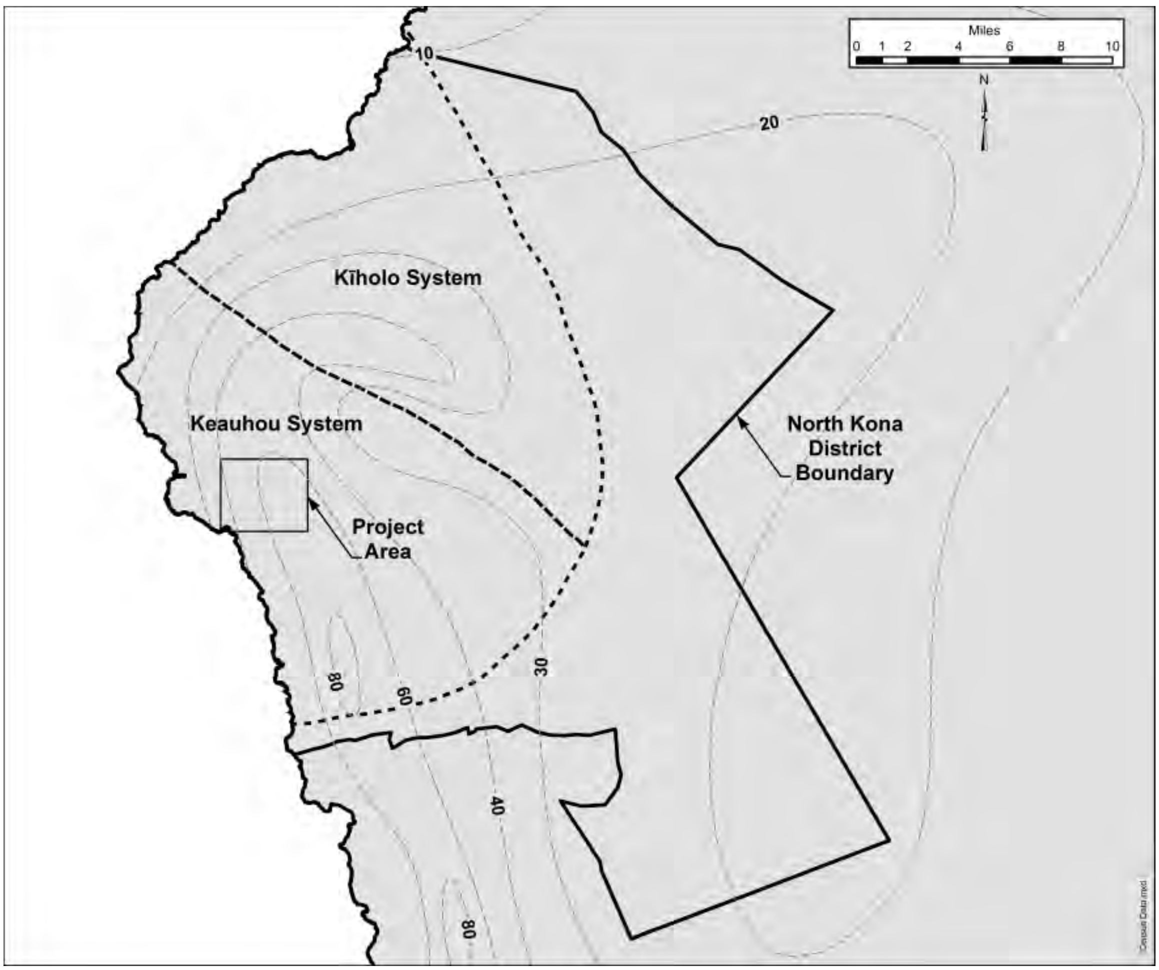
3.3 HYDROLOGY AND WATER RESOURCES

3.3.1 AFFECTED ENVIRONMENT

3.3.1.1 General Hydrology

Rainfall on the four- to five-mile wide area of Hualālai's western slopes from + 2,000-foot to the summit is the principal source of groundwater recharge in the area. As shown in Figure 3.4, average annual rainfall in this belt ranges from 30 to more than 80 inches per year.

Figure 3.4 Rainfall



Source: Engott (2011)

There are no perennial streams in North Kona; surface runoff enters the ocean only during substantial storm events. Water that does not run off is either lost to the atmosphere through evapotranspiration or percolates downward and recharges the Keauhou Aquifer System. A few small springs, such as Wai'aha Springs, occur as seepage of groundwater perched on soil and ash beds. Such springs, however, are minor and intermittent and suitable only for nominal needs. According to the State Commission on Water Resource Management (CWRM), the estimated groundwater recharge of the Keauhou Aquifer System from rainfall is 87 MGD. More recently the U.S. Geological Survey (USGS) estimated that this recharge is actually 152 MGD (Engott, 2011).

Basal Water

Prior to 1990, only basal groundwater was known to occur in North Kona. Existing drilled wells at that time indicated that the basal lens extended approximately 1.5 miles to 4.5 miles inland from the coast, with a maximum head (water level elevation, msl) of almost 5 feet at Kahaluʻu and Hōlualoa.

High-Level Water

Within the last 20 years, high-level groundwater was encountered almost simultaneously in the southern and northern regions of North Kona. On August 1, 1990, Keauhou Well 2 (State Well No. 3355-02), located 7 miles south of Kailua-Kona, encountered high-level groundwater at approximately 275 feet above sea level. Three weeks later DLNR's Kalaoa Well (Well No. 4358-01) encountered high-level groundwater at an elevation of 242 feet above sea level (later confirmed at 236 feet). These two exploratory wells were drilled at the then-unprecedented elevations of +1,620 msl and +1,800 feet msl, respectively. Less than a year later, in 1991, high-level groundwater was again discovered in the County's Honokōhau Well (Well No. 4158-02), located 2.5 miles north of the Keōpū Well. The Honokōhau Well (ground elevation of +1,675 feet msl) encountered groundwater at 109 feet above msl.

By 1993, high-level groundwater had been found in a total of 14 wells, confirming that high-level groundwater is present *mauka* of Māmalahoa Highway from Kalaoa to Keʻei, a linear distance of 19 miles. The nature of the confining geologic structure or formation is largely conjectural at this time. Based entirely upon water levels in the 14 wells, the hydrologic discontinuity between the high-level and basal-water aquifers roughly aligns with Māmalahoa Highway, and the high-level water appears to occur between 42 feet and 490 feet above sea level. These widely different water levels suggest some compartmentalization in the high-level groundwater.

3.3.1.2 Keauhou Aquifer System

The Keauhou Aquifer System delineated by the CWRM in 1990 comprises the southern half of the Hualālai Hydrologic Sector, which is defined by the exposed rocks of Hualālai Volcano (Mink and Lau 1993).[1] The Keauhou Aquifer extends over the western and southwestern flank of Hualālai and the entire coastline from Mahaiʻula to Keikiwaha Point. Having been delineated prior to the discovery of high-level groundwater, the Keauhou Aquifer was described as a basal water system in the coastal area with the possibility of having high-level, dike-confined ground-water near the rift zones of Hualālai. The sustainable yield of the Keauhou Aquifer System was estimated by the CWRM to be 38 MGD, based on a recharge estimate of 87 MGD and assuming that the groundwater occurs as an unconfined, thin basal lens.

The general direction of groundwater flow in high-level aquifers is assumed to be directly seaward into the basal aquifer, except where influenced by hydrologically confining geologic structures. The direction of groundwater flow in the basal aquifers is generally presumed to be oriented more or less directly toward the coastline.

The high-level groundwater of North Kona is of pristine quality, largely the result of the lack of saltwater intrusion and no urban development overlying the aquifer recharge area. The chloride content (a measure of freshness of Hawaiʻi's groundwater) in the high-level wells range between 5 and 10 mg/L, which is regarded as excellent quality, similar to high elevation rainfall.

[1] A Hydrologic Sector reflects an area with broad hydrogeological (subsurface) similarities while maintaining traditional hydrographic (surface), topographic, and historical boundaries. An aquifer system is an area within a Hydrologic Sector that is more specifically defined by hydrological and geological continuity among aquifers in the system.

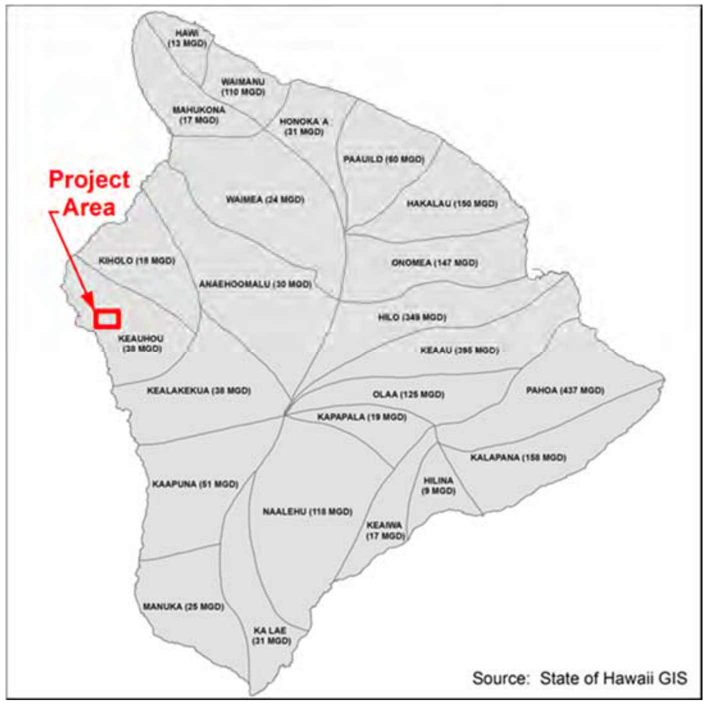
3.3.1.3 Groundwater Resource for Keōpū Well

Exploratory Keōpū Well #4

Drilled for HHFDC in 2002 by Waieli Drilling & Development Co., Keōpū Well #4's purpose was to explore and determine if the high-level aquifer underlying the State property could provide a reliable source of municipal water. The well was completed in June 2003. Pump tests on the well were initially conducted in 2002 to determine general water quality and potential yield. During initial drilling, groundwater level in the well was observed to be 43.6 feet msl.

In an effort to improve well efficiency and yield, the well was deepened approximately 110 feet from 1,690 feet to 1,799 feet. At that time, the water level in the well rose 12.9 feet. This indicated an artesian condition that was later corroborated by visual evidence of up-hole flow in a video log.

Figure 3.5 Hawai‘i Island Hydrologic Units



Source: State of Hawaii GIS

Based on a follow-up 4-day constant-rate pump test conducted in August 2003, the Keōpū Well #4 proved capable of pumping at a sustainable rate of 2.34 MGD (1,648 gpm) with a stabilized drawdown of 9.4 feet, after 1,000 minutes of pumping. The recommended maximum capacity of a permanent pump for Keōpū Well #4, however, is 2.0 MGD (1,400 gpm), or 85 percent of the test rate. However, as noted above, the planned production rate will only be 1.5 MGD. The chloride content of the well was steady at a pristine value of 7 to 9 milligrams per liter (mg/L) throughout the four days of continuous pumping. These low readings are attributed to the nature of the high-level aquifer, which is unaffected by salt-water intrusion.

Sustainable Yield

Rainfall and fog drip are the principal sources of recharge to the high-level and basal water components of the Keauhou Aquifer System. The CWRM estimated recharge to the Keauhou System to be 87 MGD, and, assuming an entirely unconfined basal aquifer, the sustainable yield for the area would be 38 MGD (CWRM 2008). As noted above, a more recent study by the USGS using more sophisticated methods (Engott 2011) estimates the recharge rate at 152 MGD. Thus, together with the now proven existence of high level groundwater, the actual sustainable yield is considerably greater than 38 MGD.

Existing Water Usage and Estimated Future Demand

Currently (March 2014), the total usage in the Keauhou Aquifer System is about 14 MGD (TNWRE, personal communication, March 2014). DWS' projections for future potable water demand in this aquifer system area total between 15.5 to 16.8 MGD by 2025 (DWS 2010, p. 809-34), depending on the population growth assumptions used for the projection.

Existing Wells in the Vicinity of Exploratory Keōpū Well #4

The existing wells in the vicinity (3 miles to the north and 1.5 miles to the south) of Keōpū Well #4 are listed in Table 3.1. These wells include municipal, industrial, and irrigation wells. As shown in this table, five of these wells are high level production wells.

Table 3.1 Existing Wells in the Project Vicinity

Well No.	Well Name	Owner/User	Year Drilled	Elev. (ft. msl)	Depth (feet)	Static Head. (ft. msl.)
3758-01	Kailua-Kona	County DWS	1944	595	615	3.32
3857-04[1]	Wai'aha-DWS	County DWS	2000	1,544	1,752	59.56
3858-01	Kalaoa Keōpū Deep	State CWRM	2001	736	1,310	4.0/27[2]
3859-01	McCaskill	McCaskill J	1942	N.A.	N.A.	N.A.
3957-01[1]	DWS Keōpū Well	County DWS	1993	1,675	1,706	47.0
3957-02	Komo Monitor	County DWS	1991	1,601	1,623	N.A.
3957-04	Douter Coffee #1	Douter Coffee Co.	2001	1,445	1,462	43.03
3957-05	Keōpū Well #4	State DLNR	2003	1,600	1,780	50.62
4057-01[1]	QLT	County DWS	1994	1,762	1,787	187.8
4059-01	Palani	State DLNR	1958	800	853	1.6
4060-1	Honokōhau Quarry	Honokōhau Property	1995	121	137	2.0
4158-02[1]	Honokōhau	County DWS	1991	1,681	1,735	109.5
4158-03	Palani Well No. 1	Lanihau Properties	2006	1,670	1,747	77.0
4258-03[1]	Hualālai	County DWS	1993	1,681	1,822	292.9

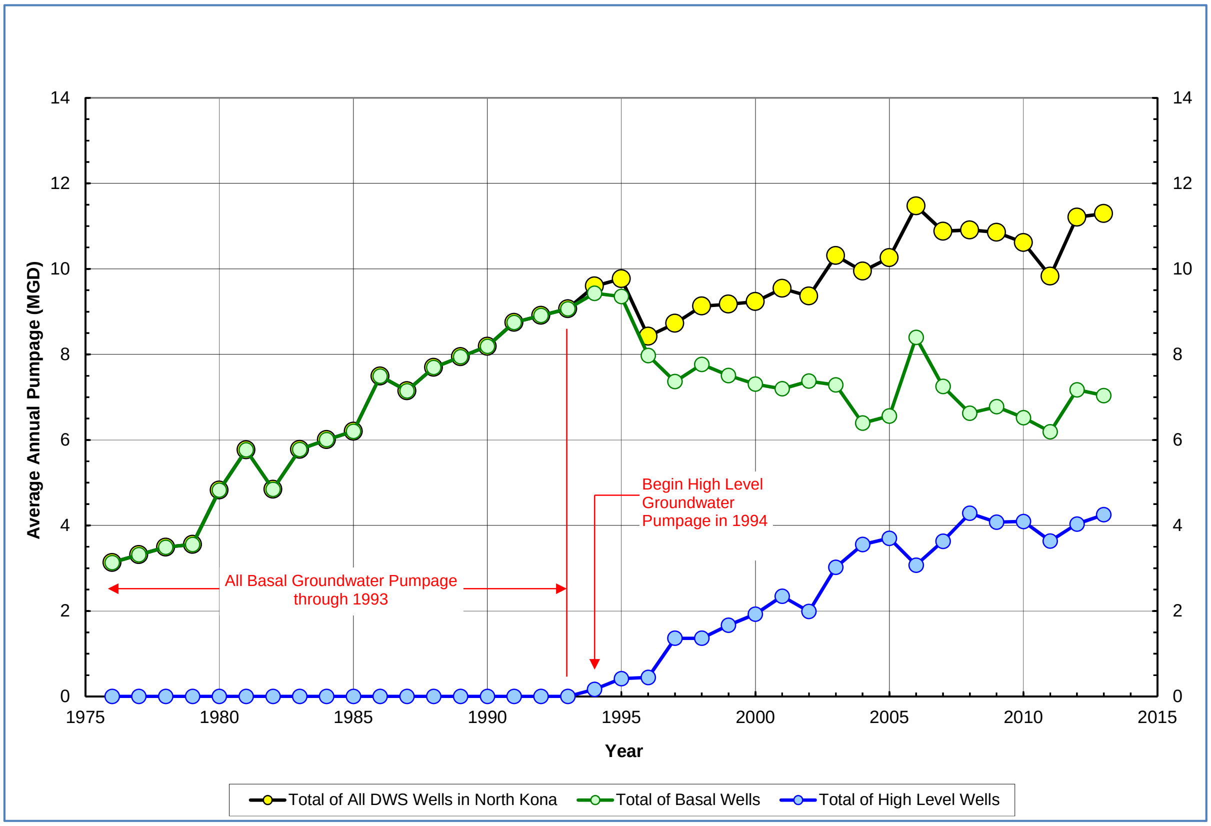
Source: Modified from HHFDC (2010) by Tom Nance Water Resources, Inc.
[1]Currently Active High Level Production Well
[2]basal/perched head

Figure 3.6 shows the history of water withdrawals from all wells in North Kona. Withdrawals from the high level wells began in 1994 when the Kalaoa Well was brought into production. In 2013, total withdrawals from all North Kona wells was about 11.5 MGD, with 4.2 MGD contributed by the high level wells.

3.3.2 POTENTIAL IMPACTS AND MITIGATION

Pumping at the Keōpū Well #4 will result in a lowering of water levels in the project area. This effect is known as a "cone of depression" which establishes a "zone of influence" around the production well. Keōpū Well #4 was previously pump tested for four days at a constant rate of 1,458 gpm, or 2.35 MGD. The drawdown in the well was stable at 9.4 feet. The impact on the nearby existing DWS Keōpū production well (3957-01) was a resulting drawdown of 0.6 feet. A somewhat lower drawdown than this minimal impact can be anticipated when Keōpū Well #4 goes into production, since the design production rate will be only 1.5 MGD, rather than this test rate of greater than 2 MGD.

Figure 3.6 Pumpage in DWS Wells in North Kona, 1976-2013



Source Tom Nance Water Resource Engineering, Inc.

Another well in the immediate area of Keōpū Well #4 is the Douter Coffee #1 well, which is approximately 650 feet west and down-gradient from Keōpū Well #4. It is privately owned and was used for landscape irrigation purposes. CWRM records currently show no reported use of this facility, which has not been used since 2005 (TRNWE, personal communication to Charles Morgan, March 2014). Thus, no significant impacts on nearby wells are anticipated. Because the addition of 1.5 MGD to the existing withdrawal of water from the Keauhou Aquifer system will not increase the total withdrawals to more than 34 percent of the sustainable yield (13 MGD out of 38 MGD), no significant impacts to the aquifer will be caused.

Another aspect of use of the Keōpū Well #4 is that water withdrawn from the well would otherwise have ultimately moved toward the shoreline and discharged into the marine environment. Of significant concern is the path of that movement. Following discovery of the high level groundwater in 1990, it was initially assumed that its water passed into the down-gradient basal lens, providing most of the recharge to the lens, and then traveled in the basal lens to discharge along the shoreline. If this is the case, pumpage from the high level aquifer would reduce the flow into the basal lens by a similar amount. This reduced flow would be reflected in gradual increases in salinity and lowering of the water level in the basal lens. As shown in Figure 3.6, pumpage from the high level groundwater began in 1994 and progressively increased to an average of 4.25 MGD in 2013. To date, monitoring of the basal lens in a number of locations between Kailua Town and Keāhole Point has shown no indication of higher salinity or lower water levels in the basal lens (see Appendix A).

An alternative interpretation of flow from the high level groundwater is that some or even most of it does not drain into the basal lens, particularly in the area between Kailua Town and Keāhole Point. Rather, it flows at depth beneath the basal lens, confined by a series of low permeability lava flows, to discharge further offshore. This interpretation is directly supported by the discoveries of fresh water at substantial depth below sea level in two deep monitor wells, the Keōpū monitoring well (State No. 3858-01) and Kamakana (State No. 3959-01). The Keōpū monitoring well is directly down-gradient of the Keōpū Well #4. The Kamakana monitoring well is directly down-gradient from two active high level production wells, Honokōhau (State No. 4158-02) and QLT (State No. 4057-01), both of which are pumped almost continuously.

This alternative interpretation is also supported, at least indirectly, by the fact that no change to the basal lens due to high level pumpage has been detected and by the anomalous characteristics of the basal lens itself if it were receiving substantial recharge from the high level aquifer. The temperature in the lens, for example, is five to eight degrees colder than the directly up-gradient high level groundwater. Also, its very modest flow rate and unusually high salinity, both preventing successful well development for potable or non-potable use, make it unlikely that significant recharge from the up-gradient high level ground water is occurring.

The evidence available to date does suggest that for the area down-gradient of Keōpū Well #4, most of the high level groundwater is passing below rather than into and through the basal lens. As such, use of the Keōpū Well #4 should have no significant impact on the basal lens.

3.4 POTENTIAL CONTAMINATION

3.4.1 AFFECTED ENVIRONMENT

Since the recharge areas of Keauhou Aquifer System are on the slopes of Hualālai, land uses and development are limited predominantly to shrub and forest lands. Land uses immediately surrounding the Keōpū Well #4 site consist predominantly of a scattering of rural residential homes, vacant lands, and minor agricultural endeavors. None of these land uses are generators of major potential contaminants. No large-scale agricultural operations (which use pesticides and herbicides extensively) are present in the area particularly up-gradient of the property, and the nearest sanitary landfill is in South Kohala more than 20 miles away. The nearest commercial and industrial facilities engaged in petroleum product use are located in the urban center of Kailua-Kona, which is more than 3 miles from the Keōpū Well #4 site. An isolated fueling station associated with a country general store is located more than two-thirds of a mile north and downslope of the Keōpū Well #4 site.

The County does not have a wastewater collection system in the uplands of North Kona or along Māmalahoa Highway. Consequently, wastewater disposal in the region is primarily accommodated by individual wastewater systems (IWS); historically these consisted predominantly of cesspools. However, strict government regulations currently prohibit the installation of new cesspools on the island, and as a result, homeowners are opting for septic tanks as an alternative. These IWSs collect and hold effluent, allowing the unit to separate and biodegrade the fluid before allowing it to cant by overflow to a drain field for disposal. Over time these will eventually replace the existing cesspools as well. The stricter wastewater disposal regulation is designed to protect the watersheds as valuable recharge areas.

The test results for Keōpū Well #4 show chloride levels of between 5 mg/L and 10 mg/L, which is regarded as excellent. Tests in this well show low levels of potential contaminants. Appendix A documents the testing results, and positive values only (above the level of detection) are reproduced in Table 3.2.

3.4.2 POTENTIAL IMPACTS AND MITIGATION

The project area is located above the Underground Injection Control (UIC) line established by the State Department of Health (DOH) (see Figure 3.7). This line marks the area of the island which strictly limits the type of injection wells that can be installed by a UIC Permit. Injection wells are typically used by individual wastewater treatment facilities to dispose their treated wastewater effluent in ground pits. The UIC control line is about 1,150 feet below the elevation of the well and at a distance of about 1.5 miles. This means that no injection wells can be installed close to the proposed Keōpū Well #4.

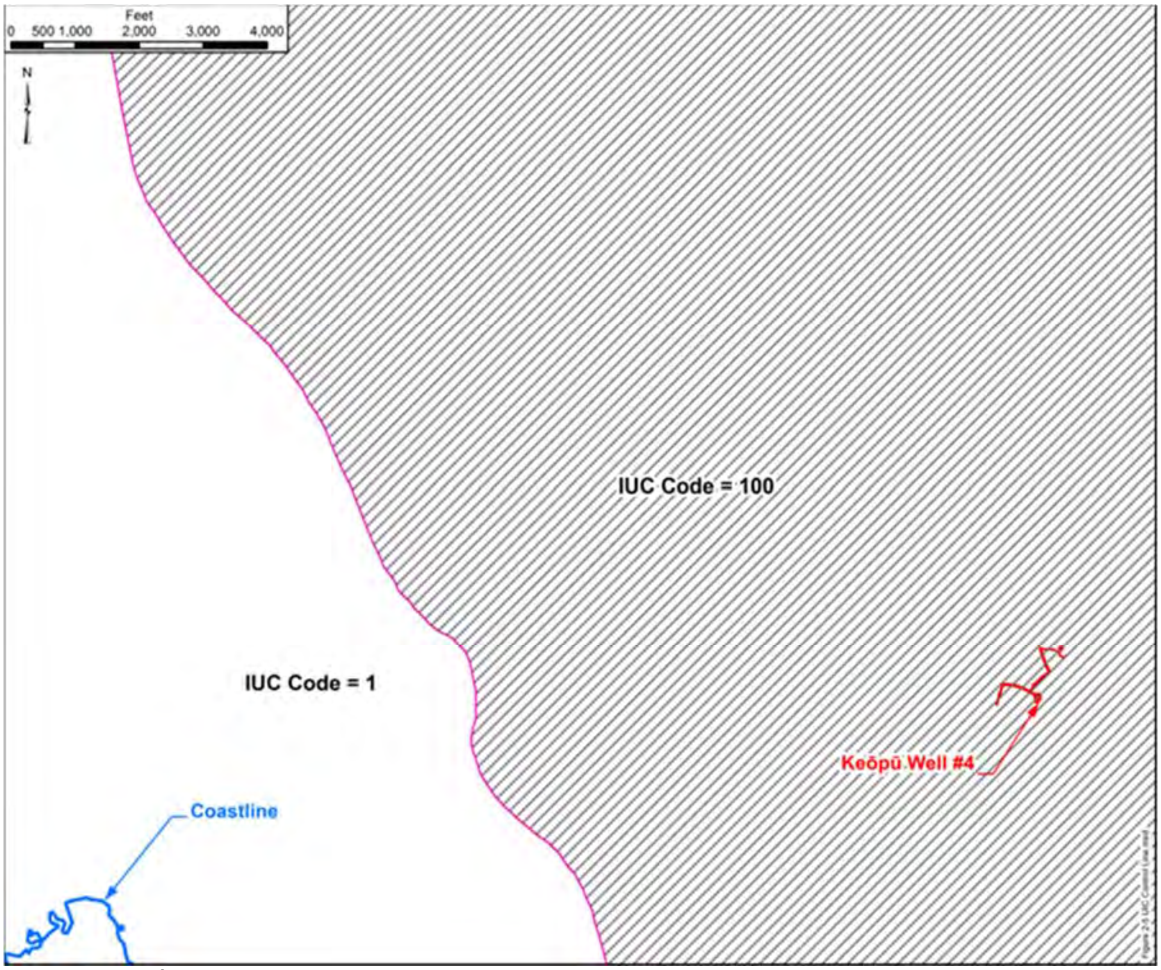
Table 3.2 Measured Contaminant Levels in Keōpū Well #4

Component	Result	Federal Max. Contaminant Level	Units	Detection Limit
Alkalinity in $CaCO_3$ units	64	-	mg/L	2
Calcium Total	8.6	-	mg/L	1
Chloroform (Trichloromethane)	1.8	-	µg/L	0.5
Chromium Total	4.4	100	µg/L	1
Copper Total	6.4	1300	µg/L	2
Fluoride	0.27	4	mg/L	0.05
Nickel Total	12	-	µg/L	5
Nitrate as Nitrogen	1.1	10	mg/L	0.1
Nitrate as NO_3 (calc)	5.0	45	mg/L	0.44
pH	8.2	-	Units	0.1
Specific Conductance, 25 C	180	-	µmho/cm	2
Total THM	1.8	80	µg/L	0.5
Turbidity	0.51	5	NTU	0.05
MWH Laboratories, 2012				

The State DOH has strict requirements for new sources of drinking water that are intended to serve a public water system. In conformance with those requirements, Forest City Hawai‘i will submit an engineering report to the DOH for approval prior to placement of Keōpū Well #4 on line with the DWS system. The report will identify all potential sources of contamination and evaluate alternative control measures which could be implemented to reduce or eliminate potential contamination, including treatment of the water source. A water quality analysis is also required for all regulated contaminants and the results will be submitted as part of the engineering report to demonstrate compliance with current drinking water standards.

Because of the location of Keōpū Well #4 far above the UIC line, the generally high quality of water produced at nearby wells, and the lack of potential sources of contamination in the vicinity of the well, no significant impacts due to contamination of the well water are likely.

Figure 3.7 Underground Injection Control Line



Source: State of Hawai'i GIS

3.5 FLORA

3.5.1 AFFECTED ENVIRONMENT

Isle Botanica conducted a botanical survey of a major portion of the project site in 2008 (Whistler 2008). The overall objectives of the survey were to provide a general description of the vegetation types occurring on the site (particularly any sensitive types of vegetation that may harbor rare plant species), make a checklist of all native and naturalized vascular plants found, and search for threatened and endangered species.

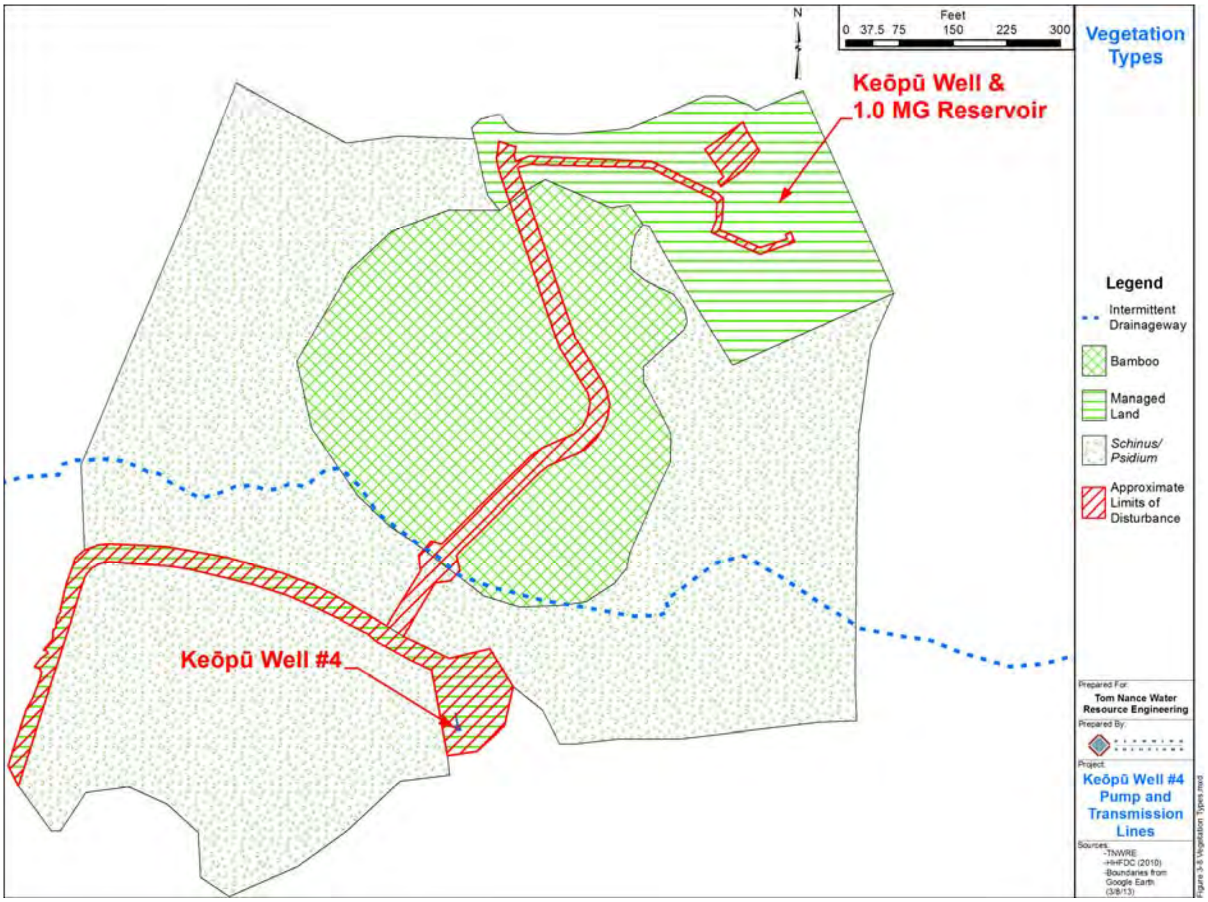
Subsequent to this initial survey, Rana Biological Consulting, Inc. completed a second botanical and faunal survey to examine the portions of the project site that were not included in the original Isle Botanica survey. The results of this second survey are presented here in Appendix A. As discussed below, the results of both surveys are generally consistent with one another and suggest that the project will not have a significant adverse effect on flora.

Prior to conducting fieldwork for the Isle Botanica survey, a review of literature was undertaken, and the United States Fish and Wildlife Service (USFWS) official database was consulted for a complete listing of all significant threatened and endangered species in the area. After the literature review was performed, the botanical field survey was conducted. All plants encountered were recorded, along with the indication of their frequency. A comprehensive listing of the recorded vegetation is provided in Appendix D. Rana Biological Consulting followed a similar procedure to identify potential threatened and endangered species that might be found in the area.

3.5.2 GROUPING OF VEGETATION AT WELL SITES

The vegetation at the well sites can be categorized into three groups: (1) Managed Land Vegetation; (2) *Schinus/Psidium* Forest; and (3) Bamboo Forest. The approximate distribution of these vegetation types is depicted in Figure 3.8 and described below.

Figure 3.8 Approximate Distribution of Vegetation Types at Well Sites



3.5.2.1 <u>Managed Land Vegetation</u>

The Managed Land Vegetation type (Figure 3.9) occurs along the existing access road to the Keōpū Well #4 site and along the access and existing production Keōpū Well (except where the area is paved). The vegetation along the existing access road includes grassy areas either cut regularly (forming a lawn along the south-central portion of the property) or irregularly (an herbaceous area around the existing well site), and what appear to be areas of former pastureland.

- The existing access road is dominated by low-growing herbaceous species such as *Desmodium intortum*, *Heterocentron subtriplinervium*, pluchea (*Pluchea carolinensis*), and comb hyptis (*Hyptis pectinata*). The herbaceous vegetation around the actual well site is dominated by alien species such *Desmodium intortum*, Canada fleabane (*Conyza canadensis*), pluchea, and partridge pea (*Chamaecrista nictitans*).

Figure 3.9 Managed Vegetation Looking at Existing Production Keōpū Well Facility

Source: Planning Solutions (January 23, 2014)

- The mowed lawn is dominated mostly by alien species, such as carpet grass (*Axonopus fissifolius*), Glenwood grass (*Sacciolepis indica*), and broom grass (*Andropogon virginicus*); the sedge *Pycreus polystachyos*; and the dicot herb sensitive plant (*Mimosa pudica*).
- In areas along the roadside that probably have not been disturbed for several years, thickets of pluchea up to 2 meters in height dominate, often overgrown with *Desmodium intortum* and *Heterocentron subtriplinervium*.
- Much of the northeast quarter of the property appears to have been formerly used as a cattle pasture. These areas are dominated by grasses, such as *Digitaria procumbens* (pangola grass), which are mainly used in cattle pastures.

Virtually no native species are found in the Managed Land Vegetation type.

3.5.2.2 ***Schinus/Psidium* Forest**

The *Schinus/Psidium* Forest (Figure 3.10) is a relatively low-stature forest. It is dominated by two species, Christmas berry (*Schinus terebinthifolius*) and strawberry guava (*Psidium cattleanum*). The forest could just as easily be classified as two separate forests, since in many places only one of the two tree species dominate, but a division into two types is unsatisfactory since the two species are often found commingled and sharing dominance. Few other trees are found in this forest, except for the previously mentioned ohi‘a lehua, tall but scattered individuals of silk oak (*Grevillea robusta*), and a few guava trees (*Psidium guajava*).

The ground cover is dominated by only a few species that are able to survive in this relatively dense forest. The most common of these are the native fern blechnum (*Blechnum occidentale*), the Polynesian-introduced herb shampoo ginger (*Zingiber zerumbet*), and the alien basket grass (*Oplismenus hirtellus*). These often form mono-dominant patches, just as the canopy trees do. In areas with more sunlight, the alien herb buttonweed (*Spermacoce assurgens*) can dominate, and

Desmodium intortum is also sometimes common here. Yellow ginger (*Hedychium flavescens*) is also common in some places.

Figure 3.10 *Schinus/Psidium* Forest

Source: Planning Solutions (January 23, 2014)

3.5.2.3 Bamboo Forest

A dense forest of bamboo (unknown species; Figure 3.11) covers most of the area where the proposed new access road will be constructed. As shown in this figure, the bamboo grows so close and thick that very few other plant species can survive.

3.5.2.4 Drainageway Vegetation

The rocky bed of the intermittent drainageway that passes through the planned crossing (Figure 3.12) is shaded by a canopy formed by the trees along the sides, particularly strawberry guava. The rocks of the drainageway bottom are covered with mosses, with only a few flowering plants being able to colonize the shaded rocks that are occasionally awash during heavy rains.

3.5.3 POTENTIAL IMPACTS

In summary, 83 plant species were recorded during the surveys (see Appendix D) occurring in three distinct groupings. All of the existing vegetation on the property is common and widespread in the region. The majority of the recorded species are classified as alien plants, which have been

Figure 3.11 Bamboo Forest

Source: Planning Solutions (January 23, 2014)

Figure 3.12 Intermittent Drainageway

Source: Planning Solutions (January 23, 2014) accidentally or intentionally introduced to Hawai‘i; nine species are native. The botanical survey noted that this is an unusually low number of native species, which is possibly the result of extensive prior disturbance in the area. No species that are federally listed as threatened or endangered or classified as sensitive were found. Since there is a noticeable absence of native vegetation and no presence of threatened or endangered species at the well sites, mitigation measures would not be necessary.

3.6 FAUNA

3.6.1 AFFECTED ENVIRONMENT

Rana Biological Consulting, Inc. completed a reconnaissance-level survey of the fauna occurring at the well sites and along the Māmalahoa Highway where a new pipeline will be installed (Appendix A). The methodology and results of the survey, which form the basis of the discussion of potential impacts on fauna, are presented below in Sections 3.6.1.1 and 3.6.1.2. Section 3.6.2 describes the anticipated effects and mitigation measures.

3.6.1.1 Survey Methods

The avian phylogenetic order and nomenclature used in the faunal survey follows the *AOU Check-List of North American Birds* (American Ornithologists’ Union, 1998), and the 42nd through the 51st supplements to the Check-List (American Ornithologists’ Union, 2000; Banks et al., 2002, 2003, 2004, 2005, 2006, 2007, 2008; Chesser et al., 2009, 2010, 2011, 2012, 2013). Mammal scientific names follow Wilson and Reeder (2005). Place names follow Pukui et al. (1976).

Four avian count stations were sited roughly equidistant from each other within the area that includes the well sites and the proposed access road between them. A single eight-minute avian point count was made at each of the four count stations. Field observations were made with the aid of Leica™ 8 X 42 binoculars and by listening for vocalizations. The counts and subsequent searches of the site, were conducted in the early morning. Time not spent counting at the point count stations was used to search the remainder of the area for species and habitats not detected during the point counts. Weather conditions were ideal, with no rain, unlimited visibility at area and winds of between 0 and 3 kilometers an-hour, during point count periods.

With the exception of the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), or ‘ōpe‘ape‘a as it is known locally, all terrestrial mammals currently found on the Island of Hawai’i are alien species and most are common. The survey of mammals was limited to visual and auditory detection, coupled with visual observation of scat, tracks, and other animal sign. A running tally was kept of all terrestrial vertebrate mammalian species detected within the site. The mammalian survey was conducted concurrently with the avian survey.

The well sites and also the approximately 1,100-meter section of the Māmalahoa Highway right of way that the new water line will be placed under was searched on foot for native host plants of the endangered Blackburn’s sphinx moth (*Manduca blackburni*), as well as for tree tobacco (*Nicotiana glauca*) a secondary alien host plant.

3.6.1.2 Fauna Survey Results

Avian Resources

A total of 53 individual birds of 12 species, representing nine separate families, were recorded during the station counts. All 12 of the species detected are alien to the Hawaiian Islands. No avian species currently protected or proposed for protection under either the federal or State of Hawai‘i endangered species laws were detected during the course of this survey (DLNR, 1998; USFWS, 2005a, 2005b, 2014).

In keeping with the habitat present on the site, avian diversity was low. Three species, Japanese White-eye (*Zosterops japonicus*), House Finch (*Haemorhous mexicanus*), and domestic chicken (*Gallus sp.*) accounted for half of all birds recorded during the station counts. The Japanese White-eye was the most frequently recorded species, accounting for 21 percent of the total number of individual birds recorded during station counts. The findings of the avian survey are consistent with the location of the site and the habitats present on it. The findings of the current survey are comparable to the findings of a previous survey conducted by the author on sections of the current project in 2006 (David, 2006).

Although no seabirds were detected during the course of this survey, several seabird species potentially overfly the site on occasion. None are known to do so in substantial numbers or in a manner that would bring them close to the ground in or around the well sites.

The region in which the site is located supports a number of Hawaiian Hawks (*Buteo solitarius*) a species currently listed as endangered by both the federal and state endangered species statutes (David, 2014). Disturbance at the nest and persecution by humans are considered to be the most significant cause of deleterious impacts to this species. No suitable nesting trees for this species are within the well sites, although it is likely that this species overflies portions of the area on occasion.

Mammalian Resources

The findings of the mammalian survey are consistent with the location of the site, and the habitat present on it. All of the terrestrial mammalian species recorded during the course of this survey of the site are alien to the Hawaiian Islands. Although no rodents were detected during the course of this survey, it is probable that the four established muridae known from the Island of Hawaiʻi [European house mouse (*Mus musculus domesticus*), roof rat (*Rattus rattus*), brown rat (*Rattus norvegicus*), and possibly black rat (*Rattus exulans hawaiiensis*)] use resources within the well sites on a seasonal or temporal basis. All of these introduced rodents are deleterious to native ecosystems and the native faunal species that are dependent on them.

Although, no Hawaiian hoary bats were recorded during the course of this survey, this species is regularly seen foraging in the general project area (David, 2014). This species is found in almost all areas in the mid-to-low elevation areas on the Island of Hawaiʻi that still maintain dense tree cover (Bonaccorso et al., 2005, 2007; David, 2014).

Blackburn's Sphinx Moth

Neither tree tobacco nor the Blackburn's sphinx moth's native host plants were encountered during the course of the survey.

3.6.2 POTENTIAL IMPACTS AND MITIGATION

3.6.2.1 Likely Effects on Protected Species and Critical Habitat

No threatened or endangered species were detected or suspected to occur at the project site, and the species that do exist at the site are common and mostly invasive species. Also, there is no federally delineated Critical Habitat present on or adjacent to the well sites.

3.6.2.2 Minimization/Mitigation Measures

Seabird Colonies. There are no known nesting colonies of any seabird species near the well sites. Hence, seabird nest disturbance is not an issue with respect to the proposed project, and no mitigation is required.

Seabird Light Attraction. Design measures incorporated into the project also minimize the potential for lights to attract or disorient night-flying birds. The proposed project only has two exterior lights in its design. One will be a light above the entrance gate that will be down-pointed and shielded, and will be triggered by a motion sensor. The second light will be above the control room door, which will be turned on by the DWS technicians that may need to go there at night; this light will also be down-pointed and shielded to minimize potentially attracting nocturnally flying pelagic seabirds.[2] No nighttime construction is planned for the project.

Hawaiian Hawk. The endangered Hawaiian Hawk could potentially forage on the well sites in very small numbers. Because construction and operation of the proposed project would not result in significant impact to the native species or habitats on which the hawks depend, the proposed well facilities would not have a measurable effect on food supplies. In the unlikely event that a Hawaiian Hawk nest is found during construction, work in the immediate vicinity of the nest would be halted and the USFWS would be contacted and consulted prior to any re-commencement of work.

Hawaiian Hoary Bat. The endangered Hawaiian Hoary Bat may from time to time be present within woody vegetation that exists on the project site. However, they are vulnerable only during the brief time when pregnant females are roosting on woody vegetation (i.e., from June 1st to September 15th). To avoid the potential for harm to this species, woody vegetation taller than 4.6 meters (15-feet) high (located on the southern edge of the project), will not be cleared during that time.

3.7 AIR QUALITY

3.7.1 AFFECTED ENVIRONMENT

Air quality in the Kona area is generally good except for the degradation occurring as a result of the volcanic emissions from the active Kīlauea Volcano. These emissions, known locally as "vog" can be noticeable, but generally do not cause ambient air quality to exceed Hawaiʻi or Federal air quality standards. For example, the daily averages for the State Department of Health Kona monitoring station[3] between 2012 and 2013 did not exceed a value of 0.0301 parts per million for sulfur dioxide and 32.3 $\mu g/m^3$ for fine particulate matter ($PM_{2.5}$.). The State 24-hour standards for these pollutants are, respectively, 0.14 ppm and 35 $\mu g/m^3$.

3.7.2 POTENTIAL IMPACTS AND MITIGATION

3.7.2.1 Construction Period Air Quality Impacts

Construction activities may result in short-term air quality impacts, including the generation of dust from soil excavation and emissions from construction vehicles and equipment. To mitigate these impacts, the contractor will be required to comply with the DOH Hawaiʻi Administrative Rules (HAR), Title 11, Chapter 60.1, "Air Pollution Control." Compliance with State regulations will require adequate measures to control fugitive dust by such methods as:

- Planning different phases of construction, focusing on minimizing the amount of dust generating materials and activities, centralizing on-site vehicular traffic routes, and locating potentially dusty equipment to areas of the least impact;
- Frequent watering of exposed dirt areas;
- Landscaping and rapid covering of bare areas, including slopes;
- Controlling of dust from unpaved access roads;
- Controlling dust from debris being hauled away from the project site; and
- Constructing a dust barrier/fence.

Exhaust emissions from construction vehicles are anticipated to have negligible impacts on air quality, as emissions would be relatively minor and readily dissipated.

---

[2] These design elements will also help the project comply with the Hawaiʻi County Code § 14 – 50 et seq. which requires the shielding of exterior lights so as to lower the ambient glare caused by unshielded lighting to the astronomical observatories located on Mauna Kea.

[3] Located at Konawaena High School, some 10 miles south of the project area at an elevation of +1,650 feet msl.

3.7.2.2 Operational Impacts on Air Quality

Operation of the proposed facilities does not entail the on-site emission of regulated pollutants. The generation of the electrical power that will be used to power the well pump will require the combustion of fossil and/or biofuel at one or more of the island's electrical power generating facilities that will result in air pollutant emissions. However, the energy use will be so small that it does not have the potential to significantly alter air quality.

3.8 NOISE

3.8.1 AFFECTED ENVIRONMENT

The predominant noise sources in the vicinity of the well sites are traffic from Māmalahoa Highway and surrounding neighbors engaged in agricultural activities. The majority of the land uses above Māmalahoa Highway in the uplands of North Kona are undeveloped or in open space.

3.8.2 POTENTIAL IMPACTS AND MITIGATION

There will be daily monitoring inspections and periodic maintenance work; otherwise, the proposed project will operate as unmanned facilities. Noise will be generated by the vehicle used to access the site, but this will be very brief and almost identical to the noise made from passing traffic along the highway. Noise from the Keōpū #4 well pump is expected to be insignificant, since it is electrically operated and located deep within the well (see Figure 1.3). No noise was audible from the operating pump or any other facility source in the existing Keōpū Well site during a field inspection conducted for the project. Thus, no significant adverse impacts are anticipated during the long-term operations of the Keōpū #4 Well.

To mitigate short-term construction-related noise impacts, the contractor will comply with the provisions of HAR 11-46, "Community Noise Control". A noise permit will be required if the noise levels from construction activity are expected to exceed the standards specified in HAR §11-46-4. It will be the contractor's responsibility to minimize noise by properly maintaining mufflers and other noise-attenuating equipment. If construction work is required during evenings, night, and weekend hours, a variance will be sought from the DOH.

3.9 FLOODING

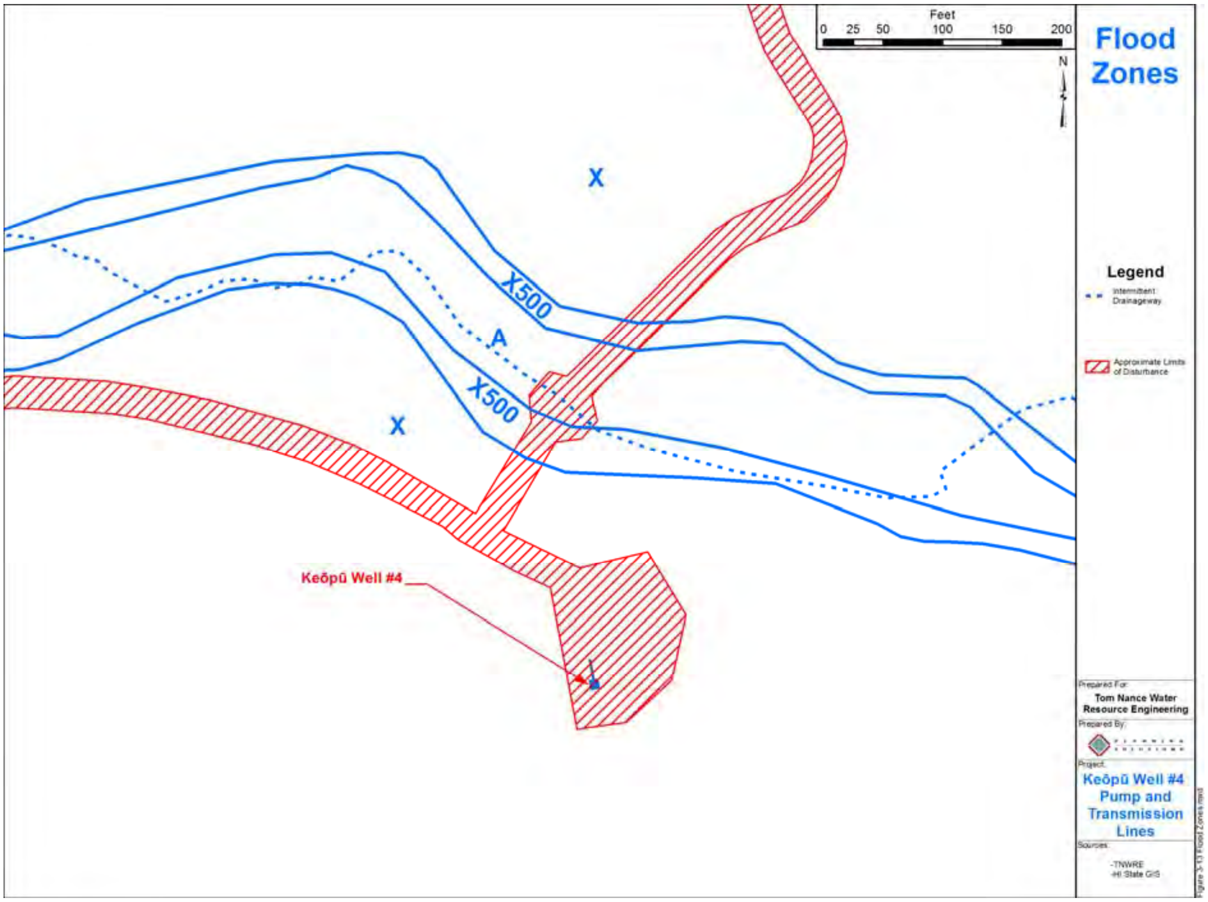
3.9.1 AFFECTED ENVIRONMENT

A natural drainageway crosses the lower portion of the State parcel and through the project site to and beyond the Māmalahoa Highway. Through the well site, the channel width varies from 20 feet to 80 feet. The Federal Emergency Management Agency (FEMA) designates this drainageway in Flood Zone AE on its Flood Insurance Rate Maps (FIRM). Flood Zones AE are areas that are subject to inundation by potential 100-year floods (see Figure 3.13). Along the outer edges of the Flood Zone AE, FEMA delineates Flood Zone X. These areas are subject to flooding from a potential 500-year flood or from a 100-year flood with flood levels less than one foot.

3.9.2 POTENTIAL IMPACTS AND MITIGATION

Site planning for the well facilities has taken into account the location and extent of these identified flood zones. The only portion of the proposed facilities that might be affected is the access road between the two well sites. Design of the drainageway crossing will include a paved at-grade in the flood zone and protective riprap that would minimize disruption to any flow in the drainageway and in turn, prevent washouts of the access road and pipeline. The channel crossing design will be in compliance with Chapter 27 of the Hawaiʻi County Code relating to Floodplain Management.

Figure 3.13 Flood Zones



3.10 EARTHQUAKES

3.10.1 AFFECTED ENVIRONMENT

Most earthquakes which occur in the State are localized around the island of Hawaiʻi, and most are too small to be detected except by highly sensitive instrument. However, potentially destructive earthquakes do occur.

The most powerful earthquake in Hawaiʻi on record occurred in 1868 beneath the Kaʻū District on the southeast flank of Mauna Loa, on the island of Hawaiʻi. It had an estimated magnitude of between 7.5 and 8.1 and caused damage across all of Hawaiʻi Island.

3.10.2 POTENTIAL IMPACTS AND MITIGATION

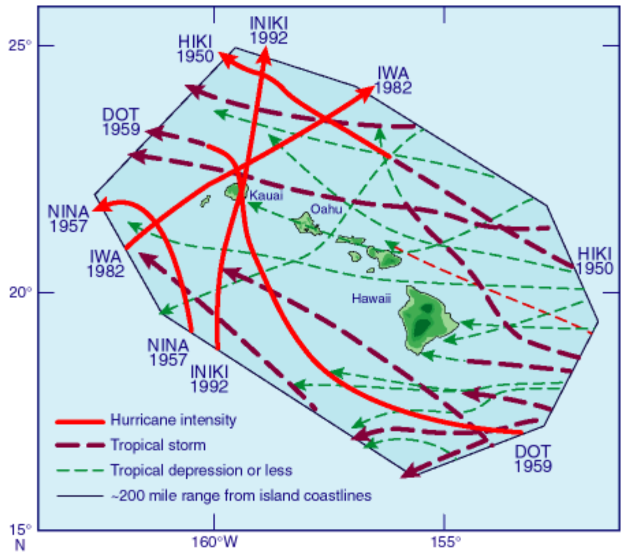
Engineers, seismologists, architects, and planners have devised a system of classifying seismic hazards based on the expected strength of ground shaking and the probability of the shaking actually occurring within a specified time. The results are included in the Uniform Building Code (UBC) seismic provisions. The UBC contains six seismic zones, ranging from 0 (no chance of severe ground shaking) to 4 (10 percent chance of severe shaking in a 50-year interval). For the purposes of structural design, the entire island of Hawaiʻi is classified as Zone 4. Forest City Hawaiʻi will construct all structures associated with the proposed project in compliance with the Uniform Building Codes for Zone 4. The construction and operation of the proposed facilities will not increase the seismic vulnerability of the area.

3.11 HURRICANES AND TROPICAL STORMS

3.11.1 AFFECTED ENVIRONMENT

While many hurricanes have passed near Hawai‘i Island during the last 50 years, until this year, none have directly affected the island (Figure 3.14). On Friday, August 8, 2014, Tropical Storm Iselle landed on the eastern side of Hawai‘i Island. It was the strongest tropical system to make landfall on the island since reliable records began in 1950. The storm made landfall just prior to 3:00 AM HST with sustained winds near 60 mph and higher gusts. A gust of 66 mph was observed at Volcano National Park, and a gust to 72 mph occurred at O‘ahu Forest National Wildlife Reserve (AccuWeather 2014). Another tropical storm in 1958 reached sustained speeds of 30 knots with gusts of 45 knots near Hilo. In other areas of the island, as judged by damage, winds reached sustained speeds of at least 50 knots with gusts of 75 knots or more (CPHC 2013).

Figure 3.14 Hurricane Tracks, 1950 to 2012



Source: U. Hawai‘i School of Ocean and Earth Science & Technology

3.11.2 POTENTIAL IMPACTS AND MITIGATION

No documented hurricanes have directly affected Hawai‘i Island, and all the tropical storms that have impacted the island have affected only the eastern, windward side of the island. The control building and other above-ground structures associated with the project will be compliant with the County building codes and able to withstand significant winds. Thus the likelihood of impacts to the project from such storms is very low.

3.12 VOLCANIC ERUPTIONS

3.12.1 AFFECTED ENVIRONMENT

The well sites are located on the western flank of Hualālai, one of five prominent volcanoes on the island of Hawai‘i. The estimated lava production rate for Hualālai over the past 3,000 years is about 2 percent of the current rate for Kīlauea Volcano. The last volcanic eruption of Hualālai in the general project area occurred in 1800 to 1801. Lavas emerged from the northwest volcanic rift zone at about the 1,600-foot elevation (in the vicinity of the Puhi-a-Pele Cinder Cone, just *makai* of Māmalahoa Highway), creating a flow that entered the ocean north of Keāhole Point.

3.12.2 POTENTIAL IMPACTS

The Lava Flow Hazard Map prepared by the Hawaiian Volcano Observatory of the USGS shows the island of Hawaiʻi in nine Lava Flow Hazard Zones (Zone 1 being the most hazardous and Zone 9 being the least), based on geologic criteria, including frequency of past lava flows and coverage, distance from eruptive vents, and topography that currently protects certain areas from lava inundation. The summit of Mauna Loa and its rift zones as well as Kilauea Crater and its rift zones are located in Zone 1. The project site and the town of Kailua-Kona are located in Zone 4, a moderately rated hazardous zone. Thus the likelihood of impacts to the project facilities from lava flows is low.

3.12.3 TSUNAMI WAVES

The well facilities and transmission lines will be located far above any potentially hazardous areas. The lowest portion of the proposed facilities, on the Māmalahoa Highway, is at an elevation of about 1,470 feet msl, more than 2-1/2 miles from the shoreline. Although tsunami inundation can be devastating to coastal properties, the proposed project will not be impacted.

3.12.4 WILDFIRES

The Hawaiʻi Wildfire Management Organization rates the area as being in a "Moderate Hazard Area" with respect to wildfires (HWMO 2014). The site plan provides adequate clearance between the above-ground facilities that are proposed and surrounding vegetation to keep them safe should a wildfire pass through the area.

3.13 CLIMATE CHANGE AND POTENTIAL SEA LEVEL RISE

3.13.1 AFFECTED ENVIRONMENT

The global community of climate scientists has concluded that sea levels are currently rising, and that this trend is expected to continue for the foreseeable future. The Intergovernmental Panel on Climate Change (IPCC) recently predicted (Church et al. 2013; IPCC 2013) that the average temperature in the Hawaiian Islands is likely to increase by 0.5 to 1.5 C° (0.9 – 1.7 F°) by 2100, rainfall is likely to decrease by, at most 10 percent, and sea level could rise between 0.26 to 0.98 m (0.85 to 3.2 ft.). Given this likelihood, it is incumbent upon planners to look at the potential effects this trend could have on development and examine ways in which project design can accommodate these changes.

3.13.2 POTENTIAL IMPACTS

This small anticipated temperature change and small predicted decrease in rainfall would not significantly affect the project. Because the project involves only upland areas, well above sea level, a rise in average sea level even of 3.2 feet would not affect the project design. Neither would it affect the homes that water from the well is intended to serve.

3.14 SCENIC RESOURCES

3.14.1 AFFECTED ENVIRONMENT

The existing visual character of the well sites can be described as undeveloped sloping land overgrown with dense vegetation. The project area cannot be seen from Māmalahoa Highway or other public vantage points due the intervening topographic and vegetation barriers. The Pacific Ocean and Kona coastline form the backdrop of views toward the *makai* lands from the site's upper elevations.

3.14.2 POTENTIAL IMPACTS AND MITIGATION

The proposed control building and pump station will be modest in size and unobtrusive. They will not be visible from the Māmalahoa Highway and will be partially blocked from view by trees from the adjacent properties. View planes from properties in the vicinity to the sea and mountains will not be affected.

3.15 ARCHAEOLOGICAL RESOURCES

3.15.1 AFFECTED ENVIRONMENT

Rechtman Consulting, LLC, conducted an archaeological inventory survey of the original project site in 2008 (see Appendix E). The survey encompassed a 17-acre portion of the State parcel lying between the 980-foot and 2,460-foot elevations. The purpose of the survey was to summarize the background information concerning the project area's physical setting, cultural context, previous archaeological work, and current survey expectations based on four previous archaeological studies in the project area (Halpern and Rosendahl 1996; Kawachi 1994; and Yent 1991, 1999). These studies identified five features in the project area, which were all reconfirmed by Rechtman Consulting, LLC. The sites included four core-filled ranching/boundary walls (Sites 20754, 20755, 20757, and 20758) and a terrace/wall (Site 20759) located along the edge of the natural drainage which were all likely used for agricultural activities.

In 2014 ASM Affiliates completed an updated archaeological inventory survey to include the area in the current project that was not included in the original project scope, i.e. the planned roadway right of way between the Keōpū Well Site #4 and Keōpū Well. This new study was submitted to the State Historic Preservation Division (SHPD) for review in March 2014 and is reproduced here as Appendix F. As a result of the current field investigation three previously undocumented features were observed and recorded. All three of these features are located on TMK: (3) 7-5-001:159 (formerly Parcel 044). Two of these are agricultural field system features, called *kuaiwi*[4], (Site 22975 Features B and C) and the third is a Historic Period roadway (Site 22974 Feature B).

3.15.2 POTENTIAL IMPACTS AND MITIGATION

All of the reconfirmed and newly identified sites in these two studies are significant, based on SHPD criteria. For sites to be significant, they must possess the integrity of location, design, settings, materials, workmanship, feeling, and association and meet one or more of the following criteria provided by SHPD:

- Be associated with events that have made an important contribution to the broad patterns of our history;
- Be associated with the lives of persons important in our past;
- Embody the distinctive characteristics of a type, period, or method of construction; represent the work of a master; or possess high artistic value;
- Have yielded, or is likely to yield, information important for research on prehistory or history;
- Have an important traditional cultural value to the Native Hawaiian people or to another ethnic group of the state due to associations with traditional and customary practices.

Generally, the information collected during the previous studies, along with the current inventory survey, is sufficient to document these sites and mitigate any potential negative impacts that might result from the construction of the Keōpū Well facilities. SHPD has recommended data recovery take place at the two *kuaiwi* features prior to any proposed development activities. A data recovery plan in compliance with HAR 13§13-278 has been prepared and submitted to SHPD for their review and approval. ASM Affiliates has been retained to complete the recovery work when the plan is approved by SHPD and to provide adequate reporting to SHPD to ensure adequate documentation of these sites. Given these surveys and recovery work and also the substantial earlier work completed earlier,

[4] These features are believed to be *kuaiwi*, which are long, straight stone walls believed to have been used by Hawaiians to delineate different agricultural fields.

no significant impacts to the project area archaeological resources are predicted. Should significant, undocumented archaeological features be discovered during construction, work will stop and SHPD will be consulted to determine the appropriate course of action.

3.16 CULTURAL IMPACT ASSESSMENT

3.16.1 AFFECTED ENVIRONMENT

In 2008, Paul H. Rosendahl, Ph.D., Inc. (PHRI) prepared a cultural impact assessment (CIA) of the original project area to evaluate the potential impacts of the proposed project on the cultural resources of Native Hawaiians (see Appendix G). The overall objective was to determine whether traditional and customary practices were being conducted within, or adjacent to, the project area and could possibly be constrained, constricted, prohibited, or eliminated if the proposed project were to be implemented.

In its research, the CIA documented the scarcity of information on the history of Hienaloli. The usual references used to determine place names were silent regarding the translation and meaning of Hienaloli. Over thirty informants were contacted to relate any experience or knowledge they might have of the project area. The noticeable dearth of information indicated that pre-contact cultural activities within Hienaloli were limited to agricultural and residential practices. There was little information regarding current day practices specific to the study area.

3.16.2 POTENTIAL IMPACTS AND MITIGATION

The information presented in the CIA, historical documentation, archaeological surveys and research, and oral reminiscences, all indicate that the development of the well facilities will have little effect on Native Hawaiian traditional or customary rights and practices. Thus, no mitigation measures would be necessary. PHRI, however, emphasized that remnants of Native Hawaiian practices may reveal themselves during site construction. If that were to occur, work in the immediate area would be halted and SHPD would be contacted for appropriate action or treatment.

THIS PAGE WAS INTENTIONALLY LEFT BLANK

4. SOCIO-ECONOMIC SETTING

4.1 POPULATION

4.1.1 AFFECTED ENVIRONMENT

For most of the 20th century, North Kona thrived historically as an agricultural region. With its scenic coastal resources, the area has experienced tremendous change and growth since statehood, driven by resort development and a second-home residential market. The population in the North Kona area has increased dramatically since 1990 (see Table 4.1 and Figure 4.1). In the center of the district is Kailua-Kona, a thriving urban center that has become a hub for government, commercial, industrial, and resort services and facilities for West Hawaiʻi. As of 2007, Kailua-Kona had 170 retail establishments with gross sales of almost $600 million, 23 percent of the island's total. The retail workforce alone in Kailua numbered 2,406 (DBEDT 2012).

Table 4.1 Growth in North Kona Area, 1990 – 2010, by Zip Code

Zip Code	Population			% Growth
	1990	2000	2010	1990-2010
96725	2,096	2,956	3,592	71.4%
96740	19,616	25,132	33,321	69.9%
96750	1,309	2,629	3,793	189.8%
Total	23,021	30,717	40,706	76.8%

Note: See Figure 4.1 for zip code boundaries.

Source: U.S. Census Bureau (2013)

In addition to the gradual in-filling of residential homes between Kailua-Kona and Keauhou, urban development has been moving north toward the Kona International Airport in Keāhole. HHFDC's Kamakana Project is located in this northern growth pattern, and substantial amounts of public money are being invested in infrastructure to support this growth.

4.1.2 POTENTIAL IMPACTS AND MITIGATION

North Kona has been designated in the Hawaiʻi County General Plan as an area that can accommodate population growth (see Section 6.1). By supplying potable water to the Kamakana Project dwellings and other North Kona residences, the project will facilitate this planned growth, but will not cause additional population growth. Thus, the project impacts on population growth will not be significant.

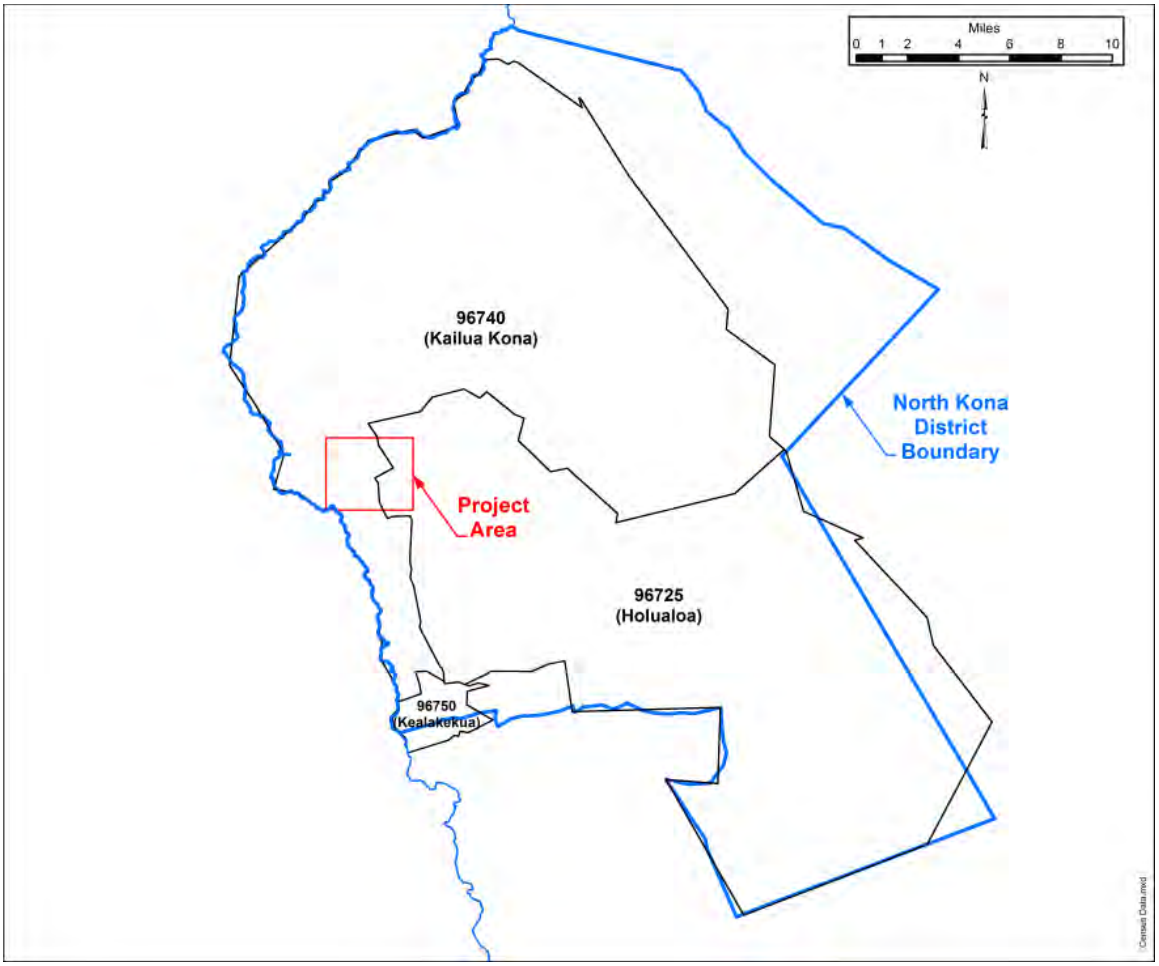
4.2 ECONOMIC CONSIDERATIONS

4.2.1 AFFECTED ENVIRONMENT

Kailua-Kona is considered the center for government, banking, and retail activities in West Hawaiʻi. The old Kailua industrial area and new industrial subdivisions in Kaloko provide the largest concentration of such activities in the region, accommodating a wide range of manufacturing, service, and wholesale operations.

Despite the expansion of urban activities in North Kona, agricultural enterprises continue to prosper particularly in the uplands and southern sections of the district. In 2013, Kona coffee reached sales valued at $31.5 million.[5] Other agricultural operations have flourished including cattle ranching and the harvesting of fruits, macadamia nuts, flowers, and vegetables.

Figure 4.1 Zip Codes in North Kona Area



Source: State of Hawaiʻi GIS

4.2.2 POTENTIAL IMPACTS AND MITIGATION

The estimated cost of about $8 million (see Section 1.4) to construct the project facilities will generate substantial beneficial short-term effects in the local economy. During the design and construction stage of the project, work will be created in planning, engineering, landscape architecture, construction trades, material and supply vendors, and related fields. Secondary and induced effects will occur as monies from these industries are spent and re-spent generating a greater impact in the economy.

In the long-term, the new source of water for North Kona will accommodate continued planned development. It will support the development of new homes and businesses, prompt additional

[5] *Pacific Business News*, May 31, 2013, URL: http://www.bizjournals.com/pacific/news/2013/05/31/hawaiis-kona-coffee-farmers-to-get.html

mobilization in the construction industry, stir another round of income and spending, and continue to generate state income tax and sales tax revenues. This will constitute a minor but positive economic impact to the local area.

4.3 SOCIAL CONSIDERATIONS

4.3.1 AFFECTED ENVIRONMENT

All state, county, regional, and community plans discussed in subsequent sections recognize the social and moral obligations for government and community leaders to plan for and provide the necessary infrastructure that support residential growth in the County. The County of Hawaiʻi General Plan (County of Hawaiʻi 2005, p. 9-1) states:

> *In the social and human realm, adequate housing is one of the primary factors that provide a person a sense of satisfaction and wellbeing. For most families, it is a major expenditure of the household income and represents, in varying degrees, long term commitments to a place and/or community. In turn, these commitments contribute to a community's sense of wellbeing and stability.*
>
> *From governments' perspective, adequate housing for residents is part of the considerations of public health, welfare and safety. Housing and residential use of land is a generator of government revenue through local real property taxes. The revenues are balanced by significant expenditures of public funds for roads, schools, protective services and other capital improvement projects that service residential areas. Thus, the provision of housing requires the coordination of planning and implementation on all levels of government.*

4.3.2 POTENTIAL IMPACTS AND MITIGATION

The proposed production well will supply water and provide an important service to the residents of North Kona, including the Kamakana Project. As a utility, it will be an essential component for growth supported by State and County planning and land use policies. Notably, these policies include objectives to improve the infrastructure to support new development. Keōpū Well #4 is a component that is intended to support the planned development and growth in Kamakana as well as support for development of other nearby communities served by DWS.

THIS PAGE WAS INTENTIONALLY LEFT BLANK

5. PUBLIC FACILITIES AND SERVICES

5.1 CIRCULATION AND TRAFFIC

5.1.1 AFFECTED ENVIRONMENT

Māmalahoa Highway, a County right of way, is a two-lane highway that serves as the primary access through the uplands of North Kona and the Keōpū well sites. Traffic volume on this meandering rural road can be categorized as low.

5.1.2 POTENTIAL IMPACTS AND MITIGATION

Long-term operations of the production well will not generate any notable traffic. Typically, a monitoring crew of one technician would make daily trips to the site, while a maintenance crew would make periodic trips. Overall, however, there would be no multiple trips to the well facility on a per day basis.

In the short-term, construction activities at the project site will generate traffic associated with construction workers commuting to and from the property, delivery of construction material and equipment, and removal of construction wastes and debris. Traffic delays are expected to be intermittent and brief at isolated locations along the project's primary route: Māmalahoa Highway and Palani Road.

Installation of a transmission line in Māmalahoa Highway will require trenching, placement of the pipeline, and backfilling. These activities will require temporary closure of a traffic lane and rerouting of passing vehicles to the opposite lane. Such a procedure could generate temporary, short-term traffic delays. As provided in Section 8.1 below, mitigation measures will be employed to minimize project impact on traffic.

5.2 POTABLE WATER

5.2.1 AFFECTED ENVIRONMENT

An 8-inch DWS water line currently runs along Māmalahoa Highway below the project site. This line is part of the North Kona Water System that consists of high-level, mid-level, and shaft wells; storage tanks; and an interconnecting distribution system serving DWS customers from Keāhole to Keauhou.

5.2.2 POTENTIAL IMPACTS AND MITIGATION

The water from Keōpū Well #4 will connect to this system in the Kamakana land tract where an existing 16-inch DWS line occurs. The connection is situated in Māmalahoa Highway approximately 7,000 feet to the north of the project site. The new line will be 16 inches in diameter and aligned parallel with the existing 8-inch line. The new line will be entirely within the highway's existing right of way.

Completion of this project will have a positive impact on the stability and capacity of the DWS water supply for the North Kona area.

5.3 SEWER

5.3.1 AFFECTED ENVIRONMENT

The County's sewer collection system currently services the town of Kailua-Kona, the coastal properties along Aliʻi Drive, several inland subdivisions between Kailua-Kona and Keauhou, and new development above Queen Kaʻahumanu Highway, mauka of the County's Kealakehe Wastewater

Reclamation Facility. However, the County system does not serve the upland homes and agricultural properties along Māmalahoa Highway.

Historically, these unserved properties have used independent waste systems consisting primarily of cesspools to accommodate their wastewater disposal needs. However, recent government regulations now require an environmentally safer method of disposal to protect the area's watershed. Homeowners must eventually install septic tanks that collect and hold the effluent, allowing the system to separate and biodegrade the outflow before the liquid component is canted by overflow into a drain field for disposal.

5.3.2 POTENTIAL IMPACTS

The planned unmanned facilities at Keōpū Well #4 will not require an independent waste system. Hence, no impact from wastewater disposal is expected to occur.

5.4 ELECTRICITY

Electricity is provided by Hawaii Electric Light Company (HELCO) via existing overhead lines along Māmalahoa Highway. A new overhead line will be installed to connect this system to the Keōpū Well #4 facilities. HELCO has confirmed that no upgrading to the connection at the existing DWS Keōpū production well site will be required for the booster pump station. The new production well, pump station, and support facilities will require electrical power for operations, but the power demand is expected to be nominal and have no adverse impact on HELCO's capacity to serve other customers.

5.5 TELECOMMUNICATIONS

Telecommunications service is available from Hawaiian Telcom. Telemetering equipment or a Supervisory Control and Data Acquisition (SCADA) system will be installed at the control building to monitor the well's operations. An overhead line along the project area's driveway will be installed to connect the SCADA with existing Hawaiian Telcom lines along Māmalahoa Highway. The proposed project will not require telephone land line services and no significant impact on telecommunications facilities is anticipated.

5.6 SOLID WASTE

5.6.1 AFFECTED ENVIRONMENT

The County of Hawai‘i provides solid waste collection service. Property owners or occupants hire private companies to haul their waste or self-haul their waste to the County's Pu‘uanahulu Landfill in North Kona or to the County's transfer stations in Kailua, Keauhou, Ke‘ei, Wailea, and Miloli‘i. Most self-hauled wastes are taken to the transfer stations that are provided for use primarily from single-family residences. Other solid wastes, such as agricultural wastes, do not enter the county waste stream and are usually recycled at the source.

5.6.2 POTENTIAL IMPACTS AND MITIGATION

Solid waste generated for the proposed project, including construction and maintenance debris, is expected to be minimal and have no noticeable effect on County solid waste disposal facilities. Construction contractors, notably, often re-use construction material for subsequent projects. This economic use of supplies helps minimize solid waste disposal at the public landfills. Thus, no significant impact on solid waste facilities will be caused by the project.

5.7 PUBLIC FACILITIES AND SERVICES

5.7.1 AFFECTED ENVIRONMENT

5.7.1.1 Police Services

The project area is located within the Hawaiʻi County Police Department's Kona District which is headquartered in Kealakehe. Substations are located in Captain Cook, Kailua-Kona, and Keauhou.

5.7.1.2 Fire and Emergency

A 24-hour fire station with fire, emergency medical service (EMS), and rescue capabilities is located in Kailua-Kona. In addition, fire stations with regular full-time fire and EMS services are located in Keauhou, Captain Cook, and at the Makalei Fire station. On-call volunteer services operate out of Kalaoa Mauka, Miloliʻi Village, and Kona Paradise Subdivision.

5.7.1.3 Medical Services

Kona Community Hospital, which serves West Hawaiʻi, is a full-service hospital located in Kealakekua. Hospital services include acute inpatient medical/surgical, obstetrics, skilled nursing, intensive care, and outpatient surgery. Outpatient and ancillary services include a 24-hour emergency room, laboratory, radiology, pharmacy, occupational, physical, respiratory and speech therapy, and dietary services.

5.7.1.4 Public Education

The Kona public school system is comprised of the Konawaena and Kealakehe complexes. The Konawaena complex includes Konawaena High School, Konawaena Middle School, Konawaena Elementary School, Hoʻokena Elementary School, and Honaunau Elementary School. The Kealakehe complex includes Kealakehe High School, Kealakehe Intermediate School, Kealakehe Elementary School, Hōlualoa Elementary School, and Kahakai Elementary School.

5.7.2 POTENTIAL IMPACTS AND MITIGATION

The Keōpū Well #4 facility will be secured by fencing and a locked gate. The structures will be almost entirely constructed out on non-flammable materials. No additional personnel will be hired by DWS to service the facility who could impact local police, fire, medical or educational facilities. Thus, due to the purpose and function of the proposed project, adverse impacts to these public facilities and services are not anticipated. Best management practices in the construction, signage, and operation of the chlorination system will be used to mitigate the potential of any accidental releases or exposure to DWS workers or the public.

THIS PAGE WAS INTENTIONALLY LEFT BLANK

6. RELATIONSHIPS TO PUBLIC AND LAND USE POLICIES

6.1 COUNTY OF HAWAIʻI GENERAL PLAN

6.1.1 APPLICABLE GOALS, POLICIES AND RECOMMENDED ACTIONS

The Department of Water Supply operates and maintains over twenty separate water systems on the Island of Hawaiʻi, including the Keōpū Wells. The *2005 Hawaiʻi County General Plan* contains goals and policies concerning the development and operation of essential water supply facilities. The General Plan recognizes that water supply facilities are needed to support the patterns of development which the General Plan seeks to achieve. It makes planning for the location of utility facilities such as wells, reservoirs, and pumping stations an integral part of the land planning process.

The *2005 General Plan* identifies the following County policies with regard to public water systems that are relevant to the proposed project:

> *(a) Water system improvements shall correlate with the County's desired land use development pattern.*
>
> *(b) All water systems shall be designed and built to Department of Water Supply standards.*
>
> *(c) Improve and replace inadequate systems.*
>
> *(d) Water sources shall be adequately protected to prevent depletion and contamination from natural and man-made occurrences or events.*
>
> *(e) Water system improvements should be first installed in areas that have established needs and characteristics, such as occupied dwellings, agricultural operations and other uses, or in areas adjacent to them if there is need for urban expansion.*
>
> *(f) A coordinated effort by County, State and private interests shall be developed to identify sources of additional water supply and be implemented to ensure the development of sufficient quantities of water for existing and future needs of high growth areas and agricultural production.*

The *2005 Hawaiʻi County General Plan* identifies a number of actions to implement these policies in the North Kona District. Specifically, it directs DWS to:

- Continue to pursue groundwater source investigation, exploration and development in areas that would provide for anticipated growth and that would provide for an efficient and economic system operation.
- Increase the capacity of the booster pump stations as required. Continue to evaluate growth conditions to coordinate improvements as required to the existing water system in accordance with the North Kona Water System Master Plan.

6.1.2 CONFORMANCE WITH THE 2005 HAWAIʻI COUNTY GENERAL PLAN

The proposed project will improve the County's capacity to serve customers in the North Kona region by adding a much needed pump station and transmission line from the well sites northward. Thus, the project is compatible with the County Water Use and Development plan and the County General Plan.

6.2 COUNTY OF HAWAIʻI ZONING ORDINANCE

The County zoning in the project area is Agriculture (A-20a and A-5a) for the well sites, and County roadways for the transmission lines. However, the Keōpū Well #4 site is also designated by the State Land Use Commission as Conservation land (see Section 6.7). Lands that are located in the State Conservation District are regulated by the State DLNR and administered by the Office of Conservation and Coastal Lands. Since the well site is located in the State Conservation District, land use approval is obtained through a Conservation District Use Permit from the State BLNR. County zoning requirements are not applicable.

6.3 KEĀHOLE TO KAILUA DEVELOPMENT PLAN

In 1990, the County adopted the *Keāhole to Kailua Development Plan* to serve as a guide for future land use development and infrastructure in the region. The 20-year plan includes residential, resort, commercial, industrial, recreational, and public facility uses.

At its conception, the plan recognized that the development of potable water resources would be crucial for the continued development of the Keāhole to Kailua area and that the availability of potable water may become a limiting factor. In the plan's program policies, a series of wells above the 1,500- to 1,800-foot elevation was proposed for development. This project is completely consistent with this plan.

6.4 KONA COMMUNITY DEVELOPMENT PLAN

The Kona Community Development Plan, adopted by the County in September 2008, translates the broad statements of the General Plan to specific actions as they apply to geographical areas of the region. Its vision for the future is:

> *A more sustainable Kona characterized by a deep respect for the culture and the environment and residents that responsively and responsibly accommodate change through an active and collaborative community.*

The plan's goal for public facilities, infrastructure, and services is a community where the public infrastructure and facilities are sustainably built and maintained with innovation and pride, promote a sense of community, and support a quality of life where visitors and residents feel safe, healthy, and inspired.

As a utility and a component of required infrastructure, the proposed well and reservoir will support the planned growth of Kona as provided in the County's General Plan Land Use Pattern Allocation Guide and Kona CDP's Official Kona Land Use Map. The proposed project recognizes the identification of the Kona Mauka Watershed Management Program and will comply with the workings of that program.

6.5 SPECIAL MANAGEMENT AREA

Under HRS Chapter 205A (Coastal Zone Management), the County is authorized to regulate land uses within the Special Management Area (SMA) of the island of Hawai‘i. The SMA encompasses a defined area along the coast of the Big Island.

The proposed Keōpū Well #4, reservoir, and water lines are located outside of the SMA, and therefore, not subject to the SMA Rules and Regulations of the County of Hawai‘i.

6.6 HAWAI‘I STATE PLAN

The Hawai‘i State Planning Act (Planning Act) has served as a guide for the long-range development of the state since its adoption into law in 1978 as Hawai‘i Revised Statutes (HRS) Chapter 226. The Planning Act identifies goals, objectives, and policies for the state to: (1) provide a basis for determining priorities and allocating limited resources, such as public funds, services, human resources, land, energy, water, and other resources; (2) improve coordination of federal, state, and county plans, policies, programs, projects, and regulatory activities; and (3) establish a system for plan formulation and program coordination to provide for an integration of all major state and county activities. Of the 107 sections that comprise HRS Chapter 226, three are directly applicable to the proposed project, discussed below. For each section, the applicable objectives and policies are listed in italics, followed by a discussion of the project compliance with them.

6.6.1 HRS §226-13 - OBJECTIVES AND POLICIES FOR THE PHYSICAL ENVIRONMENT – LAND, AIR, AND WATER QUALITY

(a) Planning for the State's physical environment with regard to land, air, and water quality shall be directed towards achievement of the following objectives:

(1) Maintenance and pursuit of improved quality in Hawai‘i's land, air, and water resources.

(2) Greater public awareness and appreciation of Hawai'i's environmental resources.

(b) To achieve the land, air, and water quality objectives, it shall be the policy of this State to:
(2) Promote the proper management of Hawai'i's land and water resources.
(3) Promote effective measures to achieve desired quality in Hawai'i's surface, ground, and coastal waters.
(6) Encourage design and construction practices that enhance the physical qualities of Hawai'i's communities.
(7) Encourage urban developments in close proximity to existing services and facilities.
(8) Foster recognition of the importance and value of the land, air, and water resources to Hawai'i's people, their cultures and visitors.

Conversion of Keōpū Well #4 to a production well will add a new source to the DWS water system. The long-term impact of the project will improve the County's capacity to serve customers in the North Kona region. The proposed project will also include a storage reservoir and transmission lines to enhance the County's overall delivery system. No long-term detrimental impacts on the County's existing water supply system are anticipated.

6.6.2 HRS §226-14 - OBJECTIVE AND POLICIES FOR FACILITY SYSTEMS – IN GENERAL

(a) Planning for the State's facility systems in general shall be directed towards achievement of the objective of water, transportation, waste disposal, and energy and telecommunication systems that support statewide social, economic, and physical objectives.

(b) To achieve the general facility systems objective, it shall be the policy of this State to:
(1) Accommodate the needs of Hawai'i's people through coordination of facility systems and capital improvement priorities in consonance with state and county plans.
(2) Encourage flexibility in the design and development of facility systems to promote prudent use of resources and accommodate changing public demands and priorities.
(3) Ensure that required facility systems can be supported within resource capacities and at reasonable cost to the user.
(4) Pursue alternative methods of financing programs and projects and cost-saving techniques in the planning, construction, and maintenance of facility systems.

The proposed project fully supports the objectives and policies for "facility systems" as set forth in HRS §226-14. It is also consistent with the County General Plan, Kona Community Development Plan, and Hawai'i County Water Use and Development Plan. The proposed project will supply water to HHFDC's Kamakana Project, which will offer a range of affordable and market-priced housing units. The proposed project will be located in the high-level zone of the Keauhou Aquifer at about the 1,600-foot elevation where previous exploratory wells have encountered favorable groundwater levels at 25 to 460 feet above sea level.

6.6.3 HRS §226-16 - OBJECTIVES AND POLICIES FOR FACILITY SYSTEMS – WATER.

(a) Planning for the State's facility systems with regard to water shall be directed towards achievement of the objective of the provision of water to adequately accommodate domestic, agricultural, commercial, industrial, recreational, and other needs within resource capacities.

(b) To achieve the facility systems water objective, it shall be the policy of this State to:
(1) Coordinate development of land use activities with existing and potential water supply.
(2) Support research and development of alternative methods to meet future water requirements well in advance of anticipated needs.
(4) Assist in improving the quality, efficiency, service, and storage capabilities of water systems for domestic and agricultural use.
(5) Support water supply services to areas experiencing critical water problems.

The County recognizes Keōpū Well #4 as a potential source for serving new development in the Kamakana area. Forest City Hawaiʻi will construct the Keōpū Well#4 facilities, including its pump station and transmission lines, and dedicate the improvements to the DWS.

6.7 STATE LAND USE LAW

The State Land Use District Maps, administered by the State Land Use Commission, designate the project site in the Conservation District. The Conservation District includes primarily lands in existing forest and water reserves, and areas necessary for protecting watersheds and water sources. It also includes lands for preserving scenic/historic areas, park areas, wilderness, and beach reserves, as well as for conserving indigenous or endemic plants, forestry, and fish.

The State BLNR oversees the Conservation District, which includes five subzones: Protective, Limited, Resource, General, and Special. The Keōpū Well #4 site is located in the Conservation District and the Resource subzone. As a water system that will serve a public purpose, the proposed facilities are permitted uses in the Conservation District. Forest City Hawaiʻi obtained a Conservation District Use Permit (CDUP) for the project from BLNR in September, 2010 and received an amendment to the CDUP extending the time for project completion until September 22, 2014. However, due to a number of delays, Forest City Hawaiʻi must seek another extension to have sufficient time to complete the work.

6.8 STATE ENVIRONMENTAL POLICY

The State Environmental Policy under HRS Chapter 344, established a policy that (1) encourages productive and enjoyable harmony between people and their environment; (2) promotes efforts that will prevent or eliminate damage to the environment and biosphere; (3) stimulates the health and welfare of humanity; and (4) enriches the understanding of the ecological systems and natural resources important to the people of Hawaiʻi.

HRS 344-3(1) states that it shall be the policy of the State, through its programs, authorities, and resources to:

> *Conserve the natural resources, so that land, water, mineral, visual, air and other natural resources are protected by controlling pollution, by preserving or augmenting natural resources, and by safeguarding the State's unique natural environmental characteristics in a manner which will foster and promote the general welfare, create and maintain conditions under which humanity and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of the people of Hawaiʻi.*

The Keōpū Well #4 has the capacity of producing a sustainable yield up to 1.5 MGD to supply a substantial portion of water needs for the future Kamakana residents, without a detrimental effect on the water resource of the district. The use of the island's water resource to fulfill the County's social, economic, and other requirements would be highly beneficial to the people of Hawaiʻi.

6.9 OTHER PERMITS AND APPROVALS

Construction permits will be required for the outfitting of Keōpū Well #4 and construction of its appurtenant facilities. These would include a water use permit, issued by the CWRM, and well construction and pump installation permit, approved by the State DOH. A National Pollutant Discharge Elimination System (NPDES) general permit coverage authorizing discharge of storm water associated with construction activities will be required from the State DOH.

If a dry well is constructed at the Keōpū Well #4 site, an UIC Permit will also be required for the project.

At the County level, a grading permit and building permit must be obtained from the County DPW. Water pipeline installation plans are reviewed and approved by the DWS, and subdivision plans are reviewed and approved through the coordination of the County Planning Department.

6.10 SUMMARY OF REQUIRED PERMITS AND APPROVALS

The following is a summary of the required permits and approvals for the construction of the proposed well, well control building, access road and transmission lines, pump station, and associated facilities.

Table 6.1 Summary of Required Permits and Approvals

Permits/Approvals	Approving Agency
State of Hawai‘i	
Conservation District Use Permit	Board of Land and Natural Resources
Water Use Permit	Commission on Water Resource Management
Well Construction & Pump Installation Permits	Commission on Water Resource Management
NPDES Permit (NOI-C coverage)	Department of Health
Underground Injection Control Permit	Department of Health
Conditional Approval, New Potable Water Source	Dept. of Health Safe Drinking Water Branch
County of Hawai‘i	
Subdivision	Planning Department
Building Permit	Department of Public Works
Grading Permit	Department of Public Works
Water Pipeline Installation	Department of Water Supply
Source: Compiled by Planning Solutions	

.

THIS PAGE WAS INTENTIONALLY LEFT BLANK

7. SUMMARY OF IMPACTS

7.1 SHORT-TERM POTENTIAL IMPACTS

Conversion of the exploratory well to a production well will involve construction activities that generate short-term, temporary impacts. Construction activities for the proposed project will include site preparation work, well pump installation, control building construction, utility line placement, new driveway pavement, landscaping, and construction area cleanup. The potential impacts associated with these activities include construction noise, fugitive dust, storm water runoff, and sedimentation. On the roadways, there would be construction vehicles delivering equipment and supplies to the construction site and construction employees commuting to and from the work area. The volume of construction-related trips would be small and occur at various times in the day, but not necessarily during the morning and afternoon peak-hour traffic.

Construction of the new water line along Māmalahoa Highway would involve the conventional trenching methodology. Installation of the utility would occur in phases over an approximately 6- to 12-month time period and involve short-term, temporary impacts from site preparation, trenching, pipeline placement, backfilling, and cleanup operations. Heavy equipment including jack hammers, backhoes, dump trucks, pick-up trucks, boom-mounted flatbed trucks, asphaltic concrete hauling trucks, pavers, and rollers would be employed, and diesel-powered generators may be used if on-site temporary electric power is required.

During the pipeline installation, when construction work calls for excavation or trenching, noise and fugitive dust would be generated. Adjacent residential properties would be affected, but mitigation measures (discussed in Section 8.1) will be employed to minimize potential impacts. Also, after heavy rainfall, runoff and possible sedimentation may occur in adjacent private properties and County storm water drainage systems.

Although existing and as-built utility plans have been reviewed, unexpected or altered utility line alignments may be encountered during trenching for the new water lines. Additionally, though all surface archaeological features within the road rights-of-way have been properly inventoried, underground archaeological deposits may be encountered. Mitigation measures as described in the next section will be employed to address these potentials.

The installation of water lines within the road rights-of-way will also disrupt vehicular travel as traffic will be diverted to adjacent lane or to another area of the right of way while the pipeline work is being performed. No encroachment on adjacent private properties is anticipated; however vehicle access to some properties may be temporarily obstructed when construction occurs directly in front of them.

The economic impact of the proposed action would be positive and include the mobilization of construction personnel and equipment in the construction industry and the purchases of construction material and supplies in the local market generating a multiplier effect as monies are spent and re-spent on other purchases in the economy.

7.2 LONG-TERM POTENTIAL IMPACTS

Once the proposed facilities are constructed and the utility is in full operation, the long-term impacts would be positive to area residents. The availability of additional water to the community would be a major public benefit.

The conversion of the exploratory Keōpū Well #4 to a production well would have minimal or minor impact on other wells in the vicinity. Pumpage at Keōpū Well #4 will result in a lowering of water levels in the project area, a condition known as “cone of depression.” Pump tests at the Keōpū Well #4 have shown that the nearby Keōpū production will experience a drawdown of about 0.6 feet. Similarly, the nearby Douter Well located downslope of the project site is expected to be affected by a drawdown of 0.6 feet or less. These drawdowns are considered insignificant and limited to the immediate vicinity of the

Keōpū Well #4 site. Overall, no long-term effect is anticipated on the sustainable yield of the Keauhou Aquifer System.

Once in production, the proposed Keōpū Well #4 will be an unmanned operation that would be monitored by telemetry and associated telecommunications equipment. There will also be regular daily monitoring and periodic maintenance of facilities by DWS personnel, but these activities would not result in major long-term impacts on traffic, fugitive dust, fauna, flora, archaeological sites, or cultural resources. The staff required for monitoring the well operations would consist of one technician, while the maintenance crew would include no more than a handful of repairmen and groundskeepers. Including Keōpū Well #4 in DWS's North Kona Water System is not expected to generate the hiring of additional DWS staff. However, if such a need is required, the number of new personnel would be minimal, resulting in no substantial increase in resident population and resultant increase in housing, public facilities, and public services demand.

Noise from the Keōpū #4 well pump will be insignificant and require no special buffering.

Electrical energy will be required to operate the project's well pump, but not in significant quantities to exhaust the current supply of power to the area.

7.3 CUMULATIVE IMPACTS

Each well development must demonstrate that it would not draw more than the sustainable yield of the groundwater at its site. As described in Section 3.3.1.3, the high level aquifer does not appear to be directly connected to the basal aquifer, so it is unlikely that continued development of these water resources will affect the basal groundwater.

Meanwhile, all high-level aquifer production wells are already required to monitor salinity (as chlorides) on a monthly basis and submit its data to the State Commission on Water Resource Management, and water conservation practices will be promoted in the Villages to aid in the reduction of excessive water consumption.

Existing groundwater protection procedures such as Best Management Practices (BMPs), Storm Water Pollution Prevention Plan approval, and NPDES permits are in place to regulate and control discharges to our state's groundwater resources. The Hawai‘i State Water Code requires the CWRM to develop minimum standards to prevent polluting, contaminating, and wasting groundwater, and to minimize saltwater intrusion into wells and groundwater. Since well construction and pump installation permits require adherence to the Hawai‘i Well Construction and Pump Installation Standards, the CWRM is ensuring adequate protection, testing, and optimization of aquifers with respect to the development of new groundwater sources.

8. PROPOSED MITIGATION MEASURES

8.1 MITIGATION FOR SHORT-TERM IMPACTS

The noise generated from construction activities will be short-term and localized to the immediate vicinity of the construction work in progress. A community noise permit will be sought from the DOH prior to the commencement of any construction activity. Night-time construction is not anticipated, but should such activity be necessary, a public informational meeting would be held for the affected residents and property owners. DOH's maximum permissible noise level for construction equipment during night hours in residential areas is 45 dBA. If the generated noise is expected to exceed the State's maximum permissible level, a noise variance will be sought from the DOH.

Construction equipment and on-site vehicles that emit gas or other emissions during operations (excluding pneumatic hand tools weighing less than 15 pounds) must be equipped with mufflers. Dust control measures would include the use of dust screens, if necessary, frequent water sprinkling of exposed dirt areas, and temporary ceasing of operations during high wind conditions.

Although there are a few surface archaeological features on the well property, project engineers have designed the placement of the well facilities to minimize impacts to the identified features. Additionally, if any buried cultural deposits are found during construction, work will cease in the immediate area of the find, and the SHPD will be notified and consulted regarding proper treatment before any construction work is allowed to resume.

Erosion and sedimentation control measures and BMPs, such as berms, silt screens, snake bags, and sedimentation basins, will be employed, if necessary, to ensure that no runoff from the construction site flows onto adjacent properties and County storm water drainage systems.

No dewatering will be required for the project. Groundwater is located far beneath the surface of the site and will not be encountered during excavation or trenching operations. All solid waste and debris generated during construction will be collected and hauled away to a public landfill by the construction contractor.

A traffic control plan (TCP) for the water line construction along Māmalahoa Highway will be prepared and submitted to the County for review and approval. The TCP will include traffic controls and management provisions designed to maintain safe vehicular passage through or around the project construction area.

Traffic cones and posted signs will be placed far in advance of the construction site to provide adequate warnings to motorists. Lane closures may be required during trenching and pipeline placement resulting in the use of the remaining lane for local traffic to pass through. Traffic monitors or flaggers will be employed to control and direct vehicular movement through the construction area. Work on the water line will be conducted in phases so affected areas would occur in short sections at a time.

To further minimize traffic impact, work will be conducted during off-peak hours to avoid the day's heaviest traffic periods. In the event that the pipeline construction blocks a resident's direct access to his or her home, the construction contractor will immediately cease work in the area, place a metal plate over the pipeline trench, and allow the property owner to traverse the obstructed area. This procedure would also apply to the County Fire Department where access to its fire hydrants may be hindered during construction.

The project engineers (or consultants) and construction contractor are expected to coordinate construction of the water line with all potentially affected utility companies. This coordination would begin early in the planning and design process, with the construction contractor continuing the effort into the construction stage. The cost of any concessions or required alterations to the affected utilities may be borne by the project owner, contractor or design engineer, or a combination of these three.

8.2 MITIGATION FOR LONG-TERM IMPACTS

Keōpū Well #4 was designed to protect the high-level aquifer from potential surface contamination by including cement-grouting in the annular space around the well's steel casing from the ground surface to a depth of 1,529 feet (72 feet above the static water level). Further, when Keōpū Well #4 is converted to a production well, standard engineering practice would be employed to direct surface drainage away from the well bore.

The visual impact of the proposed project on motorists traveling on Māmalahoa Highway will be mitigated by existing vegetation on the property. The colors of the new facility will be in natural hues that harmonize with the surrounding setting.

Long-term use of electrical energy to power the well pump and control building will be minor in scale and not require special conservation practices.

Since adverse impacts to the social and economic environment of the community are expected to be negligible, no mitigation measures would be necessary.

9. DETERMINATION AND SUPPORT FOR DETERMINATION

This EA demonstrates that the proposed action will have no significant adverse impact on the environment and that an Environmental Impact Statement is not warranted. A Finding of No Significant Impact (FONSI), therefore, is anticipated for this project.

The following findings and reasons, demonstrate that the proposed action will have no significant adverse impact on the environment based on the 13 significance criteria provided in HAR 11-200-12.

9.1 IRREVOCABLE COMMITMENT TO LOSS OR DESTRUCTION OF ANY NATURAL OR CULTURAL RESOURCE

Alternative plans were considered in determining the best concept for the proposed project and associated facilities in order to avoid or minimize environmental impacts. The proposed project would not result in significant loss or destruction of the area's natural and cultural resources.

9.2 CURTAILS THE RANGE OF BENEFICIAL USES OF THE ENVIRONMENT

The proposed project is identified in the *Villages of La'i'opua Water Master Plan* as a source for the water system to serve the Kamakana area. No other uses are planned for the project area. The proposed facilities would not curtail future beneficial uses of the land.

The proposed water transmission lines will be installed in existing County rights-of-way, which are intended to accommodate public roads and utilities.

9.3 CONFLICTS WITH THE STATE'S LONG-TERM ENVIRONMENTAL POLICIES OR GOALS AND GUIDELINES AS EXPRESSED IN CHAPTER 344, HRS, AND ANY REVISIONS THEREOF AND AMENDMENTS THERETO, COURT DECISIONS, OR EXECUTIVE ORDERS.

As demonstrated in Section 6.8, the proposed action is consistent with the state's long-term environmental policies and guidelines as expressed in HRS, Chapter 344.

9.4 SUBSTANTIALLY AFFECTS THE ECONOMIC OR SOCIAL WELFARE OF THE COMMUNITY OR STATE

The proposed project is expected to provide an essential utility that would stimulate and sustain growth in the community as well as create economic benefits in the Kona region. The construction activity associated with the proposed project will mobilize existing labor forces and generate an infusion of business and personal income into the local economy. No negative effects on the social welfare of the Kona community are anticipated.

9.5 SUBSTANTIALLY AFFECTS PUBLIC HEALTH

The proposed project would not result in the uncontrolled and unsupervised use of hazardous material or construction methodology that would detrimentally affect the area's public health and safety. Existing State DOH regulations are established to protect air and water quality. Construction noise will be minimized through compliance with HAR Chapter 11-46, Community Noise Control.

9.6 SUBSTANTIAL SECONDARY IMPACTS, SUCH AS POPULATION CHANGES OR EFFECTS ON PUBLIC FACILITIES

The proposed project will provide a basic service for the planned Kamakana Project and other DWS customers in North Kona. To that effect, the proposed project is not intended to have substantial secondary impacts such as population changes or effects on public facilities.

9.7 INVOLVES A SUBSTANTIAL DEGRADATION OF ENVIRONMENTAL QUALITY

The proposed project will occupy only a portion of the State property leaving a substantial area unaltered. The new production facility will be unmanned so no constant human activity will take place at the site; only regular monitoring and periodic maintenance will occur. The proposed facilities will be designed to harmonize with the land, and the area's dense vegetation will continue to provide visual screens for the surrounding properties.

9.8 IS INDIVIDUALLY LIMITED BUT CUMULATIVELY HAS CONSIDERABLE EFFECT UPON THE ENVIRONMENT OR INVOLVES A COMMITMENT FOR LARGER ACTION

The current design of Keōpū Well #4 and associated equipment represents the complete facility. No expansion plans or additions are being contemplated.

9.9 SUBSTANTIALLY AFFECTS A RARE, THREATENED, OR ENDANGERED SPECIES, OR ITS HABITAT

Field surveys of the area's existing natural resources indicate that no federal- or state-listed rare, threatened, or endangered wildlife or flora species will be negatively affected by the proposed project.

9.10 DETRIMENTALLY AFFECTS AIR OR WATER QUALITY OR AMBIENT NOISE LEVELS

The anticipated impacts associated with the project's construction, such as fugitive dust, noise, and erosion and sedimentation, are short-term and temporary. These impacts would be minimized by the implementation of BMPs and mitigation measures in accordance with applicable laws, statutes, ordinances, as well as rules and regulations of the federal, state, and county governments.

Long-term operations of the proposed project are expected to generate minor or no impacts on air quality, water quality or ambient noise levels. The unmanned facility will have minimal human operations and heavy machinery on the property.

9.11 AFFECTS OR IS LIKELY TO SUFFER DAMAGE BY BEING LOCATED IN AN ENVIRONMENTALLY SENSITIVE AREA SUCH AS A FLOOD PLAIN, TSUNAMI ZONE, BEACH, EROSION-PRONE AREA, GEOLOGICALLY HAZARDOUS LAND, ESTUARY, FRESH WATER, OR COASTAL WATERS

The Keōpū Well #4 and associated facilities are located more than 2.5 miles from the shoreline. The proposed project will not affect or be affected by high surf and tsunami inundation. Groundwater is typically connected to the coastal and shoreline resources including estuaries, natural ponds, and coastal waters. Studies, groundwater working groups, and groundwater monitoring are ongoing to attain a fuller understanding of the dynamics and condition of the groundwater resource in the Keauhou Aquifer System. Forest City Hawai‘i is participating in these government and community efforts to minimize groundwater impacts.

A natural, intermittent drainage way traverses the property, but will not significantly affect well operations, except for interrupting passage through the access road during flood events. The Keōpū Well #4 and reservoir will be constructed on high ground, and the service driveway and pipeline connecting the two facilities on either side of the drainage way will be designed to accommodate floodwaters without washing out. Planned re-landscaping will mitigate any erosion-prone areas around the new facilities.

9.12 SCENIC VISTAS AND VIEW PLANES IDENTIFIED IN COUNTY OR STATE PLANS OR STUDIES

The Keōpū Well #4 and associated facilities will be located more than 280 feet above Māmalahoa Highway and out of view from traveling motorists on the County right of way. No scenic vistas or view planes, identified by public plans, will be adversely impacted.

9.13 REQUIRES SUBSTANTIAL ENERGY CONSUMPTION

The proposed project will require little electrical energy to operate. Use of the public utility would not result in a significant drain on the power supply for the County.

THIS PAGE WAS INTENTIONALLY LEFT BLANK

10. REFERENCES

AccuWeather 2014. URL: http://www.accuweather.com/en/weather-news/hurricane-iselle-to-impact-haw/31586142

American Ornithologist's Union. 1998. *Check-list of North American Birds*. 7th edition. AOU. Washington D.C. 829pp.

American Ornithologist's Union. 2000. Forty-second supplement to the American Ornithologist's Union Check-list of North American Birds. *The Auk* 117:847-858.

Banks, R. C., C. Cicero, J. L. Dunn, A. W. Kratter, P. C. Rasmussen, J. V. Remsen, Jr., J. D. Rising, and D. F. Stotz. 2002. Forty-third supplement to the American Ornithologist's Union Check-list of North American Birds. *The Auk* 119:897-906.

Banks, R. C., C. Cicero, J. L. Dunn, A. W. Kratter, P. C. Rasmussen, J. V. Remsen, Jr., J. D. Rising, and D. F. Stotz. 2003. Forty-fourth supplement to the American Ornithologist's Union Check-list of North American Birds. *The Auk* 120:923-931.

Banks, R. C., C. Cicero, J. L. Dunn, A. W. Kratter, P. C. Rasmussen, J. V. Remsen, Jr., J. D. Rising, and D. F. Stotz. 2004. Forty-fifth supplement to the American Ornithologist's Union Check-list of North American Birds. *The Auk* 121:985-995.

Banks, R. C., C. Cicero, J. L. Dunn, A. W. Kratter, P. C. Rasmussen, J. V. Remsen, Jr., J. D. Rising, and D. F. Stotz. 2005. Forty-sixth supplement to the American Ornithologist's Union Check-list of North American Birds. *The Auk* 122:1031-1031.

Banks, R. C., C. Cicero, J. L. Dunn, A. W. Kratter, P. C. Rasmussen, J. V. Remsen, Jr., J. D. Rising, and D. F. Stotz. 2006. Forty-seventh supplement to the American Ornithologist's Union Check-list of North American Birds. *The Auk* 123:926-936.

Banks, R. C., C. R. Terry Chesser, C. Cicero, J. L. Dunn, A. W. Kratter, I. J. Lovette, P. C. Rasmussen, J. V. Remsen, Jr., J. D. Rising, and D. F. Stotz. 2007. Forty-eighth supplement to the American Ornithologist Union Check-list of North American Birds. *The Auk* 124:1109-1115.

Banks, R. C., C. R. Terry Chesser, C. Cicero, J. L. Dunn, A. W. Kratter, I. J. Lovette, P. C. Rasmussen, J. V. Remsen, Jr., J. D. Rising, and D. F. Stotz, and K. Winker. 2008. Forty-ninth supplement to the American Ornithologist Union Check-list of North American Birds. *The Auk* 125:758-768.

Bonaccorso, F. J., C. M. Todd and, A. C. Miles. 2005. *Interim Report on Research to Hawaiian Bat* Research Consortium for The Hawaiian Hoary Bat, Opeʻapeʻa, Lasiurus cinsereus semotus. 1 September 2004 to 31 August 2005.

Bonaccorso, F. J., C. M. Todd and, A. C. Miles. 2007. *Interim Report on Research to the Hawaiian Bat* Research Consortium for The Hawaiian Hoary Bat, Opeʻapeʻa, Lasiurus cinsereus semotus. April 1, 2007.

Chesser, R. T., R. C. Banks, F. K. Barker, C. Cicero, J. L. Dunn, A. W. Kratter, I. J. Lovette, P. C. Rasmussen, J. V. Remsen, Jr., J. D. Rising, and D. F. Stotz, and K. Winker. 2009. Fiftieth supplement to the American Ornithologist Union Check-list of North American Birds. *The Auk* 126:1-10.

Chesser, R. T., R. C. Banks, F. K. Barker, C. Cicero, J. L. Dunn, A. W. Kratter, I. J. Lovette, P. C. Rasmussen, J. V. Remsen, Jr., J. D. Rising, and D. F. Stotz, and K. Winker. 2010. Fifty-first supplement to the American Ornithologist Union Check-list of North American Birds. *The Auk* 127:726-744.

Chesser, R. T., R. C. Banks, F. K. Barker, C. Cicero, J. L. Dunn, A. W. Kratter, I. J. Lovette, P. C. Rasmussen, J. V. Remsen, Jr., J. D. Rising, and D. F. Stotz, and K. Winker. 2011. Fifty-second supplement to the American Ornithologist Union Check-list of North American Birds. *The Auk* 128:600-613.

Chesser, R. T., R. C. Banks, F. K. Barker, C. Cicero, J. L. Dunn, A. W. Kratter, I. J. Lovette, P. C. Rasmussen, J. V. Remsen, Jr., J. D. Rising, and D. F. Stotz, and K. Winker. 2012. Fifty-third supplement to the American Ornithologist Union Check-list of North American Birds. *The Auk* 129: 573-588.

Chesser, R. T., R. C. Banks, F. K. Barker, C. Cicero, J. L. Dunn, A. W. Kratter, I. J. Lovette, P. C. Rasmussen, J. V. Remsen, Jr., J. D. Rising, and D. F. Stotz, and K. Winker. 2013. Fifty-fourth supplement to the American Ornithologist Union Check-list of North American Birds. *The Auk* 130: 558:571.

Church, J.A., P.U. Clark, A. Cazenave, J.M. Gregory, S. Jevrejeva, A. Levermann, M.A. Merrifield, G.A. Milne, R.S. Nerem, P.D. Nunn, A.J. Payne, W.T. Pfeffer, D. Stammer and A.S. Unnikrishnan, 2013: Sea Level Change. In: *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

County of Hawai‘i, 2005. *County of Hawai‘i General Plan.* URL: http://www.cohplanningdept.com/wp-content/uploads/2013/01/GP2005AmendthruOrd12-089.pdf

CPHC (Central Pacific Hurricane Center) 2013. *The 1958 Central Pacific Tropical Cyclone Season.* National Weather Service. URL: http://www.prh.noaa.gov/cphc/summaries/1958.php#TD

CWRM (Commission on Water Resource Management) 2008. *Hawaii Water Plan: Water Resource Protection Plan.* Prepared by Wilson Okamoto Corp., 1907 S. Beretania St., Suite 400, Honolulu, HI. June 2008. 556 p. URL: http://files.hawaii.gov/dlnr/cwrm/planning/wrpp2008update/FINAL_WRPP_20080828.pdf

David, R. E. 2006. *Keōpū-Pu‘uhonua Production Well and Reservoir Site Biological Reconnaissance Survey.* Prepared for: Planning Solutions, Inc., and the Hawai‘i, County Department of Water Supply.

David, R. E. 2014. *Unpublished field notes* – Hawai‘i 1980 - 2014.

DBEDT (State of Hawai‘i Dept. of Business, Economic Development, and Tourism) 2012. *2012 State of Hawai‘i Data Book.*, Section 23, Domestic Trade and Services. URL: http://dbedt.hawaii.gov/economic/databook/db2012/

DLNR (Department of Land and Natural Resources). 1998. *Indigenous Wildlife, Endangered and Threatened Wildlife and Plants, and Introduced Wild Birds.* Department of Land and Natural Resources. State of Hawaii. Administrative Rule §13-134-1 through §13-134-10, dated March 02, 1998.

Engott, J.A., 2011, A water-budget model and assessment of groundwater recharge for the Island of Hawai‘i: U.S. Geological Survey Scientific Investigations Report 2011–5078, 53 p.

Halpern, M., and P. Rosendahl. 1996. Archaeological Reconnaissance Survey, Keopuolani Estates Access Road. Land of Hienaloli 1, North Kona District, Island of Hawai‘i (TMK:7-5-13:13 and 22). PHRI Report 1712-040396. Prepared for David Z. Arakawa, Attorney-at-Law.

HHFDC (State of Hawai‘i Housing Finance and Development Corporation) 2010. *Final Environmental Assessment: Keōpū Well, Reservoir, and Water Transmission Lines, Hienaloli 1-*

6, North Kona, Hawai'i. March 4, 2010, URL: http://health.hawaii.gov/oeqc, EA and EIS Library, 251 p.

HWMO (Hawai'i Wildfire Management Organization) 2014. URL http://www.hawaiiwildfire.org/hwmo-services.html

Kawachi, C. 1994. An Archaeological Survey for the Proposed Keopu-HFDC Exploratory Well No. 1. Hienaloli, North Kona, Hawaii Island.

IPCC, (2013) Annex I: Atlas of Global and Regional Climate Projections [van Oldenborgh, G.J., M. Collins, J. Arblaster, J.H. Christensen, J. Marotzke, S.B. Power, M. Rummukainen and T. Zhou (eds.)]. In: *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Macdonald, G.A., A.T. Abbott, and F.L. Peterson, 1983. *Volcanoes in the Sea: The Geology of Hawaii, 2nd Edition*. University of Hawai'i Press, Honolulu, HI, 517 p.

Mink, J.F. and L.S. Lau, 1993. *Aquifer Identification and Classification for the Island of Hawai`i: Groundwater Protection Strategy for Hawai`i,* Technical Report Number 191, May 1993, Water Resources Research Center, University of Hawai`i at Manoa, Honolulu, Hawaii 96822. 116 p.

Pukui , M. K., S. H. Elbert, and E. T. Mookini 1976. *Place Names of Hawaii*. University of Hawaii Press. Honolulu, Hawai'i. 289 pp.

U.S. Census Bureau, 2013, *Gazetteer by Zip Code,* URL: http://www.census.gov/geo/maps-data/data/gazetteer.html

USFWS (U.S. Fish & Wildlife Service). 2005a. *Endangered and Threatened Wildlife and Plants*. 50CFR 17:11 and 17:12 (Tuesday, November 1, 2005).

———, 2005b. 50 CFR 17. *Endangered and Threatened Wildlife and Plants. Review of Species That are Candidates or Proposed for Listing as Endangered or Threatened; Annual Notice of Findings on Resubmitted Petition; Annual Description of Progress on Listing Actions*. Federal Register, 70 (90; Wednesday, May 11, 2005): 24870-24934.

———, 2014. USFWS *Environmental Conservation Online System* URL: http://ecos.fws.gov/tess_public/StateListing.do=HI&status=listed. Last accessed February 26. 2014.

Whistler, A. 2008. *Botanical Survey of the Keahuolu Affordable Housing Project Proposed Well Site, North Kona, Island of Hawai'i.* Report prepared for Belt Collins Hawai'i, Ltd., January 2008. 15 p.

Wilson, D.E., and D. M. Reeder, (Editors), 2005. *Mammal species of the world: a taxonomic .and geographic reference*. 3rd edition. 2 vols. John Hopkins University Press. Baltimore, Maryland. 2142 pp.

Yent, M. 1991. Archaeological Reconnaissance Survey: Hienaloli 1st, North Kona, Island of Hawaii (TMK:7-5-13:13 and 22). Division of State Parks, Department of Land and Natural Resources. Prepared for Division of Forestry and Wildlife, Department of Land and Natural Resources.

———, 1999. Archaeological Inspection of Proposed Well Site (Keopu-HFDC Exploratory Well No. 1), Hienaloli 1st, North Kona, Island of Hawaii (TMK:7-5-13:22). Division of State Parks, Department of Land and Natural Resources. Prepared for Division of Forestry and Wildlife, Department of Land and Natural Resources.

THIS PAGE WAS INTENTIONALLY LEFT BLANK

11. CONSULTATION & DISTRIBUTION

Copies of this Draft Environmental Assessment are being distributed to the parties listed in Table 11.1.

Table 11.1. Draft EA Distribution List

State Agencies	**County of Hawai‘i**
Office of Environmental Quality Control (2 HC, 1 CD)	Planning Department (1 HC, 1 CD)
Department of Agriculture	Department of Water Supply
Department of Accounting and General Services	Department of Public Works
Department of Business, Economic Development, and Tourism (DBEDT)	Department of Research and Development
DBEDT - Energy Division	Department of Environmental Management
DBEDT – Office of Planning	Department of Parks & Recreation
Department of Defense	County of Hawai‘i Fire Department
Department of Education	County of Hawai‘i Police Department
Department of Hawaiian Home Lands	**Elected Officials**
Environmental Planning Office, Department of Health	U.S. Senator Brian Schatz
Clean Air Branch, Department of Health	U.S. Senator Mazie Hirono
Clean Water Branch, Department of Health	US Representative Colleen Hanabusa
Safe Drinking Water Branch, Dept. of Health	US Representative Tulsi Gabbard
Wastewater Branch, Department of Health	State Senator Josh Green
Department of Human Services	State Senator Malama Solomon
Department of Labor and Industrial Relations	State Representative Richard Creagan
Department of Land and Natural Resources (DLNR)	State Representative Nicole Lowen
DLNR Historic Preservation Division	State Representative Cindy Evans
DLNR Commission on Water Resource Management	Mayor Billy Kenoi
Department of Transportation – Highway Division	County Councilmember Brenda Ford (District 6)
Hawaii Housing Finance and Development Corp.	County Councilmember Dru Mamo Kanuha (District 7)
Office of Hawaiian Affairs	County Councilmember Karen Eoff (District 8)
UH Environmental Center	Kona Community Development Plan Action Committee
Federal Agencies	**Libraries and Depositories**
US Army Corps of Engineers	Hawai‘i State Library Hawai‘i Documents Center
US Geological Survey, Pacific Islands Water Science Center	Kailua-Kona Public Library
US Fish and Wildlife Service	Kealakekua Public Library
US National Park Service, Kaloko Honokohau NHP	**News Media**
US Department of Transportation (Federal Transit Administration)	West Hawai‘i Today
US Environmental Protection Agency	Hawai‘i Tribune Herald
Utility Companies	**Other**
Hawaiian Telcom	Queen Lili‘uokalani Trust
Hawai‘i Gas	
Hawai‘i Electric Light Company, Inc.	
Source: Compiled by Planning Solutions, Inc. (2014)	

THIS PAGE WAS INTENTIONALLY LEFT BLANK

A. IMPACT OF THE USE OF HIGH LEVEL GROUNDWATER ON THE BASAL LENS IN THE KEAUHOU AQUIFER

THIS PAGE WAS INTENTIONALLY LEFT BLANK

Impact of the Use of High Level Groundwater on the Basal Lens in the Keauhou Aquifer

Prepared for:

Hawaii Leeward Planning Conference
P. O. Box 2159
Kamuela, Hawaii 96738

Prepared by:

Tom Nance Water Resource Engineering
560 N. Nimitz Hwy. - Suite 213
Honolulu, Hawaii 96817

July 2014

EXECUTIVE SUMMARY

Using monitoring data of North Kona groundwater that TNWRE has compiled, this report addresses whether or not impacts to basal groundwater have occurred as a result of pumping the six high level groundwater wells located above Mamalahoa Highway from Kalaoa to Waiaha. High level pumpage began in 1994 and is now at about 4.0 to 4.5 MGD (Figures 2 and 3 in the report).

The TNWRE monitoring data which address this question consists of continuous water level recording in the Kamakana well and time series salinity profiles in the Kamakana, Kaloko-2, Ooma Mauka, and Ooma Makai wells. The report presents and evaluates this data. Based on the water levels at the Kamakana Well and the salinity profiles at all four wells, no impact to basal groundwater as a result of high level groundwater pumpage has been identified to date.

A key unresolved issue is whether or not the high level groundwater actually drains into the nominally downgradient basal lens in the area between Keahole Point and Kailua Town. Evidence gathered to date suggests that at least some, if not most, of the high level groundwater actually flows at depth beneath the basal lens to discharge into the marine environment offshore. The anomalous characteristics of the basal lens suggest this: very low water levels relative to the actual ocean level; very high salinity; temperatures significantly lower than the high level groundwater; and increasing salinity in wells under modest pumping rates. The more compelling evidence is provided by the discovery of fresh water under artesian pressure at depth below the basal lens in the Keopu and Kamakana deep monitor wells. If leakage of high level groundwater into the basal lens is limited to the modest amounts that evidence collected to date suggests, then the foreseeable future increases in pumpage of high level groundwater will have little or no impact on the basal lens.

With the unresolved issue of high level groundwater leaking into or passing beneath the basal lens, monitoring for potential impacts to basal groundwater going forward should be continued and even expanded. This expansion should include deepening the Kaloko-2 well so that possible changes to the thickness of the basal lens at this location can be tracked.

Table of Contents

List of Figures

List of Figures
(continued)

List of Tables

INTRODUCTION

This report has been prepared in response to a petition by the National Park Service (NPS) to the State Commission on Water Resource Management to designate the Keauhou Aquifer as a Groundwater Management Area. The petition asserts that present or planned future use of groundwater from the Keauhou Aquifer will reduce the flow of basal groundwater through Kaloko Honokohau (KAHO) National Historical Park, thereby causing harm to KAHO's anchialine ponds and its nearshore marine environment.

This report contains data from monitoring and production wells as compiled by Tom Nance Water Resource Engineering (TNWRE) to assess whether or not an impact to the basal lens has occurred due to ongoing groundwater use. It also presents an opinion as to whether or not the present level of monitoring can provide sufficient information to evaluate groundwater impacts as the future use of groundwater increases over present levels.

GROUNDWATER OCCURRENCE AND USE IN THE KEAUHOU AQUIFER

Prior to 1990, it was commonly assumed that all groundwater in the Keauhou Aquifer was basal, that is a lens of fresh and brackish water floating on saline groundwater beneath it and in dynamic equilibrium with the ocean along the shoreline. At that time, the Hawaii County Department of Water Supply (DWS) was operating six basal wells, all located in the southern part of the aquifer (shown in red on Figure 1 and listed in Table 1) and was pumping about eight (8) million gallons per day (MGD). Groundwater use by others everywhere else in the aquifer was quite modest. It amounted to pumping brackish wells at Keauhou to supplement the supply of a treated wastewater used to irrigate the Kona Country Club golf courses and use of saline groundwater for aquaculture at NELHA at Keahole Point.

In 1990, first at Keauhou Well 2 (State No. 3355-01) and soon after at the Kalaoa Well (No. 4358-01), high level groundwater was discovered. High level groundwater stands much higher above sea level than basal groundwater. Unlike basal groundwater which is subject to increasing salinity if it is overpumped, the subsurface geologic control which creates the high level groundwater also protects it from salinity intrusion in response to pumping.

As shown on Figure 2, use of high level groundwater in the Keauhou Aquifer began in 1994 with the Kalaoa Well and now includes six wells pumping between 4.0 and 4.5 MGD. All six of these wells are in the northern part of the aquifer in the area from Kalaoa to Waiaha (their locations are shown in blue on Figure 1). Use of high level groundwater has enabled DWS to reduce pumping its basal wells (Figure 3). Prior to this, DWS' basal pumpage at eight or more MGD was causing salinity issues.

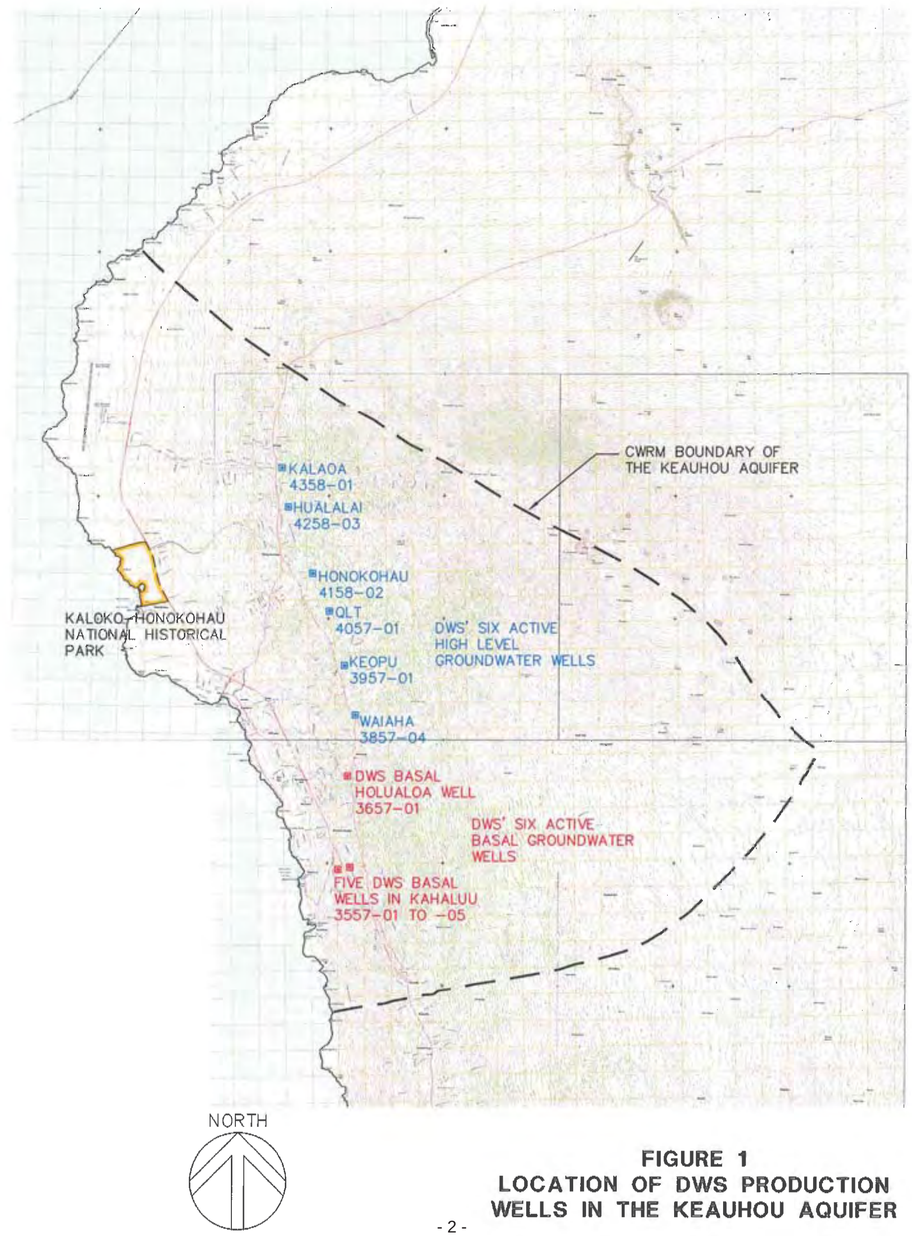


FIGURE 1
LOCATION OF DWS PRODUCTION WELLS IN THE KEAUHOU AQUIFER

Table 1

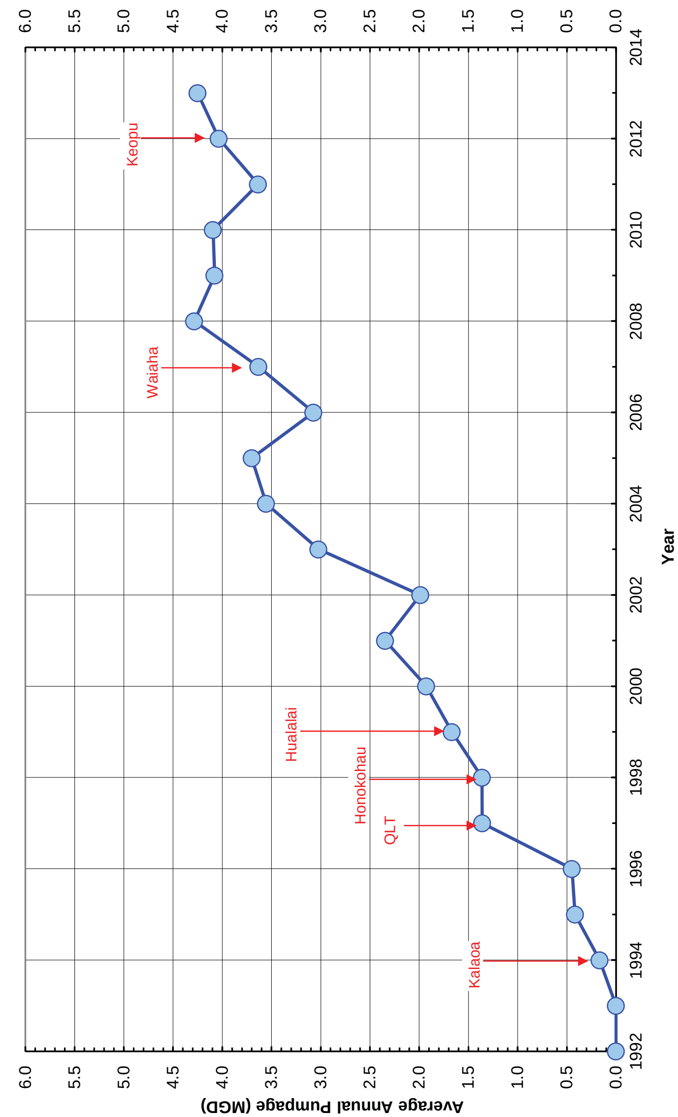
Pumpage by DWS Basal and High Level Wells

Well		Average Annual Pumpage (MGD)		
State No.	Name	1990	1994	2013
Basal Wells				
3557-05	Kahaluu Shaft	4.737	5.614	4.234
3557-01	Kahaluu A	0.807	0.777	0.686
3557-02	Kahaluu B	0.992	1.050	0.514
3557-03	Kahaluu C	0.491	0.713	0.747
3557-04	Kahaluu D	0.672	0.952	0.330
3657-01	Holualoa	0.491	0.324	0.000
	Total for Basal Wells	8.190	9.430	7.040
High Level Wells				
4358-01	Kalaoa	--	0.168	0.889
4057-01	QLT	--	--	1.299
4158-02	Honokohau	--	--	1.648
4258-03	Hualalai	--	--	0.000
3857-04	Waiaha	--	--	0.529
3957-01	Keopu	--	--	0.415
	Total for High Level	0.000	0.168	4.251

Note: All pumpage data provided by DWS.

o:_14-26

Figure 2. Average Pumpage of High Level Groundwater by DWS from Kalaoa to Keopu and Years Each of the High Level Wells was Brought On Line



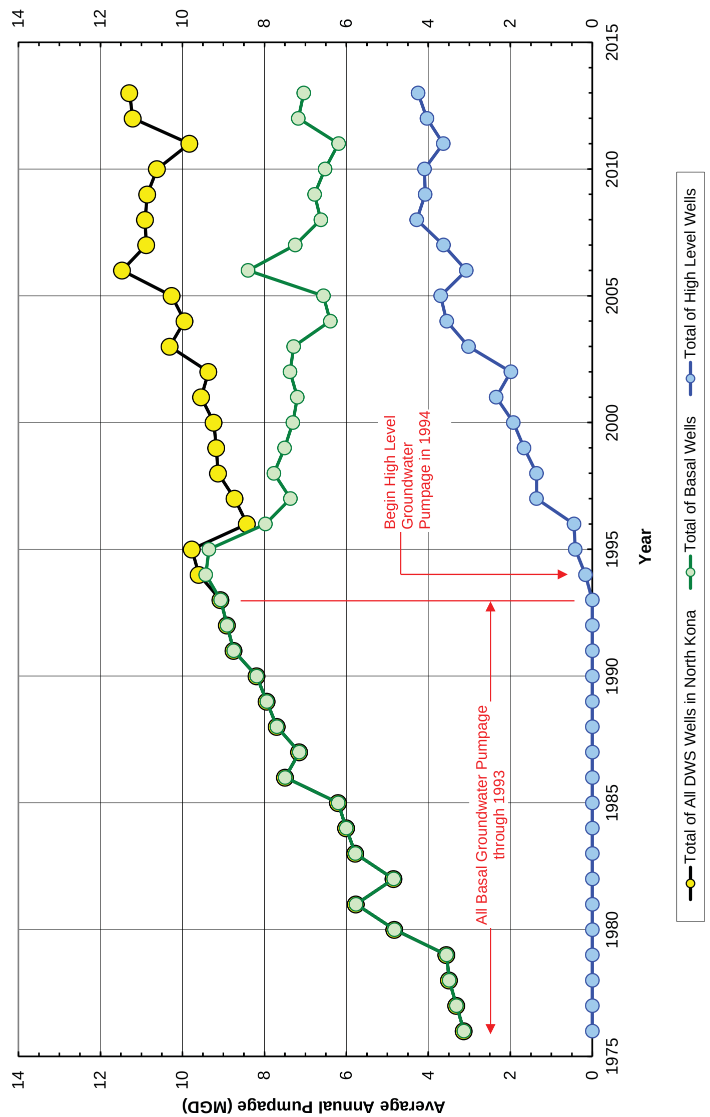


Figure 3. Pumpage of DWS Wells in North Kona from 1976 through 2013

HYDROLOGIC CONNECTION BETWEEN INLAND HIGH LEVEL GROUNDWATER AND THE NOMINALLY DOWNGRADIENT BASAL LENS

The subsurface geology that creates the high level groundwater is not known for certain, but the most likely explanation appears to be a series of poorly permeable lava flows that are in aggregate at least tens and possibly hundreds of feet thick. The information presented in the paragraphs below are the basis for this statement.

Findings of Two Deep Monitor Wells

Two deep monitor wells, Keopu (No. 3858-01) and Kamakana (No. 3959-01), have encountered fresh water under artesian pressure at depth below the basal lens and the saline groundwater below the lens (the locations of these two wells are shown on Figure 4). The comparative salinity and temperature profiles before and after encountering the fresh water at depth in the Kamakana Well illustrate this (Figures 5 and 6). Of particular note is the temperature decline and then reversal with depth in the saline groundwater zone. In combination with the unvarying salinity 500 to 950 feet below sea level, these data identify the strata confining the freshwater at depth (Figure 7). These results suggest that at least some, if not most, of the high level groundwater is flowing beneath the confining layers to the ocean at depth offshore rather than into and through the basal lens.

Anomalous Temperature, Salinity, and Water Levels of Basal Groundwater Between Keahole Point and Kailua Town

If all or even most of the high level groundwater is flowing into the nominally downgradient basal lens, this flow would constitute, by far, the largest component of recharge to the basal lens. It would be expectable that water levels in the lens would be at least two to three feet above the actual ocean level, that salinities would be of at least irrigation (brackish) quality, that salinities would be stable under at least moderate rates of pumping, and that basal water temperatures would be similar to the temperatures of the high level groundwater. In fact, basal groundwater between Keahole Point and Kailua Town exhibits none of these characteristics. Instead, occurrence of the basal groundwater can be characterized as follows:

- Based on a density analysis of the salinity profile in the Kamakana Well (Figure 5 prior to encountering fresh water at depth), the water level in the basal lens at this location is no more than 0.4 feet above the actual ocean level.

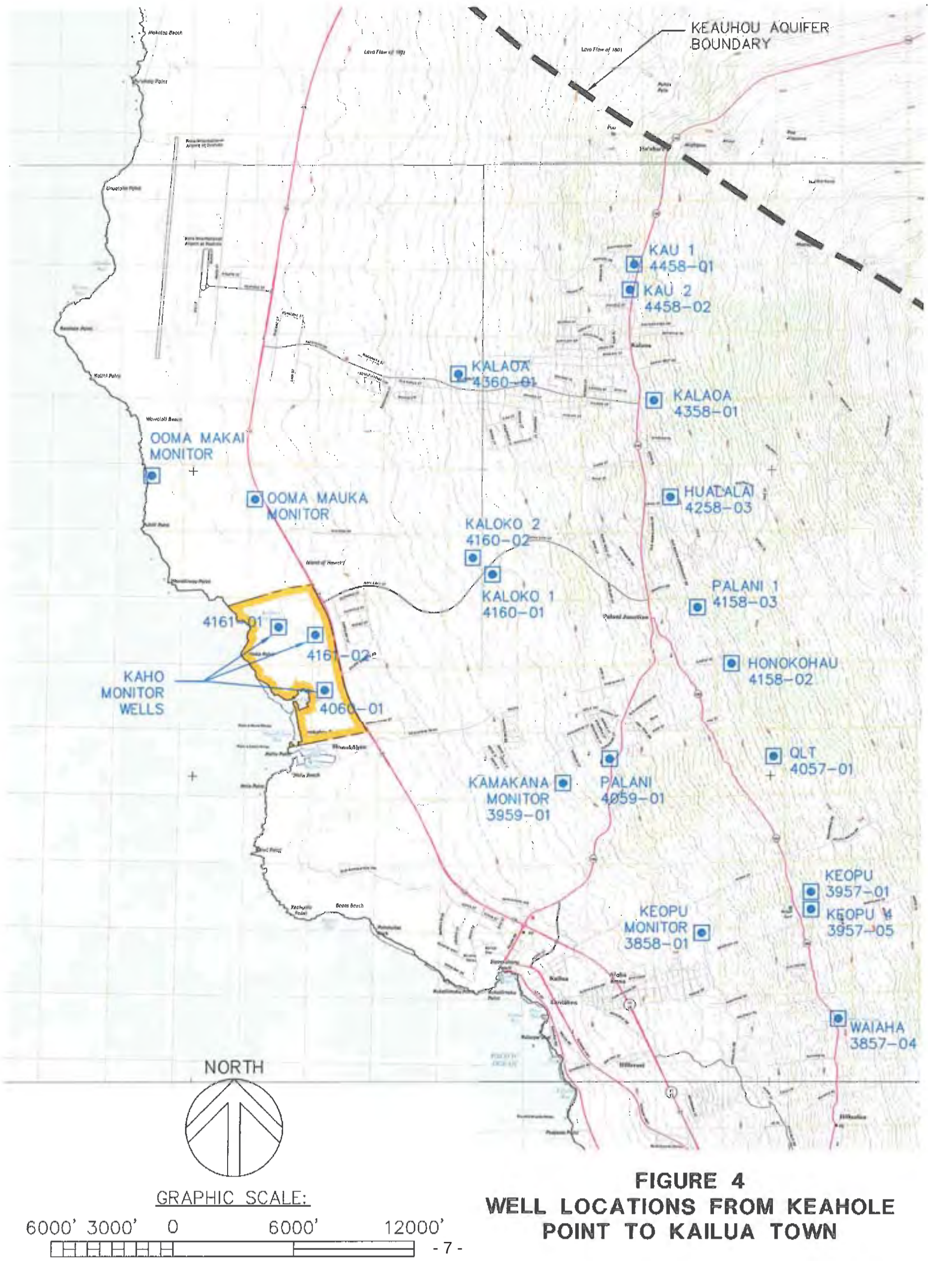


FIGURE 4
WELL LOCATIONS FROM KEAHOLE POINT TO KAILUA TOWN

Figure 5. Salinity and Temperature Profile through the Water Column of the Kamakana Monitor Well on April 3, 2010 Prior to Encountering Fresh Water at Depth

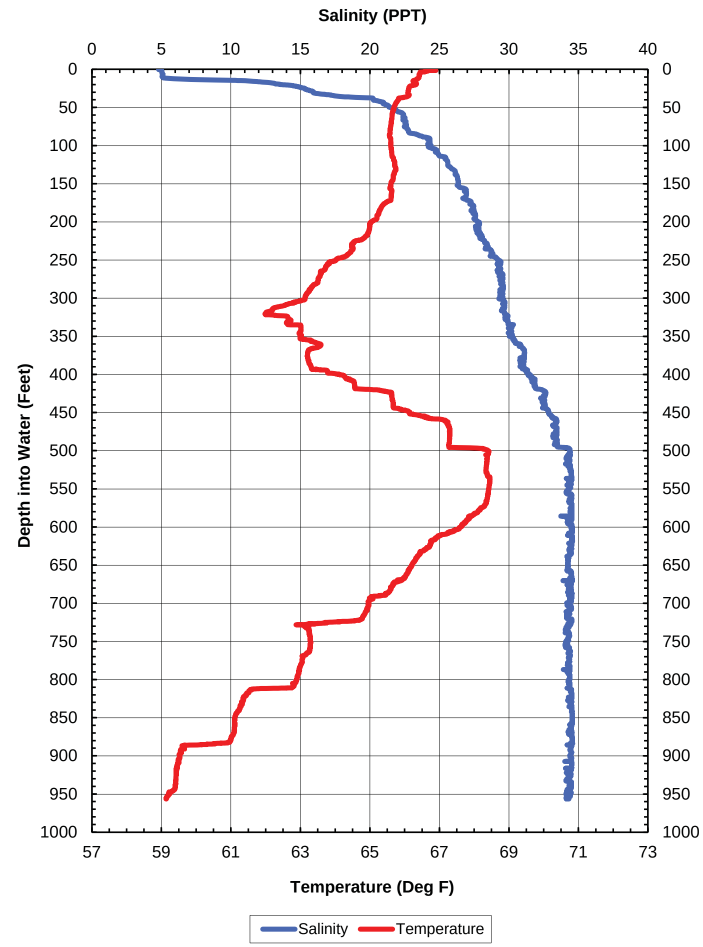


Figure 6. Profile through the Water Column of the Kamakana Monitor Well on May 12, 2010 After Encountering Fresh Water at Depth

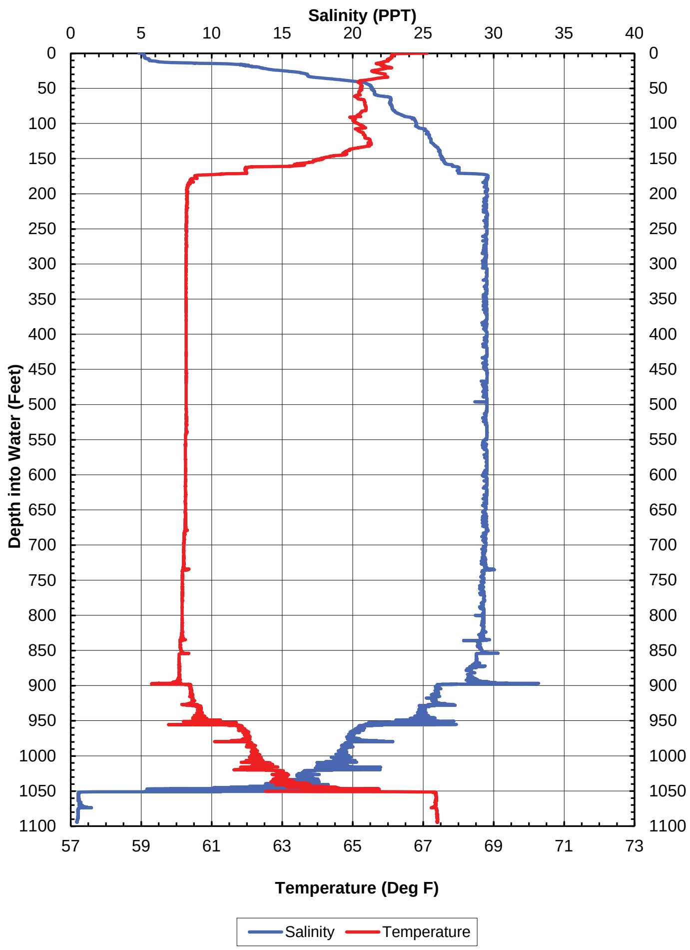
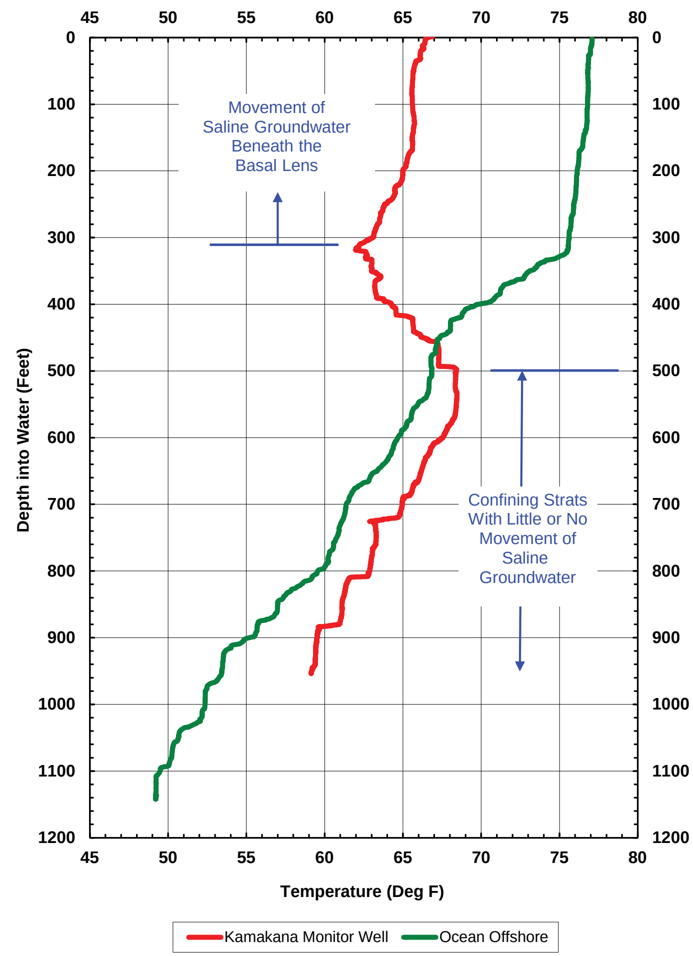


Figure 7. Temperature in Saline Groundwater Below the Basal Lens at the Kamakana Monitor Well



- There are no successful salinity-dependent production wells in the basal lens between Keahole Point and Kailua Town. The very high and unstable salinity at very modest pumping rates in Palani Well (No. 4059-01), which is located 2.6 miles in from the shoreline, is a prime example of this. Results of the Kaloko 1 and Kaloko 2 Wells (No. 4160-01 and -02) are similar examples
- Temperatures at the top of the basal lens are significantly colder than the high level groundwater and these temperatures decrease with depth (Table 2 and Figure 8).

Significance of the Natural Discharge of High Level Groundwater into or Beneath the Basal Lens

If recharge to basal groundwater included substantial leakage from the upgradient high level groundwater, then pumpage from the array of high level groundwater production wells shown on Figures 1 and 4 would ultimately reduce the flow in the basal lens, causing at least some decline in basal water levels and a gradual increase in salinity. In this case, a monitoring well network would be critical to detecting and quantifying the impact on the basal lens.

The discovery of fresh water at depth in the two deep monitor wells (Keopu and Kamakana) and characteristics of basal groundwater between Keahole and Kailua Town suggest that some or perhaps even most of the high level groundwater is not leaking into the basal lens but is instead flowing beneath the lens and discharging offshore along this section of the Keauhou Aquifer. If this interpretation ultimately proves to be the case, a monitoring well network would presumably document that little or no change to basal groundwater as a result of pumping the high level wells has occurred.

MONITORING WELL DATA COMPILED BY TNWRE

As shown on Figures 1 and 4, all six of DWS' active high level wells are located above Mamalahoa Highway and in a linear array from Kalaoa to Waiaha. Any impact to basal groundwater as a result of pumping these high level wells would most obviously occur in the area between Keahole Point to Kailua Town. If the high level groundwater is flowing into the basal lens, high level pumping would reduce the flowrate in the basal lens. Although the basal flowrate is not measurable directly, a reduction in its flowrate should be identifiable as a progressive lowering of the basal water level and/or as a progressive increase in salinity. Both would reflect a shrinking of the lens in response to a lesser flowrate through it. The sections following present monitoring data compiled by TNWRE which provide insight on whether such changes have been detected.

Table 2

Comparative Basal and High Level
Groundwater Temperatures

High Level

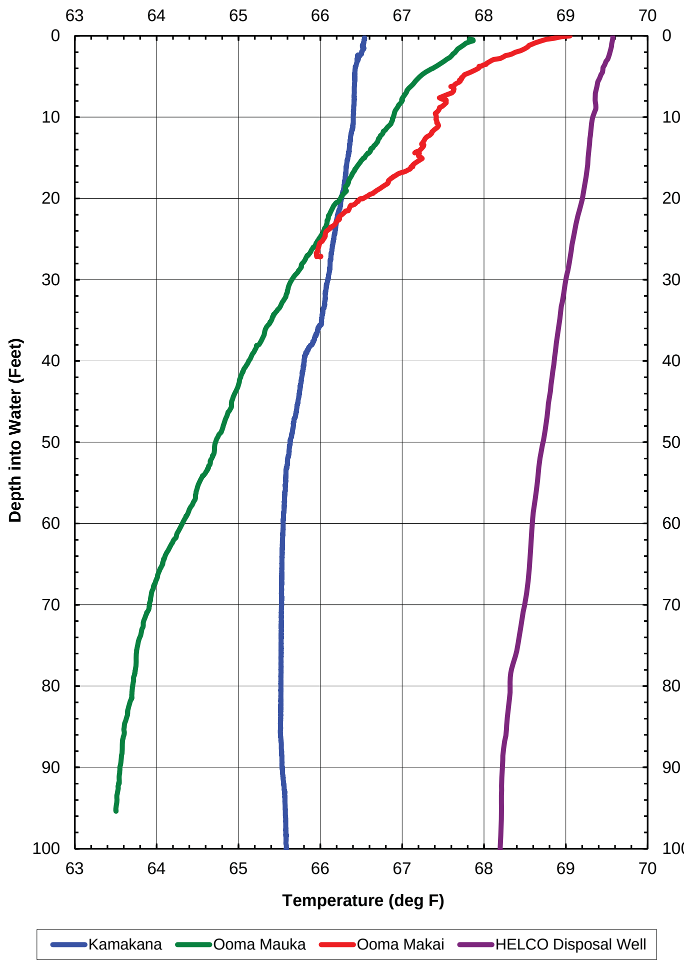
State No.	Name	Temperature (of)
3857-04	Waiaha	70.0
3858-01	Keopu Monitor's	69.8
3957-01	Keopu	70.0
4057-01	QLT	68.0
4158-02	Honokohau	70.3
4258-03	Hualalai	69.8
4358-01	Kalaoa	73.9

Basal

State No.	Name	Temperature (of)
3959-01	Kamakana	66.1
4059-01	Palani	67.5
4160-02	Kalako 2	64.7
- -	Ooma Mauka	67.1
- -	Ooma Makai	68.4

o:_14-26

Figure 8. Temperature Profiles in Basal Groundwater Between Keahole Point and Kailua Town



Continuous Water Level Recording of Basal Groundwater at the Kamakana Monitor Well

As shown on Figure 4, the Kamakana Monitor Well (State No. 3959-01) is located directly downgradient of DWS' Honokohau and QLT Wells (Nos. 4158-02 and 4057-01, respectively). These are the two most actively used of DWS' six high level production wells (refer back to Table 1 for their use rates). As such, the Kamakana Well is ideally situated to document a declining basal water level, should that be occurring. Water level recording in the Kamakana Monitor Well was begun in August 2011. Except for a 29-day period in August-September 2012, the record is continuous through April 2014. There are three issues which complicate an interpretation of this record. First, as can be expected for basal groundwater in a highly permeable formation, there is a substantial water level response to the ocean's semi-diurnal tide. Second, there are also substantial changes to the ocean's mean water level due to large scale meteorological events and these are reflected in corresponding changes in the mean groundwater levels. Third, the datum for the elevation benchmark used to measure water levels in the Kamakana Well is not from the same datum used by NOAA for its tide gage in Kawaihae Harbor. As described below, these complications can be sorted out to determine if the basal groundwater level has declined with respect to the actual ocean level over the recording period of the Kamakana Well.

- Figure 9 is a comparative plot of the Kamakana water level data and the ocean level as measured by NOAA at Kawaihae Harbor (Figure 9). Except for the obvious disconnect in elevation datums, the data are difficult to interpret as presented in this manner.
- The semi-diurnal ocean tide in both the NOAA and Kamakana data can be filtered out by calculating their respective moving 24-hour averages (24-MAV), making it easier to see that most of the changes in the mean groundwater level are the result of the changes in the mean ocean level (Figures 10 and 11).
- When these water levels are averaged over identical periods (either as averages of the data itself or as averages of the 24-MAVs), the data establish that no decline in the basal water level relative to the actual ocean level has occurred over the August 2011 through April 2014 period. In fact, there has been a slight and gradual rise of the basal water level relative to the ocean level over this period (tally below).

Comparative Mean Water Levels

Year	Kamakana Well (Feet MSL)	Kawaihae Tide (Feet MSL)	Height Difference (Feet)
2011 (Aug. thru Dec.)	3.2085	0.0913	3.1172
2012	3.1552	0.0187	3.1365
2013	3.2844	0.0986	3.1858
2014 (thru 4/30)	3.2352	-0.00.12	3.2364

Figure 9. Water Level in the Kamakana Monitor Well in Comparison to the Ocean Tide at Kawaihae Harbor

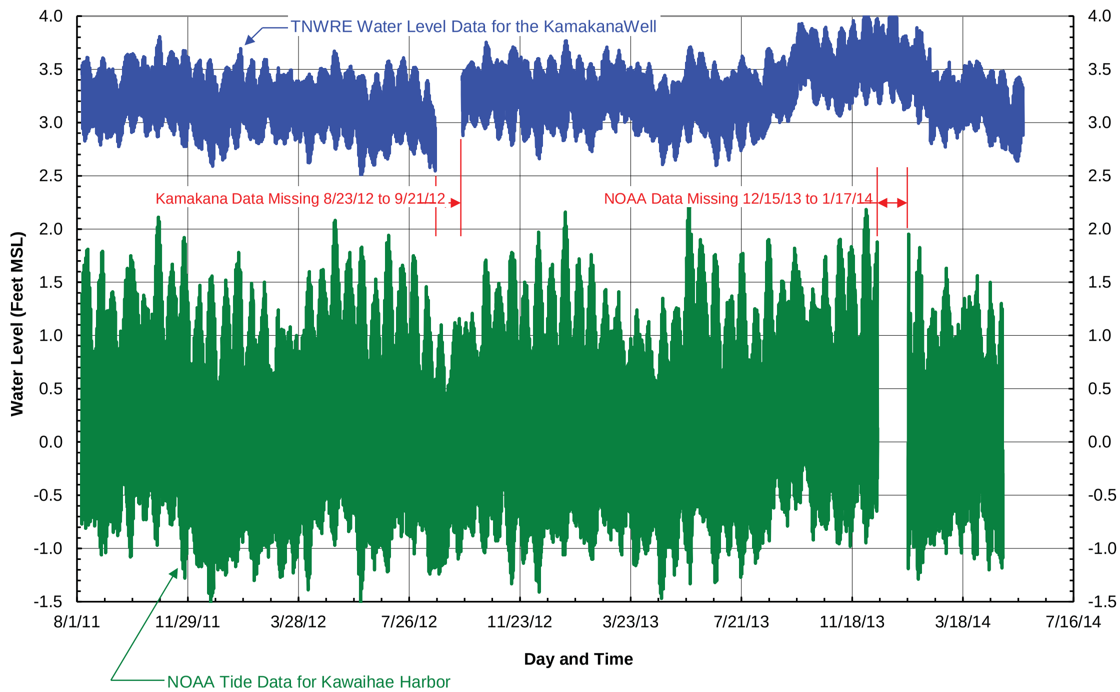


Figure 10. Filtering the Semi-Diurnal Tide Using the 24-MAV Statistic

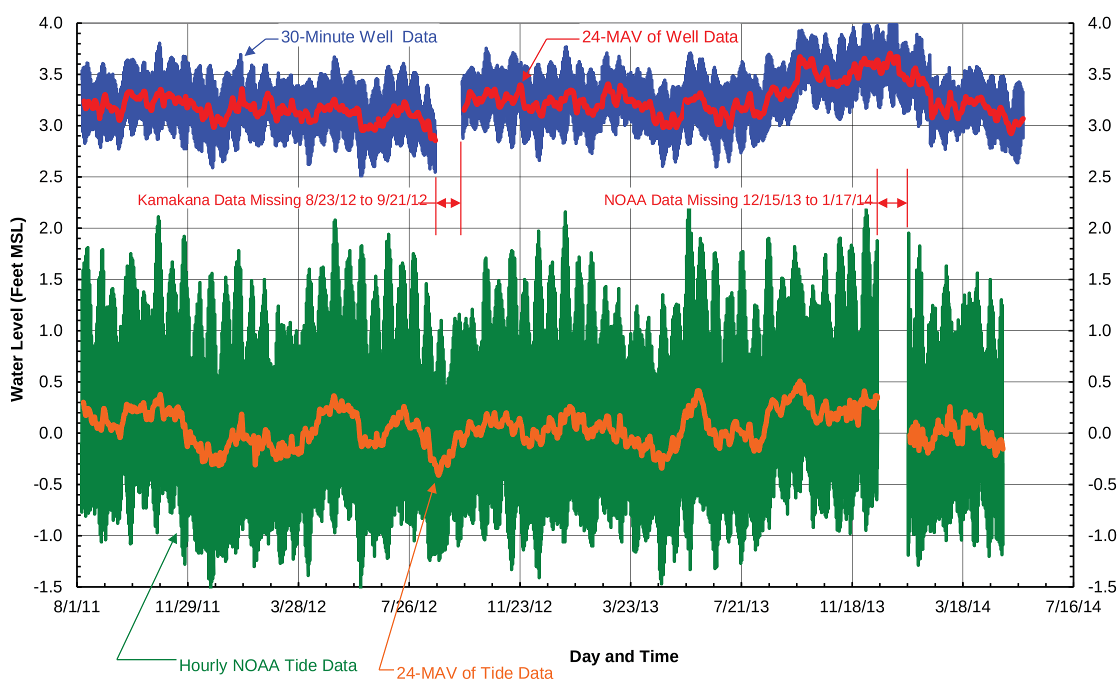
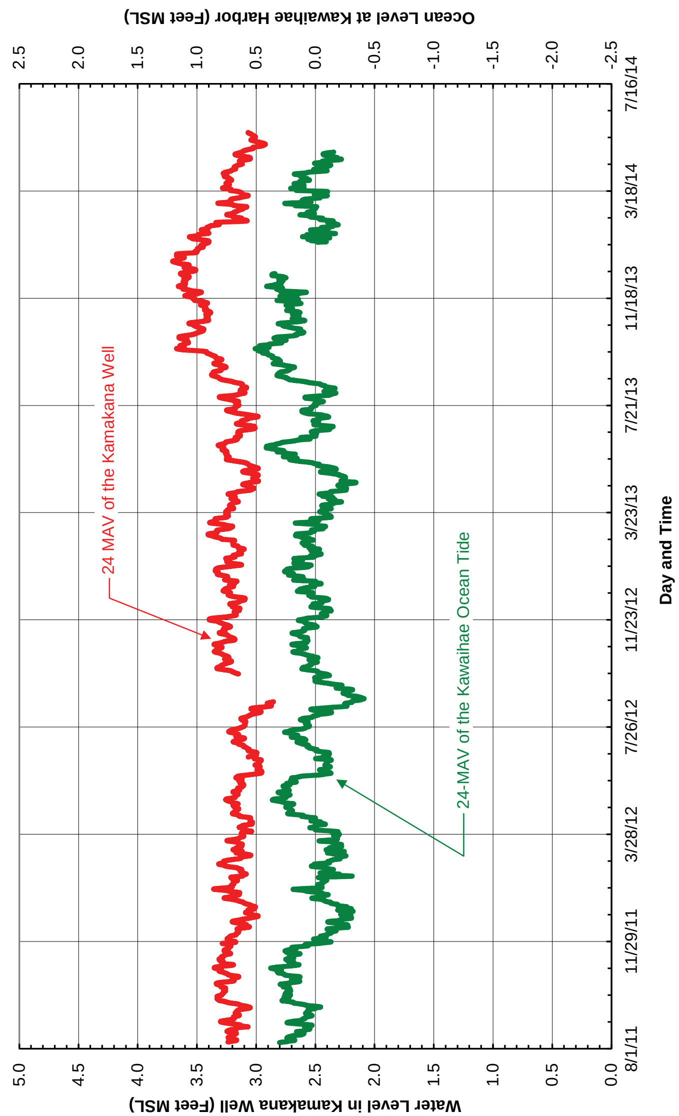


Figure 11. Comparison of the 24-MAVs of Water Levels in the Kamakana Monitor Well and at Kawaihae Harbor



Salinity Profiling to Track Changes in a Basal Lens

In nearshore areas with very permeable strata, mean water level changes in basal groundwater as a result of changes in the flowrate through the lens are very subtle and difficult to identify, particularly in comparison to the magnitude mean level changes resulting from the varying mean ocean level. Decades of monitoring by TNWRE have demonstrated that a far more effective way to monitor changes in basal groundwater is by a series of salinity profiles through the water columns of wells. The method is described below using results of the FG-2 monitor well in the Puuloa Sector of the very permeable Ewa limestone aquifer on Oahu.

- Using an instrument that records data at 10 times a second, a continuous salinity profile is made through the well's water column. A typical sigmoid salinity curve is obtained which depicts the brackish basal lens and the transition zone from the basal lens above the saline groundwater below (Figure 12). If a basal lens is shrinking due to a reduced flowrate, a time sequence of salinity profiles will shift to the right and shrink upwards over time.
- As shown on Figure 13, two indicators from the salinity profile are selected to track changes over time. For the FG-2 well, these indicators are the salinity at a depth of 10 feet into groundwater and the depth to the midpoint of the transition zone, defined for the FG-2 well as the depth where the salinity is 17.5 parts per thousand (PPT). 17.5 PPT is half of seawater's 35 PPT salinity. If the lens is shrinking due to a reduced flowrate, the salinity 10 feet into water would gradually increase and the depth to the midpoint of the transition zone would gradually decrease.
- The two indicators parameters are graphically arrayed over the 20-year record for FG-2 on Figure 14. Over that time, major changes to the aquifer are readily identified. Over this same 20-year period, TNWRE has recorded groundwater levels at a number of locations in the aquifer. Other than the dramatic impact of the November 1996 storm, the water level record over this 20 year period does not identify these changes as they are one to two orders of magnitude less than the effects of the varying mean ocean level.

<u>Salinity Profiling Results in the Kamakana Monitor Well</u>. Salinity profiling through the basal lens in the Kamakana Monitor Well has been done 22 times since April 2010. Figure 15 depicts the first (April 3, 2010) and most recent (May 22, 2014) profiles. Using as indicators the salinity ten feet into groundwater and the depth to the midpoint of the transition zone (ie. the depth at a salinity of 17.5 PPT), the series of results for the 22 profiles is presented on Figure 16. The salinity 10 feet into water at present is essentially the same as its level in April 2010. There has been a slight decrease in the depth to the midpoint of the transition zone, an aspect that bears watching during future monitoring.

Figure 12. Salinity and Temperature Profile through the Water Column of the FG-2 Monitor Well on May 4, 2014

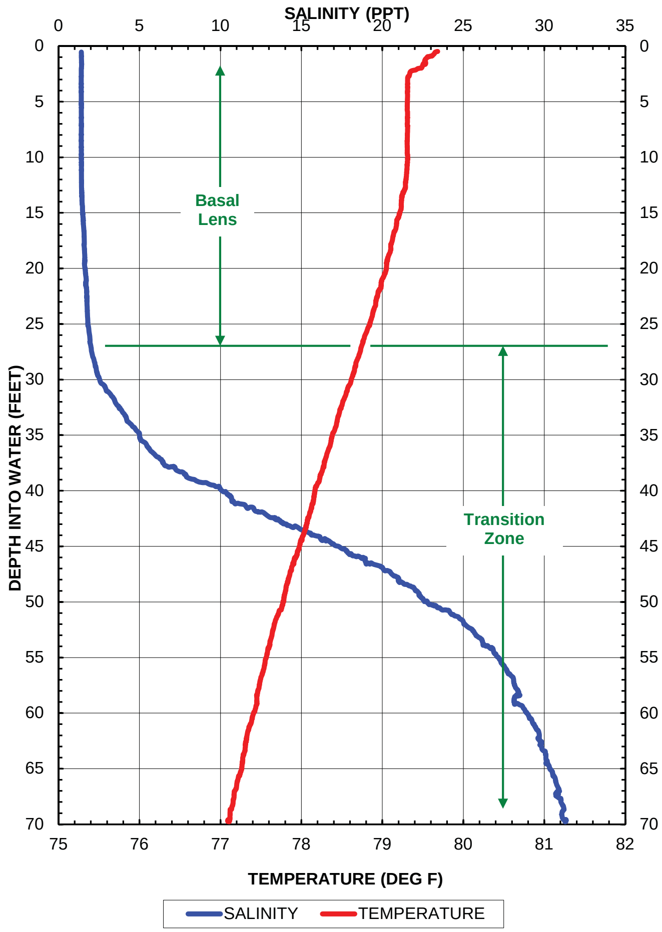


Figure 13. Salinity Profile Indicator Parameters

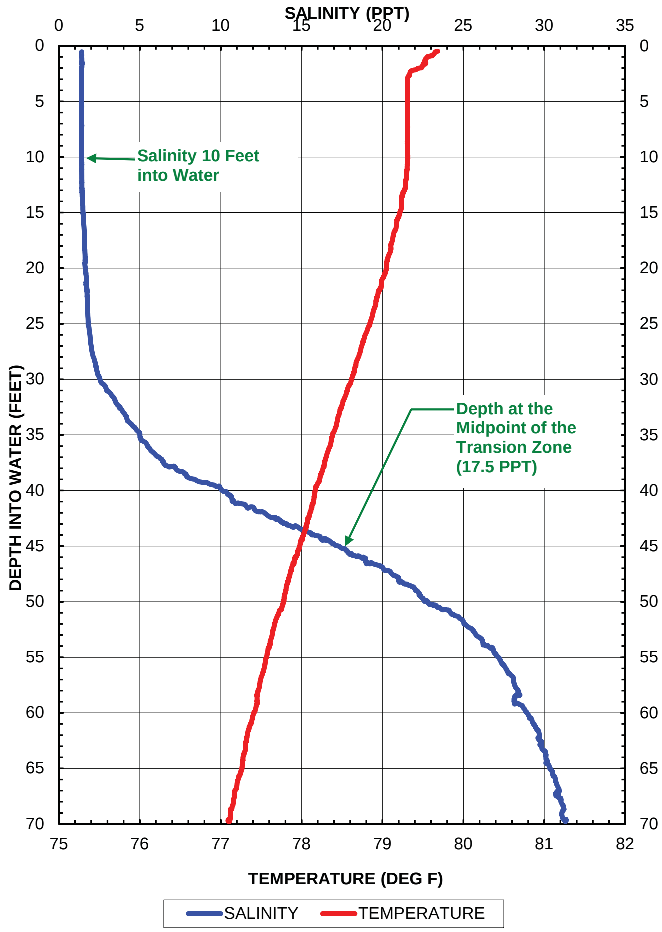


Figure 14. Salinity Trends in the Puuloa Sector of the Ewa Limestone Aquifer as Depicted by Data from the FG-2 Monitor Well

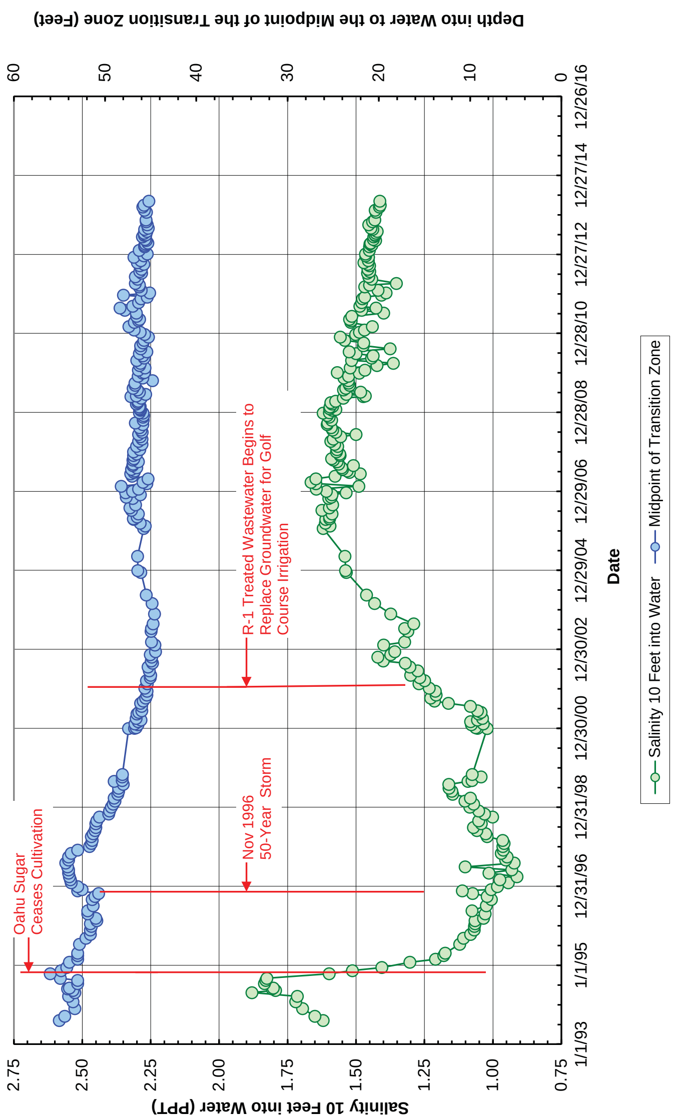


Figure 15. Comparative Salinity Profiles through the Water Column of the Kamakana Monitor Well, April 3, 2010 Versus May 22, 2014

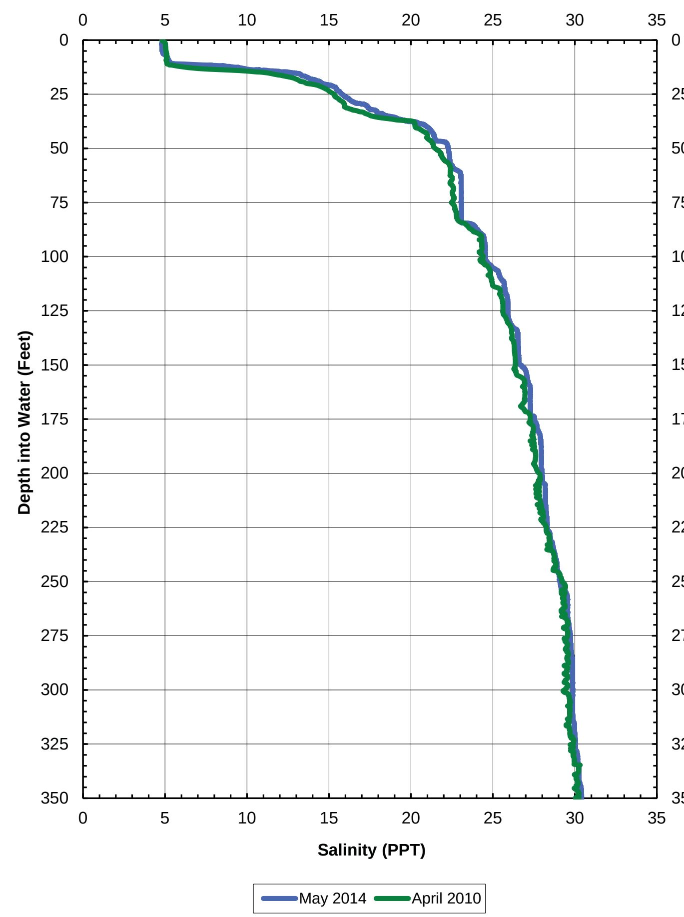
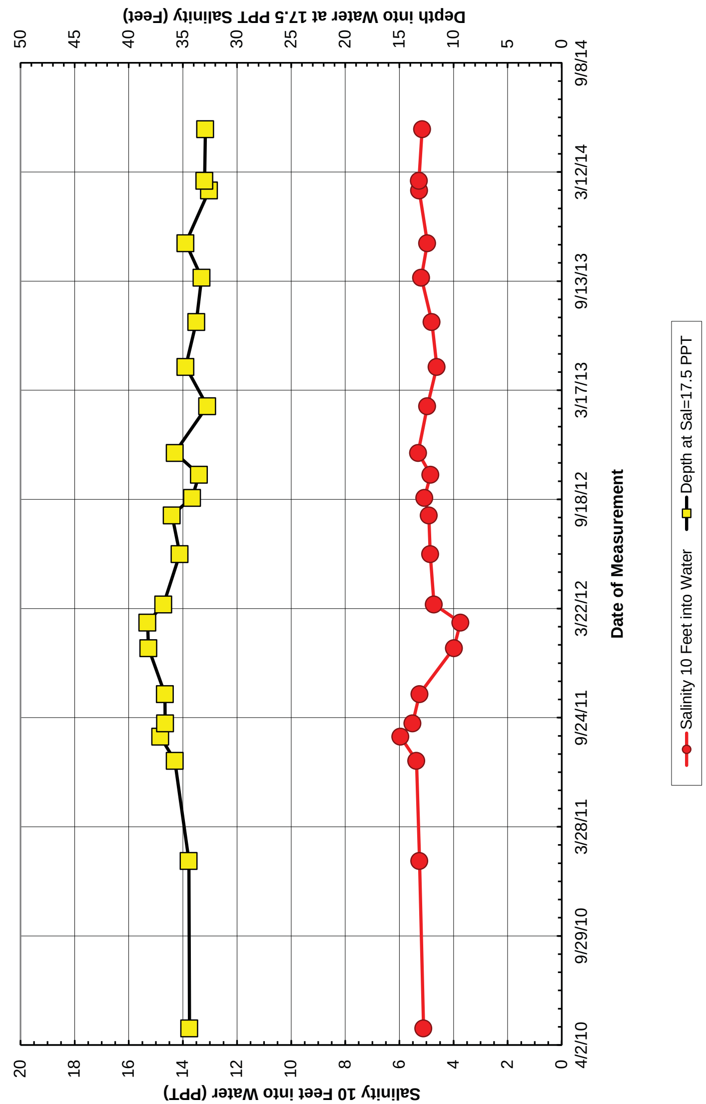


Figure 16. Trends of Salinity Indicator Parameters from Salinity Profiling in the Kamakana Monitor Well



Salinity Profiling Results in the Ooma Monitor Wells. Locations of the two Ooma monitor wells are shown on Figure 4. Although they have not been profiled as frequently as the Kamakana Monitor Well, their record starts in November 2002, a longer period of time than for the Kamakana well. Its most recent salinity and temperature profiles are shown on Figures 17 and 18. Trends of salinity (10 feet into water) and lens thickness (depth to 17.5 PPT salinity) are shown on Figures 19 and 20. Over the 12-year period of record, the salinities 10 feet into water are the same or slightly fresher than in November 2002 and the depths to the midpoint of the transition zone are essentially unchanged. The closely spaced sequence of profiles in May 2009 and again in May 2014 were done to see the effect on the profiles of the semi-diurnal tide. For nearshore wells such as the two at Ooma, that effect is relatively significant, creating significant variability in the indicator parameters.

Salinity Profiling Results in the Kaloko 2 Irrigation Well. The Kaloko 2 irrigation well only penetrates about 18 feet into groundwater, not deep enough to reach the midpoint of the transition zone (Figure 21). In lieu of this, the salinity at varying depths into groundwater have been tracked (Figure 22). No trend of increasing salinity in this well has occurred since the first salinity profile done in March 1996.

FUTURE MONITORING AS PUMPAGE OF HIGH LEVEL GROUNDWATER INCREASES

So far, monitoring data of the basal lens as complied by TNWRE has not shown an impact of high level groundwater pumpage on the nominally downgradient basal lens. However, there is still an unresolved question on whether the natural discharge of groundwater is into or beneath the basal lens. Also, it is virtually certain that high level groundwater pumpage will increase in the future. A number of new wells in production are foreseeable, including Palani 1 (No. 4158-03), Keopu 4 (No. 3957-05), another QLT well, and another well near Waiaha. Greater use of the Keopu Well (No. 3957-01) will be made possible with transmission improvements in the Mamalahoa corridor to be completed as a part of outfitting the Keopu 4 Well. Similarly, greater use of the Waiaha Well (No. 3857-04) will occur with completion of a nearby mauka-to-makai transmission corridor. In light of the foreseeable increase in high level groundwater pumpage, it is reasonable to ask if current ongoing monitoring will adequately detect changes to basal groundwater resulting from this use. Recommendations for groundwater monitoring going forward are as follows:

- Continue salinity profiling and water level recording in the Kamakana Monitor Well. It is ideally located downgradient of present and foreseeable future high level groundwater pumping.
- Drill the Kaloko 2 irrigation well at least 400 feet deeper and convert it to a permanent monitoring well with continuous water level recording and salinity profiling. The recommended depth will completely portray the basal lens and transition zone and also the temperature reversal at depth. As with the Kamakana Well, the well is ideally located. It is downgradient of DWS' Hualalai Well

Figure 17. Salinity and Temperature Profile in the Ooma Mauka Monitor Well on May 20, 2014

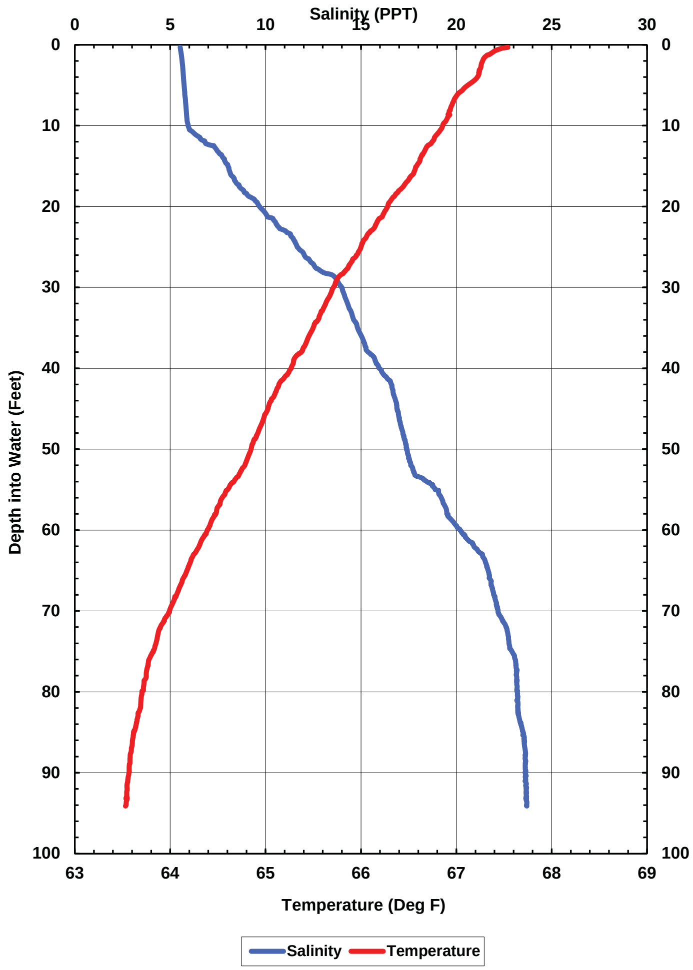


Figure 18. Salinity and Temperature Profile in the Ooma Makai Monitor Well on May 20, 2014

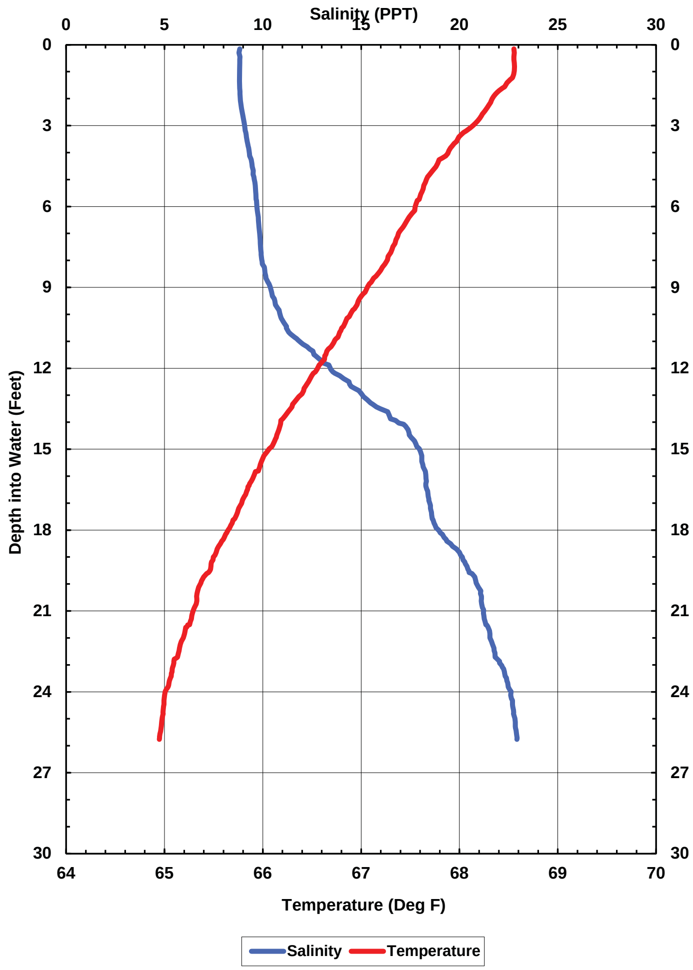


Figure 19. Trends of Salinity Indicator Parameters in the Ooma Mauka Monitor Well

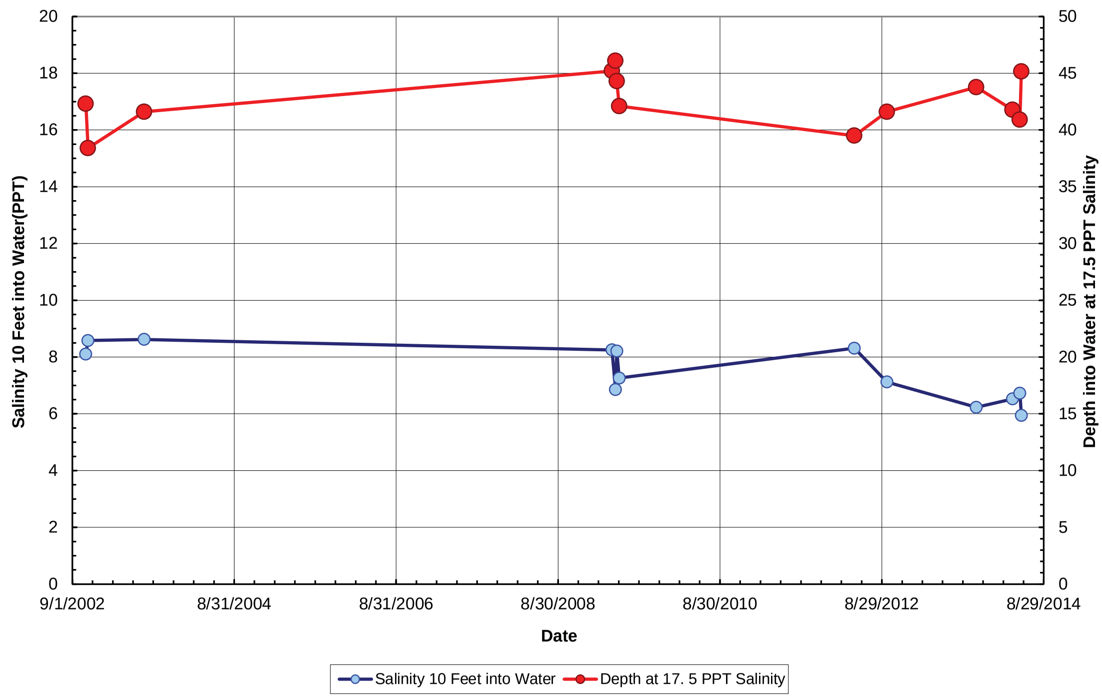


Figure 20. Trends of Salinity Indicator Parameters in the Ooma Makai Monitor Well

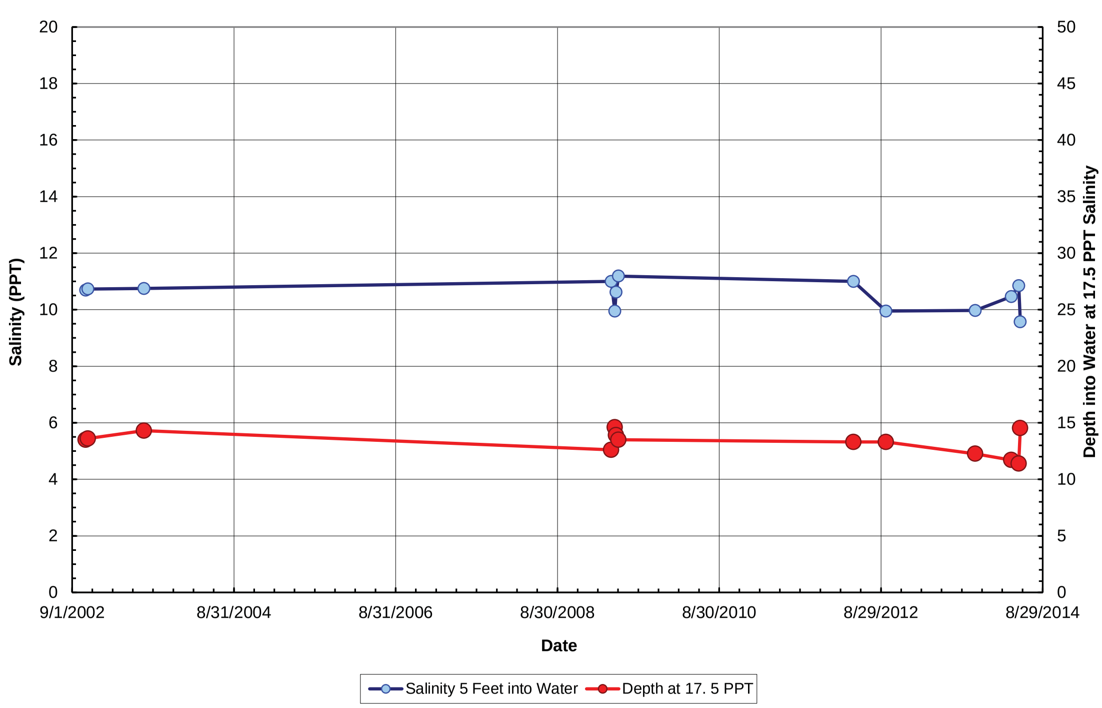


Figure 21. Salinity and Temperature Profile through the Water Column of the Kaloko 2 Irrigation Well (No. 4160-02) on May 13, 2014

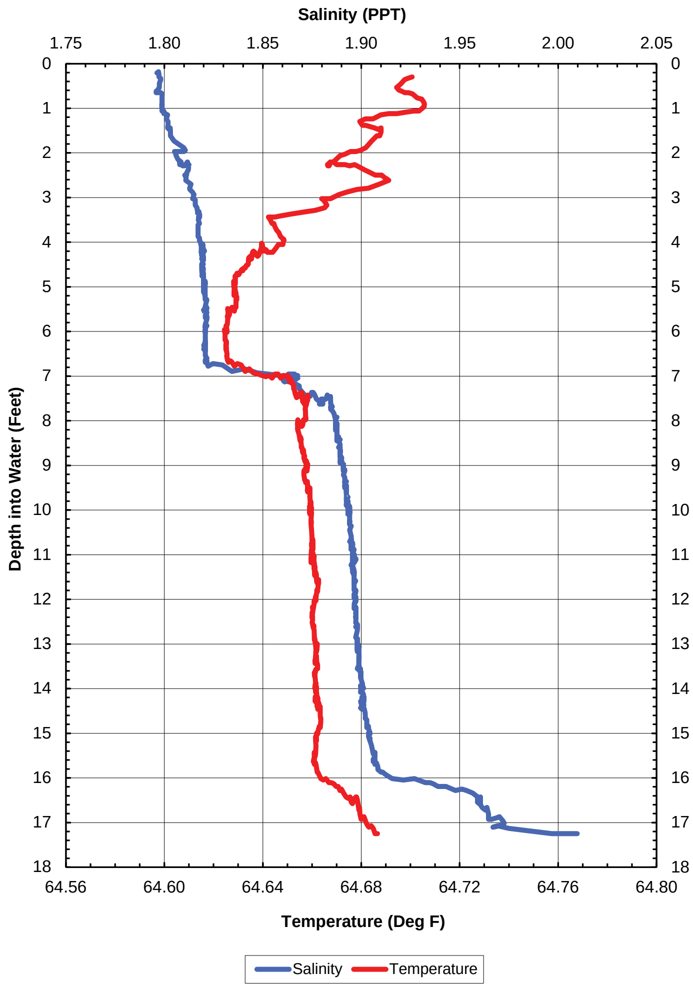
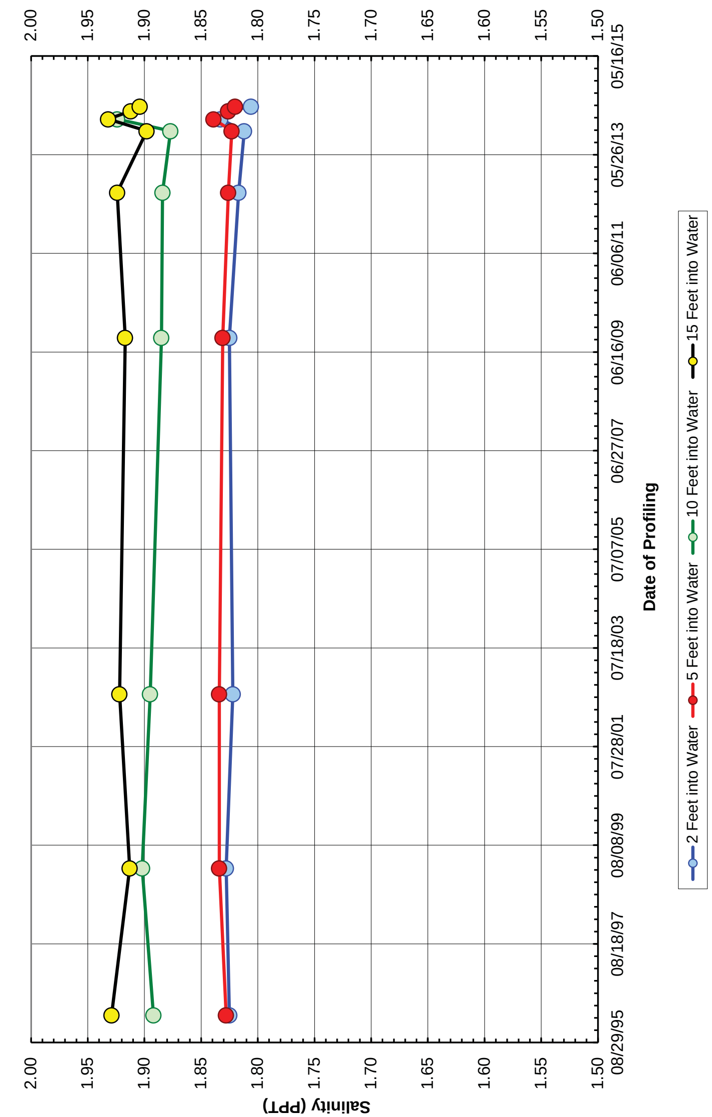


Figure 22. Salinity Trends in the Water Column of the Kaloko 2 Irrigation Well



(No. 4258-03) and the soon to be put into service Palani Well (No. 4158-03). It is also directly upgradient of KAHO. The water levels and periodic salinity profiles in both the Kamakana and Kalaoa 2 Wells would enable an accurate depiction of potential changes in the basal lens downgradient of pumpage of the high level aquifer between Kalaoa and Waiaha.

- Continue periodic salinity profiling in the Ooma monitor wells. Although these wells are not ideally located, their records predate the start of pumpage in the high level aquifer and are useful in that respect.

B. WATER TESTING FOR KEŌPŪ WELL #4

THIS PAGE WAS INTENTIONALLY LEFT BLANK

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory Report

for

Tom Nance Water Resource Engineering
560 N. Nimitz Hwy. - Suite 213
Honolulu, HI 96817
Attention: Tom Nance
Fax: 808-538-7757

Date of Issue
04/17/2012
MWH LABORATORIES

01114CA

Report: 389611
Project: DRINKING
Group: Keopu Well

DST: David S Tripp

Project Manager

Laboratory certifies that the test results meet all **NELAC** requirements unless noted in the Comments section or the Case Narrative. Following the cover page are Hits Reports, Comments, QC Summary, QC Report and Regulatory Forms. This report shall not be reproduced except in full, without the written approval of the laboratory.

MWH LABORATORIES

STATE CERTIFICATION LIST

State	Certification Number	State	Certification Number
Alabama	41060	**Mississippi**	Certified
Alaska	CA00006	**Montana**	Cert 0035
Arizona	AZ0455	**Nevada**	CA00006-2010-1
Arkansas	Certified	**New Hampshire**	2959-11
California – NELAP	01114CA	**New Jersey**	CA 008
California – ELAP	1422	**New Mexico**	Certified
Colorado	Certified	**New York**	11320
Connecticut	PH-0107	**North Carolina**	06701
Delaware	CA 006	**North Dakota**	R-009
Florida	E871024	**Oregon**	CA 200003-009
Georgia	947	**Pennsylvania**	68-565
Guam	11-004r	**Rhode Island**	01114CA
Hawaii	Certified	**South Carolina**	87016001
Idaho	Certified	**South Dakota**	Certified
Illinois	200033	**Tennessee**	TN02839
Indiana	C-CA-01	**Texas**	T104704230-11-2
Kansas	E-10268	**Utah**	Mont-1
Kentucky	90107	**Vermont**	VT0114
Louisiana	LA110022	**Virginia**	00210
Maine	CA0006	**Washington**	C383
Maryland	224	**West Virginia**	9943 C
Commonwealth of Northern Marianas Is.	MP0004	**Wisconsin**	998316660
Massachusetts	M-CA006	**Wyoming**	8TMS-L
Michigan	9906	**EPA Region 5**	Certified

MWH LABORATORIES

Acknowledgement of Samples Received

Addr: **Tom Nance Water Resource Engineering**
560 N. Nimitz Hwy. - Suite 213
Honolulu, HI 96817

Attn: Tom Nance
Phone: 808-537-1141

Client ID: TOMNANCE
Folder #: 389611
Project: DRINKING
Sample Group: Keopu Well
Project Manager: David S Tripp
Phone: (626) 386-1158

The following samples were received from you on **February 29, 2012**. They have been scheduled for the tests listed below each sample. If this information is incorrect, please contact your service representative. Thank you for using MWH Laboratories.

Sample #	Sample ID	Sample Date
201202290206	Keopu Well	02/28/2012 1100

Field Conductivity: 184.2
Field Temperature (F): 74.4
Field pH: 8.07

@ICPMS	Mercury	@2378-TCDD_Dioxin
@504MOD	@505PAC	@525PAC
@DIQUAT	@ML515.4	@ML531.2
@RA226 GA	@RA228 GA	@RAD
@VOASDWA	Alkalinity in CaCO3 units	Asbestos by TEM - >10 microns
Cadmium Total ICAP/MS	Calcium Total ICAP	Cyanide
Endothall	Fluoride	Glyphosate
Nitrate as Nitrogen by IC	Nitrate as NO3 (calc)	Nitrite Nitrogen by IC
PH (H3=past HT not compliant)	Specific Conductance	Turbidity
Uranium ICAP/MS		

Sample #	Sample ID	Sample Date
201202290207	TRAVEL BLANK	02/28/2012 0800

@VOASDWA TB

Test Description

@ICPMS -- ICPMS Metals
@2378-TCDD_Dioxin -- 2,3,7,8-TCDD_Dioxin
@504MOD -- EPA Method 504.1
@505PAC -- Organochlorine Pesticides/PCBs
@525PAC -- Semivolatiles by GCMS
@DIQUAT -- Diquat and Paraquat
@ML515.4 -- Chlorophenoxy Herbicides
@ML531.2 -- Aldicarbs
@RA226 GA -- Radium 226
@RA228 GA -- Radium 228
@RAD -- Gross Alpha/Beta Radiation
@VOASDWA -- Volatile Organics by GCMS
@VOASDWA TB -- Volatile Organics by GCMS

MWH Laboratories
A Division of MWH Americas, Inc.

750 Royal Oaks Drive, Suite 100
Monrovia, California 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

CHAIN OF CUSTODY RECORD

389611

MWH LABS USE ONLY:
LOGIN COMMENTS: W/ TB

SAMPLE TEMP RECEIVED AT:
☐ Colton / Sacramento / Scottsdale ____ °C (Compliance: 4 ± 2 °C)
☑ Monrovia 4.0 °C (Compliance: 4 ± 2 °C)
CONDITION OF BLUE ICE: FROZEN ✓ PARTIALLY FROZEN ___ THAWED ___ WET ICE ___ NO ICE ___
METHOD OF SHIPMENT: Pick-Up / Walk-In / (FedEx) / UPS / DHL / Area Fast / Top Line / Other: ____

SAMPLES CHECKED AGAINST COC BY:
SAMPLES LOGGED IN BY:
SAMPLES REC'D DAY OF COLLECTION? ☐ (check for yes)

TO BE COMPLETED BY SAMPLER:
COMPANY/AGENCY NAME: TOM NANCE WATER RESOURCE ENGINEERING
PROJECT CODE:
MWH LABS CLIENT CODE:
COC ID:
SAMPLE GROUP:
TAT requested: rush by adv notice only STD ☒ 1 wk ___ 3 day ___ 2 day ___ 1 day ___

COMPLIANCE SAMPLES ☒ (check for yes) - Requires state forms
NON-COMPLIANCE SAMPLES ☐ (check for yes) REGULATION INVOLVED: (eg. SDWA, Phase V, NPDES, FOA, ...)
Type of samples (circle one): ROUTINE SPECIAL CONFIRMATION
SEE ATTACHED BOTTLE ORDER FOR ANALYSES ☒ (check for yes) OR list ANALYSES REQUIRED (enter number of bottles sent for each test for each sample)

SAMPLE DATE	SAMPLE TIME	SAMPLE ID	CLIENT LAB ID	MATRIX*	Field Data	Field Data	Analyses	SAMPLER COMMENTS
2/28/12	AM	HFDC KEOPU WELL					SEE ATTACHED BOTTLE ORDER	SP. COND = 184.2
								TEMP = 74.4°F
								pH = 8.09

4/44

* MATRIX TYPES: RSW = Raw Surface Water, RGW = Raw Ground Water, CFW = Chlor(am)inated Finished Water, FW = Other Finished Water, SEAW = Sea Water, WW = Waste Water, BW = Bottled Water, SW = Storm Water, SO = Soil, SL = Sludge, O = Other - Please Identify

	SIGNATURE	PRINT NAME	COMPANY/TITLE	DATE	TIME
SAMPLED BY:	Tom Nance	TOM NANCE	TNWRE Inc.	2/28/12	11:00
RELINQUISHED BY:	Tom Nance	TOM NANCE	TNWRE Inc	2/28/12	11:00
RECEIVED BY:	[signature]	Chris Cabrera	MWH	2/29/12	1020
RELINQUISHED BY:					
RECEIVED BY:					

PAGE ___ OF ___

MWH LABORATORIES
A Division of MWH Americas, Inc
750 Royal Oaks Drive Suite 100
Monrovia, CA 91016 (626) 386-1100 FAX (626) 386-1124

Kit Order for Tom Nance Water Resources Engineering

David S Tripp is Your MWH Labs Project Manager

Sampler: please return this paper with your samples

Kit #: 45668
Created By: DST
Order Date: 02/14/2012
STG: Bottle Orders

Client Code: TOMNANCE
Project Code: DRINKING Bottle Orders
Group Name: Keopu Well
PO#/JOB#:

Ship By: 02/04/2012

Ship Sample Kits to	Send Report to	Billing Address
Tom Nance Water Resource Engineering 560 N. Nimitz Hwy. - Suite 213 Honolulu, HI 96817 Attn: Tom Nance Phone: 808-537-1141 Fax: 808-538-7757	Tom Nance Water Resource Engineering 560 N. Nimitz Hwy. - Suite 213 Honolulu, HI 96817 Attn: Tom Nance Phone: 808-537-1141 Fax: 808-538-7757	Tom Nance Water Resource Engineering 560 N. Nimitz Hwy. - Suite 213 Honolulu, HI 96817 Attn: Tom Nance Phone: 808-537-1141 Fax: 808-538-7757

# of Samples	Tests	Bottles - Qty for each sample, type & preservative if any	UN DOT #
1	@2378-TCDD_Dioxin	2 1L amber glass D1613_NO_PRESERVATIVE	
1	@504MOD	3 40ml amber glass vial no preservative	
1	@505PAC	4 40ml amber glass vial 1drop thio (6%)	
1	@525PAC	2 1L amber glass 2ml of 6N HCl	UN1789
1	@DIQUAT	1 1L amber poly no preservative	
1	@ICPMS, Mercury, Cadmium Total ICAP/MS, Calcium Total ICAP, Uranium ICAP/MS	1 500ml acid poly 2ml HNO3 (18%)	UN2031
1	@ML515.4	2 125ml amber glass 7mg SULFITE xls	
1	@ML531.2	2 40ml amber glass vial 0.37g KH2Citrate+6mg ThioSO4	
1	@RA226 GA, @RA228 GA	3 1L poly 4ml HNO3 (18%)	UN2031
1	@RAD	1 500ml poly 2ml 18%HNO3+125ml poly/no pres	UN2031
1	@VOASDWA	3 40ml amber glass vial 4drops 6N HCL (36%)	UN1789
1	@VOASDWA TB	2 40ml amber glass vial 4drops of 1:1 HCL + H2O	UN1789
1	Alkalinity in CaCO3 units	1 250ml poly no preservative	
1	Asbestos by TEM - >10 microns	1 1L poly sonicated no preservative	
1	Cyanide	1 250 ml poly 2 ml NaOH (30%)+6 scoops AA	
1	Endothall	1 250ml amber glass no preservative	
1	Fluoride, Nitrate as Nitrogen by IC, Nitrate as NO3 (calc), Nitrite Nitrogen by IC, PH (H3=past HT not compliant), Specific Conductance, Turbidity	1 125ml poly no preservative	
1	Glyphosate	1 125ml amber glass no preservative	

Comments

SHIPPING: Please include extra ice packs for Hawaii. Deliver no later than Thursday 2/9.

LABEL cooler and bottles - KEOPU WELL

Code	Status	Date Shipped	Via	Tracking #	# of Coolers	Prepared By

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory
Hits Report: 389611

Tom Nance Water Resource Engineering
Tom Nance
560 N. Nimitz Hwy. - Suite 213
Honolulu, HI 96817

Samples Received on:
02/29/2012

Analyzed		Analyte	Sample ID	Result	Federal MCL	Units	MRL
	201202290206		**Keopu Well**				
03/01/2012	15:47	Alkalinity in CaCO3 units		64		mg/L	2
03/09/2012	20:03	Calcium Total ICAP		8.6		mg/L	1
03/01/2012	20:03	Chloroform (Trichloromethane)		1.8		ug/L	0.5
03/02/2012	21:27	Chromium Total ICAP/MS		4.4	100	ug/L	1
03/02/2012	21:27	Copper Total ICAP/MS		6.4	1300	ug/L	2
03/06/2012	17:43	Fluoride		0.27	4	mg/L	0.05
03/02/2012	21:27	Nickel Total ICAP/MS		12		ug/L	5
03/01/2012	00:45	Nitrate as Nitrogen by IC		1.1	10	mg/L	0.1
03/01/2012	00:45	Nitrate as NO3 (calc)		5.0	45	mg/L	0.44
03/01/2012	15:47	PH (H3=past HT not compliant)		8.2		Units	0.1
03/01/2012	15:47	Specific Conductance, 25 C		180		umho/cm	2
03/01/2012	20:03	Total THM		1.8	80	ug/L	0.5
03/01/2012	09:44	Turbidity		0.51	5	NTU	0.05

SUMMARY OF POSITIVE DATA ONLY

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory Data
Report: 389611

Tom Nance Water Resource Engineering
Tom Nance
560 N. Nimitz Hwy. - Suite 213
Honolulu, HI 96817

Samples Received on:
02/29/2012

Keopu Well (201202290206) **Sampled on 02/28/2012 1100**

Field Conductivity: 184.2
Field Temperature (F): 74.4
Field pH: 8.07

Prepared	Analyzed	QC Ref #	Method	Analyte	Result	Units	MRL	Dilution
	EPA 200.8 - ICPMS Metals							
	03/02/2012 21:27	641635	(EPA 200.8)	Antimony Total ICAP/MS	ND	ug/L	1	1
	03/02/2012 21:27	641635	(EPA 200.8)	Arsenic Total ICAP/MS	ND	ug/L	1	1
	03/02/2012 21:27	641635	(EPA 200.8)	Barium Total ICAP/MS	ND	ug/L	2	1
	03/02/2012 21:27	641635	(EPA 200.8)	Beryllium Total ICAP/MS	ND	ug/L	1	1
	03/02/2012 21:27	641635	(EPA 200.8)	Cadmium Total ICAP/MS	ND	ug/L	0.5	1
	03/02/2012 21:27	641635	(EPA 200.8)	Chromium Total ICAP/MS	4.4	ug/L	1	1
	03/02/2012 21:27	641635	(EPA 200.8)	Copper Total ICAP/MS	6.4	ug/L	2	1
	03/02/2012 21:27	641635	(EPA 200.8)	Lead Total ICAP/MS	ND	ug/L	0.5	1
	03/02/2012 21:27	641635	(EPA 200.8)	Nickel Total ICAP/MS	12	ug/L	5	1
	03/02/2012 21:27	641635	(EPA 200.8)	Selenium Total ICAP/MS	ND	ug/L	5	1
	03/02/2012 21:27	641635	(EPA 200.8)	Thallium Total ICAP/MS	ND	ug/L	1	1
	03/07/2012 14:34	642335	(EPA 200.8)	Uranium ICAP/MS	ND	ug/L	1	1
	EPA 200.7 - ICP Metals							
	03/09/2012 20:03	642969	(EPA 200.7)	Calcium Total ICAP	8.6	mg/L	1	1
	EPA 245.1 - Mercury Total							
3/16/2012	03/20/2012 21:36	644505	(EPA 245.1)	Mercury	ND	ug/L	0.2	1
	EPA 100.2 - Asbestos by TEM - >10 microns							
2/29/2012	03/28/2012 00:00	645813	(EPA 100.2)	Asbestos by TEM - >10 microns	ND	MFL	0.2	1
	EPA 505 - Organochlorine Pesticides/PCBs							
3/5/2012	03/05/2012 22:25	642407	(EPA 505)	Alachlor (Alanex)	ND	ug/L	0.1	1
3/5/2012	03/05/2012 22:25	642407	(EPA 505)	Aldrin	ND	ug/L	0.01	1
3/5/2012	03/05/2012 22:25	642407	(EPA 505)	Chlordane	ND	ug/L	0.1	1
3/5/2012	03/05/2012 22:25	642407	(EPA 505)	Dieldrin	ND	ug/L	0.01	1
3/5/2012	03/05/2012 22:25	642407	(EPA 505)	Endrin	ND	ug/L	0.01	1
3/5/2012	03/05/2012 22:25	642407	(EPA 505)	Heptachlor Epoxide	ND	ug/L	0.01	1
3/5/2012	03/05/2012 22:25	642407	(EPA 505)	Lindane (gamma-BHC)	ND	ug/L	0.01	1
3/5/2012	03/05/2012 22:25	642407	(EPA 505)	Methoxychlor	ND	ug/L	0.05	1
3/5/2012	03/05/2012 22:25	642407	(EPA 505)	PCB 1016 Aroclor	ND	ug/L	0.08	1
3/5/2012	03/05/2012 22:25	642407	(EPA 505)	PCB 1221 Aroclor	ND	ug/L	0.1	1
3/5/2012	03/05/2012 22:25	642407	(EPA 505)	PCB 1232 Aroclor	ND	ug/L	0.1	1

Rounding on totals after summation.
(c) - indicates calculated results

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory Data
Report: 389611

Tom Nance Water Resource Engineering
Tom Nance
560 N. Nimitz Hwy. - Suite 213
Honolulu, HI 96817

Samples Received on:
02/29/2012

Prepared	Analyzed	QC Ref #	Method	Analyte	Result	Units	MRL	Dilution
3/5/2012	03/05/2012 22:25	642407	(EPA 505)	PCB 1242 Aroclor	ND	ug/L	0.1	1
3/5/2012	03/05/2012 22:25	642407	(EPA 505)	PCB 1248 Aroclor	ND	ug/L	0.1	1
3/5/2012	03/05/2012 22:25	642407	(EPA 505)	PCB 1254 Aroclor	ND	ug/L	0.1	1
3/5/2012	03/05/2012 22:25	642407	(EPA 505)	PCB 1260 Aroclor	ND	ug/L	0.1	1
3/5/2012	03/05/2012 22:25	642407	(EPA 505)	Total PCBs	ND	ug/L	0.1	1
3/5/2012	03/05/2012 22:25	642407	(EPA 505)	Toxaphene	ND	ug/L	0.5	1
	EPA 515.4 - Chlorophenoxy Herbicides							
3/6/2012	03/09/2012 13:32	642518	(EPA 515.4)	2,4,5-T	ND	ug/L	0.2	1
3/6/2012	03/09/2012 13:32	642518	(EPA 515.4)	2,4,5-TP (Silvex)	ND	ug/L	0.2	1
3/6/2012	03/09/2012 13:32	642518	(EPA 515.4)	2,4-D	ND	ug/L	0.1	1
3/6/2012	03/09/2012 13:32	642518	(EPA 515.4)	2,4-DB	ND	ug/L	2	1
3/6/2012	03/09/2012 13:32	642518	(EPA 515.4)	3,5-Dichlorobenzoic acid	ND	ug/L	0.5	1
3/6/2012	03/09/2012 13:32	642518	(EPA 515.4)	Acifluorfen	ND	ug/L	0.2	1
3/6/2012	03/09/2012 13:32	642518	(EPA 515.4)	Bentazon	ND	ug/L	0.5	1
3/6/2012	03/09/2012 13:32	642518	(EPA 515.4)	Dalapon	ND	ug/L	1	1
3/6/2012	03/09/2012 13:32	642518	(EPA 515.4)	Dicamba	ND	ug/L	0.1	1
3/6/2012	03/09/2012 13:32	642518	(EPA 515.4)	Dichlorprop	ND	ug/L	0.5	1
3/6/2012	03/09/2012 13:32	642518	(EPA 515.4)	Dinoseb	ND	ug/L	0.2	1
3/6/2012	03/09/2012 13:32	642518	(EPA 515.4)	Pentachlorophenol	ND	ug/L	0.04	1
3/6/2012	03/09/2012 13:32	642518	(EPA 515.4)	Picloram	ND	ug/L	0.1	1
3/6/2012	03/09/2012 13:32	642518	(EPA 515.4)	Tot DCPA Mono&Diacid Degradate	ND	ug/L	0.1	1
3/6/2012	03/09/2012 13:32	642518	(EPA 515.4)	2,4-Dichlorophenyl acetic acid	115	%		1
3/6/2012	03/09/2012 13:32	642518	(EPA 515.4)	4,4-Dibromooctafluorobiphenyl	100	%		1
	EPA 504.1 - EPA Method 504.1							
3/8/2012	03/09/2012 01:48	642808	(EPA 504.1)	1,2,3-Trichloropropane (TCP)	ND	ug/L	0.04	1
3/8/2012	03/09/2012 01:48	642808	(EPA 504.1)	Dibromochloropropane (DBCP)	ND	ug/L	0.01	1
3/8/2012	03/09/2012 01:48	642808	(EPA 504.1)	Ethylene Dibromide (EDB)	ND	ug/L	0.01	1
3/8/2012	03/09/2012 01:48	642808	(EPA 504.1)	1,2-Dibromopropane	113	%		1
	EPA 525.2 - Semivolatiles by GCMS							
3/8/2012	03/13/2012 17:48	643417	(EPA 525.2)	Atrazine	ND	ug/L	0.05	1
3/8/2012	03/13/2012 17:48	643417	(EPA 525.2)	Benzo(a)pyrene	ND	ug/L	0.02	1
3/8/2012	03/13/2012 17:48	643417	(EPA 525.2)	Di-(2-Ethylhexyl)adipate	ND	ug/L	0.6	1
3/8/2012	03/13/2012 17:48	643417	(EPA 525.2)	Di(2-Ethylhexyl)phthalate	ND	ug/L	0.6	1
3/8/2012	03/13/2012 17:48	643417	(EPA 525.2)	Heptachlor	ND	ug/L	0.03	1

Rounding on totals after summation.
(c) - indicates calculated results

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory Data
Report: 389611

Tom Nance Water Resource Engineering
Tom Nance
560 N. Nimitz Hwy. - Suite 213
Honolulu, HI 96817

Samples Received on:
02/29/2012

Prepared	Analyzed		QC Ref #	Method	Analyte	Result	Units	MRL	Dilution
3/8/2012	03/13/2012	17:48	643417	(EPA 525.2)	Hexachlorobenzene	ND	ug/L	0.05	1
3/8/2012	03/13/2012	17:48	643417	(EPA 525.2)	Hexachlorocyclopentadiene	ND	ug/L	0.05	1
3/8/2012	03/13/2012	17:48	643417	(EPA 525.2)	Molinate	ND	ug/L	0.1	1
3/8/2012	03/13/2012	17:48	643417	(EPA 525.2)	Simazine	ND	ug/L	0.05	1
3/8/2012	03/13/2012	17:48	643417	(EPA 525.2)	Thiobencarb (ELAP)	ND	ug/L	0.2	1
3/8/2012	03/13/2012	17:48	643417	(EPA 525.2)	1,3-Dimethyl-2-nitrobenzene	107	%		1
3/8/2012	03/13/2012	17:48	643417	(EPA 525.2)	Acenaphthene-d10	71	%		1
3/8/2012	03/13/2012	17:48	643417	(EPA 525.2)	Chrysene-d12	82	%		1
3/8/2012	03/13/2012	17:48	643417	(EPA 525.2)	Perylene-d12	85	%		1
3/8/2012	03/13/2012	17:48	643417	(EPA 525.2)	Phenanthrene-d10	78	%		1
3/8/2012	03/13/2012	17:48	643417	(EPA 525.2)	Triphenylphosphate	118	%		1
		EPA 548.1 - Endothall							
3/1/2012	03/07/2012	15:57	642560	(EPA 548.1)	Endothall	ND	ug/L	5	1
		EPA 1613B - 2,3,7,8-TCDD_Dioxin							
3/6/2012	03/08/2012	17:05	642855	(EPA 1613B)	2,3,7,8-TCDD	ND	pg/L	5	1
3/6/2012	03/08/2012	17:05	642855	(EPA 1613B)	C12-2,3,7,8-TCDD	81	%		1
		EPA 547 - Glyphosate							
	03/07/2012	18:26	642527	(EPA 547)	Glyphosate	ND	ug/L	6	1
		EPA 531.2 - Aldicarbs							
	03/03/2012	05:37	642147	(EPA 531.2)	3-Hydroxycarbofuran	ND	ug/L	0.5	1
	03/03/2012	05:37	642147	(EPA 531.2)	Aldicarb (Temik)	ND	ug/L	0.5	1
	03/03/2012	05:37	642147	(EPA 531.2)	Aldicarb sulfone	ND	ug/L	0.5	1
	03/03/2012	05:37	642147	(EPA 531.2)	Aldicarb sulfoxide	ND	ug/L	0.5	1
	03/03/2012	05:37	642147	(EPA 531.2)	Baygon	ND	ug/L	0.5	1
	03/03/2012	05:37	642147	(EPA 531.2)	Carbaryl	ND	ug/L	0.5	1
	03/03/2012	05:37	642147	(EPA 531.2)	Carbofuran (Furadan)	ND	ug/L	0.5	1
	03/03/2012	05:37	642147	(EPA 531.2)	Methiocarb	ND	ug/L	0.5	1
	03/03/2012	05:37	642147	(EPA 531.2)	Methomyl	ND	ug/L	0.5	1
	03/03/2012	05:37	642147	(EPA 531.2)	Oxamyl (Vydate)	ND	ug/L	0.5	1
	03/03/2012	05:37	642147	(EPA 531.2)	4-Bromo-3,5-dimethylphenyl-N-methylc arbamate	87	%		1
		EPA 549.2 - Diquat and Paraquat							
3/2/2012	03/06/2012	14:06	642315	(EPA 549.2)	Diquat	ND	ug/L	0.4	1
3/2/2012	03/06/2012	14:06	642315	(EPA 549.2)	Paraquat	ND	ug/L	2	1
		EPA 300.0 - Nitrate, Nitrite by EPA 300.0							

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory Data
Report: 389611

Tom Nance Water Resource Engineering
Tom Nance
560 N. Nimitz Hwy. - Suite 213
Honolulu, HI 96817

Samples Received on:
02/29/2012

Prepared	Analyzed		QC Ref #	Method	Analyte	Result	Units	MRL	Dilution
	03/01/2012	00:45	641518	(EPA 300.0)	Nitrate as Nitrogen by IC	1.1	mg/L	0.1	1
	03/01/2012	00:45	641518	(EPA 300.0)	Nitrate as NO3 (calc)	5.0	mg/L	0.44	1
	03/01/2012	00:45	641518	(EPA 300.0)	Nitrite Nitrogen by IC	ND	mg/L	0.05	1
		EPA 900.0 - Gross Alpha/Beta Radiation							
3/5/2012	03/12/2012	18:29	643399	(EPA 900.0)	Alpha, Gross	ND	pCi/L	3	1
3/5/2012	03/12/2012	18:29	643399	(EPA 900.0)	Alpha, Min Detectable Activity	3.0	pCi/L		1
3/5/2012	03/12/2012	18:29	643399	(EPA 900.0)	Alpha, Two Sigma Error	2.0	pCi/L		1
3/5/2012	03/12/2012	18:29	643399	(EPA 900.0)	Beta, Gross	ND	pCi/L	3	1
3/5/2012	03/12/2012	18:29	643399	(EPA 900.0)	Beta, Min Detectable Activity	3.0	pCi/L		1
3/5/2012	03/12/2012	18:29	643399	(EPA 900.0)	Beta, Two Sigma Error	1.1	pCi/L		1
3/5/2012	03/12/2012	18:29	643399	(EPA 900.0)	Gross Alpha + adjusted error	ND	pCi/L	3	1
		Ra-226 GA - Radium 226							
3/23/2012	04/08/2012	15:04	647427	(Ra-226 GA)	Radium 226	ND	pCi/L	1	1
3/23/2012	04/08/2012	15:04	647427	(Ra-226 GA)	Radium 226 Min Detect Activity	0.40	pCi/L		1
3/23/2012	04/08/2012	15:04	647427	(Ra-226 GA)	Radium 226 Two Sigma Error	0	pCi/L		1
		RA-228 GA - Radium 228							
3/23/2012	04/08/2012	15:04	647432	(RA-228 GA)	Radium 228	ND	pCi/L	1	1
3/23/2012	04/08/2012	15:04	647432	(RA-228 GA)	Radium 228 Min Detect Activity	0.84	pCi/L		1
3/23/2012	04/08/2012	15:04	647432	(RA-228 GA)	Radium 228 Two Sigma Error	0	pCi/L		1
		EPA 524.2 - Volatile Organics by GCMS							
3/1/2012	03/01/2012	20:03	642021	(EPA 524.2)	1,1,1,2-Tetrachloroethane	ND	ug/L	0.5	1
3/1/2012	03/01/2012	20:03	642021	(EPA 524.2)	1,1,1-Trichloroethane	ND	ug/L	0.5	1
3/1/2012	03/01/2012	20:03	642021	(EPA 524.2)	1,1,2,2-Tetrachloroethane	ND	ug/L	0.5	1
3/1/2012	03/01/2012	20:03	642021	(EPA 524.2)	1,1,2-Trichloroethane	ND	ug/L	0.5	1
3/1/2012	03/01/2012	20:03	642021	(EPA 524.2)	1,1-Dichloroethane	ND	ug/L	0.5	1
3/1/2012	03/01/2012	20:03	642021	(EPA 524.2)	1,1-Dichloroethylene	ND	ug/L	0.5	1
3/1/2012	03/01/2012	20:03	642021	(EPA 524.2)	1,1-Dichloropropene	ND	ug/L	0.5	1
3/1/2012	03/01/2012	20:03	642021	(EPA 524.2)	1,2,3-Trichlorobenzene	ND	ug/L	0.5	1
3/1/2012	03/01/2012	20:03	642021	(EPA 524.2)	1,2,3-Trichloropropane	ND	ug/L	0.5	1
3/1/2012	03/01/2012	20:03	642021	(EPA 524.2)	1,2,4-Trichlorobenzene	ND	ug/L	0.5	1
3/1/2012	03/01/2012	20:03	642021	(EPA 524.2)	1,2,4-Trimethylbenzene	ND	ug/L	0.5	1
3/1/2012	03/01/2012	20:03	642021	(EPA 524.2)	1,2-Dichloroethane	ND	ug/L	0.5	1
3/1/2012	03/01/2012	20:03	642021	(EPA 524.2)	1,2-Dichloropropane	ND	ug/L	0.5	1
3/1/2012	03/01/2012	20:03	642021	(EPA 524.2)	1,3,5-Trimethylbenzene	ND	ug/L	0.5	1

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory Data
Report: 389611

Tom Nance Water Resource Engineering
Tom Nance
560 N. Nimitz Hwy. - Suite 213
Honolulu, HI 96817

Samples Received on:
02/29/2012

Prepared	Analyzed	QC Ref #	Method	Analyte	Result	Units	MRL	Dilution
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	1,3-Dichloropropane	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	2,2-Dichloropropane	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	2-Butanone (MEK)	ND	ug/L	5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	4-Methyl-2-Pentanone (MIBK)	ND	ug/L	5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Benzene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Bromobenzene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Bromochloromethane	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Bromodichloromethane	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Bromoethane	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Bromoform	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Bromomethane (Methyl Bromide)	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Carbon disulfide	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Carbon Tetrachloride	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Chlorobenzene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Chlorodibromomethane	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Chloroethane	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Chloroform (Trichloromethane)	1.8	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Chloromethane(Methyl Chloride)	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	cis-1,2-Dichloroethylene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	cis-1,3-Dichloropropene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Dibromomethane	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Dichlorodifluoromethane	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Dichloromethane	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Di-isopropyl ether	ND	ug/L	3	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Ethyl benzene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Hexachlorobutadiene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Isopropylbenzene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	m,p-Xylenes	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	m-Dichlorobenzene (1,3-DCB)	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Methyl Tert-butyl ether (MTBE)	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Naphthalene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	n-Butylbenzene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	n-Propylbenzene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	o-Chlorotoluene	ND	ug/L	0.5	1

Rounding on totals after summation.
(c) - indicates calculated results

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory Data
Report: 389611

Tom Nance Water Resource Engineering
Tom Nance
560 N. Nimitz Hwy. - Suite 213
Honolulu, HI 96817

Samples Received on:
02/29/2012

Prepared	Analyzed	QC Ref #	Method	Analyte	Result	Units	MRL	Dilution
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	o-Dichlorobenzene (1,2-DCB)	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	o-Xylene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	p-Chlorotoluene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	p-Dichlorobenzene (1,4-DCB)	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	p-Isopropyltoluene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	sec-Butylbenzene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Styrene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	tert-amyl Methyl Ether	ND	ug/L	3	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	tert-Butyl Ethyl Ether	ND	ug/L	3	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	tert-Butylbenzene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Tetrachloroethylene (PCE)	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Toluene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Total 1,3-Dichloropropene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Total THM	1.8	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Total xylenes	ND	ug/L	1	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	trans-1,2-Dichloroethylene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	trans-1,3-Dichloropropene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Trichloroethylene (TCE)	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Trichlorofluoromethane	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Trichlorotrifluoroethane(Freon 113)	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Vinyl chloride (VC)	ND	ug/L	0.3	1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	1,2-Dichloroethane-d4	99	%		1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	4-Bromofluorobenzene	104	%		1
3/1/2012	03/01/2012 20:03	642021	(EPA 524.2)	Toluene-d8	95	%		1
	SM4500CN-F - Cyanide							
	03/02/2012 00:32	641764	(SM4500CN-F)	Cyanide	ND	mg/L	0.025	1
	SM 4500F-C - Fluoride							
	03/06/2012 17:43	642142	(SM 4500F-C)	Fluoride	0.27	mg/L	0.05	1
	SM 2320B - Alkalinity in CaCO3 units							
	03/01/2012 15:47	641785	(SM 2320B)	Alkalinity in CaCO3 units	64	mg/L	2	1
	SM4500-HB - PH (H3=past HT not compliant)							
	03/01/2012 15:47	641804	(SM4500-HB)	PH (H3=past HT not compliant)	8.2	Units	0.1	1
	EPA 180.1 - Turbidity							
	03/01/2012 09:44	641851	(EPA 180.1)	Turbidity	0.51	NTU	0.05	1
	SM2510B - Specific Conductance							

Rounding on totals after summation.
(c) - indicates calculated results

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory Data
Report: 389611

Tom Nance Water Resource Engineering
Tom Nance
560 N. Nimitz Hwy. - Suite 213
Honolulu, HI 96817

Samples Received on:
02/29/2012

Prepared	Analyzed	QC Ref #	Method	Analyte	Result	Units	MRL	Dilution
	03/01/2012 15:47	641806	(SM2510B)	Specific Conductance, 25 C	180	umho/cm	2	1

TRAVEL BLANK (201202290207) **Sampled on 02/28/2012 0800**

EPA 524.2 - Volatile Organics by GCMS

Prepared	Analyzed	QC Ref #	Method	Analyte	Result	Units	MRL	Dilution
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	1,1,1,2-Tetrachloroethane	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	1,1,1-Trichloroethane	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	1,1,2,2-Tetrachloroethane	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	1,1,2-Trichloroethane	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	1,1-Dichloroethane	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	1,1-Dichloroethylene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	1,1-Dichloropropene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	1,2,3-Trichlorobenzene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	1,2,3-Trichloropropane	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	1,2,4-Trichlorobenzene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	1,2,4-Trimethylbenzene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	1,2-Dichloroethane	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	1,2-Dichloropropane	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	1,3,5-Trimethylbenzene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	1,3-Dichloropropane	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	2,2-Dichloropropane	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	2-Butanone (MEK)	ND	ug/L	5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	4-Methyl-2-Pentanone (MIBK)	ND	ug/L	5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	Benzene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	Bromobenzene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	Bromochloromethane	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	Bromodichloromethane	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	Bromoethane	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	Bromoform	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	Bromomethane (Methyl Bromide)	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	Carbon disulfide	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	Carbon Tetrachloride	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	Chlorobenzene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	Chlorodibromomethane	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	Chloroethane	ND	ug/L	0.5	1

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory Data
Report: 389611

Tom Nance Water Resource Engineering
Tom Nance
560 N. Nimitz Hwy. - Suite 213
Honolulu, HI 96817

Samples Received on:
02/29/2012

Prepared	Analyzed	QC Ref #	Method	Analyte	Result	Units	MRL	Dilution
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	Chloroform (Trichloromethane)	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	Chloromethane(Methyl Chloride)	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	cis-1,2-Dichloroethylene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	cis-1,3-Dichloropropene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	Dibromomethane	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	Dichlorodifluoromethane	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	Dichloromethane	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	Di-isopropyl ether	ND	ug/L	3	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	Ethyl benzene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	Hexachlorobutadiene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	Isopropylbenzene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	m,p-Xylenes	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	m-Dichlorobenzene (1,3-DCB)	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	Methyl Tert-butyl ether (MTBE)	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	Naphthalene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	n-Butylbenzene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	n-Propylbenzene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	o-Chlorotoluene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	o-Dichlorobenzene (1,2-DCB)	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	o-Xylene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	p-Chlorotoluene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	p-Dichlorobenzene (1,4-DCB)	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	p-Isopropyltoluene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	sec-Butylbenzene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	Styrene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	tert-amyl Methyl Ether	ND	ug/L	3	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	tert-Butyl Ethyl Ether	ND	ug/L	3	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	tert-Butylbenzene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	Tetrachloroethylene (PCE)	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	Toluene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	Total 1,3-Dichloropropene	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	Total THM	ND	ug/L	0.5	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	Total xylenes	ND	ug/L	1	1
3/1/2012	03/01/2012 20:27	642021	(EPA 524.2)	trans-1,2-Dichloroethylene	ND	ug/L	0.5	1

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory Data
Report: 389611

Tom Nance Water Resource Engineering
Tom Nance
560 N. Nimitz Hwy. - Suite 213
Honolulu, HI 96817

Samples Received on:
02/29/2012

Prepared	Analyzed		QC Ref #	Method	Analyte	Result	Units	MRL	Dilution
3/1/2012	03/01/2012	20:27	642021	(EPA 524.2)	trans-1,3-Dichloropropene	ND	ug/L	0.5	1
3/1/2012	03/01/2012	20:27	642021	(EPA 524.2)	Trichloroethylene (TCE)	ND	ug/L	0.5	1
3/1/2012	03/01/2012	20:27	642021	(EPA 524.2)	Trichlorofluoromethane	ND	ug/L	0.5	1
3/1/2012	03/01/2012	20:27	642021	(EPA 524.2)	Trichlorotrifluoroethane(Freon 113)	ND	ug/L	0.5	1
3/1/2012	03/01/2012	20:27	642021	(EPA 524.2)	Vinyl chloride (VC)	ND	ug/L	0.3	1
3/1/2012	03/01/2012	20:27	642021	(EPA 524.2)	1,2-Dichloroethane-d4	104	%		1
3/1/2012	03/01/2012	20:27	642021	(EPA 524.2)	4-Bromofluorobenzene	104	%		1
3/1/2012	03/01/2012	20:27	642021	(EPA 524.2)	Toluene-d8	99	%		1

Rounding on totals after summation.
(c) - indicates calculated results

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory Comments
Report: #389611

Tom Nance Water Resource Engineering
Tom Nance
560 N. Nimitz Hwy. - Suite 213
Honolulu, HI 96817

The Comments Report may be blank if there are no comments for this report.

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Tom Nance Water Resource Engineering

QC Ref # 641518 - Nitrate, Nitrite by EPA 300.0 — **Analysis Date: 03/01/2012**
201202290206 Keopu Well — Analyzed by: SXK

QC Ref # 641635 - ICPMS Metals — **Analysis Date: 03/02/2012**
201202290206 Keopu Well — Analyzed by: DYH

QC Ref # 641764 - Cyanide — **Analysis Date: 03/02/2012**
201202290206 Keopu Well — Analyzed by: QMK

QC Ref # 641785 - Alkalinity in CaCO3 units — **Analysis Date: 03/01/2012**
201202290206 Keopu Well — Analyzed by: CYP

QC Ref # 641804 - PH (H3=past HT not compliant) — **Analysis Date: 03/01/2012**
201202290206 Keopu Well — Analyzed by: CYP

QC Ref # 641806 - Specific Conductance — **Analysis Date: 03/01/2012**
201202290206 Keopu Well — Analyzed by: CYP

QC Ref # 641851 - Turbidity — **Analysis Date: 03/01/2012**
201202290206 Keopu Well — Analyzed by: NEM

QC Ref # 642021 - Volatile Organics by GCMS — **Analysis Date: 03/01/2012**
201202290206 Keopu Well — Analyzed by: KAM
201202290207 TRAVEL BLANK — Analyzed by: KAM

QC Ref # 642142 - Fluoride — **Analysis Date: 03/06/2012**
201202290206 Keopu Well — Analyzed by: KXS

QC Ref # 642147 - Aldicarbs — **Analysis Date: 03/03/2012**
201202290206 Keopu Well — Analyzed by: XWO

QC Ref # 642315 - Diquat and Paraquat — **Analysis Date: 03/06/2012**
201202290206 Keopu Well — Analyzed by: SZZ

QC Ref # 642335 - ICPMS Metals — **Analysis Date: 03/07/2012**
201202290206 Keopu Well — Analyzed by: VXT

QC Ref # 642407 - Organochlorine Pesticides/PCBs — **Analysis Date: 03/05/2012**
201202290206 Keopu Well — Analyzed by: ARH

QC Ref # 642518 - Chlorophenoxy Herbicides — **Analysis Date: 03/09/2012**
201202290206 Keopu Well — Analyzed by: HETAL

QC Ref # 642527 - Glyphosate — **Analysis Date: 03/07/2012**
201202290206 Keopu Well — Analyzed by: SZZ

QC Ref # 642560 - Endothall — **Analysis Date: 03/07/2012**
201202290206 Keopu Well — Analyzed by: CRW

QC Ref # 642808 - EPA Method 504.1 — **Analysis Date: 03/09/2012**
201202290206 Keopu Well — Analyzed by: HETAL

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Tom Nance Water Resource Engineering
(continued)

QC Ref # 642855 - 2,3,7,8-TCDD_Dioxin — **Analysis Date: 03/08/2012**
201202290206 Keopu Well — Analyzed by: PAC

QC Ref # 642969 - ICP Metals — **Analysis Date: 03/09/2012**
201202290206 Keopu Well — Analyzed by: NINA

QC Ref # 643399 - Gross Alpha/Beta Radiation — **Analysis Date: 03/12/2012**
201202290206 Keopu Well — Analyzed by: MAL

QC Ref # 643417 - Semivolatiles by GCMS — **Analysis Date: 03/13/2012**
201202290206 Keopu Well — Analyzed by: JWC

QC Ref # 644505 - Mercury Total — **Analysis Date: 03/20/2012**
201202290206 Keopu Well — Analyzed by: MXT

QC Ref # 645813 - Asbestos by TEM - >10 microns — **Analysis Date: 03/28/2012**
201202290206 Keopu Well — Analyzed by: CJB

QC Ref # 647427 - Radium 226 — **Analysis Date: 04/08/2012**
201202290206 Keopu Well — Analyzed by: WBH

QC Ref # 647432 - Radium 228 — **Analysis Date: 04/08/2012**
201202290206 Keopu Well — Analyzed by: WBH

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory
QC Report: 389611

Tom Nance Water Resource Engineering

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
QC Ref# 641518 - Nitrate, Nitrite by EPA 300.0 by EPA 300.0						**Analysis Date: 02/29/2012**			
LCS1	Nitrate as Nitrogen by IC		2.5	2.42	mg/L	97	(90-110)		
LCS2	Nitrate as Nitrogen by IC		2.5	2.42	mg/L	97	(90-110)	20	0.0
MBLK	Nitrate as Nitrogen by IC			<0.10	mg/L				
MRL_CHK	Nitrate as Nitrogen by IC		0.05	0.0503	mg/L	101	(50-150)		
MRLLW	Nitrate as Nitrogen by IC		0.013	0.0155	mg/L	124	(50-150)		
MS_201202290199	Nitrate as Nitrogen by IC	6.6	1.3	9.28	mg/L	105	(80-120)		
MS_201202280556	Nitrate as Nitrogen by IC	5.0	1.3	7.59	mg/L	104	(80-120)		
MSD_201202280556	Nitrate as Nitrogen by IC	5.0	1.3	7.66	mg/L	107	(80-120)	20	0.92
MSD_201202290199	Nitrate as Nitrogen by IC	6.6	1.3	9.24	mg/L	104	(80-120)	20	0.43
LCS1	Nitrite Nitrogen by IC		1.0	0.943	mg/L	94	(90-110)		
LCS2	Nitrite Nitrogen by IC		1.0	0.943	mg/L	94	(90-110)	20	0.0
MBLK	Nitrite Nitrogen by IC			<0.10	mg/L				
MRL_CHK	Nitrite Nitrogen by IC		0.05	0.0468	mg/L	94	(50-150)		
MRLLW	Nitrite Nitrogen by IC		0.013	0.0123	mg/L	98	(50-150)		
MS_201202280556	Nitrite Nitrogen by IC	ND	0.5	0.927	mg/L	93	(80-120)		
MS_201202290199	Nitrite Nitrogen by IC	ND	0.5	0.924	mg/L	92	(80-120)		
MSD_201202290199	Nitrite Nitrogen by IC	ND	0.5	0.924	mg/L	92	(80-120)	20	0.0
MSD_201202280556	Nitrite Nitrogen by IC	ND	0.5	0.943	mg/L	94	(80-120)	20	1.7
QC Ref# 641635 - ICPMS Metals by EPA 200.8						**Analysis Date: 03/02/2012**			
LCS1	Antimony Total ICAP/MS		50	54.3	ug/L	109	(85-115)		
LCS2	Antimony Total ICAP/MS		50	52.4	ug/L	105	(85-115)	20	3.6
MBLK	Antimony Total ICAP/MS			<1	ug/L				
MRL_CHK	Antimony Total ICAP/MS		1.0	0.964	ug/L	96	(50-150)		
MS_201202290144	Antimony Total ICAP/MS	ND	50	50.8	ug/L	101	(70-130)		
MS2_201202290204	Antimony Total ICAP/MS	ND	50	52.4	ug/L	105	(70-130)		
MSD_201202290144	Antimony Total ICAP/MS	ND	50	53.1	ug/L	106	(70-130)	20	4.4
MSD2_201202290204	Antimony Total ICAP/MS	ND	50	54.7	ug/L	109	(70-130)	20	4.3
LCS1	Arsenic Total ICAP/MS		20	20.1	ug/L	101	(85-115)		
LCS2	Arsenic Total ICAP/MS		20	19.8	ug/L	99	(85-115)	20	1.5
MBLK	Arsenic Total ICAP/MS			<1	ug/L				
MRL_CHK	Arsenic Total ICAP/MS		1.0	0.960	ug/L	96	(50-150)		
MS_201202290144	Arsenic Total ICAP/MS	ND	20	19.6	ug/L	98	(70-130)		
MS2_201202290204	Arsenic Total ICAP/MS	ND	20	19.9	ug/L	96	(70-130)		
MSD_201202290144	Arsenic Total ICAP/MS	ND	20	20.1	ug/L	100	(70-130)	20	2.5

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
(S) Indicates surrogate compound.
(I) Indicates internal standard compound.
RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory
QC Report: 389611

Tom Nance Water Resources Engineering
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
MSD2_201202290204	Arsenic Total ICAP/MS	ND	20	20.6	ug/L	99	(70-130)	20	3.0
LCS1	Barium Total ICAP/MS		100	99.4	ug/L	99	(85-115)		
LCS2	Barium Total ICAP/MS		100	97.2	ug/L	97	(85-115)	20	2.2
MBLK	Barium Total ICAP/MS			<2	ug/L				
MRL_CHK	Barium Total ICAP/MS		2.0	1.99	ug/L	100	(50-150)		
MS_201202290144	Barium Total ICAP/MS	6.0	100	98.1	ug/L	92	(70-130)		
MS2_201202290204	Barium Total ICAP/MS	29	100	120	ug/L	90	(70-130)		
MSD_201202290144	Barium Total ICAP/MS	6.0	100	102	ug/L	96	(70-130)	20	3.9
MSD2_201202290204	Barium Total ICAP/MS	29	100	124	ug/L	95	(70-130)	20	3.3
LCS1	Beryllium Total ICAP/MS		5.0	5.02	ug/L	100	(85-115)		
LCS2	Beryllium Total ICAP/MS		5.0	5.02	ug/L	100	(85-115)	20	0.0
MBLK	Beryllium Total ICAP/MS			<1	ug/L				
MRL_CHK	Beryllium Total ICAP/MS		1.0	0.952	ug/L	95	(50-150)		
MS_201202290144	Beryllium Total ICAP/MS	ND	5.0	4.9	ug/L	98	(70-130)		
MS2_201202290204	Beryllium Total ICAP/MS	ND	5.0	4.95	ug/L	99	(70-130)		
MSD_201202290144	Beryllium Total ICAP/MS	ND	5.0	5.11	ug/L	102	(70-130)	20	4.2
MSD2_201202290204	Beryllium Total ICAP/MS	ND	5.0	5.05	ug/L	101	(70-130)	20	2.0
LCS1	Cadmium Total ICAP/MS		20	19.9	ug/L	99	(85-115)		
LCS2	Cadmium Total ICAP/MS		20	19.5	ug/L	98	(85-115)	20	2.0
MBLK	Cadmium Total ICAP/MS			<0.5	ug/L				
MRL_CHK	Cadmium Total ICAP/MS		0.5	0.471	ug/L	94	(50-150)		
MS_201202290144	Cadmium Total ICAP/MS	ND	20	19.1	ug/L	96	(70-130)		
MS2_201202290204	Cadmium Total ICAP/MS	ND	20	18.2	ug/L	91	(70-130)		
MSD_201202290144	Cadmium Total ICAP/MS	ND	20	20.0	ug/L	100	(70-130)	20	4.6
MSD2_201202290204	Cadmium Total ICAP/MS	ND	20	18.8	ug/L	94	(70-130)	20	3.2
LCS1	Chromium Total ICAP/MS		100	106	ug/L	106	(85-115)		
LCS2	Chromium Total ICAP/MS		100	104	ug/L	104	(85-115)	20	1.9
MBLK	Chromium Total ICAP/MS			<1	ug/L				
MRL_CHK	Chromium Total ICAP/MS		1.0	1.02	ug/L	102	(50-150)		
MS_201202290144	Chromium Total ICAP/MS	ND	100	97.5	ug/L	97	(70-130)		
MS2_201202290204	Chromium Total ICAP/MS	27	100	121	ug/L	94	(70-130)		
MSD_201202290144	Chromium Total ICAP/MS	ND	100	99.9	ug/L	100	(70-130)	20	2.4
MSD2_201202290204	Chromium Total ICAP/MS	27	100	124	ug/L	97	(70-130)	20	2.5
LCS1	Copper Total ICAP/MS		100	102	ug/L	102	(85-115)		
LCS2	Copper Total ICAP/MS		100	101	ug/L	101	(85-115)	20	0.99

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
(S) Indicates surrogate compound.
(I) Indicates internal standard compound.
RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory
QC Report: 389611

Tom Nance Water Resources Engineering
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
MBLK	Copper Total ICAP/MS			<2	ug/L				
MRL_CHK	Copper Total ICAP/MS		2.0	1.95	ug/L	98	(50-150)		
MS_201202290144	Copper Total ICAP/MS	ND	100	94.3	ug/L	93	(70-130)		
MS2_201202290204	Copper Total ICAP/MS	ND	100	88.0	ug/L	88	(70-130)		
MSD_201202290144	Copper Total ICAP/MS	ND	100	96.7	ug/L	96	(70-130)	20	2.5
MSD2_201202290204	Copper Total ICAP/MS	ND	100	90.3	ug/L	90	(70-130)	20	2.6
LCS1	Lead Total ICAP/MS		20	20.1	ug/L	100	(85-115)		
LCS2	Lead Total ICAP/MS		20	19.5	ug/L	98	(85-115)	20	3.0
MBLK	Lead Total ICAP/MS			<0.5	ug/L				
MRL_CHK	Lead Total ICAP/MS		0.5	0.464	ug/L	93	(50-150)		
MS_201202290144	Lead Total ICAP/MS	ND	20	18.3	ug/L	91	(70-130)		
MS2_201202290204	Lead Total ICAP/MS	ND	20	17.4	ug/L	87	(70-130)		
MSD_201202290144	Lead Total ICAP/MS	ND	20	19.1	ug/L	95	(70-130)	20	4.3
MSD2_201202290204	Lead Total ICAP/MS	ND	20	18.2	ug/L	91	(70-130)	20	4.5
LCS1	Nickel Total ICAP/MS		50	50.0	ug/L	100	(85-115)		
LCS2	Nickel Total ICAP/MS		50	48.9	ug/L	98	(85-115)	20	2.4
MBLK	Nickel Total ICAP/MS			<5	ug/L				
MRL_CHK	Nickel Total ICAP/MS		5.0	4.85	ug/L	97	(50-150)		
MS_201202290144	Nickel Total ICAP/MS	ND	50	45.6	ug/L	91	(70-130)		
MS2_201202290204	Nickel Total ICAP/MS	ND	50	43.5	ug/L	85	(70-130)		
MSD_201202290144	Nickel Total ICAP/MS	ND	50	46.6	ug/L	93	(70-130)	20	2.2
MSD2_201202290204	Nickel Total ICAP/MS	ND	50	44.4	ug/L	87	(70-130)	20	2.0
LCS1	Selenium Total ICAP/MS		20	21.6	ug/L	108	(85-115)		
LCS2	Selenium Total ICAP/MS		20	21.2	ug/L	106	(85-115)	20	1.9
MBLK	Selenium Total ICAP/MS			<5	ug/L				
MRL_CHK	Selenium Total ICAP/MS		5.0	5.26	ug/L	105	(50-150)		
MS_201202290144	Selenium Total ICAP/MS	ND	20	23.2	ug/L	114	(70-130)		
MS2_201202290204	Selenium Total ICAP/MS	ND	20	21.9	ug/L	106	(70-130)		
MSD_201202290144	Selenium Total ICAP/MS	ND	20	24.1	ug/L	119	(70-130)	20	3.8
MSD2_201202290204	Selenium Total ICAP/MS	ND	20	22.5	ug/L	109	(70-130)	20	2.7
LCS1	Thallium Total ICAP/MS		20	22.3	ug/L	112	(85-115)		
LCS2	Thallium Total ICAP/MS		20	21.6	ug/L	108	(85-115)	20	3.2
MBLK	Thallium Total ICAP/MS			<1	ug/L				
MRL_CHK	Thallium Total ICAP/MS		1.0	0.960	ug/L	96	(50-150)		
MS_201202290144	Thallium Total ICAP/MS	ND	20	20.6	ug/L	103	(70-130)		

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
(S) Indicates surrogate compound.
(I) Indicates internal standard compound.
RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory
QC Report: 389611

Tom Nance Water Resources Engineering
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
MS2_201202290204	Thallium Total ICAP/MS	ND	20	19.4	ug/L	97	(70-130)		
MSD_201202290144	Thallium Total ICAP/MS	ND	20	21.3	ug/L	106	(70-130)	20	3.3
MSD2_201202290204	Thallium Total ICAP/MS	ND	20	20.4	ug/L	102	(70-130)	20	5.0
LCS1	Uranium ICAP/MS		20	22.4	ug/L	112	(85-115)		
LCS2	Uranium ICAP/MS		20	21.8	ug/L	109	(85-115)	20	2.7
MBLK	Uranium ICAP/MS			<1	ug/L				
MRL_CHK	Uranium ICAP/MS		1.0	0.834	ug/L	83	(50-150)		
MS_201202290144	Uranium ICAP/MS		20	21.7	ug/L	108	(70-130)		
MS2_201202290204	Uranium ICAP/MS		20	22.1	ug/L	110	(70-130)		
MSD_201202290144	Uranium ICAP/MS		20	22.6	ug/L	113	(70-130)	20	4.1
MSD2_201202290204	Uranium ICAP/MS		20	23.2	ug/L	116	(70-130)	20	4.9

QC Ref# 641764 - Cyanide by SM4500CN-F **Analysis Date: 03/01/2012**

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
LCS1	Cyanide		0.1	0.0954	mg/L	95	(80-120)		
LCS2	Cyanide		0.1	0.0904	mg/L	90	(80-120)	20	3.3
MBLK	Cyanide			<0.025	mg/L				
MRL_CHK	Cyanide		0.025	0.0256	mg/L	102	(50-150)		
MS_201202280122	Cyanide	ND	0.1	0.0921	mg/L	87	(80-120)		
MS_201202290377	Cyanide	ND	0.1	0.0908	mg/L	85	(80-120)		
MSD_201202280122	Cyanide	ND	0.1	0.0976	mg/L	92	(80-120)	20	5.8

QC Ref# 641785 - Alkalinity in CaCO3 units by SM 2320B **Analysis Date: 03/01/2012**

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
LCS1	Alkalinity in CaCO3 units		100	94.4	mg/L	94	(90-110)		
LCS2	Alkalinity in CaCO3 units		100	97.6	mg/L	98	(90-110)	20	3.3
MBLK	Alkalinity in CaCO3 units			<2	mg/L				
MRL_CHK	Alkalinity in CaCO3 units		2.0	1.96	mg/L	98	(50-150)		
MS_201202280173	Alkalinity in CaCO3 units	220	100	321	mg/L	98	(80-120)		
MS_201202280500	Alkalinity in CaCO3 units	130	100	224	mg/L	97	(80-120)		
MSD_201202280500	Alkalinity in CaCO3 units	130	100	224	mg/L	97	(80-120)	20	0.0
MSD_201202280173	Alkalinity in CaCO3 units	220	100	321	mg/L	98	(80-120)	20	0.0

QC Ref# 641804 - PH (H3=past HT not compliant) by SM4500-HB **Analysis Date: 03/01/2012**

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
DUP_201202280173	PH (H3=past HT not compliant)	7.5		7.55	Units		(0-20)	20	0.24
DUP_201202280500	PH (H3=past HT not compliant)	8.0		7.98	Units		(0-20)	20	0.14
LCS1	PH (H3=past HT not compliant)		6.0	6.00	Units	100	(98-102)		
LCS2	PH (H3=past HT not compliant)		6.0	5.99	Units	100	(98-102)	20	0.17

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
(S) Indicates surrogate compound.
(I) Indicates internal standard compound.
RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Tom Nance Water Resources Engineering
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%

QC Ref# 641806 - Specific Conductance by SM2510B **Analysis Date: 03/01/2012**

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
DUP1_201202280500	Specific Conductance	280		284	umho/cm		(0-20)	20	0.25
LCS1	Specific Conductance		1000	988	umho/cm	99	(95-105)		
LCS2	Specific Conductance		1000	986	umho/cm	99	(95-105)	20	0.20
MBLK	Specific Conductance			<2	umho/cm				
MRL_CHK	Specific Conductance		2.0	2.00	umho/cm	100	(50-150)		

QC Ref# 641851 - Turbidity by EPA 180.1 **Analysis Date: 03/01/2012**

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
DUP1_201202290070	Turbidity	0.058		0.0590	NTU		(0-10)	10	1.7
DUP2_201202290150	Turbidity	0.27		0.270	NTU		(0-10)	10	0.74
LCS1	Turbidity		20	20.8	NTU	104	(90-110)		
LCS2	Turbidity		20	20.9	NTU	105	(90-110)	20	0.48
MBLK	Turbidity			<0.05	NTU				
MRL_CHK	Turbidity		0.05	0.0560	NTU	112	(50-150)		

QC Ref# 642021 - Volatile Organics by GCMS by EPA 524.2 **Analysis Date: 03/01/2012**

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
LCS1	1,1,1,2-Tetrachloroethane		5.0	5.83	ug/L	117	(70-130)		
LCS2	1,1,1,2-Tetrachloroethane		5.0	5.4	ug/L	108	(70-130)	20	7.7
MBLK	1,1,1,2-Tetrachloroethane			<0.25	ug/L				
MRL_CHK	1,1,1,2-Tetrachloroethane		0.5	0.450	ug/L	90	(50-150)		
LCS1	1,1,1-Trichloroethane		5.0	5.4	ug/L	108	(70-130)		
LCS2	1,1,1-Trichloroethane		5.0	5.04	ug/L	101	(70-130)	20	6.9
MBLK	1,1,1-Trichloroethane			<0.25	ug/L				
MRL_CHK	1,1,1-Trichloroethane		0.5	0.480	ug/L	96	(50-150)		
LCS1	1,1,2,2-Tetrachloroethane		5.0	5.71	ug/L	114	(70-130)		
LCS2	1,1,2,2-Tetrachloroethane		5.0	5.64	ug/L	113	(70-130)	20	1.2
MBLK	1,1,2,2-Tetrachloroethane			<0.25	ug/L				
MRL_CHK	1,1,2,2-Tetrachloroethane		0.5	0.540	ug/L	108	(50-150)		
LCS1	1,1,2-Trichloroethane		5.0	4.93	ug/L	99	(70-130)		
LCS2	1,1,2-Trichloroethane		5.0	4.87	ug/L	97	(70-130)	20	1.2
MBLK	1,1,2-Trichloroethane			<0.25	ug/L				
MRL_CHK	1,1,2-Trichloroethane		0.5	0.430	ug/L	86	(50-150)		
LCS1	1,1-Dichloroethane		5.0	6.29	ug/L	126	(70-130)		
LCS2	1,1-Dichloroethane		5.0	6.06	ug/L	121	(70-130)	20	3.7
MBLK	1,1-Dichloroethane			<0.25	ug/L				
MRL_CHK	1,1-Dichloroethane		0.5	0.590	ug/L	118	(50-150)		

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
(S) Indicates surrogate compound.
(I) Indicates internal standard compound.
RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory
QC Report: 389611

Tom Nance Water Resources Engineering
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
LCS1	1,1-Dichloroethylene		5.0	5.68	ug/L	114	(70-130)		
LCS2	1,1-Dichloroethylene		5.0	5.23	ug/L	105	(70-130)	20	8.3
MBLK	1,1-Dichloroethylene			<0.25	ug/L				
MRL_CHK	1,1-Dichloroethylene		0.5	0.480	ug/L	96	(50-150)		
LCS1	1,1-Dichloropropene		5.0	4.96	ug/L	99	(70-130)		
LCS2	1,1-Dichloropropene		5.0	4.77	ug/L	95	(70-130)	20	3.9
MBLK	1,1-Dichloropropene			<0.25	ug/L				
MRL_CHK	1,1-Dichloropropene		0.5	0.420	ug/L	84	(50-150)		
LCS1	1,2,3-Trichlorobenzene		5.0	5.48	ug/L	110	(70-130)		
LCS2	1,2,3-Trichlorobenzene		5.0	5.45	ug/L	109	(70-130)	20	0.55
MBLK	1,2,3-Trichlorobenzene			<0.25	ug/L				
MRL_CHK	1,2,3-Trichlorobenzene		0.5	0.510	ug/L	102	(50-150)		
LCS1	1,2,3-Trichloropropane		5.0	5.44	ug/L	109	(70-130)		
LCS2	1,2,3-Trichloropropane		5.0	5.62	ug/L	112	(70-130)	20	3.3
MBLK	1,2,3-Trichloropropane			<0.25	ug/L				
MRL_CHK	1,2,3-Trichloropropane		0.5	0.500	ug/L	100	(50-150)		
LCS1	1,2,4-Trichlorobenzene		5.0	5.13	ug/L	103	(70-130)		
LCS2	1,2,4-Trichlorobenzene		5.0	5.22	ug/L	104	(70-130)	20	1.7
MBLK	1,2,4-Trichlorobenzene			<0.25	ug/L				
MRL_CHK	1,2,4-Trichlorobenzene		0.5	0.520	ug/L	104	(50-150)		
LCS1	1,2,4-Trimethylbenzene		5.0	5.93	ug/L	119	(70-130)		
LCS2	1,2,4-Trimethylbenzene		5.0	5.68	ug/L	114	(70-130)	20	4.3
MBLK	1,2,4-Trimethylbenzene			<0.25	ug/L				
MRL_CHK	1,2,4-Trimethylbenzene		0.5	0.500	ug/L	100	(50-150)		
LCS1	1,2-Dichloroethane		5.0	5.18	ug/L	104	(70-130)		
LCS2	1,2-Dichloroethane		5.0	4.78	ug/L	96	(70-130)	20	8.0
MBLK	1,2-Dichloroethane			<0.25	ug/L				
MRL_CHK	1,2-Dichloroethane		0.5	0.460	ug/L	92	(50-150)		
LCS1	1,2-Dichloroethane-d4 (S)			99.4	%	99	(70-130)		
LCS2	1,2-Dichloroethane-d4 (S)			96.6	%	97	(70-130)		
MBLK	1,2-Dichloroethane-d4 (S)			97.8	%	98	(70-130)		
MRL_CHK	1,2-Dichloroethane-d4 (S)			104	%	104	(70-130)		
MRLLW	1,2-Dichloroethane-d4 (S)			100	%	100	(70-130)		
LCS1	1,2-Dichloropropane		5.0	5.00	ug/L	100	(70-130)		
LCS2	1,2-Dichloropropane		5.0	4.48	ug/L	90	(70-130)	20	11

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
(S) Indicates surrogate compound.
(I) Indicates internal standard compound.
RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory
QC Report: 389611

Tom Nance Water Resources Engineering
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
MBLK	1,2-Dichloropropane			<0.25	ug/L				
MRL_CHK	1,2-Dichloropropane		0.5	0.480	ug/L	96	(50-150)		
LCS1	1,3,5-Trimethylbenzene		5.0	5.92	ug/L	118	(70-130)		
LCS2	1,3,5-Trimethylbenzene		5.0	6.02	ug/L	120	(70-130)	20	1.7
MBLK	1,3,5-Trimethylbenzene			<0.25	ug/L				
MRL_CHK	1,3,5-Trimethylbenzene		0.5	0.510	ug/L	102	(50-150)		
LCS1	1,3-Dichloropropane		5.0	5.27	ug/L	105	(70-130)		
LCS2	1,3-Dichloropropane		5.0	4.85	ug/L	97	(70-130)	20	8.3
MBLK	1,3-Dichloropropane			<0.25	ug/L				
MRL_CHK	1,3-Dichloropropane		0.5	0.500	ug/L	100	(50-150)		
LCS1	2,2-Dichloropropane		5.0	5.27	ug/L	105	(70-130)		
LCS2	2,2-Dichloropropane		5.0	4.78	ug/L	96	(70-130)	20	9.8
MBLK	2,2-Dichloropropane			<0.25	ug/L				
MRL_CHK	2,2-Dichloropropane		0.5	0.450	ug/L	90	(50-150)		
LCS1	2-Butanone (MEK)		50	48.3	ug/L	97	(70-130)		
LCS2	2-Butanone (MEK)		50	43.9	ug/L	88	(70-130)	20	9.5
MBLK	2-Butanone (MEK)			<2.5	ug/L				
MRL_CHK	2-Butanone (MEK)		5.0	4.41	ug/L	88	(50-150)		
LCS1	4-Bromofluorobenzene (S)			103	%	103	(70-130)		
LCS2	4-Bromofluorobenzene (S)			105	%	105	(70-130)		
MBLK	4-Bromofluorobenzene (S)			105	%	105	(70-130)		
MRL_CHK	4-Bromofluorobenzene (S)			101	%	101	(70-130)		
MRLLW	4-Bromofluorobenzene (S)			103	%	103	(70-130)		
LCS1	4-Methyl-2-Pentanone (MIBK)		50	55.2	ug/L	110	(70-130)		
LCS2	4-Methyl-2-Pentanone (MIBK)		50	50.1	ug/L	100	(70-130)	20	9.7
MBLK	4-Methyl-2-Pentanone (MIBK)			<2.5	ug/L				
MRL_CHK	4-Methyl-2-Pentanone (MIBK)		5.0	4.91	ug/L	98	(50-150)		
LCS1	Benzene		5.0	5.26	ug/L	105	(70-130)		
LCS2	Benzene		5.0	4.81	ug/L	96	(70-130)	20	8.9
MBLK	Benzene			<0.25	ug/L				
MRL_CHK	Benzene		0.5	0.470	ug/L	94	(50-150)		
LCS1	Bromobenzene		5.0	5.53	ug/L	111	(70-130)		
LCS2	Bromobenzene		5.0	5.52	ug/L	110	(70-130)	20	0.18
MBLK	Bromobenzene			<0.25	ug/L				
MRL_CHK	Bromobenzene		0.5	0.500	ug/L	100	(50-150)		

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
(S) Indicates surrogate compound.
(I) Indicates internal standard compound.
RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory
QC Report: 389611

Tom Nance Water Resources Engineering
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
LCS1	Bromochloromethane		5.0	5.13	ug/L	103	(70-130)		
LCS2	Bromochloromethane		5.0	4.81	ug/L	96	(70-130)	20	6.4
MBLK	Bromochloromethane			<0.25	ug/L				
MRL_CHK	Bromochloromethane		0.5	0.470	ug/L	94	(50-150)		
LCS1	Bromodichloromethane		5.0	5.27	ug/L	105	(70-130)		
LCS2	Bromodichloromethane		5.0	4.73	ug/L	95	(70-130)	20	11
MBLK	Bromodichloromethane			<0.25	ug/L				
MRL_CHK	Bromodichloromethane		0.5	0.420	ug/L	84	(50-150)		
LCS1	Bromoethane		5.0	5.53	ug/L	111	(70-130)		
LCS2	Bromoethane		5.0	5.2	ug/L	104	(70-130)	20	6.2
MBLK	Bromoethane			<0.25	ug/L				
MRL_CHK	Bromoethane		0.5	0.510	ug/L	102	(50-150)		
LCS1	Bromoform		5.0	5.81	ug/L	116	(70-130)		
LCS2	Bromoform		5.0	5.48	ug/L	110	(70-130)	20	5.8
MBLK	Bromoform			<0.25	ug/L				
MRL_CHK	Bromoform		0.5	0.460	ug/L	92	(50-150)		
LCS1	Bromomethane (Methyl Bromide)		5.0	6.13	ug/L	123	(70-130)		
LCS2	Bromomethane (Methyl Bromide)		5.0	5.4	ug/L	108	(70-130)	20	13
MBLK	Bromomethane (Methyl Bromide)			<0.25	ug/L				
MRL_CHK	Bromomethane (Methyl Bromide)		0.5	0.680	ug/L	136	(50-150)		
LCS1	Carbon disulfide		5.0	5.42	ug/L	108	(70-130)		
LCS2	Carbon disulfide		5.0	4.98	ug/L	100	(70-130)	20	8.5
MBLK	Carbon disulfide			<0.25	ug/L				
MRL_CHK	Carbon disulfide		0.5	0.510	ug/L	102	(50-150)		
LCS1	Carbon Tetrachloride		5.0	5.72	ug/L	114	(70-130)		
LCS2	Carbon Tetrachloride		5.0	5.21	ug/L	104	(70-130)	20	9.3
MBLK	Carbon Tetrachloride			<0.25	ug/L				
MRL_CHK	Carbon Tetrachloride		0.5	0.430	ug/L	86	(50-150)		
LCS1	Chlorobenzene		5.0	5.44	ug/L	109	(70-130)		
LCS2	Chlorobenzene		5.0	5.08	ug/L	102	(70-130)	20	6.8
MBLK	Chlorobenzene			<0.25	ug/L				
MRL_CHK	Chlorobenzene		0.5	0.520	ug/L	104	(50-150)		
LCS1	Chlorodibromomethane		5.0	5.31	ug/L	106	(70-130)		
LCS2	Chlorodibromomethane		5.0	4.94	ug/L	99	(70-130)	20	7.2
MBLK	Chlorodibromomethane			<0.25	ug/L				

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
(S) Indicates surrogate compound.
(I) Indicates internal standard compound.
RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Tom Nance Water Resources Engineering
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
MRL_CHK	Chlorodibromomethane		0.5	0.440	ug/L	88	(50-150)		
LCS1	Chloroethane		5.0	5.53	ug/L	111	(70-130)		
LCS2	Chloroethane		5.0	5.2	ug/L	104	(70-130)	20	6.2
MBLK	Chloroethane			<0.25	ug/L				
MRL_CHK	Chloroethane		0.5	0.440	ug/L	88	(50-150)		
LCS1	Chloroform (Trichloromethane)		5.0	5.26	ug/L	105	(70-130)		
LCS2	Chloroform (Trichloromethane)		5.0	4.97	ug/L	99	(70-130)	20	5.7
MBLK	Chloroform (Trichloromethane)			<0.25	ug/L				
MRL_CHK	Chloroform (Trichloromethane)		0.5	0.420	ug/L	84	(50-150)		
LCS1	Chloromethane(Methyl Chloride)		5.0	5.24	ug/L	105	(70-130)		
LCS2	Chloromethane(Methyl Chloride)		5.0	4.66	ug/L	93	(70-130)	20	12
MBLK	Chloromethane(Methyl Chloride)			<0.25	ug/L				
MRL_CHK	Chloromethane(Methyl Chloride)		0.5	0.600	ug/L	120	(50-150)		
LCS1	cis-1,2-Dichloroethylene		5.0	5.04	ug/L	101	(70-130)		
LCS2	cis-1,2-Dichloroethylene		5.0	4.91	ug/L	98	(70-130)	20	2.6
MBLK	cis-1,2-Dichloroethylene			<0.25	ug/L				
MRL_CHK	cis-1,2-Dichloroethylene		0.5	0.370	ug/L	74	(50-150)		
LCS1	cis-1,3-Dichloropropene		5.0	5.21	ug/L	104	(70-130)		
LCS2	cis-1,3-Dichloropropene		5.0	4.75	ug/L	95	(70-130)	20	9.2
MBLK	cis-1,3-Dichloropropene			<0.25	ug/L				
MRL_CHK	cis-1,3-Dichloropropene		0.5	0.430	ug/L	86	(50-150)		
LCS1	Dibromomethane		5.0	5.01	ug/L	100	(70-130)		
LCS2	Dibromomethane		5.0	4.95	ug/L	99	(70-130)	20	1.2
MBLK	Dibromomethane			<0.25	ug/L				
MRL_CHK	Dibromomethane		0.5	0.480	ug/L	96	(50-150)		
LCS1	Dichlorodifluoromethane		5.0	5.25	ug/L	105	(70-130)		
LCS2	Dichlorodifluoromethane		5.0	5.11	ug/L	102	(70-130)	20	2.7
MBLK	Dichlorodifluoromethane			<0.25	ug/L				
MRL_CHK	Dichlorodifluoromethane		0.5	0.320	ug/L	64	(50-150)		
LCS1	Dichloromethane		5.0	6.51	ug/L	130	(70-130)		
LCS2	Dichloromethane		5.0	6.12	ug/L	122	(70-130)	20	6.2
MBLK	Dichloromethane			<0.25	ug/L				
MRL_CHK	Dichloromethane		0.5	0.720	ug/L	144	(50-150)		
LCS1	Di-isopropyl ether		5.0	5.73	ug/L	115	(70-130)		
LCS2	Di-isopropyl ether		5.0	5.61	ug/L	112	(70-130)	20	2.1

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
(S) Indicates surrogate compound.
(I) Indicates internal standard compound.
RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Tom Nance Water Resources Engineering
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
MBLK	Di-isopropyl ether			<1.5	ug/L				
MRL_CHK	Di-isopropyl ether		0.5	0.530	ug/L	106	(50-150)		
LCS1	Ethyl benzene		5.0	5.46	ug/L	109	(70-130)		
LCS2	Ethyl benzene		5.0	5.21	ug/L	104	(70-130)	20	4.7
MBLK	Ethyl benzene			<0.25	ug/L				
MRL_CHK	Ethyl benzene		0.5	0.450	ug/L	90	(50-150)		
LCS1	Hexachlorobutadiene		5.0	6.31	ug/L	126	(70-130)		
LCS2	Hexachlorobutadiene		5.0	5.99	ug/L	120	(70-130)	20	5.2
MBLK	Hexachlorobutadiene			<0.25	ug/L				
MRL_CHK	Hexachlorobutadiene		0.5	0.590	ug/L	118	(50-150)		
LCS1	Isopropylbenzene		5.0	5.92	ug/L	118	(70-130)		
LCS2	Isopropylbenzene		5.0	5.68	ug/L	114	(70-130)	20	4.1
MBLK	Isopropylbenzene			<0.25	ug/L				
MRL_CHK	Isopropylbenzene		0.5	0.500	ug/L	100	(50-150)		
LCS1	m,p-Xylenes		10	11.5	ug/L	115	(70-130)		
LCS2	m,p-Xylenes		10	10.5	ug/L	105	(70-130)	20	9.1
MBLK	m,p-Xylenes			<0.25	ug/L				
MRL_CHK	m,p-Xylenes		1.0	0.910	ug/L	91	(50-150)		
MRLLW	m,p-Xylenes		0.5	0.500	ug/L	100	(50-150)		
LCS1	m-Dichlorobenzene (1,3-DCB)		5.0	5.78	ug/L	116	(70-130)		
LCS2	m-Dichlorobenzene (1,3-DCB)		5.0	5.58	ug/L	112	(70-130)	20	3.5
MBLK	m-Dichlorobenzene (1,3-DCB)			<0.25	ug/L				
MRL_CHK	m-Dichlorobenzene (1,3-DCB)		0.5	0.480	ug/L	96	(50-150)		
LCS1	Methyl Tert-butyl ether (MTBE)		5.0	5.52	ug/L	110	(70-130)		
LCS2	Methyl Tert-butyl ether (MTBE)		5.0	5.26	ug/L	105	(70-130)	20	4.8
MBLK	Methyl Tert-butyl ether (MTBE)			<0.25	ug/L				
MRL_CHK	Methyl Tert-butyl ether (MTBE)		0.5	0.530	ug/L	106	(50-150)		
LCS1	Naphthalene		5.0	4.93	ug/L	99	(70-130)		
LCS2	Naphthalene		5.0	5.1	ug/L	102	(70-130)	20	3.4
MBLK	Naphthalene			<0.25	ug/L				
MRL_CHK	Naphthalene		0.5	0.400	ug/L	80	(50-150)		
LCS1	n-Butylbenzene		5.0	5.72	ug/L	114	(70-130)		
LCS2	n-Butylbenzene		5.0	5.38	ug/L	108	(70-130)	20	6.1
MBLK	n-Butylbenzene			<0.25	ug/L				
MRL_CHK	n-Butylbenzene		0.5	0.460	ug/L	92	(50-150)		

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
(S) Indicates surrogate compound.
(I) Indicates internal standard compound.
RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory
QC Report: 389611

Tom Nance Water Resources Engineering
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
LCS1	n-Propylbenzene		5.0	5.78	ug/L	116	(70-130)		
LCS2	n-Propylbenzene		5.0	5.75	ug/L	115	(70-130)	20	0.52
MBLK	n-Propylbenzene			<0.25	ug/L				
MRL_CHK	n-Propylbenzene		0.5	0.520	ug/L	104	(50-150)		
LCS1	o-Chlorotoluene		5.0	5.75	ug/L	115	(70-130)		
LCS2	o-Chlorotoluene		5.0	5.42	ug/L	108	(70-130)	20	5.9
MBLK	o-Chlorotoluene			<0.25	ug/L				
MRL_CHK	o-Chlorotoluene		0.5	0.570	ug/L	114	(50-150)		
LCS1	o-Dichlorobenzene (1,2-DCB)		5.0	5.62	ug/L	112	(70-130)		
LCS2	o-Dichlorobenzene (1,2-DCB)		5.0	5.4	ug/L	108	(70-130)	20	4.0
MBLK	o-Dichlorobenzene (1,2-DCB)			<0.25	ug/L				
MRL_CHK	o-Dichlorobenzene (1,2-DCB)		0.5	0.510	ug/L	102	(50-150)		
LCS1	o-Xylene		5.0	5.49	ug/L	110	(70-130)		
LCS2	o-Xylene		5.0	5.17	ug/L	103	(70-130)	20	6.0
MBLK	o-Xylene			<0.25	ug/L				
MRL_CHK	o-Xylene		0.5	0.490	ug/L	98	(50-150)		
LCS1	p-Chlorotoluene		5.0	5.85	ug/L	117	(70-130)		
LCS2	p-Chlorotoluene		5.0	5.67	ug/L	113	(70-130)	20	3.1
MBLK	p-Chlorotoluene			<0.25	ug/L				
MRL_CHK	p-Chlorotoluene		0.5	0.510	ug/L	102	(50-150)		
LCS1	p-Dichlorobenzene (1,4-DCB)		5.0	5.97	ug/L	119	(70-130)		
LCS2	p-Dichlorobenzene (1,4-DCB)		5.0	5.91	ug/L	118	(70-130)	20	1.0
MBLK	p-Dichlorobenzene (1,4-DCB)			<0.25	ug/L				
MRL_CHK	p-Dichlorobenzene (1,4-DCB)		0.5	0.550	ug/L	110	(50-150)		
LCS1	p-Isopropyltoluene		5.0	5.88	ug/L	118	(70-130)		
LCS2	p-Isopropyltoluene		5.0	5.65	ug/L	113	(70-130)	20	4.0
MBLK	p-Isopropyltoluene			<0.25	ug/L				
MRL_CHK	p-Isopropyltoluene		0.5	0.470	ug/L	94	(50-150)		
LCS1	sec-Butylbenzene		5.0	5.73	ug/L	115	(70-130)		
LCS2	sec-Butylbenzene		5.0	5.55	ug/L	111	(70-130)	20	3.2
MBLK	sec-Butylbenzene			<0.25	ug/L				
MRL_CHK	sec-Butylbenzene		0.5	0.480	ug/L	96	(50-150)		
LCS1	Styrene		5.0	6.08	ug/L	122	(70-130)		
LCS2	Styrene		5.0	5.45	ug/L	109	(70-130)	20	11
MBLK	Styrene			<0.25	ug/L				

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
(S) Indicates surrogate compound.
(I) Indicates internal standard compound.
RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory
QC Report: 389611

Tom Nance Water Resources Engineering
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
MRL_CHK	Styrene		0.5	0.430	ug/L	86	(50-150)		
LCS1	tert-amyl Methyl Ether		5.0	5.05	ug/L	101	(70-130)		
LCS2	tert-amyl Methyl Ether		5.0	4.62	ug/L	92	(70-130)	20	8.9
MBLK	tert-amyl Methyl Ether			<1.5	ug/L				
MRL_CHK	tert-amyl Methyl Ether		0.5	0.470	ug/L	94	(50-150)		
LCS1	tert-Butyl Ethyl Ether		5.0	4.88	ug/L	98	(70-130)		
LCS2	tert-Butyl Ethyl Ether		5.0	4.45	ug/L	89	(70-130)	20	9.2
MBLK	tert-Butyl Ethyl Ether			<1.5	ug/L				
MRL_CHK	tert-Butyl Ethyl Ether		0.5	0.460	ug/L	92	(50-150)		
LCS1	tert-Butylbenzene		5.0	5.97	ug/L	119	(70-130)		
LCS2	tert-Butylbenzene		5.0	5.72	ug/L	114	(70-130)	20	4.3
MBLK	tert-Butylbenzene			<0.25	ug/L				
MRL_CHK	tert-Butylbenzene		0.5	0.510	ug/L	102	(50-150)		
LCS1	Tetrachloroethylene (PCE)		5.0	5.82	ug/L	116	(70-130)		
LCS2	Tetrachloroethylene (PCE)		5.0	5.11	ug/L	102	(70-130)	20	13
MBLK	Tetrachloroethylene (PCE)			<0.25	ug/L				
MRL_CHK	Tetrachloroethylene (PCE)		0.5	0.470	ug/L	94	(50-150)		
LCS1	Toluene		5.0	5.39	ug/L	108	(70-130)		
LCS2	Toluene		5.0	4.93	ug/L	99	(70-130)	20	8.9
MBLK	Toluene			<0.25	ug/L				
MRL_CHK	Toluene		0.5	0.460	ug/L	92	(50-150)		
LCS1	Toluene-d8 (S)			103	%	103	(70-130)		
LCS2	Toluene-d8 (S)			99.2	%	99	(70-130)		
MBLK	Toluene-d8 (S)			95.4	%	95	(70-130)		
MRL_CHK	Toluene-d8 (S)			99.8	%	100	(70-130)		
MRLLW	Toluene-d8 (S)			99.0	%	99	(70-130)		
LCS1	trans-1,2-Dichloroethylene		5.0	6.37	ug/L	127	(70-130)		
LCS2	trans-1,2-Dichloroethylene		5.0	5.72	ug/L	114	(70-130)	20	11
MBLK	trans-1,2-Dichloroethylene			<0.25	ug/L				
MRL_CHK	trans-1,2-Dichloroethylene		0.5	0.610	ug/L	122	(50-150)		
LCS1	trans-1,3-Dichloropropene		5.0	5.00	ug/L	100	(70-130)		
LCS2	trans-1,3-Dichloropropene		5.0	4.65	ug/L	93	(70-130)	20	7.3
MBLK	trans-1,3-Dichloropropene			<0.25	ug/L				
MRL_CHK	trans-1,3-Dichloropropene		0.5	0.410	ug/L	82	(50-150)		
LCS1	Trichloroethylene (TCE)		5.0	4.93	ug/L	99	(70-130)		

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
(S) Indicates surrogate compound.
(I) Indicates internal standard compound.
RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory
QC Report: 389611

Tom Nance Water Resources Engineering
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
LCS2	Trichloroethylene (TCE)		5.0	4.87	ug/L	97	(70-130)	20	1.2
MBLK	Trichloroethylene (TCE)			<0.25	ug/L				
MRL_CHK	Trichloroethylene (TCE)		0.5	0.380	ug/L	76	(50-150)		
LCS1	Trichlorofluoromethane		5.0	5.58	ug/L	112	(70-130)		
LCS2	Trichlorofluoromethane		5.0	5.15	ug/L	103	(70-130)	20	8.0
MBLK	Trichlorofluoromethane			<0.25	ug/L				
MRL_CHK	Trichlorofluoromethane		0.5	0.330	ug/L	66	(50-150)		
LCS1	Trichlorotrifluoroethane(Freon		5.0	5.63	ug/L	113	(70-130)		
LCS2	Trichlorotrifluoroethane(Freon		5.0	5.32	ug/L	106	(70-130)	20	5.7
MBLK	Trichlorotrifluoroethane(Freon			<0.25	ug/L				
MRL_CHK	Trichlorotrifluoroethane(Freon		0.5	0.380	ug/L	76	(50-150)		
LCS1	Vinyl chloride (VC)		5.0	4.89	ug/L	98	(70-130)		
LCS2	Vinyl chloride (VC)		5.0	4.61	ug/L	92	(70-130)	20	5.9
MBLK	Vinyl chloride (VC)			<0.15	ug/L				
MRL_CHK	Vinyl chloride (VC)		0.5	0.360	ug/L	72	(50-150)		
MRLLW	Vinyl chloride (VC)		0.25	0.230	ug/L	92	(50-150)		

QC Ref# 642142 - Fluoride by SM 4500F-C **Analysis Date: 03/06/2012**

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
LCS1	Fluoride		1.0	1.03	mg/L	103	(81-116)		
LCS2	Fluoride		1.0	1.03	mg/L	103	(81-116)	20	0.0
MBLK	Fluoride			<0.05	mg/L				
MRL_CHK	Fluoride		0.05	0.0548	mg/L	110	(50-150)		
MS_201202210015	Fluoride	ND	1.0	1.00	mg/L	97	(73-124)		
MS2_201203010001	Fluoride	0.14	1.0	1.02	mg/L	88	(73-124)		
MSD_201202210015	Fluoride	ND	1.0	1.05	mg/L	102	(73-124)	20	4.9

QC Ref# 642147 - Aldicarbs by EPA 531.2 **Analysis Date: 03/02/2012**

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
CCCH	3-Hydroxycarbofuran		25	22.5	ug/L	90	(70-130)		
CCCM	3-Hydroxycarbofuran		10	9.01	ug/L	90	(70-130)		
LCS1	3-Hydroxycarbofuran		10	8.07	ug/L	81	(70-130)		
MBLK	3-Hydroxycarbofuran			<0.25	ug/L				
MRL_CHK	3-Hydroxycarbofuran		0.5	0.488	ug/L	98	(50-150)		
MS_201202270031	3-Hydroxycarbofuran	ND	10	9.1	ug/L	91	(70-130)		
MSD_201202270031	3-Hydroxycarbofuran	ND	10	9.28	ug/L	93	(70-130)	20	2.0
CCCH	4-Bromo-3,5-dimethylphenyl-N-methylcarbamate (			106	%	106	(70-130)		
CCCM	4-Bromo-3,5-dimethylphenyl-N-methylcarbamate (			104	%	104	(70-130)		

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
(S) Indicates surrogate compound.
(I) Indicates internal standard compound.
RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory
QC Report: 389611

Tom Nance Water Resources Engineering
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
LCS1	4-Bromo-3,5-dimethylphenyl-N-methylcarbamate (			99.2	%	99	(70-130)		
MBLK	4-Bromo-3,5-dimethylphenyl-N-methylcarbamate (			82.9	%	83	(70-130)		
MRL_CHK	4-Bromo-3,5-dimethylphenyl-N-methylcarbamate (			81.0	%	81	(70-130)		
MS_201202270031	4-Bromo-3,5-dimethylphenyl-N-methylcarbamate (			106	%	106	(70-130)		
MSD_201202270031	4-Bromo-3,5-dimethylphenyl-N-methylcarbamate (			99.2	%	99	(70-130)		
CCCH	Aldicarb (Temik)		25	23.0	ug/L	92	(70-130)		
CCCM	Aldicarb (Temik)		10	9.07	ug/L	91	(70-130)		
LCS1	Aldicarb (Temik)		10	8.42	ug/L	84	(70-130)		
MBLK	Aldicarb (Temik)			<0.25	ug/L				
MRL_CHK	Aldicarb (Temik)		0.5	0.413	ug/L	83	(50-150)		
MS_201202270031	Aldicarb (Temik)	ND	10	9.81	ug/L	98	(70-130)		
MSD_201202270031	Aldicarb (Temik)	ND	10	9.57	ug/L	96	(70-130)	20	2.5
CCCH	Aldicarb sulfone		25	23.5	ug/L	94	(70-130)		
CCCM	Aldicarb sulfone		10	9.29	ug/L	93	(70-130)		
LCS1	Aldicarb sulfone		10	7.73	ug/L	77	(70-130)		
MBLK	Aldicarb sulfone			<0.25	ug/L				
MRL_CHK	Aldicarb sulfone		0.5	0.427	ug/L	85	(50-150)		
MS_201202270031	Aldicarb sulfone	ND	10	9.23	ug/L	92	(70-130)		
MSD_201202270031	Aldicarb sulfone	ND	10	8.98	ug/L	90	(70-130)	20	2.8
CCCH	Aldicarb sulfoxide		25	22.5	ug/L	90	(70-130)		
CCCM	Aldicarb sulfoxide		10	8.71	ug/L	87	(70-130)		
LCS1	Aldicarb sulfoxide		10	8.21	ug/L	82	(70-130)		
MBLK	Aldicarb sulfoxide			<0.25	ug/L				
MRL_CHK	Aldicarb sulfoxide		0.5	0.411	ug/L	82	(50-150)		
MS_201202270031	Aldicarb sulfoxide	ND	10	8.99	ug/L	90	(70-130)		
MSD_201202270031	Aldicarb sulfoxide	ND	10	9.09	ug/L	91	(70-130)	20	1.1
CCCH	Baygon		25	23.5	ug/L	94	(70-130)		
CCCM	Baygon		10	9.49	ug/L	95	(70-130)		
LCS1	Baygon		10	9.17	ug/L	92	(70-130)		
MBLK	Baygon			<0.25	ug/L				
MRL_CHK	Baygon		0.5	0.510	ug/L	102	(50-150)		
MS_201202270031	Baygon	ND	10	8.93	ug/L	89	(70-130)		
MSD_201202270031	Baygon	ND	10	9.51	ug/L	95	(70-130)	20	6.3
CCCH	Carbaryl		25	23.4	ug/L	93	(70-130)		
CCCM	Carbaryl		10	9.06	ug/L	91	(70-130)		

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
(S) Indicates surrogate compound.
(I) Indicates internal standard compound.
RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Tom Nance Water Resources Engineering
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
LCS1	Carbaryl		10	9.16	ug/L	92	(70-130)		
MBLK	Carbaryl			<0.25	ug/L				
MRL_CHK	Carbaryl		0.5	0.420	ug/L	84	(50-150)		
MS_201202270031	Carbaryl	ND	10	9.22	ug/L	92	(70-130)		
MSD_201202270031	Carbaryl	ND	10	9.39	ug/L	94	(70-130)	20	1.8
CCCH	Carbofuran (Furadan)		25	23.8	ug/L	95	(70-130)		
CCCM	Carbofuran (Furadan)		10	9.58	ug/L	96	(70-130)		
LCS1	Carbofuran (Furadan)		10	9.04	ug/L	90	(70-130)		
MBLK	Carbofuran (Furadan)			<0.25	ug/L				
MRL_CHK	Carbofuran (Furadan)		0.5	0.520	ug/L	104	(50-150)		
MS_201202270031	Carbofuran (Furadan)	ND	10	9.17	ug/L	92	(70-130)		
MSD_201202270031	Carbofuran (Furadan)	ND	10	9.24	ug/L	92	(70-130)	20	0.76
CCCH	Methiocarb		25	23.5	ug/L	94	(70-130)		
CCCM	Methiocarb		10	9.69	ug/L	97	(70-130)		
LCS1	Methiocarb		10	8.96	ug/L	90	(70-130)		
MBLK	Methiocarb			<0.25	ug/L				
MRL_CHK	Methiocarb		0.5	0.343	ug/L	69	(50-150)		
MS_201202270031	Methiocarb	ND	10	9.64	ug/L	96	(70-130)		
MSD_201202270031	Methiocarb	ND	10	9.42	ug/L	94	(70-130)	20	2.3
CCCH	Methomyl		25	22.5	ug/L	90	(70-130)		
CCCM	Methomyl		10	8.89	ug/L	89	(70-130)		
LCS1	Methomyl		10	8.25	ug/L	83	(70-130)		
MBLK	Methomyl			<0.25	ug/L				
MRL_CHK	Methomyl		0.5	0.410	ug/L	82	(50-150)		
MS_201202270031	Methomyl	ND	10	8.79	ug/L	88	(70-130)		
MSD_201202270031	Methomyl	ND	10	8.8	ug/L	88	(70-130)	20	0.11
CCCH	Oxamyl (Vydate)		25	22.4	ug/L	90	(70-130)		
CCCM	Oxamyl (Vydate)		10	8.07	ug/L	81	(70-130)		
LCS1	Oxamyl (Vydate)		10	8.06	ug/L	81	(70-130)		
MBLK	Oxamyl (Vydate)			<0.25	ug/L				
MRL_CHK	Oxamyl (Vydate)		0.5	0.447	ug/L	89	(50-150)		
MS_201202270031	Oxamyl (Vydate)	ND	10	8.9	ug/L	89	(70-130)		
MSD_201202270031	Oxamyl (Vydate)	ND	10	9.07	ug/L	91	(70-130)	20	1.9

QC Ref# 642315 - Diquat and Paraquat by EPA 549.2 **Analysis Date: 03/06/2012**

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
CCCH	Diquat		20	20.6	ug/L	103	(80-120)		

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
(S) Indicates surrogate compound.
(I) Indicates internal standard compound.
RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Tom Nance Water Resources Engineering
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
CCCL	Diquat		0.4	0.365	ug/L	91	(80-120)		
CCCM	Diquat		10	9.88	ug/L	99	(80-120)		
CCCM	Diquat		10	9.85	ug/L	99	(80-120)		
LCS1	Diquat		5.0	4.86	ug/L	97	(70-130)		
LCS2	Diquat		5.0	4.34	ug/L	87	(70-130)	20	11
MBLK	Diquat			<0.2	ug/L				
MRL_CHK	Diquat		0.4	0.329	ug/L	82	(50-150)		
MS_201203010098	Diquat	ND	5.0	4.34	ug/L	87	(70-130)		
MS2_201203010093	Diquat	ND	5.0	4.85	ug/L	97	(70-130)		
MSD_201203010098	Diquat	ND	5.0	4.06	ug/L	81	(70-130)	20	6.7
CCCH	Paraquat		20	21.1	ug/L	105	(80-120)		
CCCL	Paraquat		2.0	1.97	ug/L	98	(80-120)		
CCCM	Paraquat		10	9.68	ug/L	97	(80-120)		
CCCM	Paraquat		10	10.1	ug/L	101	(80-120)		
LCS1	Paraquat		5.0	4.95	ug/L	99	(70-130)		
LCS2	Paraquat		5.0	4.39	ug/L	88	(70-130)	20	12
MBLK	Paraquat			<1	ug/L				
MRL_CHK	Paraquat		2.0	1.85	ug/L	92	(50-150)		
MS_201203010098	Paraquat	ND	5.0	4.54	ug/L	91	(70-130)		
MS2_201203010093	Paraquat	ND	5.0	4.49	ug/L	85	(70-130)		
MSD_201203010098	Paraquat	ND	5.0	4.62	ug/L	92	(70-130)	20	1.8

QC Ref# 642335 - ICPMS Metals by EPA 200.8 **Analysis Date: 03/07/2012**

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
LCS1	Uranium ICAP/MS		20	19.9	ug/L	100	(85-115)		
LCS2	Uranium ICAP/MS		20	19.9	ug/L	100	(85-115)	20	0.0
MBLK	Uranium ICAP/MS			<1	ug/L				
MRL_CHK	Uranium ICAP/MS		1.0	1.06	ug/L	106	(50-150)		
MS_201202280500	Uranium ICAP/MS	ND	20	19.0	ug/L	94	(70-130)		
MSD_201202280500	Uranium ICAP/MS	ND	20	19.3	ug/L	96	(70-130)	20	1.6

QC Ref# 642407 - Organochlorine Pesticides/PCBs by EPA 505 **Analysis Date: 03/05/2012**

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
CCCH	Alachlor (Alanex)		1.0	1.02	ug/L	102	(70-130)		
CCCH	Alachlor (Alanex)		1.0	1.09	ug/L	109	(70-130)		
CCCH	Alachlor (Alanex)		1.0	1.09	ug/L	109	(70-130)		
CCCH	Alachlor (Alanex)		1.0	1.02	ug/L	102	(70-130)		
MBLK	Alachlor (Alanex)			<0.1	ug/L				

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
(S) Indicates surrogate compound.
(I) Indicates internal standard compound.
RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory
QC Report: 389611

Tom Nance Water Resources Engineering
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
MRL_CHK	Alachlor (Alanex)		0.1	0.118	ug/L	118	(50-150)		
MS1_201202280127	Alachlor (Alanex)	ND	0.2	0.222	ug/L	111	(65-135)		
MS2_201203010151	Alachlor (Alanex)	ND	1.0	0.932	ug/L	92	(65-135)		
CCCH	Aldrin		0.1	0.111	ug/L	111	(70-130)		
CCCH	Aldrin		0.1	0.111	ug/L	111	(70-130)		
CCCH	Aldrin		0.1	0.110	ug/L	110	(70-130)		
CCCH	Aldrin		0.1	0.111	ug/L	111	(70-130)		
MBLK	Aldrin			<0.01	ug/L				
MRL_CHK	Aldrin		0.01	0.0116	ug/L	116	(50-150)		
MS1_201202280127	Aldrin	ND	0.02	0.0199	ug/L	100	(65-135)		
MS2_201203010151	Aldrin	ND	0.1	0.108	ug/L	105	(65-135)		
CCCH	Chlordane		0.5	0.587	ug/L	117	(70-130)		
CCCH	Chlordane		0.5	0.585	ug/L	117	(70-130)		
MBLK	Chlordane			<0.1	ug/L				
MRL_CHK	Chlordane		0.1	0.122	ug/L	122	(50-150)		
MS2_201203010151	Chlordane	ND	0.5	0.674	ug/L	120	(65-135)		
CCCH	Dieldrin		0.1	0.126	ug/L	126	(70-130)		
CCCH	Dieldrin		0.1	0.116	ug/L	116	(70-130)		
CCCH	Dieldrin		0.1	0.116	ug/L	116	(70-130)		
CCCH	Dieldrin		0.1	0.125	ug/L	125	(70-130)		
MBLK	Dieldrin			<0.01	ug/L				
MRL_CHK	Dieldrin		0.01	0.0133	ug/L	133	(50-150)		
MS1_201202280127	Dieldrin	ND	0.02	0.0238	ug/L	119	(65-135)		
MS2_201203010151	Dieldrin	0.042	0.1	0.149	ug/L	106	(65-135)		
CCCH	Endrin		0.1	0.0946	ug/L	95	(70-130)		
CCCH	Endrin		0.1	0.0993	ug/L	99	(70-130)		
CCCH	Endrin		0.1	0.0890	ug/L	89	(70-130)		
CCCH	Endrin		0.1	0.0893	ug/L	89	(70-130)		
MBLK	Endrin			<0.01	ug/L				
MRL_CHK	Endrin		0.01	0.0106	ug/L	106	(50-150)		
MS1_201202280127	Endrin	ND	0.02	0.0157	ug/L	79	(65-135)		
MS2_201203010151	Endrin	ND	0.1	0.0829	ug/L	83	(65-135)		
CCCH	Heptachlor Epoxide		0.1	0.113	ug/L	113	(70-130)		
CCCH	Heptachlor Epoxide		0.1	0.112	ug/L	112	(70-130)		
CCCH	Heptachlor Epoxide		0.1	0.122	ug/L	122	(70-130)		

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
(S) Indicates surrogate compound.
(I) Indicates internal standard compound.
RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory
QC Report: 389611

Tom Nance Water Resources Engineering
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
CCCH	Heptachlor Epoxide		0.1	0.122	ug/L	122	(70-130)		
MBLK	Heptachlor Epoxide			<0.01	ug/L				
MRL_CHK	Heptachlor Epoxide		0.01	0.0129	ug/L	129	(50-150)		
MS1_201202280127	Heptachlor Epoxide	ND	0.02	0.0224	ug/L	112	(65-135)		
MS2_201203010151	Heptachlor Epoxide	ND	0.1	0.104	ug/L	98	(65-135)		
CCCH	Lindane (gamma-BHC)		0.1	0.106	ug/L	106	(70-130)		
CCCH	Lindane (gamma-BHC)		0.1	0.106	ug/L	106	(70-130)		
CCCH	Lindane (gamma-BHC)		0.1	0.116	ug/L	116	(70-130)		
CCCH	Lindane (gamma-BHC)		0.1	0.117	ug/L	117	(70-130)		
MBLK	Lindane (gamma-BHC)			<0.01	ug/L				
MRL_CHK	Lindane (gamma-BHC)		0.01	0.0128	ug/L	128	(50-150)		
MS1_201202280127	Lindane (gamma-BHC)	ND	0.02	0.0212	ug/L	80	(65-135)		
MS2_201203010151	Lindane (gamma-BHC)	ND	0.1	0.0986	ug/L	99	(65-135)		
CCCH	Methoxychlor		0.5	0.552	ug/L	110	(70-130)		
CCCH	Methoxychlor		0.5	0.596	ug/L	119	(70-130)		
CCCH	Methoxychlor		0.5	0.543	ug/L	109	(70-130)		
CCCH	Methoxychlor		0.5	0.596	ug/L	119	(70-130)		
MBLK	Methoxychlor			<0.05	ug/L				
MRL_CHK	Methoxychlor		0.05	0.0638	ug/L	128	(50-150)		
MS1_201202280127	Methoxychlor	ND	0.1	0.112	ug/L	85	(65-135)		
MS2_201203010151	Methoxychlor	ND	0.5	0.510	ug/L	102	(65-135)		
MBLK	PCB 1016 Aroclor			<0.08	ug/L				
MBLK	PCB 1221 Aroclor			<0.1	ug/L				
MBLK	PCB 1232 Aroclor			<0.1	ug/L				
MBLK	PCB 1242 Aroclor			<0.1	ug/L				
MBLK	PCB 1248 Aroclor			<0.1	ug/L				
MBLK	PCB 1254 Aroclor			<0.1	ug/L				
MBLK	PCB 1260 Aroclor			<0.1	ug/L				
MBLK	Total PCBs			<0.08	ug/L				
CCCH	Toxaphene		2.5	2.75	ug/L	110	(70-130)		
CCCH	Toxaphene		2.5	2.82	ug/L	113	(70-130)		
MBLK	Toxaphene			<0.5	ug/L				
MRL_CHK	Toxaphene		0.5	0.614	ug/L	123	(50-150)		
MS1_201202280127	Toxaphene		2.5	2.66	ug/L	106	(65-135)		

QC Ref# 642518 - Chlorophenoxy Herbicides by EPA 515.4 **Analysis Date: 03/09/2012**

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
(S) Indicates surrogate compound.
(I) Indicates internal standard compound.
RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory
QC Report: 389611

Tom Nance Water Resources Engineering
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
CCCH	2,4,5-T		4.0	3.91	ug/L	98	(70-130)		
CCCM	2,4,5-T		1.0	0.990	ug/L	99	(70-130)		
MBLK	2,4,5-T			<0.1	ug/L				
MRL_CHK	2,4,5-T		0.2	0.184	ug/L	92	(50-150)		
MS1_201203050019	2,4,5-T	ND	3.0	3.66	ug/L	122	(70-130)		
MSD1_201203050019	2,4,5-T	ND	3.0	3.4	ug/L	113	(70-130)	30	7.4
CCCH	2,4,5-TP (Silvex)		4.0	3.7	ug/L	93	(70-130)		
CCCM	2,4,5-TP (Silvex)		1.0	0.927	ug/L	93	(70-130)		
MBLK	2,4,5-TP (Silvex)			<0.1	ug/L				
MRL_CHK	2,4,5-TP (Silvex)		0.2	0.200	ug/L	100	(50-150)		
MS1_201203050019	2,4,5-TP (Silvex)	ND	3.0	3.85	ug/L	127	(70-130)		
MSD1_201203050019	2,4,5-TP (Silvex)	ND	3.0	3.14	ug/L	104	(70-130)	30	20
CCCH	2,4-D		2.0	1.9	ug/L	95	(70-130)		
CCCM	2,4-D		0.5	0.520	ug/L	104	(70-130)		
MBLK	2,4-D			<0.05	ug/L				
MRL_CHK	2,4-D		0.1	0.114	ug/L	114	(50-150)		
MS1_201203050019	2,4-D	ND	1.5	2.01	ug/L	134	(70-130)		
MSD1_201203050019	2,4-D	ND	1.5	1.99	ug/L	133	(70-130)	30	1.0
CCCH	2,4-DB		40	35.8	ug/L	90	(70-130)		
CCCM	2,4-DB		10	8.89	ug/L	89	(70-130)		
MBLK	2,4-DB			<1	ug/L				
MRL_CHK	2,4-DB		2.0	2.03	ug/L	102	(50-150)		
MS1_201203050019	2,4-DB	ND	30	38.5	ug/L	127	(70-130)		
MSD1_201203050019	2,4-DB	ND	30	34.8	ug/L	115	(70-130)	30	10
CCCH	2,4-Dichlorophenyl acetic acid (S)			90.8	%	91	(70-130)		
CCCM	2,4-Dichlorophenyl acetic acid (S)			98.9	%	99	(70-130)		
MBLK	2,4-Dichlorophenyl acetic acid (S)			98.7	%	99	(70-130)		
MRL_CHK	2,4-Dichlorophenyl acetic acid (S)			109	%	109	(70-130)		
MS1_201203050019	2,4-Dichlorophenyl acetic acid (S)			99.8	%	100	(70-130)		
MSD1_201203050019	2,4-Dichlorophenyl acetic acid (S)			90.0	%	90	(70-130)		
CCCH	3,5-Dichlorobenzoic acid		10	10.8	ug/L	108	(70-130)		
CCCM	3,5-Dichlorobenzoic acid		2.5	3.13	ug/L	125	(70-130)		
MBLK	3,5-Dichlorobenzoic acid			<0.25	ug/L				
MRL_CHK	3,5-Dichlorobenzoic acid		0.5	0.737	ug/L	147	(50-150)		
MS1_201203050019	3,5-Dichlorobenzoic acid	ND	7.5	11.0	ug/L	144	(70-130)		

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
(S) Indicates surrogate compound.
(I) Indicates internal standard compound.
RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory
QC Report: 389611

Tom Nance Water Resources Engineering
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
MSD1_201203050019	3,5-Dichlorobenzoic acid	ND	7.5	11.7	ug/L	153	(70-130)	30	6.2
CCCH	4,4-Dibromooctafluorobiphenyl (I)			100	%	100	(50-150)		
CCCM	4,4-Dibromooctafluorobiphenyl (I)			101	%	101	(50-150)		
MBLK	4,4-Dibromooctafluorobiphenyl (I)			100	%	100	(50-150)		
MRL_CHK	4,4-Dibromooctafluorobiphenyl (I)			101	%	101	(50-150)		
MS1_201203050019	4,4-Dibromooctafluorobiphenyl (I)			99.1	%	99	(50-150)		
MSD1_201203050019	4,4-Dibromooctafluorobiphenyl (I)			97.7	%	98	(50-150)		
CCCH	Acifluorfen		4.0	3.87	ug/L	97	(70-130)		
CCCM	Acifluorfen		1.0	0.994	ug/L	99	(70-130)		
MBLK	Acifluorfen			<0.1	ug/L				
MRL_CHK	Acifluorfen		0.2	0.233	ug/L	116	(50-150)		
MS1_201203050019	Acifluorfen	ND	3.0	3.12	ug/L	103	(70-130)		
MSD1_201203050019	Acifluorfen	ND	3.0	2.88	ug/L	95	(70-130)	30	8.0
CCCH	Bentazon		10	8.93	ug/L	89	(70-130)		
CCCM	Bentazon		2.5	2.17	ug/L	87	(70-130)		
MBLK	Bentazon			<0.25	ug/L				
MRL_CHK	Bentazon		0.5	0.313	ug/L	63	(50-150)		
MS1_201203050019	Bentazon	ND	7.5	9.32	ug/L	124	(70-130)		
MSD1_201203050019	Bentazon	ND	7.5	9.56	ug/L	128	(70-130)	30	2.5
CCCH	Dalapon		20	16.7	ug/L	84	(70-130)		
CCCM	Dalapon		5.0	4.49	ug/L	90	(70-130)		
MBLK	Dalapon			<0.5	ug/L				
MRL_CHK	Dalapon		1.0	0.976	ug/L	98	(50-150)		
MS1_201203050019	Dalapon	ND	15	16.3	ug/L	108	(70-130)		
MSD1_201203050019	Dalapon	ND	15	16.7	ug/L	111	(70-130)	30	2.4
CCCH	Dicamba		2.0	2.06	ug/L	103	(70-130)		
CCCM	Dicamba		0.5	0.551	ug/L	110	(70-130)		
MBLK	Dicamba			<0.04	ug/L				
MRL_CHK	Dicamba		0.1	0.146	ug/L	146	(50-150)		
MS1_201203050019	Dicamba	ND	1.5	2.1	ug/L	139	(70-130)		
MSD1_201203050019	Dicamba	ND	1.5	2.17	ug/L	144	(70-130)	30	3.3
CCCH	Dichlorprop		10	9.53	ug/L	95	(70-130)		
CCCM	Dichlorprop		2.5	2.61	ug/L	104	(70-130)		
MBLK	Dichlorprop			<0.25	ug/L				
MRL_CHK	Dichlorprop		0.5	0.493	ug/L	99	(50-150)		

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
(S) Indicates surrogate compound.
(I) Indicates internal standard compound.
RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory
QC Report: 389611

Tom Nance Water Resources Engineering
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
MS1_201203050019	Dichlorprop	ND	7.5	9.87	ug/L	131	(70-130)		
MSD1_201203050019	Dichlorprop	ND	7.5	10.5	ug/L	139	(70-130)	30	6.2
CCCH	Dinoseb		4.0	4.01	ug/L	100	(70-130)		
CCCM	Dinoseb		1.0	1.09	ug/L	109	(70-130)		
MBLK	Dinoseb			<0.1	ug/L				
MRL_CHK	Dinoseb		0.2	0.249	ug/L	125	(50-150)		
MS1_201203050019	Dinoseb	ND	3.0	3.52	ug/L	117	(70-130)		
MSD1_201203050019	Dinoseb	ND	3.0	3.16	ug/L	105	(70-130)	30	11
CCCH	Pentachlorophenol		0.8	0.764	ug/L	96	(70-130)		
CCCM	Pentachlorophenol		0.2	0.202	ug/L	101	(70-130)		
MBLK	Pentachlorophenol			<0.02	ug/L				
MRL_CHK	Pentachlorophenol		0.04	0.0494	ug/L	123	(50-150)		
MS1_201203050019	Pentachlorophenol	ND	0.6	0.689	ug/L	114	(70-130)		
MSD1_201203050019	Pentachlorophenol	ND	0.6	0.652	ug/L	108	(70-130)	30	5.5
CCCH	Picloram		2.0	1.43	ug/L	71	(70-130)		
CCCM	Picloram		0.5	0.429	ug/L	86	(70-130)		
MBLK	Picloram			<0.05	ug/L				
MRL_CHK	Picloram		0.1	0.103	ug/L	103	(50-150)		
MS1_201203050019	Picloram	ND	1.5	1.5	ug/L	100	(70-130)		
MSD1_201203050019	Picloram	ND	1.5	1.21	ug/L	81	(70-130)	30	21
CCCH	Tot DCPA Mono&Diacid Degradate		2.0	1.96	ug/L	98	(70-130)		
CCCM	Tot DCPA Mono&Diacid Degradate		0.5	0.534	ug/L	107	(70-130)		
MBLK	Tot DCPA Mono&Diacid Degradate			<0.5	ug/L				
MRL_CHK	Tot DCPA Mono&Diacid Degradate		0.1	0.114	ug/L	114	(50-150)		
MS1_201203050019	Tot DCPA Mono&Diacid Degradate	ND	1.5	1.91	ug/L	126	(70-130)		
MSD1_201203050019	Tot DCPA Mono&Diacid Degradate	ND	1.5	1.52	ug/L	100	(70-130)	30	23
QC Ref# 642527 - Glyphosate by EPA 547						**Analysis Date: 03/07/2012**			
CCCH	Glyphosate		25	22.4	ug/L	90	(80-120)		
CCCM	Glyphosate		10	8.96	ug/L	90	(80-120)		
LCS1	Glyphosate		10	8.67	ug/L	87	(80-120)		
MBLK	Glyphosate			<6	ug/L				
MRL_CHK	Glyphosate		6.0	5.67	ug/L	95	(50-150)		
MS_201202280088	Glyphosate	ND	10	9.17	ug/L	92	(83-119)		
MS2_201202280500	Glyphosate	ND	10	9.42	ug/L	94	(83-119)		
MSD_201202280088	Glyphosate	ND	10	9.01	ug/L	90	(83-119)	20	1.8

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
(S) Indicates surrogate compound.
(I) Indicates internal standard compound.
RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory
QC Report: 389611

Tom Nance Water Resources Engineering
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
QC Ref# 642560 - Endothall by EPA 548.1						**Analysis Date: 03/07/2012**			
LCS1	Endothall		25	17.9	ug/L	72	(63-144)		
MBLK	Endothall			<5	ug/L				
MRL_CHK	Endothall		5.0	3.29	ug/L	66	(50-150)		
MS_201202280122	Endothall	ND	25	16.7	ug/L	67	(38-157)		
MS_2ND_201203010010	Endothall	ND	25	19.0	ug/L	76	(38-157)		
MSD_201202280122	Endothall	ND	25	17.5	ug/L	70	(38-157)	30	4.7
QC Ref# 642808 - EPA Method 504.1 by EPA 504.1						**Analysis Date: 03/08/2012**			
CCCM	1,2,3-Trichloropropane		1.3	1.45	ug/L	116	(70-130)		
DUP_201202290199	1,2,3-Trichloropropane	ND		ND	ug/L		(0-20)		
MBLK	1,2,3-Trichloropropane			<0.01	ug/L				
MRLLW	1,2,3-Trichloropropane		0.04	0.0261	ug/L	65	(60-140)		
MS_201202280171	1,2,3-Trichloropropane		1.3	1.25	ug/L	100	(65-135)		
CCCM	1,2-Dibromo-3-chloropropane		0.25	0.280	ug/L	112	(70-130)		
DUP_201202290199	1,2-Dibromo-3-chloropropane	ND		ND	ug/L		(0-20)		
MBLK	1,2-Dibromo-3-chloropropane			<0.01	ug/L				
MRL_CHK	1,2-Dibromo-3-chloropropane		0.01	0.00750	ug/L	75	(60-140)		
MS_201202280171	1,2-Dibromo-3-chloropropane	ND	0.25	0.275	ug/L	110	(65-135)		
CCCM	1,2-Dibromoethane		0.25	0.311	ug/L	125	(70-130)		
DUP_201202290199	1,2-Dibromoethane	ND		ND	ug/L		(0-20)		
MBLK	1,2-Dibromoethane			<0.01	ug/L				
MRL_CHK	1,2-Dibromoethane		0.01	0.00660	ug/L	66	(60-140)		
MS_201202280171	1,2-Dibromoethane	ND	0.25	0.254	ug/L	102	(65-135)		
CCCM	1,2-Dibromopropane (S)			105	%	105	(60-140)		
DUP_201202290199	1,2-Dibromopropane (S)			118	%	118	(60-140)		
MBLK	1,2-Dibromopropane (S)			103	%	103	(60-140)		
MRL_CHK	1,2-Dibromopropane (S)			108	%	108	(60-140)		
MRLLW	1,2-Dibromopropane (S)			96.6	%	97	(60-140)		
MS_201202280171	1,2-Dibromopropane (S)			105	%	105	(60-140)		
QC Ref# 642855 - 2,3,7,8-TCDD_Dioxin by EPA 1613B						**Analysis Date: 03/08/2012**			
LCS1	2,3,7,8-TCDD		200	170	pg/L	85	(73-146)		
MBLK	2,3,7,8-TCDD			<1.67	pg/L				
MRL_CHK	2,3,7,8-TCDD		5.0	4.3	pg/L	86	(50-150)		
MS_201203050116	2,3,7,8-TCDD	ND	200	176	pg/L	88	(73-146)		

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
(S) Indicates surrogate compound.
(I) Indicates internal standard compound.
RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory
QC Report: 389611

Tom Nance Water Resources Engineering
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
MSD_201203050116	2,3,7,8-TCDD	ND	200	155	pg/L	78	(73-146)	20	13
LCS1	C12-2,3,7,8-TCDD			84.8	%	85	(25-141)		
MBLK	C12-2,3,7,8-TCDD			83.5	%				
MRL_CHK	C12-2,3,7,8-TCDD			84.8	%	85	(31-137)		
MS_201203050116	C12-2,3,7,8-TCDD	83		88.6	%	89	(25-141)		
MSD_201203050116	C12-2,3,7,8-TCDD	83		79.6	%	80	(25-141)		

QC Ref# 642969 - ICP Metals by EPA 200.7 **Analysis Date: 03/09/2012**

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
LCS1	Calcium Total ICAP		50	50.6	mg/L	101	(85-115)		
LCS2	Calcium Total ICAP		50	49.4	mg/L	99	(85-115)	20	2.4
MBLK	Calcium Total ICAP			<1	mg/L				
MRL_CHK	Calcium Total ICAP		1.0	1.05	mg/L	105	(50-150)		
MS_201202290281	Calcium Total ICAP	2.4	50	51.9	mg/L	99	(70-130)		
MS2_201202290283	Calcium Total ICAP	2.0	50	51.8	mg/L	100	(70-130)		
MSD_201202290281	Calcium Total ICAP	2.4	50	53.4	mg/L	102	(70-130)	20	2.9
MSD2_201202290283	Calcium Total ICAP	2.0	50	52.0	mg/L	100	(70-130)	20	0.39

QC Ref# 643399 - Gross Alpha/Beta Radiation by EPA 900.0 **Analysis Date: 03/01/2012**

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
DUP1_201202230469	Alpha, Gross	ND		ND	pCi/L		(0-20)		
DUP2_201202230481	Alpha, Gross	ND		ND	pCi/L		(0-20)		
LCS1	Alpha, Gross		33	35.6	pCi/L	108	(80-120)		
LCS2	Alpha, Gross		33	36.4	pCi/L	110	(80-120)	20	2.2
MBLK	Alpha, Gross			<3	pCi/L				
MS_201202230466	Alpha, Gross	ND	33	28.5	pCi/L	86	(70-130)		
DUP1_201202230469	Beta, Gross	ND		ND	pCi/L		(0-20)		
DUP2_201202230481	Beta, Gross	ND		ND	pCi/L		(0-20)		
LCS1	Beta, Gross		34	36.1	pCi/L	105	(80-120)		
LCS2	Beta, Gross		34	39.7	pCi/L	116	(80-120)	20	9.5
MBLK	Beta, Gross			<3	pCi/L				
MS_201202230466	Beta, Gross	ND	34	29.9	pCi/L	86	(70-130)		

QC Ref# 643417 - Semivolatiles by GCMS by EPA 525.2 **Analysis Date: 03/13/2012**

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
LCS1	1,3-Dimethyl-2-nitrobenzene (S)			89.9	%	90	(70-130)		
LCS2	1,3-Dimethyl-2-nitrobenzene (S)			94.0	%	94	(70-130)		
MBLK	1,3-Dimethyl-2-nitrobenzene (S)			96.2	%	96	(70-130)		
MRL_CHK	1,3-Dimethyl-2-nitrobenzene (S)			109	%	109	(70-130)		
MS_201203080075	1,3-Dimethyl-2-nitrobenzene (S)			97.9	%	98	(70-130)		

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
(S) Indicates surrogate compound.
(I) Indicates internal standard compound.
RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory
QC Report: 389611

Tom Nance Water Resources Engineering
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
LCS1	Acenaphthene-d10 (I)			89.9	%	90	(50-150)		
LCS2	Acenaphthene-d10 (I)			100	%	100	(50-150)		
MBLK	Acenaphthene-d10 (I)			84.1	%	84	(50-150)		
MRL_CHK	Acenaphthene-d10 (I)			90.3	%	90	(50-150)		
MS_201203080075	Acenaphthene-d10 (I)			85.6	%	86	(50-150)		
LCS1	Atrazine		2.0	1.99	ug/L	100	(70-130)		
LCS2	Atrazine		2.0	2.15	ug/L	108	(70-130)	20	7.7
MBLK	Atrazine			<0.025	ug/L				
MRL_CHK	Atrazine		0.05	0.0560	ug/L	112	(50-150)		
MS_201203080075	Atrazine	ND	2.0	2.13	ug/L	106	(70-130)		
LCS1	Benzo(a)pyrene		2.0	2.19	ug/L	109	(70-130)		
LCS2	Benzo(a)pyrene		2.0	2.27	ug/L	113	(70-130)	20	3.6
MBLK	Benzo(a)pyrene			<0.01	ug/L				
MRL_CHK	Benzo(a)pyrene		0.02	0.0220	ug/L	110	(50-150)		
MS_201203080075	Benzo(a)pyrene	ND	2.0	2.5	ug/L	125	(70-130)		
LCS1	Chrysene-d12 (I)			110	%	110	(50-150)		
LCS2	Chrysene-d12 (I)			126	%	126	(50-150)		
MBLK	Chrysene-d12 (I)			92.3	%	92	(50-150)		
MRL_CHK	Chrysene-d12 (I)			96.9	%	97	(50-150)		
MS_201203080075	Chrysene-d12 (I)			74.4	%	74	(50-150)		
LCS1	Di-(2-Ethylhexyl)adipate		2.0	2.12	ug/L	106	(70-130)		
LCS2	Di-(2-Ethylhexyl)adipate		2.0	2.1	ug/L	105	(70-130)	20	0.95
MBLK	Di-(2-Ethylhexyl)adipate			<0.15	ug/L				
MRL_CHK	Di-(2-Ethylhexyl)adipate		0.3	0.375	ug/L	125	(50-150)		
MS_201203080075	Di-(2-Ethylhexyl)adipate	ND	2.0	1.75	ug/L	87	(70-130)		
LCS1	Di(2-Ethylhexyl)phthalate		2.0	1.97	ug/L	99	(70-130)		
LCS2	Di(2-Ethylhexyl)phthalate		2.0	2.05	ug/L	102	(70-130)	20	4.0
MBLK	Di(2-Ethylhexyl)phthalate			<0.15	ug/L				
MRL_CHK	Di(2-Ethylhexyl)phthalate		0.6	0.733	ug/L	122	(50-150)		
MS_201203080075	Di(2-Ethylhexyl)phthalate	ND	2.0	2.49	ug/L	101	(70-130)		
LCS1	Heptachlor		2.0	1.83	ug/L	92	(70-130)		
LCS2	Heptachlor		2.0	1.93	ug/L	97	(70-130)	20	5.3
MBLK	Heptachlor			<0.015	ug/L				
MRL_CHK	Heptachlor		0.04	0.0400	ug/L	100	(50-150)		
MS_201203080075	Heptachlor	ND	2.0	1.92	ug/L	96	(70-130)		

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
(S) Indicates surrogate compound.
(I) Indicates internal standard compound.
RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory
QC Report: 389611

Tom Nance Water Resources Engineering
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
LCS1	Hexachlorobenzene		2.0	1.88	ug/L	94	(70-130)		
LCS2	Hexachlorobenzene		2.0	1.98	ug/L	99	(70-130)	20	5.2
MBLK	Hexachlorobenzene			<0.025	ug/L				
MRL_CHK	Hexachlorobenzene		0.05	0.0530	ug/L	106	(50-150)		
MS_201203080075	Hexachlorobenzene	ND	2.0	1.96	ug/L	98	(70-130)		
LCS1	Hexachlorocyclopentadiene		2.0	1.75	ug/L	88	(70-130)		
LCS2	Hexachlorocyclopentadiene		2.0	1.8	ug/L	90	(70-130)	20	2.8
MBLK	Hexachlorocyclopentadiene			<0.025	ug/L				
MRL_CHK	Hexachlorocyclopentadiene		0.05	0.0270	ug/L	54	(50-150)		
MS_201203080075	Hexachlorocyclopentadiene	ND	2.0	1.6	ug/L	80	(70-130)		
LCS1	Molinate		2.0	2.1	ug/L	105	(70-130)		
LCS2	Molinate		2.0	2.1	ug/L	105	(70-130)	20	0.48
MBLK	Molinate			<0.05	ug/L				
MRL_CHK	Molinate		0.1	0.104	ug/L	104	(50-150)		
MS_201203080075	Molinate	ND	2.0	2.12	ug/L	106	(70-130)		
LCS1	Perylene-d12 (S)			97.7	%	98	(70-130)		
LCS2	Perylene-d12 (S)			94.8	%	95	(70-130)		
MBLK	Perylene-d12 (S)			81.4	%	81	(70-130)		
MRL_CHK	Perylene-d12 (S)			77.5	%	77	(70-130)		
MS_201203080075	Perylene-d12 (S)			62.8	%	**63**	(70-130)		
LCS1	Phenanthrene-d10 (I)			97.4	%	97	(50-150)		
LCS2	Phenanthrene-d10 (I)			110	%	110	(50-150)		
MBLK	Phenanthrene-d10 (I)			91.7	%	92	(50-150)		
MRL_CHK	Phenanthrene-d10 (I)			95.6	%	96	(50-150)		
MS_201203080075	Phenanthrene-d10 (I)			96.0	%	96	(50-150)		
LCS1	Simazine		2.0	2.08	ug/L	104	(70-130)		
LCS2	Simazine		2.0	2.2	ug/L	110	(70-130)	20	5.6
MBLK	Simazine			<0.025	ug/L				
MRL_CHK	Simazine		0.05	0.0550	ug/L	110	(50-150)		
MS_201203080075	Simazine	ND	2.0	2.13	ug/L	107	(70-130)		
LCS1	Thiobencarb		2.0	2.31	ug/L	115	(70-130)		
LCS2	Thiobencarb		2.0	2.27	ug/L	113	(70-130)	20	1.8
MBLK	Thiobencarb			<0.1	ug/L				
MRL_CHK	Thiobencarb		0.1	0.0980	ug/L	98	(50-150)		
MS_201203080075	Thiobencarb	ND	2.0	2.25	ug/L	112	(70-130)		

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
(S) Indicates surrogate compound.
(I) Indicates internal standard compound.
RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

MWH LABORATORIES
A Division of MWH Americas, Inc.

750 Royal Oak Dr., Suite 100
Monrovia, California, 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory
QC Report: 389611

Tom Nance Water Resources Engineering
(continued)

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
LCS1	Triphenylphosphate (S)			115	%	115	(70-130)		
LCS2	Triphenylphosphate (S)			118	%	118	(70-130)		
MBLK	Triphenylphosphate (S)			114	%	114	(70-130)		
MRL_CHK	Triphenylphosphate (S)			115	%	115	(70-130)		
MS_201203080075	Triphenylphosphate (S)			114	%	114	(70-130)		
QC Ref# 644505 - Mercury Total by EPA 245.1						**Analysis Date: 03/20/2012**			
LCS1	Mercury		1.5	1.57	ug/L	104	(85-115)		
LCS2	Mercury		1.5	1.34	ug/L	89	(85-115)	20	16
MBLK	Mercury			<0.2	ug/L				
MRL_CHK	Mercury		0.2	0.223	ug/L	112	(50-150)		
MS_201202290172	Mercury		1.5	1.94	ug/L	104	(70-130)		
MS_201202280173	Mercury	ND	1.5	1.56	ug/L	104	(70-130)		
MSD_201202290172	Mercury		1.5	1.91	ug/L	102	(70-130)	20	1.6
MSD_201202280173	Mercury	ND	1.5	1.6	ug/L	107	(70-130)	20	2.5
QC Ref# 647427 - Radium 226 by Ra-226 GA						**Analysis Date: 04/06/2012**			
LCS1	Radium 226		3.0	3.08	pCi/L	103	(80-120)		
LCS2	Radium 226			2.9	pCi/L				
MBLK	Radium 226			<1	pCi/L				
MS_201203210177	Radium 226	ND	3.0	3.09	pCi/L	87	(70-130)		
QC Ref# 647432 - Radium 228 by RA-228 GA						**Analysis Date: 04/06/2012**			
LCS1	Radium 228		3.1	2.78	pCi/L	89	(80-120)		
LCS2	Radium 228			2.69	pCi/L				
MBLK	Radium 228			<1	pCi/L				
MS_201203210177	Radium 228	ND	3.1	3.26	pCi/L	104	(70-130)		

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
(S) Indicates surrogate compound.
(I) Indicates internal standard compound.
RPD not calculated for LCS2 when different a concentration than LCS1 is used
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level)

C. BIOLOGICAL SURVEYS CONDUCTED FOR THE KEŌPŪ WELL #4 PROJECT, NORTH KONA DISTRICT, ISLAND OF HAWAIʻI

THIS PAGE WAS INTENTIONALLY LEFT BLANK

Biological Surveys Conducted for the Keōpū Well #4 Project, North Kona District, Island of Hawaiʻi

Prepared by:

Reginald E. David
Rana Biological Consulting, Inc.
P.O. Box 1371
Kailua-Kona, Hawaiʻi 96745

Prepared for:

Planning Solutions, Inc.
210 Ward Avenue, Suite 330
Honolulu, HI 96814

March 5, 2014

Table of Contents

Introduction and Background

Hawaii Housing Finance & Development Corporation's (HHFDC), in collaboration with Forest City Hawai'i, is proposing to develop a supplemental source of potable water for the North Kona Water System to serve North Kona DWS customers including HHFDC's planned Keahuolū affordable housing development (referred to as "Keahuolū Project").

This report describes the methods used and the results of the biological surveys conducted on the subject property. The primary purpose of the surveys was to determine whether any species currently proposed for, or listed as threatened or endangered under either federal of State of Hawai'i endangered species statutes are present within the project site. The federal and State of Hawai'i listed species status follows species identified in the following referenced documents, Department of Land and Natural Resources (DLNR) 1998; U. S. Fish & Wildlife Service (USFWS 2005a, 2005b, 2014). Fieldwork was conducted on January 22, 2014.

Hawaiian and scientific names are italicized in the text. A glossary of technical terms and acronyms used in the document, which may be unfamiliar to the reader, are included at the end of the narrative text.

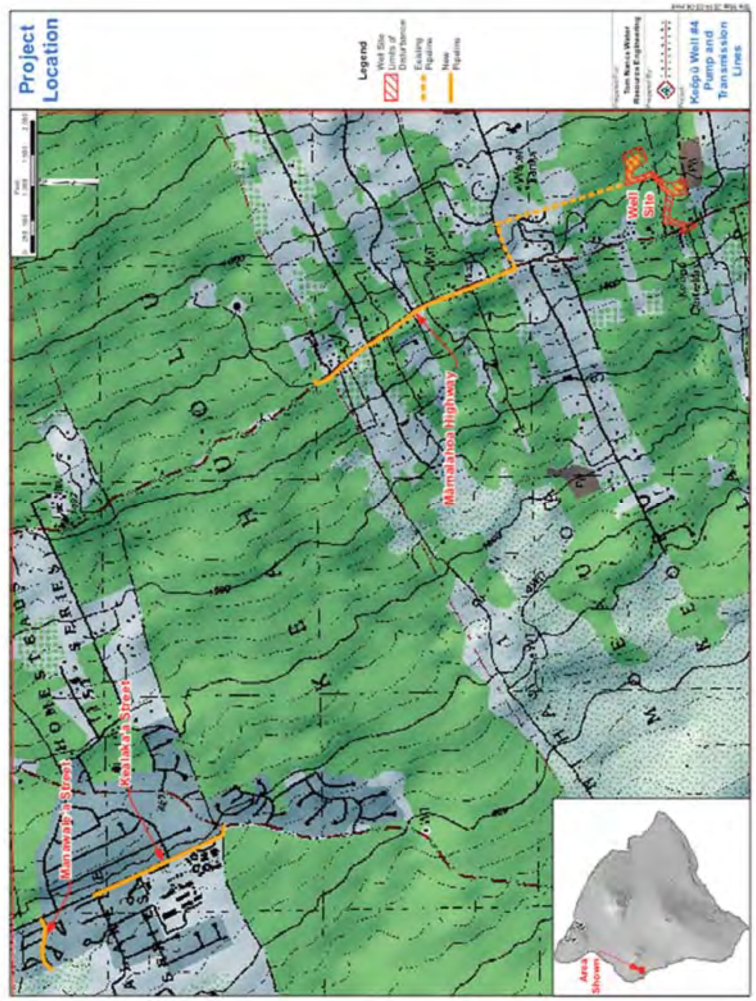
General Project and Site Description

HHFDC seeks to convert the existing exploratory well, Keōpū-HFDC Well No. 3957-05[1] (also known as Keōpū-HFDC Exploratory Well No. 1), in the Hienaloli 1-6 land tract of North Kona, into a production well and construct an accompanying control building and booster pump. The existing well, hereafter referred to as Keōpū Well, has been pump tested and its test results have shown a sustainable yield of at least 2.0 million gallons per day (MGD).

HHFCD also proposes to install water transmission lines to connect the Keōpū Well with the North Kona Water System. This would allow DWS to distribute the water to area customers as well as to the Keahuolū Project. The new water lines will be located within Māmalahoa Highway, Kealaka'a Street, and Manawale'a Street (see Figures 1, 2 and 3).

The project site contains a mix of developed and paved features and section of highly disturbed vegetation and maintained roadways (Figures 3 & 4). The bulk of the site that is vegetated rather than disturbed is comprised of an almost monotypic stand of Hanon bamboo (*Phyllostachys nigra*)(Figure 3).

[1] Well number designated by Commission on Water Resource Management, State of Hawai'i.



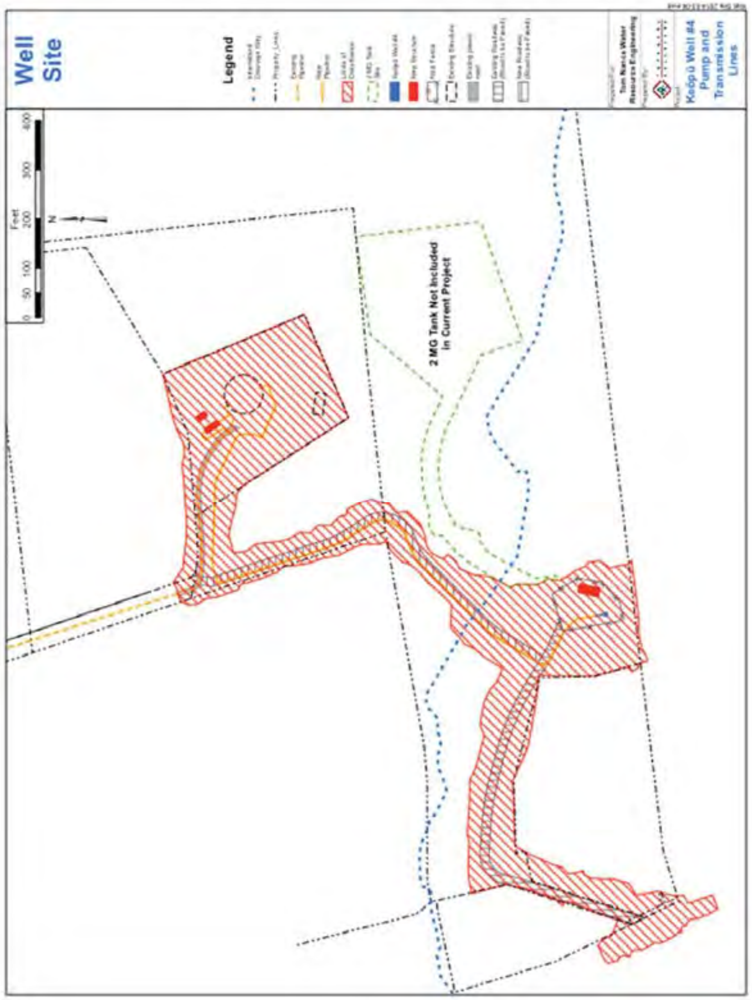


Figure 3 – Bamboo forest

Figure 4 – Māmalahoa Highway looking north near the end of the project site.

On the southern end of the site there is a narrow band of secondary vegetation made up predominately of Christmasberry (*Shinus terebinthefolius*) and Guinea grass (*Urochloa maxima)* (Figure 4). Vegetation within the project site is almost exclusively alien in its makeup.

Figure 5 – Christmasberry and Guinea grass on the southern end of the project site

Methods

The avian phylogenetic order and nomenclature used in this report follows the *AOU Check-List of North American Birds* (American Ornithologists' Union, 1998), and the 42nd through the 51st supplements to the Check-List (American Ornithologists' Union, 2000; Banks et al., 2002, 2003, 2004, 2005, 2006, 2007, 2008; Chesser *et al*., 2009, 2010, 2011, 2012, 2013). Mammal scientific names follow (Wilson and Reeder, 2005). Place names follow (Pukui *et al.*, 1976).

Avian Survey Methods

Four avian count stations were sited equidistant from each other across the project site. A single eight-minute avian point count was made at each of the four count stations. Field observations were made with the aid of Leica 8 X 42 binoculars and by listening for vocalizations. The counts and subsequent searches of the site, were conducted in the early morning. Time not spent counting the point count stations was used to search the remainder of the site for species and habitats not detected during the point counts. Weather conditions were ideal, with no rain, unlimited visibility at the sites and winds of between 0 and3 kilometers an-hour, during point count periods.

Mammalian Survey Methods

With the exception of the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), or *'ōpe'ape'a* as it is known locally, all terrestrial mammals currently found on the Island of Hawai'i are alien species, and most are common. The survey of mammals was limited to visual and auditory detection, coupled with visual observation of scat, tracks, and other animal sign. A running tally was kept of all terrestrial vertebrate mammalian species detected within the site. The mammalian survey was conducted concurrently with the avian survey.

Blackburn's Sphinx Moth Survey Methods

The approximately 1,100-meter section of Māmalahoa Highway that the main new water line will be placed under was searched on foot for native host plants of the endangered Blackburn's sphinx moth (*Manduca blackburni*), as well as for tree tobacco (*Nicotiana glauca*) a secondary alien host plant (Figures 1 and 4).

Results

Avian Surveys

A total of 53 individual birds of 12 species, representing nine separate families, were recorded during the station counts. All 12 of the species detected are alien to the Hawaiian Islands (Table 1).

No avian species currently protected or proposed for protection under either the federal or State of Hawai'i endangered species programs were detected during the course of this survey (DLNR, 1998; USFWS, 2005a, 2005b, 2014).

Avian diversity was low, though in keeping with the habitat present on the site. Three species, Japanese White-eye (*Zosterops japonicus*), House Finch (*Haemorhous mexicanus*), and domestic chicken (*Gallus* sp.) accounted for 51 percent of all birds recorded during the station counts. The Japanese White-eye was the most frequently recorded species, accounting for 21 percent of the total number of individual birds recorded during station counts.

Table 1 - Avian Species Detected During Point Counts Kēopū Well # 4 Project Site

Common Name	*Scientific Name*	*ST*	*RA*
	PHASIANIDAE - Pheasants & Partridges		
	Phasianinae - Pheasants & Allies		
Chicken (Domestic)	*Gallus sp.*	D	1.5
Kalij Pheasant	*Lophura leucomelanos*	A	0.25
	COLUMBIFORMES		
	COLUMBIDAE - Pigeons & Doves		
Spotted Dove	*Streptopelia chinensis*	A	0.50
Zebra Dove	*Geopelia striata*	A	0.75
	PASSERIFORMES		
	ZOSTEROPIDAE - White-eyes		
Japanese White-eye	*Zosterops japonicus*	A	2.75
	STURNIDAE - Starlings		
Common Myna	*Acridotheres tristis*	A	0.25
	THRAUPIDAE - Tanagers		
Yellow-billed Cardinal	*Paroaria capitata*	A	0.75
	EMBERIZIDAE - Emberizids		
Saffron Finch	*Sicalis flaveola*	A	0.75
	CARDINALIDAE - Cardinals Saltators & Allies		
Northern Cardinal	*Cardinalis cardinalis*	A	2.00
	FRINGILLIDAE - Fringilline and Carduleline Finches & Allies		
	Carduelinae - Carduline Finches		
House Finch	*Haemorhous mexicanus*	A	2.50
Yellow-fronted Canary	*Serinus mozambicus*	A	0.50
	ESTRILDIDAE - Estrildid Finches		
Java Sparrow	*Padda oryzivora*	A	0.75

KEY TO TABLE 2

ST Status
D Domesticated – A species which is introduced and is not established in the wild on the Island of Hawaiʻi
A Alien – Introduced to the Hawaiian Islands by humans
RA Relative Abundance – Number of birds detected divided by the number of count stations (4)

Mammalian Survey Results

Three terrestrial mammalian species were detected during the course of this survey. Numerous dogs (*Canis familiaris*) were heard barking from residents and small farms adjacent to the project site. One small Indian mongoose (*Herpestes auropunctatus*) was seen along the roadway on the southern side of the site. Scat, tracks and sign of pig (*Sus scrofa*), were encountered in several locations within the project site.

Hawaiʻi's sole endemic terrestrial mammalian species, the endangered Hawaiian hoary bat, was not detected during this survey. All of the alien mammalian species recorded during this survey are deleterious to avian and floristic components of the remaining native ecosystems present on the Island.

Discussion

Avian Resources

The findings of the avian survey are consistent with the location of the site, and the habitats present on it. The findings of the current survey are comparable to the findings of a previous survey conducted by the author on sections of the current project in 2006 (David, 2006). As previously discussed, all 12 avian species recorded during this survey are alien to the Hawaiian Islands, as were the 11 species detected during the course of the 2006 survey (David, 2006).

Although no seabirds were detected during the course of this survey, several seabird species potentially overfly the site on occasion. The primary cause of mortality in resident seabirds is thought to be predation by alien mammalian species at the nesting colonies (USFWS, 1983; Simons and Hodges, 1998; Ainley et al., 2001). As there are no known nesting colonies of any seabird species near the project site, this is not an issue with respect to the proposed project.

Collision with man-made structures is considered to be the second most significant cause of mortality in locally nesting seabird species in Hawaiʻi. Nocturnally flying seabirds, especially fledglings on their way to sea in the summer and fall, can become disoriented by exterior lighting. When disoriented, seabirds often collide with manmade structures, and if they are not killed outright, the dazed or injured birds are easy targets of opportunity for feral mammals (Hadley, 1961; Telfer 1979; Sincock, 1981; Reed et al., 1985; Telfer et al., 1987; Cooper and Day, 1998; Podolsky et al. 1998; Ainley et al., 2001; Hue et al., 2001; Day et al., 2003).

The proposed project only has two exterior lights in its design. One will be a light above the entrance gate that will be down-pointed and shielded, and will be triggered by a motion sensor. The second light will be above the control room door, which will be turned on by the DWS technicians that may need to go there at night, this light will also be down-pointed and shielded to minimize potentially attracting nocturnally flying pelagic seabirds. No nighttime construction is planned for the project.

The greater project area supports a number Hawaiian Hawks (*Buteo solitarius*) a species currently listed as endangered by both the federal and state endangered species statutes (David, 2014). Disturbance at the nest and persecution by humans are considered to be the most significant cause of deleterious impacts to this species. No suitable nesting trees for this species are within the project site, although it is likely that this species overfly's portions of the project on occasion.

Mammalian Resources

The findings of the mammalian survey are consistent with the location of the site, and the habitat present on it. All of the terrestrial mammalian species recorded during the course of this survey of the site are alien to the Hawaiian Islands.

Although no rodents were detected during the course of this survey, it is probable that the four established *muridae* known from the Island of Hawai'i, European house mouse (*Mus musculus domesticus*), roof rat (*Rattus rattus*), brown rat (*Rattus norvegicus*), and possibly black rat (*Rattus exulans hawaiiensis*) use resources within the subject site and within the general project area on a seasonal or temporal basis. All of these introduced rodents are deleterious to native ecosystems and the native faunal species that are dependant on them.

Although, no Hawaiian hoary bats were recorded during the course of this survey this species is regularly seen foraging in the general project area (David, 2014). This species is found in almost all areas in the mid-to-low elevation areas on the Island of Hawaii that still maintain dense tree cover (Bonaccorso et al., 2005, 2007; David, 2014).

Blackburn's Sphinx Moth

As discussed earlier in this report surveys were conducted along the approximately 1,100-meter section of Māmalahoa Highway that the main new water line will be placed under was searched for native host plants and tree tobacco a secondary alien host plant of the endangered Blackburn's sphinx moth. Tree tobacco is a ruderal species, which is commonly found in disturbed areas and in the greater Kona area along roadway verges.

Potential Impacts to Protected Species

Botanical

No species of plant listed as threatened or endangered under state or federal statutes was recorded during the survey. Therefore the further modification of the habitat present on this site is not expected to result in deleterious impacts to any species currently proposed or listed under either the federal or State of Hawai'i endangered species statutes.

Seabirds

As only two on demand exterior lights are planned for the project which will only be turned on when emergency service or response to the site is required after nightfall and no nighttime construction activities are planned for this project, it is not expected that the construction and operation of the proposed well and associated infrastructure will result in deleterious impacts to listed seabird species.

Hawaiian Hawk

As the site does not contain any trees suitable for nesting by this species, and construction and DWS personnel will not be shooting hawks it is not expected that hawks will experience any impacts from the construction and operation of the project.

Hawaiian hoary bat

The principal potential impact that the project poses to bats is during the clearing and grubbing phase of the construction. The trimming or removal of foliage and/or trees may temporarily displace individual bats, which may use the vegetation as a roosting location. As bats use multiple roosts within their home territories, the potential disturbance resulting from the removal of the vegetation is likely to be minimal. During the pupping season, female carrying their pups may be less able to rapidly vacate a roost site as the vegetation is cleared. Additionally, adult female bats sometimes leave their pups in the roost tree while they themselves forage, and very small pups may be unable to flee a tree that is being felled. Potential adverse effects from such disturbance can be avoided or minimized by not clearing woody vegetation taller than 4.6 meters (15-feet), between June 1 and September 15, the period during which bats are potentially at risk from vegetation clearing. Within the project site the only location where potentially suitable bat roosting vegetation exists is on the southern edge of the site extending approximately 30 meters north until the Christmasberry transitions into bamboo. Hawaiian hoary bats are not know to roost in bamboo.

Blackburn's Sphinx Moth

Neither tree tobacco nor the moths native host plants were encountered, thus it is not expected that the construction of the proposed water infrastructure project will result in deleterious impacts to Blackburn's sphinx moth.

Recommendations

- It is recommended that the two exterior lights discussed in the seabird section be down-pointed, and shielded to reduce the potential for interactions of nocturnally flying seabirds with external lights and man-made structures (Reed et al., 1985; Telfer et al., 1987). While also complying with the Hawai'i County Code § 14 – 50 et seq. which requires the shielding of exterior lights so as to lower the ambient glare caused by unshielded lighting to the astronomical observatories located on Mauna Kea.

- It is recommended that to minimize potential impacts to roosting Hawaiian hoary bats, woody vegetation taller than 4.6 meters (15-feet) high (located on the southern edge of the project site Figure 4), not be cleared between June 1 and September 15.

Critical Habitat

There is no federally delineated Critical Habitat present on or adjacent to the project site. Thus, the proposed action will not result in impacts to federally designated Critical Habitat. There is no equivalent statute under state law.

Glossary

Alien – Introduced to Hawaiʻi by humans
Endangered – Listed and protected under the Endangered Species Act of 1973, as amended (ESA) as an endangered species
Endemic – Native and unique to the Hawaiian Islands
Indigenous – Native to the Hawaiian Islands, but also found elsewhere naturally
Muridae – Rodents, including rats, mice and voles, one of the most diverse families of mammals
Nocturnal – Night-time, after dark
ʻŌpeʻapeʻa – Endemic endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*)
Pelagic – An animal that spends its life at sea – in this case seabirds that only return to land to nest and rear their young
Sign – Biological term referring tracks, scat, rubbing, odor, marks, nests, and other signs created by animals by which their presence may be detected
Threatened – Listed and protected under the ESA as a threatened species

DLNR – Department of Land and Natural resources
DOFAW – Division of Forestry and Wildlife
ESA – Endangered Species Act of 1973, as amended
USFWS – United State Fish & Wildlife Service

Literature Cited

Ainley, D. G, R. Podolsky, L. Deforest, G. Spencer, and N. Nur. 2001. The Status and Population Trends of the Newell's Shearwater on Kaua'i: Insights from Modeling, *in*: Scott, J. M, S. Conant, and C. Van Riper III (editors) *Evolution, Ecology, Conservation, and Management of Hawaiian Birds: A Vanishing Avifauna.* Studies in Avian Biology No. 22: Cooper's Ornithological Society, Allen Press, Lawrence, Kansas. (Pg. 108-123).

American Ornithologist's Union. 1998. *Check-list of North American Birds*. 7th edition. AOU. Washington D.C. 829pp.

______. 2000. Forty-second supplement to the American Ornithologist's Union *Check-list of North American Birds*. The Auk 117:847-858.

Banks, R. C., C. Cicero, J. L. Dunn, A. W. Kratter, P. C. Rasmussen, J. V. Remsen, Jr., J. D. Rising, and D. F. Stotz. 2002. Forty-third supplement to the American Ornithologist's Union *Check-list of North American Birds*. The Auk 119:897-906.

______. 2003 Forty-fourth supplement to the American Ornithologist's Union *Check-list of North American Birds*. The Auk 120:923-931.

______. 2004 Forty-fifth supplement to the American Ornithologist's Union *Check-list of North American Birds*. The Auk 121:985-995.

______. 2005 Forty-sixth supplement to the American Ornithologist's Union *Check-list of North American Birds*. The Auk 122:1031-1031.

______. 2006 Forty-seventh supplement to the American Ornithologist's Union *Check-list of North American Birds*. The Auk 123:926-936.

Banks, R. C., C. R. Terry Chesser, C. Cicero, J. L. Dunn, A. W. Kratter, I. J. Lovette, P. C. Rasmussen, J. V. Remsen, Jr., J. D. Rising, and D. F. Stotz. 2007 Forty-eighth supplement to the American Ornithologist Union *Check-list of North American Birds*. The Auk 124:1109-1115.

Banks, R. C., C. R. Terry Chesser, C. Cicero, J. L. Dunn, A. W. Kratter, I. J. Lovette, P. C. Rasmussen, J. V. Remsen, Jr., J. D. Rising, and D. F. Stotz, and K. Winker. 2008 Forty-ninth supplement to the American Ornithologist Union *Check-list of North American Birds*. The Auk 125:758-768.

Bonaccorso, F. J., C. M. Todd and, A. C. Miles. 2005. Interim Report on Research to Hawaiian Bat Research Consortium for The Hawaiian Hoary Bat, Ope'ape'a, *Lasiurus cinsereus semotus*. 1 September 2004 to 31 August 2005.

______. 2007. Interim Report on Research to the Hawaiian Bat Research Consortium for The Hawaiian Hoary Bat, Ope'ape'a, *Lasiurus cinsereus semotus*. April 1, 2007.

Chesser, R. T., R. C. Banks, F. K. Barker, C. Cicero, J. L. Dunn, A. W. Kratter, I. J. Lovette, P. C. Rasmussen, J. V. Remsen, Jr., J. D. Rising, and D. F. Stotz, and K. Winker. 2009. Fiftieth supplement to the American Ornithologist Union *Check-list of North American Birds*. The Auk 126:1-10.

______. 2010. Fifty-first supplement to the American Ornithologist Union *Check-list of North American Birds*. The Auk 127:726-744.

______. 2011. Fifty-second supplement to the American Ornithologist Union *Check-list of North American Birds*. The Auk 128:600-613.

______. 2012. Fifty-third supplement to the American Ornithologist Union *Check-list of North American Birds*. The Auk 129: 573-588.

______. 2013. Fifty-fourth supplement to the American Ornithologist Union *Check-list of North American Birds*. The Auk 130: 558:571.

Cooper, B. A and R. H. Day. 1998. Summer Behavior and Mortality of Dark-rumped Petrels and Newells' Shearwaters at Power Lines on Kauai. Colonial Waterbirds, 21 (1): 11-19.

Day, R. H., B. Cooper, and R. J. Blaha. 2003. Movement Patterns of Hawaiian Petrels and Newell's Shearwaters on the Island of Hawai'i. Pacific Science, 57, 2:147-159.

Day, R. H., B. Cooper, and T. C. Telfer. 2003. Decline of Townsend's (Newell's Shearwaters (*Puffinus auricularis newelli*) on Kauai, Hawaii. The Auk 120: 669-679.

David, R. E. 2006. Keōpū-Pu'uhonua Production Well and Reservoir Site Biological Reconnaissance Survey. Prepared for: Planning Solutions, Inc., and the Hawai'i County Department of Water Supply

David, R. E. 2014. Unpublished field notes – Hawai'i 1980 - 2014.

Department of Land and Natural Resources (DLNR). 1998. Indigenous Wildlife, Endangered And Threatened Wildlife And Plants, And Introduced Wild Birds. Department of Land and Natural Resources. State of Hawaii. Administrative Rule §13-134-1 through §13-134-10, dated March 02, 1998.

Hadley, T. H. 1961. Shearwater calamity on Kauai. Elepaio 21:60.

Hue, D., C. Glidden, J. Lippert, L. Schnell, J. MacIvor and J. Meisler. 2001. Habitat Use and Limiting Factors in a Population of Hawaiian Dark-rumped Petrels on Mauna Loa, Hawai'i. , *in:* : Scott, J. M, S. Conant, and C. Van Riper III (editors) *Evolution, Ecology, Conservation, and Management of Hawaiian Birds: A Vanishing Avifauna*. Studies in Avian Biology No. 22. Cooper's Ornithological Society, Allen Press, Lawrence, Kansas (Pg. 234-242).

Podolsky, R., D.G. Ainley, G. Spencer, L. de Forest, and N. Nur. 1998. "Mortality of Newell's Shearwaters Caused by Collisions with Urban Structures on Kaua'i". Colonial Waterbirds 21:20-34.

Pukui , M. K., S. H. Elbert, and E. T. Mookini 1976. *Place Names of Hawaii*. University of Hawaii Press. Honolulu, Hawai'i. 289 pp.

Reed, J. R., J. L Sincock, and J. P. Hailman 1985. Light Attraction in Endangered Procellariform Birds: Reduction by Shielding Upward Radiation. Auk 102: 377-383.

Simons, T. R., and C. N. Hodges. 1998. Dark-rumped Petrel (*Pterodroma phaeopygia*). *In* A. Poole and F. Gill (editors). The Birds of North America, No. 345. The Academy of Natural Sciences, Philadelphia, PA. and the American Ornithologists Union, Washington, D.C.

Sincock, J. L. 1981. Saving the Newell 's Shearwater. Pages 76-78 in Proceedings of the Hawaii Forestry and Wildllife Conference, 2-4 October 1980. Department of Land and Natural Resources, State of Hawaii, Honolulu.

Telfer, T. C. 1979. Successful Newell's Shearwater Salvage on Kauai. 'Elepaio 39:71

Telfer, T. C. , J. L. Sincock, G. V. Byrd, and J. R. Reed. 1987. Attraction of Hawaiian seabirds to lights: Conservation efforts and effects of moon phase. Wildlife Society Bulletin 15:406-413.

U.S. Fish & Wildlife Service (USFWS) 1983. Hawaiian Dark-Rumped Petrel & Newell's Manx Shearwater Recovery Plan. USFWS, Portland, Oregon. February 1983.

______. 2005a. Endangered and Threatened Wildlife and Plants. 50CFR 17:11 and 17:12 (Tuesday, November 1, 2005).

______. 2005b. 50 CFR 17. Endangered and Threatened Wildlife and Plants. Review of Species That Are Candidates or Proposed for Listing as Endangered or Threatened; Annual Notice of Findings on Resubmitted Petition; Annual Description of Progress on Listing Actions. Federal Register, 70 (90; Wednesday, May 11, 2005): 24870-24934.

______. 2014. USFWS Environmental Conservation Online System online at http://ecos.fws.gov/tess_public/StateListing.do=HI&status=listed. Last accessed February 26. 2014.

Wilson, D.E., and D. M. Reeder, (Editors), 2005. *Mammal species of the world: a taxonomic and geographic reference.* 3rd edition. 2 vols. John Hopkins University Press. Baltimore, Maryland. 2142 pp.

D. CHECKLIST OF PLANT SPECIES AT THE STUDY SITE

THIS PAGE WAS INTENTIONALLY LEFT BLANK

APPENDIX

Table 2. Checklist of plant species at the study site.

The following is a checklist of the vascular plants inventoried during the field studies on the Keahuolu Affordable Housing project proposed well site. The plants are divided into three groups, Ferns (including fern allies), Monocots, and Dicots. Within these groups, the species are presented taxonomically by family, with each family and each species in the family in alphabetical order. The taxonomy and nomenclature of the ferns follow Palmer 2003 and the flowering plants (Monocots and Dicots) follow Wagner *et al*. (1990). In most cases, common English and/or Hawaiian names listed here have been taken from St. John (1973) or Porter (1972).

For each species, the following information is provided:

1. Scientific name with author citation.
2. Common English and/or Hawaiian name, when known.
3. Biogeographic status. The following symbols are used.
   - E = endemic (found only in Hawai‘i).
   - I = indigenous (native to Hawai‘i as well as other geographic areas).
   - P = Polynesian introduction (introduced to Hawai‘i by Polynesians before the advent of the Europeans).
   - X = Introduced or alien (not native, introduced to Hawai‘i, either accidentally or intentionally, after the advent of the Europeans).

Species	Common Names	Status[1]
FERNS AND FERN ALLIES		
ADIANTACEAE (Maiden's-hair Family)		
Adiantum hispidulum Sw.	rough maidenhair fern	X
BLECHNACEAE (Blechnum Family)		
Blechnum occidentale L	blechnum	I
DENNSTAEDTIACEAE		
Pteridium aquilinum (L.) Kuhn	bracken fern, kilau	I
DICKSONIACEAE (Tree Fern Family)		
Cibotium chamissoi Kaulf.	haupu‘u ‘i‘i	E
LINDSAEACEAE (Lace Fern Family)		
Sphenomeris chinensis (L.) Maxon	pala‘a	I
NEPHROLEPIDACEAE (Sword Fern Family)		
Nephrolepis multiflora (Roxb.)	hairy swordfern	X
POLYPODIACEAE (Common Fern Family)		
Phlebodium aureum (L.) J. Sm.	laua‘e-haole	X
Pleopeltis thunbergiana Kaulf.	pakahakaha	I
PSILOTACEAE (Psilotum Family)		
Psilotum nudum L.	moa	I

Species	Common Names	Status[1]
THELYPTERIDACEAE (Downy Woodfern Family)		
Christella dentata (Forssk.) Brownsey & Jermy	downy woodfern	X
Christella parasitica (L.) Leville	oak fern	X
MONOCOTS		
AGAVACEAE (Agave Family)		
Dracaena fragrans (L.) Ker-Gawler	fragrant dracaena	X
Dracaena cf. *deremensis* Engler	----------	X
COMMELINACEAE (Spiderwort Family)		
Commelina diffusa N. L. Burm.	honohono	X
CYPERACEAE (Sedge Family)		
Kyllinga brevifolia Rottb.	kyllinga	X
Pycreus polystachyos (Rottb.) P. Beauv.	----------	X
POACEAE (Grass Family)		
Andropogon virginicus L.	broomsedge	X
Axonopus fissifolius (Raddi) Kuhlm.	carpet grass	X
Bambusa vulgaris Schrader ex Wendl.	bamboo	X
Digitaria procumbens Stent	pangola grass	X
Eragrostis tenella (L.) P. Beauv. ex Roem. & Schult.	love grass	X
Melinus minutiflora P. Beauv.	molasses grass	X
Oplismenus hirtellus (L.) P. Beauv.	basket grass	X
Panicum maximum Jacq.	Guinea grass	X
Paspalum conjugatum Bergius	t-grass	X
Paspalum scrobiculatum L.	rice grass	I?
Pennisetum purpureum Schumach.	elephant grass	X
Pennisetum setaceum (Forssk.) Chiov.	fountain grass	X
Rhynchelytrum repens (Willd.) C.E. Hubb.	Natal redtop	X
Sacciolepis indica (L.) Chase	Glenwood grass	X
Setaria gracilis Kunth	perennial foxtail	X
Sporobolus cf. *africanus* (Poir.) Robyns & Tournay	African dropseed	X
ZINGIBERACEAE (Ginger Family)		
Hedychium flavescens N. Carey ex Roscoe	yellow ginger	X
Zingiber zerumbet (L.) Sm.	shampoo ginger, ‘awapuhi	P
DICOTS		
ANACARDIACEAE (Mango Family)		
Schinus terebinthifolius Raddi	Christmas berry	X

Species	Common Names	Status[1]
ASTERACEAE (Sunflower Family)		
Ageratum conyzoides L.	ageratum	X
Bidens alba (L.) DC.	beggar's-tick	X
Conyza canadensis (L.) Cronq.	Canada fleabane	X
Elephantopus mollis Kunth	elephant's-foot	X
Galinsoga parviflora Cav.	----------	X
Gnaphalium japonicum Thunb.	cudweed	X
Pluchea carolinensis (Jacq.) G. Don	pluchea	X
Youngia japonica (L.) DC.	Oriental hawksbeard	X
BEGONIACEAE (Begonia Family)		
Begonia hirtella Link	----------	X
BIGNONIACEAE (Bignonia Family)		
Spathodea campanulata P. Beauv.	African tulip tree	X
BUDDLEIACEAE (Butterfly-bush Family)		
Buddleia asiatica Lour.	dogtail, heulo'ilio	X
CRASSULACEAE (Stonecrop Family)		
Kalanchoë pinnata (Lam.) Pers.	air plant	X
EUPHORBIACEAE (Spurge Family)		
Codiaeum variegatum (L.) Juss.	variegata croton	X
FABACEAE (Pea Family)		
Caesalpinia decapetala (Roth) Alston	wait-a-bit	X
Chamaecrista nictitans (L.) Moench	partridge pea, lau-ki	X
Crotalaria pallida Aiton	smooth rattlepod	X
Desmodium incanum DC.	Spanish clover	X
Desmodium intortum (Mill.) Urb.	----------	X
Indigofera suffruticosa Mill.	indigo, ʻiniko	X
Mimosa pudica L.	sensitive plant	X
Pterocarpus indicus Willd.	narra	X
Senna septemtrionalis (Viv.) H. Irwin & Barneby	kolomona	X
LAMIACEAE (Mint Family)		
Hyptis pectinata (L.) Poir.	comb hyptis	X
LYTHRACEAE (Loosestrife Family)		
Cuphea carthagenensis (Jacq.) Macbr.	tarweed	X
Cuphea hyssopifolia Kunth	false heather	X
MALVACEAE (Mallow Family)		
Sida acuta N.L. Burm.	----------	X
Sida rhombifolia L.	Cuba jute	X
MELASTOMATACEAE (Melastoma Family)		
Clidemia hirta (L.) D. Don	Koster's curse	X
Heterocentron subtriplinervium (Link & Otto) A. Braun & C. Bouche	----------	X

Species	Common Names	Status[1]
MELIACEAE (Mahogany Family)		
Melia azedarach L.	Chinaberry tree	X
MYRSINACEAE (Myrsine Family)		
Ardisia crenata Sims	Hilo holly	X
MYRTACEAE (Myrtle Family)		
Metrosideros polymorpha Gaud.	ʻohiʻa lehua	E
Psidium cattleianum Sabine	strawberry guava	X
Psidium guajava L.	guava	X
PASSIFLORACEAE (Passionflower Family)		
Passiflora edulis Sims	passionfruit, lilikoʻi	X
PLANTAGINACEAE (Plantain Family)		
Plantago lanceolata L.	narrow-leafed plantain	X
POLYGALACEAE (Milkwort Family)		
Polygala paniculata L.	bubblegum plant	X
PROTACEAE (Protea Family)		
Grevillea robusta A. Cunn. ex R. Br.	silk oak	X
Macadamia ternifolia F. Muell.	macadamia	X
ROSACEAE (Rose Family)		
Eriobotrya japonica (Thunb.) Lindl.	loquat	X
Rubus rosifolius Sm.	thimbleberry	X
RUBIACEAE (Coffee Family)		
Spermacoce assurgens Ruiz & Pav.	buttonweed	X
SOLANACEAE (Nightshade Family)		
Solanum americanum Mill.	black nightshade, popolo	I?
STERCULIACEAE (Cacao Family)		
Melochia umbellata (Houtt.) Stapf	----------	X
TILIACEAE (Linden Family)		
Triumfetta rhombifolia Jacq.	burbush	X
URTICACEAE (Nettle Family)		
Pilea microphylla (L.) Liebm.	rockweed	X
VERBENACEAE (Verbena Family)		
Stachytarpheta cayennensis (Rich.) Vahl	blue rat's-tail	X
Stachytarpheta dichotoma (Ruiz & Pav.) Vahl	owi	X

Status[1]: I = Indigenous. E = Endemic. X = Alien (introduced). P = Polynesian introduction.

E. AN ARCHAEOLOGICAL INVENTORY SURVEY OF A PORTION OF TMK:3-7-5-13:022 FOR THE PROPOSED DEVELOPMENT OF WELL SITE NO. 4 (2008)

THIS PAGE WAS INTENTIONALLY LEFT BLANK

RC-0525

An Archaeological Inventory Survey of a Portion of TMK:3-7-5-13:022 for the Proposed Development of Well Site No. 4

Hienaloli 1st Ahupua'a
North Kona District
Island of Hawai'i

PREPARED BY:

Matthew R. Clark, B.A.,
J. David Nelson, B.A.,
Amy L. Ketner, B.A.,
and
Robert B. Rechtman, Ph.D.

PREPARED FOR:

Belt Collins Ltd.
2153 North King Street, Suite 200
Honolulu, HI 96819

June 2008

RECHTMAN CONSULTING, LLC
HC 1 Box 4149 Kea'au, Hawai'i 96749-9710
phone: (808) 966-7636 fax: (808) 443-0065
e-mail: bob@rechtmanconsulting.com
ARCHAEOLOGICAL, CULTURAL, AND HISTORICAL STUDIES

An Archaeological Inventory Survey of a Portion of TMK: 3-7-5-13:022 for the Proposed Development of Well Site No. 4

Hienaloli 1st Ahupua'a
North Kona District
Island of Hawai'i

RECHTMAN CONSULTING

EXECUTIVE SUMMARY

At the request of Mary O'Leary, AICP of Belt Collins Hawaii Ltd., Rechtman Consulting, LLC conducted an Archaeological Inventory Survey of a roughly 17-acre portion of TMK:3-7-5-13:022 for the proposed development of production Well No. 4 within Hienaloli 1st Ahupuaʻa, North Kona District, Island of Hawaiʻi. The proposed well is part of the off-site development of infrastructure facilities associated with the proposed Keahuolu Affordable Housing project. The development was initiated by the Hawaiʻi Housing Finance & Development Corporation (HHFDC), which is the State's agency tasked with developing and financing low and moderate income housing projects and administering home ownership programs. The property currently contains a test well (Well No. 1) that will be developed into a production well (Well No. 4). Other improvements to the property may include the construction of a two million gallon reservoir. The parcel is owned by the State of Hawaiʻi Department of Land and Natural Resources.

Four previously conducted archaeological studies have included the current project area (Halpern and Rosendahl 1996; Kawachi 1994; and Yent 1991, 1999). As a result of the current inventory survey five previously recorded sites were relocated within the project area. The sites include four core-filled ranching/boundary walls (Sites 20754, 20755, 20757, 20758) and a terrace and wall located along the edge of a natural drainage that was likely utilized for agricultural purposes (Site 20759). A single test unit (TU-1) was excavated at Site 20759 revealing a soil deposit, but only modern cultural debris.

Sites 20754, 20755, 20757, 20758, and 20759 are all considered significant for information they have yielded relative to past use of the current project area. It is argued that the information collected during the previous studies and the current inventory survey is sufficient to document these sites and to mitigate any potential negative impacts that might result from the proposed development of Well No. 4. As such, no further work is the recommended treatment for all of the sites.

Contents

Figures

Tables

INTRODUCTION

At the request of Mary O'Leary, AICP of Belt Collins Hawaii Ltd., Rechtman Consulting, LLC conducted an Archaeological Inventory Survey of a roughly 17-acre portion of TMK:3-7-5-13:022 for the proposed development of production Well No. 4 within Hienaloli 1st Ahupua'a, North Kona District, Island of Hawai'i (Figures 1 and 2). The proposed well is part of the off-site development of infrastructure facilities associated with the proposed Keahuolu Affordable Housing project. The development was initiated by the Hawai'i Housing Finance & Development Corporation (HHFDC), which is the State's agency tasked with developing and financing low and moderate income housing projects and administering home ownership programs. The property currently contains a test well (Well No. 1) that will be developed into a production well (Well No. 4). Other improvements to the property may include the construction of a two million gallon reservoir. The parcel is owned by the State of Hawai'i Department of Land and Natural Resources. The current project was undertaken in compliance with both the historic preservation review process requirements (HAR 13§13-275-5) of the Department of Land and Natural Resources-State Historic Preservation Division (DLNR-SHPD) and the County of Hawai'i Planning Department.

This report contains summary background information concerning the project area's physical setting, cultural contexts, previous archaeological work, and current survey expectations based on the previous work. Also presented is an explanation of the project's methods, descriptions of the archaeological features encountered, interpretation and evaluation of those resources, and treatment recommendations for sites documented within the proposed development area.

Project Area Description

The current project area consists of a roughly 17-acre portion of TMK:3-7-5-13:022 located within Hienaloli 1st Ahupua'a, North Kona District, Island of Hawai'i (see Figures 1 and 2). The project area (Parcel 22) includes a dirt access road that runs *mauka* from Māmalahoa Highway between Parcels 13 and 21 (Figure 3). The parcel then widens, following the eastern boundary of Parcel 21 to the north, and the northern and eastern boundaries of Parcel 13 to the south. Rock walls are present along both of these parcels' boundaries, but the wall along Parcel 21 includes concrete and is of more recent construction than the other wall (Parcel 21 contains a modern residence, while Parcel 13 does not). At the southeastern corner of Parcel 13 and the northeastern corner of Parcel 21 the study parcel's boundaries turn east. A rock wall runs along the northern boundary and a wire fence line follows the southern boundary. The land to the south of the project area is mostly developed, and an area near the eastern end of the project area along the northern boundary was recently bulldozed. The eastern boundary of the project area follows the 1,780-foot contour across Parcel 22. At the time of the current fieldwork, this boundary had been recently marked with flagging tape (Figure 5).

A natural drainage runs through the center of the project area (Figure 6). Terrain within the project area slopes locally into this drainage, but overall it slopes fairly steeply and consistently to the west. Soils in the project area are classified as Honuaula extremely stoney silty clay loam where stones cover up to 15% of the surface (Yent 1999). The area receives 60-80 inches of rain per year, causing the aforementioned drainage to flow intermittently. Vegetation consists primarily of Christmas-berry (*Schinus terebinthifolius*) and guava (*Psidium guajava*), with an under story of grasses, ferns, and flowers over much of the project area, but a large patch of bamboo (*Bambusa*) is present in the western portion of the project area to the north of the drainage and an area to the south of the drainage that was previously bulldozed contains a plethora of grasses and non-native weeds (Figure 7). Yent (1999) indicated that this bulldozing took place sometime between 1997 and 1999. West of the bulldozed area is an existing well site with a rock retaining wall. The dirt road that accesses the parcel leads to this well site, and another branch runs east up the center of the parcel. The road is only wide enough for ATV access. Several wire fence lines are also present within the project area. The fences are no longer maintained, but their presence indicates that the parcel was formerly used for cattle ranching purposes.

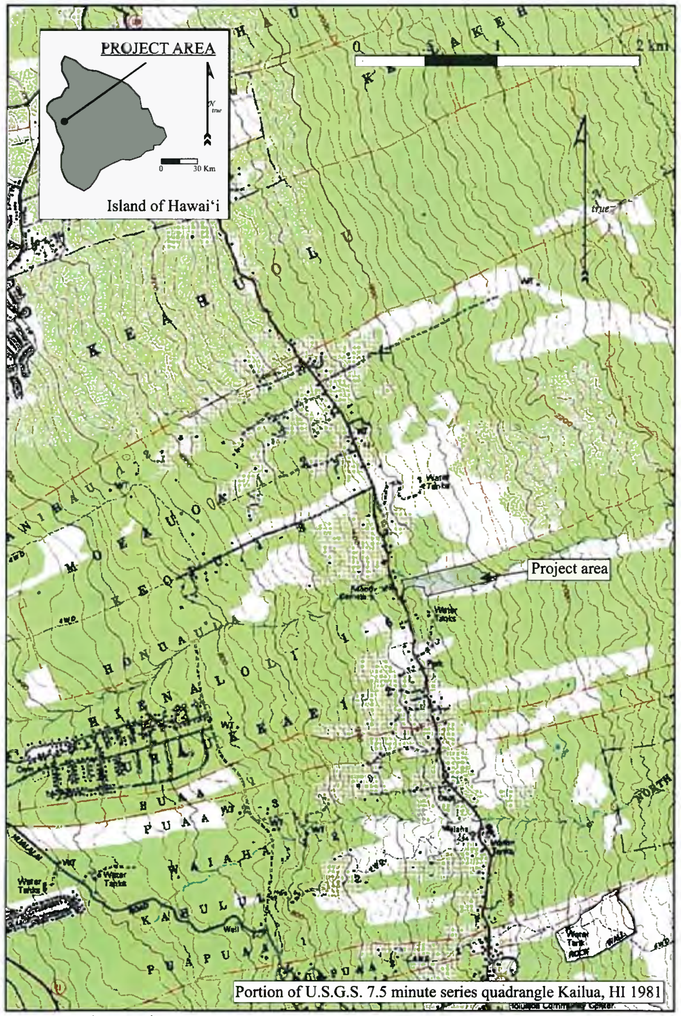


Figure 1. Project area location.

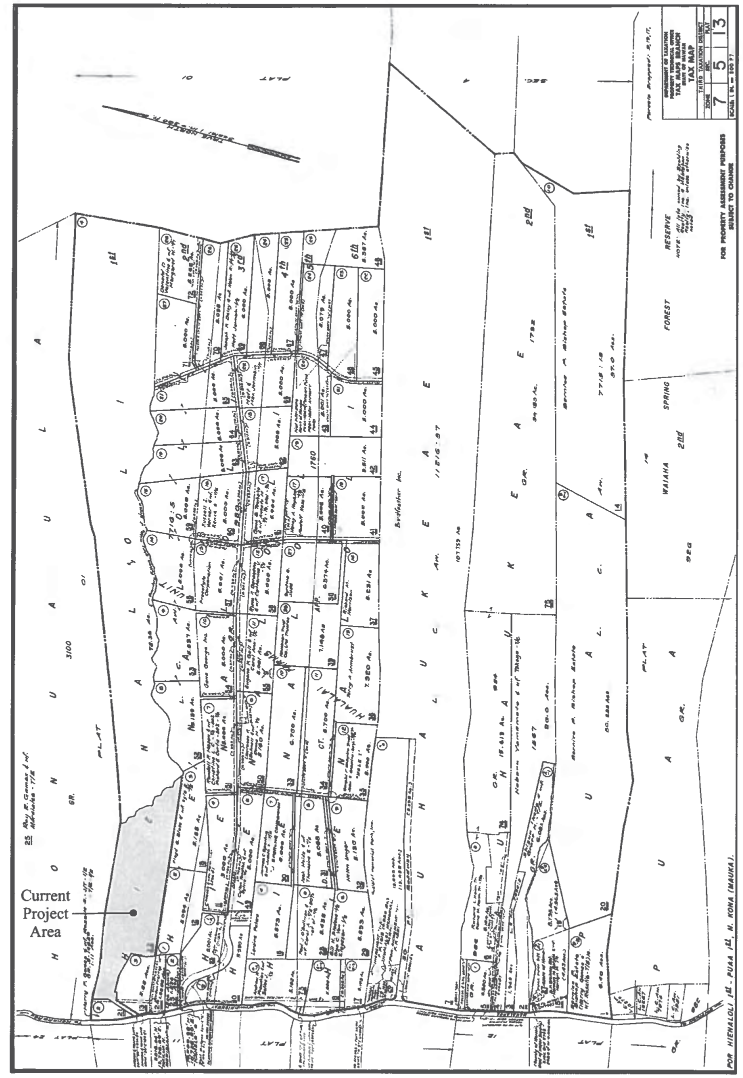


Figure 2. Tax Map Key (TMK): 3-7-5-13 showing current project area (portion of Parcel 22).

Figure 3. View to southwest (toward Māmalahoa Highway) of access road leading to Parcel 22.

Figure 4. View to northwest of rock wall with concrete along the eastern boundary of Parcel 21.

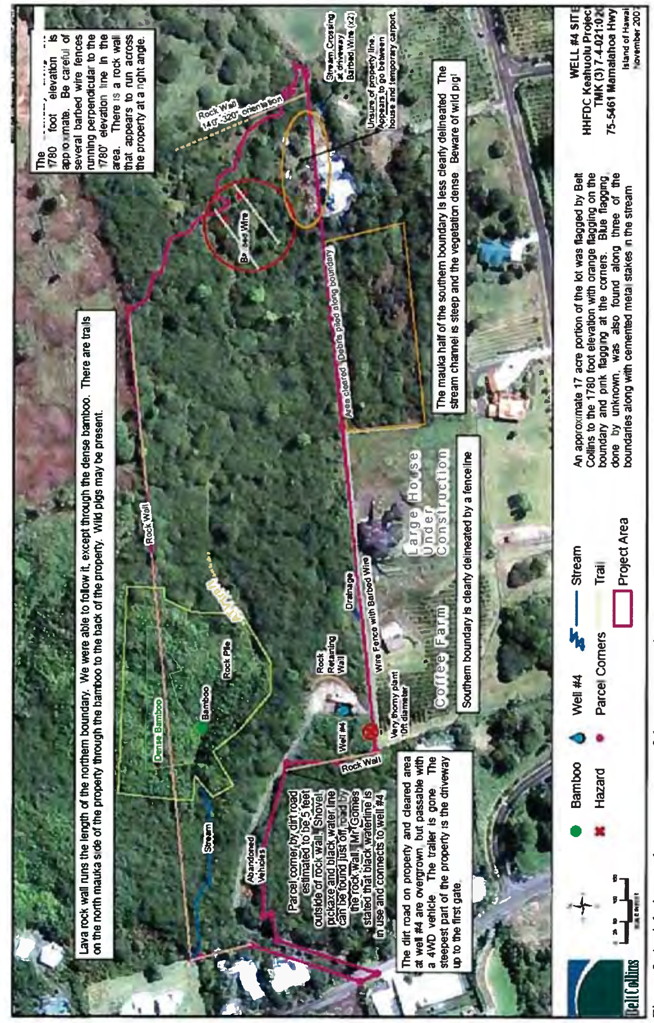


Figure 5. Aerial view and surveyor map of the current project area.

Figure 6. View to west of the natural drainage within the current project area.

Figure 7. View to east of the vegetation within the area bulldozed between 1997 and 1999.

BACKGROUND

To generate a set of expectations regarding the nature of archaeological resources that might be encountered within the project area, and to establish an environment within which to assess the significance of any such resources, a general historical context for the region is presented and previous archaeological studies conducted within and near the current project area are summarized.

Cultural-Historical Context

In an effort to provide a comprehensive and holistic understanding of the current study area in order to generate a set of expectations for the subject parcel, archival and historical data relevant to Hienaloli 1st Ahupua'a, along with the general settlement patterns for the District of North Kona are presented.

A Brief Overview of Hawaiian Settlement and the Kona Field System

The current project area lies within what has been termed the Kona Field System (Cordy 1995; Newman 1970; Schilt 1984). This area of dry-land agricultural fields extends north from Ho'okena Ahupua'a to at least Kaū Ahupua'a and east from the coastline all the way to the forested slopes of Hualālai (Cordy 1995). A large portion of the field system is designated in the Hawai'i State Inventory of Historic Places (SIHP) as Site 50-10-37-6601 and has been determined eligible for inclusion in the National Register of Historic Places. The basic characteristics of this agricultural/residential system as presented in Newman (1970) have been confirmed and elaborated on by ethnohistorical investigations (Kelly 1983) and summarized by Cordy (1995). The construct is based on the Hawaiian terms for the major vegetation zones, which are used to define and segregate space within the region's *ahupua'a* (Table 1). These zones are bands roughly parallel to the coast that mark changes in elevation and rainfall.

Table 1. Traditional Hawaiian vegetation zone classification (after Newman 1970 and Kelly 1983).

Zone	*Approx. Elevation Limits (ft)**	*Agricultural uses*
kula	Sea level – 500	Sweet potato, paper mulberry, gourds
kalu'ulu	500-1000	Breadfruit, sweet potato, paper mulberry
'āpa'a	1000-2500	Taro, sweet potato, sugar cane, ti
'ama'u	2500-4000	Banana, plantain

***above sea level.**

The current study area is located within what has been termed the *'āpa'a* zone. This zone lies between 300-750 meters (980-2460 feet) above sea level and has an average annual rainfall of 140 to 200 centimeters. Prehistorically, the dry-land cultivation of taro, sweet potato, ti, and sugar cane dominated this zone. There are, although infrequently recorded, also archaeological indications of temporary and permanent habitations within the *'āpa'a* zone (Barrera 1991; Burtchard 1995; Haun et al. 1998; Kaschko and Rosendahl 1987). Early European visitors to Kona recorded sparse habitation at higher elevations within the fields, especially the use of temporary field houses. Burial and ceremonial areas are rare in the upper elevations (Kawachi 1989), but not unheard of (Barrera 1992).

Kuaiwi are prominent features of the landscape within the *'āpa'a* (Cordy 1995; Newman 1970). These are low, broad, long multifunctional piles of rocks that were by-products of land clearing and rock removal from the planting areas. *Kuaiwi* are oriented upslope-downslope with shorter, perpendicular cross-wall segments connecting them. The cross-walls function as soil traps and retaining features, creating terrace-like areas to enhance planting. *Kuaiwi* can also function to move water downslope in a controlled manner, ensuring optimal distribution of the available runoff water (personal observation, Rechtman Consulting, LLC on going research in Kahalu'u Ahupua'a). The presence of *kuaiwi* is indicative of "formal walled fields," as opposed to the scattered planting mounds and terraces, or "informal fields." However, the distribution of soils suitable for agriculture determines, in part, the locations of the formal walled fields, and there is a direct relationship between suitable soils and older lava flows. Consequently, areas of young lava flow in the *'apa'a* do not always have *kuaiwi* (Burtchard 1995; Hammatt et al. 1987; Haun et al. 1998).

The archaeological record contributes to an understanding of how the Kona Field System developed over time. Precisely how the record is interpreted is reflected in the various chronologies proposed for the system (Burtchard 1995; Cordy 1995; Haun et al. 1998; Hommon 1986; Kirch 1985; Schilt 1984). The chronology and terminology outlined by Haun et al. (1998) is used in the present discussion, and the chronological summary below is abstracted from Rechtman et al. (1999).

The Kona Field System was not brought to Kona as a fully developed system; but rather, it reflects a developmental adaptation to the area that was concomitant with the evolving sociopolitical structure and increasing population of the island. The first inhabitants of Hawai'i Island probably arrived by at least A.D. 600, and focused habitation and subsistence activity on the windward side of the island (Burtchard 1995; Kirch 1985; Hommon 1986). To date, there is no archaeological evidence for occupation of the Kona region during this initial, or Colonization stage of island occupation (A.D. 300 to 600).

There is also little indication that during the subsequent period, Early Expansion (A.D. 600 to 1100), much activity was taking place in Kona (Burtchard 1995). Through the first half of the Early Expansion Period, permanent habitation was still concentrated on the windward side of the island. It is likely that windward residents traveled to the leeward Kona coast for resource extraction purposes (Cordy 1995). By the latter half of the Early Expansion Period, permanent habitation was beginning in Kona (Cordy 1981; 1995; Schilt 1984). Habitation was concentrated along the shoreline and lowland slopes, and informal fields were probably situated in areas with higher rainfall.

Agricultural fields and habitation areas expanded across the slopes and coastal area of Hualālai during the Late Expansion Period (A.D. 1100 to 1400) (Burtchard 1995; Cordy 1995). The earliest fields may have been located in the southern portion of the system (Schilt 1984), with new fields expanding northward over time (Haun et al. 1998).

The development of extensive formal walled fields, sometime during the initial stages of the Intensification Period (A.D. 1400 to 1600), marks the beginnings of the Kona Field System (Schilt 1984). The growth of the fields may reflect the need of prehistoric Hawaiian populations to extract more subsistence resources from an increasingly limited agricultural base. Radiocarbon data indicates that the population in Kona increased dramatically during this period (Burtchard 1995; Haun et al. 1998; Schilt 1984).

By the time of the Competition Period (A.D. 1600 to 1800), the environment may have reached its maximum carrying capacity, resulting in social stress between neighboring groups. The resulting hostility is reflected archaeologically with the frequent occurrence of refuge caves dating to this period (Schilt 1984). This volatile period was probably accompanied by internal rebellion and territorial annexation (Hommon 1986; Kirch 1985).

The first historic period of Hawai'i's history, termed the Last of the Ruling Chiefs (A.D. 1778-1819), begins with Captain Cook's arrival in the islands and ends with King Kamehameha's death in 1819 (Haun et al. 1998). The end of this period also sees the overthrow of the old religion, which took place when Liholiho, Kamehameha's heir, broke the traditional *kapu* laws and won a battle against the supporters of the old religion at Kuamo'o, along the southern coastline of Keauhou. Early historical accounts emphasize that modern day Kailua Town was a significant political seat and population center during this period. Settlement and subsistence practices within the Kona Field System continued to operate much as it had prehistorically through the first few decades of the historic era (Handy and Handy 1972).

The second quarter of the 19th century, the Merchants and Missionaries Period (A.D. 1820-1847), was a time of profound social change in Hawai'i. Kamehameha I died in mid-1819, and a council of chiefs supported Kamehameha's son Liholiho as the successor (Kelly 1983). Within six months after Kamehameha's death, Liholiho, Ka'ahumanu, and the Queen mother Keopuolani broke the *kapu* prohibiting men and women eating together. This act of "free eating" symbolized the end of the entire traditional *kapu* system. Changes in the social and economic patterns then began to affect the lives of the common people. Liholiho moved his court to O'ahu, so the burden of resource procurement for the chiefly class lessened considerably on the Island of Hawai'i. However, some of the work of the commoners shifted from subsistence agriculture to the production of foods and goods for trade to the early Western visitors. Introduced crops, such as yams, coffee, melons, Irish potatoes, Indian corn, beans, figs, oranges, guavas,

and grapes (Wilkes 1845) were grown specifically for trade with Westerners. Other commodities, especially sandalwood, were collected to purchase Western goods, often to the detriment of agricultural pursuits. The arrival of the missionaries to Hawai'i in the 1820s brought further changes to the social and religious systems of the islands.

The socioeconomic and demographic changes that took place in the period between 1790 and the 1840s, promoted the establishment of a Euro-American style of land ownership, and the Great *Māhele* became the vehicle for determining ownership of native lands. During this period, termed the Legacy of the Great *Māhele* (1848-1899), land interests of the King (Kamehameha III), the high-ranking chiefs, and the low-ranking chiefs, the *konohiki,* were defined. The chiefs and *konohiki* were required to present their claims to the Land Commission to receive awards for lands provided to them by Kamehameha III. They were also required to provide commutations to the government in order to receive royal patents on their awards. The lands were identified by name only, with the understanding that the ancient boundaries would prevail until the land could be surveyed. This process expedited the work of the Land Commission and speeded the transfers (Chinen 1961:13).

During the *Māhele* all lands were placed in one of three categories: Crown Lands (for the occupant of the throne), Government Lands, and *Konohiki* Lands. All three types of land were subject to the rights of the native tenants therein. In 1862, the Commission of Boundaries (Boundary Commission) was established in the Kingdom of Hawai'i to legally set the boundaries of all the *ahupua'a* that had been awarded as a part of the *Māhele*. Subsequently, in 1874, the Commissioners of Boundaries was authorized to certify the boundaries for lands brought before them. The primary informants for the boundary descriptions were old native residents of the lands, many of which had also been claimants for *kuleana* during the *Māhele*. The information was collected primarily between A.D. 1873 and 1885. The testimonies were generally given in Hawaiian and transcribed in English as they occurred.

As a result of the *Māhele*, the *ahupua'a* of Hienaloli 1st was retained as Government Lands. These lands were usually later sold as grant parcels or leased by the government. No grants were sold in Hienaloli 1st Ahupua'a, but an 1880s map of the area shows the ruins of the Greenwell's house located south of the current project area (Figure 8), and a 1920s map shows that a large portion of Hienaloli 1st Ahupua'a (including the current project area) was leased (Lease No. 1691) to Manual Gomes (Figure 9). Both the Greenwells and Gomes were prominent early ranching families in Kona, so it is likely that the project area was used for ranching throughout the Historic Period. The above summary of Hawaiian settlement patterns and the Kona Field System provides a general context in which to assess information specific to Hienaloli 1st Ahupua'a and the current project area.

Hienaloli 1st Ahupua'a

Helen Wong-Smith, M.A., cultural resources specialist prepared a cultural impact assessment for the proposed current development area (Wong-Smith 2008). The assessment was "based on a review of a wide range of written material including archaeological reports, government and other historical records, Hawaiian language sources translated into English, and interviews with long-term residents, including native Hawaiians, familiar with the cultural history and resources of Hienaloli. The research utilized resources at the Hawai'i State Archives, Edwin H. Mo'okini Library of the University of Hawai'i-Hilo, the Hilo Public Library, online resources, and previous historical and cultural reports and interviews" (Wong-Smith 2008:A-1). The following discussion of Hienaloli 1st Ahupua'a is summarized from the Wong-Smith (2008) cultural impact assessment with information cited from other sources as deemed appropriate.

According to the cultural impact assessment, information on the *ahupua`a* of Hienaloli is scarce, and the usual references for translations of *ahupua`a* names are silent regarding the meaning of Hienaloli (Wong-Smith 2008:A-1). *Hiena* could mean a kind of soft porous stone used to smooth and polish utensils, and *loli* has several possible meanings including: 1. to turn, change, alter, turn over…2. sea slug…sea cucumber…3. Spotted, speckled, daubed; to color in spots, as tapa (Pukui and Elbert 1965:194). Wong-Smith (2008:A-1) also notes that Hienaloli is often written as Hinaloli and Hianaloli in various 19th and early 20th century documents.

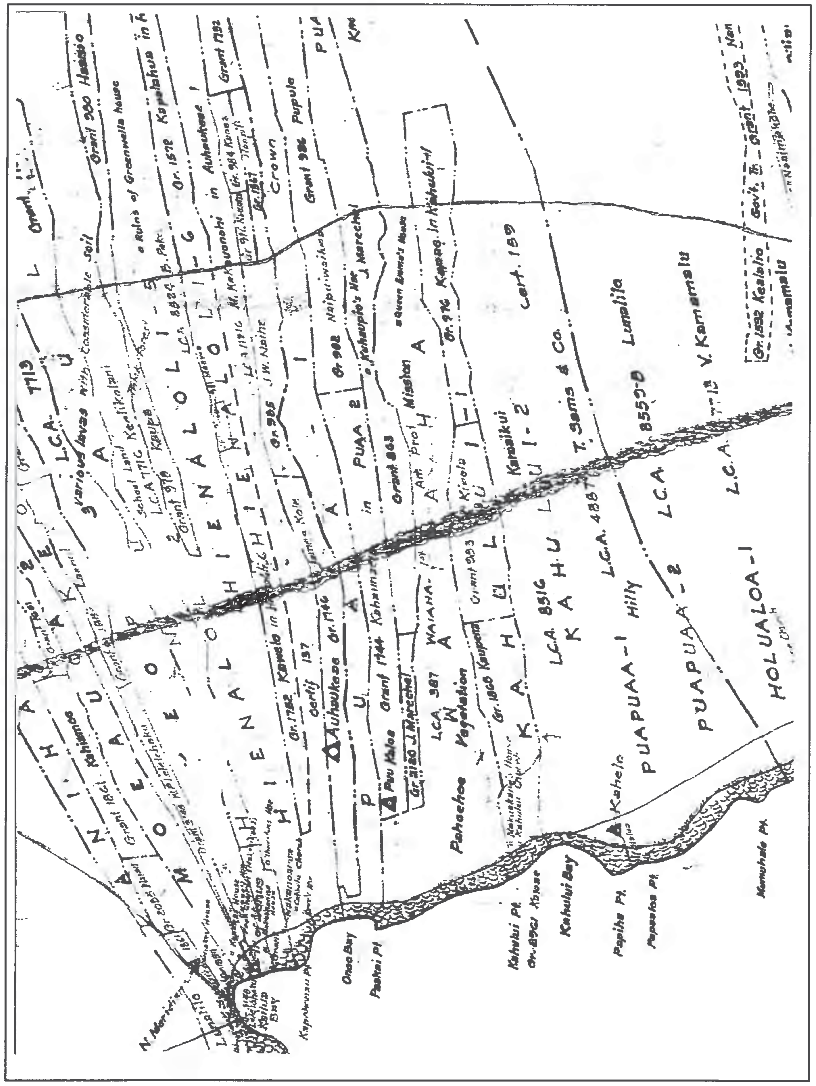


Figure 8. Portion of Emerson's Late 1880's Map of Kailua (from Haun and Henry 2001:11).

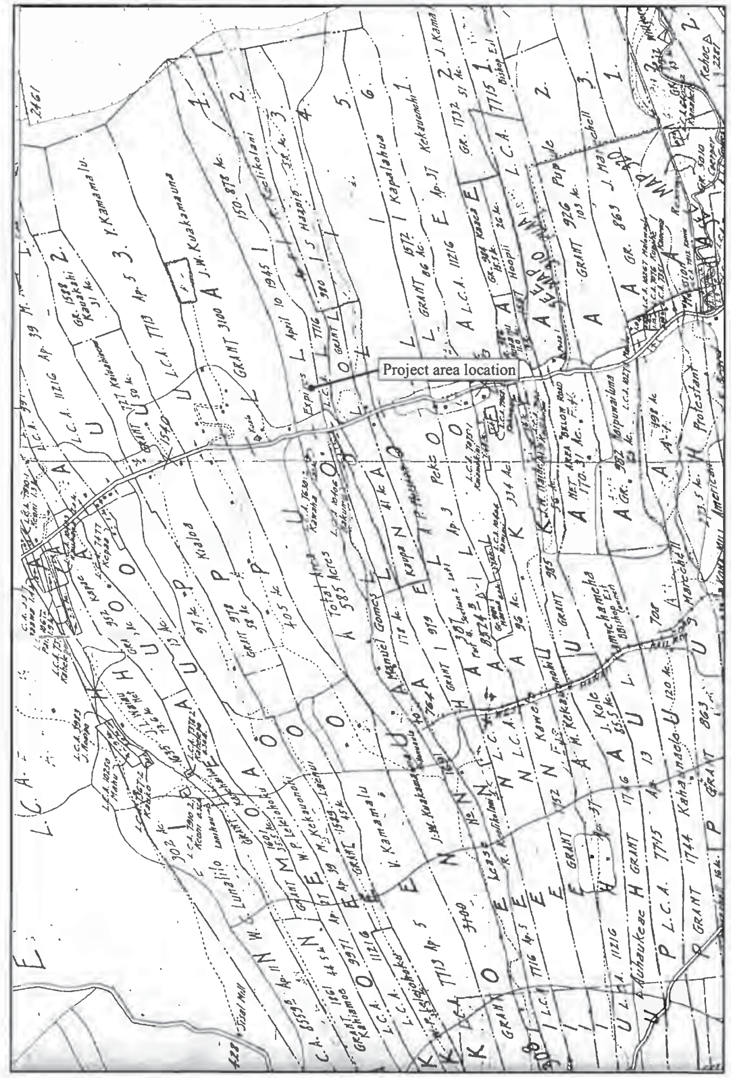


Figure 9. Portion of a 1928 Strip Map of North Kona.

A legendary reference to Hienaloli is found in *Ka`ao Ho`oniua Pu`uwai No Ka-Miki* (The Heart Stirring Story of Ka-Miki) translated by Kepā Maly, a legendary account of two super-natural brothers, Ka-Miki and Maka-ʻiole, who traveled around Hawaiʻi Island set in the period when Pili-a-Kaʻaiea was chief of Kona, ca. 12th-13th century). It was originally published in serial form between 1914 and 1917 in the Hilo-based Hawaiian language newspaper *Ka Hōkū o Hawaiʻi* by Hawaiian historians John H. Wise and John Whalley Hermosa Isaac Kihe (Maly 1996). Wong Smith (2008:A-5) provides two excerpts from Maly's translation:

> *Auhaukeaʻē and Hinaloli* (meaning uncertain) – After an *ʻawa* ceremony, *Ka-Miki* and *Maka-ʻiole* ventured from *Kalama`ula* to visit some of the lands of Kona. Upon returning to Kalamaʻula, *Ka-uluhe* described the nature of the lands they had visited; The *ahupuaʻa* of Auhaukeaʻē borders *Oneō* bay, and sits between the *ahupuaʻa* of Hinaloli (Hienaloli) and Puaʻa. Important features associated with these lands included: *Oneō* and *Niumalu* – with the *hālau aliʻi* (chief's compound) and *hālau waʻa* (canoe sheds) of the chief *Pili-a-kapu-nui-Paiʻea; Huihā-a* – a surfing spot named for a war counselor of *Pili*; and *Ka māla ʻuala* (sweet potato gardens) extended across the lands of Oneō bay and Hinakahua. [May 24, 1917 & June 14, 1917]

> *Waikūpua* (Supernatural [beings'] water) – land of Hinaloli – Following Ka-Miki's bold appearance before *Ahuʻena ma,* the stewards of the great chief *Pili-a-Kaʻaiea*, Pili's royal court was astir with word that *Ka-Miki* was seeking rebellion. *Kamalokaimalino*, high war counselor of *Pili* and overseer of the games at *Hinakahua* (Puapuaʻa) sent *ʻĪliopiʻil,* Pili's messenger, to summon *Waikūpua, Huihā, Kaʻaipuhi, Kahoʻoholoholo,* and *Haʻakona*. These individuals were the war counselor-generals of Pili, and guards to the arena of Hinakahua, and many of them became associated with place names, perhaps identifying places associated with the individuals. *Pili* wanted Waikūpua *mā* to bring *Ka-Miki* before the council to determine if he was a rebel. Waikūpua and the other *pūkaua* (war counselors) attempted to seize *Ka-Miki* but were defeated. [April 26, 1917]

The cultural impact assessment also provides several firsthand Historic accounts of Hienaloli and the general vicinity, as described in the logs and journals of early visitors to the area (between 1815 and 1902). The accounts describe the uplands of Kona as a fertile agricultural area. Around 1820, M. Gaimard, a member of de Freycinet's expedition, wrote the following description of the Kailua environs:

> In order to reach the mountain that lies to the southeast of the village…we first went across dry fields, where hardly any young growth was visible; but, after reaching a certain elevation; we found much richer terrain where the paper mulberry, breadfruit tree, the mountain apple, tobacco, cabbage, sweet potatoes and yams were cultivated. We were given water of a delicious coolness. [de Freycinet 1978:8]

In April of 1820, the first Protestant missionaries arrived in Hawaiʻi at Kailua. In 1823, one of the missionaries, William Ellis, reported on observations made by Reverends Thurston and Bishop who walked the coastline from Kailua toward Kaʻiwi Point and explored the uplands (Wong-Smith 2008:A-9). Ellis wrote:

> The environs were cultivated to a considerable extent; small gardens were seen among the barren rocks on which the houses were built, wherever soil could be found sufficient to nourish the sweet potato, the watermelon, or even a few plants of tobacco, and in many places these seemed to be growing literally in the fragments of lava, collected in small heaps around their roots.

> The next morning, Messrs. Thurston, Goodrich, and Harwood, walked towards the mountains, to visit the high cultivated parts of the district. After traveling over the lava

> for about a mile, the hollows of the rocks began to be filled with a light brown soil; and about half a mile further, the surface was entirely covered with a rich mould, formed by decayed vegetable matter and decomposed lava.

> Here they enjoyed the agreeable shade of bread-fruit and ohia trees; the latter is a deciduous plant, a variety of Eugenia, resembling the Eugenia malaccensis, bearing red pulpy fruit, of the size and consistence of an apple, juicy, but rather insipid to the taste. The trees are elegant in form, and grow to the height of twenty or thirty feet; the leaf is oblong and pointed, and the flowers are attached to the branches by a short stem. The fruit is abundant, and is generally ripe, either on different places in the same island, or on different islands, during all the summer months. [Ellis 1963:31-32]

According to Wong-Smith, "the cultivation and environs described above fall within the zone the project area is located and dispenses the assumption this was all barren lava supporting little life" (2008:A-10). Wong-Smith goes on to relate that, "this type of gardening in lava is called *makaili* when even small pockets of semi-disintegrated lava are utilized, and potatoes are grown by fertilizing with rubbish and by heaping up fine gravel and stones around the vines" (2008:A-10).

By 1825, one of the missionary couples, Asa and Lucy Thurston, was given a house lot in Hienaloli 1st Ahupuaʻa by then governor of the island Kuakini (*makai* of the current project area; Rechtman et al. 2005). Kaʻahumanu, as *kuhina nui* [prime minister], acting on behalf of the government, gave a part of Hienaloli for the mission's support (Kelly 1983:10). The Thurston's homestead was called Laniākea, after the nearby cave used for refuge during times of war. The lot consisted of five acres straddling the border of Honuaʻula and Hienaloli 1st. Ellis, who entered the cave in 1823 looking for water, provides the following description:

> …they also explored a celebratory cave in the vicinity, called Raniakea [Laniākea]. After entering it by a small aperture, they passed on in a direction nearly parallel with the surface; sometimes along a spacious arched way, at other times, by a passage so narrow, that they could with difficulty press through, till they had proceeded about 1200 feet; here their progress was arrested by a pool of water, wide, deep, and as salt as that found in the hollows of the lava, within a few yards of the sea. This latter circumstance, in a great degree, damped their hopes of finding fresh water by digging through the lava. ...The mouth of the cave is about half a mile from the sea, and the perpendicular depth to the water probably not less than fifty or sixty feet.…From its ebbing and flowing with the tide, it [the pool] has probably a direct communication with the sea. [Ellis 1963:30]

Ellis also described a fortification near the mouth of the cave, which at the time of his visit reached a height of 18 to 20 feet, with a base 14 feet thick:

> …In the upper part of the wall are apertures resembling embrasures; but they could not have been designed for cannon, that being an engine of war with which the natives have but recently become acquainted.

> The part of the wall now standing is near the mouth of Raniakea [Laniākea], the spacious cavern already mentioned, which formed a valuable appendage to the fort. In this cavern, children and aged persons were placed for security during an assault or sally from the fort, and sometimes the wives of the warriors also, when they did not accompany their husbands to the battle.

> The fortification was probably extensive, as traces of the ancient walls are discoverable in several places; but what were its original dimensions, the native who were with us could not tell. They asserted, however, that the cavern, if not the fort also, was formerly surrounded by a strong palisade. [Ellis 1963:62]

In 1840, Commodore Wilkes of the U.S. Exploring Expedition wrote the following about the environs of Kailua:

> The natives during the rainy season...plant, in excavations among the lava rocks, sweet potatoes, melons, and pineapples... The...staple commodities are sweet potatoes, upland taro, and yams. Sugar cane, bananas...bread-fruit, cocoa-nuts, and melons, are also cultivated. The Irish potato, Indian corn, beans, coffee, cotton, figs, oranges, guavas, and grapes, have been introduced....[Two miles from the coast, in a belt half a mile wide, the bread-fruit is met with in abundance, and above this the taro is cultivated with success...A considerable trade is kept up between the south and north end of this district. The inhabitants of the barren portion of the latter are principally occupied in fishing and the manufacture of salt, which articles are bartered with those who live in the more fertile regions of other south, for food and clothing. [Wilkes 1845:4, 91-92, 95-97 in Kelly 1983:19]

The cultural impact assessment prepared for the current proposed development also provides a chronological history of residency and land ownership in Hienaloli. According to Wong-Smith, "the above description of subsistence farming and trading within the land divisions is characteristic of pre-contact Hawaiian culture", but, "with the introduction of a market system and the call for labor to harvest sandalwood, agriculture in the Kailua area changed greatly, as did the native population" (2008:A-11). Although early demographics for Hienaloli are difficult to ascertain (Wong-Smith 2008:A-11), Schmitt recorded four epidemics for the years 1848 and 1849, including measles, whooping cough, diarrhea, and influenza, which killed more than 10,000 of the perhaps 87,000 persons in little more than a twelve-month period (Schmitt 1968:37).

Also, by the early to mid-1800s, the growing number of feral animals running rampant in Kona (i.e. cattle, goats, dogs, and pigs) had made agriculture increasingly difficult (O'Hare and Wolforth 1998). In response to this problem, wall building flourished. One of these walls was recorded by John Papa I'i at Honua'ula (inland and slightly north of Hienaloli) in 1812; I'i writes, "A stone wall to protect food plots stretched back of the village from one end to the other and beyond" (1959:111). Kelly (1983) postulates this wall was later incorporated into what became known as Kuakini Wall, which may be traced from its starting point at Palani Road above Kailua Bay to beyond Kahalu'u Bay (Wong-Smith 2008:A-12). Although no record exists of Governor Kuakini having ordered the wall built, its final configuration was attributed to him. John Adams Kuakini was governor of Hawai'i Island between 1820 and 1844. According to Kelly (1983), prior to 1855 this wall was simply known as the Great Wall or the Great Stone Wall. It is perhaps a result of the Reverend Albert Baker's 1915 account of the wall that it has commonly become known as the Kuakini Wall:

> Just a little above [the stone church at Kahalu'u], and continuing all the way to Kailua, is a huge stone wall built in Kuakini's time to keep pigs from the cultivated lands above. (Baker 1915:83)

Other early references to this wall are contained in *Māhele* records for *kuleana* awarded bordering the wall. Typical of these is a ca. 1850 map (Figure 10) that accompanied the Land Commission Award to the ABCFM in the *makai* portion of Hienaloli 1st Ahupua'a. The wall is again documented crossing Hienaloli on a ca. 1880 map of Kailua town (Figure 11) prepared by J. S. Emerson and S. M. Kanakanui. In addition to the Great Wall of Kuakini, many smaller historic walls were also built at this time for similar purposes and to mark boundaries (Wong-Smith 2008:A-12).

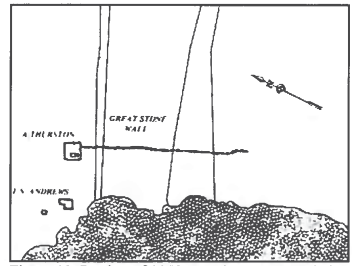


Figure 10. Portion of 1850 map that accompanied LCAw. 387 (from Kelly 1983:41).

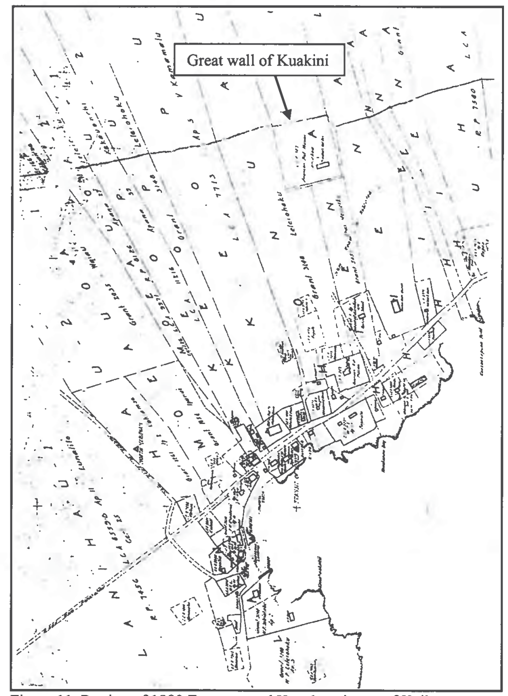


Figure 11. Portion of 1880 Emerson and Kanakanui map of Kailua town and vicinity (retraced by Lane in 1928).

As discussed above, in 1848, during the reign of Kamehameha III, the traditional Hawaiian land tenure system was replaced with a more Western-style of land ownership, this change was known as the The Great *Māhele* (division). As a result of the *Māhele*, the *ahupua'a* of Hienaloli 1st and 3rd and 6th were retained as Government Lands, Hienaloli 2nd was awarded to Ruth Ke`elikōlani (LCAw. 7716H), Hienaloli 4th was awarded to the American Protestant Mission (LCAw. 387, part 4, Section 2), and May Peke, daughter of Issac Davis, received Hienaloli 5th (LCAw. 8542B). Haun and Henry (2001:6) state that 31 LCAw. claims were made for a total of 60 parcels in Hienaloli (1-6), but that only 16 of the parcels were awarded. All of the LCAw. parcels are located *makai* of the current project area, with quite a few consisting of house lots clustered at the coast. Figure 12 shows all but three of the awarded parcels, which do not appear on the current tax maps (Haun and Henry 2001). The LCAw. testimonies provide some insight into the land activities and residency patterns of Hienaloli. Haun and Henry provide a summary of the land uses listed in the testimony of Hienaloli:

> House lots are described in the testimonies primarily for coastal parcels. Cultivated plots are described for the inland parcels. Fifteen claims included house lots with at least 24 houses. Enclosing walls are described for seven house lots. The testimonies refer to 167 *kihapai*. Named crops include taro (18 references), sweet potatoes (10), coffee (5), potato plots (3), coconut tree (2), and a gourd plot. Most claims for cultivated parcels include multiple parcels in two or more zones of the Kona field System. [2001:10]

The two parcels awarded closest to the current project area were LCAw. 7630:2 to Kawaha and LCAw. 10406 to Nakunu. Both are located across Māmalahoa Highway from the current project area, and one (LCAw. 10406) was subject to archaeological inventory survey and data recovery excavations conducted by Haun and Associates (Haun 2000; Haun and Henry 2000a, 2000b; see Previous Archaeology section above). The Native Testimony for these two parcels is presented below:

> LCA 10406 to Nakunu
> Kapule sworn: I've seen there in the land parcel of Iliiloa, land of Hianaloli, 8 cultivated patches in two sections. 1. Upland, my land; toward Kau, Ulua's land; shoreward, mine also; towards Kohala, Ulua's also. 2. Sweet potato [patch]: upland, my land; towards Kau, Ulua's land; shoreward, mine also; towards Kohala, ulua's also. 1 cultivated patch. His land was from me in the year 1847, no one has objected. [Native Testimony v4:537]
>
> LCA 7630 to Kawaha
> Mose sworn: I have seen there in the land parcel of Iliiloa, lands of Hianaloli 3; 14 cultivated patches as he claimed in the award document. There is the land parcel of Papa`awela, lands of Hinanaloli 2, are 8 cultivated patches, everything is under cultivation. His land was given by me at the time the Kingdom went to Kamehameha III. No one has objected to him. The cultivated patches in Hianaloli 2 are an old land [award] from Kamehameha I, and in his time, it is from Wahakane. No one has objected. He also has a house claim in the lot of Kaupa, when his life ended, Kaupa will receive his house claim. [Native Testimony v4:519] [from Wong Smith 2008:A-13]

Following the *Māhele*, many Government Lands were divided and sold as Grant Parcels. However, Government Land sales for Hienaloli between 1852 and 1853 are recorded for only Hienaloli 3 and 6 (Kelly 1983:43). Correspondence and other documents relating to holdings in Hienaloli were compiled from The Land File at the State Archives and are found in Wong-Smith (2008:A-16).

Although not listed above, a 1920s map of North Kona from Lanihau to Kahului (see Figure 9) shows that a large portion of Hienaloli 1st Ahupua'a (roughly 150 acres) including the current project area was leased to Manual Gomes as Lease No. 1691 (expired on April 10, 1945). Gomes, who had started ranching in the Kona area in the 1920s, created the Gomes Ranch, which at its peak included 8,500 acres of leased and purchased lands and 2,700 head of cattle (O'Hare and Wolforth 1998). The project area continued to be used as pasture into modern times.

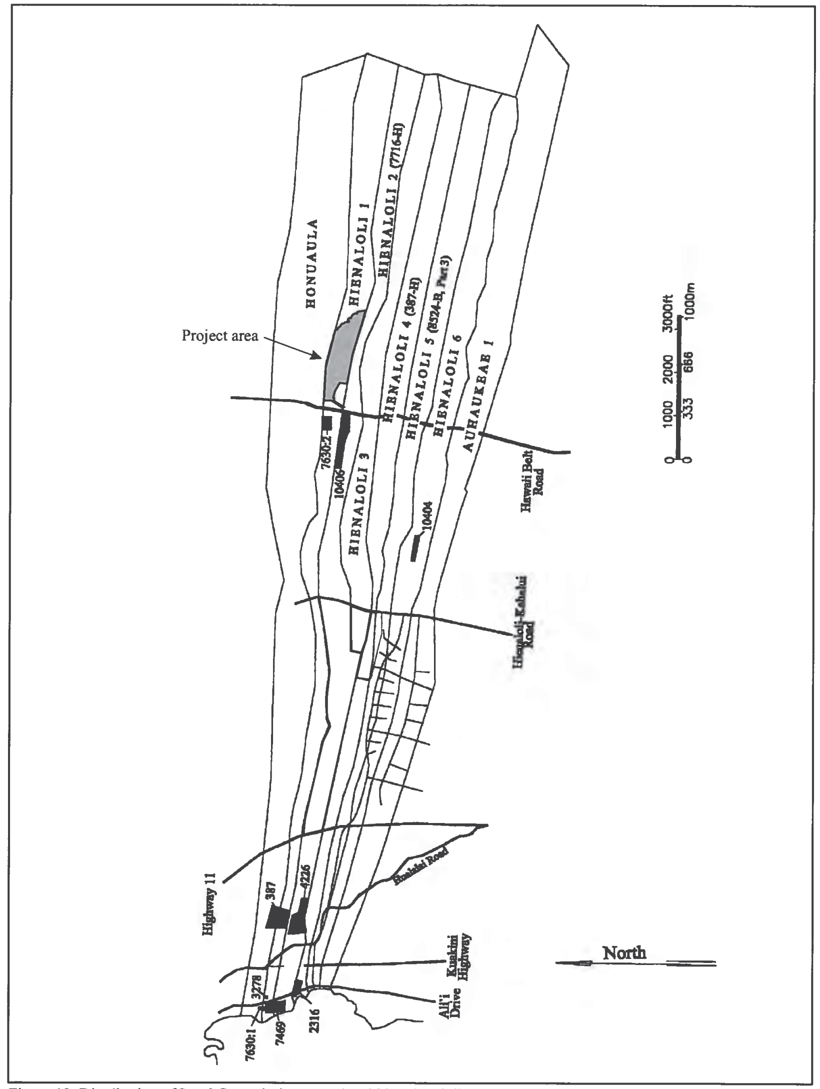


Figure 12. Distribution of Land Commission Awards within Hienaloli (adapted from Haun and Henry 2001:4).

Previous Archaeological Research

Several previous archaeological studies have been conducted in the *ahupua'a* of Hienaloli 1st through 6th (Donham and Kai 1990; Haun 2000; Haun and Henry 2000a, 2000b, 2001; Haun et al. 2003; Henry et al. 1996; Moore et al. 1997; Rechtman et al. 2005). In addition to these, four other studies have included the current project area (Halpern and Rosendahl 1996; Kawachi 1994; and Yent 1991, 1999). All of the aforementioned studies are discussed in detail below and their locations relative to the current project area are shown in Figure 13.

Yent (1991) conducted an archaeological reconnaissance survey of a portion of the current study parcel that extended from Māmalahoa Highway to an elevation of 2,424 feet above sea level. The study area encompassed approximately 80 acres and included all of the current project area. Yent (1991) noted, however, that the amount of area actually seen was limited due to dense vegetation and time constraints. As a result of the survey Yent (1991) identified several agricultural sites, a petroglyph, walls and a rock mound (Figure 14). These sites were only briefly described by Yent (1991), and they were not assigned state site numbers. One of the features recorded by Yent (1991) was an enclosure located at an elevation of 1,620 feet above sea level near the southern boundary of the current project area. Yent describes the site as follows:

> North-south wall that measures 80cm high on the upslope side (east), 120cm high on downslope (west), and 60cm in width [Figure 15]. This wall runs from the southern property line to the stream on the north. At approximately 30 meters north of the southern property line, there is a wide wall or 'ramp' that runs downslope (west) from the north-south wall. This 'ramp' measures 2.5m wide with walls 1m high on both sides. The length of the 'ramp' is approximately 50 meters and it meets another north-south wall on the west end.
>
> The lower north-south wall measures 1m high 60cm wide on the southern end. After this wall intersects the 'ramp', it changes to a retaining wall. The retaining wall measures 1m high. The southern property wall, the two north-south walls, and the 'ramp' create an enclosure feature. Within the enclosure is at least one low retaining wall running east-west. [Yent 1991:21]

Kawachi (1994) conducted an archaeological survey of a roughly 15-acre portion of TMK:3-7-5-13:22 for the proposed development of an exploratory well (Well No. 1) on the parcel at an elevation of 1,660 feet above sea level. The Kawachi (1994) survey area included nearly all of the current project area. Kawachi included a map of the sites previously recorded by Yent (1991) on the parcel (see Figure 13), but stated that no new sites were identified as a result of the survey and noted that "much of the area covered in the survey had been heavily disturbed by bulldozing and ranching" (1994:14).

Halpern and Rosendahl (1996) conducted an archaeological reconnaissance survey for a proposed Keopuolani Estates access road that traversed the current project area (see Figure 13). The proposed road corridor ran *mauka* from Māmalahoa Highway, at elevations ranging from 1,485 to 1,840 feet above sea level, across TMKs:3-7-5-13:13 and 22 to access the residential development. Although the road was never built, Halpern and Rosendahl (1996) recorded six sites within the corridor, five of which are included in the current project area. The sites consisted of three rock walls (Sites 20754, 20757, and 20758), a terrace (Site 20756), a terrace and wall complex (Site 20759), and a platform/wall feature (Site 20755). Site 20756 was the only site recorded by Halpern and Rosendahl (1996) not located within the current project area. Halpern and Rosendahl described the five sites recorded in the current project area as follows:

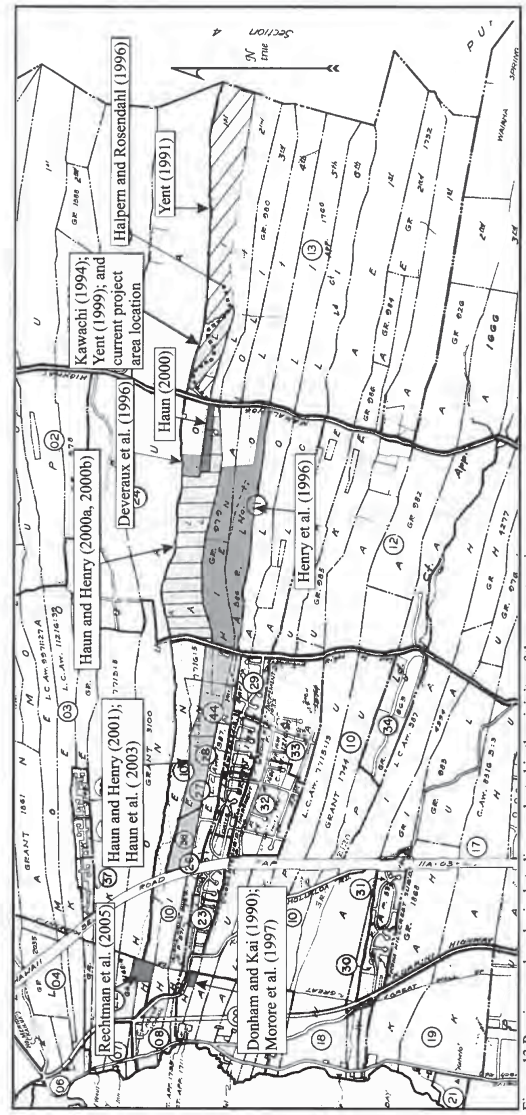


Figure 13.Previous archaeological studies conducted in the vicinity of the current project area.

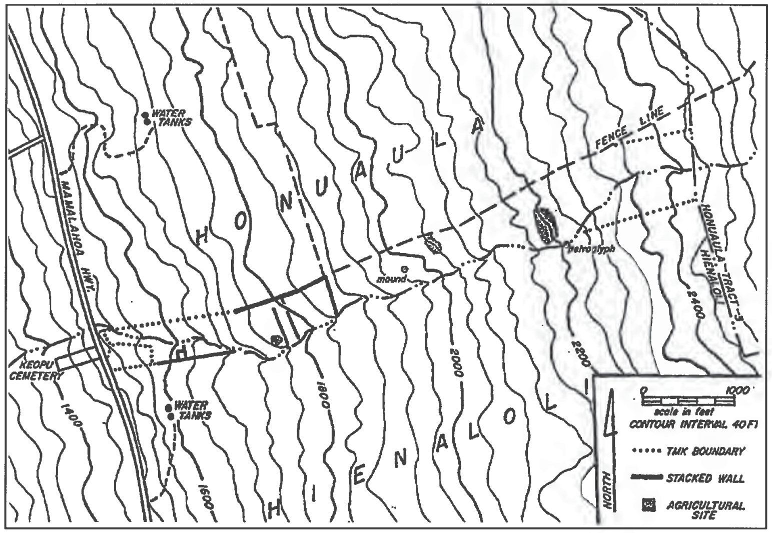


Figure 14. Site location map from Yent (1991:14).

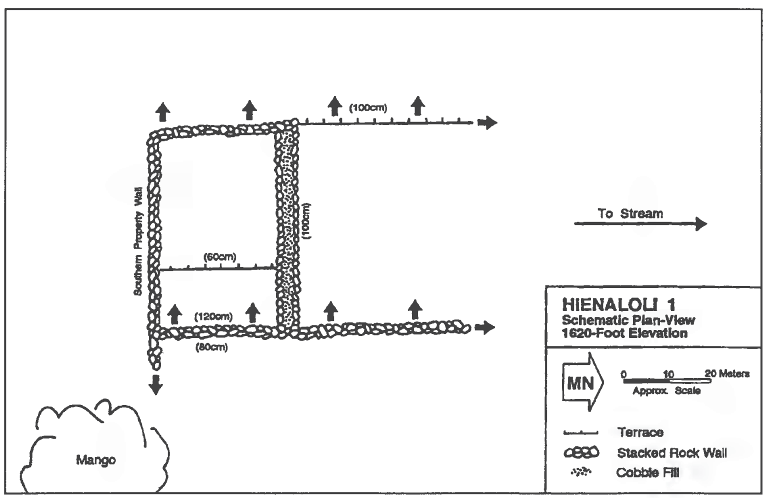


Figure 15. Plan view of site recorded at approximately the 1620-foot contour by Yent (1991).

SITE 20754 (PHRI T-1)

This wall of stacked basalt cobbles and boulders (four-five courses) stands c. 1.0 m high, c. 0.8 m wide and crosses the corridor on a bearing of 166°....Topped by barbed wire, it extends beyond the project boundaries both north and south, intersecting another wall (Site 20758) to the north. Its total length is unknown. Another barbed wire fence runs southwest from it near the northwest edge of the corridor. Some pahoehoe outcrops and loose cobbles are visible in the general area, which has undergone clearing and is now used as pastureland. A broken, modern carpenter's hammer was found in the vicinity of... About 30 m downslope of this site, a bulldozer berm crosses the corridor roughly parallel to the wall and intersects the aforementioned barbed wire fence. This is an area of dense strawberry guava growth. The wall probably dates to the historic period and was built as a boundary or in conjunction with ranching activities. [1996:9]

SITE 20755 (PHRI T-2)

Most of this L-shaped platform/wall lies outside the corridor to the south and is hidden under dense grass and foliage. Its broadest, platform-like end extends to within c. 3.0 m of the centerline...It is built of cobbles and boulders and is faced and stacked to five courses in some places. Its breadth reaches c. 3.0 m. The wall runs c. 20.0 m at 162°, narrowing as it goes. It then turns southwest, running c. 20.0 m downslope and terminating in a broad, low platform topped by a large plywood outhouse. The nature of this platform is uncertain as only its edges are visible. A bulldozer pushpile in roughly the same alignment as this site lies just outside the corridor to the north. Other, similar piles lie just *makai*... [1996:9]

SITE 20757 (PHRI T-4)

This stacked and faced cobble and boulder wall crosses the corridor on a bearing of c. 90°, though there is a short jog to the north and then east again... The wall stands over 1.0 m high (six-eight courses) and is 0.4-0.5 m wide. The area to the north has been cleared and is dominated by dense grass. Abandoned cars abound. Along the wall and to the south Christmas-berry trees form a dense canopy; there is little underbrush. Old chicken coops stand just south of the wall.

The contour map, supplied by Reid & Associates, indicates that this wall is part of a very large enclosure. Most of this enclosure lies well outside the project area and was not investigated. However, the east-west line was followed to its northeast corner where it is joined by a barbed-wire fence crossing the corridor. This fence turns west at the corner and tops the wall for a short distance. The long southwest-northeast segment from the junction of Sites 20756 and 20757 to the edge of the Mamalahoa Highway could not be found. [1996:9-10]

SITE 20758 (PHRI T-5)

This stacked and faced cobble and boulder wall stands over a meter high (to five courses). Bearing 62°... A barbed-wire fence on metal posts abuts and runs parallel to the wall's north side. Here, the vegetation is a mixture of pasture grass, ferns, Christmas-berry and strawberry guava...

Running downslope, the wall crosses the north end of Site 20754, where it continues to be coincident with a barbed-wire fence... A single opihi shell was noted near this section of the wall, lying on a gentle, cobble-strewn slope... Farther downslope it lies well north of the corridor (c. 25.0 m north of Site 20759) and forms the southern boundary of an extensive series of walls (including core-filled segments) enclosing platforms, terraces and other features extending at least 100 meters north. The entire landscape appears to have been modified in this area, which was examined briefly. This site may be a continuous wall but no attempt was made to follow its entire length.

This site is probably a historic boundary or ranching wall and may represent the border between the ahupuaʻa of Hienaloli 1 and Honuaula. [1996:10]

SITE 20759 (PHRI T-6)

This wall and terrace complex occupies an area c. 7.0 by 7.0 m adjacent to the southern edge of the exposed pahoehoe stream bed mentioned above.... The wall borders the edge of the stream bed and is composed of stacked cobbles and boulders bearing 80°. The lower terrace face is an alignment of pahoehoe boulders paralleling the wall to the south. A large tree growing on the terrace has disrupted what might have been a second terrace face of cobbles.

This site could be part of the Kona Field System. Its research value is moderate and detailed recording, surface collection, and testing of the architecture and adjacent surface deposit is recommended. [1996:10-11]

Based on the results of their survey, Halpern and Rosendahl concluded that:

Six sites (20754-20159) were identified in or near the corridor. While three of these can probably be assigned to the historic period, three (20755, 20756, and 20759) may belong to the pre-contact Kona Field System. All sites present are preliminarily assessed as containing moderate research value and low interpretive and cultural value. Based on this provisional assessment, the recommended further data collection should consist of detailed inventory-level recording of all sites. Sites 20755, 20756 and 20759 will also require surface collection and test excavations. Once these additional tasks have been completed, it is unlikely that any further work would be recommended. [Halpern and Rosendahl 1996:12]

Henry et al. (1996) conducted an archaeological inventory survey of a roughly 50-acre parcel (TMK:3-7-5-11:2) located within Hienaloli 3rd and 4th *ahupuaʻa* to the west of Māmalahoa Highway at elevations ranging from 750 to 1,450 feet above sea level (see Figure 13). As a result of the survey nine archaeological sites were recorded on the parcel. The sites included two agricultural complexes (Sites 18658 and 18661), two Historic boundary walls (Sites 18659 and 18660), three Precontact habitation enclosures (Sites 18662, 20689, and 20691), a Precontact platform interpreted as a men's house (Site 20690), and a platform used for Precontact habitation (Site 18663).

One of the agricultural complexes (Site 18658) was interpreted as being used during Historic times. It contained 20 features including 15 mounds, 3 walls, an alignment, and a terrace. The other agricultural complex (Site 18661) was interpreted as being used during Precontact and Historic times. It contained 131 features including 21 mounds, 60 terraces, 4 modified outcrops, 11 enclosures, 34 walls, and one feature that was bulldozed beyond recognition. Both agricultural sites were interpreted as being part of the Kona Field System. In addition to the recording of surface features, forty shovel test pits were excavated in the vicinity surface features revealing a partially disturbed, Precontact cultural deposit that extended to a depth of 0.15 meters below ground surface. Cultural debris recovered from the test pits included volcanic glass flakes, charcoal, a stoneware ceramic fragment, and a metal nail.

Moore et al. (1996) conducted an archaeological data recovery at eight sites located on TMK: 3-7-5-09:48 (por.) within Hienaloli 6th Ahupuaʻa to the southwest of the current project area at elevations ranging from 50 to 120 feet above sea level (see Figure 13). The property was previously the subject of an inventory survey conducted by Donham and Kai (1990) during which thirteen sites containing a total of seventeen features were recorded. The features consisted of modified outcrops, stone alignments, a terrace, walls, caves, a *pāhoehoe* excavation, and a rock concentration. Donham and Kai (1990) concluded that their project area had been utilized during both Precontact and Historic times for agriculture and temporary habitation purposes. During the data recovery, a total of 48.0 m^2 were excavated. The findings of the data recovery generally supported the findings of the inventory survey, concluding that:

Utilization of the sites on the subject property would have been minimal with some domestic activities occurring at the temporary habitation features, the cultivation of a few crops at the agricultural features, and the control of livestock in the post-contact period (Moore et al. 1996: 123).

Artifacts recovered during the data recovery excavations included volcanic glass, adzes, abraders, utilized shark teeth, pig tooth ornaments, modified bones, basalt flakes, worked shell, basalt weights, anvil stones, hammer stones, and *ʻula maika*, along with a conch shell fragment, gourd fragments, marine shell, fish, mammal, and bird bone, and a large amount of Historic debris. A single radiocarbon sample analyzed during the data recovery had a 1 sigma calibrated age range of 1518-1596 and a 2 sigma calibrated age range of 1471-1676.

Yent (1999) conducted an archaeological inspection of a Keopu-HFDC Exploratory Well No. 1 prior to its development within the current project area. The well site is located on TMK:3-7-5-13:22 at an elevation of 1,590 feet above sea level. Yent conducted a field inspection on June 24, 1999, and noticed several changes in the project area vicinity since her 1991 survey (Figure 16). Yent noted that:

- A new residence has been constructed to the south of he project area in Hienaloli 2 (TMK: 7-5-13: 12). In addition, grubbing and grading has occurred in the area of the new residence with subsequent planting of trees. It is believed that the grubbing, grading, and construction occurred sometime in the past 2 years as it was not mentioned in the [Kawachi] 1994 or [Halpern and Rosendahl] 1996 survey reports.
- Apparently in conjunction with this grubbing and grading, a portion of Hienaloli 1 was also bulldozed. This area measures approximately 100' (N-S) by 500' (E-W) and is along the Hienaloli 1-2 boundary of parcel 13. The area affected by the grubbing and grading is marked by growth of 3-foot high grasses and weeds and the lack of Christmas berry or guava trees that previously grew in the area.
- Erection of a new fenceline along the boundary of Hienaloli 1 and 2.
- The absence of the walled platform site at the 1620-foot elevation (approximate contour). It appears that this site was destroyed when the area was grubbed and graded. In addition, there was no evidence of the stacked rock wall on the southern property line of Hienaloli 1 that ran from the 1600-foot to 1680-foot elevation (approximate)…[Yent 1999:6, 9]

Yent (1999) believed that the walls of parcel 13 were Historic, probably built as property boundaries, and possibly associated with ranching in h area. She recommended that the walls be flagged and a 10-foot buffer established during drilling associated with Well No. 1. Also that Site 20759, although out of the potential area of impact, be pointed out to the construction crew, so that they could avoid the area. Yent (1999) did not recommend monitoring due to the shallow nature of the soils and the lack of significant surface features in the area. As a result of the Yent (1999) work, Well No. 1 was constructed on the parcel without any further destruction of archaeological sites.

Haun (2000) conducted an archaeological inventory survey of TMK:3-7-5-11:23 (por.) located within Hienaloli 2nd Ahupuaʻa to the west of the current project area, across Mamālahoa Highway (see Figure 13). The survey identified one site (Site 21848) with 17 features corresponding to the boundaries of LCAw. 10406. The features consisted of a modern house, a probable animal pen, an enclosure, and an enclosing wall with a series of subdividing walls and a terrace forming at least ten formal agricultural fields. LCAw. testimony for the parcel indicated that the property was used for the cultivation of taro, sweet potatoes, and coffee during the early to mi 1800s. As a result of the survey Site 21848 was recommended for data recovery.

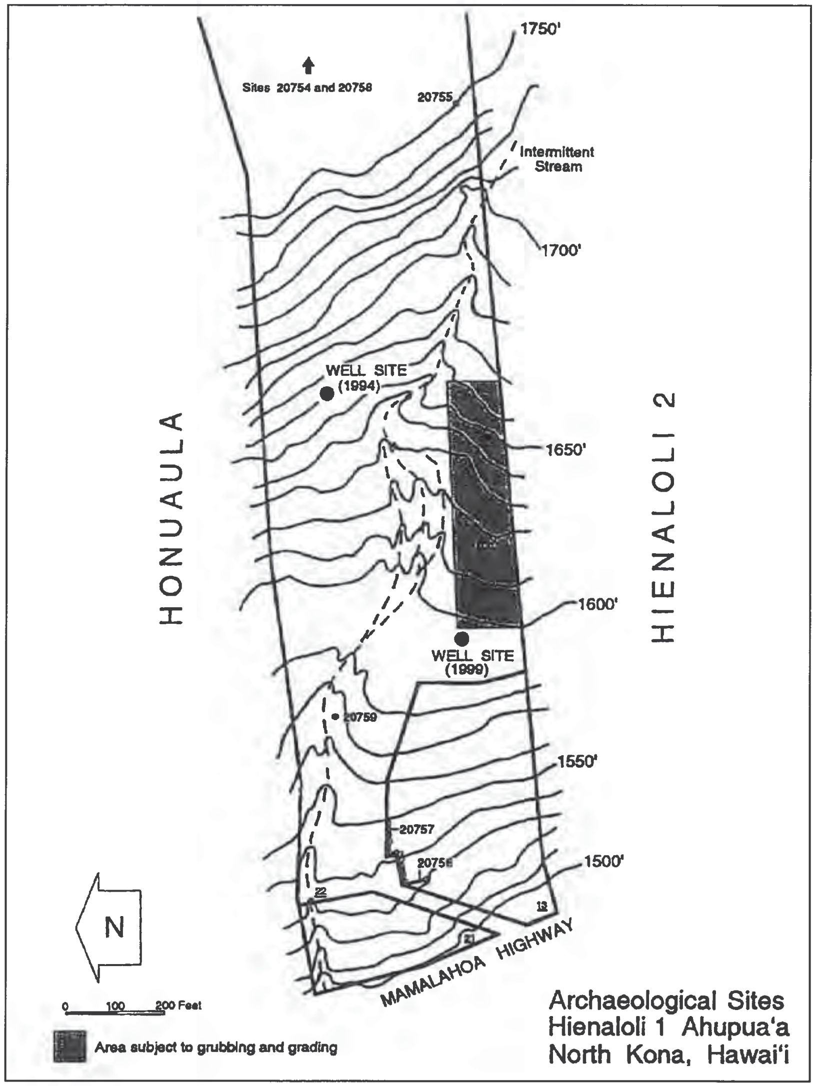


Figure 16. Map from Yent (1999) showing the approximate area impacted by grubbing and grading prior to 1999.

Haun and Henry (2000a) conducted an archaeological inventory survey of a roughly 56-acre property (TMK:3-7-5-11:3, 4 and 24) located west of the current project area, across Mamālahoa Highway, within Hienaloli 1st and 2nd *ahupua'a* (see Figure 13). Elevations within the project area ranged from 750 to 1,480 feet above sea level. As a result of the survey Haun and Henry (2000a) identified eight archaeological sites containing a total of thirty-nine features. The recorded sites included five Historic ranch walls (Sites 5085, 18659, 20846, 21878, and 21879), a railroad bed (Site 7214), a *heiau* (Site 21880), and an agricultural complex (Site 21881). The agricultural complex contained thirty-two features including mounds, modified outcrops, *kuaiwi*, platforms, and terraces that were concentrated in areas least affected by mechanical clearing. Haun and Henry (2000a) suggested that Site 21880 was probably a small agricultural *heiau* based on its setting, and that its construction and initial use likely dated to sometime between A.D. 1400 and 1600. As a result of the inventory survey Site 21881 was recommended for data recovery, Site 21880 was recommended for preservation, and the remaining sites were recommended for no further work.

Haun and Henry (2000b) conducted the data recovery excavations at Site 21848 located on TMK: 3-7-5-11:23 (por.) and Site 21881 on TMK:3-7-5-11:3, 4 and 24. The data recovery consisted of mechanical sectioning of selected terraces and *kuaiwi* to obtain stratigraphic data and radiocarbon samples. In all seven trenches that bisected five terraces and a *kuaiwi* were excavated. The results of the data recovery suggested that, "initial agricultural use of the area began in the early 1400s with the formation of *kua'iwi* (sic) followed by the construction of terraces within a few decades", and that, "the agricultural features probably continued in use until at least the early to mid-1800s" (Haun and Henry 200b:ii).

Haun and Henry (2001) conducted an archaeological inventory survey of a roughly 51-acre property (TMK:3-7-5-10: 52, 65, and 66) located southwest of the current project area within Hienaloli 2nd-5th *ahupua'a* (see Figure 13). Elevations within the project area ranged from 270 to 740 feet above sea level. As a result of the survey, Haun and Henry (2001) identified twenty-two archaeological sites containing a total of 134 features. The recorded sites included thirteen walls (Sites 5086, 22947, 22950, 22953, 22954, 22955, 22956, 22957, 22959, 22960, 22962, 22963, and 22964), a railroad bed (Site 7214), an agriculture complex consisting of 111 features (Site 22946), a livestock loading chute (Site 22948), a temporary habitation enclosure (Site 22949), a permanent habitation terrace (Site 22951), a temporary habitation complex consisting of three features (Site 22952), a permanent habitation platform (Site 22958), a livestock enclosure (Site 22961), and a platform used as a foundation in the Historic Period (Site 22965). The 111 features of the agricultural complex (Site 22946) consisted of modified outcrops, terraces, mounds, and *kuaiwi*, which were only located in the *makai* portion of the project area. Haun and Henry (2001) surmise that this is because of modern disturbances to the area above the 520-foot elevation contour. The inventory report recommended that five sites (Sites 22949, 22946, 22951, 22952, and 22958) undergo data recovery, while the other seventeen were recommended for no further work.

Haun et al. (2003) conducted the data recovery excavations at the five sites located on TMK:3-7-5-10: 52, 65, and 66. During the data recovery seven agricultural features were sectioned with a backhoe at site 22946, and 11.0 m^2 were excavated within the habitation features at Sites 22949, 22951, 22952, and 22958. Eleven radiocarbon samples were submitted for dating, indicating construction and use of the features from A.D. 1400 to 1890. Haun et al. concluded that:

> Artifacts, midden debris, and structural modifications indicate a variety of on-site and off-site activities. Widespread marine resources indicate that people using the area were in direct contact with the coastal region. Evidence of animal husbandry is inferred from domesticated dog bones in the faunal assemblage from Site 22958. traditional Hawaiian artifacts, a radiocarbon calibrated rang of A.D. 1440 to 1640 and commercial items, including a coin from the Republic of Mexico indicate that multicomponent deposits are preserved at Site 22958. On site activities include feature and fire construction, food preparation and consumption; stone, bone, and shell tool use and manufacture; and crop cultivation. Inferred off-site activities include marine food procurement, animal husbandry, and procurement of stone for construction and raw material for tool. [Haun et al. 2003i]

Rechtman et al. (2005) conducted an archaeological inventory survey of three adjoining parcels (TMK:3-7-5-04:2, 35, and TMK:3-7-5-22:173) comprising roughly 5.3 acres in Honua'ula and Hienaloli 1st *ahupua'a* to the west of the current project area at elevations ranging from 80 to 120 feet above sea level (see Figure 13). The project area roughly corresponded to the 5 acres given to the Reverend Asa Thurston and his family in 1825. Although the bulk of the study area was extensively grubbed and graded in 1991, the survey revealed the presence of three previously known sites within the project area. The sites included a homestead initially occupied around A.D.1825 as the parsonage for the Reverend Asa Thurston and his family (Site 7248), Laniākea Cave (Site 24385), a traditional cultural site that was a fortified defensive location used during the Precontact Period as a secure location in times of conflict, and the Kuakini Wall (Site 6302). The Historic residential complex contained ten features including the ruins of two stone and mortar structures, a stone terrace, a stone-lined pit used for the manufacture of coral/lime mortar and plaster, and several wall remnants. Scattered human remains were found within Laniākea Cave, indicating that the cave was also used for burial. As a result of the survey all three sites were recommended for preservation.

AHUPUA'A SETTLEMENT PATTERNS AND CURRENT SURVEY EXPECTATIONS

Archaeological studies undertaken within the greater North Kona District indicate that initial prehistoric settlement was concentrated primarily along the coast (Cordy 1981, Cordy et al.1991). As coastal populations increased, so did the development of agricultural fields in the upland areas, reaching their greatest extent in the late 1700s. As the fields expanded so did native populations in the upland resource areas. By the sixteenth century temporary and permanent habitations were found at higher elevations within the *'apa'a* zone (Barrera 1991).

In Historic times, with the shift to a market economy and a western style of land ownership in Hawai'i, populations shifted from the coast to the upland areas (Cordy 1985, Ellis 1963). Much of the old style of agriculture was abandoned in favor of coffee farms and cattle ranches, which have had a significant impact on the Prehistoric archaeological record.

Based on the previous archaeological work undertaken within the current project area, a fairly detailed set of project expectations can be arrived at. Yent (1999) and Halpren and Rosendahl (1996) both list five sites as being extant within the current project area. A sixth site, recorded by Yent (1991) at the 1,620 foot contour within the project area was destroyed prior to the Yent (1999) study and was outside the Halpern and Rosendahl (1996) study area. The previously recorded sites include core-filled walls and wall complexes dating to the Historic Period that were constructed for ranching and boundary purposes, along with a wall and terrace site that was suggested by Halpern and Rosendahl (1996) to be a remnant Precontact agricultural feature.

If other Precontact features (that were not previously recorded) are discovered within the project area, they may include mounds, modified outcrops, terraces, and low rock walls (*kuaiwi*) related to agricultural use of the area, or enclosures, platforms, or lava tubes that were used for habitation purposes, and perhaps trails that once connected these sites with other sites, and the upland areas with the coastal areas. If any burials are present, they may be found within lava tubes or neatly constructed platforms. The construction of Historic features for ranching purposes likely had a negative impact on any Precontact features that were once present, as stones were taken to build walls and corrals, and cows trampled them. If any unrecorded Historic Features are encountered they could include additional core-filled walls used for ranching and boundary purposes, roads, habitation features (i.e. enclosures, platforms, cisterns, etc.), or possibly agricultural features similar to those described above. If any Historic Period burials are encountered they may be located in above ground mausoleums. Many of the features within the project area are likely to have been negatively impacted by mechanical clearing for ranching and residential purposes during modern times.

FIELDWORK

Fieldwork for the current inventory survey was conducted on February 12-14 2008 by Matthew R. Clark, B. A., J. David Nelson, B.A., Christopher S. Hand, B.A., Olivier M. Bautista, B.A., Ashton K. Dircks, B.A., Johnny R. Dudoit, B.A., and Michael K. Vitousek, B.A. under the direction of Robert B. Rechtman, Ph.D.

Methods

During the inventory survey fieldwork the entire project area was subject to north-south pedestrian transects with fieldworkers spaced at 10-meter intervals. When archaeological features were encountered, they were plotted on a map of the study area using Garmin 76s handheld GPS technology (with sub five-meter accuracy). They were then cleared of vegetation, mapped in detail, photographed (with a meter stick for scale), and described using standardized site record forms. With the aid of the previous survey reports for the project area, the identified features were then matched to their existing SIHP site numbers. The features were also evaluated at that time for the need of subsurface testing.

All test units (TUs) excavated during the current project measured 1 x 1 meter. Excavation of test units proceeded following natural stratigraphic layer. Where applicable, the layers were excavated in arbitrary 10-centimeter levels. The recovered soil matrix was passed through quarter inch mesh screen, and all recovered cultural material was remanded to the laboratory for detailed analysis. Level record forms, filled out for each level of each layer in each unit, were used to record soil descriptions, Munsell color notations, cultural constituents collected, and a general description of the level. Upon completion of a unit, photographs were taken, profile drawing was prepared, and the unit was back filled as close to its original specifications as possible.

Recovered cultural material was processed at the Rechtman Consulting, LLC laboratory facility and is currently curated at that location. The recovered cultural material was first washed and then separated by level into material classes. An accession number (ACC #) was then sequentially assigned to each group of related items; and the material encompassed by an individual accession number was quantified by the number of identified specimens (NISP), weighed, and when applicable considered for the minimum number of individuals (MNI) present. The findings of the inventory survey along with detailed descriptions of the encountered archaeological resources and the subsurface testing are presented below.

Findings

As a result of the current inventory survey five previously recorded sites were relocated within the project area (Table 2). The sites include four core-filled ranching/boundary walls (Sites 20754, 20755, 20757, 20758) and a terrace and wall located along the edge of a natural drainage that may have been utilized for agricultural purposes (Site 20759). A single test unit (TU-1) was excavated at Site 20759 revealing a soil deposit, but only modern cultural debris. The location of each of these sites, relative to the boundaries of the current project area, is shown in Figure 17, and detailed descriptions of each of the sites follow below.

Table 2. Archaeological sites recorded within the current project area.

Site No.	*Formal Type*	*Functional type*	*Temporal Affiliation*	*Test unit*
20754	Core-filled wall	Ranching/boundary	Historic	-
20755	Core-filled wall	Ranching/boundary	Historic	-
20757	Core-filled wall	Ranching/boundary	Historic	-
20578	Core-filled wall	Ranching/boundary	Historic	-
20759	Terrace and wall	Agriculture	Precontact/Historic	TU-1

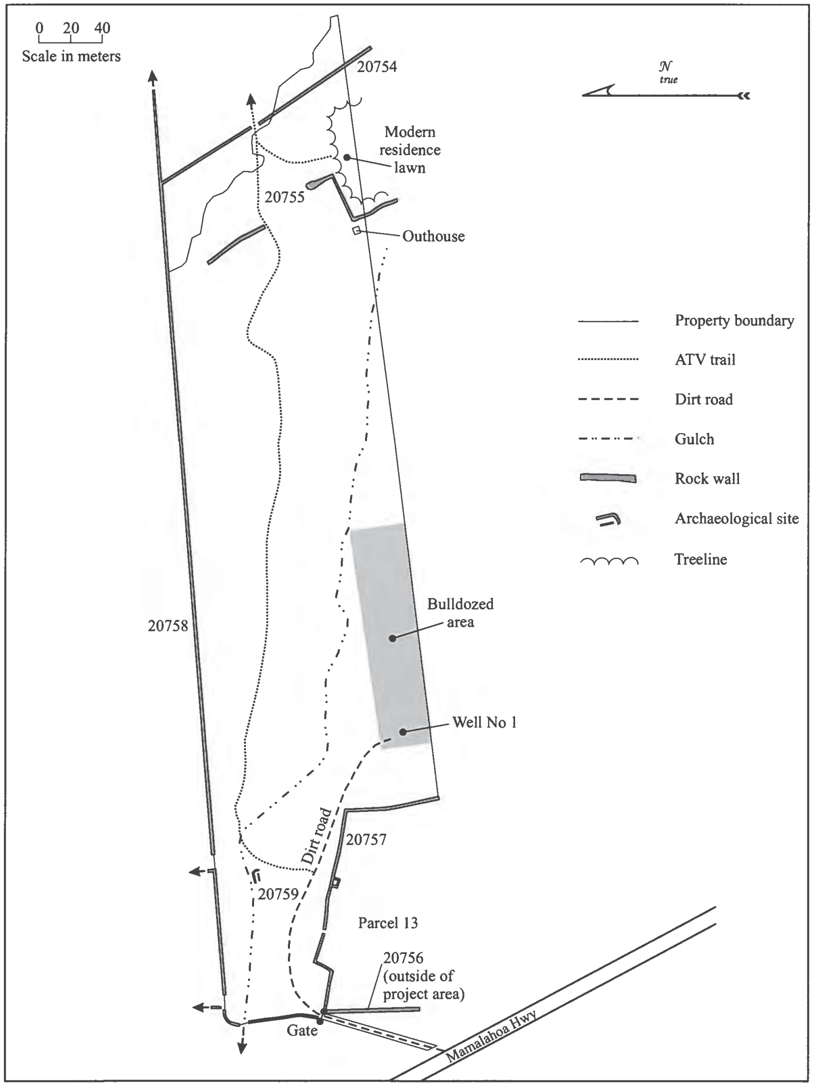


Figure 17. Site location map.

SIHP Site 20754

SIHP Site 20754 is a core-filled wall that runs in a northwesterly/southeasterly direction across the eastern portion of the current project area (see Figure 17). The wall was previously recorded by Yent (1991, 1999), Kawachi (1994), and Halpern and Rosendahl (1996). The Halpern and Rosendahl (1996) description of Site 20754 presented in the Previous Archaeology section of this report accurately describes the wall as it appeared during the current study.

Site 20754 crosses the eastern end of the current project area in a northwesterly/southeasterly direction the 1,800-foot elevation contour. The section of wall located within the project area measures 55 meters long but it continues for an undetermined distance to both the northwest and southeast. The wall is constructed of medium to large sized *pāhoehoe* cobbles standing 2-5 courses high along each edge, with small cobbles filling in the interior space. The wall averages 70 centimeters tall and has an average width of 75 centimeters (Figure 18). The wall is mostly intact and a barbed wire fence runs along its top edge. A break appears in the wall where the ATV trail crosses its length. To the north (outside of the current project area) Site 20754 continues to Site 20758 (another core-filled wall). As mentioned by Halpern and Rosendahl (1996), and based on its formal attributes and location, Site 20754 was likely built during the Historic Period for cattle control and boundary marking purposes.

Figure 18. SIHP Site 20754, view to east.

SIHP Site 20755

SIHP Site 20755 is a core-filled wall located in the southeastern portion of the current project area (see Figure 18). The wall was previously recorded by Yent (1991, 1999), Kawachi (1994), and Halpern and Rosendahl (1996). Halpern and Rosendahl (1996) called Site 20755 a platform/wall (see Previous Archaeology section of this report). Although the wall does not appear to be a platform, just an unusually wide wall, the description generally describes Site 20755 as it appeared during the current study, but some of the wall's component sections are not mentioned.

The wall is located in the eastern portion of the current study parcel, approximately 50 meters west of, and running parallel to Site 20754. The site is located adjacent to the northwestern corner of the lawn of a modern residence that encroaches into the current study parcel. Based on its formal attributes and location (parallel to Site 20754 near a fence line and property boundary) it is likely that Site 20755 was constructed during Historic times for ranching and/or boundary purposes.

Beginning at its southernmost end, outside of the current project area, Site 20755 runs from a modern concrete and stone retaining wall in a northwesterly direction for 35 meters. This section of the wall averages 1.6 meters wide by 0.6 meter tall. It is constructed of 2-3 courses of medium sized cobbles, but is mostly collapsed. At a point approximately 10 meters north of the project area's southern boundary, the wall makes a 90° turn and runs northeast for an additional 35 meters to another corner.

The plywood outhouse (Figure 19) mentioned by Halpern and Rosendahl (1996) is located just to the west of the first turn in the wall. It is built over a natural depression in the bedrock terrain that has been modified with stacked cobbles. The cobbles used to build the outhouse may have been taken from Site 20755, as the two are not contemporaneous, and the outhouse was clearly built later. Based on the construction materials, it is likely that the outhouse is no more than 25 years old. A walking path, leading in the direction of the modern residence has been cleared through Site 20755.

At the second (easternmost) corner, the wall once again makes a 90° turn and continues northwest for an additional 20 meters, gradually increasing in stature as it proceeds, and eventually terminating at bulldozed pasture and a fence line. At the southeastern end of this section, the wall is core-filled, neatly stacked 3-4 courses (up to 1.1 meters) tall, and measuring 1.6 meters wide. The wall increases in size as it proceeds to the northwest reaching a maximum width of 3.6 meters and a maximum height of 1.6 meters (5-7 courses) (Figures 20 and 21). Although this portion of Site 20755 was described as a platform by Halpern and Rosendahl (1996), bulldozer scaring on some of the rocks indicates that the wall was likely restacked and consequently widened for clearing purposes subsequent to the bulldozing of the nearby pasture. Some exposed bedrock was also present in the wall, suggesting that it was perhaps built over a raised outcrop, which would have contributed to its size. Where the wall terminates at the fence line and pasture, a 35-meter gap is present in the wall before a rough alignment of bulldozed cobbles picks up continuing in the same general direction as the wall was where it terminated. It is possible that this alignment represents a former continuation of Site 20755, but it has been so thoroughly destroyed by bulldozing that this is difficult to determine with any certainty.


Figure 19. View to southwest of the plywood outhouse near Site 20755.


Figure 20. SIHP Site 20755, view to east of western edge.


Figure 21. SIHP Site 20755, view to northwest of the top surface of the widest section of the wall.

SIHP Site 20757

SIHP Site 20757 is a core-filled wall that runs along the southwestern boundary of the current study parcel where it borders Parcel 13 (see Figure 17). The wall was previously recorded by Yent (1991, 1999), Kawachi (1994), and Halpern and Rosendahl (1996). The Halpren and Rosendahl (1996) description of Site 20757 presented in the Previous Archaeology section of this report generally describes the wall as it appeared during the current study.

Site 20757 runs a meandering course east for approximately 130 meters, from the gate across the access road in the southwestern corner of the parcel to the northeastern corner of Parcel 13 (Figure 22). The wall then turns south and runs for approximately 50 meters along the eastern boundary of Parcel 13 to the southern boundary of the current project area. Site 20757 is constructed of medium to large sized *pāhoehoe* cobbles that are stacked 3-4 courses (0.8 to 1 meter) high. It has an average width of 1 meter. A constructed gap, 1.3 meters wide, is located in the center of the east-west trending section of Site 20757, and small rectangular enclosure is constructed along the southern edge of the wall, approximately 35 meters east of the constructed gap, outside of the current project area (see Figure 17). The enclosure measures 2 meters (east-west) by 1.5 meters (north-south), by 0.5 meter tall, and the interior is partially filled with loose cobbles. A modern barbed wire fence runs along the wall in places and black PVC water line follows the north edge of the wall for its entire length. It is likely, based on its formal attributes and location (along parcel boundaries), that Site 20757 was built during the Historic Period for ranching and/or boundary purposes.

Figure 22. SIHP Site 20757, view to southwest at the northeastern corner of parcel 13.

SIHP Site 20758

SIHP Site 20758 is a core-filled wall that runs along the northern boundary of the current project area (see Figure 17). The wall was previously recorded by Yent (1991, 1999), Kawachi (1994), and Halpern and Rosendahl (1996). The Halpern and Rosendahl (1996) description of Site 20757 presented in the Previous Archaeology section of this report generally describes the wall as it appeared during the current study.

Site 20758 is the northern boundary wall of the current project area. Although the wall runs east-west along the parcel boundary for the entire length of the study area, it appears to have been constructed in sections corresponding to parcel boundaries to the north of the project area (two core-filled walls run north from Site 20758 and constructed gaps are present in Site 20758 at both of these intersections). The wall is of core-filled construction with stacked edges standing 4-5 courses (1.0 to 1.2 meters) high, by 0.8 to 1-meter wide (Figure 23). The wall is fairly intact for its entire length, but erosion has caused soil to build up along its northern edge and caused it to collapse downhill to the south where it runs along steep terrain. At its western end, also due to erosion, the wall has collapsed where it follows along the natural edge of the drainage that crosses the property. Site 20758, based on its formal attributes and location (along the parcel boundary) was likely built in the Historic Period for boundary delineation and cattle control purposes.

Figure 23. SIHP Site 20758, view to north of intact southern edge.

SIHP Site 20759

SIHP Site 20759 consists of a wall and terrace located in the western portion of the current project area (see Figure 17) The site was previously recorded by Halpern and Rosendahl (1996), and Yent (1999). The Halpern and Rosendahl (1996) description of Site 20759 presented in the Previous Archaeology section of this report generally describes the wall as it appeared during the current study.

Site 20759 consists of a wall and terrace located south of the drainage in the west-central portion of the project area. The site occupies a roughly 15 meter by 15 meter area directly adjacent to the drainage edge (Figure 24). The wall is constructed along the edge in a north/northeasterly direction (Figure 25). It measures roughly 6.0 meters long by 0.8 to 1.5 meters wide, and has an average height of 0.5 meters along its southern edge (Figure 26). Along its northern edge, where it borders the drainage, the wall is loosely stacked up to 4 courses (up to 1.5 meters) tall, with areas of collapse (Figure 27). The northern end of the wall fades into the natural terrain. At its southern end the wall follows a bedrock contour that runs south toward the terrace. Ground surface to the south of the wall consists of level soil covered by ferns and organic material.

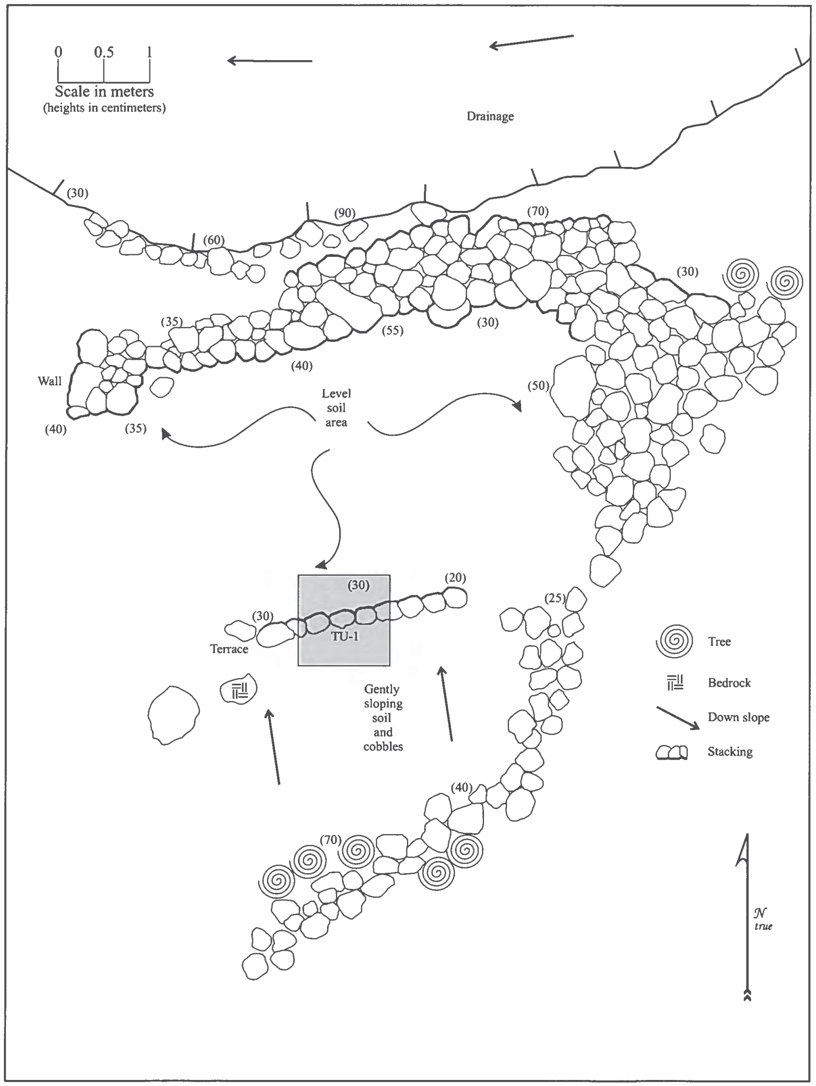


Figure 24. SIHP Site 20759 plan view.

The terrace is located 2.9 meters south of the wall, and its northern edge parallels the southern edge of the wall. The terrace edge faces north and is constructed of a single course of medium to large sized, angular *pāhoehoe* cobbles on soil ground surface (Figure 28). The terrace edge measures 3.0 meters long and averages 30 centimeters tall. To the south, the terrace surface measures 4 meters (north-south) by 6 meters (east-west) and slopes gently down to the north. The terrace surface consists of soil with a few cobbles present. A possible second terrace is located at the southern end of the first, but it is obscured by the roots of a large Christmas-berry tree growing out of it. A 1 x 1 meter test unit (TU-1) was excavated into the northern portion of the terrace so as to include the terrace wall and area north of the wall.

Excavation of TU-1 revealed a single stratigraphic soil layer (Layer I; Figure 29). Layer I consisted of very dark brown (10YR 3/2) granular silt with very little gravel present. The terrace wall consisted of 5 medium to large cobbles running east-west through the center of the unit. The terrace wall was only a single course high and it was constructed on the Layer I soil (Figure 30). Layer I was excavated to approximately 65 centimeters below the terrace surface in the southern portion of TU-1, and to approximately 35 centimeters below the lower ground surface in the northern portion. A fragment of a black plastic grow bag was encountered in the southwestern corner of the unit at approximately 60 centimeters below the surface. Modern debris at that depth suggests recent soil deposits from the flooding of the nearby seasonal stream. No other cultural material was observed. TU-1 was terminated at 65 centimeters below the terrace surface following the excavation of six sterile 10-centimeter levels (Figure 31).

As mentioned by Halpern and Rosendahl (1996), the formal attributes Site 20759 suggests that it is the remains of a Precontact feature of the Kona Field System. Excavation of TU-1 revealed a deep soil deposit within the site, and its location near the intermittent drainage would have provided easy access to water, and perhaps even the opportunity for irrigation. However, cultural material recovered from the unit was limited to a fragment of black plastic from a modern grow bag. This debris was found beneath the terrace portion of Site 20759, suggesting that at least that portion of the site was constructed during modern times. The black plastic could have either flowed down the drainage during an episode of flooding, or been deposited during the construction of the terrace. The wall and interior space between the wall and the Christmas-berry tree to the south of the terrace may be part of an older feature perhaps used for agriculture during the Precontact and Historic Periods.

Summary

As a result of the current inventory survey five previously recorded sites were relocated within the project area. The sites include four core-filled ranching/boundary walls (Sites 20754, 20755, 20757, 20758) and a terrace and wall located along the edge of a natural drainage (Site 20759) that was likely used for agricultural purposes. An additional enclosure site recorded by Yent (1991) near the southern boundary of the project area at the 1,620-foot elevation contour was destroyed prior to the Yent (1999) study. No evidence of this site was observed during the current study.

A 1920s map of North Kona from Lanihau to Kahului (see Figure 9) shows that a large portion of Hienaloli 1st Ahupua'a (roughly 150 acres) including the current project area was leased to Manual Gomes as Lease No. 1691 (expired on April 10, 1945). Gomes, who had started ranching in the Kona area in the 1920s, created the Gomes Ranch, which at its peak included 8,500 acres of leased and purchased lands and 2,700 head of cattle (O'Hare and Wolforth 1998). It is likely that many of the core-filled walls were built during the Gomes Leasehold to delineate boundaries and to control livestock. Some of the walls could also be later, as the project area continued to be used for cattle pasture into modern times.

A single test unit (TU-1) was excavated at Site 20759 revealed a deep soil deposit with only modern cultural debris present. Based on these findings, it is suggested that the terrace portion of Site 20759 was likely constructed during modern times, but that the remainder of the site could have been utilized for agriculture purposes during Precontact and Historic times. The site is located near the intermittent drainage that would have provided easy access to water, and perhaps even the opportunity for irrigation.


Figure 25. SIHP Site 20759, view to southwest.


Figure 26. SIHP Site 20759, view to north of the southern edge of the wall.


Figure 27. SIHP Site 20759, view to southeast of the northern edge of the wall along the drainage.


Figure 28. SIHP Site 20759, view to southwest of the terrace's northern edge.

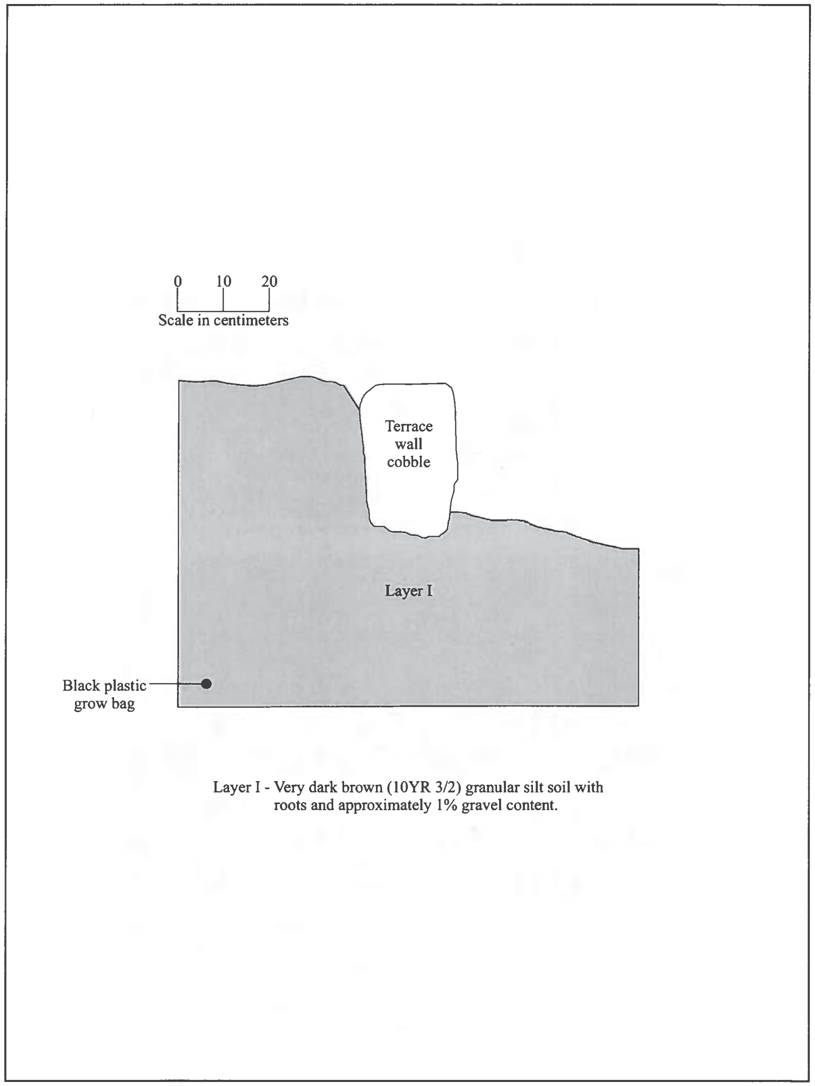


Figure 29. SIHP Site 20759, TU-1 west wall profile.

Figure 30. SIHP Site 20759, TU-1, view to south of the terrace wall construction on the Layer I soil.

Figure 31. SIHP Site 20759, TU-1, base of excavation view to south.

SIGNIFICANCE EVALUATION AND TREATMENT RECOMMENDATIONS

The sites recorded during the current study are assessed for their significance based on criteria established and promoted by the DLNR-SHPD and contained in the Hawai'i Administrative Rules 13§13-284-6. These significance evaluations should be considered as preliminary until DLNR-SHPD provides concurrence. For resources to be considered significant they must possess integrity of location, design, setting, materials, workmanship, feeling, and association and meet one or more of the following criteria:

A Be associated with events that have made an important contribution to the broad patterns of our history;

B Be associated with the lives of persons important in our past;

C Embody the distinctive characteristics of a type, period, or method of construction; represent the work of a master; or possess high artistic value;

D Have yielded, or is likely to yield, information important for research on prehistory or history;

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—these associations being important to the group's history and cultural identity.

The significance and recommended treatments for the sites are discussed below and are presented in Table 3.

Table 3. Site significance and treatment recommendations.

Site No.	*Site Type*	*Temporal Affiliation*	*Significance*	*Treatment*
20754	Core-filled wall	Historic	D	No further work
20755	Wall complex	Historic	D	No further work
20757	Core-filled wall	Historic	D	No further work
20578	Core-filled wall	Historic	D	No further work
20759	Terrace and wall	Precontact/Historic	D	No further work

Sites 20754, 20755, 20757, 20758, and 20759 are all considered significant under Criterion D for information they have yielded relative to past use of the current project area. It is argued that the information collected during the previous and current inventory surveys is sufficient to document these sites and to mitigate any potential negative impacts resulting from the proposed development of Well No. 4. As such, no further work is the recommended treatment for these sites.

REFERENCES CITED

Baker, A.
1915 "Between the Bays in Kona." Thrum's Hawaiian Annual for the Year 1916 (1915): 86.

Barrera, W.
1991 Kohanaiki, North Kona, Hawaii Island: Archaeological Inventory Survey and Data Recovery. Chiniago Inc. Prepared for Richard M. Sato and Associates, Honolulu.

1992 Kalaoa, North Kona, Hawaii Island: Archaeological Data Recovery for the Church of Jesus Christ of Latter Day Saints (TMK 7-3-02:8). Chiniago Inc. Prepared for the Church of Jesus Christ of Latter Day Saints, Kona Hawaii Stake.

Burtchard, G.
1995 Population and Land Use on the Keauhou Coast, the Mauka Land Inventory Survey, Keauhou, North Kona, Hawai'i Island. Part 1: Narrative Volume. International Archaeological Research Institute, Inc. Prepared for Belt, Collins and Associates and Kamehameha Investment Corporation, Honolulu.

Chinen, J.
1961 *Original Land Titles in Hawaii*. Honolulu: privately published.

Cordy, R.
1981 *A Study of Prehistoric Social Change: The Development of Complex Societies in the Hawaiian Islands*. New York: Academic Press.

1995 Central Kona Archaeological Settlement Patterns. State Historic Preservation Division, Department of Land and Natural Resources, State of Hawaii.

Cordy, R., J. Tainter, R. Renger, and R. Hitchcock
1991 Ahupua'a Study: The 1971 Archaeological Work at Kaloko Ahupua'a, North Kona, Island of Hawai'i. Archaeology at Kaloko-Honokōhau National Historical Park. National Park Service, U.S. Department of the Interior. *Western Archaeological and Conservation Center Publications in Anthropology 58.*

de Freychet, L.
1978 Hawai'i in 1819 : A Narrative Account /. Honolulu: Dept. of Anthropology, Bernice Pauahi Bishop Museum, 1978.

Donham, T., and V. Kai
1990 Archaeological Inventory Survey, Hienaloli 6th Development Parcel, Land of Hienaloli 6th, North Kona District, Island of Hawaii. PHRI Report 696-050390. Prepared for Sidney Fuke & Associates.

Ellis, W.
1963 *Journal of William Ellis, Narrative of a Tour of Hawaii, or Owhyee...* Honolulu: Advertiser Publishing Co., Ltd. (original 1823)

Halpern, M., and P. Rosendahl
1996 Archaeological Reconnaissance Survey, Keopuolani Estates Access Road. Land of Hienaloli 1, North Kona District, Island of Hawai'i (TMK:7-5-13:13 and 22). PHRI Report 1712-040396. Prepared for Davies Pacific Center, Honolulu.

Hammatt, H., D. Shideler, and D. Borthwick
1987 Archaeological Survey and Test Excavations of a 15-Acre Parcel, Kealakehe, Kona, Hawaii (TMK 7-4-17:30). Cultural Surveys Hawaii. Prepared for Mauna Lani Resort, Inc.

Handy, E. S. C., and E. G. Handy
1972 Native Planters in Old Hawai'i. *B.P. Bishop Museum Bulletin* 233. Bishop Museum Press, Honolulu. (With M.K. Pukui)

Haun, A.
2000 Archaeological Inventory Survey TMK: 7-5-11:23, Hienaloli 2, North Kona, Island of Hawaii. Haun & Associates, Keaau, Hawaii. Prepared for Douter Coffee Co. Hawaii, Ltd.

Haun, A. and D. Henry
2000a Archaeological Inventory Survey TMK: 7-5-11:3, 4, and 24, Hienaloli 1 and 2, North Kona, Island of Hawaii. Haun & Associates, Keaau, Hawaii. Prepared for Douter Coffee Co. Hawaii, Ltd.

2000b Archaeological Data Recovery Sites 21848 and 21881 Lands of Hienaloli 1 and 2, North Kona District, Island of Hawaii. Haun & Associates, Keaau, Hawaii. Prepared for Douter Coffee Co. Hawaii, Ltd.

2001 Archaeological Inventory Survey TMK: 7-5-10:52, 65, 66, Hienaloli 2-5, North Kona District, Island of Hawaii. Haun & Associates, Keaau, Hawaii. Prepared for Bolton, Inc., Kailua-Kona, Hawaii.

Haun, A., D. Henry, and M. Berrigan
2003 Archaeological Data Recovery, Sites 22946, 22949, 22951, 22952, and 22958, Land of Hienaloli 2-5, North Kona District, Island of Hawaii (TMK: 7-5-10:52, 65, 66). Haun & Associates Report # 110-090103. Prepared for Bolton, Inc., Kailua-Kona, Hawaii.

Haun, A., J. Henry, J. Jimenez, M. Kirkendall, K. Maly, and T. Wolforth
1998 Ali'i Highway Phased Mitigation Program Phase I – Archaeological Intensive Survey, North Kona District, Island of Hawai'i, Vol. 1, Summary. PHRI Report 1320-052798. Submitted to County of Hawai'i.

Henry, J., T. Wolforth, and P. Rosendahl
1996 Archeological Inventory Survey, Hienaloli 3 and 4, North Kona District, Island of Hawaii (TMK:7-5-11:2). PHRI Report 1348-032996. Prepared for Maryl Development, Inc.

Hommon, R.
1986 Social Evolution in Ancient Hawai'i. IN Kirch, P.V. (ed.), *Island Societies: Archaeological Approaches to Evolution and Transformation*: 55-88. Cambridge: University Press.

Kaschko, M., and P. Rosendahl
1987 Full Archaeological Reconnaissance Survey, Kealakekua Ranch Makai Land Subdivision, Land of Kealakekua, South Kona, Island of Hawaii (TMK:3-8-2-02:2,33). PHRI Report 244-100186. Prepared for Kealakekua Ranch, Ltd.

Kawachi, C.
1989 An Upland Habitation and Agricultural Complex in North Kona, Hawai'i Island. Master's Thesis, Department of Anthropology, University of Hawaii.

1994 Archaeological Survey for the Proposed Keopu-HFDC Exploratory Well No. Hienaloli 1, North Kona, Hawai'i Island, TMK:7-5-13:por. 22. Report prepared for Department of Land and Natural Resources, Division of Water and Land Development, Department of Budget and Finance, Housing Finance and Development Corporation.

Kelly, M.
1983 *Na Mala O Kona*: Gardens of Kona. A History of Land Use in Kona, Hawai'i. *Departmental Report Series* 83-2. Department of Anthropology, B.P. Bishop Museum, Honolulu. Prepared for the Department of Transportation, State of Hawaii.

Kirch, P.
1985 *Feathered Gods and Fishhooks: An Introduction to Hawaiian Archaeology and Prehistory. Honolulu*: University of Hawaii Press.

Maly, K.
1996 Appendix A: Historical Documentary Research IN Archaeological Inventory Survey, Hienaloli 3-4 Mauka Parcel, Lands of Heinaloli 3 and 4, North Kona District, Island of Hawaii (TMK:7-5-11:2). Vol. PHRI Report 1348-032996. Hilo: Paul H. Rosendahl, Inc.

Moore, James, D. Kyle Latinis, and J. Kennedy
1997 An Archaeological Data Recovery Report for the Hienaloli 6th Development Parcel in the Ahupua'a of Hienaloli 6th, District of North Kona, Island of Hawai'i, December 1997. Archaeological Consultants of the Pacific, Inc.. Prepared for David S. DeLuz, Hilo, Hawai'i.

Newman, T.
1970 Hawaiian Fishing and Farming on the Island of Hawaii in A.D. 1778, Division of State Parks, Department of Land and Natural Resources, Honolulu.

O'Hare, C., and T. Wolforth
1998 Archaeological Inventory Survey of the Gomes Property Parcel (TMK:3-7-5-19:5,38,40) Land of Kahului 1st, North Kona, Island of Hawai'i. Paul H. Rosendahl, Ph. D., Inc., Report 1807-090998, Hilo, Hawaii. Prepared for Towne Development of Hawaii, Inc., Honolulu, Hawaii.

Pukui, M., and S. Elbert
1965 *Hawaiian–English Dictionary*. Honolulu: University of Hawaii Press.

Rechtman, R., M. Clark, and A. Ketner
2005 An Archaeological Inventory Survey of TMKs:3-7-5-03:2, 25 and 3-7-5-22:173, Honua'ula and Heinaloli 1st *ahupua'a*, North Kona District, Island of Hawai'i. Rechtman Consulting Report RC-0211. Prepared for The Laniākea Foundation, Honolulu, Hawai'i.

Rechtman R., J. Henry, and T. Wolforth
1999 Inventory of Ho'omalu on Ali'i Subdivision, Kaumalumalu and Pāhoehoe 1st Ahupua'a, North Kona District, Island of Hawai'i. PHRI Report 1881. Prepared for Nohona Partners, Inc., Hilo.

Schilt, R.
1984 Subsistence and Conflict in Kona, Hawaii. An Archaeological Study of the Kuakini Highway Realignment Corridor. Departmental Report Series 84-1. Department of Anthropology, B.P. Bishop Museum, Honolulu. Prepared for the Department of Transportation, State of Hawaii.

Schmitt, R.
1968 *Demographic Statistics of Hawaii: 1778–1965*. Honolulu: University of Hawaii Press.

Wilkes, C.
1845 Narrative of the United States Exploring Expedition During the Years 1838-1842, Under the Command of C. Wilkes, U.S.N., Volume 4. Philadelphia: Loa and Blanchard.

Wong-Smith, H.
2008 Cultural Impact Assessment, Well Site No. 4, TMK: 7-5-013:Por. 22, Land of Hienaloli, North Kona District, Island of Hawai‘i. PHRI Report # 2667-011008. Prepared for Belt Collins Hawaii, Ltd., Honolulu.

Yent, M.
1991 Archaeological Reconnaissance Survey: Hienaloli 1st, North Kona District, Island of Hawai‘i (TMK: 7-5-13:13 and 22). Report prepared for DLNR, Division of Forestry and Wildlife.

1999 Archaeological Inspection of Proposed Well Site (Keopu-HFDC Exploratory Well No. 1) Hienaloli 1, North Kona, Island of Hawai‘i, TMK:7-5-13:22. Report prepared for Department of Land and Natural Resources, Division of State Parks.

F. AN ARCHAEOLOGICAL INVENTORY SURVEY UPDATE FOR THE PROPOSED KEŌPŪ WELL #4 DEVELOPMENT AREA TMK: (3) 7-5-13:022

THIS PAGE WAS INTENTIONALLY LEFT BLANK

An Archaeological Inventory Survey Update for the Proposed Keōpū Well No. 4 Development Area

TMK: (3) 7-5-13:022

Hienaloli 1st Ahupuaʻa
North Kona District
Island of Hawaiʻi

Prepared By:

Robert B. Rechtman, Ph.D.

Prepared For:

Charles L. Morgan, Ph.D.
Planning Solutions, Inc.
210 Ward Avenue, Suite 330
Honolulu, HI 96814

March 2014

ASM affiliates
Archaeology • History • Ethnography • Architectural History
Office: (808) 969-6066 • Fax: (808) 443-0065

ASM Project Number 21540.01

An Archaeological Inventory Survey Update for the Proposed Keōpū Well No. 4 Development Area

TMK: (3) 7-5-13:022

Hienaloli 1st Ahupuaʻa
North Kona District
Island of Hawaiʻi

ASM affiliates

EXECUTIVE SUMMARY

At the request of Planning Solutions, Inc., ASM Affiliates, Inc. has prepared this archaeological inventory survey (AIS) update as an addendum to an earlier AIS prepared by Rechtman Consulting, LLC (Clark et al. 2008) for the development of what has been termed Keōpū Well No. 4, which is located on TMK: (3) 7-5-13:022 in Hienaloli 1st Ahupua'a, North Kona, Island of Hawai'i. This addendum study was deemed necessary due to a redesign of the proposed access road and storage tank for this project. The new design utilizes an existing tank on a neighboring parcel (TMK: (3) 7-5-01:015) connecting to the original Clark et al. (2008) study area via a proposed 50-foot wide utility and access corridor along the *makai* boundary of TMK: (3) 7-5-01:159 (formerly a portion of TMK: (3) 7-5-01:044). The existing developed storage tank parcel (TMK: (3) 7-5-01:115) and the property over which the 50 foot wide access and utility corridor extends was subject to an AIS conducted by Haun & Associates (2001) for two parcels (TMKs: (3) 7-5-01:044 and 115) in Honua'ula and Keōpū *ahupua'a*. As a result of the current field investigation three previously undocumented features were observed and recorded. All three of these features are located on TMK: (3) 7-5-001:159 (formerly Parcel 044). Two of these are agricultural field system features (Site 22975 Features B and C) and the third is a Historic Period roadway (Site 22974 Feature B).

The newly recorded Site 22974 Feature B retains enough integrity to be assessed as significant under Criterion D similar to the other feature of the site. The portion of this feature within the current study corridor was thoroughly documented as part of the present study and no further historic preservation work is recommended with respect to mitigating any possible impacts to this feature as a result of the proposed utility and access improvements. Likewise the two newly recorded features Site 22975 retain sufficient integrity to also be evaluated as significant under Criterion D. Together with the previously recorded feature of Site 22975 along with any other undocumented features that may be present outside of the current study corridor this site represents a series of features that were a part of the larger agricultural field system that once blanketed this general area. A representative sample of such features have been preserved at the nearby Site 22978. Given the truncated (bulldozer impacted) nature of these two features within the study corridor and the preservation of a more intact agricultural landscape within nearby Site 22978, it is the recommendation of the current study that no further historic preservation work is necessary with respect to mitigating any possible impacts to these features as a result of the proposed development activities.

CHAPTERS

FIGURES

TABLES

1. INTRODUTION

At the request of Planning Solutions, Inc., ASM Affiliates, Inc. has prepared this archaeological inventory survey (AIS) update as an addendum to an earlier AIS prepared by Rechtman Consulting, LLC (Clark et al. 2008) for the development of what has been termed Keōpū Well No. 4, which is located on TMK: (3) 7-5-13:022 in Hienaloli 1st Ahupuaʻa, North Kona, Island of Hawaiʻi. This addendum study was deemed necessary due to a redesign of the proposed access road and storage tank for this project (Figures 1 and 2). The new design utilizes an existing tank on a neighboring parcel (TMK: (3) 7-5-01:015) connecting to the original Clark et al. (2008) study area via a proposed 50-foot wide utility and access corridor along the *makai* boundary (see Figure 1) of TMK: (3) 7-5-01:159 (formerly a portion of TMK: (3) 7-5-01:044). The existing developed storage tank parcel (TMK: (3) 7-5-01:115) and the property over which the 50 foot wide access and utility corridor extends was subject to an AIS conducted by Haun & Associates (2001) for two parcels (TMKs: (3) 7-5-01:044 and 115) in Honuaʻula and Keōpū *ahupuaʻa*.

Following a discussion with the DLNR-SHPD Archaeology Branch Chief, a scope of work for the current field investigation and reporting was agreed upon. The entire proposed 50-foot wide access and utility corridor (the current study area) extending across both previously surveyed properties was reexamined. All previously unrecorded archaeological features are documented in this report, which also contains a summary of the prior archaeological work conducted by Rechtman Consulting, LLC and Haun & Associates within and adjacent to the current study area. This addendum report has been prepared in accordance with HAR 13§13-276 and will accompany a supplemental environmental assessment being prepared in compliance with HRS Chapter 343.

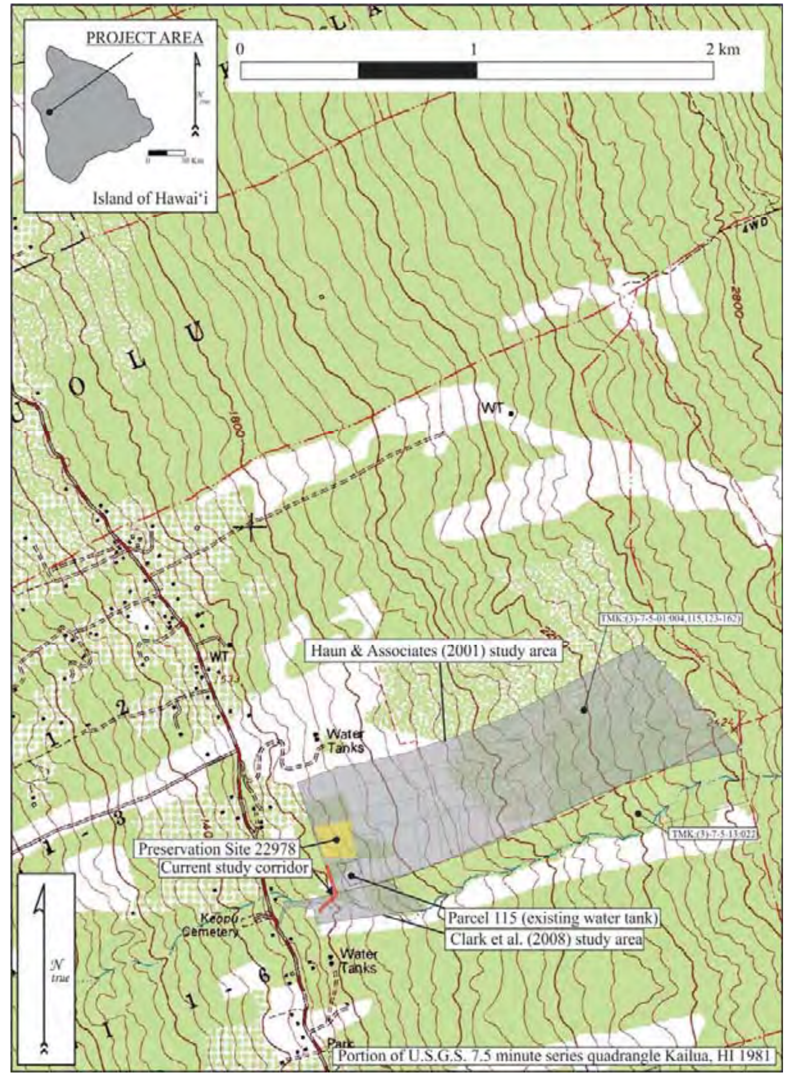


Figure 1. Study area location.

Figure 2. Google Earth™ satellite imagery showing the current study corridor (outlined in yellow).

2. SUMMARY OF PRIOR ARCHAEOLOGICAL WORK

In 2008 at the request of Belt Collins Hawaii Ltd., Rechtman Consulting, LLC (Clark et al. 2008) completed an archaeological inventory survey of a roughly 17-acre portion of TMK: (3) 7-5-13:022 for the proposed development of Keōpū Well No. 4 as part of the off-site development of infrastructure facilities associated with the proposed Keahuolu Affordable Housing Project. The development was initiated by the Hawai‘i Housing Finance & Development Corporation (HHFDC), which is the State's agency tasked with developing and financing low and moderate income housing projects and administering home ownership programs. The parcel is owned by the State of Hawai‘i Department of Land and Natural Resources. Four previously conducted archaeological studies (Halpern and Rosendahl 1996; Kawachi 1994; and Yent 1991, 1999) also included the Clark et al. (2008) study area. Five sites were recorded within the roughly 17-acre project area (Figure 3). The sites include four core-filled ranching/boundary walls (Sites 20754, 20755, 20757, and 20758) and a terrace and wall (Site 20759) located along the edge of a natural drainage that was likely utilized for agricultural purposes. A 1 x 1 meter test unit was excavated at Site 20759 revealing a soil deposit, but only modern cultural debris. As a result of the Clark et al. (2008) study, Sites 20754, 20755, 20757, 20758, and 20759 were all determined to be significant under Criterion D for information yielded relative to past use of the project area. DLNR-SHPD reviewed and approved the report concurring with a no further work treatment for all of the sites. Site 20758 crosses the current study corridor.

In 2001 at the request of John Price & Associates, Inc., Haun & Associates (2001) conducted an archaeological inventory survey of TMK: (3) 7-5-01:044 and 115, a roughly 200-acre project area in Honua‘ula and Keōpū *ahupua‘a*. The Parcel 115 portion along with a 50 foot wide access corridor across the Parcel 044 portion of the Haun and Associates (2001) study area had earlier been the subject of an AIS conducted by PHRI (Rosendahl 1991) on a portion of what was then TMK: (3) 7-5-01:001. While Rosendahl (1991:2) observed that the area, "had been extensively disturbed by historic ranching and agriculture" and that "[p]resent in the area were agricultural terraces, bulldozer cuts, old road grades, cattle walls and paddocks" and that "[s]ome of the agricultural terraces may be part of the Kona Field System" including "[r]emnants of *kuaiwi*," he concluded that "considering the extent of disturbance in the survey area, and the abundance of such features in the general vicinity, these features are assessed here as not significant . . ." Rosendahl did note the presence of two stone platforms on other side of a "historic cattle wall" (Figure 4) that were avoided by rerouting the access road slightly to the south (Rosendahl 1991:3).

Within TMK: (3) 7-5-01:044 and 115, Haun and Associates (2001) recorded twenty-nine sites containing eighty-nine features (Figure 5). Twenty-seven of the sites were described as single feature sites and two sites (Sites 22950 and 22978) contained multiple features. Haun & Associates (2001) assigned the designation of Site 22973 to the earlier recorded Site 20758. Also in the vicinity of the current study corridor they recorded an agricultural mound (Site 22975) and a poorly preserved rock wall (Site 22974) (see Figure 3). Directly to the north of the current study corridor, they recorded an agricultural site complex (Site 22978) containing fifty-nine features typical of the "feature types expected in the *‘apa‘a* zone of the Kona Field System" (Haun & Associates 2001:ii). Many of the numerous other single-feature sites recorded elsewhere on the property were also considered "Kona Field System agricultural features . . . that apparently escaped subsequent historic modification" (ibid.). Other recorded sites included scattered Precontact habitations, burials, and Historic Period ranching-related features. Haun & Associates (2001) assessed all twenty-nine sites as significant under Criterion D. Site 22978 was assessed as further significant under Criterion C; and Sites 22957 and 22977 were additionally assessed as significant under Criterion E because of the presence of burials. Haun & Associates (2001) recommended and DLNR-SHPD approved no further work for twenty sites, preservation for the two burial sites (Sites 22957 and 22977), data recovery for six sites (22950, 22953, 22954, 22955, 22960, and 22968), and a combination of data recovery and preservation for the agricultural site complex (Site 22978).

In 2002 a burial treatment plan for Sites 22957 and 22977 was prepared by Haun & Associates (2002) and approved by the Hawai‘i Island Burial Council and DLNR-SHPD. These two sites are preserved with protective buffers of 20 feet. Also in 2002, on behalf of Sunra Coffee, LLC, Haun & Associates prepared a preservation plan (Haun and Henry 2002) for Site 22978 (Figure 6). The preservation plan established a preservation easement that included the site's features along with a protective buffer of 5 meters (see Figure 1). The easement was to be marked with stone and concrete cairns erected at 20 meters intervals along the easement perimeter.

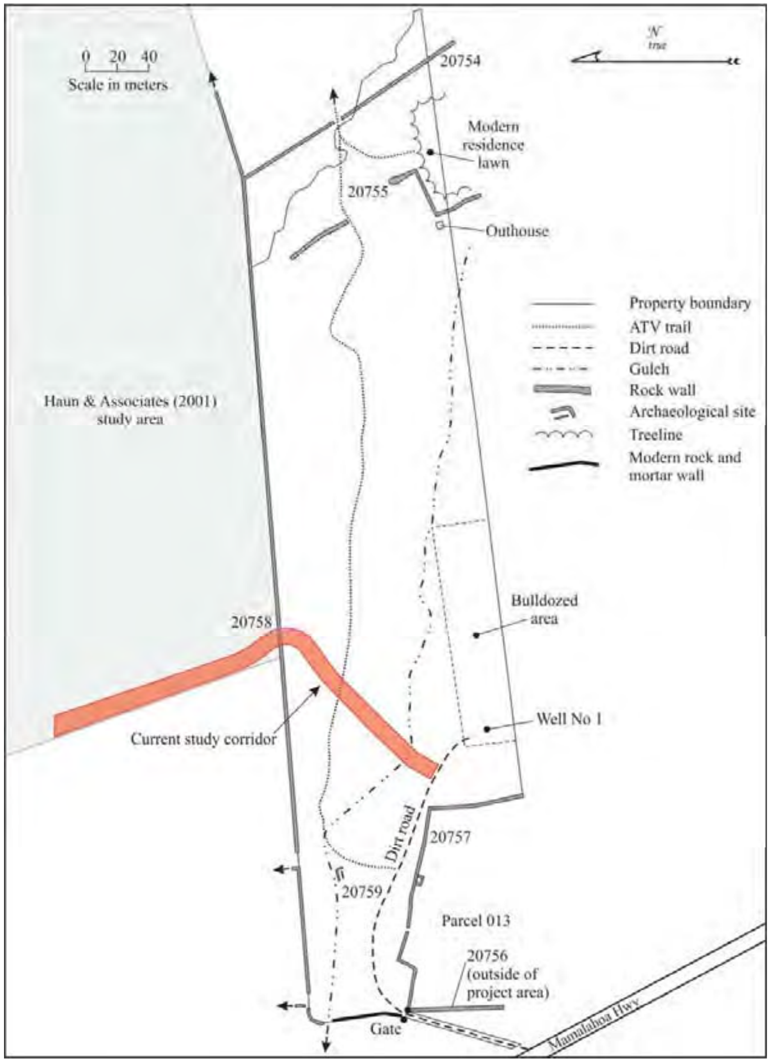


Figure 3. Archaeological site location map from Clark et al (2008).

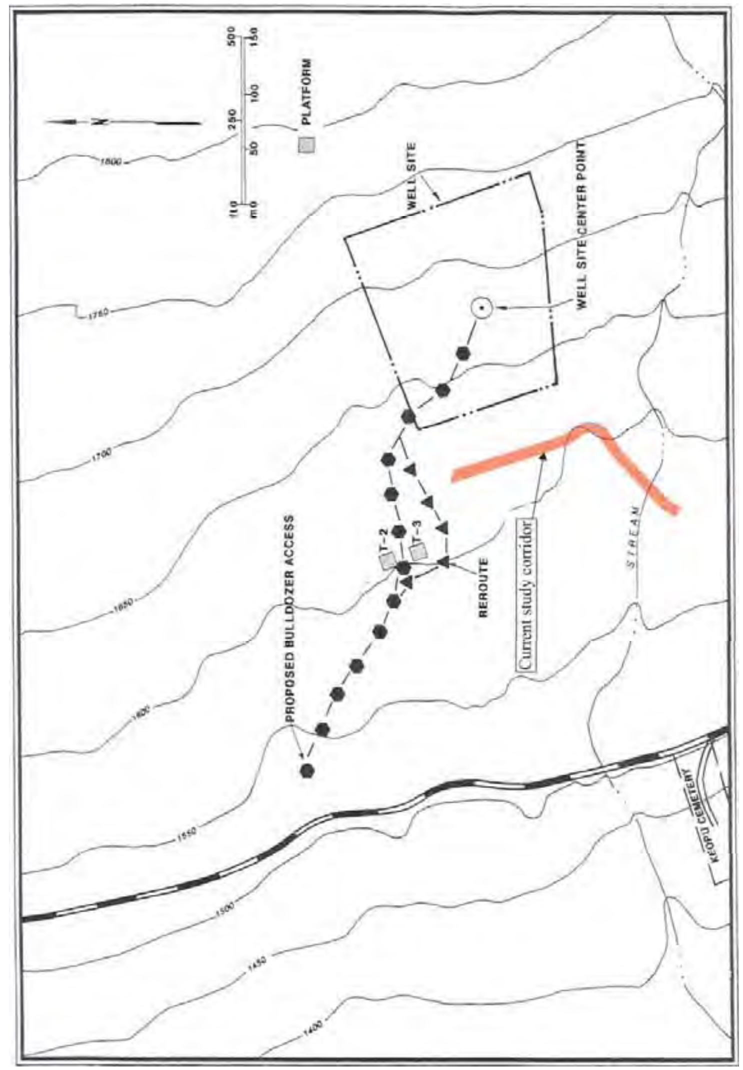


Figure 4. Archaeological site location map from Rosendahl (1991).

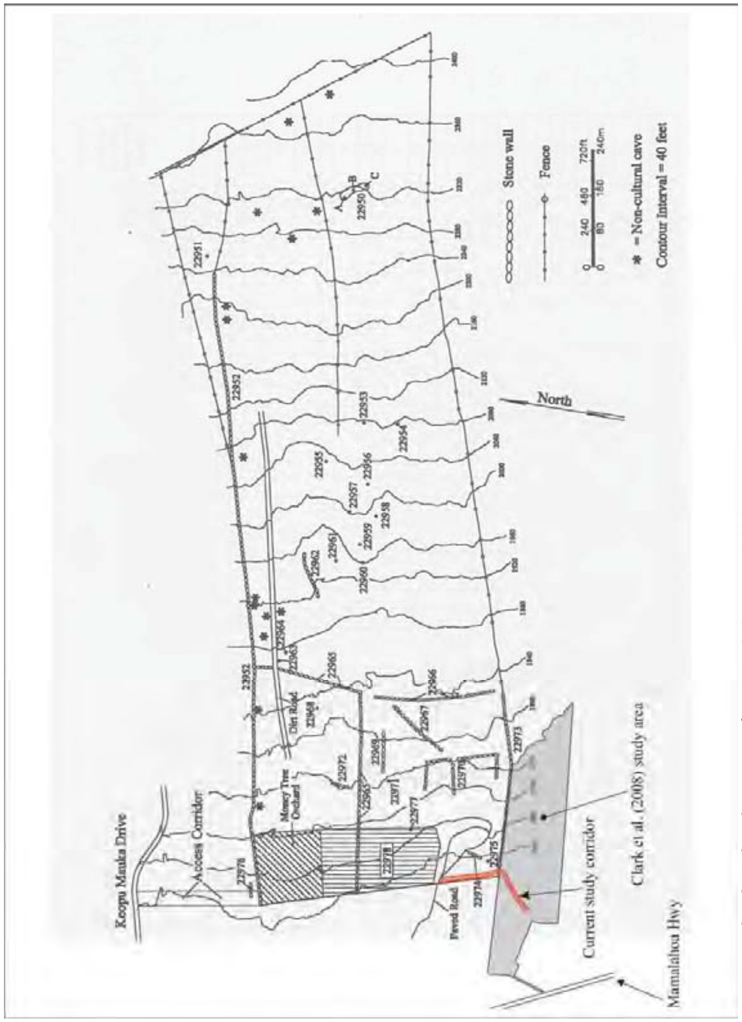


Figure 5. Archaeological site location map from Haun & Associates (2001).

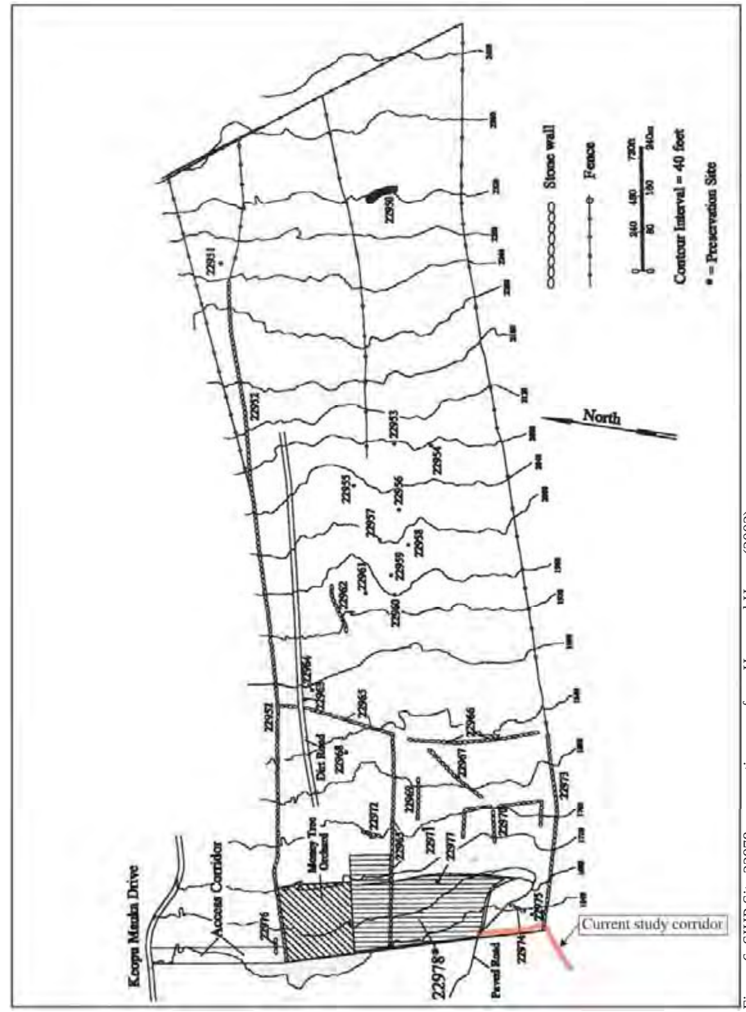


Figure 6. SIHP Site 22978 preservation map from Haun and Henry (2002).

In 2004 Haun & Associates completed archaeological data recovery (Haun et al. 2004) at seven sites. Data recovery consisted of hand-excavating a total of 28.25 square meters at Sites 22950, 22953, 22954, 22955, and 22968. In addition, three agricultural features were sectioned with a backhoe at Site 22978. Data recovery at Site 22960 consisted of analyzing a charcoal sample obtained during the inventory survey testing. Six radiocarbon samples were analyzed, and the resultant radiocarbon age determinations were interpreted to indicate Precontact (A.D. 1430 to 1680) construction and use of five features: the Site 22955 habitation terrace, the Site 22960 habitation terrace, and three agricultural terraces at Site 22978. According to Haun et al., "the sparse cultural material recovered from the majority of the sites precludes anything other than general interpretations. Inferred on-site activities include feature and fire construction, food preparation and consumption; stone tool use and manufacture; animal husbandry, and crop cultivation. Inferred off-site activities include marine food procurement, and procurement of stone for construction and raw material for tools." (2004:ii).

Lastly, further supplemental archaeological data recovery was conducted at Site 22978 (Haun et al. 2005). The objective of this work was to mitigate impacts to four *kuaiwi* (Features G, AD, AI and AL) that might result from the construction of a roadway and placement of a water line. Data recovery fieldwork involved the mechanical excavation of trenches across the features in an effort to obtain stratigraphic, subsistence, and radiometric data. Only charcoal was recovered from the excavations; radiocarbon samples were submitted from three of the features. The resultant dates were interpreted to indicate that the "*kua'iwi* [sic] were in place between A.D. 1440 and 1680" (Haun et al. 2005:ii), which was consistent with the age determinations obtained earlier for three terraces at the same site (Haun et al. 2004).

3. CURRENT STUDY FINDINGS

As a result of the current field investigation, which was conducted by Matthew R. Clark, B.A. and J. David Nelson, B.A. under the supervision of Robert B. Rechtman, Ph.D. on January 23 and February 12, 2014, three previously undocumented features were observed and recorded (Figure 7; Table 1). All three of these features are located on TMK: (3) 7-5-001:159 (formerly Parcel 044). Two of these are agricultural field system features and given the Haun & Associates (2001) findings, are assigned the designation of Features B and C of Site 22975 (a single feature agricultural site previously recorded in the immediate vicinity). The third is a Historic Period roadway and has been assigned the designation of Feature B of Site 22974 due to its proximate and likely temporal affiliation with this previously recorded (Haun et al. 2001) core-filled wall remnant.

Table 1. Features/Sites recorded in the current study corridor.

Site/Feature #	*Description*	*Function*	*Association*
22975/B	*Kuaiwi*	Agricultural	Precontact
22975/C	*Kuaiwi*	Agricultural	Precontact
22974/B	Roadway	Ranching/transportation	Historic

SITE 22975 FEATURE B

Site 22975 Feature B is a *kuaiwi* located in the central portion of the current study corridor (see Figure 7). The wall extends 4.8 meters into the study corridor from the east. The wall continues to the east *mauka* of the study corridor for an undetermined distance. Within the current study corridor the wall is fairly straight and has a width that varies from 1.5 to 2 meters (Figure 8). Extending along the top edge of a slope that descends to the southwest, and constructed of piled small boulders and small to medium cobbles mixed with dark brown organic soil, the wall is as high as 1.1 meters on its southern side (Figure 9), and 40 centimeters on its northern side (Figure 10). At its western end the wall has been truncated by bulldozing (Figure 11).

SITE 22975 FEATURE C

Site 22975 Feature C is a *kuaiwi* located approximately 17 meters north of Feature B (see Figure 7). The wall extends 4.2 meters into the survey corridor from the east. This wall continues east, outside the survey corridor, for an unknown distance. Within the survey corridor the wall is fairly straight, averaging 1.5 meters wide. It is constructed of stacked/piled small to large cobbles and a few small boulders mixed with dark brown organic soil (Figure 12). The surrounding ground surface is slightly lower on the north side of the wall than on its south side (Figure 13), thus the wall appears to follow a slightly elevated *mauka*/*makai* running landform. The wall averages 0.55 meters tall along its northern edge and 0.4 meters tall along its southern edge. This feature is truncated by bulldozing at its western end (Figure 14).

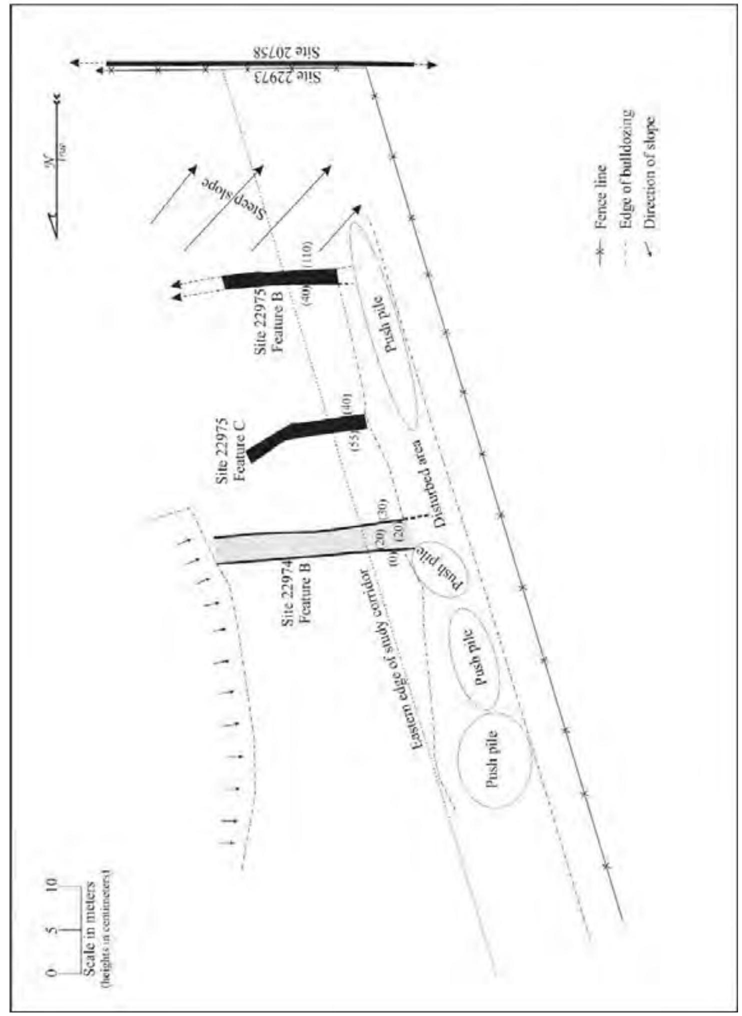


Figure 7. Features/sites recorded in the current study corridor.

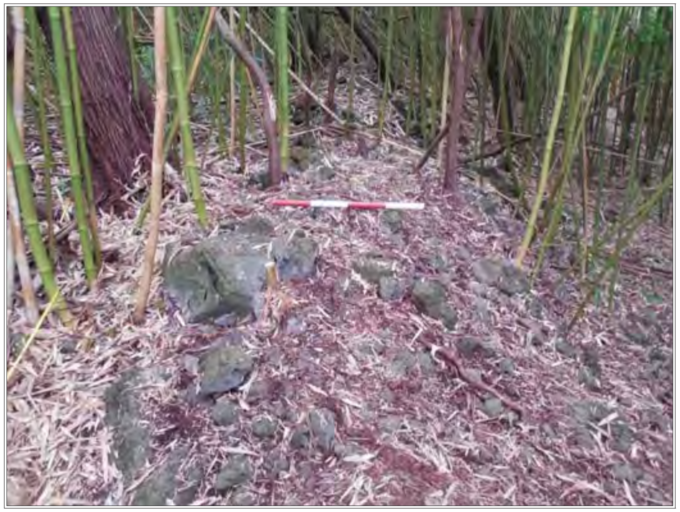


Figure 8. SIHP Site 22975 Feature B wall width, view to the east.

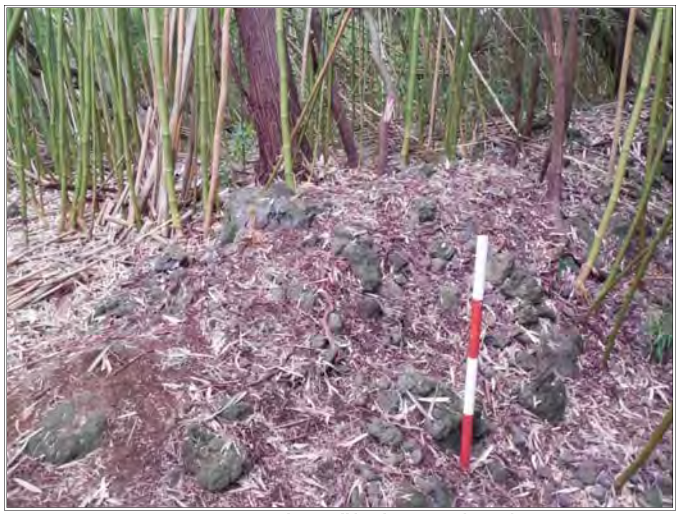


Figure 9. SIHP Site 22975 Feature B southern wall height, view to the northeast.

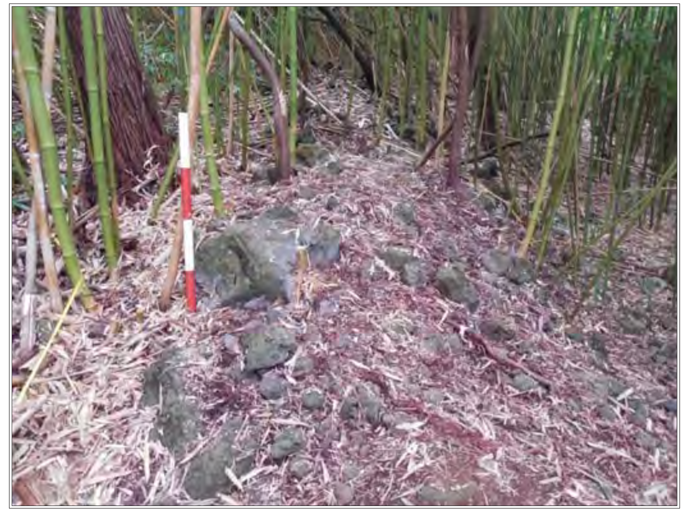


Figure 10. SIHP Site 22975 Feature B northern wall height, view to the east.

Figure 11. SIHP Site 22975 Feature B truncated western end of wall, view to the west.


Figure 12. SIHP Site 22975 Feature C, view to the east.


Figure 13. SIHP Site 22975 Feature C, view to the west.


Figure 14. SIHP Site 22975 Feature C truncated western end, view to the west.

SITE 22974 FEATURE B

Site 22974 Feature B is Historic Period road located in the east-central portion of the current survey corridor, approximately 11 meters north of Site 22975 Feature C (see Figure 7). The road extends 8.8 meters into the survey corridor from the east. The road extends in an easterly direction for an undetermined distance *mauka* of the survey corridor; it was also observed extending *makai* of the current survey corridor. The road averages 3 meters wide and its soil surface slopes moderately in a *makai* direction. The road's surface is mostly flat with a few cobbles in the center along a slightly elevated hump (Figure 15). Upon close examination, the road surface exhibits slight linear depressions on either side of the central hump, indicative of former wheeled vehicular use of the roadway. A single course alignment of small to large cobbles stands 0.2 meters tall above the road's surface along its northern edge (Figure 16). Along this north edge the road cuts below the natural ground surface. Along its south edge, the road is elevated with a cobble fill that stands 0.3 meters tall above the ground surface. Medium and large cobbles along with a few small cobbles, haphazardly line the road's southern edge (Figure 17), with heights up to 0.3 meters. The road is truncated at its western end by bulldozing.

This constructed roadway appears to have been associated with the former ranching use of the property as documented by Haun & Associates (2001) and projected *mauka* would have been adjacent to the core-filled wall described by Haun & Associates (2001) as Site 22974. The *mauka* projection of the road also aligns with a similarly sized gap in a core-filled wall at Site 22970 (see Figure 5), a livestock enclosure with northern and southern compartments. It is possible that this roadway extended between the compartments.

Figure 15. SIHP Site 22974 Feature B, view to the east.

Figure 16. SIHP Site 22974 Feature B northern edge of roadway, view to the north.

Figure 17. SIHP Site 22974 Feature B southern edge of roadway, view to the east.

4. SIGNIFICANCE EVALUATION AND TREATMENT RECOMMENDATIONS

The sites documented during the current study are assessed for their significance based on criteria established and promoted by the DLNR-SHPD and contained in the Hawai'i Administrative Rules 13§13-284-6. This significance evaluation should be considered as preliminary until DLNR-SHPD provides concurrence. For a resource to be considered significant it must possess integrity of location, design, setting, materials, workmanship, feeling, and association and meet one or more of the following criteria:

A Be associated with events that have made an important contribution to the broad patterns of our history;

B Be associated with the lives of persons important in our past;

C Embody the distinctive characteristics of a type, period, or method of construction; represent the work of a master; or possess high artistic value;

D Have yielded, or is likely to yield, information important for research on prehistory or history;

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—these associations being important to the group's history and cultural identity.

The significance and recommended treatments for the newly recorded features of Sites 22974 and 22975 are discussed below and presented in Table 2.

Table 2. Site significance and treatment recommendations.

Site #	*Description*	*Association*	*Significance*	*Treatment*
22974	Roadway	Historic	D	No further work
22975	Agricultural (*kuaiwi*)	Precontact	D	No further work

Site 22974 was previously assessed as significant under Criterion D (Haun & Associates 2001) and the DLNR-SHPD-approved treatment was no further work. The newly recorded Feature B of this site, while different from the earlier recorded feature of this site with respect to specific function, is likely temporally associated and grossly functionally similar with respect to the association with former ranching activities that occurred on the property. While only a highly disturbed portion of the feature exists within the current study corridor, it retains enough integrity to be assessed as significant under Criterion D similar to the other feature of the site. The portion of this feature within the current study corridor was thoroughly documented as part of the present study and no further historic preservation work is recommended with respect to mitigating any possible impacts to this feature as a result of the proposed utility and access improvements.

Site 22975 was previously assessed as significant under Criterion D (Haun & Associates 2001) and the DLNR-SHPD-approved treatment was no further work. Although the two newly recorded features of Site 22975 only extend a few meters (Feature B 4.8 meters and Feature B 4.2 meters) into the current study corridor they retain sufficient integrity to also be evaluated as significant under Criterion D. Together with the previously recorded feature of Site 22975 along with any other undocumented features that may be present outside of the current study corridor this site represents a series of features that were a part of the larger agricultural field system that once blanketed this general area. A representative sample of such features have been preserved at the nearby Site 22978 (Haun and Henry 2002). Given the truncated (bulldozer impacted) nature of these two features within the study corridor and the preservation of a more intact agricultural landscape within nearby Site 22978, it is the recommendation of the current study that no further historic preservation work is necessary with respect to mitigating any possible impacts to these features as a result of the proposed development activities.

REFERENCES CITED

Clark, M., J. D. Nelson, A. Ketner, and R. Rechtman
2008 An Archaeological Inventory Survey of a Portion of TML:3-7-5-13:022 for the Proposed Development of Well Site No. 4. Hienaloli 1st Ahupua‘a, North Kona District, Island of Hawai‘i. Rechtman Consulting Report RC-0525. Prepared for Beld Collins Ltd. Honolulu.

Halpern, M., and P. Rosendahl
1996 Archaeological Reconnaissance Survey, Keopuolani Estates Access Road. Land of Hienaloli 1, North Kona District, Island of Hawai‘i (TMK:7-5-13:13 and 22). PHRI Report 1712-040396. Prepared for David Z. Arakawa, Attorney-at-Law.

Haun & Associates
2001 Archaeological Inventory Survey TMK: 7-5-001: 44 and 115. Lands of Honuaula and Keopu, North Kona District, Island of Hawaii. Haun & Associates Report 085-032302. Prepared for John Price & Associates.

Haun & Associates
2002 Burial Treatment Plan Sites 22957 and 22977. Land of Honuaula, North Kona District, Island of Hawaii (TMK: 7-5-001:44). Haun & Associates Report 218-100802. Prepared for Sunra Coffee LLC, Kailua-Kona.

Haun, A., and J. Henry
2002 Archaeological Site Preservation Plan Site 22978. Land of Honuaula, North Kona District, Island of Hawaii (TMK: 7-5-001:44). Haun & Associates Report 219-100802. Prepared for Sunra Coffee LLC, Kailua-Kona.

Haun, A., J. Henry, and D. Berrigan
2004 Archaeological Data Recovery Sites 22950, 22953, 22954, 22955, 22960, 22968, and 22978. Land of Honuaula, North Kona District, Island of Hawaii (TMK: 7-5-001:44). Haun & Associates Report 217-111003. Prepared for Sunra Coffee LLC, Kailua-Kona.

Haun, A., J. Henry, and D. Berrigan
2005 Addendum Archaeological Data Recovery Site 22978. Land of Honuaula, North Kona District, Island of Hawai‘i (TMK: 7-5-001:44). Haun & Associates Report 432-080405. Prepared for Sunra Coffee LLC, Kailua-Kona.

Kawachi, C.
1994 An Archaeological Survey for the Proposed Keopu-HFDC Exploratory Well No. 1. Hienaloli, North Kona, Hawaii Island.

Rosendahl. P.
1991 Archaeological Inventory Survey Honuaula Well Site. Land of Honuaula, North Kona District, Island of Hawaii (TMK:3-7-5-01:1. PHRI Report 1190-120291. Prepared for Ms. Sandra Schutt, Hilo.

Yent, M.
1991 Archaeological Reconnaissance Survey: Hienaloli 1st, North Kona, Island of Hawaii (TMK:7-5-13:13 and 22). Division of State Parks, Department of Land and Natural Resources. Prepared for Division of Forestry and Wildlife, Department of Land and Natural Resources.

1999 Archaeological Inspection of Proposed Well Site (Keopu-HFDC Exploratory Well No. 1), Hienaloli 1st, North Kona, Island of Hawaii (TMK:7-5-13:22). Division of State Parks, Department of Land and Natural Resources. Prepared for Division of Forestry and Wildlife, Department of Land and Natural Resources.

G. CULTURAL IMPACT ASSESSMENT WELL #4 SITE (TMK: 7-7-13: POR.022)

THIS PAGE WAS INTENTIONALLY LEFT BLANK

Report 2667-062508

Cultural Impact Assessment
Well No. 4 Site
TMK: 7-5-013:Por.022

Land of Hienaloli, North Kona District
Island of Hawai'i

PHRI
Paul H. Rosendahl, Ph.D., Inc.
Archaeological • Historical • Cultural Resource Management Studies & Services

Report 2667-062508

Cultural Impact Assessment
Well No. 4 Site
TMK: 7-5-013:Por.022

Land of Hienaloli, North Kona District
Island of Hawai'i

BY

Helen Wong-Smith, M.A. • Cultural Resources Specialist

PREPARED FOR

State of Hawai'i
c/o Belt Collins Hawaii, Ltd.
2153 North King Street, Suite 200
Honolulu, Hawai'i 96819-4554

JULY 2008

PHRI Paul H. Rosendahl, Ph.D., Inc.
Archaeological • Historical • Cultural Resource Management Studies & Services

HAWAII: 224 Waianuenue Avenue • Hilo, Hawaii 96720 • (808) 969-1763 • GUAM: P.O. Box 23305 • G.M.F., Guam 96921 • (671) 472-3117

Contents

Figure

Table

INTRODUCTION

BACKGROUND

At the request of Mary O'Leary of Belt Collins Hawaii, Ltd., on behalf of the State of Hawai'i Housing Finance and Development Corporation (HFDC), Paul H. Rosendahl, Ph.D., Inc. (PHRI) prepared a cultural impact assessment (CIA) in connection with preparation of an Environmental Assessment (EA) for Well No. 4 Site – TMK:7-5-013:Por.022, located in the land of Hienaloli, North Kona District, Island of Hawai'i (*Figure 1*). The well site is part of the infrastructure to be built in support of a planned approximately 272-acre community of affordable housing (Kona Non-Ceded Lands project; Corbin and Wong-Smith 2007; labeled "Project Parcel" on *Figure 1*). The overall objective of the current project was to comply with the current historic preservation requirements of the Hawai'i State Historic Preservation Division (SHPD).

SCOPE OF WORK

Based on (a) project specifications provided by Belt Collins Hawaii, (b) prior PHRI work within the Land of Hienaloli, and (c) our familiarity with both the general project area and the current regulatory review requirements of the SHPD and the Hawai'i County Planning Department (HCPD), the following tasks were determined to constitute an adequate and appropriate scope of work for the current project:

1. Conduct (a) appropriate archaeological and historical documentary background review and research; and (b) identification of and consultation with appropriate local informants and agency staff;

2. Conduct informal (non-taped) interviews with identified knowledgeable informants;

3. Preparation of draft and final reports; and

4. Coordination and consultation with client, client representatives, local informants, agency staff, etc.

PURPOSE, GOALS, AND OBJECTIVES

The purpose of this cultural impact assessment is to comply with the requirements of *Chapter 343 (Haw. Rev. Stat.)*, as amended by H.B. No.2895 H.D. 1 of the Hawai'i State Legislature (2000) and approved by the Governor as *Act 50* on April 26, 2000, and which among other things requires that environmental assessments (EA) and environmental impact statements (EIS) identify and assess the potential effects of any proposed project upon the "...cultural practices of the community and State...." *Chapter 343 (Haw.Rev.Stat.)* was amended by the State legislature because of the perceived need to assure that the environmental review process explicitly addressed the potential effects of any proposed project upon "...Hawai'i's culture, and traditional and customary rights." Guidelines previously prepared and adopted by the State Office of Environmental Quality Control (OEQC 1997) provide compliance guidance. Both *Act 50* and the OEQC *Guidelines for Assessing Cultural Impacts* mandate consideration of all the different groups comprising the multi-ethnic community of Hawaii. This inclusiveness, however, is

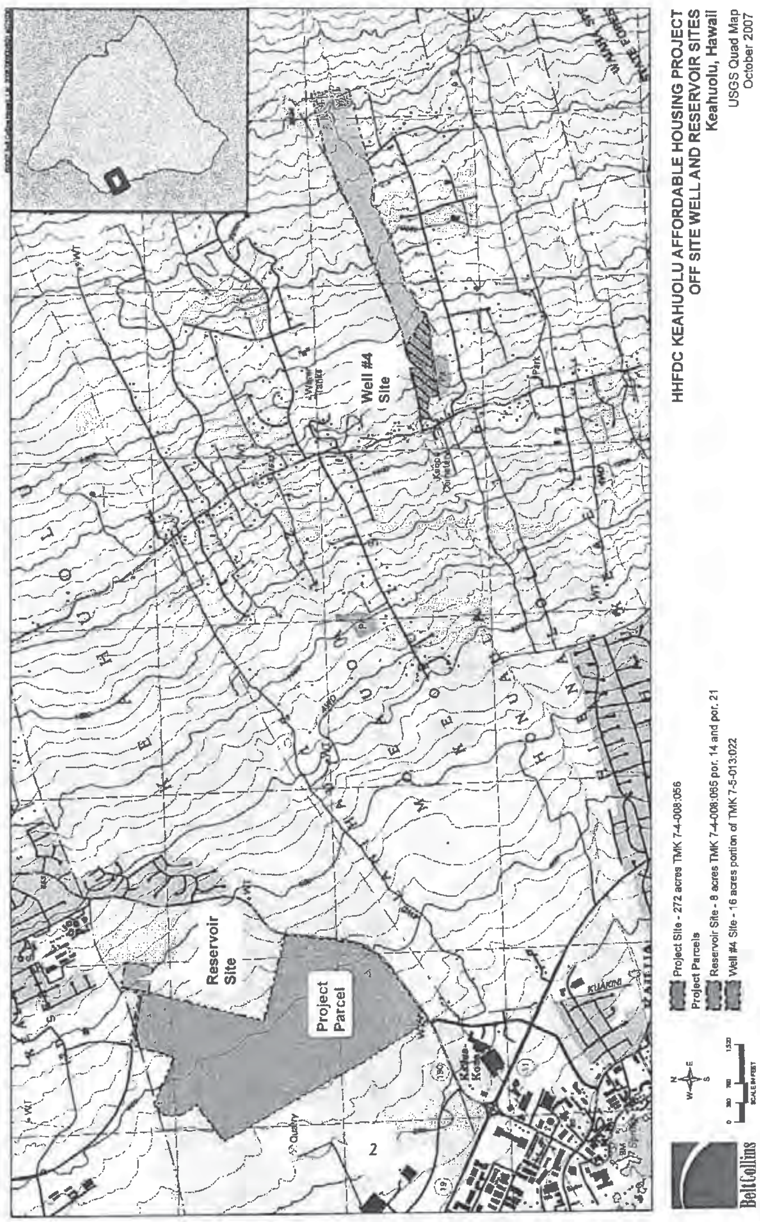


Figure 1: Project Location

generally understated, and the emphasis – as indicated by a background review (*Appendix A*) of the cultural impact assessment issue, and the intent and evolution of both the legislative action and the guidelines – is clearly meant to be primarily upon aspects of Native Hawaiian culture – particularly traditional and customary access and use rights.

Cultural resources include a broad range of often overlapping categories of cultural items – places, behaviors, values, beliefs, objects, records, stories, and so on. A traditional cultural property ("TCP") is one specific type of cultural resource that falls within the purview of the historic preservation review process. A "TCP" is a historic property or place that is important because it possesses "traditional cultural significance":

> "Traditional" in this context refers to those beliefs, customs, and practices of a living community of people that have been passed down through the generations, usually orally or through practice. The traditional cultural significance of a historic property, then, is significance derived from the role the property plays in a community's historically rooted beliefs, customs, and practices....
>
> A traditional cultural property, then, can be defined generally as one that is...[important/significant]...because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community (Parker and King 1990:1).

In addition, it is important to realize that sometimes a traditional cultural property may not have a visible physical manifestation:

> Although many traditional cultural properties have physical manifestations that anyone walking across the surface of the earth can see, others do not have this kind of visibility, and more important, the meaning, the historical importance of most traditional cultural properties can only be evaluated in terms of the oral history of the community (Sebastian 1993:22).

There are at least two significant differences that distinguish traditional cultural properties as a subset within the larger sphere of cultural resources. First, while cultural resources such as practices and beliefs may be spatially associated with general types of geographical areas, such as the exposed lava lands of the Keahole Point area, a traditional cultural property is a specific physical entity or feature with a definable boundary, such as a specific location within the current project site. Second, while cultural resources such as practices and beliefs can include general cultural behaviors such as the gathering of various natural resources for general subsistence, industrial, or ceremonial uses, a traditional cultural property is a specific place or feature directly associated with specific behaviors the continuity of which over time, in either actual practice or remembrance, can be demonstrated.

Based on these two significant distinctions, it is possible to suggest three types of practitioner claims relating to cultural practices, beliefs, and features that are likely to be encountered in the course of conducting a cultural impact assessment study. These claims can be referred to as (a) traditional cultural property claims, (b) traditional and customary cultural practice claims, and (c) contemporary or neo-traditional cultural practice claims.

Traditional cultural property claims would be those which lie within the purview of the current historic preservation review process (DLNR 2002a,b); that is, they are claims involving the traditional practices and beliefs of a local ethnic community or members of that community that (a) are associated with a definable physical property (an entity such as a site, building, structure, object, or district), (b) are founded in the history of the local community, (c) contribute to the maintenance of the cultural identity of the community, and (d) demonstrate a historical continuity of practice or belief up to the present–through either actual practice or historical documentation. Furthermore, to qualify as a legitimate traditional cultural property within the historic preservation context, a potential traditional cultural property must be able to demonstrate its historical significance in terms of established evaluation criteria, such as those of the National Register of Historic Places and/or the Hawai'i Register of Historic Places.

Traditional and customary cultural practice claims would be those native Hawaiian claims which lie within the purview of Article XII, Section 7, of the Hawai'i State Constitution ("Traditional and Customary Rights"), and various other state laws and court rulings, particularly as reaffirmed in 1995 by the Hawai'i State Supreme Court in the decision commonly referred to as the "PASH decision," and as further clarified more recently in its 1998 decision in State of Hawai'i v. Alapa'i Hanapi and its 2000 decision in Ka Pa'akai o Ka 'Aina et al. v. Land Use Commission, State of Hawai'i et al. The notable points of the decisions in PASH and in Hanapi can be summarized as follows: (a) the reasonable exercise of ancient Hawaiian usage is entitled to protection under Article XII, Section 7 of the Hawai'i State Constitution; and (b) those persons claiming their conduct is constitutionally protected must prove that they are a native Hawaiian as defined in PASH, that the claimed right is constitutionally protected as a traditional or customary native Hawaiian practice, and that the exercise of the right is occurring on undeveloped or less than fully developed property. Ka Pa'akai generally reaffirms the same points as in the PASH and Hanapi decisions and, in addition, (a) indicates the explicit responsibility of the regulatory agency involved in any application review to arrive at affirmative and substantive conclusions regarding potential impacts upon traditional and customary native Hawaiian cultural practices and resources, and (b) suggests an "analytical framework" for the identification of and potential impacts upon any such cultural practices and resources.

Traditional native Hawaiian cultural practices can be categorized as two general types: (a) practices with active behaviors involving both observable activities with material results and their inherent values or beliefs; and (b) practices with more passive behaviors that seek to produce nonmaterial results. The former type of behaviors – practices with active behaviors, for example, would involve practices like the gathering and collecting of different animal and plant resources for various purposes, such as subsistence, medicinal, adornment, social, and ceremonial possibly other uses. Uses such as these usually have associated beliefs and values (both explicit and implicit) relating to a pervasive general theme that flows throughout traditional native Hawaiian culture and binds it together. To native Hawaiians, the natural elements of the physical environment–the land, sea, water, winds, rains, plants, and animals, and their various embodied spiritual aspects–comprise the very foundation of all cultural life and activity – subsistence, social, and ceremonial; to native Hawaiians, the relationship with these natural elements is one of family and kinship. The latter type of behaviors – practices with more passive behaviors – involves more experiential activities focused on "communing with nature"; that is, behaviors relating to spiritual communication and interaction that reaffirm and reinforce familial and kinship relationships with the natural environment.

While traditional cultural property claims, as defined above, would certainly fall within the general domain of traditional and customary cultural practice claims, not all traditional and customary cultural practice claims would necessarily qualify as traditional cultural property claims. Traditional and customary cultural practice claims subsume a broad range of cultural practices

and beliefs associated with a general geographical area or region, rather than a clearly definable property or site–for example, the gathering of marine resources from along a section of shoreline for traditional subsistence or ceremonial purposes, in contrast to the gathering of a specific marine resource species for a specific use by current generation members of a family that had obtained the same resource from the same recognized site for several generations.

Contemporary, or "neo-traditional", cultural practice claims overlap with neither traditional property claims nor traditional and customary practice claims. Contemporary cultural practice claims would be those made by cultural practitioners relating to current practices or beliefs for which no clear specific historical basis in traditional culture can be clearly established or demonstrated; for example, the conducting of ritual ceremonies of uncertain authenticity at sites or features for which no such prior use can be demonstrated.

The specific purpose of the present cultural impact assessment study is to assess the potential impacts of the proposed project upon the cultural resources – the practices, features and/or beliefs – of native Hawaiians or any other ethnic group that might be associated with project area. To accomplish this purpose, several specific objectives were established:

1. Identify any native Hawaiian or other ethnic group cultural practices currently being conducted by individual cultural practitioners or groups;

2. Collect sufficient information so as to define the general nature, location, and authenticity of any identified cultural practices;

3. Assess the potential impacts of the proposed project upon identified cultural practices; and

4. Recommend appropriate mitigation measures for any potentially adverse impacts upon identified cultural practices.

Thus, the overall goal or objective of the present cultural impact assessment study was to identify any native Hawaiian or other cultural practices currently being conducted within or immediately adjacent to present project area that might potentially be in some manner constrained, restricted, prohibited, or eliminated if the proposed project were to be approved. The types of practices to be identified would be inclusive; that is, claims for all three types of practices – traditional cultural property, traditional and customary cultural practices, and contemporary cultural practices – would be identified and considered. More specifically, the objectives of the cultural impact assessment were to determine the following: (a) if the project area is currently being accessed by native Hawaiian cultural practitioners for any traditional and customary cultural uses; (b) if the proposed project would have any adverse impacts upon any identified current native Hawaii cultural uses of the area; and (c) what measures might be proposed to mitigate any adverse impacts the proposed project might have upon any identified current native Hawaiian uses of the area. The present study scope and methodology is discussed in detail in relation to cultural impact assessment issues and the OEQC guidelines in *Appendix A*.

CIA STUDY BY HELEN WONG-SMITH

Cultural Resources Specialist Helen Wong-Smith, M.A., conducted the current CIA study. Ms. Wong-Smith has extensive experience in historical documentary and informant research, having worked for many years as a Historical Researcher/Cultural Resources Specialist for PHRI. She is currently the Hawaiian and Pacific Collection Librarian at University of Hawaii at Hilo.

The informant research for this project initially involved compiling a list of potential informants for the project area and the general vicinities of Keahuolu and Kealakehe. The list of potential informants was compiled by contacting informants known through past projects, and through inquiries with departments and cultural specialists such as Kepâ Maly, OHA, Ruby McDonald, and Keola Lindsey, formerly of the Hawaii Island SHPD office. One contact usually led to another until a list of over thirty potential informants was compiled (*Table 1*). The potential informants were contacted by phone and e-mail and those responsive were interviewed preliminarily to assess their potential to and willingness to provide information. To further assess informants, informants were asked to fill out written forms to answer some preliminary questions such as: Who are in your immediate family? What was your previous occupation and education? What is your family background? What are your residential ties? Do you know of any specific historic/cultural properties, practices, and/or beliefs relevant to the project area? This was followed up with phone conversations. Helen Wong-Smith then conducted further interviews with a few selected individuals who had potential to provide further information, and to provide further documentary information on the Hienaloli project area.

Table 1. List of Potential Informants

	Name	Status/Expertise	Affiliation
1	Ruby P. Keana'aina McDonald	Native Hawaiian, executive director	OHA, NAHKHAC
2	Elaine Watai	Native Hawaiian	KCA/SAFIS
3	Craig "Bo" Kahui	Native Hawaiian, president of organization	KCAVL
4	Wally Lau	Native Hawaiian, executive director	NPK
5	Reginald Lee	Native Hawaiian	DOCARE
6	Elizabeth Lee	Native Hawaiian, *lauhala* weaving master	—
7	Michael Ikeda	Community Building Facilitator IV	QLCC
8	Mahealani Pai	Native Hawaiian, cultural specialist	BHI
9	J. Curtis Tyler III	Native Hawaiian, cultural resource specialist	KCDPSC
10	Geraldine Bell	Native Hawaiian, park superintendent	KHNHP, NAHKHAC
11	Kahu Akahai	Native Hawaiian, *kahu*, minister, pastor	MZCC
12	David Garcia	Counselor	QLCC
13	Clarence Medeiros, Jr.	Native Hawaiian, journeyman mason	
14	Lily Kong	Native Hawaiian	KOONKOK
15	Ulalia Ka'ai-Berman	Native Hawaiian, *kumu hula*	NAHKHAC
16	Taro Fujimori	Native Hawaiian	N/A
17	Zachary Kanuha	Native Hawaiian	N/A
18	Clement "Junior" Kanuha	Native Hawaiian	N/A
19	Raeanne Kahaiali'i	Native Hawaiian	N/A
20	Clarence Rapoza	Native Hawaiian	N/A
21	E. Kalani Flores	Native Hawaiian, *kumu olelo* Hawaii	HL-HCCW
22	Gail Souza-Save	General knowledge	QLCC
23	Lydia Mahi	General knowledge	KCDPSC,HCEOC
24	Arthur "Uncle Aka" Mahi	Native Hawaiian	N/A
25	Rae Ann (Fujimori) Godden	Native Hawaiian	N/A
26	Gloria Muraki	General knowledge	N/A
27	Violet Leihulu Mamac	General knowledge	N/A
28	Angel Pilago	Native Hawaiian	HCC
29	Kelly Greenwell	General knowledge	N/A
30	Michael Keala Ching	General knowledge	N/A
31	Iris Nalei Napaepae-Kunewa	General knowledge	N/A
32	Dr. Frank Sayre	General knowledge	N/A
33	Robert Kawaiula Brancp	General knowledge	N/A
34	Kahu Henry Kanoelani Boshard	Native Hawaiian, *kahu*, minister, pastor	MC
35	Kahu Brian Boshard	Native Hawaiian, *kahu*, minister, pastor	MC
36	Ka'ea Lyons Alapai	Native Hawaiian, *kumu olelo* Hawaii	KAPA, EHES

TABLE KEY:

Affiliation:

N/A	Not Available
KCA	Kealakehe Community Association
SAFIS	Salvation Army Family Intervention Services
OHA	Office of Hawaiian Affairs
QLCC	Queen Liliuokalani Children's Center
BHI	Bishop Holdings, Inc.
MZCC	Mauna Ziona Congregational Church
KHNHP	Kaloko-Honokōhau National Historical Park
NPK	Neighborhood Place of Kona
NAHKHAC	Na Hoapili o Kaloko Honokōhau Advisory Commission
KCAVL	Kaniohale Comm. Association at the Villages of La'I 'Ōpua
DOCARE	State of Hawaii DLNR – Department of Conservation and Resources Enforcement Division
KCDPSC	Kona Community Development Plan Steering Committee
KOONKOK	Ka 'Ohana O Na Kupuna O Kona
HCEOC	Hawaii County Economic Opportunity Council
HL-HCCW	Hawaiian Lifestyles – West Hawaii Community College
MC	Mokuaikaua Church
HCC	Hawaii County Council
KAPA	Kapa Radio
EHES	Ehunuikaimalino Hawaiian Immersion School

CULTURAL IMPACT ASSESSMENT STUDY

by Helen Wong-Smith, M.A., Cultural Resources Specialist

ABSTRACT

This report provides a cultural impact assessment for TMK 7-5-013:022, in Hienaloli. The assessment is based on a review of a wide range of written material – archaeological reports, government and other historical records, Hawaiian language sources translated into English, and interviews with long-term residents, including native Hawaiians, familiar with the cultural history and resources of Hienaloli. The research took place between August 17 and December 15, 2007 and utilized resources at the Hawai'i State Archives, Edwin H. Mo'okini Library of the University of Hawai'i-Hilo, the Hilo Public Library, online resources, and previous historical and cultural reports and interviews.

INTRODUCTION

Information on the *ahupua`a* of Hienaloli is scarce. Further, the usual references for translations of *ahupua`a* names are silent regarding the meaning of Hienaloli. One of the meanings given for *hiena* is a kind of soft porous stone used to smooth and polish utensils. There are several meanings of *loli* including: 1. to turn, change, alter, turn over…2. sea slug…sea cucumber…3. Spotted, speckled, daubed; to color in spots, as tapa[1]. *Hienaloli* is often written as *Hinaloli* and *Hianaloli* in various 19th and early 20th century documents. In his decades-long compilation of place names, archaeologist Lloyd Soehren refers to the *ahupua'a* as *Hianaloli* and lists 26 place names within it[2].

Hienaloli is located in the *moku o loko* (district) of Kona, a bit south of Keahuolu. This northern section of Kona was divided into two regions, Kona kai `opua (Maly provides the interpretive translations "Kona of the distant horizon clouds above the ocean[3]) and Kekaha-wai-`ole (the waterless place). Kekaha-wai-`ole-o-nā-Kona spans from Kalaoa ahupua`a (Keāhole Point) to Kealakehe ahupua`a. Kekaha is described as "a dry, sun-baked land[4]." Sheltered by the abrupt rise of Hualālai, Kekaha receives very little rain below the 1,000-ft elevation contour. Maly provides the following description of residential movement within Kekaha-wai-`ole-o-nā-Kona during the late 1800s and early 1900s in the Hawaiian Newspaper *Ke Hōkū o Hawai`i*:.

> "O ia ka wāe ne`e `ana ka lā iā Kona, hele a malo`o ka `āina i ka `ai kupakupa `ia e ka lā, a o nā kānaka, nā li`l o Kona, pūhe`e aku la a noho i kahakai kāhi o ka wai e ola ai nā kānaka. (It was during the season, when the sun moved over Kona, drying and devouring the land, that the

[1] Pukui and Elbert 1965:194
[2] Hawaiian Place Names – Ulukau http://ulukau.org/cgi-bin/hpn?a=q&r=1&hs=1&t=1&e=q-0mahele--00-0-0--010---4------0-0l--1haw-Zz-1---20-about---00031-00110escapewin-00&q=Hienaloli&h=dtx&summarise=0
[3] Maly IN O`Hare 1993:Appendix B1
[4] Kelly 1972:2

> chiefs and people fled from the uplands to dwell along the shore where water could be found to give life to the people[5].

Hawaiian authority and *kumu hula* Pualani Kanaka`ole Kanahele states: "This clearly communicates that the natives of Kekaha-wai-`ole-o-nā-Kona had great knowledge of their land's cycles and its productive abilities. There were springs and brackish water ponds inland from the shore and the ocean was abundant. They planted in the *ma uka* or upland forest and had sufficient amount of rain for their crop. When the rainy season passed, they camped at the shore, grew sweet potato, and fished. Their basic needs were satisfied[6]."

Hienaloli is situated four *ahupua`a* south of Keahuolū (based on *ahupua`a* names, not the further division of each). By the time of the 1948 Mahele, the *ahupua`a* of Hienaloli had been divided into six smaller parcels, Hienaloli 1-6. The well site (TMK 7-5-013, Por.022) for this project is located within the *ahupua`a* of Hienaloli 1st. Soehren provides the following information on the general *ahupua`a* of Hianaloli [Hienaloli] with insight into the individual parcels. Information on place names specific to Hienaloli 1 and 2 are then provided:

> Hianaloli[7]
> Ahupuaa: Hianaloli 1-6
> Feature: ahupuaa
> Comments: Ahp 1 returned by Lunalilo, retained by aupuni. Ahp 2 retained by Keelikolani, LCAw 7716:5 but no RP. Ahp 3 returned by Asa Kaeo, retained by aupuni. Ahp 4 given to ABCFM, LCAw 387; had ancient fishing rights extending out to sea (BCT). Ahp 5 retained by Peke, LCAw 8524-B:3 but no RP. Ahp 6 retained by aupuni. Hianaloli 1 & 6 were named School Lands in 1850 (IDLL). Now called Hienaloli, (q.v.).
> Lexicology: hiana-loli. PE: hole frequented by sea cucumbers.
>
> Puu Koheu[8]
> Ahupuaa: Hianaloli 1/2
> Feature: boundary point
> Comments: An oioina between Halulu & Mamalahoa Hwy on s. boundary Hienaloli 1.
>
> Puu Hau[9]
> Ahupuaa: Hianaloli 1/2
> Feature: boundary point
> Comments: "a grove of hau trees" on south boundary Hienaloli 1, between Wawaekeekee & Hualahaula.

[5] Hawaiian orthography will be employed by this author except when directly quoting. For this reason many of the quotations will lack diacritical and other marks as they are presented verbatim.
[6] Kanehele 2001:4
[7] Mahele Book 21,22,46,173; Boundary Commission Testimony 1:346; Indices of Awards, Land Commission 29,67,139,457; Interior Dept., Land, Letters (Incoming). Archives of Hawaii 1850 Dec. 23
[8] Boundary Commission Testimony 1:380; 2:282
[9] Boundary Commission Testimony 1:379; 2:281

Kaiuhu[10]
Ahupuaa: Hianaloli 1/2
Feature: kihapai
Comments: "a kihapai koele, where Honuaula cuts these lands off" on S boundary Hienaloli 1, between Wailoa & mauka boundary. Elev. about 2400 ft.

Hulia[11]
Ahupuaa: Hianaloli ½
Feature: kihapai
Comments: ""a kihapai on both sides of the iwi aina" mauka of Mamalahoa Hwy, along S boundary Hienaloli 1
Lexicology: hulia. PE: overturned; sought.

Wawaekeekee[12]
Ahupuaa: Hianaloli 1/2
Feature: boundary point
Comments: "where the land crooks" on south boundary Hienaloli 1, between Halulu & Puu Hau.
Lexicology: wāwae-ke'eke'e. PE: crooked leg.

Papakolea[13]
Ahupuaa: Hianaloli 1/2
Feature: boundary point
Comments: "a large hole of water in a kahawai among ferns" ("stream or gulch" PE] on south boundary Hienaloli 1, between Hulia & Wailoa.
Lexicology: papa-kōlea. PEM: plover flats.

Wailoa[14]
Ahupuaa: Hianaloli 1/2
Feature: pool
Comments: "another large pool of water in the gulch, there the boundary runs up the south pali and leaves the gulch." On south boundary Hienaloli 1, between Papakolea & Kaiuhu.
Lexicology: wai-loa. PEM: long water. Name of a star & a chief.

Hua[15]
Ahupuaa: Hianaloli 1/2
Feature: boundary point
Comments: "Boundary point at shore between Hienaloli 1 & 2 is Hua, a lua kii [lua kī; artesian spring] in the sea." (p.380) See also Kauhiawaawa.
Lexicology: hua. PE: fruit, egg.

[10] Boundary Commission Testimony 1:380
[11] Boundary Commission Testimony BCT 1:380
[12] Boundary Commission Testimony 1:379; 2:281
[13] Boundary Commission Testimony BCT 1:380
[14] Boundary Commission Testimony 1:380; 2:282
[15] Boundary Commission Testimony 1:380; 2:282

MO`OLELO `AINA: NATIVE TRADITIONS AND HISTORIC ACCOUNTS OF HIENALOLI

Kekāhi Mo`olelo Hawai`i (Selected Hawaiian Traditions)

Legendary references to Hienaloli are few; therefore this report includes a few references to nearby Keahuolu and Lanihau, for which there is much more information available. From these references one can at least gain some general idea of activity in the vicinity.

A legendary reference to Keahuolū is found in *Ka`ao Ho`oniua Pu`uwai No Ka-Miki* (The Heart Stirring Story of Ka-Miki) translated by Kepā Maly, a legendary account of two super-natural brothers, Ka-Miki and Maka-`iole, who traveled around Hawai`i Island set in the period when Pili-a-Ka`aiea was chief of Kona, ca. 12th-13th century). It was originally published in serial form between 1914 and 1917 in the Hilo-based Hawaiian language newspaper *Ka Hōkū o Hawai`i* by Hawaiian historians John H. Wise and John Whalley Hermosa Isaac Kihe. Here are excerpts from Maly's translation:

> ...Within the lands of Keahuolū you saw Hale-pa`u which is also near Ka-pā-wai (The water enclosure). Kapāwai is also known as Makā`eo (Look with anger), and a coconut grove encircled those places. Further on, between the lands of Keahuolū and Kealakehe was the *āhua* (Hillock-plantation mound) of Lae-oniau...[16]
>
> ...The priest who officiated over rituals of Keahuolū and Kealakehe was named Kalua`ōlapauila. He was the priest of the temple Kalihi, which is also called Kalua`ōlapauila. This temple is in the coastal area[17] along the border of Keahuolū and Kealakehe, near the old road into Kailua....[18]
>
> ...The district of Keahuolū and divisions of Lanihau (1 and 2) were under the rule of Kapohuku`imaile (kāne) and Papalūlā (wahine), and Papaumauma was their warriors champion. When Papaumauma competed with Ka-Miki at the contest site `Iwa`awa`a (at Kohana-iki), he was defeated. Papumauma was honorable, and he greatly admired the superior skills of Ka-Miki and asked to turn his status and land rights over to Ka-Miki, but Ka-Miki declined...[19]
>
> *Ka-noenoe* (The mist, fogginess) – The mound-hill called Pu`u-o-Kaloa sits upon the plain of Kanoenoe which is associated with both Keahuolū and Kealakeha. The setline of mists upon Pu`u-o-Kaloa was a sign of pending rains; thus the traditional farmers of this area would prepare their fields. This plain was referenced by Pili when he described to Ka-Miki the extent of the lands which Ka-Miki would over see upon marrying the sacred chiefess Paehala of Honokōhau. The inheritance lands

[16] April 2 and 9, 1914
[17] Boundary Commission Testimony places this place at the midpoint of Keahuolū rather than the coast.
[18] April 30, 1914
[19] May 21, 1914

included everything from the uplands of Hikuhia above Nāpu`u and the lands of the waterless Kekaha, which spanned from the rocky plain of Kanikū (Keahualono) to the plain of Kanoenoe at Pu`uokaloa[20].

*Pu`u-okaloa* (Mound, or hill of Kaloa) – The narratives of Ka-Miki identify Pu`uokaloa as *"Pu`uokaloa I ka malo o Ka`eha e waiho ala..."* Pu`uokaloa where Ka`eha's loin cloth (symbolic of the mists) was spread out[21].

References to Hienaloli within *The Legend of Ka-Miki* as translated by Maly follow:

*Auhauke`ē and Hinaloli* (meaning uncertain) – After an `*awa* ceremony, *Ka-Miki* and *Maka-`iole* ventured from *Kalama`ula* to visit some of the lands of Kona. Upon returning to Kalama`ula, *Ka-uluhe* described the nature of the lands they had visited; The *ahupua`a* of Auhaukea`ē borders *Oneō* bay, and sits between the *ahupua`a* of Hinaloli (Hienaloli) and Pua`a. Important features associated with these lands included: *Oneō* and *Niumalu* – with the *hālau ali`i* (chief's compound) and *hālau wa`a* (canoe sheds) of the chief *Pili-a-kapu-nui-Pai`ea*[22]; *Huihā-a* – a surfing spot named for a war counselor of *Pili*; and *Ka māla `uala* (sweet potato gardens) extended across the lands of Oneō bay and Hinakahua[23].

Waikūpua (Supernatural [beings'] water) – land of Hinaloli – Following Ka-Miki's bold appearance before *Ahu`ena mā*[24], the stewards of the great chief *Pili-a-Ka`aiea*, Pili's royal court was astir with word that *Ka-Miki* was seeking rebellion. *Kamalokaimalino*, high war counselor of *Pili* and overseer of the games at *Hinakahua* (Puapua`a) sent *`Īliopi`il*, Pili's messenger, to summon *Waikūpua*[25], *Huihā, Ka`aipuhi, Kaho`oholoholo,* and *Ha`akona*. These individuals were the war counselor-generals of Pili, andguards to the arena of Hinakahua, and many of them became associated with place names, perhaps identifying places associated with the individuals. *Pili* wanted Waikūpua *mā* to being *Ka-Miki* before the council to determine if he was a rebel. Waikūpua and the other *pūkaua* (war counselors) attempted to seize *Ka-Miki* but were defeated[26].

Ka Hōkū o Hawai`i published another legendary account provided by J.W.H.I. Kihe entitled "Nā Ho`onanea o ka Manawa, Kekāhi mau wahi pana o Kekaha ma Kona" (A pleasant passing of time, [stories from] some of famous places of Kekaha in Kona]. This section describing agricultural practices as related to Pu`uokaloa is translated by Maly:

*Pu`u-o-kaloa* is a mound-hill site in the lands of Keahuolū – Kealakehe, not far from the shore of Kaiwi and Hi`iakanoholae. During periods of dry weather (*ka lā malo`o*) when planted crops, from the grassy plains to the *`āma`auma`u* (fern forest zone), and even the ponds (*ki`o wai*) were dry,

[20] October 25, 1917
[21] October 25, 1917; Maly 1996:12-13
[22] 4/9/1914 IN Maly .xxx:A-3
[23] 5/24/1917 & 6/14/1917 c/2 IN Maly A-3
[24] *mā* - A Hawaiian word meaning "and companions or associates"
[25] 4/5/1917
[26] 4/26/1917

people would watch this hill for signs of coming rains. When the *lihau* (light dew mists) sat atop the hill of Pu`u-o-kaloa, rains were on the way. Planters of the districts agricultural fields watched for omens at Pu`uokaloa, and it was from keen observation and diligent work that people prospered on the land. If a native of the land was hungry, and came asking for food, the person would be asked:

Ua ka ua I Pu`uokaloa, ihea `oe?
When rains fell at Pu`uokaloa, where were you?

[If the answer was...]

I Kona nei no!
In Kona!

[There would be no sweet potatoes for this person.]

[But if the answer was:]

I Kohala nei no!
In Kohala!

[The person would be given food to eat for they had been away, thus unable to accomplish the planting[27].]

Within S.N. Hale`ole's epic *Ka Mo`olelo o Lā`ieikawai* (The Hawaiian Romance of Lā`ieikawai a short reference to Keahuolū and Lanihau as parents is found in the story of *Hiku and Kawelu*:

The son of Keaauolu [sic] and Lanihau, who live in Kaumalumalu, Kona, once sends his arrow, called Puane, into the hut of Kawelu, a chiefess of Kona. She falls violently in love with the stranger who follows to seek it, and will not let him depart. He escapes, and she dies of grief for him, her spirit descending to Milu. Hiku, hearing of her death, determines to fetch her thence. He goes out into mid-ocean, lets down a *koali* vine, smears himself with rancid *kukui* oil to cover the smell of a live person, and lowers himself on another vine. Arrived in the lower world, he tempts the spirits to swing on his vines. At last he catches Kawelu, signals to his friends above, and brings her back with him to the upper world. Arrived at the house where the body lies, he crowds the spirit in from the feet up. After some days the spirit gets clear in. Kawelu crows like a rooster and is taken up, warmed, and restored[28].

Fornander provides a longer version of this tradition providing the father's name as Keahuolū[29]. *Figure 1 shows the project area in relation to* place names compiled by Lloyd Soehren and presented as *Hawaiian Place Names*[30]. Soehren assigned their locations from Boundary Commission testimonies, surveyor field books, and a myriad of primary resources.

[27] May 19, 1914; 1996:13
[28] Hale`ole 1997:660
[29] Fornander 1919 v5:182-184
[30] http://www.ulukau.org/cgi-bin/hpn?

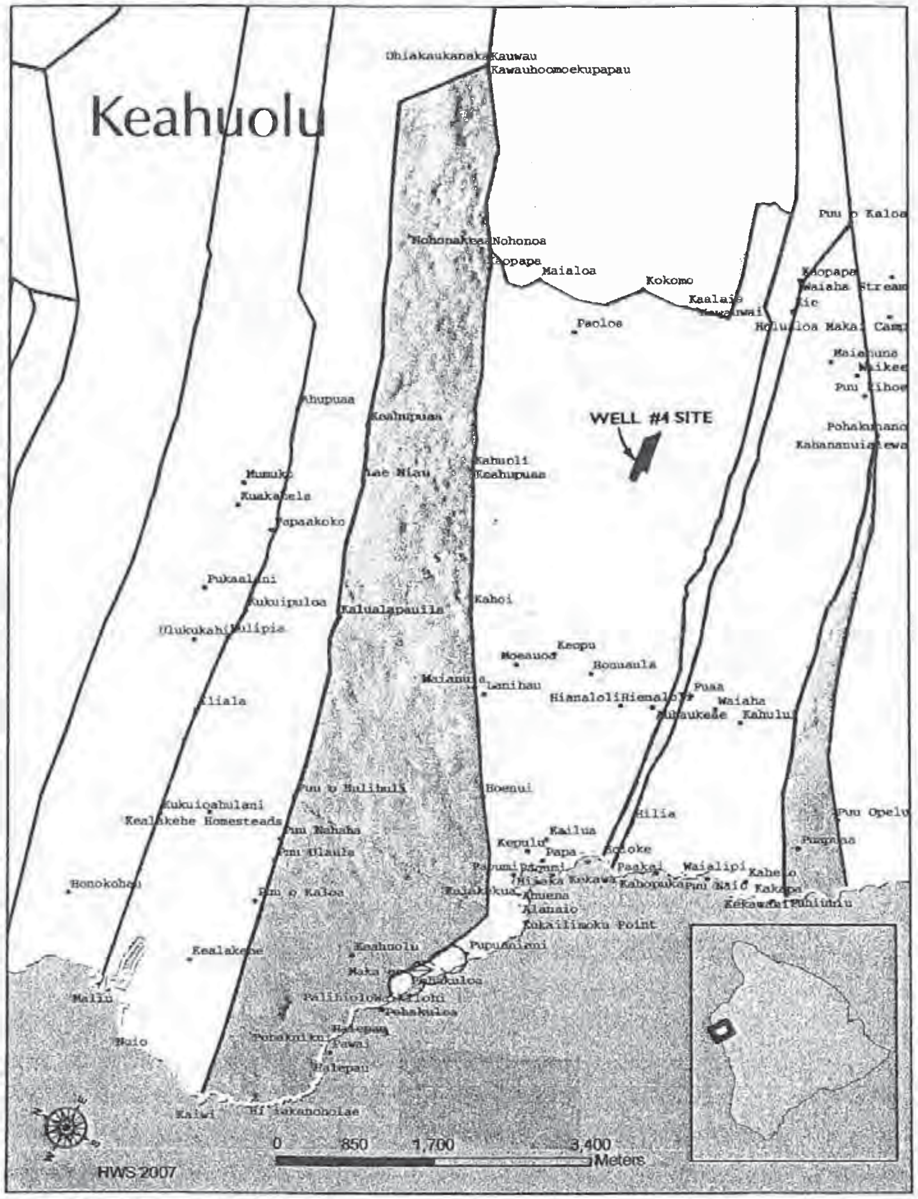


Figure 2. Place Names in the Vicinity of the Project Area

Hienaloli and General Vicinity Described in the Journals and Logs of Historic Visitors (1815 to 1902)

The earliest reference to Kailua concerns Kamehameha's residence there after his unification of the islands:

> In 1812, two years after all the islands and finally been united under his rule, Kamehameha returned to Hawai`i island from O`ahu, where he had lived for the past nine years. Kamehameha lived most of his remaining years in Kailua, at his principal residence at Kamakahonu in Lanihau ahupua`a [Lanihau is between Keahuolū and Hienaloli][31].
>
> The accounts of early visitors at Kailua were, in the main, those of explorers...The *Columbia* came to Kailua Bay five times between 1815 and 1818, and then was sold to Kamehameha for sandalwood. The ship [was] renamed the *Laholile*...
>
> On its first visit to Kailua, in January of 1815, the *Columbia* took on board "hogs, vegetables, rope, and cloth of the country" (Corney 1896:35). Peter Corney, one of its officers, who remained in Hawai`i when the ship was sold and left descendants here, remarked that "island rope" made excellent running rigging[32]. Corney noted that the American ship *Milwood* was then at Kailua, "purchasing sandalwood at the rate of 7 dollars for 133 pounds (a picul)[33]" ...Corney provides a unique and graphic account of the sea traffic at Kailua Bay in the early 1800s.
>
> At the time of Kamehameha's death in May 1819, and for the early months of Liholiho's reign, the court households at Kailua apparently were very large[34].
>
> It was at Kailua in November 1819, approximately six months after the death of Kamehameha, that the "free eating" (`*ai noa*) incident took place, symbolizing the end of the kapu system....The act of "free eating" at Kailua was followed by a general purging and burning of god images from the large heiau[35].

Hawaiian historian Samuel Kamakau offers this reference to the life in the area at the time of Liholiho:

> Many of the old chiefs were alive in Liholiho's day...The sands of Kaiakeakua were worn down like a dromedary's back by the many feet of

---

[31] Kelly 1983:3
[32] Ibid:48
[33] Ibid:47
[34] Ibid:5
[35] Ibid:6

chiefs and chiefesses tramping over them, and at Kamakahonu could be seen at night the sparkle of lights reflected in the sea like diamonds, from the homes of the chiefs from Kahelo [in Puapua`a *ahupua`a*] to Lanihau. The number of chiefs and lesser chiefs reached into the thousands[36].

At this time M. Gaimard, a member of de Freycinet's expedition, wrote the following description of the Kailua environs:

> In order to reach the mountain that lies to the southeast of the village…we first went across dry fields, where hardly any young growth was visible; but, after reaching a certain elevation; we found much richer terrain where the paper mulberry, breadfruit tree, the mountain apple, tobacco, cabbage, sweet potatoes and yams were cultivated. We were given water of a delicious coolness[37].

Missionary occupation of Hawai`i had its beginnings at Kailua. Kelly notes that:

> Liholiho…[was] at Kailua when the first band of Protestant missionaries arrived there in April of 1820…the missionaries were granted permission to remain in the kingdom on trial for a year. Two missionary families remained in Kailua, while the rest went on to Honolulu[38].

It was at Kailua that Liholiho entrusted the island to Kuakini, younger brother of Ka`ahumanu and faithful aide of Kamehameha I. Three years into Kuakini's stewardship, the Reverend William Ellis began his tour around the island at Kailua in 1823. This passage from his journal reflects the population and resources of Kailua:

> Kairua, though healthy and populous, is destitute of fresh water, except what is found in pools, or small streams, in the mountains, four or five miles from the shore[39].

Ellis reports the observations made by Reverends Thurston and Bishop who walked the coastline from Kailua toward Ka`iwi Point crossing the entire coastline of Keahuolū:

> The environs were cultivated to a considerable extent; small gardens were seen among the barren rocks on which the houses were built, wherever soil could be found sufficient to nourish the sweet potato, the watermelon, or even a few plants of tobacco, and in many places these seemed to be growing literally in the fragments of lava, collected in small heaps around their roots.
>
> The next morning, Messrs. Thurston, Goodrich, and Harwood, walked towards the mountains, to visit the high cultivated parts of the district. After traveling over the lava for about a mile, the hollows of the rocks began to be filled with a light brown soil; and about half a mile further, the surface was entirely covered with a rich mould, formed by decayed vegetable matter and decomposed lava.

[36] Kamakau 1961:221-222
[37] de Freycinet 1978:8
[38] Kelly 1983:7
[39] Ellis 1969:29

> Here they enjoyed the agreeable shade of bread-fruit and ohia trees; the latter is a deciduous plant, a variety of Eugenia, resembling the *Eugenia malaccensis*, bearing red pulpy fruit, of the size and consistence of an apple, juicy, but rather insipid to the taste. The trees are elegant in form, and grow to the height of twenty or thirty feet; the leaf is oblong and pointed, and the flowers are attached to the branches by a short stem. The fruit is abundant, and is generally ripe, either on different places in the same island, or on different islands, during all the summer months[40].

The cultivation and environs described above fall within the zone the project area is located and dispenses the assumption this was all barren lava supporting little life.

This type of gardening in lava is called *makaili*[41] when even small pockets of semi-disintegrated lava are utilized, and potatoes are grown by fertilizing with rubbish and by heaping up fine gravel and stones around the vines. Handy writes, "Such cultivation produces inferior potatoes; they are said to be rather tasteless and ridged (*`awa`awa*) or wrinkled[42].

Kuakini gave the aforementioned missionary couples houselots in the Kailua area. Ka`ahumanu, as *kuhina nui* [prime minister], acting on behalf of the government, gave a part of Hienaloli for the mission's support[43]. The Thurston's homestead was called Laniakea, after the nearby cave, and consisted of five acres straddling the border of Honua`ula and Hienaloli 1st. Ellis provides a description of the cave:

> …they also explored a celebratory cave in the vicinity, called Raniakea. After entering it by a small aperture, they passed on in a direction nearly parallel with the surface; sometimes along a spacious arched way, at other times, by a passage so narrow, that they could with difficulty press through, till they had proceeded about 1200 feet; here their progress was arrested by a pool of water, wide, deep, and as salt as that found in the hollows of the lava, within a few yards of the sea. This latter circumstance, in a great degree, damped their hopes of finding fresh water by digging through the lava....The mouth of the cave is about half a mile from the sea, and the perpendicular depth to the water probably not less than fifty or sixty feet….From its ebbing and flowing with the tide, it [the pool] has probably a direct communication with the sea[44].

While describing an old military fortification for the *maka`āinana* (commoners) Ellis speaks of the remaining wall, which at his visit reached a height of 18 to 20 feet, with a base 14 feet thick:

> The part of the wall now standing, is near the mouth of Raniakea,…which formed a valuable appendage to the fort. In this cavern, children and aged persons were placed for security during assault or sally forth from the fort, and sometimes the wives of the warriors also, when they did not accompany their husbands to battle[45].

[40] Ellis 1963:31-32
[41] Fornander 1919-1920, Vol. 6:164
[42] Handy 1972:129
[43] Kelly 1983:10
[44] Ellis 1963:30
[45] Ibid:62

Historian James Jarves explored the cave in 1840, and swam in the pool. Adding to Ellis' description, he noted the water was cold and that it held a sulfurous odor and taste[46].

Commodore Wilkes of the U.S. Exploring Expedition made these comments about the environs of Kailua in 1840:

> The natives during the rainy season...plant, in excavations among the lava rocks, sweet potatoes, melons, and pineapples... The...staple commodities are sweet potatoes, upland taro, and yams. Sugar cane, bananas...bread-fruit, cocoa-nuts, and melons, are also cultivated. The Irish potato, Indian corn, beans, coffee, cotton, figs, oranges, guavas, and grapes, have been introduced....[Two miles from the coast, in a belt half a mile wide, the bread-fruit is met with in abundance, and above this the taro is cultivated with success...A considerable trade is kept up between the south and north end of this district. The inhabitants of the barren portion of the latter are principally occupied in fishing and the manufacture of salt, which articles are bartered with those who live in the more fertile regions of other south, for food and clothing[47].

CHRONOLOGICAL HISTORY OF RESIDENCY AND LAND OWNERSHIP IN HIENALOLI

The above description of subsistence farming and trading within the land divisions is characteristic of pre-contact Hawaiian culture. With the introduction of a market system and the call for labor to harvest sandalwood, agriculture in the Kailua area changed greatly, as did the native population. Early demographics for Hienaloli are difficult to ascertain. Schmitt recorded epidemics for the years 1848 and 1849 as follows:

> Four devastating epidemics occurred in rapid succession in 1848 and 1849: measles, whooping cough, diarrhea, and influenza. Together, these four diseases killed more than 10,000 of the perhaps 87,000 persons in little more than a twelve-month period[48].

Kelly presents population demographics for North Kona between 1836-1980 reflecting what she suspects reflects successes and failures of various commercial agriculture ventures dependent on the rise and fall of world prices of crops[49]:

Table 2. Population Demographics for North Kona Between 1836-1980

Year	Population	% Increase/Decrease	Year	Population	% Increase/Decrease
1836	5,957	----	1884	1,773	-9.8
1853	4,110	-31.0	1890	1,753	-1.1
1860	3,488	-15.1	1896	3,061	+74.6
1866	3,268	-6.3	1900	3,819	-24.7
1872	2,218	-32.1	1910	3,377	-11.5
1878	1.967	-11.3			

[46] Jarves 1844:215-216
[47] Wilkes 1845:4, 91-92, 95-97 IN Kelly 1983:19
[48] Schmitt 1968:37
[49] Kelly 1983:92

During Kuakini's stewardship of the island, walls were built to protect the cultivated lands from the ravages of free-roaming dogs and pigs kept near the coastal habitations[50]. One of these walls was recorded by John Papa I`i at Honua`ula (inland and slightly north of Hienaloli) in 1812; I`i writes, "A stone wall to protect food plots stretched back of the village from one end to the other and beyond[51]." Kelly postulates this wall was later incorporated into what became known as Kuakini Wall, which may be traced from its starting point at Palani Road above Kailua Bay to beyond Kahalu`u Bay. It has long been presumed this wall built sometime during Kuakini's governorship (1820-1844) to protect the cultivated uplands from the depredations of cattle, introduced to the island by Captain George Vancouver in 1793. It was not known by this name until after 1855. Until that time it was consistently referred to as the Great Wall, or the Great Stone Wall by surveyors. The Emerson-Kanakanui map of Kailua Town & Vicinity (Reg. Map No. 1676, dated c.1880) identifies it as the "Kuakini Great Wall." The following reference to what is no doubt Kuakini Wall was made by the Reverend Albert Baker:

> Just a little above [the stone church at Kahaluu], and continuing all the way to Kailua, is the huge stone wall built in Kuakini's time to keep pigs from the cultivated lands above[52].

In his reconnaissance survey of Keahuolū, Rosendahl (1972) notes, "...the Great Wall of Kuakini...is a historic period structure built during the period A.D. 1830-1840 at the direction of Kuakini, Governor of the Island of Hawaii..." Kelly writes of Kuakini Wall:

> It has long been presumed that this wall was built sometime during the governorship of John Adam Kuakini (1820-1844) to protect the cultivated uplands from the depredations of cattle. However, as the wall is at all points less than a mile from the seacoast, only the food plots in the coastal region would have been protected by it. It probably would have only kept cattle and horses grazing on the kula away from the houselots and small gardens along the shoreline[53].
>
> Unnecessarily high as a barrier to roaming...the Kuakini wall may have been the Pa'aina named as the makai boundary in several claims to land along its course. At times, the wall reaches a height of 8 or 9 feet, which seems cattle or pigs...The fact that the term used in the register of claims is "papipi," which refers to to a wall or enclosure for cattle, not pigs, should answer the question of what kind of animal the wall was meant to restrict in the 1840s. Perhaps in more recent years it served other purposes. Why it is located between the grazing land and the gardens, or why it is so high in places, we can only surmise[54].

In addition to this notable structure were smaller historic walls for similar and boundary purposes. In her report of subsistence lifestyles in Kona, Schilt writes of the *ahupua`a* in this vicinity:

[50] *Ke Au `Ōkoa*, March 19, 1868
[51] I`i: 1959:111
[52] Baker 1915:83
[53] ibid:75
[54] ibid:76

> 62 historic walls listed....23 walls trending *mauka-makai* pass through the ROW, defining *ahupua`a* boundaries. All are double-faced and core-filled, in good to excellent states of repair. Functioning today as portions of cattle range boundaries, theses walls probably originated in historic times, as early as the mid-1800s, having been built for that purpose[55].

In 1848, during the reign of Kamehameha III, the traditional Hawaiian land ownership system was replaced with a more Western-style system. This radical restructuring was called The Great *Mahele* (division). The *Mahele* separated and defined the undivided land interests of the King and the high-ranking chiefs, and the *konohiki*, who were originally in charge of tracts of land on behalf to the king or a chief[56]. More than 240 of the highest-ranking chiefs and *konohiki* in the kingdom joined Kamehameha III in this division.

Although Soehren cites above Hienaloli 1 was "returned by Lunalilo" it is not listed as one of his awards in the *Indices of Awards* but is listed as a Government land along with Hinaloli 2[57]. Hienaloli 3 was awarded to Ruth Ke`elikōlani; portions of Hienaloli 4 to the American Protestant Mission and May Peke, daughter of Issac Davis, received Hienaloli 5[58]. As royal claimants and awardees were not required to provide documentation for their claims, and due to the nature of government and royal claims for much of Hienaloli, there is little information in the LCA of the *Mahele*. The few LCA testimonies for Hienaloli are provided here to give some insight to the land activities and residency patterns:

> LCA 10406 to Nakunu
> Kapule sworn: I've seen there in the land parcel of Ililoa, land of Hianaloli, 8 cultivated patches in two sections. 1. Upland, my land; toward Kau, Ulua's land; shoreward, mine also; towards Kohala, Ulua's also. 2. Sweet potato [patch]: upland, my land; towards Kau, Ulua's land; shoreward, mine also; towards Kohala, ulua's also. 1 cultivated patch. His land was from me in the year 1847, no one has objected[59].
>
> LCA 7630 to Kawaha
> Mose sworn: I have seen there in the land parcel of Ililoa, lands of Hianaloli 3; 14 cultivated patches as he claimed in the award document. There is the land parcel of Papa`awela, lands of Hinanaloli 2, are 8 cultivated patches, everything is under cultivation. His land was given by me at the time the Kingdom went to Kamehameha III. No one has objected to him. The cultivated patches in Hianaloli 2 are an old land [award] from Kamehameha I, and in his time, it is from Wahakane. No one has objected. He also has a house claim in the lot of Kaupa, when his life ended, Kaupa will receive his house claim[60].

[55] Schilt 1984:44
[56] Chinen 1958:vii and Chinen 1961:13
[57] Board of Land Commissioners 1929:29
[58] Kelly 1983:22
[59] Native Testimony v4:537
[60] Native Testimony v4:519

> LCA 10735 to Pupule
> Mose sworn: I have seen in the land parcels of Ililoa I, Kaauelua, Paohale, Kaumeo 1 and Kaumeo 2 of Kamuku ahupuaa. Section 1: mauka, banana patch of Kemeki; Kau, Hianaloli 4 ili; makai, land of Waihou; Kohala, Hianaloli 2 ili. 5 cultivated *paukū* (garden plots), no house. Section 2 – house lot: mauka, Wahineiki's lot; Kau, Mikakina's [Meineke's] trail (*ala nui*); makai, Keawelawaia's lot; Kohala, a pathway. He has the lot enclosed with 4 houses for himself there, 1 stone house. I have him the house; the agricultural plots and house lot is an old place from the elders. No one has objected to him to this day[61].
>
> LCA 4226 to Kuae
> Keawelawaia sworn: I have seen one section in Hianaloli 2 and in Hianaloli 4 ahupuaa the other section. Section 1 – house lot: towards the uplands, Kau, and shoreward is idle land; towards Kohala is Mikakina's lot. Keawekolohe fenced the lot, 1 house if for Keawekolohe, all this work was done by Keawekolohe, and it was acquired by Kuae in the year 1842. Section 2 – house lot: towards the uplands is idle land; towards Kau is the lot of Manunu [spelling?]; towards the shore is the *alanui aupuni* [government road]; towards Kohala is Haleokau's lot. Keawekolohe fenced houses in the lot, one for Keawekolohe and for the foreigner. Kuae has no house at this time. He acquired all the work in the year 1842, he is in possession of it now, no one has objected. Kawaha sworn; we both have known alike[62].
>
> LCA 2334 to Kupuna
> Greetings to you commissioners who quiet [land] titles. I claim here my house lot; here in Kailua, it is not surveyed on all sides. This is an old residence of ours from the time of Kamehameha I, before our living there, our parents lived there, when our parents and relatives died we returned and live there. So we remain at this time. It is our claim[63].
>
> LCA 2316 to Haleokane
> Kuia sworn: He has seen in Hianaloli 4 ahupuaa a house lot. Mauka, idle land; Kau, Kaupa's land; makai, Kupeina's land; Kohala, Catholic's lot. Lot has been enclosed, 3 houses in there, Haleokane lives there. Kimo sworn: both have known similarly[64].

[61] Native Testimony v4:523
[62] Native Testimony v5:552
[63] Native Register v3:456
[64] Native Testimony v5:555

LCA 7469 to Kaupa
Mose Mo`o (landlord) sworn: He has seen one section in Hianaloli 2 and another in Hianaloli 1. House lot boundaries are: upland, Waikele's lot; towards Kau, Palaumu's lot; shoreward, Malo's lot. The lot is enclosed, Kaupa has 3 houses and a land claim; it is not accurately surveyed, when the land surveyor comes he will set the boundaries right. Certain sections are cultivated, one section is left undone. I gave him his agricultural parcels in the land parcel of Kaumeo; the house lot was left empty so Kaupa built his house there. No one has objected[65]. [Kaupa is identified as Kaupu on the March 1928 R. Lane tracing of the J.S. Emerson – S.M. Kanakanui Map of "Kailua Town and Vicinity" Reg. Map 1676 ca. 1880.]

LCA 10404 to Namimi
Makaole (*wahine*) sworn: she has seen in Hianaloli ahupuaa, 25 kihapai [*kīhāpai* (agricultural lots)] partially cultivated and no house. Two kihapai are not cultivated in Hianaloli 5 ahupuaa. The boundaries are not known to Makaole but the surveyor will establish the correct boundaries. The interest had been from Papakai at the time at the Mokuaikaua Lai [Moku`aikaua La`i] Chapel had been built. Land from Makaole at this time, no one has objected. Inoaole sworn: we both have known in the same way[66].

LCA 10698 to Pupuka
Kuae (Konohiki) sworn he has seen in Hianaloli 5 ahupuaa: Section 1 – mauka, Kamahiwahine's land, Kau, Hianaloli 6 ahupuaa; makai and Kohala, Kuae's land. 6 partially cultivated kihapai patches, and 1 house for Pupuka, no fence. Section 2 – mauka, Kiooaiopua's land; Kau, Hianaloli 6 ahupuaa; makai, Kiooaiopua's land; Kohala, Kuae's land. 7 cultivated kihapai patches. Section 3 – mauka, Kamahiwahine's land; Kau, Hianaloli 6 ahupuaa; makai, Keiooaipua's land; Kohala, Kuae's land. 3 partially cultivated kihapai. Section 4 – mauka, Kiooaiopua's land; Kau, Hianaloli 6 ahupuaa; makai, Kiooaipua's land; Kohala, Kuae's land. 1 uncultivated kihapai. Section 5 – mauka, idle land; Kau, Hianaloli 6 ahupuaa; makai, Konohiki; Kohala, Hianaloli 4 ahupuaa. 1 cultivated kihapai patch. Section 6 – mauka, Kamahiwahine's land; Kau, Kuae's land; makai, Kamahiwahine's land; Kohala, Hianaloli 4 ahupuaa. 4 kihapai patches, land from Kuae in 1826. No one has objected to him to the present day[67].

LCA 3278 to Waikele
Napela (*wahine*) sworn she has seen in Hianaloli ahupuaa, a house lot. All Konohiki boundaries, 1 enclosed house lot for Waikele. Land from Lapalaau by a sale in cloth costing $3.00 in 1844, no one has objected. Keliimaikai sworn, both have known in the same way[68].

[65] Native Testimony v4:519
[66] Native Testimony v5:556
[67] Native Testimony v5:559
[68] Native Testimony v5:561

Government land sales for Hienaloli between 1852 and 1853 are recorded for only Hienaloli 3 and 6[69]. When the Provisional Government and the Republic of Hawaii were in control of Crown Lands which were now considered Government Lands, 192.16 acres were sold in Hienaloli 6[70].

The Land File at the State Archives provides correspondence and other documents relating to holdings in Hienaloli. One can recognize awardees mentioned previously:

Hienaloli 1 - Interior Department 1855 June 25
Application by Isaaka to the Minister (Lot Kamehameha) for the above *ahupua`a* and offering 50¢ per acre.

Hienaloli 1 – Interior Department 1894 December 10
George McDougall to Minister offering $250 for the above *ahupua`a*

Hienaloli 1 – Executive Office 1911 January 19
Commissioner of Public Lands to Governor Frear submitting land patent #5451 in name of Charles Maineckeon for makai portion for his proposal.

Hianaloli – Interior Department Document 365
Showing 2 acres in North Kona had been leased by the Minister of the Interior.

Hianaloli – Interior Department 1863 January 1
In report to S.C. Wiltse that part of the above ili was sold to…

Hianaloli – Interior Department 1853 July 9
Awarded to the American Board of Commissioners for Foreign Missions

Hienaloli – Privy Council Vol. 3:99
Land set off to Peke as heir of John Young[71].

Hienaloli – Public Instruction 1852 February 11
Wahineiki to Minister of Public Instruction. Desires to secure 300 acres of land in settlement of debt due to him.

Hienaloli – Interior Department Book 6:12, 1852 August 5
Letter to Minister from J. Fuller informing him Keelikolani [Ruth Ke`elikōlani] and Peke own each one Hienaloli, the mission [ABCFM] one, Thomas Hopu one.

Hienaloli 1 & 2 – Interior Department 1850 November 25
Letter from Governor Kapeau to Minister of Interior John Young. To reserve the above lands for the use of the government.

Hienaloli 1 & 2 – Privy Council Vol. 6:220
Regarding resolution reserve the above land for educational purposes.

[69] Kelly 1983:43
[70] Kelly 1983:44
[71] Although Peke was a child of Isaac Davis, after Davis' early death, John Young assumed guardianship for his children.

According to Kona historian Jean Greenwell the numerous grants in the *ma uka* section of Hienaloli indicate as good agricultural land[72]. This corroborates references cited in this report of land use patterns cited during the 19th and early 20th centuries.

The above examination of the history of residency and land ownership in Hienaloli indicates that Hienaloli land was used principally for agriculture. The texts refer to "food plots" and "cultivated patches." There is, however, no specific mention of the gathering or cultivation of any plants or other materials in any particular locale, or any other information that would be relevant to the current project area's cultural impact assessment.

SELECTED DOCUMENTATION OF THE ARCHAEOLOGY OF HIENALOLI

Archaeological surveys of Hienaloli 1st have been infrequent. On January 17, 1978 Soehren surveyed TMK 3-7-5-08:12, 22 within Hienaloli 1st. He identified artifacts (small waterworn coral and stone pebbles along with shellfish remains indicative of pre-contact habitation sites). Of note was a *hoana* a portable grindstone found in parcel 22. Helen Aiu pointed out a burial cave on the adjoining Catholic church property, the entrance to which had been closed and marked with a large wooden cross. According to Helen, the stone wall fronting the property on Ali`i Drive was constructed by her maternal grandfather, Samuel Benjamin Ka`omea. Ms. Aiu also recalled that sweet potatoes were formerly grown on much of parcel 22 and Soehren postulates the parcel was subject to periodic flooding by Keopu stream prior the construction of the present concrete channel, making it an ideal pre-contact garden site[73].

Another Soehren survey included both Hienaloli 1 and Honuaula (TMK 3-7-4-04:2), a portion of LCA 387 covered by Royal Patents 1600 and 1930. As the parcel had been recently bulldozed there were no features, but based on the presence of coral pieces, seashell and waterworn rocks, Soehren postulated the area formerly held habitation sites[74].

In 1980 Soehren conducted a survey of TMK 3-7-5-04:2. The area contained the *ma uka* portion of the Laniakea lava tube. Outside of the possible cultural uses of the lava tube and the cave itself, Soehren reported no other archaeological features[75].

In 1996 Halpern and Rosendahl conducted a survey of a road corridor (TMK 7-5-13:13,22), which includes the current project area. Six sites were identified within or near the corridor. The sites included three rock walls, a terrace, a terrace and wall complex, and a platform/wall feature. Three sites were historic and three were prehistoric and belonging to the Kona Field System. All sites were assessed as having moderate research value and further inventory-level recording was recommended.

[72] Pers. Comm. 12/4/89
[73] Soehren 1978:1-2
[74] Soehren 1979:1-2
[75] Soehren 1980:1-2

INFORMANT INTERVIEWS

Despite considerable effort expended, informant information on Hienaloli was scarce. Of the informants contacted, only Clarence Medeiros, Jr. could provide any clear information, and the information was not concerning any cultural practice in the vicinity. Two other informants, Mahealani Pai and Ulalia Berman, provided information not about Hienaloli specifically, but the general vicinity.

Clarence A. Medeiros, Jr. is a descendant of several well-known *kama`āina* families of the Kona region. The son of Clarence A. Medeiros, Sr. and Pansy Wiwoole Hua Medeiros, his grandparents include Frank C. Medeiros and Violet Mokuohai Parker and Charles Hua, Sr. and Annie Man Sing Zen Hua Weeks. He has familial ties to the lands of Honokua, South Kona and Haleki`i and Kanaueue, North Kona. Both of his parents were native speakers, his mother an accomplished weaver is a descendent of native fishermen and canoe builders; his father descended from two renowned canoe builders, John Mokuohai and Charlie Mokuohai Parker. Clarence Sr. repaired rock walls in Kona and Kohala including the walls of National Parks of Pu`uhonua o Hōnaunau and Pu`ukoholā. Clarence Sr. was recognized as a cultural and historical resource and it was from him and Earl Leslie, Sr. Clarence Jr. learned much of his knowledge of cultural practices and history. Clarence Jr.'s only comment regarding the lands of Heinaloli was his mother's family, the Kawaha `ōhana resided there some seven or eight generations ago. He postulates they cultivated coffee on the lands there.

Clarence, Jr. continues to harvest *maiapilo* or *pilo* (*Capparis sandwichiana)* within Keahuolū for the plant's medicinal properties. During an interview on December 17, 2007 he stated the *pilo* grew readily on the area currently being cleared by Queen Lili`ūokalani Trust, near the Queen Ka`ahumanu Highway. According to Clarence, *pilo* does grow *ma uka* of the highway and up to the 300' elevation, but at these elevations it is mixed in with other shrubs and harder to procure. Clarence, Jr. also referred to the sisal plants in Keahuolū used to make rope. Provided with maps of the project areas, Clarence voiced his concern that the environment will be compromised and the *pilo* will be endangered.

Mahealani Pai

Mahealani Pai, Cultural Specialist for Kamehameha Investment Corporation [Bishop Holding Corporation], is a descendent of an *'ohana* who traces their residence in the Kona district to the 1700s, specifically to Honokōhau-Kaloko. He is widely recognized as a cultural practitioner and authority representing the Royal Order of Kamehameha at many public hearings. He is also a contributor to published works, e.g., *Islands in Captivity: The International Tribunal on the Rights of Indigenous Hawaiians* and *All Our Relations: Native Struggles for Land and Life*[76]; and is tireless advocate for the preservation of Hawaiian sites and practices.

Mahealani's *`ohana* resided near the shoreline of Keahuolū during the 1930s, moving there from Honokōhau. They fished Keahuolū waters for *`ōpelu* and *aku*, selling their catch to George Kailiwai *mā*. Mahealani's young father found temporary employment at the sisal mill *ma uka* of the present Queen Ka`ahumanu Highway. Mahealani's grandfather utilized sisal for the making of *kaula* (rope), and he dyed the rope, and used it to secure and hang fishing implements.

[76] Churchill, W. et al. 2005; Laduke, W, 1999

Mr. Pai noted that *alahe`e* (*Canthium odoratum*) which was used for the batten of traditional thatched structures, was gathered in the *ma uka* lands of Keahuolū. Mahealani's concern for the present project is that cultural resources like *kauila* (*Alphitonia ponderosa* ), *uhiuhi* (*Mezoneuron kauaiense*), and *alahe`e* (*Canthium odoratum*) be preserved.

Mr. Pai was able to provide information on several places and geographical features in Keahuolū. Mahealani noted a trail his mother would utilize as recently as the 1950s. Starting in Kailua between the current Taco Bell and a car rental agency office, the trail went through Keahuolū onto Kealakehe and Honokōhau. When the seas were *mālie* (calm) they would take the canoe to reach Honokōhau, but when the seas were rough, they would take this trail. The home of Kaelemakule was located at the Kailua end of this trail.

Pai said that Makaeo is the place name for the stretch of area formerly known as the Kailua Kona Airport, where cattle were held before being shipped out on the steamer *Humu`ula*. Makaeo was identifiable by a large coconut grove.

A landmark known as *Pohakūloa* is located south of patches of sand beaches owned by Queen Lili`uokalani Trust, stands as a lone sentinel for locating a nearby *`ōpelu ko`a*. The *'ōpelu ko`a* is known as *Halepao'o*, for the jumping fish *`o`opu* (general name for fishes included in the families Eleotridae, Gobiidae, and Blennidae).

Mr. Pai also noted that Kalualapauila Heiua is located on the northern *ma uka* boundary of the Kealakehe and Honokohauiki, in the vicinity of La'iopua near the Kealakehe Homestead [this would place the *heiau* outside the current project area]. If this *heiau* can be identified, he notes, it too should be preserved.

Ulalia Ka`ai-Berman

Ulalia Ka`ai-Berman is a *kupuna* with the Department of Education's Kūpuna Hawaiian Studies Program. A child of Ernest Kakihoku Ka`ai and Josephine Ulalia `Ikuwā Ka`ai, her family has over 70 years of residential ties with North Kona. Learned of the *mo`olelo* of Keahuolū from A`ala Roy Akoa between 1970-1981, she is knowledgeable regarding the fishing and farming traditions of the area. During conversations with Ms. Berman she noted the cultural practice of gathering grasses for thatching and the building a hālau at Pāwai in Keahuolū.

CULTURAL IMPACTS

The cultural impacts to any locale in Hawai`i are not always readily evident. What is assessed by Western eyes as "barren land" may be a rich resource to Hawaiians for harvesting material i.e. *pili* grass; spiritual aspects, i.e. the wind; or for the trails on which to travel. Cultural activities within Hienaloli indicate agricultural and residential usage in pre-contact times. The location of the well site within Hieanaloli is not in the vicinity of the Laniakea Lava Tube.

Based on previous and the current research, adaptations similar to those have been observed further north in North Kona, are likely to have occurred in Hienaloli. Permanent populations appear to have been present along the coast, the midlands were used for temporary habitation and were crossed by trails linking the coast to the uplands, and the uplands were used for agricultural cultivation.

SUMMARY AND RECOMMENDATIONS

The review of the information presented in this cultural impact assessment – historical documentation, archaeological surveys and research, and oral reminiscences – indicates development of the parcel will have little effect on Hawaiian cultural resources, beliefs and practices. It should be noted, however, that remnants of Hawaiian practices, be it agricultural, temporary habitation sites, or additional burials, may reveal themselves during development, as they have been identified in other areas of North Kona. In the event such resources are encountered during land-altering activities associated with construction, work in the immediate area of the discovery should be halted and DLNR-SHPD contacted, as outlined in the Hawaii Administrative Rules 13§13-280.

REFERENCES CITED

Archaeological Research Center Hawaii. Archaeological Reconnaissance of Liliuokalani Trust Lands, Keahuolu, Kona, Hawaii Island. Lawai, Kauai, Hawaii: The Center, 1986.

Archaeological Research Center Hawaii. Portion of Report. Archaeological Research Center Hawaii, 1978.

Bailey, Paul. Those Kings and Queens of Old Hawaii : A Mele to their Memory. Los Angeles: Westernlore Books, 1975.

Baker, Albert S. "Between the Bays in Kona." Thrum's Hawaiian Annual for the Year 1916 (1915): 86.

Beckwith, Martha Warren. Hawaiian Mythology. Honolulu: University of Hawaii Press, 1976. <http://ulukau.org/elib/cgi-bin/library?c=beckwit1&l=en>.

Belt, Collins and Associates, and Liliuokalani Trust. Keahuolu Lands of Kailua-Kona : Draft Environmental Impact Statement. Honolulu: The Trust, 1990.

---. Keahuolu Lands of Kailua-Kona : Final Environmental Impact Statement. Honolulu: The Trust, 1990.

Chinen, Jon J. The Great Mahele : Hawaii's Land Division of 1848. Honolulu: University of Hawaii Press, 1958.

---. Original Land Titles in Hawaii. Honolulu?, 1961.

Clark, Jeffrey T., et al. Archaeological Investigations of the Mudlane-Waimea-Kawaihae Road Corridor, Island of Hawai□i : An Interdisciplinary Study of an Environmental Transect. Vol. 83-1. Honolulu, Hawaii: Dept. of Anthropology, Bernice P. Bishop Museum, 1983.

Clark, John R. K. Beaches of the Big Island. Honolulu: University of Hawaii Press, 1985.

---. Hawai'i Place Names : Shores, Beaches, and Surf Sites. Honolulu, Hawaii: University of Hawai'i Press, 2002.

Corbin, Alan B. Phased Archaeological Mitigation Program Phase II: Archaeological Data Recovery Block C, Queen Liliuokalani Trust Property, Land of Keahuolu, North Kona District, Island of Hawai`i (TMK:3-7-04-08:Por.2, 12). Vol. 1483-060101. Hilo: PHRI, 2001.

Corbin, A.B., and H. W. Smith. Archaeological Survey and Cultural Impact Assessment in Support of an EIS for the Kona Non-Ceded Lands, Land of Keahuolu, North Kona District, Island of Hawai'i, TMK:3-7-4-21:020,Por.014,Por. 021). PHRI Report 2667-101907. Hilo: PHRI, 2007.

DLNR (Department of Land and Natural Resources, State of Hawai`i). Chapter 275: *Rules Governing Procedures for Historic Preservation Review for Governmental Projects Covered Under Sections 6E-7 and 6E-8, HRS.* Hawaii Administrative Rules; Title 13, Department of Land and Natural Resources; Subtitle 13, State Historic Preservation Division Rules. Honolulu: DLNR 2002.

DLNR (Department of Land and Natural Resources, State of Hawai`i). Chapter 284: *Rules Governing Procedures for Historic Preservation Review to Comment on Chapter 6E-42, HRS, Projects.* Hawaii Administrative Rules; Title 13, Department of Land and Natural Resources; Subtitle 13, State Historic Preservation Division Rules. Honolulu: DLNR, 2003

de Freycinet,Louis Claude Desaulses. Hawai'i in 1819 : A Narrative Account /. Honolulu: Dept. of Anthropology, Bernice Pauahi Bishop Museum, 1978.

Donham, Theresa. Archaeological Inventory Survey Queen Liliuokalani Trust Property, Land of Keahuolu, North Kona District, Island of Hawaii (TMK:3-7-4-8-:Por.2, 12). Hilo: PHRI, 1990.

Ellis, William. Journal of William Ellis : Narrative of a Tour of Hawaii, Or Owhyhee : With Remarks on the History, Traditions, Manners, Customs and Language of the Inhabitants of the Sandwich Islands. Honolulu: Advertiser Publishing Co., 1963.

Emory, K. P. Inventory of Archaeological and Historical Sites in the Districts of Kona and Ka`u and in Anaehoomali, South Kohala, Island of Hawaii. Departmental Report Series 70-12 ed. Vol. 61-1. Honolulu: Department of Anthropology, B.P. Bisho Museum, 1970.

Estioko-Griffin, A., and G. W. Lovelace. Archaeological Reconnaissance of Old Kona Airport State Park, Kailua-Kona, Island of Hawaii (TMK 7-5-05:7). Historic Sites Section, DLNR, 1980.

Folk, W. H. Archaeological Survey and Selective Subsurface Testing of Liliuokalani Trust Lands, Keauholu, Kona, Hawaii Island. Vol. 14-139 II. Honolulu: Archaeological Research Center Hawaii., 1980.

Fornander, Abraham, and Jean Charlot. Selections from Fornander's Hawaiian Antiquities and Folk-Lore. Honolulu: University of Hawaii Press, 1959.

Fornander, Abraham. Fornander Collection of Hawaiian Antiquities and Folk-Lore ... Gathered from Original Sources. Vol. 4. Honolulu: H.I., Bishop Museum Press, 1916.

---. Fornander Collection of Hawaiian Antiquities and Folk-Lore ... Gathered from Original Sources. Vol. 4. Honolulu: H.I., Bishop Museum Press, 1916.

Freycinet, L. de. "Hawaii in 1819: A Narrative Account by Louis Claude De Saulses Freycinet." Pacific Anthropological Records 26 (1978).

Fuke, Sidney, and Virginia Goldstein. Archaeological Site no. 10-27-2000 Reconnaissance Survey, Lanihau, North Kona, Island of Hawaii, TMK:7-5-05:14 through 47. County of Hawaii Planning Department. Hilo:, 1978.

Halpern, M., and P.H. Rosendahl. Archaeological Reconnaissance Survey, Keopuolani Estates Access Road. Land of Hienaloli 1, North Kona District, Island of Hawai'i (TMK:7-5-13:13 and 22). PHRI Report 1712-040396. 1996.

Handy, E. S. Craighill, Elizabeth Green Handy, and Mary Kawena Pukui. Native Planters in Old Hawaii: Their Life, Lore, and Environment. Vol. 233. Honolulu: Bishop Museum Press, 1972.

Handy, E. S. Craighill. Native Planters in Old Hawaii: Their Life, Lore, and Environment. Honolulu: Bishop Museum Press, 1972.

Haun, Alan E. and Henry, Dave S. Archaeological Assessment TMK: (3) 7-4-015:15, Land of Keahuolu, North Kona District, Island of Hawai`i. Vol. 514-032307. Kea`au, Hawai`i: Haun & Associates, March 2007.

---. Archaeological Inventory Survey TMK: (3) 7-4-015:014, Land of Keahuolu, North Kona District, Island of Hawai`i. Vol. 514-040307. Kea`au: Haun & Associates, May 2007.

Hawaiian Almanac and Annual for .. Honolulu: Black & Auld Printers, 1875.

Head, James, and Paul Rosendahl. Archaeological Mitigation Program Queen Lili`uokalani Trust Property: Phase II - Data Recovery Amendment no. 1. May ed. Vol. 1466042695. Hilo: PHRI, 1995.

Helber, Hastert & Fee (Firm), and Hawaii. State Land Use Commission. Environmental Assessment: Urban Expansion State Lands : Keahole to Kailua Region, North Kona, Hawaii. Honolulu: The Firm, 1992.

Hommon, Robert J., C. M. Poulton Corp, and Hawaii Marine Research, Inc. An Assessment of the Archaeological and Historic Resources of Kaumalumalu Makai, North Kona, Hawaii. Honolulu: Hawaii Marine Research, Inc., 1980.

Ii, John Papa, ed. Fragments of Hawaiian History, as Recorded.Honolulu Bishop Museum Press, 1959.

Jarves, James Jackson. History of the Hawaiian Or Sandwich Islands, Embracing their Antiquities, Mythology, Legends, Discovery. 2d ed. Boston: J. Munroe and co, 1844.

Jensen, Peter, and Theresa K. Donham, Paul H. Rosendahl. Archaeological Mitigation Program Queen Liliuokalani Trust Property: Phase I: Mitigation Plan for Data Recovery, Interim Site Preservation, and Monitoring. March ed. Vol. 1152-012192. Hilo: PHRI, 1992.

Ka mo'olelo o Lā'ieikawai. 1st ed. Honolulu, Hawai'i: First People's Productions, 1997.

Kamakau, Samuel Manaiakalani. Ruling Chiefs of Hawaii. Honolulu: Kamehameha Schools Press, 1961.

Kame'eleihiwa, Lilikalā. Native Land and Foreign Desires : How Shall we Live in Harmony?. Honolulu, HI: Bishop Museum Press, 1992.

Kanahele, Pualani Kanaka`ole. Cultural Impact Assessment [for] Kealakehe Commercial/Industrial Park, North Kona, Island of Hawai`i for Department of Hawaiian Homes Land. Hilo:, 2001.

Kelly, M. Changes in Land Tenure in Hawaii, 1778-1850. Vol. [no. 346]. Honolulu:, 1956.

---. Kekaha: 'aina malo'o; a Survey of the Background and History of Kaloko and Kukio, North Kona, Hawaii. Rev. ed. Honolulu: Dept. of Anthropology, Bernice P. Bishop Museum, 1971.

---. Kekaha: 'Aina Malo'o; a Survey of the Background and History of Kaloko and Kukio, North Kona, Hawaii. Rev. ed. Vol. 71-2 [1971]. Honolulu: Dept. of Anthropology, Bernice P. Bishop Museum, 1971.

---. Nā māla o Kona. Honolulu, Hawai'i : Published by the Dept. of Transportation, State of Hawaii, in cooperation with the Federal Highway Administration: U.S. Dept. of Transportation, and the Dept. of Land and Natural Resources, State of Hawaii ; Dept. of Anthropology, Bernice Pauahi Bishop Museum, 1983.

---. Nā māla o Kona. Honolulu, Hawai'i : Published by the Dept. of Transportation, State of Hawaii, in cooperation with the Federal Highway Administration: U.S. Dept. of Transportation, and the Dept. of Land and Natural Resources, State of Hawaii ; Dept. of Anthropology, Bernice Pauahi Bishop Museum, 1983.

Kinney, Henry Walsworth. The Island of Hawaii. San Francisco: Cal., Hicks, Judd co., 1913.

Maly, Kepā, and Paul H. Rosendahl, Ph.D., Inc. Ka'ao ho'oniua pu'uwai no Ka-Miki = the Heart Stirring Story of Ka-Miki. S.l.:, 1992.

Maly, Kepā. Appendix A: Historical Documentary Research IN Archaeological Inventory Survey, Hienaloli 3-4 Mauka Parcel, Lands of Heinaloli 3 and 4, North Kona District, Island of Hawaii (TMK:7-5-11:2). Vol. PHRI Report 1348-032996. Hilo: Paul H. Rosendahl, Inc., 1996.

Neller, Earl, Hawaii. Division of State Parks, Outdoor Recreation, and Historic Sites. Historic Sites Section, and Hawaii. Historic Sites Section. An Archaeological Reconnaissance at the Old Kona Airport Beach Park, Keahuolu and Lanihau, Kona, Hawaii. Revis ed. Honolulu: Historic Sites Section, Division of State Parks, Department of Land & Natural Resources, 1980.

Newman, T. Stell. Archaeological Inspection of the Old Kona Airport., 1970.

OEQC (Office of Environmental Quality Control, State of Hawai'i). *Guidelines for Assessing Cultural Impacts*. Adopted by the Environmental Council; November 19, 1997.

O'Hare, C. R., and Paul H. Rosendahl. Archaeological Inventory Survey, Queen Liliuokalani Trust 100-Acre KIS Expansion Site, Land of Keahuolu, North Kona District, Island of Hawaii (TMK:3-7-4-08:Por2). Vol. 1311-011193. Hilo: PHRI, 1993.

Parker, P.L., and T.F. King. Guidelines for Evaluating and Documenting Traditional Cultural Properties. National Register Bulletin No. 38. Washington, D.C.: U.S. Dept. Interior, National Park Service. 1990

Pukui, Mary Kawena. Hawaiian-English Dictionary /. 3rd ed. Honolulu: University of Hawaii Press, 1965.

---. Place Names of Hawaii. Rev. and enl. ed. Honolulu: University Press of Hawaii, 1974.

Reinecke, John E. Survey of West Hawaiian Sites: From Kailua, Kona, to Kalahuipuaa, Kohala. Honolulu: Manuscript. Department of Anthropology, B.P. Bishop Museum, 1930.

Rosendahl, Paul H., Palani Development Company, and Liliuokalani Trust. Report on a Walk-through Archaeological Survey of the Queen Liliuokalani Village, Unit 3 Tract, Keahuolu, North Kona, Hawaii : Preliminary Draft. Liliuokalani Village, Unit 3, Keahuolu, North Kona. Honolulu: Dept. of Anthropology, B. P. Bishop Museum, 1972.

Schilt, Rose. Subsistence and Conflict in Kona, Hawai'i : An Archaeological Study of the Kuakini Highway Realignment Corridor. Honolulu, Hawai'i : Published by the Dept. of Transportation, State of Hawaii, in cooperation with the Federal Highway Administration: U.S. Dept. of Transportation, and the Dept. of Land and Natural Resources, State of Hawaii ; Dept. of Anthropology, Bernice Pauahi Bishop Museum, 1984.

Schmitt, Robert C. Demographic Statistics of Hawaii: 1778-1965. Honolulu: U of Hawaii Press, 1968.

Sebastian, L. Protecting Traditional Cultural Properties through the Section 106 Process. *CRM* Vol. 16 (Special Issue): 22-26. 1993.

Sinoto, Aki, Bernice Pauahi Bishop Museum. Dept. of Anthropology, and Belt, Collins and Associates. Archaeological Reconnaissance Survey of Proposed Access-Road Corridor at Keahuolu, Island of Hawaii. Honolulu: Dept. of Anthropology, Bernice P. Bishop Museum, 1975.

Soehren, Lloyd J., Kilo Aina, and Affordable Homes of Hawaii. Archaeological and Historical Features on the Parcel Identified by Tax Map Key 7-4-08:Por. 1, Situated at Keahuolu, North Kona, Hawaii. Captain Cook, Hawaii: Kilo °Aina, 1983.

Soehren, Lloyd J. Archaeological and Historical Features on that Portion of TMK 7-5-04:2 Identified as "Lot A" Containing 3.825 Acres, Situated at Honuaula and Hienaloli 1, North Kona, Hawaii. Captain Cook, Hawaii:, 1979.

---. Archaeological and Historical Features on that Portion of TMK 7-5-04:2 Identified as "Lot A" Containing 3.825 Acres, Situated at Honuaula and Hienaloli 1, North Kona, Hawaii. Captain Cook, Hawaii:, 1979.

---. Archaeological and Historical Features on the Parcel Identified. Captain Cook, Hawaii: Kilo 'Aina, 1983.

---. Archaeological and Historical Features on the Undeveloped Portion of the Parcel Identified., 1979.

---. Archaeological Features and Materials in the Mauka Portion of the Laniakea Lava Tube, Situated in Hienaloli 1, North Kona, TMK 7-5-04:2., 1980.

---. Archaeological Features and Materials in the Mauka Portion of the Laniakea Lava Tube, Situated in Hienaloli 1, North Kona, TMK 7-5-04:2., 1980.

---. An Archaeological Reconnaissance Survey of Portions of Keahuolu and Lanihau 1st, North Kona, Hawaii. Captain Cook, Hawaii: S.N., 1976.

---. Archaeological Survey of Property at Hienaloli, North Kona, TMK 7-5-08:12 and 22., 1978.

Stokes, John F. G., and Tom Dye. Heiau of the Island of Hawaii : A Historic Survey of Native Hawaiian Temple Sites. Vol. 2. Honolulu: Bishop Museum Press, 1991.

Tango, Taupouri, Ku`ulei Higashi Kanahele, and William Mahealani Pai. Kona Kai Ola Project: Kealakehe and Keahuolu Ahupua`a: Cultural Impact Assessment., 2006.

Wilkes, Charles. "Map of the Island of Hawaii, Sandwich Islands Shewing the Craters and Eruption of may and June 1840 [Electronic Resource] by the U.S. Ex. Ex., 1841 ; Sherman & Smith Sc., N.Y." .

Wong Smith, Helen. Appendix B: Limited Historical Documentary Resarch Land of Hienaloli 6th, Island of Hawaii. Vol. PHRI 696-050390. Hilo: Paul H. Rosendahl, Inc.

Wulzen, Warren, Thomas R. Wolforth, and Leta J. Franklin. Archaeological Inventory Survey Proposed Henry Street Extension Road Corridor, Lands of Keahuolu and Lanihau, North Kona District, Island of Hawai`i (TMK: 3-7-4-08:Por.1; 3-7-5-03:Por.21). Vol. 1465-092696. Hilo, Hawai`i: Paul H. Rosendahl, Ph.D, Inc., September 1996.

APPENDIX A:

THE PRESENT STUDY SCOPE AND METHODOLOGY IN RELATION TO CULTURAL IMPACT ASSESSMENT ISSUES AND THE OEQC GUIDELINES

CULTURAL IMPACT ASSESSMENT AND OEQC GUIDELINES

To understand the cultural impact assessment issue, particularly as it is addressed by the present study, a summary review of the intent and evolution of the OEQC guidelines is necessary. The guidelines evolved out of what are commonly referred to as "PASH/Kohanaiki" issues – issues relating to native Hawaiian traditional and customary access and land use rights as they were reasserted by a State Supreme Court decision in August 1995 and further clarified in its 1998 decision in State v. Hanapi – and the need for appropriate means to address these issues within the State environmental impact review process. For a good discussion of the issues and options involved, the "Report on Native Hawaiian Traditional and Customary Practices Following the Opinion of the Supreme Court of the State of Hawai'i in Public Access Shoreline Hawai'i v. Hawai'i County Planning Commission" prepared by the PASH/Kohanaiki Study Group (1998) should be consulted.

Initial attempts to address various issues relating to native Hawaiian traditional and customary access and land use rights within the framework of the State environmental impact review process were made in the form of proposed changes to the State EIS law as contained in Chapter 343 (HRS). These attempts to require a formal cultural impact assessment failed to pass the State legislature in 1996 and 1997.

A subsequent, second attempt to address various issues relating to native Hawaiian traditional and customary access and land use rights was made in the form of proposed changes in the "Administrative Rules" for compliance with Chapter 343 (DOH Title 11, Chapter 200). This attempt to require an explicitly defined cultural impact assessment also failed, as the governor declined to approve the proposed amendments.

The third attempt to address various issues relating to native Hawaiian traditional and customary access and land use rights within the State environmental impact review process resulted in the current OEQC "Guidelines for Assessing Cultural Impacts" (OEQC 1997b). Draft guidelines were initially issued for public review and comment on September 8, 1997. The Environmental Council formally adopted the guidelines in their final form on November 19, 1997.

The relationship of the OEQC guidelines to the State Supreme Court "PASH decision" was clearly stated on the front page of the September 8, 1997 issue of the OEQC bulletin, *"The Environmental Notice,"* when the draft guidelines were first issued for public review and comment:

> For years, a controversy has simmered over developer's responsibility to perform a "Cultural Impact Study" prior to building a project. The recent Supreme Court "PASH" decision reaffirmed the state's duty to protect the gathering rights of native Hawaiians. In light of these events, the Environmental Council has drafted a guidance document to provide clarity on when and how to assess a project's impacts on the cultural practices of host communities.

It should be noted that the guidelines for cultural impact assessment are meant to include consideration of all the different groups comprising the multi-ethnic community of Hawai'i; however, this inclusiveness is generally understated, and the clear emphasis is meant to be upon aspects of native Hawaiian culture.

More than 20 letters were received by OEQC in response to the publication of the draft guidelines, and relevant comments were said to have been incorporated into a final version of the guidelines (OEQC n.d.). The Environmental Council formally adopted the final guidelines (OEQC 1997b) on November 19, 1997. The final guidelines are virtually identical to the draft guidelines initially published on September 8, 1997, and the degree to which any of the received comments on the draft guidelines were considered prior to issuance of the final guidelines is uncertain. In fact, the overall process through which the guidelines were prepared and adopted brings out several important questions relating to such topics as (a) the source or basis utilized for the content of the guidelines, (b) the background and qualifications of the preparer(s) of the guidelines, (c) the criteria to be used for the adequacy of cultural impact assessment studies prepared in response to the guidelines, and (d) the legal question of how compliance can be required when the standards are guidelines.

According to the Chair's Report contained in *The 1997 Annual Report of the Environmental Council*, the Cultural Impacts Committee drafted the guidelines:

> The Committee drafted guidelines recommending a methodology to assess the impact of proposed actions on cultural resources, including Native Hawaiian cultural resources, values, and beliefs. The guidelines also specify the contents of a cultural impact assessment.
>
> To prepare the Guidelines, the Committee reviewed public testimony and solicited input from interested parties. Expertise from the DLNR's Historic Preservation Division as well as Federal regulations governing the "Protection of Historic Properties" were used to model the draft guidelines.
>
> The draft cultural impact guidelines were published for review and comment in the Sept. 8 *Environmental Notice*, and over 20 letters were received. Relevant comments were incorporated into a final draft version of the guidelines, which were adopted as a policy document by the Environmental Council on November 19, 1997 (OEQC n.d.:5).

Direct inquiries to OEQC (Gary Gill, then-Director) and SHPD (Dr. Holly McEldowney, then-Staff Specialist in the History and Culture Branch) provided additional background information relating to the formulation of the cultural impact assessment guidelines. The principal author or compiler of the guidelines was Arnold Lum, Esq., a member of the Environmental Council's Cultural Impacts Committee. Mr. Lum was also a staff attorney at the Native Hawaiian Legal Corporation. OEQC staff also assisted in the preparation of the guidelines. Several internal drafts were prepared, reviewed, and revised. Preparation of the guidelines relied to some degree upon National Register Bulletin No. 38, *Guidelines for Evaluating and Documenting Traditional Cultural Properties* (Parker and King 1990) for basic content information. Other sources, including the SHPD draft rules for conducting ethnographic surveys and dealing with traditional cultural properties (DLNR n.d.), were consulted; in fact, a copy of the SHPD draft rules was provided to OEQC and the Cultural Impacts Committee by then-SHPD Administrator, Dr. Don Hibbard. Professional staff in the SHPD-History and Culture Branch took part in the preparation and review of the guidelines. Certainly the inclusion of such professional anthropological and historical expertise in the preparation of the guidelines was appropriate; however, much of the professional advice on the extent to which detailed expectations – regarding study scope, content, methodology, documentation, and impact assessment – should be explicitly addressed in the guidelines was apparently discounted.

The most recent attempt to address various issues relating to native Hawaiian traditional and customary access and land use rights within the State environmental impact review process resulted in the amendment to *Chapter 343 (Haw.Rev.Stat.)*, as amended by H.B. No.2895, H.D.1 of the Hawai'i State Legislature (2000) and approved by the Governor as *Act 50* on April 26, 2000. While no specific administrative rules for the implementation of this amendment have been adopted, it is generally accepted that the *Guidelines* previously prepared and adopted by the State Office of Environmental Quality Control (OEQC 1997) are meant to provide general compliance guidance.

The OEQC *Guidelines* consist of three basic sections. The first section is an introduction which notes the various statutory and other bases for addressing potential impacts upon cultural resources within the context of the environmental assessment review process, and "...encourages preparers of environmental assessments and environmental impact statements to analyze the impact of a proposed action on cultural practices and features associated with the project area" (OEQC 1997:1). The second section of the guidelines discusses methodological considerations for conducting cultural impact assessments, and presents a recommended six-step protocol to be followed by the assessment preparers. The third section of the guidelines outlines eleven topics or "matters" that a cultural assessment should address; these topics basically represent the desired content and organization of a cultural impact assessment report.

As "guidelines," the OEQC Guidelines would seem to have neither the specific statutory authority of law, nor the regulatory authority of administrative rules. As guidelines, they can be regarded as providing general guidance; that is, they represent general suggestions and recommendations as to how to approach the assessment of potential cultural impacts. The guidelines provide little or no guidance relative to many important questions, perhaps the most significant of which would be the following:

1. How would project-specific determinations be made as to whether or not a cultural impact assessment study might even be necessary or appropriate – given the specific nature and location of a proposed project;

2. If a cultural impact assessment study is to be conducted, how does one determine what constitutes an appropriate project-specific level of effort – that is, the general scope of work or objectives for the study, and the specific tasks or activities required to accomplish successfully the scope of work or objectives;

3. What criteria are to be used for determining the credibility and reliability of potential cultural information sources (generally referred to as "informants" or "knowledgeable individuals");

4. If specific cultural practices, beliefs, or features are definitely identified as being associated with a project area, what criteria are to be applied for evaluating (a) the descriptive adequacy and (b) the cultural authenticity of the identified practices, beliefs, or features;

5. If specific culturally authentic practices, beliefs, or features are definitely identified as being associated with a project area, what criteria are to be used for assessing the nature and extent of potential impacts of a proposed project on the identified practices, beliefs, or features – that is, "no effect," "no adverse effect," or "adverse effect;"

6. If a project is determined to have potentially adverse impacts upon specific identified culturally authentic practices, beliefs, or features, what criteria are to be used for evaluating the adequacy and appropriateness of alternative potential mitigation actions;

7. Within the purview of what regulatory office or agency would the review and acceptance or rejection of a completed cultural impact assessment study legitimately fall; and

8. What standards or criteria are to be used to evaluate the overall adequacy or acceptability of a completed cultural impact assessment study?

Consideration of these questions, and their implications, has direct relevance to the present cultural impact assessment study. These implications relate most importantly to (a) the level of study effort believed appropriate for the project-specific context, and (b) the rationale adopted for both the study overall, as well as for the identification and evaluation of any identified cultural practice claims, the assessment of potential project-specific impacts, and the formulation of any specific recommendations for further study or other mitigation actions.

BASIC GUIDANCE DOCUMENTS

Several references are available to serve as basic guidance documents for carrying out cultural impact assessment studies of various scopes and intensities. The principal sources are the following:

1. The OEQC Guidelines for Assessing Cultural Impacts (OEQC 1997);

2. The Native Hawaiian Rights Handbook (MacKenzie 1991), and more specifically the discussions of traditional and customary rights contained in the two chapters on access rights (Lucas 1991a) and gathering rights (Lucas 1991b);

3. The Report on Native Hawaiian Traditional and Customary Practices Following the Opinion of the Supreme Court of the State of Hawai`i in Public Access Shoreline Hawaii v. Hawai`i County Planning Commission prepared by the PASH/Kohanaiki Study Group (1998);

4. The text of several relevant decisions of the Hawai'i Supreme Court, including the decision commonly referred to as the "PASH decision" (1995), and the more recent decisions in State of Hawai'i v. Alapa'i Hanapi (1998) and Ka Pa'akai o Ka 'Aina et al. v. Land Use Commission, State of Hawai'i et al. (2000);

5. The federal regulations of the Advisory Council on Historic Preservation for the National Register of Historic Places (CFR 1981) and the Protection of Historic Properties (CFR 1986);

6. National Register Bulletin No. 38, Guidelines for Evaluating and Documenting Traditional Cultural Properties (Parker and King 1990); and

7. Recently approved versions of the State Historic Preservation Division (SHPD) administrative rules (effective December 11, 2003), including Chapter 275: Rules Governing Procedures for Historic Preservation Review for Governmental Projects Covered Under Sections 6E-7 and 6E-8, HRS (DLNR 2002a), and

8. Chapter 284: Rules Governing Procedures for Historic Preservation Review to Comment on Chapter 6E-42, HRS, Projects (2002b), as well as an earlier draft Chapter 284--Rules Governing Procedures for Ethnographic Inventory Surveys, Treatment of Traditional Cultural Properties, and Historical Data Recovery (DLNR n.d.).

While the general nature and content of the first four referenced sources are self-explanatory, further comment should be made regarding the final three items. In the absence of any formally adopted administrative rule specifically addressing the treatment of traditional cultural properties, SHPD currently utilizes National Register Bulletin No. 38, *Guidelines for Evaluating and Documenting Traditional Cultural Properties* (Parker and King 1990), as its principal source of guidance for reviewing and evaluating the adequacy and acceptability of traditional cultural property study reports prepared in connection with various permit applications for which SHPD regulatory review is required. Bulletin No. 38 provides detailed guidance for the assessment of traditional cultural properties within the framework of the National Register significance criteria evaluation process (NPS 1990).

The SHPD draft administrative rule relating to ethnographic surveys and traditional cultural properties (DLNR n.d.) has existed in finalized draft version since at least early 1997; however, it has never been circulated openly, much less formally provided for public review, comment, and eventual adoption by the Department of Land and Natural Resources. This situation is unfortunate because the draft rule goes well beyond National Register Bulletin No. 38 in providing detailed guidance for conducting traditional cultural property studies, and more specifically for dealing with the identification, evaluation, and documentation of native Hawaiian traditional cultural properties and their associated cultural practices and beliefs.

In the absence of any formally adopted administrative rule specifically addressing the treatment of traditional cultural properties, SHPD can also be said to basically follow the federal regulations of the Advisory Council on Historic Preservation for guidance in the evaluation of significance – as contained in Section 60.4 ("Criteria for evaluation") of the "National Register of Historic Places" (CFR 1981), and for guidance in the assessment of potential effects – as contained in Section 800.9 ("Criteria of effect and adverse effect") of the "Protection of Historic Properties" (CFR 1986).

PRESENT STUDY SCOPE AND METHODOLOGY

The scope of work and methodology for the current project is based on the general assumption that the level of study effort appropriate in any project-specific context should involve the consideration of several factors, the most relevant of which are the following: (a) the probable number and significance of known or suspected cultural properties, features, practices, or beliefs within or associated with the specific project area; (b) the potential number of individuals (potential informants) with cultural knowledge of the specific project area; (c) the availability of historical and cultural information on the specific project area or immediately adjacent lands; (d) the physical size, configuration, and natural and human modification history of the specific project area; and (e) the potential effects of the project on known or expected cultural properties, features, practices, or beliefs within or related to the specific project area.

Consideration of these factors within the specific nature and context of the proposed project, it was thought that the most appropriate level of study for an adequate assessment of potential cultural impacts would be a limited assessment study. Based on the location, project size, number and quality of sites, this study assumes that (a) potential cultural impact assessment issues would be moderate, (b) the results of the archaeological survey conducted for the project would confirm both the limited number and scope of cultural resources within or related to the project area, and (c) in the instance that any legitimate cultural impact assessment issues should arise during the environmental review period, they could be addressed

adequately within the framework of the review process (i.e., from Draft to Final Environmental Impact Statement).

Consideration of these factors within the specific nature and context of the proposed project indicated that the relatively greater levels of study effort that can be characterized as identification or documentation studies would be inappropriate and excessive. The distinctive characteristics of an identification study are that it would be restricted to (a) the identification of native Hawaiian or other ethnic group cultural practices, beliefs, properties, features, or exploitable natural resources associated with and/or present within or related to the specific project area that are currently being conducted by and/or known to individual cultural practitioners or groups, and (b) the collection of information reasonably sufficient so as to define the general nature, location, and likely authenticity of identified cultural claims. An identification study would not involve the considerably greater level of study effort – both calendar months and hours of labor – needed to carry out a full documentation study. The distinctive characteristics of the latter, which would commonly be referred to as a full ethnographic or oral history study, would be (a) the collection of detailed information regarding identified native Hawaiian or other ethnic group cultural practices by means of formal oral history interviews which are usually tape recorded and transcribed, and (b) the analysis and synthesis of all collected data – from interviews, as well as relevant historical documentary and archival research – within the general cultural-historical context of traditional native Hawaiian or other ethnic group culture and the defined specific geographical area of a specific project.

The overall rationale guiding the present limited assessment study has been that the level of study effort should be commensurate with the potential of the proposed project for making any adverse impacts upon any native Hawaiian or other ethnic group cultural practices currently conducted by cultural practitioners within the project area. The study presented in this report is believed to comprise a reasonable approach for the assessment of potential cultural impacts within this specific project area.

REFERENCES CITED

CFR (US Code of Federal Regulations)

1981 36 CFR Part 60: National Register of Historic Places. (Including Part 60.4: Criteria for evaluation.)

1986 36 CFR Part 800: Protection of Historic Properties. (Including Part 800.9: Criteria of effect and adverse effect.)

DLNR (Department of Land and Natural Resources, State of Hawai`i)

2002a Chapter 275: *Rules Governing Procedures for Historic Preservation Review for Governmental Projects Covered Under Sections 6E-7 and 6E-8, HRS.* Hawaii Administrative Rules; Title 13, Department of Land and Natural Resources; Subtitle 13, State Historic Preservation Division Rules. (October) (Effective December 11, 2003)

2002b Chapter 284: *Rules Governing Procedures for Historic Preservation Review to Comment on Chapter 6E-42, HRS, Projects.* Hawaii Administrative Rules; Title 13, Department of Land and Natural Resources; Subtitle 13, State Historic Preservation Division Rules. (October) (Effective December 11, 2003) n.d. Chapter 284: *Rules Governing Procedures for Ethnographic Inventory Surveys, Treatment of Traditional Cultural Properties, and Historical Data Recovery*. Hawaii Administrative Rules; Title 13, Department of Land and Natural Resources; Subtitle 13, State Historic Preservation Division. (Draft rule; 1997)

Lucas, P.N.

1991a Traditional and Customary Rights: Access Rights. IN MacKenzie, ed. 1991:211-222.

1991b Traditional and Customary Rights: Gathering Rights. IN MacKenzie, ed. 1991: 223-228.

MacKenzie, M.K. (editor)

1991 *Native Hawaiian Rights Handbook*. Honolulu: Native Hawaiian Legal Corporation and Office of Hawaiian Affairs

NPS (National Park Service)

1990 How to Apply the National Register Criteria for Evaluation. National Register Bulletin No. 15. Washington, D.C.: U.S. Dept. Interior, National Park Service. (Revised 1991, 1995)

OEQC (Office of Environmental Quality Control, State of Hawai'i)

1997 *Guidelines for Assessing Cultural Impacts*. Adopted by the Environmental Council; November 19, 1997.

n.d. Environmental Report Card, 1997: An Assessment of Hawaii's Environmental Health. *The 1997 Annual Report of the Environmental Council*, State of Hawaii.

Parker, P.L., and T.F. King

1990 Guidelines for Evaluating and Documenting Traditional Cultural Properties. National Register Bulletin No. 38. Washington, D.C.: U.S. Dept. Interior, National Park Service.

PASH/Kohanaiki Study Group

1998 Report on Native Hawaiian Traditional and Customary Practices Following the Opinion of the Supreme Court of the State of Hawai'i in Public Access Shoreline Hawai'i v. Hawai'i County Planning Commission. Prepared in Response to H. R. No. 197, H.D. 1, Regular Session of 1997, Nineteenth State Legislature, State of Hawai'i. Submitted by the Office of Planning, State of Hawai'i. (January)