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Office of the Vice Chancellor for Research

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September 17, 2018

Director Scott Glenn
Office of Environmental Quality Control
Department of Health, State of Hawai'i
235 S. Beretnia Street, Room 702
Honolulu, HI 96813

Dear Director Glenn,

With this letter, the University of Hawai'i hereby transmits the draft environmental assessment and anticipated finding of no significant impact (DEA-AFONSI) for the Hydrogeochemical Assessment of the Pālāwai Basin situated at TMK 249002061 on the Island of Lāna'i for publication in the next available edition of the Environmental Notice.

Enclosed is a completed OEQC Publication Form, one copy of the DEA-AFONSI, an Adobe Acrobat PDF file of the same, and an electronic copy of the publication form in MS Word. Simultaneous with this letter, we have submitted the summary of the action in a text file by electronic mail to your office.

If there are any questions, please contact Dr. Nicole Lautze at (808) 956-3499.

Sincerely,

Michael Bruno, Ph.D.
Vice Chancellor for Research and
Interim Vice Chancellor for Academic Affairs

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OFC. OF ENVIRONMENTAL QUALITY CONTROL

2500 Campus Road, Hawai'i Hall 211
Honolulu, Hawai'i 96822
Telephone: (808) 956-7837 Fax: (808) 956-2751

19-094

AGENCY
PUBLICATION FORM

Project Name:	Detailed hydrogeochemical investigation of the Pālāwai Basin
Project Short Name:	Hydrogeochemical assessment of Lanai
HRS §343-5 Trigger(s):	(1) Propose the use of state or county lands
Island(s):	Lāna'i
Judicial District(s):	Lāna'i District
TMK(s):	249002061
Permit(s)/Approval(s):	
Proposing/Determining Agency:	University of Hawai'i
Contact Name, Email, Telephone, Address	Nicole Lautze, lautze@hawaii.edu, (808) 956-3499, 1680 East West Road, POST 602, Honolulu, HI 96822
Accepting Authority:	(for EIS submittals only)
Contact Name, Email, Telephone, Address	
Consultant:	
Contact Name, Email, Telephone, Address	

Status (select one)	**Submittal Requirements**
_X_ DEA-AFNSI	Submit 1) the proposing agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the DEA, and 4) a searchable PDF of the DEA; a 30-day comment period follows from the date of publication in the Notice.
____ FEA-FONSI	Submit 1) the proposing agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEA, and 4) a searchable PDF of the FEA; no comment period follows from publication in the Notice.
____ FEA-EISPN	Submit 1) the proposing agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEA, and 4) a searchable PDF of the FEA; a 30-day comment period follows from the date of publication in the Notice.
____ Act 172-12 EISPN ("Direct to EIS")	Submit 1) the proposing agency notice of determination letter on agency letterhead and 2) this completed OEQC publication form as a Word file; no EA is required and a 30-day comment period follows from the date of publication in the Notice.
____ DEIS	Submit 1) a transmittal letter to the OEQC and to the accepting authority, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the DEIS, 4) a searchable PDF of the DEIS, and 5) a searchable PDF of the distribution list; a 45-day comment period follows from the date of publication in the Notice.
____ FEIS	Submit 1) a transmittal letter to the OEQC and to the accepting authority, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEIS, 4) a searchable PDF of the FEIS, and 5) a searchable PDF of the distribution list; no comment period follows from publication in the Notice.
____ FEIS Acceptance Determination	The accepting authority simultaneously transmits to both the OEQC and the proposing agency a letter of its determination of acceptance or nonacceptance (pursuant to Section 11-200-23, HAR) of the FEIS; no comment period ensues upon publication in the Notice.
FEIS Statutory Acceptance	Timely statutory acceptance of the FEIS under Section 343-5(c), HRS, is not applicable to agency actions.
____ Supplemental EIS Determination	The accepting authority simultaneously transmits its notice to both the proposing agency 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 or is not required; no EA is required and no comment period ensues upon publication in the Notice.

19-004

____ Withdrawal Identify the specific document(s) to withdraw and explain in the project summary section.

____ Other Contact the OEQC if your action is not one of the above items.

Project Summary
Provide a description of the proposed action and purpose and need in 200 words or less.

This proposed project is an effort by the University of Hawai'i to better understand the unique hydrology of the Lāna'i.Island. Water wells within the Pālāwai Basin, the caldera region of Lāna'i volcano, tap high level brackish water that is at elevated temperatures. This is the only location in the state where brackish water exists above sea level, and here it is hundreds of feet above sea level. The origin of this high-level brackish water is unknown. The proposed action is to deepen two existing wells within Lāna'i's Pālāwai Basin using core drilling technology (core will be less than 4 inches diameter). This study will improve the overall understanding of the groundwater system within the Island of Lāna'i and therein provide valuable information for conservation of this resource. It will expand our understanding of the dynamics of groundwater systems within specific geologic regimes (the caldera regions of the Hawaiian volcanoes), which is applicable to groundwater management statewide. Although the preparation of an EA for small diameter test wells is often waived, we have elected to prepare this document to evaluate any environmental impacts of this program, and to ensure that stakeholders are informed and able to provide input on the project.

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DRAFT ENVIRONMENTAL ASSESSMENT

DETAILED HYDROGEOCHEMICAL INVESTIGATION OF THE PĀLĀWAI BASIN

Island of Lānaʻi

Water Resources Research Center
University of Hawaiʻi

September 19, 2018

EXECUTIVE SUMMARY

This proposed project is an effort by the University of Hawaiʻi to gain a better understanding of the unique hydrology of the island of Lānaʻi. Water wells within the Pālāwai Basin (which is the caldera region of Lānaʻi volcano) tap high level brackish water that is at elevated temperatures. This is the only location in the state where brackish water exists above sea level, and here it is several hundred feet above sea level. The origin of the high-level brackish water is unknown. Hypotheses include that it is due to: i) circulatory mixing of warm sea water, ii) a giant tsunami, and iii) an abundance of sea salt aerosols in a basin that is relatively dry, or at least was relatively dry for a period of time. Obtaining data on how salinity varies with depth within the Pālāwai Basin, to deeper levels than currently measured, should provide insight into the origin of Lānaʻi's brackish water. The proposed action is to deepen Lānaʻi Well #10 using wireline core drilling technology. Lānaʻi Well #10 was drilled in 1989 but has not been used by the current land management company, Pūlama Lānaʻi. Depending on the outcome of Well #10 deepening, and if all conditions allow, we may deepen Lānaʻi Well #9, also. Lānaʻi Well #9 has posed problems for Pūlama Lānaʻi and is currently not in use. Similar drilling projects in other islands of the state have revealed greater amounts of groundwater accumulation and storage than predicted by standard models, and have provided data to revise and update these models. This study will improve the overall understanding of the groundwater system within the island of Lānaʻi and therein provide valuable information for conservation of this resource. Further, it will expand our understanding of the dynamics of groundwater systems within specific geologic regimes (namely, the caldera regions of the Hawaiian volcanoes) and how they age, which is applicable to groundwater management statewide.

This Draft Environmental Assessment (EA) is prepared in accordance with HRS Chapter 343, which states an EA is required for an agency's proposed actions on state or county lands. Test wells have a minimal environmental impact and are often exempt from this requirement, but the University of Hawaiʻi is conducting this EA to make stakeholders aware of the proposed project so they may have input concerning its potential impacts. This project is also in compliance with: the Clean Air Act, with respect to emissions from stationary sources; HAR Title 13, Chapter 168, regarding well construction standards; the Endangered Species Act, with respect to endangered flora and fauna in immediate vicinity of the two proposed wells; Executive Order 13112, requiring

project activities to prevent the introduction of invasive species; the Historic Preservation Act, regarding protection of aboriginal remains or artifacts found within the project's regions of impact; the Coastal Zone Management Act, regarding impacts on coastal resources; the Clean Water Act, regarding potential impacts on surface or ground waters; and the Farmland Protection Policy Act that preserves valuable farmlands within the United States. The project is compatible with, and supports, many of the objectives of the Hawaiʻi State Plan and Lānaʻi Community Plan.

The proposed project is to drill a small-diameter, continuously-cored borehole through the base of existing Well #10 on the island of Lānaʻi. Well #10 (WELL ID: 5-4555-001, latitude 20.765278º, and longitude -156.919444º) was drilled in 1989. Depending on drilling results of Well #10, and if all conditions allow, we may move to Lānaʻi Well #9 (WELL ID: 5-4854-001, latitude 20.81082º, and longitude -156.914048º) Lānaʻi Well #9 was drilled in 1990. Both wells are located on land parcel TMK 249002061. Well Completion Reports were filed for both boreholes in 1993.

The University of Hawaiʻi is in possession of a drill rig to conduct diamond wireline core drilling, which can be used to obtain the following types of data: detailed stratigraphic and geologic information from recovered rock core samples; monitoring of groundwater pressure/saturation and temperature during drilling; fluid sample collection. By utilizing existing wells, this scientific investigation can be conducted in a cost-effective manner that will have a minimal adverse impact on the local environment. Selection of the drilling sites was based on the following criteria: locations of existing but unused wells that could be deepened for further groundwater investigation; access to said wells via existing roadways; ability to conduct the project in an area already disturbed by prior uses so as to minimize our adverse environmental impacts.

In this assessment of the environmental impacts of our proposed project, the following were considered and evaluated: geology and soils; land use; water resources; potable water; wastewater disposal; solid and hazardous wastes; anthropogenic noise and light; transportation, air quality; flora; fauna; cultural resources; socioeconomic environment; and environmental justice and protection of children. The proposed project will have no reasonably anticipated impacts on: geology and soils; land use; flora; potable water; wastewater disposal; cultural resources; and environmental justice and protection of children.

The actions considered include: the proposed action; drilling test holes at new locations away from existing boreholes; and the no-action alternative.

For the proposed action (deepening two existing but unused bores) our proposed findings are that: there may be minor adverse impacts associated with: anthropogenic noise and light; transportation; air quality; fauna; and solid and hazardous wastes. In each of these cases, these impacts did not meet the "significant impact" thresholds and observed impacts can be mitigated. Positive impacts of the project can be reasonably expected for our understanding of Lānaʻi's groundwater resources and long term sustainability of that resource and for the socioeconomic environment.

For the alternative action #1 (drilling two bores from the surface at alternative locations), our findings are that those actions would lead to greater land disturbance and surface impacts associated with development of access infrastructure and site installation; and a greater commitment of irrecoverable resources due to the need to drill substantially more borehole from the surface in order to access the same proposed depths through the existing bores; greater air quality impacts due to the longer operation of the drill rig and support equipment required to achieve the desired depths of the boreholes; and potentially greater community impacts due to the needed longer duration of the project and operation of the drilling equipment.

For the alternative action #2 (the no-action alternative), our findings are that the impacts of the proposed action will largely be avoided, in the near term, but that the improved information and understanding of the Lānaʻi groundwater resources will likewise be lost resulting in less effective management of the resource and, potentially, an increase in the needed exploratory development drilling required to provide a reliable groundwater resource to the residents of Lānaʻi.

An analysis of proposed alternative project impacts was also conducted with respect to the mandated thresholds of HRS Chapter 343 that require the completion of an Environmental Impact Statement (EIS). The factors considered in our analysis are as follows:

1) Involves an irrevocable commitment to loss or destruction of any natural or cultural resource;

2) Curtails the range of beneficial use of the environment;

3) Conflicts with the State's long-term environmental policies;

4) Adversely affects the economic and social welfare or cultural practices of the community or the State;

5) Substantially affects public health;

6) Involves substantial secondary impacts;

7) Involves a substantial degradation of environmental quality;

8) Is individually limited but cumulatively has considerable effect on the environment or involves a commitment for larger actions;

9) Substantially affects a rare, threatened or endangered species;

10) Detrimentally affects air or water quality or ambient noise levels;

11) Affects, or is likely to suffer damage by being located in an environmentally sensitive area such as a flood plain, tsunami zone, erosion-prone area, geologically hazardous land, estuary, fresh water or coastal waters;

12) Substantially affects scenic vistas view planes identified in County or State plans or studies;

13) Requires substantial energy consumption.

Our analysis found that none of these impacts would meet or exceed mandated thresholds, and our project will have no significant effect on the environment.

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APPENDICES

LIST OF ACRONYMS and DEFINITIONS

AMSL	Above Mean Sea Level
Artesian	Groundwater that is under pressure when tapped by a well and is able to rise above the level at which it is first encountered
Brackish	Water that contains more salt than fresh water, but less than seawater
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CWA	Clean Water Act
CZM	Coastal Zone Management
dBA	Decibels, A-weighted
DEA	Draft Environmental Assessment
DHHL	Department of Hawaiian Home Lands
DLNR	Department of Land and Natural Resources
EA	Environmental Assessment
EIS	Environmental Impact Statement
HAR	Hawai‘i Administrative Rules
HRS	Hawai‘i Revised Statutes
HGRP	Humu‘ula Groundwater Research Project
HSDP	Hawai‘i Scientific Drilling Project
LUC	Land Use Classification
LUPAG	Land Use Planning Allocation Guide
ROI	Region of Influence
SY	Sustainable Yield
TMK	Tax Map Key
Tonnes	Metric tons, 1000 kg

CHAPTER 1: PURPOSE, NEED, AND SCOPE

1.1 Introduction

The University of Hawai‘i proposes to conduct a detailed hydrologic assessment and core drilling program to further develop our understanding of the groundwater processes and internal geology of the island of Lāna‘i. The planned project will be located at two unused brackish water wells (Lāna‘i Wells 9 and 10) located on the large land parcel TMK 249002061. The University of Hawai‘i is preparing this Environmental Assessment (EA) in compliance with HRS Chapter 343-5; although the preparation of an EA for small diameter test wells is often waived, the University has elected to prepare this document in order to evaluate the likely environmental impacts of this program and to ensure that all stakeholders are informed of the project and are provided the maximum opportunity to provide input on the proposed actions.

1.2 Overview and Background

The standard model of groundwater hydrology within ocean islands was developed by Badon-Ghyben and Herzberg over 100 years ago (Herzberg, 1901), and is today known as the Ghyben-Herzberg relation. This model is based on many assumptions, but is still commonly used in Hawai‘i. However, scientific drilling on Hawai‘i island over the past 25 years has revealed a much more complex groundwater hydrology than predicted by this simple model. Each and every scientifically drilled borehole on this island has provided unique and surprising information about the local groundwater hydrology that was previously unknown.

The only deep groundwater drilling on the Hawaiian Islands was conducted on the island of Hawai‘i via the Hawai‘i Scientific Drilling Project and Humu‘ula Groundwater Research Project. A description on the nature of those deep groundwater drilling projects and ensuing results are provided here as background for our anticipated interpretations of the proposed drilling on Lāna‘i, the subject of this EA. The Hawai‘i Scientific Drilling Project (HSDP) produced rock and groundwater samples from two coastal boreholes in the Hilo area. The pilot hole was drilled in 1993, while the main hole was largely drilled in 1999 with additional phases of deepening in 2003 and 2006. These holes unexpectedly tapped fresh, artesian groundwater at 300 meters below sea level (mbsl) at the interface between Mauna Loa and Mauna Kea as marked by soil and ash layers

in the rock samples retrieved. Artesian groundwater was unexpected on Hawai‘i, as the island has relatively young, highly permeable subaerial lava flows and little of the carbonate caprock that helps create artesian aquifers on the island of O‘ahu. Additional freshwater aquifers were discovered from 2000 to over 3000 mbsl, and isotopic sampling indicated that this deep fresh water originated as rainfall on the slopes of Mauna Kea over 2000 m above mean sea level (amsl). While fresh groundwater discharge into the shallow ocean around Hilo is well known to local residents, these deeper freshwater aquifers are also presumed to discharge along the lower flanks of Mauna Kea as submarine springs (Thomas and Pailet, 1996). These results indicated that the volcanoes that make up the Hawaiian Islands contain more and deeper fresh water aquifers than predicted by the standard model.

The Humu‘ula Groundwater Research Project (HGRP) was another scientific drilling investigation into groundwater on Hawai‘i island. This study was prompted by geophysical surveys across the saddle undertaken by the University of Hawai‘i in partnership with the U.S. Geological Survey. These surveys indicated high-elevation fresh groundwater beneath the relatively dry saddle that could be a potential resource to landholders in the area. In addition to ranching operations, the U.S. Army Pohakuloa Training Area (PTA) was particularly interested in exploring this potential resource as they incur significant costs from trucking water to the training area for their needs. With funding from the U.S. Army, two more boreholes were drilled in the Saddle region of the island in 2013 and 2015 as part of this project. The first hole, drilled at an elevation of ~2000 m amsl discovered multiple confined aquifers as shallow as 250 m below the PTA cantonment ground surface, and freshwater-saturated lava rock deeper and through the bottom of the hole. The second hole, 10 km to the west and ~300 m downslope, encountered a variety of fresh groundwater regimes under variable amounts of hydrostatic pressure as drilling progressed downward. Both holes indicated there is a large freshwater resource at relatively shallow depth beneath the Humu‘ula Saddle that was unexpected prior to the results of the geophysical surveys and not predicted by the standard model. Both of these drilling projects provided valuable data that can be used to make more informed decisions about how to best utilize and sustainably manage these valuable groundwater resources within the island.

Lāna‘i’s unique hydrology, with brackish water above sea level in the Pālāwai Basin, has long

been known (Mink, 1983; Hardy, 1996). Recent geophysical surveys conducted by the University of Hawai‘i on Lāna‘i indicate complex groundwater hydrology on this island as well, that begs direct investigation.

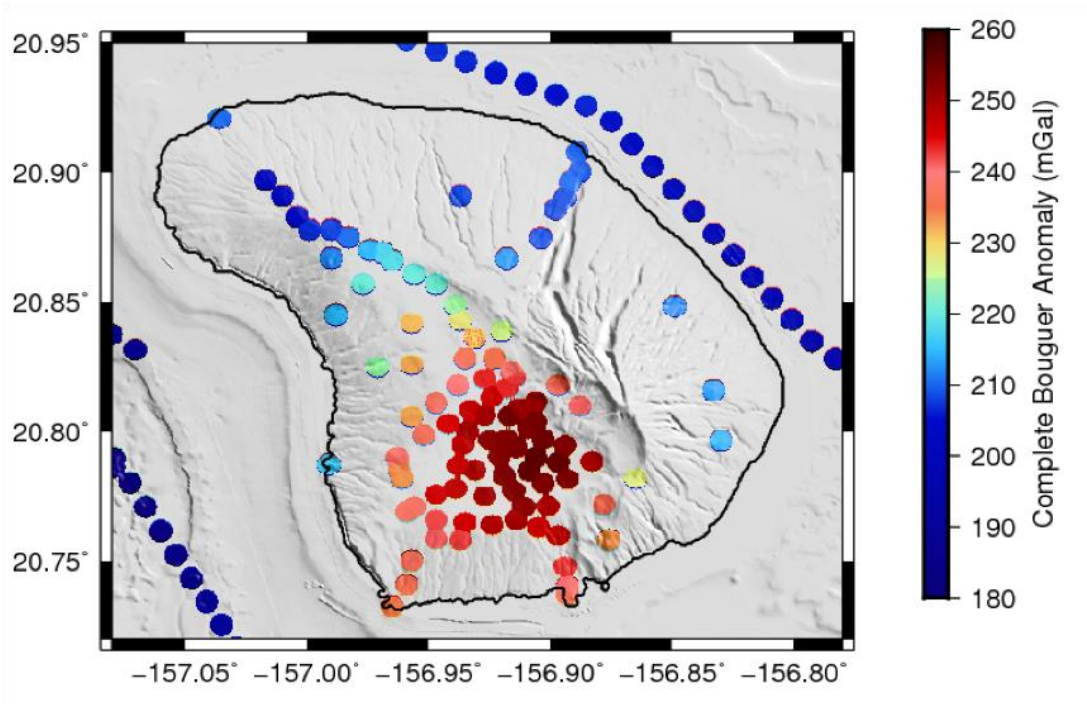

Figure 1-1. Geophysical survey of the island of each circle represents a gravity survey point. Higher gravity in the Pālāwai Basin is consistent with an abundance of dike rock in the caldera region.

1.3 Purpose and Need of the Proposed Action

The purpose of the proposed action is to better understand the groundwater of Lāna‘i Island. The groundwater hydrology of Lāna‘i has a number of unique aspects that have led to uncertainty on its distribution and transport within the island. Lāna‘i has very limited rainfall, lying in the rain-shadow of Maui and most of the near-shore areas of the island have very limited basal freshwater aquifers. Drilling at higher elevations, in the inferred rift zone of Lāna‘i volcano, has encountered high elevation, very low-salinity freshwater resources that are presumed to be dike-impounded within the rift zone. High elevation drilling within the Pālāwai Basin, which is the caldera region of Lāna‘i volcano, has likewise encountered so-called high-level water with elevations of several hundred feet above sea level, but with variably elevated salinity.

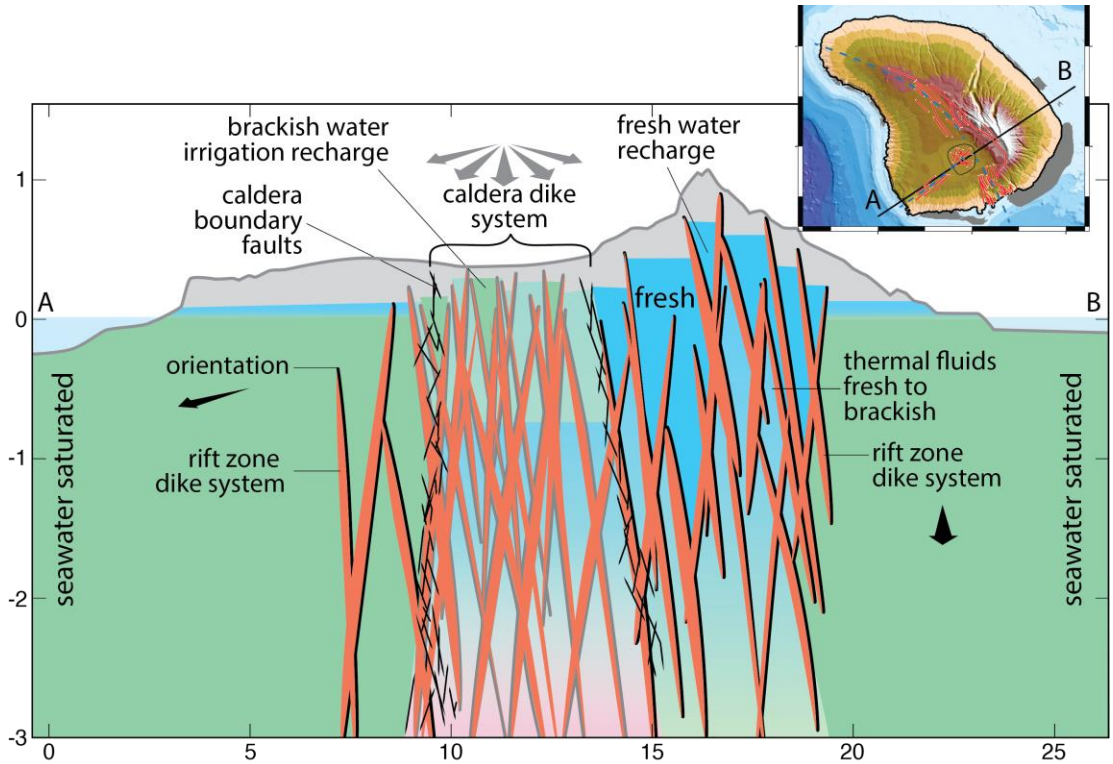

Figure 1-2. Schematic cross section illustrating the hydrogeology of Lānaʻi. Depth on the vertical y-axis is labeled in kilometers, as is width on the horizontal x-axis. Pictured in the upper right corner is an inset of a map of the rift zones on Lānaʻi, displaying how the orientation of the cross section.

This latter aspect of the Lānaʻi waters is unique: high elevation groundwater is nearly always of low salinity and there are very few credible mechanisms for saline water to be transported to high elevation. Although commonly hypothesized, we do not consider infiltration of sea water to be a viable mechanism due to the large hydrostatic head difference between the high-level water and sea level. Other prospective processes could be through concentration of salts present in marine aerosols or through transport of seawater due to mega-tsunami events for which there is evidence in the surface geology of Lānaʻi. Either of these mechanisms would require that there is minimal recharge from other high elevation water sources in the dike-impounded aquifers of the Lānaʻi rift zones, an issue that has engendered significant debate. A further uncertainty, with respect to the unique characteristics of the groundwater hydrology, is the role that any residual heat within the Lānaʻi caldera could play in accelerating or inhibiting fresh or saline water transport into or out of the caldera dike complex of Lānaʻi volcano. This project will access the deeper region of Lānaʻi

caldera which will allow us to i) sample its groundwater for analyses of the chemistry and age, ii) sample and describe its subsurface geology, especially with respect to the influence of the dike complex on the groundwater system, and iii) to assess how the caldera dike complex has aged and cooled over time.

The need for this action is to provide more accurate information for water resource management. The current prevailing model for groundwater in Hawai‘i is generalized and outdated, and commonly provides an inaccurate and oversimplified picture of groundwater dynamics within the ocean islands of the state. Direct drilling and sampling of the groundwater resource will provide residents and their decision-makers with more accurate and specific groundwater information so they can better understand and manage this resource.

1.4 Scope and Organization of this Document

This Draft Environmental Assessment considers deepening two existing but unused brackish water wells via scientific drilling of small-diameter core holes. These holes will allow sampling and collection of deep rock and water samples near the northern and the southwest edge of the Pālāwai Basin.

Chapter 2: Regulatory Framework and Compatibility with State, County, and District Planning Documents will discuss Federal and State requirements that the project will be subject to, and will review the objectives of the project in the context of relevant State, County, and District/Community plans.

Chapter 3: The Proposed Project and Alternatives will discuss the selection of the technology to accomplish the project goals and the selection of prospective locations for execution of the drilling program using a sequence of screening criteria. Development of the technology screening criteria is based on those conditions that will enable the project to attain the scientific goals of the study, using a cost effective technology, while also minimizing and/or mitigating the environmental impact of the overall project; screening criteria for selection of location is based on minimizing adverse environmental impacts, cost effectiveness of the overall project, and maximizing the technical and scientific value of the information recovered

from the project.

Chapter 4: Affected Environment and Environmental Consequences will discuss the existing conditions of environmental attributes along with the impacts on each of those attributes that the proposed action may reasonably be expected to have. The effects of the proposed action will be compared with existing, baseline conditions, and the effects of the No Action alternative will be discussed and analyzed. The environmental attributes that will be discussed in this analysis include:

- Topography, Soils, and Geology
- Water Resources
- Noise
- Anthropogenic Light
- Air Quality
- Flora
- Fauna
- Cultural Resources
- Potable Water
- Wastewater Disposal
- Solid, Hazardous, and Medical Wastes
- Transportation
- Land Use
- Socioeconomic Environment
- Environmental Justice and Protection of Children

Chapter 5: Cumulative Impacts will discuss and analyze potential cumulative impacts that may arise from the execution of the proposed action occurring concurrently with recent or planned actions likely to be taken in the area whether they are private, State, or Federal actions. This chapter will also consider follow-on impacts that can be reasonably foreseen to occur as a result of the proposed action.

Chapter 6: Determination of Significance and Findings will compare the impacts of the

proposed action with the criteria defined in HRS Chapter 343 that require an Environmental Impact Statement to be prepared. The results of that comparison will result in a proposed Finding of No Significant Impact.

Chapter 7 will present a list of **References** relied upon in this assessment.

CHAPTER 2: REGULATORY FRAMEWORK AND COMPATIBILITY WITH STATE, COUNTY, AND DISTRICT/COMMUNITY PLANNING DOCUMENTS

2.1 Introduction

The present document is being prepared under HRS Chapter 343-5(b) which states that "Whenever an agency (of the State) proposes an action in subsection (a), other than ….. that is not a specific type of action declared exempt under section 343-6, the agency shall prepare an environmental assessment for such action at the earliest practicable time to determine whether an environmental impact statement shall be required". In addition to HRS Chapter 343, the proposed action must comply with a number of other State and Federal regulations that will govern the planned approach and mitigation of the impacts of the proposed action. Those regulations that are most relevant to the proposed action are discussed in the following sections.

Although not carrying the same force of law, there are also a number of long-range planning documents at the State, County, and Community level that reflect a consensus view of the desired evolution of the natural, social, and economic future of Hawai‘i's residents. In subsequent sections, the compatibility and consistency of the proposed action with those plans will be examined.

2.2 Regulatory Requirements

2.2.1 Chapter 343 Environmental Impact Statements

Preparation of this Environmental Assessment

As noted above, when an agency, such as the University of Hawai‘i, undertakes any action on state lands that is not specifically exempted within Chapter 343, that agency is required to conduct an environmental assessment and, "A statement shall be required if the agency finds that the proposed action may have a significant effect on the environment." (§343-5(b)(1)(D)). Although the drilling of test wells is often exempted from the requirement to prepare an environmental assessment due to their minor impacts and short duration, this environmental assessment is being prepared to both meet this requirement and to ensure that the public has an opportunity for review and comment on the proposed action.

Public Involvement

Chapter 343 also requires that, pursuant to §343-3, the draft environmental assessment shall be available through the Office of Environmental Quality Control (OEQC) for a period of thirty days for public review and comment and that "The applicant shall respond in writing to the comments received during the review…" (§343-5(b)(1)(C)).

This Draft Environmental Assessment and Notice will be filed with the OEQC for publication and public comments will be received at:

Water Resources Research Center
Attn: Nicole Lautze
1680 East West Road, POST 602
Honolulu, HI 96822

After incorporation of the written comments and responses, a Final Environmental Assessment, and determination of whether an Environmental Impact Statement will be required, will be prepared by the University of Hawai‘i and will be published by the OEQC.

2.2.2 Clean Air Act As Amended (42 USC 7401, et seq.)

Under the Clean Air Act, any stationary source that has the capacity to emit more than threshold quantities of criteria pollutants over a 12-month period must apply for a source permit and meet required air emission limits. The Environmental Protection Agency has delegated enforcement authority under this program to the State of Hawai‘i Department of Health.

This project will use one or more diesel engines for drilling and fluid pumping, so it is required to obtain a Non-Covered Source Permit for the combination of these sources. If the combined sources are found to have the potential to degrade air quality in the area around the project activities, then limitations will be imposed on the emission rates, or on the configuration of the sources, in order to allow the project to meet air quality standards.

2.2.3 Hawai‘i Administrative Rules Title 13 Chapter 168 Water Use, Wells, and Stream Diversion Works

In order to protect groundwater resources from contamination due to improperly designed wells, Hawai‘i's Administrative rules (§13-168-12 Well construction and pump installation permits) require most drilling projects to obtain a well construction permit and comply with “Hawai‘i Well Construction and Pump Installation Standards.” For the present proposed action, extending the depth of existing wells, a well modification permit application will be submitted to the Commission on Water Resources Management for approval. Because the project objectives are only to investigate the deeper geologic and hydrologic conditions within this region, we do not anticipate modifying the existing shallow casing, nor would our modifications allow the use of the well as a production well, and hence, a pump installation permit will not be sought.

2.2.4 Endangered Species Act, 16 U.S.C. 1536(a)(2) and (4)

Threatened or endangered species in the United States are protected by the Endangered Species Act (ESA) (16 U.S.C. §§ 1531-1544, December 28, 1973, as amended 1976-1982, 1984 and 1988). The United States Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) are responsible for compiling the lists of threatened and endangered species of plants and animals and designating the critical habitat for animal species. The ESA defines an endangered species as any species in danger of extinction throughout all or a significant area of its range and a threatened species as any species likely to become endangered in the near future. Among the 64 plant species listed as endangered, candidate, or of concern on Lāna‘i Island are those added to the endangered list in 2013: ‘Āwikiwiki (*canavalia pubescens*), hāhā (*cyanea munroi*), (*phyllostegia haliakalae*), hala pepe (*pleomele fernaldii*), and ‘iliahi (*santalum haleakalae* var. *Lāna‘i ense*). Two varieties of Lāna‘i tree snails, (*partulina semicarinata*) and (*partulina variabilis*) were also added to the endangered list at this time and there is a restoration effort within the Lāna‘ihale Forest Conservation Area focused on the endangered ‘ua‘u (*pterodroma sandwichensis*) aka Hawaiian petrel (Maui County, 2016, Lāna‘i Community Plan).

2.2.5 Executive Order 13112 Invasive Species

Executive Order 13112 requires all Federal agencies to prevent the introduction of invasive species, provide control, and minimize the economic, ecologic, and human health impacts that

invasive species may cause. Because this project anticipates bringing some supplies from the Mainland U.S. to Hawai‘i, mitigation measures to prevent introduction of invasive species will be detailed in the following discussion.

2.2.6 Historic Preservation Act (16 U.S.C. § 470)

The National Historic Preservation Act (NHPA; Public Law 89-665; 16 U.S.C. 470 *et seq.*) seeks to preserve historical, archaeological, and culturally significant sites. As part of this effort, State Historic Preservation Offices have been developed along with listing of recognized significant sites. The act requires Federal agencies to evaluate the impact of Federally funded (or permitted) projects on sites – natural or man-made – that have historical or cultural significance. The evaluation, referred to as a Section 106 Review, is part of the Environmental Assessment process and will be discussed in the appropriate sections below.

2.2.7 Coastal Zone Management Act, 16 U.S.C.1456(c)(1)

The Hawai‘i Coastal Zone Management Act established the Hawai‘i Coastal Zone Management (CZM) Program in 1977 by establishing HRS Chapter 205A, which requires that projects with federal involvement, whether permitting or funding, must undergo review for consistency with the Hawai‘i’s CZM law. Under this program, all of Hawai‘i’s lands are considered subject to this review. The CZM objectives are to ensure protection of recreational, historic, and scenic resources as well as protect coastal ecosystems and to take appropriate measures to minimize damage arising from coastal natural hazards. The Federal funding for this project thus triggers the requirement that the proposed actions will undergo review for impacts on the Coastal Zone.

2.2.8 Clean Water Act of 1977; Water Quality Act of 1987 (33 U.S.C. § 1251 *et seq.*); HAR Chapter 11-55 Water Pollution Control

The Clean Water and Water Quality acts are intended to protect surface waters in the United States from pollutant discharges. As currently defined, those waters “...includes only those relatively permanent, standing or continuously flowing bodies of water ‘forming geographic features’ that are described in ordinary parlance as ‘streams,’ ‘oceans, rivers, [and] lakes.’” (U.S. Supreme Court. *Rapanos v. United States*, 547 U.S. 715 (2006)). Hawai‘i’s Water Pollution Control expands the coverage to include groundwater as well. These regulations require that National Pollutant

Discharge Elimination System (NPDES) permits must be obtained for the discharge of drilling fluids or storm water runoff for certain construction activities. Where permits are required, operators must commit to employing best management practices to minimize the impact of discharges on surface waters and groundwaters.

2.2.9 Farmland Protection Policy Act (P.L. 97-98, Sec. 1539-1549; 7 U.S.C. 4201, et seq.)

Congress enacted the Farmland Protection Policy Act (FPPA) as a subtitle of the 1981 Farm Bill. The purpose of the law is to "...minimize the extent to which Federal programs contribute to the unnecessary conversion of farmland to nonagricultural uses..." (P.L. 97-98, Sec. 1539-1549; 7 U.S.C. 4201, et seq.). The FPPA also stipulates that federal programs be compatible with state, local and private efforts to protect farmland. Hawai‘i's policy and planning program for agricultural lands has assigned management of Agricultural Lands of Importance to the State of Hawai‘i (ALISH) to the Department of Agriculture who has surveyed and classified agricultural lands as Prime, Unique, and Other. Wells 9 & 10 are located on former Dole Plantation land, which is classified as Agricultural Unique. The use of existing wells will minimize any impacts of the drilling effort on future use of these agricultural lands.

2.3 Compatibility with State and County Planning Documents

The proposed project advances and supports a number of community-, economic-, and water-related components of planning documents that have been developed at the State, County, and local level. The following section will highlight each portion of the plan that the project supports or is compatible with along with a brief statement of the impact of the project on the plan.

2.3.1 Hawai‘i State Plan

The Hawai‘i State Plan, adopted in 1978 and revised both in 1986 and in 1991 (HRS Chapter 226, as amended) establishes goals, objectives, and policies that provide guidance to State and County agencies in actions or decisions that affect the State's growth, economic development, and cultural development. The proposed drilling will recover fundamentally new information on Lāna‘i Island's geologic structure and groundwater resources in an area about which there are a number of questions regarding recharge, storage, and groundwater interaction with adjacent aquifers. Under the best possible outcome from this research, the results of this investigation may provide

insights into regional flow patterns for groundwater and a broader understanding of the quality and resource capacity of the diverse aquifer systems within and around the Lānaʻi caldera; under less favorable findings, the data will provide guidance to State agencies in more accurately assessing the impacts of land-use decisions on a more limited resource.

More specific plan elements having relevance to the expected findings in the State Plan are as follows:

§226-7 Objectives and policies for the economy—agriculture:

Objective (2): Growth and development of diversified agriculture throughout the State;

Policy (2): Encourage agriculture by making best use of natural resources.

Policy (3): Provide the governor and the legislature with information and options needed for prudent decision making for the development of agriculture.

Policy (8): Support research and development activities that strengthen economic productivity in agriculture, stimulate greater efficiency, and enhance the development of new products and agricultural by-products.

Policy (10): Assure the availability of agriculturally suitable lands with adequate water to accommodate present and future needs.

Policy (12): Expand Hawaiʻi's agricultural base by promoting growth and development of flowers, tropical fruits and plants, livestock, feed grains, forestry, food crops, aquaculture, and other potential enterprises.

The development of additional field-based information on Lānaʻi's groundwater resources, as a contribution to the effort to validate and improve existing models for groundwater storage and transport within the island will support all of the above objectives.

§226-10 Objective and policies for the economy--potential growth activities:

Policy (1): Facilitate investment and employment growth in economic activities that have the potential to expand and diversify Hawaiʻi's economy, including but not limited to **diversified agriculture**, aquaculture, renewable energy development, creative media, and **science and technology-based sectors**;

Favorable results from the test holes, in terms of clarifying groundwater flow and storage within Lānaʻi could support further investment into diversified agriculture on now fallow lands; should the temperature data recovered from the proposed action indicate adequate

thermal gradients, more cost effective desalination of brackish water could become possible; and an even stronger thermal gradient may indicate that a non-fossil fuel energy source for the island could be developed.

§226-13 Objectives and policies for the physical environment--land, air, and water quality.

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

Policy (1): Foster educational activities that promote a better understanding of Hawai‘i’s limited environmental resources;

Policy (2): Promote the proper management of Hawai‘i’s land and water resources.

The new scientific data generated by the proposed boreholes will provide the State with new insights into groundwater resources, groundwater storage, and groundwater transport within the interior reaches of all of our islands. Incorporation of new, more accurate models of groundwater storage and flow within an ocean island environment into secondary and post-secondary teaching curricula will help Hawai‘i’s residents to better understand the importance of a critical resource. A better understanding of those resources will, inevitably, enable their better management.

§226-16 Objective and policies for facility systems--water.

Objective (a): Planning for the States 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.

Policy (2): Support research and development of alternative methods to meet future water requirements well in advance of anticipated needs.

Policy (5): Support water supply services to areas experiencing critical water problems.

The new scientific data generated by the proposed work will enable the State to make better decisions regarding a source of groundwater that has hitherto been considered to be of value in meeting the needs of some of the Stakeholder communities of Lāna‘i.

§226-18 Objectives and policies for facility systems--energy.

Objective (1): Dependable, efficient, and economical statewide energy systems capable of supporting the needs of the people;

Objective (2): Increased energy self-sufficiency where the ratio of indigenous to imported energy use is increased;

Objective (3): Greater energy security and diversification in the face of threats to Hawai‘i’s energy supplies and systems; and

Objective (4): Reduction, avoidance, or sequestration of greenhouse gas emissions from energy supply and use.

Policy (c)(1): Support research and development as well as promote the use of renewable energy sources;

Policy (c)(7): Promote alternate fuels and transportation energy efficiency;

Policy (c)(8): Support actions that reduce, avoid, or sequester greenhouse gases in utility, transportation, and industrial sector applications;

Among the possible outcomes of the current investigation will be a better definition of accessible, potable groundwater resources within the higher elevation caldera region of Lāna‘i. Should those resources be indicated to be of substantial volumes, then application of energy intensive brackish-water desalination could be avoided or forestalled for the island. Should greater availability of potable groundwater not be demonstrated, evidence of a significant temperature gradient could allow desalination of brackish-water to be accomplished in a less energy intensive way. And should even higher temperature gradients be encountered, then the potential would exist for displacing some, or all, of the energy demand for Lāna‘i (currently supplied dominantly by diesel-fueled sources) with low-to-intermediate temperature binary thermal power generation.

Within the State Plan, there are additional “Priority Guidelines” with which the proposed work is compatible:

§226-103 Economic priority guidelines. (a) Priority guidelines to stimulate economic growth and encourage business expansion and development to provide needed jobs for Hawai‘i's people and achieve a stable and diversified economy.

Guideline (d): Priority guidelines to promote the growth and development of

diversified agriculture and aquaculture:

Policy (2): Assist in providing adequate, reasonably priced **water for agricultural activities**.

Policy (3): Encourage public and private investment to increase water supply and to improve transmission, storage, and irrigation facilities in support of diversified agriculture and aquaculture.

Guideline (e): Priority guidelines for water use and development:

Policy (3): Increase the support for research and development of economically feasible alternative water sources.

§226-109 Climate change adaptation priority guidelines. Priority guidelines to prepare the State to address the impacts of climate change, including impacts to the areas of agriculture; conservation lands; coastal and nearshore marine areas; natural and cultural resources; education; **energy**; higher education; health; historic preservation; **water resources**; the built environment, such as housing, recreation, transportation; and the economy shall:

Policy (3) Invest in continued monitoring and research of Hawai‘i's climate and the impacts of climate change on the State;

Policy (7) Promote sector resilience in areas such as **water**, roads, airports, and public health, by encouraging the identification of climate change threats, assessment of potential consequences, and evaluation of adaptation options;

Policy (8) Foster cross-jurisdictional collaboration between county, state, and federal agencies and partnerships between government and private entities and other nongovernmental entities, including nonprofit entities;

Policy (9) Use management and implementation approaches that encourage the **continual collection, evaluation, and integration of new information** and strategies into new and existing practices, policies, and plans; and

Among the more serious impacts that are anticipated to arise from climate change are changes in rainfall and recharge to Hawai‘i’s groundwater aquifers. Of particular

significance to the present project are the provisions in sections (3), (7),)8), and (9) above.

With the new information provided by the proposed scientific drilling, all sectors of the government will be better able to manage the groundwater resources available to, and to respond more effectively to the impacts associated with, both climate change and to changing demographics on the island as well as to maintain a sustainable food and water supply for Lānaʻi.

2.3.2 Maui Countywide General Policy Plan and Lānaʻi Community Plan

The Maui Countywide General Policy Plan (MCGPP) provides broad goals, objectives, policies, and implementing actions that portray the desired direction of the County's future. The relevant core themes of the plan applicable to this project are:

- Protect the Natural Environment: A better understanding of the available groundwater resources will enable better decision-making on the most appropriate and sustainable approaches to providing municipal and agricultural water to Lānaʻi 's population.
- Strengthen the Local Economy: our project will assist in decision-making on the most cost-effective supplies of water and whether those supplies can sustainably supply the proposed demand.

More specifically, the Lānaʻi Community Plan (LCP) contains the following guiding principles and goals in alignment with the MCGPP that are also relevant to the proposed project:

- Diversify the economy to provide opportunities and resiliency.
- Provide opportunities for the island keiki to live and work on Lānaʻi. Diversifying the economy and creating more job opportunities requires our population to grow; we commit to finding constructive ways to assimilate the growing population into the community.
- Malama ʻaina: protect and restore the environment.
- Protect our water and provide efficient, effective, and environmentally sound infrastructure and services.
- Establish Lānaʻi as a model sustainable island to be known for its bold integration of innovative green technologies into a traditional rural island community.

2.3.3 Lānaʻi Island Water Use and Development Plan (WUDP)

The Lānaʻi Community Plan's stated infrastructure and utilities goal is that: "Lānaʻi will have a sufficient supply of potable and non-potable water provided in an environmentally sustainable and cost-effective manner." (Section 7, LCP) The issues and strategies, policies, and recommended actions put forth by Pūlama Lānaʻi in the 2016 Maui County Lānaʻi Community Plan support the proposed action.

Existing Conditions

Lānaʻi has only one aquifer that is divided into two sub-aquifers, Leeward and Windward. Each has a sustainable yield of three million gallons per day (MGD), for a total island sustainable yield of six MGD. As of 2013, metered pumpage totaled approximately 1.8 MGD. Although the 1.8 MGD represents approximately 30 percent of the total sustainable yield, most of the 1.8 MGD comes from the Leeward sub-aquifer. Hydrologists have cautioned against this practice and instead recommend increased redundancy by spreading the pumpage throughout both sub-aquifers. The Manele PD uses approximately 1.0 MGD, or about 66 percent, of the total water used. (Lānaʻi Island Water Use Development Plan Ordinance 3885, 2011)

The Lānaʻi Community Plan Advisory Committee (CPAC) predicated their decisions on the availability of significant additional water sources for future development proposals. Listed below are the issues and strategies, policies, and recommended actions of Pūlama Lānaʻi that are supported by the proposed action brought forth in this EA of deepening existing groundwater wells on Lānaʻi.

Lānaʻi Water Advisory Committee (LWAC)

Issues and strategies of the Lānaʻi Water Advisory Committee LWAC supported by the proposed action include the following:

> **Issue 5:** Based on the WUDP, build-out of the island requires existing groundwater source to be supplemented by alternative sources that are not from the Lānaʻi high-level aquifer system.
>
> **Strategy 5:** Continue the development of alternative water sources, such as desalination. Continue planning and design to direct the development of an alternative

water source that will be used to supplement the existing high-level aquifer water source.

Policies of the Lānaʻi Island Water Use and Development Plan (WUDP) that are supported by the proposed action include the following:

4) Support the provisions under Land Use Entitlements of the WUDP by deferring additional or incremental discretionary entitlements pending careful consideration of the adequacy of long-term water supply sources and infrastructure.

5) Protect the long-term health of the Lānaʻihale watershed for groundwater recharge.

6) Encourage and improve data exchange and coordination among Federal, State, County, LWAC or a committee of Lānaʻi residents sanctioned by the County, and private land use planning and water resource management agencies.

9) Support the planning, design, and development of an alternative water source that will supplement the existing high-level aquifer while protecting the integrity of the high-level aquifer.

The recommended Pūlama Lānaʻi Water Actions supported by the proposed action include the following:

4) Evaluate the status of available water resources on the island, if CWRM identifies major flaws in the monthly water status reports. (Policies 1, 3)

10) Continue planning, exploring, testing, and developing alternative water resources, such as a desalination plant. (Policy 9)

2.4 Required Permits and Approvals

Two permits and approvals will be required to implement this project. They are listed here under their granting agencies.

1) *Hawaiʻi State Commission on Water Resources Management:* Well Modification Permit to allow deepening of the existing wells.

2) *Hawaiʻi State Department of Health:* A temporary Non-Covered Source Permit will be required for use of the drilling rig on Lānaʻi for the duration of the project.

CHAPTER 3: THE PROPOSED ACTION AND ALTERNATIVES

3.1 Description of the Proposed Action and Alternatives

This document evaluates two actions: the Proposed Action and the No Action alternative. A third option would be to drill a new hole from the surface. This would clearly entail more impacts from longer drilling time and site clearing, and more use of resources due to the need for additional casing, fuel, and drilling materials.

3.1.1 Selection of Technology

The goal of the Proposed Action is to develop a better understanding of the hydrology within the interior of Lānaʻi Island, specifically the Pālāwai Basin. In order to achieve this objective, we will need to: perform a geologic analysis of the stratigraphy and structures that underlie this region; conduct a stratified fluid sampling program through the saturated zone(s) within the stratigraphic section; measure the temperature of the borehole during and after drilling activities; and conduct chemical and isotopic analysis of the fluid samples collected. Hence, the screening criteria for selection of the technology to be used for the planned work are as follows:

1) Develop as complete a geologic record of the stratigraphic section beneath the Pālāwai Basin as is possible with currently available technology;
2) Allow for the detection of fluid saturation zones while drilling;
3) Enable collection of fluid samples at frequent intervals, with minimal contamination, as the borehole progresses through the saturation zone;
4) Allow for regular, frequent temperature measurements while drilling and a complete downhole temperature log of the holes after drilling when they have returned to ambient.
5) Perform the investigation with minimal adverse environmental impact to the region;
6) Develop the geologic and hydrologic data in a cost-effective manner while ensuring that significant new information on the Pālāwai Basin hydrologic system is obtained.

Three technological approaches were considered for achieving the scientific objectives outlined above: rotary drilling a conventional groundwater exploration hole; rotary drilling a small diameter test hole; drilling a small diameter test hole using wireline coring technology. Our evaluation of these three alternatives is summarized in Table 3-1 below.

	Conventional Rotary	Small Diameter Rotary	Wireline Core Drilling
1. Quality of Geologic Record	3	2	9.5
2. Detection of fluid saturation	4	4	9
3. Enable frequent fluid collection	1	1	9.5
4. Temperature measurement	1	1	9
5. Identity of volcanic system	3	3	8
6. Minimal adverse impact	-4	-2	-1
7. Cost effectiveness of tech.	-8	-3	-3
Total	0	6	42

Table 3-1. Screening Analysis of Drilling Technology for Emplacing Test Holes

The rating of each technology was arrived at as follows:

1) The quality of the geologic record is rated on a scale of 1 to 10 based on the geologic information that can be recovered. Both Conventional Rotary and Small Diameter Rotary drilling advance a borehole by grinding the rock into small fragments and flushing them up the wellbore using a drilling fluid. In this process, much of the structural geologic information is lost; although rock fragments can be harvested at the wellhead to conduct a limited analysis, Hawai‘i lava flow geology often results in loss of all the drilling fluids into the rock formation with no recoverable fragments returning to the surface for extended portions of the hole. Further, soft ash or soil formations, which are critically important to the analysis of the hydrology, are often washed completely away. Conventional Rotary drilling is ranked somewhat higher than Small Diameter Rotary only because it is more amenable to downhole geophysical logging and will allow the recovery of limited information relevant to the geologic record. With these technologies, we estimate a likely loss of relevant geologic information as being 70% and 80% respectively for Conventional Rotary and Small Diameter Rotary drilling, respectively.

In core drilling technology, cylindrical samples of the formation are recovered continuously as the hole is advanced. Past core drilling programs in Hawai‘i have been able to maintain recovery rates as high as 98% over several thousand feet of hole. The soft

soil and ash formations, that are vulnerable to washout in rotary drilling, have consistently been recovered using coring technology. Hence, the extent and quality of the geologic record recovered by core drilling is far better than that using rotary drilling.

2) Detection of formation saturation is rated on a 1 to 10 scale. Rotary drilling with conventional fluids will not detect a significant change in drilling conditions and the only way to determine saturation is to halt drilling and measure water levels using a probe.

With wireline core drilling, when each fresh core tube is inserted into the drill string, it is lowered to the bottom on a wireline cable. When water is present in the hole, it is immediately apparent by the decreased fall rate of the tube. Hence, detection of saturation, and elevation of the standing water table in the borehole, is significantly better with the wireline equipment than with rotary tools since the latter typically allows detection of water levels only during bit changes which occur at intervals of tens to hundreds of feet of penetration.

3) Ease of sampling is rated on a 1 to 10 scale. With Conventional or Small Diameter Rotary drilling, once we have detected a saturated formation, it will be necessary to remove the entire drill string in order to collect samples of the fluids from the formation. At the depths being drilled, the time required to trip the drill string out and return it after sampling would take as much as a day. Further, with the larger volumes of drilling fluid required for rotary drilling, the degree of contamination of the formation water will be higher and, hence, cleanup of the water will be more time-consuming to remedy in order to allow clean samples to be collected.

With core drilling, once a saturation zone is encountered, a fluid sampler can be lowered down the drill string and a sample can be collected with only minimal disruption of the drilling program. Even at the maximum depths anticipated, collection of a water sample might require an hour or two with the wireline.

4) Ease of temperature measurement is rated on a 1 to 10 scale. Similar to frequent fluid

collection, temperature measurements can only be taken during Conventional and Small-diameter Rotary Drilling by removing the entire drill string and then sending a separate tool down the hole. This could again take up to a day, and would produce an episodic temperature profile of the borehole. In contrast, Wireline Core Drilling allows a temperature tool to be attached to the top of the core barrel for continuous temperature data collection during drilling, if so desired. Likewise, with the smaller volumes of fluid being circulated for the wireline coring, the cooling of the formation is less extreme; as a result, the return of the formation to its natural temperature equilibrium is significantly faster than for a rotary drilled borehole.

5) Being able to identify the volcanic system hosting a given aquifer is rated on a 1 to 10 scale. With the loss of the geologic information from rotary drilling, it will be difficult-to-impossible to identify the soil and ash zones that are expected to mark the transition from one volcanic system to another while the drilling is underway. It will only be possible to distinguish these transitions using downhole logging, which is only done at the end of a drilling interval or at the end of the drilling program.

Because core drilling provides a near real-time geologic record as the hole is being drilled, the critical transition zones can be identified as core is withdrawn from the hole. This allows the scientific staff to provide guidance to the drillers to watch for changes in rock type or in degree of saturation as these transitions are approached.

6) We have gauged the adverse impact based on the acreage of land likely to be impacted by the drilling and testing program and assigned it a negative value. For Conventional Rotary drilling, about 4 acres are required for the drill rig, the ancillary equipment, and vehicle access and mobility around the rig. Significantly less area is required for a Small Diameter drilling rig and ancillary equipment that is estimated at about 2 acres. Wireline core drilling will require an area of about 1 acre for placement of the rig, supply containers and ancillary equipment. Although not included in the acreage value, other impacts such as air emissions, are consistent with these relative numbers: rotary drilling requires heavier equipment, and hence will have higher air emissions, than core drilling. Other potentially

adverse impacts scale similarly.

7) Cost effectiveness was ranked in inverse proportion to the cost. Where Conventional Rotary boreholes to the anticipated depths would cost an estimated $1.5-$2 million, small diameter rotary and core holes were estimated to both cost about $0.75 - $1.2 million.

In summary, the combined ratings for each of these technologies show that wireline core drilling is a far superior method to Conventional or Small Diameter rotary drilling, largely due to the much more complete scientific information produced as well as the smaller impact on the environment. Hence, the rotary drilling methods will be dropped from further consideration of alternative actions.

3.1.2 Selection of Location

The objectives of the present investigation have guided the selection of the specific sites being considered for conducting the planned action. Several of the same screening criteria applied to the selection of the technology are also applied to the selection of the location for the exploratory drilling along with several other criteria that are specific to location but not to the technology.

The Screening Criteria for site selection are as follows:

1) A site where the geologic structure is most representative of Lānaʻi's Pālāwai Basin subaerial stratigraphic section, that will allow us to characterize the internal structure of the volcano;

2) A site that will allow the gathering of data on: i) the hydrologic conditions within the Pālāwai Basin, ii) the thermal conditions within the caldera region and, iii) the effects of those conditions on the groundwater quality;

2) Existing access to the drill site is available for equipment with a minimum of ground disturbance;

3) Support infrastructure for the drilling program is readily available;

4) The site will allow us to perform the investigation and analysis with minimal adverse environmental impact to the region's environmental attributes;

5) The location will enable us to conduct the investigations where there will be least impact on existing or anticipated land uses and access.

The relevant analysis for each of the screening criteria is as follows:

1) Selection Criteria #1: High-level groundwater is known to exist in both wells 9 and 10, at depths of ~180 and ~310 m below the surface, respectively.

2) Selection Criteria #2: Both sites are located on the margins of the Pālāwai Basin, and the existing wells allow for deeper penetration and investigation of the subaerial lava of this region.

3) Selection Criteria #3: Well 9 is located near existing electrical power facilities that we will tie in to and meter.

4) Selection Criteria #4: Well 9 sits within a flat concrete pad constructed when it was first drilled, while Well 10 is located on land flat enough for our truck-mounted drill rig to function over it. Both wells are accessible by nearby roads and are within <1-6 miles of Lānaʻi City.

5) Selection Criteria #5: Both wells have been drilled at least once with some disruption of the local environment; subsequent deepening is not expected to cause significant further disruption – certainly not as much as drilling new wells from the surface.

6) Selection Criteria #6: Wells 9 and 10 are the only wells not currently in use on Lānaʻi, and Pūlama Lānaʻi supports this investigation.

3.1.3 The Proposed Action

The proposed action will be the deepening of two boreholes at Wells 9 and 10, via scientific drilling. Samples of rock core will be collected continuously during drilling, and will be analyzed for structural information as the core is recovered. The diameter of the existing wells is 25-45 cm (10-17.5”), but will be reduced to 9.7 cm (3.8”) diameter at depth; depending on formation conditions, the bottomhole diameter may be as small as 6.4 cm (2.5”). During drilling, and subsequent to completion, water samples will be collected from the borehole and tested for chemical composition and other physical and chemical properties; analysis of the age of the water samples will be conducted to determine their average residence times in the aquifers and isotopic analysis will enable us to determine at what altitude the recharge entered the hydrologic system.

The steps in conducting the drilling will consist of the following actions:

- A site having an area of ~0.5 hectares (1 acre) will be prepared by leveling and clearing any debris and obstructions that may exist;
- A gyroscopic test will be conducted to determine if the hole is straight enough for scientific drilling;
- A stabilizing temporary casing string will be installed in the existing hole to minimize the amount of drilling fluid required, protect and stabilize the drill string, and minimize erosion of the sidewalls of the open hole.
- Core drilling will commence using conventional water well drilling fluids on a 24/7 schedule with two alternating drilling crews with periodic breaks to allow for equipment maintenance and repair, downhole measurements, or borehole stabilization operations;
- Our objective is to achieve a depth of at least 3000' of total hole depth to allow us to characterize the deeper geologic and hydrologic conditions beneath the Pālāwai Basin. If drilling conditions are favorable, a greater depth may be achieved but permit conditions will limit maximum drilling temperatures to less than 100°C and may restrict the total drilling depth attained.
- Drilling will be periodically suspended, to allow samples of formation fluids to be collected.

After drilling is completed, a perforated liner will be lowered into the borehole to stabilize the formation and then drilling fluids will be cleared from the borehole by bailing. After the bore is cleared of drilling fluids, monitoring instruments will be suspended in the hole to allow us to periodically determine formation water conditions and to sample formation fluids.

If drilling proceeds to the second borehole, the sequence of actions described above will be repeated.

At the conclusion of the groundwater analysis process, a determination will be made, in collaboration with CWRM staff, as to whether one or both of these observation holes would be

useful for monitoring conditions in the identified aquifers; should such monitoring not appear to be feasible or useful, then the holes will be configured according to State Water Commission and Department of Health requirements.

3.1.4 No Action Alternative

The no-action alternative does not meet the needs of the University and Stakeholders in their continued management of the Pālāwai Basin lands. Without the proposed hydrologic evaluation, we will be unable to document existing conditions within the groundwater aquifers beneath the region. Stakeholders will also be deprived of ground truth data with which to develop plans for sustainable long-term utilization of these lands and for development the groundwater resource. The no-action alternative would also preclude any contribution to the State Plan as it relates to management of water resources or to the Lānaʻi Community Plan's stated strategy to continue planning, exploring, testing, and developing alternative water resources.

CHAPTER 4: AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

4.1 Introduction

This chapter will present an overview of the baseline physical, biological, social, and economic conditions of the environmental attributes that occur within the region of influence (ROI) of the Proposed Action. The potential impacts on the environment will also be presented for the Proposed Action and the No Action alternative. Only those environmental and socioeconomic conditions relevant to the Proposed Action are presented, as follows:

- Topography, Soils, and Geology
- Water Resources
- Noise
- Anthropogenic Light
- Air Quality
- Flora
- Fauna
- Cultural Resources
- Potable Water
- Wastewater Disposal
- Solid, Hazardous, and Medical Wastes
- Transportation
- Land Use
- Socioeconomic Environment
- Environmental Justice and Protection of Children

Each of the above environmental attributes will be presented in a separate section with a background and overview of existing conditions followed by a discussion of the impacts, both positive and negative, of the Proposed Action and No Action alternatives.

4.1.1. Terminology

Impacts are all described where they occur, within their Region of Influence (ROI) for each resource, including both direct and indirect impacts as well as cumulative impacts:

- The Region of Influence is that area/location that can be reasonably expected to be impacted by the proposed action and will be of a specified extent for each environmental attribute;
- Direct Impacts are caused by the Proposed Action and occur at the same time and place of the action;
- Indirect Impacts are caused by the Proposed Action but occur at a later time or at a distance from the Proposed Action;
- Cumulative Impacts are those that may occur as a result of pursuit of the Proposed Action simultaneously with other actions occurring within the ROI of either project, or as a result of accumulating impacts associated with the consecutive execution of multiple projects having overlapping ROI; Cumulative Impacts will be discussed in Chapter 5.
- Significant Impact, as defined in HRS 343-2, means the sum of effects on the quality of the environment, including actions that irrevocably commit a natural resource, curtail the range of beneficial uses of the environment, are contrary to the State's environmental policies or long-term environmental goals as established by law, or adversely affect the economic welfare, social welfare, or cultural practices of the community and State.

There may be both adverse and beneficial impacts associated within a single environmental attribute. Beneficial impacts are identified and discussed where applicable.

The following sections describe the impacts using the following levels of significance:

- Significant impact
- Significant impact but mitigatable to less than significant
- Less than Significant
- No Impact

4.1.2 Summary of Impacts

Table 4-1 presents a summary of the anticipated impacts of the Proposed Action and the No Action alternatives on the three sites under consideration. Less than Significant and No Impacts were

identified for all Environmental Attributes.

Environmental Attribute	Preferred Alternative		No Action Alternative
	Well #10	Well #9	
Topography, Soils, and Geology	⊙	⊙	⊙
Water Resources	⊕	⊕	⊙
Noise	◎	◎	⊙
Anthropogenic Light	◎	◎	⊙
Air Quality	◎	◎	⊙
Flora	⊙	⊙	⊙
Fauna	◎	◎	⊙
Cultural Resources	⊙	⊙	⊙
Potable Water	⊙	⊙	⊙
Wastewater Disposal	⊙	⊙	⊙
Solid and Hazardous Wastes	◎	◎	⊙
Transportation	◎	◎	⊙
Land Use	⊙	⊙	⊙
Socioeconomic Environment	⊕	⊕	⊙
Environmental Justice and Protection of Children	⊙	⊙	⊙

Table 4-1. Summary of Impacts of Project Alternatives.

LEGEND

Positive Impact	⊕
Less than Significant Impact	◎
No Impact	⊙
Significant Impact	●

Figure 4-1. *Left*- The head of Lānaʻi Well #10. *Right*- Showcases ease of axis to Lānaʻi Well #10 via foot and truck.

Figure 4-.2 Lānaʻi Well #9.

4.2 Background, Location, and History

Text excerpts transferred from Maly, K., 2016, Cultural landscape considerations for a magnetotelluric survey on the island of Lānaʻi: Pūlama Lānaʻi, Lānaʻi Culture & Heritage Center Memo Report, 10 p.

By the early 1600s, all the islands of the Hawaiian group were settled sufficiently to develop an organized way to manage scarce resources. Each island was divided into political and subsistence subdivisions called ahupuaʻa. The island of Lānaʻi is comprised of two major districts, Koʻolau (windward) and Kona (leeward). Under the rule of Piʻilani, Lānaʻi was divided into 13 ahupuaʻa, or native land subdivisions, which typically extend from a fishery area in the ocean fronting the ahupuaʻa to an area on the mountain lands. Though in four instances, the ahupuaʻa cross the entire island from Koʻolau to Kona. Native tradition describes ahupuaʻa divisions as being marked by stone cairns (ahu) with a carved pig (puaʻa) image placed upon them, and these ancient divisions remain the primary land unit in the Hawaiian system of land management on Lānaʻi today.

In the period leading up to 1800, there was a decline in the native population, and in the capacity of Lānaʻi to produce agricultural resources. This was, in part, due to disputes between the rulers of Maui and Hawaiʻi which overflowed onto Lānaʻi in the mid to late 18th century. In the late 18th century and early 19th century, foreign diseases and influences spread across the islands, leading to a further decline in the population. By the 1840s, there were approximately 600 inhabitants residing on Lānaʻi. By the 1870s, the population hovered below 300 residents, and by the early 1890s, there were just 175 native residents. In 1922, when James Dole purchased 99% of the island to form the Lānaʻi plantation, the population was approximately 125.

James Dole, president of the Hawaiian Pineapple Company (HAPCo), purchased the island of Lānaʻi for $1.1 million dollars in 1922. In 1923, he sent engineers to begin the design of Lānaʻi City, the Kaumālapaʻu Harbor, pineapple fields, and facilities which would support the envisioned pineapple plantation. Between 1923 and 1925, the city was laid out. It included houses (for individual families and group homes for single men); a hospital dispensary; a theatre; stores; churches; a hotel; offices; and labor yards. Outlying plantation camps, overlooking Pālāwai, at Miki, Quarry Camp and Kaumālapaʻu, were also built. As this work was going on, and housing

became available in Lānaʻi City and outlying work camps, tracts of land in Pālāwai Basin and around the new city were being cleared of stones and boulders both by hand and with livestock, and then planted in pineapple. Castle & Cooke bought out Dole Foods in 1961 and planned new resort and residential development for Lānaʻi in the 1970s which they never saw to fruition. David H. Murdock bought out Castle & Cooke in 1985 for ownership of Lānaʻi and ended pineapple farming in 1922.

The proposed drilling sites are located within the Pālāwai Basin on Lānaʻi. The project proposes to expand the well present at each drilling location by digging deeper into the subsurface with the intent of gaining new geologic and hydrologic insights to groundwater systems of Lānaʻi. Lānaʻi Well #10 (20.765278º, -156.919444º), depicted in Figure 4-1, is the primary target of the study located on the southern rim of Pālāwai Basin. Lānaʻi Well #9 (20.8180820º, -156.914048º) as shown in Figure 4-2 is the secondary target of the study should resources allow. It is located closer to Lānaʻi City distinctly within the Pālāwai Basin.

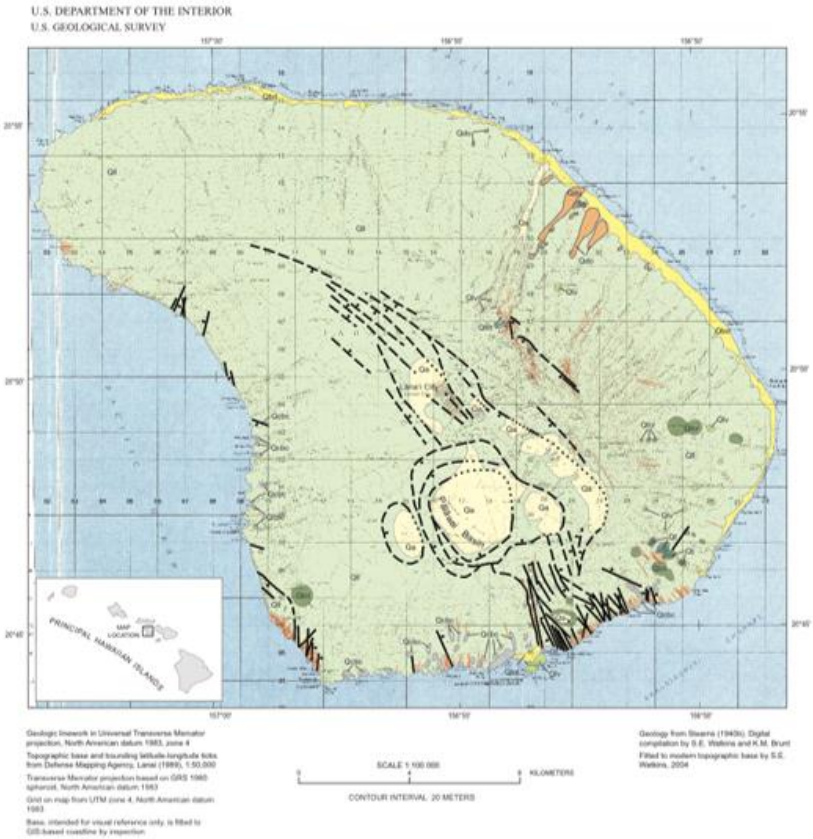

Figure 4-3. Geologic map of the island of Lānaʻi from D.R. Sherrod, J.M. Sinton, S.E. Watkins, and K.M. Brunt, 2007.

4.3 Topography, Soils, and Geology

4.3.1 Affected Environment

The regional area containing both the primary proposed drilling site and the secondary location is the Pālāwai Basin, a remnant of the unfilled caldera, in the central and southern region of the island of Lānaʻi, near Lānaʻi City. Lānaʻi City has an elevation of 1,620 feet above sea level.

The island of Lānaʻi is formed by a single shield volcano, now extinct, estimated to be 1.3 Ma and active from approximately 2 Ma to 1 Ma. The Lānaʻi Volcanics is an igneous geologic unit that comprises all the volcanic rock units forming the island (Figure 4-3). The bioclastic Hulopoe Gravel is a carbonate-cemented gravel on the southern slopes of the island, with competing theories of origin, including sea level rise and megatsunamis. A rift zone extends from the northwest to the southeast of the island, radiating from the caldera of Pālāwai Basin. An additional rift zone extends southwest from the caldera. Both are marked by dike complexes.

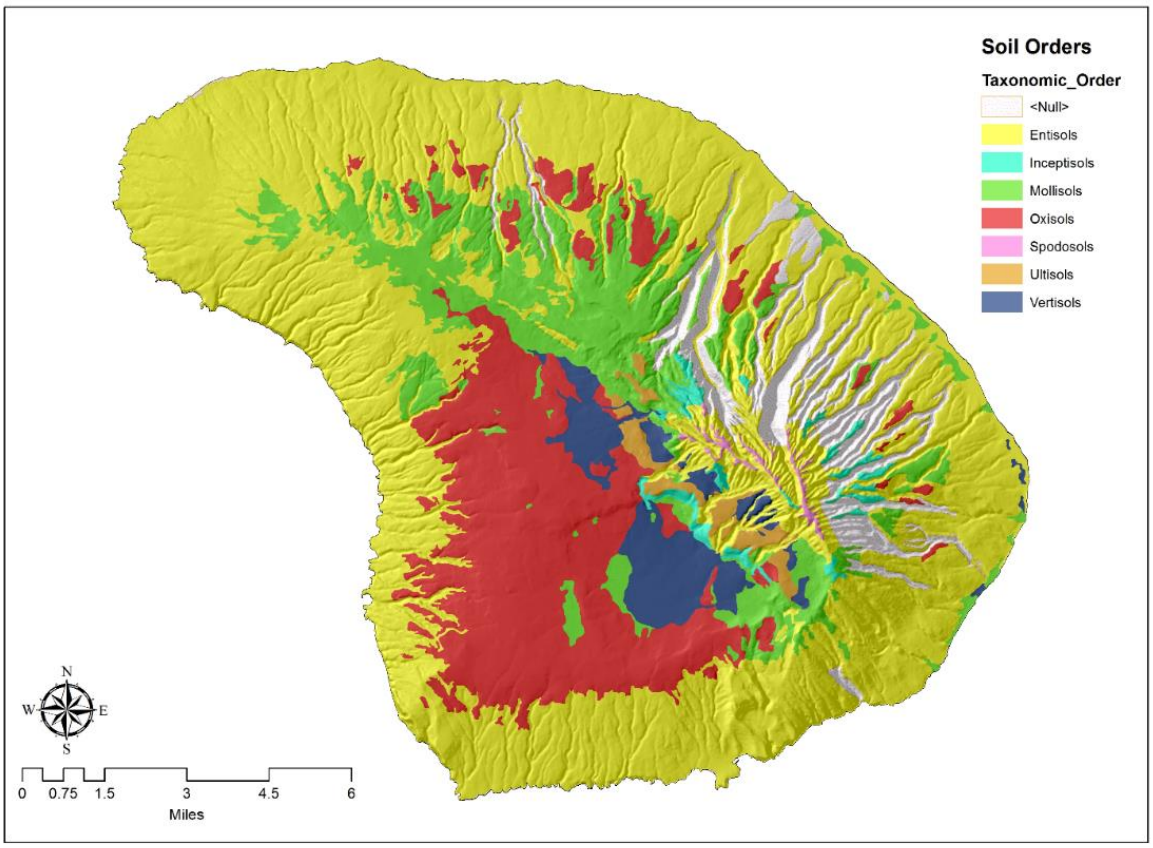

Figure 4-4. Soils map of the island of Lānaʻi from J. Deenik, 2014, University of Hawaiʻi College of Tropical Agriculture and Human Resources.

With the introduction of agriculture and grazing by goats and deer on Lānaʻi, wind erosion has caused an increase in soil loss. The majority of the soil in Pālāwai Basin near the drill site at Lānaʻi Well #9 is a vertisol, a clay-rich material. The soil at drill site Lānaʻi Well #10 at the edge of the basin is a oxisol, defined by its highly weathered minerals and oxidized subsurface layer (Figure 4-4). Both of these soils played an important role in Lānaʻi's pineapple production (Hawaiʻi Soil Atlas, 2014).

4.3.2 Environmental Consequences

The ROI for the effects of the proposed drilling on the Topography, Soils, and Geology of the area is limited to the immediate vicinity of the drill site in both proposed locations: an area of about 2 acres. We do not anticipate any impacts on the topography beyond the boundaries of the drill sites themselves.

Proposed Action (Preferred Alternative): For the test drilling to be conducted, an area of approximately 2 acres will need to be available for rig-up and short-term storage of drilling materials at each site used. This area needs to be reasonably flat and accessible to vehicles but will not need to be paved. At prospective drill sites, minimal grading and grubbing will have to be done over this area as it is flat and allows placement of all necessary equipment. A wellhead slab has been previously installed on both sites. For Well 10, the area has been since overgrown by shrubs. For Well 9, the well slab remains cemented.

The activities at the site associated with mechanical disturbance of the ground are likely to increase the possibility of dust creation and wind erosion of the finest grain soil components. It is not expected that the ground disturbance will interfere with normal water infiltration and, hence, no significant increase in water erosion is believed to be likely as a result of the drilling activities. The temporary nature of these activities at each of the prospective sites that have been previously disturbed will not result in a significant impact to their existing condition.

No Action Alternative: Under the no action alternative soils and topography will remain as they are.

Mitigation: Standard erosion control measures will be implemented during ground disturbing activities to minimize erosion impacts. On those sites where soil is exposed during site preparation and drilling operations, shipping containers, used for storage of materials, will be placed in a fashion to block the prevailing trade winds and shelter exposed soils to minimize wind-blown dust erosion.

4.4 Water Resources

4.4.1 Affected Environment

Lānaʻi has a subtropical climate, with Lānaʻi City at 1,620 feet in elevation and an average annual temperature of 68.1º F. Lānaʻi experiences the northeasterly trade winds and is partly sheltered by West Maui and East Molokai. Lānaʻi falls within the rain shadow of Maui, decreasing the importance of orographic rainfall caused by those northeasterly trade winds. Average annual rainfall is as low as 10 inches at the coast to 38 inches at the summit, but will vary greatly year to year. Rainfall also varies within the year, with a dry season and wet season; this wet season is marked by the presence of southerly Kona storms in addition to the regular orographic rainfall that approach the island unmitigated from the south. Heavy rains in a Kona storm can account for a large portion of the annual rainfall, sometimes as much as 80% in arid regions. Naulu storms are also sudden and heavy rainfall events forming off the south or west coast of Lānaʻi during periods of hot weather (Stearns, 1940).

Lānaʻi's sustainable yield is estimated to be 6 million gallons per day, most of which comes from the Central aquifer encompassing portions of the Pālāwai Basin and rift zone. In 2008, total withdrawals from the central aquifer system were approximately 2.2 million gallons per day, coming from six primary wells.

There are two types of groundwater on Lānaʻi: basal groundwater near the coast and high level groundwater inland in the rift zone and caldera complex. Coastal basal groundwater a few feet above sea level is often too brackish for human consumption. High level inland groundwater is contained by dike-impounded reservoirs or perched aquifers, sustained by an impermeable soil bed at the base of the alluvium layer. Where the land has been eroded to intersect these dike complexes, groundwater would flow freely as perennial springs (Stearns, 1940; Mink, 1983).

These springs have since stopped after tunnels diverted the water sources; there are no perennial streams on the island.

Both target wells are within the Pālāwai Basin, with Lānaʻi Well #10 being on the southern rim of the basin, and Lānaʻi Well #9 well within the confines of Pālāwai Basin. Well #10 is near the proposed boundary between Kealia and Leeward Central aquifer; Well #9 is within the Leeward Central aquifer as proposed by Mink and Lau, 1993 (Figure 4-5).

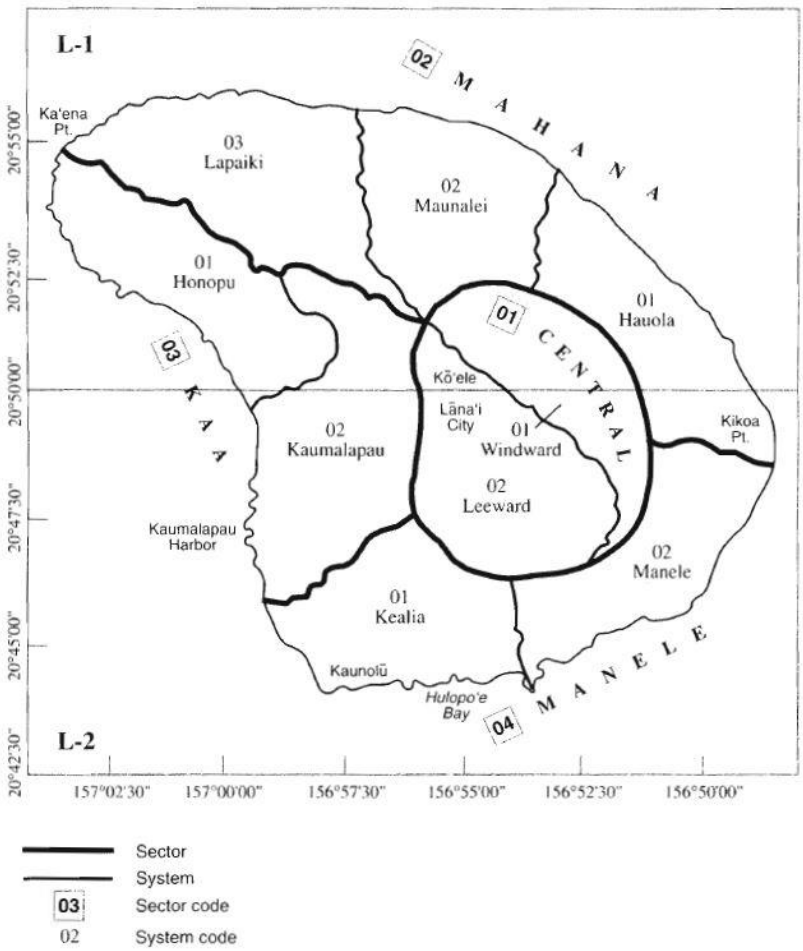

Figure 4-5. Aquifer map of the island of Lānaʻi from Mink and Lau, 1993.

4.4.2 Environmental Consequences for Water Resources

The ROI for the effects of the proposed drilling on the Water Resources within the region of drilling sites is limited to the aquifers within the Pūlama Lānaʻi controlled lands. Drilling fluids will eventually make their way into the saturated aquifers that reside below the Pālāwai Basin; the limited rainfall characteristics within the region will ensure that their transport toward the water

table will occur slowly and allow the compounds to both biodegrade and become highly diluted before they are transported out of the immediate area of the Pālāwai Basin.

Proposed Action (Preferred Alternative): Site preparation at the proposed drilling locations is not expected to have any impact on ground waters underlying the prospective drill sites. The drilling itself will introduce some compounds immediately around the well bore. These compounds consist of ~~soap~~ bentonite clay (Appendix B, Naturagel), and a vegetable-derived polymer (Appendix B, Alcomer 120L) that is used in formulating the drilling fluids for air drilling or gel-based drilling fluids. It is likely that most of the drilling fluids injected into the hole during drilling will, in time, enter the local water table; the conventional drilling fluid, containing bentonite and polymer, will be used after the water table is reached and these fluids will also be lost to the saturated formations during the drilling. The drilling polymer is biodegradable and expected to break down over time; bentonite is a natural product, a clay, that poses no threat to the groundwater quality.

In a broader context, the new information generated by the proposed project will have a positive impact on water resources island-wide by providing new information and insights into the hydrological cycle for the island as a whole, which may be relatable to statewide water resource management. These new insights will enable the State, the County, and Pūlama Lānaʻi to better manage the groundwater resources. Hence, this action will have a net positive impact on groundwater resources.

No Action Alternative: Under the no-action alternative, there would be no impact on the groundwater supplies in the immediate vicinity of the Pālāwai Basin. However, the no-action alternative is likely to result in continued incomplete knowledge of the hydrology of Lānaʻi and a limited understanding of the island's potential groundwater resource.

Mitigation: The selection of drilling fluids as bentonite clay and vegetable-based polymer is itself a mitigation measure as both are natural products that have been long-used in water well drilling with no adverse impact. Further, a specialized stabilization casing string will be used to minimize the rate of drilling fluid used.

4.5 Noise

4.5.1 Affected Environment

Lānaʻi Island is generally quiet. The primary sources of anthropogenic daytime noise include: vehicle operation, aircraft, traffic noise, construction.

Lānaʻi Well #10 is located a substantial distance from Lānaʻi City and in close proximity to the diesel power-generating facility, which generates noise. Lānaʻi Well #9 is just outside Lānaʻi City which generates anthropogenic noise during the day.

4.5.2 Environmental Consequences for Noise

The ROI for the effects of the proposed drilling on the ambient noise levels is estimated to be approximately 1 km from the drilling activity. At this distance, the noise generated by the drilling activities will be well below nuisance levels for Well #10. If drilling of Well #9 occurs, we will work with the community to determine the best path forward. Options include the use of specialized mufflers on the drilling engines or to drill exclusively during daytime hours. To date, no studies of ambient noise at either well have been performed.

Proposed Action (Preferred Alternative): Noise sources associated with the drilling include increased vehicle traffic to and from the drilling sites as well as noise associated with operation of the drilling motors which will be operated on a nearly continuous basis with two shifts of twelve hours each on a daily basis, unless there is negative feedback from the community on the level of noise. The drill rig engines (cooling fans, exhaust, etc.) are expected to generate a noise level around 75 dB(A) at 10 m. Although there is some variation in sound levels, the engines typically operate at a constant power level and generate a steady drone. There may also be sound emissions classified as “impact noise”: hammering on drill pipe, driving pins, etc. These sound levels are likely to exceed 85 dB(A) at the site but are typically short of duration.

The most relevant noise receptors to the proposed project will be the community of Lānaʻi City adjacent to the proposed secondary drill site of Lānaʻi Well #9.

No Action Alternative: Under the no-action alternative there would be no noise generated at the proposed drilling locations.

Mitigation: The location of the proposed drill site at Lānaʻi Well #10 is isolated from the region's main population centers, and noise from this location will naturally dissipate before reaching more densely populated regions.

Should unacceptable levels of sound be experienced, we will have the option of replacing the mufflers on the rig and associated equipment with "hospital" type mufflers that will further reduce exhaust-generated noise from the drilling operations. We will also have the option of deploying the storage containers in a way that will further deaden the sound transmission as needed.

Noise generated by the small addition of rig traffic to existing traffic loads is believed to be insignificant and requires no additional mitigation.

4.6 Anthropogenic Light

4.6.1 Affected Environment

Because of the moderate population within Lānaʻi City, anthropogenic light sources are present in and throughout this developed region near Lānaʻi Well #9. Near Lānaʻi Well #10, sparse population coverage limits the number of anthropogenic light sources over most of the landscape. The largest contributor to nighttime light sources is form traffic that traverses the Kaumālapaʻu Highway and Manele Road during nighttime hours, although this source is intermittent and mobile. Fixed sources of lights are those in the vicinity of rural communities. The nearest major, continuous, night time light source will be the existing diesel power generation station located approximately 1 km from the Lānaʻi Well #10 site. Lānaʻi Well #9 has a nighttime security light installed.

4.6.2 Environmental Consequences for Anthropogenic Light

The ROI for the effects of the proposed drilling on nighttime light levels in the Pālāwai Basin may extend as much as 2 to 3 km.

Proposed Action (Preferred Alternative): During drilling, the site and drill rig mast will be lighted during nighttime hours for the safety of the drilling crew and others working at onsite. Typically, there will be area lights for navigation of the site itself, to allow use of a forklift of other heavy equipment safely, and the rig mast and rig floor will be lighted to allow crew to monitor and work on the equipment. Although prospective sites are not within the approach of Lānaʻi Airports, for the safety of aircraft it may be necessary to maintain a navigation light at the top of the mast.

At prospective site Lānaʻi Well #9, the rig will be surrounded by existing nighttime area lighting near the outskirts of Lānaʻi City; the addition of the area and rig mast lights will not add significantly to the existing ambient lighting. At prospective site Lānaʻi Well #10, the rig will be isolated from any other developed areas and hence the lighting there will stand out in a broad region that is otherwise dark at night. Because of its isolation, the additional lighting will not affect existing uses of the area and will have no impact on humans. As an isolated light in an otherwise dark environment, there is the potential for the lights to affect birds or bats in their nighttime foraging or transiting the area.

No Action Alternative: Under the no-action alternative there would be no additional lighting within the drilling location

Mitigation: In order to minimize the likelihood of disorienting nocturnal bird navigation, the lights will be directed downward and shielded so that there is a minimum of stray light given off by the site. Area lights will be designed to minimize upward escape of light and will be maintained, to the extent possible, below the elevation of the top of the containers to further minimize unnecessary light leakage off site. When and where possible, motion sensor lights will be used so that, if a work area is not in active use, lights will be automatically shut off. Finally, the drill crew will be educated to watch for birdlife that may be attracted to the nighttime lighting and one of the management staff will monitor the site for incidents of bird disorientation or bird strikes and adjust lighting deployment to minimize these effects.

The temporary use of lights during the drilling activities is not considered likely to cause a significant impact on mammal or bird populations in the area.

4.7 Air Quality

4.7.1 Affected Environment

Under the Federal Clean Air Act (42 USC 85 § 7401 et seq.) each state is required to identify areas that have ambient air quality in violation of federal standards. All of Hawai‘i is categorized as attainment, meaning that federal ambient air standards are being met, or unclassifiable if data are not available to support such a determination.

Air quality in the Pālāwai Basin is typically very good. The primary anthropogenic sources of air pollutants include vehicular traffic and overland travel. Many anthropogenic sources are variable and intermittent, producing a negligible impact on overall air quality within the Pālāwai Basin.

4.7.2 Environmental Consequences for Air Quality

The ROI for the effects of the proposed drilling on the air quality of the Pālāwai Basin will be within ~2 km of the drilling activities. Beyond this radius, the emissions from the drill rig or from dust producing activities will be diluted or settled out of the air column.

Proposed Action (Preferred Alternative): Short-term impacts on air quality would occur during site preparation and drilling. Site preparation impacts would include dust generated by rig up and installation of containers as well as diesel exhaust from the equipment being used. During drilling, the primary impact on air quality would be from diesel exhaust produced by the drilling, compressor, and generator engines. Data sheets on the emissions of the drilling equipment and compressor engines are listed in Appendix C. In both cases, these engines will be of similar or smaller capacity than truck engines routinely used in transiting across the Pālāwai Basin. They will be evaluated for their ability to meet air quality standards during the permitting process under a Non-Covered Source Permit issued by the Hawai‘i State Department of Health. Any fuel use or emission requirements imposed by that permit will be met by the project.

Adjacent lands to the drill site. Because of the distance of the drill cites to developed areas, only the residents of Lāna‘i City are expected to experience even small impacts from the drilling activities and only from activities at prospective drill site Lāna‘i Well #9, the secondary priority

drill site; the other regions are far enough removed from actively occupied lands that impacts from those sites would be insignificant.

No Action Alternative: Under the no-action alterative there will be no additional diesel emissions nor dust beyond existing loads associated with typical vehicle traffic across the Pālāwai Basin.

Mitigation: As noted above, we will configure the drill site to minimize the impacts of wind on cleared portions of the drill site and, hence, also mitigate the impacts of dust generation. Fugitive dust control measures will be implemented as necessary and as indicated by the conditions occurring at the site during drilling. At the conclusion of project activities, we will work with Pūlama Lānaʻi to restore natural vegetation to our drill site as recommended by them to help further minimize any longer-term impact from the drill site activities.

4.8 Flora

4.8.1 Affected Environment

Text excerpts transferred from ICF International, 2013, Terrestrial vegetation and wildlife surveys: Report of Findings prepared for Pūlama Lānaʻi, 19 p.

The vegetation of Lānaʻi has been impacted historically by unrestricted grazing by goats (*Capra hircus*), domestic sheep (*Ovis aries*), European mouflon sheep (*O. gmelini musimon*), cattle (*Bos taurus*), pigs (*Sus scrofa*) (Towill 2007, Allen and Murakami 1999, Hobdy 1993), and more recently by deer (*Axis axis*); commercial agriculture; introduction of alien plants; and by construction of roads and appurtenances associated with the resort at Hulopoe.

The endemic *Canavalia Lānaʻi ensis (ʻawikiwiki)* was reported to be found in the 1980s (M&E Pacific, 1986; and Nagata, 1988), and in a single occurrence along the coast in a 1991 report (Belt Collins & Associates, 1991) but not more recently (ICF, 2013).

Lānaʻihale Forest Conservation Area consists of 3.588 acres of wet forest. Kānephuʻu Preserve encompasses 590 acres of lowland olopua/lama dryland forest. Neither of these natural area preserves will be affected by the aforementioned drilling at either proposed drill site.

4.8.2 Environmental Consequences for Flora

The ROI for effects of proposed drilling on flora at the prospective drill site will be the site itself.

Proposed Action (Preferred Alternative): Overall impacts to flora will be from work activities at the site that would potentially trample or abrade plants. Given the already highly disturbed nature of the prospective site, impacts of the project on native and sensitive plants will be negligible.

Because the equipment to be used for the drilling will be transported Hawai‘i Island, there is no possibility of introduction of exotic or invasive species. Still, care will have to be taken to ensure that the equipment is thoroughly cleaned prior to its introduction to Lāna‘i.

No Action Alternative: Under the no-action alternative there would be no impact on the existing flora located at the individual prospective drill sites.

Mitigation:

No impact on native flora is anticipated from the proposed activities.

4.9 Fauna

4.9.1 Affected Environment

Text excerpts transferred from ICF International, 2013, Terrestrial vegetation and wildlife surveys: Report of Findings prepared for Pūlama Lāna‘i, 19 p.

The endangered Hawaiian hoary bats or *‘ope‘ape‘a* (*Lasiurus cinereus semotus*) are known to occur on Lāna‘i; however, their breeding status is unknown. They are crepuscular, typically feeding in at twilight and after dark within edge habitats such as tree lines bordering roads, often adjacent to or near water courses and coastlines and feed on both native and alien insects (Whitaker and Tomich 1983, USFWS 1998, Fullard 2001, Mitchell et al 2005), including insects attracted to lights. USFWS (2008) noted that “Occasional observations of bats on O‘ahu , Molokai, and Lāna‘i are considered to be migrant or vagrant individuals from other islands.” They also noted that “Only one bat sighting was recorded during 485 hours of ornithological radar sampling sessions (0.005 bats/hr)…” on Lāna‘i in the vicinity of the meteorological towers erected as part of the proposed

Big Wind project.

4.9.2 Environmental Consequences for Fauna

The ROI for effects of proposed drilling on the indigenous fauna is estimated to be less than 2 km.

Proposed Action (Preferred Alternative): Planned activities at the prospective drill site are expected to have minimal impacts on the native fauna of the region. The limited size of the area impacted by drilling activities is expected to be too small to deprive the fauna of habitat. However, as noted in 4.6 Anthropogenic Light, drilling activities are planned to continue through the nighttime hours. For the safety of the site workers, the rig mast and work areas around the rig will need to be lighted during those hours and these fixed lights may have the potential to cause disorientation for night birds or serve to attract foraging bats.

No Action Alternative: Under the no-action alternative there would be no additional impacts on the fauna resources within the ROI of the drilling.

Mitigation: To minimize the impacts of nighttime activities, lights will be shielded and, where possible, directed downward. Further, work area lights that can safely be equipped with motion-sensor activation will be fitted with sensors. Shift supervisors and staff will also be directed to be alert to evidence of bird or bat activity, or losses, associated with nighttime work; if evidence of significant losses is found, we will work with Pūlama Lānaʻi biologists to implement further strategies in an effort to limit these losses.

4.10 Cultural Resources

4.10.1 Affected Environment

Text excerpts transferred from Maly, K., 2016, Cultural landscape considerations for a magnetotelluric survey on the island of Lānaʻi: Pūlama Lānaʻi, Lānaʻi Culture & Heritage Center Memo Report, 10 p.

The culture, beliefs, and practices of the ancient Hawaiians mirrored the natural environment around them. They learned to live within the wealth and limitations of their surroundings. The

earliest traditional lore of Lānaʻi, recorded in the early to middle 1800s, describes the arrival of the gods Kāne, Kanaloa, their younger god-siblings and companions to the southern shores of the island. In the tradition of Kāneʻāpua, we find references to the plateau lands of the Kaunolū, Kalulu and Kamoku. Later accounts describe the visit of the goddess Pele and members of her family to the windward region of Lānaʻi, and noted localities in the ahupuaʻa of Kaʻā.

Subsequent narratives describe the settlement of Lānaʻi by evil spirits, and the difficulties that the early human settlers encountered in attempts to safely colonize the island. Another tradition relates that in the early 1400s, a young Maui chief by the name of Kaululāʻau traveled around Lānaʻi vanquishing the evil ghosts/spirits of the island, making it safe for people to live on Lānaʻi, and is the source of the island's name (Lānaʻi a Kaululāʻau). Notable events and stories place names are recorded across Lānaʻi in this tradition, the locations of which are still known by some residents.

There is significant archaeological evidence on the island indicating that in the period before western contact, more people lived on the land sustainably—growing and catching all they needed—than currently live upon the island. The earliest population estimates cite at least 6,000 residents on the island. Several important traditions pertaining to the settlement of Lānaʻi, and the beliefs and practices of the ancient residents, are commemorated at such places as Kaululāʻau, Kalaehī, Ke-ahi-a-Kawelo, Hālulu, Puʻupehe, Pōhaku ō, Kānepuʻu, Kaʻena iki, Nānāhoa, Haʻalelepaʻakai, and Puhi-o-Kaʻala.

Ancient Hawaiian villages, ceremonial features, dryland agricultural fields, fishponds, and a wide range of cultural sites dot the shoreline of Lānaʻi at places like Keone, Kalama nui and Kalama iki, Kaumālapaʻu, Kaunolū, Māmaki, Kapalaoa, Huawai, Kapihaʻā, Hulopoʻe, Mānele, Kamaiki, Naha, Kahemanō, Lōpā, Kahalepalaoa, Kāheʻa, Keōmoku, Kaʻa, Hauola, Maunalei (including a wet land taro field system in the valley), Kahōkūnui, Kaiolohia, Kahāʻulehale, Kahue, Lapaiki, Pōkeana, Awalua, Polihua, and Kaʻena.

In the uplands, localities at Hoʻopulupuluamoa and Malulani, Kōʻele and Kihamāniania, Kalulu uka, Kaunolū uka, Keālia Kapu, Keālia Aupuni, and Pālāwai were also locations of significant traditional settlements and agricultural endeavors. We also know that over the generations, families

with permanent residences in the Lāhaina District of Maui frequented Lānaʻi to take advantage of its rich fisheries.

The story of ranching on Lānaʻi spans close to 100 years of the island's history. The "paniolo" (cowboy) heritage of the island is a rich one, with formal ranching efforts spanning ca. 1850 to 1951. Ranching efforts initially focused on herds of sheep and goats, whose numbers on Lānaʻi grew to a nearly uncontrollable 100,000 animals by the 1890s. The most significant impact of the animals between the 1830s to 1890s was the rapid deforestation and drying up of the island's water resources. Loss of vegetation had an effect on every other aspect of life on Lānaʻi and contributed to the continual decline in the native population of the island.

In 1900, there were around 800 head of cattle on Lānaʻi, while more than 20,000 sheep grazed on the island. In the early 1900s, Charles Gay and family continued ranching large herds of sheep (following the lead of the Gibson and Hayselden operations), though they slowly increased the herds of cattle and horses. In 1910, Gay sold a large portion of his fee-simple interest in the island to W.G. Irwin and J. D. McCrosson, who formed the "Lānaʻi Company, Ltd.," and focused their ranching interests on cattle, based out of the Kōʻele Ranch Headquarters.

In 1911, Lānaʻi Company, Ltd., brought George Munro to Lānaʻi to manage the ranch operations, and he recognized the dismal state of the environment. Water was a critical issue and, in 1912, a tunneling project between the water source at Maunalei and the ranch headquarters at Kōʻele was completed. Water could then be drawn up to Kōʻele, where a reservoir was constructed, and piped to remote pasture locations across the plateau lands. In 1917, the Baldwin brothers, of Maui, purchased the Lānaʻi Company, Ltd. ranch lands, continuing cattle ranching in conjunction with the Kahoʻolawe Ranch, and other Baldwin family ranching interests on Maui. Then in 1922, they sold the Lānaʻi ranch lands to James Dole's Hawaiian Pineapple Company, Ltd., by which time there were more than 5,000 head of cattle, and almost no sheep on Lānaʻi. The Hawaiian Pineapple Company (HAPCo.) maintained the Lānaʻi Ranch operations from 1922 to 1951, when the last round-up took place.

The impacts of uncontrolled grazing and loss of forests and ground cover led to significant erosion

from both wind and storm water flow. In many areas wind and rain nearly erased all evidence of traditional Hawaiian residency. This said, anywhere outside of the cultivated pineapple fields, lithic scatter, coral, shell, fire pits, and artifacts are still visible in deflated features, and in sheltered areas in cultural features that retain a high level of integrity.

A series of articles, published in the Maui News between 1926 and 1939, provide us with eyewitness accounts of the growth and development of the Lānaʻi pineapple plantation operations and city. The first article published in the Maui News on February 3, 1926, told readers of the visit by James Dole and his associates, as he unveiled the plantation and city to all Hawaiʻi. The account, describing development which had occurred on Lānaʻi between 1923 and January 1926, reads:

> "January 31, 1926: Developments on Lānaʻi Visited by Businessmen and Government Officials. 'Hawaiian Pineapple Company Runs Excursion to its property and Entertains Visitors.'
>
> Sunday was show day at Lānaʻi , the Hawaiian Pineapple Company having chartered the Inter-Island steamer Kilauea to take almost 150 prominent Honoluluans to see what it has done with the property it purchased from Baldwin interests in the way of pineapple developments. The Governor and other territorial officials as well as some of the city and county officials were in the party.
>
> The Kilauea sailed from Honolulu at 10 o'clock Saturday night and discharged her passengers at Kaumalapau at 6 Sunday morning. Awaiting them were some 40 automobiles and they were taken about in cars for their sightseeing trip, most of which were brought with them from Honolulu. James D. Dole, president of the company personally conducted the party. The motorcade started at 7:50 headed by H. Bloomfield Brown in charge of affairs for the company on the island.
>
> Dinner was served at noon and there was speech making, among the speakers being the Governor. A heavy rainfall cut short the sightseeing trip and the Kilauea sailed on her return trip at 3:30. The Hawaiian Pineapple Company has spent for purchase of the property and

> its development more than $3,000,000 and the visitors were much impressed with what has been done on the property."

The following facts and figures as to Lānaʻi are taken from a folder which was prepared for the excursionists:

> Island of Lānaʻi , 140 square miles, 90,000 acres; located 65 miles southeast of Honolulu; estimated pineapple land, 15,000 to 20,000 acres; option on Lānaʻi taken September 5, 1922; option exercised December 5, 1922; population at that time about 150; present population, 1000; elevation of Lānaʻi City, 1650 feet; building of Lānaʻi City commenced August 1923; number of schools, two; attendance, 150; seven miles of asphalt macadam road to Lānaʻi City, eight to 12 inches thick, and 200 feet wide, widened at turns; maximum grade of road to Lānaʻi City, about 6per cent; water supply lifted 750 feet by electric pump from tunnels in bottom of Maunalei gulch; water brought in six inch redwood pipe through three riders by three tunnels, aggregating 5300 feet in length; capacity of old Kaiholena reservoir, 500,000 gallons; capacity new Kaiholena reservoir, 3,900,00 gallons; electric power generated by 100 KW oil engine generator set, generated at 440 volts, transmitted at 2300 volts; capacity moving picture theater, 450; Kaumalapau harbor development work commenced September 1923; length of break water 300 feet; tonnage of rock in breakwater, 116,000; minimum depth of Kaumalapau harbor, 27 feet; depth of Kaumalapau harbor entrance, 65 feet; length of wharf, 400 feet; number of cattle on ranch at present time, 4000. [Maui News Editorial, February 3, 1926, page 1, c. 2]

By 1930, the population on Lānaʻi totaled 2,356 residents. In the middle 1930s, efforts in expanding the amount of acreage were made, and new laborers, primarily of Filipino and Japanese ancestry, settled on Lānaʻi. All planting, picking, weeding and most field clearing was done by hand labor. There were no pineapple picking machines. The pickers picked by hand, loaded bags, walked to the end of the rows and then loaded the pine in boxes. The boxes were then hand loaded onto trucks and driven down to Kaumālapaʻu, where cranes would load the truck bins onto the barges for shipping to the cannery at Iwilei in Honolulu.

Later Maui News articles document the following descriptions of Lānaʻi City, the island community and plantation operations, noting that sixteen years after Dole's acquisition of Lānaʻi, the island had become the world's largest pineapple plantation. The following reports on the success of the Lānaʻi venture were published in 1938 and 1939:

> "1938: 'Hawaiian Pine Improves Conditions on Lānaʻi Isle. The past ten years have brought phenomenal development to the island of Lānaʻi under the guidance of the Hawaiian Pineapple Co., which is creating ideal working conditions for its employees.'
>
> Ten years ago, Lānaʻi was just another unimportant island on the map of the Hawaiian group; today the Hawaiian Pineapple Co. operates on it the largest pineapple plantation in the world, to supply fruit for its cannery in Honolulu, also the largest in the world.
>
> Ten years ago, Lānaʻi 's population was approximately 600, and about 4,000 acres were under cultivation. Today the land under cultivation has increased five-fold to 20,000 acres, and the island's population has grown to an estimated 3,500.
>
> The five year period from 1925 to 1930 was one of great building activity on Lānaʻi as the pineapple company conducted an extensive building program to provide housing for the hundreds of workers who were arriving almost on every boat to make their homes on the island.
>
> Homes for married couples were erected by blocks, in numerical order. There were model two bedroom homes, with large airy living rooms and spotless kitchens, running water, electricity and spacious grassed yards.
>
> Single men's houses were divided in two by a partition with three furnished rooms in each section. All these houses were supplied with running water and electricity. They were laid out to provide ample space around each house.
>
> Attractive as these homes were eight years ago, they are now being remodeled and made

better, finer homes. More spacious rooms are being added and sanitary toilets and baths installed…" [Maui News Editorial, January 22, 1938, page 1 c. 2]

In the early years of the Lānaʻi Plantation, harvests were picked and bagged in the field and taken to small crates along the roads. The crates were then loaded on wagons (later on trucks) and taken to Kaumālapaʻu Harbor for shipping to Honolulu.

Over the years, various machines and equipment were developed to simplify the planting, watering and harvesting process. Machines laid out mulch paper, marking the planting rows. Large boom and spray sprinklers were developed to water and fertilize the crops. Conveyor booms 62 feet long - with lights - were developed so fruit could be harvested day and night. Gangs of pineapple pickers would walk along rows of pineapple (planted along contour lines), pick the fruit, toss it on the conveyor and send it to the large bins (of some 7 tons) on the trucks, for shipping to Honolulu from Kaumālapaʻu Harbor.

For almost 70 years, Lānaʻi was the world's largest working pineapple plantation (comprised of some 20,000 cultivated acres). All of the families of Lānaʻi, regardless of their place of origin, proudly observed that they were from the "Pineapple Island." In 1961, Castle & Cooke bought out Dole Foods' interests, and in the 1970s began planning for new resort and residential developments on Lānaʻi. Those plans never materialized, and in 1985 David H. Murdock bought out Castle & Cooke's interests, which included the island of Lānaʻi. Under Murdock's ownership, development plans were revitalized, and steps towards phasing out the pineapple plantation acted upon. Although pineapple was once "King" on Lānaʻi, this 70-year tradition ended in 1992 with the final pineapple harvest.

Throughout the years of cultivation, artifacts would periodically be found in the fields. Typically, ulu maika (round, disc-like game stones), koʻi (adze) and other tools would be found, and significant collections of these artifacts are now housed at the Lānaʻi Culture & Heritage Center. While the land has radically changed were cultivation occurred, the result of 70 years of bulldozing, tilling and erosion, evidence of traditional residency may still be found. Recent work conducted in partnership with qualified archaeologists, Pūlama Lānaʻi and the Lānaʻi Culture &

Heritage Center have identified scattered cultural deposits in areas of the former fields. The most common finding are lithic scatters, broken artifacts, and outlines of ancient fire pits.

4.10.2 Environmental Consequences for Cultural Resources

The ROI for the effects of the proposed drilling activities on the Cultural Resources within the Pālāwai Basin is within the confines of the prospective drill sites themselves. No impacts were identified that extend outside of prospective sites.

Proposed Action (Preferred Alternative): No archaeological sites are known nor believed to exist in the immediate vicinity of any of the prospective drill sites.

No Action Alternative: Under the no-action alternative, there would be no impacts on the cultural resources within the prospective drill site.

Mitigation: Should evidence of archeological or cultural resources be encountered during site preparation work or during drilling, then activities at the site will be suspended and Pūlama Lānaʻi and the DLNR State Historic Preservation Division will be contacted immediately for review, evaluation, and recommendations on how to preserve or avoid damage to the resources.

No impacts are anticipated on the cultural resources within Pālāwai Basin lands.

4.11 Potable Water

4.11.1 Affected Environment

Text excerpts transferred from Department of Water Supply, 2011, Lānaʻi island water use and development plan: Maui County Water Use & Development Plan -- Lānaʻi, 190 p.

Historical pumpage on Lānaʻi peaked at around 3.5 million gallons per day (MGD) in 1989. With the end of the pineapple economy in 1992, pumpage dropped to just under 2 MGD, gradually rising to 2.24 MGD in 2008.

Metered demand on Lānaʻi in 2008 was roughly 1.66 MGD. Of that amount, roughly 0.76 MD

was from Wells 1, 9 & 14, serving brackish water for irrigation to the Manele Project District area. Roughly 0.52 MGD was for the areas of Lānaʻi City, Koele and Kaumālapaʻu, and roughly 0.38 was fresh water for Manele Project District and the Pālāwai Irrigation Grid.

By region, metered demand for the Manele Project District was the highest, with consumption in 2008 of 1.08 MGD of combined fresh and brackish water, followed by Lānaʻi City with 0.36 MGD of metered demand, Koele Project District with 0.15 MGD of metered demand, the Pālāwai Irrigation Grid with 0.05 MGD of metered demand, and finally Kaumālapaʻu with 0.015 MGD of metered demand.

Demand was forecasted to the year 2030 using three methods: simple time trend regressions; projections using forecast coefficients derived based upon the SMS forecast prepared for the ongoing Community Plan update process; and analysis of build-out of CCR project development proposals. Time trend analysis yielded projections of water consumption ranging from 2.4 to 3.2 MGD in 2030.

4.11.2 Environmental Consequences for Water Resources

There are no known potable drinking water resources in the ROI of the proposed drilling.

Proposed Action (Preferred Alternative): As noted in the previous discussion, there are no shallow sources of potable drinking water within the Pālāwai Basin.

We will use a conventional water-well drilling fluid composed of bentonite clay and polymer. All the materials that will be used during the drilling are typically used for potable water well drilling and are considered to pose a minimal risk of degrading the water quality in the formations being drilled.

No Action Alternative: Under the no-action alterative, there would be no impact on potable water resources within the Pālāwai Basin.

Mitigation: There are no known prospective potable water sources in the area surrounding either proposed drill location at Lānaʻi Well #10 and Lānaʻi Well #9. Nonetheless, the non-toxic drilling materials have been selected to protect against possible impacts to unknown resources. Secondly, as part of the completion work on the well, we will use fluid bailers to remove as much of the drilling fluids from the bore as is possible to enable us to collect clean samples of formation water for the planned chemical analysis of and evolution of water quality.

An additional impact come from the use of water during drilling, which is estimated to be less than or equal to 25,000 gallons per day. To minimize the impacts of our water use on the potable water resources of the island of Lānaʻi, we will be using non-potable water for the drilling fluids.

The impact of the drilling activity on any groundwater resources below the Pālāwai Basin lands will be temporary and insignificant.

4.12 Wastewater Disposal

4.12.1 Affected Environment

Text excerpts transferred from Maui County, 2016, Lānaʻi Community Plan: Ordinance No. 4343, Bill No. 67, 198 p.

Wastewater consists of used water and waste from homes and workplaces, also known as sewage. It typically contains materials such as organic matter (human waste and food scraps), oil and grease, debris, and traces of heavy metals.

Management of the wastewater stream is important because it protects the water supply from becoming contaminated and aids in water conservation by allowing reclaimed water to be used for non-potable water purposes. Improper disposal of wastewater has the potential to damage the drinking-water supply, coastal water quality, and other important resources.

Lānaʻi has both the Manele Wastewater Treatment Plant and a County of Maui wastewater treatment facility. The majority of the rural and agriculturally developed areas of Maui County are served by individual cesspools and septic tanks.

The use of reclaimed wastewater for irrigation is economically and environmentally beneficial. The State of Hawai‘i defines R-1 water as the highest-quality recycled water; it has undergone filtration and disinfection to make it safe for use on lawns, golf courses, parks, and other areas used by people. R-2 recycled water has a slightly lower quality relative to R-1 recycled water and can only be used under restricted circumstances where human contact is minimized. R-1 is primarily used in West Maui, South Maui, and Lāna‘i. The resort facilities on Lāna‘i operate and maintain their own wastewater-treatment facilities and utilize their own wastewater, as well as the wastewater from Lāna‘i City for irrigation. This water-reclamation activity dramatically improves the efficiency of water use.

4.12.2 Environmental Consequences for Wastewater Disposal

The ROI for the effects of the proposed drilling on wastewater disposal is expected to be restricted to the drill site area only.

Proposed Action (Preferred Alternative): The project will maintain portable toilets at any drill site in use. Any wastewater generated will be disposed of by a licensed contractor from whom these units will be leased. We do not anticipate any further impact on wastewater disposal within the Pālāwai Basin.

No Action Alternative: Under the no-action alternative there would be no impact on the wastewater processes that are currently employed in the Pālāwai Basin.

4.13 Solid and Hazardous Wastes

4.13.1 Affected Environment

Text excerpts transferred from Maui County, 2016, Lāna‘i Community Plan: Ordinance No. 4343, Bill No. 67, 198 p.

The existing County landfill occupies about 20 acres of a 36-acre parcel and is located four miles south of Lāna‘i City, between Kaumālapa‘u Highway and the Kalamaiki gulch at an elevation of about 850-1,020 feet. The landfill has been operating since 1969. As a small landfill in an arid area, it was developed without a liner and leachate collection and removal. County employees

divert both inert material and green waste from materials brought to the landfill. The green waste is collected in a dedicated area where its volume is reduced before it is used for slope stabilization. The landfill receives about 14 tons of solid waste per day and is forecasted to reach capacity by 2029. The County of Maui Department of Environmental Management (DEM) updated its Integrated Solid Waste Management Plan in 2007-2009 which assessed options for expanding the landfill or shipping solid waste off island in containers.

The Lānaʻi landfill operated by Maui County is free of charge for residents, while commercial users must have an established account with the landfill. Acceptable waste includes non-friable Asbestos, construction and demolition, contaminated soil, municipal solid waste, ash, and yard waste. Private haulers bring 64%, county crews 19%, and self-haulers 17% of the waste of the landfill. County crews collect waste from 640 of the 1,300 homes on the island. For the past four years, the Community Work Day Program and DEM's Abandoned Vehicles Office have held three to four collection events each year for scrap metal, white goods (refrigerators, stoves, freezers, washing machines, etc.), tires, and batteries at the Lānaʻi recycling center.

4.13.2 Environmental Consequences for Solid and Hazardous Wastes

The ROI for effects of proposed drilling on solid and hazardous waste will be restricted to the site.

Proposed Action (Preferred Alternative): The proposed activities are not expected to generate any solid or hazardous wastes that will require special treatment. Any waste products generated at the drilling sites will be consolidated into waste containers and trucked to the Lānaʻi landfill. Similarly, any waste oil generated by equipment maintenance will be consolidated and a contract will be secured to transport that waste oil to a recycling or disposal facility offsite.

No Action Alternative: Under the no-action alternative there will be no effects on the disposal of solid or hazardous wastes.

Mitigation: Proper waste management protocols will be implemented and maintained at the site at all times. Drilling activities are not anticipated to have any impact on solid or hazardous wastes on the island.

4.14 Transportation

4.14.1 Affected Environment

There are two major roads on Lānaʻi under the jurisdiction of the State of Hawaiʻi Department of Transportation Highways Division: Kaumālapaʻu Highway from Kaumālapaʻu Harbor to Manele Road (Route 440), and Manele Road from Kaumālapaʻu Highway to the entrance of Hulopoe Beach Park near Manele Bay (Route 440). There are roughly 30 miles of paved road and 400 miles of unpaved road throughout the island.

Lānaʻi Airport provides the main air transportation for the island.

4.14.2 Environmental Consequences for Transportation

The ROI for the effects of the proposed drilling on transportation is expected to extend to Lānaʻi City due to project staff and supplies transiting from these population centers to the drilling site.

Proposed Action (Preferred Alternative): The proposed drilling activities will generate between 5 and 8 trips per day for crew changes and securing supplies required for the drilling. This is expected to have minimal impact on the existing traffic load currently using Kaumālapaʻu Highway and Manele Road for transport of goods and services.

No Action Alternative: Under the no-action alternative, existing traffic levels would remain.

Mitigation: We will minimize vehicle traffic by having crew carpool for shift changes and work to coordinate supply runs with shift changes and other required trips to Lānaʻi City.

4.15 Land Use Classification and Land Use

4.15.1 Affected Environment

Text excerpts transferred from Maui County, 2016, Lānaʻi Community Plan: Ordinance No. 4343, Bill No. 67, 198 p.

With the decline and then eventual closure of pineapple production in 1992, tourism and resorts came to Lānaʻi. Currently, a single landowner owns approximately 98% of the island, while the State, County, and other private landowners own the remaining 2%.

The majority of the island is undeveloped open space covered by fallow and active agricultural fields, barren land, rocky areas, and patches of dry forest. Along the high ridgelines of Lānaʻihale is an expanse of wet forest lands. The State Land Use Commission has designated most of Lānaʻi's lands as Agriculture or Conservation District. Both of the proposed drill sites, Wells #10 and #9, exist within land designated as "cropland and pasture" by the State of Hawaiʻi Office of Planning.

Acreage by State Land Use District		
State Land Use District	Acres	Percent
Urban	3,039	3.4
Rural	2,076	2.3
Agriculture	44,612	49.4
Conservation	40,570	44.9
TOTAL	90,298*	100

Table 4-2. Source: State of Hawaiʻi, Office Planning, February 2013

*Note: Acreage total is rounded from 90,297 to 90,298 to fractions of acres.

4.15.2 Environmental Consequences for Land Use

The ROI for the effects of the proposed drilling on Land Use within the Lahaina District extends over only the drill sites. Both drill sites are designated Agriculture land.

Proposed Action (Preferred Alternative): The proposed drilling activities will not affect existing land uses in the area. The exploratory drilling activities will last for several months and leave behind minimal changes to the existing landscape.

No Action Alternative: Under the no-action alterative, there will be no impact on regional land uses.

Mitigation: Mitigation is not required.

4.16 Socioeconomic Environment

4.16.1 Affected Environment

Text excerpts transferred from Maui County, 2016, Lānaʻi Community Plan: Ordinance No. 4343, Bill No. 67, 198 p.

According to the Federal Census results for 2010, there are 3,135 residents of Lānaʻi. According to the County's Land Use forecast produced in December 2012, an additional 885 residents are forecast to live on the island by the year 2030 to each a total population of 4,020. However, the Pūlama Lānaʻi's future growth estimate and future development plans predict a total population of 6,000 by 2030. The median income for Maui County of which Lānaʻi is a part of is $47,790. The largest income bracket is $50,000-$74,999 at 13.17% of reporting census participants. Approximately 7-8% of the Lānaʻi population is unemployed.

Lānaʻi had approximately 673 visitors per day in 2010. The Maui County Socio-Economic Forecast projects the average visitor census for Lānaʻi will reach 912 visitors per day by the end of 2035. The islands of Lānaʻi and Molokai combined account for just over 1% of the total number of visitors to the state of Hawaiʻi.

4.16.2 Environmental Consequences for Socioeconomic Environment

The ROI for the effects of the proposed drilling on the regional Socioeconomics will extend to the population centers of Lānaʻi City.

Proposed Action (Preferred Alternative): The proposed exploratory drilling is expected to have minimal direct impacts on Lahaina District's socioeconomic environmental conditions. What effects it will bring will mostly be short term employment opportunities for a small number of workers. Although this type of drilling is highly specialized, and will require trained drillers, we have, in past drilling projects, provided employment to minimally trained laborers as drill hands. In some cases, these opportunities have led to longer term employment for some of the incumbents at the end of the project.

Also, more sustainable use of the water, that is based on the scientific information gained by this project, will lead to a greater assurance that future needs will be met.

No Action Alternative: Under the no action alternative, the socioeconomic environment will remain what it is.

Mitigation: Mitigation is not required.

4.17 Environmental Justice and Protection of Children

4.17.1 Affected Environment

Title VI of the 1964 Civil Rights Act and Executive Order 12898 on Environmental Justice mandates that each Federal agency identify and address, to the extent possible, disproportionately high and adverse human health or environmental effects of policies, programs, or activities on low-income and minority populations. In terms of major categories recognized by the U.S. Census (2010), most residents of the state of Hawai‘i are Asians (38.8 percent) with the reminder mostly white (30.2 percent). African Americans comprise 3.2 percent and Native Hawaiian and Pacific Islanders comprise 9.2 percent of the population. The most economically disadvantaged of the recognized ethnic groups is generally considered to be that of Native Hawaiian ancestry, having the lowest average family income and showing disproportionately high incidences of adverse health conditions, incarceration rates, and chemical dependencies (U.S. Department of Health and Human Services, Office of Minority Health).

Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks (April 21, 1997), recognizes a growing body of scientific knowledge demonstrating that children may suffer disproportionately from environmental health risks and safety risks. The Executive Order directed each Federal agency to identify and assess environmental health and safety risks that may disproportionately affect children and ensure that each agency’s policies, programs, activities, and standards address any of these risks.

The nearest residential area to the proposed work is Lānaʻi City; the socioeconomic description of this community can be found above in section 4.16. There are sporadic rural residences throughout the island.

4.17.2 Environmental Consequences for Environmental Justice and Protection of Children

The ROI for the effects of the proposed drilling on the Environmental Justice and Protection of Children may extend to the Lānaʻi City population centers on the island.

Proposed Action (Preferred Alternative): There are currently no communities near the proposed drilling locations that have significant populations of minorities or that could be adversely impacted by the proposed exploratory drilling activities. As noted above, the project will generate increased temporary employment opportunities for lesser skilled laborers and, hence, those opportunities would accrue to the benefit of the more vulnerable population of economically disadvantaged individuals on the island.

No Action Alternative: Under the no action alternative, environmental justice will remain in its existing condition.

Mitigation: Mitigation is not required.

CHAPTER 5: ANALYSIS OF IMPACTS

In our consideration of impacts, we will consider only those impact areas that have some adverse impact from the proposed project. These include: Noise, Anthropogenic Light, Air Quality, Solid Waste, and Transportation which all have less than significant impacts; the other impact areas were considered to incur either no impact or a positive impact.

5.1 Noise Impacts

Our scientific drilling rig typically produces noise on the order of 75 dB at 10 m. The location of the proposed drill site at Lānaʻi Well #10 is isolated from the region's main population centers, and noise from this location will naturally dissipate before reaching more densely populated regions. Lānaʻi Well #10 is also in close proximity to the diesel power-generating facility which generates noise itself, as Lānaʻi Well #9 is just outside Lānaʻi City which generates anthropogenic noise during the day. Rotary drilling of both wells was much louder than scientific drilling will be.

5.2 Anthropogenic Light

Lights on the drill rig are mainly focused toward the rig and work area rather than outward, and many lights are shielded on one side to ensure this and to minimize any disruption of nighttime bird flight. As with noise, the range of strong lighting is limited and not expected to disturb residents in the drilling areas. The top of the mast of the drill rig reaches less than 50 ft. in the air, with the highest lights lower and directed downward.

5.3 Air Quality Impacts

Impacts on air quality will come from drill rig engine and support equipment emissions. The expected duration of drilling at each site is only one month, which will limit the impact on air quality.

5.4 Fauna Impacts

There is a potential impact on fauna from lighting, which may disrupt the flight paths of nighttime birds or bats. As mentioned above, this impact will be minimized by shielding of the lights and directing them downward and toward the drill rig.

5.5 Solid, Hazardous, or Medical Wastes Impacts

Any solid wastes generated by the proposed drilling activities will be managed by qualified contractors. The combined solid wastes are not expected to exceed the waste management capacity available on the island. We do not anticipate generating any hazardous or medical waste during the drilling program.

5.6 Transportation Impacts

Impacts on transportation arising from the proposed drilling will be for work and science crews commuting to and from PTA for their respective shifts, and for project scientists and managers to make periodic visits to the site to review the rock core and drilling progress. The crew shift change will be scheduled at off-peak traffic commute times to minimize the contribution of the drilling staff to the peak traffic loads on the island.

5.7 Follow-on or Secondary Impacts

Results of this project are anticipated to be incorporated into future planning and siting of water supply wells on Lānaʻi. Results will also enable more informed decisions to be made with respect to alternative water sources (e.g. desalinization) to supply the needs of Lānaʻi stakeholders.

CHAPTER 6: DETERMINATION OF SIGNIFICANCE AND FINDINGS

6.1 Criteria

"Significant effect" is defined in HRS 343 as: "the sum of effects on the quality of the environment, including actions that irrevocably commit a natural resource, curtail the range of beneficial uses of the environment, are contrary to the States environmental policies or long-term environmental goals as established by law, or adversely affect the economic welfare, social welfare, or cultural practices of the community and State. Based on this definition, the anticipated determination for the proposed project is a Finding of No Significant Impact (FONSI). A discussion of this finding and reasons supporting this determination is provided below.

6.1.1 Involves an irrevocable commitment to loss or destruction of any natural or cultural resource

The proposed project will not result in a loss of natural or cultural resources because the planned project areas have been previously graded or developed and drilled. No threatened or endangered plant species are located within the ROI of the prospective project sites. The proposed activity is not expected to have a detectable impact on the population of native and alien birds on the island of Lānaʻi. No threatened or endangered avifaunal or mammal species were identified at the prospective drilling locations.

No archaeological sites were recorded and none are believed to exist within the ROI of the prospective drill sites. No further archaeological work is recommended in the project area but, if cultural features are encountered during the site preparation and drilling activities, cultural resource personnel will be notified and drilling activities will be suspended until the University has consulted with DLNR State Historic Preservation Division, the Office of Hawaiian Affairs, and others having an interest in the disposition of cultural finds.

6.1.2 Curtails the range of beneficial uses of the environment

The majority of the project area has been previously graded or developed and drilled; therefore, the proposed project does not curtail beneficial uses of the environment.

6.1.3 Conflicts with the State's long-term environmental policies or goals and guidelines as expressed in Chapter 343, Hawai'i Revised Statutes (HRS), and any revisions thereof and amendments thereto; court decisions; or executive orders

The proposed action is in accordance with guidelines and regulations established in Chapter 343, HRS; the National Environmental Policy Act (NEPA); Council on Environmental Quality (CEQ).

6.1.4 Adversely affects the economic and social welfare of the community or State

The proposed activities would not adversely affect social or economic conditions of the surrounding area. If new resources are identified, they could potentially have positive economic impacts on the island but this, and other long-range impacts of these boreholes, is speculative without the data sought by the present project.

6.1.5 Substantially affects public health

Factors related to public health, including air, noise, and water quality, are expected to be temporary and minimally affected or unaffected by the drilling activities. Department of Health regulations will be followed to mitigate any potential public health impacts.

6.1.6 Involves substantial secondary impact, such as population changes or effects on public facilities

The proposed project will not in itself generate new population growth. The proposed activities will generate new information that, in and of itself, will not have a broad impact on the island. Public facilities will not be adversely affected by the planned activities.

6.1.7 Involves a substantial degradation of environmental quality

The proposed impacts of the planned drilling on air and water quality, noise levels, natural resources, and land use associated with these activities are anticipated to be minimal. Practical mitigation measures will be employed to further minimize potentially detrimental effects to the environment associated with the proposed activities.

6.1.8 Is individually limited but cumulatively has considerable effect upon the environment or involves a commitment for larger actions

The proposed activities were not found to significantly impact, or interact with, other proposed and ongoing activities in the Pālāwai Basin region in a way that would result in significant cumulative impacts. Follow-on impacts that may result from future decisions that may be made based on the results of the present action are so speculative that no credible analysis can be made of those impacts.

6.1.9 Substantially affects a rare, threatened, or endangered species

No rare, threatened, or endangered species are known to exist in the immediate vicinity of the prospective drilling sites.

6.1.10 Detrimentally affects air or water quality or ambient noise levels

During drilling there will be a slight impact on the groundwater in the immediate vicinity of the wellbores being drilled due to loss of drilling fluids into the formation. These impacts will be minimized through the use of specific drilling technology that will minimize the volume of materials deposited in the formation and those materials used will be selected to be non-toxic and non-threatening to the long-term water quality around the test wells. Air quality will temporarily decrease during drilling and on-site activities but this impact will be minimized and temporary. Ambient noise levels will increase during drilling but measures are available to ensure that these impacts are minimal and they will be temporary.

6.1.11 Affects, or is likely to suffer damage, by being located in an environmentally sensitive area such as a flood plain, tsunami zone, erosion-prone area, geologically hazardous land, estuary, fresh water or coastal waters

The proposed activity will not affect, nor is it located in, any environmentally sensitive areas such as those listed.

6.1.12 Substantially affects scenic vistas and view planes identified in County or State plans or studies

The proposed project will not substantially alter view planes within the Pālāwai Basin lands, and

what effects do occur will be temporary in nature.

6.1.13 Requires substantial energy consumption

Drilling activities are not expected to require a substantial amount of electrical energy.

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APPENDIX A

Pre-Consultation Communications

Representatives from the University of Hawaii consulted with the community of Lanai in a public advertised and attended community meeting hosted by Pulama Lanai. A presentation was provided by University of Hawaii, followed by questions and open forum discussion.

The information meeting took place on Monday, September 10, 2018 at 5 p.m. in ILWU Hall. The flyer for the event is included below.

APPENDIX B

Material Safety Data Sheets

For Drilling Materials

Ciba Specialty Chemicals Corporation

Material Safety Data Sheet

OSHA / ANSI Z400.1-2004 Compliant

MSDS date: 30-Mar-2006

NFPA Rating:	**Health:** 1	**Flammability:** 1	**Instability:** 0	
HMIS Rating:	**Health:** 1	**Flammability:** 1	**Physical Hazard:** 0	**Personal Protection:** X

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name: **ALCOMER 120L**

Product Number: **5991062**

Chemical Family: Copolymer of sodium acrylate and acrylamide dispersed in mineral oil.

Manufacturer/Supplier:
Ciba Specialty Chemicals Corporation
2301 Wilroy Road
Suffolk, VA 23434
8:30am - 5pm Phone Number: 1-757-538-3700
MSDS Request Line (voicemail): 1-800-431-2360
Customer Service/Product Information 1-800-322-3885

Emergency 24-Hour Health/Environmental Phone: 1-800-873-1138

2. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

Signal Word: CAUTION!
Physical Form: Liquid
Color: White to off-white
Odor: Slight hydrocarbon oil-like odor
Health: Contact causes eye irritation. Contact causes skin irritation.
Physical Hazards: Slip hazard when wet.

OSHA Hazardous Substance: This material is classified as hazardous under OSHA regulations.

Primary Route(s) of Entry: Eyes, Skin, Inhalation, Ingestion.

3. COMPOSITION/INFORMATION ON INGREDIENTS

HAZARDOUS COMPONENTS

Components	CAS Number	Weight %
Distillates, petroleum, hydrotreated heavy naphthenic	64742-52-5	30-40
Alcohols, C12-15, ethoxylated propoxylated	68551-13-3	1-5
Naphtha, petroleum, hydrotreated heavy	64742-48-9	0-5

4. FIRST AID MEASURES

Eyes: Flush the eye(s) with lukewarm, gently flowing water for 5-10 minutes or until the chemical is removed. Get medical attention if irritation persists.

Skin: Wash off immediately with soap and plenty of water. Get medical attention if irritation occurs. If clothing is contaminated, remove and launder before reuse.

Inhalation: Remove to fresh air, if not breathing give artificial respiration. If breathing is difficult, give oxygen and get immediate medical attention.

Ingestion: Do not induce vomiting. If vomiting occurs naturally, have casualty lean forward to reduce the risk of aspiration. Seek medical attention immediately.

5. FIRE FIGHTING MEASURES

Fire Fighting Measures: Standard procedure for chemical fires. The product becomes slippery when wet. Restrict pedestrian and vehicular traffic in areas where slip hazard may exist.

Suitable Extinguishing Media: Carbon dioxide, dry chemical or foam.

Unsuitable Extinguishing Media: If water is used, restrict pedestrian and vehicular traffic in areas where slip hazard may exist.

Fire Fighting Equipment: Wear self-contained breathing apparatus and protective suit.

Unusual hazards: The product is slippery when wet.

Hazardous Combustion Products: Burning may produce oxides of carbon or nitrogen.

6. ACCIDENTAL RELEASE MEASURES

Cleanup Instructions: Absorb spill with inert material (e.g. dry sand or earth), then place in a chemical waste container. Spills are very slippery. Clean up promptly.

Other Information: This product may be classified as an oil under Section 311 of the Clean Water Act and 40 CFR Part 1 10, Part 1 12. Spills entering (A) surface waters or (B) any water courses or sewers entering/leading to surface waters that cause a sheen must be reported to the National Response Center (NRC: 800-424-8801). In Washington, DC metropolitan areas call 202-426-2675.

7. HANDLING AND STORAGE

Handling: As with all industrial chemicals, use good industrial practices when handling. Avoid eye, skin, and clothing contact. Do not inhale. Do not taste or swallow. Use only with adequate ventilation.

Storage: Keep containers tightly closed in a cool, well-ventilated place. Avoid extremes of temperature.

For Industrial Use Only

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure Guidelines:

There are no OSHA or ACGIH exposure guidelines available for component(s) in this product.

Components	OSHA PEL	OSHA STEL	ACGIH TWA	ACGIH STEL	Ciba/ Manufacturer IEL:
Distillates, petroleum, hydrotreated heavy naphthenic 64742-52-5	2000 mg/m^3 500 ppm				

Personal Protective Equipment

Eye/Face Protection: Wear splash proof chemical goggles.

Skin Protection: Wear chemical resistant gloves and protective clothing.

Respiratory Protection: Use NIOSH approved respirator as needed to mitigate exposure.

Engineering Controls: Work in well ventilated areas. Do not breathe vapors or mist. Local exhaust/ventilation recommended.

Other Protective Equipment: Eye wash station and safety shower should be available in immediate work area. Select additional protective equipment based upon potential for exposure.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical Form: Liquid
Color: White to off-white
Odor: Slight hydrocarbon oil-like odor.
Boiling Point: > 100°C (212°F)
Freezing/Melting Point: Not determined
Solubility in water: Soluble, solubility limited by viscosity
Vapor Density: Not determined
Vapor Pressure: Not determined
Specific Gravity: 1.1
pH: 7.5 (1 % solution)
Percent Volatile: Not determined
VOC: Not determined
Partition Coefficient (Octanol/Water): Not determined
Autoignition Temperature: Not determined
Decomposition Temperature: Not determined
Flammability Limits in Air:
- **Upper** Not determined
- **Lower** Not determined

Flash point: > 93°C (200°F)
- **Test Method (for Flash Point):** PMCC

10. STABILITY AND REACTIVITY

Stability:	Stable.
Conditions to Avoid:	Avoid temperature extremes, especially frost and freezing conditions.
Incompatibility:	Strong oxidizing agents. (may degrade polymer)
Hazardous Decomposition Products:	No decomposition expected under normal storage conditions.
Possibility of Hazardous Reactions:	None expected.

11. TOXICOLOGICAL INFORMATION

Acute Oral Toxicity:	Not determined.
Acute Dermal Toxicity:	Not determined
Acute Inhalation Toxicity:	Not determined.
Eye Irritation:	Not determined.
Skin Irritation:	Not determined.
Skin Sensitization:	Not determined
Carcinogenicity (IARC; NTP; OSHA; ACGIH):	None of the components in this product at concentrations greater than 0.1% are listed by IARC; NTP, OSHA or ACGIH as a carcinogen.
Carcinogenicity Studies:	Not listed as a carcinogen by IARC, NTP, OSHA, or ACGIH.
Mutagenicity:	Not determined
Reproductive Toxicity:	Not determined
Teratogenicity:	Not determined.
Neurotoxicity:	Not determined
Subacute Toxicity:	Not determined
Subchronic Toxicity:	Not determined
Chronic toxicity:	Not determined
Absorption / Distribution / Excretion / Metabolism:	Not determined
Additional Information:	Not determined

12. ECOLOGICAL INFORMATION

Toxicity to Fish:	LC50 811 mg/L 96 hour (Rainbow trout)
Toxicity to Invertebrates:	Not determined
Toxicity to Algae:	Not determined
Toxicity to Sewage Bacteria:	Not determined
Activated Sludge Respiration Inhibition Test:	Not determined
Biochemical Oxygen Demand (BOD):	Not determined
Chemical Oxygen Demand (COD):	Not determined
Total Oxygen Demand (TOD):	Not determined
Biodegradability:	Not determined
Bioaccumulation:	Not determined
Additional Environmental Data:	Product not considered toxic to aquatic organisms.

13. DISPOSAL CONSIDERATIONS

Waste Disposal: Dispose in accordance with local, state, provincial and federal regulations.

14. TRANSPORT INFORMATION

U.S. Department of Transportation (DOT):

Not regulated for this mode of transport.

DOT (Bulk) Oil Statement:
This product is considered to be an oil per the definitions in 49 CFR 130.2. If packed in a container with a capacity of 3,500 gallons or more, the Communication Requirements at 49 CFR 130.11 and the Response Plan Requirements at 49 CFR 130.31 and 130.33 apply to Domestic transportation by motor vehicles and rolling stock.

Notification of releases to the National Response Center (NRC), 800-424-8802, may be necessary. In the Washington, DC metropolitan area, call 202-426-2675.

International Maritime Dangerous Goods (IMDG):

Not regulated for this mode of transport.

International Air Transportation Authority (IATA):

Not regulated for this mode of transport.

15. REGULATORY INFORMATION

Federal Regulations

OSHA Hazardous Substance: This material is classified as hazardous under OSHA regulations

Clean Air Act - Hazardous Air Pollutants (HAP): This product contains the following Hazardous Air Pollutants (HAP), as defined by the U.S. Clean Air Act Section 112 (40 CFR 61).

Components	CAA Section 112 Statutory Hazardous Air Pollutants
2-propenamide 79-06-1 (0-0.05 %)	Listed.

Clean Air Act - Volatile Organic Compounds (VOC): This product contains the following SOCMI Intermediate or Final Volatile Organic Compounds (VOC), as defined by the U.S. Clean Air Act Section 111 (40 CFR 60.489).

Components	CAA Section 111 Volatile Organic Compounds
2-propenamide 79-06-1	Listed.

Clean Air Act - Ozone Depleting Substances (ODS): This product neither contains, nor was manufactured with, a Class I or Class II ozone depleting substance (ODS), as defined by the U.S. Clean Air Act Section 602 (40 CFR 82, Subpt. A, App. A+B).

Clean Water Act - Priority Pollutants (PP): This product does not contain any priority pollutants listed under the U.S. Clean Water Act Section 307 (2)(1) Priority Pollutant List (40 CFR 401.15).

Resource Conservation and Recovery Act (RCRA): Not a hazardous waste under RCRA (40 CFR 261.21).

SARA Section 302 Extremely Hazardous Substances (EHS): This product contains the following component(s) regulated under Section 302 (40 CFR 355) as Extremely Hazardous Substances.

Components	Section 302 Extremely Hazardous Substances (EHS)
2-propenamide 79-06-1 (0-0.05 %)	Listed.

SARA Section 304 CERCLA Hazardous Substances: This product contains the following component(s) regulated under Section 304 (40 CFR 302) as hazardous chemicals for emergency release notification ("CERCLA" List).

Components	Section 304 CERCLA Hazardous Substances	CERCLA Reportable Quantity
2-propenamide 79-06-1 (0-0.05 %)	Listed.	5000 LBS

SARA Section 311/312 Hazard Communication Standard (HCS): This product is regulated under Section 311/312 HCS (40 CFR 370). Its hazard(s): Acute (immediate) health hazard.

SARA Section 313 Toxic Chemical List (TCL): This product does not contain any component(s) listed on the Section 313 Toxic Chemical List.

TSCA Section 8(b) Inventory Status: All component(s) comprising this product are either exempt or listed on the TSCA inventory.

TSCA Section 5(e) Consent Orders: This product is not subject to a Section 5(e) Consent Order.

TSCA Significant New Use Rule (SNUR): This product is not subject to a Significant New Use Rule (SNUR).

TSCA Section 5(f): This product is not subject to a Section 5(f)/6(a) rule.

TSCA Section 12(b) Export Notification: This product does not contain any component(s) that are subject to a Section 12(b) Export Notification

State Regulations

California Proposition 65: This product contains the following component(s) currently on the California list of Known Carcinogens and Reproductive Toxins.

Components	California Proposition 65
2-propenamide *79-06-1*	Carcinogenic.

Pennsylvania Right-To-Know: This product contains the following component(s) which are subject to Pennsylvania Right-to-Know disclosure requirement.

Components	CAS Number	Pennsylvania Right-to-Know
2-Propenoic acid, sodium salt, polymer with 2-propenamide	25085-02-3	Not Listed.
Distillates, petroleum, hydrotreated heavy naphthenic	64742-52-5	Listed.
Naphtha, petroleum, hydrotreated heavy	64742-48-9	Not Listed.
Alcohols, C12-15, ethoxylated propoxylated	68551-13-3	Not Listed.
2-propenamide	79-06-1	Listed. Environmental hazard.

International Regulations

Chemical Weapons Convention (CWC): This product does not contain any component(s) listed under the Chemical Weapons Convention Schedule of Chemicals.

Domestic Substance List (DSL) Status: All components either exempt or listed on the DSL.

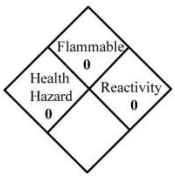
16. OTHER INFORMATION

Reason for revision: MSDS update.

Disclaimer: The information contained herein is based upon data believed to be correct. However, no guarantee or warranty of any kind, expressed or implied, is made with respect to such data or information. The user is responsible for determining whether the product is suitable for its intended conditions of use.

WYO-BEN, INC.

MATERIAL SAFETY DATA SHEET



NFPA FIRE HAZARD IDENTIFICATION SYSTEM

I. PRODUCT IDENTIFICATION

Trade Name(s): **NATURALGEL ®**

Generic Name(s): Wyoming (Western) Bentonite; Bentonite Clay (CAS No. 1302-78-9)

Chemical Name(s): Sodium Montmorillonite (CAS No. 1318-93-0)

Manufacturer: **WYO-BEN, INC.** Address: P.O. Box 1979 Billings, Montana 59103	Telephone Numbers: Information: (406) 652-6351 EMERGENCY: (406) 652-6351

II. HAZARDOUS INGREDIENTS

Ingredient	CAS NO.	%	Hazard
Crystalline Silica (SiO_2) as Quartz	14808-60-7	See Note	Low concentrations of crystalline silica (SiO_2) in the form of quartz may be present in airborne bentonite dust. See Section VI for discussion of health hazard.

Note: Although the typical quartz content of western bentonite is in the range of 2 to 6% most of the quartz particles are larger than the 10 μ respirable threshold size. The actual respirable quartz concentration in airborne bentonite dust will depend upon bentonite source, fineness of product, moisture content of product, local humidity and wind condition at point of use and other use specific factors.

III. PHYSICAL DATA

Boiling Point (°F): NA	Specific Gravity (H_2O=1): 2.45-2.55
Vapor Pressure (mm. Hg): NA	Melting Point: Approx. 1450°C
Vapor Density (Air = 1): NA	Evaporation Rate (Butyl Acetate = 1): NA
Solubility in Water: Insoluble, forms colloidal suspension.	pH: 8-10 (5% aqueous suspension)
Density (at 20° C): 55-68 lbs./cu.ft. as product.	

Appearance and Odor: Bluegray to green as moist solid, light tan to gray as dry powder. No odor.

IV. FIRE AND EXPLOSION DATA

Flash Point: NA	Flammable Limits: LEL: NA UEL: NA

Special Fire Fighting Procedures: NA

Unusual Fire and Explosion Hazards: None. Product will not support combustion.

Extinguishing Media: None for product. Any media can be used for the packaging. Product becomes slippery when wet.

V. REACTIVITY

Stability: Stable

Hazardous Polymerization: None

Incompatibility: None

Hazardous Decomposition Products: None

NA = Not Applicable ND = Not Determined

Date Prepared: October 5, 2007 Doc #1060-00:

VI. HEALTH HAZARD INFORMATION

Routes of Exposure and Effects:

Skin: Possible drying resulting in dermatitis.

Eyes: Mechanical irritant.

Inhalation: *Acute* (short term) exposure to dust levels exceeding the PEL may cause irritation of respiratory tract resulting in a dry cough. *Chronic* (long term) exposure to airborne bentonite dust containing respirable size (≤ 10 µm) quartz particles, where respirable quartz particle levels are higher than TLV's, may lead to development of silicosis or other respiratory problems. Persistent dry cough and labored breathing upon exertion may be symptomatic.

Ingestion: No adverse effects.

Permissible Exposure Limits: (for air contaminants)	OSHA PEL (8hr. TWA)	ACGIH TLV
Bentonite as "Particulates not otherwise regulated" (formerly nuisance dust)		
Total dust	15mg/m^3	ND
Respirable dust	5mg/m^3	ND
Crystalline Silica: Quartz (respirable)	10 mg/m^3 / % Silica + 2	0.025 mg/m^3

Carcinogenicity: Bentonite is not listed by ACGIH, IARC, NTP or OSHA. IARC, 1997, concludes that there is sufficient evidence in humans for the carcinogenicity of inhaled crystalline silica from occupational sources (IARC Class 1), that carcinogenicity was not detected in all industrial circumstances studied and that carcinogenicity may depend on characteristics of the crystalline silica or on external factors affecting its biological activity. NTP classifies respirable crystalline silica as "known to be a human carcinogen" (NTP 9th Report on Carcinogens – 2000). ACGIH classifies crystalline silica, quartz, as a suspected human carcinogen (A2).

Acute Oral LD_{50}: ND	Acute Dermal LD_{50}: ND	Aquatic Toxicology LC_{50}: ND

Emergency and First Aid Procedures:

Skin: Wash with soap and water until clean.

Eyes: Flush with water until irritation ceases.

Inhalation: Move to area free from dust. If symptoms of irritation persist contact physician. Inhalation may aggravate existing respiratory illness.

VII. HANDLING AND USE PRECAUTIONS

Steps to be Taken if Material is Released or Spilled: Avoid breathing dust; wear respirator approved for silica bearing dust. Vacuum up to avoid generating airborne dust. Avoid using water. Product slippery when wetted.

Waste Disposal Methods: Product should be disposed of in accordance with applicable local, state and federal regulations.

Handling and Storage Precautions: Use NIOSH/MSHA respirators approved for silica bearing dust when free silica containing airborne bentonite dust levels exceed PEL/TLV's. Clean up spills promptly to avoid making dust. Storage area floors may become slippery if wetted.

VIII. INDUSTRIAL HYGIENE CONTROL MEASURES

Ventilation Requirements: Mechanical, general room ventilation. Use local ventilation to maintain PEL's/TLV's.

Respirator: Use respirators approved by NIOSH/MSHA for silica bearing dust.

Eye Protection: Generally not necessary. Personal preference.

Gloves: Generally not necessary. Personal preference.

Other Protective Clothing or Equipment: None

IX. SPECIAL PRECAUTIONS

Avoid prolonged inhalation of airborne dust.

DEPARTMENT OF TRANSPORTATION HAZARDOUS MATERIAL INFORMATION

Shipping Name: NA (Not Regulated)	Hazard Class: NA
Hazardous Substance: NA	Caution Labeling: NA

Date Prepared: October 5, 2007 Doc #1060-00:

APPENDIX C

Drilling Equipment

Photograph of Drill Rig Proposed for Use in Core Drilling Project

Photograph of drill rig proposed for use in Core Drilling Project:
Operator end with mast fully extended

Photograph of Drill Rig Proposed for Use in Core Drilling Project:
Side view of rig with mast extended

Power Products

Print Version

Back | Current Location: Home > Serial Number Database > Results (Power Units)

Power Units | DC Gensets | CANtrak | MyCPP | International | Records | Contact Us

Details for Engine Serial Number: 46800895 - View Full Order

Cummins Distributors - Click Here for Additional Details

Purchased By:	Cummins Eastern Canada, Inc.	P.O. Number:	1338078
Job Name:	ANDRE ROY	Ship Date:	9/28/2007 1:12:02 PM
Order Date	5/7/2007 10:52:55 AM	Horsepower:	275
Engine Model:	QSC8.3-P	Base Only:	☐
Paint Code:	Primer	Enclosure:	☑
Comments:			

CPP Option	Cummins Option	Description	Parts Information
AA11186	AAPU10153	25 G/CFM AIR CLEANER	
DE11083	DEPU10062	DECALS	
EA11034	EAPU10020	ENGINE ACCESSORIES, J1939 HARNESS	
EC11097	ECPU10081	ENGINE CONTROL, 12 FT. EXTENSION	
EN11134	ELPU10108	ENCLOSURE, FULL, TOP A/C	
GE11109	GEPU10096	ELECTRICAL SYSTEM, HEATER GRID, 12V	
GE11128	GEPU10117	ELECTRICAL SYSTEM, 12V DELCO 20SI OR GREATER	
GE11134	GEPU10121	GROUND STRAP	
IN11177	INPU10163	INSTRUMENT ASSY., 12V OR 24V, 24FT. EXTENSION	
MM11184	MMPU10151	BASE RAILS, W/O ISOLATION, SAE#1	
OD11006	ODPU10002	Oil Drain	
PP11004	PPPU10004	PACKING MATERIALS	
RA11216	RAPU10137	COOLING SYSTEM, SUCKER, 125 LAT, W/CAC	
RI11003	RIPU10003	A-SERIES TO QSK23 RESTRICTION INDICATOR W/ 25" H2O RESTRICTION	
WL11009	WLPU10009	WATER LEVEL SENSOR	

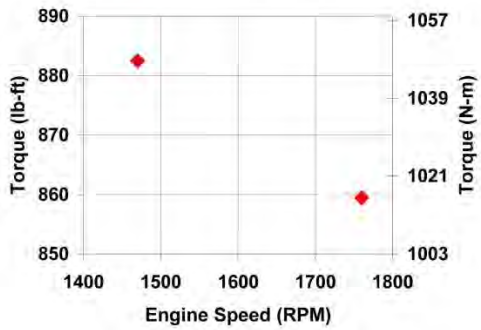
Engine specifications for the preferred drilling equipment for this project

Fire Power	Engine Performance Curve Cummins Fire Power DePere, WI 54115 http://www.cumminsfirepower.com	Basic Engine Model CFP83-F40 Curve Number: FR - 90940 Revision Date: November 2006

Engine Family:	G Drive	CPL Code:	8000
Displacement - in.3 (litre):	505 (8.3)	Emission Certification:	2002 EPA/CARB Tier 2
Dry Weight - lbs (kg):	2045 (920)	Aspiration:	Turbocharged, Chrg Air Cooled
Compression Ratio:	16.8:1	Engine Configuration:	D413035GX02
No. of Cylinders:	6	Minimum rating:	247 HP @ 1470 RPM
Fuel System:	Bosch - P7100 Inline	Maximum rating:	288 HP @ 1760 RPM

Torque Output *

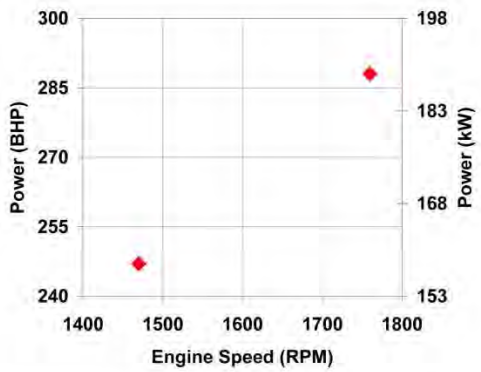
RPM	lb-ft	N-m
1470	882	1196
1760	859	1165



Horsepower Output *

RPM	BHP	kW
1470	247	184
1760	288	215

*CFP83-F40 is not a speed rated engine.



1. Curves shown above represent mature gross engine performance capabilities obtained and corrected in accordance with SAE J1349 conditions of 29.61 in Hg (100 kPa) barometric pressure [300 ft. (91.4 m) altitude], 77 °F (25 °C) inlet air temperature, and 0.30 in. Hg (1 kPa) water vapor pressure with No. 2 diesel fuel.

2. The engine may be operated without changing the fuel setting up to 300 ft. (91.4 m) altitude and up to 77°F (25 °C) ambient temperature. For sustained operation at high altitudes, the fuel rate of the engine should be adjusted to limit performance by 3% per 1,000 ft. (305 m) above 300 ft. (91.4 m) altitude. For sustained operation at high ambient temperatures, the fuel rate of the engine should be adjusted to limit performance by 1% per 10 °F above 77 °F (2% per 11 °C above 25 °C).

3. Engine is certified at only 1470 and 1760 RPM.

Scott Danforth
Engineering Manager

Certified Within 5%

Performance Curve for CFP83-F40 Drawing No. 9744, Rev. C Page 1 of 1

This and the next several pages provide the engine operating characteristics and atmospheric emissions of the preferred drilling equipment.

Cummins Fire Power	**Engine Datasheet** **Cummins Fire Power** DePere, WI 54115 http://www.cumminsfirepower.com	Basic Engine Model **CFP83-F40** Curve Number: **FR - 90940** CPL Code: **8000**
Configuration Number: **D413035GX02** Installation Drawing: **8710**		Engine Family: **Industrial** Revision Date: **November 2006**

General Engine Data

Type	4 Cycle; In-Line; 6 Cylinder	
Aspiration	Turbocharged, Chrg Air Cooled	
Bore & Stroke - in. (mm)	4.49 x 5.32	(114 x 135)
Displacement - in.^{3} (litre)	505	(8.3)
Compression Ratio	16.8:1	
Valves per Cylinder - Intake	1	
- Exhaust	1	
Dry Weight - lb (kg)	2045	(920)
Wet Weight - lb (kg)	2117	(953)
Maximum Allowable Bending Moment @ Rear Face of Block - lb.-ft. (N-m)	1000	(1356)

Air Induction System

Max. Temperature Rise Between Ambient Air and Engine Air Inlet - °F (°C)	30	(16.7)
Maximum Inlet Restriction with Dirty Filter - in. H_2O (mm H_2O)	25	(635)
Recommended Air Cleaner Element - (Standard) Donaldson (CFP)	B105006	(8535)
- (Optional) K&N (CFP)	RU5045	(9606)

Lubrication System

Oil Pressure Range at Rated - PSI (kPa)	40-60	(276-414)
Oil Capacity of Pan (High - Low) - U.S. quarts (litre)	20-16	(18.9-15.1)
Total System Capacity - U.S. Gal. (litre)	6.3	(23.8)
Recommended Lube Oil Filter Fleetguard (Cummins)	LF9009	(3401544)

Cooling System

Raw Water Working Pressure Range at Heat Exchanger - PSI (kPa)	60	(413) MAX
Recommended Min. Water Supply Pipe Size to Heat Exchanger - in. (mm)	1.00	(25.40)
Recommended Min. Water Disch. Pipe Size From Heat Exchanger - in. (mm)	1.25	(31.75)
Coolant Water Capacity (Engine Side) - U.S. gal. (litre)	5.9	(22.3)
Standard Thermostat - Type	Modulating	
- Range - deg F (deg C)	180-203	(82-95)
Minimum Raw Water Flow with Water Temperatures to 90 °F (32 °C) - U.S. GPM (litre/s)	30	(1.89)
Recommended Cooling Water Filter Fleetguard (Cummins)	WF2072	(4058964)

A jacket water heater is mandatory on this engine. The recommended heater wattage is 2250 down to 40 °F (4 °C).

Exhaust System

Max. Back Pressure Imposed by Complete Exhaust System in in. H_2O (kPa)	40.8	(10.2)
Exhaust Pipe Size Normally Acceptable - in. (mm)	5.0	(127)

Noise Emissions

Top	97.7 dBa
Right Side	97.7 dBa
Left Side	97.7 dBa
Front	97.7 dBa
Exhaust	N/A dBa

The noise emission values are estimated sound pressure levels at 3.3 ft. (1 m.).

Fuel Supply / Drain System	**1470**	**1760**
CFP83-F40 Nominal Fuel Consumption - Gal./hr. (L/hr)	11.8 (44.8)	14.5 (55.0)
Fuel Type	Number 2 Diesel Only	
Minimum Supply Line Size - in. (mm)	0.375	(9.53)
Minimum Drain Line Size - in. (mm)	0.25	(6.35)
Maximum Fuel Line Length Between Supply Tank & Fuel Pump - ft. (m)	40	(12)
Maximum Fuel Height above C/L Crankshaft - in. (mm)	80	(2032)
Recommended Fuel Filter - Primary ... Fleetguard (Cummins)	FS1251	(3286503)
- Secondary	None	
Maximum Restriction @ Lift Pump-Inlet - With Clean Filter - in. Hg (mm Hg)	4.0	(102)
Maximum Restriction @ Lift Pump-Inlet - With Dirty Filter - in. Hg (mm Hg)	8.0	(203)
Maximum Return Line Restriction - Without Check Valves - in. Hg (mm Hg)	10	(254)
Minimum Fuel Tank Vent Capability - ft^3/hr (m^3/hr)	12	(0.36)
Maximum Fuel Temperature @ Lift Pump Inlet - °F (°C)	160	(71)

Starting and Electrical System	**12V**	**24V**
Min. Recommended Batt. Capacity - Cold Soak at 0°F (-18°C) or Above		
Engine Only - Cold Cranking Amperes - (CCA)	1250	625
Engine Only - Reserve Capacity - Minutes	400	800
Battery Cable Size (Maximum Cable Length Not to Exceed 5 ft. [1.5 m] AWG)	00	00
Maximum Resistance of Starting Circuit - Ohms	0.002	0.004
Typical Cranking Speed - RPM	120	120
Alternator (Standard), Internally Regulated - Ampere	95	45
Wiring for Automatic Starting (Negative Ground)	Standard	
Reference Wiring Diagram	8512	

Performance Data

All data is based on the engine operating with fuel system, water pump, lubricating oil pump, air cleaner, and alternator; not included are compressor, fan, optional equipment, and driven components. Data is based on operation at SAE standard J1394 conditions of 300 ft. (91.4 m) altitude, 29.61 in. (752 mm) Hg dry barometer, and 77 °F (25 °C) intake air temperature, using No.2 diesel or a fuel corresponding to ASTM-D2.

Altitude Above Which Output Should be Limited - ft. (m)	300	(91.4)
Correction Factor per 1000 ft. (305 m) above Altitude Limit	3%	
Temperature Above Which Output Should be Limited - °F (°C)	77	(25)
Correction Factor per 10 °F (11 °C) Above Temperature Limit	1%	(2%)

Exhaust Emissions (EPA Tier T2) [Reference Emissions Data Doc. 9812]	**g/kW-hr**	**g/BHP-hr**
Hydrocarbons (HC/OMHCE)	0.14	0.10
Oxides of Nitrogen (NOx)	5.37	4.00
Non-Methane Hydrocarbons + NOx (NMHC+NOx)	5.51	4.11
Carbon Monoxide (CO)	0.60	0.45
Particulate	0.09	0.07

FM Approved and UL Listed Ratings for CFP83-F40

Engine Speed - RPM	1470	1760
CFP83-F40 Output - BHP (kW)	**247 (184)**	**288 (215)**
Ventilation Air Required for Combustion - CFM (litre/sec)	492 (232)	657 (310)
Exhaust Gas Flow - CFM (litre/sec)	1247 (589)	1632 (770)
Exhaust Gas Temperature - °F (°C)	971 (522)	952 (511)
Engine Heat Rejection to Coolant- BTU/min. (kW)	3184 (56)	3854 (68)
Engine Heat Rejection to Ambient - BTU/min. (kW)	1497 (26)	1470 (26)

All Data is Subject to Change Without Notice.

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