APPENDIX A

Field Exploration

We explored the subsurface conditions at the project site by drilling and sampling two borings, designated as Boring Nos. 1 and 2, extending to a depth of about 50 feet below the existing ground surface. The approximate boring locations are shown on the Site Plan, Plate 2. The borings were drilled using a truck-mounted drill rig equipped with continuous flight augers and coring tools.

Our logger classified the materials encountered in the borings by visual and textural examination in the field in general accordance with ASTM D2488, Standard Practice for Description and Identification of Soils, and monitored the drilling operations on a near-continuous (full-time) basis. These classifications were further reviewed visually and by testing in the laboratory. Soils were classified in general accordance with ASTM D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System), as shown on the Soil Log Legend, Plate A-0.1. Deviations made to the soil classification in accordance with ASTM D2487 are described on the Soil Classification Log Key, Plate A-0.2. Graphic representations of the materials encountered are presented on the Logs of Borings, Plates A-1.1 through A-2.2.

Relatively "undisturbed" soil samples were obtained in general accordance with ASTM D3550, Ring-Lined Barrel Sampling of Soils, by driving a 3-inch OD Modified California sampler with a 140-pound hammer falling 30 inches. In addition, some samples were obtained from the drilled borings in general accordance with ASTM D1586, Penetration Test and Split-Barrel Sampling of Soils, by driving a 2-inch OD standard penetration sampler using the same hammer and drop. The blow counts needed to drive the sampler the second and third 6 inches of an 18-inch drive are shown as the "Penetration Resistance" on the Logs of Borings at the appropriate sample depths. The penetration resistance shown on the Logs of Borings indicates the number of blows required for the specific sampler type used. The blow counts may need to be factored to obtain the Standard Penetration Test (SPT) blow counts.

Core samples of the rock materials encountered at the project site were obtained by using diamond core drilling techniques in general accordance with ASTM D2113, Diamond Core Drilling for Site Investigation. Core drilling is a rotary drilling method that uses a hollow bit to cut into the rock formation. The rock material left in the hollow core of the bit is mechanically recovered for examination and description. Rock cores were described in general accordance with the Rock Description System, as shown on the Rock Log Legend, Plate A-0.3. The Rock Description System is based on the publication "Suggested Methods for the Quantitative Description of Discontinuities in Rock Masses" by the International Society for Rock Mechanics (March 1977).

Recovery (REC) may be used as a subjective guide to the interpretation of the relative quality of rock masses, where appropriate. Recovery is defined as the actual length of material recovered from a coring attempt versus the length of the core attempt. For example, if 3.7 feet of material is recovered from a 5.0-foot core run, the recovery would be 74 percent and would be shown on the Logs of Borings as REC = 74%.

The Rock Quality Designation (RQD) is also a subjective guide to the relative quality of rock masses. RQD is defined as the percentage of the core run in rock that is sound material in excess of 4 inches in length without any discontinuities, discounting any drilling, mechanical, and handling induced fractures or breaks. If 2.5 feet of sound material is recovered from a 5.0-foot core run in rock, the RQD would be 50 percent and would be shown on the Logs of Borings as RQD = 50%. Generally, the following is used to describe the relative quality of the rock based on the "Practical Handbook of Physical Properties of Rocks and Minerals" by Robert S. Carmichael (1989).

Rock Quality	**RQD** (%)
Very Poor	0 – 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	90 – 100

The excavation characteristic of a rock mass is a function of the relative hardness of the rock, its relative quality, brittleness, and fissile characteristics. A dense rock formation with a high RQD value would be very difficult to excavate and probably would require more arduous methods of excavation.

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Soil Log Legend

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

MAJOR DIVISIONS			USCS	TYPICAL DESCRIPTIONS
COARSE-GRAINED SOILS	GRAVELS	CLEAN GRAVELS	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		LESS THAN 5% FINES	GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
		MORE THAN 12% FINES	GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS	CLEAN SANDS	SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		LESS THAN 5% FINES	SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
MORE THAN 50% OF MATERIAL RETAINED ON NO. 200 SIEVE	50% OR MORE OF COARSE FRACTION PASSING THROUGH NO. 4 SIEVE	SANDS WITH FINES	SM	SILTY SANDS, SAND-SILT MIXTURES
		MORE THAN 12% FINES	SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE-GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
50% OR MORE OF MATERIAL PASSING THROUGH NO. 200 SIEVE	SILTS AND CLAYS	LIQUID LIMIT 50 OR MORE	MH	INORGANIC SILT, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

LEGEND

- (2-INCH) O.D. STANDARD PENETRATION TEST
- (3-INCH) O.D. MODIFIED CALIFORNIA SAMPLE
- SHELBY TUBE SAMPLE
- GRAB SAMPLE
- CORE SAMPLE
- WATER LEVEL OBSERVED IN BORING AT TIME OF DRILLING
- WATER LEVEL OBSERVED IN BORING AFTER DRILLING
- WATER LEVEL OBSERVED IN BORING OVERNIGHT

LL	LIQUID LIMIT (NP=NON-PLASTIC)
PI	PLASTICITY INDEX (NP=NON-PLASTIC)
TV	TORVANE SHEAR (tsf)
UC	UNCONFINED COMPRESSION OR UNIAXIAL COMPRESSIVE STRENGTH
TXUU	UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (ksf)

Plate

A-0.1

LOG LEGEND FOR SOIL 8424-00.GPJ GEOLABS.GDT 3/30/22

GEOLABS, INC.

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Soil Classification Log Key
(with deviations from ASTM D2488)

GEOLABS, INC. CLASSIFICATION*

GRANULAR SOIL (- #200 <50%)

- **PRIMARY** constituents are composed of the largest percent of the soil mass. Primary constituents are capitalized and bold (i.e., **GRAVEL**, **SAND**)
- **SECONDARY** constituents are composed of a percentage less than the primary constituent. If the soil mass consists of 12 percent or more fines content, a cohesive constituent is used (**SILTY** or **CLAYEY**); otherwise, a granular constituent is used (**GRAVELLY** or **SANDY**) provided that the secondary constituent consists of 20 percent or more of the soil mass. Secondary constituents are capitalized and bold (i.e., **SANDY** GRAVEL, **CLAYEY** SAND) and precede the primary constituent.
- **accessory descriptions** compose of the following:
  with some: >12%
  with a little: 5 - 12%
  with traces of: <5%
  accessory descriptions are lower cased and follow the Primary and Secondary Constituents
  (i.e., SILTY GRAVEL **with a little sand**)

COHESIVE SOIL (- #200 ≥ 50%)

- **PRIMARY** constituents are based on plasticity. Primary constituents are capitalized and bold (i.e., **CLAY**, **SILT**)
- **SECONDARY** constituents are composed of a percentage less than the primary constituent, but more than 20 percent of the soil mass. Secondary constituents are capitalized and bold (i.e., **SANDY** CLAY, **SILTY** CLAY, **CLAYEY** SILT) and precede the primary constituent.
- **accessory descriptions** compose of the following:
  with some: >12%
  with a little: 5 - 12%
  with traces of: <5%
  accessory descriptions are lower cased and follow the Primary and Secondary Constituents
  (i.e., SILTY CLAY **with some sand**)

EXAMPLE: Soil Containing 60% Gravel, 25% Sand, 15% Fines. Described as: **SILTY GRAVEL** with some sand

RELATIVE DENSITY / CONSISTENCY

Granular Soils			Cohesive Soils			
N-Value (Blows/Foot)		Relative Density	N-Value (Blows/Foot)		PP Readings (tsf)	Consistency
SPT	MCS		SPT	MCS		
0 - 4	0 - 7	Very Loose	0 - 2	0 - 4		Very Soft
4 - 10	7 - 18	Loose	2 - 4	4 - 7	< 0.5	Soft
10 - 30	18 - 55	Medium Dense	4 - 8	7 - 15	0.5 - 1.0	Medium Stiff
30 - 50	55 - 91	Dense	8 - 15	15 - 27	1.0 - 2.0	Stiff
> 50	> 91	Very Dense	15 - 30	27 - 55	2.0 - 4.0	Very Stiff
			> 30	> 55	> 4.0	Hard

MOISTURE CONTENT DEFINITIONS

Dry: Absence of moisture, dry to the touch

Moist: Damp but no visible water

Wet: Visible free water

ABBREVIATIONS

WOH: Weight of Hammer

WOR: Weight of Drill Rods

SPT: Standard Penetration Test Split-Spoon Sampler

MCS: Modified California Sampler

PP: Pocket Penetrometer

GRAIN SIZE DEFINITION

Description	Sieve Number and / or Size
Boulders	> 12 inches (305-mm)
Cobbles	3 to 12 inches (75-mm to 305-mm)
Gravel	3-inch to #4 (75-mm to 4.75-mm)
Coarse Gravel	3-inch to 3/4-inch (75-mm to 19-mm)
Fine Gravel	3/4-inch to #4 (19-mm to 4.75-mm)
Sand	#4 to #200 (4.75-mm to 0.075-mm)
Coarse Sand	#4 to #10 (4.75-mm to 2-mm)
Medium Sand	#10 to #40 (2-mm to 0.425-mm)
Fine Sand	#40 to #200 (0.425-mm to 0.075-mm)

Soil descriptions are based on ASTM D2488-09a, Visual-Manual Procedure, with the above modifications by Geolabs, Inc. to the Unified Soil Classification System (USCS).

Plate

A-0.2

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Rock Log Legend

ROCK DESCRIPTIONS

	BASALT		CONGLOMERATE
	BOULDERS		LIMESTONE
	BRECCIA		SANDSTONE
	CLINKER		SILTSTONE
	COBBLES		TUFF
	CORAL		VOID/CAVITY

ROCK DESCRIPTION SYSTEM

ROCK FRACTURE CHARACTERISTICS

The following terms describe general fracture spacing of a rock:

Massive: Greater than 24 inches apart

Slightly Fractured: 12 to 24 inches apart

Moderately Fractured: 6 to 12 inches apart

Closely Fractured: 3 to 6 inches apart

Severely Fractured: Less than 3 inches apart

DEGREE OF WEATHERING

The following terms describe the chemical weathering of a rock:

Unweathered: Rock shows no sign of discoloration or loss of strength.

Slightly Weathered: Slight discoloration inwards from open fractures.

Moderately Weathered: Discoloration throughout and noticeably weakened though not able to break by hand.

Highly Weathered: Most minerals decomposed with some corestones present in residual soil mass. Can be broken by hand.

Extremely Weathered: Saprolite. Mineral residue completely decomposed to soil but fabric and structure preserved.

HARDNESS

The following terms describe the resistance of a rock to indentation or scratching:

Very Hard: Specimen breaks with difficulty after several "pinging" hammer blows.
Example: Dense, fine grain volcanic rock

Hard: Specimen breaks with some difficulty after several hammer blows.
Example: Vesicular, vugular, coarse-grained rock

Medium Hard: Specimen can be broked by one hammer blow. Cannot be scraped by knife. SPT may penetrate by ~25 blows per inch with bounce.
Example: Porous rock such as clinker, cinder, and coral reef

Soft: Can be indented by one hammer blow. Can be scraped or peeled by knife. SPT can penetrate by ~100 blows per foot.
Example: Weathered rock, chalk-like coral reef

Very Soft: Crumbles under hammer blow. Can be peeled and carved by knife. Can be indented by finger pressure.
Example: Saprolite

Plate
A-0.3

GEOLABS, INC.

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KEKAULIKI AVENUE
EMERGENCY REPAIRS AT M.P. 8.2
REDERAL AID PROJECT NO. ER-25(001)
KULA, MAUI, HAWAII

Log of Boring **1**

Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Approximate Ground Surface Elevation (feet MSL): 3406 *
											Description
	51	49			21					SM	6-inch **ASPHALTIC CONCRETE** 2-inch Grayish brown **SANDY GRAVEL** with a little silt, moist (base course)
	40				4						Brown **SILTY SAND** with traces of gravel, medium dense, moist (fill)
					13		5				grades with some gravel, loose
											grades with some cobbles and boulders
Sieve - #200 = 32.0%	33		0		8		10				grades with multi-color mottling
LL=NP PI=NP	33	77	0		44		15			ML	Brown with multi-color mottling **SANDY SILT** with some gravel, very stiff, moist (residual soil)
	23		57	31	34		20			GP-GM	Gray with multi-color mottling **SANDY GRAVEL** with a little silt, dense to medium dense, moist (saprolite)
UC= 16580 psi	6	93	86	33	70		25				Gray **BASALT**, severely to closely fractured, slightly weathered, medium hard
			48	48			30				grades to moderately fractured, hard
							35				

Date Started:	January 19, 2022	Water Level: ▽	Not Encountered	Plate
Date Completed:	January 19, 2022			
Logged By:	G. Castle	Drill Rig:	CME-45C TRUCK *(Energy Transfer Ratio = 78%)*	
Total Depth:	50 feet	Drilling Method:	4" Solid-Stem Auger & PQ Coring	A - 1.1
Work Order:	8424-00	Driving Energy:	140 lb. wt., 30 in. drop	

BORING_LOG 8424-00.GPJ GEOLABS.GDT 3/31/22

GEOLABS, INC.

Geotechnical Engineering

KEKAULIKI AVENUE
EMERGENCY REPAIRS AT M.P. 8.2
REDERAL AID PROJECT NO. ER-25(001)
KULA, MAUI, HAWAII

Log of Boring 1

Laboratory			Field							
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS

(Continued from previous plate)

Description

UC= 21690 psi			100	100							grades to massive
			100	100			40				
			100	47			45				
UC= 23780 psi											grades to closely fractured, moderately weathered
							50				Boring terminated at 50 feet
											* Elevations estimated from Topographic Survey transmitted by Fukumoto Engineering, Inc. dated December 27, 2021.
							55				
							60				
							65				
							70				

Date Started:	January 19, 2022	Water Level: ▽	Not Encountered	Plate
Date Completed:	January 19, 2022			
Logged By:	G. Castle	Drill Rig:	CME-45C TRUCK *(Energy Transfer Ratio = 78%)*	
Total Depth:	50 feet	Drilling Method:	4" Solid-Stem Auger & PQ Coring	A - 1.2
Work Order:	8424-00	Driving Energy:	140 lb. wt., 30 in. drop	

BORING_LOG 8424-00.GPJ GEOLABS.GDT 3/31/22

GEOLABS, INC.

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KEKAULIKI AVENUE
EMERGENCY REPAIRS AT M.P. 8.2
REDERAL AID PROJECT NO. ER-25(001)
KULA, MAUI, HAWAII

Log of Boring **2**

Approximate Ground Surface Elevation (feet MSL): 3417.5 *

Laboratory			Field							
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	USCS	Description
	54	42			24				GP ML	5-inch **ASPHALTIC CONCRETE** Grayish brown **SANDY GRAVEL** with a little silt, moist (base course)
	65				5					Brown **SANDY SILT**, stiff, moist (fill) grades with multi-color mottling, medium stiff
Sieve - #200 = 14.0%	20	71			32		5		GM	Brown with gray mottling **SILTY GRAVEL** with some sand, medium dense, moist (saprolite)
	16				30		10			grades to grayish brown
	51	68	100	43	50/2"		15			Gray with multi-color mottling **BASALT**, severely fractured, highly weathered, soft to medium hard (basalt formation)
UC= 6880 psi			90	78			20			Gray **BASALT**, closely to moderately fractured, slightly weathered, hard (basalt formation)
UC= 19540 psi			43	15			25			**VOID**
										Gray with multi-color mottling **BASALT**, severely fractured, highly weathered, soft (basalt formation)
			0				30		GM	Brown with multi-color mottling **SILTY GRAVEL** with some sand, loose, wet (clinker)
							35			

Date Started:	January 20, 2022	Water Level: ▽	Not Encountered		Plate
Date Completed:	January 20, 2022				
Logged By:	G. Castle	Drill Rig:	CME-45C TRUCK	*(Energy Transfer Ratio = 78%)*	A - 2.1
Total Depth:	50 feet	Drilling Method:	4" Solid-Stem Auger & PQ Coring		
Work Order:	8424-00	Driving Energy:	140 lb. wt., 30 in. drop		

BORING_LOG 8424-00.GPJ GEOLABS.GDT 3/31/22

GEOLABS, INC.

Geotechnical Engineering

KEKAULIKI AVENUE
EMERGENCY REPAIRS AT M.P. 8.2
REDERAL AID PROJECT NO. ER-25(001)
KULA, MAUI, HAWAII

Log of Boring **2**

Laboratory			Field							
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS

(Continued from previous plate)

Description

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
Sieve - #200 = 14.7%	52	62	0		12			GM	
	26		100	67	76/6" Ref.		40		Gray with multi-color mottling **BASALT**, moderately fractured, moderately weathered, hard to very hard (basalt formation)
									grades to closely fractured
UC= 10520 psi			83	57			45		
									grades to severely fractured, soft
							50		Boring terminated at 50 feet
							55		
							60		
							65		
							70		

Date Started:	January 20, 2022	Water Level: ▽	Not Encountered	Plate
Date Completed:	January 20, 2022			
Logged By:	G. Castle	Drill Rig:	CME-45C TRUCK *(Energy Transfer Ratio = 78%)*	
Total Depth:	50 feet	Drilling Method:	4" Solid-Stem Auger & PQ Coring	A - 2.2
Work Order:	8424-00	Driving Energy:	140 lb. wt., 30 in. drop	

BORING_LOG 8424-00.GPJ GEOLABS.GDT 3/31/22