GEOTECHNICAL INVESTIGATION
DLNR MAUI OFFICE ANNEX BUILDING
DESIGN PHASE
MAHALANI STREET
WAILUKU, MAUI, HAWAII

for

THE LIMTIACO CONSULTING GROUP

HIRATA & ASSOCIATES, INC.
W.O. 15-5591.1
April 23, 2015

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Hirata & Associates

Geotechnical Engineering

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Ms. Yvonne Turro
The Limtiaco Consulting Group
1622 Kanakanui Street
Honolulu, Hawaii 96817

Dear Ms. Turro:

Our report, "Geotechnical Investigation, DLNR Maui Office Annex Building, Design Phase, Mahalani Street, Wailuku, Maui, Hawaii," dated April 23, 2015, our Work Order 15-5591.1 is enclosed. This investigation was conducted in general conformance with the scope of services presented in our proposal dated May 9, 2014.

The predominant onsite soil consisted of tannish brown coralline sand. The sand stratum was in a medium dense to dense condition, with cementation observed at deeper depths. Overlying the sand, borings B1 through B4 encountered a thin layer of silty sand, ranging from about 2 to 3 feet in thickness. Neither groundwater nor seepage water was encountered in our borings.

Conventional spread footings founded on the medium dense sand may be used to support the proposed structures. However, due to the cohesionless nature and poorly graded condition of the onsite sand, it may be difficult to maintain the medium dense condition of the sands exposed at the bottom of footing excavations. As a result, a thin layer of imported granular structural fill may be compacted at the bottom of footings excavations to facilitate the construction of foundations.

The following is a summary of our geotechnical recommendations. This summary is not intended to be a substitute for our report which includes more detailed explanations of our recommendations, as well as additional requirements.

- Allowable bearing value = 3,000 psf
- Coefficient of friction = 0.4
- Passive earth pressure = 300 pcf

We appreciate this opportunity to be of service. Should you have any questions concerning this report, please feel free to call on us.

Very truly yours,

HIRATA & ASSOCIATES, INC.

Paul S. Morimoto President

PSM:DK

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GEOTECHNICAL INVESTIGATION
DLNR MAUI OFFICE ANNEX BUILDING - DESIGN PHASE
MAHALANI STREET
WAILUKU, MAUI, HAWAII

INTRODUCTION

This report presents the results of our geotechnical investigation performed for the proposed DLNR Maui Office Annex Building on Mahalani Street in Wailuku, Maui, Hawaii. Our scope of services for this study included the following:

- A review of the current site plan and our previous report titled, "Preliminary Soils Investigation, DLNR Administration Building, Mahalani Street, Wailuku, Maui, Hawaii," dated January 29, 2014.
- Preparation of this report presenting geotechnical recommendations for the design of foundations, including seismic considerations, retaining walls, resistance to lateral pressure, slabs-on-grade, flexible pavement, and site grading.

PROJECT CONSIDERATIONS

Information regarding the proposed project was provided by personnel from your office.

We understand that the proposed project will consist of two phases. Phase I will consist of the demolition of an existing structure, and construction of the new DLNR Administration Building, main parking lot, and retaining walls. Phase II will consist of the construction of the marine vehicles parking lot, covered boat storage area, and storage facilities. Site grading work will primarily consist of cuts into the existing slope along the southeastern property line and the eastern area of the site. Retaining walls will be used to accommodate the grade changes with retained heights generally ranging from about 4 to 8 feet.

Based on the current site plan, the proposed administration building will be located in the central portion of the site, partially over the footprint of the existing building. The main parking lot will be located southwest of the proposed administration building, with the new driveway extending from the south and along the east property line, adjacent to the new retaining wall.

The proposed covered boat storage area will be located north of the new administration building in the area of the existing concrete slab. The proposed storage facilities will be located near the northeastern corner of the site, and the new marine vehicles parking lot will be located between the administration building and the storage facilities.

SITE CONDITIONS

The project site is a triangular-shaped parcel located on the east side of Mahalani Street, south of its intersection with West Kaahumanu Avenue in Wailuku, Maui, Hawaii. The site is bordered on the north by the Maui News facility, on the northwest by the Cameron Center, on the southwest by Maui Memorial Medical Center, and on the southeast by single family residences.

The western portion of the property slopes down to Mahalani Street at an approximate 2H:1V gradient. Total relief in this area ranges from about 7 to 15 feet. The southeastern portion of the parcel slopes upward at gradients ranging from about 3H:1V to 4H:1V. Total relief in this area is about 4 to 8 feet. The northern portion of the property slopes downward at an approximate 2H:1V gradient, with a total relief of about 15 feet.

SOIL CONDITIONS

Borings B1 through B4 encountered surface soil classified as tannish brown silty sand. The silty sand was in a medium dense condition in borings B1 through B3, in a loose condition in boring B4, and extended to depths of about 3 feet. Sampling resulted in blow counts ranging from 13 to 33 blows per foot of penetration in borings B1 through B3, and 4 blows per foot of penetration in boring B4.

Underlying the silty sand in borings B1 through B4, and surfacing in the areas of the remaining borings, was tannish brown, poorly graded, coralline sand. The sand was in a medium dense to dense and slightly moist condition, with slight cementation observed at deeper depths. The sand stratum extended to the maximum depths drilled. Sampling generally resulted in blow counts ranging from 24 to 98 blows per foot of penetration, with occasional refusal prior to 12 inches of penetration.

Neither groundwater nor seepage water was encountered in the borings.

CONCLUSIONS AND RECOMMENDATIONS

Based on our exploratory fieldwork and laboratory testing, we believe that from a geotechnical viewpoint, the site can generally be developed as planned. Conventional spread footing founded directly on the medium dense sands may be used to support the proposed structures.

Due to the cohesionless nature and poorly graded condition of the onsite sand, it may be difficult to maintain the medium dense condition of the sands exposed at the bottom of footing excavations. As a result, a thin layer of imported granular structural fill may be compacted at the bottom of footings excavations to facilitate the construction of foundations.

Foundations

Conventional spread footings founded on medium dense sands may be used to support the proposed structures. Foundations may be designed for an allowable bearing value of 3,000 pounds per square foot. The recommended allowable bearing value is for the total of dead and frequently applied live loads, and may be increased by one-third for short duration loading which includes the effect of wind and seismic forces.

Spread footings should be a minimum 16 inches in width and embedded at least 12 and 18 inches below finish adjacent grade for one and two story structures, respectively. The bottom of footing excavations should be thoroughly moistened, tamped and cleaned of loose material prior to placement of reinforcing steel and concrete.

Foundations located on, or near the top of slopes, should be embedded such that a minimum horizontal distance of 5 feet is maintained between the bottom edge of footing and slope face. In addition, to avoid imposing additional loads on existing foundations, footings for the proposed covered boat storage area (Phase II) located adjacent to the new administration building should be founded at approximately the same elevation as that of the administration building foundations (Phase I).

Seismic Design

Based on the borings drilled as part of this study and our knowledge of deep soil conditions in the area, the subsurface soils can be characterized as a dense soil profile. Therefore, based on the 2006 International Building Code, Site Class D is recommended for this site.

Lateral Design

Resistance to lateral loading may be provided by friction acting at the base of foundations, and by passive earth pressure acting on the buried portions of foundations.

A coefficient of friction of 0.4 may be used with the dead load forces. Passive earth pressure may be computed as an equivalent fluid having a density of 300 pounds per cubic foot with a maximum earth pressure of 3,000 pounds per square foot. Unless covered by pavement or concrete slabs, the upper 12 inches of soil should not be considered in computing lateral resistance.

Retaining Walls

Based on the current site plan, we understand that retaining walls will be used to accommodate grade changes along the east property line and near the northeastern corner of the site. Retaining wall foundations may be designed using recommendations in the *Foundations, Seismic Design,* and *Lateral Designs* sections of this report.

For active earth pressure considerations, equivalent fluid pressures of 35 and 45 pounds per cubic foot may be used for level and sloping backfill conditions, respectively. An equivalent fluid pressure of 50 pounds per cubic foot may be used for restrained conditions.

Both the onsite sands and imported structural fill may be used for backfill behind new retaining walls. Backfill should be compacted in lifts to a minimum 90 percent compaction as determined by ASTM D 1557. Overcompaction of the backfill material should be avoided.

To prevent buildup of hydrostatic pressures, retaining walls should be well-drained. The standard of practice consists of placing a minimum 12-inch thick layer of free-draining gravel at the back of the wall. The gravel should extend from the base of the wall, around subdrains and/or weepholes, and up to within 12 inches of finish grade.

Alternatively, prefabricated drainage geocomposites, such as Miradrain or J-drain, may be used in lieu of the free-draining gravel. As with the free-draining gravel, the drainage geocomposites should be placed at the back of the wall, be connected with the weepholes and/or subdrains (in accordance with manufacturers specifications), and extend to within 12 inches of finish grade. For freestanding walls, the drainage system should be covered by at least 12 inches of low permeability soil. If the backfill is covered by interior or exterior concrete slabs, the gravel fill should extend to the bottom of slab cushion elevation.

Foundation Settlement

Although structural loads were not available at the time of this report, neither excessive total nor differential settlement is anticipated as final building loads are expected to be relatively light.

Slabs-on-Grade

To provide uniform support, all building slabs-on-grade should be underlain by a 4-inch cushion of clean gravel, such as #3 Fine (ASTM C33 Size No. 67). All building slabs should also be protected by a vapor barrier.

The slab subgrade should be scarified to a minimum depth of 6 inches, moisture conditioned about 2 percent above optimum moisture content, and compacted to a minimum 90 percent compaction as determined by ASTM D 1557. The overlying gravel cushion should be compacted to a level surface using vibratory equipment.

In terms of serving as slab cushion, basaltic termite barrier (BTB) may be used in place of the 4 inches of clean gravel. The recommended minimum thickness of BTB material should be compacted as indicated by the manufacturer specifications.

Slabs-on-grade which will receive floor covering should include control joints saw-cut into the concrete slab. The purpose of this is to help reduce the potential for reflective cracking of the floor covering due to shrinkage cracks in the concrete slab. Proper curing of the concrete slabs will help reduce shrinkage cracking.

Exterior slabs, such as the boat canopy slab and concrete walkways, should be underlain by a minimum 4 inches of aggregate base course. The base course should be compacted to a minimum 95 percent compaction as determined by ASTM D 1557.

Pavement Design

We assume that the parking lots will generally be limited to passenger vehicles, light trucks, marine vehicles and boats with their trailers. Based on the results of our laboratory testing, the parking lots may be designed using the following section:

2.0"	Asphaltic Concrete
6.0"	Base Course (CBR = 85 minimum)
8.0"	Total Thickness

The exposed subgrade should be scarified to a minimum depth of 6 inches, moisture conditioned to about 2 percent above optimum moisture content, and compacted to a minimum 90 percent compaction as determined by ASTM D 1557. The base course should also be compacted in lifts to a minimum 95 percent compaction as determined by ASTM D 1557.

Site Grading

Site Preparation - The project site should be cleared of all vegetation, debris, and other deleterious material. In areas requiring fill placement, the exposed subgrade should be scarified to a minimum depth of 6 inches, moisture conditioned to about 2 percent above optimum moisture, and compacted to a minimum 90 percent compaction as determined by ASTM D 1557.

Due to the cohesionless nature and poorly graded condition of the onsite sand, it may be difficult to maintain the medium dense condition of the sands exposed at the bottom of footing excavations. As a result, a thin layer of imported granular structural fill may be compacted at the bottom of footings excavations to facilitate the construction of foundations.

Onsite Fill Material - The onsite sands will be acceptable for reuse in compacted fills and backfills. All rock fragments larger than 3 inches in maximum dimension should be removed from the onsite sands prior to reuse.

Imported Fill Material - Imported structural fill should be well-graded, non-expansive granular material. Specifications for imported granular structural fill should indicate a maximum particle size of 3 inches, and state that between 8 and 20 percent of soil by weight shall pass the #200 sieve. In addition, the plasticity index (P.I.) of that portion of the soil passing the #40 sieve shall not be greater than 10.

Granular structural fill should also have a minimum CBR value of 15 and a CBR expansion value less than 1.0 percent when tested in accordance with ASTM D 1883.

Compaction - The onsite sands should be placed in horizontal lifts restricted to eight inches in loose thickness, and compacted to a minimum 90 percent compaction as determined by ASTM D 1557. Imported granular structural fill should also be placed in 8-inch lifts, but compacted to a minimum 95 percent compaction as determined by ASTM D 1557.

Structural Excavations - Based on our exploratory borings, we believe that excavations into the onsite soils can generally be accomplished using conventional excavating equipment.

Temporary cuts into the near surface soils should be stable at slope gradients of 3H:1V or flatter. However, due to the cohessionless and poorly graded condition of the onsite sand, some sloughing should be expected. It should be the Contractor's responsibility to conform to all OSHA safety standards for excavations.

ADDITIONAL SERVICES

We recommend that we perform a general review of the final design plans and specifications. This will allow us to verify that the foundation design and earthwork recommendations have been properly interpreted and implemented in the design plans and specifications.

For continuity, we recommend that we be retained during construction to (1) check footing excavations prior to placement of reinforcing steel and concrete, (2) review and/or perform laboratory testing on import borrow to determine its acceptability for use in structural fills, (3) observe structural fill placement and perform compaction testing, and (4) provide geotechnical consultation as required. Our services during construction will allow us to verify that our recommendations are properly interpreted and included in construction, and if necessary, to make modifications to those recommendations, thereby reducing construction delays in the event subsurface conditions differ from those anticipated.

LIMITATIONS

The boring logs indicate the approximate subsurface soil conditions encountered only at those times and locations where our borings were made, and may not represent conditions at other times and locations.

This report was prepared specifically for The Limtiaco Consulting Group and their sub-consultants for design of the proposed DLNR Administration Building on Mahalani Street in Wailuku, Maui, Hawaii. The boring logs, laboratory test results, and recommendations presented in this report are for design purposes only, and are not intended for use in developing cost estimates by the contractor.

During construction, should subsurface conditions differ from those encountered in our borings, we should be advised immediately in order to re-evaluate our recommendations, and to revise or verify them in writing before proceeding with construction.

Our recommendations and conclusions are based upon the site materials observed, the preliminary design information made available, the data obtained from our site exploration, our engineering analyses, and our experience and engineering judgement. The conclusions and recommendations in this report are professional opinions which we have strived to develop in a manner consistent with that level of care, skill, and competence ordinarily exercised by members of the profession in good standing, currently practicing under similar conditions in the same locality. We will be responsible for those recommendations and conclusions, but will not be responsible for the interpretation by others of the information developed. No warranty is made regarding the services performed, either expressed or implied.

Respectfully submitted,

HIRATA & ASSOCIATES, INC.

Rick Yoshida, Project Manager

RY:DK

RICK I.K. YOSHIDA
LICENSED PROFESSIONAL ENGINEER
No. 11118-C
HAWAII, U.S.A.

This work was prepared by
me or under my supervision
Expiration Date of License:
April 30, 2016

APPENDIX A

FIELD INVESTIGATION

DESCRIPTION OF FIELD INVESTIGATION

GENERAL

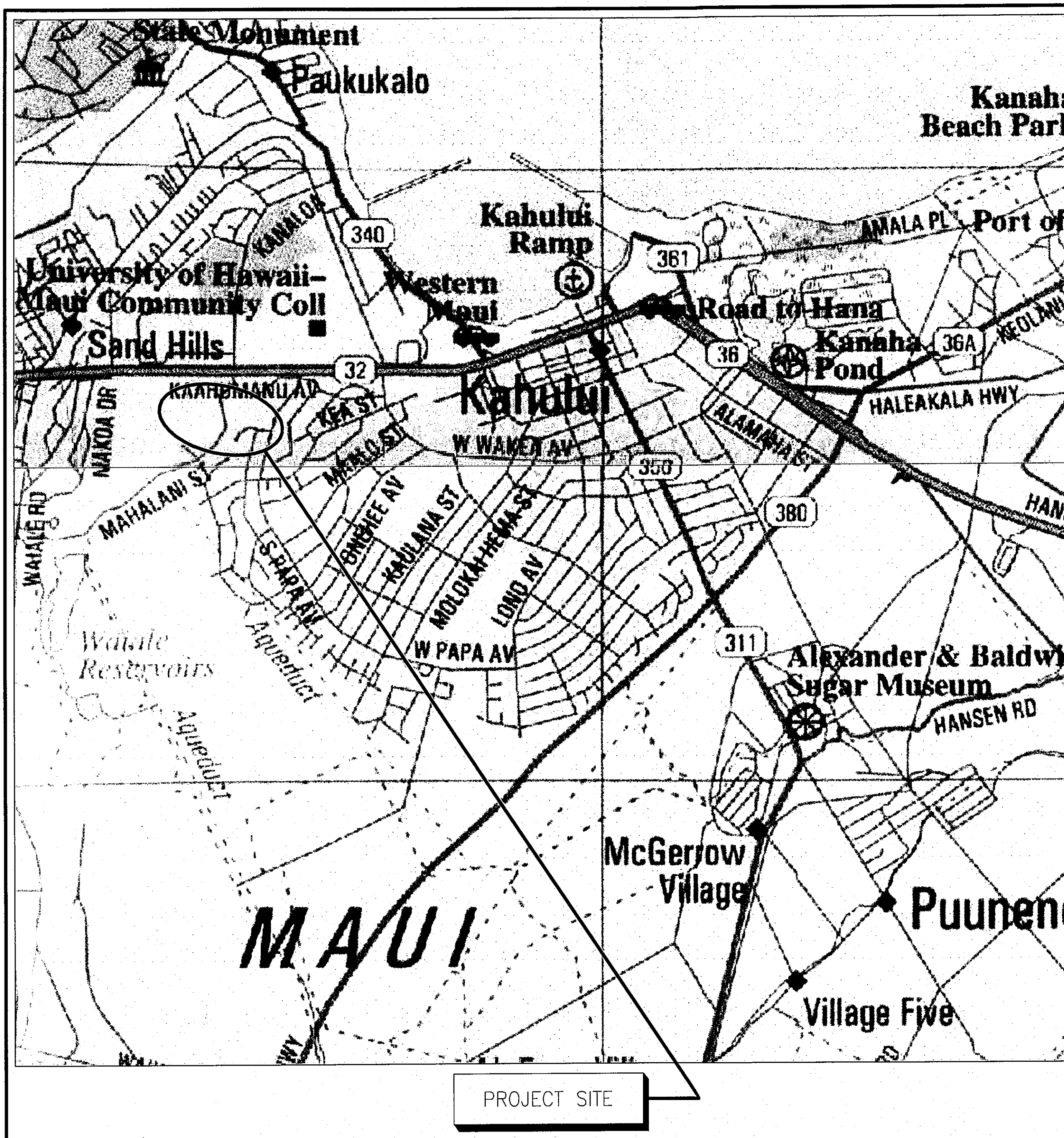
As part of our preliminary soils investigation, the site was explored on December 11 to 13, 2013, by performing a visual reconnaissance of the site and drilling six exploratory test borings to depths ranging from about 14.5 to 20.5 feet with a Mobile B53 truck-mounted drill rig.

During drilling operations, the soils were continuously logged by our field engineer and classified by visual examination in accordance with the Unified Soil Classification System. The boring logs indicate the depths at which the soils or their characteristics change, although the change could actually be gradual. If the change occurred between sample locations, the depth was interpreted based on field observations. Classifications and sampling intervals are shown on the boring logs. A Boring Log Legend is presented on Plate A3.1, while the Unified Soil Classification Systems is shown on Plate A3.2. The soils encountered are logged on Plates A4.1 through A4.6.

Borings were located in the field by measuring/taping offsets from existing site features shown on the plans. Surface elevations at boring locations were estimated based on a Topographic Survey Map provided by The Limtiaco Consulting Group. The accuracy of the boring locations shown on Plate A2.2 and the boring elevations shown on Plates A4.1 through A4.6 are therefore approximate, in accordance with the field methods used.

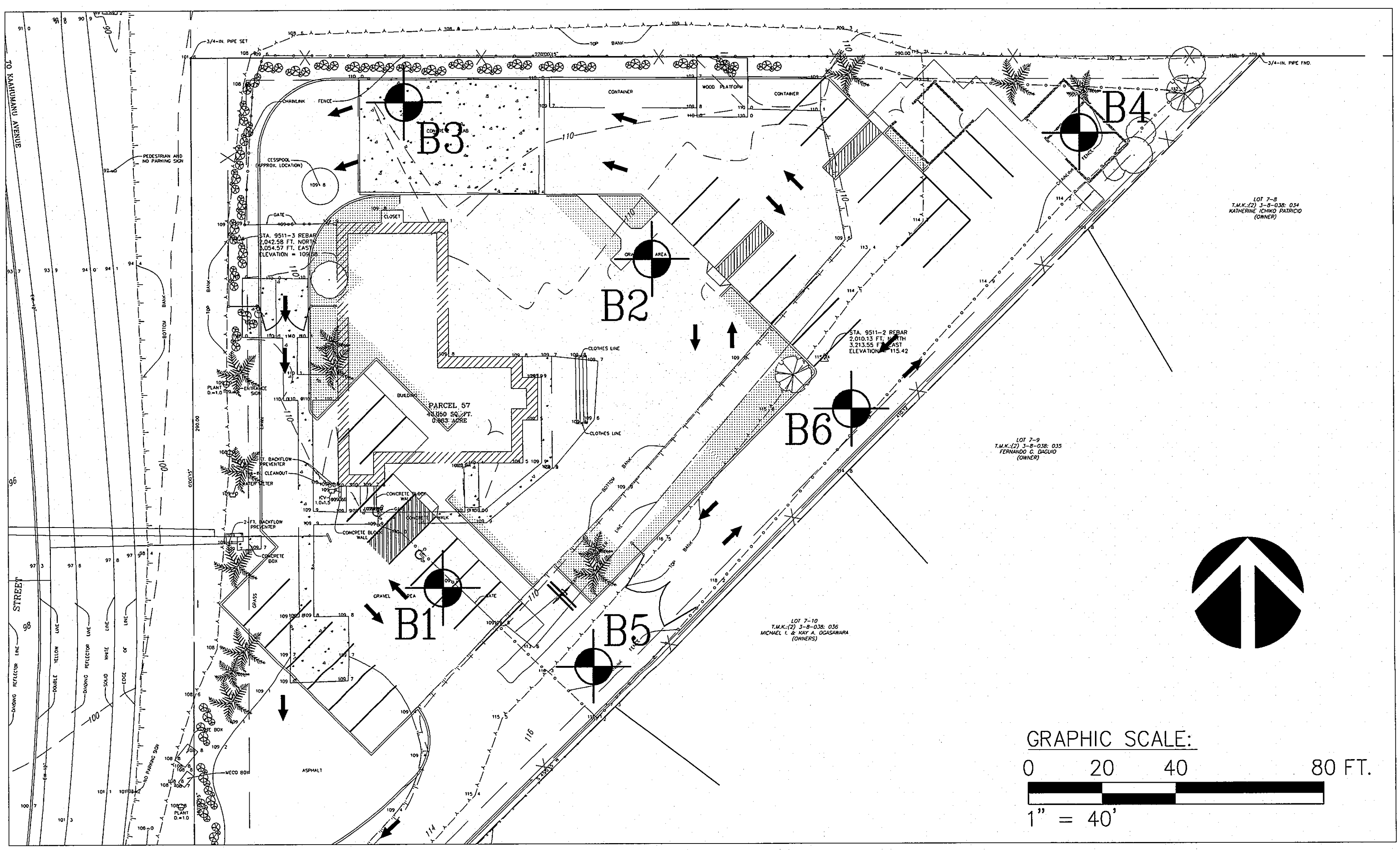
SOIL SAMPLING

Representative and bulk soil samples were recovered from the borings for selected laboratory testing and analyses. Representative samples were recovered by driving a 3-inch O.D. split tube sampler a total of 18 inches with a 140-pound hammer dropped from a height of 30 inches. The number of blows required to drive the sampler the final 12 inches are recorded at the appropriate depths on the boring logs, unless noted otherwise. A bulk soil sample was recovered from near boring B2 at a depth of about 1 foot below grade.



Reference: Hawaii Atlas & Gazetteer, Topo Maps of the Entire State by DeLorme (1999)

W.O. 15-5591.1	DLNR Maui Office Annex Building, Mahalani Street
Hirata & Associates, Inc.	LOCATION MAP Plate A2.1



Reference: A Topographic Survey Map provided by The Limtiaco Consulting Group on April 6, 2015.

LEGEND:

Approximate location of borings

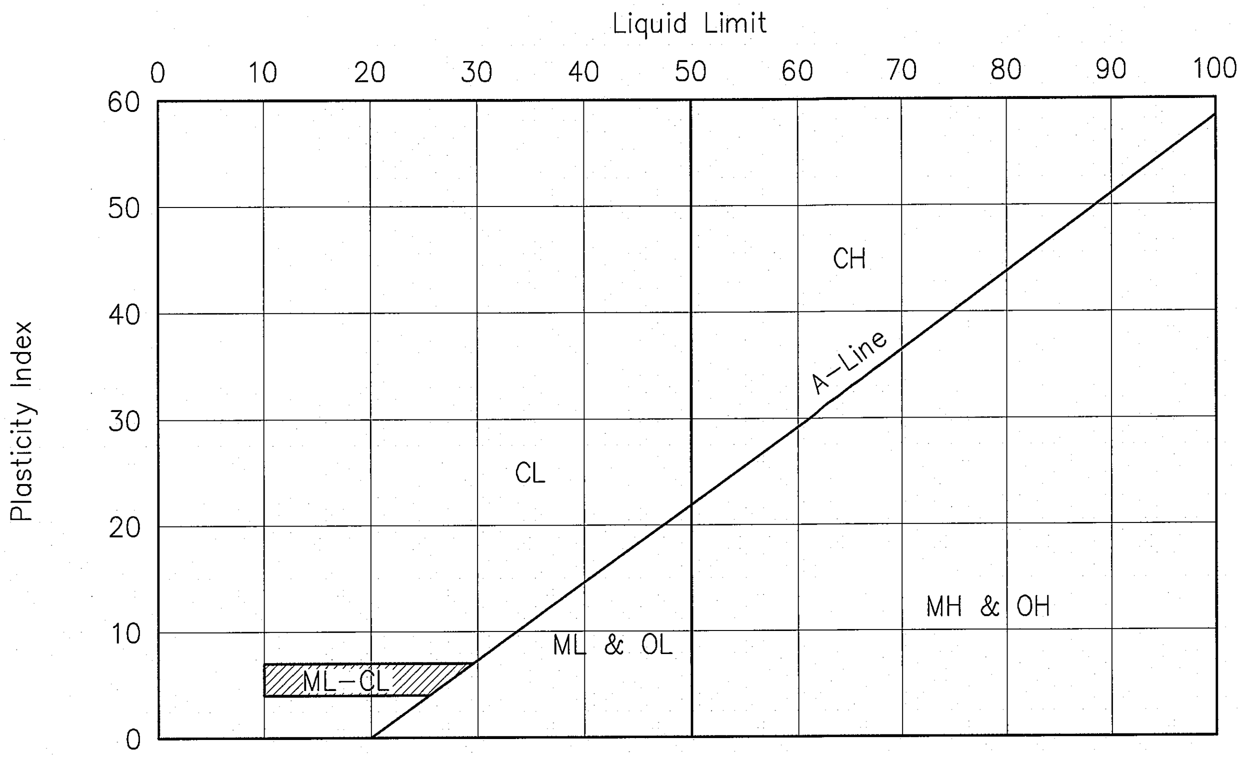
W.O. 15-5591.1	DLNR Maui Office Annex Building, Mahalani Street
Hirata & Associates, Inc.	BORING LOCATION PLAN Plate A2.2

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOILS (More than 50% of the material is LARGER than No. 200 sieve size.)	GRAVELS (More than 50% of coarse fraction is LARGER than the No. 4 sieve size.)	CLEAN GRAVELS (Little or no fines.)	GW	Well graded gravels, gravel-sand mixtures, little or no fines.
			GP	Poorly graded gravels or gravel-sand mixtures, little or no fines.
		GRAVELS WITH FINES (Appreciable amt. of fines.)	GM	Silty gravels, gravel-sand-silt mixtures.
			GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS (More than 50% of coarse fraction is SMALLER than the No. 4 sieve size.)	CLEAN SANDS (Little or no fines.)	SW	Well graded sands, gravelly sands, little or no fines.
			SP	Poorly graded sands or gravelly sands, little or no fines.
		SANDS WITH FINES (Appreciable amt. of fines.)	SM	Silty sands, sand-silt mixtures.
			SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS (More than 50% of the material is SMALLER than No. 200 sieve size.)	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.
	SILTS AND CLAYS (Liquid limit GREATER than 50.)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS			PT	Peat and other highly organic soils.
				FRESH TO MODERATELY WEATHERED BASALT
				VOLCANIC TUFF / HIGHLY TO COMPLETELY WEATHERED BASALT
				CORAL

SAMPLE DEFINITION		
2" O.D. Standard Split Spoon Sampler	Shelby Tube	RQD Rock Quality Designation
3" O.D. Split Tube Sampler	NX / 4" Coring	Water Level

W.O. 15-5591.1	DLNR Maui Office Annex Building, Mahalani Street
Hirata & Associates, Inc.	BORING LOG LEGEND Plate A3.1

PLASTICITY CHART



GRADATION CHART

COMPONENT DEFINITIONS BY GRADATION	
COMPONENT	SIZE RANGE
Boulders	Above 12 in.
Cobbles	3 in. to 12 in.
Gravel	3 in. to No. 4 (4.76 mm)
Coarse gravel	3 in. to 3/4 in.
Fine gravel	3/4 in. to No. 4 (4.76 mm)
Sand	No. 4 (4.76 mm) to No. 200 (0.074 mm)
Coarse sand	No. 4 (4.76 mm) to No. 10 (2.0 mm)
Medium sand	No. 10 (2.0 mm) to No. 40 (0.42 mm)
Fine sand	No. 40 (0.42 mm) to No. 200 (0.074 mm)
Silt and clay	Smaller than No. 200 (0.074 mm)

W.O. 15-5591.1	DLNR Maui Office Annex Building, Mahalani Street
Hirata & Associates, Inc.	UNIFIED SOIL CLASSIFICATION SYSTEM Plate A3.2

HIRATA & ASSOCIATES, INC.

BORING LOG

W.O. 15-5591.1

BORING NO. B1 DRIVING WT. 140 lb. START DATE 12/12/13

SURFACE ELEV. 109±* DROP 30 in. END DATE 12/12/13

DEPTH	GRAPH	SAMPLE	BLOWS PER FOOT	DRY DENSITY (PCF)	MOIST. CONT. (%)	DESCRIPTION
0						Silty SAND (SM) – Tannish brown, moist, medium dense.
		☐	22	97	12	
						SAND (SP) – Tannish brown, slightly moist, dense.
		☐	95/10"	104	7	
5		☐	53/6"	99	8	
10		☐	98/11"	101	7	
15		☐	87/10"	98	3	
						End boring at 15.5 feet.
20						Neither groundwater nor seepage water encountered.
						* Elevations based on a Topographic Survey Map provided by The Limtiaco Consulting Group on November 21, 2013.
25						
30						

Plate A4.1

HIRATA & ASSOCIATES, INC.

BORING LOG

W.O. 15-5591.1

BORING NO. B2 DRIVING WT. 140 lb. START DATE 12/13/13

SURFACE ELEV. 109.5± DROP 30 in. END DATE 12/13/13

DEPTH	GRAPH	SAMPLE	BLOWS PER FOOT	DRY DENSITY (PCF)	MOIST. CONT. (%)	DESCRIPTION
0						Silty SAND (SM) – Tannish brown, moist, medium dense.
			33	89	9	
						SAND (SP) – Tannish brown, slighly moist, dense.
5			88/11"	94	3	
			52/6"	98	4	
10						
			73	105	3	
15						
			50/5"	101	3	
20						End boring at 19 feet.
25						Neither groundwater nor seepage water encountered.
30						

Plate A4.2

HIRATA & ASSOCIATES, INC.

BORING LOG

W.O. 15-5591.1

BORING NO. B3 | DRIVING WT. 140 lb. | START DATE 12/11/13

SURFACE ELEV. 110± | DROP 30 in. | END DATE 12/11/13

DEPTH	GRAPH	SAMPLE	BLOWS PER FOOT	DRY DENSITY (PCF)	MOIST. CONT. (%)	DESCRIPTION
0						Silty SAND (SM) – Tannish brown, moist, medium dense.
		☐	13	86	10	
						SAND (SP) – Tannish brown, slightly moist, dense.
		☐	50	99	4	
5		☐	52/6"	96	9	Moist at 5 feet.
		☐	54/6"	99	5	
10						
		☐	50/2"	No Recovery		
15						End boring at 15 feet.
20						Neither groundwater nor seepage water encountered.
25						
30						

Plate A4.3

HIRATA & ASSOCIATES, INC.

BORING LOG

W.O. 15-5591.1

BORING NO. B4
SURFACE ELEV. 114±
DRIVING WT. 140 lb.
DROP 30 in.
START DATE 12/12/13
END DATE 12/12/13

DEPTH	GRAPH	SAMPLE	BLOWS PER FOOT	DRY DENSITY (PCF)	MOIST. CONT. (%)	DESCRIPTION
0						Silty SAND (SM) - Tannish brown, slightly moist, loose.
		☐	4	100	4	
		☐	65	116	5	SAND (SP) - Tannish brown, slightly moist, dense.
5		☐	95/11"	115	5	
		☐	54/6"	110	3	
10						
		☐	90/9"	103	3	
15						
		☐	50/5"	106	3	
20						End boring at 20 feet.
25						Neither groundwater nor seepage water encountered.
30						

Plate A4.4

HIRATA & ASSOCIATES, INC.

BORING LOG

W.O. 15-5591.1

BORING NO. B5 DRIVING WT. 140 lb. START DATE 12/12/13
SURFACE ELEV. 118± DROP 30 in. END DATE 12/12/13

DEPTH	GRAPH	SAMPLE	BLOWS PER FOOT	DRY DENSITY (PCF)	MOIST. CONT. (%)	DESCRIPTION
0						SAND (SP) – Tannish brown, slightly moist, medium dense to dense,
			38	100	5	
			24	94	7	
5			52/6"	102	6	
10			52/6"	108	5	
15			88/9"	115	4	
20			90/9"	107	5	
						End boring at 20.5 feet.
25						Neither groundwater nor seepage water encountered.
30						

Plate A4.5

HIRATA & ASSOCIATES, INC.

BORING LOG

W.O. 15-5591.1

BORING NO. B6 DRIVING WT. 140 lb. START DATE 12/12/13

SURFACE ELEV. 115± DROP 30 in. END DATE 12/12/13

DEPTH	GRAPH	SAMPLE	BLOWS PER FOOT	DRY DENSITY (PCF)	MOIST. CONT. (%)	DESCRIPTION
0						SAND (SP) – Tannish brown, slightly moist, dense.
		☐	39	105	4	
5		☐	71	104	3	
		☐	54/6"	108	3	
10						
		☐	86/9"	99	3	
15						End boring at 14.5 feet.
20						Neither groundwater nor seepage water encountered.
25						
30						

APPENDIX B

LABORATORY TESTING

DESCRIPTION OF LABORATORY TESTING

CLASSIFICATION

Field classification was verified in the laboratory in accordance with the Unified Soil Classification System. Laboratory classification was determined by both visual examination and sieve analysis tests performed in general accordance with ASTM D 422. The final classifications are shown at the appropriate locations on the Boring Logs, Plates A4.1 through A4.6.

MOISTURE-DENSITY

Representative samples were tested for field moisture content and dry unit weight. The dry unit weight was determined in pounds per cubic foot while the moisture content was determined as a percentage of dry weight. Samples were obtained using a 3-inch O.D. split tube sampler. Test results are shown at the appropriate depths on the Boring Logs, Plates A4.1 through A4.6.

CONSOLIDATION

Selected representative samples were tested for their consolidation characteristics. Test samples were 2.42 inches in diameter and 1 inch high. Porous stones were placed in contact with the top and bottom of test samples to permit addition and release of pore fluid. Loads were then applied in several increments in a geometric progression, and the resulting deformations recorded at selected time intervals. Test results are plotted on the Consolidation Test Reports, Plates B2.1 and B2.2.

SHEAR TESTS

Shear tests were performed in the Direct Shear Machine which is of the strain control type. Each sample was sheared under varying confining loads in order to determine the Coulomb shear strength parameters, cohesion and angle of internal friction. Test results are presented on Plates B3.1 through B3.3.

PROCTOR TEST

A Modified Proctor test was performed in general accordance with ASTM D 1557 on a bulk sample obtained from near boring B2 at a depth of about one foot below grade. The test is used to determine the optimum moisture content at which the soil compacts to 100 percent density. Results are shown on Plate B4.1.

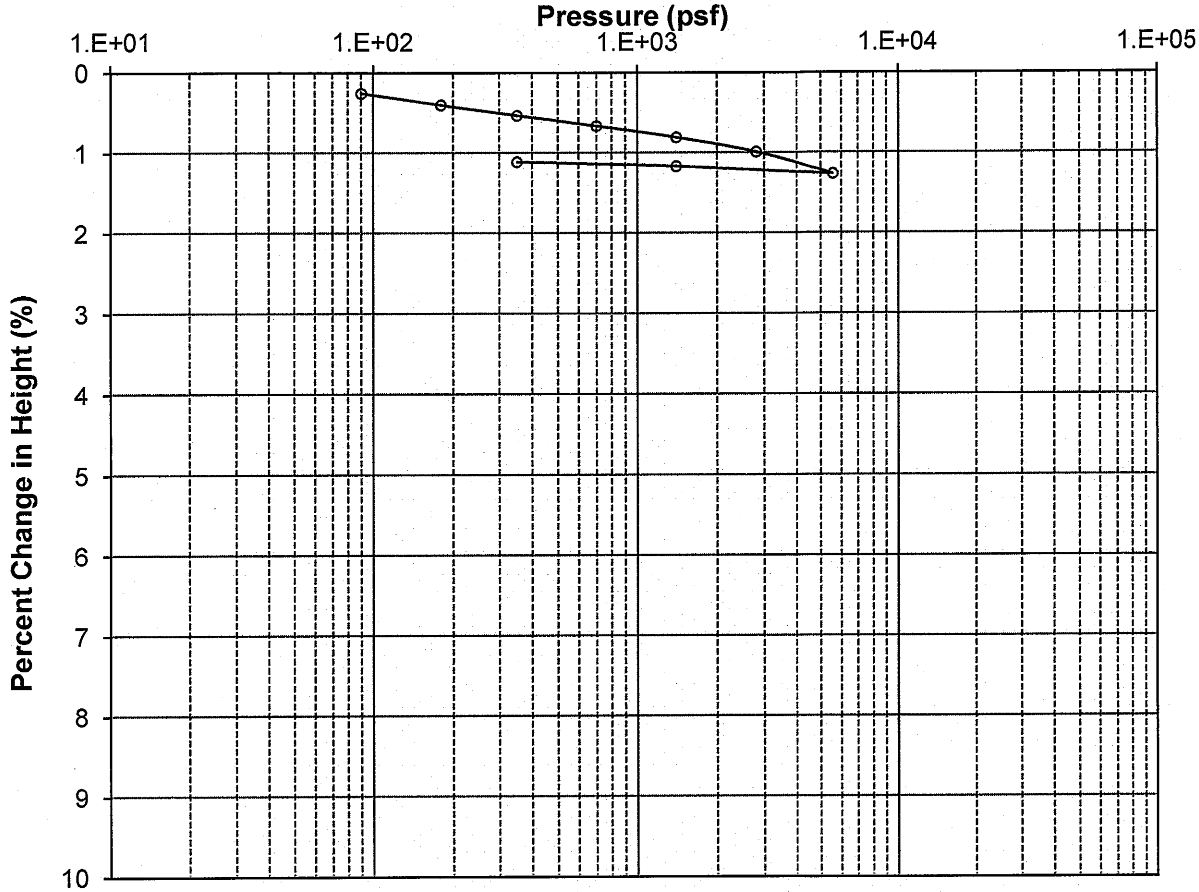
CALIFORNIA BEARING RATIO TEST

A CBR test was performed on a bulk sample, obtained from near boring B2 at a depth of about one foot, in general accordance with ASTM D 1883. The test is used to evaluate the relative quality of subgrade soils to be used in the design of flexible pavement. Results are shown on Plate B5.1.

SIEVE ANALYSES

Sieve analyses tests were conducted in general accordance with ASTM D 422 on samples obtained from boring B4 and on a bulk sample obtained from near boring B2 at a depth of about 1 foot below grade. The test is used to determine the grain size distribution. Test results are presented on Plate B6.1.

Consolidation Test Results



<u>Sample Description</u>

Boring No.: B3 Depth (ft): 3

Soil Description: Tannish brown sand

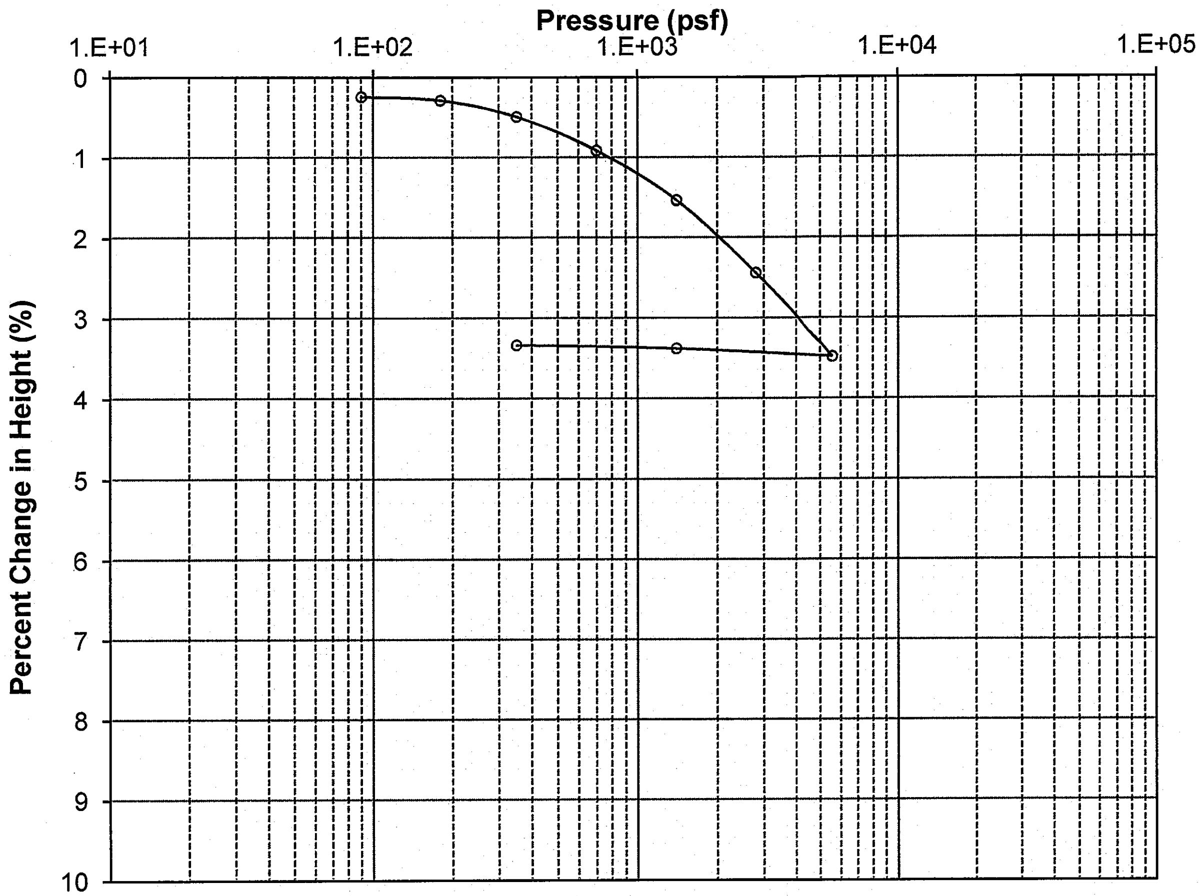
	Moisture Content (%)	Dry Density (pcf)
Initial	4.0	99.0
Final	2.9	100.1

Remark: 1/3/14

W.O. 15-5591.1	DLNR Maui Office Annex Building, Mahalani Street
Hirata & Associates, Inc.	CONSOLIDATION TEST

Plate B2.1

Consolidation Test Results



Sample Description

Boring No.: B4 Depth (ft): 5

Soil Description: Tannish brown sand

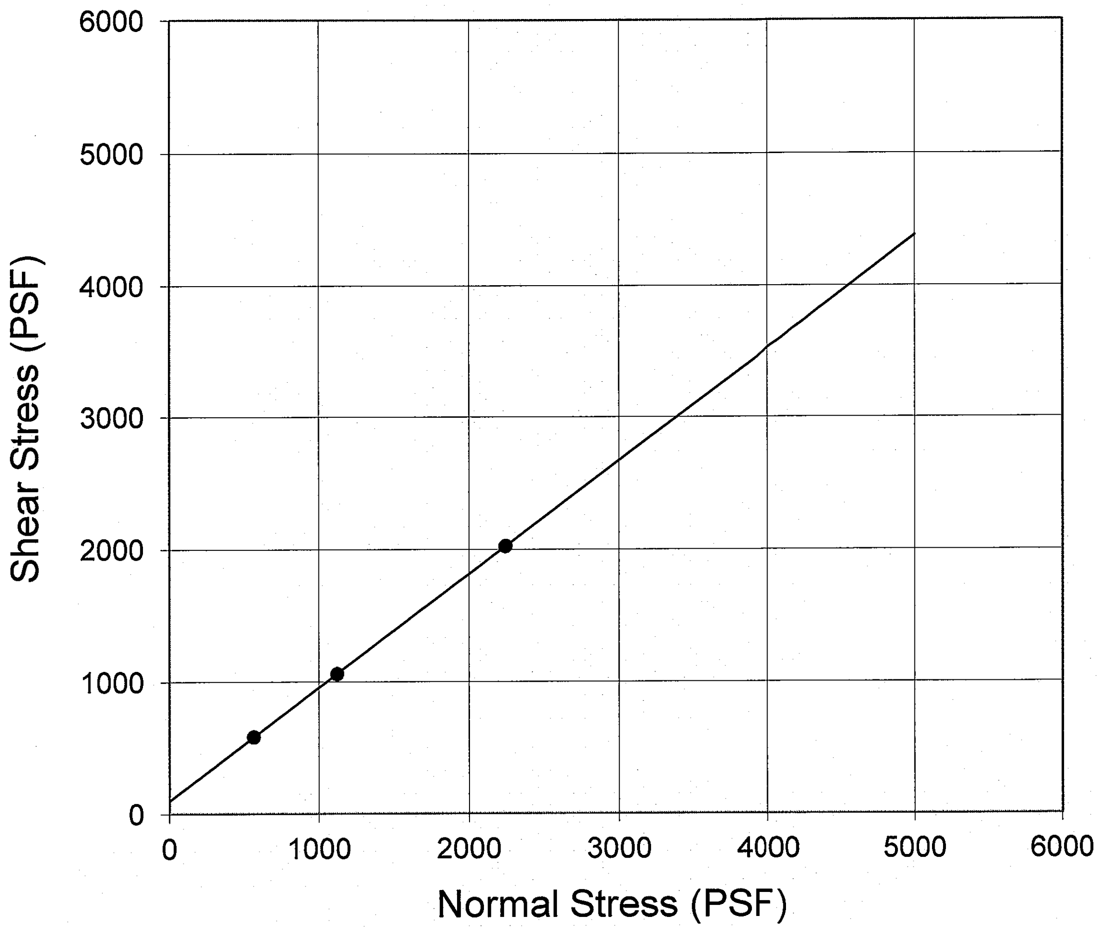
	Moisture Content (%)	Dry Density (pcf)
Initial	5.0	115.0
Final	4.3	119.1

Remark: 1/3/14

W.O. 15-5591.1	DLNR Maui Office Annex Building, Mahalani Street
Hirata & Associates, Inc.	CONSOLIDATION TEST

Plate B2.2

Direct Shear Test Results



<u>Sample Description</u>

Boring No.: B2 Depth (ft): 4
Soil Description: Tannish brown sand
Strength Intercept (C): 105.3 PSF (Peak Strength)
Friction Angle (ϕ): 40.6 DEG (Peak Strength)

Remark: 1/7/14

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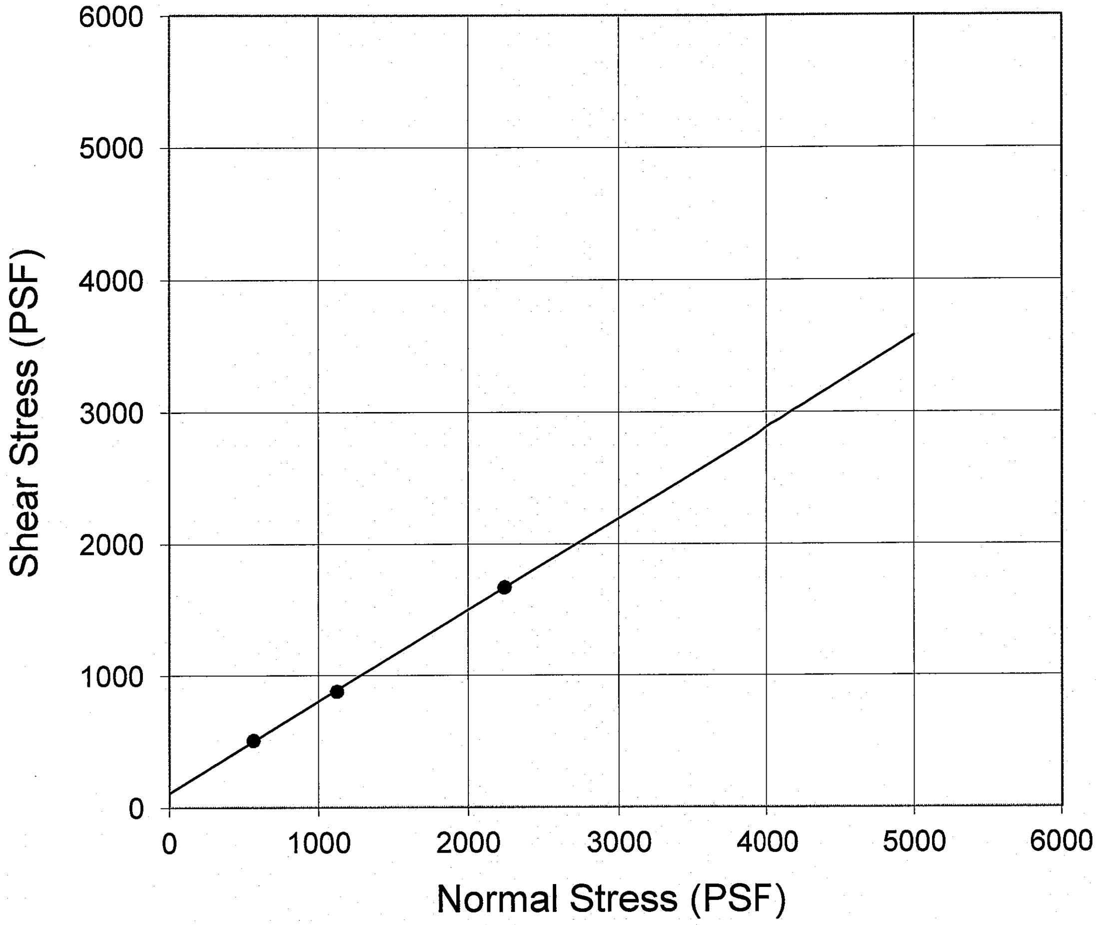
Hirata & Associates, Inc.	DIRECT SHEAR TEST

Plate B3.1

Direct Shear Test Results



Sample Description

Boring No.: B4 Depth (ft): 3

Soil Description: Tannish brown sand

Strength Intercept (C): 114.8 PSF (Peak Strength)

Friction Angle (ϕ): 34.7 DEG (Peak Strength)

Remark: 1/7/14

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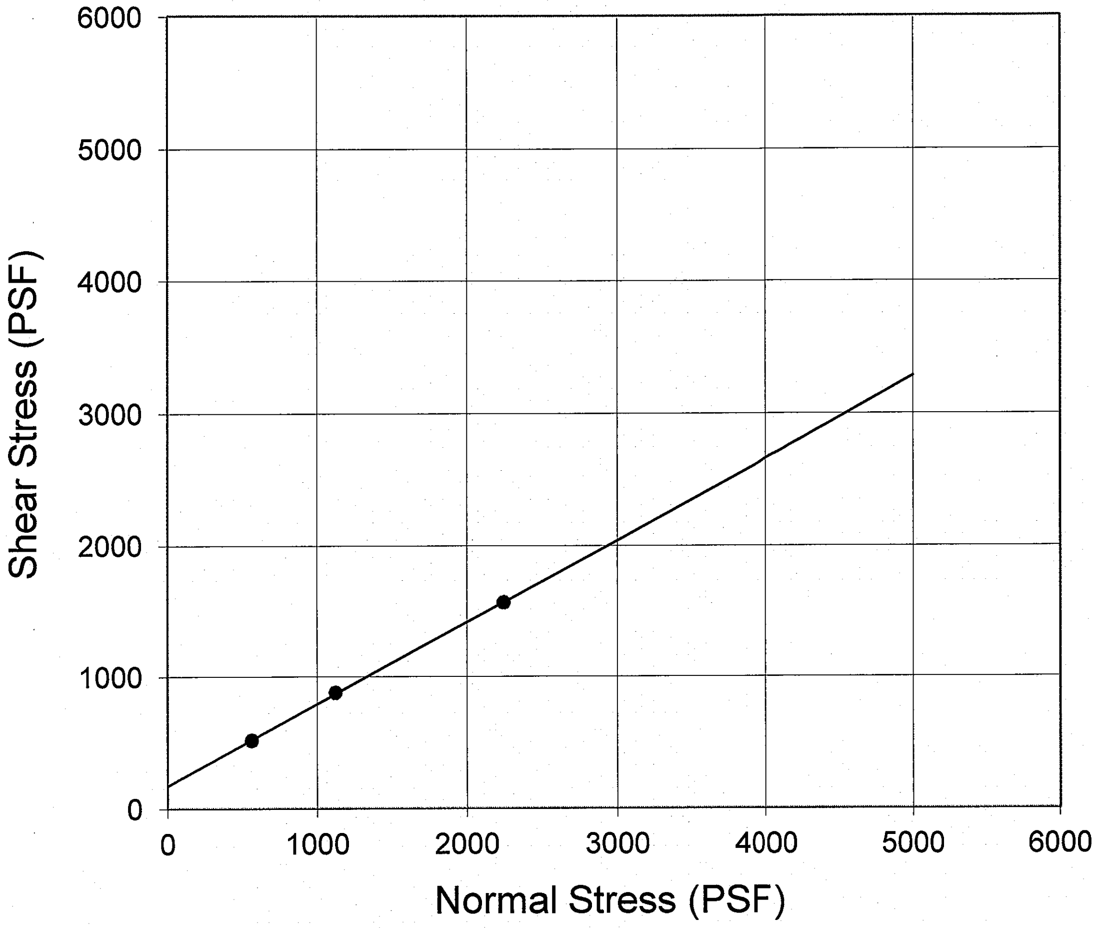
Hirata & Associates, Inc.	DIRECT SHEAR TEST

Plate B3.2

Direct Shear Test Results



Sample Description

Boring No.: B5	Depth (ft): 1		
Soil Description:	Tannish brown sand		
Strength Intercept (C):		176.7 PSF	(Peak Strength)
Friction Angle (ϕ):		31.9 DEG	(Peak Strength)

Remark: 1/8/14

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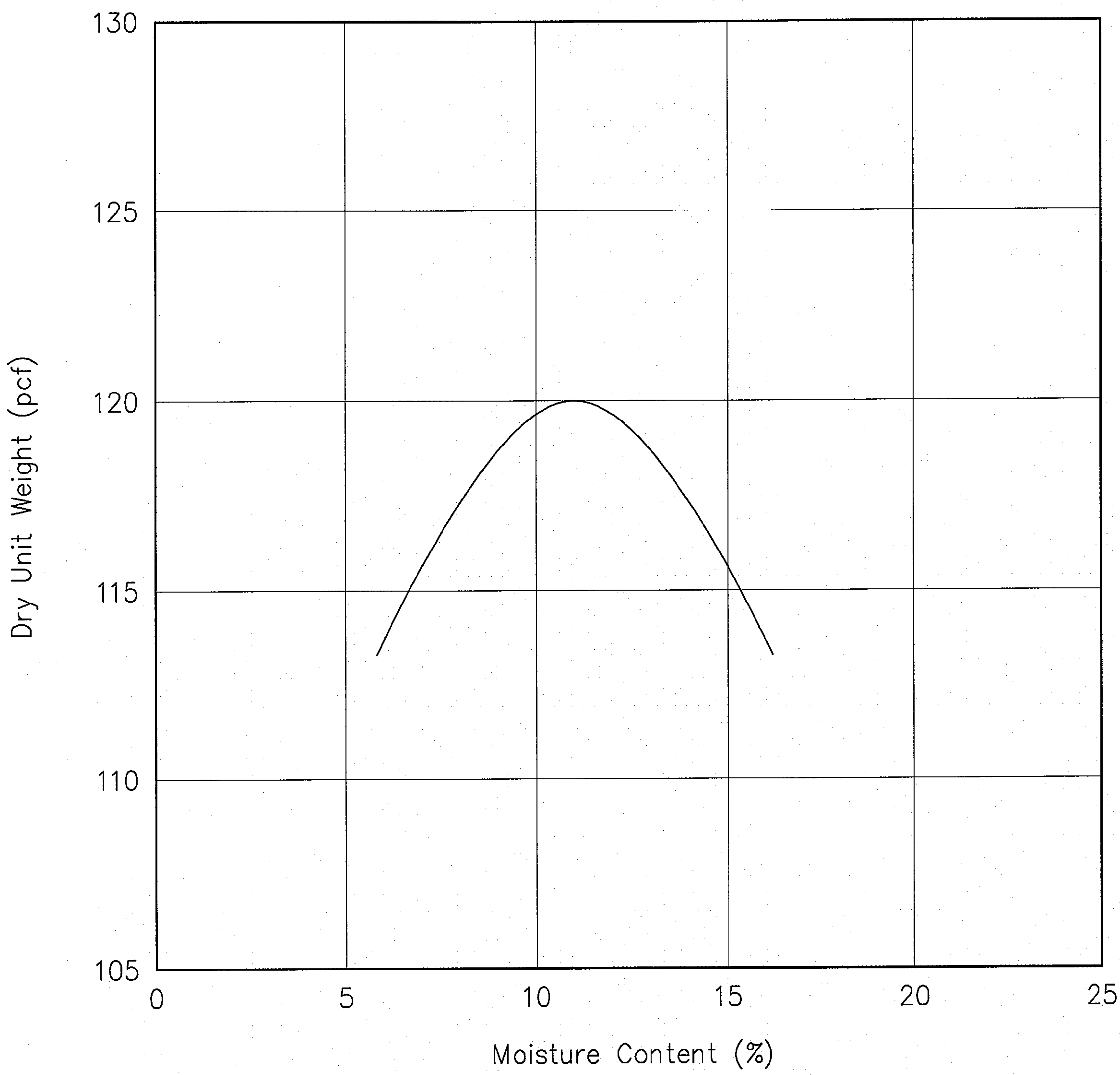
Hirata & Associates, Inc.	DIRECT SHEAR TEST

Plate B3.3



Soil Data

Location: Boring B2 at 1 foot

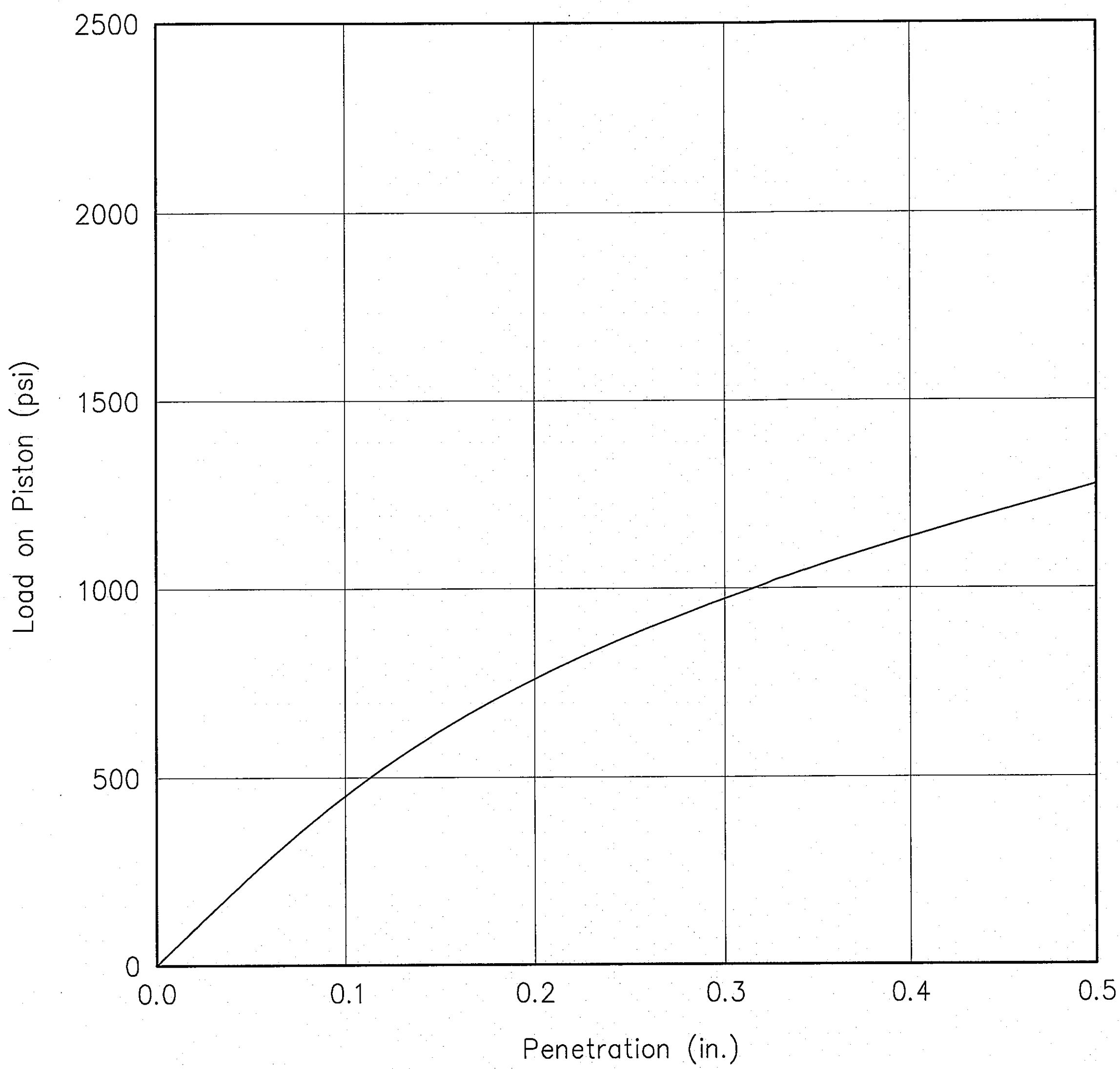
Description: Tannish brown silty sand

Test Results

Maximum Dry Density: 120 pcf

Optimum Moisture Content: 11.0%

W.O. 15-5591.1	DLNR Maui Office Annex Building, Mahalani Street
Hirata & Associates, Inc.	MODIFIED PROCTOR CURVE Plate B4.1



Soil Data

Location:	Boring B2 at 1 foot
Description:	Tannish brown silty sand
Sample Dry Density:	120 pcf
Sample Moisture Content:	11%

Test Results

CBR Value:	45%
Expansion:	0%

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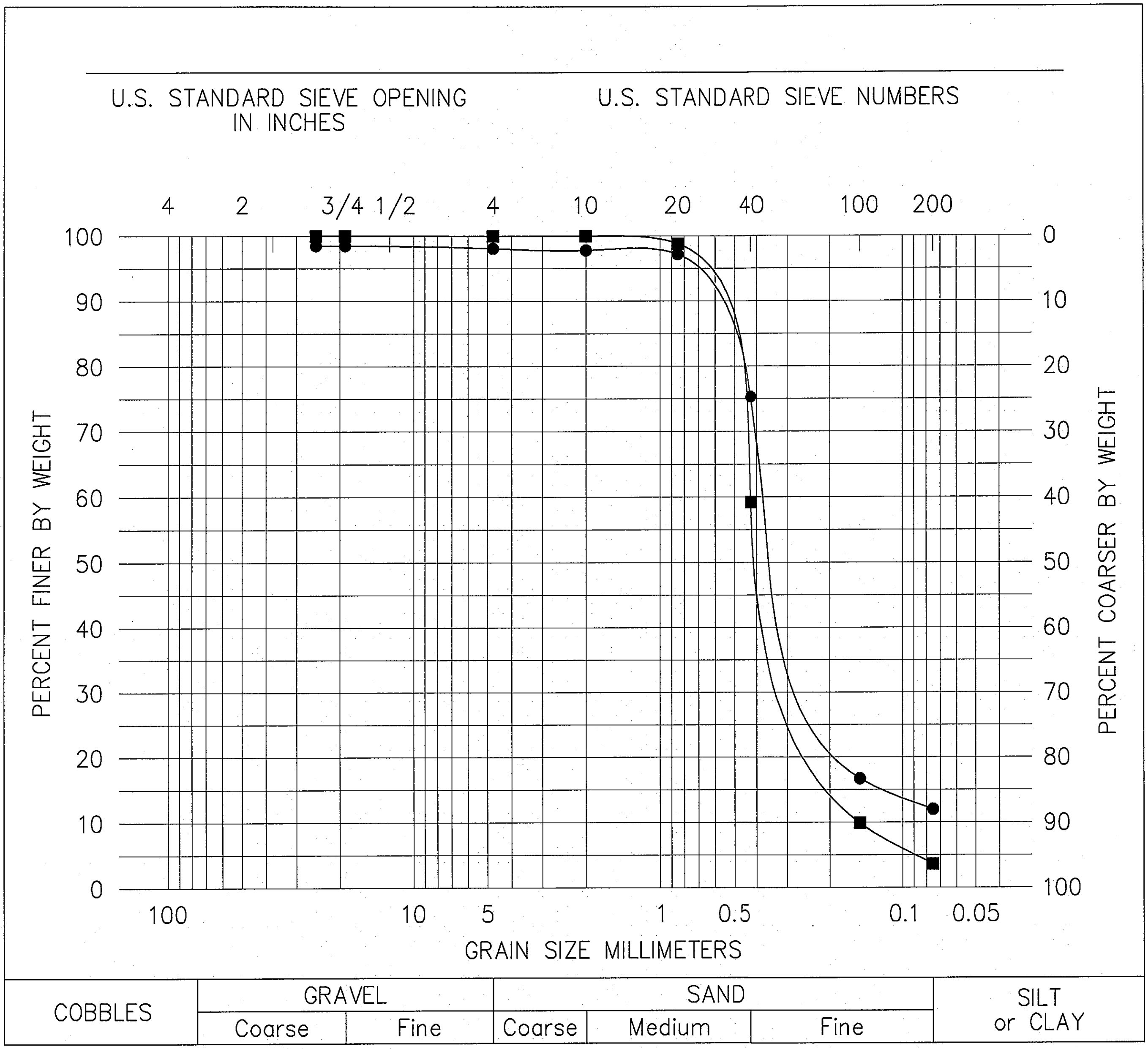
Hirata & Associates, Inc.	CBR STRESS PENETRATION CURVE

Plate B5.1



● Sample #1	Location:	Boring B2 at 1 foot
	Description:	Tannish brown silty sand
■ Sample #2	Location:	Boring B4 between 9 to 14 feet
	Description:	Tannish brown sand

W.O. 15-5591.1	DLNR Maui Office Annex Building, Mahalani Street
Hirata & Associates, Inc.	GRADATION CURVE Plate B6.1