REPORT
SOILS INVESTIGATION

PROPOSED RESIDENCES
AKUMU STREET
KAILUA, OAHU, HAWAII
TMK: 4-2-083: 074 & 075

for

THREE W CORP.

Project No. 10-0131
April 16, 2012

SHINSATO ENGINEERING, INC.
98-747 KUAHAO PLACE, #E
PEARL CITY, HI 96782

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April 16, 2012
Project No. 10-0131

Three W Corp.
Attention: Richard Wheelock
700 Bishop Street, Suite 1000
Honolulu, Hawaii 96813

Dear Mr. Wheelock:

The attached report presents the results of a soils investigation at the site of the proposed residences to be located at Akumu Street in Kailua, Oahu, Hawaii. TMK: 4-2-083: 074 & 075

A summary of the findings is as follows:

1) The subsurface conditions at the site were explored by excavating 14 test pits to depths of 9 to 12 feet below existing grade. In general, the test pits disclosed the site to be underlain by soft to stiff, gray brown and red brown CLAY with gravel to the final depth of pits.

2) Groundwater was encountered in the test pits at depths of 4 to 8 feet at the time of the field investigation.

3) Special considerations will be required in the design and construction of the project due to existing site conditions. These include but may not be limited to the following:

    a) The on-site CLAY soil has high to very high shrink-swell potential. In order to minimize the possible adverse effects from shrinking and swelling of the clay soils, it is recommended that interior type floor slabs be constructed with a minimum of 24 inches of non-expansive granular fill beneath the slab. For exterior slabs, the thickness of granular fill may be reduced to 12 inches. Isolated column and perimeter edge footings should be embedded a minimum of 36-inches below the lowest adjacent finished grade.

    b) The on-site CLAY soil should not be used as structural fill or retaining wall backfill (within a 1H:2V plane projected upwards from the edge of the retaining wall footing).

    c) The CLAY soil has high in-situ moisture content. In order to obtain proper compaction of the on-site soils, aeration will likely be required.

    d) The test pits excavated on the westerly side of the properties (test pit numbers 1, 2, 4, 5, 7 and 8) encountered soft to very soft soils at depths of 1 to 7 feet below grade. These soils have high to very high compression characteristics. Where this portion of the site is to be filled, excessive ground settlement could occur. The amount and rate of settlement will depend on the height and areal extent of fill placement. It is estimated that the ground settlement may be on the order of 1/2 to 1 inch per foot of fill.

    e) The soft to very soft soils may not be able to support construction equipment. Stabilization of the soft to very soft soils may be necessary to support the construction equipment. The

bottom of utility trench excavations that encounter the soft to very soft soils may require over excavation and replacement with granular fill or bedding material.

4) Based on the findings and observations of this investigation, it is concluded that footings bearing on firm on-site soils or properly compacted fill may be used to support the proposed structure. A summary of the foundation design parameters is as follows:

a)	Allowable soil bearing value:	1,500 psf for footings bearing on firm on-site soils or properly compacted structural fill.
b)	Footing embedment:	For footings bearing on the on-site CLAY, the minimum footing embedment depth shall be 36 inches below the lowest adjacent finished grade. For footings bearing on a minimum of 24 inches of properly compacted structural fill, the minimum footing embedment depth may be reduced to 12 inches below lowest adjacent finished grade.
c)	Estimated settlement:	less than 1 inch
d)	Passive earth resistance:	300 pcf above groundwater; 200 pcf below groundwater
e)	Frictional resistance:	0.4 times the dead load for the underlying soils or imported select granular fill
f)	Active earth pressure:	30 pcf free-standing wall, level backfill using imported structural fill that extends within a 1H:2V plane project upwards and outwards from the heel of the wall footing; where this condition cannot be met and for on-site CLAY soils, the active earth pressure shall be increased to 45 pcf; for restrained walls, the active earth pressure shall be increased by 50 percent; additional increases shall be made for surcharge loading and sloping backfill
g)	Soil Type Profile:	E - “soft soil” (2003 and 2006 IBC)
h)	Slab-on-grade:	Provide a minimum of 24 inches of structural fill beneath concrete floor slabs; any granular cushion may be considered as a part of the 24-inch thickness.

Details of the findings and recommendations are presented in the attached report.

This investigation was made in accordance with generally accepted engineering procedures and included such field and laboratory tests considered necessary for the project. In the opinion of the undersigned, the accompanying report has been substantiated by mathematical data in conformity with generally accepted engineering principles and presents fairly the design information requested by your organization. No other warranty is either expressed or given.

Respectfully submitted,

SHINSATO ENGINEERING, INC.

Lawrence S. Shinsato, P.E.
President

LSS:DS

This work was prepared by me
or under my supervision.
License Expires 04/30/14

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INTRODUCTION

This investigation was made for the purpose of obtaining information on the subsurface conditions from which to base recommendations for foundation design for the proposed residences to be located at Akumu Street in Kailua, Oahu, Hawaii. The location of the site, relative to the existing streets and landmarks, is shown on the Vicinity Map, Plate 1.

SCOPE OF WORK

The services included logging the excavation of 14 test pits to depths of 9 to 12 feet below existing grade, obtaining samples of the underlying soils, performing laboratory tests to determine pertinent engineering properties of the representative soil samples, and performing an engineering analysis to determine foundation design parameters. The following information is provided for use by the Architect and/or Engineer:

1. General subsurface conditions, as disclosed by the test pits.
2. Physical characteristics of the soils encountered.
3. Recommendations for foundation design, including bearing values, embedment depth and estimated settlement.
4. Recommendations for placement of fill and backfill.
5. Special design considerations.

PLANNED DEVELOPMENT

From the information provided, the project will consist of developing the properties for single family homes.

SITE CONDITIONS

Surface

The properties are located in the Enchanted Lakes area of Kailua at the westerly end of Akumu Street. The parcels are bordered by residential lots on all sides. At the time of the field investigation, the site was unoccupied and covered with a moderate to dense vegetative growth. The ground surface is gently sloping

with an elevated terrace on the eastern portion of parcel 74.

Subsurface

The subsurface conditions at the site were explored by excavating 14 test pits to depths of 9 to 12 feet. The locations of the test pits are shown on the Plot Plan, Plate 2. Detailed logs of the test pits are presented in the Appendix to this report.

In general, the test pits disclosed the site to be underlain by soft to stiff, gray brown and red brown CLAY with gravel to the final depth of pits. At Test Pits 1, 2, 3, and 4, loose to very loose, gray clayey GRAVEL was found below the CLAY at depths of 5 to 7 feet below grade.

Groundwater was encountered in the test pits at depths of 4 to 8 feet at the time of the field investigation.

From the USDA Soil Conservation Service "Soil Survey of the Islands of Kauai, Oahu, Maui, Molokai and Lanai, State of Hawaii," the site is located in an area designated as Hanalei silty clay, 0 to 2 percent slopes (HnA), Papaa clay, 6 to 20 percent slopes (PYD), and Papaa clay, 20 to 35 percent slopes (PYE). The Hanalei series consists of somewhat poorly drained to poorly drained soils on bottom lands on the islands of Kauai and Oahu. These soils developed in alluvium derived from basic igneous rock. On this soil, permeability is moderate. Runoff is very slow, and the erosion hazard is no more than slight (USDA, 1972, pg. 38, Plate 65). The Papaa series consists of well-drained soils on uplands on the island of Oahu. These soils developed in colluvium and residuum derived from basalt. On this soil, runoff is slow to medium, and the erosion hazard is slight to moderate (USDA, 1972, pg. 110, Plate 65).

Geology

The site is located within the caldera of the old Koolau Volcano which is an elongated shield that is believed to have formed during late Tertiary/early Pleistocene time (between 1 and 12 million years ago) by lavas

flowing from rift zones along a northwest-trending rift zone. The caldera of the volcano is presumed to have extended from near Waimanalo at the southeast to beyond Kaneohe at the northwest, at the base of the Pali to the southwest and somewhere between the hills of Lanikai and the Mokulua Islands (offshore) to the east. This eastern side was probably destroyed by erosion (Stearns and Vaksvik, 1935).

CONCLUSIONS AND RECOMMENDATIONS

General

Based on the findings and observations of this investigation, it is concluded that the proposed structure may be supported on spread and continuous footings that bear on firm on-site soil or properly compacted fill.

Special Consideration

Special considerations will be required in the design and construction of the project due to the existing soil conditions. These include but may not be limited to the following:

a) The on-site CLAY soil has high to very high shrink-swell potential. In order to minimize the possible adverse effects from shrinking and swelling of the clay soils, it is recommended that interior type floor slabs be constructed with a minimum of 24 inches of non-expansive granular fill beneath the slab. For exterior slabs, the thickness of granular fill may be reduced to 12 inches. Isolated column and perimeter edge footings should be embedded a minimum of 36-inches below the lowest adjacent finished grade.

b) The on-site CLAY soil should not be used as structural fill or retaining wall backfill (within a 1H:2V plane projected upwards from the edge of the retaining wall footing).

c) The CLAY soil has high in-situ moisture content. In order to obtain proper compaction of the on-site soils, aeration will likely be required.

d) The test pits excavated on the westerly side of the properties (test pit numbers 1, 2, 4, 5, 7 and 8) encountered soft to very soft soils at depths of 1 to 7 feet below grade. These soils have high to very high compression characteristics. Where this portion of the site is to be filled, excessive ground settlement could occur. The amount and rate of settlement will depend on the height and areal extent of fill placement. It is estimated that the ground settlement may be on the order of 1/2 to 1 inch per foot of fill.

e) The soft to very soft soils may not be able to support construction equipment. Stabilization of the soft to very soft soils may be necessary to support the construction equipment. The bottom of utility trench excavations that encounter the soft to very soft soils may require over excavation and replacement with granular fill or bedding material.

Foundations

An allowable bearing value of 1,500 pounds per square foot may be used for footings that bear on firm on-site soils or properly compacted fill. The bearing value is for dead plus live loads and may be increased by one-third (1/3) for momentary loads due to wind or seismic forces. If any footing is eccentrically loaded, the maximum edge pressure shall not exceed the bearing pressure for permanent or for momentary loads.

For footings bearing on the on-site CLAY, the minimum footing embedment depth shall be 36 inches below the lowest adjacent finished grade. For footings bearing on a minimum of 24 inches of properly compacted structural fill, the minimum footing embedment depth may be reduced to 12 inches below lowest adjacent finished grade.

For footings located adjacent to utility trenches, the bottom of the footing shall be deepened below a 1 horizontal to 1 vertical plane projected upwards from the edge of the utility trench.

For footings located on or adjacent to slopes, the footing shall be deepened such that there is a minimum horizontal distance of 5 feet from the edge of the footing to the slope face.

Where footings are to be located adjacent to retaining walls or other structural elements which are not designed for surcharge loading, the new footing shall be deepened below a 45-degree plane projected upwards from the adjacent structure.

All loose and disturbed soil at the bottom of footing excavations shall be removed to firm soil or the disturbed soil shall be compacted prior to laying of steel or pouring of concrete.

In accordance with the 2003 and 2006 International Building Code, the site class and soil profile name may be assumed as E: soft soil profile.

Settlement

Under the fully applied recommended bearing pressure, it is estimated that the total settlement of footings up to 5 feet square or 3 feet continuous that bear on properly compacted fill or firm on-site soil will be less than 1 inch.

Differential settlement between footings will vary according to the size and bearing pressure of the footing.

Lateral Resistance

For resistance of lateral loads, such as wind or seismic forces, an allowable passive resistance equivalent to that exerted by a fluid weighing 300 pounds per cubic foot (pcf) may be used for footings, or other structural elements, provided the vertical surface is in direct contact with undisturbed soil or properly compacted fill. For submerged conditions, the value shall be decreased to 200 pcf.

Frictional resistance between footings and slabs, and the underlying soils may be assumed as 0.4 times the dead load.

Lateral resistance and friction may be combined.

Retaining Walls

Foundations for retaining walls shall be designed as per the foundation section of this report.

For design of free-standing retaining walls that have properly draining select granular backfill within a 1H:2V plane projected upwards from the bottom of the footing, the following active earth pressures may be used:

Backfill Slope	Horizontal Component	Vertical Component
Level backfill	30 psf/lin. ft.	0
3H:1V backfill	40 psf/lin. ft.	13 psf/lin. ft.
2H:1V backfill	45 psf/lin. ft.	22 psf/lin. ft.

In the case of free-standing property line walls supporting a cut slope where the select granular material will not satisfy the 1H:2V zone, the active earth pressure shall be increased by 1.5 times the recommended value.

Free-standing walls are defined as walls that are allowed to rotate between 0.005 and 0.01 times the wall height. The rotation of the wall develops "active earth pressures." If the wall is not allowed to move as in the case of basement walls or walls that are restrained at the top, the soil pressure that will develop is known as an "at-rest" pressure. For restrained walls, the above active earth pressures shall be increased by 50 percent.

The on-site CLAY soil is not suitable for use as backfill material within the 45-degree plane projected upwards from the bottom of the wall footing.

Drainage of the retaining wall backfill material shall be accomplished by providing 4-inch diameter weepholes

spaced 8-feet on-center or by using a minimum 4-inch diameter perforated PVC footing drain pipe. One (1) cubic foot of crushed rock (#3-fine or similar) that is wrapped with geotextile fabric shall be placed behind each weephole. Footing drain pipes shall be surrounded with crushed gravel (minimum 12-inches by 12-inches in cross section) which is wrapped with geotextile filter fabric. Geotextile fabric shall be MIRAFI 140N, or similar.

Backfill for retaining walls shall be properly compacted in accordance with the Site Preparation and Grading section to this report.

The above active pressures do not include surcharge loads such as footings located within a 45-degree plane projected upwards from the heel of the footing, and/or from hydrostatic pressures. If such conditions occur, the active pressure shall be increased accordingly.

Slab-on-Grade

The on-site CLAY soil has high to very high shrink-swell potential. In order to minimize the possible adverse effects from shrinking and swelling of the clay soils, it is recommended that interior type floor slabs be constructed with a minimum of 24 inches of non-expansive granular fill beneath the slab. For exterior slabs, the thickness of granular fill may be reduced to 12 inches.

It is recommended that slabs-on-grade with moisture sensitive floor covering be protected with a moisture barrier.

It is recommended that the subgrade soil be prepared in accordance with the Site Preparation and Grading section to this report.

Slopes

Cut and fill slopes shall not exceed 2 horizontal to 1 vertical.

Exposed slopes shall be covered as soon as practical after construction to minimize erosion.

Fill slopes shall be constructed by either overfilling and cutting back to compacted soil, or the slope shall be track-rolled.

Pavement Design

For the design of private roadways, the recommended pavement sections are as follows:

a. Private Driveways

Pavement Type	Flexible	Rigid
	AC: 2 inch	PCC: 5 inch
	UTB: 6 inch	UTB or SB: 4 inch
TOTAL THICKNESS	8 inches	9 inches

b. Streets

Pavement Type	Flexible	Rigid
	AC: 2 inch	PCC: 6 inches
	ATB: 4 inch	UTB: 12 inches
	UTB: 12 inch	
TOTAL THICKNESS	18 inches	18 inches

AC: Asphaltic Concrete
ATB: Asphalt-treated base
UTB: Untreated aggregate base course gravel
SB: Select borrow

If the pavement area is filled with soil having a higher bearing strength than the on-site CLAY soil, the pavement section may be reduced. The amount of reduction will depend on the strength and thickness of the fill material.

The top 6 inches of pavement subgrade, select borrow and base course gravel shall be compacted to at least 95 percent of the maximum dry density (ASTM D1557).

All material quality and compaction requirements for the pavement section shall be in accordance with the City and County of Honolulu, Standard Specifications for Public Works Construction, dated 1986.

Site Preparation and Grading

It is recommended that the site be prepared in the following manner:

1. Clearing and Grubbing:

   In all areas to receive fill and in structural areas, all vegetation, weeds, brush, roots, stumps, rubbish, debris, soft soil and other deleterious material shall be removed and disposed of off-site.

2. Preparation of Ground to Receive Fill:

   The exposed surface shall then be scarified to a depth of 6 inches, moisture conditioned to near optimum moisture (ASTM D1557-00) and then compacted to the degree of compaction specified below. In areas where the subgrade soil is soft/very soft and cannot be adequately compacted, stabilization of the soft/very soft subgrade may be necessary. If stabilization is needed, the following procedure is suggested.

   1. Over-excavate the soft/very soft soil to a depth of 24-inches.
   2. Place a layer of geotextile filter fabric (MIRAFI 180N or similar) over the exposed subgrade. Seams should be overlapped a minimum of 24-inches.
   3. Place select granular fill over the fabric. The first layer should be placed in a 12-inch thick loose lift. The top of this fill layer shall be compacted to an unyielding surface with a smooth-drum roller. Heavy vibratory compaction effort should be avoided as it may cause damage to adjacent structures.

4. The select granular fill material may consist of well-graded granular material such as recycled concrete, cold-plane A.C. material (in roadway and non-structural areas only), City and County of Honolulu select borrow or base course gravel, or other similar granular soils.

5. Subsequent layers of fill material shall be placed and compacted in 8-inch loose lifts to a minimum of 95 percent of the maximum dry density.

It should be noted that the use of a geotextile filter fabric may hinder future utility line excavations if the invert of the lines are below the filter fabric layer. Where the filter fabric is removed or damaged by the trench excavation, the damaged section of fabric shall be replaced.

3. Types of Fill and Backfill Material:

Structural fill and backfill shall be described as material placed beneath buildings and extending a horizontal distance of 3 feet beyond the edge of the building line. Non-structural fill shall be described as material placed beyond 3 feet from the building line.

4. Material Quality:

Fill and backfill material shall consist of soil which is free of organics and debris. The maximum size particle for fill and backfill material shall be as follows:

Structural Fill	
Top 2 feet below finished subgrade (FSG)	3"
Below 2 feet from FSG	6"
Non-structural fill and Pavement areas	
Top 2 feet from FSG	3"
2 to 6 feet from FSG	6"
Below 6 feet from FSG	*

(FSG = Finished Subgrade Elevation)

*Generally minus 12-inch size material is preferred. However, larger rock or boulders (up to 24 inches in diameter) may be used in deep fills provided they are well embedded and geotextile filter fabric is placed over the "boulder" fill. If utility lines are to be installed within fill areas, the maximum particle size shall be reduced to minimize obstruction of trenching work.

Structural fill shall have a Unified Soil Classification of either GW, GM, SW, or SM. The plasticity index of the fine portion as determined by the ASTM D4318-84 test shall be less than 15.

The on-site CLAY soil is not suitable for use as structural fill and backfill (in the upper 3 feet from finished subgrade, and within a 1H:2V plane projected upwards from the bottom of the retaining wall footing).

5. Placement of Fill and Backfill:

Each layer of fill and backfill material shall be placed in lifts not exceeding the following (loose thickness):

Structural Fill (including pavement areas)	
Top 2 feet below finished subgrade (FSG)	8"
Below 2 feet from FSG	12"
Non-structural fill	
Top 6 feet from FSG	12"
Below 6 feet from FSG	*

*The loose thickness of this layer shall not exceed 1.5 times the largest size particle; this is predicated upon proper compaction of each lift.

Prior to placing of fill and backfill material, the material shall be aerated or moistened to near optimum moisture content (ASTM D1557-00 test procedure).

Where fill is placed on existing ground that is steeper than 5 horizontal to 1 vertical, the existing ground surface shall be benched into firm soil as the fill is placed.

6. Degree of Compaction:

Each layer of fill and backfill shall be thoroughly compacted from edge to edge using conventional compaction equipment designed for the purpose. The minimum degree of compaction for each layer (as determined by the ASTM D1557-00 test procedure) shall be as follows:

Structural Fill (under and 3 feet beyond the edge of buildings):	95%
Non-structural fill	*90%

*Where compaction tests are not practical due to the size of the material, each layer shall be compacted by track rolling until it does not weave or creep under the weight of the track rolling equipment (D-8 dozer or larger).

It is particularly important to see that all fill and backfill soils are properly compacted in order for the design parameters to remain applicable.

7. Preparation of Footing Excavations:

Footing excavations shall be cleaned of loose material and soils disturbed by the excavation prior to placing of steel or pouring of concrete. Any soft soil encountered at the bottom of the footing excavation shall be removed to firm material. The resulting depression shall then be backfilled with properly compacted structural fill.

8. Site Drainage:

During construction, drainage shall be provided to minimize ponding of water adjacent to or on

foundation and pavement areas. Ponded areas shall be drained immediately. Any subgrade soil that has become soft due to ponding shall be removed to firm material and replaced with compacted structural fill.

INSPECTION

During the progress of construction, so as to evaluate compliance with the design concepts, specifications and recommendations contained in this report, qualified engineering personnel should be present to observe the following operations:

1. Site preparation.
2. Placement of fill and backfill.
3. Footing excavations.

REMARKS

The conclusions and recommendations contained herein are based on the findings and observations made at the test pit locations. If conditions are encountered during construction which appear to differ from those disclosed by the explorations, this office shall be notified so as to consider the need for modifications.

This report has been prepared for the exclusive use of Three W Corp. and their respective design consultants. It shall not be used by or transferred to any other party or to another project without the consent and/or thorough review by this facility. Should the project be delayed beyond the period of one year from the date of this report, the report shall be reviewed relative to possible changed conditions.

Samples obtained in this investigation will deteriorate with time and will be unsuitable for further laboratory tests within one (1) month from the date of this report. Unless otherwise advised, the samples will be discarded at that time.

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The following are included and complete this report:

Appendix

Field Investigation

Laboratory Testing

Vicinity Map

Plot Plan

Logs of Test Pits

Results of Laboratory Tests

APPENDIX

FIELD INVESTIGATION

General

The field investigation consisted of excavating test pits with a Case 9030B Excavator at the locations shown on the Plot Plan. Material excavated from the pit and the sides and bottom of the pit were visually inspected and a continuous log of the hole was kept.

Soil Sampling

Bulk samples of the underlying soils were obtained from test pits. The soil samples were visually classified in the field using the Unified Soil Classification System. Samples were packed in moisture proof containers and transported to the laboratory for testing.

LABORATORY TESTING

General

Laboratory tests are performed on various soil samples to determine their engineering properties. Description of the various tests are listed below.

Unit Weight and Moisture Content

The in-place moisture content and unit weight of the samples are used to correlate similar soils at various depths. The sample is weighed, the volume determined, and a portion of the sample is placed in the oven. After oven-drying, the sample is again weighed to determine the moisture loss. The data is used to determine the wet-density, dry-density and in-place moisture content.

Classification Tests

The terms and symbols used to describe the soil materials are based on the Unified Soil Classification System which provides a basis for classifying soils using either visual methods or laboratory test results. Laboratory tests include sieve and hydrometer analysis for particle size distribution, and Atterberg Limits test for liquid limit, and plasticity index determination.

Grain-size distribution of the soil is determined by passing the soil through a series of sieves. If 50 percent or more of the soil by dry weight passes the #200 sieve, the soil is classified as fine-grained. If more than 50 percent of the soil by dry weight is retained on the #200 sieve, the soil is classified as coarse grained.

Coarse grained soils are described as follows:

Boulder:	Material retained on a 12-inch square sieve
Cobble:	Material passing a 12-inch sieve but retained on a 3-inch sieve
Gravel:	Material passing a 3-inch sieve but retained on a #4 sieve
Sand:	Material passing a #4 sieve but retained on a #200 sieve

Fine-grained materials are silts and clays. The liquid limit and plastic limit results from an Atterberg Limits test are used to determine if the soil is a silt or clay.

Direct Shear

Direct shear tests are performed to determine the strength characteristics of the representative soil samples. The test consists of placing the sample into a shear box, applying a normal load and then shearing the sample

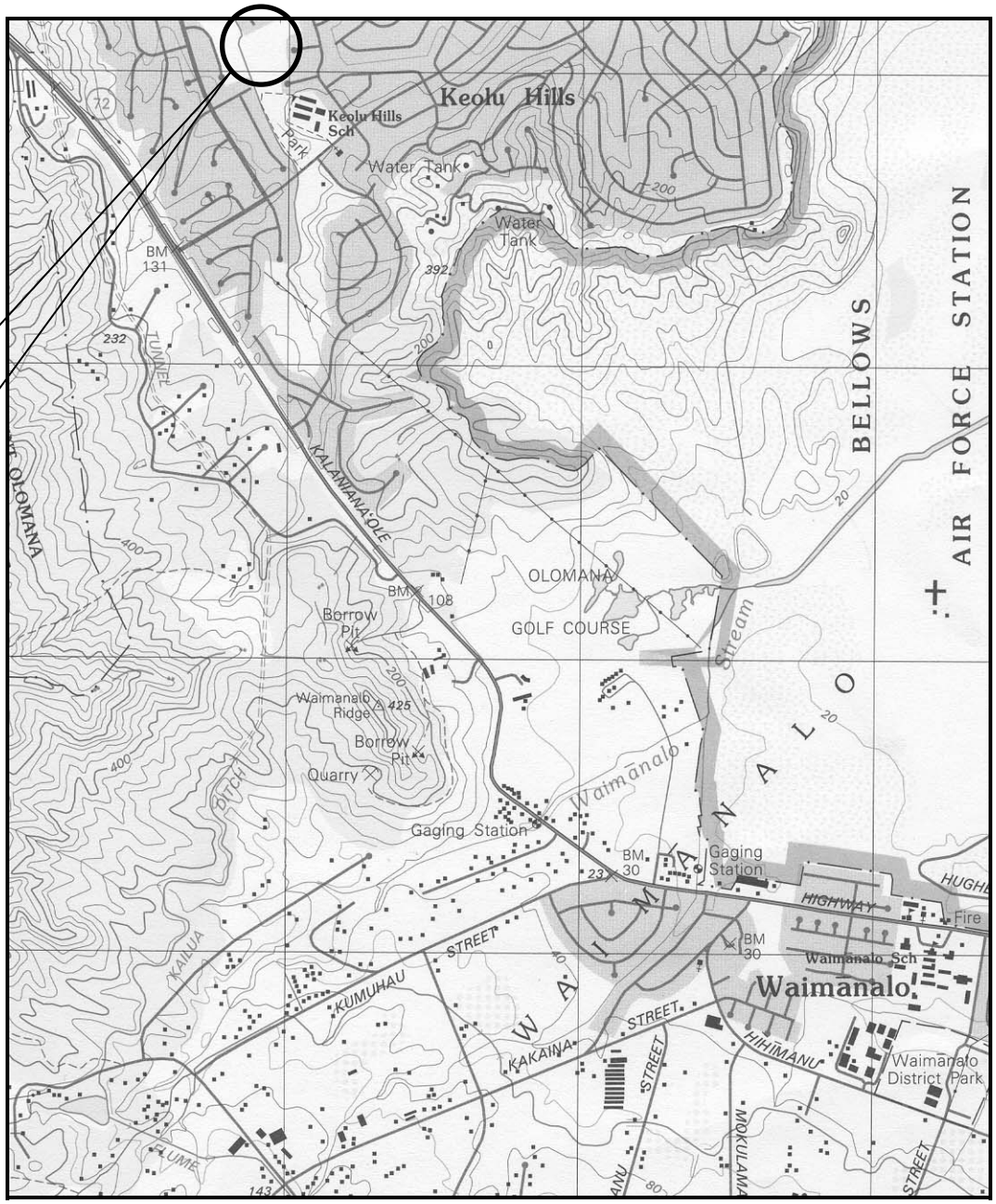
at a constant rate of strain. The shearing resistance is recorded at various rates of strain. By varying the normal load, the angle of internal friction and cohesion can be determined.

Consolidation Test

Consolidation tests are performed to obtain data from which time rates of consolidation and amounts of settlement may be estimated. The test is performed by placing a specimen in a consolidation apparatus. Loads are applied in increments to the circular face of a one (1) inch high sample. Deformation or changes in thickness of the specimen are recorded at selected time intervals. Water is introduced to or allowed to drain from the sample through porous disks placed against the top and bottom faces of the specimen. The data is then used to plot a stress-volume strain curve which is used in estimating settlement.

VICINITY MAP

SITE LOCATION



TRUE NORTH

REFERENCE:
USGS TOPOGRAPHIC MAP
KOKOHEAD QUADRANGLE
DATED 1999

PROPOSED RESIDENCES
AKUMU STREET

SHINSATO ENGINEERING, INC.
CONSULTING GEOTECHNICAL ENGINEERS

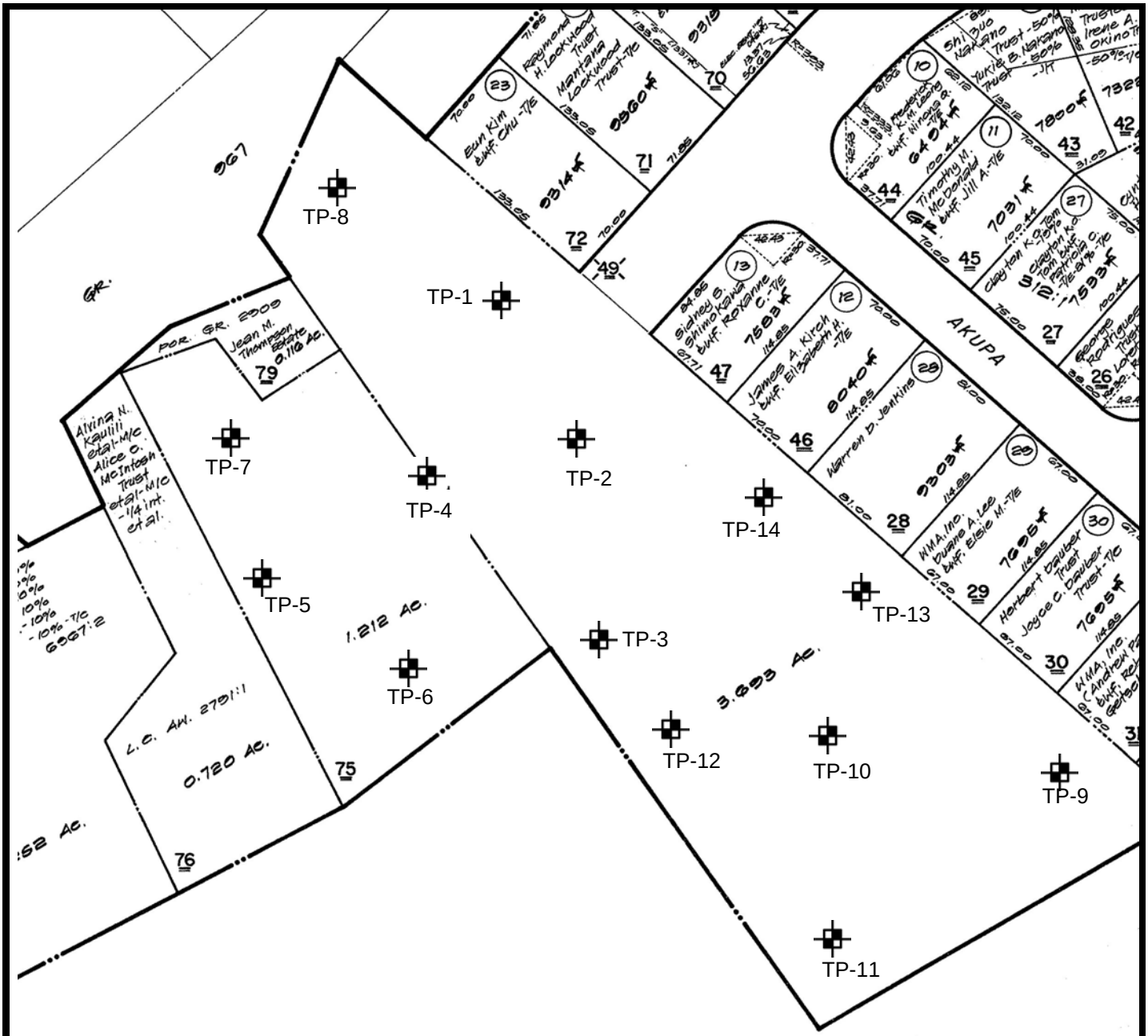
98-747 KUAHAO PL. PEARL CITY, HI 96782

PROJECT NO. 10-0131

DATE: 04/12

SCALE: 1"=2000'

PLATE 1



LEGEND:

TEST PIT LOCATION

PLOT PLAN

SCALE: 1" = 100'

Project: PROPOSED RESIDENCES AKUMU STREET Project No.: 10-0131	SHINSATO ENGINEERING, INC. CONSULTING GEOTECHNICAL ENGINEERS 98-747 KUAHAO PL. PEARL CITY, HI 96782	**PLATE 2**

LOG OF TEST PIT NO. 1

EQUIPMENT USED: **Case 9030 B Excavator**
DATE EXCAVATED: **December 7, 2010**

ELEVATION: **Unknown**
DEPTH OF TEST PIT (FT.): **10**
DEPTH TO GROUNDWATER (FT.): **8.0'**

DEPTH (FT.)	GRAPHIC SYMBOL	UNIFIED SOIL CLASSIFICATION	DESCRIPTION	SAMPLE	COLOR	MOISTURE	CONSISTENCY	DRY DENSITY (PCF)	MOISTURE CONTENT (% OF DRY WT.)	PENETROMETER (TSF)	TORVANE STRENGTH (TSF)
0		**CH**	CLAY; few cobbles, few sand, few concrete debris, few asphaltic concrete debris		brown	moist	medium stiff to stiff		32.4		
1										2.5	
2			--no concrete and asphaltic concrete debris								
3					gray	very moist	soft		53.1		
4										0.8	
5											
6											
7		**GC**	clayey GRAVEL (calcareous)(finger coral);				very loose		65.5		
8						▼					
9											
10			END OF TEST PIT								
11											
12											
13											
14											
15											
16											

PROJECT NAME: PROPOSED RESIDENCES
AKUMU STREET

PROJECT NO.: 10-0131

SHINSATO ENGINEERING, INC.
Consulting Geotechnical Engineers
98-747 Kuahao Place, #E
Pearl City, HI 96782

PLATE
3

LOG OF TEST PIT NO. 2

EQUIPMENT USED: **Case 9030 B Excavator**
DATE EXCAVATED: **December 7, 2010**

ELEVATION: **Unknown**
DEPTH OF TEST PIT (FT.): **9**
DEPTH TO GROUNDWATER (FT.): **5.5'**

DEPTH (FT.)	GRAPHIC SYMBOL	UNIFIED SOIL CLASSIFICATION	DESCRIPTION	SAMPLE	COLOR	MOISTURE	CONSISTENCY	DRY DENSITY (PCF)	MOISTURE CONTENT (% OF DRY WT.)	PENETROMETER (TSF)	TORVANE STRENGTH (TSF)
0		**CH**	CLAY; few cobbles, few gravel, few sand, trace asphaltic concrete debris		brown	slightly moist	medium stiff				
3			--no cobbles, gravel, sand,and asphaltic concrete debris		gray	very moist				0.8	
5		**GC**	clayey GRAVEL (calcareous), some seashells			▼	loose				
7			--finger coral fragments								
9			END OF TEST PIT								

PROJECT NAME: PROPOSED RESIDENCES
AKUMU STREET

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SHINSATO ENGINEERING, INC.
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Pearl City, HI 96782

PLATE
4

LOG OF TEST PIT NO. 3

EQUIPMENT USED: **Komatsu PC 90 Excavator**
DATE EXCAVATED: **December 7, 2010**

ELEVATION: **Unknown**
DEPTH OF TEST PIT (FT.): **9**
DEPTH TO GROUNDWATER (FT.): **7.0'**

DEPTH (FT.)	GRAPHIC SYMBOL	UNIFIED SOIL CLASSIFICATION	DESCRIPTION	SAMPLE	COLOR	MOISTURE	CONSISTENCY	DRY DENSITY (PCF)	MOISTURE CONTENT (% OF DRY WT.)	PENETROMETER (TSF)	TORVANE STRENGTH (TSF)
0		**CH**	CLAY; few roots		brown	moist	soft to medium stiff				
2			--trace to no roots, some orange mottlings		gray brown	very moist	medium stiff		60.9	0.5	
5		**GC**	clayey GRAVEL (calcareous); some light brown areas		light gray		loose		58.4		
7		**MH**	elastic SILT; some sand		light brown orange	▼	stiff		83.6		
9			END OF TEST PIT								

PROJECT NAME: PROPOSED RESIDENCES
AKUMU STREET

PROJECT NO.: 10-0131

SHINSATO ENGINEERING, INC.
Consulting Geotechnical Engineers
98-747 Kuahao Place, #E
Pearl City, HI 96782

PLATE
5

LOG OF TEST PIT NO. 4

EQUIPMENT USED: **Komatsu PC 90 Excavator**
DATE EXCAVATED: **December 7, 2010**

ELEVATION: **Unknown**
DEPTH OF TEST PIT (FT.): **9**
DEPTH TO GROUNDWATER (FT.): **4.0'**

DEPTH (FT.)	GRAPHIC SYMBOL	UNIFIED SOIL CLASSIFICATION	DESCRIPTION	SAMPLE	COLOR	MOISTURE	CONSISTENCY	DRY DENSITY (PCF)	MOISTURE CONTENT (% OF DRY WT.)	PENETROMETER (TSF)	TORVANE STRENGTH (TSF)
0		**CH**	CLAY; some roots		brown	moist to very moist	medium stiff				
1			--no roots, lagoonal deposits		gray		soft				
2											
3											
4			--with coral gravel, with seashells			▼					
5											
6											
7		**GC**	clayey GRAVEL (calcareous)(finger coral); some sea shells				loose to medium dense				
8											
9			END OF TEST PIT								
10											
11											
12											
13											
14											
15											
16											

PROJECT NAME: PROPOSED RESIDENCES
AKUMU STREET

PROJECT NO.: 10-0131

SHINSATO ENGINEERING, INC.
Consulting Geotechnical Engineers
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Pearl City, HI 96782

PLATE
6

LOG OF TEST PIT NO. 5

EQUIPMENT USED: **Komatsu PC 90 Excavator**
DATE EXCAVATED: **December 7, 2010**

ELEVATION: **Unknown**
DEPTH OF TEST PIT (FT.): **9**
DEPTH TO GROUNDWATER (FT.): **7.0'**

DEPTH (FT.)	GRAPHIC SYMBOL	UNIFIED SOIL CLASSIFICATION	DESCRIPTION	SAMPLE	COLOR	MOISTURE	CONSISTENCY	DRY DENSITY (PCF)	MOISTURE CONTENT (% OF DRY WT.)	PENETROMETER (TSF)	TORVANE STRENGTH (TSF)
0		**CH**	CLAY; with roots		brown	moist	medium stiff		42.7	2.0	
1			--trace to no roots, lagoonal deposits		gray	moist to very moist	soft to medium stiff				
2											
3											
4											
5							soft				
6			--with coral gravel								
7						▼					
8											
9			END OF TEST PIT								
10											
11											
12											
13											
14											
15											
16											

PROJECT NAME: PROPOSED RESIDENCES
AKUMU STREET

PROJECT NO.: 10-0131

SHINSATO ENGINEERING, INC.
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98-747 Kuahao Place, #E
Pearl City, HI 96782

PLATE
7

LOG OF TEST PIT NO. 6

EQUIPMENT USED: **Komatsu PC 90 Excavator**
DATE EXCAVATED: **December 7, 2010**

ELEVATION: **Unknown**
DEPTH OF TEST PIT (FT.): **12**
DEPTH TO GROUNDWATER (FT.): **5.0'**

DEPTH (FT.)	GRAPHIC SYMBOL	UNIFIED SOIL CLASSIFICATION	DESCRIPTION	SAMPLE	COLOR	MOISTURE	CONSISTENCY	DRY DENSITY (PCF)	MOISTURE CONTENT (% OF DRY WT.)	PENETROMETER (TSF)	TORVANE STRENGTH (TSF)
0		**CH**	CLAY; few gravel, few roots		brown	very moist	medium stiff				
2			--no roots		light brown gray light brown	moist					
5						▼					
10							stiff				
12			END OF TEST PIT								

PROJECT NAME: PROPOSED RESIDENCES
AKUMU STREET

PROJECT NO.: 10-0131

SHINSATO ENGINEERING, INC.
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Pearl City, HI 96782

PLATE
8

LOG OF TEST PIT NO. 7

EQUIPMENT USED: **Case 9030 B Excavator**
DATE EXCAVATED: **December 7, 2010**

ELEVATION: **Unknown**
DEPTH OF TEST PIT (FT.): **10**
DEPTH TO GROUNDWATER (FT.): **Unknown**

DEPTH (FT.)	GRAPHIC SYMBOL	UNIFIED SOIL CLASSIFICATION	DESCRIPTION	SAMPLE	COLOR	MOISTURE	CONSISTENCY	DRY DENSITY (PCF)	MOISTURE CONTENT (% OF DRY WT.)	PENETROMETER (TSF)	TORVANE STRENGTH (TSF)
0		**CH**	CLAY; few sand		brown	slightly moist	medium stiff				
1					gray brown						
2						moist					
3											
4											
5											
6											
7			--few lagoonal deposits, few coral gravel				soft				
8					dark gray brown						
9					dark gray	very moist			70.7		
10			END OF TEST PIT								
11											
12											
13											
14											
15											
16											

PROJECT NAME: PROPOSED RESIDENCES
AKUMU STREET

PROJECT NO.: 10-0131

SHINSATO ENGINEERING, INC.
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98-747 Kuahao Place, #E
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PLATE
9

LOG OF TEST PIT NO. 8

EQUIPMENT USED: **Case 9030 B Excavator**
DATE EXCAVATED: **December 8, 2010**

ELEVATION: **Unknown**
DEPTH OF TEST PIT (FT.): **10**
DEPTH TO GROUNDWATER (FT.): **6.0'**

DEPTH (FT.)	GRAPHIC SYMBOL	UNIFIED SOIL CLASSIFICATION	DESCRIPTION	SAMPLE	COLOR	MOISTURE	CONSISTENCY	DRY DENSITY (PCF)	MOISTURE CONTENT (% OF DRY WT.)	PENETROMETER (TSF)	TORVANE STRENGTH (TSF)
0		**CH**	CLAY; some roots		brown	moist	medium stiff				
1			--no roots		brown gray	very moist	soft				
2										0.5	
3											
4											
5										0.5	
6		**OL**	ORGANIC SILT; with seashells, some coral, lagoonal deposits		gray	▼	very soft		47.4		
7											
8											
9											
10			END OF TEST PIT								
11											
12											
13											
14											
15											
16											

PROJECT NAME: PROPOSED RESIDENCES
AKUMU STREET

PROJECT NO.: 10-0131

SHINSATO ENGINEERING, INC.
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PLATE
10

LOG OF TEST PIT NO. 9

EQUIPMENT USED: **Case 9030 B Excavator**
DATE EXCAVATED: **December 8, 2010**

ELEVATION: **Unknown**
DEPTH OF TEST PIT (FT.): **12**
DEPTH TO GROUNDWATER (FT.): **Unknown**

DEPTH (FT.)	GRAPHIC SYMBOL	UNIFIED SOIL CLASSIFICATION	DESCRIPTION	SAMPLE	COLOR	MOISTURE	CONSISTENCY	DRY DENSITY (PCF)	MOISTURE CONTENT (% OF DRY WT.)	PENETROMETER (TSF)	TORVANE STRENGTH (TSF)
0		**CH**	CLAY; with roots, some gravel		brown	moist	medium stiff				
1											
			--no roots and gravel		gray brown		very stiff				
2									34.7	4.5	
3										4.5	
4											
5										4.5	
6											
7											
8											
9											
10											
11										4.5	
12			END OF TEST PIT								
13											
14											
15											
16											

PROJECT NAME: PROPOSED RESIDENCES
AKUMU STREET

PROJECT NO.: 10-0131

SHINSATO ENGINEERING, INC.
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PLATE
11

LOG OF TEST PIT NO. 10

EQUIPMENT USED: **Case 9030 B Excavator**
DATE EXCAVATED: **December 8, 2010**

ELEVATION: **Unknown**
DEPTH OF TEST PIT (FT.): **11**
DEPTH TO GROUNDWATER (FT.): **Unknown**

DEPTH (FT.)	GRAPHIC SYMBOL	UNIFIED SOIL CLASSIFICATION	DESCRIPTION	SAMPLE	COLOR	MOISTURE	CONSISTENCY	DRY DENSITY (PCF)	MOISTURE CONTENT (% OF DRY WT.)	PENETROMETER (TSF)	TORVANE STRENGTH (TSF)
0		**CH**	CLAY; with roots		brown	moist	medium stiff				
1			--no roots		gray brown					3.5	
2							very stiff				
3										4.5	
4											
5										4.5	
6											
7											
8										4.5	
9											
10											
11			END OF TEST PIT								
12											
13											
14											
15											
16											

PROJECT NAME: PROPOSED RESIDENCES
AKUMU STREET

PROJECT NO.: 10-0131

SHINSATO ENGINEERING, INC.
Consulting Geotechnical Engineers
98-747 Kuahao Place, #E
Pearl City, HI 96782

PLATE
12

LOG OF TEST PIT NO. 11

EQUIPMENT USED: **Case 9030 B Excavator**
DATE EXCAVATED: **December 8, 2010**

ELEVATION: **Unknown**
DEPTH OF TEST PIT (FT.): **11**
DEPTH TO GROUNDWATER (FT.): **Unknown**

DEPTH (FT.)	GRAPHIC SYMBOL	UNIFIED SOIL CLASSIFICATION	DESCRIPTION	SAMPLE	COLOR	MOISTURE	CONSISTENCY	DRY DENSITY (PCF)	MOISTURE CONTENT (% OF DRY WT.)	PENETROMETER (TSF)	TORVANE STRENGTH (TSF)
0		**CH**	CLAY; with roots, trace gravel		brown	moist	medium stiff				
2			--trace to no roots		brown gray		very stiff			4.5	
5										4.5	
9										4.5	
11			END OF TEST PIT								

PROJECT NAME: PROPOSED RESIDENCES
AKUMU STREET

PROJECT NO.: 10-0131

SHINSATO ENGINEERING, INC.
Consulting Geotechnical Engineers
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Pearl City, HI 96782

PLATE
13

LOG OF TEST PIT NO. 12

EQUIPMENT USED: **Case 9030 B Excavator**
DATE EXCAVATED: **December 8, 2010**

ELEVATION: **Unknown**
DEPTH OF TEST PIT (FT.): **10.5**
DEPTH TO GROUNDWATER (FT.): **Unknown**

DEPTH (FT.)	GRAPHIC SYMBOL	UNIFIED SOIL CLASSIFICATION	DESCRIPTION	SAMPLE	COLOR	MOISTURE	CONSISTENCY	DRY DENSITY (PCF)	MOISTURE CONTENT (% OF DRY WT.)	PENETROMETER (TSF)	TORVANE STRENGTH (TSF)
0		**CH**	CLAY; with roots, some gravel		brown	moist	very stiff		27.6	5.7	
2		**MH**	elastic SILT (alluvium); with cobbles and gravel (highly weathered to completely weathered)		brown orange		stiff		21.0	3.0	
5		**CH**	CLAY;		brown gray		very stiff			4.5	
10			END OF TEST PIT								

PROJECT NAME: PROPOSED RESIDENCES
AKUMU STREET

PROJECT NO.: 10-0131

SHINSATO ENGINEERING, INC.
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PLATE
14

LOG OF TEST PIT NO. 13

EQUIPMENT USED: **Case 9030 B Excavator**
DATE EXCAVATED: **December 8, 2010**

ELEVATION: **Unknown**
DEPTH OF TEST PIT (FT.): **12**
DEPTH TO GROUNDWATER (FT.): **Unknown**

DEPTH (FT.)	GRAPHIC SYMBOL	UNIFIED SOIL CLASSIFICATION	DESCRIPTION	SAMPLE	COLOR	MOISTURE	CONSISTENCY	DRY DENSITY (PCF)	MOISTURE CONTENT (% OF DRY WT.)	PENETROMETER (TSF)	TORVANE STRENGTH (TSF)
0		**CH**	CLAY; some roots		brown	moist	medium stiff				
2		**GM**	silty GRAVEL; with highly to completely weathered gravel, with rounded and sub rounded gravel, some black mottling		orange brown		medium dense		20.3		
8		**CH**	CLAY;		brown gray		very stiff			4.5	
12			END OF TEST PIT								

PROJECT NAME: PROPOSED RESIDENCES
AKUMU STREET

PROJECT NO.: 10-0131

SHINSATO ENGINEERING, INC.
Consulting Geotechnical Engineers
98-747 Kuahao Place, #E
Pearl City, HI 96782

PLATE
15

LOG OF TEST PIT NO. 14

EQUIPMENT USED: **Case 9030 B Excavator**
DATE EXCAVATED: **December 8, 2010**

ELEVATION: **Unknown**
DEPTH OF TEST PIT (FT.): **12**
DEPTH TO GROUNDWATER (FT.): **Unknown**

DEPTH (FT.)	GRAPHIC SYMBOL	UNIFIED SOIL CLASSIFICATION	DESCRIPTION	SAMPLE	COLOR	MOISTURE	CONSISTENCY	DRY DENSITY (PCF)	MOISTURE CONTENT (% OF DRY WT.)	PENETROMETER (TSF)	TORVANE STRENGTH (TSF)
0		**CH**	CLAY; with roots, few gravel		brown	moist	medium stiff				
4			--trace to no roots				medium stiff to stiff			3.5	
6					light gray green gray	moist to very moist	medium stiff		72.4	1.0	
12			END OF TEST PIT								

PROJECT NAME: PROPOSED RESIDENCES
AKUMU STREET

PROJECT NO.: 10-0131

SHINSATO ENGINEERING, INC.
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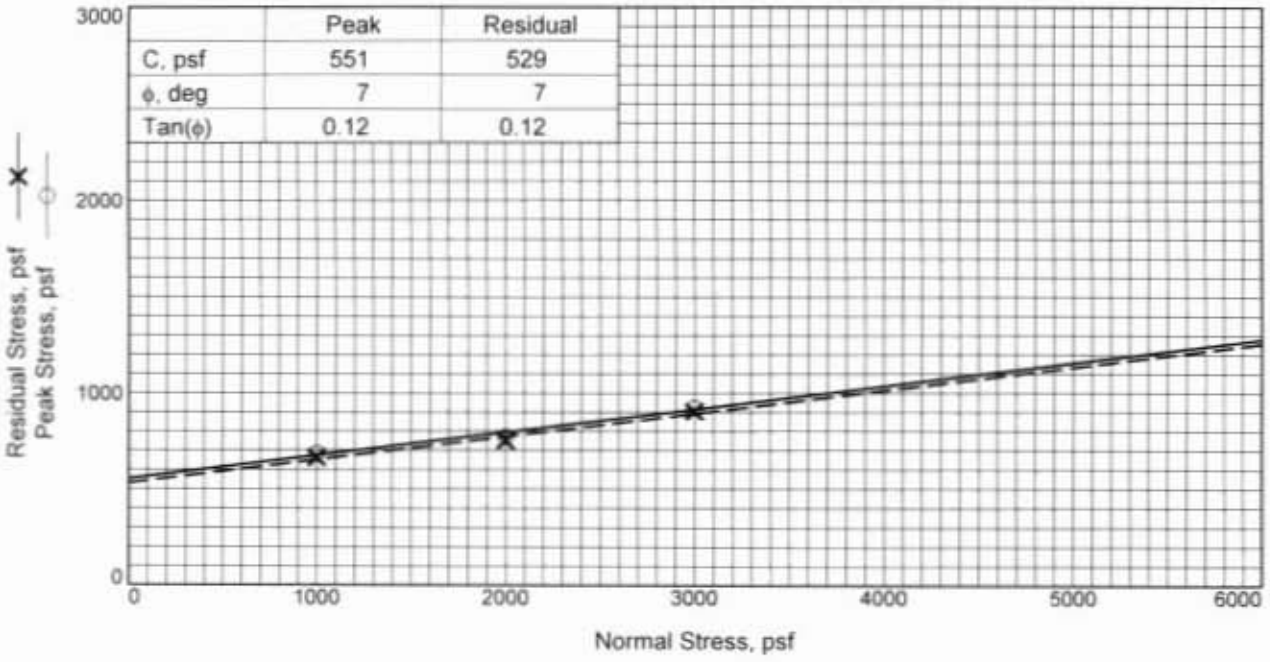
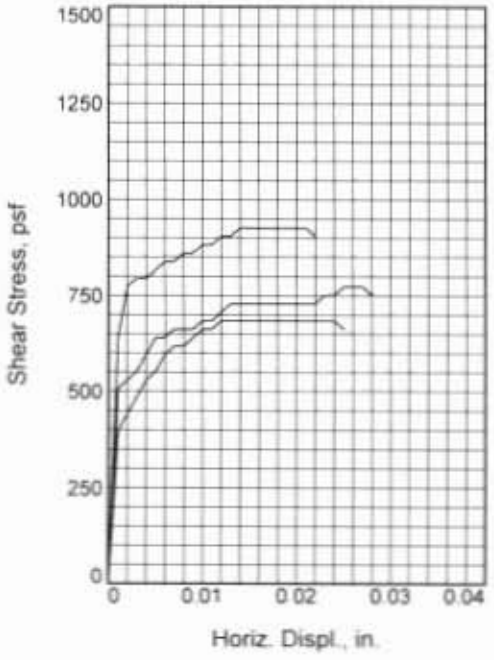
98-747 Kuahao Place, #E
Pearl City, HI 96782

PLATE
16

	Peak	Residual
C, psf	551	529
ϕ, deg	7	7
Tan(ϕ)	0.12	0.12





Sample No.		1	2	3
Initial	Water Content, %	N/A	N/A	N/A
	Dry Density, pcf	N/A	N/A	N/A
	Saturation, %	N/A	N/A	N/A
	Void Ratio	N/A	N/A	N/A
	Diameter, in.	2.42	2.42	2.42
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	N/A	N/A	N/A
	Dry Density, pcf			
	Saturation, %			
	Void Ratio			
	Diameter, in.			
	Height, in.			
Normal Stress, psf		1000	2000	3000
Peak Stress, psf		683	771	926
Displacement, in.		0.02	0.03	0.01
Residual Stress, psf		661	749	904
Displacement, in.		0.03	0.03	0.02
Strain rate, in./min.		N/A	N/A	N/A

Sample Type:
Description: CH

Assumed Specific Gravity=
Remarks:

PLATE 17

Client:

Project: PROPOSED RESIDENCES
AKUMU STREET
Source of Sample: 3 **Depth:** 2.0
Sample Number: 1
Proj. No.: 10-0131 **Date Sampled:**

DIRECT SHEAR TEST REPORT

Shinsato Engineering, Inc.

CONSOLIDATION TEST REPORT

Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (ksf)	P_c (ksf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
90.9 %	53.2 %	67.0			2.88	0.40	1.66	0.34	0.07	1.683

MATERIAL DESCRIPTION	USCS	AASHTO
	CH	

Project No. 10-0131 **Client:**

Project: PROPOSED RESIDENCES
AKUMU STREET

Source: 1 **Sample No.:** 2 **Elev./Depth:** 3.0

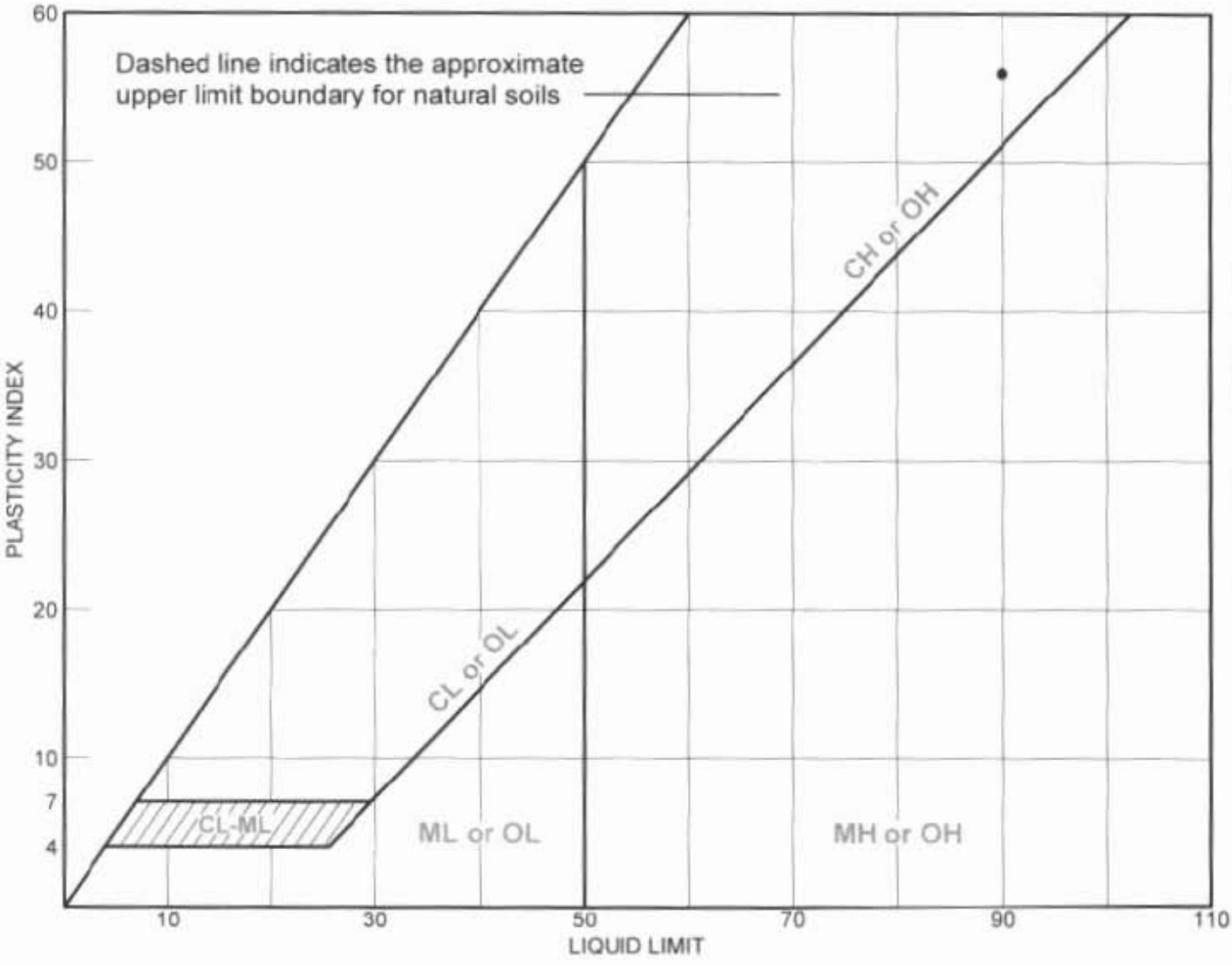
Remarks:

CONSOLIDATION TEST REPORT

Shinsato Engineering, Inc.

PLATE 18

ATTERBERG LIMITS



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	1	1	0.0	32.4	34	90	56	CH

ATTERBERG LIMITS

Shinsato Engineering, Inc.

Client:

Project: PROPOSED RESIDENCES
AKUMU STREET

Project No.: 10-0131 **PLATE** 19