WAikalua Road Subdivision
Preliminary Soil Report

Kaneohe, Oahu, Hawaii
Tax Map Key: 4-5-07: 1
4-5-08: 1, 4, 38

To:
Community Planning, Incorporated

Walter Lum Associates, Inc.
Civil, Structural, Soils Engineers

May 9, 1973
FROM: H. J. YOUNG, CHIEF
TO: DISTRICT CONSTRUCTION ENGINEER
DISTRICT CONSTRUCTION ENGINEER - EAST
DISTRICT CONSTRUCTION ENGINEER - WEST
FIELD SURVEY
DRAFT REPLY
SIGNATURE
INFORMATION
FILE
WORK ORDER
SEE ME
APPROPRIATE ATTENTION AND ACTION
ARRANGE MEETING
LOG. NO. 7377
SUSPENSE
DATE

CITY AND COUNTY OF HONOLULU
DEPARTMENT OF PUBLIC WORKS
DIVISION OF ENGINEERING

FOR:

DRAFT REPLY
SIGNATURE
INFORMATION
FILE
WORK ORDER
SEE ME

APPROPRIATE ATTENTION AND ACTION
ARRANGE MEETING
LOG. NO. 7377
SUSPENSE
TO: Mr. Edward Hirata  
Dept. of Public Works  
City and County of Honolulu  
Honolulu, Hawaii

DATE: July 16, 1973

Gentlemen:

RE: Waikalua Road Subdivision  
Kaneohe, Koolaupoko, Oahu, Hawaii

We are sending you herewith: ☑ Under separate cover ☐

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<tr>
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<tr>
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<td>Revised sheet 7 of preliminary soils report</td>
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<tr>
<td>1 ea.</td>
<td>Revised sheets 2 and 3 of proposed grading specification</td>
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</table>

General Remarks:

As requested by your letter of July 5, 1973.

Very truly yours,

COMMUNITY PLANNING, INC.

[Signature]

George K. Houghtailing
into stiff natural ground by cutting steps into the slopes and compacting the fill into these steps.

8. Fills should be laid in 6-in. compacted layers to 90% of the maximum density determined by the AASHO T-180-57 test method. The top 2-ft layer in roadway fills should be compacted to 95% of the maximum density.

9. Provisions should be included to drain the site during and after filling operations.

Slopes

In general, slope heights less than 4 to 5 ft should be considered. Cut and fill slopes of 2 horizontal to 1 vertical or flatter should be used.

To minimize erosion, the runoff from rainstorms should be diverted away from slopes by berms or ditches whenever practicable. If drainage is down the face of slope, lined ditches should be considered.

The surface of fill slopes should be compacted by cat-tracking or with a sheepsfoot roller.

Slope planting is recommended on cut and fill slopes to minimize erosion.
Borrow soils shall be select soils generally less than 6-in. maximum size, with more than 30% fines and a plasticity index generally less than 20.

Fill material placed in the top 2 ft of fills shall contain less than 30% gravel.

**Placing, Spreading and Compacting Fill Material**

The selected fill material shall be placed in level layers which, when compacted, shall not exceed 6 inches. Each layer shall be spread evenly and blade-mixed during the spreading to attain uniformity of material and water content within each layer.

Rocks or cobbles shall not be allowed to nest and voids between rocks shall be filled and compacted with small stones or earth.

When the water content of the fill material is well below the optimum for compacting purposes, water shall be added until the water content is near the optimum.

When the water content of the material is well above the optimum for compacting purposes, the fill material shall be aerated by blading or by other satisfactory methods until the water content is near the optimum.

After each layer has been placed, mixed and spread evenly, it shall be compacted to 90% of maximum density in accordance with AASHO Test No. T-180-57 or other comparable density tests. The top 2-ft layer in roadway fills shall be compacted to 95% of the maximum density. Compaction shall be with sheepsfoot rollers, multiple-wheel pneumatic-tired rollers or other acceptable rollers which shall be able to compact the fill to the
specified density. Rolling shall be accomplished while the fill material is at the specified water content. The rolling of each layer shall be continuous over its entire area and the roller shall make sufficient passes to obtain the desired density.

Field density tests shall be made to get an indication of the compaction of the fill. Where sheepfoot rollers are used, the soil may be disturbed to a depth of several inches. Density readings shall be taken as often as necessary in the compacted material below the disturbed surface. When these readings indicate that the density of a layer of fill or portion thereof is below the required density, that layer or portion shall be reworked until the required density has been obtained.

The fill operation shall be continued in 6-in. compacted layers, as specified above, until the fill has been brought to the finished slopes and grades as shown on the accepted plans.

Excavation

Suitable material from excavation shall be used in the fill and unsuitable material from excavation shall be disposed of.

Unforeseen Conditions

If unforeseen or undetected soil conditions such as soft spots, seepage water or expansive soil pockets are encountered, corrective measures shall be made in the field as they are detected.
July 5, 1973

Mr. George K. Houghtailing
Community Planning, Inc.
700 Bishop Street, Suite 608
Honolulu, Hawaii 96813

Dear Mr. Houghtailing:

RE: WAIKALUA ROAD SUBDIVISION SOILS REPORT

The subject soils report has been reviewed and is acceptable. However, to avoid any misunderstanding in the future, we request that the following requirement be included in the report.


Add: The top 2-ft. layer in roadway fills shall be compacted to at least 95% of the maximum dry density of the soil.

Please resubmit the applicable revised sheet(s) so that we may attach it to the report that was previously submitted.

Very truly yours,

EDWARD Y. HIRATA
Director and Chief Engineer

cc: Dist. Engineer
    Control Section
    Walter Im Assoc., Inc.
CITY AND COUNTY OF HONOLULU
DEPARTMENT OF PUBLIC WORKS
DIVISION OF ENGINEERING

DATE MAY 25, 1972

FROM: H. J. YOUNG, CHIEF
TO:

CHIEF

CHIEF PLANNING & DESIGN ENG.
CHIEF ADMINISTRATIVE ENGR.
CHIEF STRUC. ENG.
CHIEF STRUCTURAL ENGR.
CHIEF DRAINAGE ENGINEER
CHIEF HIGHWAY ENGINEER
CHIEF TESTING LAB.
CHIEF ENGINEER

FOR:

APPROPRIATE ATTENTION AND ACTION
DRAFT REPLY
COMMENTS & RECOMMENDATIONS
SEE ME
WORK ORDER

LOG. NO. 645
SUSPENSE

Please no under review. 5-30-72

[Signature]
TO: Mr. Edward Hifata  
Director and Chief Engineer  
Department of Public Works  
City and County of Honolulu  
Honolulu, Hawaii

Gentlemen:

RE: Waikalua Road Subdivision  
Kāneōhe, Koolau, Oahu

We are sending you herewith [✓] Under separate cover [ ]

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<tr>
<td>2</td>
<td>Check set with hydrologic map</td>
</tr>
<tr>
<td>1</td>
<td>Structural calculations for retaining walls</td>
</tr>
<tr>
<td>1</td>
<td>Soils Report</td>
</tr>
<tr>
<td>1</td>
<td>Revised Hydrologic Map with calculations</td>
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</table>

General Remarks:
For review and approval.

As suggested, the carports have been raised and A.C. curb and walkway proposed to accommodate the future widening of Waikalua Road.

The carport and homes will be of wooden construction on pier and post to conform to the natural terrain of each lot.

The sewer check set was returned to the Sewer Division earlier.

Very truly yours,

COMMUNITY PLANNING, INC.

By, George K. Houghtailing
CITY AND COUNTY OF HONOLULU
DEPARTMENT OF PUBLIC WORKS

DATE ..........................

TO:
  □ DIRECTOR
  □ DEPUTY DIRECTOR
  □ ADMINISTRATIVE SERVICES
  □ ENVIRONMENTAL ENGINEER
  □ PLANNING COORDINATOR
  □ PROGRAM COORDINATOR
  □ PUBLIC WORKS FISCAL
  □ PUBLIC WORKS PERSONNEL
  □ CHIEF - AUTO EQUIPMENT SERVICES
  □ CHIEF - ENGINEERING
  □ CHIEF - LAND SURVEY & ACQUISITION
  □ CHIEF - REFUSE COLLECTION & DISPOSAL
  □ CHIEF - MOW MAINTENANCE
  □ CHIEF - REFUSE & DISPOSAL
  □ CHIEF - WATER & SEWERS
  □ CHIEF - WATER & SEWERS
  □ APPROPRIATE ATTENTION AND ACTION
  □ ARRANGE MEETING
  □ PREPARE REPLY
  □ SIGNATURE
  □ COMMENTS & RECOMMENDATIONS
  □ IN INFORMATION
  □ SEE ME
  □ FILE

F/6/12/73

LOG. NO. .........................

SUSPENSE ........................
May 9, 1973

MR. GEORGE HOUGHTAILING  
Community Planning, Inc.  
700 Bishop Street, Suite 608  
Honolulu, Hawaii 96813

Dear Mr. Houghtailing:

Subject: Waikalua Road Subdivision  
Preliminary Soil Report  
(for residential development)  
Kaneohe, Oahu, Hawaii  
Tax Map Key: 4-5-07: 1  
4-5-08: 1, 4, 38

Transmitted herewith is our preliminary soil exploration report for the proposed Waikalua Road Subdivision at Kaneohe, Oahu, Hawaii.

The site is located on the slopes that border the flood plain of Kaneohe Stream. Along the top and face of the slope, the soils may be described as stiff clayey silts (Mi soils) with decomposed rocks about 7 to 20 ft thick. Along the toe of slope, the stiff soils are underlain by loose organic silts (Oh soils). A "CH" clay layer was noted in the boring at the toe of slope at the west end of the site.

Fills along the top of the sloping terrace should be kept down to a minimum. In general, whenever practicable, the upper areas of the slope should be cut and the lower areas should be filled.

Post and beam foundations are recommended for light residential house construction on the site.

Some grading of the site is contemplated. The earthwork should be done in accordance with the requirements of Chapter 23, Revised Ordinances of Honolulu, 1969, As Amended and the recommendations contained herein.

This report includes a Boring Location Sketch, boring logs, laboratory test results, recommendations and limitations.

Respectfully submitted,

WALTER LUM ASSOCIATES, INC.

By Ezra Koike
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B. SUMMARY OF LABORATORY TEST RESULTS - Tables IA and IB
C. PLASTICITY CHART
D. MOISTURE-DENSITY CURVE
E. CBR TESTS
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SCOPE OF EXPLORATION

The purpose of this exploration was to determine general soil conditions for residential development for the proposed Waikalua Road Subdivision, Kaneohe, Oahu, Hawaii.

This report includes field explorations, laboratory tests and general recommendations for site grading and residential foundation design and limitations.

FIELD EXPLORATION

Four borings and 1 probing were made at the site. The locations of the borings and probing are shown on the Boring Location Sketch. Descriptions of the underlying soils encountered are shown on the boring logs.

Borings were made with 3-in. diameter augers using a finger type bit. Soil samples were recovered with 2-in. thin-wall tube samplers and a standard split spoon sampler driven with a 140-lb hammer falling 30 inches.

The probing was made with a 2-in. diameter blunt point attached to "A" rods and driven with a 140-lb hammer falling 30 inches.
LABORATORY TESTS

Laboratory tests included: natural water content and density, unconfined compression, laboratory vane shear, Atterberg limit, grain-size analysis, specific gravity, AASHO T-180-57 density, expansion and CBR.

A summary of the laboratory test results is given in Tables IA and IB.

SOIL DESCRIPTIONS BY OTHERS


p. 38: Hanalei silty clay (MH soils on stream bottoms and flood plains)

p. 83: Lolekaa silty clay (MH, ML-MH soils on terraces and fans)

SOIL CLASSIFICATION SYSTEM

Soil samples were visually observed and subjected to appropriate tests in the laboratory. Based on visual observations and laboratory tests, the soil descriptions given on the boring logs are generally made in accordance with the "Unified Soil Classification System."

GENERAL SITE CONDITIONS

The proposed residential site is located in Kaneohe along the south side of Waikalua Road about 0.7 mile east of Kamehameha Highway.
The existing ground slopes down away from Waikalua Road toward the flood plain of Kaneohe Stream at about 20 to 30% gradients with variations in localized areas. Trees, haole koa, utility poles, rubbish piles and abandoned autos were noted on the site.

Levees or dikes are located along the southern toe of the sloping terrace and in other areas in the stream flood plain. The dikes vary in height from little to about 5 ft above the existing ground surface.

**INTERPRETATION OF SOIL CONDITIONS**

From the field exploration and laboratory test results, the soils may be generally approximated as follows:

In Boring Nos. 1 and 2 along the top of slope, a surface layer varying in thickness from about 7 to 20 ft of clayey silts (MH soils) with decomposed rocks.

In Boring No. 3 near the bottom of slope at the west edge, the "MH" surface soils were underlain by stiff "CH" clays from about the 11-ft depth.

In Boring No. 4 near the lower section along the southern boundary, the surface crust of about 7 ft was underlain by soft organic silts (OH soils) to about 20-ft depths.
Water was noted in Boring No. 4 at about 10.5-ft depth during the field explorations. Water was not noted in the other borings.

Variations to the above soil conditions are to be expected in localized areas. For more detailed descriptions of soils encountered in the borings, refer to the boring logs.

DISCUSSION AND RECOMMENDATIONS

In general, the present plan is to widen and improve the existing Waikalua Road alongside the subdivision and provide driveways from the roadway to about the building setback line in the lots. Little to no grading is proposed in the lots.

The site is generally located on ground that slopes downward from the side of the existing Waikalua Road. Because surface soils on a slope tend to creep, fills should generally be avoided. However for road widening and access driveway work, low fills may be unavoidable. In such instances, fills should be kept down to a minimum and generally less than about 4 to 5 ft in height. The fills should be constructed with fairly well-graded granular materials.

Clay "CH" soils were noted in Boring No. 3. Cut and fill slopes and foundations may require adjustments or repairs when clay pockets are encountered.

A shallow (3 to 4-ft depth) sewer line is proposed along a portion of the southern boundary near the toe of slope. The sewer line should be
constructed in short segments as practicable and backfilled with select, fairly well-graded material tamped into place. This would minimize removal of the support for the sloping terrace.

**Site Grading**

In general, selected on-site soils may be used for the construction of low fills. Grading work should be done as required by the Revised Ordinances of Honolulu, 1969, As Amended and as recommended below:

1. The area should be cleared and grubbed. Surface vegetation, miscellaneous debris and rubbish piles should be cleared and removed prior to site development.

2. Loose surface soils and stockpiled soils should be stripped to stiff natural ground before the placement of low fills. Loose surface soils at finish grades should be scarified and recompacted.

3. Localized soft spots or "CH" clay pockets encountered during site preparations should be excavated and replaced with select material compacted in thin lifts.
4. Hard surfaces of existing utility maintenance or access roads should be scarified down to stiff soils and recompacted to match the density of the surrounding soil.

5. Where low fills are proposed in depressions or drainageways, loose material at the bottom and sides should be stripped down to stiff natural ground before the placement of fills. Subdrains or drainage blanket of filter material should be placed along low points to provide drainage paths. New fills should be keyed into the stiff natural ground.

6. Thin sidehill fills (sliver fills) on the sloping terrace should be avoided.

7. The low fills should be constructed in approximately level layers starting at the lower end and working upward. Where fills are made on sloping areas steeper than about 5 horizontal to 1 vertical, the ground at the toe of the fill should be benched to a generally level condition. As the fill is brought up, it should be continually keyed
into stiff natural ground by cutting steps into the slopes and compacting the fill into these steps.

8. Fills should be laid in 6-in. compacted layers to 90% of the maximum density determined by the AASHO T-180-57 test method.

9. Provisions should be included to drain the site during and after filling operations.

**Slopes**

In general, slope heights less than 4 to 5 ft should be considered. Cut and fill slopes of 2 horizontal to 1 vertical or flatter should be used.

To minimize erosion, the runoff from rainstorms should be diverted away from slopes by berms or ditches whenever practicable. If drainage is down the face of slope, lined ditches should be considered.

The surface of fill slopes should be compacted by cat-tracking or with a sheepsfoot roller.

Slope planting is recommended on cut and fill slopes to minimize erosion.
Slope adjustments or other precautions may be necessary if seepage zones, expansive "CH" clay pockets or soft spots are encountered in localized areas. In general, when "CH" clay pockets are encountered in slopes, they should be removed and replaced with a buttress fill constructed with select material.

Foundations

In general, light 2-story wood-frame residential structures are proposed.

The preliminary grading plan indicates that the structures will be located over the sloping lots.

Because of soft soils encountered near the toe of slope, house foundations should be kept as high as practicable up the slope near Waikalua Road.

Structures should be designed to tolerate and resist some settlements. Structures should be designed as small units on floating platforms or decks resting on post and beams that will allow the floors to be leveled should settlements occur. Odd shapes and split level structures should be minimized or designed to float as a unit.

To minimize the effects of slope creep, the foot blocks should be supported on short pipe piles that extend below
an imaginary plane drawn upward at a 4 to 1 ratio from the toe of the slope. Pipe piles should be about 8 ft or more in depth. The foot blocks should be tied together up and down the slope. See Figure 1.

Loads of about 4000 pounds per pipe pile may be considered.

Good surface drainage away from the foundations of structures should be maintained and the site should be graded to prevent the ponding of water.

Low Retaining Walls
In general, retaining walls should be avoided on the sloping lots.

For the short entry driveways along Waikalua Road, use of low flexible, gravity walls would probably minimize load increase. In general, the walls should be designed carefully with fairly deep, reinforced foundations and good drainage provisions along the back and base of the wall. The backfill of the walls should be constructed with fairly well-graded granular soils.

Lateral earth pressures of about 40 p.c.f. equivalent fluid may be considered assuming a drained backfill.

Where the garage platform meets the driveway retaining wall, a sliding joint should be considered to minimize the transfer of lateral movement from the retaining wall against the garage or residential structure.
Roadway

In general, an estimate of the roadway pavement thickness for the light automobile traffic and drained subgrade conditions is as follows:

2. Base course - 6-in. base course.
3. Subbase - 12-in. select borrow over a prepared subgrade.

Clay pockets will probably be encountered in localized areas.

Provisions should be made in the contract documents to allow for local adjustments regarding select borrow subbase and borrow material requirements in the field in accordance with the design standards of the City and County of Honolulu. In fill areas, the use of select soils within the top 2 to 3 ft of the subgrade may reduce the thickness of or eliminate the need for the select borrow subbase or borrow courses.

The subgrade should be compacted and shaped to drain. To avoid the ponding of water and softening of the subgrade at low points, weep holes should be placed at subgrade levels thru the walls of the catch basins which are placed in these low areas.
Underground Utilities

Underground utilities should be placed after the fills are constructed.

The bottom of utility trenches should be daylighted and graded to shed water. The backfill and drainage of these utility trenches should be carefully designed.

Flexible connections should be used.

Sewer Main

A sewer main is proposed along a portion of the toe of the sloping terrace.

To minimize removal of support of the slope at the toe due to excavations for the sewer main, construction should proceed in small increments or segments as practicable. The excavations should be backfilled with select, fairly well-graded material tamped into place.

Unforeseen Conditions

Unforeseen or undetected conditions such as soft spots, seepage water or expansive soil pockets may occur in localized areas and will have to be adjusted and corrected in the field as they are detected.
Site Regrading

After mass grading work is done and cuts and fills are made according to the grading plan, regrading at some future date should be avoided unless done under the guidance of a Soils Engineer.
PROPOSED SPECIFICATION FOR EARTHWORK

WAIKALUA ROAD SUBDIVISION

General Description

This item shall consist of clearing and grubbing, preparing of land to be filled, excavating and filling of the land, spreading, compacting and testing of the fill, and subsidiary work necessary for grading the site.

Clearing, Grubbing and Preparing Areas to be Filled

Vegetation, rubbish and miscellaneous material shall be removed and disposed of, leaving the disturbed area with a neat, debris-free appearance.

Loose surface soils and stockpiled soils shall be stripped to stiff natural ground before the placement of fills. Loose surface soils encountered at finish grade shall be scarified and recompacted.

Hard surfaces of existing access roads shall be scarified down to stiff soils and recompacted to match the density of the surrounding soil.

The bottom and sides of gullies or natural drainageways shall be stripped down to stiff natural ground before the placement of fills.

Materials

Fill material shall consist of selected on-site soils or approved borrow soils. The soils shall contain no more than a trace of organic and deleterious matter.
Borrow soils shall be select soils generally less than 6-in. maximum size, with more than 30% fines and a plasticity index generally less than 20.

Fill material placed in the top 2 ft of fills shall contain less than 30% gravel.

**Placing, Spreading and Compacting Fill Material**

The selected fill material shall be placed in level layers which, when compacted, shall not exceed 6 inches. Each layer shall be spread evenly and blade-mixed during the spreading to attain uniformity of material and water content within each layer.

Rocks or cobbles shall not be allowed to nest and voids between rocks shall be filled and compacted with small stones or earth.

When the water content of the fill material is well below the optimum for compacting purposes, water shall be added until the water content is near the optimum.

When the water content of the material is well above the optimum for compacting purposes, the fill material shall be aerated by blading or by other satisfactory methods until the water content is near the optimum.

After each layer has been placed, mixed and spread evenly, it shall be compacted to 90% of maximum density in accordance with AASHO Test No. T-180-57 or other comparable density tests. Compaction shall be with sheepsfoot rollers, multiple-wheel pneumatic-tired rollers or other acceptable rollers which shall be able to compact the fill to the
specified density. Rolling shall be accomplished while the fill material is at the specified water content. The rolling of each layer shall be continuous over its entire area and the roller shall make sufficient passes to obtain the desired density.

Field density tests shall be made to get an indication of the compaction of the fill. Where sheepfoot rollers are used, the soil may be disturbed to a depth of several inches. Density readings shall be taken as often as necessary in the compacted material below the disturbed surface. When these readings indicate that the density of any layer of fill or portion thereof is below the required 90% density, that layer or portion shall be reworked until the required density has been obtained.

The fill operation shall be continued in 6-in. compacted layers, as specified above, until the fill has been brought to the finished slopes and grades as shown on the accepted plans.

Excavation

Suitable material from excavation shall be used in the fill and unsuitable material from excavation shall be disposed of.

Unforeseen Conditions

If unforeseen or undetected critical soil conditions such as soft spots, seepage water or expansive soil pockets are encountered, corrective measures shall be made in the field as they are detected.
Rainy Weather

Fill material shall not be placed, spread or rolled during unfavorable weather conditions. When the work is interrupted by heavy rain, fill operations shall not be resumed until field tests indicate that the water content and density are as previously specified.
BORING LOGS

The stratification lines shown on each of the boring logs represent the approximate boundary between soil types and the transition may be gradual.

Symbols

Symbols used generally are in accordance with the Unified Soil Classification System.

Where a parenthesis "(MH)" is used, the soil sample was classified by visual observation of the sample recovered.

Where no parenthesis "MH" is used, the soil sample was classified from either the Atterberg limit or sieve analysis test results.
Boring Log

PROJECT: WAikalua Road Subdivision
LOCATION: Kaneohe, Oahu, Hawaii

Tax Map Key: 4-5-08: 1, 4, 38
& 4-5-07: 1

HMAMER:
Weight: 140#
Drop: 30"

SAMPLER:
2 1/2 - 2 O.D. Thin Wall Tube
2 1/2 - 2 Standard Split Spoon

LOCATION: Hamule, Oahu, Hawaii

Type of Boring: AUGER

Elevation: 40' + 0" Datum 3' 6"

Drill Bit: FINGER TYPE

Penetration Data

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End of Boring @ 21.5'

* Elevation Estimated from Exist. Topo Map

NOTE:
LL% Liquid Limit, %
P% Plastic Limit, %
**Boring Log**

**PROJECT**  WAikalua Road Subdivision  
**LOCATION**  Kaneohe, Oahu, Hawaii  
**Tax Map Key**  4-5-08: 1, 4, 38 & 4-5-07: 1  
**HAMMER**  FliPGE-R  
**Weight**  140#  
**Drop**  30"  
**STATION**  2.5" O.D. Thin Wall Tubing  
**SAMPLER**  2.5"-2" Standard Split Spoon  

**LOCATION**  Kaneohe, Oahu, Hawaii  
**Tax Map Key**  4-5-08: 1, 4, 38 & 4-5-07: 1  
**FIELD PARTY**  RADOVICH, KAU  
**Type of Drilling**  AUGER (MOBILE)  
**Diameter**  3"  
**Depth**  29' + 7"  
**Datum**  --  
**ELEVATION**  29' + 7"  
**DROP**  30"  
**DRILL BIT**  FINGER TYPE  
**WATER LEVEL**  NT NOTED  
**TIME**  --  
**DATE**  4-2-75

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<th>Description</th>
<th>Depth (Ft)</th>
<th>Sampler</th>
<th>Sample No.</th>
<th>Wet Density, P.I.C.</th>
<th>Water Content</th>
<th>Dry Density, P.C.I.</th>
<th>Unconfined Comp.</th>
<th>Penetrometer Test</th>
<th>2&quot; O.D. THIN WALL TUBE SAMPLER</th>
</tr>
</thead>
<tbody>
<tr>
<td>MH</td>
<td>Stiff, Mottled Brown Clayey Silt w/ Gray Decomposed Rock</td>
<td>15</td>
<td>2.5</td>
<td>2-A</td>
<td>31</td>
<td>72</td>
<td>15,140</td>
<td></td>
<td></td>
<td>5/0.5 - 5/0.5</td>
</tr>
<tr>
<td>MH</td>
<td>Hard, Brown Clayey Silt w/ Traces of Sand</td>
<td>15</td>
<td>2-D</td>
<td>73</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>40/0.3</td>
</tr>
</tbody>
</table>

*Elevation Estimated from Existing Topo Map*
**Boring Log**

**PROJECT**: WAIKALUA ROAD SUBDIVISION  
**LOCATION**: Kaneohe, Oahu, Hawaii  
**Tax Map Key**: 4-5-08: 1, 4, 38 & 4-5-07: 1  
**WALTER LUM ASSOCIATES, INC.**

<table>
<thead>
<tr>
<th>Soil Classification</th>
<th>Description</th>
<th>ELEV.: 24' 1/2</th>
<th>Penetration Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>MH</td>
<td>MISC. FILL: CORAL &amp; ROCK FRAGMENTS &amp; SILTY SAND</td>
<td>2 2/6</td>
<td>Standard Penetration Test</td>
</tr>
<tr>
<td>MH</td>
<td>STIFF, MOTTLED BROWN CLAYEY SILT W/GRAY, DECOMPOSED ROCK</td>
<td>2 2/6</td>
<td>2' O.D. THIN WALL TUBE SAMPLER</td>
</tr>
<tr>
<td>MH</td>
<td>STIFF, MOTTLED TAN: GRAY CLAYEY SILT W/GRAY, CLAY</td>
<td>2 2/6</td>
<td>N (Blows per foot)</td>
</tr>
<tr>
<td>MH</td>
<td>STIFF, GRAY CLAY</td>
<td>2 2/6</td>
<td></td>
</tr>
<tr>
<td>CH</td>
<td>MOTTLED BROWN CLAYEY SILT</td>
<td>2 2/6</td>
<td></td>
</tr>
<tr>
<td>CH</td>
<td>STIFF, GRAY &amp; BROWN CLAY</td>
<td>2 2/6</td>
<td></td>
</tr>
</tbody>
</table>

**END OF BORING @ 16'**

**NOTE:**  
LL= LIQUID LIMIT, %  
PL= PLASTIC LIMIT, %

* ELEVATION ESTIMATED FROM EXIST. TOPO MAP
**Boring Log**

**PROJECT:** WAikalua Road Subdivision  
**LOCATION:** Kaneohe, Oahu, Hawaii  
**Tax Map Key:** 4-5-08: 1, 4, 38 & 4-5-07: 1

---

### Penetration Data

<table>
<thead>
<tr>
<th>Unified Soil Classification</th>
<th>DESCRIPTION</th>
<th>Penetration Test</th>
<th>Standard Penetration Test</th>
<th>N (Blows per foot)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(MH)</td>
<td>STIFF, BROWN SILTY CLAY W/ROOTS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MH</td>
<td>STIFF, GRAY &amp; BROWN SILTY CLAY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OH</td>
<td>SOFT, BLACK ORGANIC SILT W/SHALE &amp; SHELLS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OH</td>
<td>SOFT, BLACK ORGANIC SILT W/SAND</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(MH)</td>
<td>MEDIUM, MOTTLED GRAY &amp; BROWN SILTY CLAY W/SAND, GRAVEL &amp; DECOMPOSITION</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Elevation:**

- **10'-0"**
  - **Sample No.:** 4-A  
  - **Sample Drift:** 2"
  - **Weight:** 140 lbs
  - **Drop:** 30'

---

**Notes:**

- **Note:** LL: Liquid Limit, %  
  - **LL:** 60%  
  - **Plastic Limit, %:** 10%

---

**End of Boring @ 21'**

---

**Additional Information:**

- **Drill Bit:** Finger Type
- **Datum:**  
- **Time:**  
- **Water Level:** 10.5'
- **Date:** 4-2-73

---

**WALTER LUM ASSOCIATES, INC.**  
3030 Waialae Avenue • Honolulu, Hawaii 96816 • Phone 737-7931
# Boring Log

**PROJECT**  WAIKALUA ROAD SUBDIVISION  
**LOCATION**  Kaneohe, Oahu, Hawaii  
**Tax Map Key:**  4-5-08: 1, 4, 38  
& 4-5-07: 1  
**HAMMER:**  
- **Weight:** 140 lbs  
- **Drop:** 80"  
**SAMPLE:**  2" DIA. BLUNT POINT  

---

**PROBING NO.** 2A  
**Sheet No.**  of  
**Driller:**  W. LUM ASSOC., INC.  
**Date:**  APRIL 2, 1973  
**Field Party:**  RADOVICH, KAU  
**Type of Boring:** CONTINUOUS PENETRATION TEST  
**Diam:** 2'  
**Elev.**  25'  
**Datum:**  
**Drill Bit:**  
**Water Level:**  
**Time:**  
**Date:**  4-2-73  

---

### PENETRATION DATA

<table>
<thead>
<tr>
<th>Penetration Test</th>
<th>N (Blows per foot)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous Penetration Test</td>
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</tr>
<tr>
<td>0</td>
<td>10</td>
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</tbody>
</table>

---

**UNIFIED CLASSIFICATION**  
**DESCRIPTION**  
**ELEV.:** 25'  
**END OF PROBING @ 8.2'**  

---

* ELEVATION ESTIMATED FROM EXIST. TOPO MAP
### TABLE I A - SUMMARY OF LABORATORY TEST RESULTS

<table>
<thead>
<tr>
<th>BORING NO.</th>
<th>SAMPLE NO.</th>
<th>DEPTH BELOW SURFACE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>SURFACE 9'-21.5'</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MOTTLED</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BROWN</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CLAYEY SILT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WITRACES OF SAND &amp; ROOTS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10'-11.5'</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MOTTLED</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BROWN &amp; GRAY</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CLAYEY SILT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WITRACES OF WIDEROCK</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15'-16'</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MOTTLED</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GRAY &amp; BROWN</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CLAYEY SILT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WIGRAY CLAY</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CLAY</td>
</tr>
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</table>

#### GRAIN-SIZE ANALYSIS (% Passing)

<table>
<thead>
<tr>
<th>Sieve</th>
<th>1&quot;</th>
<th>1/2&quot;</th>
<th>#4</th>
<th>#10</th>
<th>#20</th>
<th>#40</th>
<th>#100</th>
<th>#200</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100</td>
<td>100</td>
<td>99.7</td>
<td>96.4</td>
<td>97.1</td>
<td>91.3</td>
<td>96.7</td>
<td>96.3</td>
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</table>

#### ATTERBERG LIMITS

<table>
<thead>
<tr>
<th>Air Dried or Natural</th>
<th>NATURAL</th>
<th>NATURAL</th>
<th>NATURAL</th>
<th>NATURAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid Limit</td>
<td>11.8</td>
<td>92</td>
<td>133</td>
<td>105</td>
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<tr>
<td>Plastic Limit</td>
<td>62</td>
<td>51</td>
<td>56</td>
<td>40</td>
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<tr>
<td>Plasticity Index</td>
<td>56</td>
<td>41</td>
<td>71</td>
<td>65</td>
</tr>
</tbody>
</table>

#### UNIFIED SOIL CLASSIFICATION

| MH | MH | MH | CH |

#### APPARENT SPECIFIC GRAVITY

| 2.65 |

#### EXPANSION AND CBR TESTS

<table>
<thead>
<tr>
<th>(Surcharge-51 P.S.F.)</th>
<th>45.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molding Moisture, %</td>
<td></td>
</tr>
<tr>
<td>Molding Dry Density, P.C.F.</td>
<td>72.0</td>
</tr>
<tr>
<td>Swell upon saturation, %</td>
<td>3.4</td>
</tr>
<tr>
<td>CBR at 0.1&quot; Penetration</td>
<td>4.7</td>
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</tbody>
</table>

#### MOISTURE-DENSITY RELATIONS OF SOILS

<table>
<thead>
<tr>
<th>(AASHO T-180-57 Method)</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry to Wet or Wet to Dry</td>
<td>WET TO DRY</td>
</tr>
<tr>
<td>Max. Dry Density (P.C.F.)</td>
<td>72.9</td>
</tr>
<tr>
<td>Optimum Moisture (%)</td>
<td>44.4</td>
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</tbody>
</table>

#### REMARKS:

Date 4-17-73 By DJT
**TABLE I-B - SUMMARY OF LABORATORY TEST RESULTS**

<table>
<thead>
<tr>
<th>BORING NO.</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAMPLE NO.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEPTH BELOW SURFACE</td>
<td>SURFACE 5'-6.5'</td>
<td>10'-11'</td>
<td>15'-16'</td>
<td></td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>DARK BROWN</td>
<td>GRAY &amp; SILT CLAY</td>
<td>ORGANIC ROOTS</td>
<td>SILT CLAY &amp; SHELLS</td>
</tr>
</tbody>
</table>

**GRAIN-SIZE ANALYSIS** (% Passing)

<table>
<thead>
<tr>
<th>Sieve</th>
<th>#</th>
<th>#8</th>
<th>#40</th>
<th>#100</th>
<th>#200</th>
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</table>

**ATTERBERG LIMITS**

<table>
<thead>
<tr>
<th>Air Dried or Natural</th>
<th>Liquid Limit</th>
<th>Plastic Limit</th>
<th>Plasticity Index</th>
<th>Dilatancy</th>
<th>Toughness</th>
<th>Dry Strength</th>
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<tbody>
<tr>
<td>NATURAL</td>
<td>64</td>
<td>42</td>
<td>42</td>
<td>SLOW</td>
<td>MED.-HIGH</td>
<td>HIGH</td>
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<tr>
<td>Natural</td>
<td>65</td>
<td>40</td>
<td>45</td>
<td>NONE</td>
<td>MED.-HIGH</td>
<td>HIGH</td>
</tr>
<tr>
<td>Natural</td>
<td>67</td>
<td>40</td>
<td>21</td>
<td>QUICK</td>
<td>SLIGHT-MED.</td>
<td>MEDIUM</td>
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<tr>
<td>Natural</td>
<td>68</td>
<td>40</td>
<td>28</td>
<td>NONE-SLOW</td>
<td>MED.-HIGH</td>
<td></td>
</tr>
</tbody>
</table>

**UNIFIED SOIL CLASSIFICATION**

| MH | MH | OH | OH |

**APPARENT SPECIFIC GRAVITY**

|   |   |   |   |

**EXPANSION AND CBR TESTS**

(Surcharge-51 P.S.F.)

<table>
<thead>
<tr>
<th>Molding Moisture, %</th>
<th>Molding Dry Density, P.C.F.</th>
<th>Swell upon saturation, %</th>
<th>CBR at 0.1&quot; Penetration</th>
</tr>
</thead>
<tbody>
<tr>
<td>37.9</td>
<td>62.4</td>
<td>1.7</td>
<td>6.0</td>
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</tbody>
</table>

**MOISTURE-DENSITY RELATIONS OF SOILS**

(AASHO T-180-57 Method)

<table>
<thead>
<tr>
<th>Dry to Wet or Wet to Dry</th>
<th>Max. Dry Density (P.C.F.)</th>
<th>Optimum Moisture (%)</th>
</tr>
</thead>
</table>

**REMARKS:**

Date 4-17-75  By B7

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS
PLASTICITY CHART

PROJECT: WAIKALUA ROAD SUBDIVISION
LOCATION: KANEHOE, OAHU, HAWAII

DATE APRIL 11, 1973  BY C. RACUYA
MOISTURE-DENSITY CURVE (AASHO T-180-57, METHOD A)

PROJECT: WAIKALUA ROAD SUBDIVISION

LOCATION: KANEÔHE, OAHU, HAWAII

SAMPLE NO: 1 SURFACE

SAMPLE DESCRIPTION: MOTTLED BROWN CLAYEY SILT WITH TRACES OF SAND & ROOTS

AGGREGATE: 1/4" MINUS

MOLD SIZE: 4" X 4.584" HIGH

HAMMER: 10 LBS 18" DROP

LAYERS: 5

BLOWS: ~25/LAYER

MAXIMUM DRY DENSITY - 130 pcf

OPT. MOISTURE CONTENT - 48.4%

ZERO AIR HOLE CURVE

SPECIFIC GRAVITY - 2.6

DATE 4-17-73

BY WALTER LUM ASSOCIATES, INC.

CIVIL, STRUCTURAL, SOILS ENGINEERS
CBR TEST

PROJECT: WAIALUA ROAD SUBDIVISION

LOCATION: KANEHOE, OAHU, HAWAII

SAMPLE NO: 1 SURFACE

SAMPLE DESCRIPTION: MOTTLED BROWN CLAYEY SILT

WITRACES OF SAND & ROOTS

TEST RESULTS:

MOLDING MOISTURE, %: 45.6
MOLDING DRY DENSITY, P.C.F.: 72.8)
CBR @ 0.1" PENETRATION: 4.7

DAYS SOAKED: 6

DATE: 4-9-73 BY BS

DATE: 4-10-73 BY NI

CBR PENETRATION DATA

<table>
<thead>
<tr>
<th>PENETRATION (INCHES)</th>
<th>LOAD (LBS)</th>
<th>LOAD (PSI)</th>
</tr>
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<tbody>
<tr>
<td>0.025</td>
<td>21</td>
<td>7</td>
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<tr>
<td>0.050</td>
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<tr>
<td>0.075</td>
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<td>0.300</td>
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<td>110</td>
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<td>132</td>
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<td>0.400</td>
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<td>0.450</td>
<td>425</td>
<td>145</td>
</tr>
<tr>
<td>0.500</td>
<td>468</td>
<td>156</td>
</tr>
</tbody>
</table>

AGGREGATE 1/4" MINUS
HAMMER WEIGHT 10 LBS
HAMMER DROP 18"
No. OF BLOWS 56/LAYER
No. OF LAYERS 5

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS
CBR TEST

PROJECT: WAIALUA ROAD SUBDIVISION

LOCATION: KANEHOE, OAHU, HAWAII

SAMPLE NO: 4 SURFACE
SAMPLE DESCRIPTION: DARK BROWN SILTY CLAY WITH TRACES OF SAND

TEST RESULTS:
MOLDING MOISTURE, %: 87.9
MOLDING DRY DENSITY, P.C.F: 82.4
CBR @ 0.1" PENETRATION: 8.0
DAYS SOAKED: 6

DATE: 4-9-73 BY TK & BS
DATE: 4-10-73 BY HL

WALTER LUM ASSOCIATES INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS
Figure 1
Suggested Foundations
Waikalua Road Subdivision
Kaneohe, Oahu, Hawaii
TMK: 4-5-08: 1, 4, 33 & 4-5-07: 1

WALTER LUM ASSOCIATES, INC.
Civil, Structural, Soils Engineers

May, 1973
LIMITATIONS

In general, soil formations are commonly erratic and rarely uniform or regular. The boring logs indicate the approximate subsurface soil conditions encountered only at the drill holes where the borings were made at the times designated on the logs and may not represent conditions at other locations or at other dates. Soil conditions and water levels may change with the passage of time and construction methods or improvements at the site.

During construction, should subsurface conditions much different from those in the borings be observed, encountered, or otherwise indicated, we should be advised immediately to review or reconsider our recommendations in light of the new developments.

If there is a substantial lapse of time between the submission of this report and the start of work at the site, or if conditions have changed due to natural causes, plan changes, or construction operations at or adjacent to the site, it is recommended that this report be reviewed to determine the applicability of the recommendations considering the time lapse and the changed conditions.

Our professional services were performed, findings obtained and recommendations prepared in accordance with generally accepted engineering practices. This warranty is in lieu of all other warranties expressed or implied.