HALE LUMI - ACCESS ROAD
PRELIMINARY SOIL REPORT

WAIPIO, EWA, OAHU, HAWAII
TAX MAP KEY: 9-4-07; POR. 19

FOR REFERENCE
not to be taken from this room

To:
COMMUNITY PLANNING, INC.

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

AUGUST 1, 1973
January 5, 1981

COMMUNITY PLANNING, INC.
Suite 608, 700 Bishop Street
Honolulu, Hawaii  96813

Gentlemen:

Subject: Lumpholi Street Extension
(formerly "Hale Lumi - Access Road")
Waipio, Ewa, Oahu, Hawaii
Tax Map Key: 9-4-07: Por. 19

As requested, we have reviewed the preliminary plans (Sheets 2 and 3)
stamped December 29, 1980 for the above project. Our review was for
general conformance of the roadwork design with our preliminary soil
report, "Hale Lumi - Access Road" (August 1, 1973), and not for specific
details.

In our opinion, the plans appear to be in general conformance with the
intent of the guidelines presented in our soil exploration report.

Respectfully submitted,

WALTER LUM ASSOCIATES, INC.

By Ezra Koike

EK:1w
December 9, 1980

COMMUNITY PLANNING, INC.
700 Bishop Street, Suite 608
Honolulu, Hawaii 96813

Gentlemen:

Subject: Lumipolu Street Extension
Waipio, Ewa, Oahu, Hawaii
Tax Map Key: 9-4-07: Por. 19
Soil Exploration Report of August 1, 1973
for the Hale Lumi Access Road

As requested, we have reviewed our soil exploration report "Hale Lumi Access Road" of August 1, 1973 as it relates to the presently proposed Lumipolu Street Extension project.

A site visit was made by the writer on December 2, 1980 to observe, in general, the existing conditions at the site.

OBSERVATIONS

The alignment of the proposed roadway appears similar to conditions of 1973 except that the brush and rubbish piles have increased along the edges of the existing dirt road.

The drainage swale near the end of Lumipolu Street has been eroded and deepened.

The inlet and outlet of the concrete culvert Station 1800 were eroded almost across the width of the road.

COMMENTS

The design guidelines presented in the soil exploration report of 1973 are generally applicable to the presently proposed road extension project. As recommended in the report, site preparation and mass grading operations should be done with care. Soft spots and eroded areas should be excavated and replaced with select materials compacted in thin level layers.
Since soil conditions at subgrade level will vary depending on the cuts and fills involved in grading of the site, we recommend that during construction additional laboratory testing be done on soil samples from the subgrade for the actual pavement section.

Field observations and testing should commence during site preparation and roadway grading work.

Respectfully submitted,

WALTER LUM ASSOCIATES, INC.

By

Ezra Kojke

EK:lw
August 1, 1973

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

Dear Mr. Houghtailing:

Subject: Hale Lumi - Access Road
Preliminary Soil Report
(for roadway pavement design purposes)
Waipio, Ewa, Oahu, Hawaii
Tax Map Key: 9-4-07: Por. 19

Transmitted herewith is our preliminary soil report for roadway pavement design purposes for the proposed Hale Lumi - Access Road.

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

Respectfully submitted,

WALTER LUM ASSOCIATES, INC.

By Ezra Koike

CM/EK:rmf
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HALE LUMI - ACCESS ROAD
PRELIMINARY SOIL REPORT

WAIPIO, EWA, OAHU, HAWAII
TAX MAP KEY: 9-4-07: POR. 19

SCOPE OF EXPLORATION

The purpose of this exploration was to evaluate general soil conditions for general roadway pavement design purposes for the proposed Hale Lumi - Access Road, Waipio, Ewa, Oahu, Hawaii.

This report includes field explorations, laboratory tests, general recommendations for design of roadway pavement section and limitations.

FIELD EXPLORATION

Seven exploratory borings and 6 probings were made at the site. The approximate locations of these borings and probings are shown on the Boring Location Sketch. Descriptions of the soils encountered are shown on the boring logs.

Borings were made with 3-in. diameter augers using finger type and drag bits. Soil samples were recovered using a 2-in. standard split spoon sampler driven with a 140-lb hammer falling 30 inches. Rock samples were recovered using a "BXM" double tube core barrel with diamond coring bits. The probings were made by driving an A-rod with an 8-lb sledge hammer.
LABORATORY TESTS

Laboratory tests included: natural water content, 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 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 borings logs are generally made in accordance with the "Unified Soil Classification System."

GENERAL SITE CONDITIONS

The proposed access roadway is located on the western slope of Panakauahi Gulch and adjacent to the eastern boundary of Crestview Subdivision at Waipio, Ewa, Oahu, Hawaii.

The proposed road alignment generally follows an existing unpaved roadway. This roadway is generally situated on a bench that is cut in the side slope of the gulch. The cross slope generally varies from about 60 to 80% on the low side of the roadway and about 20 to 80% on the high side.

Several feet of loose fill, boulders and rubbish were noticed in localized areas along the top and face of slopes on the eastern side of the roadway. Boulders were noted in localized areas along the western side of the roadway.
A concrete pipe culvert crosses under the existing road at about Sta. 18+00. This section of the road was partially eroded.

An existing stream or drainageway is located about 100 to 200 ft east of the proposed roadway alignment. Haole Koa trees and weeds grow on the slopes on both sides of the road.

**INTERPRETATION OF SOIL CONDITIONS**

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

- A surface layer, 4 to 9 ft, of stiff clayey silt and silty clay (MH or ML-CL soils) underlain by
- silty sand, decomposed rock and lava rock to about
- 7 to 20 ft, the depths drilled.

Water was not noted in the borings during the field explorations.

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 proposed plan is to develop an access roadway that would extend from the north end of Lumipolu Street in a northerly direction about 1,100 ft.
A 44-ft access roadway is proposed. In general, the proposed roadway will follow the existing access road alignment.

Cut slopes up to about 15 ft in height and retaining walls up to about 14 ft are contemplated on the western side of the roadway. Fills generally less than about 5 ft are contemplated.

Because miscellaneous fills may have been placed in localized sections along the existing access road or shoulder area, the grading design should include allowances for removal and reconstruction of the existing fills where loose or unsuitable material are encountered.

Some slope reconstruction may have to be done on the existing slopes in the vicinity of Sta. 12+00 to 16+00. Because the top of slope is close to the edge of the roadway and the fills thin in some sections, it is suggested that select, granular material be used for slope reconstruction to minimize effects of creep.

The surface soils tested were generally silty clays with expansion values of about 0.3% to 1.3% by the CBR test method. If the roadway subgrade generally rests on soils similar to those tested in the laboratory, a subbase course of about 6 in. may be considered below the wearing course and base course.

Due to the sidehill slopes, sloughing or erosion in localized areas may occur.
General Site Grading

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 and miscellaneous debris should be cleared and removed prior to site filling.

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

3. Localized soft pockets and pockets of unsuitable material encountered during site preparation should be excavated and replaced with select material compacted in thin lifts.

4. Where fills are proposed on sidehill areas, gullies and in drainageways, loose material at the bottom and sides should be stripped down to stiff natural ground before the placement of fills. New fills should be keyed into the stiff natural ground.
5. Trenches should be cut and subdrains installed in the trenches along the bottom and sides of natural drainageways or dips before the placement of fills. The locations of subdrains should be determined in the field after clearing and grubbing.

6. Thin sidehill fills (sliver fills) on sloping areas should be generally avoided.

7. 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 continually be keyed into stiff natural ground by cutting steps into the slopes and compacting the fill into these steps.

8. In general, fills should be laid in 6-in. compacted layers to 90% of the maximum density determined by the AASHO T-180-57 test method. In roadway areas, the top 2 ft of fill should be compacted to 95% of the maximum density.
9. Provisions to drain the site should be included during and after the completion of filling operations.

Slopes

In general, 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 the top of slopes by berms or ditches whenever practicable.

The surface of fill slopes should be compacted by cat-tracking or with a sheepfoot 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 clay pockets or soft spots are encountered in localized areas.

Retaining Walls

Two sections of retaining walls are planned on the western side of the roadway at about Sta. 13+50 to 14+50 and Sta. 19+00 to 21+50. Heights of up to about 14 ft are contemplated.

Walls located on sloping ground with bottoms resting on soil overlying rocky material may be subjected to downhill creep.
The bottom of walls should generally rest on decomposed rock. Soft or loose pockets at the bottom of wall footing excavations should be removed and replaced with on-site or select soils compacted in thin lifts.

Subdrains should be placed behind the walls below the footing level and should be daylighted at low points.

Fairly well-graded granular material or select granular material should be used for backfilling against the wall.

Bearing values of about 3000 p.s.f. may be used for retaining wall foundations resting on stiff natural ground or compacted select fill. The bearing values may be somewhat increased for the toe pressures.

For lateral earth pressures, an equivalent fluid pressure of about 45 p.c.f. plus sloping ground surcharges may be used. The center of pressure should be considered to act somewhat above the lower third of the triangular fluid pressure diagram, assuming that subdrainage and drainage of the backfill are provided.

Slopes above walls should be 2 horizontal to 1 vertical or flatter.
Roadway

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

2. Base course - 6-in. base course.
3. Subbase course - 6-in. select material over a prepared subgrade.
   0 in. over rocky subgrade.

In general, the subbase thickness will depend upon the type of material within the top 2 ft of subgrade. 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.

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.
Utilities

Utilities should be placed after the fills are constructed. Utility lines should be designed with flexible joints, particularly where lines are connected to structures.

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.
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** | HALE LUMI - ACCESS ROAD  
**LOCATION** | Waipio, Ewa, Oahu, Hawaii  
**Tax Map Key** | 9-4-07: Por. 19  
**HAMMER:**  
- **Weight:** 140*  
- **Drop:** 30"  
**LOCATION** | Waipio, Ewa, Oahu, Hawaii  
**Field Party:** | RADOVICH, CHOW, SUZUKI, OSHIRO  
**Type of Boring:** | FINGER TYPE & DIAMOND CORING  
**Elev.:** | 136.4'  

### BORING DATA

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<th>Sample No.</th>
<th>Plastic Limit</th>
<th>Water Cont.</th>
<th>Liquid Limit</th>
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<td>1-B</td>
<td>No RECOVERY</td>
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<td>1-D</td>
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<td>40</td>
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**DESCRIPTION**

- **ELEV. = 136.4'**  
- **STIFF, REDDISH, BROWN Silty Clay w/ Coral (Fill)**  
- **STIFF, REDDISH BROWN Silt & Silt Sand w/ Coral Fragments (Fill)**  
- **MOTTLED GRAY & BROWN Silt, Sand w/ Gravel & Decomposed Rock**  
- **STIFF, GRAY & BROWN Sandy Silt w/ Decomposed Rock**  
- **REDDISH BROWN PLUKA PLUKA ROCK**  
- **GRAY PLUKA PLUKA ROCK**  
- **REDDISH BROWN, WEATHERED PLUKA PLUKA ROCK**  
- **END OF BORING 6-20-73**

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*ELEVATION ESTIMATED FROM TOPO MAP BY R.M. TOWILL CORP. MAY, 1973.*
### Boring Log

**PROJECT:** HALE LUM - ACCESS ROAD  
**LOCATION:** Waipio, Ewa, Oahu, Hawaii  
**Tax Map Key:** 9-4-07: Por. 19

#### HAMMER:
- **Weight:** 8 lb SLEDGE HAMMER
- **Drop:**
- **SAMPLER:** A KOP

#### Probing No. 1A & 1B
- Driller: W. LUM ASSOC, INC.  
- Date: JUNE 27, 1975
- Field Party: SUZUKI, OSHIRO  
- Type of Boring: CONTINUOUS
- Diam.: A KOP

#### Elevation vs. Depth

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* ELEVATION ESTIMATED FROM TOPO MAP  
BY A.M. TOWILL CORP., MAY 1975.
Boring Log

PROJECT: HALE LUMI - ACCESS ROAD

LOCATION: Waipio, Ewa, Oahu, Hawaii

Tax Map Key: 9-4-07: Por. 19

HAMMER:
- Weight: 140#
- Drop: 20"

SAMPER: 2" STANDARD SPLIT SPOON

LOCATION: Waipio, Ewa, Oahu, Hawaii

Type of Boring: AUGER (MOBILE)

Elev. 140' Datum

Drill Bit: FINGER TYPE

Driller: WALTER LUM ASSOCIATES, INC.

Date: JUNE 20, 1973

Penetration Data

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<th>DESCRIPTION</th>
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<th>Plastic %</th>
<th>Water Cont.</th>
<th>Liquid Limit</th>
<th>Unconf. Comp.</th>
<th>Vane Shear</th>
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<td>(MH)</td>
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<td></td>
<td>2-B</td>
<td>27</td>
<td>12</td>
<td>46</td>
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<tr>
<td></td>
<td>DENSE, GRAY GRAVEL &amp; SILTY SAND</td>
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<td>2-C</td>
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Note: Drill Rate
10' G' 110' - 20 min.

**Boring Log**

**PROJECT**
HALE LUMI - ACCESS ROAD

**LOCATION**
Waipio, Ewa, Oahu, Hawaii

**Tax Map Key:** 9-4-07: Por. 19

**HAMMER:**
Weight
Drop

**SAMPLER:**
A. Rod

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* ELEVATION ESTIMATED FROM TOPO MAP

**BY R.M. TOMILL CORP. JAN. 1973**

**Field Party:** SUEKIKO OSIRO

**Driller:** W. LUM ASSOCIATES, INC.

**Date:** JUNE 27, 1973
**Boring Log**

**PROJECT**
HALE LUMI - ACCESS ROAD

**LOCATION**
Waipio, Ewa, Oahu, Hawaii

**Tax Map Key:** 9-4-07: Por. 19

**HAMMER:**

- **Weight:** 140 lbs
- **Drop:** 30"

**SAMPLER:** 2" STANDARD SPLIT SPOON

---

**Penetration Data**

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<th>Sampler</th>
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<tr>
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**ELEVATION ESTIMATED FROM TOPO MAP BY R.M. TOWILL CORP. MAY, 1973.**
**Boring Log**

**PROJECT**  
HALE LUMI - ACCESS ROAD

**LOCATION**  
Waipio, Ewa, Oahu, Hawaii

**Tax Map Key**  
9-4-07: Por. 19

**HAMMER:**
Weight 8# SLEDGE HAMMER
Drop

**SAMPLER:**  
A. ROD

**Elevation**

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<th>Elev.</th>
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* ELEVATION ESTIMATED FROM TOPO MAP

**Probing No.**  
3A  3B

**Driller**  
W. LUM ASSOC., INC.

**Date**  
JUNE 27, 1973

**Field Party**  
SUZUKI OSHIRO  
CONTINUOUS

**Type of Boring**  
PENETRATION

**Diag.**  
A. ROD
**Boring Log**

**PROJECT**: HALE LUMI - ACCESS ROAD

**LOCATION**: Waipio, Ewa, Oahu, Hawaii

**Tax Map Key**: 9-4-07: Par. 19

**HAMMER**:
- Weight: 140 #
- Drop: 30" 2.55. 2" STANDARD SPLIT SPOON 4 "BK" - 2XM DOUBLE TUBE CORE BARREL

**LOCATION**
- Elev. 140' *
- Datum 6-21-73
- Field Party: RADOVICH, CHOW, SUZUKI, OSHIKO
- Type of Boring: AUGER, MOBILE DRILL
- Diam. 3" 6-23-73

**SAMPLER**
- Type: FINGER TYPE 4 DIAMOND CORING
- Water Level: NOT NOTED
- Time: —
- Date: 6-21-73

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sampler</th>
<th>Sample No.</th>
<th>Plastic Limit</th>
<th>Liquid Limit</th>
<th>Unconf. Comp.</th>
<th>Vane Shear</th>
<th>Standard Penetration Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2&quot;55</td>
<td>4-A</td>
<td>28</td>
<td>17</td>
<td>46</td>
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<tr>
<td>5</td>
<td>2&quot;55</td>
<td>4-B</td>
<td>18</td>
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</tr>
<tr>
<td>10</td>
<td>2&quot;55</td>
<td>4-C</td>
<td>17</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE**: DRILL RATE 7-6: 80' in 20 MIN.

- BLUE, DENSE LAVA ROCK
- SOME LARGE VEGETATION
- END OF BORING & 10' 6-26-73

**REACTION**: RUN #1 COATED 50' RECOVER 44'

*ELEVATION ESTIMATED FROM TOTO MAP BY R.M. TOWILL CORP. MAY 1973*
# Boring Log

**PROJECT**: HALE LUMI - ACCESS ROAD  
**LOCATION**: Waipio, Ewa, Oahu, Hawaii  
**Tax Map Key**: 9-4-07: Por. 19

**HAMMER**:  
- **Weight**: 140 lb  
- **Drop**: 30"  
**SAMPLER**: 2" STANDARD SPLIT SPOON

---

**BORING NO.**: 5  
**Sheet No.**: of  
**Driller**: W. LUM ASSOC., INC.  
**Date**: JUNE 22, 1973  
**Field Party**: RADOVICH, CHOW  
**Type of Boring**: AUGER (MOBILE)  
**Diam.**: 6"  
**Datum**:  
**Drill Bit**: FINGER TYPE

---

**PENETRATION DATA**

<table>
<thead>
<tr>
<th>Depth (Ft.)</th>
<th>Sampler</th>
<th>Sample No.</th>
<th>Plastic Limit</th>
<th>Water Content</th>
<th>Liquid Limit</th>
<th>Unconfined P.S.F.</th>
<th>Vane Shear P.S.F.</th>
<th>N (Blows per foot)</th>
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<td>5-B</td>
<td>21</td>
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<td></td>
</tr>
<tr>
<td>5</td>
<td>5-C</td>
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<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**NOTE**: DRILL RATE: 6.0'-7.5' 90MIN.

**END OF BORING**: 8.15'  
**G: 22-73**  
**NOTE**: DRILL RATE: 6.0'-7.5' 90MIN.

---

**ELEVATION ESTIMATED FROM TOP MAP BY R. M. TOWILL CORP., MAY, 1973.**
# Boring Log

**PROJECT:** HALE LUMI - ACCESS ROAD  
**LOCATION:** Waipio, Ewa, Oahu, Hawaii  
**Tax Map Key:** 9-4-07; Per. 19

**HAMMER:**  
- Weight: 140 lb.  
- Drop: 20 in.  

**BORING NO.:** G  
**W. LUM ASSOC., INC.**  
**Date:** JUNE 24 & 27, 1975  
**Driller:** SUZUKI, OSHIRO  
**Field Party:** AUGER & DRILL

**Type of Boring:** AUGER & DRILL  
**Diam.:** 3" x 3"  
**Elev.:** 154'  
**Date:** G-27-75  
**Drill Bit:** T.C. DRILL & DIAMOND CORING

### Location
- **Tax Map Key:** 9-4-07; Per. 19

## Penetration Data

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sampler</th>
<th>Sample No.</th>
<th>Plastic Limit</th>
<th>Water Content</th>
<th>Liquid Limit</th>
<th>Undrained Comp.</th>
<th>Vane Shear</th>
<th>N (Blows per foot)</th>
<th>Standard Penetration Test</th>
</tr>
</thead>
<tbody>
<tr>
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<td>19</td>
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<tr>
<td>2.55</td>
<td>G-A</td>
<td>21</td>
<td>55</td>
<td>24</td>
<td>24</td>
<td>-</td>
<td>-</td>
<td>10</td>
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<td>G-B</td>
<td>24</td>
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<td>24</td>
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<td>-</td>
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<td>-</td>
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<td>-</td>
<td>30</td>
<td>10</td>
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</tbody>
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* ELEVATION ESTIMATED FROM TOPO MAP BY R.M. TOWILL CORP. MAY, 1975.
Boring Log

**PROJECT:** HALE LUMI - ACCESS ROAD  
**LOCATION:** Waipio, Ewa, Oahu, Hawaii  
**Tax Map Key:** 9-4-07: Por. 19

**HAMMER:**  
- **Weight:** 140 lb  
- **Drop:** 30"  
- **Type of Boring:** 2" 55 - 2" STANDARD SPLIT SPOON  
- **Sampler:** "BX" - BXM DOUBLE TUBE CORE BARREL

**LOCATION:** Waipio, Ewa, Oahu, Hawaii  
Tax Map Key: 9-4-07: Por. 19

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sampler</th>
<th>Sample No.</th>
<th>Plastic Limit</th>
<th>Water Cont.</th>
<th>Liquid Limit</th>
<th>Undrained Comp.</th>
<th>Vane Shear</th>
<th>P.S.F.</th>
<th>N (Blows per foot)</th>
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</thead>
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<tr>
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<td>1:A</td>
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<tr>
<td>2.55</td>
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<td></td>
<td>20</td>
</tr>
<tr>
<td>2.55</td>
<td>1:P</td>
<td>20</td>
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<td></td>
<td>56/0.5'</td>
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<td>30</td>
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<tr>
<td>2.55</td>
<td>1:E</td>
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</tbody>
</table>

**END OF BORING**  
G-28-73

**ELEVATION ESTIMATED FROM TOPO MAP BY R.M. TOWILL & CORP. MAY, 1973."
### TABLE I.A - SUMMARY OF LABORATORY TEST RESULTS

<table>
<thead>
<tr>
<th>BORING NO.</th>
<th>SAMPLE NO.</th>
<th>DEPTH BELOW SURFACE</th>
<th>DESCRIPTION</th>
<th>GRAIN-SIZE ANALYSIS (% Passing)</th>
<th>ATTERBERG LIMITS</th>
<th>UNIFIED SOIL CLASSIFICATION</th>
<th>APPARENT SPECIFIC GRAVITY</th>
<th>EXPANSION AND CBR TESTS</th>
<th>MOISTURE-DENSITY RELATIONS OF SOILS</th>
<th>REMARKS:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tr>
<tr>
<td>1</td>
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<td>SURFACE 3'-4.5'</td>
<td>REDDISH-BROWN SILO CLAY WiSDE ROCK &amp; GRAVEL</td>
<td>100</td>
<td>NATURAL 45</td>
<td>ML-CL</td>
<td>2.94</td>
<td>22.8</td>
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<tr>
<td>2</td>
<td></td>
<td>25'-4' SURFACE</td>
<td>REDDISH-BROWN CLAYSiY CLAY WISAND &amp; CORA L</td>
<td>100</td>
<td>NATURAL 46</td>
<td>ML-CL</td>
<td></td>
<td>103.4</td>
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<td></td>
</tr>
</tbody>
</table>

- **BORING NO.**
- **SAMPLE NO.**
- **DEPTH BELOW SURFACE**
- **DESCRIPTION**
- **GRAIN-SIZE ANALYSIS (% Passing)**
  - Sieve
    - 1"
    - 1/2"
    - #4
    - #10
    - #20
    - #40
    - #100
    - #200
- **ATTERBERG LIMITS**
  - Air Dried or Natural Liquid Limit
  - Plastic Limit
  - Plasticity Index
  - Dilatancy
  - Toughness
  - Dry Strength
- **UNIFIED SOIL CLASSIFICATION**
  - ML-CL
  - SM
- **APPARENT SPECIFIC GRAVITY**
  - 2.94
- **EXPANSION AND CBR TESTS**
  - (Surcharge-52 P.S.F.)
    - Molding Moisture, %
    - Molding Dry Density, P.C.F.
    - Swell upon saturation, %
    - CBR at 0.1" Penetration
  - 22.8
  - 103.4
  - 10.7
  - 90.5
- **MOISTURE-DENSITY RELATIONS OF SOILS**
  - (AASHO T-180-57 Method)
    - Dry to Wet or Wet to Dry
    - Max. Dry Density (P.C.F.)
    - Optimum Moisture (%)
  - A
  - 106.7
  - 22.4
- **REMARKS:**

**WALTER LUM ASSOCIATES, INC.**
**CIVIL, STRUCTURAL, SOILS ENGINEERS**

**Date 7-6-72**
**By [Signature]**
## Table 18 - Summary of Laboratory Test Results

<table>
<thead>
<tr>
<th>BORING NO.</th>
<th>4</th>
<th>5</th>
<th>5</th>
<th>6</th>
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<tbody>
<tr>
<td>SAMPLE NO.</td>
<td>6</td>
<td>5</td>
<td>2</td>
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</tr>
<tr>
<td>DEPTH BELOW SURFACE</td>
<td>0.5'-2'</td>
<td>0.5'-2'</td>
<td>2.5'-4'</td>
<td></td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>REDDISH BROWN SOD ден CLAY</td>
<td>REDDISH BROWN CLAY</td>
<td>REDDISH BROWN SOD ден CLAY</td>
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</tr>
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</table>

### Grain-Size Analysis (% Passing)

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<tr>
<th>Sieve</th>
<th>1&quot;</th>
<th>1/2&quot;</th>
<th>0.4&quot;</th>
<th>0.10&quot;</th>
<th>0.040&quot;</th>
<th>0.010&quot;</th>
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<tbody>
<tr>
<td>Passing</td>
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<td>99</td>
<td>96</td>
<td>94</td>
<td>91</td>
<td>89</td>
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<tr>
<td>Loss</td>
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<td>1</td>
<td>4</td>
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<td>7</td>
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### Atterberg Limits

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<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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<tr>
<td>NATURAL</td>
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<td>NATURAL</td>
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<td>18</td>
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<td>MEDIUM</td>
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<td>MEDIUM</td>
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</tbody>
</table>

### Unified Soil Classification

| ML | ML | ML | MH |

### Apparent Specific Gravity

| ML | ML | ML | MH |

### Expansion and CBR Tests

(Surcharge-51 P.S.F.)

<table>
<thead>
<tr>
<th>Molding Moisture, %</th>
<th>22.8</th>
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<tbody>
<tr>
<td>Molding Dry Density, P.C.F.</td>
<td>103.9</td>
</tr>
<tr>
<td>Swell upon saturation, %</td>
<td>0.6</td>
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<tr>
<td>CBR at 0.1&quot; Penetration</td>
<td>29.7</td>
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</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 7-6-77 By D.T.
PLASTICITY CHART

PROJECT: HALE LUMI-ACCESS ROAD
LOCATION: WAIPIO, EWA, OAHU, HAWAII

DATE: 7-6-73  BY: PJT.

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS
MOISTURE-DENSITY CURVE (AASHO T-180-57, METHOD A)

PROJECT: HALE LUMI-ACCESS ROAD

LOCATION: WAIPIO, EWA, OAHU, HAWAII

SAMPLE NO.: 1 SURFACE

SAMPLE DESCRIPTION: REDDISH BROWN SILTY CLAY

WISOME SAND & CORAL

MOISTURE-DENSITY CURVE (AASHO T-180-57, METHOD A)

MOISTURE CONTENT (°/o)

WATER CONTENT (°/o)

DENSITY (P.C.F.)

130

120

110

100

90

80

70

60

50

40

30

20

10

0

0 10 20 30 40 50 60

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

DATE 7-6-73  BY B.J.
CBR TEST
PROJECT: HALE LUMI - ACCESS ROAD
LOCATION: WAIPIO, EWA, OAHU, HAWAII
SAMPLE NO: 1 SURFACE
SAMPLE DESCRIPTION: REDDISH-BROWN SILTY CLAY W/SOME SAND & CORAL

TEST RESULTS:
MOLDING MOISTURE, %: 9.2
MOLDING DRY DENSITY, P.C.F.: 101.1
CBR @ 0.1" PENETRATION: 67
DAYS SOAKED: 4

DATE 6-29-73 BY EM
DATE 7-2-73 BY ML

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

PROJECT: HALE LUMI ACCESS ROAD

LOCATION: WAIPIO, EWA, OAHU, HAWAII

SAMPLE NO: 3 SURFACE

SAMPLE DESCRIPTION: REDDISH BROWN CLAYEY SILT
WITRACES OF SAND & GRAVEL

CBR PENETRATION DATA

<table>
<thead>
<tr>
<th>PENETRATION (INCHES)</th>
<th>LOAD (LBS)</th>
<th>LOAD (PSI)</th>
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<td>57</td>
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<td>0.050</td>
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<tr>
<td>0.500</td>
<td>2150</td>
<td>717</td>
</tr>
</tbody>
</table>

AGGREGATE 1/4" MINUS
HAMMER WEIGHT 10 LBS
HAMMER DROP 16" NO.
OF BLOWS 56
LAYERS 5

TEST RESULTS:
MOLDING MOISTURE, %: 2.7
MOLDING DRY DENSITY, P.C.F.: 103.4
CBR @ 0.1" PENETRATION: 34.8
DAYS SOAKED: 4

DATE: 6-29-73 BY EMA
DATE: 7-2-73 BY NL1

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

PROJECT: HALE LUMI-ACCESS ROAD

LOCATION: WAIPIO, EWA, OAHU, HAWAII

SAMPLE NO: 5 SURFACE

SAMPLE DESCRIPTION: MOTTLED BROWN CLAYEY SILT
W/TraceS OF SAND & GRAVEL

TEST RESULTS:

MOLDING MOISTURE, %: 22.8
MOLDING DRY DENSITY, P.C.F.: 102.9
CBR @ 0.1" PENETRATION: 29.1
DAYS SOAKED: 4

DATE 6-29-73 BY EM

DATE 7-2-73 BY HH

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