FOUNDATION INVESTIGATION
0.2 M.G. RESERVOIR SITE
NIU VALLEY HIGHLANDS
TMK: 3-7-03-72
for
BUDGET REALTY

June 29, 1973
W.O. 198

ERNEST K. HIRATA & ASSOCIATES, INC.

MUNICIPAL REFERENCE & RECORDS CENTER
City & County of Honolulu
City Hall Annex, 558 S. King Street
Honolulu, Hawaii 96813
Budget Realty
1234 Kaumualii Street
Honolulu, Hawaii 96817

Attention: Mr. Richard Mew

Gentlemen:

Our report, "Foundation Investigation, 0.2 M.G. Reservoir Site, Niu Valley Highlands, TMK: 3-7-03-72," dated June 29, 1973 is enclosed.

This is the report requested by you and planned in cooperation with Mr. Yasuo Arakaki, Civil Engineer.

The one exploratory boring indicates that the upper 21 feet of surface soil consists of gravelly silt with numerous cobbles and boulders. The gravelly silt is slightly clayey and dense. Underlying the gravelly silt was a reddish brown porous weathered rock.

The proposed site was found to be feasible for the reinforced concrete reservoir. The site should be grossly stable against any slope failure. Recommendations are included in this report for the development of the structure.

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

Very truly yours,


Ernest K. Hirata
INTRODUCTION

This report presents the results of our foundation investigation performed on the subject property. The purpose of this investigation was to determine the nature of the soils underlying the site, to ascertain their engineering properties, and to provide recommendations for foundation design and floor slabs.

This investigation included drilling one exploratory test boring, obtaining representative soil samples, laboratory testing and analysis, and the preparation of this report. The exploratory boring location is shown on the enclosed Grading Plan.

STRUCTURAL CONSIDERATIONS

The proposed reservoir will be constructed of reinforced concrete having a plan dimension of approximately 50 feet in diameter and 17 feet high. Four precast columns will be used to support the concrete roof loads.
The maximum load on the floor of the reservoir due to the weight of the water will be approximately 1000 PSF. The maximum column load will be on the order of 37 kips.

The proposed grading plan indicates a maximum cut of 25 feet with a variable height retaining wall along the uphill face of the slope. The maximum height of the retaining wall will be approximately 20 feet, with cut slope gradients of $1\frac{1}{2}:1$ (horizontal to vertical).

**SITE CONDITIONS**

The proposed reservoir site is situated along the Ewa slope of Hawaiiloa Ridge approximately 0.4 miles from the end of Anolani Street in Niu Valley. The site for the reservoir has an existing slope gradient of approximately 36 percent. The site is heavily covered with brush and trees, and numerous boulders were observed on the surface.

**FIELD EXPLORATION**

The site was explored on June 20, 1973 by drilling one exploratory test boring with a truck-mounted rotary drill rig. Prior to drilling, a bulldozer was used to provide access to the site.
The boring was drilled to a maximum depth of 40 feet. The boring location is shown on the Grading Plan, and the soils encountered are logged on Plates A1 and A2.

The soils were continuously logged by our field engineer and classified by visual examination in accordance with the Unified Soil Classification System.

Undisturbed and bag samples were recovered from the borings for laboratory testing. Undisturbed samples were obtained by driving a thin walled steel sampler with a 140 pound hammer from a height of 30 inches. The required blow count for each six inches of penetration is shown on the enclosed "Boring Logs".

SOIL CONDITIONS

The onsite surface soil can be classified as colluvium material deposited from the weathering of Hawaiiloa Ridge.

The exploratory boring indicates that the upper 21 feet of surface soil consists of gravelly silt with numerous cobbles and boulders. The gravelly silt is slightly clayey and appears to be dense. Underlying the gravelly silt was a reddish brown porous weathered rock.

Groundwater was not encountered to the maximum depth drilled.
RECOMMENDATIONS

General

The site was found to be feasible for the proposed 0.2 M.G. reinforced concrete reservoir. Conventional shallow foundations may be used to support the structure.

Foundations

Conventional spread footings may be used to support the structure. An allowable bearing value of 3000 PSF may be used for the design of the footings.

Lateral Design

The bearing value indicated above is for the total of dead and frequently applied live loads, and may be increased by one-third for short duration loading which includes the effect of wind or seismic forces. Resistance to lateral loading may be provided by friction acting at the base of foundations. An allowable coefficient of friction of 0.4 may be used with the dead load forces.

Floor Slabs

A six inch layer of crushed rock should be placed under all concrete slabs.
Site Grading

Cut slopes should be stable at slope gradients of $1\frac{1}{3}:1$ (horizontal to vertical). Fill slopes should be stable at slope gradients of 2:1. All slopes should be planted as soon as possible upon completion of grading.

Since approximately 25 feet of the upper material will be removed, the reinforced concrete reservoir will be founded on the weathered rock. The site should be grossly stable against mass slope failure since the weight of the soil removed will be nearly equal to the total weight of the proposed reservoir.

Inspection

It is recommended that all footings be inspected by a qualified soils engineer prior to placing concrete or steel. Any fill which is placed should be inspected and tested. Any import of fill material should be inspected by us to ascertain that the engineering properties meet our recommendations for foundation design.

Limitations

The boring log indicates the approximate subsurface soil conditions encountered only at the location where the boring
was made and may not represent conditions at other locations.

During construction, should subsurface conditions differ from those encountered in the boring, we should be advised immediately in order to review and to revise our recommendations.

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.

Respectfully submitted,


Ernest K. Hirata  P.E. 2732

Enc: Log of Borings
       Consolidation Test Report
       Maximum Density Curve
       Grading Plan

       Plates A1 and A2
       Plate B1

EKH:ph
# Boring Log

**Boring No.:** B1  
**Driving Wt.:** 140 lb.  
**Date of Drilling:** 6-20-73

<table>
<thead>
<tr>
<th>Depth Feet</th>
<th>Core</th>
<th>Core Bag</th>
<th>Penetration Blows/6 in.</th>
<th>Dry Density Pcf</th>
<th>Moisture Content %</th>
<th>Relative Compaction %</th>
<th>Direct Shear Strength Parameters</th>
<th>Classification</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>24</td>
<td>70.7</td>
<td>133</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Gravelly SILT (GM) - Grayish brown, dry, clayey, stiff with boulders, cobbles and sand.</td>
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<tr>
<td></td>
<td>14</td>
<td>77.5</td>
<td>138</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>25</td>
<td>79.4</td>
<td>39</td>
<td></td>
<td></td>
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<td></td>
<td>45</td>
<td>95.3</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Weathered Rock - Reddish brown, porous, hard.</td>
</tr>
<tr>
<td></td>
<td>46/2.5&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>70</td>
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<tr>
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<td>80</td>
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Plate A1
**BORING LOG**

**SURFACE ELEV.** 295

<table>
<thead>
<tr>
<th>DEPTH FEET</th>
<th>CORE</th>
<th>BAG</th>
<th>PENET. RESIST. BLOWS/6 in.</th>
<th>DRY DENSITY P CF</th>
<th>MOISTURE CONTENT %</th>
<th>RELATIVE COMPACTION</th>
<th>DIRECT SHEAR STRENGTH PARAMETERS</th>
<th>CLASSIFICATION (% Sand, % Silt, % Clay)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>x</td>
<td>38</td>
<td>91.6</td>
<td>18.9</td>
<td></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td>63</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>100/2.5''</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>x</td>
<td>50</td>
<td>87.9</td>
<td>19.2</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
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<td>100/3''</td>
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End boring at 40 feet.

Plate A2
### CONSOLIDATION TEST REPORT

**Type of Specimen:** Undisturbed

<table>
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<tr>
<th>Diameter (in)</th>
<th>Height (in)</th>
<th>Water Content, ( w_0 )</th>
<th>Void Ratio, ( e_0 )</th>
<th>Overburden Pressure, ( P_o ) T/sq ft</th>
<th>Preconsol. Pressure, ( P_c ) T/sq ft</th>
<th>Compression Index, ( C_a )</th>
<th>Void Ratio, ( e_0 )</th>
<th>Saturation, ( S_0 )</th>
<th>Dry Density, ( \gamma_d )</th>
<th>Cross-section</th>
<th>Budget Realty</th>
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</thead>
<tbody>
<tr>
<td>2.40</td>
<td>1.0</td>
<td>18.9 %</td>
<td>( e_0 )</td>
<td>( P_o ) T/sq ft</td>
<td>( P_c ) T/sq ft</td>
<td>( C_a )</td>
<td>( e_0 )</td>
<td>( S_0 )</td>
<td>( \gamma_d )</td>
<td>Decomposed Rock</td>
<td>91.6 lb/ft³</td>
</tr>
</tbody>
</table>

**Classification:** Decomposed Rock

\[ k_{20} \text{ at } e_o = x \times 10^2 \text{ cm/sec} \]

**Remarks:**

- Project: 0.2 M.G. Reservoir Site
- Budget Realty
- Area: W.O. 198
- Boring No.: B1
- Sample No.
- Depth: 33'
- El.
- Date: 6-28-73

**Plate B1**
MAXIMUM DENSITY CURVE

UNIT WEIGHT DRY (pcf)

MOISTURE CONTENT (%)

Boring: B1
Depth: 3' - 5'
Classification: Gravelly Silt
W.O. 198

Plate C