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PRELIMINARY SOILS INVESTIGATION

(LAU) MAKAUA SUBDIVISION

KAAAWA, OAHU, HAWAII

W. O. 312-10 - NOVEMBER 29, 1971

GEOLABS-HAWAII, INC.

1553 COLBURN STREET, SUITE 203

HONOLULU, HAWAII 96817

MUNICIPAL REFERENCE & RECORDS CENTER

City & County of Honolulu
City Hall Annex, 558 S. King Street
Honolulu, Hawaii 96813

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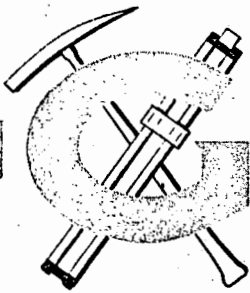
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Standard Grading Specifications



GEOLABS-HAWAII, Inc.

Soils and Foundation Engineering, Geology
1553 Colburn Street, Suite 203 • Honolulu, Hawaii 96817 • (808) 841-5064

November 29, 1971

W. O. 312-10

William Hee and Associates, Inc.
Suite 1, Bldg. 1
1020 Auahi Street
Honolulu, Hawaii 96814

Attention: Mr. Jerry Nakagawa

Subject: Preliminary Soils Investigation
Makaua Subdivision
Kaaawa, Oahu, Hawaii

Gentlemen:

As requested, submitted herewith is our findings and conclusions of a preliminary soils investigation performed on the proposed Makaua Subdivision in Kaaawa, Oahu, Hawaii (TMK: 5-1-03: 9 and 10). The purpose of this investigation was to evaluate the soils underlying the site with respect to the planned construction, to define their engineering characteristics and to provide preliminary recommendations for slopes, excavations, pavement design and grading.

This investigation included a geologic reconnaissance of the area, drilling exploratory test borings, identification, logging, and sampling of the soils encountered, laboratory testing and engineering analysis.

PROPOSED DEVELOPMENT

According to the information we have received from Mr. Nakagawa of William Hee and Associates, the proposed site will be divided into 14 residential lots along a road to be constructed through the center of the project. This road will extend about 400 feet up the hill from Kam Highway; the lower portion will be filled ranging from 0 to 14 feet high and the upper portion will be cut from 0 to 35 feet high. The location of roadway and soil profile are shown on Site Plan, Plate 1, and Profile, Plate 2, respectively.

SITE CONDITIONS

The proposed subdivision consists of a long lot about 200 feet wide and more than 500 feet long, rising from an elevation of 5 feet at Kam Highway to over 100 feet at the rear of the property. The lower portion is covered with a thick growth of grass and weeds with a few scattered coco palms and mango trees. The area is fenced off in small corrals for pasturing cattle. An abandoned dug well with windmill is located near the center of the property about 60 feet from the highway. Part way up the slope is an old, two-story frame house, the access to which is along a dirt-gravel packed road on the west

side of the site. At the rear of the house, there is a large wooden water tank, sheds and corrals separated by rock walls and barbed-wire fences. The ground slopes up steeply in this portion of the property and is covered with many large boulders and a heavy growth of small trees with a few large mangos.

Several shallow drainage courses running from southwest to southeast were noted. Some abandoned water pipes extend up the slope 300 to 400 feet beyond the house.

GEOLOGY

A study of the geologic map and a geologic reconnaissance of the site indicates the area is underlain by recent deposits of white coral sand and gravel near the highway. About 100 feet in from the highway, this material grades into the underlying older alluvium consisting of brown silty clay and gravel with clay layers which covers most of the site. This older clayey formation overlies basalt at about 20 feet below the existing ground surface indicated in the logs for Boring No. 2 and No. 3. Basalt outcrops in the nearly vertical slopes 1000 feet from the highway and these rise more than 1000 feet above sea level. Many large rock slabs and boulders have accumulated at the base of this steep Pali slope. Some of these rocks are more than four

feet across. Their size and close spacing makes the area inaccessible to truck mounted drill rigs.

FIELD EXPLORATION

Three borings were drilled to depths of 12.0 to 26.0 feet using a rotary drill with four-inch diameter flight augers. The logs of the borings are presented on Plates 3 through 7 and the approximate locations of the borings are shown on Plate 1.

Undisturbed samples were obtained using a 2.4 inch I.D. sampler and disturbed samples with a standard split spoon sampler using a 140-lb. hammer. The blow counts are recorded in the appropriate spaces on the drill logs. Where rock was encountered, continuous cores were taken using a NX diamond core barrel. Bulk samples of the soils encountered were also obtained for classification and testing purposes. The samples were brought to the laboratory for analysis.

The materials encountered in the drill holes do not necessarily represent subsurface conditions at other points on the site; however, sampling procedures are believed to be representative.

LABORATORY TESTING

Samples recovered from the test borings and shallow test pit were brought to the laboratory for testing to determine pertinent engineering properties. Testing consisted of performing natural moisture content tests, Atterberg limit tests, proctor, CBR test, and consolidation tests. Field visual identifications were verified in the laboratory by plotting the results of the Atterberg limit tests in the plasticity chart. Final soil classification is based on the Unified Soil Classification System. Results of laboratory tests are found appended to this report.

SOIL CONDITIONS

The logs of Boring No. 1 and No. 2 indicate a soft layer of CLAY 1.5 to 2.5 feet thick overlying 1.5 to 3.5 feet of medium dense SAND. Generally below 4 feet, the sand becomes very loose and contains coral fragments or gravel. There is an apparent mixture of the younger Coral SAND with the underlying older clayey alluvium somewhere between Boring No. 1 and No. 2 where the older soil was encountered below 12-foot depth. The loose and soft soils may terminate where the ground rises at Elevation 14 or 16. See Soil Profile, Plate 2, for estimated soil

stratification.

CONCLUSIONS AND RECOMMENDATIONS

General

The information obtained during our investigation indicates that the subject site is suited to the proposed construction insofar as the recommendations contained in this report are incorporated in the design considerations, project plans and job specifications.

The soils in the lower area consist of 1.5 to 2.5 feet of soft to stiff CLAY and about 2.5 feet of medium dense SAND overlying more than 12 feet of loose SAND. These soils will consolidate when subjected to fill loads. It is estimated the settlement will be on the order of 4 to 6 inches, most of which will take place during construction.

Grubbing and Clearing

1. Debris, vegetation and other deleterious materials should be removed from the site. This includes the existing structures, water tank, trees, rock walls, large boulders and pipe lines.
2. Cesspools, if encountered, should be cleaned and filled in

accordance with the following procedures:

(a) Rock Fill in Sludge at Bottom of Cesspool

Use rocky materials 2" to 12" in size. The materials should be forced through the sludge and rammed into place by end dumping or by vibration. Rock fill may extend to about 2' above the sludge.

(b) Granular Fill Above Sludge

Use granular material, uniformly graded from 6" to 0". The fines passing the No. 200 sieve should be less than 20%. The materials should be placed in thin layers and compacted with vibratory equipment.

(c) Top 3' of Fill

Use onsite materials. Compaction should be in thin layers to 90% of ASTM D 1557-70.

3. The root balls of the trees should be removed and the cavities filled with compacted fill. This removal will probably be on the order of 3 to 3½ feet.

Treatment of Existing Ground

1. Remove all grass and clay soil at least 2 feet below existing ground surface.
2. Scarify and compact the underlying sandy layer to 90% relative compaction as outlined in our Standard Grading Specification, Page 2, #3.
3. Onsite soils excavated for the new road may be used as fill material provided it is properly processed and compacted as outlined in Standard Grading Specifications.

Fill Placement

1. Fill materials, consisting of soils approved by the soils engineer, shall be placed in controlled compacted layers with approved compaction equipment. The excavated onsite soils are considered satisfactory for reuse in the controlled fills.
2. All imported fill shall be examined and approved by the soils engineer prior to use in controlled fill areas.
3. All fill shall be compacted to a minimum relative compaction of 90 percent of the laboratory maximum density as determined by test ASTM D-1557-70.

4. Inspection and field tests shall be carried on during grading by the soils engineer to assist the contractor in obtaining the required degree of compaction and the proper moisture content. Where compaction is less than required, additional compactive effort shall be made with adjustment of the moisture content as necessary until 90 percent compaction is obtained.

Cut Slopes and Fill Slopes

Graded cut slopes should be designed at a slope ratio of 1½-horizontal to 1-vertical with 8-foot wide benches at intervals of 15 feet vertically. Fill slopes should be designed at a slope ratio of 2-horizontal to 1-vertical.

Paving

In areas to be paved, the existing soils should be scarified to a depth of 6 inches, brought to optimum moisture content, and recompact to 95 percent of the maximum dry density as determined by ASTM D-1557-70. Based on result of CBR Test Data on Table I, the following pavement section is recommended:

<u>Pavement Thickness</u> <u>(inches)</u>	<u>Base Course</u> <u>(inches)</u>
2	4

Design Review

The grading plans should be forwarded to the soils engineer for review and comments prior to finalizing the design.

Additional analysis and/or subsurface investigation should be made where conditions different from the basic assumptions indicated herein are used or are encountered.

INVESTIGATION LIMITATIONS

The materials encountered on the project site are considered representative of the total area; however, soil materials may vary in characteristics between borings. Since our investigation is based on a fraction of the site materials, selective laboratory testing and analyses, the conclusions and recommendations are professional opinions. These opinions have been derived in accordance with current standards of practice and a warranty is not expressed nor implied.

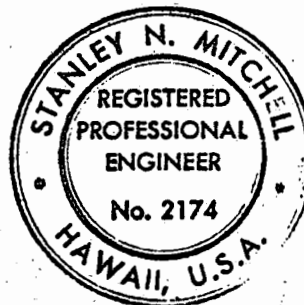
Respectfully submitted,

GEOLABS-HAWAII, INC.

Stanley N. Mitchell
Stanley N. Mitchell, P.E.

Peter S. C. Chan

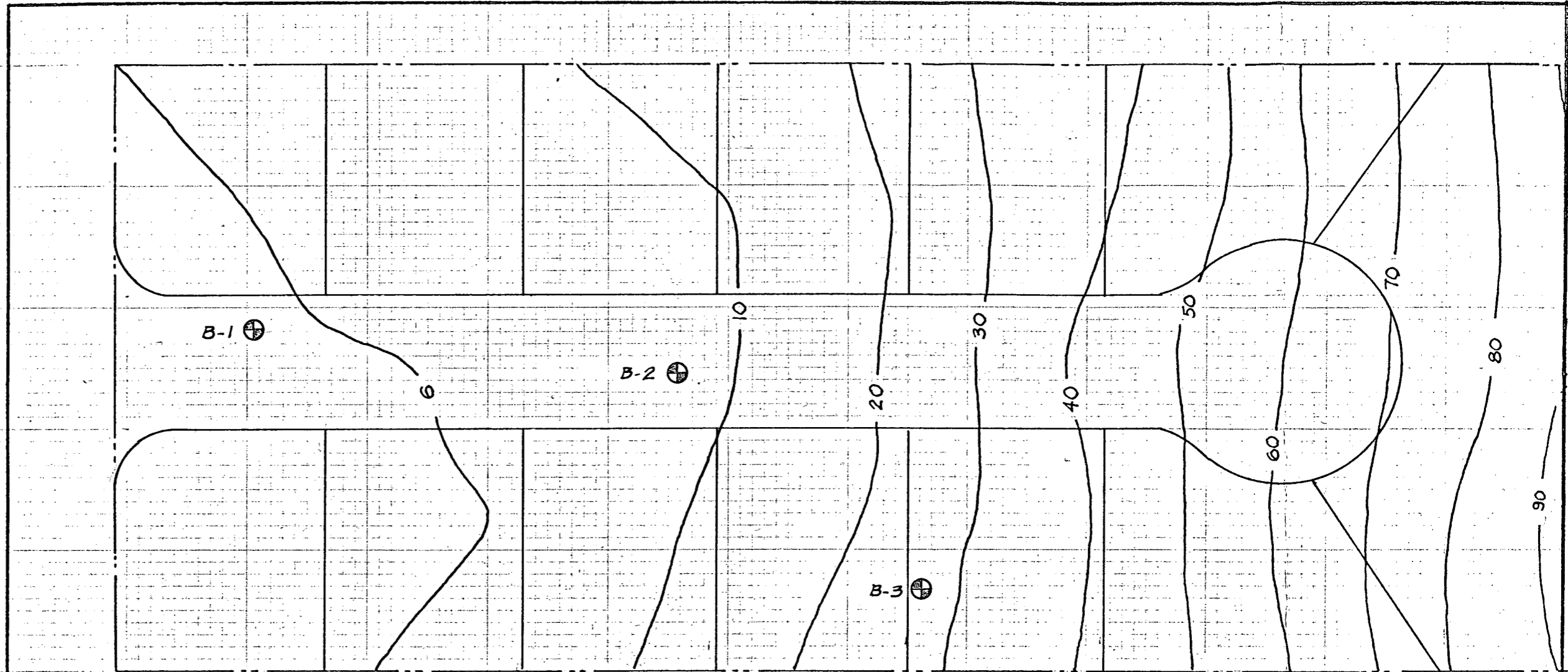
Peter S. C. Chan
Vice President



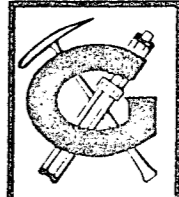
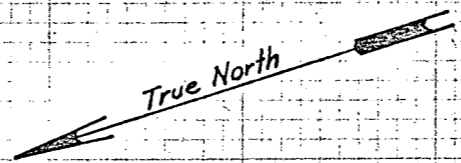
xc: (6) Addressee

A P P E N D I X A

S I T E P L A N



Legend:
 ⊕ Test boring location
 Reference:
 Contour map furnished by
 William Hee & Associates

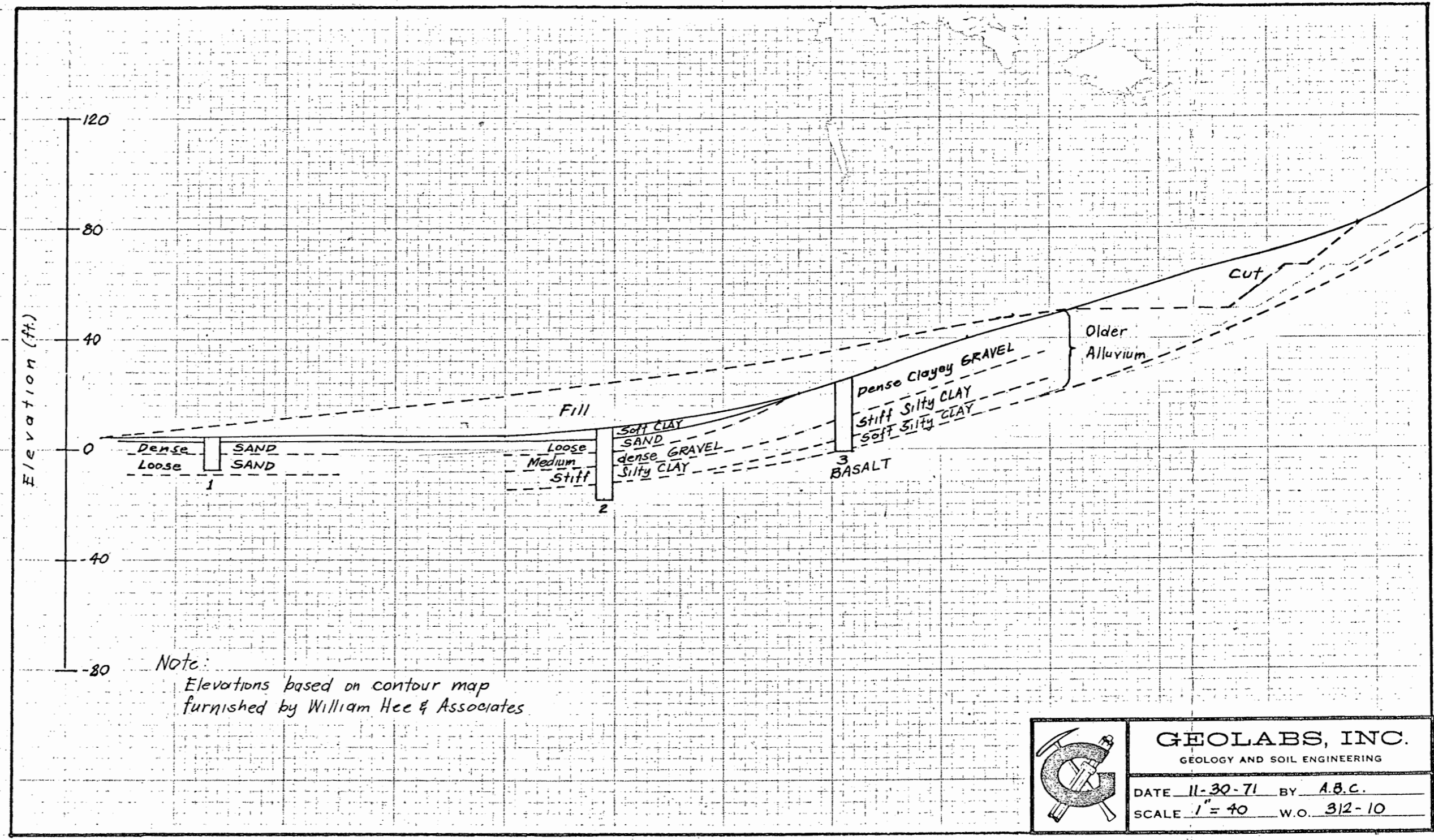


GEOLABS, INC.
 GEOLOGY AND SOIL ENGINEERING
 DATE 11-30-71 BY A.B.C.
 SCALE 1" = 40' W.O. 312-10


PLATE I

A P P E N D I X B

IDEALIZED SUBSURFACE PROFILE



Note:
Elevations based on contour map
furnished by William Hee & Associates

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	GEOLOGY AND SOIL ENGINEERING	
	DATE 11-30-71	BY A.B.C.
SCALE 1" = 40'		W.O. 312-10

A P P E N D I X C

LOGS OF BORINGS

GEOLABS - HAWAII, INC.

BORING LOG 1

Drilling Date 11-15-71 Driving Wt. 140 lbs Elevation 5'

Job Makaua Subdivision Drop 30" Work Order 312-10

Sample Depth ft	Blows per ft.	Moisture Content %	Dry Unit Weight p.c.f.	Depth in feet	Graphic Log	Description
				0		
		41.4			CH	Soft, dark brown Silty CLAY and grass.
1.0					CH	Stiff, gray Silty CLAY. Moist
3.0	45	23.0	79.4			
					SP	Dense, white coral SAND. Water at 3.5' Moist to wet.
				5		
5.0					SM	Loose, white Silty SAND with coral fragments.
7.0	7	25.7				
					SP	Very loose, gray SAND with coral fragments.
				10		
10.0						
12.0	2					
						Bottom of Hole 12.0 Feet
				15		
				20		

GEOLABS—HAWAII, INC.

BORING LOG 2

Drilling Date 11-12-71 Driving Wt. 140 lbs Elevation 8'

Job Makaua Subdivision Drop 30" Work Order 312-10

Sample Depth ft.	Blows per ft.	Moisture Content %	Dry Unit Weight p.c.f.	Depth in feet.	Graphic Log	Description
				0		
					CH	Soft, dark brown CLAY with grass.
1.5 3.0	13	37.2	73.2		CH	Medium to stiff, brown Silty CLAY. Moist
					SP	Medium dense, light brown, fine SAND. moist
				5	SP	Loose, gray, fine SAND with some coral fragments. Moist to wet.
7.0 8.5	6	20.8			GM	Loose, brown Silty GRAVEL and SAND.
					GP	Medium dense, dark gray gravel-size, angular BASALT fragments.
10.0 11.5	21			10		
11.5 13.0	14				MH	Stiff, brown Sandy CLAY.
				15		
15.0 17.0	13	78			MH	Stiff, brown, Silty CLAY.
				20		

GEOLABS - HAWAII, INC.

BORING LOG 2 (cont.)

Drilling Date 11-12-71 Driving Wt. 140 lbs Elevation 8'

Job Makaua Subdivision Drop 30" Work Order 312-10

Sample	Depth ft.	Blows per ft.	Moisture Content %	Dry Unit Weight p.c.f.	Depth in feet	Graphic Log	Description
20.0	21.0	80					Hard, gray basalt. (Very slow drilling)
					25		
							Bottom of Hole 26.0 Feet

GEOLABS—HAWAII, INC.

BORING LOG 3

Drilling Date 11-16-71 Driving Wt. 140 lbs Elevation 26'

Job Makaua Subdivision Drop 30" Work Order 312.-10

Sample Depth ft	Blows per ft.	Moisture Content %	Dry Unit Weight p.c.f.	Depth in feet.	Graphic Log	Description
				0		
2.0 3.5	28	34.1			GC	Medium dense to dense, brown, Clayey GRAVEL with clay layers.
				5		
5.0 6.0	41					Boulder
					GC	Dense, brown Clayey GRAVEL.
				10		
14.5 16.5	16	52.1			MH	Stiff to very stiff, brown and gray Silty CLAY with basalt fragments.
				15		
					MH	Soft, brown Clayey SILT. Very moist
				20		

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BORING LOG 3 (cont.)

Drilling Date 11-16-71 Driving Wt. 140 lbs Elevation 26'

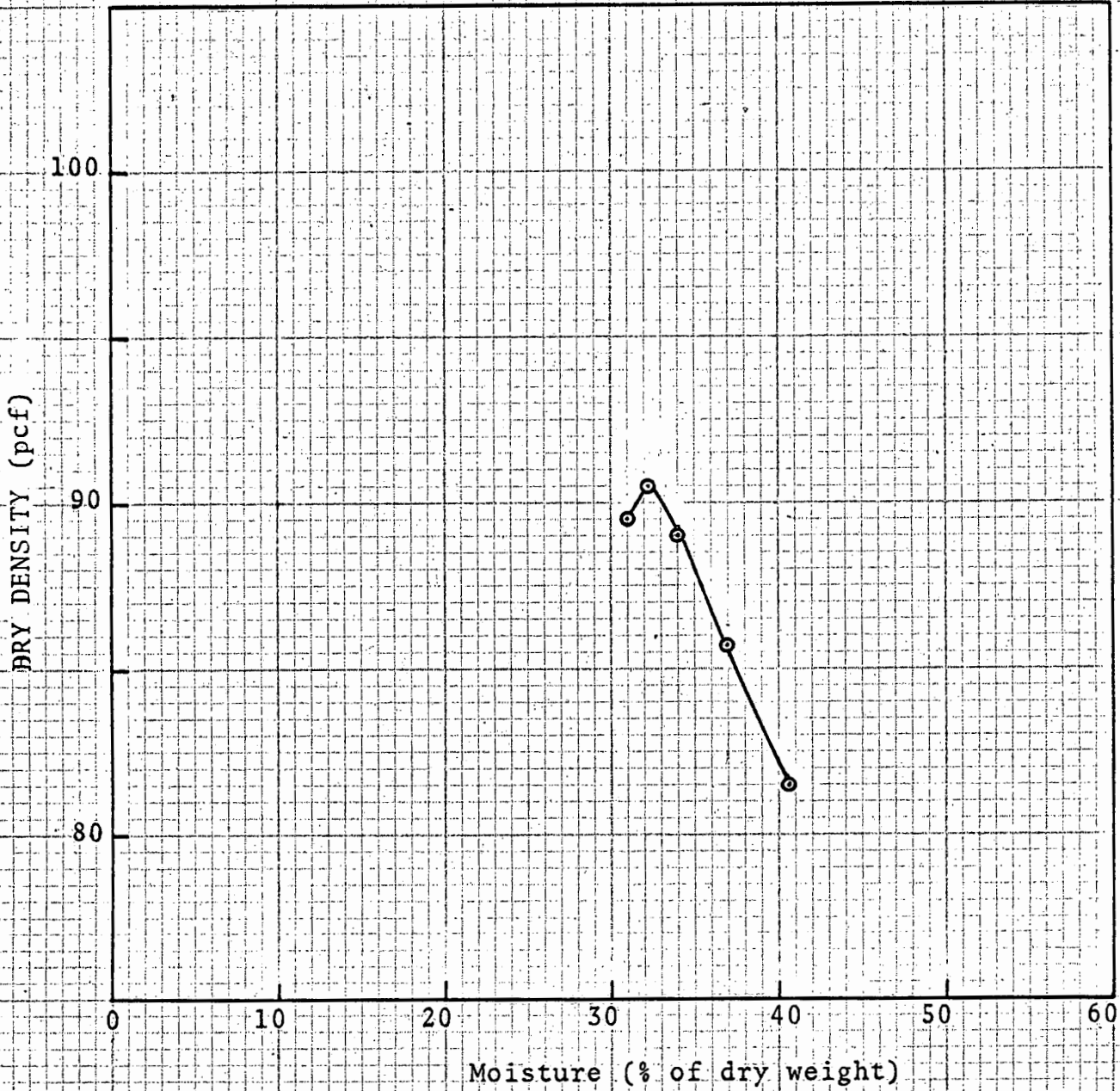
Job Makaua Subdivision Drop 30" Work Order 312-10

Sample Depth ft	Blows per ft.	Moisture Content %	Dry Unit Weight p.c.f.	Depth in feet.	Graphic Log	Description
22.0 24.0	6	104.4			MH	Soft to medium, brown, Clayey SILT. Very moist to wet.
24.5 25.4	50			25		Hard, gray Basalt with clay seams.
						Bottom of Hole 25.4 Feet
				30		
				35		
				40		

A P P E N D I X D

LABORATORY TEST RESULTS

STANDARD PROCTOR TEST



GEOLABS, INC.

GEOLOGY AND SOIL ENGINEERING

DATE 11-30-71 BY A.B.C.

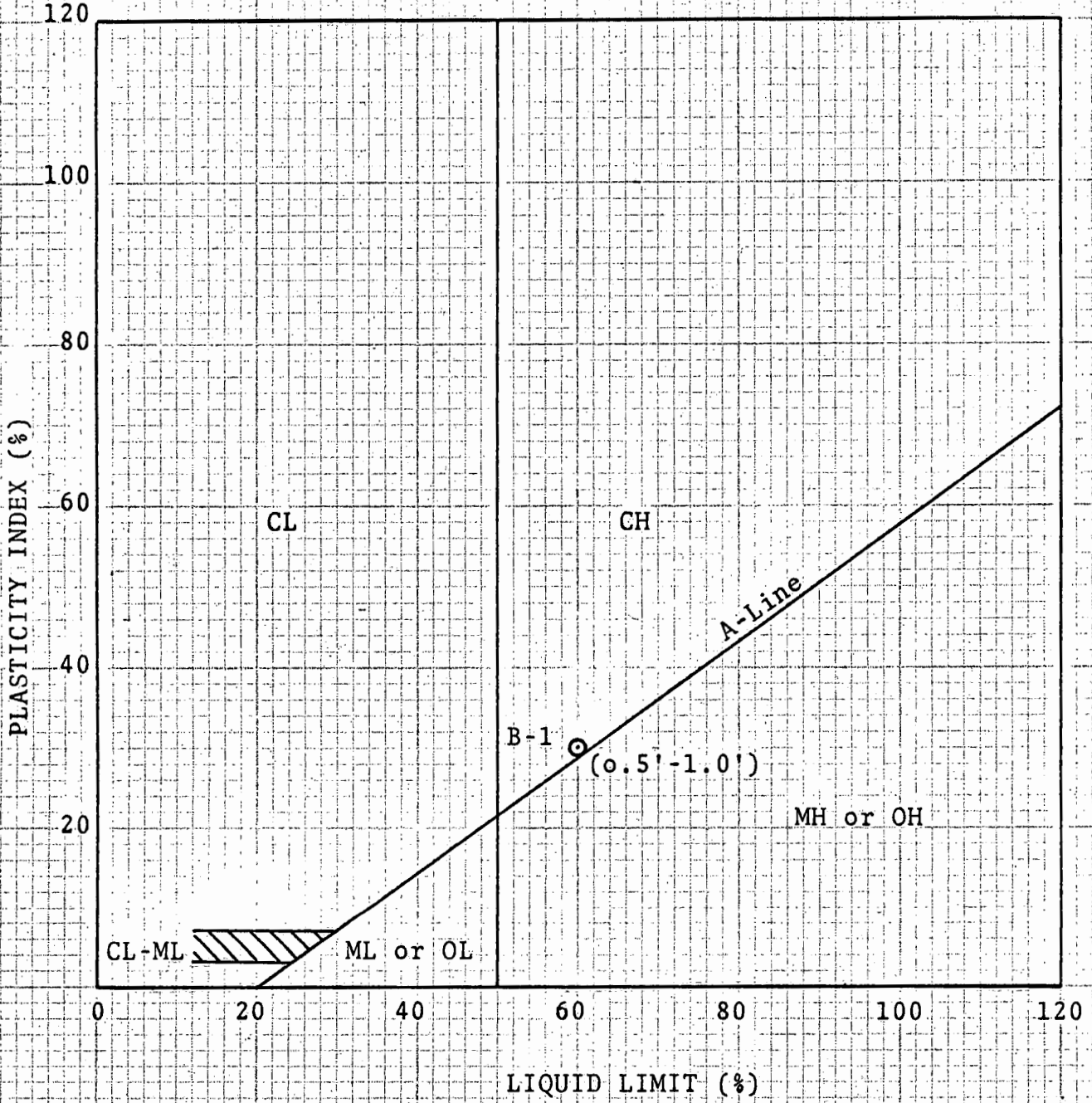
SCALE s shown W.O. 312-10

TABLE I

CBR TEST DATA

Test No.	Depth Feet	USCS	Dry Density (pcf)	Moisture (%)	CBR (%)	Expansion (%)
B-1	0.5 - 1.0	CH	90.5	32.0	12.6	1.5

PLASTICITY CHART



GEOLABS, INC.
GEOLOGY AND SOIL ENGINEERING

DATE 11-30-71 BY A.B.C.
SCALE as shown W.O. 312-10

GEOLABS - HAWAII, INC.

DATE 11-23-71

W.O. 312-10

JOB Makaua Subdivision

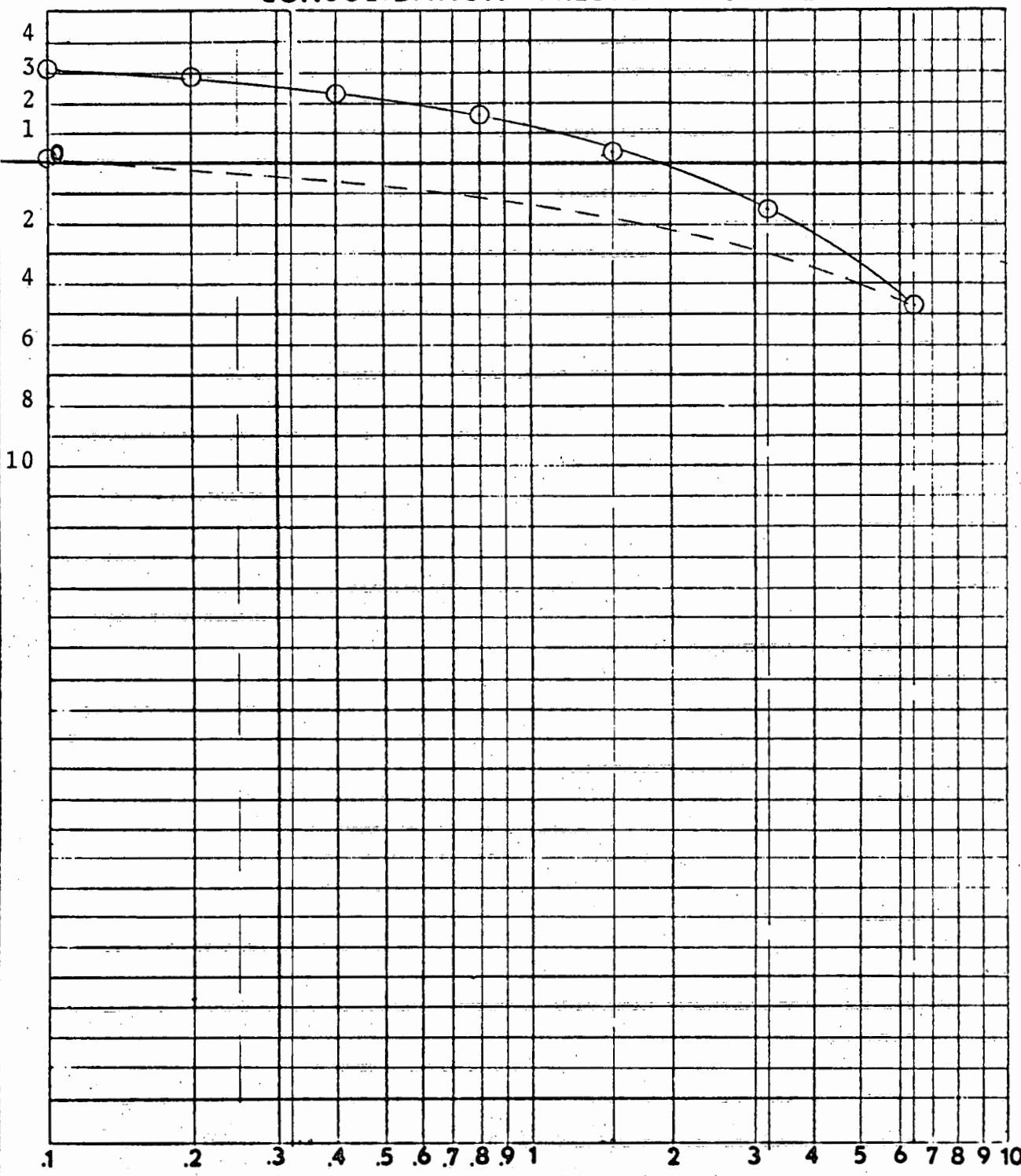
BORING NO. 2

DEPTH 1.5' - 3.0'

CONSOLIDATION - PRESSURE CURVE

% SWELL

% CONSOLIDATION



NORMAL PRESSURE, KIPS PER SQ. FT

SOIL TYPE CH
DRY UNIT WT. 70 PCF
LIQUID LIMIT 62 %
PLASTIC LIMIT 30%
PLASTIC INDEX 32%

A P P E N D I X E

STANDARD GRADING SPECIFICATIONS

STANDARD GRADING SPECIFICATIONS
MAKAUA SUBDIVISION
KAAAWA, OAHU, HAWAII

The work under this section includes:

1. Clearing and grubbing of site
2. Preparation of natural ground
3. Preparation of fill areas
4. Placement and control of fill operations
5. Compaction equipment
6. Removal and backfill of underground structures
7. Supervision of earthwork
8. Seasonal requirements

1. Clearing

All areas within contract limit lines shall be cleared of trash, debris and organic matter, and such material shall be burned and removed from the site.

2. Preparation of Natural Ground

In areas where the bottom of footings are designed on or below existing natural ground, the soils shall be scarified to a depth as determined by the soils engineer until the material is free of all uneven features and shall be precompacted as outlined in the following Section #4b.

3. Preparation of Fill Areas

All areas upon which fill is to be placed after clearing, as outlined in Section #1 of these specifications, shall be scarified until free of uneven features to a depth as determined by the soils engineer, and watered and compacted according to Section #4 of these specifications.

4. Placement of Fill

a. Material for fill shall consist of onsite soils. Fill material shall be free of all organic matter and other deleterious material, and shall not contain rocks or lumps in excess of four inches (4") in diameter.

b. Compaction of Fill

After the base for the fill has been prepared as described above, it shall be brought to the proper moisture content and compacted to not less than 90% of maximum density in accordance with Test ASTM D-1557-70.

c. Depth of Fill

Fill shall be placed in horizontal layers which,

when compacted, will not exceed six inches (6").

5. Compaction Equipment

The soils engineer shall determine the type of compacting equipment which will attain the specified results in the most efficient manner. Sheepsfoot, vibratory, or pneumatic tire rollers may be used in the test section and the equipment which produces the specified results in the most expedient manner as determined by the soils engineer shall be employed by the contractor. The equipment used in rolling shall be in good working condition, fully ballasted, and self cleaning. Fill material placed in an unsatisfactory condition and not within the enclosed specifications shall be rejected by the soils engineer and the contractor shall rework the fill placed such that the specifications are followed.

6. Removal and Backfill of Underground Structures

Any underground structures such as cesspools, cisterns, septic tanks, wells, pipe lines, etc. shall be removed under the direction of the soils engineer. Backfill of the excavation shall be in accordance with these specifications.

7. Supervision of Earthwork

Field density tests shall be made by the soils engineer during the earthwork operation such that he may certify that the fill was placed according to accepted specifications. In the event that field density tests of a layer or any portion thereof is less than the required density, the particular layer or portion shall be reworked until the required density is obtained.

8. Seasonal Requirements

No fill shall be placed during unfavorable weather conditions as determined by the soils engineer. After interruption of work due to heavy rain, the soils engineer shall approve previously placed fill before resumption of earthmoving operations.