PART I
SOIL INVESTIGATION
PROPOSED KAILUA SITE DEVELOPMENT
KAILUA, OAHU, HAWAII

4-2-16-1

HML&A Job No. 3906,001.06

Prepared for

International Telephone and Telegraph Company
c/o Community Planning, Inc.
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Honolulu, Hawaii 96813

by

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Civil Engineer - 2531 (Hawaii)

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Honolulu, Hawaii 96814

April 27, 1971

INTRODUCTION

This report presents the results of Part I of the Soil Investigation we are providing for your proposed Kailua Development. The scope of the investigation was outlined in our proposal dated March 11, 1971.

The site is located northwest of Kailua Road just inside the southwest boundary of Kailua and in the east corner of the Kawainui Swamp. The configuration of the site is shown on the Site Plan, Plate 1. Most of the site is a low-lying marsh area; however, there is a wedge-shaped piece of "high ground" in the east corner with a surface elevation around 5 to 10 feet above the marsh surface. There are several old wood frame buildings located in this higher area.

Plans for development of the site, including the ultimate site use, have not yet been prepared; however, we understand both commercial and residential uses are being considered. It is anticipated that at least a portion of the low-lying marsh area will be reclaimed by filling. We understand around 10 feet of fill will be required to raise the site above flood level.

The purpose of Part I of the investigation was to perform a limited exploration program in order to provide general recommendations required during planning. Specifically, our scope of work for Part I included developing

1. Conclusions regarding the depth and extent of marsh soils
2. General recommendations for filling the marsh area
3. Preliminary estimates of fill settlements and an estimate of the suitability of surcharging
4. Probable foundation types for various building loads and building locations

FIELD EXPLORATION

Subsurface conditions in the "high ground" portion of the site were explored by drilling three test borings 9 to 25 feet in depth, using truck mounted, flight auger equipment. The borings were logged by our engineer who obtained core samples from them for visual examination. In addition, our engineer performed 32 shallow hand probes through the soft soils in the marsh area using 3/4-inch closed-end pipe. The locations of the borings and probes are shown on Plate 1; logs of the borings are presented on Plates 2 and 3. The soils are classified in accordance with the Unified Soil Classification System, presented on Plate 4.

SURFACE AND SUBSURFACE CONDITIONS

Most of the site is a low-lying marsh area with a surface elevation close to sea level. The marsh surface is covered with thick grass and reeds and up to four feet of water. Probes in the marsh area encountered up to four feet of soft marsh soils (organic silt) beneath the thick vegetation and water. The probes indicate the marsh soils are underlain by coral sand; however, since the probes did not penetrate the sand, its depth and physical characteristics were not determined. Test borings performed by the City and County of Honolulu for the small bridge just east of the site encountered coral sand to depths of more than 60 feet.

The wedge of "high ground" in the east corner of the site was apparently developed by cutting into the adjacent hill and

filling a lower area adjacent to the marsh. Grading in this area was probably done about 1924, during construction of Kailua Road. The test borings drilled in the "high ground" portion encountered around eight feet of old fill over residual soil and weathered rock. Old grading plans for Kailua Road obtained from the City indicate that a small section of the "high ground" area was developed by cutting; it is likely this area is underlain by stiff residual soils and/or weathered rock.

The approximate boundaries between the marsh area and the cut and fill areas are shown on Plate 1.

SUMMARY OF CONCLUSIONS

1. The marsh area can be developed by filling; however, fill should be placed carefully to avoid disturbing the thickness of the soft soils.

2. Settlement of fill placed over the marsh surface will be appreciable (around one or two feet) but will occur fast (probably most settlement will have taken place a few months after construction). Surcharging will probably not be necessary.

3. We anticipate that light commercial and/or residential buildings can be supported on spread foundations.

CONCLUSIONS AND DISCUSSION

High Ground

The wedge of "high ground" in the east corner of the site will require few special considerations from a foundation standpoint. It is likely that structures located in this area can be supported on spread foundations bottomed at shallow depths. The existing fill in this area is nonuniform in density and composition, and it

will be necessary to excavate and recompact some of it beneath building foundations. The depth of excavation and recompaction will depend upon actual structural loads; however, for low-rise buildings, 18 inches of recompacted material beneath foundations will probably be sufficient.

Marsh Area

Fill Placement

Fill in the marsh area should be started by first placing a thin working pad of earth over the marsh surface without attempting to compact it. The working pad should be developed by dumping fill material on the adjacent high ground and advancing it out over the marsh on a broad front. It should be placed so that the water which covers the area is forced out into the marsh and not trapped. The pad should be as thin as possible and still support lightweight compaction equipment; we estimate 18 to 24 inches of material will be sufficient. Brush and trees should be removed before placing the pad; however, it should be placed over the marsh grass and reeds.

After the working pad is in place, a second lift of fill can be placed and lightly compacted. Subsequent lifts should be placed with normal compactive effort.

Fill slopes over the marsh surface, both during and after construction, will have to be kept relatively flat; probably four horizontal to one vertical, or flatter.

Settlement

Substantial settlements will occur as the soft marsh soils

consolidate under the weight of new fill. Settlement will probably be on the order of magnitude of one or two feet, and should be more or less uniform over the filled areas (assuming the depth of fill is relatively uniform).

Since the marsh soils are not thick, settlements will occur relatively fast, and most settlement will probably take place within a few months after grading has been completed. If building loads are light, a surcharge fill will probably not be required, although the area should be overfilled to compensate for expected settlement.

Building Foundations

It is likely that light buildings (say concrete buildings two stories high or less, and wood and metal buildings four stories high or less) can be supported on spread foundations bottomed at shallow depths in the fill. Light flexible buildings constructed of metal or wood would be most resistant to differential settlement. Concrete buildings would require a more rigid foundation system.

Heavier buildings (say more than two-story high concrete buildings and more than four-story high wood and metal buildings) will probably require either surcharging the building area or supporting the structure on driven piles or a rigid mat. The most suitable foundation scheme would depend on the actual building configuration, structural loads and economic considerations.

Since appreciable differential settlement will occur between the "high ground" and the marsh, buildings should not be located

over the boundary between these two areas. Buildings should also be located at least 25 feet behind the top of the fill slopes adjacent to the unfilled marsh.

SUBSEQUENT WORK

During master planning for the development we should work with your engineers and planners in order to aid in determining appropriate building types, size and locations.

When ultimate site use has been determined and building types and locations are accurately known, we should complete Part II of the foundation investigation outlined in our proposal. Preliminary conclusions presented in this report, especially regarding foundations and settlements in the marsh area, are predicated upon assumed subsurface conditions and physical properties of underlying soils. These should be verified prior to final design.

PLATES

Plate 1 Site Plan

Plate 2 Log of Boring 1

Plate 3 Log of Boring 2

Plate 4 Log of Boring 3

Plate 5 Soil Classification Chart and Key to Test Data

DISTRIBUTION

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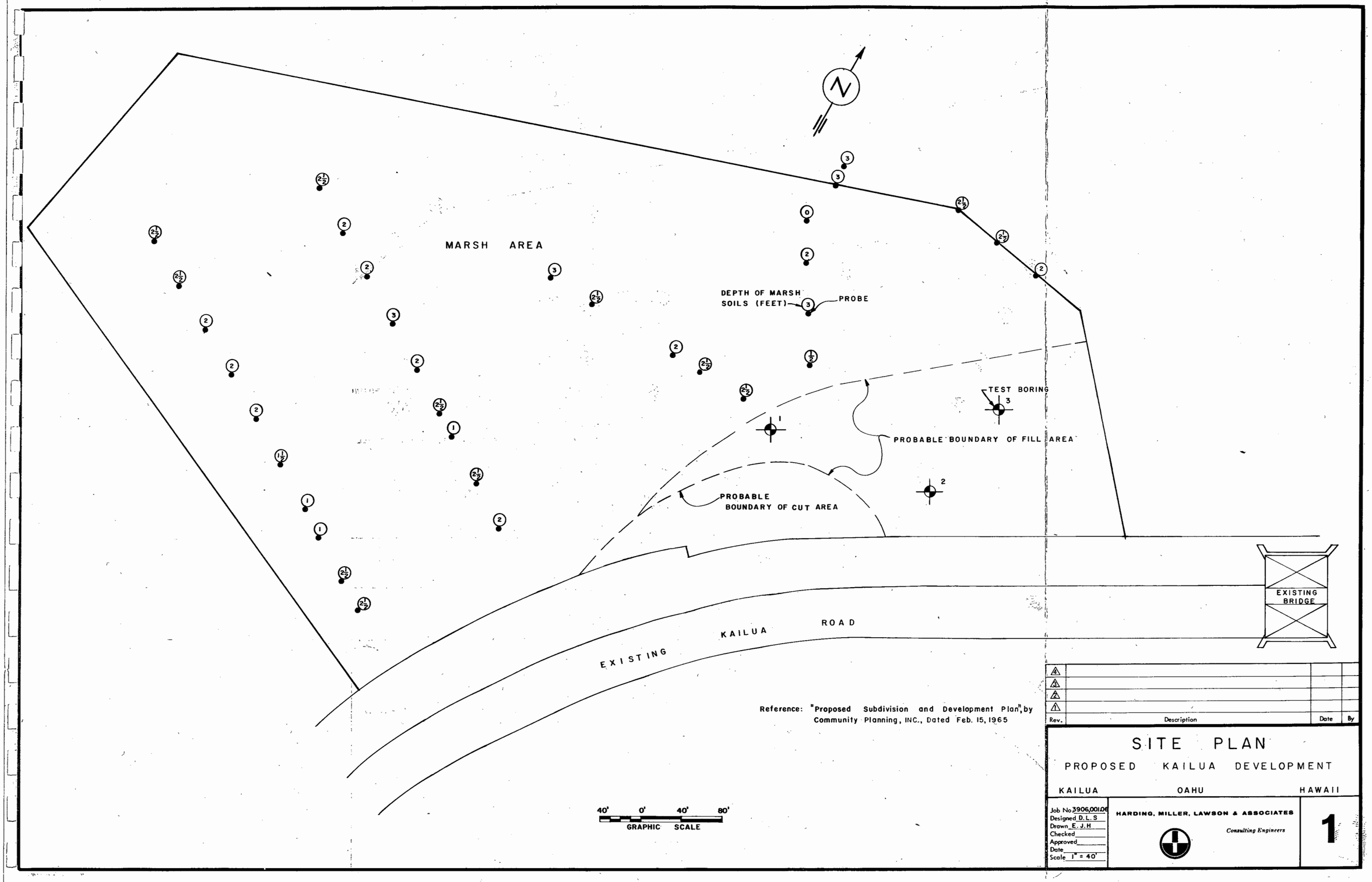
700 Bishop Street, Suite 608
Honolulu, Hawaii 96813

Attn: Mr. George K. Houghtailing



Reference: "Proposed Subdivision and Development Plan", by Community Planning, INC., Dated Feb. 15, 1965

Rev.	Description	Date	By
4			
3			
2			
1			

SITE PLAN

PROPOSED KAILUA DEVELOPMENT

KAILUA OAHU HAWAII

Job No 3906.001.06
Designed D. L. S
Drawn E. J. H
Checked
Approved
Date
Scale 1" = 40'

HARDING, MILLER, LAWSON & ASSOCIATES
Consulting Engineers

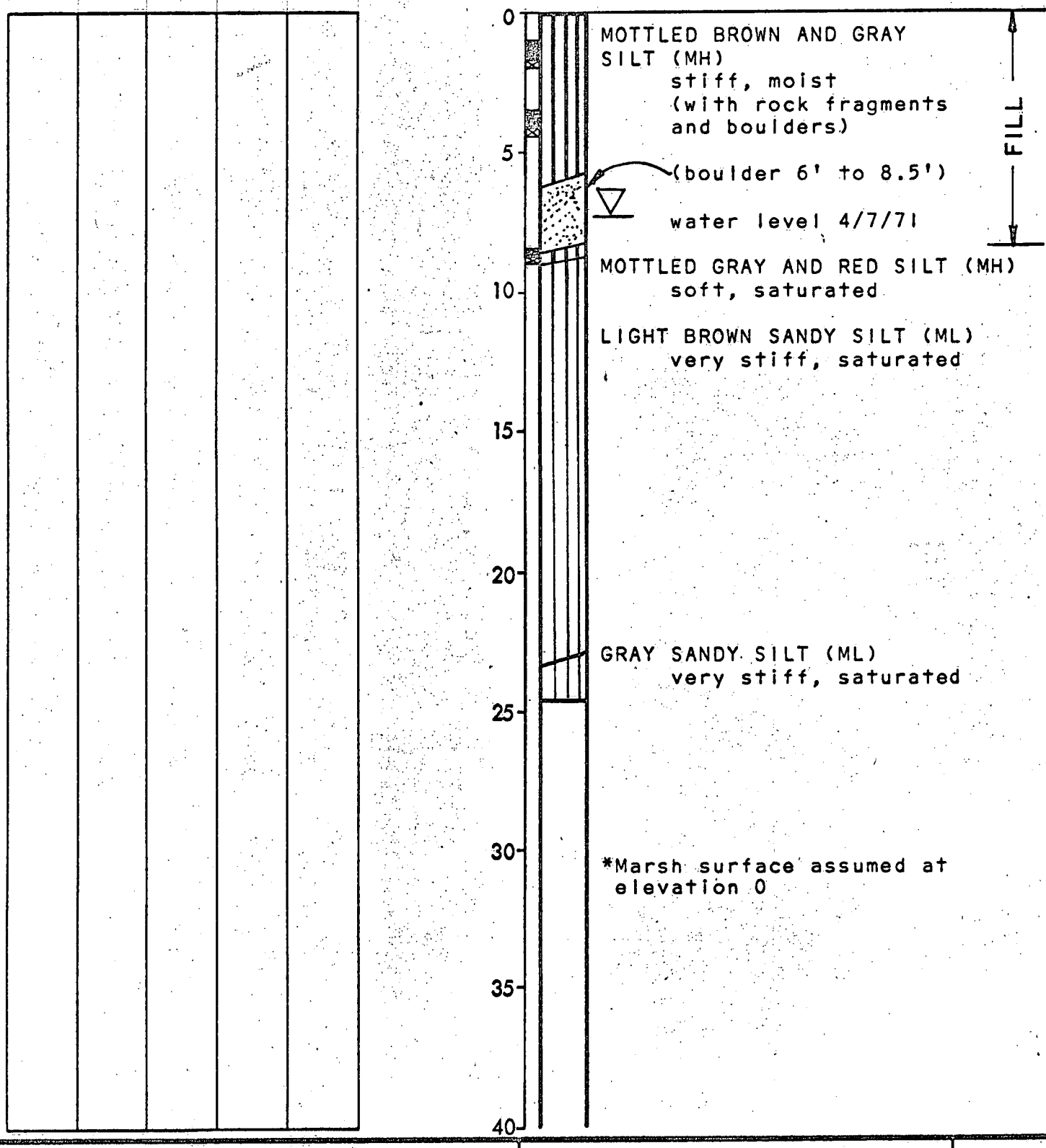
1

RF11

LOG OF BORING 1

Equipment 6" Flight Auger

Elevation +7* Date 4/6/71



HARDING, MILLER, LAWSON & ASSOCIATES

Consulting Engineers

Job No: 3906.1 Appr: ~~ds~~ /gs Date 4/26/71

LOG OF BORING 1

Proposed Kailua Development
Kailua, Oahu, Hawaii

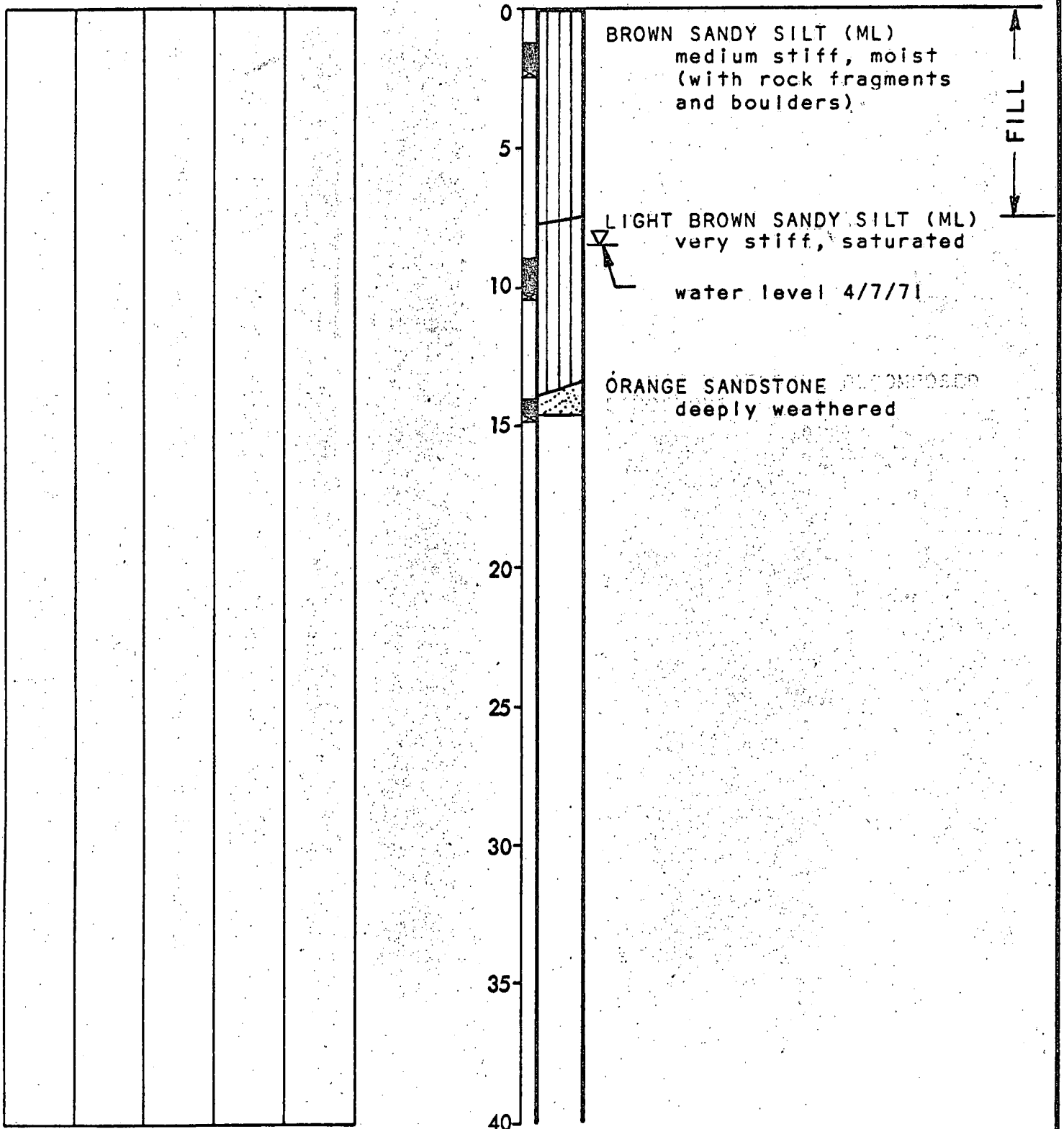
PLATE 2

RF11

LOG OF BORING 2

Equipment 6" Flight Auger

Elevation +8 Date 4/6/71



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LOG OF BORING 2

Proposed Kailua Development
Kailua, Oahu, Hawaii

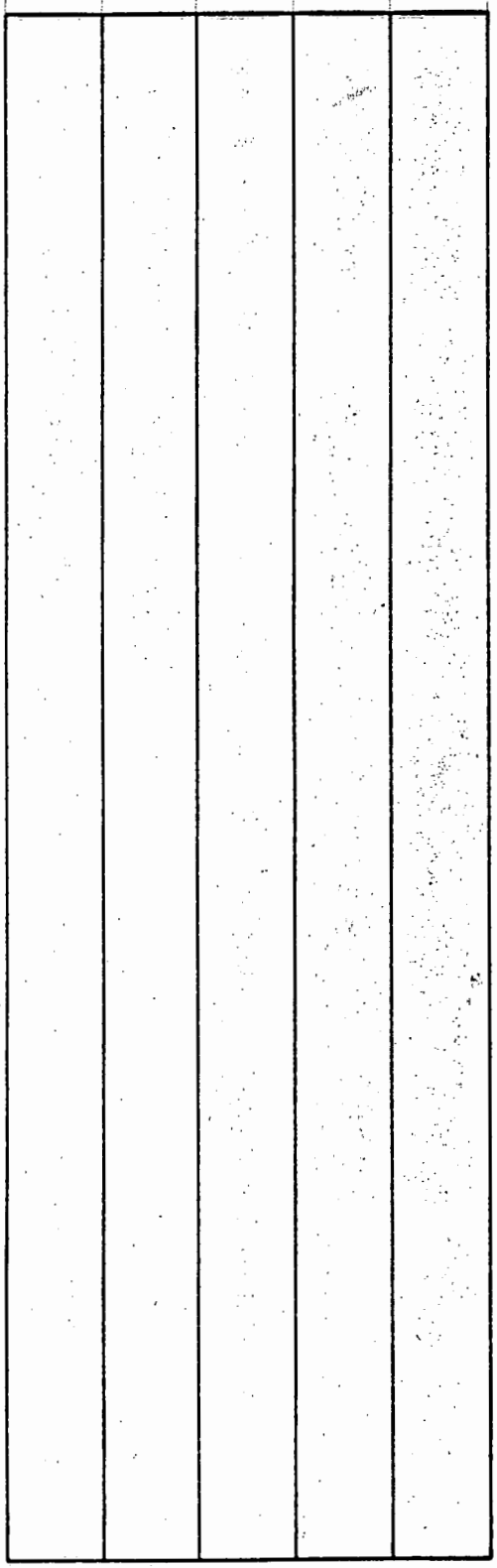
PLATE 3

RF11

LOG OF BORING 3

Equipment 6" Flight Auger

Elevation +7 Date 4/7/71



Moisture Content (%)

Dry Density (pcf)

Depth (ft)

Sample

0
5
10
15
20
25
30
35
40

BROWN SANDY SILT (ML)
medium stiff, wet
(boulder 1.5' to 3')

FILL

MOTTLED BROWN, GRAY AND ORANGE SILTY CLAY (CH)
medium stiff, moist

LIGHT BROWN SANDY SILT (ML)
stiff, saturated

(water level not observed)

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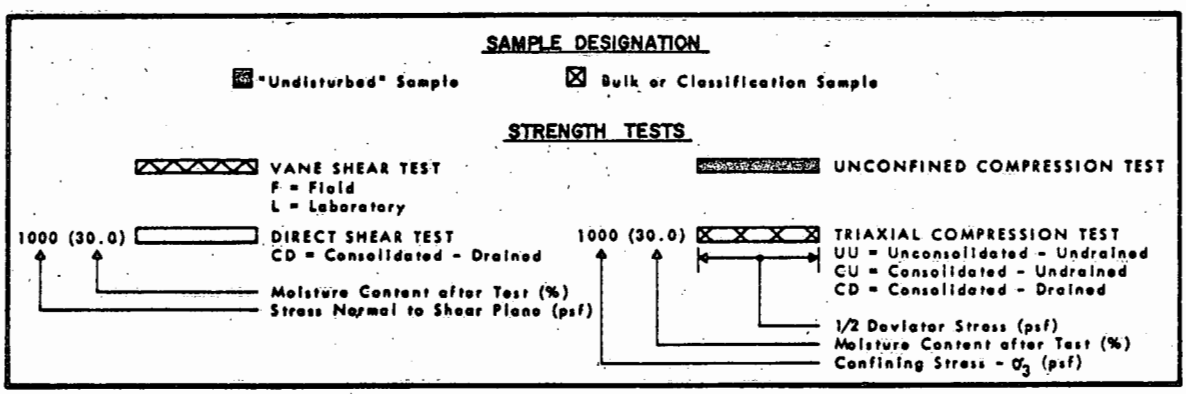
LOG OF BORING 3

Proposed Kailua Development
Kailua, Oahu, Hawaii

PLATE 4

MAJOR DIVISIONS				TYPICAL NAMES
COARSE GRAINED SOILS (MORE THAN HALF IS LARGER THAN #200 SIEVE)	GRAVELS (MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE)	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL GRADED GRAVELS, GRAVEL - SAND MIXTURES
			GP	POORLY GRADED GRAVELS, GRAVEL - SAND MIXTURES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, POORLY GRADED GRAVEL - SAND - SILT MIXTURES
			GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL - SAND - CLAY MIXTURES
	SANDS (MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE)	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL GRADED SANDS, GRAVELLY SANDS
			SP	POORLY GRADED SANDS, GRAVELLY SANDS
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS, POORLY GRADED SAND - SILT MIXTURES
			SC	CLAYEY SANDS, POORLY GRADED SAND - CLAY MIXTURES
FINE GRAINED SOILS (MORE THAN HALF IS SMALLER THAN #200 SIEVE)	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACIOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS

UNIFIED SOIL CLASSIFICATION SYSTEM



KEY TO TEST DATA

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SOIL CLASSIFICATION CHART AND KEY TO TEST DATA

Proposed Kailua Development

PLATE 5