GEOTECHNICAL ENGINEERING EXPLORATION
DEPARTMENT OF HAWAIIAN HOME LANDS
HANAPEPE RESIDENTAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

W.O. 8251-00 NOVEMBER 10, 2022

Prepared for

SSFM INTERNATIONAL, INC.

and

STATE OF HAWAII
DEPARTMENT OF HAWAIIAN HOME LANDS

GEOLABS, INC.
Geotechnical Engineering and Drilling Services

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Prepared for

SSFM INTERNATIONAL, INC.

ROBIN M. LIM
LICENSED PROFESSIONAL ENGINEER
No. 8436-C
HAWAII, U.S.A.

THIS WORK WAS PREPARED BY
ME OR UNDER MY SUPERVISION.

4-30-24

SIGNATURE   EXPIRATION DATE OF THE LICENSE

GEOLABS, INC.
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Hawaii • California

GEOLABS, INC.

Geotechnical Engineering and Drilling Services

November 10, 2022
W.O. 8251-00

Mr. Richard Y. Santo, P.E.
SSFM International, Inc.
501 Sumner Street, Suite 620
Honolulu, HI 96817

Dear **Mr. Santo:**

Geolabs, Inc. is pleased to submit our report entitled "Geotechnical Engineering Exploration, Department of Hawaiian Home Lands, Hanapepe Residential Subdivision, Phase 2, Hanapepe, Kauai, Hawaii" prepared in support of the design of the project.

Our work was performed in general accordance with the scope of services outlined in our revised fee proposal dated November 19, 2020 and the Subconsultant Agreement between our firms dated January 20, 2021.

Please note that the soil and rock samples recovered during our field exploration (remaining after testing) will be stored for a period of two months from the date of this report. The samples will be discarded after that date unless arrangements are made for a longer sample storage period. Please contact our office for alternative sample storage requirements, if appropriate.

Detailed discussion and specific design recommendations are contained in the body of this report. If there is any point that is not clear, please contact our office.

Very truly yours,

GEOLABS, INC.

Robin M. Lim, P.E.
President

RML:GB:rl

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SUMMARY OF FINDINGS AND RECOMMENDATIONS

Generally, the subsurface conditions across the project site consist of residual soil and saprolite overlying basalt formation. The residual soils consisted of very stiff to hard silts and clays and the saprolite consisted of medium dense to dense sands and gravel. The residual soils and saprolite extended to depths of about 8 to 19 feet below the existing ground surface. Below the residual soils and saprolite, medium hard basalt formation was encountered extending to the maximum depth explored. We did not encounter groundwater in the borings at the time of our field exploration.

We anticipate earthwork for the project likely will involve cuts and fills on the order of about 2 feet or less to achieve the design finished grades. Deeper cuts and thicker fills on the order of about 16 and 10 feet, respectively, are planned at the detention basin location. In general, the excavated on-site materials may be re-used as a source of general fill material provided that deleterious materials such as vegetation are removed and over-sized materials greater than 3 inches in maximum dimension are screened. Imported general fill materials should consist of soil materials with a maximum particle size of 3 inches or less with sufficient fines (between 10 and 60 percent particles passing the No. 200 sieve) to prevent the occurrence of voids in the compacted mass. General fill materials also should have a CBR value of 12 or greater and a swell of 2 percent or less when tested in accordance with ASTM D1883.

As mentioned above, a detention basin is planned at the project site. We conducted falling head infiltration tests to evaluate the infiltration characteristics of the subsurface materials encountered at the basin location. Based on the infiltration test results, the average infiltration rate of the subsurface soils encountered at the basin is about 2.2 inches per hour. It should be noted that the average infiltration rate is the rate of infiltration through the soil exposed at the bottom of a 4-inch diameter borehole, which may not represent the actual infiltration condition within a typical open basin. Due to the variability of the subsurface conditions, the infiltration rate of the storm water disposal system should be confirmed by conducting additional infiltration tests during construction.

The text of this report should be referred to for detailed discussions and specific geotechnical recommendations.

END OF SUMMARY OF FINDINGS AND RECOMMENDATIONS

SECTION 1. GENERAL

This report presents the results of our geotechnical engineering exploration performed for the *Department of Hawaiian Home Lands, Hanapepe Residential Subdivision, Phase 2* project in Hanapepe on the Island of Kauai, Hawaii. The project location and general vicinity are shown on the Project Location Map, Plate 1.

This report summarizes the findings and geotechnical recommendations resulting from our field exploration, laboratory testing, and engineering analyses for the project. These findings and geotechnical recommendations are intended for the design of site grading, storm water Low Impact Development (LID), pavements, sidewalks, and underground utilities only. The findings and recommendations presented herein are subject to the limitations noted at the end of this report.

1.1 Project Considerations

The Department of Hawaiian Home Lands (DHHL) Hanapepe Residential Subdivision, Phase 2 is to be constructed on a 27.77-acre parcel located in the Hanapepe area on the south side of the Island of Kauai, Hawaii. The development site is an approximately rectangular shaped parcel located to the north of Kaumualii Highway near the northwest portion of the Town of Hanapepe.

Based on the available information, approximately 82 residential lots are planned for the project. The main access road into the new residential subdivision will connect to the existing Ahi Road and Alii Road. We understand cuts and fills on the order of about 2 feet or less are planned for the residential lots and roads. A detention basin, which is planned to have a storage volume of about 9,300 cubic yards (1.9 million gallons), is planned at the southwest corner of the site.

We also understand an off-site sewer line is planned south of the residential subdivision. The off-site sewer line will extend from the south perimeter of the subdivision to about 1,300 feet south, then bend to the east, and connect to the existing sewer line located at the intersection of Moi Road and Eleu Road.

1.2 Purpose and Scope

The purpose of our exploration was to obtain an overview of the surface and subsurface conditions to develop an idealized soil and/or rock data set to formulate geotechnical recommendations for the design of the project. The work was performed in general accordance with our revised fee proposal dated November 19, 2020. The scope of work for this exploration included the following tasks and work efforts:

1. Research and review of available plans, in-house soils boring data, and other geologic information for the project area.
2. Coordination of site access, boring stakeout, and utility clearances by our engineer.
3. Mobilization and demobilization of mechanized trail clearing equipment and operator.
4. Trail clearing with mechanized equipment to provide access to the boring locations.
5. Mobilization and demobilization of a truck-mounted drill rig and two operators from Honolulu to the project site and back.
6. Drilling and sampling of fifteen borings extending to depths of about 20 to 20.25 feet below the existing ground surface. In addition, six shallow borings (about 6 and 10 feet deep) were drilled for field infiltration testing. Five bulk samples of the near-surface soils were collected for California Bearing Ratio (CBR) testing.
7. Coordination of the trail clearing, field exploration, and logging of the borings by our engineer.
8. Performance of field infiltration testing in six borings (about 6 and 10 feet deep) to evaluate the infiltration characteristics of the subsurface materials to aid in the design of the storm water disposal system.
9. Laboratory testing of selected soil samples obtained during the field exploration as an aid in classifying the materials and evaluating their engineering properties.
10. Analyses of the field and laboratory data to formulate geotechnical recommendations for the design of the project.
11. Preparation of this report summarizing our work and presenting our findings and geotechnical recommendations.
12. Coordination of our overall work on the project by our engineer.

13. Quality assurance of our work and client/design team consultation by our principal engineer.

14. Miscellaneous work efforts, such as drafting, word processing, and clerical support.

Detailed descriptions of our field exploration methodology and the Logs of Borings are presented in Appendix A. Results of the laboratory tests performed on selected soil samples are presented in Appendix B. Photographs of the rock cores are presented in Appendix C. Field infiltration test results are presented in Appendix D.

END OF GENERAL

SECTION 2. SITE CHARACTERIZATION

Of interest to our geotechnical analysis for design of the residential subdivision project are the subsurface materials encountered at the project site, the engineering properties of the materials encountered, and the variability of the subsurface conditions across the project site. Therefore, the following subsections provide a description of the geologic setting of the project site and the surface and subsurface conditions encountered at the site.

2.1 Regional Geology

The Island of Kauai is composed of a single basalt shield volcano built by the extrusion of lavas of the Waimea Canyon Volcanic Series. Following the cessation of this main shield-building phase, there was renewed volcanic activity with the extrusion of basaltic lavas of the post-erosional Koloa Volcanic Series and the concurrent deposition of alluvial sediments of the Palikea Formation.

The Island of Kauai is the oldest of the main Hawaiian Islands and today encompasses approximately 555 square miles with a maximum elevation of about 5,170 feet above Mean Sea Level (MSL) at Mount Wai`ale`ale near the center of the island. It is believed that during the Tertiary Period (about 5 to 6 million years ago in the Pliocene Epoch), basaltic lavas belonging to the Waimea Canyon Volcanic Series built a roughly circular island volcano from the ocean floor, which is estimated to have been about 20,000 feet deep at the time. Near the end of the Pliocene Epoch, this main shield building volcanic phase came to a halt.

Following an extended period of erosion and island mass subsidence, volcanism was renewed during the early Pleistocene Epoch (about 1.5 million years ago) with the eruption of the Koloa Volcanic Series from multiple vents throughout the island. This post erosional volcanic activity laid a veneer of fresh lava and interbedded volcanic sediments over the older deposits of the Waimea Canyon Series. Because of the prolonged period of erosion that occurred between the eruption of the Waimea Volcanic Series and the Koloa Volcanic Series, the deposits of the Koloa Volcanic Series typically filled the erosional valleys and depressions that existed at that time. Consequently, the basaltic rocks of the Kola Volcanic Series are commonly found to overlie thick residual soil and alluvial deposits. The project site is located at the southern portion of the Island of Kauai and generally is underlain by basaltic lavas of the Koloa Volcanic Series.

2.2 Existing Site Conditions

The project site is located at the northwestern portion of the Town of Hanapepe on the Island of Kauai, Hawaii. The project site consists of former agricultural land that is west of Moi Road between Eleu Road and Walea Street. The approximate location of the project site is shown on the Site Plans, Plate 2.1 and 2.2.

In general, the residential subdivision site appears to be relatively flat. The existing ground surface elevations decrease from the north to the south at a slope inclination of about 3 to 4 percent. Based on the available information, the existing ground surface ranges from about +260 MSL (Mean Sea Level) at the north side of the project site to about +170 feet MSL at the south side of the project site.

Existing residential dwellings were observed outside of the eastern perimeter of the project site. The vegetation at the site consisted of a heavy ground cover of wild grasses of about 3 to 5 feet high. In addition, a sparse amount of relatively small trees were observed at the site.

2.3 Subsurface Conditions

We explored the subsurface conditions at the project site by drilling and sampling fifteen borings, designated as Boring Nos. 1 through 15, extending to depths of about 20 to 20.25 feet below the existing ground surface. In addition, six shallow borings (about 6 and 10 feet deep), designated at Boring Nos. I-1 through I-6, were drilled for field infiltration testing. Five bulk samples of the near-surface soils, designated as Bulk-1 through Bulk-5, were obtained to evaluate the pavement support characteristics of the near-surface soils. The approximate locations of the borings, infiltration test borings, and bulk samples are shown on the Site Plans (Plates 2.1 and 2.2).

The borings (Boring Nos. 1 through 13) drilled at the residential subdivision area generally encountered residual soils and saprolite overlying basalt formation. The residual soils consisted of very stiff to hard sandy and clayey silts extending to depths of about

8 to 14 feet below the existing ground surface. Saprolite consisting of medium dense to dense sands and gravel extended to depths of about 15 to 19 feet below the existing ground surface. Below the residual soils and saprolite, medium hard basalt formation was encountered extending to the maximum depth explored.

Two borings (Boring Nos. 14 and 15) drilled along the sewer line alignment generally encountered residual soils consisting of very stiff to hard silts and clays extending to depths of about 14 to 15 feet below the existing ground surface. The residual soils were underlain by medium hard basalt formation extending to the maximum depth explored.

The infiltration test borings that extended to a depth of about 6 feet below the existing ground surface generally encountered stiff to hard clayey silts. The infiltration test borings that extended to a depth of about 10 feet below the existing ground surface encountered residual soils consisting of very stiff clayey silts over saprolite consisting of dense silty sands.

We did not encounter groundwater in the drilled borings at the time of our field exploration. However, it should be noted that groundwater levels are subject to change due to rainfall, time of year, seasonal precipitation, surface water runoff, and other factors.

Detailed descriptions of our field exploration methodology and the Logs of Borings are presented in Appendix A. Results of the laboratory tests performed on selected soil samples are presented in Appendix B. Photographs of the rock cores are presented in Appendix C. Field infiltration test results are presented in Appendix D.

END OF SITE CHARACTERIZATION

SECTION 3. DISCUSSION AND RECOMMENDATIONS

Based on our field exploration, the subsurface conditions across the residential subdivision project site generally consisted of residual soils consisting of very stiff to hard silts and clays underlain by saprolite consisting of medium dense to dense sands and gravel. The residual soils and saprolite extended to depths of about 8 to 19 feet below the existing ground surface. The residual soils and saprolite were underlain by medium hard basalt formation extending to the maximum depth explored. We did not encounter groundwater in the borings at the time of our field exploration.

The earthwork for the residential subdivision project will involve cuts and fills on the order of about 2 feet or less to achieve the design finished grades. Deeper cuts on the order of about 16 feet and thicker fills on the order of about 10 feet are planned at the detention basin location. In general, the excavated on-site materials may be re-used as a source of general fill material provided that deleterious materials such as vegetation are removed and over-sized materials greater than 3 inches in maximum dimension are screened. The residential project site will require imported general fill to achieve the design finished grades. Imported general fill materials should consist of soil materials with a maximum particle size of 3 inches or less with fine particles between 10 and 60 percent passing the No. 200 sieve. The imported general fill should have sufficient fines to prevent the occurrence of voids in the compacted mass. General fill materials also should have a CBR value of 12 or greater and a swell of 2 percent or less when tested in accordance with ASTM D1883.

We conducted falling head infiltration tests to evaluate the infiltration characteristics of the subsurface materials encountered at the detention basin location. Based on the infiltration test results, the average infiltration rate of the subsurface soils encountered at the basin location is about 2.2 inches per hour. It should be noted that the average infiltration rate is the rate of infiltration through the soil exposed at the bottom of a 4-inch diameter borehole, which may not represent the actual infiltration condition within a typical open basin. Due to the variability of the subsurface conditions, the infiltrating capacity of the storm water disposal system should be confirmed by conducting additional infiltration tests during construction.

Detailed discussions and recommendations for the design site grading, field infiltration testing, pavements, sidewalks, underground utilities, and other geotechnical aspects of the project are presented in the following sections.

3.1 Site Grading

Based on the available grading plans for the project site, we anticipate earthwork for the project likely will involve cuts and fills on the order of about 2 feet or less to achieve the design finished grades. Deeper cuts and thicker fills on the order of about 16 and 10 feet, respectively, are planned at the detention basin location. Items of earthwork that are addressed in the subsequent subsections include the following:

1. Site Preparation;
2. Fills and Backfills;
3. Fill Placement and Compaction Requirements;
4. Cut and Fill Slopes; and
5. Excavation.

A Geolabs representative should monitor site grading operations to observe whether undesirable materials are encountered during the excavation and scarification process and to confirm whether the exposed soil conditions are similar to those assumed in this report.

3.1.1 Site Preparation

At the onset of earthwork, areas within the contract grading limits should be cleared and grubbed thoroughly. Vegetation, debris, deleterious materials, and other unsuitable materials should be removed and disposed of properly to reduce the potential for contaminating the excavated materials to be used as embankment fill materials. Soft and/or loose, weak, or yielding areas disclosed during clearing and grubbing should be over-excavated to expose firm ground, and the resulting excavation should be backfilled with well-compacted fill (minimum 90 percent relative compaction).

After clearing and grubbing, areas designated to receive fills should be scarified to a depth of about 8 inches, moisture-conditioned to at least 2 percent above the optimum moisture content, and recompacted to a minimum of 90 percent relative compaction. Where minor shrinkage cracks are observed after subgrade preparation, we recommend thoroughly moistening the soil to close the cracks prior to re compacting. Saturation and subsequent yielding of the exposed subgrade due to inclement weather and poor drainage may require over-excavation of the soft areas and replacement with well-compacted fill.

3.1.2 Fills and Backfills

In general, the excavated on-site material may be re-used as a source of general fill material provided that deleterious materials (such as vegetation) are removed and over-sized materials greater than 3 inches in maximum dimension are screened. Imported general fill materials should consist of soil materials with a maximum particle size of 3 inches or less with sufficient fines (between 10 and 60 percent particles passing the No. 200 sieve) to prevent the occurrence of voids in the compacted mass. In addition, general fill materials should have a CBR value of 12 or greater and a swell of 2 percent or less when tested in accordance with ASTM D1883. It should be noted that the general fill requirements presented herein are intended as guidelines only and may be modified based on additional laboratory testing and field observations on the available fill materials conducted by Geolabs.

Select granular fill should consist of granular material that is well-graded from coarse to fine with particles no larger than 3 inches in largest dimension and should contain between 10 and 30 percent particles passing the No. 200 sieve. The material should have a laboratory California Bearing Ratio (CBR) value of 20 or more and should have a maximum swell of 1 percent or less when tested in accordance with ASTM D1883.

Imported fill materials should be tested for conformance with these recommendations prior to delivery to the project site for the intended use. Geolabs (or an accredited laboratory) should test and evaluate the imported fill materials for conformance with these recommendations prior to delivery to the project site for the intended use.

3.1.3 Fill Placement and Compaction Requirements

General fill materials should be placed in level lifts not exceeding 8 inches in loose thickness, moisture-conditioned to at least 2 percent above the optimum moisture content, and compacted to at least 90 percent relative compaction. The compaction requirement for fill within the top 8 inches of areas subjected to vehicular traffic (paved areas) should be increased to a minimum of 95 percent relative compaction.

Imported select granular fill materials, where required, should be moisture-conditioned to above the optimum moisture content, placed in level lifts of about 8 inches in loose thickness, and compacted to a minimum of 90 percent relative compaction, as appropriate. Aggregate base course and subbase materials should be moisture-conditioned to above the optimum moisture content, placed in level lifts not exceeding 8 inches in loose thickness, and compacted to a minimum of 95 percent relative compaction.

Compaction should be accomplished by sheepsfoot rollers, vibratory rollers, or other types of acceptable compaction equipment. Water tamping, jetting, or ponding should not be allowed to compact the fills.

Where compaction is less than required, additional compactive effort should be applied with adjustment of moisture content, as necessary, to obtain the specified compaction. It should be noted that the moisture requirement of the general fills and subgrades (at least 2 percent above the optimum moisture) is an important requirement for the use of on-site silty and clayey soils.

3.1.4 Cut and Fill Slopes

Cut and fill slopes should be designed with a slope inclination of two horizontal to one vertical (2H:1V) or flatter. Fills placed on slopes steeper than 5H:1V should be keyed and benched into the existing slope to provide stability of the new fill against sliding. The filling operations should start at the lowest point and continue up in level horizontal compacted layers in accordance with the above fill placement recommendations.

Fill slopes should be constructed by overfilling and cutting back to the design slope ratio to obtain a well-compacted slope face. Track-rolling of slopes to achieve the required degree of compaction should not be permitted. If over-cutting of a slope occurs, keying and benching requirements should be implemented instead of backfilling the slope to the design grade with sliver fills. Water should be diverted away from the tops of slopes, and slope planting should be provided as soon as possible to reduce the potential for significant erosion of the finished slopes.

3.1.5 Excavation

Based on our field exploration, the project site generally is underlain by stiff to hard residual soils and medium dense to dense saprolite. Basalt formation, which was generally medium hard, was encountered at depths of about 14 to 19 feet below the existing ground surface. It is anticipated that the near-surface soils may be excavated with normal heavy excavation equipment, such as excavating with a backhoe excavator or ripping with a bulldozer. However, it should be noted that hard cobbles and boulders are frequently encountered in the residual soil and saprolite horizon that may require the use of hoerams or chipping. Deeper excavations also may encounter the medium hard basalt formation that also may require the use of hoerams or chipping to advance the excavation.

The above discussions regarding the rippability of the subsurface materials are based on our field exploration data from the borings drilled and experience in the project vicinity. We recommend that contractors proposing to bid on this project be encouraged to examine the site conditions and the boring data to make their own prudent interpretation.

3.2 Field Infiltration Testing

Based on the information provided, on-site storm water runoff management systems are planned at the project site in order to meet the drainage requirements for Low Impact Development (LID). We understand that a large detention basin is planned at the southwest corner of the project site. To obtain subsurface infiltration information in support of the design of the detention basin, we conducted falling head infiltration tests at the basin location to evaluate the infiltration characteristics of the subsurface materials encountered. Infiltration tests were conducted at six locations, designated at I-1 through I-6, for a total of six infiltration tests. These tests were performed in general accordance with the procedures in Appendix D of the State of Maryland, Department of the Environment "Stormwater Design Manual, Volumes I and II" (rev. 2009). These procedures are consistent with several state's procedures and generally may be considered an industry standard.

The field infiltration tests were performed by augering a borehole to test depths of about 6 and 10 feet below the existing ground surface. Upon reaching the test depth, a 4-inch diameter solid steel or PVC casing was set to the bottom of the drilled borehole to allow infiltration only through the soil exposed on the bottom of the borehole. Falling head infiltration tests were performed to determine the average infiltration rates of the underlying subsurface materials. Each test consisted of four trials of filling the casing with 24 inches of water and taking periodic readings over a one-hour trial period or until the water completely infiltrated into the ground. The infiltration rates are then calculated based on the result of the fourth and last trial for each test location. The calculated infiltration rates at each test location are summarized in the table below. The field infiltration test results are presented on Plates D-1 through D-6 of Appendix D.

FIELD INFILTRATION TEST RESULTS		
Test Location	**Test Depth** (feet)	**Final Measured Infiltration Rate** (inches/hour)
I-1	6.0	0.25
I-2	6.0	3.06
I-3	6.0	3.50
I-4	10.0	4.63
I-5	10.0	0.63
I-6	10.0	0.88
Average Infiltration Rate for Basin		**2.2**

It should be noted that the infiltration values presented above are the rates of infiltration through the soil exposed at the bottom of a 4-inch diameter borehole, which may not represent the actual infiltration condition within a typical open basin. Due to the variability of the subsurface conditions, the infiltrating capacity of the storm water disposal system should be confirmed by conducting additional infiltration tests during construction.

3.3 Pavement Design

We envision flexible pavements will be used for the proposed residential subdivision roadways. The design traffic for the proposed roadways was not available at the time this report was prepared. However, we anticipate that vehicle loading for the subdivision roadways will consist of primarily passenger vehicles, light pick-up trucks, and occasional heavy trucks (garbage trucks, delivery trucks, and fire trucks).

We have assumed the pavement subgrade soils will consist of general fill and the on-site residual sandy and clayey silt soils. On this basis, we recommend utilizing the following preliminary pavement designs for the project:

New Roadway and Access Roadways (Flexible Pavement)

2.0-Inch Asphaltic Concrete
6.0-Inch Aggregate Base Course (95 Percent Relative Compaction)
6.0-Inch Aggregate Subbase Course (95 Percent Relative Compaction)
14.0-Inch Total Pavement Thickness on Moist Compacted Subgrade

The pavement subgrades should be scarified to a depth of about 8 inches, moisture-conditioned to at least 2 percent above the optimum moisture content, and recompacted to a minimum of 95 percent relative compaction. Relative compaction refers to the in-place dry density of soil expressed as a percentage of the maximum dry density of the same soil established in accordance with ASTM D1557. Optimum moisture is the water content (percentage by dry weight) corresponding to the maximum dry density.

The aggregate base course and aggregate subbase materials should meet the requirements stipulated in Sections 31 and 30 of the Standard Specifications for Public Works Construction, County of Kauai (September 1986), respectively. Aggregate base course and subbase course materials should be moisture-conditioned to above the optimum moisture content, placed in level lifts not exceeding 8 inches in loose thickness, and compacted to no less than 95 percent relative compaction. California Bearing Ratio and field density tests should be performed on the actual subgrade soils encountered during construction to confirm the adequacy of the above sections.

Paved areas should be sloped, and drainage gradients should be maintained to carry surface water off the site. Surface water ponding should not be allowed on the site during or after construction. Where concrete curbs are used to isolate landscaping in or adjacent to the pavement areas, we recommend extending the curbs a minimum of 2 inches into the soils below the aggregate subbase course layer to reduce the potential for migration of landscape water into the pavement section. Alternatively, a subdrain system could be constructed to collect excess water from landscaping irrigation. For long-term performance, we recommend constructing a subdrain system adjacent to the paved/landscaped areas.

3.4 Sidewalks and Exterior Flatwork

As indicated previously, the project site is underlain by residual soils consisting of stiff to hard sandy and clayey silt soils with low to moderate expansion potential when subjected to moisture fluctuations. To reduce the potential for structural distress resulting from the swelling of the on-site soils, we recommend providing a 6-inch thick layer of non-expansive, select granular fill (or select borrow subbase) material below the sidewalk slabs to serve as a cushion fill layer. The select granular fill (or select borrow subbase) should be compacted to a minimum of 90 percent relative compaction.

Prior to placing the select granular fill, we recommend scarifying the subgrade soils to a depth of about 8 inches, moisture-conditioning the soils to at least 2 percent above the optimum moisture content, and compacting to a minimum of 90 percent relative compaction. The underlying subgrade soils and select granular fill should be wetted and kept moist until the final placement of sidewalk slab concrete. Where shrinkage cracks are observed after compaction of the subgrade, we recommend preparing the soils again as recommended.

Crack control joints should be provided at intervals equal to the width of the walkways with expansion joints at right-angle intersections. It should be emphasized that the areas adjacent to the slab edges should be backfilled tightly against the edges of the slabs with relatively impervious soils. These areas should also be graded to divert water away from the slabs and to reduce the potential for water ponding around the slabs.

3.5 Corrosion Potential

Chemical analyses, including pH, minimum resistivity, chloride content, and sulfate content tests, were performed on selected soil samples obtained during our field exploration for corrosivity evaluation.

Resistivity, pH, chloride content, and sulfate content tests generally are recognized as the most significant soil characteristics with regard to the corrosivity of the soil. Based on the Board of Water Supply, City and County of Honolulu, Water System External Corrosion Control Standards, Volume 3 (2021), soil corrosivity can be categorized as Corrosion Category A (Moderately to Severely Corrosive) or Corrosion Category B (Negligibly to Mildly Corrosive). The criteria for determining the soil category are presented in the following table.

CORROSION CATEGORY		
Soil Parameter	**Corrosion Category A** (Moderately to Severely Corrosive)	**Corrosion Category B** (Negligibly to Mildly Corrosive)
Resistivity (ohm-cm)	≤ 5,000	> 5,000
pH	≤ 6.5	> 6.5
Chloride Content (ppm)	≥ 500	< 500
Sulfate Content (ppm)	≥ 1,000	< 1,000

Based on the test results presented on Plate B-22, the subsurface soils at the project site exhibit minimum resistivity values ranging between about 5,300 and 12,000 ohm-cm, pH values ranging between about 7.87 and 8.58, chloride contents ranging between about 18 and 56 ppm, and sulfate contents of up to about 16 ppm. These results indicate that the soils at the site may be considered in Corrosion Category B (Negligibly to Mildly Corrosive). However, it may be appropriate to consult with a professional corrosion engineer to review the test results and provide detailed recommendations for corrosion protection.

3.6 Utility Trenches

We envision new underground utilities, such as sewer, drainage, water, and electrical lines will be required for the project. In general, good construction practices should be utilized for the installation and backfilling of the trenches for the new utilities. The contractor should determine the method and equipment to be used for trench excavation, subject to practical limits and safety considerations. In addition, the excavations should comply with the applicable federal, state, and local safety requirements. The contractor should be responsible for trench shoring design and installation.

In general, we recommend providing granular bedding consisting of 6 inches of free-draining materials, such as bedding sand or open-graded gravel (ASTM C33, No. 67 gradation), below the pipes for uniform support. Free-draining granular materials, such as bedding sand or open graded gravel (ASTM C33, No. 67 gradation), also should be used for the initial trench backfill (pipe cover) up to about 12 inches above the crown of the pipes to provide adequate support around the pipes and to reduce the need for substantial effort in compacting the backfill, thus reducing the potential for damage to the pipes.

The trench backfill above the pipe cover to the finished subgrade or finished grade may consist of the excavated on-site soils. The backfill should be moisture conditioned to at least 2 percent above the optimum moisture content, placed in maximum 8-inch level loose lifts, and mechanically compacted to not less than 90 percent relative compaction to reduce the potential for appreciable future ground subsidence. Where trenches are located in the pavement areas, the upper 3 feet of the trench backfill below the pavement grade should be compacted to at least 95 percent relative compaction. Compaction efforts by water tamping, jetting, or ponding should not be allowed.

3.7 Design Review

Preliminary and final drawings and specifications for the project should be forwarded to Geolabs for review and written comments prior to construction bid solicitation. This review is necessary to evaluate the conformance of the plans and specifications with the intent of the geotechnical recommendations provided herein. If this review is not made, Geolabs cannot be responsible for misinterpretation of our recommendations.

3.8 Post-Design Services/Services During Construction

Geolabs should be retained to provide geotechnical engineering services during construction. The critical items of construction monitoring that require "Special Inspections" include the following:

- Observation of subgrade preparation;
- Observation of general fill placement and compaction;
- Observation of select granular fill, aggregate base course, and aggregate subbase course placement and compaction

A Geolabs representative also should monitor other aspects of earthwork construction to observe compliance with the design concepts, specifications, or recommendations and to expedite suggestions for design changes that may be required in the event that subsurface conditions differ from those anticipated at the time this report was prepared. Geolabs should be accorded the opportunity to provide geotechnical services during construction to confirm our assumptions in providing the recommendations presented herein.

If the actual exposed subsurface conditions encountered during construction differ from those assumed or considered herein, Geolabs should be contacted to review and/or revise the geotechnical recommendations presented herein.

END OF DISCUSSION AND RECOMMENDATIONS

SECTION 4. LIMITATIONS

The analyses and recommendations submitted herein are based in part upon information obtained from the field borings and bulk samples. Variations of the subsurface conditions between and beyond the field borings and bulk samples may occur, and the nature and extent of these variations may not become evident until construction is underway. If variations then appear evident, it will be necessary to re-evaluate the recommendations presented herein.

The field boring and bulk sample locations indicated herein are approximate, having been located with a handheld GPS device. Elevations of the borings were estimated from the contours shown on the Overall Grading Plan-1 and Overall Grading Plan-2 dated April 2022. The field boring and bulk sample locations and elevations should be considered accurate only to the degree implied by the methods used.

The stratification breaks shown on the graphic representations of the borings depict the approximate boundaries between soil types and, as such, may denote a gradual transition. Water level data from the borings were measured at the times shown on the graphic representations and/or presented in the text of this report. These data have been reviewed and interpretations made in the formulation of this project. It should be noted that groundwater levels are subject to change due to variation in seasonal rainfall, surface water runoff and other factors.

This report has been prepared for the exclusive use of SSFM International, Inc. and their project subconsultants for specific application to the design of the *Department of Hawaiian Home Lands, Hanapepe Residential Subdivision, Phase 2* project in accordance with generally accepted geotechnical engineering principles and practices. No warranty is expressed or implied.

This report has been prepared solely for the purpose of assisting the design engineers in the design of the project. Therefore, this report may not contain sufficient data, or the proper information, to serve as a basis for detailed construction cost estimates.

The owner/client should be aware that unanticipated soil conditions are commonly encountered. Unforeseen subsurface conditions, such as perched groundwater, soft deposits, hard layers, or cavities may occur in localized areas and may require additional probing or corrections in the field (which may result in construction delays) to attain a properly constructed project. Therefore, a sufficient contingency fund is recommended to accommodate these possible extra costs.

This geotechnical engineering exploration conducted at the project site was not intended to investigate the potential presence of hazardous materials existing at the project site. It should be noted that the equipment, techniques, and personnel used to conduct a geo-environmental exploration differ substantially from those applied in geotechnical engineering.

END OF LIMITATIONS

CLOSURE

The following plates and appendices are attached and complete this report:

-ΩΩΩΩΩΩΩΩΩ-

Respectfully submitted,

GEOLABS, INC.

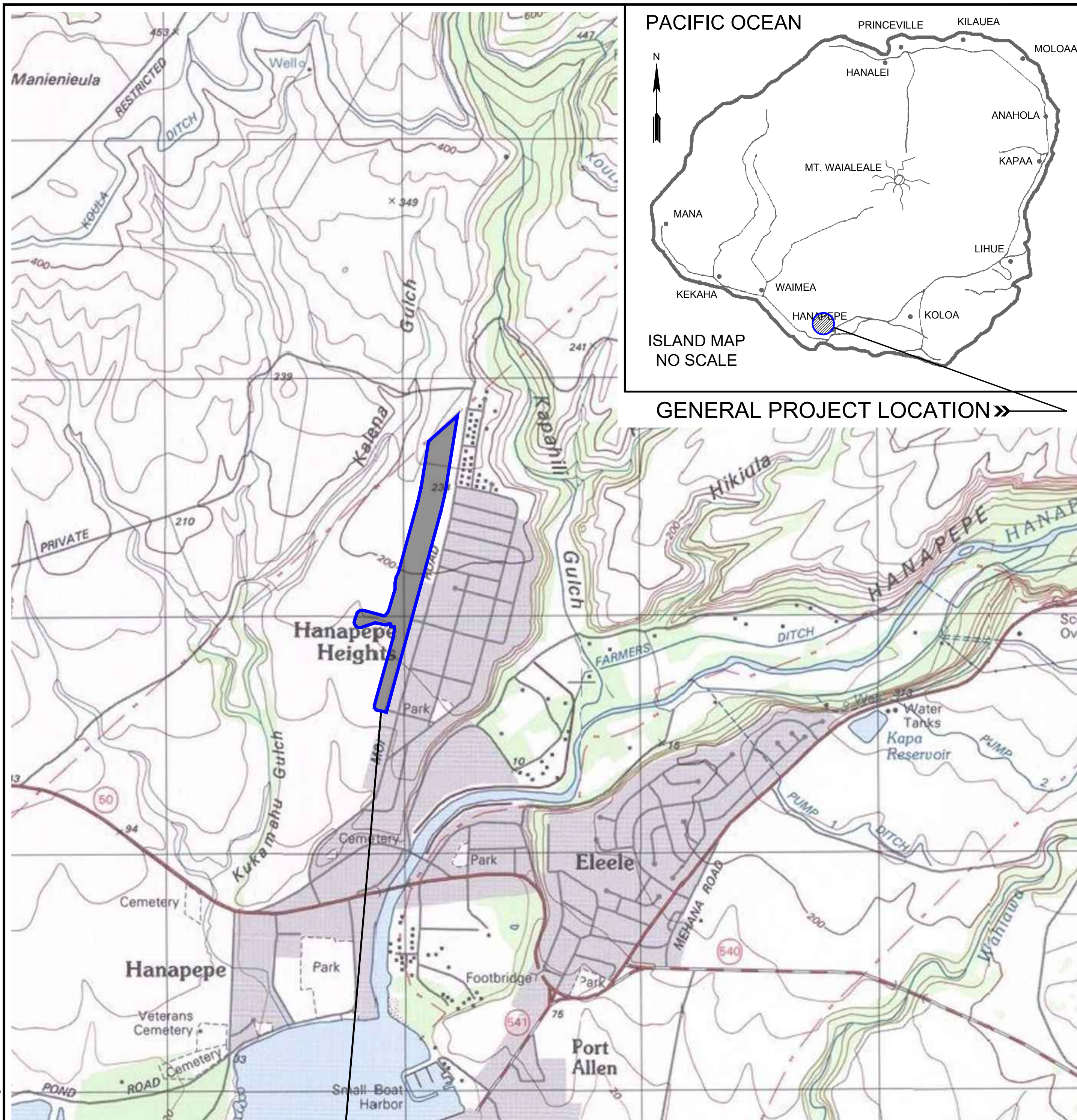
By ______________________________

Robin M. Lim, P.E.
President

RML:GB:rl

h:\8200Series\8251-00.gb1

PLATES



PROJECT LOCATION»

PROJECT LOCATION MAP

DEPARTMENT OF HAWAIIAN HOME LANDS
HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

2000 1000 0 2000 FT.
GRAPHIC SCALE

N

REFERENCE: MAP CREATED WITH TOPO!® ©2010 NATIONAL GEOGRAPHIC; ©2007 TELE ATLAS, REL. 1/2007.

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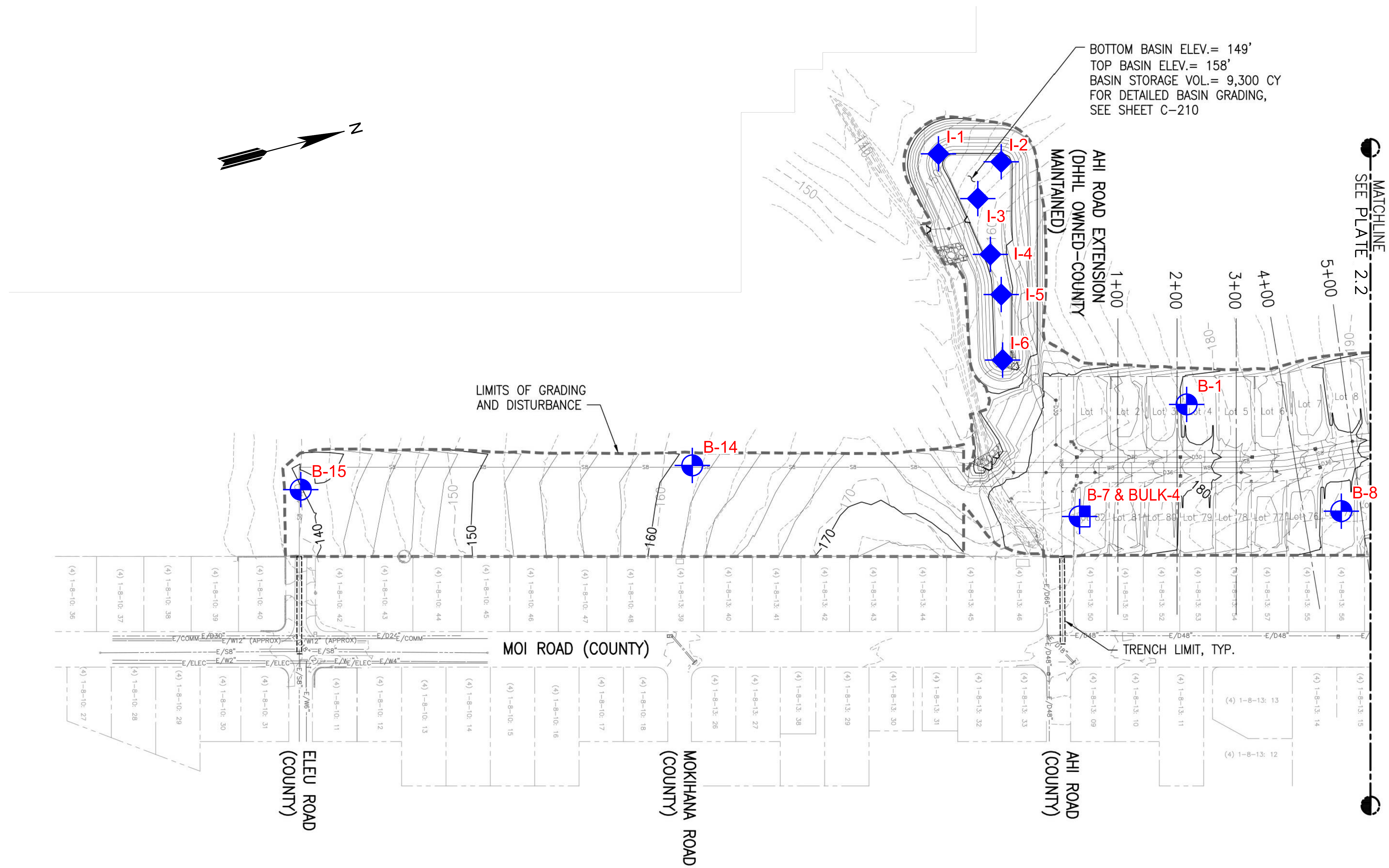
DATE	DRAWN BY	PLATE
SEPTEMBER 2022	KHN / HYC	
SCALE	W.O.	
1" = 2,000'	8251-00	1

CAD User: HENRY File Last Updated: September 12, 2022 4:29:23pm Plot Date: September 12, 2022 - 4:29:45pm
File: A:\Drafting\Working\8251-00_Hanapepe_Residential_Subdivision_Phase 2\8251-00PLM.dwg\1
Plotter: DWG To PDF-GEO.pc3 Plotstyle: GEO-No-Dithering-Blue-Boring.ctb



LEGEND:

- APPROXIMATE BORING LOCATION
- APPROXIMATE INFILTRATION TEST LOCATION
- APPROXIMATE BULK SAMPLE LOCATION

0 100 200 400 600 FT.

GRAPHIC SCALE

REFERENCE: OVERALL GRADING PLAN - 2 DATED APRIL 2022
PREPARED BY SSFM INTERNATIONAL, INC.

SITE PLAN - 1

DEPARTMENT OF HAWAIIAN HOME LANDS
HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
SEPTEMBER 2022	HYC	
SCALE	W.O.	2.1
1" = 200'	8251-00	

CAD User: HENRY File Last Updated: September 15, 2022 2:15:36pm Plot Date: September 15, 2022 - 2:34:27pm
File: A:\Drafting\Drafting\Working\8251-00_Hanapepe_Residential_Subdivision_Phase 2\8251-00SitePlan.dwg\2.1
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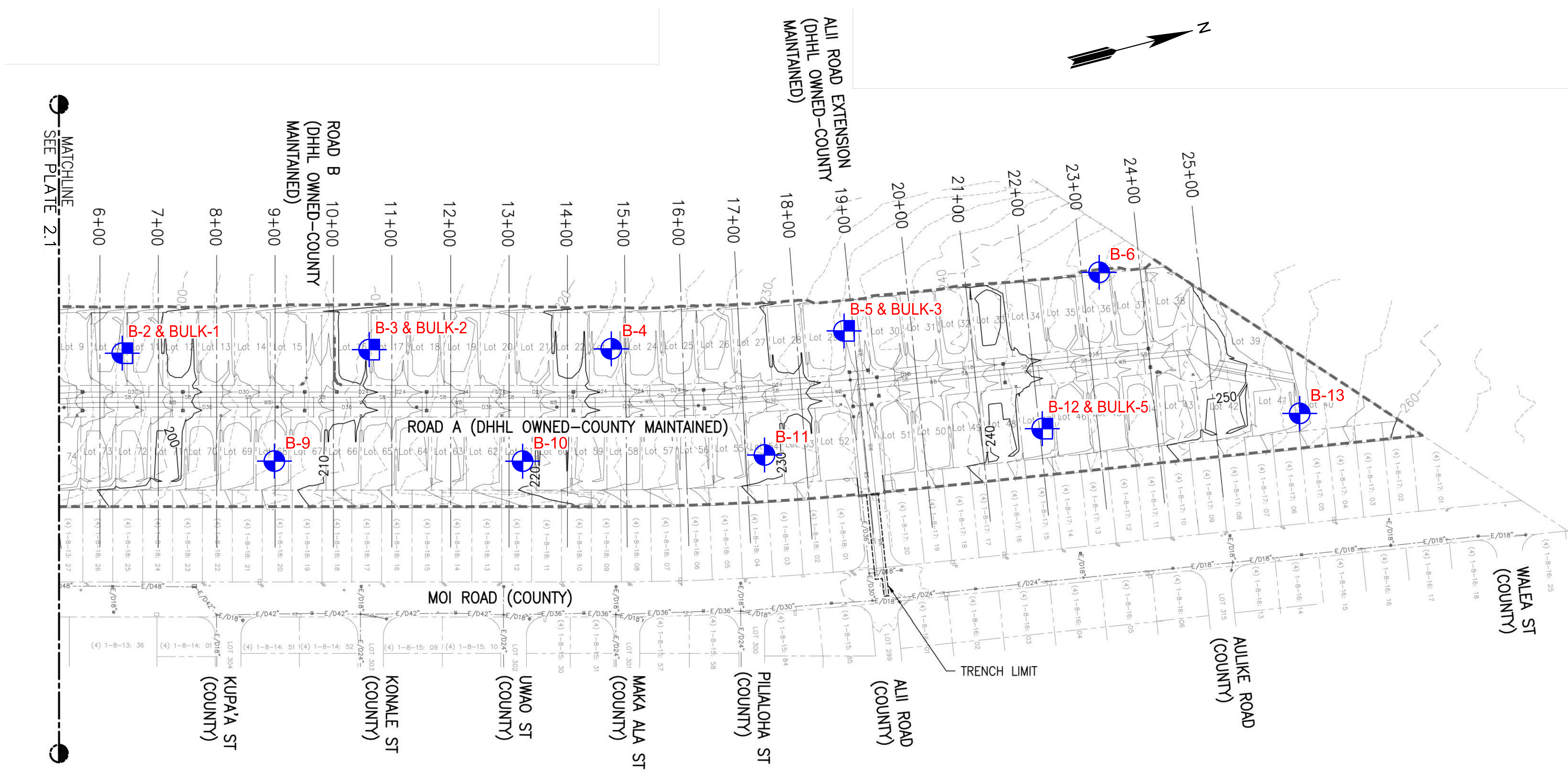

LEGEND:

- APPROXIMATE BORING LOCATION
- APPROXIMATE INFILTRATION TEST LOCATION
- APPROXIMATE BULK SAMPLE LOCATION

REFERENCE: OVERALL GRADING PLAN - 1 DATED APRIL 2022
PREPARED BY SSFM INTERNATIONAL, INC.

SITE PLAN - 2

DEPARTMENT OF HAWAIIAN HOME LANDS
HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
SEPTEMBER 2022	HYC	
SCALE	W.O.	
1" = 200'	8251-00	2.2

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Plotter: DWG To PDF-GEO.pc3 Plotstyle: GEO-No-Dithering-Blue-Boring.ctb

APPENDIX A

APPENDIX A

Field Exploration

We explored the subsurface conditions at the project site by drilling and sampling fifteen borings, designated as Boring Nos. 1 through 15, extending to depths of about 20 to 20.25 feet below the existing ground surface. In addition, six shallow boreholes (Boring Nos. I-1 through I-6 of about 6 and 10 feet deep) were drilled for field infiltration testing. Five bulk samples of the near-surface soils, designated as Bulk-1 through Bulk-5, were obtained to evaluate the pavement support characteristics of the near-surface soils. The approximate boring and bulk sample locations are shown on the Site Plans, Plates 2.1 and 2.2. The borings were drilled using a truck-mounted drill rig with continuous flight augers and rotary coring tools.

Our engineer classified the materials encountered in the borings by visual and textural examination in the field in general accordance with ASTM D2488, Standard Practice for Description and Identification of Soils, and monitored the drilling operations on a near-continuous (full-time) basis. These classifications were further reviewed visually and by testing in the laboratory. Soils were classified in general accordance with ASTM D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System), as shown on the Soil Log Legend (Plate A-0.1). Deviations made to the soil classification in accordance with ASTM D2487 are described on the Soil Classification Log Key (Plate A-0.2). Rock samples were described in general accordance with rock the description system, as shown on the Rock Log Legend (Plate A-0.3). Graphic representations of the materials encountered are presented on the Logs of Borings, Plates A-1 through A-21.

Relatively "undisturbed" soil samples were obtained in general accordance with ASTM D3550 Ring-Lined Barrel Sampling of Soils by driving a 3-inch OD Modified California sampler with a 140-pound hammer falling 30 inches. In addition, some samples were obtained from the drilled borings in general accordance with ASTM D1586, Penetration Test and Split-Barrel Sampling of Soils, by driving a 2-inch OD standard penetration sampler using the same hammer and drop. The blow counts needed to drive the sampler the second and third 6 inches of an 18-inch drive are shown as the "Penetration Resistance" on the Logs of Borings at the appropriate sample depths. The penetration resistance shown on the Logs of Borings indicates the number of blows required for the specific sampler type used. The blow counts may need to be factored to obtain the Standard Penetration Test (SPT) blow counts.

Pocket penetrometer tests were performed on selected cohesive soil samples retrieved in the field. The pocket penetrometer test provides an indication of the unconfined compressive strength of the sample. Pocket penetrometer test results are summarized on the Logs of Borings at the appropriate sample depths.

Core samples of the rock materials encountered at the project site were obtained by using diamond core drilling techniques in general accordance with ASTM D2113, Diamond Core Drilling for Site Investigation. Core drilling is a rotary drilling method that uses a hollow bit to cut into the rock formation. The rock material left in the hollow core of the bit is mechanically recovered for examination and description. Rock cores were described in general accordance with the Rock Description System, as shown on the Rock Log Legend (Plate A-0.3). The Rock Description System is based on the publication "Suggested Methods for the Quantitative Description of Discontinuities in Rock Masses" by the International Society for Rock Mechanics (March 1977).

Recovery (REC) may be used as a subjective guide to the interpretation of the relative quality of rock masses, where appropriate. Recovery is defined as the actual length of material recovered from a coring attempt versus the length of the core attempt. For example, if 3.7 feet of material is recovered from a 5.0-foot core run, the recovery would be 74 percent and would be shown on the Logs of Borings as REC = 74%.

The Rock Quality Designation (RQD) is also a subjective guide to the relative quality of rock masses. RQD is defined as the percentage of the core run in rock that is sound material in excess of 4 inches in length without any discontinuities, discounting any drilling, mechanical, and handling induced fractures or breaks. If 2.5 feet of sound material is recovered from a 5.0-foot core run in rock, the RQD would be 50 percent and would be shown on the Logs of Borings as RQD = 50%. Generally, the following is used to describe the relative quality of the rock based on the "Practical Handbook of Physical Properties of Rocks and Minerals" by Robert S. Carmichael (1989).

Rock Quality	**RQD** (%)
Very Poor	0 – 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	90 – 100

The excavation characteristic of a rock mass is a function of the relative hardness of the rock, its relative quality, brittleness, and fissile characteristics. A dense rock formation with a high RQD value would be very difficult to excavate and probably would require more arduous methods of excavation.

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Soil Log Legend

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

MAJOR DIVISIONS			USCS	TYPICAL DESCRIPTIONS
COARSE-GRAINED SOILS MORE THAN 50% OF MATERIAL RETAINED ON NO. 200 SIEVE	GRAVELS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS LESS THAN 5% FINES	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
			GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES MORE THAN 12% FINES	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS 50% OR MORE OF COARSE FRACTION PASSING THROUGH NO. 4 SIEVE	CLEAN SANDS LESS THAN 5% FINES	SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES MORE THAN 12% FINES	SM	SILTY SANDS, SAND-SILT MIXTURES
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE-GRAINED SOILS 50% OR MORE OF MATERIAL PASSING THROUGH NO. 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 SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT 50 OR MORE	MH	INORGANIC SILT, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

LEGEND

- (2-INCH) O.D. STANDARD PENETRATION TEST
- (3-INCH) O.D. MODIFIED CALIFORNIA SAMPLE
- SHELBY TUBE SAMPLE
- GRAB SAMPLE
- CORE SAMPLE
- WATER LEVEL OBSERVED IN BORING AT TIME OF DRILLING
- WATER LEVEL OBSERVED IN BORING AFTER DRILLING
- WATER LEVEL OBSERVED IN BORING OVERNIGHT

LL	LIQUID LIMIT (NP=NON-PLASTIC)
PI	PLASTICITY INDEX (NP=NON-PLASTIC)
TV	TORVANE SHEAR (tsf)
UC	UNCONFINED COMPRESSION OR UNIAXIAL COMPRESSIVE STRENGTH
TXUU	UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (ksf)

Plate

A-0.1

LOG LEGEND FOR SOIL 8251-00.GPJ GEOLABS.GDT 9/15/22

GEOLABS, INC.

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Soil Classification Log Key

(with deviations from ASTM D2488)

GEOLABS, INC. CLASSIFICATION*

GRANULAR SOIL (- #200 <50%)	COHESIVE SOIL (- #200 ≥50%)
• **PRIMARY** constituents are composed of the largest percent of the soil mass. Primary constituents are capitalized and bold (i.e., **GRAVEL, SAND**)	• **PRIMARY** constituents are based on plasticity. Primary constituents are capitalized and bold (i.e., **CLAY, SILT**)
• **SECONDARY** constituents are composed of a percentage less than the primary constituent. If the soil mass consists of 12 percent or more fines content, a cohesive constituent is used (**SILTY** or **CLAYEY**); otherwise, a granular constituent is used (**GRAVELLY** or **SANDY**) provided that the secondary constituent consists of 20 percent or more of the soil mass. Secondary constituents are capitalized and bold (i.e., **SANDY** GRAVEL, **CLAYEY** SAND) and precede the primary constituent.	• **SECONDARY** constituents are composed of a percentage less than the primary constituent, but more than 20 percent of the soil mass. Secondary constituents are capitalized and bold (i.e., **SANDY** CLAY, **SILTY** CLAY, **CLAYEY** SILT) and precede the primary constituent.
• **accessory descriptions** compose of the following: with some: >12% with a little: 5 - 12% with traces of: <5% accessory descriptions are lower cased and follow the Primary and Secondary Constituents (i.e., SILTY GRAVEL **with a little sand**)	• **accessory descriptions** compose of the following: with some: >12% with a little: 5 - 12% with traces of: <5% accessory descriptions are lower cased and follow the Primary and Secondary Constituents (i.e., SILTY CLAY **with some sand**)

EXAMPLE: Soil Containing 60% Gravel, 25% Sand, 15% Fines. Described as: **SILTY GRAVEL** with some sand

RELATIVE DENSITY / CONSISTENCY

Granular Soils			Cohesive Soils			
N-Value (Blows/Foot)		Relative Density	N-Value (Blows/Foot)		PP Readings (tsf)	Consistency
SPT	MCS		SPT	MCS		
0 - 4	0 - 7	Very Loose	0 - 2	0 - 4		Very Soft
4 - 10	7 - 18	Loose	2 - 4	4 - 7	< 0.5	Soft
10 - 30	18 - 55	Medium Dense	4 - 8	7 - 15	0.5 - 1.0	Medium Stiff
30 - 50	55 - 91	Dense	8 - 15	15 - 27	1.0 - 2.0	Stiff
> 50	> 91	Very Dense	15 - 30	27 - 55	2.0 - 4.0	Very Stiff
			> 30	> 55	> 4.0	Hard

MOISTURE CONTENT DEFINITIONS

Dry: Absence of moisture, dry to the touch

Moist: Damp but no visible water

Wet: Visible free water

ABBREVIATIONS

WOH: Weight of Hammer

WOR: Weight of Drill Rods

SPT: Standard Penetration Test Split-Spoon Sampler

MCS: Modified California Sampler

PP: Pocket Penetrometer

GRAIN SIZE DEFINITION

Description	Sieve Number and / or Size
Boulders	> 12 inches (305-mm)
Cobbles	3 to 12 inches (75-mm to 305-mm)
Gravel	3-inch to #4 (75-mm to 4.75-mm)
Coarse Gravel	3-inch to 3/4-inch (75-mm to 19-mm)
Fine Gravel	3/4-inch to #4 (19-mm to 4.75-mm)
Sand	#4 to #200 (4.75-mm to 0.075-mm)
Coarse Sand	#4 to #10 (4.75-mm to 2-mm)
Medium Sand	#10 to #40 (2-mm to 0.425-mm)
Fine Sand	#40 to #200 (0.425-mm to 0.075-mm)

**Soil descriptions are based on ASTM D2488-09a, Visual-Manual Procedure, with the above modifications by Geolabs, Inc. to the Unified Soil Classification System (USCS).*

Plate

A-0.2

GEOLABS, INC.

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Rock Log Legend

ROCK DESCRIPTIONS

	BASALT		**CONGLOMERATE**
	BOULDERS		**LIMESTONE**
	BRECCIA		**SANDSTONE**
	CLINKER		**SILTSTONE**
	COBBLES		**TUFF**
	CORAL		**VOID/CAVITY**

ROCK DESCRIPTION SYSTEM

ROCK FRACTURE CHARACTERISTICS

The following terms describe general fracture spacing of a rock:

Massive: Greater than 24 inches apart

Slightly Fractured: 12 to 24 inches apart

Moderately Fractured: 6 to 12 inches apart

Closely Fractured: 3 to 6 inches apart

Severely Fractured: Less than 3 inches apart

DEGREE OF WEATHERING

The following terms describe the chemical weathering of a rock:

Unweathered: Rock shows no sign of discoloration or loss of strength.

Slightly Weathered: Slight discoloration inwards from open fractures.

Moderately Weathered: Discoloration throughout and noticeably weakened though not able to break by hand.

Highly Weathered: Most minerals decomposed with some corestones present in residual soil mass. Can be broken by hand.

Extremely Weathered: Saprolite. Mineral residue completely decomposed to soil but fabric and structure preserved.

HARDNESS

The following terms describe the resistance of a rock to indentation or scratching:

Very Hard: Specimen breaks with difficulty after several "pinging" hammer blows.
Example: Dense, fine grain volcanic rock

Hard: Specimen breaks with some difficulty after several hammer blows.
Example: Vesicular, vugular, coarse-grained rock

Medium Hard: Specimen can be broked by one hammer blow. Cannot be scraped by knife. SPT may penetrate by ~25 blows per inch with bounce.
Example: Porous rock such as clinker, cinder, and coral reef

Soft: Can be indented by one hammer blow. Can be scraped or peeled by knife. SPT can penetrate by ~100 blows per foot.
Example: Weathered rock, chalk-like coral reef

Very Soft: Crumbles under hammer blow. Can be peeled and carved by knife. Can be indented by finger pressure.
Example: Saprolite

Plate

A-0.3

GEOLABS, INC.

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DEPARTMENT OF HAWAIIAN HOME LANDS
HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

Log of Boring

B-1

Approximate Ground Surface Elevation (feet): 176 *

Laboratory: Other Tests	Laboratory: Moisture Content (%)	Laboratory: Dry Density (pcf)	Field: Core Recovery (%)	Field: RQD (%)	Field: Penetration Resistance (blows/foot)	Field: Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
							0			MH	Reddish brown to brown **CLAYEY SILT**, stiff, moist (residual soil)
	20	79			22	>4.0					
	21				27						grades to very stiff
	39	62			39	>4.0	5				
										ML	Brownish gray with red mottling **CLAYEY SILT**, very stiff, moist (residual soil)
LL=55 PI=23	38				18		10				
			92	0							Gray **BASALT**, severely to closely fractured, moderately weathered, medium hard (basalt formation)
			93	27	10/0"		15				
					10/0"		20				Boring terminated at 20 feet
							25				* Overall Grading Plan - 1 and Overall Grading Plan - 2 dated April 2022 prepared by SSFM International, Inc.

Date Started:	August 25, 2022	Water Level: ▼	Not Encountered
Date Completed:	August 25, 2022		
Logged By:	S. Leong	Drill Rig:	CME-55D *(Energy Transfer Ratio = 77.2%)*
Total Depth:	20 feet	Drilling Method:	4" Solid-Stem Auger & HQ Coring
Work Order:	8251-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 1

GEOLABS, INC.

Geotechnical Engineering

DEPARTMENT OF HAWAIIAN HOME LANDS
HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

Log of Boring

B-2

Approximate Ground Surface Elevation (feet): 196.5 *

Other Tests (Laboratory)	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
							0	ML	Reddish brown to brown **SANDY SILT**, stiff, moist (residual soil)
LL=42 PI=14	19	76			22	>4.0			
	20				23				grades to very stiff
TXUU S_u=5.5 ksf	33	95			44	>4.0	5		
			83	13	10/0"		10		Gray vesicular **BASALT**, severely to closely fractured, moderately weathered, medium hard (basalt formation)
									grades with purplish gray clinker layer between 13 feet and 14 feet
			100	0	50/3"		15		
									grades with purplish gray clinker layer between 19 feet and 19.5 feet
					10/0"		20		Boring terminated at 20 feet
							25		

Date Started:	August 25, 2022
Date Completed:	August 25, 2022
Logged By:	S. Leong
Total Depth:	20 feet
Work Order:	8251-00

Water Level:	Not Encountered
Drill Rig:	CME-55D *(Energy Transfer Ratio = 77.2%)*
Drilling Method:	4" Solid-Stem Auger & HQ Coring
Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 2

GEOLABS, INC.

Geotechnical Engineering

DEPARTMENT OF HAWAIIAN HOME LANDS
HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

Log of Boring

B-3

Approximate Ground Surface Elevation (feet): 210 *

Other Tests (Laboratory)	Moisture Content (%) (Laboratory)	Dry Density (pcf) (Laboratory)	Core Recovery (%) (Field)	RQD (%) (Field)	Penetration Resistance (blows/foot) (Field)	Pocket Pen. (tsf) (Field)	Depth (feet)	USCS	Description
							0	MH	Dark reddish brown to brown **CLAYEY SILT**, very stiff, moist (residual soil)
	21	88			34	>4.0			
	22				22				
Consol.	25	96			52	>4.0	5		
							8	ML	Reddish brown with gray mottling **CLAYEY SILT**, very stiff, moist (residual soil)
	41				13/6" +50/3"		10		
			100	38			11		Gray **BASALT**, severely to closely fractured, moderately weathered, medium hard (basalt formation)
			92	33	10/0"		15		
					10/0"		20		Boring terminated at 20 feet
							25		

Date Started:	August 24, 2022
Date Completed:	August 24, 2022
Logged By:	S. Leong
Total Depth:	20 feet
Work Order:	8251-00

Water Level:	Not Encountered
Drill Rig:	CME-55D *(Energy Transfer Ratio = 77.2%)*
Drilling Method:	4" Solid-Stem Auger & HQ Coring
Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 3

BORING_LOG 8251-00.GPJ GEOLABS.GDT 11/8/22

GEOLABS, INC. Geotechnical Engineering	DEPARTMENT OF HAWAIIAN HOME LANDS HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2 HANAPEPE, KAUAI, HAWAII	Log of Boring B-4

Approximate Ground Surface Elevation (feet): 223 *

Other Tests (Laboratory)	Moisture Content (%) (Laboratory)	Dry Density (pcf) (Laboratory)	Core Recovery (%) (Field)	RQD (%) (Field)	Penetration Resistance (blows/foot) (Field)	Pocket Pen. (tsf) (Field)	Depth (feet)	USCS	Description
							0	MH	Dark reddish brown to brown **CLAYEY SILT**, very stiff, moist (residual soil)
	21	76			30	>4.0			
	23				23				
	26	87			32	>4.0	5		
LL=56 PI=23	33				24		10	ML	Reddish brown with orange mottling **CLAYEY SILT**, very stiff, moist (residual soil)
								SM	Light gray with red mottling **SILTY SAND**, medium dense, moist (saprolite)
	31	71			50/3"		15		
			100	57					Gray **BASALT**, closely fractured, moderately weathered, medium hard (basalt formation)
					10/0"		20		Boring terminated at 20 feet
							25		

Date Started:	August 24, 2022	Water Level: ▼	Not Encountered
Date Completed:	August 24, 2022		
Logged By:	S. Leong	Drill Rig:	CME-55D *(Energy Transfer Ratio = 77.2%)*
Total Depth:	20 feet	Drilling Method:	4" Solid-Stem Auger & HQ Coring
Work Order:	8251-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate A - 4

BORING_LOG 8251-00.GPJ GEOLABS.GDT 11/8/22

GEOLABS, INC.

Geotechnical Engineering

DEPARTMENT OF HAWAIIAN HOME LANDS
HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

Log of Boring

B-5

Approximate Ground Surface Elevation (feet): 235 *

Laboratory: Other Tests	Laboratory: Moisture Content (%)	Laboratory: Dry Density (pcf)	Field: Core Recovery (%)	Field: RQD (%)	Field: Penetration Resistance (blows/foot)	Field: Pocket Pen. (tsf)	Depth (feet)	USCS	Description
							0	MH	Reddish brown to brown **CLAYEY SILT**, very stiff, moist (residual soil)
	22	86			33	>4.0			
LL=50 PI=21	24				20				
TXUU S_u=4.8 ksf	30	96			51	>4.0	5		
							8	ML	Light gray with red mottling **CLAYEY SILT**, stiff, moist (residual soil)
	36				23		10		
							13	SM	Gray with orange mottling **SILTY SAND**, medium dense, moist (saprolite)
	22	85			24/6" +50/3"		15		
			73	27			16		Gray vesicular **BASALT**, severely to closely fractured, moderately weathered, medium hard (basalt formation)
	13				50/3"		20		
							20.25		Boring terminated at 20.25 feet
							25		

Date Started:	August 23, 2022	Water Level:	Not Encountered
Date Completed:	August 23, 2022		
Logged By:	S. Leong	Drill Rig:	CME-55D *(Energy Transfer Ratio = 77.2%)*
Total Depth:	20.25 feet	Drilling Method:	4" Solid-Stem Auger & HQ Coring
Work Order:	8251-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 5

GEOLABS, INC.

Geotechnical Engineering

DEPARTMENT OF HAWAIIAN HOME LANDS
HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

Log of Boring

B-6

Approximate Ground Surface Elevation (feet): 245 *

Other Tests (Laboratory)	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
							0	MH	Reddish brown to brown **CLAYEY SILT**, very stiff, moist (residual soil)
	21	79			32	>4.0			
LL=53 PI=14	24				35				grades to hard
TXUU S_u=6.4 ksf	25	79			32/6" +50/3"	>4.0	5		
							8	ML	Light gray with red mottling **CLAYEY SILT**, very stiff, moist (residual soil)
	26				25		10		
							13	ML	Gray with orange mottling **SANDY SILT** with traces of gravel, hard, moist (saprolite)
Sieve - #200 = 63.1%	28	85			57		15		
			100	42			19		Gray vesicular **BASALT**, closely fractured, moderately weathered, medium hard (basalt formation)
					10/0"		20		Boring terminated at 20 feet
							25		

Date Started:	August 23, 2022
Date Completed:	August 23, 2022
Logged By:	S. Leong
Total Depth:	20 feet
Work Order:	8251-00

Water Level: ▼	Not Encountered	
Drill Rig:	CME-55D	*(Energy Transfer Ratio = 77.2%)*
Drilling Method:	4" Solid-Stem Auger & HQ Coring	
Driving Energy:	140 lb. wt., 30 in. drop	

Plate

A - 6

BORING_LOG 8251-00.GPJ GEOLABS.GDT 11/8/22

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DEPARTMENT OF HAWAIIAN HOME LANDS
HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

Log of Boring

B-7

Approximate Ground Surface Elevation (feet): 175 *

Laboratory: Other Tests	Laboratory: Moisture Content (%)	Laboratory: Dry Density (pcf)	Field: Core Recovery (%)	Field: RQD (%)	Field: Penetration Resistance (blows/foot)	Field: Pocket Pen. (tsf)	Depth (feet)	USCS	Description
							0	MH	Reddish brown to brown **CLAYEY SILT**, hard, moist (residual soil)
	22	73			14	>4.0			
	22				17				grades to very stiff
Direct Shear	22	84			49	>4.0	5		
								SM	Brownish gray with red mottling **SILTY SAND**, dense, moist (saprolite)
	24				69		10		
									Gray vesicular **BASALT**, severely fractured, moderately weathered, medium hard (basalt formation)
			52	0					
									Gray with brown **CLINKER (BASALTIC)**, very soft to soft (clinker)
	13				8		15		
			57	29					
									Gray vesicular **BASALT**, closely fractured, moderately weathered, medium hard (basalt formation)
									Gray with brown **CLINKER (BASALTIC)**, very soft to soft (clinker)
									Gray vesicular **BASALT**, closely fractured, moderately weathered, medium hard (basalt formation)
					10/0"		20		Boring terminated at 20 feet
							25		

Date Started:	August 29, 2022
Date Completed:	August 29, 2022
Logged By:	S. Leong
Total Depth:	20 feet
Work Order:	8251-00

Water Level: ▼	Not Encountered
Drill Rig:	CME-55D *(Energy Transfer Ratio = 77.2%)*
Drilling Method:	4" Solid-Stem Auger & HQ Coring
Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 7

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HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

Log of Boring

B-8

Approximate Ground Surface Elevation (feet): 191 *

Other Tests (Laboratory)	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
							0	MH	Reddish brown to brown **CLAYEY SILT**, very stiff, moist (residual soil)
	19	81			27	>4.0			
Sieve - #200 = 95.7%	20				36				grades to hard
TXUU S_u=0.9 ksf	27	91			56	>4.0	5		
							9	CH	Brownish gray with red mottling **SILTY CLAY**, very stiff, moist (residual soil)
LL=61 PI=32	34				15		10		
			47	0	10/0"		15		Gray with brownish orange **CLINKER (BASALTIC)**, severely fractured, moderately weathered, medium hard (clinker)
					50/3"		20		
							20.25		Boring terminated at 20.25 feet
							25		

Date Started:	August 25, 2022
Date Completed:	August 25, 2022
Logged By:	S. Leong
Total Depth:	20.25 feet
Work Order:	8251-00

Water Level: ▼	Not Encountered
Drill Rig:	CME-55D *(Energy Transfer Ratio = 77.2%)*
Drilling Method:	4" Solid-Stem Auger & HQ Coring
Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 8

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HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

Log of Boring

B-9

Approximate Ground Surface Elevation (feet): 206.5 *

Other Tests (Laboratory)	Moisture Content (%) (Laboratory)	Dry Density (pcf) (Laboratory)	Core Recovery (%) (Field)	RQD (%) (Field)	Penetration Resistance (blows/foot) (Field)	Pocket Pen. (tsf) (Field)	Depth (feet)	USCS	Description
							0	MH	Reddish brown to brown **CLAYEY SILT**, very stiff to hard, moist (residual soil)
	19	84			39	>4.0			
	23				32				
TXUU S_u=5.4 ksf	32	85			50	>4.0	5		
	28				39		10		
								SM	Brownish gray with orange mottling **SILTY SAND**, medium dense, moist (saprolite)
	35	75			24		15		
			100	38					Gray vesicular **BASALT**, severely to closely fractured, moderately weathered, medium hard (basalt formation)
					10/0"		20		Boring terminated at 20 feet
							25		

Date Started:	August 24, 2022	Water Level:	Not Encountered
Date Completed:	August 25, 2022		
Logged By:	S. Leong	Drill Rig:	CME-55D *(Energy Transfer Ratio = 77.2%)*
Total Depth:	20 feet	Drilling Method:	4" Solid-Stem Auger & HQ Coring
Work Order:	8251-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 9

GEOLABS, INC. Geotechnical Engineering	DEPARTMENT OF HAWAIIAN HOME LANDS HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2 HANAPEPE, KAUAI, HAWAII	Log of Boring B-10

Approximate Ground Surface Elevation (feet): 219 *

Other Tests (Laboratory)	Moisture Content (%) (Laboratory)	Dry Density (pcf) (Laboratory)	Core Recovery (%) (Field)	RQD (%) (Field)	Penetration Resistance (blows/foot) (Field)	Pocket Pen. (tsf) (Field)	Depth (feet)	USCS	Description
							0	ML	Reddish brown to brown **SANDY SILT**, very stiff, moist (residual soil)
	20	83			48	>4.0			
LL=48 PI=16	21				31				grades to hard
	21	100			78	>4.0	5		
							8	ML	Light gray with red mottling **CLAYEY SILT**, very stiff, moist (residual soil)
	26				21		10		
							12	SM	Gray **SILTY SAND**, medium dense, moist (saprolite)
	11		93	30	50/3"		15		Gray vesicular **BASALT**, severely to closely fractured, moderately weathered, medium hard (basalt formation)
					10/0"		20		Boring terminated at 20 feet
							25		

Date Started:	August 24, 2022	Water Level: ▼	Not Encountered	Plate A - 10
Date Completed:	August 24, 2022			
Logged By:	S. Leong	Drill Rig:	CME-55D *(Energy Transfer Ratio = 77.2%)*	
Total Depth:	20 feet	Drilling Method:	4" Solid-Stem Auger & HQ Coring	
Work Order:	8251-00	Driving Energy:	140 lb. wt., 30 in. drop	

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DEPARTMENT OF HAWAIIAN HOME LANDS
HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

Log of Boring

B-11

Approximate Ground Surface Elevation (feet): 230 *

Laboratory: Other Tests	Laboratory: Moisture Content (%)	Laboratory: Dry Density (pcf)	Field: Core Recovery (%)	Field: RQD (%)	Field: Penetration Resistance (blows/foot)	Field: Pocket Pen. (tsf)	Depth (feet)	USCS	Description
							0	ML	Reddish brown to brown **SANDY SILT**, very stiff, moist (residual soil)
	18	83			40	>4.0			
LL=47 PI=19	20				31				grades to hard
	20	94			55	>4.0	5		
	23				26		10		
								ML	Light gray with orange mottling **CLAYEY SILT**, very stiff, moist (residual soil)
			100	21					Gray **BASALT**, severely to closely fractured, moderately weathered, medium hard (basalt formation)
			100	45	10/0"		15		
					10/0"		20		Boring terminated at 20 feet
							25		

Date Started:	August 24, 2022
Date Completed:	August 24, 2022
Logged By:	S. Leong
Total Depth:	20 feet
Work Order:	8251-00

Water Level: ▼	Not Encountered
Drill Rig:	CME-55D *(Energy Transfer Ratio = 77.2%)*
Drilling Method:	4" Solid-Stem Auger & HQ Coring
Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 11

BORING_LOG 8251-00.GPJ GEOLABS.GDT 11/8/22

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DEPARTMENT OF HAWAIIAN HOME LANDS
HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

Log of Boring

B-12

Approximate Ground Surface Elevation (feet): 243.5 *

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
							0	MH	Reddish brown to brown **CLAYEY SILT**, very stiff, moist (residual soil)
	19	77			27	>4.0			
	22				28				
	23	89			72	>4.0	5		grades to hard
	24				40		10		
							14	SW	Gray **GRAVELLY SAND** with traces of silt, medium dense, moist (saprolite)
Sieve - #200 = 3.2%	12	82			26		15		
			94	25			17		Gray vesicular **BASALT**, severely to closely fractured, moderately weathered, medium hard (basalt formation)
					10/0"		20		Boring terminated at 20 feet
							25		

Date Started:	August 23, 2022	Water Level:	Not Encountered
Date Completed:	August 23, 2022		
Logged By:	S. Leong	Drill Rig:	CME-55D *(Energy Transfer Ratio = 77.2%)*
Total Depth:	20 feet	Drilling Method:	4" Solid-Stem Auger & HQ Coring
Work Order:	8251-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 12

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HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

Log of Boring

B-13

Approximate Ground Surface Elevation (feet): 255 *

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
							0	MH	Reddish brown to brown **CLAYEY SILT**, stiff, moist (residual soil)
	18	82			24	>4.0			
	22				30				grades to very stiff
	25	87			43	>4.0	5		
	27				27		10		grades with gray mottling
								GW	Gray with orange mottling **SANDY GRAVEL** with traces of silt, medium dense, moist (saprolite)
Sieve - #200 = 4.8%	17	91			22		15		
									Gray vesicular **BASALT**, moderately weathered, medium hard (basalt formation)
					10/0"		20		Boring terminated at 20 feet
							25		

Date Started:	August 23, 2022	Water Level:	Not Encountered
Date Completed:	August 23, 2022		
Logged By:	S. Leong	Drill Rig:	CME-55D *(Energy Transfer Ratio = 77.2%)*
Total Depth:	20 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8251-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 13

BORING_LOG 8251-00.GPJ GEOLABS.GDT 11/8/22

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DEPARTMENT OF HAWAIIAN HOME LANDS
HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

Log of Boring
B-14

Approximate Ground Surface Elevation (feet): 161.5 *

Other Tests (Laboratory)	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%) (Field)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
							0	MH	Reddish brown **CLAYEY SILT**, very stiff, moist (residual soil)
	18	85			27	>4.0			
	20				30				
	20	98			62	>4.0	5		grades to hard
							9	ML	Light gray with orange mottling **CLAYEY SILT**, very stiff, moist (residual soil)
	28				29		10		
							14		Gray vesicular **BASALT**, severely fractured, moderately weathered, medium hard (basalt formation)
			79	28	50/3"		15		
					50/3"		20		Boring terminated at 20.25 feet
							25		

Date Started:	August 22, 2022
Date Completed:	August 23, 2022
Logged By:	S. Leong
Total Depth:	20.25 feet
Work Order:	8251-00

Water Level: ▼	Not Encountered
Drill Rig:	CME-55D *(Energy Transfer Ratio = 77.2%)*
Drilling Method:	4" Solid-Stem Auger & HQ Coring
Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 14

BORING_LOG 8251-00.GPJ GEOLABS.GDT 11/8/22

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DEPARTMENT OF HAWAIIAN HOME LANDS
HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

Log of Boring

B-15

Approximate Ground Surface Elevation (feet): 140 *

Laboratory: Other Tests	Laboratory: Moisture Content (%)	Laboratory: Dry Density (pcf)	Field: Core Recovery (%)	Field: RQD (%)	Field: Penetration Resistance (blows/foot)	Field: Pocket Pen. (tsf)	Depth (feet)	USCS	Description
							0	CH	Reddish brown **SILTY CLAY**, very stiff, moist (residual soil)
	20	81			44	>4.0			
LL=56 PI=27	21				62				grades to hard
	22	91			50	>4.0	5		grades to very stiff
								ML	Light gray with orange mottling **CLAYEY SILT**, very stiff, moist (residual soil)
	30	16			22		10		
					50/3"		15		Gray vesicular **BASALT**, moderately weathered, medium hard (basalt formation)
									grades to hard
					10/0"		20		Boring terminated at 20 feet
							25		

Date Started:	August 22, 2022
Date Completed:	August 22, 2022
Logged By:	S. Leong
Total Depth:	20 feet
Work Order:	8251-00
Water Level:	Not Encountered
Drill Rig:	CME-55D *(Energy Transfer Ratio = 77.2%)*
Drilling Method:	4" Solid-Stem Auger
Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 15

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HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

Log of Boring

I-1

Approximate Ground Surface Elevation (feet): 149.5 *

Laboratory: Other Tests	Laboratory: Moisture Content (%)	Laboratory: Dry Density (pcf)	Field: Core Recovery (%)	Field: RQD (%)	Field: Penetration Resistance (blows/foot)	Field: Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
							0			MH	Reddish brown to brown **CLAYEY SILT** with traces of sand, stiff, moist (residual soil)
	21	85			25	>4.0					
	20				20						grades to very stiff
- #200 = 98.7%	25				15		5				
							6				Boring terminated at 6 feet
							10				
							15				
							20				
							25				

Date Started:	August 22, 2022
Date Completed:	August 22, 2022
Logged By:	S. Leong
Total Depth:	6 feet
Work Order:	8251-00

Water Level:	Not Encountered
Drill Rig:	CME-55D *(Energy Transfer Ratio = 77.2%)*
Drilling Method:	4" Solid-Stem Auger
Driving Energy:	140 lb. wt., 30 in. drop

Plate

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HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

Log of Boring

I-2

Laboratory: Other Tests	Laboratory: Moisture Content (%)	Laboratory: Dry Density (pcf)	Field: Core Recovery (%)	Field: RQD (%)	Field: Penetration Resistance (blows/foot)	Field: Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description (Approximate Ground Surface Elevation (feet): 156.5 *)
							0			MH	Reddish brown to brown **CLAYEY SILT**, very stiff, moist (residual soil)
	23	84			32	>4.0					
	23				21						
							4			ML	Light gray **CLAYEY SILT**, hard, moist (residual soil)
LL=36 PI=6	33				41		5				
							6				Boring terminated at 6 feet

Depth scale: 5, 10, 15, 20, 25

Date Started:	August 22, 2022
Date Completed:	August 22, 2022
Logged By:	S. Leong
Total Depth:	6 feet
Work Order:	8251-00

Water Level: ▼	Not Encountered
Drill Rig:	CME-55D *(Energy Transfer Ratio = 77.2%)*
Drilling Method:	4" Solid-Stem Auger
Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 17

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HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

Log of Boring

I-3

Approximate Ground Surface Elevation (feet): 157 *

Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
							0			MH	Reddish brown to brown **CLAYEY SILT**, very stiff, moist (residual soil)
	22	85			34	>4.0					
	23				23						
	26				14		5				grades to stiff
							6				Boring terminated at 6 feet
							10				
							15				
							20				
							25				

Date Started:	August 22, 2022	Water Level:	Not Encountered
Date Completed:	August 22, 2022		
Logged By:	S. Leong	Drill Rig:	CME-55D *(Energy Transfer Ratio = 77.2%)*
Total Depth:	6 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8251-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

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BORING_LOG 8251-00.GPJ GEOLABS.GDT 11/8/22

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HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

Log of Boring

I-4

Approximate Ground Surface Elevation (feet): 160 *

Other Tests (Laboratory)	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%) (Field)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
							0			MH	Reddish brown to brown **CLAYEY SILT**, very stiff, moist (residual soil)
	21	80			28	>4.0					
	24				19					ML	Reddish brown with gray mottling **CLAYEY SILT**, very stiff, moist (residual soil)
	33	89			35	>4.0	5			SC	Gray with red mottling **CLAYEY SAND**, dense, moist (saprolite)
LL=31 PI=10	13				50/3"						grades to very dense
							10				Boring terminated at 10 feet
							15				
							20				
							25				

Date Started:	August 29, 2022
Date Completed:	August 29, 2022
Logged By:	S. Leong
Total Depth:	10 feet
Work Order:	8251-00
Water Level: ▼	Not Encountered
Drill Rig:	CME-55D *(Energy Transfer Ratio = 77.2%)*
Drilling Method:	4" Solid-Stem Auger
Driving Energy:	140 lb. wt., 30 in. drop

Plate

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GEOLABS, INC.

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DEPARTMENT OF HAWAIIAN HOME LANDS
HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

Log of Boring

I-5

Approximate Ground Surface Elevation (feet): 160 *

Other Tests (Laboratory)	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%) (Field)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
							0			MH	Dark reddish brown to brown **CLAYEY SILT**, very stiff, moist (residual soil)
	20	81			28	>4.0					
	20				17						
	27	87			35	>4.0	5				
										ML	Brownish gray with red mottling **CLAYEY SILT**, stiff, moist (residual soil)
	36				25						
							10				Boring terminated at 10 feet
							15				
							20				
							25				

Date Started:	August 29, 2022
Date Completed:	August 29, 2022
Logged By:	S. Leong
Total Depth:	10 feet
Work Order:	8251-00

Water Level:	Not Encountered
Drill Rig:	CME-55D *(Energy Transfer Ratio = 77.2%)*
Drilling Method:	4" Solid-Stem Auger
Driving Energy:	140 lb. wt., 30 in. drop

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DEPARTMENT OF HAWAIIAN HOME LANDS
HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

Log of Boring

I-6

Approximate Ground Surface Elevation (feet): 160 *

Other Tests (Laboratory)	Moisture Content (%) (Laboratory)	Dry Density (pcf) (Laboratory)	Core Recovery (%) (Field)	RQD (%) (Field)	Penetration Resistance (blows/foot) (Field)	Pocket Pen. (tsf) (Field)	Depth (feet)	USCS	Description
							0	MH	Dark reddish brown to brown **CLAYEY SILT**, very stiff, moist (residual soil)
	21	85			29	>4.0			
	22				30				
	23	96			26	>4.0	5		
LL=53 PI=27	25				17				
							10		Boring terminated at 10 feet
							15		
							20		
							25		

Date Started:	August 29, 2022	Water Level: ▼	Not Encountered
Date Completed:	August 29, 2022		
Logged By:	S. Leong	Drill Rig:	CME-55D *(Energy Transfer Ratio = 77.2%)*
Total Depth:	10 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8251-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 21

APPENDIX B

APPENDIX B

Laboratory Tests

Moisture Content (ASTM D2216) and Unit Weight (ASTM D7263) determinations were performed on selected samples as an aid in the classification and evaluation of soil properties. The test results are presented on the Logs of Borings at the appropriate sample depths.

Thirteen Atterberg Limits tests (ASTM D4318) were performed on selected soil samples to evaluate the liquid and plastic limits. The test results are summarized on the Logs of Borings at the appropriate sample depths. Graphic presentation of the test results is provided on Plates B-1 and B-2.

Five Sieve Analysis tests (ASTM D6912) were performed on selected soil samples to evaluate the gradation characteristics of the soils and to aid in soil classification. Graphic presentations of the grain size distribution are provided on Plate B-3

Ten One-Inch Ring Swell tests were performed on relatively undisturbed and remolded samples to evaluate the swelling potential of the on-site soils. The test results are summarized on Plate B-4.

Five Unconsolidated Undrained Triaxial Compression tests (ASTM D2850) were performed on selected in-situ soil samples to evaluate the undrained shear strengths of the clayey soils. The approximate in-situ effective overburden pressures were used as the applied confining pressure for the relatively “undisturbed” soil sample. The test results and the stress-strain curve are presented on Plates B-5 through B-9.

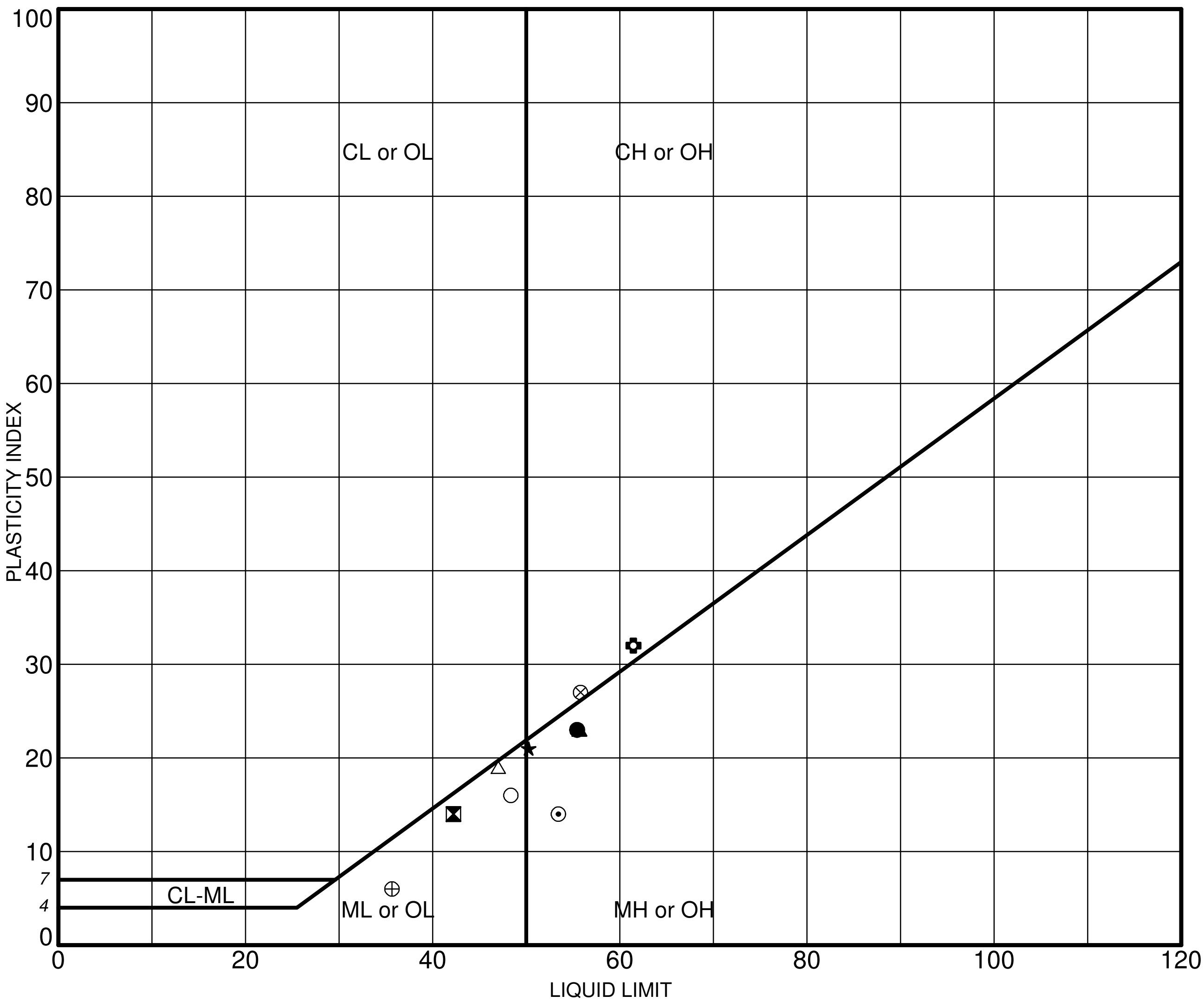
One Direct Shear test (ASTM D3080) was performed on a selected in-situ soil sample to evaluate the shear strength parameters. The test results are presented on Plate B-10.

One Consolidation test with time rates (ASTM D2435) was performed on a selected in-situ soil sample to evaluate the compressibility characteristics of the materials encountered. The consolidation test results are presented on Plate B-11.

Five laboratory California Bearing Ratio tests (ASTM D1883) were performed on bulk samples of the near-surface soils to evaluate the pavement support characteristics of the soils. The test results are presented on Plates B-12 through B-16.

Five Modified Proctor compaction tests (ASTM D1557) were performed on bulk samples of the near-surface soils to evaluate the dry density and moisture content relationships. The test results are presented on Plates B-17 through B-21.

Four sets of corrosion tests, including pH (ASTM G51), minimum resistivity (ASTM G57), chloride (EPA 300.0), and sulfate (EPA 300.0) content, were performed by our office and Eurofins TestAmerica Laboratories, Inc. on selected soil samples obtained from our field exploration. The test results are summarized on Plate B-22.



	Sample	Depth (ft)	LL	PL	PI	Description
●	B-1	10.0-11.5	55	32	23	Reddish brown clayey silt (MH)
⧗	B-2	1.0-2.5	42	28	14	Reddish brown to brown sandy silt (ML)
▲	B-4	10.0-11.5	56	33	23	Reddish brown to brown clayey silt (MH)
★	B-5	2.5-4.0	50	29	21	Reddish brown to brown clayey silt (MH)
⊙	B-6	2.5-4.0	53	39	14	Reddish brown to brown clayey silt (MH)
✿	B-8	10.0-11.5	61	29	32	Brownish gray with red mottling silty clay (CH)
○	B-10	2.5-4.0	48	32	16	Reddish brown to brown sandy silt (ML)
△	B-11	2.5-4.0	47	28	19	Reddish brown to brown sandy silt (ML)
⊗	B-15	2.5-4.0	56	29	27	Reddish brown silty clay (CH)
⊕	I-2	4.5-6.0	36	30	6	Light gray clayey silt (ML)

NP = NON-PLASTIC

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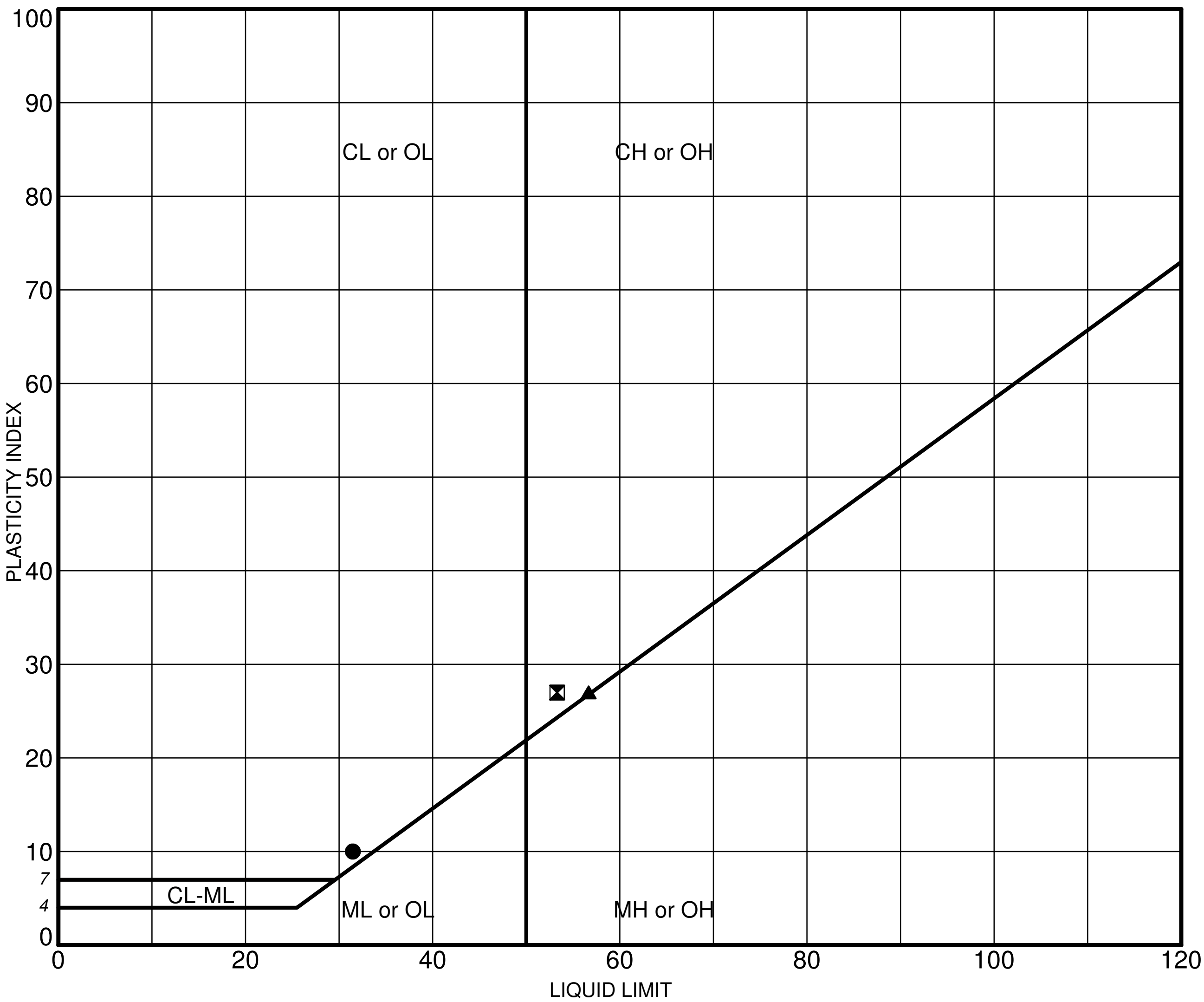
ATTERBERG LIMITS TEST RESULTS - ASTM D4318

DEPARTMENT OF HAWAIIAN HOME LANDS
HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

Plate
B - 1

G_ATTERBERG_PI-100_LL-120 8251-00.GPJ GEOLABS.GDT 11/8/22



	Sample	Depth (ft)	LL	PL	PI	Description
●	I-4	8.5-9.3	31	21	10	Gray with red mottling clayey sand (SC) with traces of gravel
⊠	I-6	8.5-10.0	53	26	27	Reddish brown silty clay (CH)
▲	Bulk-1	1.0-3.0	57	30	27	Dark reddish brown clayey silt (MH)

NP = NON-PLASTIC

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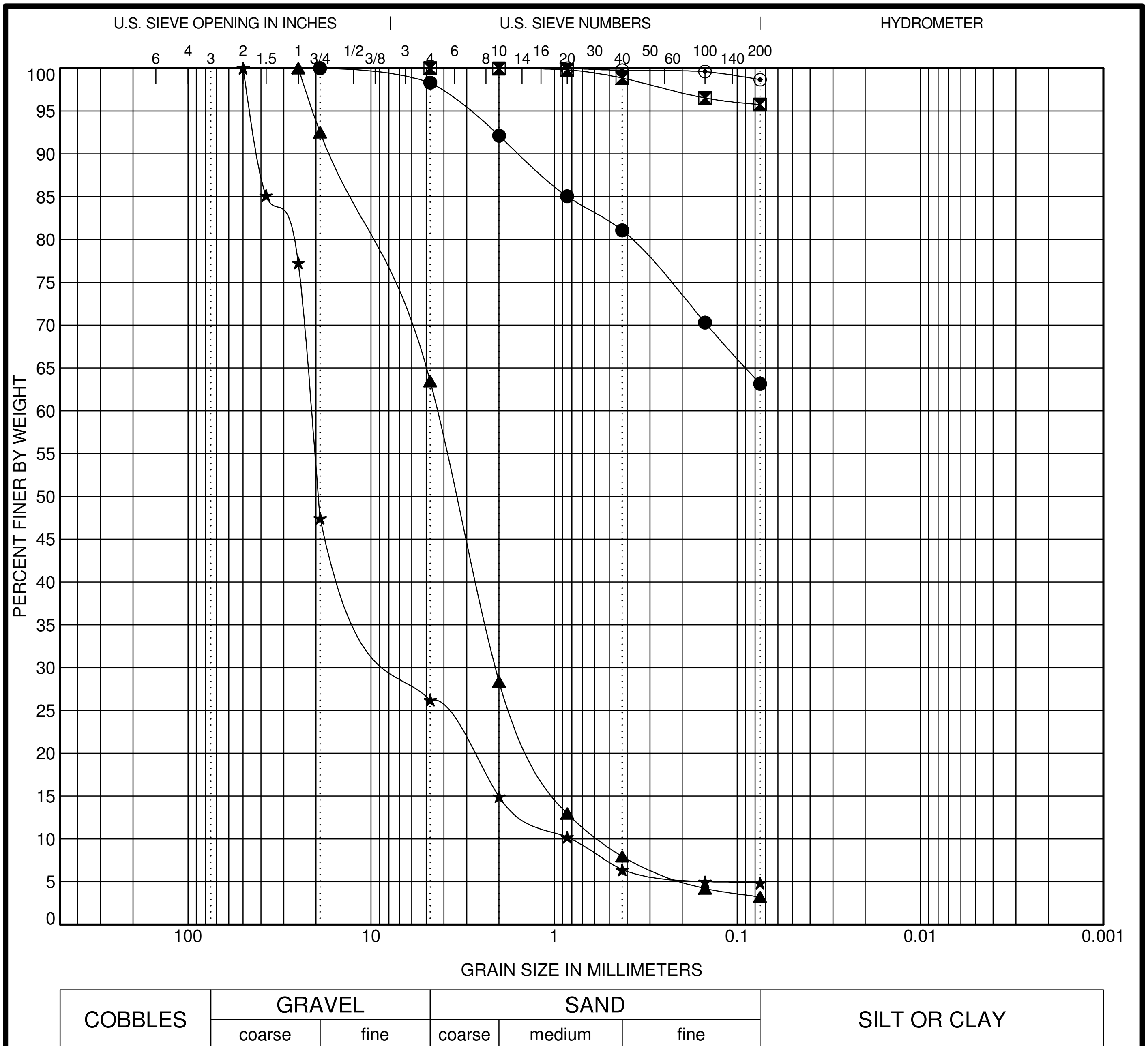
ATTERBERG LIMITS TEST RESULTS - ASTM D4318

DEPARTMENT OF HAWAIIAN HOME LANDS
HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

Plate
B - 2

G ATTERBERG PI-100 LL-120 8251-00.GPJ GEOLABS.GDT 11/8/22



	Sample	Depth (ft)	Description	LL	PL	PI	Cc	Cu
●	B-6	15.0-16.5	Gray with orange mottling sandy silt (ML) with traces of gravel					
⧗	B-8	2.5-4.0	Reddish brown clayey silt (MH) with traces of sand					
▲	B-12	15.0-16.5	Gray gravelly sand (SW) with traces of silt				1.8	7.7
★	B-13	15.0-16.5	Gray with orange mottling sandy gravel (GW) with traces of silt				2.1	26.0
⊙	I-1	4.5-6.0	Reddish brown to brown clayey silt (MH) with traces of sand					

	Sample	Depth (ft)	D100 (mm)	D60 (mm)	D30 (mm)	D10 (mm)	%Gravel	%Sand	%Fine
●	B-6	15.0-16.5	19				1.7	35.2	63.1
⧗	B-8	2.5-4.0	4.75				0.0	4.3	95.7
▲	B-12	15.0-16.5	25	4.363	2.084	0.564	36.6	60.2	3.2
★	B-13	15.0-16.5	50	21.328	6.089	0.821	73.8	21.4	4.8
⊙	I-1	4.5-6.0	0.85				0.0	1.3	98.7

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GRAIN SIZE DISTRIBUTION - ASTM C117 & C136

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HANAPEPE, KAUAI, HAWAII

Plate
B - 3

G_GRAIN_SIZE_MOD 8251-00.GPJ GEOLABS.GDT 11/8/22

Location	Depth (feet)	Soil Description	Dry Density (pcf)	Moisture Contents Initial (%)	Moisture Contents Air-Dried (%)	Moisture Contents Final (%)	Ring Swell (%)
B-1*	1.0 - 2.5	Reddish brown to brown clayey silt	77.6	20.3	15.0	43.1	1.0
B-2**	2.5 - 4.0	Reddish brown to brown sandy silt	106.2	21.3	16.8	29.0	5.8
B-3*	1.0 - 2.5	Dark reddish brown to brown clayey silt	81.1	21.9	17.1	41.2	0.9
B-4**	2.5 - 4.0	Dark reddish brown to brown clayey silt	99.9	22.9	18.4	29.3	4.3
B-8*	1.0 - 2.5	Reddish brown to brown clayey silt with traces of sand	76.1	21.0	16.1	45.4	0.8
B-9*	1.0 - 2.5	Reddish brown to brown clayey silt	80.7	20.7	16.5	42.4	1.0
B-10*	1.0 - 2.5	Reddish brown to brown sandy silt	82.7	20.5	16.0	41.0	0.9
B-11*	1.0 - 2.5	Reddish brown to brown sandy silt	76.1	18.7	14.0	45.9	0.9
B-12**	2.5 - 4.0	Reddish brown to brown clayey silt	94.2	23.6	19.3	36.7	8.1
B-13*	10.0 - 11.0	Reddish brown to brown clayey silt	98.9	28.5	22.9	33.0	8.4

NOTE: Samples tested were either relatively undisturbed or remolded in 2.4-inch diameter by 1-inch high rings. They were air-dried overnight and then saturated for 24 hours under a surcharge pressure of 55 psf.

* Relatively Undisturbed

** Remolded

G RING SWELL TEST 8251-00.GPJ GEOLABS.GDT 11/8/22

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SUMMARY OF RING SWELL TESTS

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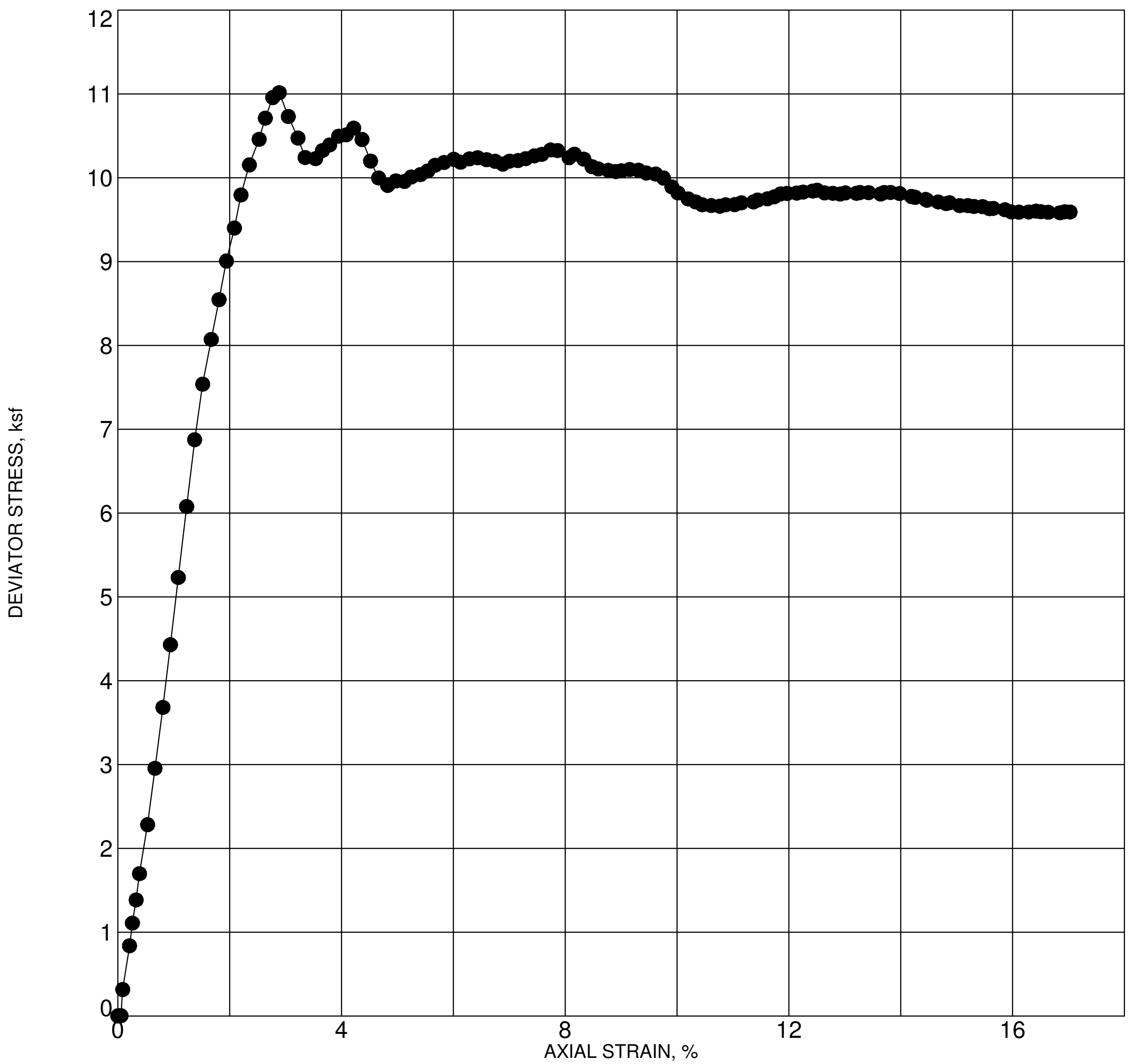
HANAPEPE, KAUAI, HAWAII

Plate B - 4



Max. Deviator Stress (ksf):	11.0
Confining Stress (ksf):	0.7

Location: B-2
Depth: 5.0 - 6.5 feet
Description: Reddish brown to brown sandy silt
Test Date: 9/20/2022

Dry Density (pcf)	101.1	Sample Diameter (inches)	2.413
Moisture (%)	26.0	Sample Height (inches)	5.100
Axial Strain at Failure (%)	7.6	Strain Rate (% / minute)	0.44

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TRIAXIAL UU COMPRESSION TEST - ASTM D2850

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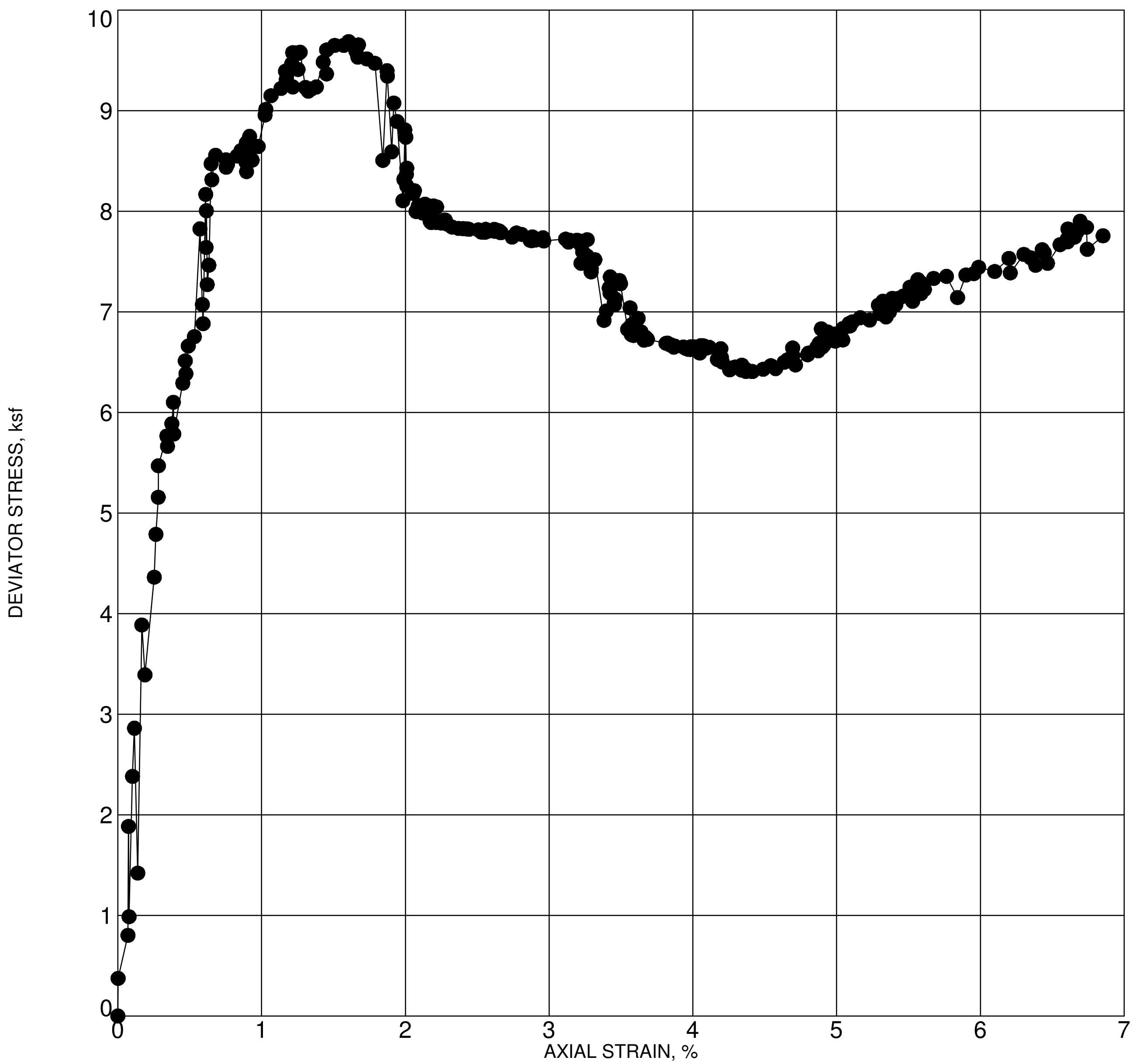
HANAPEPE, KAUAI, HAWAII

Plate
B - 5

G_TXUU 8251-00.GPJ GEOLABS.GDT 11/8/22



Max. Deviator Stress (ksf):	9.7
Confining Stress (ksf):	0.7

Location: B-5
Depth: 5.0 - 6.5 feet
Description: Reddish brown to brown clayey silt
Test Date: 9/26/2022

Dry Density (pcf)	102.1	Sample Diameter (inches)	2.413
Moisture (%)	23.2	Sample Height (inches)	5.100
Axial Strain at Failure (%)	1.6	Strain Rate (% / minute)	0.26

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TRIAXIAL UU COMPRESSION TEST - ASTM D2850

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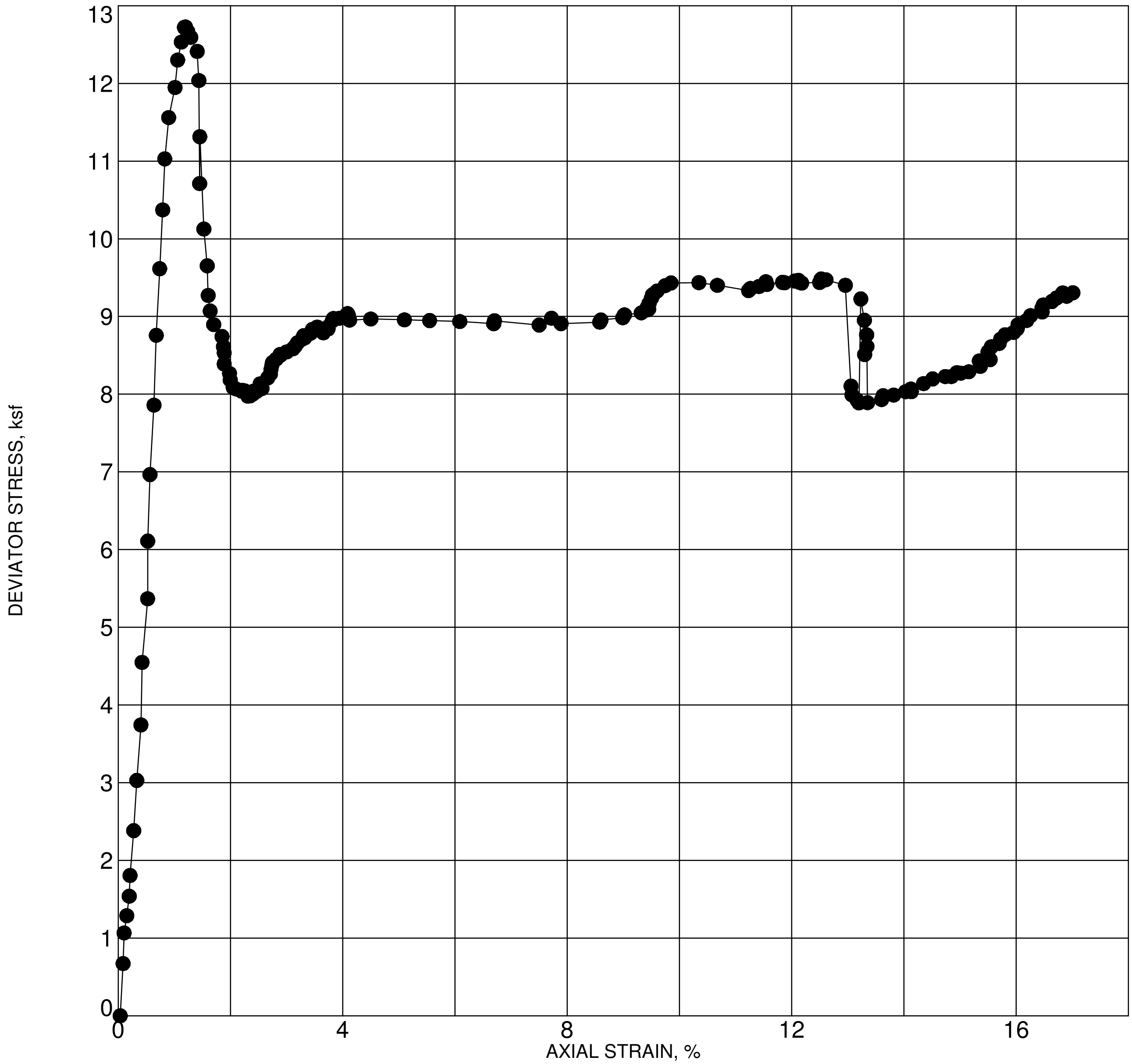
HANAPEPE, KAUAI, HAWAII

Plate
B - 6

G_TXUU 8251-00.GPJ GEOLABS.GDT 11/8/22



Max. Deviator Stress (ksf):	12.7
Confining Stress (ksf):	0.7

Location: B-6
Depth: 5.0 - 6.3 feet
Description: Reddish brown to brown clayey silt
Test Date: 9/19/2022

Dry Density (pcf)	78.9	Sample Diameter (inches)	2.413
Moisture (%)	24.6	Sample Height (inches)	5.100
Axial Strain at Failure (%)	1.2	Strain Rate (% / minute)	0.18

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TRIAXIAL UU COMPRESSION TEST - ASTM D2850

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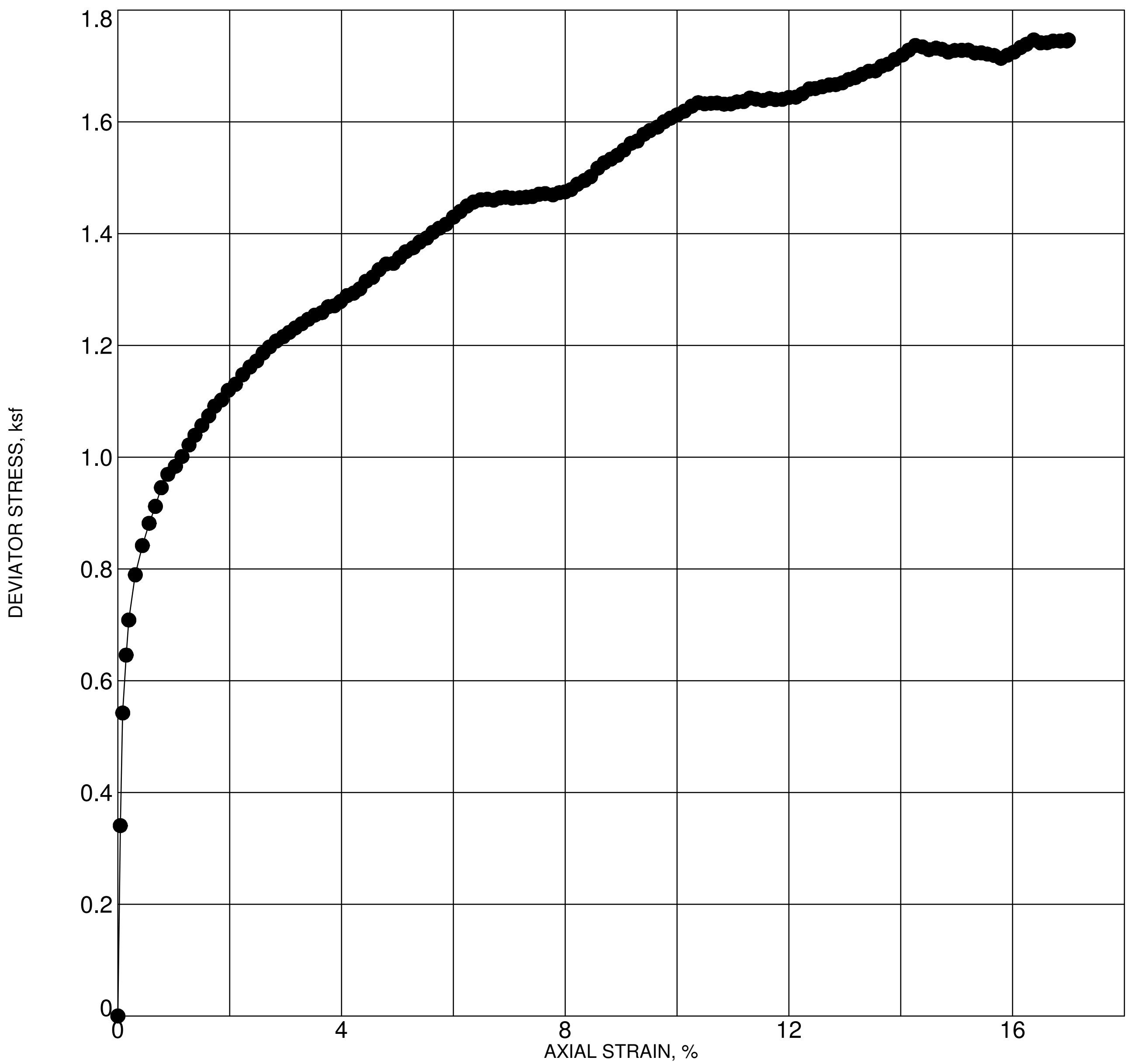
Plate
B - 7

G_TXUU 8251-00.GPJ GEOLABS.GDT 11/8/22



Max. Deviator Stress (ksf):	1.7
Confining Stress (ksf):	0.7

Location: B-8
Depth: 5.0 - 6.5 feet
Description: Reddish brown to brown clayey silt
Test Date: 9/26/2022

Dry Density (pcf)	81.5	Sample Diameter (inches)	2.413
Moisture (%)	33.3	Sample Height (inches)	5.067
Axial Strain at Failure (%)	15.0	Strain Rate (% / minute)	0.70

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TRIAXIAL UU COMPRESSION TEST - ASTM D2850

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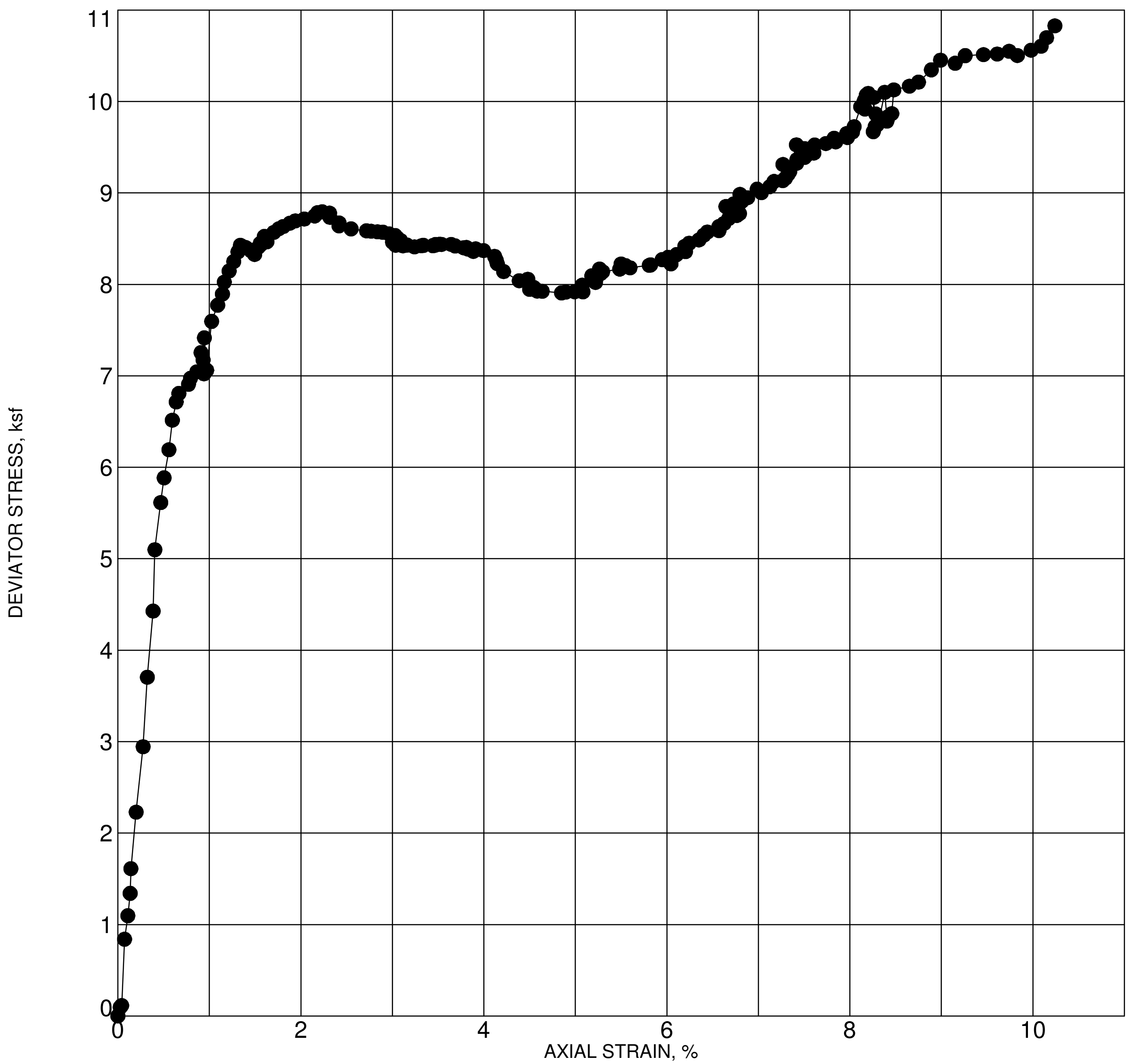
HANAPEPE, KAUAI, HAWAII

Plate
B - 8

G_TXUU 8251-00.GPJ GEOLABS.GDT 11/8/22



Max. Deviator Stress (ksf):	10.8
Confining Stress (ksf):	0.7

Location: B-9
Depth: 5.0 - 6.5 feet
Description: Reddish brown to brown clayey silt
Test Date: 9/19/2022

Dry Density (pcf)	89.7	Sample Diameter (inches)	2.413
Moisture (%)	25.2	Sample Height (inches)	5.067
Axial Strain at Failure (%)	10.2	Strain Rate (% / minute)	0.33

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TRIAXIAL UU COMPRESSION TEST - ASTM D2850

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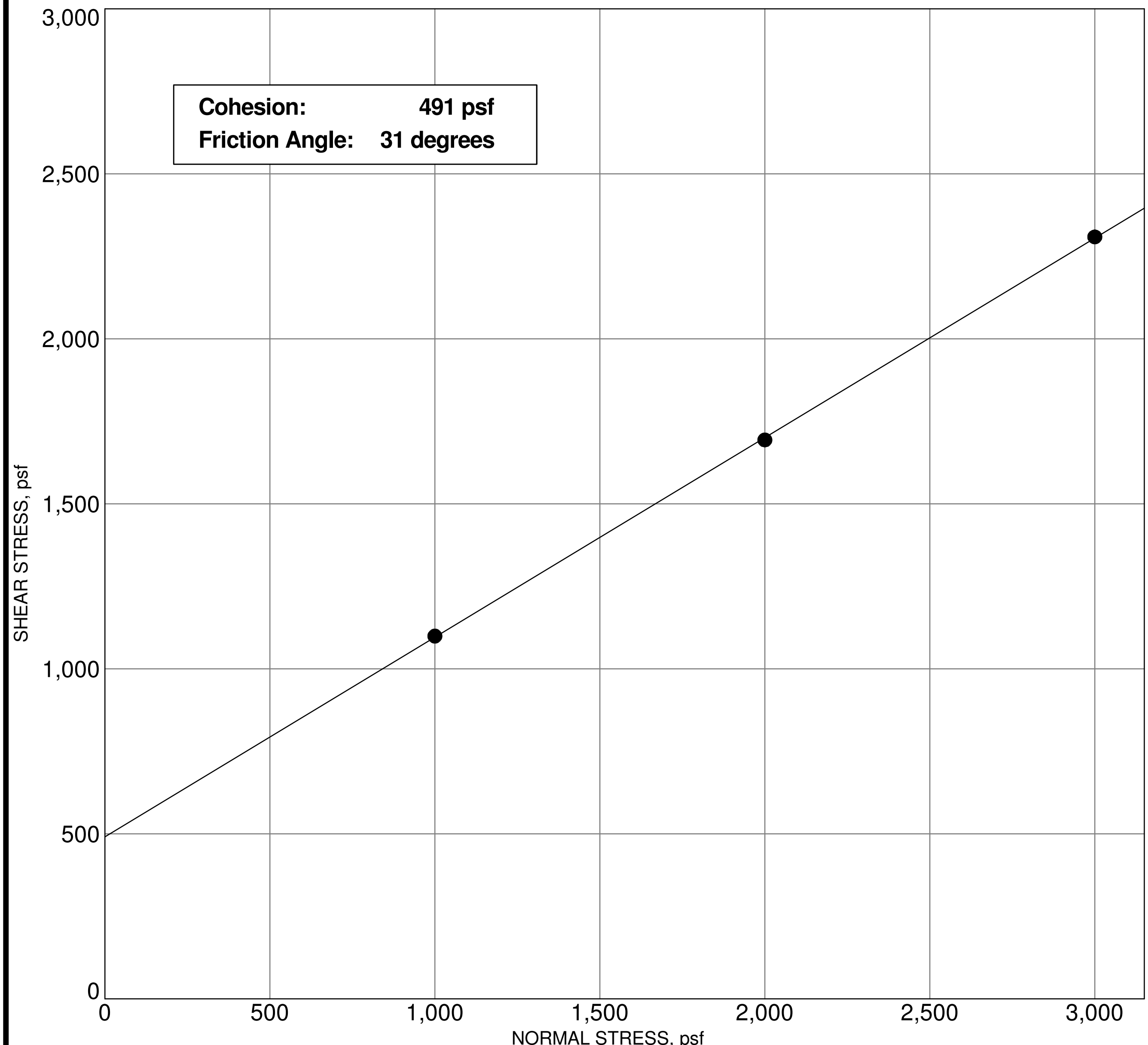
HANAPEPE, KAUAI, HAWAII

Plate
B - 9

G_TXUU 8251-00.GPJ GEOLABS.GDT 11/8/22



		Sample #1	Sample #2	Sample #3
INITIAL	Moisture Content, %	23.8	23.4	23.9
	Dry Density, pcf	76.9	76.4	82.3
	Height, inches	1.00	1.00	1.00
FINAL	Moisture Content, %	50.7	48.9	44.5
	Dry Density, pcf	76.6	78.1	83.8
	Height, inches	1.004	0.978	0.982
	Diameter, inches	2.42	2.42	2.42
	Deformation Rate, inch/minute	0.0025	0.0021	0.0022
	Normal Stress, psf	**1000**	**2000**	**3000**
	Peak Shear Stress, psf	**1099**	**1693**	**2309**
	Shear Displacement, inches	0.43	0.42	0.42

Sample: B-7
Depth: 5.0 - 6.5 feet
Description: Reddish brown to brown clayey silt

G_DIRECT_SHEAR 8251-00.GPJ GEOLABS.GDT 11/8/22

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DIRECT SHEAR TEST - ASTM D3080

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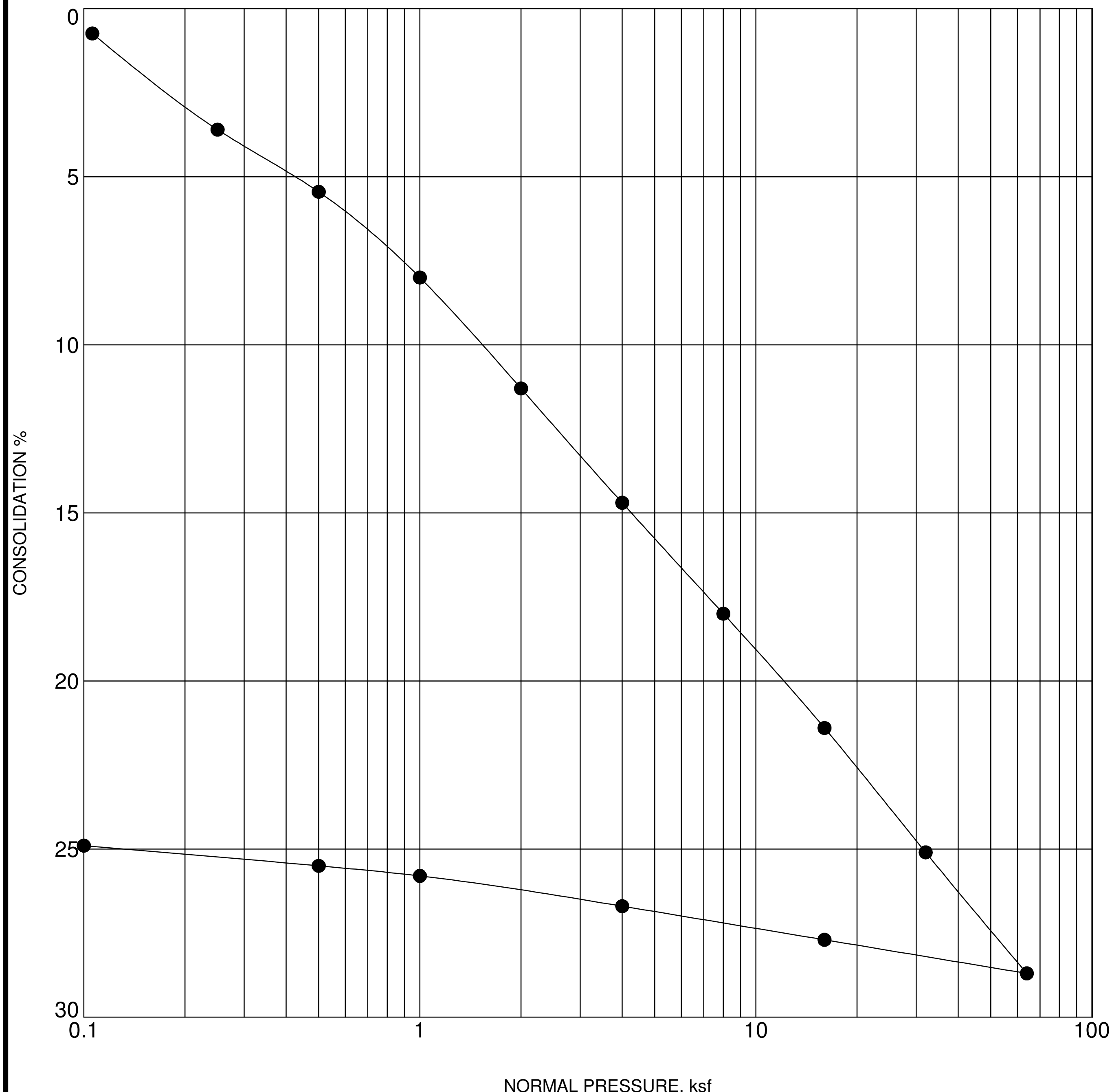
HANAPEPE, KAUAI, HAWAII

Plate
B - 10



Sample: B-3
Depth: 5.0 - 6.5 feet
Description: Dark reddish brown to brown clayey silt

Liquid Limit = N/A   Plasticity Index = N/A

	Initial	Final
Water Content, %	24.7	30.8
Dry Density, pcf:	72.9	104.0
Void Ratio	1.934	1.057
Degree of Saturation, %	43.8	100.0
Sample Height, inches	1.0000	0.7000

G_CONSOL 8251-00.GPJ GEOLABS.GDT 11/8/22

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CONSOLIDATION TEST - ASTM D2435

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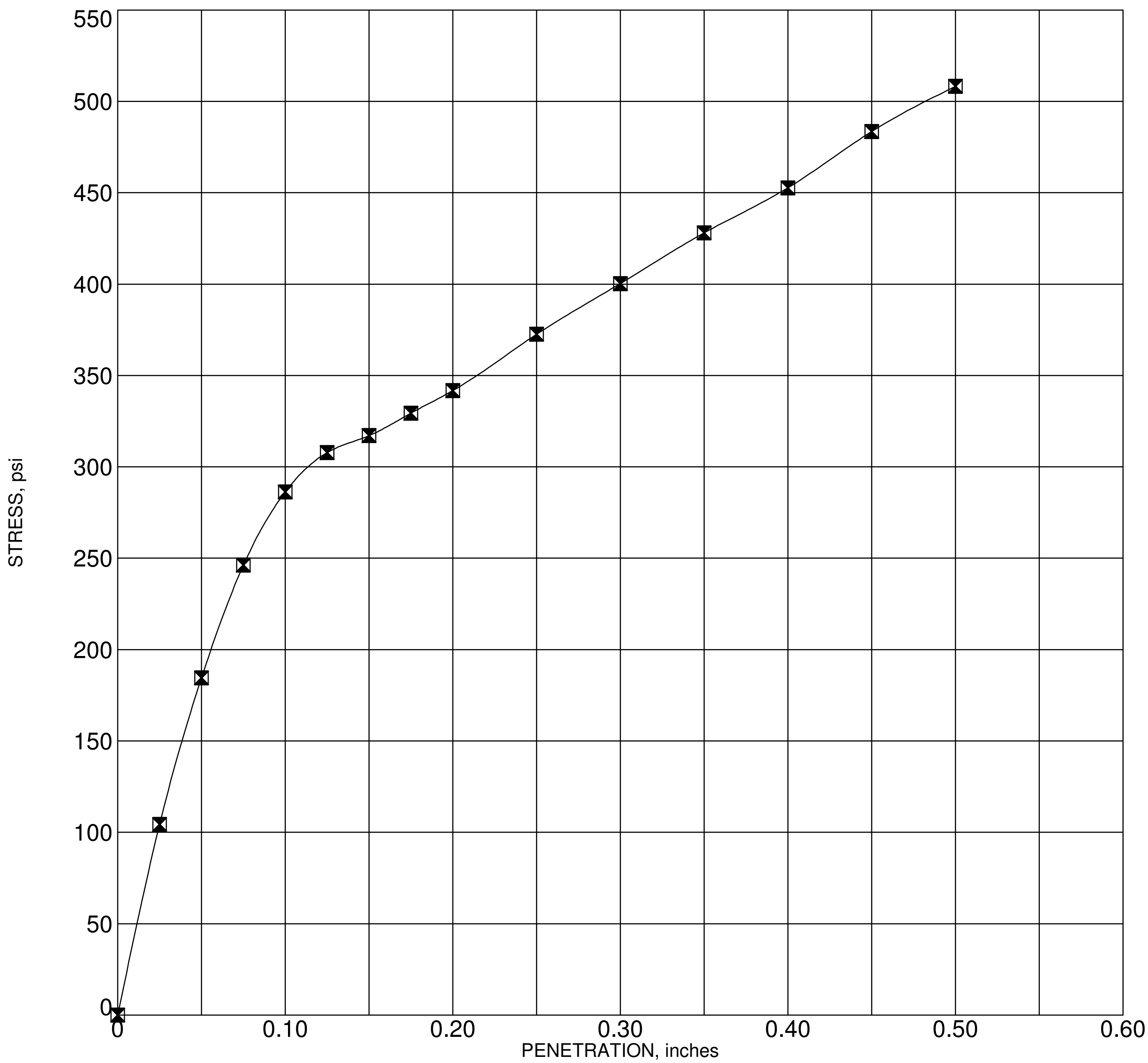
HANAPEPE, KAUAI, HAWAII

Plate
B - 11



Corr. CBR @ 0.1"	28.6
Corr. CBR @ 0.2"	22.8
Swell (%)	2.92

Sample: Bulk-1
Depth: 1.0 - 3.0 feet
Description: Dark reddish brown clayey silt (MH)

Molding Dry Density (pcf)	107.3	Hammer Wt. (lbs)	10
Molding Moisture (%)	22.6	Hammer Drop (inches)	18
Days Soaked	5	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

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CALIFORNIA BEARING RATIO - ASTM D1883

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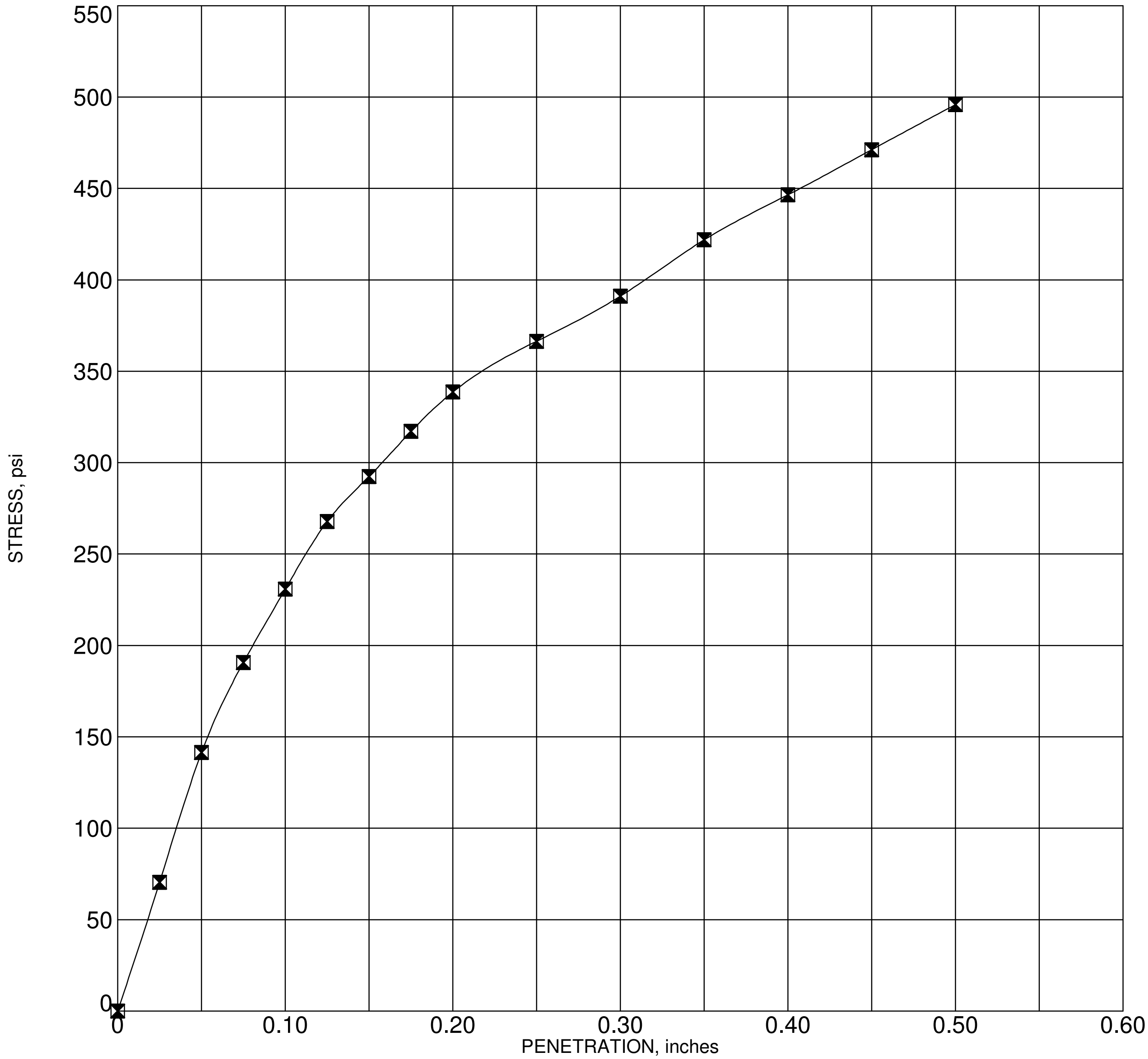
HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

Plate
B - 12



Corr. CBR @ 0.1"	23.1
Corr. CBR @ 0.2"	22.6
Swell (%)	0.20

Sample: Bulk-2
Depth: 1.0 - 3.0 feet
Description: Reddish brown clayey silt

Molding Dry Density (pcf)	107.8	Hammer Wt. (lbs)	10
Molding Moisture (%)	24.2	Hammer Drop (inches)	18
Days Soaked	4	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

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CALIFORNIA BEARING RATIO - ASTM D1883

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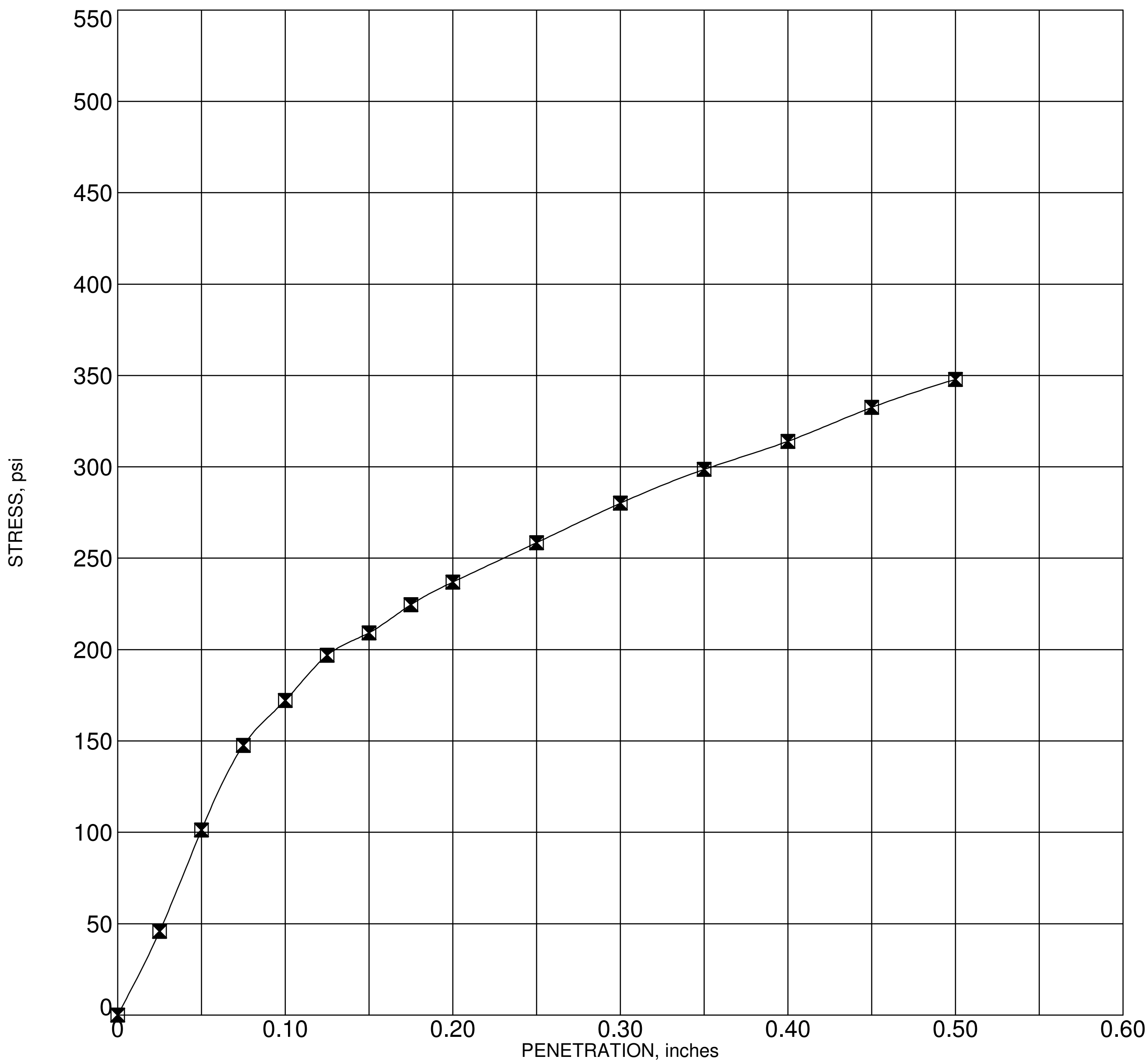
HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

Plate
B - 13

G_CBR 8251-00.GPJ GEOLABS.GDT 11/8/22



Corr. CBR @ 0.1"	17.6
Corr. CBR @ 0.2"	15.9
Swell (%)	0.89

Sample: Bulk-3
Depth: 1.0 - 3.0 feet
Description: Reddish brown clayey silt

Molding Dry Density (pcf)	107.0	Hammer Wt. (lbs)	10
Molding Moisture (%)	23.4	Hammer Drop (inches)	18
Days Soaked	4	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

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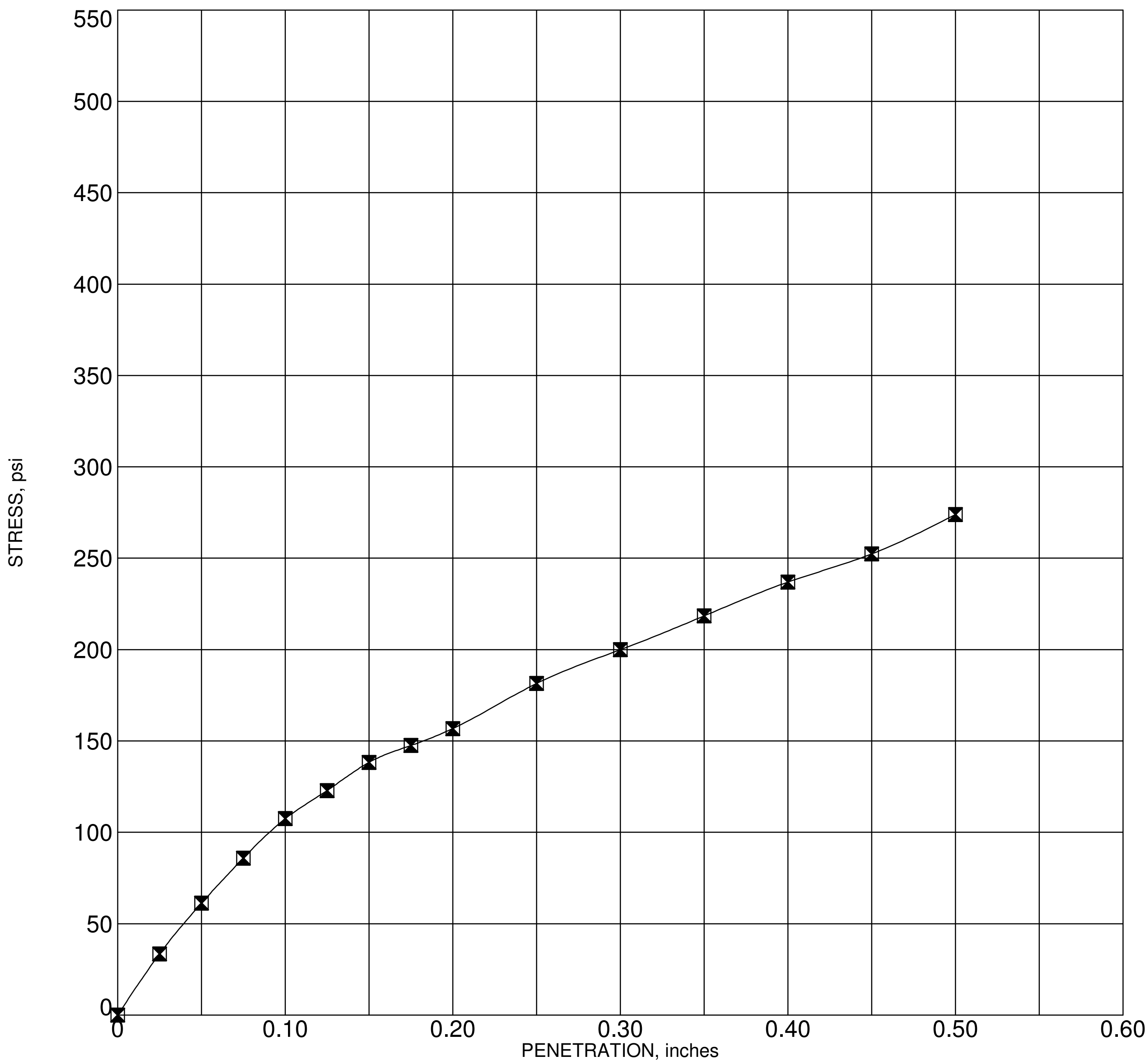
CALIFORNIA BEARING RATIO - ASTM D1883

DEPARTMENT OF HAWAIIAN HOME LANDS
HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

Plate
B - 14

G_CBR 8251-00.GPJ GEOLABS.GDT 11/8/22



Corr. CBR @ 0.1"	10.7
Corr. CBR @ 0.2"	10.5
Swell (%)	1.83

Sample: Bulk-4
Depth: 1.0 - 3.0 feet
Description: Reddish brown clayey silt

Molding Dry Density (pcf)	102.2	Hammer Wt. (lbs)	10
Molding Moisture (%)	25.0	Hammer Drop (inches)	18
Days Soaked	5	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

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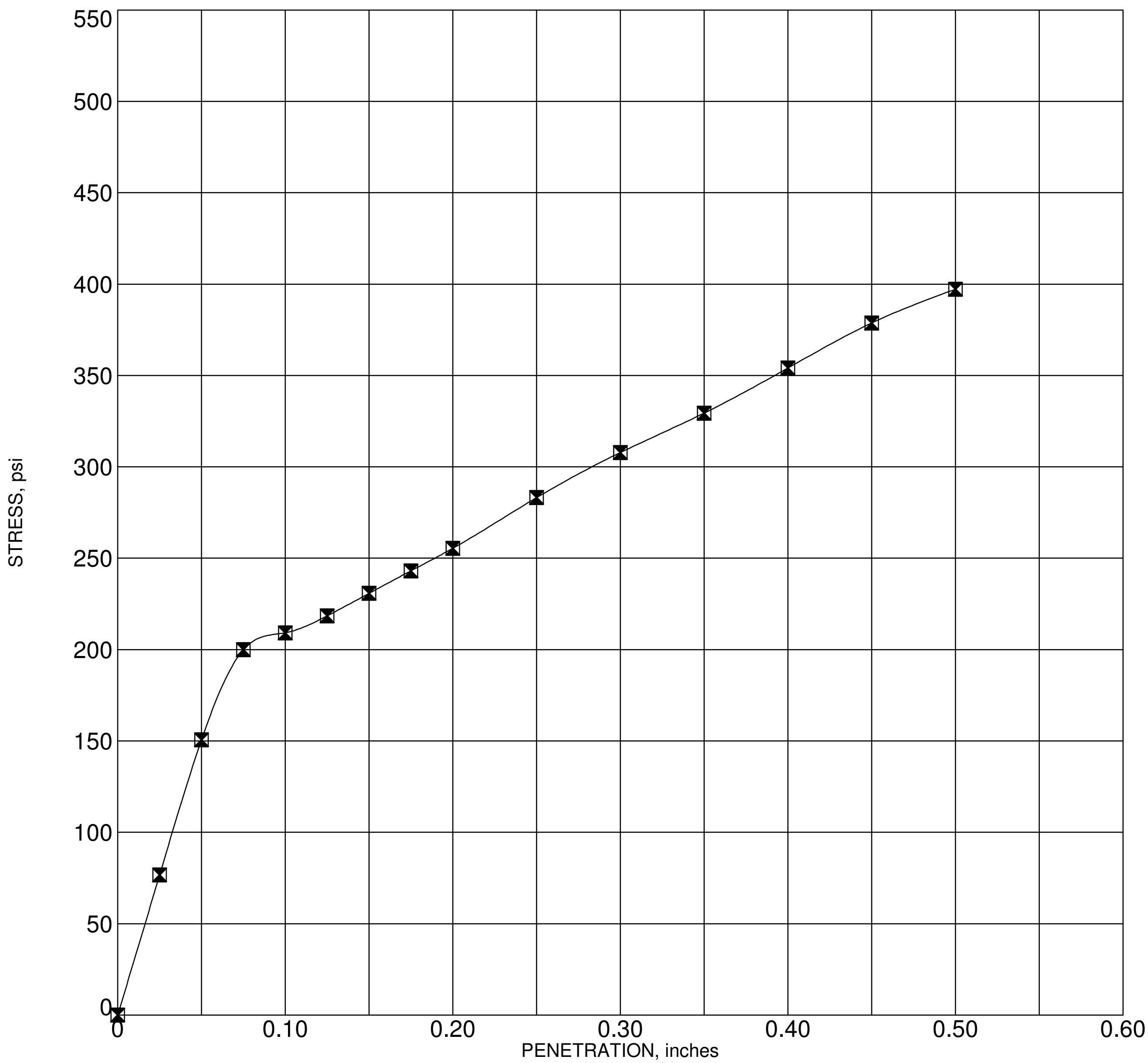
CALIFORNIA BEARING RATIO - ASTM D1883

DEPARTMENT OF HAWAIIAN HOME LANDS
HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

Plate
B - 15

G_CBR 8251-00.GPJ GEOLABS.GDT 11/8/22



Corr. CBR @ 0.1"	20.9
Corr. CBR @ 0.2"	17.0
Swell (%)	1.00

Sample: Bulk-5
Depth: 1.0 - 3.0 feet
Description: Reddish brown silty clay

Molding Dry Density (pcf)	101.3	Hammer Wt. (lbs)	10
Molding Moisture (%)	24.9	Hammer Drop (inches)	18
Days Soaked	4	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

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CALIFORNIA BEARING RATIO - ASTM D1883

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HANAPEPE, KAUAI, HAWAII

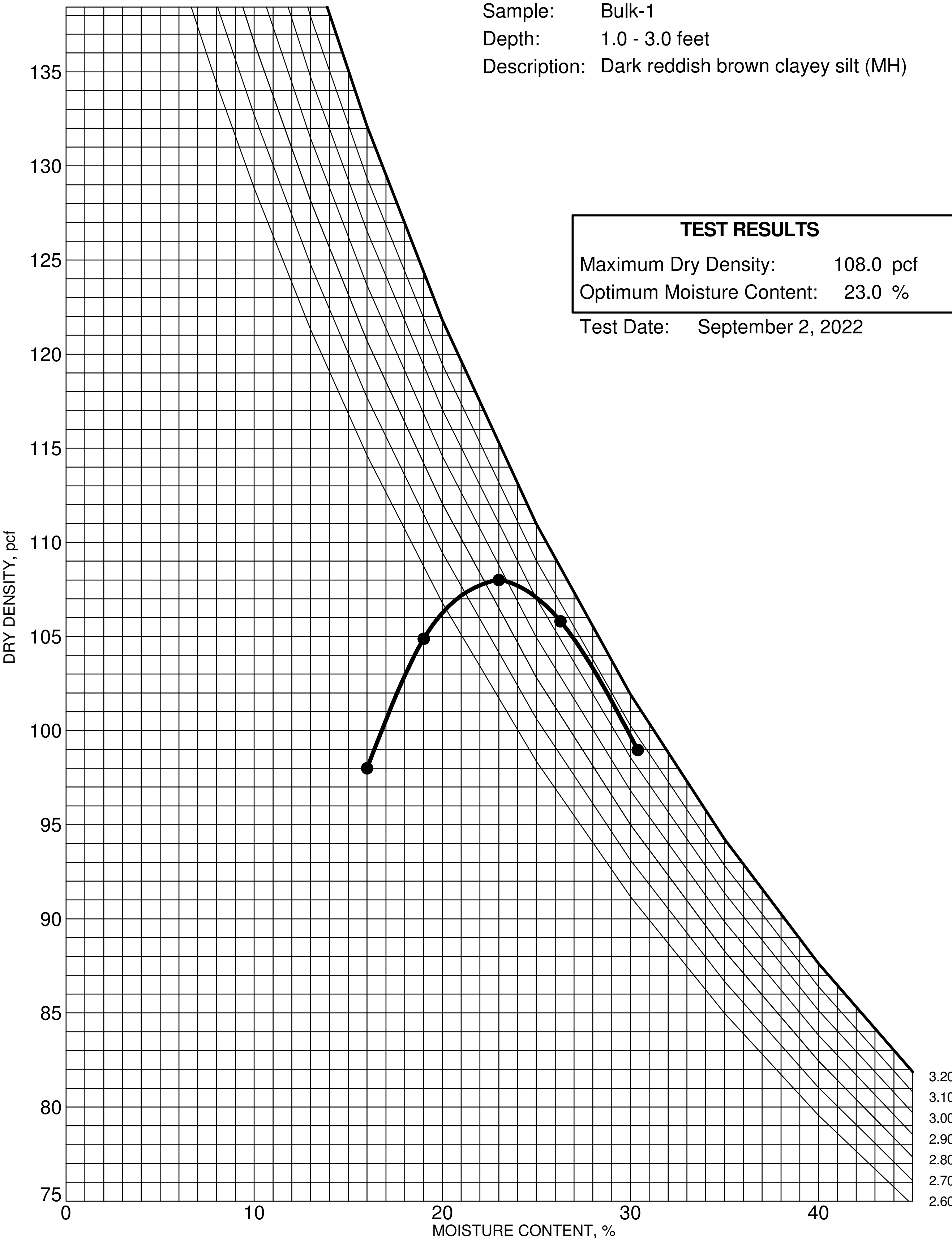
Plate
B - 16

G_CBR 8251-00.GPJ GEOLABS.GDT 11/8/22

Sample: Bulk-1
Depth: 1.0 - 3.0 feet
Description: Dark reddish brown clayey silt (MH)

TEST RESULTS	
Maximum Dry Density:	108.0 pcf
Optimum Moisture Content:	23.0 %

Test Date: September 2, 2022



G_COMPACTION 8251-00.GPJ GEOLABS.GDT 11/8/22

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MOISTURE-DENSITY RELATIONSHIP - ASTM D1557 A

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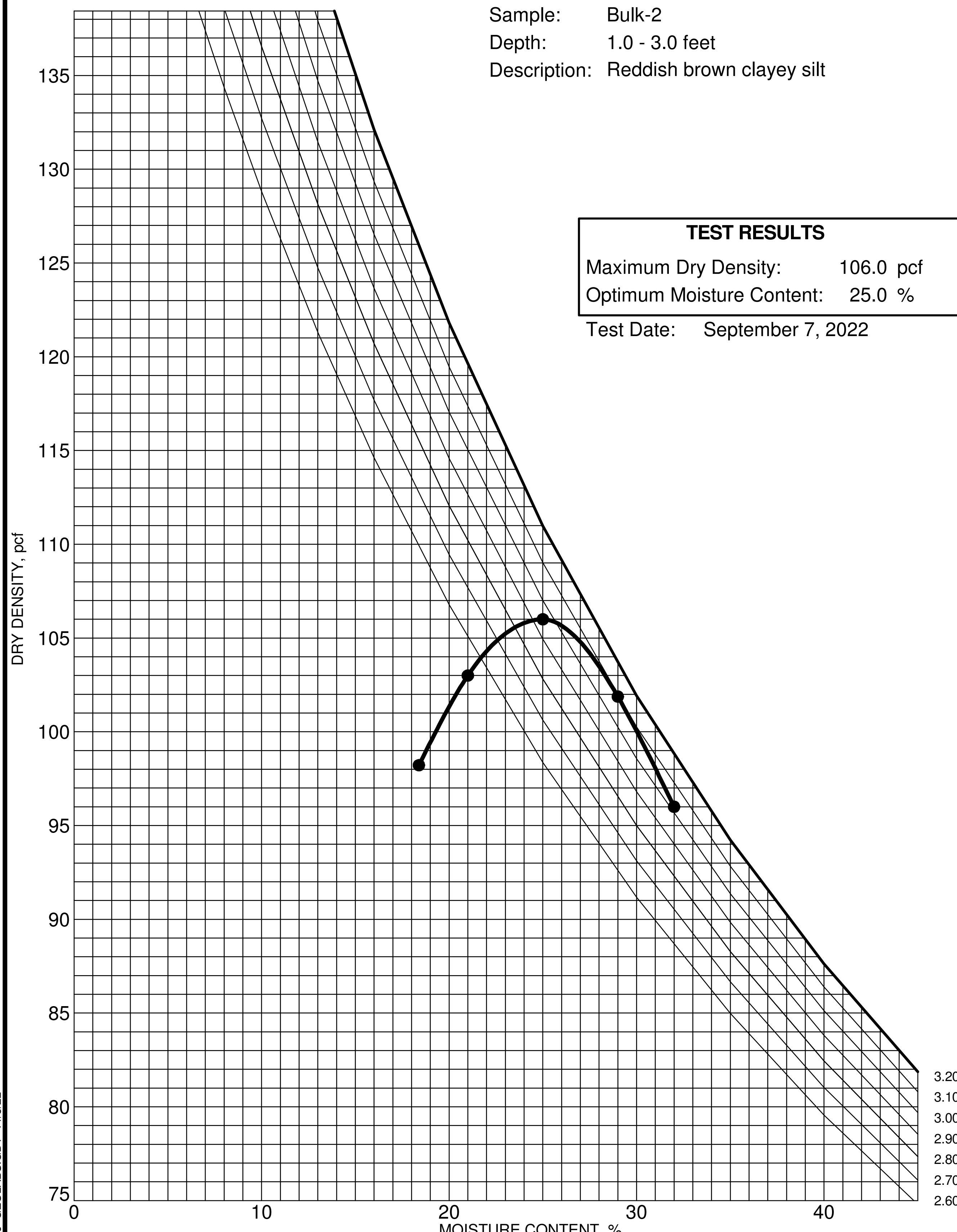
HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

Plate
B - 17

Sample: Bulk-2
Depth: 1.0 - 3.0 feet
Description: Reddish brown clayey silt

TEST RESULTS		
Maximum Dry Density:	106.0	pcf
Optimum Moisture Content:	25.0	%

Test Date: September 7, 2022



G_COMPACTION 8251-00.GPJ GEOLABS.GDT 11/8/22

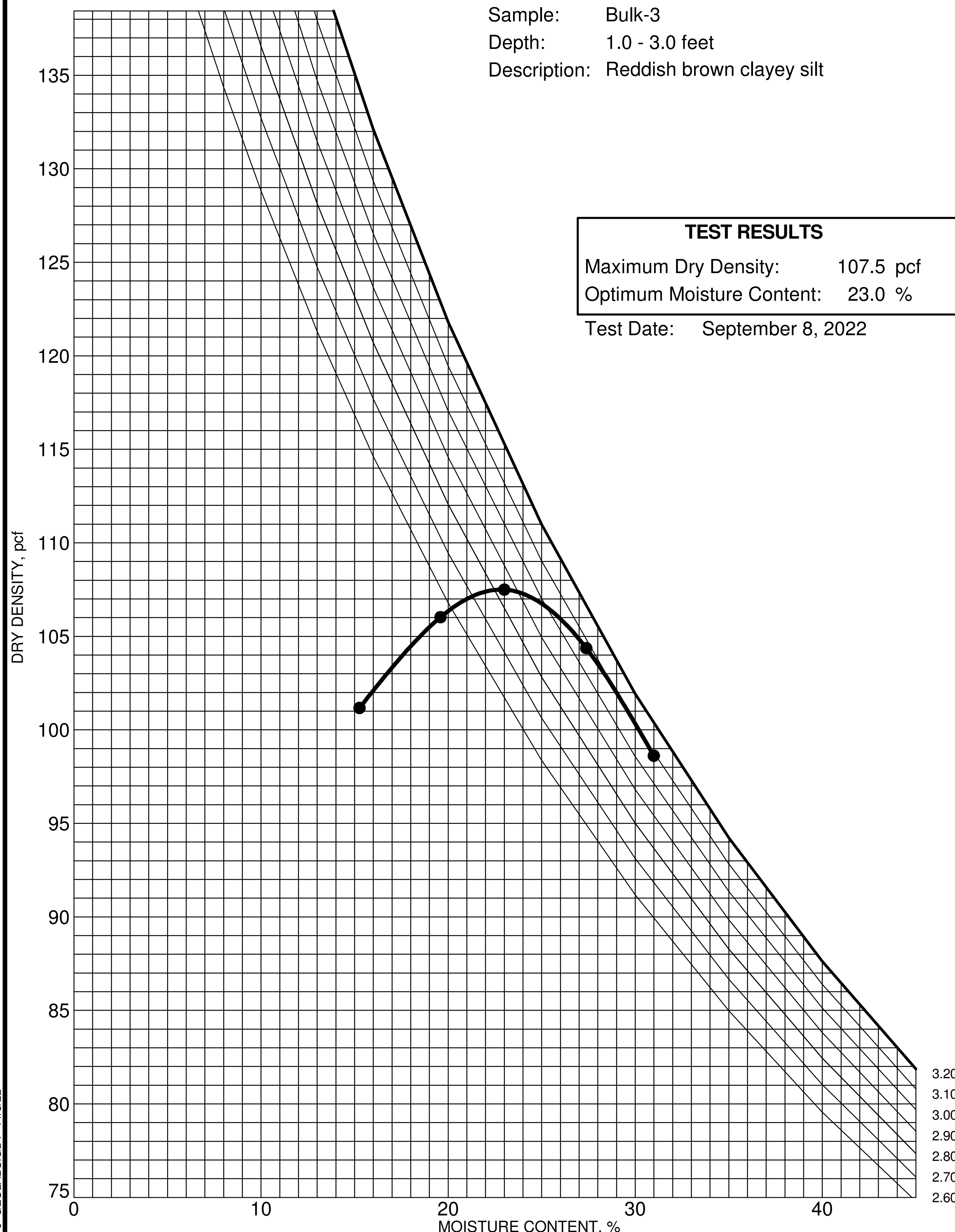
GEOLABS, INC. GEOTECHNICAL ENGINEERING	MOISTURE-DENSITY RELATIONSHIP - ASTM D1557 A	
W.O. 8251-00	DEPARTMENT OF HAWAIIAN HOME LANDS HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2 HANAPEPE, KAUAI, HAWAII	Plate B - 18

Sample: Bulk-3
Depth: 1.0 - 3.0 feet
Description: Reddish brown clayey silt

TEST RESULTS

Maximum Dry Density:	107.5 pcf
Optimum Moisture Content:	23.0 %

Test Date: September 8, 2022



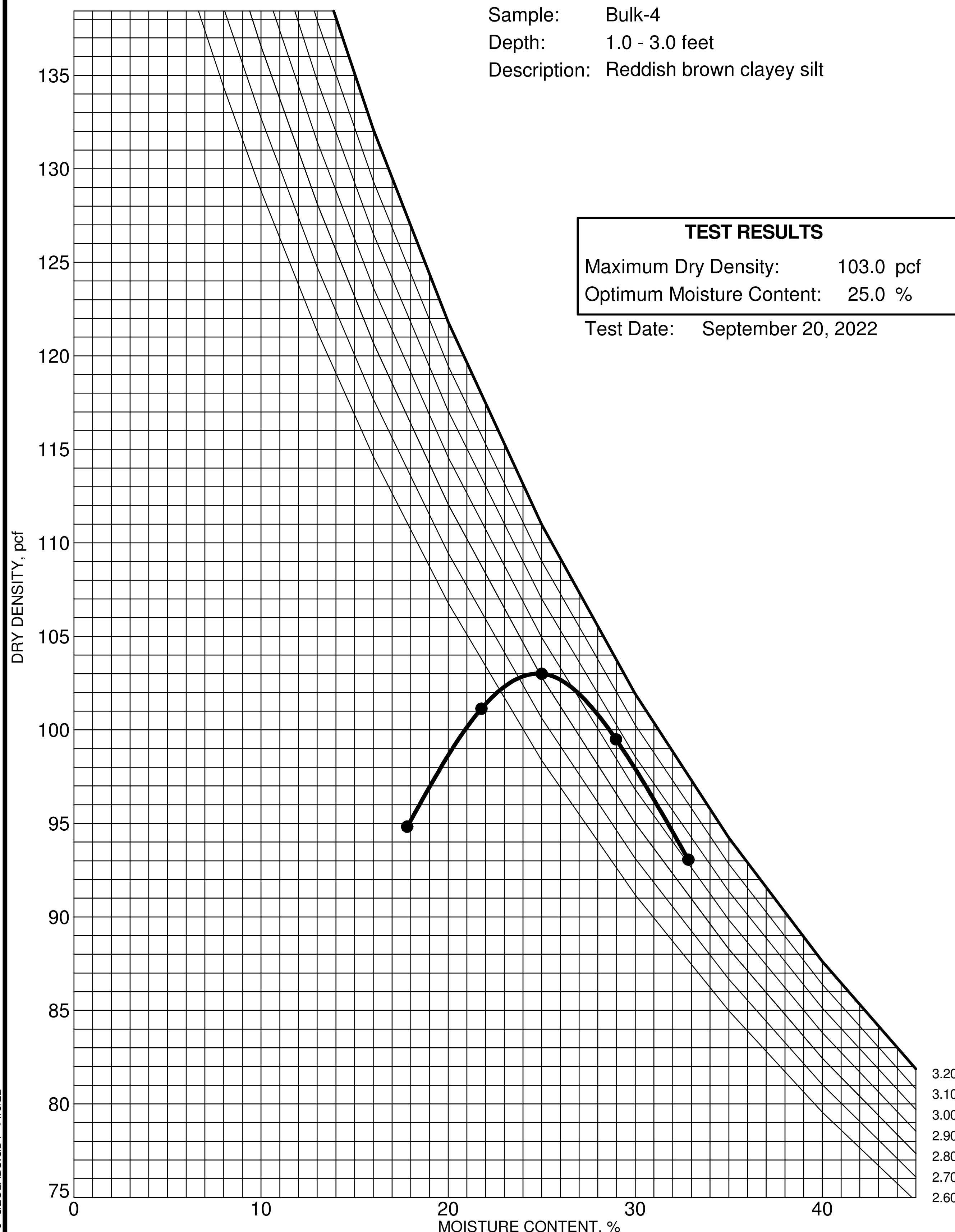
GEOLABS, INC.
GEOTECHNICAL ENGINEERING
W.O. 8251-00

MOISTURE-DENSITY RELATIONSHIP - ASTM D1557 A

DEPARTMENT OF HAWAIIAN HOME LANDS
HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

Plate
B - 19

Sample: Bulk-4
Depth: 1.0 - 3.0 feet
Description: Reddish brown clayey silt



TEST RESULTS	
Maximum Dry Density:	103.0 pcf
Optimum Moisture Content:	25.0 %

Test Date: September 20, 2022

G_COMPACTION 8251-00.GPJ GEOLABS.GDT 11/8/22

GEOLABS, INC.
GEOTECHNICAL ENGINEERING
W.O. 8251-00

MOISTURE-DENSITY RELATIONSHIP - ASTM D1557 A

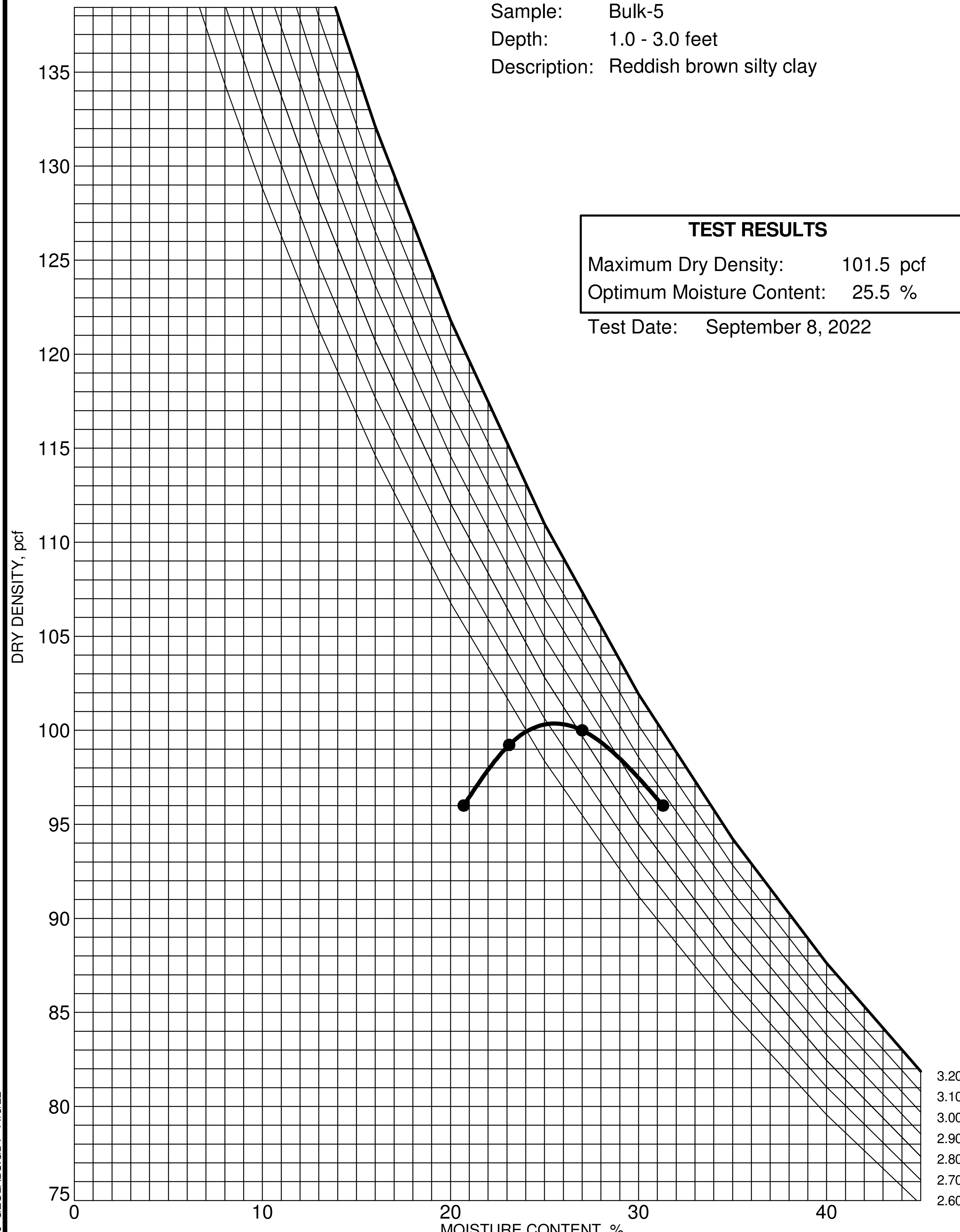
DEPARTMENT OF HAWAIIAN HOME LANDS
HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

Plate
B - 20

Sample: Bulk-5
Depth: 1.0 - 3.0 feet
Description: Reddish brown silty clay

TEST RESULTS	
Maximum Dry Density:	101.5 pcf
Optimum Moisture Content:	25.5 %

Test Date: September 8, 2022



G_COMPACTION 8251-00.GPJ GEOLABS.GDT 11/8/22

GEOLABS, INC.
GEOTECHNICAL ENGINEERING
W.O. 8251-00

MOISTURE-DENSITY RELATIONSHIP - ASTM D1557 A

DEPARTMENT OF HAWAIIAN HOME LANDS
HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

Plate
B - 21

Location	Depth (feet)	pH Value	Minimum Resistivity (ohm-cm)	Chloride Content (mg/kg)	Sulfate Content (mg/kg)
B-10	5.0 - 6.5	8.58*	5300*	39	16
B-11	5.0 - 6.5	8.24*	6100*	56	ND
B-14	5.0 - 6.5	8.3*	11000*	18	ND
B-15	5.0 - 6.5	7.87*	12000*	22	12

TEST METHODS (by Eurofins TestAmerica Laboratories, Inc.)

pH Value	Method 9045C
Minimum Resistivity	SM 2510B
Chloride Content	EPA 300.0
Sulfate Content	EPA 300.0

TEST METHODS (by Geolabs, Inc.)*

pH Value	ASTM G51
Minimum Resistivity	ASTM G57
Chloride Content	N/A
Sulfate Content	N/A

ND: Not Detected Within Reporting Limits

GEOLABS, INC.
GEOTECHNICAL ENGINEERING

W.O. 8251-00

SUMMARY OF CORROSIVITY TESTS

DEPARTMENT OF HAWAIIAN HOME LANDS
HANAPEPE RESIDENTIAL SUBDIVISION, PHASE 2
HANAPEPE, KAUAI, HAWAII

Plate
B - 22

APPENDIX C

DEPARTMENT OF HAWAIIAN HOME LANDS
HANAPEPE RESIDENTIAL SUBDIVSION, PHASE 2
HANAPEPE, KAUAI, HAWAII

B-1 14.0' TO 20.0'

14.0'

20.0'

DEPARTMENT OF HAWAIIAN HOME LANDS
HANAPEPE RESIDENTIAL SUBDIVSION, PHASE 2
HANAPEPE, KAUAI, HAWAII

B-2 10.0' TO 20.0'

10.0'

20.0'

DEPARTMENT OF HAWAIIAN HOME LANDS
HANAPEPE RESIDENTIAL SUBDIVSION, PHASE 2
HANAPEPE, KAUAI, HAWAII

B-3 11.25' TO 20.0'

11.25'

20.0'

DEPARTMENT OF HAWAIIAN HOME LANDS
HANAPEPE RESIDENTIAL SUBDIVSION, PHASE 2
HANAPEPE, KAUAI, HAWAII

B-4 15.75' TO 20.0'

15.75'

20.0'

B-5 16.25' TO 20.0'

16.25'

20.0'

DEPARTMENT OF HAWAIIAN HOME LANDS
HANAPEPE RESIDENTIAL SUBDIVSION, PHASE 2
HANAPEPE, KAUAI, HAWAII

B-6 19.0' TO 20.0'

19.0'

20.0'

B-7 11.5' TO 20.0'

11.5'

20.0'

DEPARTMENT OF HAWAIIAN HOME LANDS
HANAPEPE RESIDENTIAL SUBDIVSION, PHASE 2
HANAPEPE, KAUAI, HAWAII

B-8 15.0’ TO 20.0’ **B-9 18.0’ TO 20.0’**

15.0’

20.0’

18.0’

20.0’

DEPARTMENT OF HAWAIIAN HOME LANDS
HANAPEPE RESIDENTIAL SUBDIVSION, PHASE 2
HANAPEPE, KAUAI, HAWAII

B-10 15.25' TO 20.0'

15.25'

20.0'

DEPARTMENT OF HAWAIIAN HOME LANDS
HANAPEPE RESIDENTIAL SUBDIVSION, PHASE 2
HANAPEPE, KAUAI, HAWAII

B-11 13.0' TO 20.0'

13.0'

20.0'

DEPARTMENT OF HAWAIIAN HOME LANDS
HANAPEPE RESIDENTIAL SUBDIVSION, PHASE 2
HANAPEPE, KAUAI, HAWAII

B-12 17.0' TO 20.0'

17.0'

20.0'

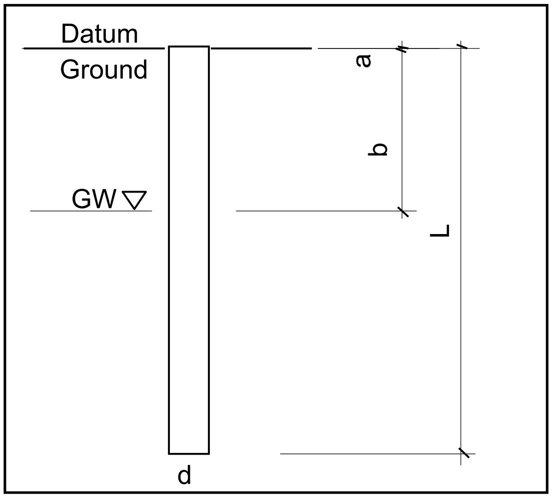
B-14 15.25' TO 20.0'

15.25'

20.0'

APPENDIX D

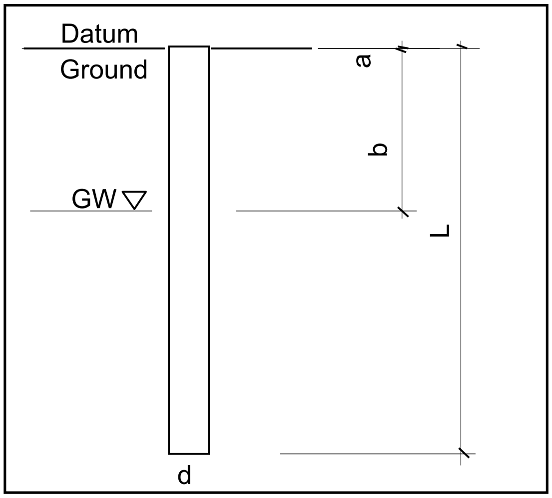
INFILTRATION TEST RECORD



Project: DHHL Hanapepe Subdivision
W.O.: 8251-00
Test No.: I-1
Date of Testing: 8/30/2022
Method of Testing: BMP Falling Head (Flush Bottom)
Source of Water: Bucket
GW level, b (from ground): N/A feet
Datum, a (above ground): 0.0 feet
Depth of Boring: 6.0 feet
Length, L (from datum): 6.0 feet
Diameter of Casing, d (I.D.): 4.0 inches

Testing Trial	Elapsed Time (minutes)	Time (hh:mm)	Depth to Water (measured from datum) (inches)	Percolation Rate (inches per hour)
Trial 1	0		48.00	
	15	0:15	48.13	
	30	0:30	48.19	
	45	0:45	48.25	
	60	1:00	48.31	0.31
Trial 2	0		48.00	
	15	0:15	48.13	
	30	0:30	48.19	
	45	0:45	48.25	
	60	1:00	48.31	0.31
Trial 3	0		48.00	
	15	0:15	48.06	
	30	0:30	48.13	
	45	0:45	48.19	
	60	1:00	48.25	0.25
Trial 4	0		48.00	
	15	0:15	48.06	
	30	0:30	48.13	
	45	0:45	48.19	
	60	1:00	48.25	0.25

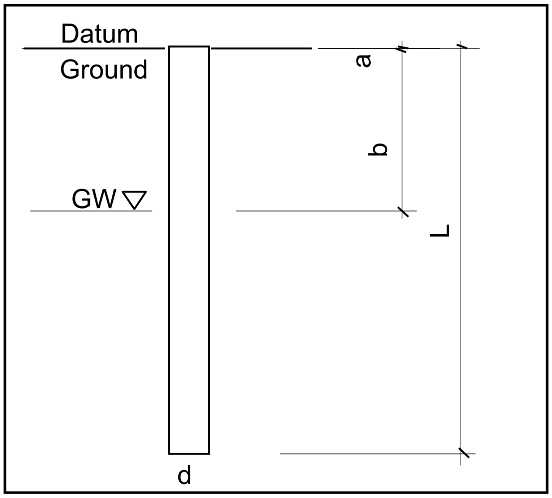
INFILTRATION TEST RECORD



Project:	DHHL Hanapepe Subdivision
W.O.:	8251-00
Test No.:	I-2
Date of Testing:	8/30/2022
Method of Testing:	BMP Falling Head (Flush Bottom)
Source of Water:	Bucket
GW level, b (from ground):	N/A feet
Datum, a (above ground):	0.0 feet
Depth of Boring:	6.0 feet
Length, L (from datum):	6.0 feet
Diameter of Casing, d (I.D.):	4.0 inches

Testing Trial	Elapsed Time (minutes)	Time (hh:mm)	Depth to Water (measured from datum) (inches)	Percolation Rate (inches per hour)
Trial 1	0		48.00	
	15	0:15	48.94	
	30	0:30	49.81	
	45	0:45	50.63	
	60	1:00	51.38	3.38
Trial 2	0		48.00	
	15	0:15	48.88	
	30	0:30	49.69	
	45	0:45	50.44	
	60	1:00	51.19	3.19
Trial 3	0		48.00	
	15	0:15	48.81	
	30	0:30	49.63	
	45	0:45	50.38	
	60	1:00	51.13	3.13
Trial 4	0		48.00	
	15	0:15	48.81	
	30	0:30	49.56	
	45	0:45	50.31	
	60	1:00	51.06	3.06

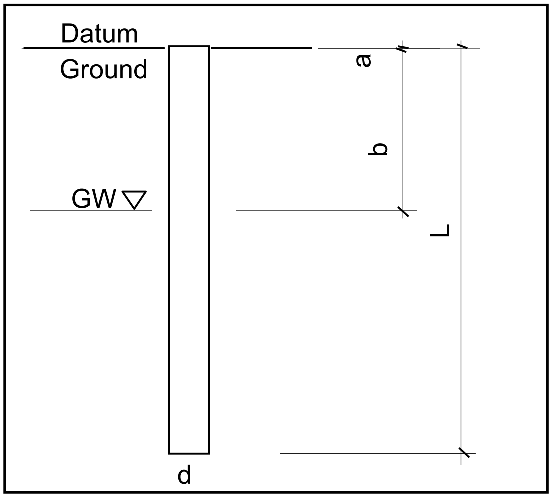
INFILTRATION TEST RECORD



Project:	DHHL Hanapepe Subdivision
W.O.:	8251-00
Test No.:	I-3
Date of Testing:	8/30/2022
Method of Testing:	BMP Falling Head (Flush Bottom)
Source of Water:	Bucket
GW level, b (from ground):	N/A feet
Datum, a (above ground):	0.0 feet
Depth of Boring:	6.0 feet
Length, L (from datum):	6.0 feet
Diameter of Casing, d (I.D.):	4.0 inches

Testing Trial	Elapsed Time (minutes)	Time (hh:mm)	Depth to Water (measured from datum) (inches)	Percolation Rate (inches per hour)
Trial 1	0		48.00	
	15	0:15	49.00	
	30	0:30	49.94	
	45	0:45	50.81	
	60	1:00	51.69	3.69
Trial 2	0		48.00	
	15	0:15	48.94	
	30	0:30	49.81	
	45	0:45	50.69	
	60	1:00	51.56	3.56
Trial 3	0		48.00	
	15	0:15	48.94	
	30	0:30	49.81	
	45	0:45	50.69	
	60	1:00	51.56	3.56
Trial 4	0		48.00	
	15	0:15	48.88	
	30	0:30	49.75	
	45	0:45	50.63	
	60	1:00	51.50	3.50

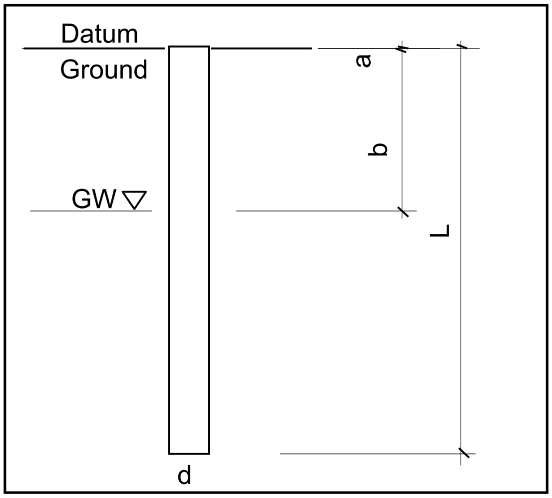
INFILTRATION TEST RECORD



Project:	DHHL Hanapepe Subdivision
W.O.:	8251-00
Test No.:	I-4
Date of Testing:	8/30/2022
Method of Testing:	BMP Falling Head (Flush Bottom)
Source of Water:	Bucket
GW level, b (from ground):	N/A feet
Datum, a (above ground):	0.0 feet
Depth of Boring:	10.0 feet
Length, L (from datum):	10.0 feet
Diameter of Casing, d (I.D.):	4.0 inches

Testing Trial	Elapsed Time (minutes)	Time (hh:mm)	Depth to Water (measured from datum) (inches)	Percolation Rate (inches per hour)
Trial 1	0		96.00	
	15	0:15	97.31	
	30	0:30	98.56	
	45	0:45	99.75	
	60	1:00	100.88	4.88
Trial 2	0		96.00	
	15	0:15	97.25	
	30	0:30	98.50	
	45	0:45	99.69	
	60	1:00	100.81	4.81
Trial 3	0		96.00	
	15	0:15	97.25	
	30	0:30	98..44	
	45	0:45	99.56	
	60	1:00	100.69	4.69
Trial 4	0		96.00	
	15	0:15	97.25	
	30	0:30	98.38	
	45	0:45	99.50	
	60	1:00	100.63	4.63

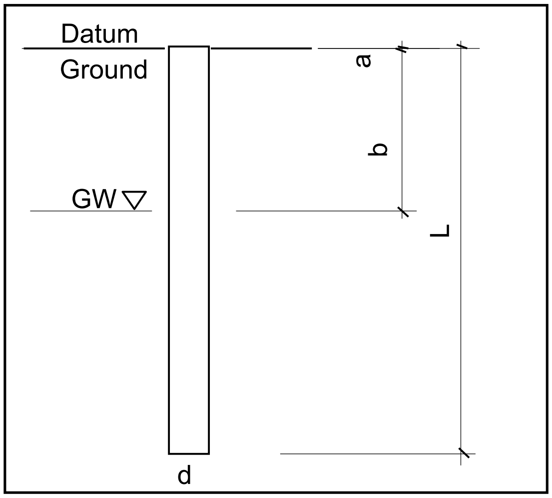
INFILTRATION TEST RECORD



Project:	DHHL Hanapepe Subdivision	
W.O.:	8251-00	
Test No.:	I-5	
Date of Testing:	8/30/2022	
Method of Testing:	BMP Falling Head (Flush Bottom)	
Source of Water:	Bucket	
GW level, b (from ground):	N/A	feet
Datum, a (above ground):	0.0	feet
Depth of Boring:	10.0	feet
Length, L (from datum):	10.0	feet
Diameter of Casing, d (I.D.):	4.0	inches

Testing Trial	Elapsed Time (minutes)	Time (hh:mm)	Depth to Water (measured from datum) (inches)	Percolation Rate (inches per hour)
Trial 1	0		96.00	
	15	0:15	96.25	
	30	0:30	96.44	
	45	0:45	96.63	
	60	1:00	96.81	0.81
Trial 2	0		96.00	
	15	0:15	96.25	
	30	0:30	96.44	
	45	0:45	96.63	
	60	1:00	96.75	0.75
Trial 3	0		96.00	
	15	0:15	96.25	
	30	0:30	96.44	
	45	0:45	96.56	
	60	1:00	96.69	0.69
Trial 4	0		96.00	
	15	0:15	96.19	
	30	0:30	96.38	
	45	0:45	96.50	
	60	1:00	96.63	0.63

INFILTRATION TEST RECORD



Project:	DHHL Hanapepe Subdivision	
W.O.:	8251-00	
Test No.:	I-6	
Date of Testing:	8/30/2022	
Method of Testing:	BMP Falling Head (Flush Bottom)	
Source of Water:	Bucket	
GW level, b (from ground):	N/A	feet
Datum, a (above ground):	0.0	feet
Depth of Boring:	10.0	feet
Length, L (from datum):	10.0	feet
Diameter of Casing, d (I.D.):	4.0	inches

Testing Trial	Elapsed Time (minutes)	Time (hh:mm)	Depth to Water (measured from datum) (inches)	Percolation Rate (inches per hour)
Trial 1	0		96.00	
	15	0:15	96.31	
	30	0:30	96.63	
	45	0:45	96.88	
	60	1:00	97.13	1.13
Trial 2	0		96.00	
	15	0:15	96.31	
	30	0:30	96.56	
	45	0:45	96.81	
	60	1:00	97.06	1.06
Trial 3	0		96.00	
	15	0:15	96.25	
	30	0:30	96.50	
	45	0:45	96.75	
	60	1:00	96.94	0.94
Trial 4	0		96.00	
	15	0:15	96.25	
	30	0:30	96.50	
	45	0:45	96.69	
	60	1:00	96.88	0.88